CAFB 94

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 27th FIGHTER WING (ACC)
CANNON AIR FORCE BASE, NEW MEXICO

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6 APR 1994

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Dear Mr. Honker

Attached is the draft Baseline Risk Assessment (BRA) for the Appendix III Solid Waste Management Units (SWMUs) at Cannon AFB. This BRA is for your review and consists of the following four volumes:

1. Volume I, BRA for Appendix III Sections 1 through 6
2. Volume II, BRA for Appendix III, Sections 7 through 10
3. Volume III, BRA for Appendix III, Sections 11 through 13 & Appendices A & B
4. Volume IV, BRA for Appendix III, Appendices C and D

The Cannon AFB point of contact for this issue is Mr. John Ekhoff (505) 784-2739.

Sincerely

WILLIAM M. GUTH
Brigadier General, USAF
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Attachment:
Appendix III, Draft BRA

cc:
Dave Morgan, NMED
Steve Pullen, NMED

DRAFT BRA
VOLUME I
SECTIONS 1 - 6

LIBRARY COPY

BASELINE RISK ASSESSMENT FOR APPENDIX III SWMUs - PHASE I

CANNON AIR FORCE BASE CLOVIS, NEW MEXICO

Prepared for:
Cannon Air Force Base
27 CES/CEVR
Environmental Flight

February 1994

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GENERAL DISCUSSION

Cannon Air Force Base has been in operation for more than 50 years as a military air base. Through the course of these operations numerous aircraft and equipment maintenance processes have been conducted, and the Air Force is currently investigating the potential that some of these operations may have contaminated the environment. Cannon AFB operates in compliance with the terms of a RCRA Permit issued jointly by the United States EPA and the State of New Mexico. This permit includes a listing of three groups of Solid Waste Management Units (SWMUs) that have been identified as Appendix I, II, and III SWMUs. A RCRA Facility Investigation (RFI) was completed for 16 of the SWMUs listed in Appendix III of the permit as required by the terms of the permit. This Baseline Risk Assessment (BRA) covers 9 of the SWMUs that were not eliminated from consideration by the risk screening in the RFI.

Woodward-Clyde (W-C) has completed the BRA under contract with the U.S. Army Corps of Engineers (USACE), Omaha District as a follow-on to the RFI.

The RFI field investigation was completed during August and September of 1993, and the Draft RFI Report was submitted to the USACE and Cannon Environmental Flight on November 24, 1993.

The RFI included a screening level Risk Evaluation using Risk Based Concentrations (RBCs) calculated as action levels as outlined in RCRA Subpart S Guidance. These RBCs were very conservative (generally comparable to a one in ten million risk of added cancer). The highest detected concentrations of chemicals of concern were compared to the RBCs, or background, or State of New Mexico requirements where applicable, for each SWMU in accordance with the decision process outlined in the RFI work plans. Sites for which the risk screening indicated the potential for unacceptable risk to human health or the environment were recommended to be included in the Baseline Risk Assessment (BRA) being completed following the RFI.

The SWMUs in the Appendix III list are as follows:

Site	SWMU Number
AGE Maintenance Shop	31
Oil/Water Separator No. 196	46
Oil/Water Separator No. 494	47
Oil/Water Separator No. 375	51
Oil/Water Separator No. 379	57
Oil/Water Separator Nos. 5077a,b,&c	61, 62, 63
Oil/Water Separator No. 326	70
Oil/Water Separator No. 5120	92
Oil/Water Separator No. 5121	93
Oil/Water Separator No. 5144	94
Oil/Water Separator No. 4095	127
Lead/Acid Battery Area	55
CE Cont. Stor. Area	77
Wastewater Playa Lake	103

SWMUs 46, 47, 57, 61, 62, and 55 were recommended for "no further action" in the RFI on the basis of the risk screening. SWMU 70 was recommended for further investigation because of significant petroleum hydrocarbon (mostly JP-4 fuel) soil contamination. The remaining 9 SWMUs were recommended for a BRA, and the results of that BRA are the subject of this report.

The BRA has been completed in accordance with USACE instructions, EPA Guidance Documents, and the work plan prepared by the Cannon AFB Environmental Flight.

BRA APPROACH

The risk assessment methodology used in this study is based on the guidance provided by EPA in Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation

Manual (Part A) (EPA 1989a). The EPA guidance was applied, because it is the most appropriate and widely accepted guidance for such an assessment. EPA cautions that these documents are intended to provide guidance only and that considerable professional judgment must be exercised in applying the guidance to site-specific human health risk assessments.

The steps in the BRA process are:

1. Identification of chemicals of concern
2. Exposure assessment
3. Toxicity assessment
4. Risk characterization (including an evaluation of uncertainties in the risk estimates)
5. Uncertainties and limitations

Specific receptors evaluated in the BRA include occupational workers, construction workers, hypothetical trespassers, and farmers. Specific exposure pathways include ingestion of and dermal contact with surface and subsurface soils, inhalation of volatile emissions and airborne particulate matter from surface and subsurface soils, and dermal contact with surface water. Potential exposures to SWMU-related contaminants that could be transported to groundwater were evaluated by performing vadose zone fate and transport modeling. Estimated concentrations of chemicals of concern in groundwater were compared to conservative risk-based concentrations (RBCs) for drinking water. Because contaminant concentrations in soil beneath the Playa Lake (i.e., that may have been leached form the lake) have not been characterized, vadose zone fate and transport modeling could not be completed at this SWMU (SWMU 103).

SWMU NO. 31 - AGE MAINTENANCE PAD

Site Usage

The Aerospace Ground Equipment (AGE) Maintenance Pad is a paved area outside to the southeast of Building 186. The area is used for maintenance of ground equipment associated with the base aircraft operations.

RFI Findings

It was found in the RFI that at SWMU 31 barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, cadmium, chromium, chrysene, indeno(1,2,3-cd)pyrene, lead, and TPH exceeded the risk screening criteria. It was concluded that there was enough data available to complete a baseline risk assessment.

BRA Summary

Potential receptors at SWMU 31 for human health risk included occupational workers, hypothetical future construction workers, and hypothetical future trespassers. These receptors were assumed to be exposed to soil via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were evaluated using fate and transport modeling. The modeling indicated that contaminants would not reach groundwater at concentrations of potential concern. Therefore, this pathway was considered insignificant.

The maximum potential excess human health risk at SWMU 31 was 5×10^{-6} for occupational workers. This is within the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was ingestion of PAHs in surface soils.

Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

SWMU NO. 51 - OIL/WATER SEPARATOR NO. 375

Site Usage

SWMU 51 is an OWS serving Building 375 within the motor pool compound. The OWS serves floor drains in the engine shop area of the building.

RFI Findings

It was found in the RFI that at SWMU 51 barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk screening criteria. It was concluded that the available data was sufficient to complete a baseline risk assessment.

BRA Summary

Potential receptors at SWMU 51 for human health risk included occupational workers, hypothetical future construction workers, and hypothetical future trespassers. These receptors were assumed to be exposed to soil via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were evaluated using fate and transport modeling. The modeling indicated that contaminants would not reach groundwater at concentrations of potential concern. Therefore, this pathway was considered insignificant.

The maximum potential excess human health risk at SWMU 51 was 1×10^{-8} for hypothetical future construction workers. This is below the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was ingestion of PAHs in surface soils.

Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

SWMU NO. 63 - OIL/WATER SEPARATOR NO. 5077C

Site Usage

SWMU 63 is the OWS (more recently identified as a sand trap) serving the wash racks at Civil Engineering Squadron Compound.

RFI Findings

It was found in the RFI that for SWMU 63 barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the risk screening criteria. It was concluded that the available data was sufficient to complete a baseline risk assessment.

BRA Summary

Potential receptors at SWMU 63 for human health risk included occupational workers, hypothetical future construction workers, and hypothetical future trespassers. These receptors were assumed to be exposed to soil via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were evaluated using fate and transport modeling. The modeling indicated that contaminants would not reach groundwater at concentrations of potential concern. Therefore, this pathway was considered insignificant.

The maximum potential excess human health risk at SWMU 63 was 2×10^{-6} for occupational workers. This is within the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was ingestion of PAHs in surface soils.

Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

SWMU NO. 92 - OIL/WATER SEPARATOR NO. 5120

Site Usage

SWMU 92 is an OWS with a leach well discharge located east of Power Check Pad 5120. The OWS served the former aircraft service and maintenance associated with Building 5120 which has been removed from the site. The OWS is no longer in service, but it and the leach well and an oil recovery tank remain in place.

RFI Findings

It was found in the RFI that for SWMU 92 benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and lead exceeded the risk screening criteria. It was concluded that the available data was sufficient to complete a baseline risk assessment.

BRA Summary

Potential receptors at SWMU 92 for human health risk included occupational workers, hypothetical future construction workers, and hypothetical future trespassers. These receptors were assumed to be exposed to soil via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were evaluated using fate and transport modeling. The modeling indicated that contaminants would not reach groundwater at concentrations of potential concern. Therefore, this pathway was considered insignificant.

The maximum potential excess human health risk at SWMU 92 was 1×10^{-5} for hypothetical future trespassers. This is within the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was dermal contact with PAHs in surface soils.

Results of the ecological risk assessment show that there is a low potential for risk to predatory birds (i.e., Northern harrier) due to chemical releases from the SWMU. However, this risk is not likely to be significant because the surface area of the SWMU represents only a very small percentage of the hunting range.
Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

SWMU NO. 93 - OIL/WATER SEPARATOR NO. 5121

Site Usage

SWMU 93 was an OWS with a leach well serving Power Check Pad 5121. It was removed in 1988 when Building 5121 was demolished. Facility 5123 has been constructed over the

former location of Building 5121, and the sampling for the RFI was adjacent to Building 5123 in the vicinity formerly occupied by the OWS and the leach field.

RFI Findings

It was found in the RFI that for SWMU 93 barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the risk screening criteria. It was concluded that the data available was sufficient to complete a baseline risk assessment.

BRA Summary

Potential receptors at SWMU 93 for human health risk included occupational workers, hypothetical future construction workers, and hypothetical future trespassers. These receptors were assumed to be exposed to soil via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were evaluated using fate and transport modeling. The modeling indicated that contaminants would not reach groundwater at concentrations of potential concern. Therefore, this pathway was considered insignificant.

The maximum potential excess human health risk at SWMU 93 was 2×10^{-7} for occupational workers. This is below the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was ingestion of PAHs in surface soils.

Results of the ecological risk assessment show that there is a low potential for risk to predatory birds (i.e., Northern harrier) due to chemical releases from the SWMU. However, this risk is not likely to be significant because the surface area of the SWMU represents only a very small percentage of the hunting range.

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

SWMU NO. 94 - OIL/WATER SEPARATOR NO. 5144

Site Usage

SWMU 94 is comprised of two sand traps and an OWS serving an automobile wash rack adjacent to the Army, Air Force Exchange Service (AAFES) service station, east of the intersection of D.L. Ingram Street and Argentia Avenue. The facility is out of service, and serves as covered parking for local workers vehicles.

RFI Findings

It was found in the RFI that for SWMU 94 antimony, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk screening criteria. It was concluded that the available data was sufficient to complete a baseline risk assessment.

BRA Summary

Potential receptors at SWMU 94 for human health risk included occupational workers, hypothetical future construction workers, and hypothetical future trespassers. These receptors were assumed to be exposed to soil via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were evaluated using fate and transport modeling. The modeling indicated that contaminants would not reach groundwater at concentrations of potential concern. Therefore, this pathway was considered insignificant.

The maximum potential excess human health risk at SWMU 94 was 6×10^{-7} for occupational workers. This is below the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was ingestion of PAHs in surface soils.

Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

SWMU NO. 127 - SAND TRAP AND LEECH FIELDS AT THE POL WASH RACK

Site Usage

SWMU 127 is a sand trap at the POL Wash Rack and the old and new leach fields that have received and now receive waste water from the wash rack. There is a new OWS in the line that was built in 1991. It is not defined as a part of SWMU 127. The wash rack is used to wash fuel trucks used to fuel aircraft on the flight line.

RFI Findings

It was found in the RFI that for SWMU 127 antimony, arsenic, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, bis(2-ethylhexyl)phthalate, chrysene, and indeno(1,2,3-cd)pyrene, exceeded the risk screening criteria. It was concluded that the available data was sufficient to complete a baseline risk assessment.

BRA Summary

Potential receptors at SWMU 127 for human health risk included occupational workers, hypothetical future construction workers, and hypothetical future trespassers. These receptors were assumed to be exposed to soil via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were evaluated using fate and transport modeling. The modeling indicated that contaminants would not reach groundwater at concentrations of potential concern. Therefore, this pathway was considered insignificant.

The maximum potential excess human health risk at SWMU 127 was 2×10^{-5} for occupational workers. This is within the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was ingestion of PAHs in surface soils.

Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

SWMU NO. 77 - CIVIL ENGINEERING CONTAINER STORAGE AREA

Site Usage

SWMU 77 is a fenced area paved with concrete that is used to store miscellaneous material, drums, transformers, and other supplies.

RFI Findings

It was found in the RFI that for SWMU 77 antimony, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene and TPH exceeded the risk screening criteria. It has been concluded that the available data is sufficient to complete a baseline risk assessment.

BRA Summary

Potential receptors at SWMU 77 for human health risk included occupational workers, hypothetical future construction workers, and hypothetical future trespassers. These receptors were assumed to be exposed to soil via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were evaluated using fate and transport modeling. The modeling indicated that contaminants would not reach groundwater at concentrations of potential concern. Therefore, this pathway was considered insignificant.

The maximum potential excess human health risk at SWMU 77 was 6×10^{-7} for occupational workers. This is below the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was ingestion of PAHs in surface soils.

Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

SWMU NO. 103 - WASTEWATER PLAYA LAKE

Site Usage

SWMU 103 is a natural playa that has been used to receive drainage from industrial sewers basewide since the early history of the Base. There has been various treatment of portions of the effluent, and the Playa Lake now receives the overflow from two aeration lagoons, and is used by nearby farmers for irrigation.

RFI Findings

It was found in the RFI that for SWMU 103 the surface water samples contained no contaminants at concentrations in excess of the risk screening criteria. The sludge/sediment samples contained concentrations of beryllium, silver, vanadium, and TPH in excess of the risk based screening criteria.

It was concluded that the available data was sufficient to complete a baseline risk assessment for all potential migration pathways except the groundwater. It was recommended that a risk assessment be done, and this report includes the BRA for all the pathways for which information was available.

BRA Summary

Potential receptors at SWMU 103 for human health risk included occupational workers, hypothetical future construction workers, hypothetical future trespassers, and farmers. These receptors were assumed to be exposed to sediment via ingestion, dermal contact and inhalation pathways. Potential human health risks from groundwater were not evaluated at this SWMU, because chemical concentrations beneath the lake were not determined.

The maximum potential excess human health risk at SWMU 103 was 9×10^{-8} for occupational workers. This is below the EPA's target risk range of 1×10^{-6} to 1×10^{-4} for risk from releases at hazardous waste sites indicating that no unacceptable risk is expected. The primary contributor to the risk was dermal contact with bis(2-ethylhexyl)phthalate in surface soils.

Results of the ecological risk assessment show that there could be a potential for ecological risks to predatory birds (i.e., herons) due to chemical releases at the SWMU. However, due to significant uncertainties associated with bioaccumulation assumptions used in this assessment as well as the exclusion of factors that would decrease the risk to herons (i.e., seasonal use of the Lake by the heron or other food sources), the actual level of risk, if any, is unknown.

Since the groundwater pathway has not been completely characterized, the assessment of risks cannot be completed for this SWMU. Therefore, it is recommended that additional data be collected so that the groundwater pathway can be fully characterized.

1.0
INTRODUCTION

1.1 BACKGROUND AND AUTHORITY

Cannon Air Force Base (AFB) is a permitted RCRA facility operating in accordance with the terms of a permit issued jointly by the United States Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED) effective October 3, 1989. This permit sets forth the conditions within which Cannon AFB can be operated as a hazardous waste facility. The authority for regulation of hazardous waste activities at Cannon AFB through this permit is derived from the Federal Resource Conservation and Recovery Act (RCRA) and its reauthorization in the form of the Hazardous and Solid Waste Amendments of 1984 (HSWA) as well as the New Mexico Hazardous Waste Management Act.

A portion of this permit governs the investigation and, where required, the implementation of corrective measures to mitigate the effects on the environment of releases of petroleum products and other chemicals that may have been released from various Solid Waste Management Units (SWMUs) at the Base. One hundred twenty-eight SWMUs were identified at Cannon AFB during the RCRA Facility Assessment completed in 1988 for the EPA by A. T. Kearney. Seventy-three of the SWMUs were identified for further investigation and were divided into three groups (Appendix I through III). Appendix I and Appendix II SWMUs have been investigated under other programs, and sixteen of the Appendix III SWMUs have been the subject of a RCRA Facility Investigation (RFI) Report. This Baseline Risk Assessment (BRA) assesses baseline risk for nine of the sixteen SWMUs from the Appendix III list.

This BRA was authorized and funded by the USAF through the United States Army Corps of Engineers (USACE).

1.2 PURPOSE AND SCOPE OF REPORT

This report details the methodologies and results of the BRA which was conducted as a follow-on to the RFI. The purpose of the BRA is to quantify the baseline risk from the

findings of the RFI, and to make recommendations on the basis of the risk identified at each site.

The scope of the RFI included identification of significant exposure pathways and chemicals of concern and a risk screening to determine whether a significant risk to human health is posed by contaminants at each site. A BRA was completed for each SWMU that was not eliminated from consideration by the risk screening.

The Appendix III SWMUs are listed in Table 1-1.

1.3 REGULATORY SUMMARY

This BRA has been completed in accordance with USACE instruction, EPA guidance, and the work plan prepared by the Environmental Management Branch, Civil Engineering Squadron, Cannon AFB, as approved by the USEPA with emendations. This work is directed at compliance with the terms of the RCRA Permit for Cannon AFB dated October 3, 1989.

Risk-based concentrations for the screening-level risk evaluation were calculated in accordance to RCRA Subpart S methodologies. The risk assessment was performed in accordance with EPA guidance (RAGS 1989). This guidance was used because it is the most appropriate and widely accepted guidance for assessing cumulative, multiple-pathway risks at a site. RAGS is consistent with the risk-based approach outlined in the RFI guidance (EPA 1989) and with the approach in RCRAs' proposed Subpart S rules (EPA 1990).

1.4 CANNON AFB OPERATIONAL HISTORY

Cannon AFB is located in Curry County, New Mexico, approximately 7 miles west of the City of Clovis. The base is situated on approximately 4,320 acres of land. The vicinity map of Cannon AFB is shown on Figure 1-1 and the site map of Cannon AFB is shown on Figure 1-2. Off-base facilities include the Melrose Bombing Range.

Cannon AFB dates to 1929, when Portair Field was established on the site. Portair Field was a civilian passenger terminal for early commercial transcontinental flights. In 1942, the Army Air Corps took control of the civilian airfield and it became known as the Clovis Army Air

Base. In early 1945, the base was renamed Clovis Army Air Field. Flying, bombing, and gunnery classes continued through the end of World War II. By mid-1946, however, the airfield was placed on a reduced operational status and flying activities decreased. The installation was deactivated in May 1947. The types of aircraft stationed at Cannon AFB from 1942 to 1947 included B-17, B-24, and B-29 heavy bombers.

The base was reassigned to the Tactical Air Command in July 1951. The first unit, the 140th Fighter-Bomber Wing, arrived in October of that year. The airfield was formally reactivated in November 1951 as Clovis Air Force Base. Between 1952 and 1957, the 50th and 388th Fighter-Bomber Wings were activated, and, upon their transfer, were replaced by the 312th and 474th Groups. Predominant aircraft stationed at Cannon AFB from 1951 to 1957 included the P-51 "Mustang" fighter and the F-86 "Sabre" fighter jet.

In June 1957, the base became a permanent installation and was renamed Cannon Air Force Base in honor of the late General John K. Cannon, a former commander of the Tactical Air Command. In October 1957, the 312th and 474th Fighter-Bomber Groups were redesignated tactical fighter wings and the 832nd Air Division was activated to oversee their activities.

In 1959, the 312th Tactical Fighter Wing (TFW) was deactivated and replaced at Cannon AFB by the 27th TFW. In December 1965, the base's mission changed to that of a replacement training unit, and the 27th TFW became the largest such unit in the Tactical Air Command. The predominant aircraft stationed at Cannon AFB from 1957 to 1965 was the F-100 "Super Sabre" fighter jet.

The 832nd Air Division was deactivated in July 1975, leaving the 27th TFW the principal Air Force unit at Cannon AFB. In early 1981, the 27th TFW was designated a Rapid Deployment Joint Task Force member.

The primary mission of Cannon AFB has remained relatively unchanged since 1965; i.e., to develop and maintain an F-111 tactical fighter wing capable of day, night, and all-weather combat operations and to provide replacement training of combat aircrews for tactical organizations worldwide. Aircraft stationed at Cannon AFB since 1965 include the F-100 "Super Sabre" fighter jet (1957-1969), the F-111A (1969), the F-111E (1969-1971) and the F-111D (1971-present). There are approximately 70 F-111D aircraft assigned to Cannon

AFB. The total work force on Cannon AFB numbers approximately 4,000, which includes 3,500 military and 450 civil service.

In 1992, Cannon AFB became part of the Air Combat Command (ACC) as the result of the overall realignment of Air Force Commands and the ongoing downsizing of the U. S. Military.

1.5 PREVIOUS INVESTIGATIONS

Prior to this RFI/BRA, investigative activities completed at Cannon AFB include the following:

- IRP Records Search - CH2M Hill - 1983
- Preliminary Review/VSI Report - RCRA Facility Assessment - A.T. Kearney - 1987
- RCRA Facility Investigation Work Plan for 27 SWMUs - Lee Wan and Associates, Inc. - 1990
- RI Investigation - Appendix I SWMUs - W-C - 1991-1992 (18 SWMUs called "First Third")
- RFI - Landfills 1 and 2 - W-C - 1992-1993
- RFI - Appendix II SWMUs - through USACE, Albuquerque, NM - 1993

Concurrently with the RFI on Appendix III SWMUs, W-C is completing Phase II RFI activities at the Old Entomology Rinse Area and at Landfill 5 under separate task orders. Investigations are also being completed at Landfills 3 and 4 and at Landfill 25.

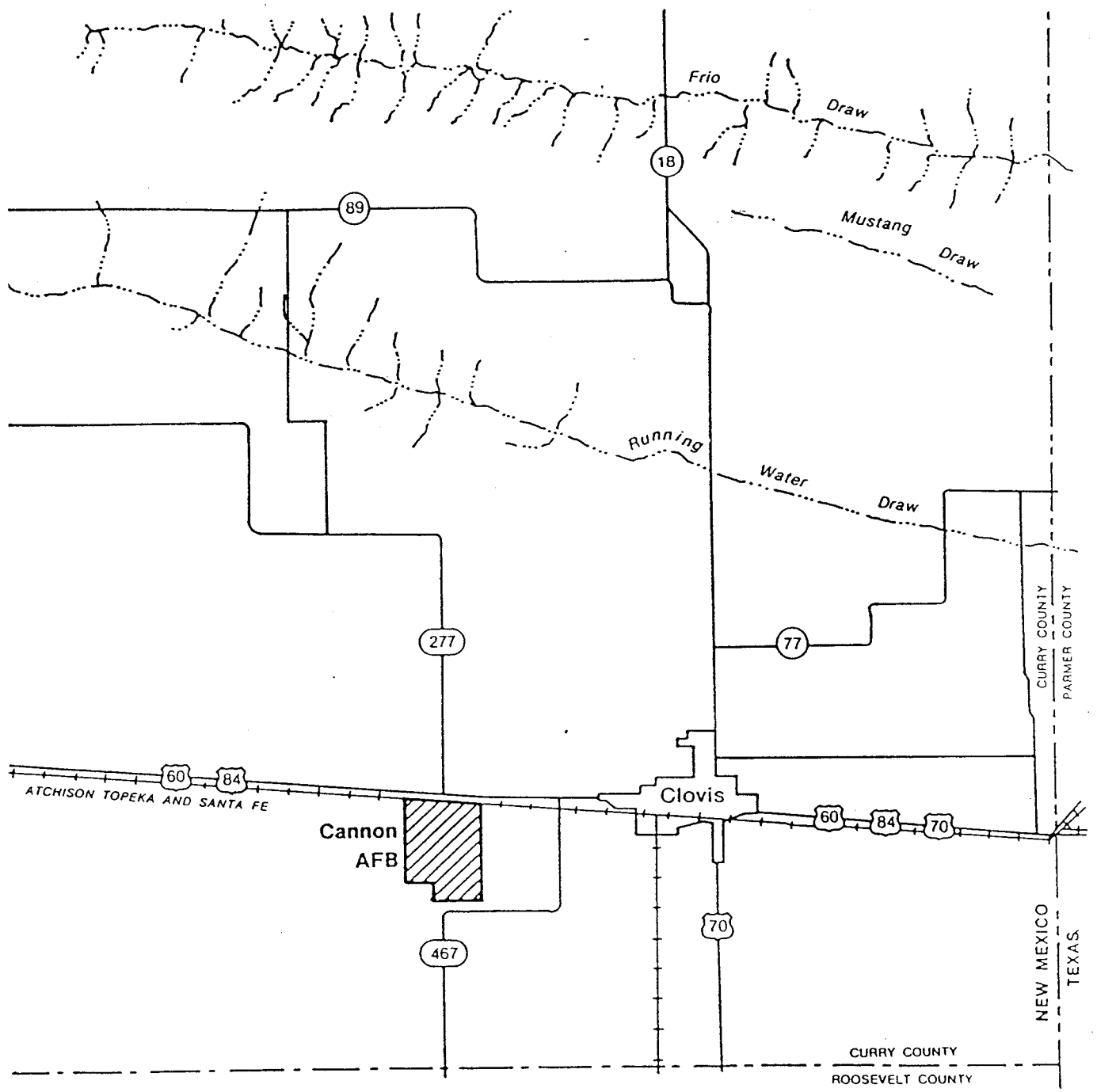
1.6 ORGANIZATION OF REPORT

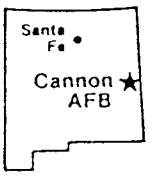
The BRA report is organized as shown in the table of contents, reporting activities and recommendations essentially in the order they were completed. The discussion of results and recommendations for each individual SWMU are presented (one site per section) in Sections 4.0 through 12.0.

TABLE 1-1

LIST OF APPENDIX III SWMUs

Site	SWMU Number
AGE Maintenance Shop	31
Oil/Water Sep #196	46
Oil/Water Sep #494	47
Oil/Water Sep #375	51
Oil/Water Sep #379	57
Oil/Water Sep #5077a,b,&c	61, 62, 63
Oil/Water Sep #326	70
Oil/Water Sep #5120	92
Oil/Water Sep #5121	93
Oil/Water Sep #5144	94
Oil/Water Sep #4095	127
Lead/Acid Battery Area	55
CE Container Storage Area	77
Wastewater Playa Lake	103





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MILES

SOURCE: FINAL REPORT, IRP PHASE II

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DRN BY: JTA/SCR	DATE: 08/18/93	VICINITY MAP CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 1-1
CHK'D BY:	DATE:			

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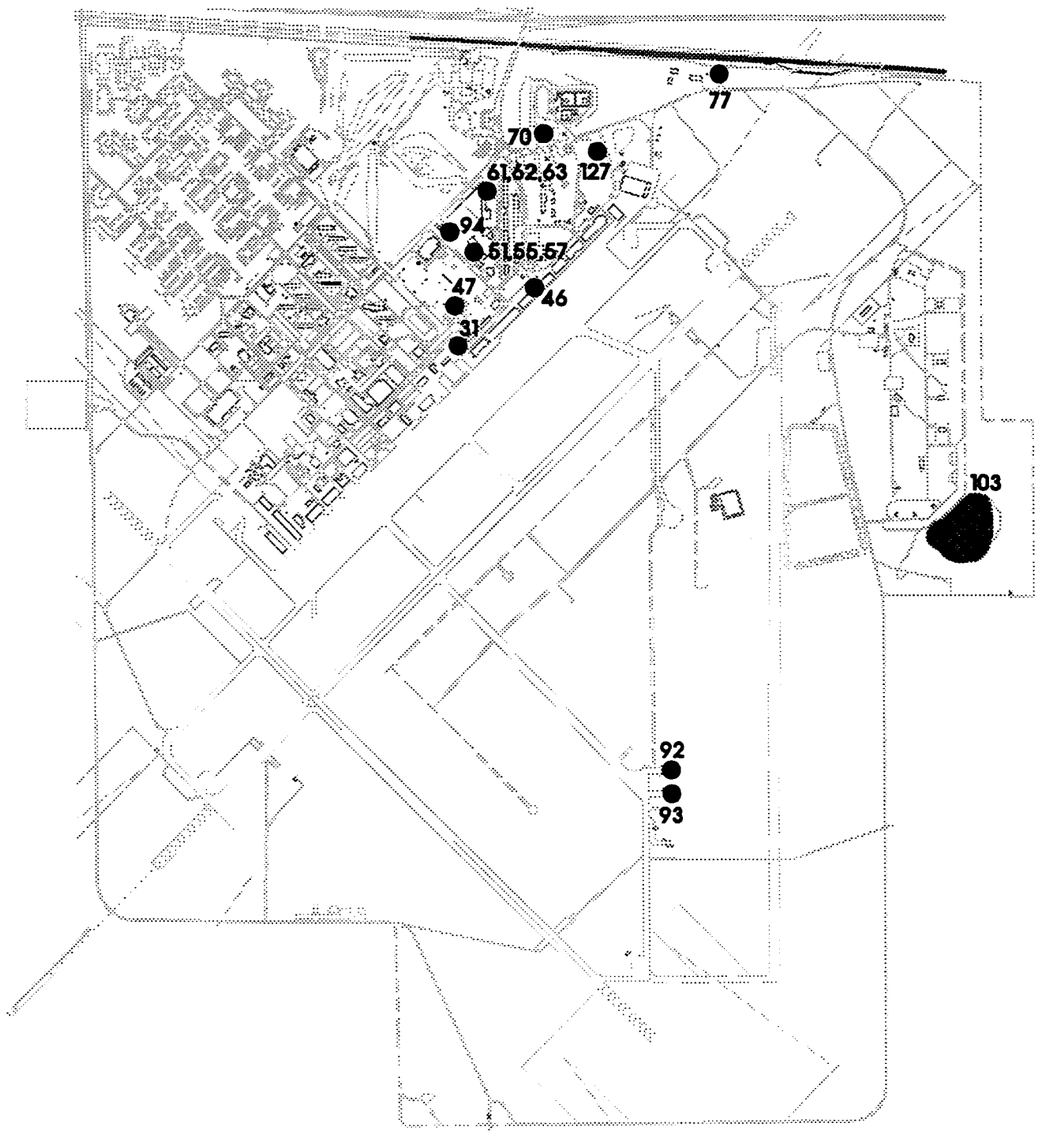


LEGEND

31 ● SOLID WASTE MANAGEMENT UNIT (SWMU) LOCATION AND NUMBER

SWMU No.	DESIGNATED AREA
31	AGE MAINTENANCE SHOP PAD
46	OIL/WATER SEPARATOR No. 196
47	OIL/WATER SEPARATOR No. 494
51	OIL/WATER SEPARATOR No. 375
55	LEAD ACID BATTERY ACCUMULATION POINT
57	OIL/WATER SEPARATOR No. 379
61	SAND TRAP No. 5077a
62	SAND TRAP No. 5077b
63	OIL/WATER SEPARATOR No. 5077c
70	OIL/WATER SEPARATOR No. 326
77	CIVIL ENGINEERING CONTAINER STORAGE AREA
92	OIL/WATER SEPARATOR No. 5120
93	OIL/WATER SEPARATOR No. 5121
94	OIL/WATER SEPARATOR No. 5144
103	WASTEWATER PLAYA LAKE
127	SAND TRAP AT POL WASHRACK

N

2000 1000 0 2000

SCALE IN FEET

DRN. BY: CJG	DATE: 08/16/93	SITE PLAN AND LOCATION OF INVESTIGATED SWMU SITES CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 1-2
CHK'D. BY:	REVISION: 0			

CAD FILE: C3M11W01.DWG 11/10/1993 17:17

2.0
CANNON AFB FACILITY DESCRIPTION

2.1 SETTING - PHYSICAL GEOGRAPHY

Cannon AFB is situated in the Southern High Plains Physiographic Province in the Llano Estacado subprovince. The Llano Estacado is a nearly flat plain sloping gently (10 to 15 feet per mile) to the east and southeast. Elevations in the eastern New Mexico portion of the Llano Estacado exceed 4,000 feet above mean sea level (msl). In the vicinity of Cannon AFB, elevations range from 4,250 feet to 4,350 feet above msl.

The most prominent geomorphic features in the vicinity of Cannon AFB are blowouts and broad, widely spaced valleys. Less common landforms are relict sand dunes located along the northern side of the Portales Valley south of the base. Relict dunes are not found on or near Cannon AFB.

Blowouts are broad shallow depressions which form as the result of soil erosion by wind. Blowouts commonly collect surface runoff from small to moderate sized drainage areas. During periods of rainfall, runoff collects in blowouts to form ephemeral playa lakes. Playas have no external surface drainage. Water is lost by infiltration to the soil and evaporation; without recharge, playa lakes persist for only a few days or weeks. Three playas are located within the base, and several more are found to the north and east of the base.

Stream valleys tend to be fairly broad and widely spaced. Streams are ephemeral and drainages are poorly developed. No streams exist on or near Cannon AFB. Running Water Draw and Frio Draw, located about 10 and 20 miles, respectively, north of Cannon AFB, are the nearest streams. These are second-order streams. Both streams are very straight, flow southeast, and have rectilinear drainage patterns with short laterals (W-C 1992).

2.2 DEMOGRAPHICS AND LAND USE NEAR CANNON AFB

Cannon AFB is located just south of U.S. Highway 60-84 in a farming and ranching area (Figure 1-1). The majority of the land surrounding Cannon AFB is productive, irrigated farmland or grassland. The major crops are wheat, sorghum, sugar beets, corn, cotton, alfalfa, barley, and peanuts. The land is also used for cattle grazing, both beef and dairy, and Clovis is considered the "Cattle Capital of the Southwest." There were 32,767 people living in Clovis in 1990, while the Cannon AFB population was estimated to be 4,650 in 1990 (W-C 1992).

2.3 CLIMATOLOGY

The climate of east-central New Mexico is classified as tropical semi-arid, with summer temperature and precipitation maxima. Average monthly temperatures range from a January low of 12°C (39°F) to a July high of 26°C (78°F). Extreme daily temperatures range from -24°C (-11°F) to 41°C (106°F) (Lee Wan and Associates 1990b). Average monthly precipitation ranges from 1 cm (0.4 inches) in winter to 6.9 cm (2.7 inches) in July (AWS 1986). The maximum recorded 24-hour rainfall is 12.2 cm (4.8 inches), which occurred in August. Rainfall occurs on eight or more days per month during the summer precipitation maximum. Mean annual precipitation is approximately 41 cm (16 inches). The mean annual evapotranspiration rate is 181.4 cm/yr (71.4 inches/yr) (Lee Wan and Associates 1990b). Prevailing winds are from the west at an average of 5 k/hr (3.1 mph) during fall, winter, and spring. During the summer, winds are from the south at an average of 3.7 km/hr (2.3 mph).

The atmosphere around the area of Cannon AFB is generally well mixed. The seasonal and annual average mixing heights can vary from 400 meters in the morning to 4,000 meters in the afternoon. The afternoon mixing heights are typically greater during the spring and fall seasons. The morning mixing heights are usually low, due to nighttime heat loss from the ground, producing surface-based temperature inversions. After sunrise, these inversions break up, and solar heating of the earth's surface causes vertical mixing in the atmosphere.

Dust is frequently entrained into the atmosphere in this region of the country because of gusty winds and the semiarid climate. The Texas Panhandle-eastern New Mexico area is considered the worst area in the United States for windblown dust. Occasionally, this windblown dust

is of sufficient quantity to restrict visibility. Most of the seasonal dust storms occur in March and April, when the wind speeds are typically high (average 5 k/hr) (W-C 1992).

2.4 GEOLOGY

The near-surface stratigraphic units of interest at Cannon AFB are the Late Miocene-Late Pliocene-age Ogallala Formation and the Early Triassic Dockum Group as shown in Figure 2-1.

The Dockum Group consists of three formations. The stratigraphically lowest unit is the Santa Rosa Sandstone. Overlying the Santa Rosa Sandstone are the Chinle and Redonda Formations. The Chinle and Redonda Formations are composed mainly of red shales with lesser interbedded sands, and are known locally as "redbeds." The top of the Dockum Group is marked by an erosional nonconformity having relief of up to several hundred feet (Lee Wan and Associates 1990b).

Overlying the Dockum Group redbeds is the Ogallala Formation. The Ogallala Formation extends from eastern New Mexico and Colorado into Texas, Oklahoma, Kansas, Nebraska, and South Dakota. Drillers' logs from Cannon AFB indicate that the Ogallala Formation varies from 360 feet to 415 feet in thickness. The incised upper surface of Triassic redbeds strongly influences Ogallala thickness. Stream valleys in the post-Triassic nonconformity are deep and trend dominantly east-west. Ogallala thickness may thus vary significantly over short north-south distances.

The Ogallala is erosionally truncated to the south along the abandoned Portales Valley, to the west along the Pecos River Valley, and to the north in a series of ephemeral stream valleys. The Ogallala Formation extends more than 125 miles to the east before terminating as an escarpment in Briscoe County, Texas. Springs and seeps are common along the erosional margins of the Ogallala.

The Ogallala dips gently and monoclinally to the southeast in the vicinity of Cannon AFB. As reported in Lee Wan and Associates (1990b), data suggest that some Quaternary warping may have occurred; however, most of the structures are well to the northwest and southwest

of Cannon AFB. No faults or buried structural lineaments are known in the vicinity of Cannon AFB.

The Ogallala Formation is composed of unconsolidated poorly sorted gravel, sand, silts, and clays. The base of the Ogallala is generally marked by a gravel, cobble, and boulder deposit. This basal member contains sediments derived from igneous and sedimentary rocks transported from the mountains to the west. The Ogallala Formation was laid down by stream and overbank deposits formed within coalescing alluvial fans. These fans form a broad pediment along the eastern flank of the Rocky Mountains. As is typical of alluvial deposits, Ogallala internal stratigraphy varies vertically and horizontally over short distances.

Except where strongly cemented by calcium carbonate (caliche), the sediments of the Ogallala are loose and friable. Authigenic and allogenic clays are found as a trace to abundant matrix mineral (Lee Wan and Associates 1990b). As reported by Lee Wan and Associates (1990b), five zones have been distinguished within the Ogallala of east central New Mexico on the basis of clay minerals. Smectites (montmorillonites) and attapulgite (with sepeotite) are the dominant clays throughout the Ogallala. Illite is a lesser, but persistent clay, as is kaolinite. Smectite is a swelling clay, causing deep cracks to form in dry surface soils. Smectite in particular and, to a lesser extent, attapulgite and illite, are clays with moderate to high cation exchange capacities (CEC). The formation as a whole should therefore have a relatively high CEC, which should inhibit the migration of charged contaminants, and especially ionic forms of metals.

Caliche is a major feature of the Ogallala Formation, occurring as nearly continuous to discontinuous layers throughout. A generalized geologic section at Cannon AFB is shown in Figure 2-1. Caliche is hard, white to pale tan on fresh surfaces, weathering to gray, and has a chalky appearance. Caliche forms as calcium carbonate, leached from overlying sediments, and precipitates in the pore space of the host sediments. Precipitation is caused by the evaporation of downward percolating water. The caliche may thus mark the position of ancient vadose zones. As reported in Lee Wan and Associates (1990b) radiocarbon dates for the upper "climax" caliche range from ~27,000 yrs. Before Present (B.P.) to ~42,000 yrs. B.P.

Caliche is relatively soluble in acidic water (pH < 7) or in waters containing dissolved CO_2. The top surface of the upper "climax" caliche in fresh outcrop shows solution etching.

The Ogallala has numerous continuous to discontinuous caliche layers throughout its thickness. The uppermost caliche, termed the "climax" caliche, is pisolitic (Lee Wan and Associates 1990b). The pisolites are thought to have formed as the caliche was repeatedly chemically-weathered and brecciated during Pleistocene pluvials and later recemented during drier intervals. This upper caliche outcrops around playas and the bounding escarpments of the Ogallala, and is locally termed "caprock." The "climax" caliche is typically 3 to 5 feet thick. Caliches which occur lower in the Ogallala are platy and harder. Caliche may be thin or absent below playas (W-C 1992).

2.5 HYDROGEOLOGY

The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are utilized in the vicinity of Cannon AFB. The Ogallala aquifer is part of the High Plains Aquifer which extends continuously from Wyoming and South Dakota into New Mexico and Texas. In east central New Mexico, the Ogallala aquifer rests on Dockum Group redbeds, which serve as the basal confining layer. The Ogallala is a water table, or unconfined, aquifer (Lee Wan and Associates 1990b). The Ogallala aquifer has a southeasterly regional gradient of about 13 feet/mile. Well yields vary from less than one gallon per minute (gpm) in thin silts and sands, and up to 1,600 gpm in thick sands and gravels (Lee Wan and Associates 1990b). Water quality is generally good, with hardness and fluorides being somewhat high (Lee Wan and Associates 1990b).

At Cannon AFB, the Ogallala aquifer has an average saturated thickness of 120 feet based on mid-1960s data. Saturated thickness ranges from 93 to 143 feet, and is influenced by the configuration of the erosional nonconformity surface marking the top of the Dockum Group. The local groundwater gradient is southeasterly at 7.5 feet/mile (Lee Wan and Associates 1990a). Figure 2-2 shows water table elevation contours for 1984. Flow within the saturated zone may be influenced by the configuration of the top of the Dockum Group. Yields in tests of Cannon AFB water wells have ranged from 776 l/min (205 gpm) to 4,353 l/min (1150 gpm). Specific capacities range from 0.14 m^3/m (11.4 gal/feet) to 0.35 m^3/m (27.9 gal/feet) (Lee Wan and Associates, 1990b).

Very rough estimates of hydraulic conductivity were made from well pump tests in water wells 5 and 9 (Figure 2-3) using the Theis equation. An estimate of hydraulic conductivity for water well 8 was based on water level recovery data using the Bouwer and Rice approach (Lee Wan and Associates 1990b). The data used in these calculations were obtained to evaluate pump rates, efficiency, and well yield, and were not intended for use in calculating aquifer properties. The results of these calculations should therefore be considered as first approximations.

Hydraulic conductivity values for water wells 5 and 9 were found to be approximately 2.0×10^{-3} cm/sec. Calculations for water well 8 result in a hydraulic conductivity of 2.0×10^{-2} cm/sec. These estimates appear to be low when compared to published hydraulic conductivity data for sands and gravels. As reported in Lee Wan and Associates (1990b) a groundwater flow velocity of about 45 m/yr (150 feet/yr) has been estimated. This calculates out to a hydraulic conductivity of approximately 1.0×10^{-1} cm/sec. Again, this appears to be low when compared with published data (Freeze and Cherry 1979).

The presence of interstitial clays may account for both the variability and low values of hydraulic conductivities. Boring logs from Cannon AFB IRP projects and published reports (Lee Wan and Associates 1990b) indicated that interstitial and interstratified clays are abundant in the Ogallala Formation. Additional aquifer testing will be required if it becomes necessary to more accurately determine hydraulic conductivity.

Recharge to the Ogallala is primarily through precipitation. As reported in Lee Wan and Associates (1990b), a recharge rate of 0.5 inches/year was calculated using the Theis equation. Lee Wan and Associates (1990b) reported that the recharge rate may be as much as 1.0 inches/yr. Due to the high evapotranspiration rate and low precipitation, recharge occurs only during heavy rainfall events in which the infiltration capacity of the soil is exceeded and runoff occurs, or during cool months when precipitation exceeds evapotranspiration. Excess runoff flows to playas, and the presence of water in playas allows deep percolation to the aquifer. The occurrence of this process is evidenced by the presence of clay deposits in, and thin or nonexistent caliche layers directly below, playas. Caliche is soluble in acidic rain waters, and is leached over time to form percolation pathways.

Discharge from the Ogallala occurs through well pumping and springs along the eroded margins. Spring discharge does not occur on or near Cannon AFB. Domestic and irrigation water wells are common on and around the base, however. The rate of discharge exceeds the rate of recharge. Water levels in the Ogallala have declined steadily from the 1930s to the present. A decline of 50 to 100 feet has been observed in the area around Clovis, New Mexico for the period from the 1930s to 1980. Lee Wan and Associates (1990b), states "the largest area of water level decline exceeding 100 feet occurs south of the Canadian River extending from Curry Co., New Mexico to Crosby Co., Texas."

The dominant uses of groundwater in the Cannon AFB area are for potable and irrigation water. Numerous wells are found in the Cannon AFB area, most of which provide only irrigation water (Figure 2-3).

The Ogallala will continue to be used as the primary source of potable and irrigation water for eastern New Mexico. The New Mexico State Engineer designated Curry County as a Water Basin in 1989. This designation allows for regulation of water rights, usage, and well drilling (W-C 1992).

2.6 SOILS

Soils in the vicinity of Cannon AFB are classified as SM to SC under the Unified Classification Systems, and as aridisols (calciorthids) under the Soil Conservation Service Comprehensive Soil Classification System. The following summary is based on the Soil Conservation Service Curry County Soil Survey as reported in Lee Wan and Associates (1990b).

The most common soil type on the base is the Amarillo fine sandy loam, 0 to 2 percent slope phase (map symbol Ab Figure 2-4). This soil consists of a thin sandy A horizon, well defined clayey B_{1-3} horizons, with a calcic B_3 horizon at depths below 40 inches. The calcic B_3 horizon lies on a calcic C horizon, or on caliche. The Amarillo fine sandy loam is present on all relatively flat surfaces at the base, but is also found on slopes associated with playas (map symbol Ac).

Clovis fine sandy loams, 0-2 percent slope phase (map symbol Cb) and 2-5 percent slope phase (map symbol Cc), are very similar to Amarillo fine sandy loams. In the Clovis soils, the depth to the calcic C horizon ranges from 28 to 56 inches. The depth to caliche exceeds 56 inches. Clovis and Amarillo fine sandy loams occur in close association.

In a few limited areas, particularly along the steeper slopes around playas, Mausker fine sandy loam, 0 to 2 percent slope phase (map symbol Ma), and 2 to 5 percent phase (map symbol M6) are found. Mausker fine sandy loams have no B horizons and are very calcareous. The calcic C horizon is within 2 feet of the surface.

The A and B horizons of Amarillo and Clovis fine sandy loams are rapidly to moderately permeable. Mausker fine sandy loam A and Ac horizons are rapidly permeable. Permeabilities in calcic B and C horizons are moderate (Lee Wan and Associates 1990b).

2.7 BACKGROUND SOIL AND WATER QUALITY

The natural soils in the vicinity of Cannon AFB are alkaline and rich in metals in general. Typically high concentrations of aluminum, iron, magnesium, manganese, and potassium combine with elevated levels of many other metals in the natural soils. Calcium is naturally present in the soils at levels up to nearly 200,000 mg/kg. Tightly cemented layers of caliche are present in several horizons in the natural soils and the Ogallala aquifer below.

The uppermost groundwater aquifer is the Ogallala, and the groundwater is more than 200 feet deep. The groundwater from the lower portions of the aquifer is used for drinking water, irrigation, and industrial applications. No deeper aquifers are utilized in the vicinity of Cannon AFB. The water quality is generally good, with dissolved solids ranging from 250 to 500 mg/L (Gutentag et al. 1984) and fluorides ranging from 2.2 to 2.7 mg/L (William Matotan and Associates, Inc. 1985).

The levels of inorganic compounds detected in 37 background soil samples collected at Cannon AFB are presented in Table 2-1 in the form of a mean value, standard deviation, and 95 percent tolerance limits (mean plus or minus two standard deviations). The data used to compile these statistics are shown in Tables A-2 through A-4 of Appendix A. The upper tolerance limit is used in screening the soil chemical results for this RFI. Table 2-2 also

includes naturally occurring concentrations for the Clovis, New Mexico region reported in USGS 1984. These values are also used for reference in determining whether concentrations at the RFI sites exceed background.

The general water quality from the Ogallala aquifer over a broad region is presented in Table 2-2, and water quality data for samples from production wells and monitoring wells within the bounds of Cannon AFB are presented in Table 2-3.

These tables of background data have been adapted from a draft report by Woodward-Clyde dated March 1993 entitled "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon Air Force Base, Clovis, New Mexico". This report summarizes background data for soil and groundwater from numerous past investigations in the vicinity.

2.8 BIOLOGICAL RESOURCES

Land adjacent to Cannon AFB is primarily used for agriculture, and there is little natural vegetation remaining in the area. The wildlife species that are common to agricultural areas throughout the region include bobwhite quail and pheasant. There are a few playa lakes in the area; these are used by upland game for cover, by waterfowl for resting and feeding, and by wildlife in general for drinking. Nearby riverbeds also provide water sources during rainy seasons. During periods of low rainfall, the riverbeds are dry (W-C 1992).

2.8.1 Plant Resources

The climate of the Base area is considered to be semiarid. The thin layer of topsoil in the vicinity of Cannon AFB is sandy loam, which is highly susceptible to wind erosion. The undisturbed natural vegetation is mostly shortgrass prairie, including blue grama grassland and mixed grama grassland vegetation types, which have moderately fast recovery rates.

Much of the study area has been previously cleared for agricultural crops. The predominant land use of the region is rangeland, primarily for cattle grazing. In general, moderately grazed rangeland areas of the types occurring in the project area are highly productive in terms of both forage quality and quantity. The rangeland in the vicinity may support up to

15 to 20 head of cattle per section, depending on the rainfall. Large trees do not uniformly exist in the vicinity of the range except where planted around buildings and other structures on the Base. Woodlands composed of large shrubs and small trees are confined to riparian areas and playa lakes in the vicinity (W-C 1992).

The following plants are candidate species for the Federal List of Endangered and Threatened Wildlife and Plants and are found within a 50-mile radius of Cannon AFB: chatterbox orchid (*Epipactus gigantea*), spiny aster (*Aster harridus*), Whittmans milkvetch (*Asragalus witmanil*), dune unicorn plant (*Proboscidea sabulosa*), and the tall plains spruce (*Eupjorbia strictior*). The dune unicorn plant is also on the state endangered plant species list. No federally protected endangered plants are known to be present on the Base (Lee Wan and Associates 1990b).

2.8.2 Wildlife Resources

The eastern New Mexico area contains many nongame wildlife species that are typical of the High Plains. Most of these species are distributed widely throughout the western United States. Species diversity is low in most habitats because of the low vegetation diversity. Most amphibian species are associated with riparian habitats and playa lakes. Reptiles are found in all terrestrial habitat types but are most abundant in scrub/grasslands. Nocturnal rodents are the most abundant members of the small mammal community.

Grasslands on the High Plains support a variety of seed-eating sparrows and other ground-dwelling birds, both as residents and migrants. Raptors (hawks and owls) are relatively abundant in all habitats in the region. Insectivorous and tree-nesting species are most abundant in riparian areas. Shorebirds and waterbirds and migratory waterfowl in general utilize the rivers, playa lakes, and reservoirs of the region.

Two National Wildlife Refuges (NWRs) are located on the periphery of the Base area. The Grulla and Muleshoe NWRs are within 30 miles of Cannon AFB. These areas provide high-quality habitat for migratory and breeding waterfowl.

Big-game species in the area include mule deer, white-tailed deer, pronghorn, and barbary sheep. Pronghorn are the most abundant game animal in the area. Several species of upland game, such as quail, ring-necked pheasant, and turkey are common in the area. Reservoirs (Ute Lake, Conchas Lake, and Clayton Lake) and playa lakes are important waterfowl habitats in the region. Numerous species of native and introduced fish inhabit the rivers and perennial streams, and the reservoirs support recreational fishing of warm-water species such as walleye, crappie, channel catfish, largemouth bass, and bluegill.

As determined by the regional office of the U.S. Fish and Wildlife Service, two federally listed endangered animal species, the bald eagle and peregrine falcon, are known to inhabit the area within a 50-mile radius of Cannon AFB. The New Mexico Department of Game and Fish also indicated that the state endangered Mississippi Kite, Baird's Sparrow, and the Black-Footed Ferret may also occur in the vicinity of the Base. The federal- and state-protected species are listed in Table 2-4.

Within Curry County, the only state-protected bird that is expected to occur is the Mississippi Kite. In New Mexico, since the early 1960s, this kite summers regularly and breeds in the Clovis region. The birds frequent the golf course at Cannon AFB. Two other state-protected birds that may occur within Curry County are the McCown's Longspur and Baird's Sparrow. These two species have not been sighted regularly in recent years, however. No information is available on the McCown's Longspur in New Mexico; however, Baird's Sparrow occurs mainly in autumn during migration in the eastern plains and southern lowlands. Migrants appear as early as the first week of August and move further south by November. The species seems to have declined in abundance throughout its range in the Southwest due to the loss of shrubby shortgrass habitats.

State-protected birds known to occur infrequently are the bald eagle and the peregrine falcon. The bald eagle migrates and winters from the northern border of New Mexico to the Gila, lower Rio Grande, middle Pecos, and Canadian valleys. It is seen occasionally in summer and as a breeding bird, with nests reported in the extreme northern and western parts of the state. Winter and migrant populations appear to have increased with reservoir construction. The peregrine falcon is widely distributed but population numbers are low. The American subspecies breeds statewide in New Mexico, but mainly west of the eastern plains (Source: Draft Environmental Impact Statement - Cannon AFB 1990).

TABLE 2-1

SUMMARY OF BACKGROUND ELEMENTAL CONCENTRATIONS IN SOIL SAMPLES (mg/kg)[1] CANNON AFB, NEW MEXICO

Element	Mean ($\bar{x}$)	Standard Deviation (SD)	95% Tolerance Limits of Background Concentrations ($\bar{x}$)±2SD	Reported Levels in Clovis, New Mexico Region
Aluminum	5,700	2,420	860 - 10,540	50,000
Antimony	6.75[2]	-	-	<1
Arsenic	3.5	6.0	0 - 15.5	6.5
Barium	166	238	0 - 642	500
Beryllium	0.41	0.16	0.09 - 0.73	1 - 2
Cadmium	1.1[2]	-	-	---
Calcium	69,200	58,600	0 - 186,400	7,900 - 18,000
Chromium	6.98	2.78	1.42 - 12.5	30
Cobalt	2.5	1.0	0.5 - 4.5	3 - 7
Copper	5.40[2]	-	-	20
Iron	4,780	1,970	840 - 8,720	100 - 15,000
Lead	7.12	9.35	0 - 25.8	15
Magnesium	4,650	3,570	0 - 11,790	2,000 - 5,000
Manganese	72.0	46.0	0 - 164	500
Mercury	0.11[2]	-	-	0.032 - 0.082
Nickel	5.0	2.0	1.0 - 9.0	15
Potassium	1,360	606	148 - 2,572	16,000
Selenium	8.23[2]	-	-	0.15 - 0.30
Silver	1.2[2]	-	-	---
Sodium	514[2]	-	-	7,000
Thallium	0.50[2]	-	-	---
Vanadium	14.9	5.20	4.50 - 25.3	30 - 70
Zinc	11.3	5.29	0.72 - 21.9	45

[1] Compiled from data collected by W-C for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel & Associates for the IRP (Walk, Haydel & Associates 1990). Data are shown in Appendix A.

[2] Mean is calculated using reporting limits for nondetect results. The actual mean background concentrations are probably lower than these values.

TABLE 2-2

REGIONAL WATER QUALITY[1] - OGALLALA AQUIFER[2]

	Sherman Co. Nebraska	Laramie Co. Wyoming	Red Willow Co. Nebraska	Kit Carson Co. Colorado	Kiowa Co. Colorado	Stanton Co. Kansas	Meade Co. Kansas	Union Co. New Mexico	Roberts Co. Texas	Gaines Co. Texas	Gaines Co. Texas	Mean ($\bar{x}$)
Silica	63	28	58	36	22	20	23	38	27	58	64	40
Calcium	94	45	56	30	228	51	63	56	46	72	231	88
Magnesium	14	5.5	15	10	114	20	19	34	18	20	225	45
Sodium and Potassium	21	6.4	19	27	226	35	245	17	37	44	845	138
Bicarbonate	336	157	200	181	184	180	210	215	243	221	282	219
Sulfate	18	6.5	13	10	1,170[5]	8.1	94	49	32	104	1,351[5]	260
Chloride	18	2.8	3.9	3.0	143	30	350[5]	46	28	43	1,109[5]	162
Fluoride	---	0.4	0.8	1.8	4.0[5]	1.4	1.0	1.6	0.8	1.5	4.0[5]	1.6
Nitrate	7.6	7.0	---	7.6	3.9	12[5]	1.7	24[5]	3.9	5.6	4.2	7.0
Dissolved Solids	403	191	273	214	2,140[5]	339	900[5]	372	312	507[5]	3,970[5]	875
pH[3]	7.7	7.4	7.7	8.0	7.7	7.6	7.7	7.4	8.0	7.3	7.4	7.6
Specific Conductance[4]	605	281	420	325	2,630	555	1,650	628	507	675	5,350	1,240

1 Concentrations are in milligrams per liter (mg/L) unless otherwise indicated
2 Source: Krothe, et al. 1982
3 pH units
4 Micro mhos (μmhos)
5 Exceed U.S. Environmental Protection Agency Regulations for Drinking Water (1976, 1977)

TABLE 2-3

WATER QUALITY SUMMARY[1] FOR CANNON AFB PRODUCTION WELLS AND MONITORING WELLS (mg/L)[1]

	Minimum	Maximum	Mean	MCL[2]
Antimony	0.06U	0.06U	0.06[5]	0.01/0.005[3]
Arsenic	0.005U	0.05U	0.02[5]	0.051
Barium	0.022	0.2	0.50[5]	1.0
Beryllium	0.002U	0.002U	0.002[5]	0.01[3]
Cadmium	0.005U	0.01U	0.0008[5]	0.005[3]
Chloride	42	63.5	52.2	250
Chromium	0.01U	0.001	0.04[5]	0.01
Cobalt	0.01U	0.01U	0.01[5]	*
Copper	0.01U	0.02U	0.012[5]	1.0[4]
Cyanide	0.005U	0.005U	0.005[5]	0.2
Fluoride	1.8	2.6	2.3	2
Lead	0.005U	0.05U	0.015[5]	0.05
Manganese	0.00	0.01U	0.0075[5]	0.05
Mercury	0.0002U	0.003	0.001[5]	0.002
Nickel	0.04U	0.032	0.04[5]	1.0[3]
Nitrate	0.9	6.6	1.8	10.0
Selenium	0.01UJ	0.0049J	0.01[5]	0.05
Silver	0.01U	0.05U	0.02[5]	1.0[4]
Sulfate	115	132	125	250
Thallium	0.01U	0.01U	0.01[5]	0.022/0.001[3]
Tin	0.1U	0.1U	0.1[5]	*
Uranium	0.0036	0.0062	0.0046	5.0
Vanadium	0.02	0.031	0.026	*
Zinc	0.0041J	0.09	0.05	5.0
TDS	385	479	451	500
pH (units)	7.5	7.95	7.78	6.5 - 8.5

MCL = Maximum contaminant level
UJ = Estimated as non-detect at the CRQL
J = Estimated value
U = Not detected
CRQL = Contract Required Quantitation Limit

* No primary or secondary MCL or proposed MCL as of March 1992

[1] Values are calculated from historical data for Cannon AFB wells 1, 2, 3, 4, 7, 8, 113A, and 101E for period from 1966 through 1991.
[2] Primary MCL in effect as of July 30, 1992
[3] Proposed primary MCL
[4] Secondary MCL in effect as of July 30, 1992
[5] Detection limits (using one times the value) were also used to calculate means.

TABLE 2-4

FEDERAL- AND STATE-PROTECTED ANIMALS POTENTIALLY OCCURRING IN THE VICINITY OF CANNON AFB (CURRY COUNTY)

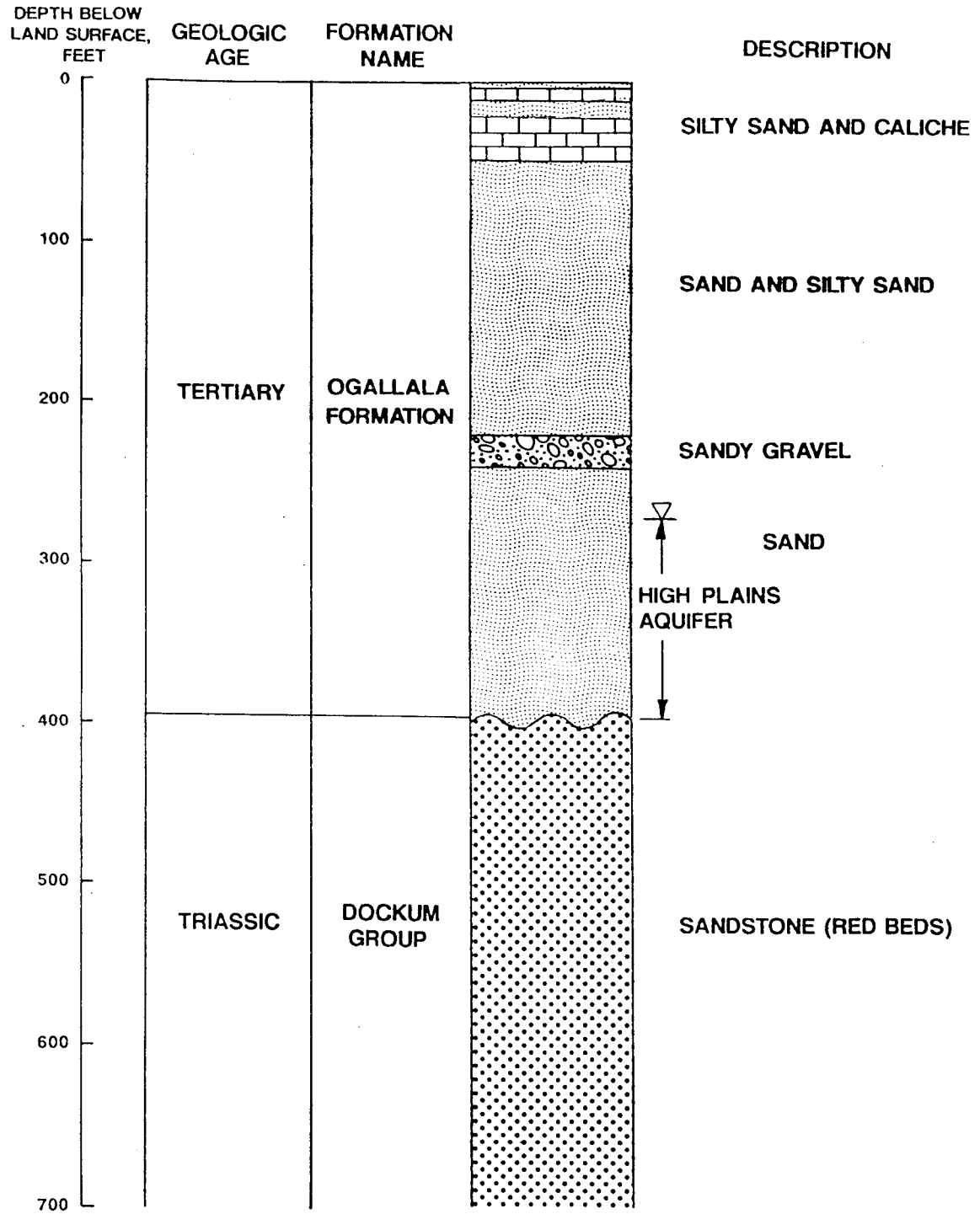
Common Name	Scientific Name	Federal Status	State Status
Birds			
Mississippi kite	*Ictinia mississippiensis*		Endangered (Group 2)
Barid's sparrow	*Ammodramus baridii*		Endangered (Group 2)
Bald eagle	*Haliaeetus leucocephalus*	Endangered	Endangered (Group 2)
Peregrine falcon	*Falco perigrinus*	Endangered	Endangered (Group 1)
Mammals			
Black-footed ferret	*Mustela nigripes*	Endangered	Possibly Extinct

Endangered (Group 1): Species whose prospects of survival or recruitment within the state are in jeopardy.

Endangered (Group 2): Species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.

Possibly Extinct: Potentially no longer in existence in the state.

Source: Lee Wan and Associates 1990



LEGEND

LITHOLOGIC CONTACT

UNCONFORMITY

WATER LEVEL

SOURCE: MODIFIED FROM GUTENTAG ET.AL., 1984

DRN BY: LLG/SCR	DATE: 08/18/93	GENERALIZED GEOLOGIC STRATA AT CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO 2-1
CHK'D BY:	DATE:			

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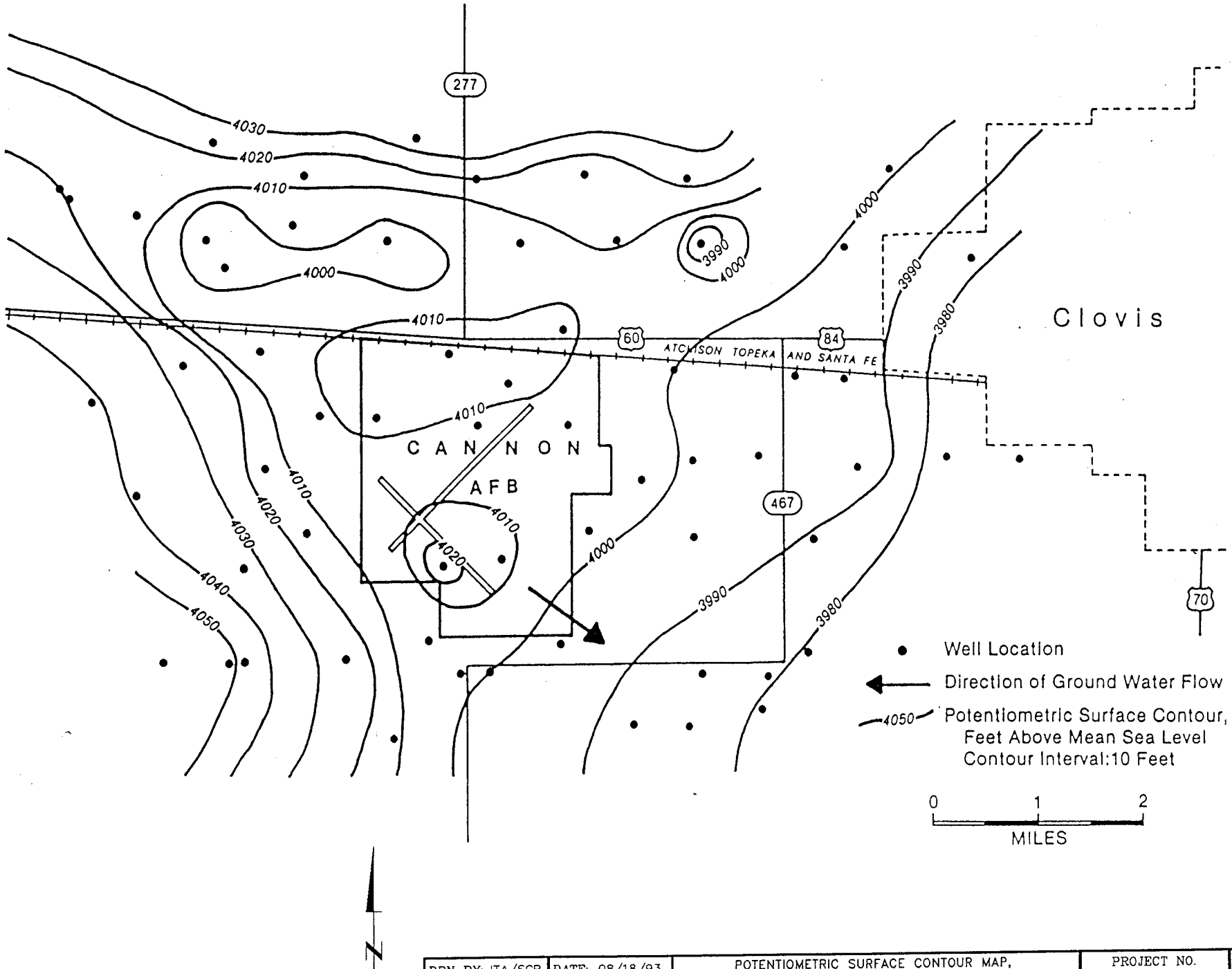
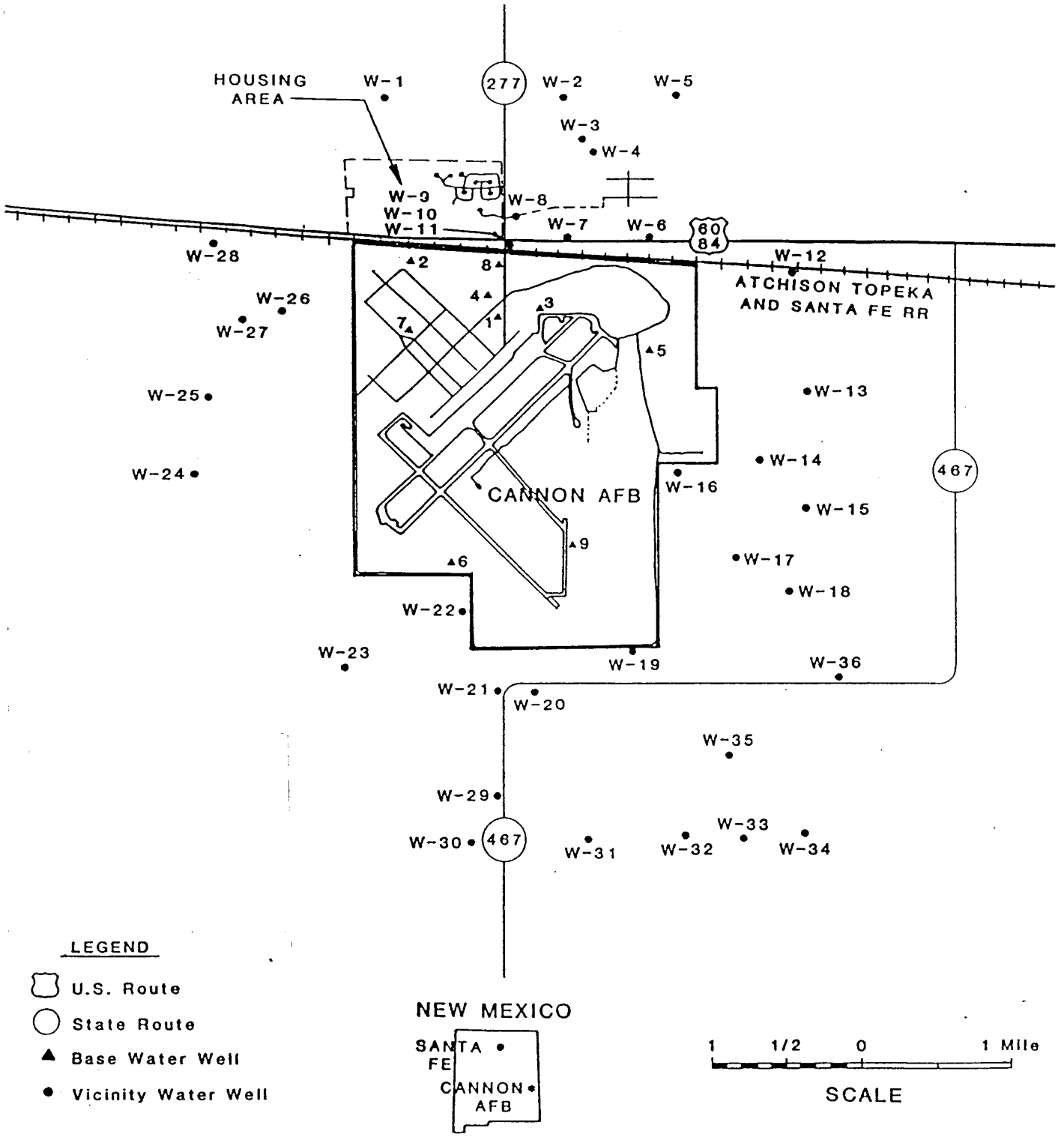
CAD FILE: FS11X8.DWG 08/18/1993 11:19



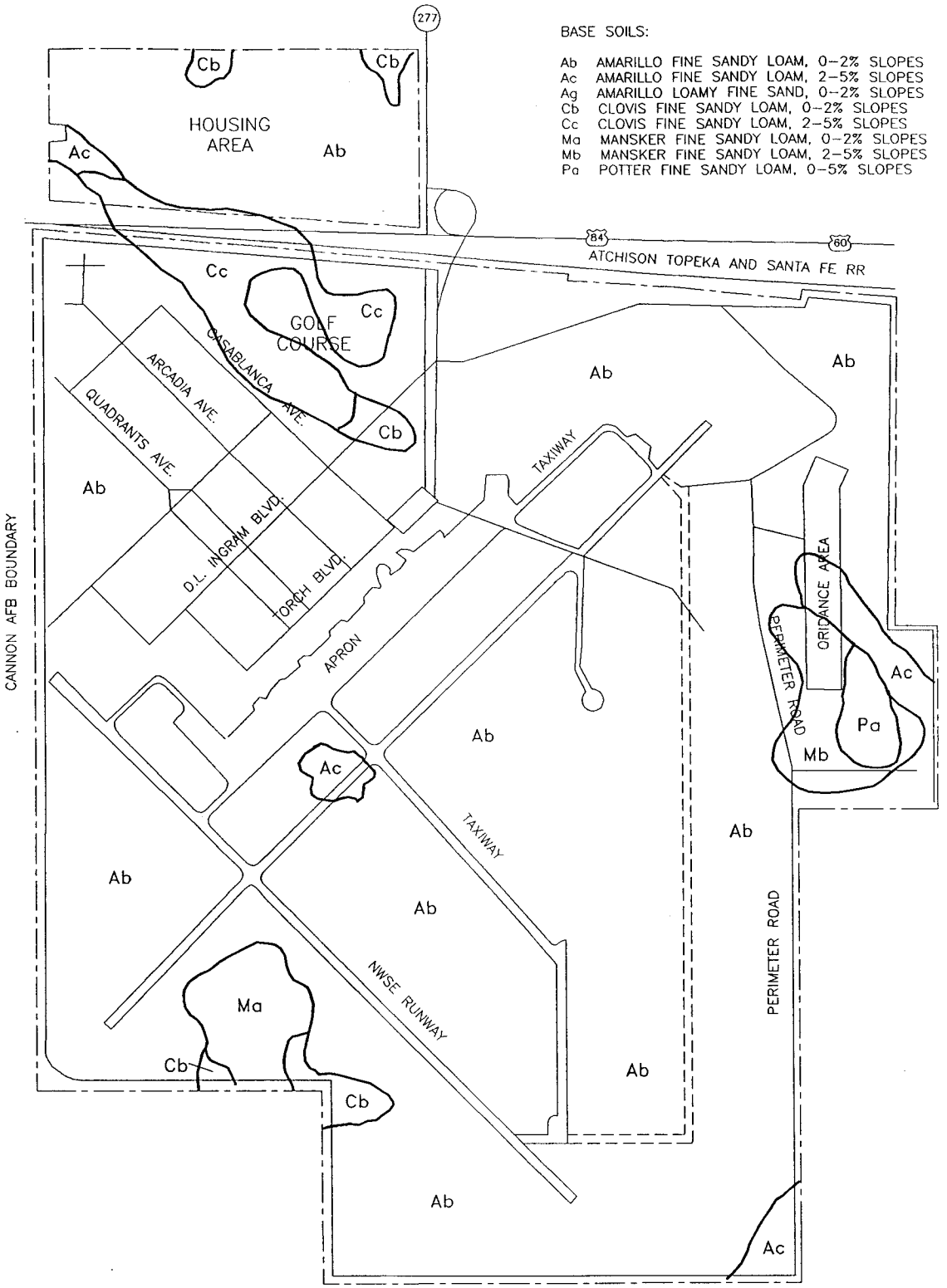
SOURCE: FINAL REPORT, IRP PHASE II

DRN BY: JTA/SCR	DATE: 08/18/93	POTENTIOMETRIC SURFACE CONTOUR MAP, VICINITY OF CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-2
CHK'D BY:	REVISION: 0			



BASE MAP ADAPTED FROM: FINAL REPORT, IRP PHASE II

DRN BY: JTA/SCR	DATE: 08/18/93	WATER WELL LOCATIONS ON AND NEAR CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO 2-3
CHK'D BY:	DATE:			



SOURCE: USDA-S.C.S., SOIL SURVEY OF CURRY COUNTY N.M., 1958

N

2000 1000 0 2000

SCALE IN FEET

DRN BY: SCR	DATE: 08/18/93	DISTRIBUTION OF SOILS, BY TYPE CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-4
CHK'D BY:	DATE:			

CAD FILE: C3M11W13.DWG 08/25/1993 13:45

3.0
SUMMARY OF RFI FINDINGS

The RFI field investigation was completed during August and September of 1993. It consisted of sampling surface and subsurface soils and at one site surface water and pond sediment. The field work also included collection of additional mapping data, and a field survey of the sampling points. Base personnel were interviewed to develop background information on operations, both currently and historically, for each of the subject sites. The samples were transported to ENSECO Rocky Mountain Analytical Laboratories for chemical testing which was completed in mid-October.

The sampling rationale was developed to collect samples in the locations and depths likely to be the most heavily contaminated at each site.

The RFI included a screening-level risk evaluation using Risk Based Concentrations (RBCs) calculated as action levels as outlined in RCRA Subpart S Guidance. These RBCs were very conservative (generally comparable to a one in ten million cancer risk). The highest detected concentrations of chemicals of concern at each SWMU were compared to the RBCs, to background, or to State of New Mexico requirements where applicable, in accordance with the decision process outlined in the work plans. Sites for which the RFI risk screening indicated the potential for unacceptable risk to human health or the environment have been evaluated in this BRA. In one case (SWMU 70), additional data collection has been recommended prior to completion of the BRA.

The conservative RBCs used in the risk screening in the RFI are considered to be protective of the environment as well. A detailed ecological risk assessment is included in this BRA for SWMUs not screened out in the RFI.

The USACE Scope of Services outlined the required chemical tests in accordance with the EPA approved work plan. Testing was in accordance with EPA SW-846 methodology. The analyte list at each SWMU was selected from the following groups on the basis of the potential contamination indicated by the past and current operations at each SWMU:

- Target Compound List (TCL) volatile organic compounds
- Semivolatile organic compounds
- Target Analyte List (TAL) metals
- Total petroleum hydrocarbons (TPH)
- Pesticides/PCBs
- Herbicides
- Total lead
- Acidity
- Appendix IX list of chemicals for surface water

Laboratory analytical data was validated in accordance with USACE and EPA guidance as outlined in the Quality Assurance Project Plan, and the validated data are the basis for the recommendations.

3.1 SCREENING-LEVEL HEALTH RISK EVALUATION METHODOLOGY

This section provides a description of the approach that was used in the screening-level health risk evaluation for each SWMU. Potential human health impacts were evaluated by comparing maximum chemical concentrations found at that SWMU with risk-based concentrations (RBCs) (Table 3-1) that were calculated for this report using conservative health-based criteria.

The goal of this evaluation was to make a determination as to whether or not a release had occurred at a SWMU that could pose a potential risk to human health or the environment. The risk-based approach outlined in this section provides an upper-bound estimate of potential human health impacts because conservative screening criteria and maximum chemical concentrations were used to estimate potential impacts. If no potential human health or environmental risks were indicated for a given SWMU using these conservative criteria, then no further investigation was recommended for a SWMU.

3.1.1 RFI Investigation Decision Process

The RFI soils investigation decision process is designed to identify appropriate recommended actions for disposition of each SWMU investigated based on three alternative recommended actions for any given SWMU: no further action, interim action, and further investigation and evaluation in a final RFI/Corrective Measures Study (CMS). The recommendations for the selection of alternative action for each SWMU depended upon whether chemicals of concern were detected in soils at levels that posed an unacceptable risk to human health or the environment.

The decision process was implemented by first evaluating and summarizing existing historical information and analytical data collected for each of the SWMUs. Historical information was used to identify potential chemicals of concern and to identify potential sites of chemical release at a SWMU. Then environmental media was sampled and analyzed for potential chemicals of concern. The analyte lists from which chemicals of concern were selected are discussed in the QAPP. Sampling was focused at points of potential releases from the SWMUs. SWMU-related chemicals of concern were selected by identifying chemicals reported above the analytical reporting limits. Metals that did not exceed background levels were not included as chemicals of concern. Organic chemicals that do not have EPA toxicity factors were not considered as chemicals of concern. Concentrations of chemicals of concern detected at each SWMU were evaluated for potential human health and environmental risks by completed a screening-level risk evaluation.

The risk evaluations are screening-level because they compare maximum detected concentrations (which are higher than concentrations to which people or ecological receptors would routinely be exposed) to highly conservative (protective) health risk-based criteria. For example, health risk-based criteria used in the evaluations are based on residential exposure assumptions, which are more stringent than criteria based on industrial use. Health risk-based criteria are based on 10^{-7} excess cancer risk or hazard quotient equal to 0.1. This conservative approach permits identifying SWMUs that pose no unacceptable risk under highly conservative exposure assumptions and that, therefore, warrant no further evaluation or action, and identifying other SWMUs that may warrant further evaluation based on exceedance of stringent risk-based criteria.

The results of this screening-level risk evaluation were used to analyze each SWMU and make recommendations regarding the three alternatives stated above. The recommendations were made on the following basis:

- If no threat or human health exists based on comparison of maximum concentrations to stringent screening criteria, and no potential threat to the environment is apparent, then no further action was recommended.

- If an unacceptable threat to human health or the environment is imminent, a source is well defined, and a source control is readily identified, an interim action to control the source was recommended.

- If there is a potential threat to human health, the SWMU was further evaluated by completing a Health and Environmental Assessment (HEA) on the SWMU.

Soil, sediment, and surface water data were collected to characterize the nature and extent of contamination that has been released from each SWMU, including a evaluation of the potential for chemicals of concern to be transported to the groundwater at concentrations that may pose a human health threat (by determining if the vertical distribution of contamination decreases with depth). The nature and extent was characterized at the suspected release sites; i.e., areas with greatest concentrations of chemicals of concern to determine whether a release had occurred which could pose a risk to human health or the environment. Sampling locations were finalized by integrating the sampling locations from the Cannon AFB June 1992 FSP with the locations needed to fulfill the data needs required by the data quality objectives. In addition, nature and extent was characterized so that appropriate exposure pathways could be addressed in HEA.

Maximum detected soil, sediment, and surface water concentrations of chemicals of concern were compared to conservative risk-based concentrations (RBCs) to evaluate whether a release had occurred that may pose an unacceptable risk to human health or the environment in the present or future. On those sites where concentrations of any SWMU-related chemicals of concern exceeded RBCs, and HEA has been completed. If the concentration of none of the SWMU-related chemicals of concern exceeded RBCs, the concentration of contaminants were judged to be insignificant, and therefore no further investigation was recommended.

3.1.2 Derivation of Screening Criteria

Using RCRA guidance, the maximum concentrations of SWMU chemicals were compared with risk-based criteria. These criteria were derived using the methodology described in RCRA Proposed Action Levels (EPA 1990).

The RBCs were calculated using the methodology defined in RCRA Subpart S to calculate RCRA Action Levels; however, unlike Subpart S action levels, these RBCs were based on 10^{-7} excess cancer risk or 0.1 hazard quotient. Subpart S Action Levels are based on 1×10^{-6} excess cancer risk for Class A (known) and Class B (probable) human carcinogens and a 1×10^{-5} excess cancer risk for Class C (possible) carcinogens, or a hazard quotient equal to 1 for ingestion assuming residential exposures. The more restrictive (protective) risk level of 10^{-7} was used for screening, as mutually agreed with USACE during project negotiation meetings, to account for the possible additive effects of multiple exposure routes in addition to ingestion (i.e., dermal contact and inhalation of vapors or particulates released from soil), and exposure to multiple chemicals. The main source for the critical toxicity values (slope factors and reference doses) used to calculate RBCs was the EPA's computer database, the Integrated Risk Information System [IRIS] (EPA 1993). If no data were available in IRIS, other sources were used. These sources are referenced in the Risk-Based Concentrations of Detected Chemicals Table 3-1. It must be emphasized that this was a highly conservative approach used for screening purposes only; risks that would be estimated in a SWMU-specific quantitative health and environmental assessment HEA are likely to be much lower than the risk levels calculated using these screening criteria. The formula used for calculating RBCs for carcinogens in soil was:

$$RBC\ (mg/kg) = \frac{TR * BW * ED}{SF * IR * CF * AF * AT}$$

where:

TR = target carcinogenic risk (1×10^{-7})

BW = average weight of adults (70 kg)

AT = assumed lifetime, averaging time (70 yr

IR = soil ingestion rate (0.1 g/day)

CF = conversion factor (0.001 kg/g)
AF = absorption factor (1)
ED = exposure duration (70 yr)
SF = chemical specific slope factor $(mg/kg\text{-}d)^{-1}$

For noncarcinogens, RBCs are the concentrations in soil that are estimated to result in a "hazard quotient" (HQ) of 0.1 to a resident at the SWMU. A hazard quotient is the ratio of the estimated daily dose from the assumed exposure to a reference dose (RfD), established by EPA, that is considered safe for a lifetime of daily exposure. A hazard quotient of 1 means that no toxic effects are likely to occur, even to sensitive individuals exposed for a lifetime. A hazard quotient above 1 does not mean that toxic effects will necessarily occur, but that further evaluation of exposures and chemical toxicity is required. The more conservative HQ of 0.1 was used for screening to account for exposure to multiple chemicals and for exposure routes other than ingestion, such as dermal contact with water or soil and inhalation of vapors or particulates released from soil. This is a highly conservative approach used for screening purposes only. The formula used for calculating RBCs for noncarcinogens in soil was calculated:

$$RBC\ (mg/kg) = \frac{RfD * BW * HQ}{IR * AF * CF}$$

where:

RfD = chemical specific oral Reference dose (mg/kg-day)
BW = weight of 5-year-old child (16 kg)
IR = soil ingestion rate (0.2 g/day)
AF = absorption factor (1)
CF = conversion factor (0.001)
HQ = hazard quotient of (0.1)

The formula used for calculating RBC's for noncarcinogens in water was:

$$RBC\ (mg/L) = \frac{RfD * BW * HQ}{IR * AF}$$

where:

RfD	=	chemical specific oral Reference dose
BW	=	average body wight of adults (70 Kg)
HQ	=	Hazard quotient of (0.1)
IR	=	groundwater ingestion rate (2 L/day)
AF	=	absorption factor (1)

A maximum chemical concentration that exceeds a screening-level RBC does not mean that a health risk exists, because the maximum concentration detected is not the concentration to which people would routinely be exposed, and the exposure assumptions used to derive the RBCs are for residential land use (not realistic for these SWMUs) and are not SWMU-specific. For example, the EPA-suggested intake parameters assume (1) that soil ingestion rates are 200 mg/day for children age 0 to 6 and 100 mg/day for adults, even though recent studies cited by EPA indicate soil ingestion rates may be significantly lower (by a factor of 4 or 5; Calabrese et al. 1989; Davis et al 1990); (2) that all of the soil/dust ingested per day is from contaminated soils at the SWMU; and (3) that exposure occurs daily for 70 years for water ingestion, 5 years at the "child" soil ingestion rate of 200 mg/day for noncarcinogens, and 70-year adult lifetime exposure for carcinogens. These assumptions could overestimate "reasonable maximum exposures", even for residential use. In addition, the water risk-based concentration assumes that surface water is used as a drinking water source. The wastewater Playa Lake is not used as a drinking water source and it is extremely unlikely that it ever will be. None of these "default" assumptions apply to current or likely future exposures at Cannon AFB. Based on the preliminary exposure evaluation, no residential exposures of any duration or magnitude occur or are likely to occur at these SWMUs. Occupational exposures are significantly less than residential, and conditions such as cold weather and clean soil cover would reduce or prevent contact with potentially contaminated soil.

It is important to note that RBCs are not cleanup goals. Cleanup goals are determined on a SWMU-specific basis. Rather, comparing soil concentrations to screening-level RBCs based on residential use, a 10^{-7} excess cancer risk level, and a HQ of 0.1 for noncarcinogens was adopted as a means of screening whether the chemicals in soils could pose a threat to human health. If the screening-level RBCs were not exceeded, no further action was recommended. If the screening-level RBCs were exceeded, a baseline HEA was performed.

The following sections discuss for each SWMU the contamination found (if any), the results of the screening-level risk evaluation, and the recommendations resulting from the evaluation.

SWMU NO. 31 - AGE MAINTENANCE PAD

The Aerospace Ground Equipment (AGE) Maintenance Pad is a paved area outside to the southeast of Building 186. The area is used for maintenance of ground equipment associated with the base aircraft operations. Potential contaminants include JP-4, mineral and synthetic oils, and diesel fuel.

Samples of soil from the surface and the subsurface to 10 feet below ground surface (bgs) were collected from four locations adjacent to the edge of the paved area. The locations were selected where rainwater and wash water may have carried oily contaminants from the slab onto the ground. Target analytes for samples collected included VOCs, SVOCs, TAL metals, and TPH.

It was found that barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, cadmium, chromium, chrysene, indeno(1,2,3-cd)pyrene, lead, and TPH concentrations exceeded the risk screening criteria. It was concluded that there is enough data available to complete a baseline risk assessment, and it was recommended that the risk assessment be done.

SWMU NO. 46 - OWS NO. 196

The Oil/Water Separator (OWS) at Building 196 serves aircraft service and maintenance operations in that building. Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

Samples of soil at depths beginning just beneath the pavement and extending to 10 feet bgs were taken from three soil borings adjacent to the OWS. The locations were as close as possible to the OWS to assure detection of any significant leakage. Target analytes for the samples collected included VOCs, SVOCs, TAL metals, and TPH.

It was found that antimony and barium were the only chemicals detected in the soil at concentrations in excess of the risk screening criteria. These two metals were found to be naturally occurring and not SWMU-related chemicals. No further action was recommended at SWMU 46.

SWMU NO. 47 - OWS NO. 494

SWMU No. 47 is comprised of a sand trap and an OWS, each serving different parts of the Auto Hobby Shop in Building 494. The OWS serves the floor drain system in the main shop area, and the sand trap serves the floor drain in the engine/auto wash and prep room. The potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, paint chips and metals.

Samples of soil from the surface and the subsurface to a depth of 10 feet bgs were collected. The locations were selected to assure detection of significant leakage or spillage from the subject units and their operation. Target analytes for the samples collected included VOCs, SVOCs, TAL metals, and TPH.

It was found that none of the maximum concentration levels detected exceeded risk screening criteria. Cobalt was detected at a maximum concentration of 5.4 mg/kg, and there is no toxicity data on which to base an RBC calculation. The detected levels of cobalt are essentially at or below naturally occurring background ranges and it was concluded that the cobalt is not a SWMU-related contaminant. No further action was recommended at SWMU 47.

SWMU NO. 51 - OWS NO. 375

SWMU 51 is an OWS serving Building 375 within the motor pool compound. The OWS serves floor drains in the engine shop area of the building. The potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

Samples of soil from three borings adjacent to the OWS were collected from depths ranging from just below the pavement to 10 feet below the pavement surface. The target analytes for the samples included VOCs, SVOCs, TAL metals, and TPH.

It was found that barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk screening criteria. It was concluded that the available data are sufficient to complete a baseline risk assessment, and it was recommended that the risk assessment be done.

SWMU NO. 57 - OWS NO. 379

SWMU 57 is an OWS serving the floor drains in the fire-truck maintenance area in Building 379. The potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

Samples of soil from three borings adjacent to the OWS were collected from depths ranging from just below the pavement to 10 feet below the pavement surface. The target analytes for the samples included VOCs, SVOCs, TAL metals, and TPH.

It was found that no contaminants exceeded the risk screening criteria. No further action was recommended at SWMU 57.

SWMU NO.'s 61, 62, AND 63 - SAND TRAPS NO. 5077A, B, AND OWS NO. 5077C

SWMUs 61 and 62 are sand traps beneath the drains for each of the wash rack areas in the Civil Engineering Squadron compound. SWMU 63, originally designated as an OWS, is another sand trap serving these wash racks. To avoid confusion with past reports, this unit

is still designated an OWS for this report. Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

Samples of soil from two borings adjacent to each of the sand traps and the OWS were collected from depths ranging from the near surface (or just below the pavement) to 10 feet below the ground (or pavement) surface. The target analytes for the samples included VOCs, SVOCs, TAL metals, and TPH.

It was found that for SWMU 61, barium was the only analyte for which the detected concentration exceeded the risk screening criteria. The maximum barium concentration of 727 mg/kg is within the background range for the Cannon AFB area and it was concluded that the barium is naturally occurring and not a site-related contaminant.

At SWMU 62 no analytes exceeded the risk screening criteria.

No further action was recommended for SWMU 61 nor SWMU 62.

At SWMU 63 barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the risk screening criteria. It was concluded that the available data are sufficient to complete a baseline risk assessment, and it was recommended that the risk assessment be done.

SWMU NO. 70 - OWS NO. 326

SWMU 70 is an OWS with a leaching well serving the floor drains for the fuel truck maintenance operations in Building 326. Potential contaminants are petroleum and synthetic lubricating oils, greases, solvents, fuels, and metals.

The original sampling plan included two 20-foot-deep borings adjacent to the OWS, and three 60-foot-deep borings adjacent to the leaching well. The two 20-foot-deep borings and one and one-half of the 60-foot-deep borings had been completed when high levels of volatile emissions required the use of respirators by the crews. It was concluded by the USACE Technical Manager at this point that the objectives had been achieved. Heavy petroleum contamination was encountered throughout the depth of the borings, with the worst areas near

the leaching well. Twenty-six soil samples were collected. The target analytes for the samples were VOCs, SVOCs, TAL metals, and TPH.

It was found that antimony, benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk screening criteria for SWMU 70. It was concluded that because the contamination was present at the 60-foot depth at concentrations greater than in the near surface soils not enough data was available to complete a baseline risk assessment for SWMU 70. It was recommended that additional investigations be completed to define the extent of contamination sufficiently to complete a baseline risk assessment, and that information be collected to support decisions regarding the applicability of corrective measure alternatives such as microbial degradation through bioventing, in-situ treatment, or natural attenuation. The recommendations included completion of a baseline risk assessment following the additional investigation.

SWMU NO. 92 - OWS NO. 5120

SWMU 92 is an OWS with a leach well discharge located east of Power Check Pad 5120. The OWS served the former aircraft service and maintenance associated with Building 5120 which has been removed from the site. The OWS is no longer in service, but it and the leach well and an oil recovery tank remain in place. Potential contaminants include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and metals.

Two borings were advanced to a depth of 20 feet bgs adjacent to the OWS and three borings were advanced to a depth of 60 feet bgs adjacent to the leach well. Thirty-five soil samples were collected from the borings. The target analytes for the samples included VOCs, SVOCs, TAL metals, and TPH.

It was found that benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and lead exceeded the risk screening criteria. It has been concluded that the available data are sufficient to complete a baseline risk assessment, and it was recommended that the risk assessment be done.

SWMU NO. 93 - OWS NO. 5121

SWMU 93 was an OWS with a leach well serving Power Check Pad 5121. It was removed in 1988 when Building 5121 was demolished. Facility 5123 has been constructed over the former location of Building 5121, and the sampling for this effort has been adjacent to Building 5123 in the vicinity formerly occupied by the OWS and the leach field. Potential contaminants include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and, metals.

Three borings were advanced to a depth of 60 feet bgs adjacent to the vicinity of OWS 5121 and the leach field. Twenty-seven soil samples were collected from the borings. The target analytes included VOCs, SVOCs, TAL metals, and TPH.

It was found that barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the risk screening criteria. It was concluded that the data available are sufficient to complete a baseline risk assessment, and it was recommended that the risk assessment be done.

SWMU NO. 94 - OWS NO. 5144

SWMU 94 is comprised of three sand traps serving an automobile wash rack adjacent to the Army, Air Force Exchange Service (AAFES) service station, east of the intersection of D.L. Ingram Street and Argentia Avenue. The sand trap in the grassy area adjacent to the wash racks was previously designated as an OWS, and the term OWS is used for this unit throughout this report. The facility is out of service, and serves as covered parking for local workers' vehicles. Potential contaminants include lubricating oils, fuels, greases, solvents, and metals.

Two borings were advanced adjacent to each of the units to a depth of 10 feet bgs or the pavement surface. Twenty-four soil samples were collected from the borings. The target analytes for the samples were VOCs, SVOCs, TAL metals, and TPH.

It was found that antimony, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk

screening criteria. It was concluded that the available data are sufficient to complete a baseline risk assessment, and it was recommended that the risk assessment be done.

SWMU NO. 127 - SAND TRAP AND LEACH FIELDS AT THE POL WASH RACK

SWMU 127 is a sand trap at the POL Wash Rack and the old and new leach fields that receive wastewater from the wash rack. There is a new OWS in a concrete vault in the line that was built in 1991. The vault was visually inspected at the premobilization visit. There was no evidence of any oil spillage or leakage. The OWS is not defined as a part of SWMU 127. The wash rack is used to wash fuel trucks used to fuel aircraft on the flight line. The potential contaminants include JP-4 fuel, grease, and motor oils.

Two borings were advanced to a depth of 10 feet bgs adjacent to the sand trap. Three borings were advanced to a depth of 60 feet bgs within each of the leach field areas. Sixty-two soil samples were collected from the borings. The target analytes included VOCs, SVOCs, TAL metals, and TPH.

It was found that antimony, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, chrysene, and indeno(1,2,3-cd)pyrene, exceeded the risk screening criteria. It has been concluded that the available data are sufficient to complete a baseline risk assessment, and it was recommended that the risk assessment be done.

SWMU NO. 55 - LEAD ACID BATTERY ACCUMULATION SITE

SWMU 55 is an area located in the northernmost corner of the fenced motorpool compound. It is used to store used lead acid motor vehicle batteries on pallets for eventual disposal. The potential contaminants include lead and sulfuric acid.

Three borings were advanced to a depth of 20 feet bgs at representative locations within the storage area. Fifteen soil samples were collected from the borings. Target analytes were total lead and acidity.

It was found that none of the analytes exceeded risk screening criteria, and no further action was recommended for SWMU 55.

SWMU NO. 77 - CIVIL ENGINEERING CONTAINER STORAGE AREA

SWMU 77 is a fenced area, paved with concrete, that is used to store miscellaneous material, drums, transformers, and other supplies. The potential contaminants include waste oil, solvents, aviation fuel, waste paint materials, PCBs, and pesticides.

Six soil borings were advanced to a depth of 20 feet bgs or below the pavement surface. Two of the borings were located within the fenced compound, and four were drilled in the soil just off the edge of the slab where it appeared that drainage was flowing off the slab. Thirty soil samples were collected from the borings. Target analytes included VOCs, SVOCs, TAL metals, TPH, PCBs, pesticides, and herbicides.

It was found that antimony, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk screening criteria. It was concluded that the available data are sufficient to complete a baseline risk assessment, and it was recommended that the risk assessment be done.

SWMU NO. 103 - WASTEWATER PLAYA LAKE

SWMU 103 is a natural playa that has been used to receive drainage from sanitary and industrial sewers basewide since the early history of the base. Portions of the effluent have been treated, and the Playa Lake now receives the overflow from two aeration lagoons. The Playa Lake is used by a nearby farmer for irrigation.

The potential contaminants include organic compounds, metals, PCBs, pesticides, and herbicides.

Four samples of the sludge and sediment from the bottom of the lake were collected with a ponar dredge, and three surface water samples from about 3 feet below the water surface were collected in a 3-liter bailer. The target analytes included the Appendix IX list of analytes for the surface water, and VOCs, SVOCs, TAL metals, TPH, PCBs, pesticides, and herbicides for the sediment.

It was found that the surface water samples contained no contaminants at concentrations in excess of the risk screening criteria. The sludge/sediment samples contained concentrations of beryllium, silver, vanadium, and TPH in excess of the risk-based screening criteria.

It was concluded that the available data are sufficient to complete a baseline risk assessment for all pathways except the groundwater. (Vadose zone fate and transport modeling was not performed, because contaminant concentrations beneath the Playa Lake [i.e., due to potential leaching] are not known.) It was recommended that a risk assessment be done.

SUMMARY OF RECOMMENDATIONS

SWMU NUMBER	RECOMMENDATION
31	BRA
46	NFA
47	NFA
51	BRA
57	NFA
61	NFA
62	NFA
63	BRA
70	FI and BRA
92	BRA
93	BRA
94	BRA
127	BRA
55	NFA
77	BRA
103	BRA

NOTE: The key to column 2 above is as follows:

- BRA = Baseline Risk Assessment
- NFA = No Further Action
- FI and BRA = Further Investigation and Baseline Risk Assessment

TABLE 3-1
RISK-BASED CONCENTRATIONS OF DETECTED CHEMICALS

Chemical	Carcinogen Class	Noncarcinogenic effects Oral RfD	Carcinogenic effects Oral slope factor	Subpart S Soils (mg/kg)	1 X 10-7 RBCs (mg/kg)	0.1 HQ RBC (mg/kg)	Reference of tox factors
1,2-Dichloropropane		0.004				3 E+01	1
2-Butanone	D	0.05		4000		4 E+02	
2-Hexanone		under review					4
2-Methylnaphthalene		no data in IRIS					7
4-Mthyl-2-Pentanone		0.05				4 E+02	3,6
4-Nitrophenol		under review					4
Acenaphthene		0.06				5 E+02	1
Acetone	D	0.1		8 E+03		8 E+02	
alpha-chlordane	B2	0.00006	1.3	5 E-01	5 E-02	5 E-01	
Aluminum		no toxicity data					
Anthraecene		0.3				2 E+03	1
Antimony	D	0.0004		3 E+01		3 E+00	
Arsenic	A	0.0003	1.75	80	4 E-02	2 E+00	1
Barium	D	0.07		4000		6 E+02	1
Benzene	A		0.029		2 E+00		1
Benzo(a)anthracene	B2		1.06		7 E-02		8
Benzo(a)pyrene	B2		7.3		1 E-02		1,8
Benzo(b)fluoranthene	B2		1.02		7 E-02		8
Benzo(g,h,i)perylene		no data in IRIS					7
Benzo(k)fluoranthene	B2		0.4		2 E-01		8
Beryllium	B2	0.005	4.3		2 E-02	4 E+01	1
Bis(2-ethylhexyl)phthalate	B2	0.02	0.014		5 E+00	2 E+02	1
Bromodichloromethane	B2	0.02	0.13	6 E-01	5 E-01	2 E+02	9
Bromoform	D	0.02		2 E+03		2 E+02	9
Butyl Benzyl Phthalate		0.2				2 E+03	1
Cadmium	B1	0.001		40		8 E+00	1
Calcium		no data in IRIS					7
Carbon disulfide	D	0.1		6 E+03		8 E+02	
Carbon tetrachloride	B2	0.0007	0.13	5 E+00	5 E-01	6 E+00	9
Carbazole		no tocixity data	0.02		4 E+00		10
Chlorobenzene	D	0.02		2 E+03		2 E+02	1
Chloroform	B2	0.01	0.0061	100	1 E+01	8 E+01	1
Chloromethane		no toxicity data					

TABLE 3-1
RISK-BASED CONCENTRATIONS OF DETECTED CHEMICALS

Chemical	Carcinogen Class	Noncarcinogenic effects Oral RfD	Carcinogenic effects Oral slope factor	Subpart S Soils (mg/kg)	1 X 10-7 RBCs (mg/kg)	0.1 HQ RBC (mg/kg)	Reference of tox factors
Chromium VI	A	0.005		400		4 E+01	1
Cobalt		under review					4
Copper	D	0.037				3 E+02	7
Chrysene	B2		0.032		2 E+00		8
DDD	B2		0.24	3 E+00	3 E-01		1
DDE	B2		0.34	2 E+00	2 E-01		1
DDT	B2	0.0005	0.34	2 E+00	2 E-01	4 E+00	1
Dibenzo(a,h)anthracene	B2		8.1		9 E-03		8
Dibenzofuran	D	no data					7
1,2-Dichloroethane	B2		0.091	8 E+00	8 E-01		9
1,1-Dichloroethylene	C	0.009	0.6	1 E+01	1 E-01	7 E+01	1
1,2-Dichloroethene (total)		0.02				2 E+02	1
Di-n-butyl Phthalate		0.1				8 E+02	1
Di-n-octyl Phthalate		0.02				2 E+02	1
Ethylbenzene	D	0.1		8 E+03		8 E+02	1
Fluoranthene		0.04				3 E+02	1
Fluorene		0.04				3 E+02	1
gamma-chlordane	B2	0.00006	1.3	5 E-01	5 E-02	5 E-01	1
Indeno(1,2,3-cd)pyrene	B2		1.69		4 E-02		8
Iron		no data in IRIS					7
Lead	B2	NA	NA			5 E+02	2
Manganese	D	0.14				1 E+03	1
Mercury	D	0.0003		20		2 E+00	3,4
Methylene chloride	B	0.06	0.0075	90	9 E+00	5 E+02	1
Naphthalene		0.04				3 E+02	6
Nickel	D	0.02		2000		2 E+02	1
Pentachlorophenol	B2	0.03	0.12	2 E+03	6 E-01	2 E+02	1
Phenanthrene		no data					7
Potassium		no data					
Pyrene		0.03				2 E+02	1
Selenium		0.005				4 E+01	1
Silver	D	0.003		20		2 E+01	1
Sodium		no data in IRIS					7

TABLE 3-1
RISK-BASED CONCENTRATIONS OF DETECTED CHEMICALS

Chemical	Carcinogen Class	Noncarcinogenic effects Oral RfD	Carcinogenic effects Oral slope factor	Subpart S Soils (mg/kg)	1 X 10-7 RBCs (mg/kg)	0.1 HQ RBC (mg/kg)	Reference of tox factors
Styrene	C	0.2		2 E+04		2 E+03	9
1,1,2,2-Tetrachloroethane	C		0.2	4 E+01	4 E-01		9
Tetrachloroethylene	B2	0.01	0.051	1 E+01	1 E+00	8 E+01	3
Thallium		0.0008				6 E+00	
Toluene	D	0.2		2 E+04		2 E+03	1
1,1,1-Trichloroethane	D	0.09		7 E+03		7 E+02	3
Trichloroethylene	B2		0.011	6 E+01	6 E+00		3
Vanadium		0.007				6 E+01	4,6
Xylenes	D	2		2 E+05		2 E+04	1
Zinc		0.3				2 E+03	1

1 = Verifiable in IRIS
2 = Lead Uptake Biokinetic model 4.0 as suggested in OSWER directive #9355.4-02, Interim guidance on establishing lead soil cleanup levels.
3 = Withdrawn from IRIS
4 = Under review in IRIS
5 = Converted from 1.3 mg/L
6 = HEAST 1992
7 = No data in IRIS
8 = ICF - Clement Associates, 1988 (chemical-specific potency factor x benzo(a)pyrene slope factor).
9= HEAST 1991
10=HEAST 1993
NA = Not available

4.1 SITE BACKGROUND

4.1.1 Site Description

The AGE Maintenance Shop Pad is an open asphaltic concrete area adjacent to the southeast side of the AGE Maintenance Shop, located in Building No. 186. The pad is approximately 60 to 70 feet wide and 240 feet long (Figure 4-1). A wash rack occupies an area about 45 feet square beyond the southeast edge of the pad. The AGE Drainage Ditch (SWMU No. 34, investigated in the Appendix I RI) (W-C 1992) lies to the southeast of the maintenance pad and carries runoff to the northeast.

The maintenance pad has a slight gradient to the southeast, which directs surface runoff from the area north and east of Building 186 toward the AGE ditch. Runoff northwest of the wash rack is directed along an expansion joint southwestward off of the pad.

4.1.2 Site History

The maintenance pad has been active since 1971. Water from washing and surface or storm water, potentially contaminated with waste oils and fuel, flows off the pad to the southeast. The Appendix I RI investigation of soils lining the AGE drainage ditch to the southeast of the AGE pad found negligible to nondetectable levels of target contaminants in the soils sampled (W-C 1992).

4.1.3 Current Use

Maintenance on aeronautical ground equipment is performed in Building No. 186 and on the south and east sections of the pad. The wash rack (not a target of this investigation) is frequently used to wash and clean support vehicles and equipment. The wash rack is separately drained to an adjacent OWS, which is not a part of this investigation. A portion of the drainage from the pad reportedly drains into a sand trap at the northwest corner of the wash rack. This sand trap reportedly empties into the OWS.

4.1 SITE BACKGROUND

4.1.1 Site Description

The AGE Maintenance Shop Pad is an open asphaltic concrete area adjacent to the southeast side of the AGE Maintenance Shop, located in Building No. 186. The pad is approximately 60 to 70 feet wide and 240 feet long (Figure 4-1). A wash rack occupies an area about 45 feet square beyond the southeast edge of the pad. The AGE Drainage Ditch (SWMU No. 34, investigated in the Appendix I RI) (W-C 1992) lies to the southeast of the maintenance pad and carries runoff to the northeast.

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4.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATION

4.2.1 Physical Investigation

Four 10-foot soil borings were drilled and soil samples were collected in areas where wash-down water and storm water from the maintenance pad enters the AGE ditch and along expansion joints or cracks in the maintenance pad to determine if a release of SWMU-related chemicals posing a hazard to human health or the environment has occurred at these points. Boring numbers and sample descriptions are in Table 4-1 and Figure 4-1. Boring 03101 was drilled in a small drainage channel entering the AGE drainage ditch to determine if maintenance pad runoff has affected soil at this location. Surface soils in the drainage channel are discolored and vegetation within the channel appears stressed. Since this drainage channel receives runoff from locations other than the AGE Maintenance Shop, (e.g., the parking area near Facility 191), other sources may be contributing contaminants to this sample location. Boring 03102 was drilled in an area of soil cover near the AGE drainage ditch to determine if runoff from the pad has contaminated soils at this location. Soils at this location did not appear contaminated and vegetation appeared normal. The high density of buried utilities under the maintenance pad forced the relocation of two borings from the pad itself to nearby sites. Boring 03103 was located just off the slab to the west of the Wash Rack near the expansion joint. Small piles of stained soil were observed at this location suggesting the potential for petroleum contamination of the near-surface soils. Boring 03104 was located about 10 feet southwest of Boring 03103, just off the edge of the AGE pad. No surface staining was evident at this location.

Soil samples were collected from the 0- to 0.5-foot, 1.5- to 3.5-foot, 4- to 6-foot, and 8- to 10-foot depth intervals in Borings 03101 and 03102 and from the 0.5- to 2-foot, 2- to 4-foot, and 8- to 10-foot depth intervals in Borings 03103 and 03104. Target analytes included VOCs, SVOCs, metals, and TPH. Surficial samples from the 0 to .5-foot interval were collected in areas of soil cover from the 0.2- to 0.5-foot depth interval to provide surface soil data for risk assessment purposes. In areas of pavement or concrete surfaces, soil sampling began immediately below the pavement/soil contact.

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4.2.2 Chemical Investigation

Soil samples were collected from four borings (03101, 03102, 03103, and 03104). Sampling and analyses performed are summarized in Table 4-1. Summaries of the analytical results for these soil samples are provided in Table 4-2a (near-surface samples) and Table 4-2b (subsurface samples). The tables provide results for analytes detected at least once in the sample group. Complete analytical results are provided in Appendix A of the RFI report.

4.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI Report, and the data were deemed to be of adequate quality to meet the objectives of the RFI. However, data quality issues that may affect the risk assessment are more fully discussed here.

Elevated reporting limits resulting from sample dilution may limit the usability of the data if concentrations of some analytes are thereby diluted to levels below the reporting limit. That is, chemicals may be reported as nondetect when they are actually present in the sample at levels of potential concern. Section 4.1.6 of the QCSR (Appendix A of the RFI report) presents a discussion of elevated reporting limits; however, only mercury had significantly elevated reporting limits. This does not affect the usability of the data at this SWMU, because mercury was properly quantified nondetect in all but two samples, so there is no reason to believe that mercury would be present at concentrations of concern in the two samples with elevated reporting limits. There were also elevated reporting limits for lead and TPH analyses; however, there is no impact on the usability of the associated data because these analytes were detected at concentrations above elevated reporting limits.

Manganese data were rejected in all samples at this SWMU. Therefore, the manganese concentration at this SWMU is unknown. Although this is a data gap, it is not viewed as crucial for the following reasons. Since manganese has not been determined to be a chemical of concern at other SWMU with similar waste streams at Cannon AFB, manganese is not likely to be associated with the wastes at this SWMU. Additionally, manganese is an essential nutrient and would have to be present at very high concentrations to be at a level of concern. Therefore, there is no reason to believe that manganese would be present at a concentration that would pose a significant health risk compared to other semivolatile and volatile compounds that are quantified at this site. Therefore, although manganese has not been quantified, it is not likely that this will impact the conclusions of the risk assessment.

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4.2.4 Nature and Extent of Contamination

The sampling at this SWMU (Figure 4-2) was directed at areas just off the edge of the pavement where materials that may have been spilled during equipment maintenance would be expected to run off or be carried by wash water or storm water. The surface samples at two of the four borings (Borings 03103 and 03101) were found to be contaminated with petroleum hydrocarbons in excess of 1,000 mg/kg. The maximum TPH concentration was 4,070 mg/kg at the surface of Boring 03103. These surface samples were also contaminated with various semivolatile organic compounds (SVOCs) at or slightly above reporting limits. In general, there was no significant contamination in the samples below 2 feet of depth, and the surface soil contamination is likely to be limited to areas immediately adjacent to the edge of the pavement. The contamination detected in surface soils could have resulted from equipment wash water and/or from the pavement itself.

4.3 HUMAN HEALTH RISK ASSESSMENT

4.3.1 Exposure Pathway Flow Charts

Figure 4-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways for the AGE Maintenance Shop Pad. In the flow chart, potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary sources are waste fluids (e.g., fuels, oils, and solvents) that may have been discharged or spilled on the pad. Chemicals from the primary source may be released to other media (soil, air, or water) that may in turn act as secondary sources of release or exposure. Mixing and infiltration of the wastes to the soil and storm water runoff are shown as primary chemical release mechanisms. Soils are a secondary source of potential chemical release. Chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion, or result in exposure via direct contact (e.g., dermal contact or incidental soil ingestion).

essential nutrient and would have to be present at very high concentrations to be at a level of concern. Therefore, there is no reason to believe that manganese would be present at a concentration that would pose a significant health risk compared to other semivolatile and volatile compounds that are quantified at this site. Therefore, although manganese has not been quantified, it is not likely that this will impact the conclusions of the risk assessment.

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As shown on the flow chart, surface soils may provide exposures to Base workers (occupational exposures), hypothetical future construction workers, or hypothetical future trespassers (if the Base is closed in the future). Air emissions (volatile and particulates) from surface soil may also provide exposures to Base workers, construction workers, and trespassers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Groundwater is used for domestic purposes on and off Base. Groundwater is probably an insignificant pathway because very little contamination was found in subsurface soils. Nevertheless, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling (Section 4.3.4.2) indicate that contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway was not evaluated further. Residential exposures to soils are not considered for this SWMU because the SWMU is located in an industrial area, so even if the Base closes in the future, industrial rather than residential use is the reasonable future use of the site.

In summary, potential complete human exposure pathways to be evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Trespassers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

4.3.2 Comparison of Metals Concentrations to Background

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In summary, potential complete human exposure pathways to be evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

Background levels were defined by the upper tolerance limit (UTL) of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; see Appendix A).

Tables 4-3 and 4-4 show the comparison of SWMU results to background levels.

The maximum detected concentrations of antimony, barium, cadmium, chromium, copper, lead, and zinc in both surface soil and total soils exceeded the background levels. Therefore, these metals were retained for further evaluation as chemicals of concern in surface and total soils. However, since barium can substitute for calcium, it is believed the high levels of barium may be a naturally-occurring constituent of the caliche (Klein and Hurlbut 1985).

4.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 31, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 4-2a and 4-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentrations of antimony, barium, cadmium, chromium, copper, lead, and zinc detected in soil exceeded background ranges according to the comparison described in Section 4.3.2. These metals are, therefore, considered as chemicals of concern in soil. Organic contaminants detected in soils were retained as chemicals of concern for risk assessment. Chemicals of concern in surface soil and total soil are listed in Tables 4-5 and 4-6, respectively.

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Trespassers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

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Cobalt, lead, and TPH are listed as chemicals of concern in Tables 4-5 and 4-6, but they do not have EPA-established toxicity factors and, therefore, cannot be evaluated quantitatively in the risk assessment. However, their potential effects on the results of the risk assessment are addressed in Sections 4.3.8 through 4.3.10.

4.3.4 Environmental Fate and Transport

4.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

4.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (DOE 1991), describes the mass balance of a contaminant (based on average soil concentrations) in the contaminated soil volume at the SWMU. The DOE model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP] Model) and accounts for sorption to soils and degradation in the vadose zone. The model conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of chemicals of concern. The input parameters and estimated leachate concentrations are given in Section 4.3.5.2. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water (Section 4.3.5.2). Since the RBCs were developed for drinking water (at the tap) and are based on very conservative exposure and health-protective (risk) assumptions, it can be concluded that modeled groundwater concentrations that do not exceed RBCs will pose no significant adverse health risks.

4.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 31, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

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4.3.4.3 Air Modeling

RME air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using RME soil concentrations of chemicals of concern. The results of the air modeling are discussed in Section 4.3.5.3. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use at hazardous waste sites to calculate soil cleanup levels (EPA 1991). Air concentrations were calculated for only those chemicals with inhalation toxicity factors. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

4.3.5 Exposure Point Concentrations

4.3.5.1 Soils

Tables 4-7 and 4-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils respectively at the AGE Maintenance Shop Pad.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C of the Baseline Risk Assessment for Appendix III Solid Waste Management Units – Phase I (W-C 1994b), the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The "nondetect" values (U-qualified data) in calculating exposure point concentrations; this is also explained in Appendix C (W-C 1994b). Nondetect values were replaced with one half the reporting limit. Tables 4-9 and 4-10 give the soil concentrations of organic compounds from surface and total soils, respectively which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils. The absorbed fraction (from Table C-26 in Appendix C [W-C 1994b]) is the ratio of the quantity of chemical that is absorbed through skin

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to the quantity that is applied to the skin in soil. As explained in Appendix C (W-C 1994b), dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

For purposes of risk assessment, surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depth (i.e., XXXXX-XXXX-0002) were actually collected from a depth of 1.5 to 3.5 feet. These samples were not considered surface samples but are included in the risk assessment for subsurface soil exposures.

4.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 31. Model results are included in Table 4-11. These modeled concentrations were then compared to EPA Region III tap-water RBCs (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 4-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap-water RBCs. No modeled concentrations exceeded the RBCs, so significant risks are not expected from the groundwater pathway. Therefore, the groundwater pathway has been determined to be insignificant and was not evaluated further.

4.3.5.3 Air

RME air concentrations of volatile and particulate emissions from surface soil were calculated using RME concentrations of chemicals of concern. The results of the air modeling are shown in Tables 4-13 and 4-14. RME air concentrations of volatile and particulate emission from total soil were also calculated using RME concentrations of concern. The results of the air modeling from total soil are shown in Tables 4-15 and 4-16.

4.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C (W-C 1994b). Appendix C (W-C 1994b) includes discussions of the intake factors used to quantify chemical intake of SWMU-related contaminants in various environmental media soil and air. Table 4-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

4.3.5 Exposure Point Concentrations

4.3.5.1 Soils

Tables 4-7 and 4-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils respectively at the AGE Maintenance Shop Pad.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use of "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C. Tables 4-9 and 4-8 give the soil concentrations of organic compounds from surface and total soils, respectively which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils. The absorbed fraction (from Table C-26 in Appendix C) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soil. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

For purposes of risk assessment, surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depth (i.e., XXXXX-XXXX-0002) were actually collected from a depth of 1.5 to 3.5 feet. These samples were not considered surface samples but are included in the risk assessment for subsurface soil exposures.

4.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C (W-C 1994b). Detailed risk calculations are shown in Appendix C (W-C 1994b) and summarized in Table 4-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to contaminated surface soil at SWMU 31. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative, because there are no occupational receptors routinely exposed to contaminated media at the SWMU. Furthermore, the surface area of the SWMU is small (approximately 200 feet by 60 feet or one-quarter acre), and long-term exposures are not likely to occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard indexes calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 31 via the dermal contact, inhalation, and ingestion pathways are 0.0002 and 0.03 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk under the assumed chronic exposure conditions is 2×10^{-8} under the average exposure case and 5×10^{-6} under the RME case. These levels are within or below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). Ingestion of benzo(a)pyrene is the primary contributor to the carcinogenic risk estimate. The estimate of risks due to ingestion probably significantly overestimates actual risks, because it is assumed that the occupational worker will daily ingest the RME concentration of benzo(a)pyrene.

4.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 31. Model results are included in Table 4-11. These modeled concentrations were then compared to EPA Region III tap-water RBCs (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 4-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap-water RBCs. No modeled concentrations exceeded the RBCs, so significant risks are not expected from the groundwater pathway. Therefore, the groundwater pathway has been determined to be insignificant and was not evaluated further.

4.3.5.3 Air

RME air concentrations of volatile and particulate emissions from surface soil were calculated using RME concentrations of chemicals of concern. The results of the air modeling are shown in Tables 4-13 and 4-14. RME air concentrations of volatile and particulate emission from total soil were also calculated using RME concentrations of concern. The results of the air modeling from total soil are shown in Tables 4-15 and 4-16.

4.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the intake factors used to quantify chemical intake of SWMU-related contaminants in various environmental media soil and air. Table 4-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

4.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 31. Exposures were assumed to occur during excavation activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 31 via the dermal contact, inhalation, and ingestion pathways is 0.0001 and 0.001 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 3×10^{-9} in the average case and 6×10^{-8} in the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991c), and are so low as to be negligible.

Hypothetical Future Trespasser Exposure

Hypothetical trespassers were assumed to be exposed (via ingestion, dermal contact and inhalation) to surface soil at SWMU 31. Hypothetical trespassers were assumed to be exposed at the SWMU for 2 and 8 hours/day, for 26 and 52 days/year, over 6 years for the average and RME cases, respectively. These assumptions are very conservative, because Cannon AFB is likely to remain a military installation, making access to SWMU 31 by trespassers unlikely.

The total hazard index calculated for noncarcinogenic health effects due to exposures to contaminants in surface soil at SWMU 31 via the dermal contact, ingestion and inhalation pathways is 0.00003 and 0.005 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed exposure conditions is 4×10^{-9} under the average exposure case and 3×10^{-7} under the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b).

for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 4-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to contaminated surface soil at SWMU 31. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative, because there are no occupational receptors routinely exposed to contaminated media at the SWMU. Furthermore, the surface area of the SWMU is small (approximately 200 feet by 60 feet or one-quarter acre), and long-term exposures are not likely to occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard indexes calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 31 via the dermal contact, inhalation, and ingestion pathways are 0.0002 and 0.03 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk under the assumed chronic exposure conditions is 2×10^{-8} under the average exposure case and 5×10^{-6} under the RME case. These levels are within or below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). Ingestion of benzo(a)pyrene is the primary contributor to the carcinogenic risk estimate. The estimate of risks due to ingestion probably significantly overestimates actual risks, because it is assumed that the occupational worker will daily ingest the RME concentration of benzo(a)pyrene.

4.3.8Qualitative Assessment of Exposures to Lead

Lead exposures are not addressed in the quantitative risk assessment, because EPA withdrew the RfD for lead in 1989, primarily due to the lack of a discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. This level is supported by EPA's Uptake/Biokinetic (UBK) Lead Model which predicts that exposures of children ages 0 to 6 to soils with approximately these levels will not result in blood lead levels that exceed a level of concern established by the Centers for Disease Control.

The maximum lead concentration measured in soils at SWMU 31 was 930 mg/kg detected in surface soil at 03101-0000. Lead was measured at 9 to 78 mg/kg in other surface soil samples at SWMU 31. The mean lead concentration in four surface soil samples was 266 mg/kg. The maximum concentration detected at SWMU 31 is near the high end of the range suggested by EPA for residential soils. However, because the area of potential contamination is very small, because elevated lead concentrations do not appear to be characteristic of soil at the site, because the mean concentration is below EPA's suggested range for long-term residential exposures, and because the maximum value is within the concentration range suggested in EPA guidance, lead detected in soils at SWMU 31 would not be expected to pose a threat to human health.

4.3.9 Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 31. Exposures were assumed to occur during excavation activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 31 via the dermal contact, inhalation, and ingestion pathways is 0.0001 and 0.001 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 3×10^{-9} in the average case and 6×10^{-8} in the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991c), and are so low as to be negligible.

Hypothetical Future Trespasser Exposure

Hypothetical trespassers were assumed to be exposed (via ingestion, dermal contact and inhalation) to surface soil at SWMU 31. Hypothetical trespassers were assumed to be exposed at the SWMU for 2 and 8 hours/day, for 26 and 52 days/year, over 6 years for the average and RME cases, respectively. These assumptions are very conservative, because Cannon AFB is likely to remain a military installation, making access to SWMU 31 by trespassers unlikely.

The total hazard index calculated for noncarcinogenic health effects due to exposures to contaminants in surface soil at SWMU 31 via the dermal contact, ingestion and inhalation pathways is 0.00003 and 0.005 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available, and when the fuel product is known. The provisional values are under review and subject to revision. RBCs derived from them are used simply as a guide to potential health hazards.)

The toxicity factors and calculation of risk-based concentrations are shown in Table 4-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,600 mg/kg. The maximum SWMU concentration of TPH is 4,070 mg/kg, well below the conservative RBC.

4.3.10 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C (W-C 1994b). The chief uncertainties specific to risk assessment for SWMU 31 and their effect on the results and conclusions of the risk assessment are listed below.

- Only one of the two surface soil samples contained detectable concentrations of PAHs. Occupational risks were calculated based on the concentrations found in that one sample and very conservative estimates of exposure duration and frequency. These exposure assumptions significantly overstate the likelihood of exposure to the contaminated area. Therefore, the RME risk of 5×10^{-6} could significantly overestimate of actual risk associated with the SWMU.

- Direct physical contact with contaminated soils was assumed to occur routinely for several hours/day, 120 to 250 days a year, for 9 to 25 years. These assumptions overstate current and likely future occupational exposure conditions to soils at this site.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens. such

The estimated lifetime excess cancer risk under the assumed exposure conditions is 4×10^{-9} under the average exposure case and 3×10^{-7} under the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b).

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Lead exposures are not addressed in the quantitative risk assessment, because EPA withdrew the RfD for lead in 1989, primarily due to the lack of a discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. This level is supported by EPA's Uptake/Biokinetic (UBK) Lead Model which predicts that exposures of children ages 0 to 6 to soils with approximately these levels will not result in blood lead levels that exceed a level of concern established by the Centers for Disease Control.

The maximum lead concentration measured in soils at SWMU 31 was 930 mg/kg detected in surface soil at 03101-0000. Lead was measured at 9 to 78 mg/kg in other surface soil samples at SWMU 31. The mean lead concentration in four surface soil samples was 266 mg/kg. The maximum concentration detected at SWMU 31 is near the high end of the range suggested by EPA for residential soils. However, because the area of potential contamination is very small, because elevated lead concentrations do not appear to be characteristic of soil at the site, because the mean concentration is below EPA's suggested range for long-term residential exposures, and because the maximum value is within the concentration range suggested in EPA guidance, lead detected in soils at SWMU 31 would not be expected to pose a threat to human health.

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Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI,

as benzo(a)pyrene, which can cause skin cancer through a direct action at the point of application. The exclusion of PAHs from quantitative evaluation in the dermal exposure pathway may underestimate the potential human health risk from dermal contact with soils at the SWMU. Because of the low actual exposure potential and because PAHs were detected in only a few samples analyzed, the uncertainty regarding direct contact risk is not likely to affect the conclusions of the risk assessment.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- Cobalt was not considered in the quantitative risk assessment, because it does not have an EPA-established toxicity factor; however, an oral RfD is pending. Its exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results or conclusions of the risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

- The soil surface area at this SWMU is too small to support chronic occupational exposures. Therefore, the exposure assumptions used are likely to significantly overestimate potential magnitude of exposure to contaminated soils and risk at this SWMU.

4.4 ECOLOGICAL RISK ASSESSMENT

4.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 31, the AGE Maintenance Shop Pad, is located in a small area of poor wildlife habitat quality, within the developed portion of Cannon AFB where existing ground cover is mostly concrete, buildings, and isolated areas of mowed non-native grasses. About 90 percent of the land surface within the immediate vicinity (within 100 feet) of SWMU 31 is concrete paving and Building 186. Mowed grassy areas are located to the northwest, across Torch Boulevard, and to the northeast, where the grass forms a slight drainage channel. The AGE Drainage Ditch begins southeast of the pad. The pad has been actively used since 1971.

BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available, and when the fuel product is known. The provisional values are under review and subject to revision. RBCs derived from them are used simply as a guide to potential health hazards.)

The toxicity factors and calculation of risk-based concentrations are shown in Table 4-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,600 mg/kg. The maximum SWMU concentration of TPH is 4,070 mg/kg, well below the conservative RBC.

4.3.10 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 31 and their effect on the results and conclusions of the risk assessment are listed below.

- Only one of the two surface soil samples contained detectable concentrations of PAHs. Occupational risks were calculated based on the concentrations found in that one sample and very conservative estimates of exposure duration

The most common species are likely to be birds, such as robin (*Turdus migratorius*), house sparrow (*Passer domesticus*), and the starling (*Sturnus vulgaris*). Seedeaters would be more limited, since the grass is maintained by mowing. Although the house mouse (*Mus musculus*) may occur in the area around the buildings, the grass habitat is probably too small, fragmented, and subject to human disturbance to be used regularly by terrestrial species such as deer mice. Raptors are unlikely to use the area for similar reasons.

Given this assessment, the robin (*Turdus migratorius*) was selected as the key receptor species for the grassy areas near SWMU 31.

4.4.2 Chemicals of Concern

The chemicals of concern (COCs) at SWMU 31 were selected using validated data from six soil samples covering the interval between 0 and 2 feet deep. This interval was selected because most soil-dwelling organisms (e.g. earthworms and deer mice) occupy this zone. Table 4-20 provides a summary of the chemicals detected in the six samples considered for this ERA. A detailed description of the soil sampling program and chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the six samples to be considered a possible COC. The following screening criteria were then applied, in the order shown, to determine if a chemical in the soil would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Exceedance of the normal range found in U.S. soils (nationwide)

The maximum detected concentration of the six samples was used in the comparison to background criteria. If no background criteria were available for comparison, as was the case for the organic chemicals, the chemicals were retained as COCs. If the maximum detected concentration of a chemical exceeded the local (i.e. Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If it exceeded this criteria, it was likely retained as a COC, even if it fell within the normal range found in U.S. soils. This is because the normal U.S. range is widely variable and was included in the screening process primarily as an additional reference. In some cases however, the normal U.S. range was the only screening criteria available. Table 4-21 lists the maximum concentrations detected and shows the screening values used. The chemicals that were retained as COCs at SWMU 31

and frequency. These exposure assumptions significantly overstate the likelihood of exposure to the contaminated area. Therefore, the RME risk of 5×10^{-6} could significantly overestimate of actual risk associated with the SWMU.

- Direct physical contact with contaminated soils was assumed to occur routinely for several hours/day, 120 to 250 days a year, for 9 to 25 years. These assumptions overstate current and likely future occupational exposure conditions to soils at this site.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens, such as benzo(a)pyrene, which can cause skin cancer through a direct action at the point of application. The exclusion of PAHs from quantitative evaluation in the dermal exposure pathway may underestimate the potential human health risk from dermal contact with soils at the SWMU. Because of the low actual exposure potential and because PAHs were detected in only a few samples analyzed, the uncertainty regarding direct contact risk is not likely to affect the conclusions of the risk assessment.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- Cobalt was not considered in the quantitative risk assessment, because it does not have an EPA-established toxicity factor; however, an oral RfD is pending. Its exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results or conclusions of the risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

following the screening process include tetrachloroethene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, carbazole, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene, pyrene, antimony, barium, cadmium, chromium, cobalt, copper, lead, selenium, zinc, and TPH.

4.4.3 Exposure Assessment

Figure 4-4 depicts the exposure pathway flow chart developed for SWMU 31. As the flowchart indicates, chemicals could potentially be released through transport in runoff, infiltration to groundwater, volatilization or wind erosion, and direct contact by ecological receptors. Except for direct contact, these exposure pathways are incomplete or of minor importance for ecological receptors at SWMU 31. Storm water runoff is a potentially complete but insignificant pathway, because the AGE Drainage Ditch was already addressed as a separate SWMU. Any storm water runoff to grassy areas bordering the pad can be considered as part of direct contact with surface soil for the purposes of this analysis. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization or wind erosion is not considered a significant pathway at this site. Although one of the COCs is a volatile organic compound (VOC), the maximum concentration was about 0.0036 mg/kg, and VOC concentrations of 100 mg/kg or greater in air are generally needed to induce toxic responses in laboratory rats and mice from inhalation (NIOSH 1987). Concentrations in soils would have to be many times greater than this to produce these toxic levels in air, even near the soil surface. Direct contact with subsurface soils (more than two feet deep) is also considered an insignificant or incomplete pathway because of the limited use of deeper soils at this site by wildlife.

Therefore, the only potentially complete and significant exposure pathway is direct contact with contaminated surface soil by species frequenting the SWMU area. Direct contact may include dermal absorption or ingestion. Dermal absorption is not considered a significant exposure route for the receptors at this site because the animals are assumed to be largely protected by their fur or feathers. Receptors at the SWMU may ingest COCs either directly or indirectly. Direct ingestion usually occurs along the food/prey chain from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of COCs that have been transferred via food webs.

Figure 4-5 depicts the Conceptual Site Model developed from the exposure pathway analysis, the ecological characterization, and the identification of the key receptor species for SWMU 31. As the figure indicates, the pathway of concern is from surface soil to the robin, via direct and indirect ingestion, with the earthworm identified as a main dietary component of the robin.

- The soil surface area at this SWMU is too small to support chronic occupational exposures. Therefore, the exposure assumptions used are likely to significantly overestimate potential magnitude of exposure to contaminated soils and risk at this SWMU.

4.4 ECOLOGICAL RISK ASSESSMENT

4.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 31, the AGE Maintenance Shop Pad, is located in a small area of poor wildlife habitat quality, within the developed portion of Cannon AFB where existing ground cover is mostly concrete, buildings, and isolated areas of mowed non-native grasses. About 90 percent of the land surface within the immediate vicinity (within 100 feet) of SWMU 31 is concrete paving and Building 186. Mowed grassy areas are located to the northwest, across Torch Boulevard, and to the northeast, where the grass forms a slight drainage channel. The AGE Drainage Ditch begins southeast of the pad. The pad has been actively used since 1971.

The most common species are likely to be birds, such as robin (*Turdus migratorius*), house sparrow (*Passer domesticus*), and the starling (*Sturnus vulgaris*). Seedeaters would be more limited, since the grass is maintained by mowing. Although the house mouse (*Mus musculus*) may occur in the area around the buildings, the grass habitat is probably too small, fragmented, and subject to human disturbance to be used regularly by terrestrial species such as deer mice. Raptors are unlikely to use the area for similar reasons.

Given this assessment, the robin (*Turdus migratorius*) was selected as the key receptor species for the grassy areas near SWMU 31.

4.4.2 Chemicals of Concern

The chemicals of concern (COCs) at SWMU 31 were selected using validated data from six soil samples covering the interval between 0 and 2 feet deep. This interval was selected because most soil-dwelling organisms (e.g. earthworms and deer mice) occupy this zone. Table 4-20 provides a summary of the chemicals detected in the six samples considered for

4.4.4 Risk Characterization

This section provides a characterization of potential risk to the selected key receptor species (robin) at SWMU 31. For the purposes of this analysis, it was assumed that the robin's diet consists of earthworms and inadvertent consumption of soil. It was also assumed that the concentration of the COCs were the same in the earthworm as in the soil, except for cadmium and selenium, for which bioaccumulation factors (BAFs) of 4.6 and 12 were used (see Section 7.4.4 (Raptor discussion)). Therefore the analysis consisted of comparing the concentration of COCs in the robin's food (i.e., the chemical concentration in soil) to selected toxicity benchmark dietary levels for those chemicals (see Table 4-22).

This is a somewhat conservative approach, because studies indicate that, for many chemicals, BAFs from soil to earthworm are less than one (Beyer and Stafford 1993). However, this assumption takes into account the soil that would be clinging to the earthworm when consumed by the robin (that is not taken into account by the BAF studies) and also accounts for minor inadvertent soil ingestion by the robin. The benchmark dietary levels were selected as explained in Appendix D, Sections D.3 and D.4; these sections also provide background toxicological information about the COCs. The soil chemical concentration used was the arithmetic mean, as described in Appendix D (Section D.6.).

Table 4-22 lists the COCs for SWMU 31 and provides a comparison between the soil concentration (arithmetic mean) and the benchmark dietary level for the robin. If the soil level exceeds the benchmark level, there is a possibility of risk, as noted in the table. The following discussion addresses those chemicals where a possibility of risk is indicated.

Benzo-a-pyrene (BaP)

The average concentration of BaP at SWMU 31 was 2.3 mg/kg, compared to the benchmark dietary level of 0.02 mg/kg, indicating a potential risk. The 2.3 mg/kg level is above reported BaP soil concentrations for various locations as reported in the literature (see Table A-6) and is higher than BaP levels found at other similar SWMUs at Cannon AFB. However, BaP was detected in only one of three samples, at 2.7 mg/kg; the other two samples were non-detects, and one of those was reported at an assumed value of 4.0 mg/kg because of the high reporting limit of 8.0 mg/kg. Therefore, it is unlikely that the robin is exposed to a level of 2.7 mg/kg in all areas in which it feeds, assuming it does not feed just at the "hot spots" in the SWMU area. Also, the low toxicity benchmark level for BaP is a reflection of BaP's carcinogenic effects

this ERA. A detailed description of the soil sampling program and chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the six samples to be considered a possible COC. The following screening criteria were then applied, in the order shown, to determine if a chemical in the soil would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Exceedance of the normal range found in U.S. soils (nationwide)

The maximum detected concentration of the six samples was used in the comparison to background criteria. If no background criteria were available for comparison, as was the case for the organic chemicals, the chemicals were retained as COCs. If the maximum detected concentration of a chemical exceeded the local (i.e. Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If it exceeded this criteria, it was likely retained as a COC, even if it fell within the normal range found in U.S. soils. This is because the normal U.S. range is widely variable and was included in the screening process primarily as an additional reference. In some cases however, the normal U.S. range was the only screening criteria available. Table 4-21 lists the maximum concentrations detected and shows the screening values used. The chemicals that were retained as COCs at SWMU 31 following the screening process include tetrachloroethene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, carbazole, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene, pyrene, antimony, barium, cadmium, chromium, cobalt, copper, lead, selenium, zinc, and TPH.

4.4.3 Exposure Assessment

Figure 4-4 depicts the exposure pathway flow chart developed for SWMU 31. As the flowchart indicates, chemicals could potentially be released through transport in runoff, infiltration to groundwater, volatilization or wind erosion, and direct contact by ecological receptors. Except for direct contact, these exposure pathways are incomplete or of minor importance for ecological receptors at SWMU 31. Storm water runoff is a potentially

through the action of its intermediate metabolites, as opposed to acute toxicity. In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, and therefore it is questionable if carcinogenesis is an important endpoint for relatively short-lived mammals and birds, such as the robin. Finally, the BaP found at SWMU 31 may not be completely bioavailable to robins. Goon et al. (1991) showed that BaP that had aged 6 months in soil was only 34 percent to 51 percent orally bioavailable for clayey and sandy soils, relative to BaP administered alone to rats. For all these reasons, it is unlikely that BaP presents an unacceptable risk at SWMU 31.

Benzo(a)anthracene (BaA)

The average concentration in the soil (2.2 mg/kg) slightly exceeds the dietary benchmark level of 2.0 mg/kg. However, Beyer and Stafford (1992) calculated BAFs of less than one for all PAHs from soil to earthworm, specifically a BAF of 0.27 for BaA. Therefore, given this and the low level of BaA detected, along with the fact that the benchmark level reflects a concern primarily for carcinogenicity, which is not a particularly important benchmark for shorter-lived birds, it is unlikely that the BaA at SWMU 31 constitutes a risk to the robin.

Lead

The average concentration of lead at SWMU 31 was 181.63 mg/kg, compared to the benchmark dietary level of 87.5 mg/kg, indicating a potential risk. However, it is unlikely that lead constitutes a risk to the robin at SWMU 31, for several reasons. First, the average soil value is high primarily because of one "hot spot" out of six samples, with lead reported at 930 mg/kg. The remaining five samples are all under the benchmark level. Therefore, it is unlikely that the robin is exposed to high levels of lead in all areas in which it feeds. In addition, the toxicity of lead to wildlife depends on the chemical form in which the lead occurs. Lead in soils at Cannon AFB is probably aged or oxidized, and therefore less toxic or bioavailable than either the lead forms typically used in studies that establish toxicity benchmark values (e.g., lead acetate) or the organolead compounds, that are unstable upon exposure to air and light and typically convert to less toxic lead oxide forms.

TPH

The average concentration of TPH at SWMU 31 was 1391.93 mg/kg, compared to the benchmark dietary level of 241 mg/kg, indicating a potential risk. However, as with lead, TPH levels are very spotty at SWMU 31, with "hot spots" indicated by three samples (ranging from

complete but insignificant pathway, because the AGE Drainage Ditch was already addressed as a separate SWMU. Any storm water runoff to grassy areas bordering the pad can be considered as part of direct contact with surface soil for the purposes of this analysis. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization or wind erosion is not considered a significant pathway at this site. Although one of the COCs is a volatile organic compound (VOC), the maximum concentration was about 0.0036 mg/kg, and VOC concentrations of 100 mg/kg or greater in air are generally needed to induce toxic responses in laboratory rats and mice from inhalation (NIOSH 1987). Concentrations in soils would have to be many times greater than this to produce these toxic levels in air, even near the soil surface. Direct contact with subsurface soils (more than two feet deep) is also considered an insignificant or incomplete pathway because of the limited use of deeper soils at this site by wildlife.

Therefore, the only potentially complete and significant exposure pathway is direct contact with contaminated surface soil by species frequenting the SWMU area. Direct contact may include dermal absorption or ingestion. Dermal absorption is not considered a significant exposure route for the receptors at this site because the animals are assumed to be largely protected by their fur or feathers. Receptors at the SWMU may ingest COCs either directly or indirectly. Direct ingestion usually occurs along the food/prey chain from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of COCs that have been transferred via food webs.

Figure 4-5 depicts the Conceptual Site Model developed from the exposure pathway analysis, the ecological characterization, and the identification of the key receptor species for SWMU 31. As the figure indicates, the pathway of concern is from surface soil to the robin, via direct and indirect ingestion, with the earthworm identified as a main dietary component of the robin.

4.4.4 Risk Characterization

This section provides a characterization of potential risk to the selected key receptor species (robin) at SWMU 31. For the purposes of this analysis, it was assumed that the robin's diet consists of earthworms and inadvertent consumption of soil. It was also assumed that the concentration of the COCs were the same in the earthworm as in the soil, except for cadmium

973 mg/kg to 4070 mg/kg) and two non-detects out of six samples. Also, it is not certain how much the robin is exposed to fresh TPH mixtures as opposed to aged products. As noted in Appendix D, the toxicity benchmarks for TPH are derived from experiments using fresh fuels, and the BTEX and PAH compounds are the compounds of primary concern in TPH mixtures in setting cleanup levels and characterizing risk. In older spills to surface soils, the volatile BTEX component may not be present or prevalent, and the total TPH value may reflect less toxic constituents. However, PAHs may still be present in older spills, and these may be of concern. At SWMU 31, PAHs were detected, but it appears that the risk related to these is minimal (see BaP and BaA discussion, above).

Cadmium & Selenium

The average concentration of cadmium in earthworms at SWMU 31 was estimated to be 11.87 mg/kg and the average selenium concentration in earthworms was 5.4 mg/kg. These levels of cadmium and selenium, which were calculated using BAFs of 4.6 and 12, respectively, are just slightly above their respective benchmark dietary levels of 10.5 mg/kg and 5 mg/kg for robins. Cadmium was detected at a level of 8.7 and 4.4 mg/kg in 2 of the 6 samples; the cadmium concentration in the remaining 4 samples was below 1. This indicates 2 possible "hot spots" for cadmium. Since the average cadmium concentration in earthworms was only slightly above the benchmark dietary level and it is unlikely robins feed only at the "hot spots", cadmium is unlikely to pose a risk to robins feeding at SWMU 31. Similarly, selenium is unlikely to pose a risk to robins since it was detected in only 2 of 6 samples and the average earthworm concentration is only slightly above the benchmark dietary level for robins. It is also likely that the selenium concentrations in soil at Cannon AFB represent natural sources (see Section 7.4.4).

4.5 SUMMARY AND CONCLUSIONS

4.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at the SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 4-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU

and selenium, for which bioaccumulation factors (BAFs) of 4.6 and 12 were used (see Section 7.4.4 (Raptor discussion)). Therefore the analysis consisted of comparing the concentration of COCs in the robin's food (i.e., the chemical concentration in soil) to selected toxicity benchmark dietary levels for those chemicals (see Table 4-22).

This is a somewhat conservative approach, because studies indicate that, for many chemicals, BAFs from soil to earthworm are less than one (Beyer and Stafford 1993). However, this assumption takes into account the soil that would be clinging to the earthworm when consumed by the robin (that is not taken into account by the BAF studies) and also accounts for minor inadvertent soil ingestion by the robin. The benchmark dietary levels were selected as explained in Appendix D, Sections D.3 and D.4; these sections also provide background toxicological information about the COCs. The soil chemical concentration used was the arithmetic mean, as described in Appendix D (Section D.6.).

Table 4-22 lists the COCs for SWMU 31 and provides a comparison between the soil concentration (arithmetic mean) and the benchmark dietary level for the robin. If the soil level exceeds the benchmark level, there is a possibility of risk, as noted in the table. The following discussion addresses those chemicals where a possibility of risk is indicated.

Benzo-a-pyrene (BaP)

The average concentration of BaP at SWMU 31 was 2.3 mg/kg, compared to the benchmark dietary level of 0.02 mg/kg, indicating a potential risk. The 2.3 mg/kg level is above reported BaP soil concentrations for various locations as reported in the literature (see Table A-6) and is higher than BaP levels found at other similar SWMUs at Cannon AFB. However, BaP was detected in only one of three samples, at 2.7 mg/kg; the other two samples were non-detects, and one of those was reported at an assumed value of 4.0 mg/kg because of the high reporting limit of 8.0 mg/kg. Therefore, it is unlikely that the robin is exposed to a level of 2.7 mg/kg in all areas in which it feeds, assuming it does not feed just at the "hot spots" in the SWMU area. Also, the low toxicity benchmark level for BaP is a reflection of BaP's carcinogenic effects through the action of its intermediate metabolites, as opposed to acute toxicity. In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, and therefore it is questionable if carcinogenesis is an important endpoint for relatively short-lived mammals and birds, such as the robin. Finally, the BaP

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU

4.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

found at SWMU 31 may not be completely bioavailable to robins. Goon et al. (1991) showed that BaP that had aged 6 months in soil was only 34 percent to 51 percent orally bioavailable for clayey and sandy soils, relative to BaP administered alone to rats. For all these reasons, it is unlikely that BaP presents an unacceptable risk at SWMU 31.

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The average concentration in the soil (2.2 mg/kg) slightly exceeds the dietary benchmark level of 2.0 mg/kg. However, Beyer and Stafford (1992) calculated BAFs of less than one for all PAHs from soil to earthworm, specifically a BAF of 0.27 for BaA. Therefore, given this and the low level of BaA detected, along with the fact that the benchmark level reflects a concern primarily for carcinogenicity, which is not a particularly important benchmark for shorter-lived birds, it is unlikely that the BaA at SWMU 31 constitutes a risk to the robin.

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The average concentration of lead at SWMU 31 was 181.63 mg/kg, compared to the benchmark dietary level of 87.5 mg/kg, indicating a potential risk. However, it is unlikely that lead constitutes a risk to the robin at SWMU 31, for several reasons. First, the average soil value is high primarily because of one "hot spot" out of six samples, with lead reported at 930 mg/kg. The remaining five samples are all under the benchmark level. Therefore, it is unlikely that the robin is exposed to high levels of lead in all areas in which it feeds. In addition, the toxicity of lead to wildlife depends on the chemical form in which the lead occurs. Lead in soils at Cannon AFB is probably aged or oxidized, and therefore less toxic or bioavailable than either the lead forms typically used in studies that establish toxicity benchmark values (e.g., lead acetate) or the organolead compounds, that are unstable upon exposure to air and light and typically convert to less toxic lead oxide forms.

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The average concentration of TPH at SWMU 31 was 1391.93 mg/kg, compared to the benchmark dietary level of 241 mg/kg, indicating a potential risk. However, as with lead, TPH levels are very spotty at SWMU 31, with "hot spots" indicated by three samples (ranging from 973 mg/kg to 4070 mg/kg) and two non-detects out of six samples. Also, it is not

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4.5 SUMMARY AND CONCLUSIONS

4.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at the SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 4-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU

4.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

TABLE 4-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
AGE MAINTENANCE SHOP PAD (SWMU NO. 31)
CANNON AFB, NEW MEXICO

Sample	Target Interval	Sample Identification	QA/QC	Sample	Analytical Parameters				Sample Containers		
Location	(ft-bgs)	Number	Type	Matrix	VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 03101	0 - 0.5	CAN031-0311-0000		Soil		X	X	X			1
	1.5 - 3.5	CAN031-0311-0002		Soil			X	X			1
	4 - 6	CAN031-0311-0004		Soil			X	X			1
	8 - 10	CAN031-0311-0008		Soil	X		X	X			1
Boring 03102	0 - 0.5	CAN031-0312-0000		Soil			X	X			1
	0 - 0.5	CAN031-0312-3161	FD	Soil			X	X			1
	0 - 0.5	CAN031-0312-3101	MRD	Soil			X	X			1
	1.5 - 3.5	CAN031-0312-0002		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN031-0312-3162	FD	Soil	X	X				2	
	1.5 - 3.5	CAN031-0312-3102	MRD	Soil	X	X				2	
	4 - 6	CAN031-0312-0004		Soil			X	X			1
	8 - 10	CAN031-0312-0008		Soil	X	X	X	X		1	1
	8 - 10	CAN031-0312-6008	MS/MSD	Soil	X	X	X	X		1	2
Boring 03103	0.5-2	CAN031-0313-0000		Soil	X	X	X	X			1
	2 - 4	CAN031-0313-0002		Soil		X	X	X			1
	4 - 6	CAN031-0313-0004		Soil			X	X			1
	8 - 10	CAN031-0313-0008		Soil			X	X			1
Boring 03104	0.5 - 2	CAN031-0314-0000		Soil			X	X			1
	2 - 4	CAN031-0314-0002		Soil	X	X	X	X		2	1
	2 - 4	CAN031-0314-3163	FD	Soil	X	X	X	X		2	1
	2 - 4	CAN031-0314-3103	MRD	Soil	X	X	X	X		2	1
	4 - 6	CAN031-0314-0004		Soil			X	X			1
	8 - 10	CAN031-0314-0008		Soil	X	X	X	X		2	1

TABLE 4-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
AGE MAINTENANCE SHOP PAD (SWMU NO. 31)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 03104, cont.		CAN031-0314-3151	AB	Water	X				2		
		CAN031-0314-3171	RB	Water	X				2		
		CAN031-0314-3181	DW	Water	X				2		
		CAN031-0314-3191	TB	Water	X				1		

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 6-1 for locations of the borings.

TABLE 4-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0311-0000			CAN031-0311-0002			CAN031-0312-0000			CAN031-0312-0002		
LAB SAMPLE NUMBER	0311830016SA			0311830017SA			0311830010SA			0311830011SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)												
Tetrachloroethene										<	5.6	U
Semivolatile Organics (µg/kg)												
Anthracene	600	4100	J							<	370	U
Benzo(a)anthracene	2400	4100	J							<	370	U
Benzo(a)pyrene	2700	4100	J							<	370	U
Benzo(b)fluoranthene	5600	4100								65	370	J
Benzo(g,h,i)perylene	2600	4100	J							<	370	U
Carbazole	500	4100	J							<	370	U
Chrysene	3100	4100	J							<	370	U
Fluoranthene	5600	4100								55	370	J
Indeno(1,2,3-cd)pyrene	2300	4100	J							<	370	U
2-Methylnaphthalene	<	4100	U							45	370	J
Phenanthrene	3200	4100	J							44	370	J
Pyrene	4600	4100								44	370	J
Metals (mg/kg)												
Aluminum	5660	12.5		4160	24.1		4260	10.5		5430	11.2	
Antimony	1.9	7.5	J	<	14.4	U	<	6.3	U	<	6.7	U
Arsenic	3.2	0.62		2.3	0.6		2.4	0.52		2.9	0.56	
Barium	1460	1.2	J	120	2.4	J	166	1	J	201	1.1	J
Beryllium	0.36	0.25		0.26	0.48	J	0.22	0.21		0.27	0.22	
Cadmium	8.7	0.62		<	1.2	U	0.85	0.52		0.63	0.56	
Calcium	6270	25		205000	48.1		48600	20.9		94400	22.3	
Chromium	130	1.2		4.2	2.4		9.9	1	J	8	1.1	J
Cobalt	3.4	1.2		2.3	2.4	J	2.6	1		3.2	1.1	

NOTE: Results presented here are chemicals which were detected at least once in near-surface soils at this SWMU and have passed data review. A complete summary of chemical results are presented in Appendix A of the RFI report.

J = Estimated value below reporting limit or estimated based on data quality criteria.

U = Not detected

Qual=Qualification

RL = Reporting Limit.

TABLE 4-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0311-0000			CAN031-0311-0002			CAN031-0312-0000			CAN031-0312-0002		
LAB SAMPLE NUMBER	0311830016SA			0311830017SA			0311830010SA			0311830011SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)												
Tetrachloroethene										<	5.6	U
Semivolatile Organics (µg/kg)												
Anthracene	600	4100	J							<	370	U
Benzo(a)anthracene	2400	4100	J							<	370	U
Benzo(a)pyrene	2700	4100	J							<	370	U
Benzo(b)fluoranthene	5600	4100								65	370	J
Benzo(g,h,i)perylene	2600	4100	J							<	370	U
Carbazole	500	4100	J							<	370	U
Chrysene	3100	4100	J							<	370	U
Fluoranthene	5600	4100								55	370	J
Indeno(1,2,3-cd)pyrene	2300	4100	J							<	370	U
2-Methylnaphthalene	<	4100	U							45	370	J
Phenanthrene	3200	4100	J							44	370	J
Pyrene	4600	4100								44	370	J
Metals (mg/kg)												
Aluminum	5660	12.5		4160	24.1		4260	10.5		5430	11.2	
Antimony	1.9	7.5	J	<	14.4	U	<	6.3	U	<	6.7	U
Arsenic	3.2	0.62		2.3	0.6		2.4	0.52		2.9	0.56	
Barium	1460	1.2	J	120	2.4	J	166	1	J	201	1.1	J
Beryllium	0.36	0.25		0.26	0.48	J	0.22	0.21		0.27	0.22	
Cadmium	8.7	0.62		<	1.2	U	0.85	0.52		0.63	0.56	
Calcium	6270	25		205000	48.1		48600	20.9		94400	22.3	
Chromium	130	1.2		4.2	2.4		9.9	1	J	8	1.1	J
Cobalt	3.4	1.2		2.3	2.4	J	2.6	1		3.2	1.1	

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LOCATOR	CAN031-0311-0000			CAN031-0311-0002			CAN031-0312-0000			CAN031-0312-0002		
LAB SAMPLE NUMBER	0311830016SA			0311830017SA			0311830010SA			0311830011SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Copper	61.4	2.5		2.7	4.8	J	9.3	2.1		10.9	2.2	
Iron	7150	12.5		3290	24.1		5570	10.5		6420	11.2	
Lead	930	125		3.5	1.2		46.9	5.2		22.3	5.6	
Magnesium	1150	25		2450	48.1		1810	20.9		2210	22.3	
Nickel	7.2	5		4.9	9.6	J	5.8	4.2		6.9	4.5	
Potassium	867	625	UJ	666	1200	J	1100	523		954	558	
Selenium	<	1.2	U	<	1.2	UJ	<	1	UJ	<	1.1	UJ
Sodium	<	625		<	1200	U	<	523	U	<	558	U
Vanadium	13.8	1.2		10.4	2.4		13.8	1		17.1	1.1	
Zinc	479	2.5		9.2	4.8		57	2.1		33.5	2.2	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	3180	500		<	48.1	U	973	209		81	44.6	

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LOCATOR	CAN031-0313-0000			CAN031-0313-0002			CAN031-0314-0000			CAN031-0314-0002		
LAB SAMPLE NUMBER	0311830002SA			0311830003SA			0311830006SA			0311830008SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)												
Tetrachloroethene	3.6	6.1								<	5.8	U
Semivolatile Organics (µg/kg)												
Anthracene	<	8000	U	<	390	U				<	380	U
Benzo(a)anthracene	<	8000	U	<	390	U				<	380	U
Benzo(a)pyrene	<	8000	U	<	390	U				<	380	U
Benzo(b)fluoranthene	<	8000	U	<	390	U				<	380	U
Benzo(g,h,i)perylene	<	8000	U	<	390	U				<	380	U
Carbazole	<	8000	U	<	390	U				<	380	U
Chrysene	<	8000	U	<	390	U				<	380	U
Fluoranthene	<	8000	U	<	390	U				<	380	U
Indeno(1,2,3-cd)pyrene	<	8000	U	<	390	U				<	380	U
2-Methylnaphthalene	<	8000	U	<	390	U				<	380	U
Phenanthrene	<	8000	U	<	390	U				<	380	U
Pyrene	<	8000	U	<	390	U				<	380	U
Metals (mg/kg)												
Aluminum	6650	12.2		5740	11.7		9430	11.7		6090	11.7	J
Antimony	<	7.3	U	<	7	U	<	7	U	<	7	U
Arsenic	4.4	0.61		2.2	0.59		4.6	0.59		2.6	0.58	
Barium	229	1.2	J	119	1.2	J	104	1.2	J	107	1.2	J
Beryllium	0.25	0.24		0.25	0.23		0.69	0.23		0.34	0.23	
Cadmium	4.4	0.61		<	0.59	U	4200	0.59	U	<	0.58	U
Calcium	42400	24.4		108000	23.4		11.8	23.5		71300	23.3	J
Chromium	24.3	1.2		6	1.2		5.1	1.2		6.4	1.2	
Cobalt	3.5	1.2		3.2	1.2		7.6	1.2		3.2	1.2	

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RL = Reporting Limit.

TABLE 4-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0313-0000			CAN031-0313-0002			CAN031-0314-0000			CAN031-0314-0002		
LAB SAMPLE NUMBER	0311830002SA			0311830003SA			0311830006SA			0311830008SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Copper	18.8	2.4		4.7	2.3		10700	2.3		5.2	2.3	J
Iron	7950	12.2		5470	11.7		9.4	11.7		6030	11.7	J
Lead	77.7	6.1		4.7	0.59		2130	0.59		6.9	1.2	J
Magnesium	2310	24.4		1940	23.4		9.7	23.5		1760	23.3	
Nickel	6.8	4.9		5.7	4.7		1610	4.7		7	4.7	
Potassium	1550	610		998	586		0.15	587		1110	583	J
Selenium	0.24	1.2	J	<	1.2	UJ	<	1.2	J	0.16	1.2	J
Sodium	193	610	J	<	586	U	21.2	587	U	<	583	U
Vanadium	16.6	1.2		13.1	1.2		29.8	1.2		13.3	1.2	
Zinc	85.8	2.4		12.6	2.3			2.3		13.2	2.3	
TPH (mg/kg)							<					
Total Petroleum Hydrocarbons	4070	488		<	46.9	U		46.9	U	<	46.6	U

NOTE: Results presented here are chemicals which were detected at least once in near-surface soils at this SWMU and have passed data review. A complete summary of chemical results are presented in Appendix A of the RFI report.

J=Estimated value below reporting limit or estimated based on data quality criteria. Qual =Qualification

U = Not detected RL = Reporting Limit.

TABLE 4-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0311-0004			CAN031-0311-0008			CAN031-0312-0004			CAN031-0312-0008			CAN031-0313-0004			CAN031-0313-0008		
LAB SAMPLE NUMBER	0311830018SA			0311830001SA			0311830014SA			0311830015SA			0311830004SA			0311830005SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	7690	11.8		3210	11.2		4210	23.5		5820	11.4		4090	23.3		5460	11.4	
Arsenic	2.4	0.59		1.1	0.56		2.2	0.59		2.6	0.57		2.7	0.58		3	0.57	
Barium	81.2	1.2	J	327	1.1	J	273	2.4	J	237	1.1	J	130	2.3	J	411	1.1	J
Beryllium	0.29	0.24		<	0.22	U	<	0.47	U	0.35	0.23		0.24	0.47	J	0.53	0.23	
Calcium	22900	23.6		60300	22.4		217000	47		68100	22.9		142000	46.6		50700	22.8	
Chromium	8.2	1.2		3.8	1.1		6.5	2.4		6.1	1.1		4.9	2.3		6.1	1.1	
Cobalt	4.4	1.2		1.7	1.1		2.4	2.4		3.1	1.1		2.5	2.3		3	1.1	
Copper	5.9	2.4		2.2	2.2		3.6	4.7	J	3.8	2.3		2.7	4.7	J	3.6	2.3	
Iron	8140	11.8		3320	11.2		3930	23.5		5900	11.4		4050	23.3		5580	11.4	
Lead	6.7	1.2		4.5	1.1		5.4	0.59		6.6	0.57		4	0.58		5.8	1.1	
Magnesium	2000	23.6		2200	22.4		3250	47		3970	22.9		2500	46.6		2960	22.8	
Nickel	7.4	4.7		3.6	4.5	J	5.7	9.4	J	6.3	4.6		5.9	9.3	J	6.5	4.6	
Potassium	1450	590		892	560		688	1180		1090	572		762	1170		1140	570	
Selenium	<	1.2	UJ	0.12	1.1	J	<	1.2	UJ	<	1.1	UJ	<	1.2	UJ	<	1.1	UJ
Vanadium	16.4	1.2		11.2	1.1		14	2.4		23.4	1.1		15.4	2.3		22.6	1.1	
Zinc	18.8	2.4		8	2.2	J	9.6	4.7		12.9	2.3		9.8	4.7		12.1	2.3	

NOTE: Results presented here are chemicals which were detected at least once in subsurface soils at this SWMU and have passed data review. A complete summary of chemical results are presented in Appendix A of the RFI report.
J=Estimated value below reporting limit or estimated based on data quality criteria.
U = Not detected RL = Reporting Limit.
Qual= Qualifier

TABLE 4-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0314-0004			CAN031-0314-0008		
LAB SAMPLE NUMBER	0311830009SA			0311830019SA		
COLLECT DATE	09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)						
Aluminum	4830	23.5		2160	23.3	
Arsenic	3.1	0.59		1.5	0.58	
Barium	1130	2.4	J	143	2.3	J
Beryllium	<	0.47	U	<	0.47	U
Calcium	156000	47		222000	46.5	
Chromium	4.5	2.4		2.3	2.3	
Cobalt	2.4	2.4		<	2.3	U
Copper	2.5	4.7	J	1.5	4.7	J
Iron	4570	23.5		1680	23.3	
Lead	4.1	0.59		1.9	0.58	
Magnesium	3390	47		2920	46.5	
Nickel	6.2	9.4	J	3.6	9.3	J
Potassium	844	1180	J	<	1160	U
Selenium	<	1.2	UJ	<	1.2	UJ
Vanadium	18.7	2.4		6	2.3	
Zinc	11.9	4.7		5.6	4.7	

NOTE: Results presented here are chemicals which were detected at least once in subsurface soils at this SWMU and have passed data review. A complete summary of chemical results are presented in Appendix A of the RFI report.
J=Estimated value below reporting limit or estimated based on data quality criteria.
U = Not detected RL = Reporting Limit.
Qual= Qualifier

TABLE 4-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SURFACE SOIL TO BACKGROUND(1)
SWMU 31, CANNON AFB
AGE Maintenance Shop Pad

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration(3)	Does maximum detected exceed background	Reported Level in Clovis, NM Region (4)
CAN031-0314-0000	Aluminum	9430	1410 - 11,000	10,540	N	50,000
CAN031-0311-0000	Antimony	1.9	<4.9 - 5.1	*	Y	<1
CAN031-0314-0000	Arsenic	4.6	0.67 - 28	15.5	N	6.5
CAN031-0311-0000	Barium	1460	14.5 - 1200	642	Y	500
CAN031-0314-0000	Beryllium	0.69	0.17 - 0.77	0.73	N	1-2
CAN031-0311-0000	Cadmium	8.7	<0.51 - 4.2	*	Y	---
CAN031-0311-0000	Chromium	130	4 - 15.4	12.5	Y	30
CAN031-0314-0000	Cobalt	5.1	0.85 - 5.3	4.5	N**	3-7
CAN031-0311-0000	Copper	61.4	<2 - 18.4	*	Y	20
CAN031-0311-0000	Lead	930	1.1 - 46	25.8	Y	15
CAN031-0314-0000	Nickel	9.7	1.3 - 9.8	9	N**	15
CAN031-0314-0000	Potassium	1610	354 - 2770	2,572	N	16,000
CAN031-0313-0000	Selenium	0.24	<0.21 - 124	*	N**	0.15-0.30
CAN031-0314-0000	Vanadium	21.2	5.2 - 28.3	25.3	N	30-70
CAN031-0311-0000	Zinc	479	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. See Appendixx A. This is for all practical purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration within or only slightly above Base-wide background range and within naturally occurring levels (USGS 1984); therefore concentration is not considered to exceed background.

TABLE 4-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN TOTAL SOILS TO BACKGROUND(1)
SWMU 31, CANNON AFB
AGE Maintenance Shop Pad

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration(3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN031-0314-0000	Aluminum	9430	1410 - 11,000	10,540	N	50,000
CAN031-0311-0000	Antimony	1.9	<4.9 - 5.1	*	Y	<1
CAN031-0314-0000	Arsenic	4.6	0.67 - 28	15.5	N	6.5
CAN031-0311-0000	Barium	1460	14.5 - 1200	642	Y	500
CAN031-0314-0000	Beryllium	0.69	0.17 - 0.77	0.73	N	1-2
CAN031-0311-0000	Cadmium	8.7	<0.51 - 4.2	*	Y	---
CAN031-0311-0000	Chromium	130	4 - 15.4	12.5	Y	30
CAN031-0314-0000	Cobalt	5.1	0.85 - 5.3	4.5	N**	3-7
CAN031-0311-0000	Copper	61.4	<2 - 18.4	*	Y	20
CAN031-0311-0000	Lead	930	1.1 - 46	25.8	Y	15
CAN031-0314-0000	Nickel	9.7	1.3 - 9.8	9	N**	15
CAN031-0314-0000	Potassium	1610	354 - 2770	2,572	N	16,000
CAN031-0313-0000	Selenium	0.24	<0.21 - 124	*	N**	0.15-0.30
CAN031-0314-0000	Vanadium	21.2	5.2 - 28.3	25.3	N	30-70
CAN031-0311-0000	Zinc	479	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practical purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or slightly above Base-wide background range and within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background.

TABLE 4-5

CHEMICALS OF CONCERN IN SURFACE SOIL

Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Carbazole
Chrysene
Fluoranthene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Phenanthrene*
Pyrene
Tetrachloroethene
TPH*
Antimony
Barium
Cadmium
Chromium
Copper
Lead*
Zinc

* No EPA-established toxicity factor.

TABLE 4-6

CHEMICALS OF CONCERN IN TOTAL SOIL

Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Carbazole
Chrysene
Fluoranthene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Phenanthrene*
Pyrene
Tetrachloroethene
TPH*
Antimony
Barium
Cadmium
Chromium
Copper
Lead*
Zinc

* No EPA-established toxicity factor.

TABLE 4-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	Tetrachloroethene (µg/kg)			Anthracene (µg/kg)			Benzo(a)anthracene (µg/kg)			Benzo(a)pyrene (µg/kg)			Benzo(b)fluoranthene (µg/kg)		
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN031-0311-0000				600	J	4100	2400	J	4100	2700	J	4100	5600		4100
CAN031-0312-0000															
CAN031-0313-0000	3.6	J	6.1		U	8000		U	8000		U	8000	4000	U	8000
CAN031-0314-0000															
Number	1			1			1			1			2		
Minimum detected	3.6			600			2400			2700			5600		
Maximum detected	3.6			600			2400			2700			5600		
Average							2400			2700			4800		
H Statistic															
Standard Deviation															
95% UCL															
RME	3.6			600			2400			2700			5600		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value result shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 4-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	Carbazole (µg/kg)			Chrysene (µg/kg)			Fluoranthene (µg/kg)			Indeno(1,2,3-cd)pyrene (µg/kg)			Pyrene (µg/kg)		
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN031-0311-0000	500	J	4100	3100	J	4100	5600		4100	2300	J	4100	4600		4100
CAN031-0312-0000															
CAN031-0313-0000		U	8000		U	8000	4000	U	8000		U	8000	4000	U	8000
CAN031-0314-0000															
Number	1			1			2			1			2		
Minimum detected	500			3100			5600			2300			4600		
Maximum detected	500			3100			5600			2300			4600		
Average	500			3100			4800			2300			4300		
H Statistic															
Standard Deviation															
95% UCL															
RME	500			3100			5600			11			4600		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value result shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 4-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	TPH (mg/kg)				Antimony (mg/kg)			Barium (mg/kg)				Cadmium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN031-0311-0000	3180	8.065		500	1.9	J	7.5	1460	7.286	J	1.2	8.7	2.163		0.62
CAN031-0312-0000	973	6.880		209		U	6.3	166	5.112	J	1	0.85	-0.163		0.52
CAN031-0313-0000	4070	8.311		488		U	7.3	229	5.434	J	1.2	4.4	1.482		0.61
CAN031-0314-0000	23.45	3.155	U	46.9		U	7	104	4.644	J	1.2	0.299	-1.207	U	0.59
Number	4	4			1			4	4.000			4	4		
Minimum detected	973				1.90			104				0.85			
Maximum detected	4070				1.90			1460				8.70			
Average	2062	6.60			1.90			490	5.62			3.56	0.57		
H Statistic		16.37							8.320				10.642		
Standard Deviation	1882	2.38						649	1.158			3.88	1.53		
95% UCL	5.55E+09	5.55E+09						1.40E+05	1.40E+05			1326	1326		
RME	4070				1.90			1460				8.70			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value result shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 4-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	Chromium (mg/kg)				Copper (mg/kg)				Lead (mg/kg)				Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN031-0311-0000	130	4.868		1.2	61.4	4.117		2.5	930	6.835		125	479	6.172		2.5
CAN031-0312-0000	9.9	2.293		1	9.3	2.23		2.1	46.9	3.848		5.2	57	4.043		2.1
CAN031-0313-0000	24.3	3.190		1.2	18.8	2.934		2.4	77.7	4.353		6.1	85.8	4.452		2.4
CAN031-0314-0000	11.8	2.468		1.2	7.6	2.028		2.3	9.4	2.241		0.59	29.8	3.395		2.3
Number	4	4			4	4			4	4			4	4		
Minimum detected	9.9				7.60				9.40				29.8			
Maximum detected	130				61.4				930				479			
Average	44.0	3.20			24.3	2.83			266	4.32			163	4.52		
H Statistic		8.32				6.244				13.29				8.32		
Standard Deviation	57.69	1.17			25.24	0.94			444	1.90			212	1.19		
95% UCL	1277	1277			1.88E+02	188			2.12E+06	2.12E+06			4973	4973		
RME	130				61				930				479			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value result shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 4-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
TOTAL SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	Tetrachloroethene (µg/kg)				Anthracene (µg/kg)				Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN031-0311-0000					600	6.397	J	4100	2400	7.783	J	4100	2700	7.901	J	4100
CAN031-0311-0002																
CAN031-0311-0004																
CAN031-0311-0008	2.8	1.030	U	5.6												
CAN031-0312-0000																
CAN031-0312-0002	2.8	1.030	U	5.6	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN031-0312-0004																
CAN031-0312-0008	2.85	1.047	U	5.7	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN031-0313-0000	3.6	1.281	J	6.1			U	8000	4000	8.294	U	8000	4000	8.294	U	8000
CAN031-0313-0002					195	5.273	U	390	195	5.273	U	390	195	5.273	U	390
CAN031-0313-0004																
CAN031-0313-0008																
CAN031-0314-0000																
CAN031-0314-0002	2.9	1.065	U	5.8	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN031-0314-0004																
Number	5	5			5	5			6	6			6	6		
Minimum detected	3.6				600				2400				2700			
Maximum detected	3.6				600				2400				2700			
Average	2.99	1.09			272	5.48			1193	6.18			1243	6.20		
H Statistic		1.921			2.5	2.5				4.802			5.184	5.184		
Standard Deviation	0.34	0.11			183.4	0.51			1635	1.45			1683	1.48		
95% UCL	3.32	3.32			519	519			31115	31115			44964	44964		
RME	3.32				519				2400				2700			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 4-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
TOTAL SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	Benzo(b)fluoranthene (µg/kg)				Carbazole (µg/kg)				Chrysene (µg/kg)				Fluoranthene (µg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN031-0311-0000	5600	8.631		4100	500	6.215	J	4100	3100	8.039	J	4100	5600	8.631		4100
CAN031-0311-0002																
CAN031-0311-0004																
CAN031-0311-0008																
CAN031-0312-0000																
CAN031-0312-0002	65	4.174	J	370	185	5.220	U	370	185	5.220	U	370	55	4.007	J	370
CAN031-0312-0004																
CAN031-0312-0008	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN031-0313-0000	4000	8.294	U	8000			U	8000	4000	8.294	U	8000	4000	8.294	U	8000
CAN031-0313-0002	195	5.273	U	390	195	5.273	U	390	195	5.273	U	390	195	5.273	U	390
CAN031-0313-0004																
CAN031-0313-0008																
CAN031-0314-0000																
CAN031-0314-0002	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN031-0314-0004																
Number	6	6			5	5			6	6			6	6		
Minimum detected	65				500				3100				55			
Maximum detected	5600				500				3100				5600			
Average	1707	6.14			242	5.44			1310	6.22			1705	6.12		
H Statistic		5.184				2.318				5.184				5.96		
Standard Deviation	2449	1.85			138.7	0.43			1758	1.51			2451	1.88		
95% UCL	1.86E+05	1.86E+05			418	418			52097	52097			4.04E+05	4.04E+05		
RME	5600				418				3100				5600			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 4-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
TOTAL SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	Indeno(1,2,3-cd)pyrene (µg/kg)				Pyrene (µg/kg)				TPH (mg/kg)				Antimony (mg/kg)		
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	Qual	RL
CAN031-0311-0000	2300	7.741	J	4100	4600	8.434		4100	3180	8.065		500	1.9	J	7.5
CAN031-0311-0002									24.05	3.180	U	48.1		U	14.4
CAN031-0311-0004									23.6	3.161	U	47.2		U	7.1
CAN031-0311-0008									22.4	3.109	U	44.8		U	6.7
CAN031-0312-0000									973	6.880		209		U	6.3
CAN031-0312-0002	185	5.220	U	370	44	3.784	J	370	81	4.394		44.6		U	6.7
CAN031-0312-0004									23.5	3.157	U	47		U	14.1
CAN031-0312-0008	190	5.247	U	380	190	5.247	U	380	22.9	3.131	U	45.8		U	6.9
CAN031-0313-0000	4000	8.294	U	8000	4000	8.294	U	8000	4070	8.311		488		U	7.3
CAN031-0313-0002	195	5.273	U	390	195	5.273	U	390	23.45	3.155	U	46.9		U	7
CAN031-0313-0004									23.3	3.148	U	46.6		U	14
CAN031-0313-0008									22.8	3.127	U	45.6		U	6.8
CAN031-0314-0000									23.45	3.155	U	46.9		U	7
CAN031-0314-0002	190	5.247	U	380	190	5.247	U	380	23.3	3.148	U	46.6		U	7
CAN031-0314-0004									23.5	3.157	U	47		U	14.1
Number	6	6			6	6			15	15			1		
Minimum detected	2300				44				81				1.9		
Maximum detected	2300				4600				4070				1.9		
Average	1177	6.17			1537	6.05			571	4.15			1.9		
H Statistic		4.802				5.96				4.222					
Standard Deviation	1620	1.44			2150	1.88			1275	1.91					
95% UCL	29874	29874			3.78E+05	3.78E+05			3424	3424					
RME	2300				4600				3424				1.90		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 4-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
TOTAL SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	Barium (mg/kg)				Cadmium (mg/kg)				Chromium (.mg/kg)				Copper (mg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN031-0311-0000	1460	7.286	J	1.2	8.7	2.163		0.62	130	4.868		1.2	61.4	4.117		2.5
CAN031-0311-0002	120	4.787	J	2.4	0.6	-0.511	U	1.2	4.2	1.435		2.4	2.7	0.993	J	4.8
CAN031-0311-0004	81.2	4.397	J	1.2	0.295	-1.221	U	0.59	8.2	2.104		1.2	5.9	1.775		2.4
CAN031-0311-0008	327	5.790	J	1.1	0.28	-1.273	U	0.56	3.8	1.335		1.1	2.2	0.788		2.2
CAN031-0312-0000	166	5.112	J	1	0.85	-0.163		0.52	9.9	2.293		1	9.3	2.230		2.1
CAN031-0312-0002	201	5.303	J	1.1	0.63	-0.462		0.56	8	2.079		1.1	10.9	2.389		2.2
CAN031-0312-0004	273	5.609	J	2.4	0.6	-0.511	U	1.2	6.5	1.872		2.4	3.6	1.281	J	4.7
CAN031-0312-0008	237	5.468	J	1.1	0.285	-1.255	U	0.57	6.1	1.808		1.1	3.8	1.335		2.3
CAN031-0313-0000	229	5.434	J	1.2	4.4	1.482		0.61	24.3	3.190		1.2	18.8	2.934		2.4
CAN031-0313-0002	119	4.779	J	1.2	0.295	-1.221	U	0.59	6	1.792		1.2	4.7	1.548		2.3
CAN031-0313-0004	130	4.868	J	2.3	0.6	-0.511	U	1.2	4.9	1.589		2.3	2.7	0.993	J	4.7
CAN031-0313-0008	411	6.019	J	1.1	0.285	-1.255	U	0.57	6.1	1.808		1.1	3.6	1.281		2.3
CAN031-0314-0000	104	4.644	J	1.2	0.295	-1.221	U	0.59	11.8	2.468		1.2	7.6	2.028		2.3
CAN031-0314-0002	107	4.673	J	1.2	0.29	-1.238	U	0.58	6.4	1.856		1.2	5.2	1.649	J	2.3
CAN031-0314-0004	1130	7.030	J	2.4	0.6	-0.511	U	1.2	4.5	1.504		2.4	2.5	0.916	J	4.7
Number	15	15			15	15			15	15			15	15		
Minimum detected	81.2				0.63				2.30				1.50			
Maximum detected	1460				8.7				130				61.4			
Average	340	5.41			1.27	-0.51			16.0	2.13			9.66	1.75		
H Statistic		2.489				2.713				2.621				2.621		
Standard Deviation	403.5	0.85			2.30	1.03			31.92	0.89			14.97	0.89		
95% UCL	564	564			2.16	2.16			23.3	23.3			16.0	16.0		
RME	564				2.16				23.3				16.0			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 4-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
TOTAL SOILS AT AGE MAINTENANCE SHOP PAD (SWMU 31)

	Lead (mg/kg)				Zinc (mg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN031-0311-0000	930	6.835		125	479	6.172		2.5
CAN031-0311-0002	3.5	1.253		1.2	9.2	2.219		4.8
CAN031-0311-0004	6.7	1.902		1.2	18.8	2.934		2.4
CAN031-0311-0008	4.5	1.504		1.1	8	2.079		2.2
CAN031-0312-0000	46.9	3.848		5.2	57	4.043		2.1
CAN031-0312-0002	22.3	3.105		5.6	33.5	3.512		2.2
CAN031-0312-0004	5.4	1.686		0.59	9.6	2.262		4.7
CAN031-0312-0008	6.6	1.887		0.57	12.9	2.557		2.3
CAN031-0313-0000	77.7	4.353		6.1	85.8	4.452		2.4
CAN031-0313-0002	4.7	1.548		0.59	12.6	2.534		2.3
CAN031-0313-0004	4	1.386		0.58	9.8	2.282		4.7
CAN031-0313-0008	5.8	1.758		1.1	12.1	2.493		2.3
CAN031-0314-0000	9.4	2.241		0.59	29.8	3.395		2.3
CAN031-0314-0002	6.9	1.932	J	1.2	13.2	2.580		2.3
CAN031-0314-0004	4.1	1.411		0.59	11.9	2.477		4.7
Number	15	15			15	15		
Minimum detected	1.90				5.60			
Maximum detected	930				479			
Average	75.9	2.44			53.5	3.07		
H Statistic		3.787				2.899		
Standard Deviation	237.2	1.53			119.7	1.11		
95% UCL	173	173			93.9	93.9		
RME	173				93.9			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 4-9
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SURFACE SOIL
SWMU 31

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
Anthracene	0.60	0.60	0.1	0.06	0.06
Benzo(a)anthracene	2.40	2.40	0.1	0.24	0.24
Benzo(a)pyrene	2.70	2.70	0.1	0.27	0.27
Benzo(b)fluoranthene	4.80	5.60	0.1	0.48	0.56
Carbazole	0.50	0.50	0.1	0.05	0.05
Chrysene	3.10	3.10	0.1	0.31	0.31
Fluoranthene	4.80	5.60	0.1	0.48	0.56
Indeno(1,2,3-cd)pyrene	2.30	2.30	0.1	0.23	0.23
Pyrene	4.30	4.60	0.1	0.43	0.46
Tetrachloroethene	0.0036	0.0036	0.03	0.0001	0.0001

(1) Absorbed fraction from Table C-25, Appendix C.

(2) Adjusted average concentration = average concentration x absorbed fraction

(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 4-10
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
TOTAL SOIL
SWMU 31

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
Anthracene	0.26	0.43	0.1	0.026	0.043
Benzo(a)anthracene	1.10	2.40	0.1	0.11	0.24
Benzo(a)pyrene	1.10	2.70	0.1	0.11	0.27
Benzo(b)fluoranthene	1.50	5.60	0.1	0.15	0.56
Carbozole	0.24	0.36	0.1	0.024	0.036
Chrysene	1.10	3.10	0.1	0.11	0.31
Fluoranthene	1.50	5.60	0.1	0.15	0.56
Indeno(1,2,3-cd)pyrene	1.10	2.30	0.1	0.11	0.23
Pyrene	1.30	4.60	0.1	0.13	0.46
Tetrachloroethene	0.003	0.003	0.03	9.00E-05	9.00E-05

(1) Absorbed fraction from Table C-25, Appendix C.

(2) Adjusted average concentration = average concentration x absorbed fraction

(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 4-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT AGE 31

	t (y)	Cs (ug/kg)	Co (g/m^3)	L (m)	W (m)	T (m)	VWC (L/L)	foc	Koc (ml/g)	Kd (ml/g)	Soil Half Life (y)	P (g/cm^3)	I (m/y)	H (m)	TOT (y)
Anthracene	0	258.33	4.13E-01	60	200	2.439	0.15	0.003	16000	48	1.26	1.6	0.015	76.829	394133
Antimony	0	1900	3.04E+00	60	200	2.439	0.15	0.003	NA	3981	NA	1.6	0.015	76.829	32625435
Barium	0	327390	5.24E+02	60	200	2.439	0.15	0.003	NA	50	NA	1.6	0.015	76.829	410523
Benzo(a)anthracene	0	1050	1.68E+00	60	200	2.439	0.15	0.003	1400000	4200	1.86	1.6	0.015	76.829	34420160
Benzo(a)pyrene	0	1092.86	1.75E+00	60	200	2.439	0.15	0.003	6500000	19500	1.45	1.6	0.015	76.829	159805088
Benzo(b)fluoraanthene	0	1490	2.38E+00	60	200	2.439	0.15	0.003	550000	1650	1.67	1.6	0.015	76.829	13522672
Cadmium	0	1230	1.97E+00	60	200	2.439	0.15	0.003	NA	7	NA	1.6	0.015	76.829	58134
Carbazole	0	241.67	3.87E-01	60	200	2.439	0.15	0.003	5100	15.3	0.2	1.6	0.015	76.829	126153
Chromium	0	15190	2.43E+01	60	200	2.439	0.15	0.003	NA	40	NA	1.6	0.015	76.829	328572
Chrysene	0	1150	1.84E+00	60	200	2.439	0.15	0.003	250000	750	2.72	1.6	0.015	76.829	6147088
Copper	0	9150	1.46E+01	60	200	2.439	0.15	0.003	NA	20	NA	1.6	0.015	76.829	164670
Fluoranthene	0	1488.57	2.38E+00	60	200	2.439	0.15	0.003	1380	4.14	1.21	1.6	0.015	76.829	34696
Indeno(1,2,3-c)pyrene	0	1035.71	1.66E+00	60	200	2.439	0.15	0.003	31000000	93000	2	1.6	0.015	76.829	762144448
Lead	0	71280	1.14E+02	60	200	2.439	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278
Pyrene	0	1344.14	2.15E+00	60	200	2.439	0.15	0.003	38000	114	5.2	1.6	0.015	76.829	935009
Tetrachloroethene	0	2.98	4.77E-03	60	200	2.439	0.15	0.003	269	0.807	1	1.6	0.015	76.829	7382
Zinc	0	50550	8.09E+01	60	200	2.439	0.15	0.003	NA	20	NA	1.6	0.015	76.829	164670

t = Time where leachate concentration is estimated
Cs = Concentration of chemical in source soil
(average concentration from Table 5-8)
Co = Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 4-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT AGE 31

	Rd	Leach Rate (y^-1)	Qo (g)	Q(t) (g)	qc (g/y)	Cl(1) (ug/l)	Cl(2) (ug/l)	K (m/s)	i (m/m)	b (m)	Qw (m^3/y)	Ql (m^3/yr)	Cw (ug/l)
Anthracene	5.13E+02	7.99E-05	1.21E+04	1.21E+04	9.67E-01	5.37E+00	0.00E+00	2.00E-04	0.0019	10	23967	180	0.00E+00
Antimony	4.25E+04	9.66E-07	8.90E+04	8.90E+04	8.59E-02	4.77E-01	4.77E-01	2.00E-04	0.0019	10	23967	180	3.56E-03
Barium	5.34E+02	7.67E-05	1.53E+07	1.53E+07	1.18E+03	6.54E+03	6.54E+03	2.00E-04	0.0019	10	23967	180	4.87E+01
Benzo(a)anthracene	4.48E+04	9.15E-07	4.92E+04	4.92E+04	4.50E-02	2.50E-01	0.00E+00	2.00E-04	0.0019	10	23967	180	0.00E+00
Benzo(a)pyrene	2.08E+05	1.97E-07	5.12E+04	5.12E+04	1.01E-02	5.60E-02	0.00E+00	2.00E-04	0.0019	10	23967	180	0.00E+00
Benzo(b)fluoraanthene	1.76E+04	2.33E-06	6.98E+04	6.98E+04	1.63E-01	9.03E-01	0.00E+00	2.00E-04	0.0019	10	23967	180	0.00E+00
Cadmium	7.57E+01	5.42E-04	5.76E+04	5.76E+04	3.12E+01	1.73E+02	1.73E+02	2.00E-04	0.0019	10	23967	180	1.29E+00
Carbazole	1.64E+02	2.50E-04	1.13E+04	1.13E+04	2.83E+00	1.57E+01	0.00E+00	2.00E-04	0.0019	10	23967	180	0.00E+00
Chromium	4.28E+02	9.59E-05	7.11E+05	7.11E+05	6.82E+01	3.79E+02	3.79E+02	2.00E-04	0.0019	10	23967	180	2.82E+00
Chrysene	8.00E+03	5.12E-06	5.39E+04	5.39E+04	2.76E-01	1.53E+00	0.00E+00	2.00E-04	0.0019	10	23967	180	0.00E+00
Copper	2.14E+02	1.91E-04	4.28E+05	4.28E+05	8.20E+01	4.55E+02	4.55E+02	2.00E-04	0.0019	10	23967	180	3.39E+00
Fluoranthene	4.52E+01	9.08E-04	6.97E+04	6.97E+04	6.33E+01	3.52E+02	0.00E+00	2.00E-04	0.0019	10	23967	180	0.00E+00
Indeno(1,2,3-c)pyrene	9.92E+05	4.13E-08	4.85E+04	4.85E+04	2.00E-03	1.11E-02	0.00E+00	2.00E-04	0.0019	10	23967	180	0.00E+00
Lead	1.07E+03	3.84E-05	3.34E+06	3.34E+06	1.28E+02	7.12E+02	7.12E+02	2.00E-04	0.0019	10	23967	180	5.31E+00
Pyrene	1.22E+03	3.37E-05	6.29E+04	6.29E+04	2.12E+00	1.18E+01	1.18E+01	2.00E-04	0.0019	10	23967	180	8.78E-02
Tetrachloroethene	9.61E+00	4.27E-03	1.40E+02	1.40E+02	5.96E-01	3.31E+00	3.31E+00	2.00E-04	0.0019	10	23967	180	2.47E-02
Zinc	2.14E+02	1.91E-04	2.37E+06	2.37E+06	4.53E+02	2.52E+03	2.52E+03	2.00E-04	0.0019	10	23967	180	1.88E+01

t = Time where leachate concentration is estimated
Cs = Concentration of chemical in source soil
(average concentration from Table 5-8)
Co = Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vado
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 4-12

COMPARISON OF MODELED GROUNDWATER CONCENTRATIONS TO RBCs(1)

	Cw(2) (ug/l)	Tap Water RBC (1) (µg/L)	Does modeled concentration exceed RBC?
Anthracene	0	11000	No
Antimony	3.56E-03	15	No
Barium	4.87E+01	2600	No
Benzo(a)anthracene	0	0.092	No
Benzo(a)pyrene	0	0.0092	No
Benzo(b)fluoranthene	0	0.092	No
Cadmium	1.29E+00	18	No
Carbazole	0	3.4	No
Chromium	2.82E+00	37000	No
Chrysene	0	9.2	No
Copper	3.39E+00	1400	No
Fluoranthene	0	1500	No
Indeno(1,2,3-C)pyrene	0	0.092	No
Lead	5.31E+00	15 (3)	No
Pyrene	8.78E-02	1100	No
Tetrachloroethene	2.47E-02	1.1	No
Zinc	1.88E+01	11000	No

(1) RBC is the EPA Region III risk based concentration for residential tap water ingestion and inhalation.
(2) Cw is the modeled groundwater concentration as defined in Table 4-11.
(3) No Region III RBC is available for lead. Value is the action level defined in the May 1993 issue of Drinking water regulation and health advisories (EPA 1993).
The modeled concentration, zero is a value less than 1E-300.

TABLE 4-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 31

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
Tetrachlorethene	2.65	1.60E-03	45	2.25	2	20250000	7.90E+08	5.55E-02	0.35	0.07852

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 4-7)
Cair = RME concentration of compound in air (Csoil/VF)

TABLE 4-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 31

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
Tetrachlorethene	364	2.59E-02	7.28E+00	1.46E-01	3.51E+03	0.004	1.03E-06

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 4-7)
Cair = RME concentration of compound in air (Csoil/VF)

TABLE 4-14
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM SURFACE SOILS AT SWMU 31

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Barium	1460	4.63E+09	3.15E-07
Benzo(a)anthracene	2.40	4.63E+09	5.18E-10
Benzo(a)pyrene	2.70	4.63E+09	5.83E-10
Benzo(b)fluoranthene	5.60	4.63E+09	1.21E-09
Cadmium	8.70	4.63E+09	1.88E-09
Chromium	130	4.63E+09	2.81E-08
Chrysene	3.10	4.63E+09	6.70E-10
Indeno(1,2,3-cd)pyrene	2.30	4.63E+09	4.97E-10

RME Soil Concentration from Table 4-7
PEF = Particulate Emission Factor default value from EPA (1991b)
Air Concentration = Soil concentration/PEF
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 4-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 31

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
Tetrachlorethene	2.65	1.60E-03	45	2.25	2	20250000	7.90E+08	5.55E-02	0.35	0.07852

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 4-8)
Cair = RME concentration of compound in air (Csoil/VF)

TABLE 4-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 31

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
Tetrachlorethene	364	2.59E-02	7.28E+00	1.46E-01	3.51E+03	0.003	9.20E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 4-8)
Cair = RME concentration of compound in air (Csoil/VF)

TABLE 4-16
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM TOTAL SOILS AT SWMU 31

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Barium	522	4.63E+09	1.13E-07
Benzo(a)anthracene	2.40	4.63E+09	5.18E-10
Benzo(a)pyrene	2.70	4.63E+09	5.83E-10
Benzo(b)fluoranthene	5.60	4.63E+09	1.21E-09
Cadmium	1.98	4.63E+09	4.28E-10
Chromium	22.0	4.63E+09	4.76E-09
Chrysene	3.10	4.63E+09	6.70E-10
Indeno(1,2,3-cd)pyrene	2.30	4.63E+09	4.97E-10

RME Soil Concentration from Table 4-8

PEF = Particulate Emission Factor default value from EPA (1991b)

Air Concentration = Soil concentration/PEF

TABLE 4-17

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Inhalation (m^3/kg-d)		
Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
Carcinogenic	1.39×10^{-3}	6.99×10^{-2}
Construction Workers	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Inhalation (m^3/kg-d)		
Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
Carcinogenic	1.03×10^{-4}	4.47×10^{-4}
Trespasser	**Average**	**RME**
Dermal Contact Soil (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Soil Ingestion (kg/kg-d		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Inhalation (m^3/k-d)		
Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 4-18

SUMMARY OF HUMAN HEALTH RISKS AT SWMU 31

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Surface Soil)						
-- Dermal Contact	6×10^{-11}		5×10^{-9}	1×10^{-8}		3×10^{-7}
-- Ingestion	2×10^{-8}		2×10^{-4}	5×10^{-6}		3×10^{-2}
-- Inhalation of VOCs	3×10^{-12}		0.00	1×10^{-10}		0.00
-- Inhalation of Particulates	2×10^{-9}		2×10^{-5}	8×10^{-8}		4×10^{-4}
	2×10^{-8}		2×10^{-4}	3×10^{-6}		3×10^{-2}
Construction Worker (Total Soil)						
-- Dermal Contact	2×10^{-12}	3×10^{-10}		5×10^{-11}	4×10^{-9}	
-- Ingestion	3×10^{-9}	1×10^{-4}		6×10^{-8}	1×10^{-3}	
-- Inhalation of VOCs	2×10^{-13}	0.00		7×10^{-13}	0.00	
-- Inhalation of Particulates	2×10^{-11}	6×10^{-7}		9×10^{-11}	3×10^{-6}	
	3×10^{-9}	1×10^{-4}		6×10^{-8}	1×10^{-3}	
Trespasser						
-- Dermal Contact	1×10^{-11}	1×10^{-10}		1×10^{-9}	1×10^{-8}	
-- Ingestion	4×10^{-9}	3×10^{-5}		3×10^{-7}	5×10^{-3}	
-- Inhalation of VOCs	5×10^{-13}	0.00		8×10^{-12}	0.00	
-- Inhalation of Particulates	3×10^{10}	7×10^{-7}		6×10^{-9}	1×10^{-5}	
	4×10^{-9}	3×10^{-5}		3×10^{-7}	5×10^{-3}	

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix C for nonrounded risk values.

TABLE 4-19

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies. They are under review and subject to revision.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

TABLE 4-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 31
CANNON AFB
(mg/kg)

Chemical	CAN031-0311-0000	CAN031-0311-0002	CAN031-0312-0000	CAN031-0312-0002	CAN031-0313-0000	CAN031-0314 0000	N	Arithmetic Mean	95% UCL	Maximum
Volatile Organics										
Tetrachloroethene				0.0028 U	0.0036		2	0.0032	0.0050	0.0036
Semivolatile Organics										
Anthracene	0.6 J			0.185 U	4 U		3	1.60	4.48	4
Benzo(a)anthracene	2.4 J			0.185 U	4 U		3	2.20	4.83	4
Benzo(a)pyrene	2.7 J			0.185 U	4 U		3	2.30	4.96	4
Benzo(b)fluoranthene	5.6			0.065 J	4 U		3	3.22	7.14	5.6
Benzo(g,h,i)perylene	2.6 J			0.185 U	4 U		3	2.26	4.92	4
Carbazole	0.5 J			0.185 U	4 U		3	1.56	4.48	4
Chrysene	3.1 J			0.185 U	4 U		3	2.43	5.17	4
Fluoranthene	5.6			0.055 J	4 U		3	3.22	7.15	5.6
Ideno(1,2,3-cd)pyrene	2.3 J			0.185 U	4 U		3	2.16	4.79	4
2-Methylnaphthalene	2.05 U			0.045 J	4 U		3	2.03	4.75	4
Phenanthrene	3.2 J			0.044 J	4 U		3	2.41	5.29	4
Pyrene	4.6			0.044 J	4 U		3	2.88	6.29	4.6
Metals										
Aluminum	5660	4160	4260	5430	6650	9430	6	5931.67	7396.03	9430
Antimony	1.9 J	7.2 U	3.2 U	3.4 U	3.7 U	4 U	6	3.90	5.23	7.2
Arsenic	3.2	2.3	2.4	2.9	4.4	4.6	6	3.30	4.04	4.6
Barium	1460 J	120 J	166 J	201 J	229 J	104 J	6	380.00	778.90	1460
Beryllium	0.36	0.26 J	0.22	0.27	0.25	0.69	6	0.34	0.47	0.69
Cadmium	8.7	0.6 U	0.85	0.63	4.4	0.3 U	6	2.58	5.11	8.7

TABLE 4-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 31
CANNON AFB
(mg/kg)

Chemical	CAN031-0311-0000	CAN031-0311-0002	CAN031-0312-0000	CAN031-0312-0002	CAN031-0313-0000	CAN031-0314 0000	N	Arithmetic Mean	95% UCL	Maximum
Calcium	6270	205000	48600	94400	42400	4200	6	66811.67	123377.65	205000
Chromium	130	4.2	9.9 J	8 J	24.3	11.8	6	31.37	68.01	130
Cobalt	3.4	2.3 J	2.6	3.2	3.5	5.1	6	3.35	4.08	5.1
Copper	61.4	2.7 J	9.3	10.9	18.8	7.6	6	18.45	34.73	61.4
Iron	7150	3290	5570	6420	7950	10700	6	6846.67	8704.99	10700
Lead	930	3.5	46.9	22.3	77.7	9.4	6	181.63	457.71	930
Magnesium	1150	2450	1810	2210	2310	2130	6	2010.00	2365.03	2450
Nickel	7.2	4.9 J	5.8	6.9	6.8	9.7	6	6.88	8.10	9.7
Potassium	867	666 J	1100	954	1550	1610	6	1124.50	1410.05	1610
Selenium	0.6 UJ	0.6 UJ	0.5 UJ	0.6 UJ	0.24 J	0.15 J	6	0.45	0.60	0.6
Sodium	313 U	600 U	262 U	279 U	193 J	294 U	6	323.50	429.82	600
Vanadium	13.8	10.4	13.8	17.1	16.6	21.2	6	15.48	18.25	21.2
Zinc	479	9.2	57	33.5	85.8	29.8	6	115.72	250.81	479
TPH										
Total Petroleum Hydrocarbons	3180	24.1 U	973	81	4070	23.5 U	6	1391.93	1391.93	4070

* Between 0 and 2 feet deep

J Estimated value below reporting limit or established based on data quality criteria.

U Non-detect, value shown i s one-half the reporting limit

TABLE 4-21

CHEMICALS OF CONCERN IN SOILS SWMU 31
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Volatile Organics					
Tetrachloroethene	0.0036	---	---	---	Y
Semivolatile Organics					
Anthracene	4	---	---	---	Y
Benzo(a)anthracene	4	---	---	---	Y
Benzo(a)pyrene	4	---	---	---	Y
Benzo(b)fluoranthene	5.6	---	---	---	Y
Benzo(g,h,i)perylene	4	---	---	---	Y
Carbazole	4	---	---	---	Y
Chrysene	4	---	---	---	Y
Fluoranthene	5.6	---	---	---	Y
Ideno(1,2,3-cd)pyrene	4	---	---	---	Y
2-Methylnaphthalene	4	---	---	---	Y
Phenanthrene	4	---	---	---	Y
Pyrene	4.6	---	---	---	Y
Metals					
Aluminum	9430	10540	5000	700 - 100000	N
Antimony	7.2	*	<1	0.2 - 10	Y
Arsenic	4.6	15.5	6.5	1.0 - 40	N
Barium	1460	642	500	10 - 5,000	Y
Beryllium	0.69	0.73	1 - 2	<1 - 15	N
Cadmium	8.7	*	---	0.01 - 2.0	Y
Calcium	205000	186400	---	---	N**
Chromium	130	12.5	30	5 -1,500	Y
Cobalt	5.1	4.5	3 - 7	0.5 - 65	Y
Copper	61.4	*	20	1 - 700	Y
Iron	10700	8720	15000	100 - 100000	N
Lead	930	25.8	15	10 - 700	Y
Magnesium	2450	11790	---	---	N**
Nickel	9.7	9	15	2 - 750	N
Potassium	1610	2572	---	---	N**
Selenium	0.6	*	0.3	<0.1 - 4.3	Y
Sodium	600	*	---	---	N**
Vanadium	21.2	25.3	---	---	N
Zinc	479	21.9	45	<5 - 2900	Y
Total Petroleum - Hydrocarbons	4070	---	---	---	Y

(1) Upper Tolerance Limit (UTL) of the mean = mean + 2 x standard deviation. This is for all practical purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k = 2.02 for n = 37
(2) USGS (1984)
(3) Values mainly from Bowen (1979). Values for copper, lead, selenium, and zinc from USGS (1984).
* Data insufficient to calculate UTL of background concentration.
** Essential nutrient natural to soils. Not expected to be of concern compared to other COCs.
Y = Yes
N = No
--- = Not available

TABLE 4-22

RISK CHARACTERIZATION SUMMARY - SWMU 31

Chemical	Sample Number CAN031-0311-0000	CAN031-0311-0002	CAN031-0312-0000	CAN031-0312-0002	CAN031-0313-0000	CAN031-0314 0000	N	Arithmetic Mean mg/kg	Robin Benchmark Dietary Level mg/kg	Risk?
Volatile Organics										
Tetrachloroethene				0.0028 U	0.0036		2	0.0032	500	--
Semivolatile Organics										
Anthracene	0.6 J			0.185 U	4 U		3	1.60	5000	--
Benzo(a)anthracene	2.4 J			0.185 U	4 U		3	2.20	2	Possible (slight)
Benzo(a)pyrene	2.7 J			0.185 U	4 U		3	2.30	0.02	Possible
Benzo(b)fluoranthene	5.6			0.065 J	4 U		3	3.22	40	--
Benzo(g,h,i)perylene	2.6 J			0.185 U	4 U		3	2.26	375	--
Carbazole	0.5 J			0.185 U	4 U		3	1.56	250	--
Chrysene	3.1 J			0.185 U	4 U		3	2.43	375	--
Fluoranthene	5.6			0.055 J	4 U		3	3.22	625	--
Ideno(1,2,3-cd)pyrene	2.3 J			0.185 U	4 U		3	2.16	72	--
2-Methylnaphthalene	2.05 U			0.045 J	4 U		3	2.03	375	--
Phenanthrene	3.2 J			0.044 J	4 U		3	2.41	150	--
Pyrene	4.6			0.044 J	4 U		3	2.88	395	--
Metals										
Antimony	1.9 J	7.2 U	3.2 U	3.4 U	3.7 U	4 U	6	3.90	16.5	--
Barium	1460 J	120 J	166 J	201 J	229 J	104 J	6	380.00	1250	--
Cadmium	8.7	0.6 U	0.85	0.63	4.4	0.3 U	6	11.87**	10.5	Possible (slight)
Chromium	130	4.2	9.9 J	8 J	24.3	11.8	6	31.37	87.5 (VI)	--
Cobalt	3.4	2.3 J	2.6	3.2	3.5	5.1	6	3.35	10	--
Copper	61.4	2.7 J	9.3	10.9	18.8	7.6	6	18.45	260	--
Lead	930	3.5	46.9	22.3	77.7	9.4	6	181.63	87.5	Possible
Selenium	0.6 UJ	0.6 UJ	0.5 UJ	0.6 UJ	0.24 J	0.15 J	6	5.4**	5	Possible (slight)
Zinc	479	9.2	57	33.5	85.8	29.8	6	115.72	875	--
TPH										
Total Petroleum Hydrocar	3180	24.1 U	973	81	4070	23.5 U	6	1391.93	241	Possible

* Between 0 and 2 feet deep
**Mean soil concentration multiplied by BAF of 4.6 for Cd and 12 for Se.
J Estimated value below reporting limit or established based on data quality criteria
U Non-detect, value shown is one-half the reporting limit

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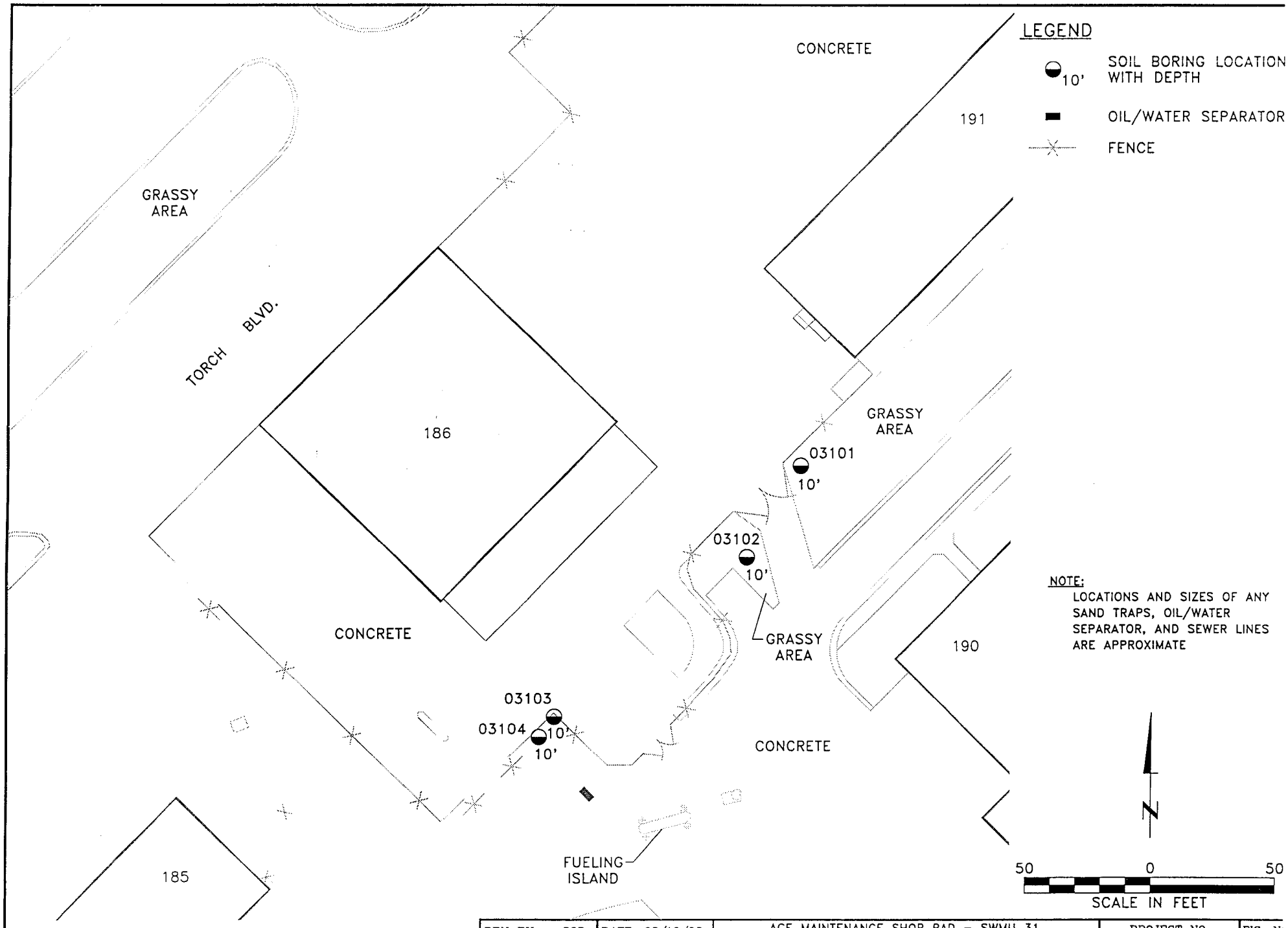
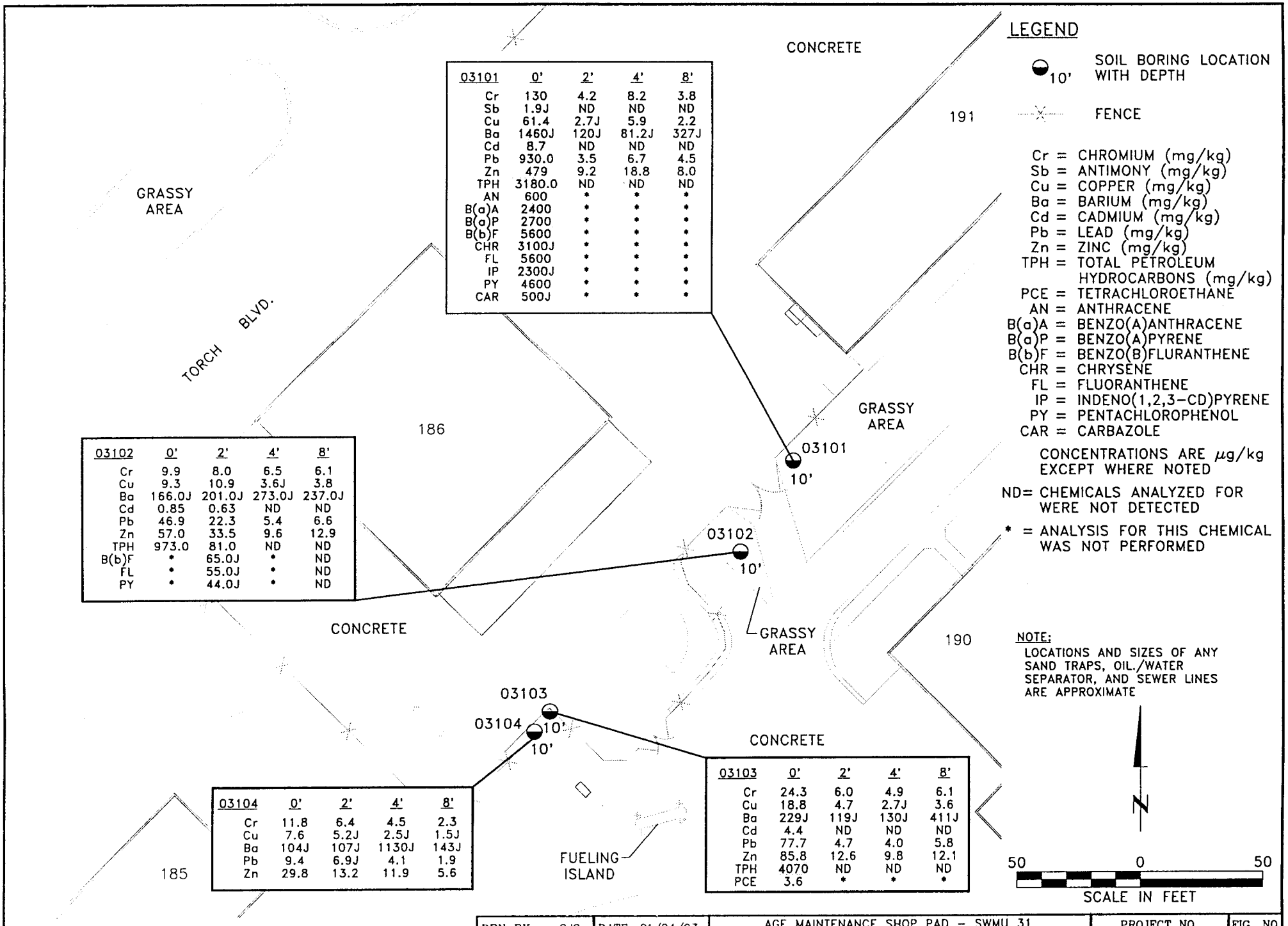


SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: SCR	DATE: 08/16/93	AGE MAINTENANCE SHOP PAD – SWMU 31 SITE MAP AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. N 4–1

CAD FILE: C3M11W02.DWG V=HITS 02/15/1994 15:01



03101	0'	2'	4'	8'
Cr	130	4.2	8.2	3.8
Sb	1.9J	ND	ND	ND
Cu	61.4	2.7J	5.9	2.2
Ba	1460J	120J	81.2J	327J
Cd	8.7	ND	ND	ND
Pb	930.0	3.5	6.7	4.5
Zn	479	9.2	18.8	8.0
TPH	3180.0	ND	ND	ND
AN	600	*	*	*
B(a)A	2400	*	*	*
B(a)P	2700	*	*	*
B(b)F	5600	*	*	*
CHR	3100J	*	*	*
FL	5600	*	*	*
IP	2300J	*	*	*
PY	4600	*	*	*
CAR	500J	*	*	*

03102	0'	2'	4'	8'
Cr	9.9	8.0	6.5	6.1
Cu	9.3	10.9	3.6J	3.8
Ba	166.0J	201.0J	273.0J	237.0J
Cd	0.85	0.63	ND	ND
Pb	46.9	22.3	5.4	6.6
Zn	57.0	33.5	9.6	12.9
TPH	973.0	81.0	ND	ND
B(b)F	*	65.0J	*	ND
FL	*	55.0J	*	ND
PY	*	44.0J	*	ND

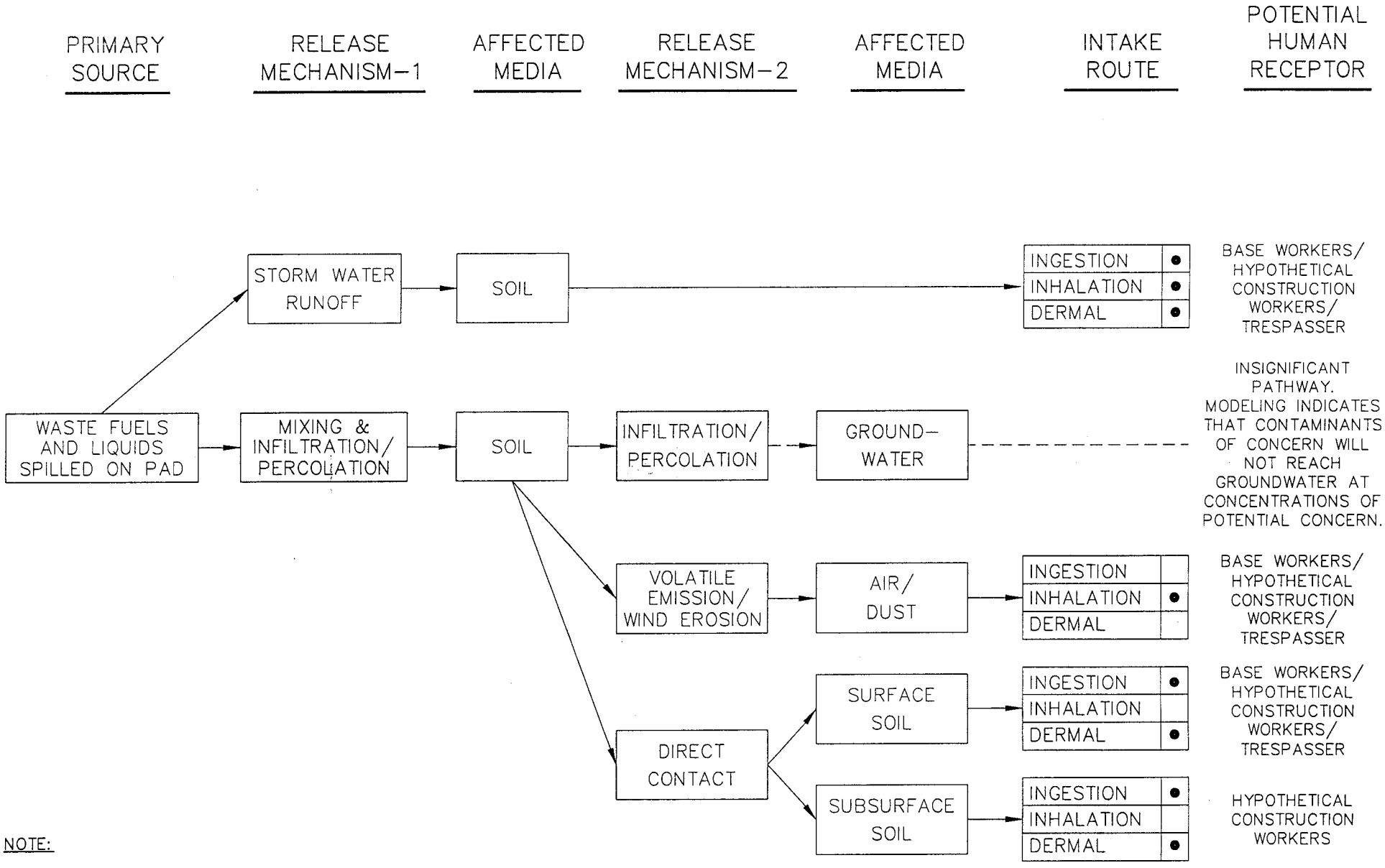
03104	0'	2'	4'	8'
Cr	11.8	6.4	4.5	2.3
Cu	7.6	5.2J	2.5J	1.5J
Ba	104J	107J	1130J	143J
Pb	9.4	6.9J	4.1	1.9
Zn	29.8	13.2	11.9	5.6

03103	0'	2'	4'	8'
Cr	24.3	6.0	4.9	6.1
Cu	18.8	4.7	2.7J	3.6
Ba	229J	119J	130J	411J
Cd	4.4	ND	ND	ND
Pb	77.7	4.7	4.0	5.8
Zn	85.8	12.6	9.8	12.1
TPH	4070	ND	ND	ND
PCE	3.6	*	*	*

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/04/93	AGE MAINTENANCE SHOP PAD - SWMU 31 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 4-2

CAD FILE: C3M11W15.DWG V=MAINTENANCE 01/17/1994 11:46



NOTE:

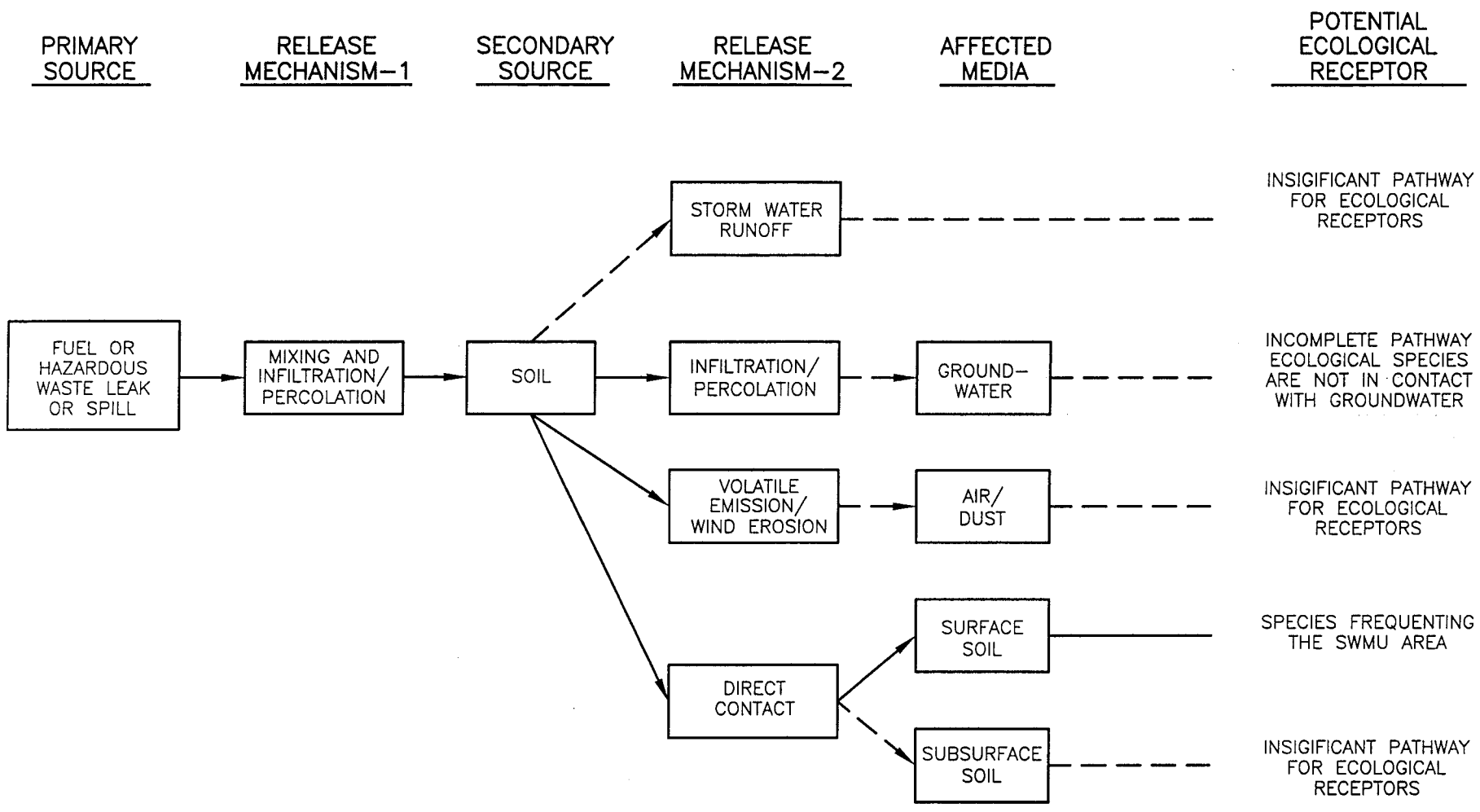
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART AGE MAINTENANCE SHOP PAD SWMU - 31 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	4-3

C3M11W22.DWG V=SWMU-31 02/15/1994 8:00

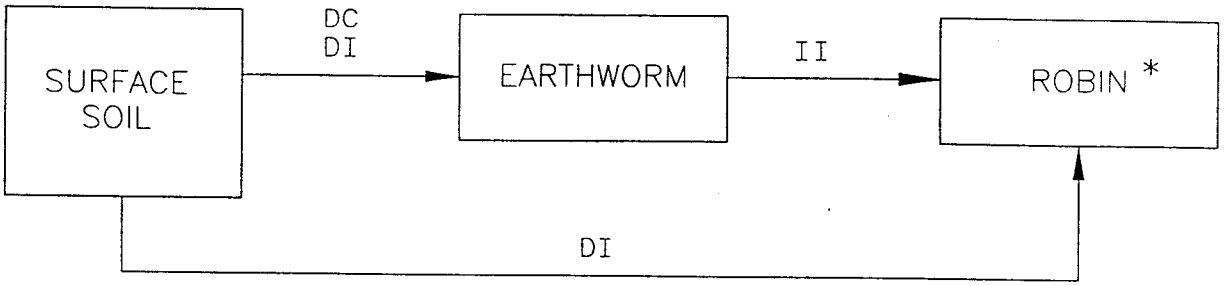


NOTES:

SOLID LINES REPRESENT POTENTIALLY COMPLETE AND SIGNIFICANT PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY NVD	DATE 12/30/93	EXPOSURE PATHWAY FLOW CHART FOR SWMU 31 ECOLOGICAL RECEPTORS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0		C3M11W	4-4



DC = DIRECT CONTACT

DI = DIRECT INGESTION

II = INDIRECT INGESTION
(i.e. SECONDARY, TERTIARY CONSUMPTION)

* = KEY RECEPTOR SPECIES

DRN BY NVD	DATE 12/30/93	CONCEPTUAL SITE MODEL SWMU 31	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0	CANNON AIR FORCE BASE NEW MEXICO	C3M11W	4-5

CAD FILE: C3M11W23.DWG V=SWMU-31 02/15/1994 9:30

5.0
OIL/WATER SEPARATOR (OWS) 375 - SWMU 51

5.1 SITE BACKGROUND

5.1.1 Site Description

OWS 375 is located beneath 0.5 feet of asphalt pavement adjacent to the northwest side of Building 375 within the motor pool compound (Figure 5-1). The OWS is constructed of portland cement, reinforced concrete and consists of a two-compartment underground unit with a nominal capacity of 1,000 gallons. The OWS extends about 5.5 feet below the pavement surface. The surface of the site is essentially flat, sloping very slightly to the northwest.

5.1.2 Site History

The OWS reportedly received wash water generated from light vehicle maintenance operations in Building 375 via a sump and drain pipe in the floor of the building. Oils recovered by the OWS were directed to the holding tank and the wastewater was discharged to the sanitary sewer line. The OWS has been active since 1968.

5.1.3 Current Use

The OWS continues to receive wash water generated from light vehicle maintenance operations in Building 375. The floor sump and drain pipe are still operational and carry fluids to the separator. The oils recovered in the OWS are directed to the holding tank and the wastewater is discharged to the sanitary sewer line.

5.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATION

5.2.1 Physical Investigation

Two 10-foot soil borings were located as close as possible to the east and west sides of the OWS to sample the soil at these sites for possible leaks from the separator holding tank. Underground utilities directly northwest of the OWS required that the third boring be relocated approximately 10 feet northwest of its originally proposed location, near the outflow pipe-sewer line junction. No surface staining of pavement was observed at this site.

Soil samples were collected from the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals. Target analytes included VOCs, SVOCs, metals, and TRPH. Samples from the 0.5- to 2-foot interval were collected immediately below the asphalt pavement at this site.

5.2.2 Chemical Investigation

Soil samples were collected from three borings (05101, 05102, and 05103). Sampling and analyses performed are summarized in Table 5-1. Summaries of the analytical results for these soil samples are provided in Table 5-2a (near-surface samples) and Table 5-2b (subsurface samples). The tables provide results for analytes that were detected at least once in the sample group. Complete analytical summary results are provided in Appendix A of the RFI Report.

5.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI Report, and the data were deemed to be of adequate quality to meet the objectives of the RFI (i.e., to evaluate potential human health and environmental risks). However, data quality issues that may affect the risk assessment are more fully discussed here.

Elevated reporting limits resulting from sample dilution may limit the usability of the data if concentrations of some analytes are thereby diluted to levels below the reporting limit.

That is, chemicals may be reported as nondetect when they are actually present in the sample at levels of potential concern. Section 5.4.6 of the QCSR (Appendix A of the RFI Report) presents a discussion of elevated reporting limits. Only lead had elevated reporting limits for samples CAN051-0512-0004 and CAN051-0512-0008, by a factor of 50 and 10, respectively. The elevated reporting limits for lead are not of concern because lead was detected above the reporting limits in both samples.

5.2.4 Nature and Extent of Contamination

There was no visible evidence of spills or leaks in the vicinity, and the entire area around the separator is paved. The chemical test results show low levels of organic contamination, including PAHs and TPH. For example, a maximum of about 9 mg/kg total PAH was detected in the 2-foot sample in boring 05103, but other samples did not contain detectable amounts of PAH. It is possible that the asphalt pavement is the source of some of the PAHs. TPH were measured in two samples at concentrations near 3,000 mg/kg; TPH concentrations in other samples ranged from nondetect (six samples) to 664 mg/kg. Figure 5-2 shows the concentrations and locations of chemicals detected at the SWMU.

5.3 HUMAN HEALTH RISK ASSESSMENT

5.3.1 Exposure Pathway Flow Chart

Figure 5-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways for OWS 375. In the flow chart, potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary sources are waste fluids (e.g., fuels, oils, and solvents) that have leaked from the separator system into subsurface soils or have been discharged or spilled on surface soil. Chemicals from the primary source may be released to other media (soil, air, or water) that may in turn act as secondary sources of release or exposure. Mixing and infiltration of the wastes to soil is shown as a primary chemical release mechanism. SWMU-related chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion, or result in exposure via direct contact (e.g.,

dermal contact or incidental ingestion). Storm water runoff is not considered to be a significant pathway for human exposures because there is little contamination in surface soils, the site is paved, the SWMU covers only a small area, surface spills are not likely to be significant, and no developed drainageways are present near the SWMU.

As shown in the flow chart, surface soils may provide exposures to Base workers (occupational exposures), hypothetical future construction workers, or hypothetical future trespassers (if the Base is closed in the future). Air emissions (volatile and particulates) from surface soil may also provide exposures to Base workers, construction workers, and trespassers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Groundwater is used for domestic purposes on and off Base. In order to assess potential impacts to public health via groundwater pathways, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling (Section 5.3.5.2) indicate that contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway was not evaluated further. Residential exposures to soils are not considered for this SWMU because the SWMU is located in an industrial area, so even if the Base closes in the future, industrial rather than residential use is the reasonable future use of the site.

In summary, potential complete human exposure pathways to be evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Trespassers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

5.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

Background levels were defined by the upper tolerance limit (UTL) of concentrations from 37 background soils samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; sese Appendix A).

Tables 5-3 and 5-4 show the comparison of SWMU results to background levels.

The maximum detected concentration of silver in surface soil exceeded background levels. The maximum detected concentration of silver in surface soil (0.62 mg/kg) may actually be at naturally occurring levels; however, since there is insufficient background data to make that determination, silver will be retained for further evaluation as a potential chemical of concern. The maximum detected concentrations of antimony, barium, cadmium, silver, and zinc in total soils exceeded background levels. These metals will be evaluated further as potential chemicals of concern.

5.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 51, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Table2s 5-2a and 5-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentration of silver detected in surface soil exceeded background ranges according to the comparison described in Section 5.3.2. Silver is, therefore, considered as a chemical of concern in surface soil. The concentrations of antimony, barium, cadmium, and silver detected in total (surface and subsurface) soil exceeded background ranges according to the comparison described in Section 5.3.2. These metals are, therefore, considered as chemicals of concern in total soil. Organic contaminants detected in soils were retained as chemicals of concern for risk assessment. Chemicals of concern in surface soil and total soil are listed in Tables 5-5 and 5-6, respectively.

Benzo(g,h,i)perylene, 2-methylnaphthalene, phenanthrene, and TPH, listed as chemicals of concern in Tables 5-5 and 5-6, do not have EPA-established toxicity factors and, therefore, cannot be evaluated quantitatively in the risk assessment. However, their potential effects on the results of the risk assessment are addressed in Sections 5.3.8 and 5.3.9.

5.3.4 Environmental Fate and Transport

5.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are: water solubility, soil

adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is pro2vided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

5.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the potential transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (INEL 1991), describes the mass balance of a contaminant (based on average soil concentrations) in the contaminated soil volume at the SWMU. The INEL model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP] Model) and accounts for sorption to soils and degradation in the vadose zone. The model conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of chemicals of concern. The input parameters and est2imated leachate concentrations are given in Section 5.3.5.2. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water (Section 5.3.5.2). Since the RBCs were developed for drinking water (at the tap) and are based on very conservative exposure and health-protective (risk) assumptions, it can be concluded that modeled groundwater concentrations that do not exceed RBCs will pose no significant adverse health risks.

5.3.4.3 Air Modeling

Air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using soil concentrations of chemicals of concern. The results of the air modeling are shown in Section 5.3.5.3. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use at hazardous waste sites to calculate soil cleanup levels (EPA 1991). Air concentrations were calculated for only those

chemicals with inhalation toxicity factors. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

5.3.5 Exposure Point Concentrations

5.3.5.1 Soils

Tables 5-7 and 5-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils respectively at OWS 375.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use of "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C. Tables 5-9 and 5-10 give the soil concentrations of organic compounds from surface and total soils, respectively, which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils. The absorbed fraction (from Table C-26, Appendix C) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soil. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

For purposes of risk assessment, surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depth (i.e., XXXXX-XXXX-0002) were actually collected from a depth of 1.5 to 3.5 feet. These samples were not considered surface samples, but are included in the risk assessment for subsurface soil exposures.

5.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 51. Model results are included in Table 5-11. These modeled concentrations were then compared to EPA Region III tap-water RBCs. These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 5-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap-water RBCs. No modeled concentrations exceeded the RBCs, so potential risks from the groundwater pathway are not expected to exceed 1×10^{-6}. Therefore, the groundwater pathway has been determined to be insignificant and was not evaluated further.

5.3.5.3 Air

RME air concentrations of volatile emissions from surface soil were calculated using the RME concentration of toluene, the only volatile chemical of concern in the surface soil. The results of the air modeling are shown in Table 5-13. There were no nonvolatile (i.e., SVOCs or metals) chemicals of concern with EPA-established toxicity factors for inhalation in the surface soil; therefore, air modeling of particulates (i.e., dust) from surface soils was not performed at this site. RME air concentrations of volatile and particulate emission from total soil were also calculated using RME concentrations of concern. The results of the air modeling from total soil are shown in Tables 5-14 and 5-15.

5.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the intake factors used to quantify chemical intake of SWMU-related contaminants in various environmental media soil and air. Table 5-16 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

5.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 5-17. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to contaminated surface soil at SWMU 51. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative, because there are no occupational receptors routinely working outdoors at the SWMU. Furthermore, the surface area of the SWMU is small (approximately 160 feet by 50 feet), and long-term occupational exposures are not likely to occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 51 via the dermal contact, inhalation, and ingestion pathways is 8×10^{-7} and 6×10^{-5} in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

No known carcinogens were detected in surface soils at SWMU 51; therefore, the estimated lifetime excess cancer risk under the assumed chronic exposure conditions is 0 under the average exposure case and 0 under the RME case.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 51. Exposures were assumed to occur during excavation activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 51 via the dermal contact, inhalation, and ingestion pathways is 0.0002 and 0.004 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 9×10^{-10} in the average case and 1×10^{-8} in the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b) and show that cancer risk is negligible for this exposure scenario.

Hypothetical Future Trespasser Exposure

Hypothetical trespassers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface soil at SWMU 51. Hypothetical trespassers were assumed to be exposed at SWMU for 2 and 8 hours/day, for 26 and 52 days/year, over 6 years for the average and RME cases, respectively. These assumptions are very conservative, because Cannon AFB is likely to remain a military installation, making access to SWMU 51 by trespassers unlikely.

The total hazard index calculated for noncarcinogenic health effects due to exposures to contaminants in surface soil at SWMU 51 via the dermal contact, ingestion and inhalation pathways is 2×10^{-7} and 2×10^{-5} in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

No known carcinogens were detected in surface soils at SWMU 51; therefore, the estimated lifetime excess cancer risk under the assumed exposure conditions is 0 under the average exposure case and 0 under the RME case.

5.3.8 Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available and when the fuel product is known. The provisional values are under review and subject to revision. RBCs derived from them are used simply as a guide to potential health hazards.)

The toxicity factors and calculation of risk-based concentrations are shown in Table 5-18. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,600 mg/kg. The maximum SWMU concentration of TPH is 3,150 mg/kg, well below the conservative RBC.

5.3.9 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 51 and their effect on the results and conclusions of the risk assessment are listed below.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens, such as benzo(a)pyrene, which can cause skin cancer through a direct action at the point of application. The exclusion of PAHs from evaluation in the dermal exposure pathway may underestimate the carcinogenic risk from dermal exposure for construction workers (PAHs were only detected in one subsurface sample). However, since risks to construction workers are infinitesimally small, any uncertainty in the dermal contact risk will not affect the conclusion of the risk assessment.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- Benzo(g,h,i)perylene, 2-methylnaphthalene, and phenanthrene were not considered in the quantitative risk assessment, because they do not have EPA-established toxicity factors. Their exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results or conclusions of the risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

- The surface area of this SWMU is too small to support chronic occupational exposures. Therefore, the exposure assumptions used are likely to significantly overestimate potential magnitude of exposure to contaminated soils and risk at this SWMU.

5.4 ECOLOGICAL RISK ASSESSMENT

5.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 51 is located in a small area of very poor wildlife habitat quality, within the developed portion of Cannon AFB where existing ground cover is mostly asphalt paving and buildings. About 100 percent of the land surface within the immediate vicinity (within 100 feet) of SWMU 51 is asphalt paving and Buildings 379, 335, and 375; no vegetation is present in the area. OWS 375 has been actively used since 1968.

Because of the lack of habitat at SWMU 51, no key receptor species were identified, and the ecological risk assessment was not carried forward.

5.5 SUMMARY AND CONCLUSIONS

5.5.1 Summary

A human health and ecological risk assessment, which considered both present and future receptors and all appropriate exposure pathways, was completed for this SWMU. Analytical data were collected for soils at the SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 5-17) show that no unacceptable health risks due to chemical releases are expected at the SWMU

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU

5.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

TABLE 5-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 375 (SWMU NO. 51)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 05101	0.5 - 2	CAN051-0511-0000		Soil	X		X	X		2	1
	2 - 4	CAN051-0511-0002		Soil	X		X	X		2	1
	4 - 6	CAN051-0511-0004		Soil	X		X	X		2	1
	8 - 10	CAN051-0511-0008		Soil	X		X	X		2	1
	8 - 10	CAN051-0511-6008	MS/MSD	Soil	X		X	X		2	2
Boring 05102	0.5 - 2	CAN051-0512-0000		Soil	X	X	X	X		2	1
	0.5 - 2	CAN051-0512-5161	FD	Soil	X	X	X	X		2	1
	2 - 4	CAN051-0512-0002		Soil	X		X	X		2	1
	4 - 6	CAN051-0512-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN051-0512-0008		Soil	X		X	X		2	1
	8 - 10	CAN051-0512-5162	FD	Soil	X		X	X		2	1
	8 - 10	CAN051-0512-5101	MRD	Soil	X	X	X	X		2	1
		CAN051-0512-5151	AB	Water	X				2		
		CAN051-0512-5171	RB	Water	X				2		
		CAN051-0512-5181	DW	Water	X				2		
		CAN051-0512-5191	TB	Water	X				2		
Boring 05103	0.5 - 2	CAN051-0513-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN051-0513-0002		Soil	X	X	X	X		2	1
	2 - 4	CAN051-0513-6002	MSD/MSD SVOC only	Soil		X					1
	4 - 6	CAN051-0513-0004		Soil	X		X	X		2	1
	8 - 10	CAN051-0513-0008		Soil	X		X	X		2	1

AB = Ambient blank
DW = Decontamination water
FD = Field duplicate
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 9-1 for locations of the borings.

TABLE 5-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0511-0000			CAN051-0511-0002			CAN051-0512-0000			CAN051-0512-0002			CAN051-0513-0000			CAN051-0513-0002		
LAB SAMPLE NUMBER	0312760001SA			0312760002SA			0312790007SA			0312790016SA			0312760005SA			0312760006SA		
COLLECT DATE	09/14/93			09/14/93			09/15/93			09/15/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Toluene	6.6	5.9		<	5.7	U	<	5.3	U	4.8	5.9	J	2.3	5.8	J	3.6	5.5	J
Xylenes (total)	1.3	5.9	J	<	5.7	U	1.6	5.3	J	<	5.9	U	<	5.8	U	1.4	5.5	J
Semivolatile Organics (µg/kg)																		
Anthracene							<	350	U				<	380	U	47	370	J
Benzo(a)anthracene							<	350	U				<	380	U	600	370	
Benzo(a)pyrene							<	350	U				<	380	U	830	370	
Benzo(b)fluoranthene							<	350	U				<	380	U	1700	370	
Benzo(g,h,i)perylene							<	350	U				<	380	U	520	370	
Carbazole							<	350	U				<	380	U	79	370	J
Chrysene							<	350	U				<	380	U	970	370	
Fluoranthene							<	350	U				<	380	U	2000	370	
Indeno(1,2,3-cd)pyrene							<	350	U				<	380	U	510	370	
Phenanthrene							<	350	U				<	380	U	800	370	
Pyrene							<	350	U				<	380	U	2000	370	
Metals (mg/kg)																		
Aluminum	8120	11.7		5180	11.5		4910	10.5		5260	23.4		7120	11.5		4010	11.1	
Antimony	<	7	U	1.7	6.9	J	<	6.3	U	<	14	U	<	6.9	U	1.8	6.6	J
Arsenic	2.3	0.59		2.1	0.57		2.1	0.53		2	0.59		2.3	0.58		4.5	0.55	
Barium	115	1.2	J	105	1.1	J	433	1.1		118	2.3		84.7	1.2	J	495	1.1	J
Beryllium	0.62	0.23		0.4	0.23		0.29	0.21	J	0.4	0.47	J	0.56	0.23		0.35	0.22	
Calcium	5360	23.4		43400	22.9		17400	21.1		137000	46.8		7630	23.1		48100	22.1	
Chromium	9.7	1.2		5.6	1.1		7.4	1.1	J	6	2.3		9.2	1.2		7.1	1.1	
Cadmium	<	0.59	J	0.81	0.57	J	<	0.53	U	1.6	1.2		<	0.58	J	0.99	0.55	J

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A complete summary of chemical results are presented in Appendix A.
J = Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Not detected RL = Reporting Limit.

TABLE 5-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0511-0000			CAN051-0511-0002			CAN051-0512-0000			CAN051-0512-0002			CAN051-0513-0000			CAN051-0513-0002		
LAB SAMPLE NUMBER	0312760001SA			0312760002SA			0312790007SA			0312790016SA			0312760005SA			0312760006SA		
COLLECT DATE	09/14/93			09/14/93			09/15/93			09/15/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cobalt	4.3	1.2		3.1	1.1		2.5	1.1		1.3	2.3	J	4.5	1.2		3.4	1.1	
Copper	9.4	2.3		6.2	2.3		5.2	2.1	J	5.1	4.7		8.1	2.3		5.7	2.2	
Iron	9120	11.7		5380	11.5		6900	10.5		5320	23.4		7720	11.5		5710	11.1	
Lead	9.1	0.59		5.6	1.1		6.5	0.53		3.9	1.2		9	0.58		5.9	1.1	
Magnesium	1680	23.4		1570	22.9		1440	21.1		1940	46.8		1520	23.1		1460	22.1	
Manganese	228	1.2		124	1.1		197	1.1		87.2	2.3		246	1.2		272	1.1	
Nickel	8.9	4.7		6.7	4.6		5.3	4.2		5.1	9.4	J	8.3	4.6		5.8	4.4	
Potassium	1510	585		1100	573		773	527		1100	1170	J	1440	577		782	554	
Silver	0.62	1.2	J	0.71	1.1	J	0.53	1.1	J	1.9	2.3	J	0.62	1.2	J	0.7	1.1	J
Sodium	203	585	J	304	573	J	309	527	J	630	1170	J	190	577	J	167	554	J
Vanadium	21.7	1.2		15.4	1.1		13.8	1.1		12.4	2.3		19.1	1.2		16.3	1.1	
Zinc	22.2	2.3		15.1	2.3		15.9	2.1		14.1	4.7		19.3	2.3		13.7	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.8	U	<	45.9	U	173	42.2		551	46.8		<	46.2	U	2690	221	
Water Quality (percent)																		
Water	15	0.1		13	0.1		5.1	0.1		15	0.1		13	0.1		9.7	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Not detected RL = Reporting Limit.

TABLE 5-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0511-0004			CAN051-0511-0008			CAN051-0512-0004			CAN051-0512-0004			CAN051-0512-0008			CAN051-0513-0004		
LAB SAMPLE NUMBER	0312760003SA			0312760004SA			0312790017SA			0316040001SA			0312790018SA			0312760007SA		
COLLECT DATE	09/14/93			09/14/93			09/15/93			09/15/93			09/15/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
1,2-Dichloroethane	<	5.8	U	<	5.7	U	4.2	6.2	J				<	5.5	U	<	5.9	U
1,2-Dichloropropane	<	5.8	U	<	5.7	U	2.4	6.2	J				<	5.5	U	<	5.9	U
Tetrachloroethene	<	5.8	U	<	5.7	U	26	6.2					<	5.5	U	<	5.9	U
Toluene	<	5.8	U	<	5.7	U	3.5	6.2	J				1.7	5.5	J	<	5.9	U
Semivolatile Organics (µg/kg)																		
Chrysene							56	410	J	<	410	U						
Metals (mg/kg)																		
Aluminum	3050	23.3		3830	11.4		2310	24.9					2690	55		2960	23.6	
Arsenic	2.2	0.58		2.4	0.57		2	0.62					2.4	0.55		2	0.59	
Barium	330	2.3	J	190	1.1	J	1100	2.5					1150	5.5		1370	2.4	J
Beryllium	0.26	0.47	J	0.34	0.23		0.29	0.5	J				<	1.1	U	<	0.47	U
Cadmium	2.3	1.2	J	1.6	0.57	J	2.7	1.2					3.4	2.8		2.4	1.2	J
Calcium	198000	46.5		97900	22.8		236000	49.7					263000	110		202000	47.2	
Chromium	<	2.3	U	3.7	1.1		<	2.5	U				<	5.5	U	3.2	2.4	
Cobalt	2.8	2.3		3	1.1		<	2.5	U				<	5.5	U	2.9	2.4	
Copper	2.6	4.7	J	4	2.3		3.3	5	J				2.7	11	J	2.1	4.7	J
Iron	2810	23.3		3980	11.4		1920	24.9					2110	55		2710	23.6	
Lead	2.6	2.9	J	5.8	1.1		5.1	12.4	J				1.4	5.5	J	1.9	3	J
Magnesium	2290	46.5		2540	22.8		2810	49.7					3830	110		3070	47.2	
Manganese	42.3	2.3		90.7	1.1		29	2.5					36.5	5.5		47.6	2.4	
Nickel	4.6	9.3	J	5.5	4.6		2.7	9.9	J				<	22	U	3.6	9.4	J
Potassium	725	1160	J	896	570		462	1240	J				611	2750	J	<	1180	U

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A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected RL = Reporting Limit.

TABLE 5-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0511-0004			CAN051-0511-0008			CAN051-0512-0004			CAN051-0512-0004			CAN051-0512-0008			CAN051-0513-0004		
LAB SAMPLE NUMBER	0312760003SA			0312760004SA			0312790017SA			0316040001SA			0312790018SA			0312760007SA		
COLLECT DATE	09/14/93			09/14/93			09/15/93			09/15/93			09/15/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	1.1	2.3	J	0.62	1.1	J	1.5	2.5	J				2.5	5.5	J	<	2.4	U
Sodium	700	1160	J	543	570	J	824	1240	J				904	2750	J	<	1180	U
Vanadium	14	2.3		17.5	1.1		8.5	2.5					7.5	5.5		14.2	2.4	
Zinc	8.5	4.7		11.5	2.3		8.3	5					6	11	J	8.4	4.7	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.5	U	182	45.6		3150	249					664	44		<	47.2	U
Water Quality (percent)																		
Water	14	0.1		12	0.1		20	0.1		20	0.1		9.2	0.1		15	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected RL = Reporting Limit.

TABLE 5-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0513-0008		
LAB SAMPLE NUMBER	0312760008SA		
COLLECT DATE	09/14/93		
	Result	RL	Qual
Volatile Organics (µg/kg)			
1,2-Dichloroethane	<	5.5	U
1,2-Dichloropropane	<	5.5	U
Tetrachloroethene	<	5.5	U
Toluene	<	5.5	U
Semivolatile Organics (µg/kg)			
Chrysene	<	360	U
Metals (mg/kg)			
Aluminum	3060	21.9	
Arsenic	2.1	0.55	
Barium	1010	2.2	J
Beryllium	<	0.44	U
Cadmium	2	1.1	J
Calcium	196000	43.9	
Chromium	2.9	2.2	
Cobalt	3.2	2.2	
Copper	2.8	4.4	J
Iron	2470	21.9	
Lead	1.8	2.7	J
Magnesium	3840	43.9	
Manganese	65.1	2.2	
Nickel	5.2	8.8	J
Potassium	785	1100	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected RL = Reporting Limit.

TABLE 5-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0513-0008		
LAB SAMPLE NUMBER	0312760008SA		
COLLECT DATE	09/14/93		
	Result	RL	Qual
Silver	1.1	2.2	J
Sodium	<	1100	U
Vanadium	12.3	2.2	
Zinc	8	4.4	
TPH (mg/kg)			
Total Petroleum Hydrocarbons	<	43.9	U
Water Quality (percent)			
Water	8.8	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected RL = Reporting Limit.

TABLE 5-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SURFACE SOIL TO BACKGROUND(1)
SWMU 51, CANNON AFB

Oil/Water Separator No. 375

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration(3)	Does maximim detected exceed background	Typical Level in Clovis, NM Region (4)
CAN051-0511-0000	Aluminum	8120	1410 - 11,000	10,540	N	50,000
CAN051-0513-0002	Arsenic	2.3	0.67 - 28	15.5	N	6.5
CAN051-0512-0000	Barium	433	14.5 - 1200	642	N	500
CAN051-0511-0000	Chromium	9.7	4 - 15.4	12.5	N	30
CAN051-0513-0000	Cobalt	4.5	0.85 - 5.3	4.5	N	3 - 7
CAN051-0511-0000	Copper	9.4	<2 - 18.4	*	N**	20
CAN051-0511-0000	Lead	9.1	1.1 - 46	25.8	N	15
CAN051-0511-0000	Nickel	8.9	1.3 - 9.8	9	N	15
CAN051-0511-0000	Silver	0.62	0.51 - 0.93	*	Y	---
CAN051-0511-0000	Vanadium	21.7	5.2 - 28.3	25.3	N	30 - 70
CAN051-0511-0000	Zinc	22.2	<4.3 - 27.5	21.9	N**	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or slightly above Base-wide background range, and is within naturally-occurring levels (USGS 1984); therefore, concentration is not considered to exceed background.

TABLE 5-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN TOTAL SOILS TO BACKGROUND(1)
SWMU 51, CANNON AFB
Oil/Water Separator No. 375

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration(3)	Does maximim detected exceed background	Typical Level in Clovis, NM Region (4)
CAN051-0511-0000	Aluminum	8120	1410 - 11,000	10,540	N	50,000
CAN051-0513-0002	Antimony	1.8	<5 - <13	*	Y	<1
CAN051-0513-0002	Arsenic	4.5	0.67 - 28	15.5	N	6.5
CAN051-0513-0004	Barium	1370	14.5 - 1200	642	Y	500
CAN051-0512-0008	Cadmium	3.4	<0.51 - 4.2	*	Y	---
CAN051-0511-0000	Chromium	9.7	4 - 15.4	12.5	N	30
CAN051-0513-0000	Cobalt	4.5	0.85 - 5.3	4.5	N	3 - 7
CAN051-0511-0000	Copper	9.4	<2 - 18.4	*	N**	20
CAN051-0511-0000	Lead	9.1	1.1 - 46	25.8	N	15
CAN051-0511-0000	Nickel	8.9	1.3 - 9.8	9	N	15
CAN051-0512-0008	Silver	2.5	0.51 - 0.93	*	Y	---
CAN051-0511-0000	Vanadium	21.7	5.2 - 28.3	25.3	N	30 - 70
CAN051-0511-0000	Zinc	22.2	<4.3 - 27.5	21.9	N**	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or slightly above Base-wide background range, and is within naturally-occurring levels (USGS 1984); therefore, concentration is not considered to exceed background.

TABLE 5-5

CHEMICALS OF CONCERN IN SURFACE SOIL

Toluene
Xylenes
TPH*
Silver

* No EPA-established toxicity factor.

TABLE 5-6

CHEMICALS OF CONCERN IN TOTAL SOIL

Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Carbazole
Chrysene
1,2-Dichloroethane
1,2-Dichloropropane
Fluoranthene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Phenanthrene*
Pyrene
Tetrachloroethene
Toluene
Xylenes
TPH*
Antimony
Barium
Cadmium
Silver

* No EPA-established toxicity factor.

TABLE 5-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 375 (SWMU 51)

	Toluene (µg/kg)				Xylenes (total) (µg/kg)			TPH (mg/kg)				Silver (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN051-0511-0000	6.6	1.887		5.9	1.3	J	5.9	23.4	3.153	U	47	0.62	-0.478	J	1.2
CAN051-0512-0000	2.65	0.975	U	5.3	1.6	J	5.3	173	5.153		42	0.53	-0.635	J	1.1
CAN051-0513-0000	2.3	0.833	J	5.8		U	5.8	23.1	3.14	U	46	0.62	-0.478	J	1.2
Number	3				2			3	3			3	3		
Minimum detected	2.30				1.30			173				2.30			
Maximum detected	6.60				1.60			173				6.60			
Average	3.85	1.23			1.45			73.17	3.82			0.59	-0.53		
H statistic		5.85							14.57				5.85		
Standard Deviation	2.39	0.57						86.46	1.16			0.05	0.09		
95% UCL	42.90	42.90						1.36E+07	1.36E+07			0.86	0.86		
RME	6.60				1.60			173				0.86			

RL = Laboratory reporting limit

RME = Lower of 95% or maximum detected. 95% UCL concentrations have not been calculated for sample sets with N <3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 5-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 375 (SWMU 51)

	1,2-Dichloroethane (µg/kg)				1,2-Dichloropropane (µg/kg)			Tetrachloroethene (µg/kg)			Toluene (µg/kg)			
Field ID	Result	Qual	Log Result	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	Log Result	RL
CAN051-0511-0000	2.95	U	1.082	5.9		U	5.9		U	5.9	6.6		1.887	5.9
CAN051-0511-0002	2.85	U	1.047	5.7		U	5.7		U	5.7	2.85	U	1.047	5.7
CAN051-0511-0004	2.9	U	1.065	5.8		U	5.8		U	5.8	2.9	U	1.065	5.8
CAN051-0511-0008	2.85	U	1.047	5.7		U	5.7		U	5.7	2.85	U	1.047	5.7
CAN051-0512-0000	2.65	U	0.975	5.3		U	5.3		U	5.3	2.65	U	0.975	5.3
CAN051-0512-0002	2.95	U	1.082	5.9		U	5.9		U	5.9	4.8	J	1.569	5.9
CAN051-0512-0004	4.2	J	1.435	6.2	2.4	J	6.2	2.6	J	6.2	3.5	J	1.253	6.2
CAN051-0512-0008	2.75	U	1.012	5.5		U	5.5		U	5.5	1.7	J	0.531	5.5
CAN051-0513-0000	2.9	U	1.065	5.8		U	5.8		U	5.8	2.3	J	0.833	5.8
CAN051-0513-0002	2.75	U	1.012	5.5		U	5.5		U	5.5	3.6	J	1.281	5.5
CAN051-0513-0004	2.95	U	1.082	5.9		U	5.9		U	5.9	2.95	U	1.082	5.9
CAN051-0513-0008	2.75	U	1.012	5.5		U	5.5		U	5.5	2.75	U	1.012	5.5
Number	12		12		1			1			12		12	
Minimum detected	4.20				2.40			2.60			1.70			
Maximum detected	4.20				2.40			2.60			6.60			
Average	2.95		1.08		2.40			2.60			3.29		1.13	
H statistic			1.84										1.98	
Standard Deviation			0.12										0.35	
95% UCL			3.15										4.04	
RME	3.15				2.40			2.60			4.04			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations have not been calculated for sample sets with N <3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 5-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 375 (SWMU 51)

	Xylenes (total) (µg/kg)			Anthracene (µg/kg)			Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)			
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	Log Result	RL	Result	Qual	Log Result	RL
CAN051-0511-0000	1.3	J	5.9											
CAN051-0511-0002		U	5.7											
CAN051-0511-0004		U	5.8											
CAN051-0511-0008		U	5.7											
CAN051-0512-0000	1.6	J	5.3		U	350	175	U	5.165	350	175	U	5.165	350
CAN051-0512-0002		U	5.9											
CAN051-0512-0004		U	6.2		U	410	205	U	5.323	410	205	U	5.323	410
CAN051-0512-0008		U	5.5											
CAN051-0513-0000		U	5.8		U	380	180	U	5.193	380	190	U	5.247	380
CAN051-0513-0002	1.4	J	5.5	47	J	370	600		6.397	370	830		6.721	370
CAN051-0513-0004		U	5.9											
CAN051-0513-0008		U	5.5		U	360	180	U	5.193	360	180	U	5.193	360
Number	3			1			5		5		5		5	
Minimum detected	1.30			47.0			600				830			
Maximum detected	1.60			47.0			600				830			
Average	1.43			47.0			268		5.45		316		5.53	
H statistic									3.11				3.66	
Standard Deviation									0.53				0.67	
95% UCL									614				582	
RME	1.60			47.0			600				582			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations have not been calculated for sample sets with N <3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 5-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 375 (SWMU 51)

	Benzo(b)fluoranthene (µg/kg)				Carbazole (µg/kg)			Chrysene (µg/kg)				Fluoranthene (µg/kg)			
Field ID	Result	Qual	Log Result	RL	Result	Qual	RL	Result	Qual	Log Result	RL	Result	Qual	Log Result	RL
CAN051-0511-0000															
CAN051-0511-0002															
CAN051-0511-0004															
CAN051-0511-0008															
CAN051-0512-0000	175	U	5.165	350		U	350	175	U	5.165	350	175	U	5.165	350
CAN051-0512-0002															
CAN051-0512-0004	205	U	5.323	410				56	J	4.025	410	205	U	5.323	410
CAN051-0512-0008															
CAN051-0513-0000	190	U	5.247	380		U	380	190	U	5.247	380	190	U	5.247	380
CAN051-0513-0002	1700		7.438	370	79	J	370	970		6.877	370	2000		7.601	370
CAN051-0513-0004															
CAN051-0513-0008	180	U	5.193	360		U	360	180	U	5.193	360	180	U	5.193	360
Number	5		5		1			5		5		5		5	
Minimum detected	1700				79			56				2000			
Maximum detected	1700				79			970				2000			
Average	490		5.67		79			314		5.30		550		5.71	
H statistic			4.91							5.41				5.41	
Standard Deviation			0.99							1.02				1.06	
95% UCL			1594							5288				9313	
RME	1594				79			970				2000			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations have not been calculated for sample sets with N <3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 5-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 375 (SWMU 51)

	Indeno(1,2,3-cd)pyrene (µg/kg)				Pyrene (µg/kg)				TPH (mg/kg)				Antimony (mg/kg)		
Field ID	Result	Qual	Log Result	RL	Result	Qual	Log Result	RL	Result	Qual	Log Result	RL	Result	Qual	RL
CAN051-0511-0000									23.4	U	3.153	46.8		U	7
CAN051-0511-0002									11.95	U	2.481	45.9	1.7	J	6.9
CAN051-0511-0004									23.25	U	3.146	46.5		U	14
CAN051-0511-0008									182		5.204	45.6		U	6.8
CAN051-0512-0000	175	U	5.165	350	175	U	5.165	350	173		5.153	42.2		U	6.3
CAN051-0512-0002									551		6.312	46.8		U	14
CAN051-0512-0004	205	U	5.323	410	205	U	5.323	410	3150		8.055	249		U	14.9
CAN051-0512-0008									664		6.498	44		U	33
CAN051-0513-0000	190	U	5.247	380	190	U	5.247	380	23.1	U	3.140	46.2		U	6.9
CAN051-0513-0002	510		6.234	370	2000		7.601	370	2690		7.897	221	1.8	J	6.6
CAN051-0513-0004									23.6	U	3.161	47.2		U	14.2
CAN051-0513-0008	180	U	5.193	360	180	U	5.193	360	24.6	U	3.203	43.9		U	13.2
Number	5		5		5		5		12		12		2		
Minimum detected	510				2000				173				1.7		
Maximum detected	510				2000				3150				1.8		
Average	252		5.43		550		5.71		628		4.78		1.8		
H statistic			2.79				5.41				5.48				
Standard Deviation			0.45				1.06				2.01				
95% UCL			476				9313				24969				
RME	476				2000				3150				1.8		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations have not been calculated for sample sets with N <3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 5-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 375 (SWMU 51)

	Barium (mg/kg)				Cadmium (mg/kg)				Silver (mg/kg)			
Field ID	Result	Qual	Log Result	RL	Result	Qual	Log Result	RL	Result	Qual	Log Result	RL
CAN051-0511-0000	115	J	4.745	1.2	0.295	UJ	-1.221	0.59	0.62	J	-0.478	1.2
CAN051-0511-0002	105	J	4.654	1.1	0.81	J	-0.211	0.57	0.71	J	-0.342	1.1
CAN051-0511-0004	330	J	5.799	2.3	2.3	J	0.833	1.2	1.1	J	0.095	2.3
CAN051-0511-0008	190	J	5.247	1.1	1.6	J	0.470	0.57	0.62	J	-0.478	1.1
CAN051-0512-0000	433		6.071	1.1	0.265	U	-1.328	0.53	0.53	J	-0.635	1.1
CAN051-0512-0002	118		4.771	2.3	1.6		0.470	1.2	1.9	J	0.642	2.3
CAN051-0512-0004	1100		7.003	2.5	2.7		0.993	1.2	1.5	J	0.405	2.5
CAN051-0512-0008	1150		7.048	5.5	3.4		1.224	2.8	2.5	J	0.916	5.5
CAN051-0513-0000	84.7	J	4.439	1.2	0.29	UJ	-1.238	0.58	0.62	J	-0.478	1.2
CAN051-0513-0002	495	J	6.205	1.1	0.99	J	-0.010	0.55	0.7	J	-0.357	1.1
CAN051-0513-0004	1370	J	7.223	2.4	2.4	J	0.875	1.2	1.2	U	0.182	2.4
CAN051-0513-0008	1010	J	6.918	2.2	2	J	0.693	1.1	1.1	J	0.095	2.2
Number	12		12		12		12		12		12	
Minimum detected	118				0.81				0.53			
Maximum detected	1370				3.40				2.50			
Average	542		5.84		1.55		0.13		1.09		-0.04	
H statistic			3.13				2.81				2.14	
Standard Deviation			1.05				0.93				0.50	
95% UCL			1614				3.85				1.52	
RME	1370				3.40				1.52			

RL = Laborator RL = Laboratory reporting limit

RME = Lower o RME = Lower of 95% UCL or maximum detected

95% UCL concentrations have not been calculated for sample sets with N <3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is Where no values are shown, no analysis was performed.

TABLE 5-9
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SURFACE SOIL
SWMU 51

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration (2 (mg/kg)	Adjusted RME Concentration (3) (mg/kg)
Toluene	0.004	0.007	0.03	1.20E-04	2.10E-04
Xylenes	0.001	0.002	0.03	3.00E-05	6.00E-05

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 5-10
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
TOTAL SOIL
SWMU 51

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration (2) (mg/kg)	Adjusted RME Concentration (3) (mg/kg)
1,2-Dichloroethane	0.003	0.003	0.0005	1.50E-06	1.50E-06
1,2-Dichloropropane	0.002	0.002	0.03	6.00E-05	6.00E-05
Anthracene	0.047	0.047	0.1	0.0047	0.0047
Benzo(a)anthracene	0.27	0.60	0.1	0.027	0.06
Benzo(a)pyrene	0.3	0.58	0.1	0.03	0.058
Benzo(b)fluoranthene	0.5	1.60	0.1	0.05	0.16
Carbozole	0.08	0.08	0.1	0.008	0.008
Chrysene	0.31	0.97	0.1	0.031	0.097
Fluoranthene	0.55	2.00	0.1	0.055	0.2
Indeno(1,2,3-cd)pyrene	0.25	0.48	0.1	0.025	0.048
Pyrene	0.55	2.00	0.1	0.055	0.2
Tetrachloroethene	0.003	0.003	0.03	9.00E-05	9.00E-05
Toluene	0.003	0.004	0.03	9.00E-05	1.20E-04
Xylenes	0.001	0.002	0.03	3.00E-05	6.00E-05

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 5-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 51

	t (y)	Cs (ug/kg)	Co (g/m^3)	L (m)	W (m)	T (m)	VWC (L/L)	foc	Koc (ml/g)	Kd (ml/g)	Soil Half Life (y)	P (g/cm^3)	I (m/y)	H (m)	TOT (y)
1,2-Dichloroethane	0	2.95	4.72E-03	30	30	2.439	0.15	0.003	30	0.09	0.2	1.6	0.02	76.829	1506
1,2-Dichloropropane	0	2.4	3.84E-03	30	30	2.439	0.15	0.003	51	0.153	3.5	1.6	0.015	76.829	2022
Anthracene	0	47	7.52E-02	30	30	2.439	0.15	0.003	16000	48	1.26	1.6	0.015	76.829	394133
Antimony	0	1750	2.80E+00	30	30	2.439	0.15	0.003	NA	3981	NA	1.6	0.015	76.829	32625435
Barium	0	541730	8.67E+02	30	30	2.439	0.15	0.003	NA	50	NA	1.6	0.015	76.829	410523
Beno(a)anthracene	0	268	4.29E-01	30	30	2.439	0.15	0.003	1400000	4200	1.86	1.6	0.015	76.829	34420160
Benzo(a)pyrene	0	316	5.06E-01	30	30	2.439	0.15	0.003	6500000	19500	1.45	1.6	0.015	76.829	159805088
Benzo(b)fluoranthene	0	490	7.84E-01	30	30	2.439	0.15	0.003	550000	1650	1.67	1.6	0.015	76.829	13522672
Cadmium	0	1550	2.48E+00	30	30	2.439	0.15	0.003	NA	7	NA	1.6	0.015	76.829	58134
Carbazole	0	156	2.50E-01	30	30	2.439	0.15	0.003	5100	15.3	0.2	1.6	0.015	76.829	126153
Chrysene	0	314.2	5.03E-01	30	30	2.439	0.15	0.003	250000	750	2.72	1.6	0.015	76.829	6147088
Fluoranthene	0	550	8.80E-01	30	30	2.439	0.15	0.003	1380	4.14	1.21	1.6	0.015	76.829	34696
Indeno(1,2,3-C)pyrene	0	252	4.03E-01	30	30	2.439	0.15	0.003	31000000	93000	2	1.6	0.015	76.829	762144448
Pyrene	0	550	8.80E-01	30	30	2.439	0.15	0.003	38000	114	5.2	1.6	0.015	76.829	935009
Silver	0	1090	1.74E+00	30	30	2.439	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278
Tetrachloroethene	0	2.6	4.16E-03	30	30	2.439	0.15	0.003	269	0.807	1	1.6	0.015	76.829	7382
Toluene	0	3.29	5.26E-03	30	30	2.439	0.15	0.003	300	0.9	0.2	1.6	0.015	76.829	8144
Xylenes	0	1.43	2.29E-03	30	30	2.439	0.15	0.003	830	2.49	0.2	1.6	0.015	76.829	21174

t = Time where leachate concentration is estimated
Cs Concentration of chemical in source soil
(average concentration from Table 7-8)
Co Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 5-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 51

	Rd	Leach Rate (y^-1)	Qo (g)	Q(t) (g)	qc (g/y)	Cl(1) (µg/L)	Cl(2) (µg/L)	K (m/s)	i (m/m)	b (m)	Qw (m^3/y)	Ql (m^3/yr)	Cw (µg/L)
1,2-Dichloroethane	1.96E+00	2.09E-02	1.04E+01	1.04E+01	2.17E-01	1.61E+01	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
1,2-Dichloropropane	2.63E+00	1.56E-02	8.43E+00	8.43E+00	1.31E-01	9.73E+00	1.27E-173	2.00E-04	0.0019	10	3595	14	4.75E-176
Anthracene	5.13E+02	7.99E-05	1.65E+02	1.65E+02	1.32E-02	9.77E-01	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Antimony	4.25E+04	9.66E-07	6.15E+03	6.15E+03	5.93E-03	4.40E-01	4.40E-01	2.00E-04	0.0019	10	3595	14	1.64E-03
Barium	5.34E+02	7.67E-05	1.90E+06	1.90E+06	1.46E+02	1.08E+04	1.08E+04	2.00E-04	0.0019	10	3595	14	4.05E+01
Beno(a)anthracene	4.48E+04	9.15E-07	9.41E+02	9.41E+02	8.61E-04	6.38E-02	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Benzo(a)pyrene	2.08E+05	1.97E-07	1.11E+03	1.11E+03	2.19E-04	1.62E-02	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Benzo(b)fluoranthene	1.76E+04	2.33E-06	1.72E+03	1.72E+03	4.01E-03	2.97E-01	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Cadmium	7.57E+01	5.42E-04	5.44E+03	5.44E+03	2.95E+00	2.19E+02	2.19E+02	2.00E-04	0.0019	10	3595	14	8.17E-01
Carbazole	1.64E+02	2.50E-04	5.48E+02	5.48E+02	1.37E-01	1.01E+01	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Chrysene	8.00E+03	5.12E-06	1.10E+03	1.10E+03	5.65E-03	4.19E-01	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Fluoranthene	4.52E+01	9.08E-04	1.93E+03	1.93E+03	1.75E+00	1.30E+02	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Indeno(1,2,3-C)pyrene	9.92E+05	4.13E-08	8.85E+02	8.85E+02	3.66E-05	2.71E-03	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Pyrene	1.22E+03	3.37E-05	1.93E+03	1.93E+03	6.51E-02	4.82E+00	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Silver	1.07E+03	3.84E-05	3.83E+03	3.83E+03	1.47E-01	1.09E+01	1.09E+01	2.00E-04	0.0019	10	3595	14	4.07E-02
Tetrachloroethene	9.61E+00	4.27E-03	9.13E+00	9.13E+00	3.90E-02	2.89E+00	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Toluene	1.06E+01	3.87E-03	1.16E+01	1.16E+01	4.47E-02	3.31E+00	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00
Xylenes	2.76E+01	1.49E-03	5.02E+00	5.02E+00	7.47E-03	5.53E-01	0.00E+00	2.00E-04	0.0019	10	3595	14	0.00E+00

t = Time where leachate concentration is estimated
Cs Concentration of chemical in source soil
(average concentration from Table 7-8)
Co Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 5-12

COMPARISON OF MODELED GROUNDWATER CONCENTRATIONS TO RBCs(1)

	Cw(2) (ug/L)	Tap Water RBC (1) (μg/L)	Does modelled concentration exceed RBC?
1,2-Dichloroethane	0	0.12	No
1,2-Dichloropropane	4.7487E-176	0.16	No
Anthracene	0	11000	No
Antimony	1.64E-03	15	No
Barium	4.05E+01	2600	No
Benzo(a)anthracene	0	0.092	No
Benzo(a)pyrene	0	0.0092	No
Benzo(b)fluoranthene	0	0.092	No
Cadmium	8.17E-01	18	No
Carbazole	0	3.4	No
Chrysene	0	9.2	No
Fluoranthene	0	1500	No
Indeno(1,2,3-C)pyrene	0	0.092	No
Pyrene	0	1100	No
Silver	4.07E-02	180	No
Tetrachloroethene	0	1.1	No
Toluene	0	750	No
Xylenes	0	12000	No

(1) RBC is the EPA Region III risk-based concentration for residential tap water ingestion and inhalation;
(2) Cw is the modeled concentration as defined in Table 5-11.
The modeled concentration, zero is a value less than 1E-300.

TABLE 5-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 51

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 5-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 5-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 51

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.007	1.04E-06

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 5-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of Concern that do not have EPA-established inhalation toxisity facators were not included in this table.

TABLE 5-14
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 51

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
1,2-Dichloroethane	2.65	3.85E-03	45	2.25	2	20250000	7.90E+08	6.82E-02	0.35	0.09643
1,2-Dichloropropane	2.65	1.11E-03	45	2.25	2	20250000	7.90E+08	5.99E-02	0.35	0.08473
Tetrachloroethene	3.65	1.17E-03	45	2.25	2	20250000	7.90E+08	5.55E-02	0.35	0.07852
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 5-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 5-14
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 51

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
1,2-Dichloroethane	30	4.31E-03	6.00E-01	2.95E-01	2.20E+03	0.003	1.46E-06
1,2-Dichloropropane	51	2.31E-03	1.02E+00	9.29E-02	4.26E+03	0.002	5.63E-07
Tetrachloroethene	364	2.59E-02	7.28E+00	1.46E-01	3.00E+03	0.003	8.65E-07
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.004	6.33E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 5-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 5-15
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM TOTAL SOILS AT SWMU 51

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Barium	1370	4.63E+09	2.96E-07
Benzo(a)anthracene	0.60	4.63E+09	1.30E-10
Benzo(a)pyrene	0.58	4.63E+09	1.26E-10
Benzo(b)fluoranthene	1.59	4.63E+09	3.44E-10
Cadmium	3.40	4.63E+09	7.34E-10
Chrysene	0.97	4.63E+09	2.10E-10
Indeno(1,2,3-cd)pyrene	0.48	4.63E+09	1.03E-10

RME Soil Concentration from Table 5-8

PEF = Particulate Emission Factor default value from EPA (1991b)

Air Concentration = Soil concentration/PEF

TABLE 5-16

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Inhalation (m^3/kg-d)		
Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
Carcinogenic	1.39×10^{-3}	6.99×10^{-2}
Construction Workers	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Inhalation (m^3/kg-d)		
Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
Carcinogenic	1.03×10^{-4}	4.47×10^{-4}
Trespasser Receptors	**Average**	**RME**
Dermal Contact Soil (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Soil Ingestion (kg/kg-d		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Inhalation (m^3/k-d)		
Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 5-17

SUMMARY OF HUMAN HEALTH RISKS AT SWMU 51

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Surface Soil)*						
-- Dermal Contact	0.00		3×10^{-10}	0.00		3×10^{-8}
-- Ingestion	0.00		7×10^{-7}	0.00		6×10^{-5}
-- Inhalation of VOCs	0.00		1×10^{-7}	0.00		2×10^{-6}
-- Inhalation of Particulates	0.00		0.00	0.00		0.00
	0.00		8×10^{-7}	0.00		6×10^{-5}
Construction Worker (Total Soil)						
-- Dermal Contact	8×10^{-13}	3×10^{-10}		1×10^{-11}	5×10^{-9}	
-- Ingestion	9×10^{-10}	2×10^{-4}		1×10^{-8}	4×10^{-3}	
-- Inhalation of VOCs	1×10^{-11}	1×10^{-6}		6×10^{-11}	5×10^{-6}	
-- Inhalation of Particulates	6×10^{-13}	2×10^{-6}		3×10^{-12}	7×10^{-6}	
	9×10^{-10}	2×10^{-4}		1×10^{-8}	4×10^{-3}	
Trespasser (Surface Soil)*						
-- Dermal Contact	0.00	9×10^{-12}		0.00	2×10^{-9}	
-- Ingestion	0.00	2×10^{-7}		0.00	2×10^{-5}	
-- Inhalation of VOCs	0.00	3×10^{-8}		0.00	5×10^{-7}	
-- Inhalation of Particulates	0.00	0.00		0.00	0.00	
	0.00	2×10^{-7}		0.00	2×10^{-5}	

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix C for nonrounded risk values.

* No carcinogenic contaminants were found in the surface soil at SWMU 51.

TABLE 5-18

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies and are under review and are subject to revision.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

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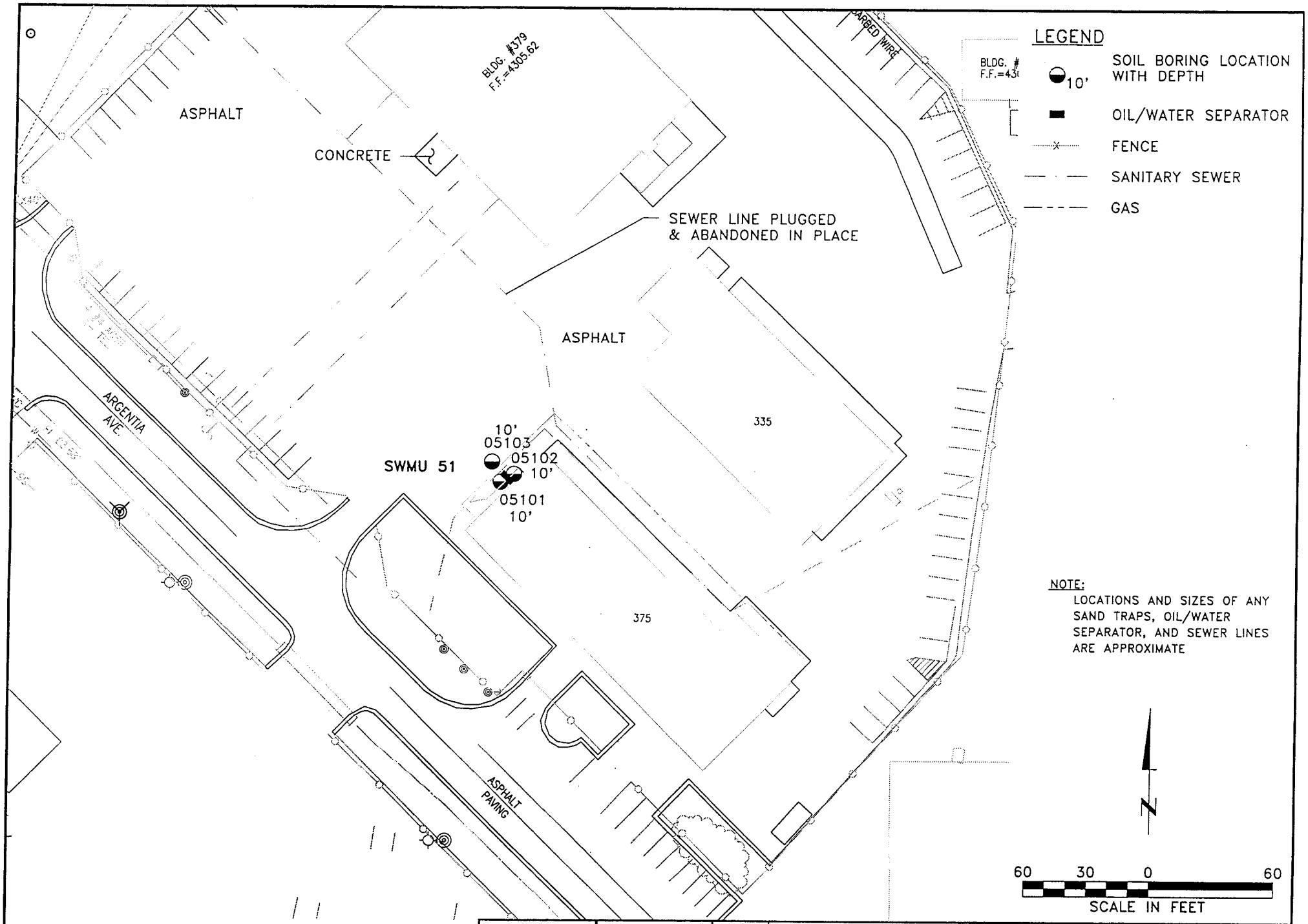
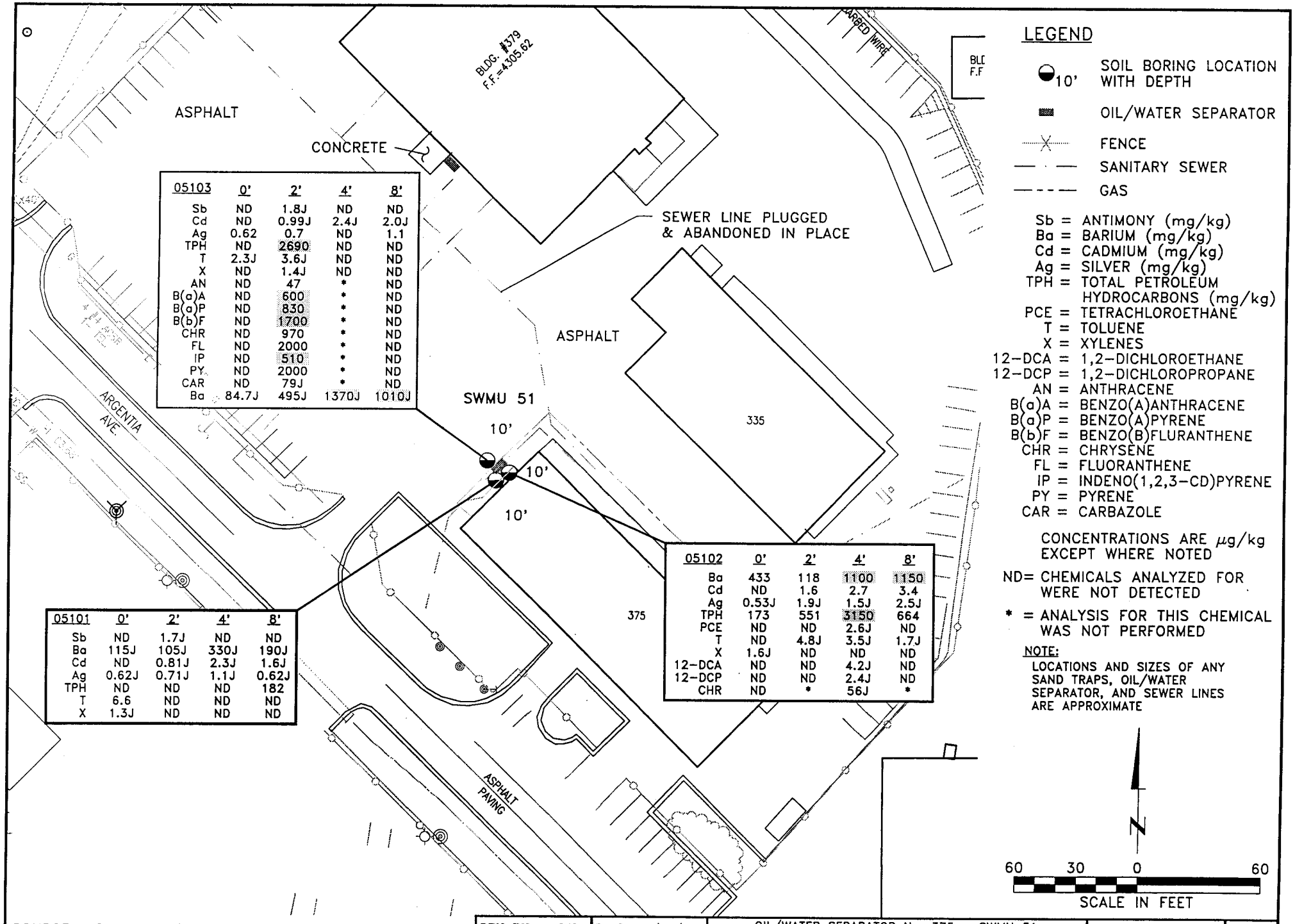


SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 375 – SWMU 51 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 5-1

CAD FILE: C3M11W05.DWG V=HITS 02/15/1994 12:50



05103	0'	2'	4'	8'
Sb	ND	1.8J	ND	ND
Cd	ND	0.99J	2.4J	2.0J
Ag	0.62	0.7	ND	1.1
TPH	ND	2690	ND	ND
T	2.3J	3.6J	ND	ND
X	ND	1.4J	ND	ND
AN	ND	47	*	ND
B(a)A	ND	600	*	ND
B(a)P	ND	830	*	ND
B(b)F	ND	1700	*	ND
CHR	ND	970	*	ND
FL	ND	2000	*	ND
IP	ND	510	*	ND
PY	ND	2000	*	ND
CAR	ND	79J	*	ND
Ba	84.7J	495J	1370J	1010J

05101	0'	2'	4'	8'
Sb	ND	1.7J	ND	ND
Ba	115J	105J	330J	190J
Cd	ND	0.81J	2.3J	1.6J
Ag	0.62J	0.71J	1.1J	0.62J
TPH	ND	ND	ND	182
T	6.6	ND	ND	ND
X	1.3J	ND	ND	ND

05102	0'	2'	4'	8'
Ba	433	118	1100	1150
Cd	ND	1.6	2.7	3.4
Ag	0.53J	1.9J	1.5J	2.5J
TPH	173	551	3150	664
PCE	ND	ND	2.6J	ND
T	ND	4.8J	3.5J	1.7J
X	1.6J	ND	ND	ND
12-DCA	ND	ND	4.2J	ND
12-DCP	ND	ND	2.4J	ND
CHR	ND	*	56J	*

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/04/94	OIL/WATER SEPARATOR No. 375 - SWMU 51 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 5-2

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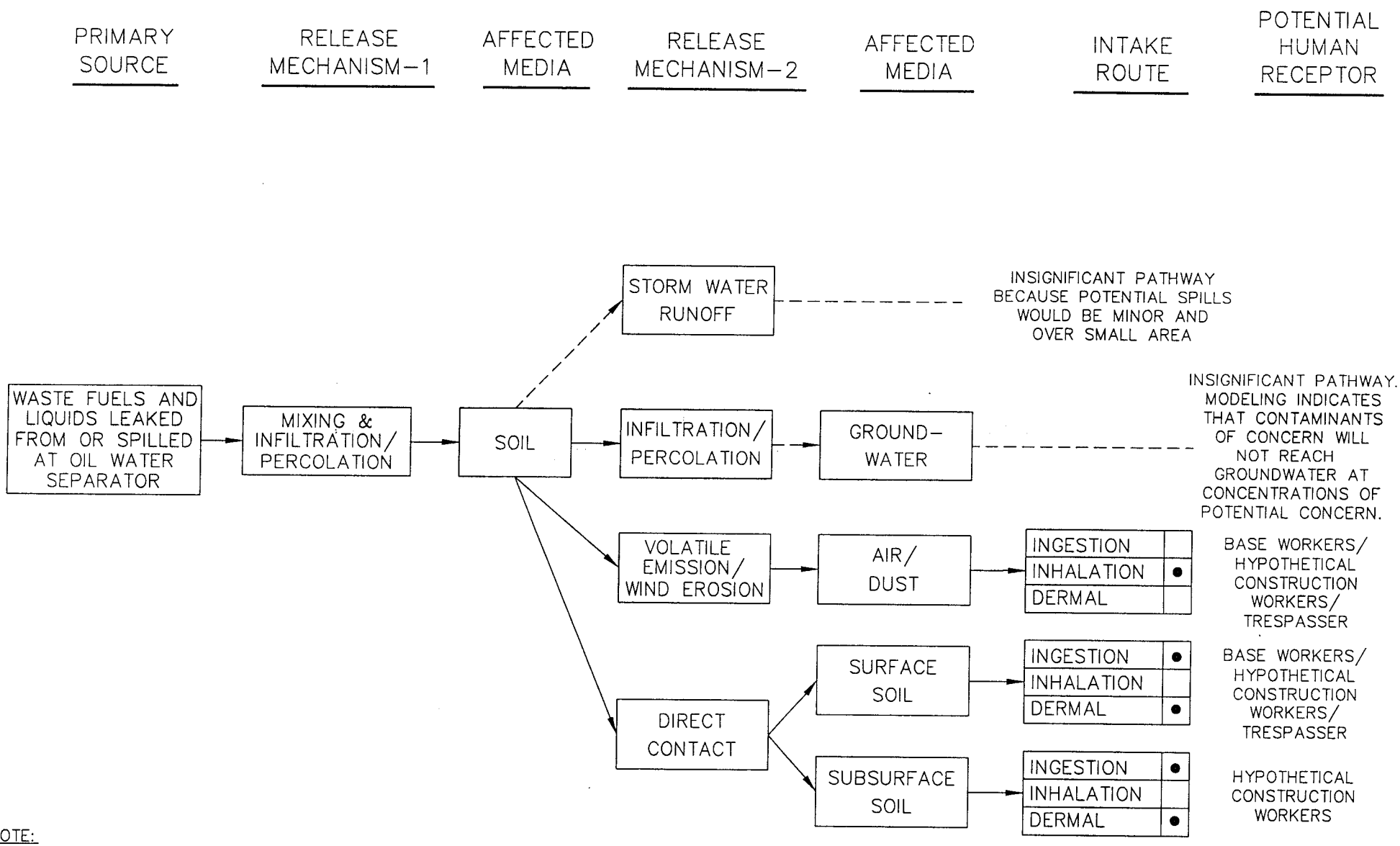

NOTE:

SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART OIL WATER SEPARATOR No.375 SWMU 51 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	5-3

6.1 SITE BACKGROUND

6.1.1 Site Description

Facility 5077 is a vehicle wash rack located in the Civil Engineering Squadron compound. The facility includes two 380-gallon sand traps (5077a and 5077b) within the limits of the concrete wash rack and a 1,675-gallon sand trap (5077c, SWMU 63) located southeast of the wash rack (Figure 6-1). Drainage from the wash rack flows into the sand traps and then into the sand trap southeast of the wash rack. The area of the SWMU is flat with no discernable gradient. The sand traps are constructed of concrete. As-built plans show the west and central sand traps measure about 3 feet square, while the southeast sand trap measures about 5 feet by 10 feet. The exact depths of the units are not known, but they are expected to be less than 10 feet. The west sand trap (5077a), the central sand trap (5077b), and the southeast sand trap (5077c) were identified as SWMUs 61, 62, and 63, respectively, and were investigated together in the RFI. Results of the RFI showed that the west and central sand traps had not had significant releases of contaminants and do not pose significant health risks. However, releases were detected at the southeast sand trap, and chemical concentrations exceeded the screening-level risk-based concentrations of the RFI. Therefore, this risk assessment has been completed to evaluate potential risks due to releases from the southeast sand trap (SWMU 63).

6.1.2 Site History

The sand traps reportedly received wash water generated from the wash down of motor vehicles. The southeast sand trap has been identified as an OWS in previous reports including the RFI report; however, it has been found to be a single-compartment concrete box with no baffles, and it appears to be a sand trap. It will be referred to as a sand trap throughout this report.

6.1.3 Current Use

While the sand traps may receive wash water generated from the wash down of motor vehicles, the wash rack was roped off and appeared to be out of service during the time of the field investigation at this site. The facility is seldom used and is currently out of service according to the Civil Engineering Office at the Base.

6.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATION

6.2.1 Physical Investigation

Two 10-foot borings were drilled during the RFI to sample the soils at SWMU 63 to determine if a release of SWMU-related chemicals posing a significant risk to human health or the environment has occurred as a result of leakage or spillage at the sand trap. Borings 06301 and 06302 were located as close as possible to the inlet and outlet pipes of sand trap to sample the soils for indications of leaks from these sources or from the unit. No surface staining or stressed vegetation was evident at the soil boring sites.

Soil samples were collected at the 0- to 0.5-foot, 1.5- to 3-foot, 4- to 6-foot, and 8- to 10-foot depth intervals. Target analytes were VOCs, SVOCs, metals, and TRPH. Surficial samples in the grass-covered area around the unit were collected at approximately 0.2 to 0.5 feet to provide surface soil data for risk assessment purposes.

6.2.2 Chemical Investigation

Sampling and analyses performed are summarized in Table 6-1. Summaries of the analytical results for these soil samples are provided in Tables 6-2a (surface soil) and 6-2b (subsurface soil). The tables provide results for analytes that were detected at least once in the sample group. Complete analytical summary results are provided in the QCSR (Appendix A of the RFI Report).

6.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI report, and the data were deemed to be of adequate quality to meet the objectives of the RFI (i.e., to evaluate potential human health and environmental risks). There were no data quality issues identified that would significantly affect the risk assessment.

6.2.4 Nature and Extent of Contamination

There was no visible evidence of spills or leaks in the vicinity, and the entire area around the unit is grassy. The chemical test results do not show any significant organic contamination except for the near-surface samples. In the surface samples near the unit, there were petroleum hydrocarbons detected at levels around 650 mg/kg, and a number of SVOCs were detected at levels ranging from 500 μg/kg to as much as 2,200 μg/kg. Deeper samples in these same borings were relatively free of contamination.

6.3 HUMAN HEALTH RISK ASSESSMENT

6.3.1 Exposure Pathway Flow Chart

Figure 6-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways of Sand Trap 5077c. In the flow chart, potentially complete pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary source is wash water discharged to the sand trap and waste fluids spilled on surface soil. Chemicals from the primary source may be released to other media that may in turn act as secondary sources of chemical release or exposure. Mixing and infiltration of the wastes to soil is shown as a primary chemical release mechanism. SWMU-related chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion of dust particulates, or result in exposure via direct contact (e.g., dermal contact or incidental soil ingestion). Storm water runoff is not considered to be a significant pathway for human exposure, because the site

covers only a small area, surface spills are not likely to be significant, and no developed drainageways are present near the SWMU.

As shown on the flow chart, surface soils may provide exposures to Base workers (occupational exposures), hypothetical future construction workers, or hypothetical future trespassers (if the Base is closed in the future). Air emissions (volatile and particulates) from surface soil may also provide exposures to Base workers, construction workers, and trespassers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Groundwater is used for domestic purposes on and off Base. Groundwater is probably an insignificant pathway because little or no contamination was found in subsurface soil samples. Nevertheless, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling (Section 6.3.5.2) indicate that contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway was not evaluated further. Residential exposures to soils are not considered for this SWMU because it is located in an industrial area, so even if the Base closes in the future, industrial rather than residential use is the reasonable future use of the site.

In summary, potential complete human exposure pathways for evaluation in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Trespassers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

6.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

Background levels were defined by the upper tolerance limit (UTL) of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; see Appendix A).

Tables 6-3 and 6-4 show the comparison of SWMU results to background levels.

The maximum detected concentrations of barium, cadmium, lead, mercury, and zinc in both surface and total soils exceeded background levels. Therefore, these metals were retained as chemicals of concern in surface soil and total soil. However, since barium can substitute for calcium, it is believed that the high levels of barium may be a naturally-occurring constituent of caliche (Klein and Hurlbut 1985).

6.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 63, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not

have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 6-2a and 6-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentrations of barium, cadmium, lead, mercury, and zinc detected in surface and subsurface soil exceeded background ranges according to the comparison described in Section 6.3.2. These metals are, therefore, considered as chemicals of concern in surface soil and total soil. Organic contaminants detected in soils were retained as chemicals of concern for risk assessment. Chemicals of concern in surface soil and total soil are listed in Tables 6-5 and 6-6, respectively. Benzo(g,h,i)perylene, 2-methylnaphthalene, phenanthrene, TPH, and lead, listed as chemicals of concern in Tables 6-5 and 6-6, do not have EPA-established toxicity factors and, therefore, cannot be evaluated quantitatively in the risk assessment. However, their potential effects on the results of the risk assessment are addressed in Sections 6.3.8 through 6.3.10.

6.3.4 Environmental Fate and Transport

6.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

6.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (DOE 1991), describes the mass balance of a contaminant (based on average soil

concentrations) in the contaminated soil volume at the SWMU. The DOE model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP] Model) and accounts for sorption to soils and degradation in the vadose zone. The model conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of chemicals of concern. The input parameters and estimated leachate concentrations are given in Section 6.3.5.2. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water (Section 6.3.5.2). Since the RBCs were developed for drinking water (at the tap) and are based on very conservative exposure and health-protective (risk) assumptions, it can be concluded that modeled groundwater concentrations that do not exceed RBCs will pose no significant health risks.

6.3.4.3 Air Modeling

RME air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using RME soil concentrations of chemicals of concern. The results of the air modeling are given in Section 6.3.5.3. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use at hazardous waste sites to calculate soil clean-up levels (EPA 1991). Air concentrations were calculated for only those chemicals with inhalation toxicity factors which were evaluated quantitatively in the risk assessment. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

6.3.5 Exposure Point Concentrations

6.3.5.1 Soils

Tables 6-7 and 6-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils respectively at OWS 5077c.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use of "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C. Tables 6-9 and 6-10 give the soil concentrations of organic compounds from surface and total soils, respectively, which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils. The absorbed fraction (from Table C-26, Appendix C) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soil. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

For purposes of risk assessment, surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depths (i.e., XXXXX-XXXX-0002) were actually collected from a depth of 1.5 to 3.5 feet. These samples are not considered surface samples, but are included in the risk assessment for subsurface soil exposures.

6.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 63. Model results are included in Table 6-11. These modeled concentrations were then compared to EPA Region III tap-water RBCs (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 6-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap-water RBCs. No modeled concentrations exceeded the RBCs, so no significant risks are

expected from the groundwater pathway. Therefore, the groundwater pathway has been determined to be insignificant and was not evaluated further.

6.3.5.3 Air

Air concentrations of volatile emissions from surface soil were calculated using concentrations of chemicals of concern. The results of the air modeling are shown in Tables 6-13 and 6-14. Air concentrations of volatile and particulate emission from total soil were also calculated using concentrations of concern in total soil. The results of the air modeling from total soil are shown in Tables 6-15 and 6-16.

6.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the intake factors used to quantify chemical intake of SWMU-related contaminants in various environmental media soil and air. Table 6-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

6.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 6-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to

contaminated surface soil at SWMU 63. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative, because there are no occupational receptors routinely working outdoors at the SWMU. Furthermore, the surface area of the SWMU is small (approximately 60 feet by 60 feet, or less than 0.1 acre), and long-term exposures are not likely to occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 63 via the dermal contact, inhalation, and ingestion pathways is 0.00007 and 0.006 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk under the assumed chronic exposure conditions is 5×10^{-9} under the average exposure case and 2×10^{-6} under the RME case. These levels are within or below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). Ingestion of benzo(a)pyrene is the primary contributor to the carcinogenic risk estimate.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 63. Exposures were assumed to occur during excavation activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 63 via the dermal contact, inhalation, and ingestion pathways is 0.0001 and 0.002 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 1×10^{-9} in the average case and 2×10^{-8} in the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b) and demonstrate that carcinogenic risk is negligible for this exposure scenario.

Hypothetical Future Trespasser Exposure

Hypothetical future trespassers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface soil at SWMU 63. Hypothetical future trespassers were assumed to be exposed at SWMU 63 for 2 and 8 hours/day, for 26 and 52 days/year, over 6 years for the average and RME cases, respectively. These assumptions are very conservative, because Cannon AFB is likely to remain a military installation, making access to contaminants at SWMU 63 by trespassers unlikely.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to contaminants in surface soil at SWMU 63 via the dermal contact, ingestion, and inhalation pathways is 0.00002 and 0.002 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed exposure conditions is 1×10^{-9} under the average exposure case and 1×10^{-7} under the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b) and demonstrate that risks are negligible for this exposure scenario.

6.3.8 Qualitative Assessment of Exposures to Lead

Lead exposures are not addressed in the quantitative risk assessment, because EPA withdrew the RfD for lead in 1989, primarily due to the lack of a discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. This level is supported by EPA's Uptake/Biokinetic (UBK) Lead Model which

predicts that exposures of children ages 0 to 6 to soils with approximately these levels will not result in blood lead levels that exceed a level of concern established by the Centers for Disease Control.

Lead was detected in concentrations ranging from 4 to 84 mg/kg. The maximum concentration detected at SWMU 63 is below the range suggested by EPA for residential soils. Therefore, lead detected in soils at SWMU 63 would not be expected to pose a threat to human health.

6.3.9 Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available, and when the fuel product is known. The provisional values are under review and may be revised. RBCs derived from them are used simply as a guide to potential health hazards.)

The toxicity factors and calculation of risk-based concentrations are shown in Table 6-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to

benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,600 mg/kg. The maximum SWMU concentration of TPH is 649 mg/kg, well below the conservative RBC.

6.3.10 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 63 and their effect on the results and conclusions of the risk assessment are listed below.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens, such as benzo(a)pyrene, which can cause skin cancer through a direct action at the point of application. The exclusion of this exposure pathway from the risk assessment may underestimate the carcinogenic risk for dermal exposure. However, since total carcinogenic risk at this SWMU is virtually negligible, any uncertainty in the dermal contact risk does not affect the conclusions of the risk assessment.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- Benzo(g,h,i)perylene, 2-methylnaphthalene, and phenanthrene were not considered in the quantitative risk assessment, because they do not have EPA-established toxicity factors. Their exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results

or conclusions of the risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

- The surface area of this SWMU is too small to support chronic occupational exposures. Therefore, the exposure assumptions used are likely to significantly overestimate the potential magnitude of exposure to contaminated soils and risks at this SWMU.

6.4 ECOLOGICAL RISK ASSESSMENT

6.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 63 is located within a short distance of SWMUs 61 and 62, Sand Traps No. 5077a and 5077b, in a small area of poor wildlife habitat quality, within the developed portion of Cannon AFB. Existing ground cover is mostly asphalt paving, buildings, and a strip of mowed non-native grasses. About 70% of the land surface within the immediate vicinity (within 100 feet) of the SWMUs is asphalt paving and Buildings 352 and 357. The mowed grassy area extends east and north of the SWMUs and is approximately 70 feet in width.

The most common species are likely to be birds, such as robin (*Turdis migratorius*), house sparrow (*Passer domesticus*), and the starling (*Sturnus vulgaris*). Seedeaters would be more limited, since the grass is maintained by mowing. Although the house mouse (*Mus musculus*) may occur in the area around the buildings, the grass habitat is probably too small, fragmented, and subject to human disturbance to be used regularly by terrestrial species such as house mice. Raptors are unlikely to use the area for similar reasons.

Given this assessment, the robin (*Turdus migratorius*) was selected as the key receptor species for the grassy area near SWMU 63.

6.4.2 Chemicals of Concern

The chemicals of concern (COCs) were selected using validated data from eight soil samples collected at SWMU 61, 62, and 63 which covered the interval between 0 and 2 feet deep. Samples from SWMUs 61 and 62 were included in this assessment because of their close

proximity to SWMU 63. The interval of 0 to 2 feet was selected because most soil-dwelling organisms (e.g., earthworms and house mice) occupy this zone. Table 6.20 provides a summary of the chemicals detected in the eight samples considered for this ERA. A detailed description of the soil sampling program and chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the eight samples to be considered a possible COC. The following screening criteria were then applied, in the order shown, to determine if a chemical in the soil would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Exceedance of the normal range found in U.S. soils (nationwide)

The maximum detected concentration of the eight samples was used in the comparison to background criteria. If no background criteria were available for comparison, as was the case for the organic chemicals, the chemicals were retained as COCs. If the maximum detected concentration of a chemical exceeded the local (i.e. Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If the maximum detected concentration exceeded this criteria, it was likely retained as a COC, even if it fell within the normal range found in U.S. soils. This is because the normal U.S. range is widely variable and was included in the screening process primarily as an additional reference. In some cases however, the normal U.S. range was the only screening criteria available. Table 6.21 lists the maximum detected concentrations and the screening criteria used. The chemicals that were retained as COCs following the screening process include bromoform, 1,2-dichloroethane, 2-hexanone, 4-methyl-2-pentanone, 1,1,2,2-tetrachloroethane, toluene, xylenes, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, butyl benzyl phthalate, carbazole, chrysene, dibenzofuran, fluoranthene, fluorene, ideno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene, barium, lead, and TPH.

6.4.3 Exposure Assessment

Figure 6-4 depicts the exposure pathway flow chart developed for SWMU 63. As the flowchart indicates, chemicals could potentially be released through transport in runoff, infiltration to groundwater, volatilization or wind erosion, and direct contact by ecological receptors. Except for direct contact, these exposure pathways are incomplete or of minor importance for ecological receptors at SWMU 63. Storm water runoff is a potentially complete but insignificant pathway, because the source of chemicals is below ground and any spillage during servicing would involve relatively small area of level terrain. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization or wind erosion is not considered a significant pathway at this site. Although several of the COCs are volatile organic compounds (VOCs), the maximum concentration were all less than 0.01 mg/kg, and VOC concentrations of 100 mg/kg or greater in air are generally needed to induce toxic responses in laboratory rats and mice from inhalation (NIOSH 1987). Concentrations in soils would have to be many times greater than this to produce these toxic levels in air, even near the soil surface. Direct contact with subsurface soils (more than two feet deep) is also considered an insignificant or incomplete pathway because of the limited use of deeper soils at this site by wildlife.

Therefore, the only potentially complete and significant exposure pathway is direct contact with contaminated surface soil by species frequenting the SWMU area. Direct contact may include dermal absorption or ingestion. Dermal absorption is not considered a significant exposure route for the receptors at this site because the animals are assumed to be largely protected by their fur or feathers. Receptors at the SWMU may ingest COCs either directly or indirectly. Direct ingestion usually occurs along the food/prey chain from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of COCs that have been transferred via food webs.

Figure 6-5 depicts the Conceptual Site Model developed from the exposure pathway analysis, the ecological characterization, and the identification of the key receptor species for SWMU 63. As the figure indicates, the pathway of concern is from surface soil to the robin, via direct and indirect ingestion, with the earthworm identified as a main dietary component of the robin.

6.4.4 Risk Characterization

This section provides a characterization of potential risk to the selected key receptor species (robin) at SWMU 63. For the purposes of this analysis, it was assumed that the robin's diet consists of earthworms and inadvertent consumption of soil. It was also assumed that the concentration of the COCs were the same in the earthworm as in the soil, and therefore the analysis consisted of comparing the concentration of COCs in the robin's food (i.e., the chemical concentration in soil) to selected toxicity benchmark dietary levels for those chemicals (see Table 6.22).

This is a somewhat conservative approach, because studies indicate that, for many chemicals, BAFs from soil to earthworm are less than one (Beyer and Stafford 1993). However, this assumption takes into account the soil that would be clinging to the earthworm when consumed by the robin (that is not taken into account by the BAF studies) and also accounts for minor inadvertent soil ingestion by the robin. The benchmark dietary levels were selected as explained in Appendix D, Section D.3 and D.4; these sections also provide background toxicological information about the COCs. The soil chemical concentration used was the arithmetic mean, as described in Appendix D (Section D.6.).

Table 6.22 lists the COCs for SWMU 63 and provides a comparison between the soil concentration (arithmetic mean) and the benchmark dietary level for the robin. If the soil level exceeds the benchmark level, there is a possibility of risk, as noted in the table. The following discussion addresses those chemicals where a possibility of risk is indicated.

<u>Benzo(a)anthracene (BaA)</u>:

The average concentration in the soil (0.69 mg/kg) slightly exceeds the dietary benchmark level of 0.4 mg/kg. However, Beyer and Stafford (1993) calculated BAFs of less than one for all PAHs from soil to earthworm, specifically a BAF of 0.27 for BaA. Therefore, given this and the low level of BaA detected, along with the fact that the benchmark level reflects a concern primarily for carcinogenicity, which is not a particularly important benchmark for shorter-lived birds, it is unlikely that the BaA at SWMU 63 constitutes a risk to the robin.

Benzo-a-pyrene (BaP):

The average concentration of BaP at SWMUs 61, 62, and 63 was 0.68 mg/kg, compared to the benchmark dietary level of 0.002 mg/kg, indicating a potential risk. The 0.68 mg/kg level is within the range of some reported BaP concentrations for various locations, as reported in the literature for non-polluted areas and for rural and agricultural soils (see Table A-6). Also, the low toxicity benchmark level for BaP is a reflection of BaP's carcinogenic effects through the action of its intermediate metabolites, as opposed to acute toxicity. In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, and therefore it is questionable if carcinogenesis is an important endpoint for relatively short-lived mammals and birds, such as the robin. Finally, the BaP found at SWMUs 61, 62, and 63 may not be completely bioavailable to robins. Goon et al. (1991) showed that BaP that had aged 6 months in soil was only 34 to 51% orally bioavailable for clayey and sandy soils, relative to BaP administered alone to rats. For all these reasons, it is unlikely that BaP presents an unacceptable risk at SWMU 63.

TPH:

The average concentration of TPH at SWMUs 61, 62, and 63 was 325 mg/kg, compared to the benchmark dietary level of 241 mg/kg, indicating a potential risk. However, TPH levels are very spotty at SWMUs 61, 62, and 63, with "hot spots" indicated by two samples (610 and 649 mg/kg) and two non-detects out of four samples analyzed for TPH. Also, it is not certain how much the robin is exposed to fresh TPH mixtures as opposed to aged products. As noted in Appendix D, the toxicity benchmarks for TPH are derived from experiments using fresh fuels, and the BTEX and PAH compounds are the compounds of primary concern in TPH mixtures in setting cleanup levels and characterizing risk. In older spills to surface soils, the volatile BTEX component may not be present or prevalent, and the total TPH value may reflect less toxic constituents. However, PAHs will still be present in older spills, and these may be of concern. At SWMUs 61, 62, and 63, PAHs were detected, but were determined unlikely to pose an unacceptable risk.

6.5 SUMMARY AND CONCLUSIONS

6.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at the SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 6-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU

6.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

TABLE 6-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP NO. 5077c (SWMU NO. 63)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
SWMU 63											
Boring 06301	0 - 0.5	CAN063-0631-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN063-0631-6361	FD	Soil	X	X	X	X		2	1
	0 - 0.5	CAN063-0631-6301	MRD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN063-0631-0002		Soil	X		X	X		2	1
	4 - 6	CAN063-0631-0004		Soil	X		X	X		2	1
	8 - 10	CAN063-0631-0008		Soil	X	X	X	X		2	1
Boring 06302	0 - 0.5	CAN063-0632-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN063-0632-0002		Soil	X		X	X		2	1
	4 - 6	CAN063-0632-0004		Soil	X		X	X		2	1
	8 - 10	CAN063-0632-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN063-0632-6362	FD	Soil	X		X	X		2	1
	8 - 10	CAN063-0632-6302	MRD	Soil	X	X	X	X		2	1

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 11-1 for locations of the borings.

TABLE 6-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 63

LOCATOR	CAN063-0631-0000			CAN063-0631-0000			CAN063-0631-0002			CAN063-0632-0000			CAN063-0632-0000			CAN063-0632-0002		
LAB SAMPLE NUMBER	0312140001SA			0314020007SA			0312140002SA			0312140005SA			0314020013SA			0312140006SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
1,2-Dichloroethane				1.5	5.2	J	<	5.5	U				<	5.3	U	<	5.6	U
Toluene				2.7	5.2	J	<	5.5	U				<	5.3	U	<	5.6	U
Xylenes (total)				1.1	5.2	J	<	5.5	U				<	5.3	U	<	5.6	U
Semivolatile Organics (µg/kg)																		
Acenaphthene	58	340	J							120	340	J						
Anthracene	96	340	J							210	340	J						
Benzo(a)anthracene	370	340								1000	340							
Benzo(a)pyrene	460	340								900	340							
Benzo(b)fluoranthene	990	340								1800	340							
Benzo(g,h,i)perylene	280	340	J							390	340							
Butyl benzyl phthalate	120	340	J							50	340	J						
Carbazole	66	340	J							100	340	J						
Chrysene	720	340								1100	340							
Dibenzofuran	51	340	J							53	340	J						
Fluoranthene	900	340								1700	340							
Fluorene	59	340	J							100	340	J						
Indeno(1,2,3-cd)pyrene	250	340	J							400	340							
2-Methylnaphthalene	120	340	J							<	340	U						
Naphthalene	80	340	J							<	340	U						
Phenanthrene	670	340	J							1400	340							
Pyrene	1100	340								2200	340							

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 6-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 63

LOCATOR	CAN063-0631-0000			CAN063-0631-0000			CAN063-0631-0002			CAN063-0632-0000			CAN063-0632-0000			CAN063-0632-0002		
LAB SAMPLE NUMBER	0312140001SA			0314020007SA			0312140002SA			0312140005SA			0314020013SA			0312140006SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	3430	10.4					8910	11		3790	10.3					7150	11.1	
Arsenic	2.2	0.52					2.6	0.55		4.1	0.52					2	0.56	
Barium	717	1					96.9	1.1		279	1					74.8	1.1	
Beryllium	0.27	0.21					0.61	0.22		0.28	0.21					0.5	0.22	
Cadmium	0.85	0.52					<	0.55	U	0.81	0.52					<	0.56	U
Calcium	44500	20.8	J				2690	22		65700	20.6					2440	22.2	
Chromium	11.9	1					9.7	1.1		16.1	1					8.3	1.1	
Cobalt	2.4	1					4	1.1		2.2	1					3.6	1.1	
Copper	11.6	2.1					7.4	2.2		10.2	2.1					5.5	2.2	
Iron	5120	10.4					8920	11		4580	10.3					7250	11.1	
Lead	84.4	5.2	J				12	1.1		82.6	5.2					6.2	1.1	
Magnesium	1970	20.8					1770	22		1940	20.6					1300	22.2	
Manganese	383	1	J				177	1.1		156	1					144	1.1	
Mercury	0.25	0.1					<	0.11	U	0.18	0.1					<	0.11	U
Nickel	8.2	4.2					8.3	4.4		5.6	4.1					7.6	4.4	
Potassium	898	519					1640	549		1150	516					1260	555	
Sodium	<	519	U				<	549	U	<	516	U				375	555	J
Vanadium	14.2	1					19.2	1.1		11.5	1					15.1	1.1	
Zinc	54.9	2.1					20.7	2.2		54.2	2.1					15.2	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	649	41.6					<	43.9	U	610	41.2					<	44.4	U
Water Quality (percent)																		
Water	3.8	0.1		4.2	0.1		8.9	0.1		3	0.1		4.9	0.1		10	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J = Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 6-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 63

LOCATOR	CAN063-0631-0004			CAN063-0631-0008			CAN063-0632-0004			CAN063-0632-0008		
LAB SAMPLE NUMBER	0312140003SA			0312140004SA			0312140007SA			0312140008SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)												
Aluminum	6080	11.2		5120	22.5		6290	11.2		5260	11.2	
Arsenic	1.9	0.56		2	0.56		1.6	0.56		2	0.56	
Barium	45.3	1.1		612	2.2		61	1.1		751	1.1	
Beryllium	0.48	0.22		0.64	0.45		0.51	0.22		0.44	0.22	
Calcium	2780	22.4		115000	45		16300	22.4		68100	22.4	
Chromium	7.8	1.1		2.1	2.2	J	6.8	1.1		3.8	1.1	
Cobalt	2.1	1.1		2.7	2.2		2.8	1.1		2.3	1.1	
Copper	4.8	2.2		3.3	4.5	J	4.4	2.2		3.3	2.2	
Iron	6070	11.2		3940	22.5		5830	11.2		4560	11.2	
Lead	15	1.1		3.9	0.56		4	0.56		3.9	1.1	
Magnesium	1450	22.4		3660	45		1530	22.4		2560	22.4	
Manganese	47.2	1.1		72.1	2.2		82.5	1.1		83.8	1.1	
Nickel	6.4	4.5		6.7	9	J	6.8	4.5		5.7	4.5	
Potassium	1310	561		1090	1120	J	1240	561		1090	561	
Vanadium	11.9	1.1		13.8	2.2		12.1	1.1		14.7	1.1	
Zinc	14.5	2.2		10.7	4.5		14.8	2.2		11	2.2	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	140	44.9		<	45	U	<	44.9	U	<	44.9	U
Water Quality (percent)												
Water	11	0.1		11	0.1		11	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 6-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SURFACE SOIL TO BACKGROUND(1)
SWMU 63, CANNON AFB

Sand Trap No. 5077c

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN063-0632-0000	Aluminum	3790	1410 - 11,000	10,540	N	50,000
CAN063-0632-0000	Arsenic	4.1	0.67 - 28	15.5	N	6.5
CAN063-0631-0000	Barium	717	14.5 - 1200	642	Y	500
CAN063-0632-0000	Beryllium	0.28	0.17 - 0.77	0.73	N	1 - 2
CAN063-0631-0000	Cadmium	0.85	<0.51 - 4.2	*	Y	---
CAN063-0632-0000	Calcium	65,700	1490-172,000	186,400	N	7900 - 18000
CAN063-0632-0000	Chromium	16.1	4 - 15.4	12.5	N**	30
CAN063-0631-0000	Cobalt	2.4	0.85 - 5.3	4.5	N	3-7
CAN063-0631-0000	Copper	11.6	<2 - 18.4	*	N**	20
CAN063-0632-0000	Lead	84.4	1.1 - 46	25.8	Y	15
CAN063-0631-0000	Mercury	0.25	<0.1 - <0.12	*	Y	0.032 - 0.082
CAN063-0631-0000	Nickel	8.2	1.3 - 9.8	9	N	15
CAN063-0631-0000	Vanadium	14.2	5.2 - 28.3	25.3	N	30 - 70
CAN063-0631-0000	Zinc	54.9	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background range and within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background

TABLE 6-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN TOTAL SOILS TO BACKGROUND(1)
SWMU 63, CANNON AFB

Sand Trap No. 5077c

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN063-0631-0002	Aluminum	8910	1410 - 11,000	10,540	N	50,000
CAN063-0632-0000	Arsenic	4.1	0.67 - 28	15.5	N	6.5
CAN063-0632-0008	Barium	751	14.5 - 1200	642	Y	500
CAN063-0631-0008	Beryllium	0.64	0.17 - 0.77	0.73	N	1 - 2
CAN063-0631-0000	Cadmium	0.85	<0.51 - 4.2	*	Y	---
CAN063-0631-0008	Calcium	115,000	1490-172,000	186,400	N	7,900 - 18,000
CAN063-0632-0000	Chromium	16.1	4 - 15.4	12.5	N**	30
CAN063-0631-0002	Cobalt	4	0.85 - 5.3	4.5	N	3 - 7
CAN063-0631-0000	Copper	11.6	<2 - 18.4	*	N**	20
CAN063-0631-0000	Lead	84.4	1.1 - 46	25.8	Y	15
CAN063-0631-0000	Mercury	0.25	<0.1 - <0.12	*	Y	0.032 - 0.082
CAN063-0631-0002	Nickel	8.3	1.3 - 9.8	9	N	15
CAN063-0631-0002	Vanadium	19.2	5.2 - 28.3	25.3	N	30 - 70
CAN063-0631-0000	Zinc	54.9	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background range and within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background

TABLE 6-5

CHEMICALS OF CONCERN IN SURFACE SOIL

Acenaphthene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Carbazole
Chrysene
Dibenzofuran*
1,2-Dichloroethane
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Naphthalene
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Barium
Cadmium
Lead*
Mercury
Zinc

* No EPA-established toxicity factor.

TABLE 6-6

CHEMICALS OF CONCERN IN TOTAL SOIL

Acenaphthene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Carbazole
Chrysene
Dibenzofuran*
1,2-Dichloroethane
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Naphthalene
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Barium
Cadmium
Lead*
Mercury
Zinc

* No EPA-established toxicity factor.

TABLE 6-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAP 5077c (SWMU 63)

	1,2-Dichloroethane (µg/kg)			Toluene (µg/kg)			Xylenes (total) (µg/kg)			Acenaphthene (µg/kg)			Anthracene (µg/kg)		
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN063-0631-0000	1.5	J	5.2	2.7	J	5.2	1.1	J	5.2	58	J	340	96	J	340
CAN063-0632-0000		U	5.3		U	5.3		U	5.3	120	J	340	210	J	340
Number	1			1			1			2			2		
Minimum detected	1.50			2.70			1.10			58.0			96.0		
Maximum detected	1.50			2.70			1.10			120			210		
Average	1.50			2.70			1.10			89.0			153		
RME	1.50			2.70			1.10			120			210		

RL = Laboratory reporting limit
RME = Maximum detected
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected.. Value shown is one-half RL

TABLE 6-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAP 5077c (SWMU 63)

	Benzo(a)anthracene (µg/kg)			Benzo(a)pyrene (µg/kg)			Benzo(b)fluoranthene (µg/kg)			Butyl benzyl phthalate (µg/kg)		
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN063-0631-0000	370		340	460		340	990		340	120	J	340
CAN063-0632-0000	1000		340	900		340	1800		340	50	J	340
Number	2			2			2			2		
Minimum detected	370			460			990			50.0		
Maximum detected	1000			900			1800			120		
Average	685			680			1395			85.0		
RME	1000			900			1800			120		

RL = Laboratory reporting limit
RME = Maximum detected
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected.. Value shown is one-half RL

TABLE 6-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAP 5077c (SWMU 63)

	Carbazole (µg/kg)			Chrysene (µg/kg)			Fluoranthene (µg/kg)			Fluorene (µg/kg)			Indeno(1,2,3-cd)pyrene (µg/kg)			Naphthalene (µg/kg)		
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN063-0631-0000	66	J	340	720		340	900		340	59	J	340	250	J	340	80	J	340
CAN063-0632-0000	100	J	340	1100		340	1700		340	100	J	340	400		340		U	340
Number	2			2			2			2			2			1		
Minimum detected	66.0			720			900			59			250			80		
Maximum detected	100			1100			1700			100			400			80		
Average	83.0			910			1300			80			325			80		
RME	100			1100			1700			100			400			80		

RL = Laboratory reporting limit

RME = Maximum detected

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected.. Value shown is one-half RL

TABLE 6-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAP 5077c (SWMU 63)

	Pyrene (µg/kg)			TPH (µg/kg)			Barium (mg/kg)			Cadmium (mg/kg)			Lead (mg/kg)			Mercury (mg/kg)			Zinc (mg/kg)		
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN063-0631-0000	1100		340	649		42	717		1	0.85		0.5	84.4	J	5.2	0.25		0.1	54.9		2.1
CAN063-0632-0000	2200		340	610		41	279		1	0.81		0.5	82.6		5.2	0.18		0.1	54.2		2.1
Number	2			2			2			2			2			2			2		
Minimum detected	1100			610			279			0.81			82.6			0.18			54.2		
Maximum detected	2200			649			717			0.85			84.4			0.25			54.9		
Average	1650			630			498			0.83			83.5			0.22			54.6		
RME	2200			649			717			0.85			84.4			0.25			54.9		

RL = Laboratory reporting limit

RME = Maximum detected

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected.. Value shown is one-half RL

TABLE 6-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAP 5077C (SWMU 63)

	1,2-Dichloroethane (µg/kg)			Toluene (µg/kg)			Xylenes (total) (µg/kg)			Acenaphthene (µg/kg)			Anthracene (µg/kg)			
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	log Result	Qual	RL
CAN063-0631-0000	1.5	J	5.2	2.7	J	5.2	1.1	J	5.2	58	J	340	96	4.564	J	340
CAN063-0631-0002		U	5.5		U	5.5		U	5.5							
CAN063-0631-0004		U	5.6		U	5.6		U	5.6							
CAN063-0631-0008		U	5.6		U	5.6		U	5.6		U	370	185	5.220	U	370
CAN063-0632-0000		U	5.3	2.65	U	5.3		U	5.3	120	J	340	210	5.347	J	340
CAN063-0632-0002		U	5.6		U	5.6		U	5.6							
CAN063-0632-0004		U	5.6		U	5.6		U	5.6							
CAN063-0632-0008		U	5.6		U	5.6		U	5.6		U	370	185	5.220	U	370
Number	1			2			1			2			4	4		
Minimum detected	1.50			2.70			1.10			58.0			96.0			
Maximum detected	1.50			2.70			1.10			120			210			
Average	1.50			2.68			1.10			89.0			169	5.09		
H Statistic														2.99		
Standard Deviation													50.07	0.35		
95% UCL													318	318		
RME	1.5			2.70			1.10			120			210			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with N <3
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value shown is one-half RL
Where no RL is shown, no analysis was performed

TABLE 6-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS
AT SAND TRAP 5077C (SWMU 63)

	Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)				Benzo(b)fluoranthene (µg/kg)				Butyl benzyl phthalate (µg/kg)		
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	Qual	RL
CAN063-0631-0000	370	5.914		340	460	6.131		340	990	6.898		340	120	J	340
CAN063-0631-0002															
CAN063-0631-0004															
CAN063-0631-0008	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370		U	370
CAN063-0632-0000	1000	6.908		340	900	6.802		340	1800	7.496		340	50	J	340
CAN063-0632-0002															
CAN063-0632-0004															
CAN063-0632-0008	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370		U	370
Number	4	4			4	4			4	4			2		
Minimum detected	370				460				990				50.0		
Maximum detected	1000				900				1800				120		
Average	435	5.82			433	5.84			790	6.21			85.0		
H Statistic		5.40				5.40				8.32					
Standard Deviation	386.6	0.80			337.6	0.77			772.9	1.17					
95% UCL	5554	5554			5119	5119			2.67E+05	2.67E+05					
RME	1000				900				1800				120		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with N <3
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value shown is one-half RL
Where no RL is shown, no analysis was performed

TABLE 6-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAP 5077C (SWMU 63)

	Carbazole (µg/kg)			Chrysene (µg/kg)				Fluoranthene (µg/kg)				Fluorene (µg/kg)		
Field ID	Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	Qual	RL
CAN063-0631-0000	66	J	340	720	6.579		340	900	6.802		340	59	J	340
CAN063-0631-0002														
CAN063-0631-0004														
CAN063-0631-0008		U	370	185	5.220	U	370	185	5.220	U	370		U	370
CAN063-0632-0000	100	J	340	1100	7.003		340	1700	7.438		340	100	J	340
CAN063-0632-0002														
CAN063-0632-0004														
CAN063-0632-0008		U	370	185	5.220	U	370	185	5.220	U	370		U	370
Number	2			4	4			4	4			2		
Minimum detected	66.0			720				900				59.0		
Maximum detected	100			1100				1700				100		
Average	83.0			548	6.01			743	6.17			79.5		
H Statistic					6.244				7.443					
Standard Deviation				446.4	0.92			721.9	1.13					
95% UCL				17332	17332			1.15E+05	1.15E+05					
RME	100			1100				1700				100		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with N <3
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value shown is one-half RL
Where no RL is shown, no analysis was performed

TABLE 6-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAP 5077C (SWMU 63)

	Ideno(1,2,3-cd)pyrene (µg/kg)				Naphthalene (µg/kg)			Pyrene (µg/kg)				TPH (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN063-0631-0000	250	5.521	J	340	80	J	340	1100	7.003		340	649	6.475		41.6
CAN063-0631-0002												21.95	3.089	U	43.9
CAN063-0631-0004												140	4.942		44.9
CAN063-0631-0008	185	5.220	U	370		U	370	185	5.220	U	370	22.5	3.114	U	45
CAN063-0632-0000	400	5.991		340		U	340	2200	7.696		340	610	6.413		41.2
CAN063-0632-0002												22.2	3.100	U	44.4
CAN063-0632-0004												11.45	2.438	U	44.9
CAN063-0632-0008	185	5.220	U	370		U	370	185	5.220	U	370	22.45	3.111	U	44.9
Number	4	4			1			4	4			8	8		
Minimum detected	250				80.0			1100				140			
Maximum detected	400				80.0			2200				649			
Average	255	5.49			80.0			918	6.28			187	4.09		
H Statistic		3.184							9.124				5.117		
Standard Deviation	101.4	0.36						957.6	1.26			276.2	1.62		
95% UCL	505	505						9.14E+05	9.14E+05			5120	5120		
RME	400				80.0			2200				649			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with N <3
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value shown is one-half RL
Where no RL is shown, no analysis was performed

TABLE 6-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAP 5077C (SWMU 63)

	Barium (mg/kg)				Cadmium (mg/kg)				Lead (mg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN063-0631-0000	717	6.575		1	0.85	-0.163		0.52	84.4	4.436	J	5.2
CAN063-0631-0002	96.9	4.574		1.1	0.275	-1.291	U	0.55	12	2.485		1.1
CAN063-0631-0004	45.3	3.813		1.1	0.28	-1.273	U	0.56	15	2.708		1.1
CAN063-0631-0008	612	6.417		2.2	0.55	-0.598	U	1.1	3.9	1.361		0.56
CAN063-0632-0000	279	5.631		1	0.81	-0.211		0.52	82.6	4.414		5.2
CAN063-0632-0002	74.8	4.315		1.1	0.28	-1.273	U	0.56	6.2	1.825		1.1
CAN063-0632-0004	61	4.111		1.1	0.28	-1.273	U	0.56	4	1.386		0.56
CAN063-0632-0008	751	6.621		1.1	0.28	-1.273	U	0.56	3.9	1.361		1.1
Number	8	8			8	8			8	8		
Minimum detected	45.3				0.81				3.90			
Maximum detected	751				0.85				84.4			
Average	330	5.26			0.45	-0.92			26.5	2.50		
H Statistic		4.091				2.45				4.428		
Standard Deviation	312.1	1.19			0.25	0.51			35.42	1.30		
95% UCL	2423	2423			0.73	0.73			246	246		
RME	751				0.73				84.4			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with N <3
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value shown is one-half RL
Where no RL is shown, no analysis was performed

TABLE 6-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAP 5077C (SWMU 63)

	Mercury (mg/kg)				Zinc (mg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN063-0631-0000	0.25	-1.386		0.1	54.9	4.006		2.1
CAN063-0631-0002	0.055	-2.900	U	0.11	20.7	3.030		2.2
CAN063-0631-0004	0.055	-2.900	U	0.11	14.5	2.674		2.2
CAN063-0631-0008	0.055	-2.900	U	0.11	10.7	2.370		4.5
CAN063-0632-0000	0.18	-1.715		0.1	54.2	3.993		2.1
CAN063-0632-0002	0.055	-2.900	U	0.11	15.2	2.721		2.2
CAN063-0632-0004	0.055	-2.900	U	0.11	14.8	2.695		2.2
CAN063-0632-0008	0.055	-2.900	U	0.11	11	2.398		2.2
Number	8	8			8	8		
Minimum detected	0.18				10.7			
Maximum detected	0.25				54.9			
Average	0.10	-2.56			24.5	2.99		
H Statistic		2.642				2.745		
Standard Deviation	0.08	0.63			18.8	0.66		
95% UCL	0.18	0.18			48.7	48.7		
RME	0.18				48.7			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected.
95% UCL concentrations have not been calculated for sample sets with N <3
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value shown is one-half RL
Where no RL is shown, no analysis was performed

TABLE 6-9
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SURFACE SOIL
SWMU 63

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
1,2-Dichloroethane	0.002	0.002	0.0005	1.00E-06	1.00E-06
Acenaphthene	0.089	0.12	0.1	0.0089	0.012
Anthracene	0.15	0.21	0.1	0.015	0.021
Benzo(a)anthracene	0.68	1.00	0.1	0.07	0.1
Benzo(a)pyrene	0.68	0.90	0.1	0.068	0.09
Benzo(b)fluoranthene	1.40	1.80	0.1	0.14	0.18
Butyl benzyl phthalate	0.085	0.12	0.1	0.0085	0.012
Carbozole	0.083	0.10	0.1	0.0083	0.01
Chrysene	0.91	1.10	0.1	0.091	0.11
Fluoranthene	1.30	1.70	0.1	0.13	0.17
Fluorene	0.08	0.10	0.1	0.008	0.01
Indeno(1,2,3-cd)pyrene	0.32	0.40	0.1	0.032	0.04
Mercury	0.22	0.25	0.01	0.0022	0.0025
Naphthalene	0.08	0.08	0.1	0.008	0.008
Pyrene	1.60	2.20	0.1	0.16	0.22
Toluene	0.003	0.003	0.03	9.00E-05	9.00E-05
Xylenes	0.001	0.001	0.03	3.00E-05	3.00E-05

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 6-10
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
TOTAL SOIL
SWMU 63

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
1,2-Dichloroethane	0.002	0.002	0.0005	1.00E-06	1.00E-06
Acenaphthene	0.089	0.12	0.1	0.0089	0.012
Anthracene	0.17	0.21	0.1	0.017	0.021
Benzo(a)anthracene	0.44	1	0.1	0.04	0.1
Benzo(a)pyrene	0.43	0.9	0.1	0.043	0.09
Benzo(b)fluoranthene	0.79	1.8	0.1	0.079	0.18
Butyl benzyl phthalate	0.085	0.12	0.1	0.0085	0.012
Carbozole	0.083	0.1	0.1	0.0083	0.01
Chrysene	0.55	1.1	0.1	0.055	0.11
Fluoranthene	0.74	1.7	0.1	0.074	0.17
Fluorene	0.08	0.1	0.1	0.008	0.01
Indeno(1,2,3-cd)pyrene	0.25	0.4	0.1	0.025	0.04
Mercury	0.10	0.18	0.01	0.001	0.0018
Naphthalene	0.08	0.08	0.1	0.008	0.008
Pyrene	0.90	2.2	0.1	0.09	0.22
Toluene	0.003	0.003	0.03	9.00E-05	9.00E-05
Xylenes	0.001	0.001	0.03	3.00E-05	3.00E-05

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 6-11
VADOSE ZONE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 63

	t (y)	Cs (ug/kg)	Co (g/m^3)	L (m)	W (m)	T (m)	VWC (L/L)	foc	Koc (ml/g)	Kd (ml/g)	Soil Half Life (y)	P (g/cm^3)	I (m/y)	H (m)	TOT (y)
1,2-Dichloroethane	0	1.5	2.40E-03	50	35	2.439	0.15	0.003	14	0.042	0.2	1.6	0.015	76.829	1112
Acenaphthene	0	89	1.42E-01	50	35	2.439	0.15	0.003	18	0.054	0.3	1.6	0.015	76.829	1211
Anthracene	0	169	2.70E-01	50	35	2.439	0.15	0.003	16000	48	1.26	1.6	0.015	76.829	394133
Barium	0	329630	5.27E+02	50	35	2.439	0.15	0.003	NA	50	NA	1.6	0.015	76.829	410523
Benzo(a)anthracene	0	435	6.96E-01	50	35	2.439	0.15	0.003	1400000	4200	1.86	1.6	0.015	76.829	34420160
Benzo(a)pyrene	0	432.5	6.92E-01	50	35	2.439	0.15	0.003	6500000	19500	1.45	1.6	0.015	76.829	159805088
Benzo(b)fluoranthene	0	790	1.26E+00	50	35	2.439	0.15	0.003	550000	1650	1.67	1.6	0.015	76.829	13522672
Benzylbutylphalate	0	85	1.36E-01	50	35	2.439	0.15	0.003	68	0.204	0.2	1.6	0.015	76.829	2440
Cadmium	0	450	7.20E-01	50	35	2.439	0.15	0.003	NA	7	NA	1.6	0.015	76.829	58134
Carbazole	0	83	1.33E-01	50	35	2.439	0.15	0.003	5100	15.3	0.2	1.6	0.015	76.829	126153
Chrysene	0	547.5	8.76E-01	50	35	2.439	0.15	0.003	250000	750	2.72	1.6	0.015	76.829	6147088
Fluoroanthene	0	742.5	1.19E+00	50	35	2.439	0.15	0.003	1380	4.14	1.21	1.6	0.015	76.829	34696
Fluorene	0	79.5	1.27E-01	50	35	2.439	0.15	0.003	5010	15.03	0.2	1.6	0.015	76.829	123941
Indeno(1,2,3-C)pyrene	0	255	4.08E-01	50	35	2.439	0.15	0.003	31000000	93000	2	1.6	0.015	76.829	762144448
Lead	0	26500	4.24E+01	50	35	2.439	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278
Mercury	0	100	1.60E-01	50	35	2.439	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278
Naphthalene	0	80	1.28E-01	50	35	2.439	0.15	0.003	550	1.65	0.2	1.6	0.015	76.829	14290
Pyrene	0	917.5	1.47E+00	50	35	2.439	0.15	0.003	38000	114	5.2	1.6	0.015	76.829	935009
Toluene	0	2.68	4.29E-03	50	35	2.439	0.15	0.003	300	0.9	0.2	1.6	0.015	76.829	8144
Xylenes	0	1.1	1.76E-03	50	35	2.439	0.15	0.003	830	2.49	0.2	1.6	0.015	76.829	21174
Zinc	0	24500	3.92E+01	50	35	2.439	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278

t = Time where leachate concentration is estimated
Cs Concentration of chemical in source soil
(average concentration from Table 7-8)
Co Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) = time required for one-half the amount of chemical to be degraded in soil.

TABLE 6-11
VADOSE ZONE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 63

	Rd	Leach Rate (y^-1)	Qo (g)	Q(t) (g)	qc (g/y)	Cl(1) (ug/l)	Cl(2) (ug/l)	K (m/s)	i (m/m)	b (m)	Qw (m^3/y)	Ql (m^3/yr)	Cw (ug/l)
1,2-Dichloroethane	1.45E+00	2.83E-02	1.02E+01	1.02E+01	2.90E-01	1.10E+01	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Acenaphthene	1.58E+00	2.60E-02	6.08E+02	6.08E+02	1.58E+01	6.02E+02	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Anthracene	5.13E+02	7.99E-05	1.15E+03	1.15E+03	9.22E-02	3.51E+00	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Barium	5.34E+02	7.67E-05	2.25E+06	2.25E+06	1.73E+02	6.58E+03	6.58E+03	2.00E-04	0.0019	10	4194	26	4.09E+01
Benzo(a)anthracene	4.48E+04	9.15E-07	2.97E+03	2.97E+03	2.72E-03	1.04E-01	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Benzo(a)pyrene	2.08E+05	1.97E-07	2.95E+03	2.95E+03	5.82E-04	2.22E-02	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Benzo(b)fluoranthene	1.76E+04	2.33E-06	5.40E+03	5.40E+03	1.26E-02	4.79E-01	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Benzylbutylphalate	3.18E+00	1.29E-02	5.80E+02	5.80E+02	7.49E+00	2.85E+02	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Cadmium	7.57E+01	5.42E-04	3.07E+03	3.07E+03	1.67E+00	6.34E+01	6.34E+01	2.00E-04	0.0019	10	4194	26	3.95E-01
Carbazole	1.64E+02	2.50E-04	5.67E+02	5.67E+02	1.42E-01	5.39E+00	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Chrysene	8.00E+03	5.12E-06	3.74E+03	3.74E+03	1.92E-02	7.30E-01	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Fluoroanthene	4.52E+01	9.08E-04	5.07E+03	5.07E+03	4.60E+00	1.75E+02	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Fluorene	1.61E+02	2.54E-04	5.43E+02	5.43E+02	1.38E-01	5.26E+00	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Indeno(1,2,3-C)pyrene	9.92E+05	4.13E-08	1.74E+03	1.74E+03	7.20E-05	2.74E-03	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Lead	1.07E+03	3.84E-05	1.81E+05	1.81E+05	6.95E+00	2.65E+02	2.65E+02	2.00E-04	0.0019	10	4194	26	1.65E+00
Mercury	1.07E+03	3.84E-05	6.83E+02	6.83E+02	2.62E-02	9.99E-01	9.99E-01	2.00E-04	0.0019	10	4194	26	6.21E-03
Naphthalene	1.86E+01	2.20E-03	5.46E+02	5.46E+02	1.20E+00	4.59E+01	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Pyrene	1.22E+03	3.37E-05	6.27E+03	6.27E+03	2.11E-01	8.04E+00	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Toluene	1.06E+01	3.87E-03	1.83E+01	1.83E+01	7.08E-02	2.70E+00	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Xylenes	2.76E+01	1.49E-03	7.51E+00	7.51E+00	1.12E-02	4.26E-01	0.00E+00	2.00E-04	0.0019	10	4194	26	0.00E+00
Zinc	1.07E+03	3.84E-05	1.67E+05	1.67E+05	6.43E+00	2.45E+02	2.45E+02	2.00E-04	0.0019	10	4194	26	1.52E+00

t = Time where leachate concentration is estimated
Cs Concentration of chemical in source soil
(average concentration from Table 7-8)
Co Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 6-12

COMPARISON OF MODELED GROUNDWATER CONCENTRATIONS TO RBCs(1)

	Cw (2) (ug/l)	Tap Water RBC(1) (µg/L)	Does modeled concentration exceed RBC?
1,2-Dichloroethane	0.00	0.12	No
Acenaphthene	0.00	2200	No
Anthracene	0.00	11000	No
Barium	4.09E+01	2600	No
Benzo(a)anthracene	0.00	0.092	No
Benzo(a)pyrene	0.00	0.0092	No
Benzo(b)fluoranthene	0.00	0.092	No
Benzylbutylphalate	0.00	7300	No
Cadmium	3.95E-01	18	No
Carbazole	0.00	3.4	No
Chrysene	0.00	9.2	No
Fluoranthene	0.00	1500	No
Fluorene	0.00	1500	No
Indeno(1,2,3-C)pyrene	0.00	0.092	No
Lead	1.65E+00	15 (3)	No
Mercury	0.01	11	No
Naphthalene	0.00	1500	No
Pyrene	0.00	1100	No
Toluene	0.00	750	No
Xylenes	0.00	12000	No
Zinc	1.52E+00	11000	No

(1) RBC is the Region III risk based concentration for residential tap water ingestion and inhalation.
(2) Cw is the modeled groundwater concentration as defined in table xxx.
(3) No Region III RBC is available for lead. Value is the action level defined in the May 1993 issue of Drinking water regulation and health advisoried (EPA 1993).
The modeled concentration, zero is a value less than 1E-300.

TABLE 6-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 63

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
1,2-Dichloroethane	2.65	3.85E-03	45	2.25	2	20250000	7.90E+08	6.82E-02	0.35	0.09643
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 6-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 6-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 63

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
1,2-Dichloroethane	30	4.31E-03	6.00E-01	2.95E-01	2.20E+03	0.002	6.82E-07
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.003	4.27E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 6-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 6-14
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM SURFACE SOILS AT SWMU 63

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Barium	717	4.63E+09	1.55E-07
Benzo(a)anthracene	1.00	4.63E+09	2.16E-10
Benzo(a)pyrene	0.90	4.63E+09	1.94E-10
Benzo(b)fluoranthene	1.80	4.63E+09	3.89E-10
Cadmium	0.85	4.63E+09	1.84E-10
Chromium	16.1	4.63E+09	3.48E-09
Chrysene	1.10	4.63E+09	2.38E-10
Indeno(1,2,3-cd)pyrene	0.40	4.63E+09	8.64E-11
Mercury	0.25	4.63E+09	5.40E-11

RME Soil Concentration from Table 6-7
PEF = Particulate Emission Factor default value from EPA (1991b)
Air Concentration = Soil concentration/PEF

TABLE 6-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 63

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
1,2-Dichloroethane	2.65	3.85E-03	45	2.25	2	20250000	7.90E+08	6.82E-02	0.35	0.09643
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 6-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 6-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 63

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
1,2-Dichloroethane	30	4.31E-03	6.00E-01	2.95E-01	2.20E+03	0.002	6.82E-07
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.003	4.27E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 6-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 6-16
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM TOTAL SOILS AT SWMU 63

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Barium	751	4.63E+09	1.62E-07
Benzo(a)anthracene	1.00	4.63E+09	2.16E-10
Benzo(a)pyrene	0.90	4.63E+09	1.94E-10
Benzo(b)fluoranthene	1.80	4.63E+09	3.89E-10
Cadmium	0.73	4.63E+09	1.58E-10
Chrysene	1.10	4.63E+09	2.38E-10
Indeno(1,2,3-cd)pyrene	0.40	4.63E+09	8.64E-11
Mercury	0.18	4.63E+09	3.89E-11

RME Soil Concentration from Table 6-8

PEF = Particulate Emission Factor default value from EPA (1991b)

Air Concentration = Soil concentration/PEF

TABLE 6-17

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Inhalation (m^3/kg-d)		
Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
Carcinogenic	1.39×10^{-3}	6.99×10^{-2}
Construction Workers	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Inhalation (m^3/kg-d)		
Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
Carcinogenic	1.03×10^{-4}	4.47×10^{-4}
Trespasser	**Average**	**RME**
Dermal Contact Soil (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Soil Ingestion (kg/kg-d		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Inhalation (m^3/k-d)		
Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 6-18

SUMMARY OF HUMAN HEALTH RISKS AT SWMU 63

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Surface Soil)						
-- Dermal Contact	1×10^{-11}		3×10^{-6}	2×10^{-9}		2×10^{-4}
-- Ingestion	5×10^{-9}		5×10^{-5}	2×10^{-6}		6×10^{-3}
-- Inhalation of VOCs	9×10^{-11}		4×10^{-8}	4×10^{-9}		8×10^{-7}
-- Inhalation of Particulates	2×10^{-12}		1×10^{-5}	1×10^{-10}		2×10^{-4}
	5×10^{-9}		7×10^{-5}	2×10^{-6}		6×10^{-3}
Construction Worker (Total Soil)						
-- Dermal Contact	7×10^{-13}	1×10^{-6}		1×10^{-11}	3×10^{-5}	
-- Ingestion	1×10^{-9}	1×10^{-4}		2×10^{-8}	2×10^{-3}	
-- Inhalation of VOCs	6×10^{-12}	3×10^{-8}		3×10^{-11}	1×10^{-7}	
-- Inhalation of Particulates	2×10^{-13}	8×10^{-7}		7×10^{-13}	4×10^{-6}	
	1×10^{-9}	1×10^{-4}		2×10^{-8}	2×10^{-3}	
Trespasser (Surface Soil)						
-- Dermal Contact	2×10^{-12}	1×10^{-6}		3×10^{-10}	1×10^{-4}	
-- Ingestion	1×10^{-9}	1×10^{-5}		1×10^{-7}	2×10^{-3}	
-- Inhalation of VOCs	2×10^{-11}	1×10^{-8}		3×10^{-10}	2×10^{-7}	
-- Inhalation of Particulates	4×10^{-13}	4×10^{-7}		8×10^{-12}	6×10^{-6}	
	1×10^{-9}	2×10^{-5}		1×10^{-7}	2×10^{-3}	

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix C for nonrounded risk values.

TABLE 6-19

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies and are under review and subject to revision.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

TABLE 6-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMUs 61, 62, AND 63
CANNON AFB
(mg/kg)

Chemical	CAN061-0611-0000	CAN061-0612-0000	CAN062-0621-0000	CAN062-0622-0000	CAN063-0631-0000	CAN063-0631-0002	CAN063-0632 0000	CAN063-0632-0002	N	Arithmetic Mean	95% UCL	Maximum
Volatile Organics												
Bromoform	0.0029 U	0.0029 U	0.0029 U	0.0012 J					4	0.0025	0.0033	0.0029
1,2-Dichloroethane					0.0015 J	0.0028 U	0.0027 U	0.0028 U	4	0.0025	0.0031	0.0028
2-Hexanone	0.006 U	0.006 U	0.006 U	0.0096 J					4	0.0069	0.0087	0.0096
4-Methyl-2-pentanone	0.006 U	0.006 U	0.006 U	0.0055 J					4	0.0059	0.0061	0.006
1,1,2,2-Tetrachloroethane	0.0029 U	0.0029 U	0.0029 U	0.0014 J					4	0.0025	0.0033	0.0029
Toluene	0.0029 U	0.0005 J	0.0012 J	0.0029 U	0.0027 J	0.0028 U	0.0027 U	0.0028 U	8	0.0023	0.0029	0.0029
Xylenes (total)	0.0029 U	0.0028 J	0.0029 U	0.0029 U	0.0011 J	0.0028 U	0.0027 U	0.0028 U	8	0.0026	0.0030	0.0029
Semivolatile Organics												
Acenaphthene					0.058 J		0.12 J		2	0.09	0.23	0.12
Anthracene					0.096 J		0.21 J		2	0.15	0.41	0.21
Benzo(a)anthracene					0.37		1		2	0.69	2.09	1
Benzo(a)pyrene					0.46		0.9		2	0.68	1.66	0.9
Benzo(b)fluoranthene					0.99 J		1.8		2	1.40	3.20	1.8
Benzo(g,h,i)perylene					0.28 J		0.39		2	0.34	0.58	0.39
Butyl benzyl phthalate					0.12 J		0.05 J		2	0.09	0.24	0.12
Carbazole					0.066 J		0.1 J		2	0.08	0.16	0.1
Chrysene					0.72 J		1.1		2	0.91	1.76	1.1
Dibenzofuran					0.051 J		0.053 J		2	0.05	0.06	0.053
Fluoranthene					0.9 J		1.7		2	1.30	3.09	1.7
Fluorene					0.059 J		0.1 J		2	0.08	0.17	0.1
Ideno(1,2,3-cd)pyrene					0.25 J		0.4		2	0.33	0.66	0.4
2-Methylnaphthalene					0.12 J		0.17 U		2	0.15	0.26	0.17
Naphthalene					0.08 J		0.17 U		2	0.13	0.33	0.17
Phenanthrene					0.67 J		1.4		2	1.04	2.66	1.4
Pyrene					1.1 J		2.2		2	1.65	4.11	2.2

TABLE 6-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMUs 61, 62, AND 63
CANNON AFB
(mg/kg)

Chemical	CAN061-0611-0000	CAN061-0612-0000	CAN062-0621-0000	CAN062-0622-0000	CAN063-0631-0000	CAN063-0631-0002	CAN063-0632 0000	CAN063-0632-0002	N	Arithmetic Mean	95% UCL	Maximum
Metals												
Aluminum	8460	8300	6310	6960	3430	8910	3790	7150	8	6663.75	7963.64	8910
Arsenic	2.1	2	2.5	1.9	2.2	2.6	4.1	2	8	2.43	2.88	4.1
Barium	80.7	99.1	72.3	87.8 J	717	96.9	279	74.8	8	188.45	329.00	717
Beryllium	0.58	0.59	0.53	0.56	0.27	0.61	0.28	0.5	8	0.49	0.58	0.61
Cadmium					0.85	0.28 U	0.81	0.28 U	4	0.56	0.88	0.85
Calcium	2190	2380	1870	1620	44500 J	2690	65700	2440	8	15423.75	31177.94	65700
Chromium	8.6	9	7.7	7.6	11.9 J	9.7	16.1	8.3	8	9.86	11.66	16.1
Cobalt	4	3.9	3.6	4.2	2.4	4	2.2	3.6	8	3.49	3.97	4.2
Copper	7.2	6.2	6.9	5.7	11.6	7.4	10.2	5.5	8	7.59	8.96	11.6
Iron	9190	9090	7630	7960	5120	8920	4580	7250	8	7467.50	8575.35	9190
Lead	7.4	7.3	7	7.3	84.4 J	12	82.6	6.2	8	26.78	48.75	84.4
Magnesium	1530	1620	1610	1940	1970	1770	1940	1300	8	1710.00	1858.99	1970
Manganese	175 J	178 J	206	181	383 J	177	156	144	8	200.00	247.73	383
Mercury					0.25	0.06 U	0.18	0.06 U	4	0.14	0.23	0.25
Nickel	7.2	7.4	6.9	7.8	8.2	8.3	5.6	7.6	8	7.38	7.91	8.3
Potassium	1450	1440	1810	1380	898	1640	1150	1260	8	1378.50	1555.86	1810
Silver	0.85 J	0.91 J	0.51 J	0.6 J					4	0.72	0.91	0.91
Sodium	290 U	292 U	265 J	284 U	260 U	275 U	258 U	375 J	8	287.38	311.04	375
Vanadium	20.1	20.6	20.2	22.3	14.2	19.2	11.5	15.1	8	17.90	20.28	22.3
Zinc	20.6	20.9	16.2	16.9	54.9	20.7	54.2	15.2	8	27.45	38.02	54.9
TPH												
Total Petroleum Hydrocarbo					649	22 U	610	22.2 U	4	325.80	683.47	649

* Between 0 and 2 feet deep

J Estimated value below reporting limit or estimated based on data quality criteria.

U Non-detect, value shown i s one-half the reporting limit

TABLE 6-21

CHEMICALS OF CONCERN IN SOILS SWMUs 61, 62, AND 63
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Volatile Organics					
Bromoform	0.0029	---	---	---	Y
1,2-Dichloroethane	0.0028	---	---	---	Y
2-Hexanone	0.0096	---	---	---	Y
4-Methyl-2-pentanone	0.006	---	---	---	Y
1,1,2,2-Tetrachloroethane	0.0029	---	---	---	Y
Toluene	0.0029	---	---	---	Y
Xylenes	0.0029	---	---	---	Y
Semivolatile Organics					
Acenaphthene	0.12	---	---	---	Y
Anthracene	0.21	---	---	---	Y
Benzo(a)anthracene	1	---	---	---	Y
Benzo(a)pyrene	0.9	---	---	---	Y
Benzo(b)fluoranthene	1.8	---	---	---	Y
Benzo(g,h,i)perylene	0.39	---	---	---	Y
Butyl benzyl phthalate	0.12	---	---	---	Y
Carbazole	0.1	---	---	---	Y
Chrysene	1.1	---	---	---	Y
Dibenzofuran	0.053	---	---	---	Y
Fluoranthene	1.7	---	---	---	Y
Fluorene	0.1	---	---	---	Y
Ideno(1,2,3-cd)pyrene	0.4	---	---	---	Y
2-Methylnaphthalene	0.17	---	---	---	Y
Naphthalene	0.17	---	---	---	Y
Phenanthrene	1.4	---	---	---	Y
Pyrene	2.2	---	---	---	Y
Metals					
Aluminum	8910	10540	5000	700 - 100000	N
Arsenic	4.1	15.5	6.5	1.0 - 40	N
Barium	717	642	500	10 - 5,000	Y
Beryllium	0.61	0.73	1 - 2	<1 - 15	N
Cadmium	0.85	*	---	0.01 - 2.0	N
Calcium	65700	186400	---	---	N**
Chromium	16.1	12.5	30	5 -1,500	N
Cobalt	4.2	4.5	3 - 7	0.5 - 65	N
Copper	11.6	*	20	1 - 700	N
Iron	9190	8720	15000	100 - 100000	N
Lead	84.4	25.8	15	10 - 700	Y
Magnesium	1970	11790	---	---	N**
Manganese	383	164	500	20 - 10000	N
Mercury	0.25	*	0.32	<0.01 - 4.6	N
Nickel	8.3	9	15	2 - 750	N

TABLE 6-21

CHEMICALS OF CONCERN IN SOILS SWMUs 61, 62, AND 63
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Potassium	1810	2572	---	---	N**
Silver	0.91	*	---	0.01 - 8	N
Sodium	375	*	---	---	N**
Vanadium	22.3	25.3	---	---	N
Zinc	54.9	21.9	45	<5 - 2900	Y
TPH	649	---	---	---	Y

(1) Upper Tolerance Limit (UTL) of the mean = mean + 2 x standard deviation. This is for all practical purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k = 2.02 for n = 37

(2) USGS (1984)

(3) Values mainly from Bowen (1979). Values for copper, lead, selenium, and zinc from USGS (1984).

* Data insufficient to calculate UTL of background concentration.

** Essential nutrient natural to soils. Not expect to be of concern compared to other COCs.

Y = Yes

N = No

--- = Not available

TABLE 6-22

RISK CHARACTERIZATION SUMMARY - SWMU 63

Chemical	CAN061-0611-0000	CAN061-0612-0000	CAN062-0621-0000	CAN062-0622-0000	CAN063-0631-0000	CAN063-0631-0002	CAN063-0632 0000	CAN063-0632-0002	N	Arithmetic Mean (mg/kg)	Robin Benchmark Dietary Level (mg/kg)	Risk?
Volatile Organics												
Bromoform	0.0029 U	0.0029 U	0.0029 U	0.0012 J					4	0.0025	250	--
1,2-Dichloroethane					0.0015 J	0.0028 U	0.0027 U	0.0028 U	4	0.0025	312.5	--
2-Hexanone	0.006 U	0.006 U	0.006 U	0.0096 J					4	0.0069	457	--
4-Methyl-2-pentanone	0.006 U	0.006 U	0.006 U	0.0055 J					4	0.0059	250	--
1,1,2,2-Tetrachloroethane	0.0029 U	0.0029 U	0.0029 U	0.0014 J					4	0.0025	0.055	--
Toluene	0.0029 U	0.0005 J	0.0012 J	0.0029 U	0.0027 J	0.0028 U	0.0027 U	0.0028 U	8	0.0023	223	--
Xylenes (total)	0.0029 U	0.0028 J	0.0029 U	0.0029 U	0.0011 J	0.0028 U	0.0027 U	0.0028 U	8	0.0026	2500	--
Semivolatile Organics												
Acenaphthene					0.058 J		0.12 J		2	0.09	0.4	--
Anthracene					0.096 J		0.21 J		2	0.15	5000	--
Benzo(a)anthracene					0.37		1		2	0.69	0.4	Possible (slight)
Benzo(a)pyrene					0.46		0.9		2	0.68	0.002	Possible
Benzo(b)fluoranthene					0.99 J		1.8		2	1.40	8	--
Benzo(g,h,i)perylene					0.28 J		0.39		2	0.34	375	--
Butyl benzyl phthalate					0.12 J		0.05 J		2	0.09	470	--
Carbazole					0.066 J		0.1 J		2	0.08	250	--
Chrysene					0.72 J		1.1		2	0.91	12	--
Dibenzofuran					0.051 J		0.053 J		2	0.05	3.3	--
Fluoranthene					0.9 J		1.7		2	1.30	625	--
Fluorene					0.059 J		0.1 J		2	0.08	625	--
Ideno(1,2,3-cd)pyrene					0.25 J		0.4		2	0.33	14.4	--
2-Methylnaphthalene					0.12 J		0.17 U		2	0.15	815	--
Naphthalene					0.08 J		0.17 U		2	0.13	267.50	--
Phenanthrene					0.67 J		1.4		2	1.04	150	--
Pyrene					1.1 J		2.2		2	1.65	375	--
Metals												
Barium	80.7	99.1	72.3	87.8 J	717	96.9	279	74.8	8	188.45	1250	--
Lead	7.4	7.3	7	7.3	84.4 J	12	82.6	6.2	8	26.78	87.5	--
Zinc	20.6	20.9	16.2	16.9	54.9	20.7	54.2	15.2	8	27.45	875	--
TPH												
Total Petroleum Hydrocarbo					649	22 U	610	22.2 U	4	325.80	241	Possible

* Between 0 and 2 feet deep
J Estimated value below reporting limit or estimated based on data quality criteria.
U Non-detect, value shown is one-half the reporting limit

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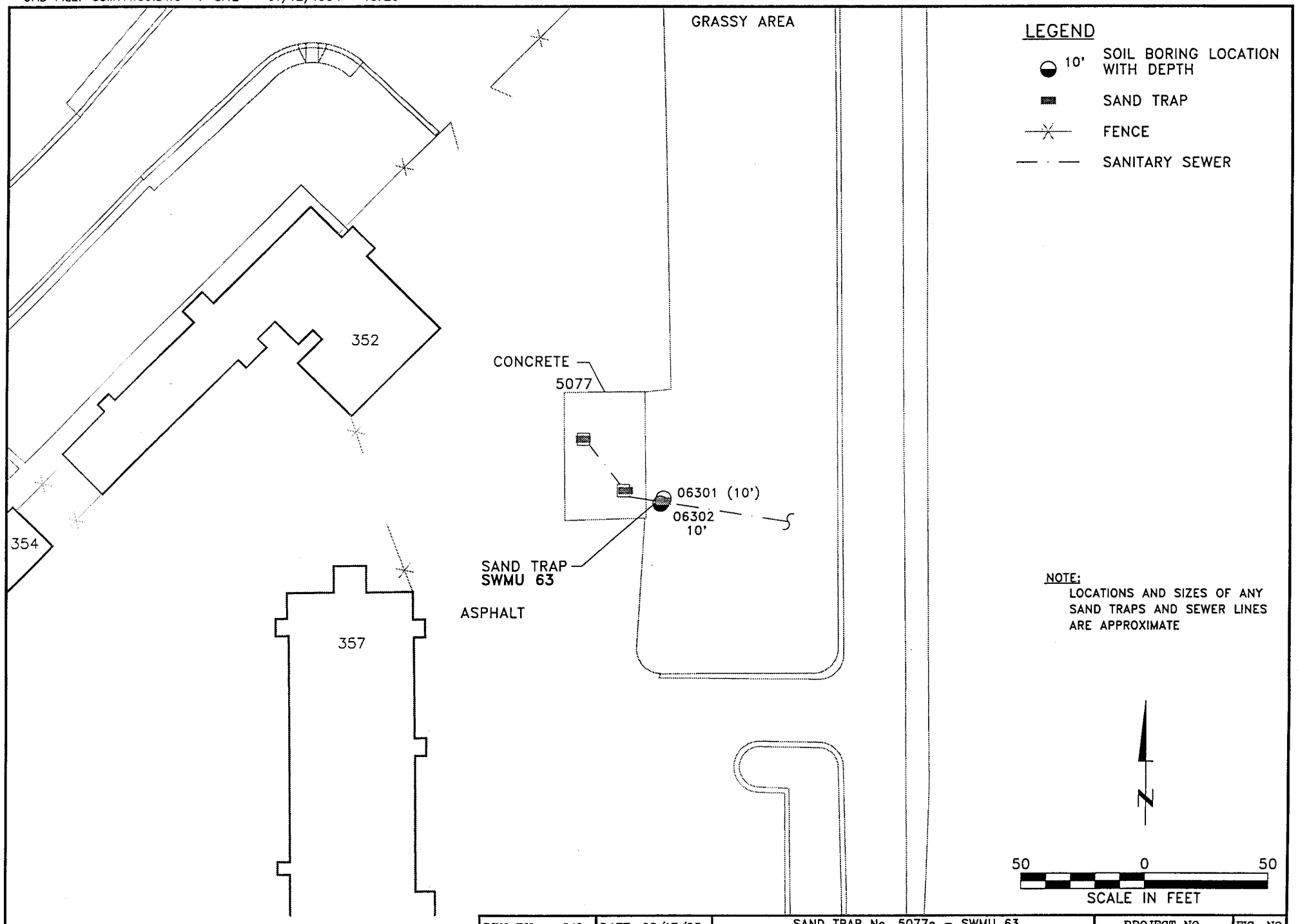
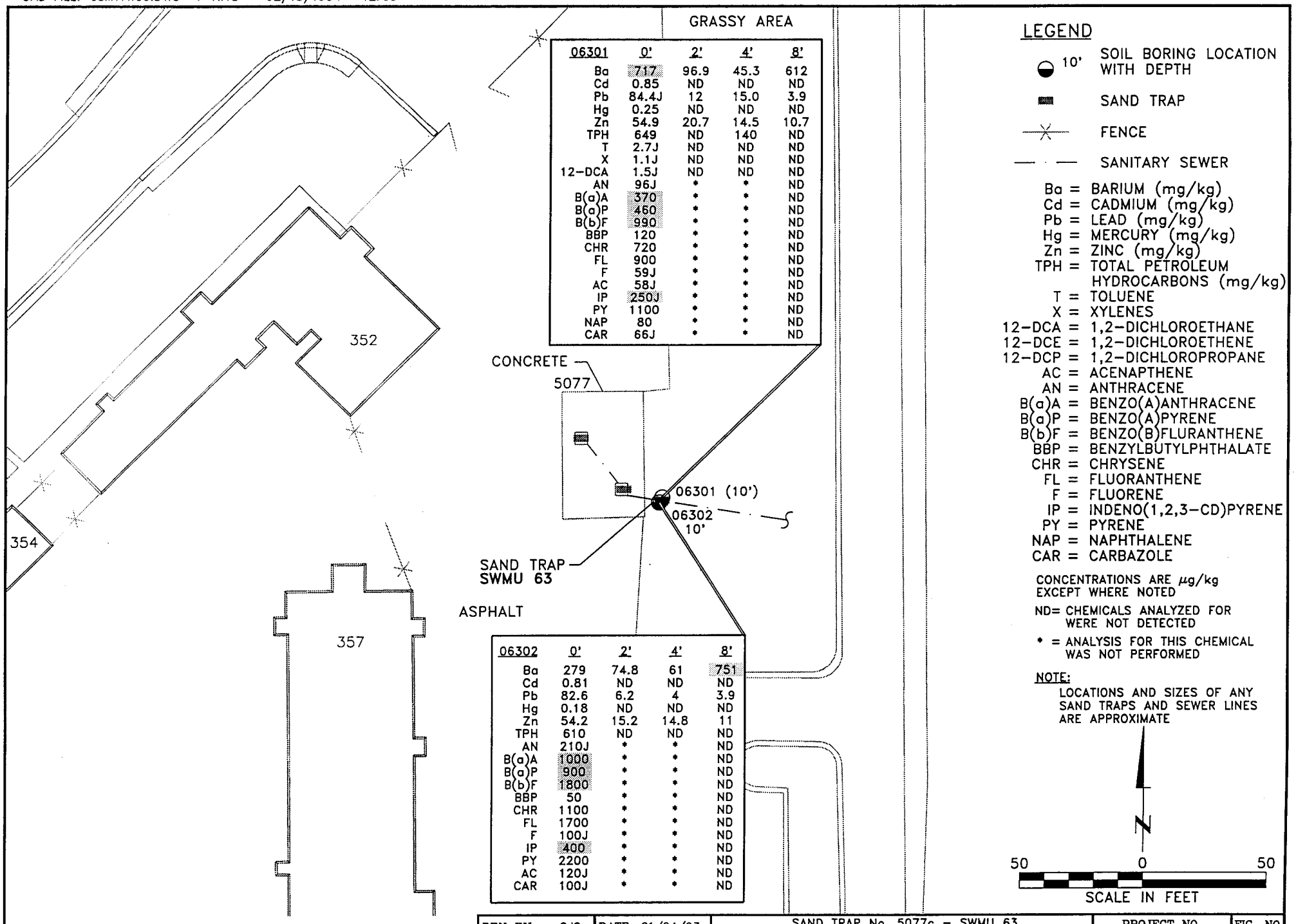


SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	SAND TRAP No. 5077c – SWMU 63 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 6–1

CAD FILE: C3M11W06.DWG V=HITS 02/15/1994 12:09



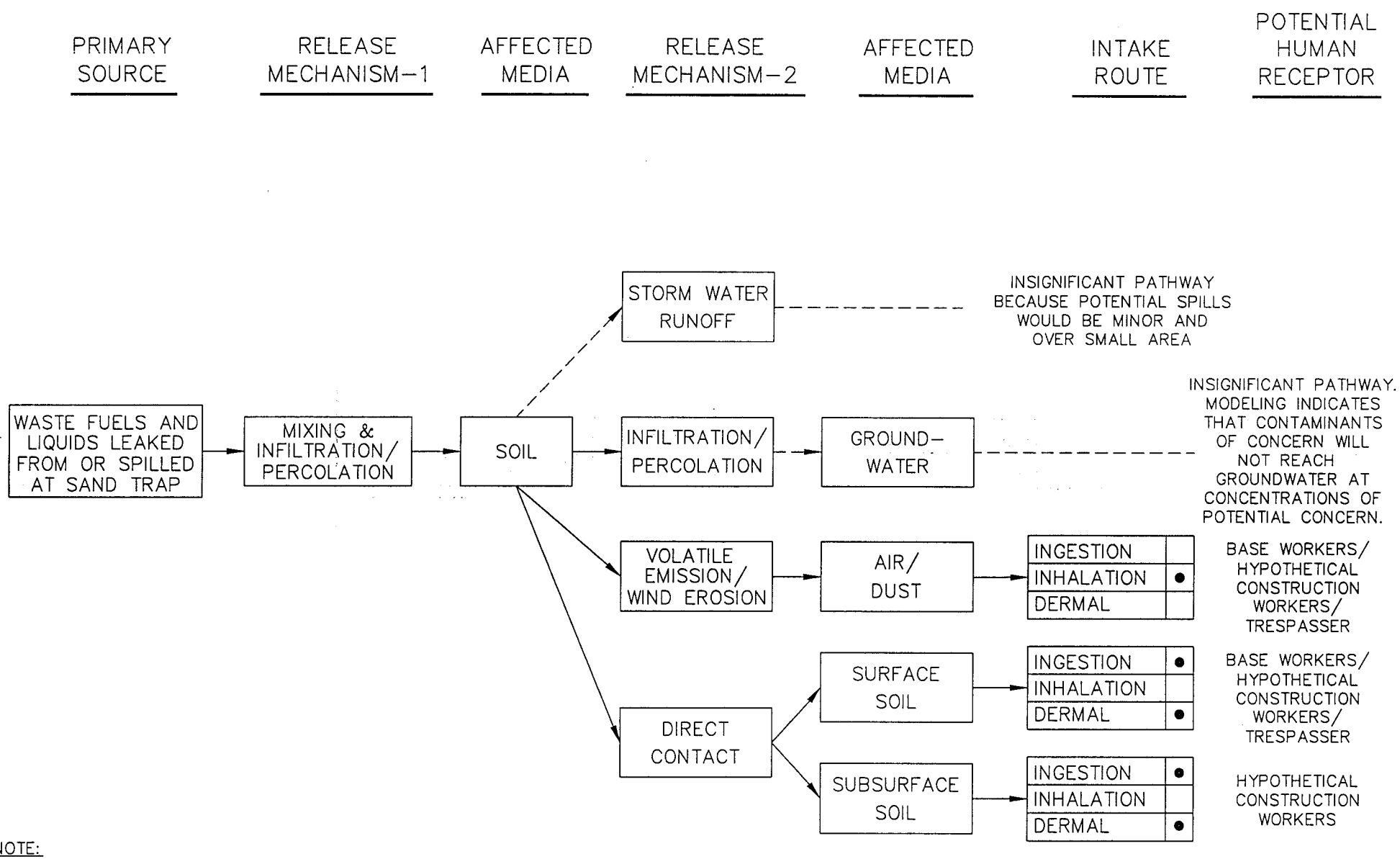
06301	0'	2'	4'	8'
Ba	717	96.9	45.3	612
Cd	0.85	ND	ND	ND
Pb	84.4J	12	15.0	3.9
Hg	0.25	ND	ND	ND
Zn	54.9	20.7	14.5	10.7
TPH	649	ND	140	ND
T	2.7J	ND	ND	ND
X	1.1J	ND	ND	ND
12-DCA	1.5J	ND	ND	ND
AN	96J	*	*	ND
B(a)A	370	*	*	ND
B(a)P	460	*	*	ND
B(b)F	990	*	*	ND
BBP	120	*	*	ND
CHR	720	*	*	ND
FL	900	*	*	ND
F	59J	*	*	ND
AC	58J	*	*	ND
IP	250J	*	*	ND
PY	1100	*	*	ND
NAP	80	*	*	ND
CAR	66J	*	*	ND

06302	0'	2'	4'	8'
Ba	279	74.8	61	751
Cd	0.81	ND	ND	ND
Pb	82.6	6.2	4	3.9
Hg	0.18	ND	ND	ND
Zn	54.2	15.2	14.8	11
TPH	610	ND	ND	ND
AN	210J	*	*	ND
B(a)A	1000	*	*	ND
B(a)P	900	*	*	ND
B(b)F	1800	*	*	ND
BBP	50	*	*	ND
CHR	1100	*	*	ND
FL	1700	*	*	ND
F	100J	*	*	ND
IP	400	*	*	ND
PY	2200	*	*	ND
AC	120J	*	*	ND
CAR	100J	*	*	ND

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/04/93	SAND TRAP No. 5077c – SWMU 63 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 6-2

CAD FILE: C3M11W20.DWG V=SWMU-63 01/17/1994 13:30



NOTE:

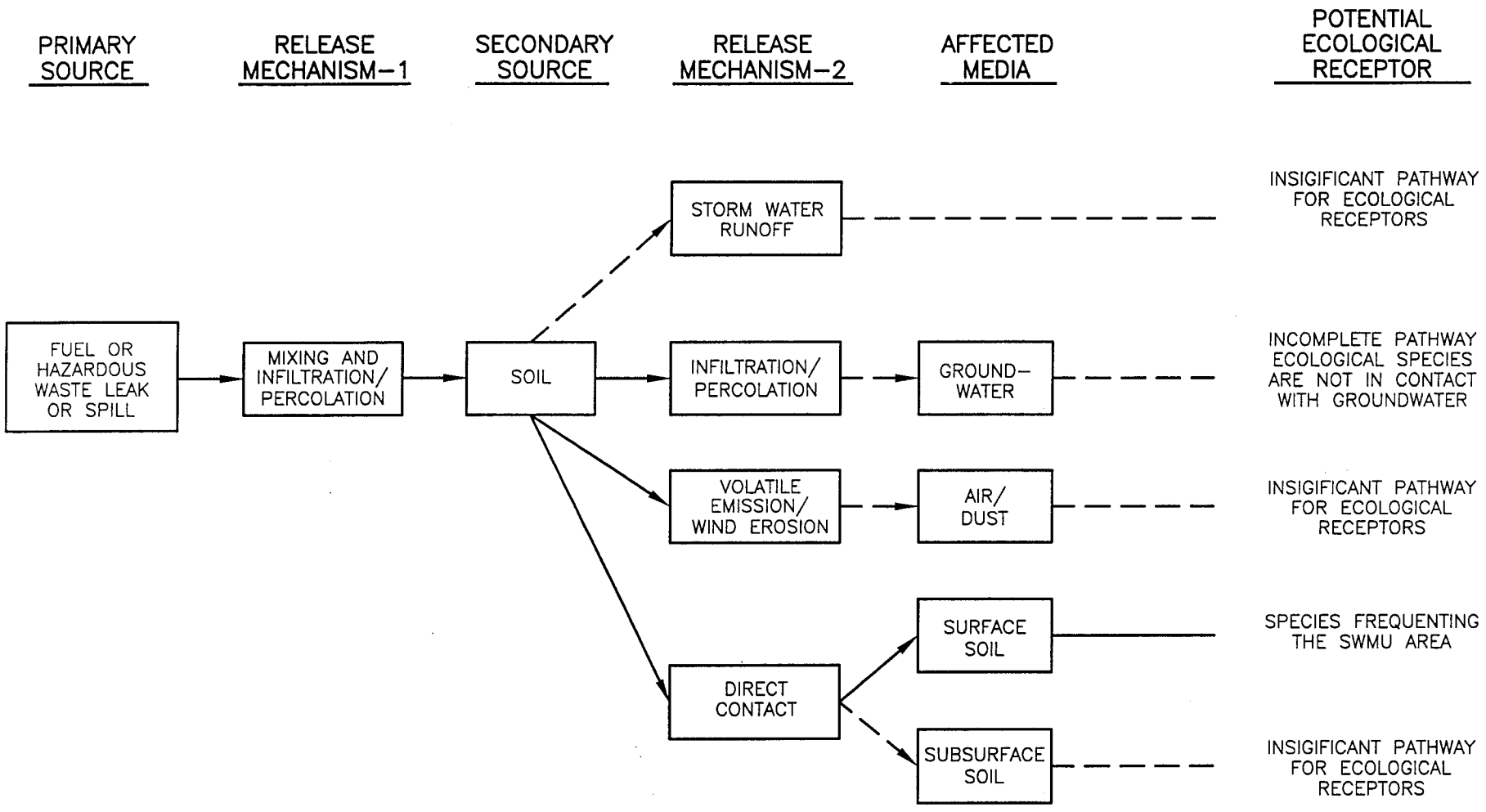
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART SAND TRAP 5077C SWMU 63 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	6-3

C3M11W22.DWG V=SWMU-63 02/15/1994 8:00

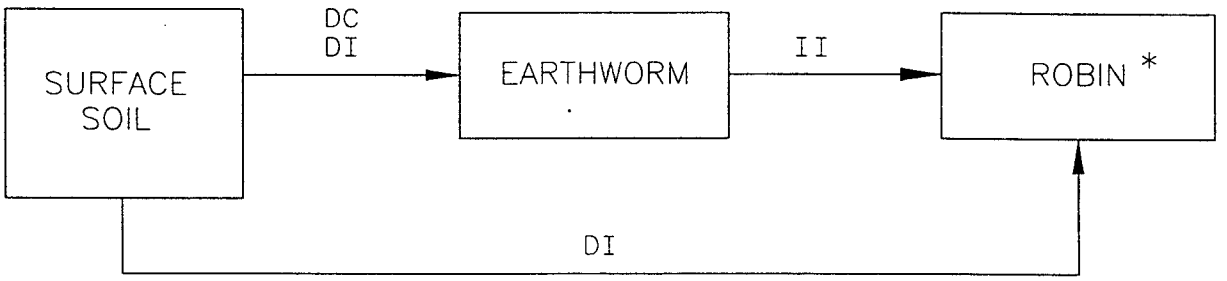


NOTES:

SOLID LINES REPRESENT POTENTIALLY COMPLETE AND SIGNIFICANT PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY NVD	DATE 12/30/93	EXPOSURE PATHWAY FLOW CHART FOR SWMU 63 ECOLOGICAL RECEPTORS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0		C3M11W	6-4



DC = DIRECT CONTACT

DI = DIRECT INGESTION

II = INDIRECT INGESTION
(i.e. SECONDARY, TERTIARY CONSUMPTION)

* = KEY RECEPTOR SPECIES

DRN BY NVD	DATE 12/30/93	CONCEPTUAL SITE MODEL SWMU 63	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0	CANNON AIR FORCE BASE NEW MEXICO	C3M11W	6-5

CAD FILE: C3M11W23.DWG V=SWMU-63 02/15/1994 9:30

VOLUME II
APPENDIX A-1 QCSR

RCRA FACILITY INVESTIGATION

APPENDIX III
SWMUs - PHASE I

CANNON AIR FORCE BASE

NEW MEXICO

Prepared for
Cannon Air Force Base
27 CES/CEVR
Environmental Flight

February 1994

C3M11W

APPENDIX A

QCSR REPORT

QUALITY CONTROL SUMMARY REPORT

APPENDIX III SWMUs

CANNON AFB, NEW MEXICO

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1.0
PROJECT DESCRIPTION

1.1 SCOPE

RCRA Facility Investigation (RFI) field activities were performed at Cannon Air Force Base in Clovis, New Mexico, by Woodward-Clyde (W-C) as contracted by the U.S. Army Corps of Engineers (USACE). This Quality Control Summary Report (QCSR) includes a description of the project as well as the field and laboratory quality control activities. The analytical data are summarized and review of the data quality and usability is provided.

To assess the reliability of the data, certain quality assurance/quality control (QA/QC) procedures were implemented as identified in the Cannon AFB RFI QAPP (W-C 1993). These activities included the documentation of field and laboratory procedures and the collection and analysis of QA/QC samples. The documentation provides a historical record of activities conducted during the field investigation and provides a mechanism for tracking samples from collection through laboratory analysis. The QC samples collected and analyzed included field duplicates, rinsates, matrix spike/matrix spike duplicate (MS/MSD), and trip blank samples. All analyses were performed by W-C's subcontract laboratory, ENSECO Rocky Mountain Analytical Laboratories (ENSECO RMAL) of Arvada, Colorado. Additional quality assurance (QA) samples, which consisted of split/duplicates, rinsate, and trip blank samples, were analyzed by the USACE Missouri River Division Laboratory (MRDL). The MRDL QA sample results can be used to assess precision and accuracy of the data collected from each Solid Waste Management Unit (SWMU). The MRDL QA sample results are not currently available to W-C and, therefore, are not discussed in this report.

1.2 REPORT INTEGRATION

This QCSR addresses quality control practices employed for this RFI. Issues covered in the document include a discussion of all data points which may have been influenced or compromised and their impact on the data quality objectives or remedial decisions.

While the QCSR is a stand-alone document, it will be incorporated into and referenced by the Cannon AFB RFI report and together the documents will be submitted as a single deliverable to meet USACE scope of services requirements. Sections or topics of these documents may be similar in content; however, each addresses specific topics required to meet appropriate guidance for the preparation of the respective documents.

1.3 SITE DESCRIPTION

Cannon AFB is located in Curry County, New Mexico, approximately 7 miles west of the City of Clovis. The base is situated on approximately 4,320 acres of land. The vicinity map of Cannon AFB and the site map of Cannon AFB can be found in the RFI report. Off-base facilities include the Melrose Bombing Range and the Conchas Lake Recreation Annex. Additional site description is presented in Section 1.4 of the RFI report, Volume 1A.

1.4 OVERVIEW OF SAMPLING EFFORT

The Appendix III SWMUs include 16 SWMUs located at 14 separate sites within Cannon AFB. In accordance with a Scope of Services for this work prepared by the USACE - Omaha District Office, approximately 400 soil samples from thirteen of the sites, and three surface water and four sludge (or sediment) samples from the other site (Playa Lake - SWMU 103) were collected to determine the nature of the contamination at each site in accordance with the approved work plan. A SWMU-specific site description and a summary of sampling and results is provided in Section 4.0 of this QCSR. This project did not include sampling of the groundwater.

2.0
LABORATORY ACTIVITIES

2.1 LABORATORY PROCEDURES

The general laboratory procedures utilized for the RFI at Cannon AFB are summarized in Table 2-1 and include EPA SW-846 and other appropriate EPA methodologies. The specific analyses utilized for each SWMU are presented in Sections 6.0 through 19.0 of the RFI. Specific laboratory practices for the methods listed below, including sample preparation, sample tracking, and documentation controls, were provided in the Laboratory Quality Management Plan located in Appendix C of the QAPP.

2.1.1 Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOCs) include compounds among varying classes such as halogenated organics, nonhalogenated organics, and aromatic organics. The first two classes generally contain contaminants associated with solvents such as TCE. The third class includes compounds associated with petroleum hydrocarbons such as BTEX.

Method 8240, modified for the use of a capillary column, was selected for this project as it is a GC method appropriate for analysis of suspected VOCs and employs mass spectrometry (MS) for detection. The power of GC/MS lies in the capacity for positive identification at project-required quantitation limits.

2.1.2 Semivolatile Organic Compounds (SVOCs)

Method 8270 was utilized as it is a GC/MS method appropriate for determining SVOCs (base/neutral and acid extractable). This procedure was selected to detect the general classes of compounds such as phenols, nitrosamines, polyaromatic hydrocarbons (PAHs), and other less volatile compounds of concern.

2.1.3 Organochlorine Pesticides and PCBs

The organochlorine pesticides and highly chlorinated aroclors or polychlorinated biphenyls (PCBs) are persistent in the environment and, therefore, more available for exposure or bioaccumulation. GC Method 8080, with the associated sample extraction, was performed on samples collected from areas where these compounds may have been utilized or disposed.

2.1.4 Chlorinated Herbicides

Chlorinated herbicides were analyzed using GC Method 8150. Method 8150 is a gas-chromatographic method employing an electron capture detector or an electrolytic conductivity detector.

2.1.5 Petroleum Hydrocarbons

Total recoverable petroleum hydrocarbons (TRPH) analysis of samples collected from areas where suspected or known releases or disposal of fuels, waste petroleum, oil, and lubricants was performed. The methodology used for the Cannon AFB RFI, Method 418.1, employed infrared (IR) spectrophotometry. Soils required preparation by soxhlet extraction Method 9071 prior to analysis.

2.1.6 Cyanide

Method 9012 was used for the analysis of cyanide in surface water. Cyanide analysis was performed when analysis of Appendix IX data was specified.

2.1.7 Sulfide

Sulfide analysis was performed for surface water where Appendix IX constituents were specified using EPA Method 376.2.

2.1.8 Metals

The methodology for metals analyses is provided in Table 2-1. The following are various factors which influence the use of particular methods:

- Detection limits
- Interference
- Stability
- Project-specific DQOs

Most metals, with a few exceptions (see Table 2-1), were detected at levels appropriate for Cannon AFB DQOs by inductively coupled plasma emission spectroscopy (ICP). Method 6010 is indicated for water and soil for ICP analysis. Atomic absorption (AA) methods for arsenic, lead, mercury, selenium and thallium were utilized to achieve lower detection limits.

2.2 LABORATORY QA/QC SAMPLES

2.2.1 Method or Preparation Blank

The method blank consisted either of deionized water for water analysis or washed sea sand for analysis of solids. The method blank was carried through each step of the analytical method. The method blank data were used to evaluate contamination attributed to laboratory operations during analysis.

2.2.2 Surrogate Spikes

Surrogate spikes were compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard when specified in the analytical methodology. The results were utilized to evaluate the accuracy of analytical measurement on a sample-specific basis. Surrogates are generally brominated, fluorinated, or isotopically labeled compounds not expected to be detected in environmental media. Results were expressed as percent recovery (% R) of the surrogate spike. Recoveries outside of criteria are evidence of matrix interference.

2.2.3 Laboratory Control Samples (LCS)

Laboratory control samples (LCS) were well-characterized, laboratory-generated samples and were used to monitor the laboratory's day-to-day performance of analytical methods. Certain LCS were used to monitor the precision and accuracy of the analytical process independent of matrix effects. Other LCS were used to identify any background interference or contamination of the analytical system which may have lead to the reporting of elevated concentration levels or false positive results.

The results of the LCS were compared to well-defined evaluation criteria to determine whether the laboratory system is "in control". Controlling lab operations with LCS (rather than surrogates or MS/MSD) offers the advantage of being able to differentiate low recoveries due to procedural errors from those due to matrix effects.

2.2.4 Analytical Spike

An analytical spike was performed and utilized in the graphite furnace atomic absorption analyses. Analytical spikes were post-digestion spikes prepared prior to analysis by adding a known quantity of the analyte to an aliquot of the digested sample. The unspiked sample aliquot compensated for any volume change in the spike samples by addition of deionized water to the unspiked sample aliquot. The volume of the spiking solution added did not exceed 10 percent of the analytical sample volume. Both the unspiked and spiked samples were analyzed in identical fashion. Analytical spike recoveries on each sample were utilized to determine whether or not the sample analytical result must be quantified through the method of standard additions.

2.3 LABORATORY REPORTING LIMITS

In accordance with the QAPP for this project, nominal laboratory reporting limits were generally three to five times above the method detection limit (MDL-the minimum concentration of a substance that can be identified, measured and reported with confidence as a concentration greater than "zero" following the prescribed methodology) or instrument detection limit (IDL-the smallest signal above background noise that an instrument can detect) depending upon the method.

MDLs and IDLs are method and instrument specific determinations made on pure water spiked with the analyte of interest. Since multiple instruments and multiple operators were involved in the analyses for this project, the nominal reporting limits were established based upon an inter-instrument, matrix-specific single laboratory determination of the level that could be reliably achieved within QAPP specified limits of precision and accuracy during routine laboratory operations on samples free from interference or matrix effects. Tables 2-2 through 2-7 list the MDLs or IDLs for each method.

2.3.1 Values Reported Below Reporting Limits

While reporting limits were set at levels above MDL or IDL, the analyst was able to identify the presence of analytes below reporting limits. Even though this data didn't meet the specified limits for reliable quantitation, an additional level of reporting was requested from the laboratory in order to track analyte identification. For volatile organic compounds analyzed by EPA Method 8240, estimated values (flagged "J") were reported down to 1/5th the reporting limit. For semivolatile organic compounds analyzed by EPA Method 8270, estimated values were reported down to 1/10th the reporting limit. For GC methods such as EPA Method 8080 for pesticide/PCB analysis, estimated values were reported down to 1/2 the reporting limit. For inorganic data, estimated values were reported down to IDLs.

TABLE 2-1

ANALYTICAL PROCEDURES FOR CANNON AFB SITE INVESTIGATIONS

Parameter	Technique[1]	Extraction and Analysis Method	
		Water	Soil
Volatile Organics	GC/MS	8240	8240
Semivolatile Organics	GC/MS	3510/8270	3540 or 3550/8270
Organochlorine Pesticides and PCBs	GC	3550/8080[2]	3550/8080[2]
Chlorinated Herbicides	GC	8150	8150
Metals[3]	ICP	3010/6010	3050/6010
Arsenic	GFAA	3020/7060	3050/7060
Lead	GFAA	3020/7421	3050/7421
Mercury	CV	7470	7471
Selenium	GFAA	3020/7740	3050/7440
Thallium	GFAA	3020/7841	3050/7841
Other Analytes			
TPH	IR	NA	9078/418.1
Cyanide	Colormetric	9012	9010/9012
Sulfide	Colormetric	376.2	376.2

1 GC = Gas chromatograph, GC/MS = gas chromatography/mass spectrometry, ICP = inductively coupled plasma, GFAA = graphite furnace atomic absorption, CV = cold vapor. The 3000-9000 methods are from the 3rd Edition, SW-846. Method 418.1 is from EPA 600/4-79-020 (1983).

2 If peak detection and identification are prevented due to interferences from other organic compounds, the extract will be cleaned up by Method 3620; if elemental sulfur is evident in the chromatogram, then the extract will be cleaned up by Method 3660.

3 Includes the following metals: aluminum, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, tin, vanadium, and zinc.

4 NA = Not applicable

TABLE 2-2

METHOD 8240 - MDL

Enseco - RMAL 9/92 Analyte	Water MDL µg/L	Soil MDL µg/kg
Dichlorodifluoromethane	0.73	0.73
Chloromethane	0.58	0.58
Vinyl chloride	0.42	0.42
Bromomethane	0.4	0.4
Chloroethane	1.02	1.02
Dichlorofluoromethane	0.44	0.44
Trichlorofluoromethane	0.37	0.37
1,1-Dichloroethene	0.59	0.59
Acrolein	7	7
Iodomethane	0.71	0.71
Carbon disulfide	0.8	0.8
Trichlorotrifluoroethane	0.63	0.63
Acetone	3.9	3.9
Methylene chloride	0.25	0.25
trans-1,2-Dichloroethene	0.55	0.55
Acrylonitrile	4.76	4.76
tert-Butyl methyl ether	0.53	0.53
Hexane	0.62	0.62
1,1-Dichloroethane	0.38	0.38
cis-1,2-Dichloroethene	0.44	0.44
1,2-Dichloroethene (total)	0.92	0.92
2-Butanone	2.17	2.17
Chloroform	0.2	0.2
1,2-Dichloroethane	0.35	0.35
Dibromomethane	0.27	0.27
Vinyl acetate	0.72	0.72
1,1,1-Trichloroethane	0.29	0.29
Carbon tetrachloride	0.3	0.3
Benzene	0.2	0.2
Trichloroethene	0.25	0.25
1,2-Dichloropropane	0.32	0.32
Bromodichloromethane	0.21	0.21
2-Chloroethyl vinyl ether	5.44	5.44
cis-1,3-Dichloropropene	0.7	0.7
trans-1,3-Dichloropropene	0.25	0.25
1,1,2-Trichloroethane	0.51	0.51

TABLE 2-2

METHOD 8240 - MDL (Continued)

Enseco - RMAL 9/92 Analyte	Water MDL µg/L	Soil MDL µg/kg
Chlorodibromomethane	0.35	0.35
1,2-Dibromoethane	1.21	1.21
Bromoform	0.56	0.56
1,2,3-Trichloropropane	1.71	1.71
Toluene	0.33	0.33
4-Methyl-2-pentanone	1.18	1.18
Tetrachloroethene	0.21	0.21
Ethylmethacrylate	1.71	1.71
2-Hexanone	1.23	1.23
Chlorobenzene	0.19	0.19
Ethylbenzene	0.18	0.18
Xylene (total)	0.7	0.7
Styrene	0.19	0.19
1,1,2,2-Tetrachloroethane	0.87	0.87
m-Dichlorobenzene	0.46	0.46
p-Dichlorobenzene	0.43	0.43
o-Dichlorobenzene	0.54	0.54

TABLE 2-3

METHOD 8270 - MDL

Enseco - RMAL 8/92 Analyte	Water MDL µg/L	Soil MDL µg/kg
N-Nitrosodimethylamine	0.85	28
Phenol	0.49	16
Aniline	1.14	38
bis(2-Chloroethyl) ether	0.82	27
2-Chlorophenol	0.44	15
1,3-Dichlorobenzene	0.67	22
1,4-Dichlorobenzene	0.66	22
Benzyl alcohol	0.54	18
1,2-Dichlorobenzene	0.75	25
2-Methylphenol	0.48	16
bis(2-Chloroisopropyl) ether	1.15	38
4-Methylphenol	0.76	25
N-Nitroso-di-n-propylamine	0.64	21
Hexachloroethane	0.85	28
Nitrobenzene	0.53	18
Isophorone	0.32	11
2-Nitrophenol	0.37	12
2,4-Dimethylphenol	0.52	17
Benzoic acid	43.57	1,451
bis(2-Chloroethoxy)methane	0.63	21
2,4-Dichlorophenol	0.39	13
1,2,4-Trichlorobenzene	0.63	21
Naphthalene	0.35	12
4-Chloroaniline	0.8	27
Hexachlorobutadiene	0.62	21
4-Chloro-3-methylphenol	0.36	12
2-Methylnaphthalene	0.47	16
Hexachlorocyclopentadiene	0.92	31
2,4,6-Trichlorophenol	0.54	18
2,4,5-Trichlorophenol	0.37	12
2-Chloronaphthalene	0.75	25
2-Nitroaniline	0.55	18
Dimethylphthalate	0.94	31
2,6-Dinitrotoluene	0.56	19
Acenaphthylene	0.43	14
3-Nitroaniline	0.57	19
Acenaphthene	0.75	25
2,4-Dinitrophenol	18.12	603

TABLE 2-3

METHOD 8270 - MDL (Continued)

Enseco - RMAL 8/92 Analyte	Water MDL µg/L	Soil MDL µg/kg
4-Nitrophenol	4.98	166
2,4-Dinitrotoluene	0.33	11
Dibenzofuran	0.77	26
Diethylphthalate	1.04	35
Fluorene	0.67	22
4-Chlorophenyl-phenyl ether	1.27	42
4-Nitroaniline	0.69	23
4,6-Dinitro-2-methylphenol	11	366
N-Nitrosodiphenylamine	0.99	33
Azobenzene	0.46	15
4-Bromophenyl phenyl ether	0.81	27
Hexachlorobenzene	0.94	31
Pentachlorophenol	3.51	117
Phenanthrene	0.63	21
Anthracene	0.66	22
Carbazole	0.89	30
Di-n-butylphthalate	1.06	35
Fluoranthene	0.57	19
Benzidine	33.69	1,122
Pyrene	0.53	18
Butylbenzylphthalate	0.62	21
3,3-Dichlorobenzidine	0.95	32
Benzo(a)anthracene	0.71	24
Chrysene	0.34	11
bis(2-Ethylhexyl)phthalate	34.48	1,148
Di-n-octylphthalate	0.99	33
Benzo(b)fluoranthene	0.42	14
Benzo(k)fluoranthene	0.7	23
Benzo(a)pyrene	0.51	17
Indeno(1,2,3-cd)pyrene	0.47	16
Dibenzo(a,h)anthracene	0.4	13
Benzo(g,h,i)perylene	0.36	12
Pyridine	1.02	34
Quinoline	0.99	33

TABLE 2-4

METHOD 8080 - MDL

Method 8080 - MDL Enseco - RMAL 1/93 Analyte - Channels 44,42	Water MDL µg/L	Soil MDL µg/kg
alpha-BHC	0.008	0.27
gamma-BHC	0.011	0.37
** beta-BHC	0.005	0.17
Heptachlor	0.012	0.40
delta-BHC	0.008	0.27
Aldrin	0.006	0.20
Heptachlor epoxide	0.009	0.30
Endosulfan I	0.021	0.70
** 4,4-DDE	0.012	0.40
Dieldrin	0.012	0.40
Endrin	0.010	0.33
4,4-DDD	0.022	0.73
Endosulfan II	0.008	0.27
4,4-DDT	0.019	0.63
Endrin aldehyde	0.011	0.37
Endosulfan sulfate	0.020	0.67
Methoxychlor	0.012	0.40
Endrin ketone	0.017	0.57
alpha-Chlordane	0.010	0.33
gamma-Chlordane	0.009	0.30
Toxaphene*	0.145	4.83
PCB (based on Aroclor 1254)	0.081	2.70

TABLE 2-5

SW-846 METHOD 8150 - HERBICIDES BY GC

Enseco - RMAL 1/93 Analyte - Channel 63	Water MDL µg/L	Soil MDL µg/kg
Dalapon	2.89	57.8
Dicamba	0.06	1.2
MCPP	35	700
MCPA	25.8	516
Dichlorprop	0.07	1.4
2,4-D	0.27	5.4
Silvex	0.02	0.4
2,4,5-T	0.01	0.2
2,4-DB	0.41	8.2
Dinoseb	0.7	14

TABLE 2-6

METHOD 6010 - METALS BY ICP

Enseco - RMAL 1/93 Analyte	Water MDL µg/L	Soil MDL µg/kg
Aluminum	0.017	0.85
Antimony	0.014	0.7
Arsenic	0.041	2.05
Barium	0.001	0.05
Beryllium	0.0003	0.015
Boron	0.005	0.25
Cadmium	0.004	0.2
Calcium	0.104	5.2
Chromium	0.009	0.45
Cobalt	0.01	0.5
Copper	0.002	0.1
Iron	0.03	1.5
Lead	0.023	1.15
Lithium	0.0003	0.015
Magnesium	0.03	1.5
Manganese	0.003	0.15
Molybdenum	0.003	0.15
Nickel	0.003	0.15
Phosphorus	0.078	3.9
Potassium	0.138	5.9
Selenium	0.05	2.5
Silicon dioxide	0.364	18.2
Silver	0.003	0.15
Sodium	0.138	6.9
Strontium	0.018	0.9
Tin	0.084	4.2
Thallium	0.194	9.7
Titanium	2.0E-06	0.0001
Vanadium	0.004	0.2
Zinc	0.008	0.4

TABLE 2-7

OTHER METALS METHODS

Analyte	Water MDL mg/L	Soil MDL mg/kg
AA Instrument Detection Limits		
Mercury (1/93)	0.00012	0.06
Arsenic (12/92)	0.0005	0.05
Lead (12/92)	0.002	0.2
Selenium (12/92)	0.0013	0.13
Thallium (12/92)	0.0027	0.27
Wet Chemistry Method Detection Limits		
Sulfide	0.032	
Cyanide	0.0099	
TPH-IR	2.6	

3.1 PLANNED FIELD QUALITY CONTROL ACTIVITIES

Document review, prework decontamination and continuous cross-checking to compare proposed sampling activities to actual field samples collected took place prior to and concurrent with the field program implementation. This work assured that the samples collected during this program would meet prescribed W-C guidelines and satisfy the identified data objectives of the RFI. Documentation of sampling activities and sample shipment chain-of-custody (COC) records was designed to confirm that all proposed investigation activities were completed as planned and to record any deviations from standard operating procedure.

3.1.1 Document Review

Prior to the start up of field activities, project workplan documents were provided the members of the field sampling teams for their review. This facilitated their familiarization with the Appendix III SWMUs being investigated, the objectives of this investigation, and the Standard Operating Procedures under which the field activities are to performed. Sampling team personnel were briefed on the work to be performed under this task prior to project startup. The Field Sampling Plan (FSP) and sample summary tables developed for sample collection tasks were provided to each field team member for ready reference if questions should arise during the implementation of the field program. To facilitate the collection of the proper samples (sample depth, analytical suite), preprinted, adhesive sample labels were produced and supplied to the field teams. Coordination of field sampling activities was carried out by maintaining constant and open communication between project management personnel, the field manager and the field sampling teams.

3.1.2 Equipment Decontamination

Prior to field mobilization, all drilling equipment brought on site to Cannon AFB by the drilling subcontractor for use in this RFI was decontaminated by steam cleaning in accordance with QAPP SOP No. 1 - Equipment Decontamination. Decontamination activities by subcontractor personnel during the field investigation were overseen and verified at various times by sample team and field management personnel. The decontamination pad was located in a natural depression and was constructed from a new, 20 foot by 22 foot section of 80 mil thick HDPE overlain by another sheet of the same material used during previous RFI work at Cannon AFB. The drill rigs were driven onto the sheeting and decontaminated using a high-pressure, "Hotsy" steam cleaner prior to undertaking intrusive activities for this project. Prior to steam cleaning, augers and connecting rods were placed on a rack within a galvanized steel horse trough located on the sheeting. As the decontamination water, overspray and soil debris collected on the sheeting and in the trough, it was pumped from the pad area into storage drums as required. Equipment decontaminated prior to the commencement of field work included the two drill rigs, all downhole augers, bits, connecting rods and four new, stainless steel split spoon samplers.

All downhole equipment, including augers, bits and connecting rods, was steam cleaned between boring locations. This equipment was transported to the decontamination area as necessary, where it was subjected to the decontamination process described above. The split-spoon samplers were decontaminated between each sample depth/location with a liquinox and water wash, potable water rinse and a deionized water rinse in accordance with QAPP SOP No. 1 - Equipment Decontamination. Scrub brushes were provided in the wash and rinse tubs to assure the removal of all remnant soil and potential contaminants on the equipment. Deionized water was liberally sprayed over the sampling equipment as a final rinse. Decontaminated samplers were allowed to air dry, then placed in a clean, clear plastic trash bag or sprayed again with deionized water before sampling to prevent possible cross-contamination between sample sites.

3.1.3 Sample Summary Tables

Sample summary tables were prepared for use by sampling personnel during the field activities. These tables summarized planned sample collection on a SWMU by SWMU basis, including borehole designation, sample identification numbers, target analytes, and required QA/QC samples. All information concerning field duplicate samples, the number and prescribed frequency of rinsate, ambient blank and trip blank samples was presented on these tables to assure that all required samples were collected from each site. The information provided on the sample summary tables, the preprinted sample labels, and in the field sampling plan was cross-checked in the field by sampling team personnel to attempt to minimize any questions or inconsistencies concerning sample depths, target analytes or QA sample requirements. Any questions or inconsistencies arising during the field activities were directed to the field manager or project manager for resolution.

3.1.4 Field Equipment Calibration

Photoionization detectors (PIDs) were utilized to perform air monitoring during drilling operations and for headspace analysis of soil samples when necessary. The PIDs were calibrated daily in accordance with manufacturers instructions, QAPP SOP No. 14 - Headspace Analysis, and Site Safety and Health Plan guidelines. All PIDS were calibrated to 70 ppm with isobutylene span gas to provide a 1:1 response factor to benzene, the most hazardous contaminant expected in this field work.

Conductivity and pH meters utilized during the surface water sampling portion of the field investigation were calibrated prior to use in the field per the manufacturer's instruction manual and in accordance with QAPP SOP No. 10 - Surface Water Sampling.

3.1.5 Sample Collection Activities

Soil samples were collected during this field investigation in accordance with QAPP SOP No. 6 - Surface Soil Sampling, and QAPP No. 7 - Subsurface Drilling and Sampling. Sludge samples were collected in accordance with QAPP SOP No. 5 - Sludge and Sediment Sampling, while surface waters were sampled in accordance with QAPP SOP No. 10 - Surface Water Sampling. Quality assurance samples, including field duplicates, MS/MSD,

and Army Corp of Engineers Missouri River Division analytical laboratory were taken in accordance with the appropriate protocols. At those sites where VOA sample collection for laboratory analysis was dependent upon headspace analysis, the respective containers of sample material were covered with aluminum foil and allowed to stabilize for approximately 30 minutes before the headspace measurements were taken in accordance with QAPP SOP No. 14 - Headspace Analysis. Only certified, precleaned containers were used for sample collection.

Rinsate blank samples were collected at prescribed intervals to verify the effectiveness of field decontamination procedures and check for potential cross-contamination between sample intervals. These samples were collected by pouring a small amount of deionized water directly from a gallon jar over the decontaminated sampling implements and collecting the runoff for sample analysis. Volumes of deionized water poured and collected ranged from approximately 500 ml to a full gallon depending upon the rinsate target analytes for the individual SWMU. Individual rinsate samples ranged in volume from 80 ml to 2 liters. Ambient blank samples were collected to test for airborne contaminants which could influence the analytical results of samples collected. These blank samples consisted of bottles or vials of deionized water left open to the atmosphere in the vicinity of the sampling activities until their completion. Positive analytical results may indicate transient atmospheric conditions during sampling which potentially affect results for all samples collected at that site. Decon water samples were collected from the potable water source used to supply decontamination wash and rinse water to check for possible background contaminants in the water which could bias the analytical results of samples collected during this investigation.

Once collected, the sample was placed in the properly labeled sample container per FSP criteria. Containers for VOA analysis of soils and sludges were filled first from grab samples from the target interval, while the remaining material was homogenized in a stainless steel bowl with stainless steel scoops and spoons prior to filling the remaining sample containers. Adhesive sample labels, preprinted with the sample identification number, targeted analytes and type of QA sample, if applicable, were affixed to the sample container. Space for the sampler to initial and record the date and time of sampling was provided on each label to fully document the actual sampling event. Sample tags affixed to the respective sample container were covered with clear tape to prevent the tearing or loss of the sample identification label should it become wet or abraded during transit in the field sample cooler.

All coolers taken to the field for sample collection contained as a minimum approximately five pounds of ice to provide preservation of all soil, sludge and water samples collected.

All samples taken were documented in the field on the geologist's drilling log and in the sample technician's field logbook. Post fieldwork documentation consisted of completing Sample Collection Data Forms for all samples collected and to document the QA/QC samples associated with the primary sample.

At the conclusion of field work for the day, all samples collected that day were placed inside ziploc plastic bags with bubble wrap, placed in coolers with ice to maintain 4° C for sample preservation. Sample information, such as identification numbers, targeted analytes, sample times and QA/QC sample type was documented on COC forms for shipment to the analytical laboratory. Samples were typically shipped to the laboratory via express courier the day after the sampling event. Coolers containing samples were sealed with custody tape and kept in a locked trailer located in a locked, secured area. In those instances when shipping services dictated the storage of samples for a period of time prior to shipment, new ice was placed on the samples twice a day to maintain the proper temperature for sample preservation. Prior to shipment, all samples were placed within a clear plastic trash bag and tied off or taped to isolate sample materials from the cooler and ice melt during shipment. Approximately 20 pounds of fresh ice was double bagged in clear plastic trash bags and added to each sample cooler prior to shipment. Completed COC forms were signed, inserted in a ziploc bag and taped to the inside lid of the cooler. One copy of the completed COC was removed and retained for the field and office files. All QA/QC samples collected for analysis at the MRD laboratory and their COCs were labeled with the designation "LIMS #2112" to denote their project association.

Communication was made daily to the analytical laboratory to alert the facility as to the number and type of samples to be shipped that day for delivery within the next 24 hours. These conversations also allowed for the expedient resolution of questions or discrepancies arising from previously shipped samples. The condition of samples received to date was also ascertained to assure sample preservation integrity.

Daily Quality Control Reports were completed at the end of the respective day or early the following morning. These reports were completed by the field manager, who summarized

the day's events as related by the respective field sampling crews. Due to their summary nature, these reports do not include detailed information concerning the actual QA samples collected, routine decontamination of sampling equipment or calibration of field equipment.

3.2 DEVIATIONS FROM PLANNED FIELD QC ACTIVITIES

The implementation of this field investigation saw some minor deviations from planned field investigation activities. The majority of these deviations can be attributed to the rapid pace of mobilization and sample collection necessary to meet scheduled deliverable dates, the field conditions encountered, and occasional breakdowns in field communications. The deviations included simple mistakes, a lack of or poor field documentation, oversights or misunderstandings by field personnel, or an inability to complete the proposed task as specified. Deviations to the project plans are highlighted and explained below. The overall affect of each deviation on the quality of the sample data obtained in this investigation is expected to be minimal or nonexistent.

Document Review: An extremely rapid pace for work performed due to the tight field and reporting schedule may have prevented the field teams from taking adequate time to fully review and become familiar with the project work plan documents. This is evident by the inconsistent documentation in the field team member's logbooks of day-to-day field activities and sampling protocols followed; the failure of one sampling team to utilize furnished photographic equipment in photographing individual investigation sites; and, the fact that one team erroneously collected used decon rinse water for sample analysis early in the program (discussed in FSP below).

Decontamination: Proper documentation for the consistent use of an alconox/liquinox detergent in the high-pressure steam cleaner used in decontaminating downhole drilling equipment does not exist.

Field Instrument Calibration: Daily calibration of PIDs to be used in air monitoring and selecting samples based upon headspace analysis was not possible the first four days of field activities due to the supplier's failure to furnish a requested regulator valve for the isobutylene span gas required for calibration.

Field Sampling Plan: Deviations from the field sampling plan occurred in those instances where the sampled interval differed from the planned interval due to difficult drilling conditions, a lack of adequate sample recovery at the targeted interval, or a misunderstanding of sampling objectives by field team members. These deviations are detailed on the field boring logs and in the geologist's field logbook, and include the following samples:

CAN051-0512-0008: Field duplicate not collected due to insufficient sample recovery.

CAN057-0571-0008: Field duplicate moved to 4 feet to 6 feet interval due to likelihood of insufficient sample recovery.

CAN092-0924-0018: Apparent confusion on actual sample depth. Sample collected at either 13 feet to 15 feet or 18 feet to 20 feet.

CAN127-1275-0058: Auger refusal at 57 feet, sample taken at 57 feet to 59 feet.

CAN127-1278-0058: Auger refusal at 57 feet, sample taken at 57 feet to 59 feet.

CAN077-0772-7781: Decon water sample collected from used decon rinse water rather than from source of clean, potable decon water.

Sample Handling and Shipment: Sample handling and shipment also suffered minor deviations from planned activities. The rapid pace of work over the course of the field program prevented the desired frequency and level of cross-checking and verification of proposed samples between the FSP, the sample summary tables, and the actual samples collected and recorded on the COCs for sample shipment. Consequently, two proposed QA/QC samples, an ambient blank and a trip blank, were not included in the shipment of samples taken from SWMU #103, and were apparently not collected. Additionally, two instances occurred in which the COCs enclosed in the sample cooler shipped to the analytical laboratory did not account for all the samples that were included in the shipment. In some instances, the COC was incomplete, with some required analytes for a given sample suite not

marked. A minor deviation also occurred when a field crew was unable to tape over the adhesive sample labels when their tape gun was misplaced temporarily. Some of the sample labels became wet during storage, and one came off the sample container during COC preparation. This label was promptly replaced while other dampened labels were gently dried and overtaped prior to shipment.

Despite the special care taken to assure that all samples taken during the field investigation were properly wrapped, labeled, and preserved with enough ice to maintain proper temperature for at least two days, one cooler of QA/QC samples shipped to the USACE-MRD laboratory was logged in on arrival at some temperature warmer than the prescribed 4 ° C.

3.3 SAMPLE QUALITY SUMMARY

The potential impact the deviations listed above may have upon the overall quality of the field sampling effort and the data generated is expected to be minimal.

Document Review: While the lack of some documenting data in field logbooks is regrettable and makes the task of recreating the field experience more difficult, the overall affect upon the quality of data generated is perceived to be minimal. All field personnel assigned to this task possess significant experience in the implementation of environmental field sampling programs. This experience with standard W-C field procedures assures an adequate level of quality assurance in all tasks undertaken during this program. Field observations made by the site manager during frequent visits to the sampling teams indicated no persistent inconsistencies with the respective W-C protocols used in this study.

The lack of a photographic record of the boring sites drilled by one crew has no impact on data quality. While physical landmarks depicted in the photo may be useful in locating boring sites in future field endeavors, all sites except for water and sludge samples have been surveyed and can be accurately located on project base maps.

Decontamination: The lack of proper documentation of decontamination methods (i.e. the question of the use of liquinox while steam cleaning augers) will not be a valid rationale for questioning the quality of data generated under this study. The extreme temperature of the high-pressure steam sprayer will tend to volatize any VOAs, solvents or hydrocarbons which

could produce cross-contamination between sample locations. Additionally, the type of sampling technique used in this program, driving a stainless split-spoon sampler with an automatic hammer in advance of the drill bit and auger string, precludes the possibility of anything other than the stainless steel sampler coming in contact with the sampled soil material. Rinsate samples collected off these samplers will indicate if cross-contamination due to inadequate decontamination has occurred.

Field Instrument Calibration: To minimize the negative impact this situation could have on the field work schedule as well as insuring safe working conditions for field personnel, drill teams were dispatched to those SWMUs believed to have a lower probability of encountering volatile contamination. Equipment such as these PIDs are calibrated and charged at the supplier agency before being sent to the field, thus allowing their use for at least one field day with a degree of confidence in the data generated. Selection of samples based upon headspace analysis was carried out by using visual indications with the relative response of the PID on a sample-by-sample basis until a regulator valve arrived at the field site and proper calibration of equipment could take place.

Field Sampling Plan: The stated purpose of this investigation is to determine if a release of SWMU related compounds to the surrounding environment has occurred from SWMU related activities. The inability to collect a very small percentage of samples from their targeted interval does not jeopardize this stated objective. The samples collected are in close proximity to their targeted interval and will still produce data useful in determining the occurrence of a SWMU related release.

The taking of used decon water for a sample to determine background chemistry is also not critical as all decon water samples originated from the same hydrant source. Once the erroneous sample is identified and thrown out, the remaining decon water sample blanks should provide sufficient information to characterize the potable water for the purpose of this investigation.

Sample Handling and Shipment: The deviations listed in this section are relatively minor and have minimal impact upon sample data quality. The lack of an ambient blank for the samples from SWMU #103 should have minimal impact due to the generally static weather conditions encountered throughout the field program. Weather was excellent with a wind typically from

the southwest with the exception of one morning of gentle rain. It is believed that a sufficient number of ambient blank samples were collected from other SWMU sites to determine the presence of any problems associated with atmospheric contamination. Likewise, the abundance of trip blanks submitted in other sample shipments should indicate the potential for cross-contamination during shipment.

Problems with incomplete COCs were overcome by maintaining close communication with analytical laboratory personnel to correct and document these deficiencies. It is not believed that the integrity of the samples affected by these deviations has been comprised.

The situation of a sample cooler arriving at the USACE MRD laboratory with sample temperatures above 4°C can best be apprised by considering the actual sample temperature on arrival at the laboratory. Even with elevated temperatures there may be no significant effect. The samples arriving at the contract test laboratory were all at or below the 4°C temperature, and the status of the MRD samples would only impact the QA, not the actual samples.

3.4 EVALUATION OF THE QUALITY OF FIELD SAMPLING

The above discussion leads to the conclusion that the field sampling quality meets the requirements for this project, and does not impact the usability of any of the data.

4.0
DATA QUALITY REVIEW

As stated in the Cannon AFB QAPP (W-C 1993), all samples underwent a data review, with approximately 10 percent additionally having undergone a full validation. The following sections are the summaries of the respective data reviews for Cannon AFB. Attachment B presents the full validations performed for this project. Attachment A (Volume III) contains the full data summary tables.

4.1 DATA QUALITY REVIEW, AGE MAINTENANCE SHOP (SWMU 31)

4.1.1 SWMU 31 Site Description

The AGE Maintenance Shop Pad is an open concrete area adjacent to the southeast side of Building No. 186. The pad is approximately 60 to 70 feet wide and approximately 240 feet long. A wash rack occupies an area about 50 feet square beyond the southeast edge of the pad. Maintenance on aircraft support equipment is done in Building No. 186 and on the south and east portions of the pad. The AGE Maintenance Shop Facility has been active since 1971. Contaminants of concern include mineral and synthetic oils, JP-4 and diesel fuels, greases, solvents, and metals.

Water from rain and the wash-down water from engine cleaning and testing generally flows in an east and north direction across the pad into the AGE Drainage Ditch (SWMU No. 34). Stains are visible on the south and east portion of the pad. The north and west portions of the pad are free of stains. Although water tends to pond slightly along the wash rack drive (southeast edge of Building 186 maintenance pad), as-built drawings show no collector connected to the OWS. This SWMU does not include the wash rack or its drains or the OWS.

Samples were collected and analyzed for this SWMU as presented in Table 6-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in the sample delivery group SDG 031183.

4.1.2 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below criteria defined by SW-846 for selenium and thallium in several of the associated samples. All selenium data in this sample delivery group were qualified **J** due to low postdigestion spike recoveries to indicate a low bias. Similarly, all associated thallium data were qualified **J** except samples CAN031-0311-0008, CAN031-0314-0000, CAN031-0312-3162, CAN031-0311-0000, and CAN31-0311-0004.

No other qualifications based on the laboratory case narrative were required for the Age Maintenance Shop.

4.1.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical method. All samples collected for this SWMU were extracted/analyzed within acceptable holding times; therefore, no qualifications based on holding times were necessary.

4.1.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were nondetect for all SVOC, TPH, and metals method blanks for SWMU 31. Acetone and methylene chloride were detected in several of the associated VOC method blanks. Since these analytes are common laboratory contaminants, associated results were qualified nondetect if the results reported for associated samples were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected in the sample qualified nondetect if it was greater than the reporting limit to reflect decreased sensitivity. Samples qualified on the basis of method blank contamination are listed below:

W-C I.D.	Lab I.D.	Concentration	Qualification	Analyte	New RLs
CAN31-0311-0008	031183-0001	8.3	U	Acetone	--
CAN31-0311-0008	031183-0001	3.6	U	Methylene Chloride	--
CAN31-0313-0000	031183-0002	10	U	Acetone	--
CAN31-0313-0000	031183-0002	4.9	U	Methylene Chloride	--
CAN31-0314-3163	031183-0007	8.2	U	Acetone	--
CAN31-0314-3163	031183-0007	5.0	U	Methylene Chloride	--
CAN31-0314-0002	031183-0008	27	U	Acetone	27
CAN31-0314-0002	031183-0008	4.6	U	Methylene Chloride	--
CAN31-0312-0002	031183-0011	16	U	Acetone	16
CAN31-0312-0002	031183-0011	3.4	U	Methylene Chloride	--
CAN31-0312-3162	031183-0013	10	U	Acetone	--
CAN31-0312-3162	031183-0013	3.7	U	Methylene Chloride	--
CAN31-0312-0008	031183-0015	8.4	U	Acetone	--
CAN31-0312-0008	031183-0015	6.2	U	Methylene Chloride	6.2
CAN31-0314-0008	031183-0019	6.1	U	Acetone	--
CAN31-0314-0008	031183-0019	3.5	U	Methylene Chloride	--
CAN31-0314-3151	031183-0020	7.6	U	Acetone	--
CAN31-0314-3191	031183-0023	1.8	U	Acetone	--

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank each were collected and analyzed for SWMU 31. Analysis of these field blank samples indicated all target SVOCs and metals were nondetect. For VOC analyses, carbon disulfide was detected in the ambient and trip blanks. Associated sample data were nondetect; therefore, no qualifications were required based on field blank contamination. All other field blank VOC target compound data were nondetect.

4.1.5 Duplicate Control Sample (DCS)

Duplicate Laboratory Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. VOC, TPH, and metals DCS recoveries for the Age Maintenance Shop were within evaluation criteria and did not require qualifications based on

outlying DCS recoveries. DCS recoveries were within evaluation criteria except acenaphthene SVOC (57%). All associated data were nondetect and subsequently qualified **UJ** based on outlying DCS recoveries to indicate a potential low bias.

4.1.6 Reporting Limits (RL)

The sample reporting limit is the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

The following samples required dilutions which increase the QAPP reporting limits by greater than 5 times. While no qualification of data was required based on elevated reporting limits, the possibility exists that organic compounds may have been diluted to below the instrument detection limit.

W-C I.D.	Analyte	Method	Dilution
CAN031-0313-0000	SVOC	8270	25
CAN031-0311-0000	SVOC	8270	12
CAN031-0311-0000	Lead	7421	250
CAN031-0311-0000	Mercury	7471	385
CAN031-0311-0002	Mercury	7471	375
CAN031-0313-0000	TPH	418.1	10
CAN031-0311-0000	TPH	418.1	12
CAN031-0313-0000	Lead	7421	12
CAN031-0312-0000	Lead	7421	10
CAN031-0312-0002	Lead	7421	10
CAN031-0312-3161	Lead	7421	10

4.1.7 Surrogate Compound Percent Recoveries

Surrogate results were utilized to evaluate the accuracy of analytical measurement on a sample-specific basis. All SVOC surrogate spike recoveries were within evaluation criteria. All VOC surrogate recoveries were within evaluation criteria except for toluene-d_8 for sample CAN031-0314-3181, which was below evaluation criteria. VOC data for sample CAN031-0314-3181 were nondetect and qualified estimated nondetect **UJ** to indicate a low bias.

4.1.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses

MS/MSD analysis were performed to assess precision and accuracy. Recoveries for all organic MS/MSD analyses were within evaluation criteria. For metals analyses, barium and magnesium recoveries were above evaluation criteria. The MS recovery for manganese was greater than 200%; therefore, manganese data were rejected **R**. Detected barium results were qualified estimated **J** to indicate a potential high bias. Barium and manganese were qualified in the following:

CANO31-0311-0000	CANO31-0312-0000	CANO31-0313-0000	CANO31-0314-0000
CANO31-0311-0002	CANO31-0312-0002	CANO31-0313-0002	CANO31-0314-0002
CANO31-0311-0004	CANO31-0312-0004	CANO31-0313-0004	CANO31-0314-0004
CANO31-0311-0008	CANO31-0312-0008	CANO31-0313-0008	CANO31-0314-0008

4.1.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Three duplicate soil samples were collected and analyzed. Evaluation criteria for field duplicate samples were defined in the Cannon AFB QAPP (W-C 1993). Detected chemicals and qualifications based on relative percent difference (RPD) are presented in Table 4.1-1 through Table 4.1-3

4.1.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 148 of the 151 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 98 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 4 of the 92 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 96 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 213 of the 214 indicators reviewed for precision were within evaluation criteria; therefore, 99 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were

within acceptable evaluation criteria. For metals analyses, only 2 of the 69 indicators reviewed for precision required qualification of associated data. Therefore, 97 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Three field duplicate soil samples were collected and analyzed. Samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample Section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, and TPH analyses. Completeness was 100 percent for inorganic analytes except for manganese, which were rejected due to a high MS recovery.

4.2 DATA QUALITY REVIEW, OWS NO. 196 (SWMU 46)

4.2.1 SWMU 46 Site Description

OWS No. 196 is located beneath the pavement near the south corner of Building 196. The separator is constructed of concrete and consists of a three-compartment underground unit with a 560-gallon main compartment and a 135-gallon oil compartment. The separator measures 7 feet by 9 feet in plan and extends about 7.5 feet below the pavement surface. The OWS has been active since 1969. Contaminants of concern include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

The OWS receives wash water generated from aircraft maintenance operations in Building 196. The recovered oils are directed to the 135-gallon holding tank and the wastewater is discharged to the sanitary sewer line (SWMU No. 98).

Samples were collected and analyzed for SWMU 46 as presented in Tables 7-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDGs 031401 and 031403.

4.2.2 Laboratory Case Narrative

It was noted that the postdigestion spike recoveries were below evaluation criteria for selenium and thallium in three of the associated samples in SDG 041401. Associated samples were qualified estimated **J** based on postdigestion spike levels below evaluation criteria to indicate potential low bias. These samples are as follows:

W-C I.D.	Lab I.D.	Compound	Qualification
CAN046-0462-0002	031401-0014	Selenium	J
CAN046-0462-0002	031401-0014	Thallium	J
CAN046-0462-0004	031401-0015	Selenium	J
CAN046-0462-0004	031401-0015	Thallium	J
CAN046-0462-0008	031401-0016	Selenium	J
CAN046-0462-0008	031401-0016	Thallium	J

The laboratory indicated the internal standard perylene-d_{12} was lower than advisory limits for samples CAN046-04603-0000. As a result of the low internal standards, the surrogate terphenyl-d_4 recovery was above criteria for sample CAN046-00463-0000, resulting in a possible high bias for benzo(b)fluoranthene, di-*n*-octylphthalate, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benz(g.h.i)perylene. These analytes were qualified estimated **J** to indicate the bias.

The laboratory also reported that the ambient blank VOC vial did not have zero headspace. VOC data for the sample were qualified **R** for nondetect results and **J** for detected results for the ambient blank CAN046-0463-4651.

No other qualifications based on the laboratory case narrative were required for OWS No. 196.

4.2.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical method. All samples collected for this SWMU were extracted/analyzed within acceptable holding times; therefore, no qualifications based on holding times were necessary.

4.2.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. All SVOC, VOC, metals, and TPH target compounds were reported nondetect for the method blank associated with SDG 031401. In the method blank associated with SDG 031403, acetone and methylene chloride were detected. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. The analytes were raised to the amount detected in the sample qualified nondetect if it was greater than the reporting limit. Reporting limits were not raised for any of the associated samples. Samples qualified based on method blank contamination are listed below:

W-C I.D.	Concentration	Qualification	Analyte
CAN046-0463-4662	8.0	U	Methylene chloride
CAN046-0461-0000	6.1	U	Methylene chloride
CAN046-0461-0002	5.7	U	Methylene chloride
CAN046-0461-0004	1.9	U	Methylene chloride
CAN046-0461-0008	2.3	U	Methylene chloride
CAN046-0463-4661	4.0	U	Methylene chloride
CAN046-0463-0000	3.8	U	Methylene chloride
CAN046-0463-0002	2.1	U	Methylene chloride
CAN046-0463-0004	4.3	U	Methylene chloride
CAN046-0463-4671	1.1	U	Methylene chloride
CAN046-0463-4651	1.3	U	Methylene chloride
CAN046-0463-4691	1.1	U	Methylene chloride

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with SWMU 46. For SDG 031401, analyses of the rinsate blank indicated carbon disulfide contamination. Associated data results were nondetect; therefore, no data required qualification based on rinsate blank analysis. Analysis of the trip blank and rinsate blank for SDG 031403 indicated contamination of carbon disulfide and 1,1,1-trichloroethane. Associated data results were nondetect; therefore, no qualifications were required due to trip blank and rinsate blank contamination. All other field blank data reported target compounds as nondetect. No other qualifications based on field blank contamination was required.

4.2.5 Duplicate Control Sample (DCS)

Duplicate control samples were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. All DCS recoveries for SDG 030401 were within evaluation criteria; therefore, no qualifications were required based on outlying DCS results. DCS recoveries for SDG 031403 were within evaluation criteria except 1,1-dichloroethene and chlorobenzene, which have percent recoveries of 74 and 116, respectively. Associated chlorobenzene data were nondetect; therefore, no qualification of chlorobenzene data was necessary. Since the

DCS recoveries for 1,1-dichloroethene was within one percentage point of the acceptable range and the surrogate recoveries were within evaluation criteria, qualification of data based on the outlying DCS recovery was judged not to be necessary.

4.2.6 Reporting Limit (RL)

The sample reporting limit is the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For this SWMU, only one sample required a dilution which would increase the QAPP reporting limit greater than 5 times. VOC analysis for sample CAN046-0463-0008 was diluted 100 times. While no qualification of data based on elevated reporting limits was necessary, the possibility exists that organic compounds could be diluted below the instrument detection limit.

4.2.7 Surrogate Compound Percent Recoveries

Surrogate results are utilized to evaluate the accuracy of analytical measurement on a sample-specific basis. The surrogate recovery for terphenyl-d_{14} for CAN046-04603-0000 was above evaluation criteria. Qualifications based on this surrogate recovery is discussed in Section 4.2.2. No other qualifications based on outlying surrogate recoveries were required.

4.2.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis

MS/MSD analysis were performed to assess precision and accuracy. All MS/MSD recoveries for SDGs 031401 and 031403 were within evaluation criteria; therefore, no qualifications were required.

4.2.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Two duplicate soil samples were collected and analyzed for this SWMUs. Evaluation criteria for field duplicate samples were defined in the Cannon AFB QAPP (W-C 1993). Detected analytes and qualifications based on RPDs recoveries for this SWMU are presented in Table 4.2-1 and Table 4.2-2.

4.2.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 193 of the 195 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 99 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 3 of the 138 indicators reviewed for accuracy (DCS and matrix spikes), required qualification

of associated data; therefore, 98 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, all of the 214 indicators reviewed for precision were within evaluation criteria; therefore, 100 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 8 of the 69 indicators reviewed for precision required qualification of associated data. Therefore, 88 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample Section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for SVOC, TPH, and metals analyses. With the rejection of nondetected VOC data for sample CAN046-0462-4651, completeness for VOC data for SWMU 46 was 94%.

4.3 DATA QUALITY REVIEW, OWS NO. 494 (SWMU 47)

4.3.1 SWMU 47 Site Description

OWS No. 494 is located beneath the drive adjacent to the northeast wall of Building 494. The separator is constructed of concrete and consists of a three-compartment underground unit with a 50-gallon main compartment and a 50-gallon oil compartment. The separator measures about 1 foot by 2.5 feet in plan. The exact depth of the unit is not known, but is expected to be less than 10 feet. A 200-gallon sand trap constructed of concrete is located in a grassy area near the east corner of Building 494. The sand trap measures 4 feet by 5 feet in plan and extends about 4 feet below the ground surface. The sand trap receives wash water from the wash and prep stall at the southeast side of the Auto Hobby Shop. No painting is done in this preparation room. The OWS and sand trap have been active since 1982. Contaminants of concern include petroleum and synthetic lubricating oils, fuels, greases, solvents, dried paints, and metals.

The OWS and sand trap receives wash water generated from vehicle maintenance operations in Building 494. The recovered oils are directed to the 50-gallon holding tank in the separator, and the wastewater is discharged to the sanitary sewer line (SWMU No. 98).

Samples were collected and analyzed for this SWMU as presented in Table 8-1 of the RFI report. Attachment A summarizes analytical results. The laboratory analyzed these samples and reported the data in the following data packages:

31276 (10-7-93)	31190 (10-5-93)
31273 (10-7-93)	31270 (10-8-93)

Sampling and analytical work were completed in accordance with Cannon AFB QAPP (W-C 1993). Results of the data review for OWS No. 494 are provided below.

4.3.2 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below SW 846 criteria for selenium and thallium in several of the samples associated with this SWMU. The associated data were qualified estimated **J** to indicate a potential low bias. Table 4.3-1 summarizes the samples qualified based on poor postdigestion recovery.

For SDG 31190, the laboratory reported that the internal standard, chlorobenzene-d_5, associated with sample CAN047-0474-000 had a low recovery. The analytes listed below associated with this sample were nondetect; however, the results were qualified estimated nondetect **UJ**.

1,1,2,2-Tetrachloroethane	Styrene
2-Hexanone	Tetrachloroethane
4-Methyl-2-pentanone	Toluene
Chlorobenzene	Xylene
Ethylbenzene	

Table 4.3-1 summarizes qualifications which are based on poor postdigestion spike recoveries.

4.3.3 Holding Times

Holding times were specified in the QAPP (W-C 1993) for each respective analytical method. All samples taken from this SWMU were extracted/analyzed within acceptable holding times. No qualifications based on holding times were necessary.

4.3.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were reported as nondetect for all SVOC and metal method blanks. Acetone, 2-butanone, and methylene chloride were detected in several of the associated VOC method blanks. Since these analytes are common laboratory contaminants, sample results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount qualified nondetect, if it was greater than the RL.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with SWMU 47 samples. Target compounds were reported as nondetect for all of the VOC target compound except benzene, ethylbenzene, toluene, and xylenes (total) which were detected in the trip blank. Sample results for these analytes were qualified nondetect if the sample concentration was less than 5 times the amount detected in the trip blank. Target compounds were reported nondetect for all other field blanks.

Table 4.3-2 summarizes qualifications based on method blank and trip blank contamination.

4.3.5 Duplicate Control Samples (DCS)

DCS were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. For SDG 31190, the DCS results for 1,4-dichlorobenzene, n-nitro-di-n-propylamine, 1,2,4-trichlorobenzene, acenaphthene, and 2,4-dinitrotoluene were reported below evaluation criteria. These associated data were nondetect; however, the results were qualified estimated nondetect for samples CAN047-0474-0000, CAN047-0474-0004, CAN047-0475-0000, and CAN047-9475-0004 to indicate a potential low bias. No other qualifications based on DCS recoveries were necessary.

4.3.6 Reporting Limit (RL)

The sample reporting limit was the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

The following analysis required dilutions of 5 times the QAPP limits.

W-C Sample Number	Analyte	Dilution Factor
CAN047-0471-0004	Lead	5

4.3.7 Surrogate Compound Percent Recoveries

For VOC analysis of sample CAN047-0474-0000, toluene-d_8 was reported above evaluation criteria, which would indicate a high bias for detected analytes. Detected VOC results were already qualified estimated **J** because the concentration reported was less than the RL; therefore, no additional qualification was required. No other qualifications were necessary based on surrogate recoveries.

4.3.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) and MS/Duplicate Analyses

MS/MSD analyses were reviewed to assess precision and accuracy. For all metals analysis, barium and manganese results were qualified based on MS/MSD or MS/Duplicate analyses. Barium results were rejected because of contrasting MS/MSD results. The MS recovery was less than 40% and MSD recovery greater than 200%. Manganese results were qualified estimated **J** based on the RPD because laboratory duplicate analyses was not performed.

4.3.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Two field duplicate samples were collected for soil. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Table 4.3-3 lists duplicate result qualifications assigned based on poor field duplicate precision. Review of field duplicate results indicated that the overall sampling precision was satisfactory.

4.3.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and general matrix. Precision and accuracy were quantitatively assess by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (where were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 298 of the 300 indicators reviewed were within acceptable evaluation criteria. Therefore, 99 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 2 of the 276 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 99 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, all of the

214 indicators reviewed for precision were within evaluation criteria; therefore, 100 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 4 of the 115 indicators reviewed for precision required qualification of associated data. Therefore, 97 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample Section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, and TPH analyses.

Completeness was 100 percent for inorganic analytes except or barium. All barium results were rejected based on MS/MSD results. These results were applied to all samples from SWMU 47 because MS/MSD criteria were the only accuracy parameters for metals.

4.4 DATA QUALITY REVIEW, OWS NO. 375 (SWMU 51)

4.4.1 SWMU 51 Site Description

OWS No. 375 is located beneath the pavement adjacent to the northwest side of Building 375. The separator is constructed of concrete and consists of a two-compartment underground unit with a nominal capacity of 1,000 gallons. The separator extends about 5.5 feet below the pavement surface. The OWS has been active since 1968. Contaminants of concern include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

The OWS receives wash water generated from vehicle maintenance operations. The recovered oils are directed to the separator's holding tank and the wastewater is discharged to the sanitary sewer line (SWMU No. 98).

Samples were collected and analyzed for this SWMU as presented in Table 8-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDGs 031276 and 031279.

4.4.2 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below SW-846 criteria for selenium and thallium in several of the associated samples in SDGs 031276 and 031279. Associated results were qualified estimated **J** to indicate a potential low bias. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented below:

W-C I.D.	Lab I.D.	Compound	Qualification
CAN051-0512-0002	031279-0016	Selenium	J
CAN051-0512-0002	031279-0016	Thallium	J
CAN051-0512-0004	031279-0017	Selenium	J
CAN051-0511-0002	031276-0002	Selenium	J
CAN051-0511-0004	031276-0003	Selenium	J
CAN051-0511-0004	031276-0003	Thallium	J
CAN051-0511-0008	031276-0004	Selenium	J
CAN051-0513-0000	031276-0005	Selenium	J
CAN051-0513-0002	031276-0006	Selenium	J
CAN051-0513-0004	031276-0007	Selenium	J
CAN051-0513-0008	031276-0008	Selenium	J

No other qualifications based on the laboratory case narrative were required for OWS No. 375.

4.4.3 Holding Times

Holding times were specified in the QAPP (W-C 1993) for each respective analytical method. All samples taken from this SWMU were extracted/analyzed within acceptable holding times. No qualifications based on holding times were necessary.

4.4.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were reported nondetect for SVOC, TPH, and metal analyses of method blanks for both SDGs. For VOC analyses, acetone and methylene chloride were detected in the method blanks for both SDGs groups. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected, in the sample qualified nondetect, if it was greater than the reporting limit. Samples qualified based on method blank contamination are listed in Table 4.4-1.

Two sets of field blanks (one trip blank, one decontamination water blank, one ambient blank, and one rinsate blank) were collected and were associated with SWMU 51. One set of field blanks was analyzed with each SDG. Analyses of the decontamination blank for SDG 031276 indicated contamination of acetone and methylene chloride. Since these two analytes were also present in the method blank, and all data subsequently qualified, no qualification was required due to decontamination water analysis. No target analytes were detected in the ambient blanks, trip blanks, and rinsate blanks associated with 031276.

The rinsate blank for the 8240 analysis detected carbon disulfide; however, the sample results for SDB 031279 of the associated data were nondetect; therefore, no qualifications were required. Analyses of the trip blank, ambient blank, and decontamination water blank associated with SDB 031279 reported all VOC, SVOC, metals, and TPH target compounds were nondetect.

4.4.5 Duplicate Control Sample (DCS)

Duplicate control samples were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. The DCS recoveries for SDGs 031276 and 031279 were within evaluation criteria; therefore, no qualifications were required based on outlying DCS results.

4.4.6 Reporting Limits (RL)

The sample reporting limit is the lowest concentration of an analyte that can be reported by the laboratory to b present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For SDG 031276 no dilutions exceed 5 times the RL limits established in the Cannon AFB QAPP (W-C 1993). Lead analyses for two samples in SDG 031279 required dilutions greater than 5 times RLs. For samples CAN051-0512-0004 and CAN051-0512-0008, the required dilutions were 50 times and 10 times, respectively, the QAPP reporting limits.

4.4.7 Surrogate Compound Percent Recoveries

All surrogate recoveries were within evaluation criteria except phenol-d_5 for sample CAN051-0512-0004. According to National Functional Guidelines, one surrogate is allowed outside criteria for SVOC analyses without requiring qualification. No qualification of the data was required for this SWMU based on outlying surrogate recoveries.

4.4.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses

MS/MSD analyses were performed to assess precision and accuracy. All MS/MSD recoveries for SDG 031279 were within evaluation criteria; therefore, no qualifications were required. For SDG 031276, all MS/MSD recoveries were within evaluation criteria except benzene and barium, which were below evaluation criteria. The associated data were qualified estimated **J** to indicate a potential low bias. The RPD for cadmium exceeded evaluation criteria. Since this was the only measure of lab precision, associated results were qualified estimated **J**. The associated data for the following samples were qualified on the basis of outlying MS/MSD recoveries and RPD.

CAN051-0511-0000	CAN051-0513-0000
CAN051-0511-0002	CAN051-0513-0002
CAN051-0511-0004	CAN051-0513-0004
CAN051-0511-0008	CAN051-0513-0008

4.4.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Two duplicate soil samples were collected and analyzed for this SWMU. Four analytes associated with CAN051-0512-0000 required qualifications based on outlying RPD recoveries: chromium, beryllium, copper, cobalt, potassium, and TPH. Detected analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Table 4.4-2 and Table 4.4-3.

4.4.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 201 of the 203 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 99 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 1 of the 138 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 99 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 96 of the 98 indicators reviewed for precision were within evaluation criteria; therefore, 98 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 4 of the 69 indicators reviewed for precision required qualification of associated data. Therefore, 94 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample Section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, TPH, and metals analyses.

4.5 DATA QUALITY REVIEW, OWS NO. 379 (SWMU 57)

4.5.1 SWMU 57 Site Description

OWS No. 379 is located beneath the pavement adjacent to the southwest side of Building 379. The separator is constructed of concrete and consists of a two-compartment underground unit with a total capacity of 500 gallons. The separator measures 5 feet by 6.5 feet in plan and extends 6 feet below the pavement surface. The OWS has been active since 1965. Contaminants of concern include petroleum and synthetic lubricating oils.

The OWS receives wash water generated from vehicle maintenance operations. The recovered oils are directed to the separator's holding tank and the wastewater is discharged to the sanitary sewer line (SWMU No. 98).

Samples were collected and analyzed for this SWMU as presented in Table 10-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDGs 031274 and 031279.

4.5.2 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below criteria defined by SW-846 for selenium and thallium in several of the associated samples. Associated data were qualified estimated **J** to indicate a potential bias. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented below:

W-C I.D.	Lab I.D.	Compound	Qualification
CAN057-0571-5762	031274-0016	Selenium	J
CAN057-0571-0000	031274-0017	Selenium	J
CAN057-0571-0004	031274-0019	Selenium	J
CAN057-0571-0008	031274-0020	Selenium	J
CAN057-0571-0008	031274-0020	Thallium	J
CAN057-0572-0004	031279-0014	Thallium	J
CAN057-0572-0008	031279-0015	Selenium	J
CAN057-0572-0008	031279-0015	Thallium	J

W-C I.D.	Lab I.D.	Compound	Qualification
CAN057-0573-0004	031279-0010	Selenium	J
CAN057-0573-0004	031279-0010	Thallium	J
CAN057-0573-0008	031279-0011	Selenium	J

No other qualifications based on the laboratory case narrative were required for OWS No. 379.

4.5.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical method. All samples collected for this SWMU were extracted/analyzed within acceptable holding times; therefore; no qualifications based on holding times were necessary.

4.5.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were reported nondetect for all SVOC and TPH method blanks for both SDGs. For metal analyses, the method blank for SDG 031274 detected calcium at 99.1 mg/kg. Associated calcium data were greater than 5 times the blank contamination; therefore, no qualifications were required. For the metal analyses, all other target compounds were reported nondetect.

Acetone, 2-butanone and methylene chloride were detected in several of the associated method blanks. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected in the sample qualified nondetect if it was greater than the reporting limit. Samples qualified on the basis of method blank contamination are listed below:

W-C I.D.	Lab I.D.	Concentration	Qualification	Analyte	New RLs
CAN057-0572-0004	031279-0014	13	U	Acetone	13
CAN057-0572-0004	031279-0014	4.9	U	Methylene Chloride	--
CAN057-0572-0008	031279-0015	24	U	Acetone	24
CAN057-0572-0008	031279-0015	2.3	U	Methylene Chloride	--
CAN057-0571-0000	031274-0017	19	U	Acetone	19
CAN057-0571-0000	031274-0017	1.6	U	Methylene Chloride	--
CAN057-0571-0002	031274-0018	12	U	Acetone	12
CAN057-0571-0002	031274-0018	4.3	U	Methylene Chloride	--
CAN057-0571-0004	031274-0019	14	U	Acetone	14
CAN057-0571-0004	031274-0019	5.0	U	Methylene Chloride	--
CAN057-0571-0008	031274-0020	9.6	U	Acetone	--
CAN057-0571-0008	031274-0020	5.4	U	Methylene Chloride	--

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and associated with SWMU 57 for each of the two SDGs. For SDG 031279, all target compounds for VOC, SVOC, TPH, and metals analyses were reported nondetect in the associated field blanks. For SDG 031274, methylene chloride was detected in the trip blank and the decontamination water. Since methylene chloride was also detected in the method blank, all samples were previously qualified based on method blank contamination. Carbon disulfide was detected in the rinsate blank associated with SDG 031274; however, all samples were nondetect; therefore, no qualifications were required. All other target compounds were reported as nondetect for the field blanks, and no other qualifications based on blank contamination were necessary.

4.5.5 Duplicate Control Samples (DCS)

Duplicate control samples were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. DCS recoveries for SDG 031274 and 021279 were both within evaluation criteria; therefore, no qualifications were required based on outlying DCS results.

4.5.6 Reporting Limit (RL)

The sample reporting limit was the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For this SWMU, no dilutions were required which exceeded 5 times the RL limits established in the Cannon AFB QAPP (W-C 1993).

4.5.7 Surrogate Compound Percent Recoveries

All SVOC and VOC surrogate analyses for this SWMU were within evaluation criteria; therefore, no qualifications were required based on outlying surrogate recoveries.

4.5.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis

MS/MSD analysis was performed to assess precision and accuracy. Results for all organic MS/MSD analysis was within evaluation criteria. For metals analyses, thallium, lead, and silver required qualification based on MS/MSD recoveries below evaluation criteria.

Associated thallium, silver, and lead data were qualified estimated **J** to indicate a low bias. Cadmium results for SDG 031279 were qualified **R** rejected based on conflicting results. The MS/MSD recoveries for cadmium were 9% and 174%, respectively. The associated barium and chromium data were qualified estimated **J** to indicate a lack of precision in the data. Table 4.5-1 summarizes the qualification of data based on MS/MSD analyses.

4.5.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined by the Cannon AFB QAPP (W-C 1993). Two duplicate soil samples were collected and analyzed. Detected chemicals and qualifications based on RPDs are presented in Table 4.5-2.

4.5.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, all of the 126 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 100 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 5 of the 138 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 96 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 100 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 9 of the 92

indicators reviewed for precision required qualification of associated data. Therefore, 90 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample Section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, and TPH analyses. Completeness was 100 percent for inorganic analytes except for cadmium. These results were

applied to all samples from SWMU 57 because MS/MSD criteria were the only accuracy parameters for metals analyses.

4.6 DATA QUALITY REVIEW, OWSs NO. 5077A, NO. 5077B, AND NO. 5077C (SWMUS 61, 62, 63)

Facility 5077 is a vehicle wash rack located in the Civil Engineering compound. The facility includes two 380-gallon sand traps within the limits of the wash rack and a 1,675-gallon OWS located southeast of the wash rack. The sand traps and the OWS are constructed of concrete. The sand traps measure about 3 feet square in plan, and the separator measures about 5 feet by 10 feet in plan. The exact depths of the units are not known, but are expected to be less than 10 feet. The sand traps and OWS have been active since 1957. The west sand trap (5077a), the east sand trap (5077b), and the OWS (5077c) have been identified as SWMUs 61, 62, and 63, respectively. SWMUs 61, 62, and 63 will be investigated together. Contaminants of concern include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

The sand traps and OWS receive wash water generated from the wash-down of motor vehicles. The recovered oils are stored in the oil compartment of the OWS and the wastewater is discharged to the sanitary sewer line (SWMU No. 98).

Samples were collected and analyzed for this SWMU as presented in Table 11-1 of the RFI report summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDG numbers 031216, 031214, 031379, 031401, and 031402.

4.6.1 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recoveries were below criteria defined by SW-846 for selenium and thallium in several of the associated samples in SDGs 031214, 031216, 031379, and 031402. The associated data were qualified estimated **J** to indicate a potential low bias. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented below:

W-C I.D.	Lab I.D.	Compound	Qualification
CAN061-0611-0000	031379-0007-SA	Selenium	J
CAN061-0611-0002	031379-0008-SA	Selenium	J
CAN061-0611-0004	031379-0009-SA	Selenium	J
CAN061-0611-0004	031379-0009-SA	Thallium	J
CAN061-0611-0008	031379-0010-SA	Selenium	J
CAN061-0611-0008	031379-0010-SA	Thallium	J
CAN061-0612-0002	031379-0012-SA	Selenium	J
CAN061-0612-0004	031379-0013-SA	Selenium	J
CAN061-0612-0008	031379-0014-SA	Selenium	J
CAN061-0612-0008	031379-0014-SA	Thallium	J
CAN061-0621-0008	031402-0012-SA	Selenium	J
CAN061-0621-0008	031402-0012-SA	Thallium	J
CAN061-0612-0000	031379-0011-SA	Selenium	J
CAN061-0631-0008	031214-0004-SA	Thallium	J
CAN061-0631-0008	031214-0004-SA	Selenium	J
CAN061-0632-0008	031214-0008-SA	Thallium	J
CAN061-0632-6362	031216-0014-SA	Selenium	J
CAN061-0622-0008	031401-0004-SA	Selenium	J
CAN061-0622-0008	031401-0004-SA	Thallium	J

No other qualifications based on the laboratory case narrative were required for OWSs No. 5077A, No. 5077B, and No. 5077C.

4.6.2 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. All samples collected for this SWMU were extracted/analyzed within acceptable holding times; therefore, no qualifications based on holding times were necessary.

4.6.3 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. Acetone and methylene chloride were detected in the method blanks associated with all SDGs. In addition, for SDG No. 031216, bis(2-ethylhexyl)phthalate was detected in the associated method blanks. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for these analytes were raised to the amount detected in the sample qualified nondetect, if it was greater than the reporting limit. All other target compounds were reported nondetect in the method blanks. Samples qualified based on method blank contamination are listed in Table 4.6-1.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with SWMUs 61, 62, and 63. For SDG 031401, carbon disulfide was detected at 4.3 μg/kg in the rinsate blank. All associated carbon disulfide data were nondetect; therefore, no data required qualification based on rinsate blank analysis. No target analytes were detected for the analysis of the ambient, decontamination, and trip blanks. Qualification of data based on field blank contamination was not necessary.

4.6.4 Duplicate Control Sample (DCS)

Duplicate control samples were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. DCS results for SDGs No. 031216, 031214, 031379, 031401, and 031402 were within evaluation criteria; therefore, no qualifications were required based on outlying DCS recoveries.

4.6.5 Reporting Limits (RL)

The sample reporting limit is the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For SDGs 031379, 031401, and 031402, no dilutions exceeded the RL established in the Cannon AFB QAPP (W-C 1993) by 5 times. Samples which required dilutions greater than 5 times for SDGs 031216 and 031214 are listed below:

W-C Sample Number	Analyte	Dilution Factor
CAN063-0631-6361	Lead	100
CAN063-0611-0008	Lead	10
CAN063-0631-0000	Lead	10
CAN063-0632-0000	Lead	10

4.6.6 Surrogate Compound Percent Recoveries

Surrogate sample results were used to evaluate the accuracy of analytical measurement on a sample-specific basis. All surrogate recoveries were within evaluation criteria except toluene-d_8 for sample CAN062-0622-6281. Associated data were qualified estimated **UJ/J** for the sample to indicate a potential low bias. All other surrogate recoveries were within evaluation criteria.

4.6.7 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis

MS/MSD analyses were performed to assess precision and accuracy. All MS/MSD recoveries for SDGs 031216, 031214, 031379, and 031402 were within evaluation criteria; therefore, no qualifications were required. For SDG 031401, all MS/MSD recoveries were within evaluation criteria for VOC, SVOC, and TPH analyses. For metal analyses, the MS/MSD recoveries for barium, silver, and manganese were outlying evaluation criteria. Barium and silver recoveries were above and below criteria, respectively. Detected barium data and all silver data for the samples listed below were qualified estimated **J** to indicate a high bias for barium and a low bias for silver.

CAN062-0622-0000	CAN062-0622-0004
CAN062-0622-0002	CAN062-0622-0008

For manganese, the MS recovery was high, and the MSD recovery was low. For the following associated samples, data were qualified estimated, due to a lack of precision of the data:

CAN061-0611-0000	CAN061-0612-0000
CAN061-0611-0002	CAN061-0612-0002
CAN061-0611-0004	CAN061-0612-0004
CAN061-0611-0008	CAN061-0612-0008

For CAN063-0631-0000, phenanthrene (SVOC), calcium, and lead had RPDs which were above evaluation criteria. The MS/MSD recoveries were within evaluation criteria; however, the associated data were qualified estimated, since the RPD for MS/MSD analysis was the only measure of laboratory accuracy.

4.6.8 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Two duplicate soil samples were collected and analyzed for this SWMU. Evaluation criteria for field duplicate sample sets were defined by the Cannon AFB QAPP (W-C 1993). Detected

analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Tables 4.6-2 through 4.6-4.

4.6.9 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, all of the 399 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 100 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 2 of the 414 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 99 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 253 of the 262 indicators reviewed for precision were within evaluation criteria; therefore, 99 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 3 of the 138 indicators reviewed for precision required qualification of associated data. Therefore, 98 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that the sampling locations selected will provide representative data for decisions at the SWMU.

Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample Section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, TPH, and metals analyses.

4.7 DATA QUALITY REVIEW, OWS NO. 326 (SWMU 70)

4.7.1 SWMU 70 Site Description

OWS No. 326 is located in a grassy area near the northwest corner of Building 326. The separator is constructed of steel and consists of a two-compartment underground unit with a 50-gallon oil separator compartment and a detached 220-gallon oil storage tank. The separator measures about 1.5 feet by 2 feet in plan and extends about 6 feet below the ground surface. The oil storage tank is strapped to a 4-foot by 7-foot concrete pad that was constructed about 7 feet below the top of the concrete sidewalk. The OWS has been active

since 1960. Contaminants of concern include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and metals.

The OWS receives wash water generated from JP-4 fuel truck maintenance operations. The recovered petroleum products are directed to the 220-gallon holding tank and the wastewater is discharged to a leach well. The leach well consists of a 5-foot-diameter by 5-foot-deep gravel-filled dry well.

Samples were collected and analyzed for this SWMU as presented in Table 12-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDGs 031215, 031278, 031403, and 031404.

4.7.2 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below criteria defined in SW-846 for selenium and thallium in several samples for this SWMU. Associated data were qualified estimated to indicate a potential low bias. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented in Table 4.7-1.

The laboratory also reported that the internal standard perylene-d_{12} (SVOC) for sample CAN070-0702-0000 had a low area, indicating the GC/MS is less sensitive to the associated analytes. Associated analytes were qualified **J** for CAN070-0702-0000 based on outlying internal standard recoveries. The internal standard area for chlorobenzene-d_5 (VOC) for samples CAN070-0702-0000, CAN070-0704-0000, and CAN0704-7062 was reported to be below criteria. Analytes associated with chlorobenzene-d_5 for these samples were qualified **J** based on low internal standard recovery, because the low area indicates the GC/MS is less sensitive to the associated analytes. Table 4.7-1 summarizes qualifications based on the laboratory case narrative.

No other qualifications based on the laboratory case narrative were required for OWS No. 326.

4.7.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. All samples collected for this SWMU were extracted/analyzed within acceptable holding times; therefore, no qualifications based on holding times were necessary.

4.7.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were reported nondetect for all SVOC, TPH, and metals analyses of method blanks for all SDGs. For VOC analyses, acetone and methylene chloride were detected in the method blanks for each SDG for OWS No. 326. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect, if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected in the sample qualified nondetect if it was greater than the reporting limit. Samples qualified based on method blank contamination are listed in Table 4.7-2

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with OWS No. 326. Methylene chloride was detected in the ambient and rinsate blanks. Methylene chloride results for those analyses were qualified estimated **U** previously due to method blank contamination; therefore, no other qualifications were necessary. Analyses of the trip blank indicated detects for benzene, ethylbenzene, toluene, and xylenes. The results were qualified **J** if the sample concentration was less than 5 times the amount detected in the trip blank. All other analyses of field blank target analytes were reported as nondetect, and no other qualifications were required.

4.7.5 Duplicate Control Sample (DCS)

Duplicate Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. DCS results for SDGs 031278, 031403, and 031404 were within evaluation criteria; therefore, no qualifications based on outlying DCS recoveries were

required. DCS results for SDG 031215 were within evaluation criteria except sodium. The DCS recovery for sodium was below evaluation criteria. The following associated sample results were nondetect; however, the data were qualified estimated nondetect to indicate a low bias.

CAN070-0704-0000
CAN070-0704-0002
CAN070-0704-0004
CAN070-0704-0008
CAN070-0704-0013
CAN070-0704-0018
CAN070-0705-0000

4.7.6 Reporting Limits (RL)

The sample reporting limit was the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

The following samples required dilutions which increase the QAPP reporting limits by greater than 10 times:

W-C Sample Number	Analyte	Dilution Factor
CAN070-0704-0000	Lead	50
CAN070-0704-0000	TPH	25
CAN070-0704-0004	SVOC	115
CAN070-0704-0013	VOC	110
CAN070-0704-0018	VOC	2,300
CAN070-0704-0018	TPH	25
CAN070-0705-0000	Lead	50
CAN070-0705-0000	TPH	25
CAN070-0705-0004	VOC	100
CAN070-0705-0008	VOC	2,500
CAN070-0705-0013	VOC	4,800
CAN070-0705-0018	VOC	2,300
CAN070-0701-0000	VOC	5,600
CAN070-0701-0000	SVOC	115
CAN070-0701-0002	SVOC	1,000
CAN070-0701-0002	SVOC	118
CAN070-0701-0008	VOC	1,200
CAN070-0701-0018	VOC	500
CAN070-0701-0028	VOC	1,000
CAN070-0701-0038	VOC	1,000
CAN070-0701-0048	VOC	380
CAN070-0701-0058	Selenium	1,000
CAN070-0702-0002	Selenium	280
CAN070-0702-0004	TPH	50
CAN070-0702-0008	Selenium	62
CAN070-0702-0004	Selenium	1,200
CAN070-0702-0008	Selenium	3,000
CAN070-0702-0018	Selenium	2,400

While no qualifications were made based on elevated reporting limits, the possibility exists that organic compounds have been diluted below instrument detection limits.

4.7.7 Surrogate Compound Percent Recoveries

Surrogate recoveries were utilized to evaluate the accuracy of analytical measurement on a sample-specific basis. All surrogate recoveries for VOC and SVOC analyses were within evaluation criteria; therefore, no qualifications were required based on outlying surrogate recoveries.

4.7.8 Matrix Spike/Matrix Spike Duplicate(MS/MSD) Analysis

MS/MSD analysis were performed to assess precision and accuracy. All MS/MSD recoveries for SDGs 031215 and 031403 were within evaluation criteria; therefore, no qualifications were required. For SDG 031278, all MS/MSD recoveries were within evaluation criteria except manganese, silver, and sodium. Associated manganese and silver results were qualified **J** based on low MS/MSD recoveries to indicate a low bias. Associated sodium results were qualified **R** based on MS/MSD recoveries exceeding 200 percent. These qualifications were made on the following samples from SDG 031278:

CAN070-0705-0002
CAN070-0705-0004
CAN070-0705-0008
CAN070-0705-0014
CAN070-0705-0018

For SDG 031404, all MS/MSD data were within evaluation criteria except barium, manganese, silver, and 1,1-dichloroethene. Associated barium, silver, 1,1-dichloroethene data were qualified **J** based on low MS/MSD recoveries to indicate a low bias. 1,1-Dichloroethane data were qualified for sample CAN080-0702-0008. Associated manganese results were qualified **R** based on MS/MSD recoveries below 10 percent. The manganese, barium, and silver data were qualified for the following samples:

CAN070-0702-0000
CAN070-0702-0002
CAN070-0702-0004

CAN070-0702-0008
CAN070-0701-0058

4.7.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Two duplicate soil samples was collected and analyzed for this SWMU. Detected analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Table 4.7-3 and Table 4.7-4.

4.7.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 381 of the 383 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 99 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 16 of the 276 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 94 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, all of the 154 indicators reviewed for precision were within criteria; therefore, 100 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, all of the 92 indicators reviewed for

precision required qualification of associated data. Therefore, 100 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design o f the sampling program, such that, the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested, which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, and TPH analyses. Metals analyses was 100 percent complete with the exception of rejected barium and manganese results for selected data. Completeness for barium and manganese results was 90 percent.

4.8 DATA QUALITY REVIEW, OWS NO. 5120 (SWMU 92)

4.8.1 SWMU 92 Site Description

OWS No. 5120 is located in a grassy area east of Power Check Pad No. 5120. The OWS is a two-compartment unit with a detached 100-gallon oil storage tank. The separator measures 4 feet by 6 feet in plan. The exact depths of the separator and storage tank are not known, but are expected to be less than 10 feet. The unit was active from approximately 1957 to 1988. Contaminants of concern include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and metals.

Facility 5120 was dismantled in 1988. The separator and leach well remain in place. The OWS received wash water generated from aircraft maintenance operations. The recovered oils were directed to the 100-gallon oil holding tank and the wastewater was discharged to a leach well located approximately 40 feet east of the separator.

Samples were collected and analyzed for this SWMU as presented in Table 13-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDGs 031214, 031374, 031381, 031402, and 031417.

4.8.2 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below criteria defined in SW-846 for selenium and thallium in several of the associated samples in SDGs 031381, 031214, and 031374. Associated selenium and thallium data were qualified estimated **J** to indicate a low bias. For sample CAN092-0925-0048, the postdigestion spike recovery for arsenic was reported above criteria, indicating a potential high bias. The associated results were nondetect, so no qualification was necessary. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented below:

W-C I.D.	Lab I.D.	Compound	Qualification
CAN092-0921-0000	031381-0001	Selenium	J
CAN092-0921-0000	031381-0001	Thallium	J
CAN092-0921-0002	031381-0002	Selenium	J
CAN092-0921-0002	031381-0002	Thallium	J
CAN092-0921-0004	031381-0003	Selenium	J
CAN092-0921-0004	031381-0003	Thallium	J
CAN092-0921-0008	031381-0004	Selenium	J
CAN092-0921-0008	031381-0004	Thallium	J
CAN092-0921-0018	031381-0005	Selenium	J
CAN092-0921-0018	031381-0005	Thallium	J
CAN092-0921-0028	031381-0006	Selenium	J
CAN092-0921-0028	031381-0006	Thallium	J
CAN092-0921-0038	031381-0007	Selenium	J
CAN092-0921-0038	031381-0007	Thallium	J
CAN092-0921-0048	031381-0008	Selenium	J
CAN092-0921-0048	031381-0008	Thallium	J
CAN092-0921-0058	031381-0009	Selenium	J
CAN092-0921-0058	031381-0009	Thallium	J
CAN092-0922-0000	031214-0010	Selenium	J
CAN092-0922-0008	031214-0013	Selenium	J
CAN092-0923-0008	031214-0017	Selenium	J
CAN092-0923-0008	031214-0017	Thallium	J
CAN092-0925-0000	031381-0014	Selenium	J
CAN092-0925-0000	031381-0014	Thallium	J
CAN092-0925-0002	031381-0015	Selenium	J
CAN092-0925-0002	031381-0015	Thallium	J
CAN092-0925-0004	031381-0016	Selenium	J
CAN092-0925-0004	031381-0016	Thallium	J
CAN092-0925-0008	031381-0017	Selenium	J
CAN092-0925-0008	031381-0017	Thallium	J
CAN092-0925-0018	031374-0015	Selenium	UJ
CAN092-0925-0028	031374-0016	Selenium	UJ
CAN092-0925-0038	031374-0017	Selenium	UJ
CAN092-0925-0038	031374-0017	Thallium	UJ
CAN092-0925-0048	031374-0018	Selenium	UJ
CAN092-0925-0048	031374-0018	Thallium	UJ
CAN092-0925-0058	031374-0019	Selenium	UJ

No other qualifications based on the laboratory case narrative were required for OWS No. 5120.

4.8.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. All samples collected for this SWMU were extracted/analyzed within acceptable holding times; therefore, no qualifications based on holding times were necessary.

4.8.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were reported as nondetect for all SVOC, TPH, and metals analysis method blanks for all SDGs. The VOC method blanks for each SDG for O/WS No. 5120 indicated detects for acetone and methylene chloride. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected in the sample qualified nondetect if it was greater than the reporting limit. Samples qualified based on method blank contamination are listed in Table 4.8-1.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with OWS No. 5120. For SDG 031381, methylene chloride was detected in VOC analyses of the ambient and rinsate blanks. Methylene chloride results for those analyses were qualified estimated **J** if the results were less than 10 times the amount detected in the associated blanks. All other target compounds were reported as nondetect for the field blanks, and no other qualifications were required.

4.8.5 Duplicate Control Sample (DCS)

Duplicate Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. DCS results for all SDGs associated with OWS No. 5120 were within evaluation criteria; therefore, no qualifications based on outlying DCS recoveries were required.

4.8.6 Reporting Limits (RL)

The sample reporting limit was the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For SDGs 031374, 031402, and 031417, no dilutions exceeded the RL established in the Cannon AFB QAPP (W-C 1993) by a factor of 5. One sample analyses in SDGs 0312214 and 031381 required dilutions greater than 5 times RLs. Lead analyses for samples CAN092-0922-0000, CAN092-0925-0000, and CAN092-0921-0000 required dilutions of 10 times, 10 times, and 100 times, respectively.

4.8.7 Surrogate Compound Percent Recoveries

All VOC and SVOC surrogate recoveries were within evaluation criteria except terphenyl-d_{14} (SVOC) for samples CAN092-0925-000 (170%) and CAN092-0924-000 (172%). According to National Functional Guidelines, one surrogate is allowed outside criteria for SVOC analysis without requiring qualification; therefore, no qualifications were required for this OWS based on outlying surrogate recoveries.

4.8.8 Matrix Spike/Matrix Spike Duplicates (MS/MSD) Analyses

MS/MSD analysis were performed to assess precision and accuracy. All MS/MSD recoveries for SDGs 031214, 031374, 031402, and 031417 were within evaluation criteria; therefore, no qualifications were required for the associated samples. For SDG 031381, all MS/MSD recoveries were within evaluation criteria except manganese, barium, and selenium. Associated barium results were rejected due to a recovery of less than 200%. The MS recoveries for selenium were below criteria; therefore, associated data were qualified estimated to indicate a low bias. Manganese had contrasting high and low MS/MSD recoveries; therefore, associated data were qualified **J** to indicate a lack of precision of the data. The following samples were qualified on the basis of MS/MSD recoveries outlying evaluation criteria for selenium, barium, and manganese:

CAN092-0921-0000	CAN092-0921-0028	CAN092-0925-0000
CAN092-0921-0002	CAN092-0921-0038	CAN092-0925-0002
CAN092-0921-0004	CAN092-0921-0048	CAN092-0925-0004
CAN092-0921-0008	CAN092-0921-0058	CAN092-0925-0008
CAN092-0921-0018		

4.8.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Two duplicate soil samples was collected and analyzed for this SWMU. Detected analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Table 4.8-2 and Table 4.8-3.

4.8.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality

control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 345 of the 348 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 99 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 4 of the 276 indicators reviewed for accuracy(DCS and matrix spikes), required qualification of associated data; therefore, 98 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 168 of the 168 indicators reviewed for precision were within criteria; therefore, 100 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 2 of the 92 indicators reviewed for precision required qualification of associated data. Therefore, 98 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design o f the sampling program, such that, the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples

within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested, which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, and TPH analyses. Metals analyses was 100 percent complete with the exception of rejected barium results for selected data. Completeness for barium results was 99 percent.

4.9 DATA QUALITY REVIEW, OWS NO. 5144 (SWMU 94)

4.9.1 SWMU 94 Site Description

Facility 5144 was a two-bay vehicle wash rack located east of the intersection of D.L. Ingram Street and Argentia Avenue. The facility included two sand traps within the limits of the wash rack and a 1,700-gallon OWS located in a grassy area northeast of the wash rack. The sand traps measure about 3.5 feet by 8 feet in plan, and the separator measures about 5 feet by 10 feet in plan. The exact depths of the units are not known, but are expected to be less than 10 feet. The sand traps and OWS were active from 1960 to approximately 1988. Contaminants of concern include lubricating oils, fuels, greases, solvents, and metals.

Facility 5144 has been partially dismantled and is no longer used as a wash rack; however, the concrete wash bays, the sand traps, and the OWS remain in place. The OWS received wash-down water from vehicle washing operations. The recovered oils were collected in the 1,700-gallon OWS and the wastewater discharged to the sanitary sewer line (SWMU No. 98).

Samples were collected and analyzed for this SWMU as presented in Table 15-1 in the RFI report. A summary of analytical results are presented in Attachment A. The laboratory

analyzed these samples and reported the data in SDGs 031181, 031216, 031401, 031402, and 031404.

4.9.2 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below the criteria defined by SW-846 for selenium and thallium in several of the associated samples in SDGs 031402 and 031181. Associated selenium and thallium results were qualified estimated **J** to indicate a potential low bias. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented below:

W-C I.D.	Lab I.D.	Compound	Qualification
CAN094-0941-0002	031402-0003	Selenium	J
CAN094-0941-0002	031402-0003	Thallium	J
CAN094-0941-0004	031402-0004	Selenium	J
CAN094-0941-0004	031402-0004	Thallium	J
CAN094-0941-0008	031402-0005	Selenium	J
CAN094-0941-0008	031402-0005	Thallium	J
CAN094-0941-0000	031181-0013	Thallium	J
CAN094-0946-0004	031181-0015	Selenium	J
CAN094-0946-0004	031181-0015	Thallium	J
CAN094-0946-0008	031181-0016	Selenium	J
CAN094-0945-0004	031181-0019	Selenium	J
CAN094-0945-0004	031181-0019	Thallium	J
CAN094-0944-0000	031404-0007	Selenium	J
CAN094-0944-0002	031404-0008	Selenium	J
CAN094-0944-0002	031404-0008	Thallium	J
CAN094-0944-0004	031404-0009	Selenium	J
CAN094-0944-0004	031404-0009	Thallium	J
CAN094-0944-0008	031404-0010	Selenium	J

For VOC analyses of sample CAN094-0941-0002, the laboratory reported an internal standard area for 1,4-difluorobenzene and chlorobenzene-d_5 were below the evaluation criteria. The VOC target compounds which are associated with these internal standards were qualified estimated to indicate that the GC/MS was less sensitive to these compounds. For SVOC analyses of sample CAN094-0941-0000, chrysene-d_{12} and perylene-d_{12} were reported to be below evaluation criteria. The SVOC target compounds which are associated with these internal standards were qualified estimated to indicate that the GC/MS is less sensitive to these compounds.

The laboratory reported that the continuing calibration for several analytes for SVOC analyses of CAN094-0945-0000 and CAN094-0946-0008 and for VOC analysis of CAN094-0946-0004 were outlying evaluation criteria. The associated data were nondetect and were qualified estimated nondetect **UJ**. Table 4.9-1 summarizes qualifications based on the laboratory narrative.

No other qualifications based on the laboratory case narrative were required for OWS No. 5144.

4.9.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. All samples collected for this SWMU were extracted/analyzed within acceptable holding times, therefore, no qualifications based on holding times were necessary.

4.9.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were nondetect for TPH and metals analysis method blanks for both SDGs. Acetone and methylene chloride were detected in the method blanks for both SDGs. Butyl benzyl phthalate was detected in the method blank for SDG 031216. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected in the sample qualified nondetect

if it was greater than the reporting limit. Samples qualified based on method blank contamination are listed in Table 4.9-2.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with SWMU 94. 1,1,1-Trichloroethene was detected in the trip blank and a decontamination water blank associated with SWMU 94. Associated data were qualified if the concentrations in the samples were greater than 5 times the amount in the blanks. No data required qualification based on contamination of 1,1,1-trichloroethene. Methylene chloride was detected in the trip blank. Methylene chloride data was qualified previously based on method blank contamination.

No other qualification of data was required based on blank contamination.

4.9.5 Duplicate Control Sample (DCS)

Duplicate Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to asses method accuracy and precision and served as a control on the analytical system. DCS results for SDGs 031216,031401, 031402, and 031181 were within evaluation criteria. For SDG 031404, the DCS recovery for 1,1-dichloroethene (VOC) was 74 percent; however, no qualification of data was judged to be required because the recovery was only 1 percent below criteria.

No qualifications based on DCS results were required.

4.9.6 Reporting Limits (RL)

The sample reporting limit is the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

Three samples associated with SWMU 94 required dilution. The lead analysis for sample CAN094-0942-0000 required a dilution 20 times the reporting limit. Samples CAN094-0941-9461 and CAN094-0941-0000 required dilutions for lead analyses 10 times the reporting limit. No other dilutions exceeded QAPP reporting limits by 10 times or more.

4.9.7 Surrogate Compound Percent Recoveries

Surrogate spike results were utilized to evaluate the accuracy of the analytical measurement on a sample-specific basis. For VOC analysis of sample CAN094-0941-0002, the recovery for toluene-d_8 was reported above evaluation criteria. The following detected VOC analytes for CAN094-0941-0002 were qualified estimated **J** to indicate a high bias: 1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, and xylenes (total). All other SVOC and VOC surrogates meet evaluation criteria; therefore, no other qualifications were required.

4.9.8 Matrix Spike/Matrix Spike Duplicate(MS/MSD) Analysis

MS/MSD analyses were performed to assess precision and accuracy. All MS/MSD recoveries for organic analyses were within evaluation criteria. For metals analyses, MS/MSD recoveries for barium, lead, silver, and magnesium were outlying the evaluation criteria. Barium data associated with SDG 031181 were rejected because the MS/MSD recoveries were less than 200%. For SDG 031404, recoveries for barium, lead, and silver and for SDG 031181, silver recoveries were reported below criteria; therefore, associated data were qualified estimated to indicate a low bias. For SDG 031181, lead and magnesium recoveries were above criteria. Associated detected lead and magnesium data were qualified estimated to indicate a high bias.

No other qualifications based on MS/MSD criteria were required. Table 4.9-3 summarizes the qualifications based on MS/MSD criteria.

4.9.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Two duplicate soil samples was collected and analyzed for this SWMU. Detected analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Table 4.9-4 and Table 4.9-5.

4.9.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 133 of the 146 indicators reviewed for accuracy(matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 91 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 64 of the 299 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 79 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 150 of the 152 indicators reviewed for precision were within criteria, therefore 99 percent of the indicators reviewed for precision(matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 6 of the 115 indicators reviewed for

precision required qualification of associated data. Therefore, 95 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that, the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated J values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, and TPH analyses. The metals analysis was 100% complete except for barium data for SWMU 94 samples in SDG 031181.

4.10 DATA QUALITY REVIEW, OWS NO. 4095 (SWMU 127)

This SWMU is a 135-gallon concrete sand trap that received wash water from the POL refueling truck wash rack at Facility 4095. The sand trap measures 2.5 feet by 4.5 feet in plan and extends about 3.5 feet below the pavement. This unit had been active from 1977 to approximately 1991. Contaminants of concern include JP-4 fuel, grease, and motor oil.

The sand trap received wash-down water from fuel truck cleaning operations. The wastewater was discharged to a leach field located away from the pavement and northeast of the wash rack. The leach field reportedly ceased to function in the late 1980's. An OWS enclosed in a concrete vault was installed in the wash rack's drain pipe in May 1991. Presently, the wastewater from the OWS discharges to a new leach field located northeast of the former leach field. The sand trap is still functioning, and the original leach field remains in place, but is bypassed and not used.

Samples were collected and analyzed for this SWMU as presented in Tables 16-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDGs 031184, 031216, 031215, 031277, and 031374.

4.10.1 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below criteria defined by SW-846 for selenium and thallium in all in SDGs associated with OWS No. 4095. The associated data were qualified estimated to indicate a potential low bias. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented in Table 4.10-5.

The laboratory reported internal standard areas which were below evaluation criteria for chlorobenzene-d_5 in samples CAN127-1278-1264 and CAN127-1278-0008. Analytes associated with internal standard chlorobenzene-d_5, as defined by National Functional Guidelines for Organic Review (12/90) Appendix A, were qualified estimated **UJ/J** to indicate

that the GC/MS was less sensitive to these analytes. No other qualifications based on the laboratory case narrative were required for OWS 4095.

4.10.2 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. All samples collected for OWS 4095 were extracted/analyzed within acceptable holding times; therefore, no qualifications based on holding times were necessary.

4.10.3 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. TPH compounds for method blanks were reported nondetect for all the SDGs associated with OWS 4095. Acetone and methylene chloride were detected in the method blanks for all the SDGs. 2-Butanone (VOC) and di-*n*-butylphthalate were detected in the method blank for SDG 031216. Also, bis(2-ethylhexyl)phthalate (SVOC) was detected in the method blank for SDG 031277. Since these analytes are common laboratory contaminants, associated analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected in the sample qualified nondetect if it was greater than the reporting limit. Method blank analyses for metals indicated all target analytes as nondetect except for calcium in SDG 031277 and lead and chromium in SDG 031184. Associated sample results for calcium, chromium, and lead were qualified if the concentration was less than 5 times the amount detected in the blank. Samples qualified based on method blank contamination are listed in Table 4.10-1.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with OWS 4095. Carbon disulfide was detected in the rinsate blank at 5.7 μg/kg. All associated data were nondetect; therefore, no qualifications based on rinsate blank analysis was required. All target compounds were reported nondetect in the ambient, decontamination, and trip blanks.

4.10.4 Duplicate Control Sample (DCS)

Duplicate Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to asses method accuracy and precision and served as a control on the analytical system. DCS results for SDGs 031216, 031277, and 031374 were within evaluation criteria. DCS results for SDGs 031184 and 031215 reported sodium DCS results below evaluation criteria. Associated data were qualified estimated **UJ/J** based on outlying DCS recoveries to indicate a low bias. No other qualification of data based on DCS results was required.

4.10.5 Reporting Limits (RL)

The sample reporting limit is the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For SDGs 031184, 031215, 031277, and 031374, no dilutions exceed 5 times the RLs established in the Cannon AFB QAPP (W-C 1993). Two sample analyses in SDG 031216 required dilutions greater than 5 times RLs. Lead analysis for samples CAN127-1273-0000 and CAN127-1276-0000 each required dilutions of 20 times QAPP limits.

4.10.6 Surrogate Compound Percent Recoveries

Surrogate spike results were utilized to evaluate the accuracy of analytical measurement on a sample-specific basis. All surrogate percent recoveries for SDGs 031216, 031277, and 031215 were within evaluation criteria. SDG 031184 reported a low surrogate recovery for 4-bromofluorobenzene (82%) for sample CAN127-1277-0000. All VOC data for CAN127-1277-0000 were qualified estimated **UJ/J** based on outlying surrogate recovery to indicate a low bias. No other qualifications based on surrogate recoveries were required.

4.10.7 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis

MS/MSD analysis were performed to assess precision and accuracy. All MS/MSD recoveries for SDGs 031184, 031216, 031215, and 031374 were within evaluation criteria. For SDG 031277, all MS/MSD recoveries were within evaluation criteria except barium and selenium. All barium data for associated samples were qualified estimated based on MS/MSD recovery below evaluation criteria to indicate a low bias. Associated detected selenium data were qualified estimated based on MS recovery above criteria to indicate a high bias.

No other qualifications based on MS/MSD recoveries were required.

4.10.8 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Four duplicate soil samples was collected and analyzed for this SWMU. Detected analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Table 4.10-2 through Table 4.10-4.

4.10.9 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and

the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 591 of the 593 indicators reviewed for accuracy(matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 99 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 4 of the 414 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 99 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 436 of the 440 indicators reviewed for precision were within criteria; therefore, 98 percent of the indicators reviewed for precision(matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, 12 of the 184 indicators reviewed for precision required qualification of associated data. Therefore, 93 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that, the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Four field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection

techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated J values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, TPH, and metals analyses.

4.11 DATA QUALITY REVIEW, LEAD ACID BATTERY ACCUMULATION POINT (SWMU 55)

4.11.1 SWMU 55 Site Description

The lead-acid battery accumulation point consists of asphaltic-concrete pavement measuring approximately 8 feet square in plan located about 100 feet north of the north corner of the Vehicle Maintenance Shop, Building 379. The pavement is contiguous with the asphalt parking lot for Building 379 and slopes toward the west. The lead-acid battery accumulation point has been in operation since 1965. Contaminants of concern include lead and sulfuric acid.

Used lead-acid vehicle batteries are stored "wet" on pallets on the pavement until a sufficient number are accumulated for sale to a battery recycling company. The batteries are prepared for storage by securing the vent caps with tape and by taping the terminals to prevent shorts. The storage area is not protected from the elements. Storm water runoff flows off site to the northeast over the pavement and asphalt parking lot and ultimately into the D.L. Ingram Street drainage ditch.

Samples were collected and analyzed for the Lead Acid Battery Accumulation Point as presented in Table 17-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples for lead and reported the data in SDGs 031275 and 031382.

4.11.2 Laboratory Case Narrative

The laboratory reported that the postdigestion spike recovery was below criteria defined by SW-846 for lead for sample CAN055-0551-0018. The lead result was qualified estimated **J** based on low postdigestion spike recovery to indicate a low bias. No other qualifications were required based on the laboratory case narrative for the Lead Acid Battery Accumulation Point.

4.11.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. All samples collected for this SWMU were extracted/analyzed within acceptable holding times, therefore, no qualifications based on holding times were necessary.

4.11.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The lead results for SDG 031382 were reported nondetect for method blank analysis. Lead was detected in the method blank for SDG 031275 at 0.61 mg/kg. All lead data for this SDG exceeded 5 times the RL; therefore, no qualifications were required based on method blank contamination.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with the Lead Acid Battery Accumulation Point. Lead was detected in each of the field blanks. Sample results for lead exceeded 5 times the RL; therefore, no qualifications for field blank contamination were required.

4.11.5 Duplicate Control Sample (DCS)

Duplicate Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to asses method accuracy and precision and served as a control on the analytical system. DCS results for SDGs 031275 and 031382 were both within evaluation criteria; therefore, no qualifications were required based on outlying DCS results.

4.11.6 Reporting Limits (RL)

The sample reporting limit was the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For SDG 031382, no dilutions exceeded 5 times the RL established in the Cannon AFB QAPP (W-C 1993). One sample analyses in SDG 031275 required dilutions greater than 5 times RLs. Lead analysis for samples CAN055-0551-0013 required a dilution of 10 times.

4.11.7 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses

MS/MSD analyses were performed to assess precision and accuracy. MS/MSD analyses were performed on sample CAN055-0553-0008. The lead MS/MSD recoveries were within evaluation criteria; therefore, no qualifications were required based on outlying MS/MSD recoveries.

4.11.8 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Three duplicate soil samples were collected and analyzed for this SWMU and are presented in Table 4.11-1 and Table 4.11-2. All field duplicate RPDs were within evaluation criteria, therefore no qualifications were required based on outlying RPDs

4.11.9 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For lead analyses, none of the 8 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 100 percent of the accuracy indicators reviewed for lead analysis were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For lead analyses, none of the 6 indicators reviewed for precision required qualification of associated data. Therefore, 100 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that, the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Four field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated **J** values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for lead and acidity analyses.

4.12 DATA QUALITY REVIEW, CIVIL ENGINEERING CONTAINER STORAGE (SWMU 77)

4.12.1 SWMU 77 Site Description

The Civil Engineering Container Storage Area (Facility No. 4038) is an open concrete pad measuring approximately 100 feet by 200 feet in plan located east of Building 252 and adjacent to the south side of the north property boundary fence of the base (Figure 2-11). The concrete pad is surrounded by an 8-foot high fence.

This unit was a passenger terminal for Portair Field during the 1930s. The building was removed in 1942 by the Army. The concrete foundation slab had been vacant until the 1970s according to historical photographs, at which time it was used for storage. Approximately 100, 55-gallon drums were stored at the facility during the RFA Visual Site Inspection (Kearney 1987). Contaminants of concern include waste oil, solvents, aviation fuel, waste paint materials, PCBs, and pesticides.

The Civil Engineering Squadron currently stores supplies and used materials on the concrete pad. The stored items include used transformers, street lights and street signs, heavy equipment parts, and approximately 25 unmarked 55-gallon drums. A preliminary inspection indicated that the drums contain varying amounts of water, oil, solvents, and asphaltic material.

Samples were collected and analyzed for the Civil Engineering Container Storage Area as presented in Table 18-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDGs 031379, 031189, and 031181.

4.12.2 Laboratory Case Narrative

It was noted that several postdigestion spike recoveries were below evaluation criteria defined by SW-846 for selenium and thallium in SDGs 031379, 031189, and 031181. The associated

data were qualified estimated to indicate a low bias. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented in Table 4.12-6.

No other qualifications based on the laboratory case narrative were required for OWS No. 196.

4.12.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. All samples collected for this SWMU were extracted/analyzed within acceptable holding times; therefore, no qualifications based on holding times were necessary.

4.12.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were nondetect for all SVOC, TPH, and metals analyses of method blanks for all SDGs associated with this SWMU. Acetone and methylene chloride were detected in the method blanks for the three SDGs. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected in the sample qualified nondetect if it was greater than the reporting limit. Samples qualified based on method blank contamination are listed in Table 4.12-1.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with SWMU 77. Methylene chloride was detected in the rinsate blank at 1.1 μg/kg. In addition, acetone and tetrachloroethene were detected in the decontamination water blank at 8.0 μg/kg and 92 μg/kg, respectively. Methylene chloride and acetone data were qualified nondetect based on method blank contamination. Tetrachloroethene data were qualified if the sample concentration was greater than 5 times the amount detected in the blanks. No other qualification of data based on blank contamination was required.

4.12.5 Duplicate Control Sample (DCS)

Duplicate Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to asses method accuracy and precision and served as a control on the analytical system. DCS results for SDGs 031379 and 031181 were within evaluation criteria. The laboratory reported semivolatile DCS recoveries were outside evaluation criteria for SDG 031189. The lab re-extracted and reanalyzed the sample and confirmed the original results to prove this anomaly may be limited to the DCSs. Considering other QC factors (surrogate recoveries, MS/MSD) and the fact the DCS results were just outside evaluation criteria, samples were not qualified based on outlying DCS recoveries. No qualification of data based on DCS results were required.

4.12.6 Reporting Limits (RL)

The sample reporting limit was the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For SDG 031189, no dilutions exceeded 5 times the RL established in the Cannon AFB QAPP (W-C 1993). Lead analyses for samples CAN077-0774-0008, CAN077-0774-0018,

and CAN077-0773-0008 required dilutions of 10 times the RL. Additionally, for SVOC analysis, sample CAN077-0774-0003 required a dilution of 10 times the RL. For SDG 031181, samples CAN077-0771-0000, CAN077-0771-7701, and CAN077-0771-7708 were diluted 10 times the RL for herbicide analysis. While data were not qualified on the basis of elevated reporting, the possibility exists that organic compounds may have been diluted to below the instrument's detection limit.

4.12.7 Surrogate Compound Percent Recoveries

All surrogate recoveries were within evaluation criteria for all data associated with this SWMU; therefore, no qualifications were required for this SWMU based on outlying surrogate recoveries.

4.12.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis

MS/MSD analysis were performed to assess precision and accuracy. All MS/MSD recoveries for SDG 031189 were within evaluation criteria. For SDG 031379, all MS/MSD recoveries were within evaluation criteria except pentachlorophenol and manganese. Because the low recoveries for pentachlorophenol (MS - 6%, MSD - 11%) and the surrogate results were noncalculable due to dilution, pentachlorophenol results for CAN077-0774-0003 were qualified estimated.

For SDG 031181, MS/MSD recoveries for lead, manganese, barium, and silver were outside evaluation criteria. Lead and manganese data results associated with this SWMU were qualified **J** based on high MS/MSD recoveries to indicate a high bias. Barium results were qualified **R** due to MS/MSD recoveries exceeding 200%. The MS/MSD recoveries for silver were below criteria so data were qualified estimated **J** to indicate a low bias. Lead, manganese, silver, and barium data were qualified for the following samples from SDG 031131:

CAN077-0771-0000	CAN077-0776-0000
CAN077-0771-7701	CAN077-0776-0003

CAN077-0771-7703	CAN077-0776-0008
CAN077-0771-7708	CAN077-0776-0013
CAN077-0771-7713	CAN077-0776-0018
CAN077-0771-7718	

4.12.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Four duplicate soil samples was collected and analyzed for this SWMU. Detected analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Table 4.12-2 through Table 4.12-5.

4.12.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 499 of the 499 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 100 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 5 of the 230 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 99 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 418 of the 418 indicators reviewed for precision were within criteria, therefore 100 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within

acceptable evaluation criteria. For metals analyses, only 14 of the 138 indicators reviewed for precision required qualification of associated data. Therefore, 90 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that, the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Four field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated J values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, and TPH analyses. Completeness was a 100 percent for metals analysis except barium which was 68 percent.

4.13 DATA QUALITY REVIEW, WASTEWATER PLAYA LAKE (SWMU 103)

4.13.1 SWMU 103 Site Description

This SWMU is a Playa Lake occupying approximately 13 acres within the boundary of Cannon AFB near the eastern edge of the base. The water level of the Playa Lake is maintained at approximately two-thirds total capacity. No discharge of water occurs from the Playa Lake except for withdrawal by a neighboring farmer for irrigation. This unit has been active since 1943. The Playa Lake received effluent from an Imhoff wastewater treatment system from 1943 to 1966. Contaminants of concern include organics, PCBs, pesticides, and metals.

The playa has received sanitary and industrial wastewater effluent from the wastewater treatment lagoons (SWMU Nos. 101 and 102) since 1966, and a broad range of both sanitary and industrial sewage, mostly untreated, from 1942 until the lagoons were built in 1966.

Samples were collected and analyzed for this SWMU as presented in Table 19-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDG 031358. As part of the scope of services for the USACE, a "full" review utilizing the raw data was completed for SDG 031358. The "full" data review can be found in Attachment B.

4.13.2 Laboratory Case Narrative

The laboratory reported a postdigestion spike recovery below criteria define in SW-846 for selenium and arsenic. The associated data were qualified estimated to indicate a low bias. Samples qualified based on postdigestion spike recoveries are listed below:

W-C Sample Number	Analyte	Qualifier
CAN103-1033-5001	Selenium	J
	Arsenic	J
CAN103-1032-5001	Arsenic	J
CAN103-1034-5001	Selenium	J
CAN103-1037-3000	Selenium	J
CAN103-1035-3000	Selenium	J
CAN103-1036-3000	Selenium	J

Although not mentioned in laboratory case narrative, all sludge samples reported a percent moisture greater than 50 percent. The Cannon AFB Data Quality Review Checklist requires that for soil samples with a percent moisture greater than 50 percent, the analytical data for VOC, SVOC, pesticide/PCBs, and herbicide analyses are to be qualified as estimated **J**. Data for samples CAN103-1031-5001, CAN103-1032-5001, CAN103-1033-5001, and CAN103-1034-5001 are qualified estimated **J/UJ**. No other qualifications based on the laboratory case narrative were required for Wastewater Playa Lake.

For pesticide/PCB analyses, samples CAN103-1031-5001, CAN103-1032-5001, CAN103-1033-5001, and CAN103-1034-5001 were diluted and reanalyzed. The samples were reanalyzed at a higher dilution to retain instrument calibration for all compounds.

4.13.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. For pesticide/PCB analyses, samples CAN103-1036-3000, CAN103-1037-3000, and CAN103-1035-3000 were extracted within holding time, but the reported re-extraction exceeded the extraction time by 8 days. Therefore, pesticide/PCB results for the above three samples were qualified estimated **J/UJ**. All other analyses met established holding times.

4.13.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. The target compounds were reported nondetect for SVOC, pesticide/PCBs, herbicides, TPH, and metals analyses method blanks. Acetone and methylene chloride were detected in the method blanks. Since these analytes are common laboratory contaminants, analyses results were qualified nondetect if the results were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes were raised to the amount detected in the sample qualified nondetect if it was greater than the reporting limit. Samples qualified based on method blank or rinsate blank contamination are listed in Table 4.13-1.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and were associated with this SWMU. Methylene chloride and acetone were detected in the trip blank. The associated data for these analytes were previously qualified due to method blank contamination. Carbon disulfide was detected in the rinsate blank. Carbon disulfide data were qualified if the sample concentration was greater than 5 times the amount detected in the blank.

4.13.5 Duplicate Control Sample (DCS)

Duplicate Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to asses method accuracy and precision and served as a control on the analytical system. DCS results for VOC, SVOC, herbicides, pesticide/PCBs, total sulfide, metals, and TPH analyses were within evaluation criteria. The DCS recovery for sodium was below evaluation criteria. The associated data for the following samples were qualified estimated to indicate a low sample:

CAN103-1031-5001
CAN103-1032-5001
CAN103-1037-5001
CAN103-1034-5001

No other qualifications based on DCS results were required.

4.13.6 Reporting Limits (RL)

The sample reporting limit is the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For SDG 031358, several dilutions exceeded 5 times the RL established in the Cannon AFB QAPP (W-C 1993). For VOC and SVOC analyses, sample CAN103-1032-5001 exceeded the established RL by 20 times. Nine dilutions were noted for pesticide/PCB analyses. These ranged from 15 times to 394 times RL limits. The laboratory case narrative stated laboratory dilutions were required due to matrix interferences. For 6010 analyses, sample CAN103-1032-5001 required a dilution 20 times the RL due to high target analyte concentrations. Also, for TRPH analyses, sample CAN103-1032-5001 also reported a dilution 20 times the RL due to high target analyte concentrations. While no qualifications based on elevated reporting limits were required, the possibility exists that the organic compounds may be diluted to below the instrument's detection limit.

4.13.7 Surrogate Compound Percent Recoveries

All surrogate recoveries for VOC and pesticide/PCBs were within evaluation criteria. For herbicide analysis, the surrogate recoveries for 2,4-dichlorophenyl acetic acid (DCAA) associated with samples CAN103-1032-5001, CAN103-1033-5001, and CAN103-1034-5001 were below evaluation criteria. All associated data for these samples were qualified estimated to indicate a low bias. For SVOC analyses, terphenyl-d_{14} surrogate recoveries were below criteria for three SWMU 103 samples. No action was taken because only one surrogate was outlying criteria. No other qualifications were required for this SWMU based on outlying surrogate recoveries.

4.13.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses

MS/MSD analysis were performed to assess precision and accuracy. For SDG 031358, all MS/MSD recoveries were within evaluation criteria except lead, arsenic, pyrene (SVOC), thallium, and TPH. The MS/MSD recoveries for all of these analytes were below evaluation criteria. Pyrene and TPH data for CAN103-1036-3000 were qualified estimated to indicate a low bias. Arsenic, lead, and thallium data for CAN103-1036-3000, CAN103-1037-3000, and CAN103-1035-3000 were qualified estimated to indicate a low bias.

No other qualifications were necessary based on MS/MSD recoveries.

4.13.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Two duplicate samples were collected and analyzed for this SWMU. Detected analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Table 4.13-2 and Table 4.13-3.

4.13.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 218 of the 226 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 96 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 0 of the 138 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 100 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, 84 of the 84 indicators reviewed for precision were within criteria; therefore, 100 percent of the indicators reviewed for precision(matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 2 of the 46 indicators reviewed for precision required qualification of associated data. Therefore, 96 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design o f the sampling program, such that, the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated J values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, pesticide/PCB, herbicides, TPH, and metals analyses.

4.14 DATA QUALITY REVIEW, OWS NO. 5121 (SWMU 93)

4.14.1 SWMU 93 Site Description

OWS No. 5121 was located on the east side of Power Check Pad No. 5121. The OWS was a two-compartment underground unit with a detached 100-gallon oil storage tank. The unit was active from approximately 1957 to 1988. Contaminants of concern include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and metals.

Facility 5121 was dismantled in 1988 and replaced with Facility 5123. OWS No. 5121 and the associated leach well were removed during the demolition of Building 5121. Facility 5123 is believed to have been constructed over the location occupied by OWS No. 5121. The OWS received wash water generated from aircraft maintenance operations. The recovered oils were directed to the 100-gallon oil holding tank and the wastewater was discharged to a leach well located approximately 40 feet east of the separator.

Samples were collected and analyzed for this SWMU as presented in Table 14-1 of the RFI report. A summary of analytical results are presented in Attachment A. The laboratory analyzed these samples and reported the data in SDGs 031273 and 031274.

4.14.2 Laboratory Case Narrative

The laboratory case narrative reported that spike compounds at estimated levels were carried over into the 8240 analyses of sample CAN093-0933-0028. The sample was re-analyzed and no spike compounds were detected. Therefore, spike compounds (benzene, chlorobenzene, 1,1-DCE, toluene, and TCE) were qualified nondetected **U** in sample CAN093-0933-0028. The table below summarize specific analytes qualified nondetect based on laboratory narrative information.

The laboratory reported that the postdigestion spike recoveries were below criteria defined by SW-846 for selenium, thallium, and arsenic in several of the associated samples in SDG 031274. Associated data were qualified estimated to indicate a low bias. Samples requiring qualification based on postdigestion spike levels outside evaluation criteria are presented below:

W-C I.D.	Lab I.D.	Compound	Qualification
CAN093-0933-0028	031273-0015-SA	Benzene	U
CAN093-0933-0028	031273-0015-SA	Chlorobenzene	U
CAN093-0933-0028	031273-0015-SA	1,1-DCE	U
CAN093-0933-0028	031273-0015-SA	Toluene	U
CAN093-0933-0028	031273-0015-SA	TCE	U
CAN093-0931-0004	031274-0004-SA	Selenium	J
CAN093-0931-0004	031274-0004-SA	Thallium	J
CAN093-0931-0018	031274-0006-SA	Thallium	J
CAN093-0931-0028	031274-0007-SA	Selenium	J
CAN093-0931-0048	031274-0009-SA	Selenium	J
CAN093-0931-0048	031274-0009-SA	Arsenic	J
CAN093-0931-0058	031274-0010-SA	Arsenic	J
CAN093-0932-0000	031273-0001-SA	Selenium	J
CAN093-0932-0002	031273-0002-SA	Selenium	J
CAN093-0932-0008	031273-0004-SA	Selenium	J
CAN093-0932-0048	031273-0008-SA	Selenium	J
CAN093-0933-0002	031273-0011-SA	Selenium	J
CAN093-0933-0004	031273-0012-SA	Selenium	J
CAN093-0933-0008	031273-0013-SA	Selenium	J
CAN093-0933-0018	031273-0014-SA	Selenium	J
CAN093-0933-0028	031273-0015-SA	Selenium	J
CAN093-0933-0038	031273-0016-SA	Selenium	J
CAN093-0933-0048	031273-0017-SA	Selenium	J
CAN093-0933-0058	031273-0018-SA	Selenium	J
CAN093-0933-0058	031273-0018-SA	Thallium	J

No other qualifications based on the laboratory case narrative were required for samples from SWMU 93.

4.14.3 Holding Times

Holding times were specified in the Cannon AFB QAPP (W-C 1993) for each respective analytical methods. All samples collected for this SWMU were extracted/analyzed within acceptable holding times, therefore, no qualifications based on holding times were necessary.

4.14.4 Blank Samples

Method blanks were used to assess laboratory contamination that may have been present in samples. Acetone and methylene chloride were detected in the method blanks for both SDGs. In addition, in SDG 031274, 2-butanone was detected. Since these analytes are common laboratory contaminants, associated results were qualified nondetect if the amount reported in samples were less than 10 times the amount detected in the associated blanks. Reporting limits for the analytes qualified nondetect were raised to the amount detected in the sample if the concentration reported was greater than reporting limits. When laboratory contaminants were reported in samples without associated blank detections, professional judgement was used to qualify analytical data nondetect **U** if analytes were reported at similar contaminant levels as those qualified with associated method bland data. Target compounds were reported as nondetect for SVOC method blanks. Samples qualified based on method blank contamination are listed in Table 4.14-1.

Calcium was detected in one method blank associated with samples from SDG 031274. All samples were reported with concentrations greater than 5 times the concentration reported in the method blank. Therefore, no qualifications were necessary based on inorganic method blank criteria.

One trip blank, one decontamination water blank, one ambient blank, and one rinsate blank were collected and associated with SWMU 0093. In SDG 031274, methylene chloride was detected in both the ambient blank and the trip blank at 1.0 and 1.1 μg/kg, respectively. Dibromochloromethane was detected in the rinsate blank at a concentration of 1.1 μg/kg and tetrachloroethene was detected at a concentration of 1.2 μg/kg in the decontamination water blank. Dibromochloromethane and tetrachloroethene were not reported in environmental samples associated with the decon or rinsate blank; therefore, no qualification was necessary

based on field blank criteria. Methylene chloride reported in samples was qualified based on the laboratory method blank criteria; therefore, no qualification was necessary based on laboratory contaminants reported in the ambient or trip blanks.

4.14.5 Duplicate Control Sample (DCS)

Duplicate Control Samples were prepared in the laboratory and analyzed with field samples. These samples were used to assess method accuracy and precision and served as a control on the analytical system. All organic DCS results for both SDGs 031273 and 031274 were within evaluation criteria; therefore, no qualifications were required based on outlying DCS results.

For inorganics in SDG 031274, the sodium DCS was recovered at 50%, seven percentage points below evaluation criteria. Table 4.14-2 summarizes samples qualified as estimated **J** to indicate a low bias based on low DCS recovery.

4.14.6 Reporting Limits (RL)

The sample reporting limit is the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with the specified level of confidence. Several factors which may prevent RLs from being as low as method quantitation limits are listed below:

- Concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the linear range of the instrument.

- Matrix interference may require that the sample be diluted to reduce or eliminate the interference.

- Analytical results and RLs are corrected for moisture content of the sample.

- Physical characteristics of the sample do not permit concentration of the final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation of RLs.

For SDGs 031273 and 031274, no organic analyses required dilutions exceeding 5 times the RL established in the Cannon AFB QAPP (W-C 1993). For inorganic analytes, lead results reported in two samples required dilutions greater than 5 times and are listed below.:

W-C Sample Number	Analyte	Dilution Factor
CAN093-0932-0058	Lead	20
CAN093-0932-0000	Lead	20

4.14.7 Surrogate Compound Percent Recoveries

Surrogate sample results evaluated the accuracy of analytical measurement on a sample specific basis. All surrogate recoveries were within evaluation criteria; therefore, no qualifications were necessary based on surrogate evaluation criteria.

4.14.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis

MS/MSD analysis were performed to assess precision and accuracy. All organic MS/MSD recoveries for SDG 031274 were within evaluation criteria, therefore no qualifications were required. For SDG 031273, all organic MS/MSD recoveries were within evaluation criteria except for the SVOC analyte pyrene which was recovered above evaluation criteria. No qualifications were judged to be required based on MS/MSD analysis alone. The surrogate and DCS results met evaluation criteria.

Inorganic MS/MSD results were all within evaluation criteria except for the following: barium (high recovery), silver (high recovery), and magnesium (low recovery). Table 4.14-3 summarizes samples qualified as estimated on the basis of outlying MS/MSD recoveries. Detected barium and silver data were qualified estimated to indicate a high bias, and magnesium data were qualified estimated to indicate a low bias.

4.14.9 Field Duplicate Samples

Overall precision for the sampling event was measured using field duplicate samples. Evaluation criteria for field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Two duplicate soil samples was collected and analyzed for this SWMU. Detected analytes and qualifications based on outlying RPD recoveries for this SWMU are presented in Table 4.14-4 and Table 4.14-5.

4.14.10 PARCC Parameters

The agreement between duplicate analyses within control limits indicates satisfactory precision in a measurement system. The recovery of predetermined amount of surrogate within control limits indicates satisfactory accuracy with respect to the method on the individual sample and the general matrix. Precision and accuracy were quantitatively assessed by evaluating quality control data. Except where otherwise specified in the data review, the majority of the spike recoveries (which were used to measure accuracy) were within acceptable evaluation criteria. For organic analyses, 254 of the 255 indicators reviewed for accuracy (matrix spikes, DCS, and surrogate spikes) were within evaluation criteria. Therefore, 99 percent of the accuracy indicators for organic analyses were reported within evaluation criteria. For metal analyses, 4 of the 138 indicators reviewed for accuracy (DCS and matrix spikes), required qualification of associated data; therefore, 97 percent of the accuracy indicators reviewed for metal analyses were within evaluation criteria. Overall, it was concluded that the accuracy of the data for this SWMU was satisfactory.

Similarly, except where otherwise specified in the data review, it was concluded that the overall precision of the data for this SWMU was satisfactory. For organic analyses, only one analyte reviewed for precision was outside evaluation criteria, therefore 99 percent of the indicators reviewed for precision (matrix spike duplicate and field duplicates) were within acceptable evaluation criteria. For metals analyses, only 5 of the 92 indicators reviewed for precision required qualification of associated data. Therefore, 94 percent of the precision indicators reviewed for metal analyses were within evaluation criteria.

Representativeness

Representativeness expresses the degree which sample data accurately and precisely represent the characteristics of a population. Representativeness is a qualitative parameter which is of concern in the proper design of the sampling program, such that, the sampling locations selected will provide representative data for decisions at the SWMU. Representativeness was assessed by the use of duplicate samples. Two field duplicate soil samples were collected and analyzed. Both samples met satisfactory evaluation criteria except where noted in the Field Duplicate Sample section; therefore, it was concluded that representativeness was satisfactory.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. In accordance with the QAPP, data are comparable when siting considerations, collection techniques, measurement methods, and reporting procedures are equivalent for the samples within a sample set. Throughout this investigation, appropriate procedures for sampling and shipping were implemented as specified in the Cannon AFB QAPP (W-C 1993) or where amended for the various field activities. Within this data set, it was concluded that results were comparable to one another as well as to other data sets generated for Cannon AFB SWMUs.

Completeness

Completeness, defined as the percentage of the total number of analytical results requested which are judged to be valid (including estimated J values) in accordance with the Cannon AFB QAPP (W-C 1993), was 100 percent for VOC, SVOC, TPH, and metals analyses.

TABLE 4.1-1

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 031, CANNON AFB

LOCATOR			CAN031-0312-0000		CAN031-0312-3161		
COLLECT DATE			9/12/93		9/12/93		
SAMPLE DELIVERY GROUP			31183		31183		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 418.1	TPH	mg/kg	973	J	415	J	80.40
EPA 6010	Aluminum	mg/kg	4260		4200		1.42
EPA 7060	Arsenic	mg/kg	2.4		2.2		8.70
EPA 6010	Barium	mg/kg	166	J	241	J	36.86
EPA 6010	Beryllium	mg/kg	0.22		0.22		0.00
EPA 6010	Cadmium	mg/kg	0.85		ND		NC
EPA 6010	Calcium	mg/kg	48600		44200		9.48
EPA 6010	Chromium	mg/kg	9.9		7.9		22.47
EPA 6010	Cobalt	mg/kg	2.6		2.6		0.00
EPA 6010	Copper	mg/kg	9.3		8.3		11.36
EPA 6010	Iron	mg/kg	5570		5540		0.54
EPA 7421	Lead	mg/kg	46.9		41.6		11.98
EPA 6010	Magnesium	mg/kg	1810		1660		8.65
EPA 6010	Manganese	mg/kg	195		173		11.96
EPA 6010	Nickel	mg/kg	5.8		5.8		0.00
EPA 6010	Potassium	mg/kg	1100		1020		7.55
EPA 6010	Vanadium	mg/kg	13.8		13.2		4.44
EPA 6010	Zinc	mg/kg	57		47.6		17.97

(1) Duplicates were analyzed for TPH and TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.1-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 031, CANNON AFB

LOCATOR			CAN031-0312-0002		CAN031-0312-3162		
COLLECT DATE			9/12/93		9/12/93		
SAMPLE DELIVERY GROUP			31183		31183		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8270	Phenanthrene	µg/kg	44		ND		NC
	Fluoranthene	µg/kg	55		ND		NC
	Pyrene	µg/kg	44		ND		NC
	Benzo(b)fluoranthene	µg/kg	65		ND		NC

(1) Duplicates were analyzed for VOCs and SVOCs
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.1-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 031, CANNON AFB

LOCATOR			CAN031-0314-0002		CAN031-0314-3163		
COLLECT DATE			9/12/93		9/12/93		
SAMPLE DELIVERY GROUP			31183		31183		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 6010	Aluminum	mg/kg	6090	J	3350	J	58.05
EPA 7060	Arsenic	mg/kg	2.6		2		26.09
EPA 6010	Barium	mg/kg	107	J	247	J	79.10
	Beryllium	mg/kg	0.34		0.25		30.51
	Calcium	mg/kg	71300	J	156000	J	74.53
	Chromium	mg/kg	6.4		5.5		15.13
	Cobalt	mg/kg	3.2		2.5		24.56
	Copper	mg/kg	5.2	J	3.1	J	50.60
	Iron	mg/kg	6030	J	3380	J	56.32
EPA 7421	Lead	mg/kg	6.9	J	2.5	J	93.62
EPA 6010	Magnesium	mg/kg	1760		2180		21.32
EPA 6010	Manganese	mg/kg	101	J	53.9	J	60.81
	Nickel	mg/kg	7		5		33.33
	Potassium	mg/kg	1110	J	627	J	55.61
EPA 7740	Selenium	mg/kg	0.16		ND		NC
	Vanadium	mg/kg	13.3		11.5		14.52
	Zinc	mg/kg	13.2		29.2		75.47

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.2-1

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 046, CANNON AFB

LOCATOR			CAN046-0463-4662		CAN046-0463-0008		
COLLECT DATE			9/24/93		9/24/93		
SAMPLE DELIVERY GROUP			31403		31403		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 418.1	TPH	mg/kg	62.5		ND		NC
EPA 6010	Aluminum	mg/kg	4150		4030		2.93
EPA 7060	Animony	mg/kg	33.4	J	ND	J	NC
EPA 7060	Arsenic	mg/kg	1.7		1.7		0.00
EPA 6010	Barium	mg/kg	134		165		20.74
EPA 6010	Calcium	mg/kg	262000		224000		15.64
EPA 6010	Copper	mg/kg	5		4.4		12.77
EPA 6010	Iron	mg/kg	3440		3330		3.25
EPA 7421	Lead	mg/kg	2.4		2.2		8.70
EPA 6010	Magnesium	mg/kg	3440		3530		2.58
EPA 6010	Manganese	mg/kg	39		39.7		1.78
EPA 6010	Potassium	mg/kg	1060		997		6.13
EPA 6010	Vanadium	mg/kg	13.4		13.9		3.66
EPA 6010	Zinc	mg/kg	8.8		ND		NC

(1) Duplicates were analyzed for VOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.2-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 046, CANNON AFB

LOCATOR			CAN046-0463-0000		CAN046-0463-4661		
COLLECT DATE			9/24/93		9/24/93		
SAMPLE DELIVERY GROUP			31403		31403		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 418.1	TPH	mg/kg	326		397		19.64
EPA 6010	Aluminum	mg/kg	9290	J	6260	J	38.97
EPA 7060	Arsenic	mg/kg	2.2		2.5		12.77
EPA 6010	Barium	mg/kg	144	J	330	J	78.48
EPA 6010	Beryllium	mg/kg	0.49		0.42		15.38
EPA 6010	Calcium	mg/kg	26200	J	43800		50.29
EPA 6010	Chromium	mg/kg	8.1	J	11.8	J	37.19
EPA 6010	Cobalt	mg/kg	3.3		4.7		35.00
EPA 6010	Copper	mg/kg	6.7	J	11.4	J	51.93
EPA 6010	Iron	mg/kg	8490		8480		0.12
EPA 7421	Lead	mg/kg	20.2		14.7		31.52
EPA 6010	Magnesium	mg/kg	1900		2330		20.33
EPA 6010	Manganese	mg/kg	172	J	394	J	78.45
EPA 6010	Nickel	mg/kg	8.1		8.1		0.00
EPA 6010	Potassium	mg/kg	1800	J	1170	J	42.42
EPA 6010	Vanadium	mg/kg	18.5		17.8		3.86
EPA 6010	Zinc	mg/kg	22.1	J	40.7	J	59.24
EPA 8240	Toluene	µg/kg	1.2		1.5		22.22
	Xylenes (total)	µg/kg	2.6		2.2		16.67
EPA 8270	Fluoranthene	µg/kg	48		51		6.06
EPA 8270	Pyrene	µg/kg	70		70		0.00
EPA 8270	Benzo(b)fluoranthene	µg/kg	46		43		6.74
EPA 8270	Benzo(a)pyrene	µg/kg	ND		39		NC
EPA 8270	Benzo(g,h,i)perylene	µg/kg	ND		39		NC

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.3-1

SUMMARY OF QUALIFICATIONS BASE POSTDIGESTION SPIKE RECOVERY AT SWMU 47

W-C SAMPLE ID	METHOD	ANALYTE	QUAL	BASIS FOR QUALIFICATION
CAN047-0471-0002	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0471-0004	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0471-0008	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0472-0002	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0472-0004	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0472-0008	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0473-0002	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0473-0004	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0473-0008	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0474-0000	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0474-0002	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0474-0004	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0474-0008	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0475-0000	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0475-0002	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0475-0004	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0475-0008	7740	Selenium	J	Low postdigestion spike recovery
CAN047-0472-0002	7841	Thallium	J	Low postdigestion spike recovery
CAN047-0472-0004	7841	Thallium	J	Low postdigestion spike recovery
CAN047-0472-0008	7841	Thallium	J	Low postdigestion spike recovery
CAN047-0473-0004	7841	Thallium	J	Low postdigestion spike recovery
CAN047-0473-0008	7841	Thallium	J	Low postdigestion spike recovery
CAN047-0474-0004	7841	Thallium	J	Low postdigestion spike recovery
CAN047-0474-0008	7841	Thallium	J	Low postdigestion spike recovery
CAN047-0475-0004	7841	Thallium	J	Low postdigestion spike recovery
CAN047-0475-0008	7841	Thallium	J	Low postdigestion spike recovery

TABLE 4.3-2

QUALIFICATIONS BASED ON BLANK SAMPLE CONTAMINATION FOR SWMU 47

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031276-0009-SA	CAN047-0471-0000	8240	Acetone	U		Detected in method blank
031276-0012-SA	CAN047-0471-0008	8240	Methylene chloride	U		Detected in method blank
031278-0001-SA	CAN047-0472-0000	8240	Acetone	U		Detected in method blank
031278-0002-SA	CAN047-0472-0002	8240	Acetone	U		Detected in method blank
031278-0002-SA	CAN047-0472-0002	8240	Methylene Chloride	U		Detected in method blank
031278-0003-SA	CAN047-0472-0004	8240	2-Butanone (MEK)	U		Detected in method blank
031278-0003-SA	CAN047-0472-0004	8240	Acetone	U		Detected in method blank
031278-0003-SA	CAN047-0472-0004	8240	Methylene Chloride	U		Detected in method blank
031278-0004-SA	CAN047-0472-0008	8240	Acetone	U		Detected in method blank
031278-0005-SA	CAN047-0472-4761	8240	Methylene Chloride	U		Detected in method blank
031278-0006-SA	CAN047-0472-4762	8240	Methylene Chloride	U		Detected in method blank
031279-0003-SA	CAN047-0473-0000	8240	Acetone	U		Detected in Method Blank
031279-0003-SA	CAN047-0473-0000	8240	Methylene Chloride	U		Detected in Method Blank
031279-0004-SA	CAN047-0473-0002	8240	Acetone	U		Detected in Method Blank
031279-0004-SA	CAN047-0473-0002	8240	Methylene Chloride	U		Detected in Method Blank
031279-0005-SA	CAN047-0473-0004	8240	Acetone	U		Detected in Method Blank
031279-0005-SA	CAN047-0473-0004	8240	Methylene Chloride	U		Detected in Method Blank
031279-0006-SA	CAN047-0473-0008	8240	Methylene Chloride	U		Detected in Method Blank
031190-0001-SA	CAN047-0474-0000	8240	Methylene Chloride	U		Detected in Method Blank
031190-0002-SA	CAN047-0474-0002	8240	Acetone	U		Detected in Method Blank
031190-0002-SA	CAN047-0474-0002	8240	Methylene Chloride	U		Detected in Method Blank
031190-0003-SA	CAN047-0474-0004	8240	Methylene Chloride	U		Detected in Method Blank
031190-0004-SA	CAN047-0474-0008	8240	Acetone	U		Detected in Method Blank
031190-0004-SA	CAN047-0474-0008	8240	Methylene Chloride	U		Detected in Method Blank
031190-0005-SA	CAN047-0475-0000	8240	Acetone	U		Detected in Method Blank
031190-0005-SA	CAN047-0475-0000	8240	Methylene Chloride	U		Detected in Method Blank
031190-0006-SA	CAN047-0475-0002	8240	Methylene Chloride	U		Detected in Method Blank
031190-0007-SA	CAN047-0475-0004	8240	Methylene Chloride	U		Detected in Method Blank
031190-0008-SA	CAN047-0475-0008	8240	Acetone	U		Detected in Method Blank
031190-0008-SA	CAN047-0475-0008	8240	Methylene Chloride	U		Detected in Method Blank
031278-0006-SA	CAN047-0472-4762	8240	Acetone	U	13	Detected in method blank, raise RL
031190-0003-SA	CAN047-0474-0004	8240	Acetone	U	12	Detected in Method Blank, Raise RL.
031190-0007-SA	CAN047-0475-0004	8240	Acetone	U	13	Detected in Method Blank, Raise RL.
031276-0009-SA	CAN047-0471-0000	8240	Methylene chloride	U	7	Detected in method blank, raise RL
031276-0010-SA	CAN047-0471-0002	8240	Acetone	U	14	Detected in method blank, raise RL
031276-0010-SA	CAN047-0471-0002	8240	Methylene chloride	U	7	Detected in method blank, raise RL
031276-0011-SA	CAN047-0471-0004	8240	Acetone	U	16	Detected in method blank, raise RL
031276-0011-SA	CAN047-0471-0004	8240	Methylene chloride	U	7	Detected in method blank, raise RL
031276-0012-SA	CAN047-0471-0008	8240	Acetone	U	19	Detected in method blank, raise RL
031278-0002-SA	CAN047-0472-0002	8240	toluene	U		Detected in trip blank
031278-0005-SA	CAN047-0472-4761	8240	Xylenes (total)	U		Detected in trip blank
031278-0006-SA	CAN047-0472-4762	8240	Toluene	U		Detected in trip blank

TABLE 4.3-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 047, CANNON AFB

LOCATOR			CAN047-0472-0008		CAN047-0472-4762			CAN047-0472-0000		CAN047-0472-4761		
COLLECT DATE			9/14/93		9/14/93			9/14/93		9/14/93		
SAMPLE DELIVERY GROUP			31278		31278			31278		31278		
		Units	Result	Qual	Result	Qual	RPD (2)(%)	Result	Qual	Result	Qual	RPD (2)(%)
EPA 418.1	TPH	mg/kg	ND		ND		NC	56.2	J	877	J	175.91
EPA 8270	Butylbenzylphthalate	µg/kg						ND		64		NC
EPA 6010	Aluminum	mg/kg	2970	J	4350	J	37.70	4150	J	6920	J	50.05
EPA 7060	Arsenic	mg/kg	1.2		1.2		0.00	2.5		2.7		7.69
EPA 6010	Barium	mg/kg	205		177		14.66	123	J	178	J	36.54
	Beryllium	mg/kg	0.25		0.32		24.56	0.47		0.58		20.95
	Calcium	mg/kg	138000		134000		2.94	23500		33400		34.80
	Chromium	mg/kg	ND		ND		NC	4.8	J	11.9	J	85.03
	Cobalt	mg/kg	ND		ND		NC	2.6		3.6		32.26
	Copper	mg/kg	1.5		1.6		6.45	4.9		6.6		29.57
	Iron	mg/kg	2060		2860		32.52	5140		7010		30.78
EPA 7421	Lead	mg/kg	4.4		3.8		14.63	7.2		8.1		11.76
EPA 6010	Magnesium	mg/kg	2770		3060		9.95	1310	J	2800	J	72.51
EPA 6010	Manganese	mg/kg	38		37.1		2.40	147		177		18.52
	Nickel	mg/kg	ND		3.8		NC	5.3	J	7.8	J	38.17
	Potassium	mg/kg	703	J	1010	J	35.84	997	J	1440	J	36.36
	Thallium	mg/kg	ND		ND		NC	ND		0.12		NC
	Vanadium	mg/kg	6.6		7.5		12.77	14.5		19.3		28.40
	Zinc	mg/kg	6.3		8.2		26.21	12.5		16.8		29.35

(1) Duplicates were analyzed for VOCs, TPH, TAL metals. Duplicate CAN047-0472-4761 was also analyzed for SVOCs.
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.4-1

QUALIFICATIONS BASED ON BLANK SAMPLE CONTAMINATION FOR SWMU 51

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031276-0001-SA	CAN051-0511-0000	8240	Acetone	U		Detected in Method Blank
031276-0001-SA	CAN051-0511-0000	8240	Methylene chloride	U		Detected in Method Blank
031276-0002-SA	CAN051-0511-0002	8240	Acetone	U		Detected in Method Blank
031276-0003-SA	CAN051-0511-0004	8240	Acetone	U		Detected in Method Blank
031276-0004-SA	CAN051-0511-0008	8240	Methylene chloride	U		Detected in Method Blank
031279-0007-SA	CAN051-0512-0000	8240	Acetone	U		Detected in Method Blank
031279-0007-SA	CAN051-0512-0000	8240	Methylene Chloride	U		Detected in Method Blank
031279-0016-SA	CAN051-0512-0002	8240	Methylene Chloride	U		Detected in Method Blank
031279-0017-SA	CAN051-0512-0004	8240	Acetone	U		Detected in Method Blank
031279-0017-SA	CAN051-0512-0004	8240	Methylene Chloride	U		Detected in Method Blank
031279-0018-SA	CAN051-0512-0008	8240	Acetone	U	15	Detected in Method Blank
031279-0002-SA	CAN051-0512-5162	8240	Acetone	U		Detected in Method Blank
031279-0002-SA	CAN051-0512-5162	8240	Methylene Chloride	U		Detected in Method Blank
031276-0005-SA	CAN051-0513-0000	8240	Acetone	U		Detected in method blank
031276-0006-SA	CAN051-0513-0002	8240	Acetone	U		Detected in method blank
031276-0006-SA	CAN051-0513-0002	8240	Methylene chloride	U		Detected in method blank
031279-0016-SA	CAN051-0512-0002	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031276-0002-SA	CAN051-0511-0002	8240	Methylene chloride	U	7.4	Detected in Method Blank, Raise RL.
031276-0003-SA	CAN051-0511-0004	8240	Methylene chloride	U	8.2	Detected in Method Blank, Raise RL.
031276-0004-SA	CAN051-0511-0008	8240	Acetone	U	13	Detected in Method Blank, Raise RL.
031276-0005-SA	CAN051-0513-0000	8240	Methylene chloride	U	8.1	Detected in Method Blank, Raise RL.
031276-0007-SA	CAN051-0513-0004	8240	Acetone	U	19	Detected in Method Blank, Raise RL.
031276-0007-SA	CAN051-0513-0004	8240	Methylene chloride	U	7.2	Detected in Method Blank, Raise RL.
031276-0008-SA	CAN051-0513-0008	8240	Acetone	U	14	Detected in Method Blank, Raise RL.
031276-0008-SA	CAN051-0513-0008	8240	Methylene chloride	U	6.3	Detected in Method Blank, Raise RL.

TABLE 4.4-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 051, CANNON AFB

LOCATOR			CAN051-0512-0000		CAN051-0512-5161		
COLLECT DATE			9/15/93		9/15/93		
SAMPLE DELIVERY GROUP			31279		31279		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8270	2-Methylnaphthalene	µg/kg	ND		480		NC
EPA 8270	Di-n-butylphthalate	µg/kg	46		ND		NC
EPA 418.1	TPH	mg/kg	173	J	98.9	J	54.51
EPA 6010	Aluminum	mg/kg	4910		6290		24.64
EPA 7060	Arsenic	mg/kg	2.1		2.9		32.00
EPA 6010	Barium	mg/kg	433		461		6.26
EPA 6010	Beryllium	mg/kg	0.29	J	0.53	J	58.54
EPA 6010	Calcium	mg/kg	17400		18000		3.39
EPA 6010	Chromium	mg/kg	7.4	J	16.7	J	77.18
EPA 6010	Cobalt	mg/kg	2.5		3.6		36.07
EPA 6010	Copper	mg/kg	5.2	J	8.8	J	51.43
EPA 6010	Iron	mg/kg	6900		8230		17.58
EPA 7421	Lead	mg/kg	6.5		7.4		12.95
EPA 6010	Magnesium	mg/kg	1440		1560		8.00
EPA 6010	Manganese	mg/kg	197		214		8.27
EPA 6010	Nickel	mg/kg	5.3		7.5		34.38
EPA 6010	Potassium	mg/kg	773		1250		47.16
EPA 6010	Silver	mg/kg	0.53		ND		NC
EPA 6010	Sodium	mg/kg	309		ND		NC
EPA 6010	Vanadium	mg/kg	13.8		18.5		29.10
EPA 6010	Zinc	mg/kg	15.9		19.6		20.85

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.4-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORINGS - SWMU 051, CANNON AFB

LOCATOR			CAN051-0512-0008		CAN051-0512-5162		
COLLECT DATE			9/15/93		9/15/93		
SAMPLE DELIVERY GROUP			31279		31279		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Toluene	µg/kg	1.7		ND		N/C
EPA 8240	Xylenes (total)	µg/kg	ND		1.4		N/C

(1) Duplicates were analyzed for VOCs, TPH, TAL metals
There were no VOC detections. NC = Noncalculable
(2) RPD = Relative Percent Difference

TABLE 4.5-1

QUALIFICATIONS BASED ON OUTLYING MS/MSD RECOVERIES FOR SWMU 57

LAB ID	W-C ID	METHOD	ANALYTE	QUAL
031279-0012-SA	CAN057-0572-0000	6010	Chromium	J
031279-0012-SA	CAN057-0572-0000	7421	Lead	J
031279-0012-SA	CAN057-0572-0000	7841	Thallium	UJ
031279-0013-SA	CAN057-0572-0002	6010	Barium	J
031279-0013-SA	CAN057-0572-0002	6010	Chromium	J
031279-0013-SA	CAN057-0572-0002	7421	Lead	J
031279-0013-SA	CAN057-0572-0002	7841	Thallium	UJ
031279-0014-SA	CAN057-0572-0004	6010	Barium	J
031279-0014-SA	CAN057-0572-0004	6010	Chromium	J
031279-0014-SA	CAN057-0572-0004	7421	Lead	J
031279-0014-SA	CAN057-0572-0004	7841	Thallium	UJ
031279-0015-SA	CAN057-0572-0008	6010	Barium	J
031279-0015-SA	CAN057-0572-0008	6010	Chromium	J
031279-0015-SA	CAN057-0572-0008	7421	Lead	J
031279-0015-SA	CAN057-0572-0008	7841	Thallium	UJ
031279-0008-SA	CAN057-0573-0000	6010	Barium	J
031279-0008-SA	CAN057-0573-0000	6010	Chromium	J
031279-0008-SA	CAN057-0573-0000	7421	Lead	J
031279-0008-SA	CAN057-0573-0000	7841	Thalliuim	UJ
031279-0009-SA	CAN057-0573-0002	6010	Barium	J
031279-0009-SA	CAN057-0573-0002	6010	Chromium	J
031279-0009-SA	CAN057-0573-0002	7421	Lead	J
031279-0009-SA	CAN057-0573-0002	6010	Silver	UJ
031279-0009-SA	CAN057-0573-0002	7841	Thalliuim	UJ
031279-0010-SA	CAN057-0573-0004	6010	Barium	J
031279-0010-SA	CAN057-0573-0004	6010	Chromium	UJ
031279-0010-SA	CAN057-0573-0004	6010	Silver	UJ
031279-0010-SA	CAN057-0573-0004	7841	Thalliuim	UJ
031279-0011-SA	CAN057-0573-0008	6010	Barium	J
031279-0011-SA	CAN057-0573-0008	6010	Chromium	UJ
031279-0011-SA	CAN057-0573-0008	7841	Thallium	UJ
031279-0012-SA	CAN057-0572-0000	6010	Cadmium	R
031279-0013-SA	CAN057-0572-0002	6010	Cadmium	R
031279-0014-SA	CAN057-0572-0004	6010	Cadmium	R
031279-0015-SA	CAN057-0572-0008	6010	Cadmium	R
031279-0008-SA	CAN057-0573-0000	6010	Cadmium	R
031279-0009-SA	CAN057-0573-0002	6010	Cadmium	R
031279-0010-SA	CAN057-0573-0004	6010	Cadmium	R
031279-0011-SA	CAN057-0573-0008	6010	Cadmium	R

TABLE 4.5-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 057, CANNON AFB

LOCATOR			CAN057-0571-0000		CAN057-0571-5761			CAN057-0571-0008		CAN057-0571-5762		
COLLECT DATE			9/15/93		9/15/93			9/15/93		9/15/93		
SAMPLE DELIVERY GROUP			31274-0017		31274-0015			31274-0020		31274-0016		
		Units	Result	Qual	Result	Qual	RPD (2)(%)	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Ethylbenzene	µg/kg	ND		ND		0.00	ND		1.2		NC
	Toluene	µg/kg	3.8		2.9		26.87	ND		ND		0.00
	Xylenes	µg/kg	7.5		3.6		70.27	ND		1.6		NC
EPA 418.1	TPH	mg/kg	144		109		27.67	49.4		ND		NC
EPA 6010	Aluminum	mg/kg	4790		5500		13.80	4740		4110		14.24
EPA 7060	Arsenic	mg/kg	2		1.8		10.53	1.6		1.5		6.45
EPA 6010	Barium	mg/kg	180		175		2.82	192		196		2.06
	Beryllium	mg/kg	0.33		0.33		0.00	ND		ND		0.00
	Cadmium	mg/kg	0.95		ND		NC	1.9	J	4.1	J	73.33
	Calcium	mg/kg	63800	J	41100	J	43.28	127000	J	231000	J	58.10
	Chromium	mg/kg	4.4		5.6		24.00	2.8		ND		NC
	Cobalt	mg/kg	2.4		2.6		8.00	ND		3		NC
	Copper	mg/kg	4.5		5.6		21.78	ND		ND		0.00
	Iron	mg/kg	4360		5260		18.71	4140		3200		25.61
EPA 7421	Lead	mg/kg	6.4		7.1		10.37	5.7	J	2.5	J	78.05
EPA 6010	Magnesium	mg/kg	2520		2870		12.99	3450		2900		17.32
EPA 6010	Manganese	mg/kg	106		128		18.80	82.4	J	45.2	J	58.31
	Nickel	mg/kg	6		6.3		4.88	ND		4.2		NC
	Potassium	mg/kg	937		1070		13.25	ND		ND		0.00
	Silver	mg/kg	0.66		0.6		0.00	ND		0.93		NC
	Sodium	mg/kg	ND		189		NC	418		ND		NC
	Vanadium	mg/kg	13.5		14		3.64	18.9	J	10.7	J	55.41
	Zinc	mg/kg	14.1		16.6		16.29	14		10.2		31.40

(1) Duplicates were analyzed for VOCs, TPH, TAL metals. Duplicate set for CAN057-0571-0000 was also analyzed for SVOCs.
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.6-1

QUALIFICATIONS BASED ON BLANK SAMPLE CONTAMINATION FOR SWMUs 61, 62, 63

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031379-0011-SA	CAN061-0612-0000	8240	Acetone	U		Detected in Method Blank
031379-0012-SA	CAN061-0612-0002	8240	Methylene Chloride	U		Detected in Method Blank
031379-0013-SA	CAN061-0612-0004	8240	Methylene Chloride	U		Detected in Method Blank
031379-0014-SA	CAN061-0612-0008	8240	Acetone	U		Detected in Method Blank
031379-0014-SA	CAN061-0612-0008	8240	Methylene Chloride	U		Detected in Method Blank
031402-0009-SA	CAN062-0621-0000	8240	Acetone	U		Detected in Method Blank
031402-0010-SA	CAN062-0621-0002	8240	Methylene Chloride	U		Detected in Method Blank
031402-0007-SA	CAN063-0631-0000	8240	Acetone	U		Detected in Method Blank
031402-0007-SA	CAN063-0631-0000	8240	Methylene Chloride	U		Detected in Method Blank
031402-0013-SA	CAN063-0631-0000	8240	Acetone	U		Detected in Method Blank
031214-0002-SA	CAN063-0631-0002	8240	Acetone	U		Detected in Method Blank
031214-0002-SA	CAN063-0631-0002	8240	Methylene Chloride	U		Detected in Method Blank
031214-0003-SA	CAN063-0631-0004	8240	Acetone	U		Detected in Method Blank
031214-0003-SA	CAN063-0631-0004	8240	Methylene Chloride	U		Detected in Method Blank
031214-0004-SA	CAN063-0631-0008	8240	Acetone	U		Detected in Method Blank
031214-0004-SA	CAN063-0631-0008	8240	Methylene Chloride	U		Detected in Method Blank
031216-0015-SA	CAN063-0631-6361	8270	Butyl benzylphthalate	U		Detected in Method Blank
031216-0015SA	CAN063-0631-6361	8240	Methylene Chloride	U		Detected in Method Blank
031402-0008-SA	CAN063-0631-6361	8240	Acetone	U		Detected in Method Blank
031402-0008-SA	CAN063-0631-6361	8240	Methylene Chloride	U		Detected in Method Blank
031214-0006-SA	CAN063-0632-0002	8240	Acetone	U		Detected in Method Blank
031214-0006-SA	CAN063-0632-0002	8240	Methylene Chloride	U		Detected in Method Blank
031214-0007-SA	CAN063-0632-0004	8240	Acetone	U		Detected in Method Blank
031214-0007-SA	CAN063-0632-0004	8240	Methylene Chloride	U		Detected in Method Blank
031214-0008-SA	CAN063-0632-0008	8240	Methylene Chloride	U		Detected in Method Blank
031401-0005-SA	CAN062-0622-6251	8240	Methylene Chloride	U		Detected in Method Blank
031401-0006-SA	CAN062-0622-6271	8240	Methylene Chloride	U		Detected in Method Blank
031401-0008-TB	CAN062-0622-6291	8240	Methylene Chloride	U		Detected in Method Blank
031379-0007-SA	CAN061-0611-0000	8240	Acetone	U	20	Detected in Method Blank, Raise RL.
031379-0008-SA	CAN061-0611-0002	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031379-0009-SA	CAN061-0611-0004	8240	Acetone	U	14	Detected in Method Blank, Raise RL.
031379-0010-SA	CAN061-0611-0008	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031379-0012-SA	CAN061-0612-0002	8240	Acetone	U	16	Detected in Method Blank, Raise RL.
031379-0013-SA	CAN061-0612-0004	8240	Acetone	U	14	Detected in Method Blank, Raise RL.
031402-0010-SA	CAN062-0621-0002	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031402-0011-SA	CAN062-0621-0004	8240	Acetone	U	18	Detected in Method Blank, Raise RL.
031402-0012-SA	CAN062-0621-0008	8240	Acetone	U	16	Detected in Method Blank, Raise RL.
031216-0015SA	CAN063-0631-6361	8240	Acetone	U	16	Detected in Method Blank, Raise RL.
031214-0008-SA	CAN063-0632-0008	8240	Acetone	U	14	Detected in Method Blank, Raise RL.
031216-0014-SA	CAN063-0632-6362	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031216-0014-SA	CAN063-0632-6362	8240	Methylene Chloride	U	7.3	Detected in Method Blank, Raise RL.

TABLE 4.6-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 063, CANNON AFB

LOCATOR			CAN063-0631-0000		CAN063-0631-6361		
COLLECT DATE			9/13/93		9/13/93		
SAMPLE DELIVERY GROUP			31214		31216		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8270	2-Methylnaphthalene	µg/kg	120		ND		NC
	Acenaphthalene	µg/kg	58		ND		NC
	Dibenzofuran	µg/kg	51		ND		NC
	Fluorene	µg/kg	59		ND		NC
	Phenanthrene	µg/kg	670	J	350	J	62.75
	Anthracene	µg/kg	96		ND		NC
	Fluoranthene	µg/kg	900	J	610	J	38.41
	Pyrene	µg/kg	1100	J	700	J	44.44
	Butylbenzylphthalate	µg/kg	120		ND		NC
	Benzo(a)anthracene	µg/kg	370		360		2.74
	bis(2-Ethylhexyl)phthalate	µg/kg	240		150		46.15
	Chrysene	µg/kg	720	J	490	J	38.02
	Benzo(b) fluoranthene	µg/kg	990	J	690	J	35.71
	Benzo(a) pyrene	µg/kg	460		400		13.95
	Indeno(1,2,3-c,d) pyrene	µg/kg	250		170		38.10
	Benzo(g,h,i) perylene	µg/kg	280		200		33.33
	Carbazole	µg/kg	66		ND		NC
EPA 418.1	TPH	mg/kg	649		626		3.61
EPA 6010	Aluminum	mg/kg	3430		3890		12.57
EPA 7060	Arsenic	mg/kg	2.2		2.4		8.70
EPA 6010	Barium	mg/kg	717		732		2.07
EPA 6010	Beryllium	mg/kg	0.27		ND		NC
EPA 6010	Calcium	mg/kg	44500	J	95200	J	72.58
EPA 6010	Chromium	mg/kg	11.9	J	7.8	J	41.62
EPA 6010	Cobalt	mg/kg	2.4		1.9		23.26
EPA 6010	Copper	mg/kg	11.6		9.6		18.87
EPA 6010	Iron	mg/kg	5120		4390		15.35
EPA 7421	Lead	mg/kg	84.4	J	195	J	79.17
EPA 6010	Magnesium	mg/kg	1970		1990		1.01
EPA 6010	Manganese	mg/kg	383	J	265	J	36.42

TABLE 4.6-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 063, CANNON AFB

LOCATOR			CAN063-0631-0000		CAN063-0631-6361		
COLLECT DATE			9/13/93		9/13/93		
SAMPLE DELIVERY GROUP			31214		31216		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 7470	Mercury	mg/kg	0.25		0.18		32.56
EPA 6010	Nickel	mg/kg	8.2		6.8		18.67
EPA 6010	Potassium	mg/kg	898		1050		15.61
EPA 6010	Vanadium	mg/kg	14.2		11.8		18.46
EPA 6010	Zinc	mg/kg	54.9		55		0.18

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.6-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 063, CANNON AFB

LOCATOR			CAN063-0631-0000		CAN063-0631-6361		
COLLECT DATE			9/24/93		9/24/93		
SAMPLE DELIVERY GROUP			31402		31402		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	1,2-Dichloroethane	µg/kg	1.5		ND		NC
	Ethylbenzene	µg/kg	ND		2.2		NC
	Toluene	µg/kg	2.7		ND		NC
	Xylenes (total)	µg/kg	1.1	J	14	J	170.86

(1) Duplicates were analyzed for VOCs
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.6-4

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 063, CANNON AFB

LOCATOR			CAN063-0632-0008		CAN063-0632-6362		
COLLECT DATE			9/13/93		9/15/93		
SAMPLE DELIVERY GROUP			31214		31216		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Acetone	µg/kg	14		15		6.90
EPA 418.1	TPH	mg/kg	173	J	98.9	J	54.51
EPA 6010	Aluminum	mg/kg	5260	J	8190	J	43.57
EPA 7060	Arsenic	mg/kg	2		2.1		4.88
EPA 6010	Barium	mg/kg	751	J	255	J	98.61
	Beryllium	mg/kg	0.44		0.43		2.30
	Calcium	mg/kg	68100		56500		18.62
	Chromium	mg/kg	3.8		5.4		34.78
	Cobalt	mg/kg	2.3		2.5		8.33
	Copper	mg/kg	3.3		3.5		5.88
	Iron	mg/kg	4560		5540		19.41
EPA 7421	Lead	mg/kg	3.9		5.8		39.18
EPA 6010	Magnesium	mg/kg	2560		3100		19.08
EPA 6010	Manganese	mg/kg	83.8		81.9		2.29
	Nickel	mg/kg	5.7		6.5		13.11
	Potassium	mg/kg	1090	J	1650	J	40.88
	Vanadium	mg/kg	14.7		15.8		7.21
	Zinc	mg/kg	11	J	16.5	J	40.00

(1) Duplicates were analyzed for VOCs, SVOC, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.7-1

QUALIFICATIONS BASED ON LABORATORY CASE NARRATIVE FOR SWMU 70

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	BASIS FOR QUALIFICATION
31404-0002-SA	CAN070-0702-0000	8270	Benzo(b)fluoranthene	J	Low internal standard area-Perylyene-d12
31404-0002-SA	CAN070-0702-0000	8270	Benzo(a)pyrene	J	Low internal standard area-Perylyene-d12
31404-0002-SA	CAN070-0702-0000	8270	Indeno(1,2,3-cd)pyrene	J	Low internal standard area-Perylyene-d12
31404-0002-SA	CAN070-0702-0000	8270	Benzo(g,h,i)perylene	J	Low internal standard area-Perylyene-d12
31404-0002-SA	CAN070-0702-0000	8270	Di-n-octyl phthalate	UJ	Low internal standard area-Perylyene-d12
31404-0002-SA	CAN070-0702-0000	8270	Benzo(k)fluoranthene	UJ	Low internal standard area-Perylyene-d12
31404-0002-SA	CAN070-0702-0000	8270	Dibenz(a,h)anthracene	UJ	Low internal standard area-Perylyene-d12
31404-0002-SA	CAN070-0702-0000	8240	Toluene	J	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	1,1,1-Trichloroethane	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Carbon tetrachloride	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Bromodichloromethant	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	1,2-Dichloropropane	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	cis-1,3-Dichloropropene	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Trichloroethene	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Dibromochloromethane	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	1,1,2-Trichloroethane	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Benzene	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	trans-1,3-Dichloropropene	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	4-Methyl-2-pentanone	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	2-Hexanone	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Tetrachloroethene	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	1,1,2,2-Tetrachloroethane	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Chlorobenzene	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Ethylbenzene	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Styrene	UJ	Low internal standard area-Chlorobenzene-d5
31404-0002-SA	CAN070-0702-0000	8240	Xylenes (total)	UJ	Low internal standard area-Chlorobenzene-d5
31404-0001-SA	CAN070-0701-0058	7740	Selenium	J	Low postdigestion spike recovery
31404-0001-SA	CAN070-0701-0058	7841	Thallium	J	Low postdigestion spike recovery
31404-0005-SA	CAN070-0702-0008	7740	Selenium	J	Low postdigestion spike recovery
31404-0005-SA	CAN070-0702-0008	7841	Thallium	J	Low postdigestion spike recovery
031215-0003-SA	CAN070-0704-0002	7740	Selenium	J	Low postdigestion spike recovery
031215-0003-SA	CAN070-0704-0002	7740	Selenium	J	Low postdigestion spike recovery
031215-0004-SA	CAN070-0704-0004	7740	Selenium	J	Low postdigestion spike recovery
031215-0004-SA	CAN070-0704-0008	7740	Selenium	J	Low postdigestion spike recovery
031215-0005-SA	CAN070-0704-0008	7740	Selenium	J	Low postdigestion spike recovery
031215-0005-SA	CAN070-0704-0008	7740	Selenium	J	Low postdigestion spike recovery
031215-0006-SA	CAN070-0704-0013	7740	Selenium	J	Low postdigestion spike recovery

TABLE 4.7-1

QUALIFICATIONS BASED ON LABORATORY CASE NARRATIVE FOR SWMU 70

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	BASIS FOR QUALIFICATION
031215-0006-SA	CAN070-0704-0013	7841	Thallium	J	Low postdigestion spike recovery
031215-0006-SA	CAN070-0704-0013	7740	Selenium	J	Low postdigestion spike recovery
031215-0006-SA	CAN070-0704-0013	7841	Thallium	J	Low postdigestion spike recovery
031215-0007-SA	CAN070-0704-0018	7740	Selenium	J	Low postdigestion spike recovery
031215-0007-SA	CAN070-0704-0018	7841	Thallium	J	Low postdigestion spike recovery
031215-0007-SA	CAN070-0704-0018	7740	Selenium	J	Low postdigestion spike recovery
031215-0007-SA	CAN070-0704-0018	7841	Thallium	J	Low postdigestion spike recovery
031215-0008-SA	CAN070-0705-0000	7740	Selenium	J	Low postdigestion spike recovery
031278-0007-SA	CAN070-0705-0002	7740	Selenium	J	Low postdigestion spike recovery
031278-0008-SA	CAN070-0705-0004	7740	Selenium	J	Low postdigestion spike recovery
031278-0009-SA	CAN070-0705-0008	7740	Selenium	J	Low postdigestion spike recovery
031278-0009-SA	CAN070-0705-0008	7841	Thallium	J	Low postdigestion spike recovery
031278-0010-SA	CAN070-0705-0014	7740	Selenium	J	Low postdigestion spike recovery
031278-0010-SA	CAN070-0705-0014	7841	Thallium	J	Low postdigestion spike recovery
031278-0011-SA	CAN070-0705-0018	7740	Selenium	J	Low postdigestion spike recovery
031278-0011-SA	CAN070-0705-0018	7841	Thallium	J	Low postdigestion spike recovery

TABLE 4.7-2
QUALIFICATIONS BASED ON SAMPLE BLANK CONTAMINATION FOR SWMU 70

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031403-0005-SA	CAN070-0701-0018	8240	Methylene Chloride	U		Detected in method blank
031215-0003-SA	CAN070-0704-0002	8240	Methylene Chloride	U		Detected in Method Blank
031278-0007-SA	CAN070-0705-0002	8240	Methlyene chloride	U		Detected in method blank
031278-0010-SA	CAN070-0705-0013	8240	Acetone	U		Detected in method blank
031403-0001-SA	CAN070-0701-0000	8240	Methylene Chloride	U		Detected in method blank
031403-0002-SA	CAN070-0701-0002	8240	Methylene Chloride	U		Detected in method blank
031403-0003-SA	CAN070-0701-0004	8240	Acetone	U		Detected in method blank
031403-0003-SA	CAN070-0701-0004	8240	Methylene Chloride	U		Detected in method blank
031403-0004-SA	CAN070-0701-0008	8240	Methylene Chloride	U		Detected in method blank
031403-0006-SA	CAN070-0701-0028	8240	Methylene Chloride	U		Detected in method blank
031403-0007-SA	CAN070-0701-0038	8240	Methylene Chloride	U		Detected in method blank
031403-0008-SA	CAN070-0701-0048	8240	Methylene Chloride	U		Detected in method blank
31404-0001-SA	CAN070-0701-0058	8240	Acetone	U		Detected in method blank
31404-0001-SA	CAN070-0701-0058	8240	Methylene chloride	U		Detected in method blank
31404-0002-SA	CAN070-0702-0000	8240	Acetone	U		Detected in method blank
31404-0002-SA	CAN070-0702-0000	8240	Methylene chloride	U		Detected in method blank
31404-0003-SA	CAN070-0702-0002	8240	Acetone	U		Detected in method blank
31404-0003-SA	CAN070-0702-0002	8240	Methylene chloride	U		Detected in method blank
31404-0004-SA	CAN070-0702-0004	8240	Acetone	U		Detected in method blank
31404-0004-SA	CAN070-0702-0004	8240	Methylene chloride	U		Detected in method blank
31404-0005-SA	CAN070-0702-0008	8240	Acetone	U		Detected in method blank
31404-0005-SA	CAN070-0702-0008	8240	Methylene chloride	U		Detected in method blank
31404-0006-SA	CAN070-0702-0018	8240	Acetone	U		Detected in method blank
31404-0006-SA	CAN070-0702-0018	8240	Methylene chloride	U		Detected in method blank
31404-0011-SA	CAN070-0704-0000	8240	Acetone	U		Detected in method blank
31404-0011-SA	CAN070-0704-0000	8240	Methylene chloride	U		Detected in method blank
31404-0012-SA	CAN070-0704-7062	8240	Acetone	U		Detected in method blank
31404-0012-SA	CAN070-0704-7062	8240	Methylene chloride	U		Detected in method blank
31404-0013-SA	CAN070-0705-0000	8240	Acetone	U		Detected in method blank
31404-0013-SA	CAN070-0705-0000	8240	Methylene chloride	U		Detected in method blank
031215-0003-SA	CAN070-0704-0002	8240	Acetone	U	250	Detected in Method Blank, Raise RL.
031278-0011-SA	CAN070-0705-0018	8240	Acetone	U	26000	Detected in method blank, raise RL
031278-0011-SA	CAN070-0705-0018	8240	Ethylbenzene	U	16000	Detected in method blank, raise RL
031278-0007-SA	CAN070-0705-0002	8240	Acetone	U	20	Detected in method blank,raise RL
031278-0007-SA	CAN070-0705-0002	8240	Toluene	U		Detected in trip blank

TABLE 4.7-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 70, CANNON AFB

LOCATOR			CAN070-0704-0000		CAN070-0704-7062		
COLLECT DATE			9/14/93		9/14/93		
SAMPLE DELIVERY GROUP			31215		31215		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8270	2-Methylnapthalene	µg/kg	640		550		15.13
	bis(2-Ethylhexyl)phthalate	µg/kg	860	J	530	J	47.48
EPA 418.1	TPH	mg/kg	4740		4780		0.84
EPA 6010	Aluminum	mg/kg	5880		6220		5.62
EPA 7060	Arsenic	mg/kg	3		2.2		30.77
EPA 6010	Barium	mg/kg	124		164		27.78
	Beryllium	mg/kg	0.46		0.42		9.09
	Cadmium	mg/kg	0.74		0.77		3.97
	Calcium	mg/kg	16900		20400		18.77
	Chromium	mg/kg	13.5		10.9		21.31
	Cobalt	mg/kg	2.9		3.1		6.67
	Copper	mg/kg	11.2		13.9		21.51
	Iron	mg/kg	6770		7820		14.39
EPA 7421	Lead	mg/kg	87.2		107		20.39
EPA 6010	Magnesium	mg/kg	1410		1570		10.74
EPA 6010	Manganese	mg/kg	134		148		9.93
	Nickel	mg/kg	6.5		7.1		8.82
	Potassium	mg/kg	1540		1600		3.82
	Vanadium	mg/kg	15.5		17.8		13.81
	Zinc	mg/kg	37.7		43.4		14.06

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.7-4

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 70, CANNON AFB

LOCATOR			CAN070-0704-0000		CAN070-0704-7062		
COLLECT DATE			9/24/93		9/15/93		
SAMPLE DELIVERY GROUP			31404/31215		31404/31215		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8270	2-Methylnaphthalene	µg/kg	640		550		15.13
	bis(2-Ethylhexyl)phthalate	µg/kg	860		530		47.48
EPA 6010	Aluminum	mg/kg	5880		6220		5.62
EPA 7060	Arsenic	mg/kg	3		2.2		30.77
EPA 6010	Barium	mg/kg	124		164		27.78
	Beryllium	mg/kg	0.46		0.42		9.09
	Cadmium	mg/kg	0.74		0.77		3.97
	Calcium	mg/kg	16900		20400		18.77
	Chromium	mg/kg	13.5		10.9		21.31
	Cobalt	mg/kg	2.9		3.1		6.67
	Copper	mg/kg	11.2		13.9		21.51
	Iron	mg/kg	6770		7820		14.39
EPA 7421	Lead	mg/kg	82.7		107		25.62
EPA 6010	Magnesium	mg/kg	1410		1570		10.74
	Manganese	mg/kg	134		148		9.93
	Nickel	mg/kg	6.5		7.1		8.82
	Potassium	mg/kg	1540		1600		3.82
	Vanadium	mg/kg	15.5		17.8		13.81
	Zinc	mg/kg	37.7		43.4		14.06
EPA 418.1	TPH	mg/kg	4740		4780		0.84

(1) Duplicates were analyzed for VOCs (SDG 031404) and SVOCs, TAL metals, and TPH (SDG 031215)
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.8-1
QUALIFICATIONS BASED ON SAMPLE BLANK CONTAMINATION FOR SWMU 92

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031214-0016-SA	CAN092-0923-0004	8240	Acetone	U		Detected in Method Blank
031214-0016-SA	CAN092-0923-0004	8240	Methylene Chloride	U		Detected in Method Blank
031214-0017-SA	CAN092-0923-0008	8240	Acetone	U		Detected in Method Blank
031214-0017-SA	CAN092-0923-0008	8240	Methylene Chloride	U		Detected in Method Blank
031417-0001-SA	CAN092-0924-0000	8240	Acetone	U		Detected in method blank
031417-0001-SA	CAN092-0924-0000	8240	Methylene Chloride	U		Detected in method blank
031417-0002-SA	CAN092-0924-0002	8240	Acetone	U		Detected in method blank
031417-0002-SA	CAN092-0924-0002	8240	Methylene Chloride	U		Detected in method blank
031417-0003-SA	CAN092-0924-0004	8240	Acetone	U		Detected in method blank
031417-0003-SA	CAN092-0924-0004	8240	Methylene Chloride	U		Detected in method blank
031417-0004-SA	CAN092-0924-0008	8240	Acetone	U		Detected in method blank
031417-0004-SA	CAN092-0924-0008	8240	Methylene Chloride	U		Detected in method blank
031417-0006-SA	CAN092-0924-0018	8240	Acetone	U	12	Detected in method blank
031417-0006-SA	CAN092-0924-0018	8240	Methylene Chloride	U		Detected in method blank
031417-0007-SA	CAN092-0924-0028	8240	Acetone	U		Detected in method blank
031417-0007-SA	CAN092-0924-0028	8240	Methylene Chloride	U		Detected in method blank
031417-0008-SA	CAN092-0924-0038	8240	Acetone	U	20	Detected in method blank
031417-0008-SA	CAN092-0924-0038	8240	Methylene Chloride	U		Detected in method blank
031417-0009-SA	CAN092-0924-0048	8240	Acetone	U		Detected in method blank
031417-0009-SA	CAN092-0924-0048	8240	Methylene Chloride	U		Detected in method blank
031417-0010-SA	CAN092-0924-0058	8240	Acetone	U		Detected in method blank
031417-0010-SA	CAN092-0924-0058	8240	Methylene Chloride	U		Detected in method blank
031417-0005-SA	CAN092-0924-9262	8240	Acetone	U		Detected in method blank
031417-0005-SA	CAN092-0924-9262	8240	Methylene Chloride	U		Detected in method blank
031214-0012-SA	CAN092-0922-0004	8240	Acetone	U	18	Detected in Method Blank, Raise RL.

TABLE 4.8-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 92, CANNON AFB

LOCATOR			CAN092-0922-0000		CAN092-0922-9261		
COLLECT DATE			9/13/93		9/13/93		
SAMPLE DELIVERY GROUP			31214		31214		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8270	Phenanthrene	µg/kg	150		220		37.84
	Di-n-butylphthalate	µg/kg	ND		73		N/C
	Fluoranthene	µg/kg	260		490		61.33
	Pyrene	µg/kg	340		450		27.85
	Butylbenzylphthalate	µg/kg	52		140		91.67
	Benzo(a)anthracene	µg/kg	89		190		72.40
	bis(2-Ethylhexyl)phthalate	µg/kg	120		420		111.11
	Chrysene	µg/kg	180		300		50.00
	Benzo(b)fluoranthene	µg/kg	290		460		45.33
	Benzo(a)pyrene	µg/kg	150		210		33.33
	Indeno(1,2,3-c,d)pyrene	µg/kg	83		130		44.13
	Benzo(g,h,i)perylene	µg/kg	86		130		40.74
EPA 418.1	TPH	mg/kg	278		184		40.69
EPA 6010	Aluminum	mg/kg	5070		6410		23.34
EPA 7060	Arsenic	mg/kg	2.2		2.3		4.44
EPA 6010	Barium	mg/kg	198		258		26.32
	Beryllium	mg/kg	0.29		0.41		34.29
	Cadmium	mg/kg	1		0.89		11.64
	Calcium	mg/kg	72500		96200		28.10
	Chromium	mg/kg	13.8	J	8.5	J	47.53
	Cobalt	mg/kg	2.9		3.3		12.90
	Copper	mg/kg	6.9		8.4		19.61
	Iron	mg/kg	12000	J	6730	J	56.27
EPA 7421	Lead	mg/kg	64.3	J	11.8	J	137.98
EPA 6010	Magnesium	mg/kg	2810		3330		16.94
EPA 6010	Manganese	mg/kg	135		178		27.48
	Nickel	mg/kg	8.2		7.7		6.29
	Potassium	mg/kg	1490		1470		1.35
	Vanadium	mg/kg	13.1		18.4		33.65
	Zinc	mg/kg	72.6	J	45.9	J	45.06

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.8-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 92, CANNON AFB

LOCATOR			CAN092-0924-0008		CAN092-0924-9262		
COLLECT DATE			9/23/93		9/23/93		
SAMPLE DELIVERY GROUP			31417		31417		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 6010	Aluminum	mg/kg	3840		4770		21.60
	Antimony	mg/kg	12.2	J	17.4	J	35.14
EPA 7060	Arsenic	mg/kg	1.8		1.8		0.00
EPA 6010	Barium	mg/kg	226		244		7.66
	Beryllium	mg/kg	0.38		0.48		23.26
	Calcium	mg/kg	156000		129000		18.95
	Chromium	mg/kg	ND		1.7		N/A
	Cobalt	mg/kg	2.4		2.3		4.26
	Copper	mg/kg	3.7		4		7.79
	Iron	mg/kg	3740		4080		8.70
EPA 7421	Lead	mg/kg	4.4		4.7		6.59
EPA 6010	Magnesium	mg/kg	3470		3650		5.06
EPA 6010	Manganese	mg/kg	68.2		78.4		13.92
	Nickel	mg/kg	7.7		5.6		31.58
	Potassium	mg/kg	1190		1350		12.60
	Vanadium	mg/kg	15.9		18.4		14.58
	Zinc	mg/kg	10		11.6		14.81

(1) Duplicates were analyzed for VOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.9-1
SUMMARY OF QUALIFICATIONS BASED ON THE LABORATORY NARRATIVE

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031402-0003-SA	CAN094-0941-0002	8240	1,1,1-Trichloroethane	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	Carbon Tetrachloride	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	Bromodichloromethane	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	Bromoform	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	1,2-Dichloropropane	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	trans-1,3-Dichloropropene	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	Trichloroethene	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	Dibromochloromethane	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	1,1,2-Trichloroethane	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	Benzene	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0003-SA	CAN094-0941-0002	8240	cis-1,3-Dichloropropene	UJ		Low internal standard, 1,4-Difluorobenzene
031402-0002-SA	CAN094-0941-0000	8270	Pyrene	J		Low internal standard, Chrysene d-12
031402-0002-SA	CAN094-0941-0000	8270	Butylbenzyl phthalate	J		Low internal standard, Chrysene d-12
031402-0002-SA	CAN094-0941-0000	8270	Benzo(a)anthracene	J		Low internal standard, Chrysene d-12
031402-0002-SA	CAN094-0941-0000	8270	Bis(2-ethylhexyl) phthalate	J		Low internal standard, Chrysene d-12
031402-0002-SA	CAN094-0941-0000	8270	Chrysene	J		Low internal standard, Chrysene d-12
031402-0002-SA	CAN094-0941-0000	8270	3,3-Dichlorobenzidine	UJ		Low internal standard, Chrysene d-12
031402-0002-SA	CAN094-0941-0000	8270	Benzo(b)fluoranthene	J		Low internal standard, Perylene-d12
031402-0002-SA	CAN094-0941-0000	8270	Benzo(a) pyrene	J		Low internal standard, Perylene-d12
031402-0002-SA	CAN094-0941-0000	8270	Indeno(1,2,3-cd) pyrene	J		Low internal standard, Perylene-d12
031402-0002-SA	CAN094-0941-0000	8270	Benzo(g,h,i) perylene	J		Low internal standard, Perylene-d12
031402-0002-SA	CAN094-0941-0000	8270	Di-n-octyl phthalate	UJ		Low internal standard, Perylene-d12
031402-0002-SA	CAN094-0941-0000	8270	Benzo(k)fluoranthene	UJ		Low internal standard, Perylene-d12
031402-0002-SA	CAN094-0941-0000	8270	Dibenz(a,h) anthracene	UJ		Low internal standard, Perylene-d12
031402-0003-SA	CAN094-0941-0002	8240	Tetrachloroethene	J		Low internal standard,Chlorobenzene-d5
031402-0003-SA	CAN094-0941-0002	8240	Toluene	J		Low internal standard,Chlorobenzene-d5
031402-0003-SA	CAN094-0941-0002	8240	Ethylbenzene	J		Low internal standard,Chlorobenzene-d5
031402-0003-SA	CAN094-0941-0002	8240	Xylenes(total)	J		Low internal standard,Chlorobenzene-d5
031402-0003-SA	CAN094-0941-0002	8240	2-Hexanone	UJ		Low internal standard,Chlorobenzene-d5
031402-0003-SA	CAN094-0941-0002	8240	4-Methyl-2-pentanone	UJ		Low internal standard,Chlorobenzene-d5
031402-0003-SA	CAN094-0941-0002	8240	1,1,2,2-Tetrachloroethane	UJ		Low internal standard,Chlorobenzene-d5
031402-0003-SA	CAN094-0941-0002	8240	Chlorobenzene	UJ		Low internal standard,Chlorobenzene-d5
031402-0003-SA	CAN094-0941-0002	8240	Styrene	UJ		Low internal standard,Chlorobenzene-d5
031402-0006-SA	CAN094-0942-0000	8240	Toluene	J		Low internal standard,Chlorobenzene-d5
031402-0006-SA	CAN094-0942-0000	8240	Xylenes(total)	J		Low internal standard,Chlorobenzene-d5
031402-0006-SA	CAN094-0942-0000	8240	2-Hexanone	UJ		Low internal standard,Chlorobenzene-d5
031402-0006-SA	CAN094-0942-0000	8240	4-Methyl-2-pentanone	UJ		Low internal standard,Chlorobenzene-d5

TABLE 4.9-1
SUMMARY OF QUALIFICATIONS BASED ON THE LABORATORY NARRATIVE

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031402-0006-SA	CAN094-0942-0000	8240	Tetrachloroethene	UJ		Low internal standard,Chlorobenzene-d5
031402-0006-SA	CAN094-0942-0000	8240	1,1,2,2-Tetrachloroethane	UJ		Low internal standard,Chlorobenzene-d5
031402-0006-SA	CAN094-0942-0000	8240	Chlorobenzene	UJ		Low internal standard,Chlorobenzene-d5
031402-0006-SA	CAN094-0942-0000	8240	Ethylbenzene	UJ		Low internal standard,Chlorobenzene-d5
031402-0006-SA	CAN094-0942-0000	8240	Styrene	UJ		Low internal standard,Chlorobenzene-d5
031181-0017-SA	CAN094-0945-0000	8270	2,4-Dinitrophenol	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	2-Methylphenol	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	3,3'-Dichlorobenzidine	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	4-Methylphenol	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	Benzo(g,h,i)perylene	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	Benzo(k)fluoranthene	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	Bis(2-chloroethyl)ether	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	Bis(2-chloroisopropyl)ether	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	Carbazole	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	Chrysene	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	Dibenzo(a,h)anthracene	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	Indeno(1,2,3-cd)pyrene	UJ		Outlying continuing calibration %D value
031181-0017-SA	CAN094-0945-0000	8270	N-nitroso-di-n-propylamine	UJ		Outlying continuing calibration %D value
031181-0013-SA	CAN094-0946-0000	8240	Chloromethane	UJ		Outlying continuing calibration %D value
031181-0014-SA	CAN094-0946-0002	8240	1,2-Dichloroethane	UJ		Outlying continuing calibration %D value
031181-0014-SA	CAN094-0946-0002	8240	Carbon disulfide	UJ		Outlying continuing calibration %D value
031181-0014-SA	CAN094-0946-0002	8240	Trans-1,3-dichloropropene	UJ		Outlying continuing calibration %D value
031181-0015-SA	CAN094-0946-0004	8240	1,2-Dichloroethane	UJ		Outlying continuing calibration %D value
031181-0015-SA	CAN094-0946-0004	8240	Carbon disulfide	UJ		Outlying continuing calibration %D value
031181-0015-SA	CAN094-0946-0004	8240	Methylene chloride	UJ		Outlying continuing calibration %D value
031181-0015-SA	CAN094-0946-0004	8240	Trans-1,3-dichloropropene	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8240	1,2-Dichloroethane	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8240	Carbon disulfide	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8240	Methylene chloride	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8240	Trans-1,3-dichloropropene	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	2,4-Dinitrophenol	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	2-Methylphenol	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	3,3'-Dichlorobenzidine	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	4-Methylphenol	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	Benzo(g,h,i)perylene	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	Benzo(k)fluoranthene	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	Bis(2-chloroethyl)ether	UJ		Outlying continuing calibration %D value

TABLE 4.9-1
SUMMARY OF QUALIFICATIONS BASED ON THE LABORATORY NARRATIVE

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031181-0016-SA	CAN094-0946-0008	8270	Bis(2-chloroisopropyl)ether	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	Bis(2-ethylhexyl)phthalate	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	Carbazole	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	Chrysene	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	Dibenzo(a,h)anthracene	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	Indeno(1,2,3-cd)pyrene	UJ		Outlying continuing calibration %D value
031181-0016-SA	CAN094-0946-0008	8270	N-nitroso-di-n-propylamine	UJ		Outlying continuing calibration %D value

TABLE 4.9-2
QUALIFICATIONS BASED ON SAMPLE BLANK CONTAMINATION FOR SWMU 94

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031402-0002-SA	CAN094-0941-0000	8240	Acetone	U		Detected in Method Blank
031402-0003-SA	CAN094-0941-0002	8240	Acetone	U		Detected in Method Blank
031402-0003-SA	CAN094-0941-0002	8240	Methylene Chloride	U		Detected in Method Blank
031402-0004-SA	CAN094-0941-0004	8240	Methylene Chloride	U		Detected in Method Blank
031402-0005-SA	CAN094-0941-0008	8240	Methylene Chloride	U		Detected in Method Blank
031402-0001-SA	CAN094-0941-9461	8240	Acetone	U		Detected in Method Blank
031216-0017-SA	CAN094-0942-0000	8270	Butyl benzylphthalate	U		Detected in Method Blank
031216-0017SA	CAN094-0942-0000	8240	Acetone	U		Detected in Method Blank
031216-0017SA	CAN094-0942-0000	8240	Methylene Chloride	U		Detected in Method Blank
031402-0006-SA	CAN094-0942-0000	8240	Acetone	U		Detected in Method Blank
031216-0018-SA	CAN094-0942-0002	8240	Acetone	U		Detected in Method Blank
031216-0018-SA	CAN094-0942-0002	8240	Methylene Chloride	U		Detected in Method Blank
031216-0019-SA	CAN094-0942-0004	8240	Acetone	U		Detected in Method Blank
031216-0019-SA	CAN094-0942-0004	8240	Methylene Chloride	U		Detected in Method Blank
031216-0020-SA	CAN094-0942-0008	8240	Methylene Chloride	U		Detected in Method Blank
31404-0007-SA	CAN094-0944-0000	8240	Acetone	U		Detected in method blank
31404-0007-SA	CAN094-0944-0000	8240	Methylene chloride	U		Detected in method blank
31404-0008-SA	CAN094-0944-0002	8240	Methylene chloride	U		Detected in method blank
31404-0009-SA	CAN094-0944-0004	8240	Methylene chloride	U		Detected in method blank
31404-0010-SA	CAN094-0944-0008	8240	Methylene chloride	U		Detected in method blank
031181-0017-SA	CAN094-0945-0000	8240	Acetone	U		Detected in Method Blank
031181-0017-SA	CAN094-0945-0000	8240	Methylene Chloride	U		Detected in Method Blank
031181-0018-SA	CAN094-0945-0002	8240	Methylene Chloride	U		Detected in Method Blank
031181-0019-SA	CAN094-0945-0004	8240	Acetone	U		Detected in Method Blank
031181-0019-SA	CAN094-0945-0004	8240	Methylene Chloride	U		Detected in Method Blank
031181-0020-SA	CAN094-0945-0008	8240	Acetone	U		Detected in Method Blank
031181-0020-SA	CAN094-0945-0008	8240	Methylene Chloride	U		Detected in Method Blank
031402-0004-SA	CAN094-0941-0004	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031402-0005-SA	CAN094-0941-0008	8240	Acetone	U	18	Detected in Method Blank, Raise RL.
031216-0020-SA	CAN094-0942-0008	8240	Acetone	U	18	Detected in Method Blank, Raise RL.
031181-0018-SA	CAN094-0945-0002	8240	Acetone	U	13	Detected in Method Blank, Raise RL.
31404-0009-SA	CAN094-0944-0004	8240	Acetone	U	14	Detected in Method blank, Raise RL
31404-0010-SA	CAN094-0944-0008	8240	Acetone	U	20	Detected in Method blank, Raise RL

TABLE 4.9-3

SUMMARY OF QUALIFICATIONS BASED ON OUTLYING MS/MSD CIRITERIA

LAB ID	W-C SAMPLE ID	METHOD	ANALYTE	QUAL	BASIS
31404-0007-SA	CAN094-0944-0000	6010	Barium	J	Low MS/MSD recoveries (31/28)
31404-0008-SA	CAN094-0944-0002	6010	Barium	J	Low MS/MSD recoveries (31/28)
31404-0009-SA	CAN094-0944-0004	6010	Barium	J	Low MS/MSD recoveries (31/28)
31404-0010-SA	CAN094-0944-0008	6010	Barium	J	Low MS/MSD recoveries (31/28)
31404-0007-SA	CAN094-0944-0000	7741	Lead	J	Low MS/MSD recoveries (47/43)
31404-0008-SA	CAN094-0944-0002	7741	Lead	J	Low MS/MSD recoveries (47/43)
31404-0009-SA	CAN094-0944-0004	7741	Lead	J	Low MS/MSD recoveries (47/43)
31404-0010-SA	CAN094-0944-0008	7741	Lead	J	Low MS/MSD recoveries (47/43)
31404-0007-SA	CAN094-0944-0000	6010	Silver	J	Low MSD recovery (74)
31404-0008-SA	CAN094-0944-0002	6010	Silver	J	Low MSD recovery (74)
31404-0009-SA	CAN094-0944-0004	6010	Silver	J	Low MSD recovery (74)
31404-0010-SA	CAN094-0944-0008	6010	Silver	J	Low MSD recovery (74)
031181-0017-SA	CAN094-0945-0000	7421	Lead	J	High MS/MSD recoveries (163/167)
031181-0018-SA	CAN094-0945-0002	7421	Lead	J	High MS/MSD recoveries (163/167)
031181-0019-SA	CAN094-0945-0004	7421	Lead	J	High MS/MSD recoveries (163/167)
031181-0020-SA	CAN094-0945-0008	7421	Lead	J	High MS/MSD recoveries (163/167)
031181-0013-SA	CAN094-0946-0000	7421	Lead	J	High MS/MSD recoveries (163/167)
031181-0014-SA	CAN094-0946-0002	7421	Lead	J	High MS/MSD recoveries (163/167)
031181-0015-SA	CAN094-0946-0004	7421	Lead	J	High MS/MSD recoveries (163/167)
031181-0016-SA	CAN094-0946-0008	7421	Lead	J	High MS/MSD recoveries (163/167)
031181-0017-SA	CAN094-0945-0000	6010	Manganese	J	High MS/MSD recoveries (200/185)
031181-0018-SA	CAN094-0945-0002	6010	Manganese	J	High MS/MSD recoveries (200/185)
031181-0019-SA	CAN094-0945-0004	6010	Manganese	J	High MS/MSD recoveries (200/185)
031181-0020-SA	CAN094-0945-0008	6010	Manganese	J	High MS/MSD recoveries (200/185)
031181-0013-SA	CAN094-0946-0000	6010	Manganese	J	High MS/MSD recoveries (200/185)
031181-0014-SA	CAN094-0946-0002	6010	Manganese	J	High MS/MSD recoveries (200/185)
031181-0015-SA	CAN094-0946-0004	6010	Manganese	J	High MS/MSD recoveries (200/185)
031181-0016-SA	CAN094-0946-0008	6010	Manganese	J	High MS/MSD recoveries (200/185)
031181-0017-SA	CAN094-0945-0000	6010	Barium	R	High MS/MSD recoveries (365/431)
031181-0018-SA	CAN094-0945-0002	6010	Barium	R	High MS/MSD recoveries (365/431)
031181-0019-SA	CAN094-0945-0004	6010	Barium	R	High MS/MSD recoveries (365/431)
031181-0020-SA	CAN094-0945-0008	6010	Barium	R	High MS/MSD recoveries (365/431)
031181-0013-SA	CAN094-0946-0000	6010	Barium	R	High MS/MSD recoveries (365/431)
031181-0014-SA	CAN094-0946-0002	6010	Barium	R	High MS/MSD recoveries (365/431)
031181-0015-SA	CAN094-0946-0004	6010	Barium	R	High MS/MSD recoveries (365/431)
031181-0016-SA	CAN094-0946-0008	6010	Barium	R	High MS/MSD recoveries (365/431)
031181-0017-SA	CAN094-0945-0000	6010	Silver	UJ	Low MS/MSD recoveries (66/75)
031181-0018-SA	CAN094-0945-0002	6010	Silver	UJ	Low MS/MSD recoveries (66/75)
031181-0019-SA	CAN094-0945-0004	6010	Silver	UJ	Low MS/MSD recoveries (66/75)
031181-0020-SA	CAN094-0945-0008	6010	Silver	UJ	Low MS/MSD recoveries (66/75)
031181-0013-SA	CAN094-0946-0000	6010	Silver	UJ	Low MS/MSD recoveries (66/75)
031181-0014-SA	CAN094-0946-0002	6010	Silver	UJ	Low MS/MSD recoveries (66/75)
031181-0015-SA	CAN094-0946-0004	6010	Silver	UJ	Low MS/MSD recoveries (66/75)
031181-0016-SA	CAN094-0946-0008	6010	Silver	UJ	Low MS/MSD recoveries (66/75)

TABLE 4.9-4

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 94, CANNON AFB

LOCATOR			CAN094-0942-0008		CAN094-0942-9462		
COLLECT DATE			9/13/93		9/13/93		
SAMPLE DELIVERY GROUP			31216		31216		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 418.1	TPH	mg/kg	ND		51.4		NC
EPA 6010	Aluminum	mg/kg	3400	J	6360	J	60.66
EPA 7060	Arsenic	mg/kg	1.5		1.9		23.53
EPA 6010	Barium	mg/kg	296	J	3070	J	164.82
	Beryllium		ND		0.31		NC
	Calcium	mg/kg	178000	J	89800	J	65.87
	Chromium	mg/kg	ND	J	3.1	J	NC
	Cobalt	mg/kg	2		2.6		26.09
	Copper	mg/kg	2.8		2.3		19.61
	Iron	mg/kg	2900	J	4190	J	36.39
EPA 7421	Lead	mg/kg	3		4		28.57
EPA 6010	Magnesium	mg/kg	2780		3520		23.49
EPA 6010	Manganese	mg/kg	38.4	J	69.1	J	57.12
	Nickel	mg/kg	4.8		6.1		23.85
	Potassium	mg/kg	842	J	1460	J	53.69
	Vanadium	mg/kg	9.6		13.2		31.58
	Zinc	mg/kg	9	J	14.3	J	45.49

(1) Duplicates were analyzed for VOCs, TPH, TAL metals
There were no VOC detections. NC = Noncalculable
(2) RPD = Relative Percent Difference

TABLE 4.9-5

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 94, CANNON AFB

LOCATOR			CAN094-0941-0000		CAN094-0941-9461		
COLLECT DATE			9/24/93		9/24/93		
SAMPLE DELIVERY GROUP			31402		31402		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Methylene chloride	µg/kg	2.2		1.6		31.58
	Toluene	µg/kg	6.1	J	13	J	72.25
	Xylenes (total)	µg/kg	9.4		4.4		72.46
EPA 8270	Pyrene	µg/kg	410	J	920	J	76.69
	Butylbenzylphthalate	µg/kg	48		150		103.03
	Benzo(a)anthracene	µg/kg	110		260		81.08
	bis(2-Ethylhexyl)phthalate	µg/kg	130		290		76.19
	Chrysene	µg/kg	180		290		46.81
	Di-n-ocytyl phthalate	µg/kg	ND		35		NC
	Benzo(b)fluoranthene	µg/kg	230		370		46.67
	Benzo(a)pyrene	µg/kg	170		240		34.15
	Indeno(1,2,3-c,d)pyrene	µg/kg	110		180		48.28
	Benzo(g,h,i)perylene	µg/kg	160		200		22.22
EPA 418.1	TPH	mg/kg	862		782		9.73
EPA 6010	Aluminum	mg/kg	3630		2840		24.42
EPA 7060	Arsenic	mg/kg	2.7		1.9		34.78
EPA 6010	Barium	mg/kg	246	J	558	J	77.61
	Beryllium	mg/kg	0.32		0.26		20.69
	Calcium	mg/kg	59100		83400		34.11
	Cadmium	mg/kg	1.8		1.7		5.71
	Chromium	mg/kg	11.5	J	7.8	J	38.34
	Cobalt	mg/kg	2.3		1.7		30.00
	Copper	mg/kg	11.2		8.7		25.13
	Iron	mg/kg	5200		4940		5.13
EPA 7421	Lead	mg/kg	61.5		59.1		3.98

TABLE 4.9-5

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 94, CANNON AFB

LOCATOR			CAN094-0941-0000		CAN094-0941-9461		
COLLECT DATE			9/24/93		9/24/93		
SAMPLE DELIVERY GROUP			31402		31402		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 6010	Magnesium	mg/kg	2000		2140		6.76
EPA 6010	Manganese	mg/kg	189	J	480	J	87.00
	Nickel	mg/kg	5.6		4.5		21.78
	Potassium	mg/kg	1430	J	778	J	59.06
	Silver	mg/kg	0.54		0.39		32.26
	Sodium	mg/kg	210		ND		NA
	Vanadium	mg/kg	13.5		11.9		12.60
	Zinc	mg/kg	56.3	J	37.2	J	40.86

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.10-1
QUALIFICATIONS BASED ON BLANK SAMPLE CONTAMINATION FOR SWMU 127

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031277-0001-SA	CAN127-1274-0000	8270	bis(2-Ethylhexyl)phthalate	U		Detected at contaminant levels; prof judgment
031277-0011-SA	CAN127-1275-0000	8270	bis(2-Ethylhexyl)phthalate	U		Detected at contaminant levels; prof judgment
031277-0015-SA	CAN127-1275-0018	8240	Methylene Chloride	U		Detected at contaminant levels; prof judgment
031277-0016-SA	CAN127-1275-0028	8240	Methylene Chloride	U		Detected at contaminant levels; prof judgment
031374-0002-SA	CAN127-1271-0000	8240	Acetone	U		Detected in Method Blank
031374-0002-SA	CAN127-1271-0000	8240	Methylene Chloride	U		Detected in Method Blank
031374-0003-SA	CAN127-1271-0002	8240	Acetone	U		Detected in Method Blank
031374-0003-SA	CAN127-1271-0002	8240	Methylene Chloride	U		Detected in Method Blank
031374-0004-SA	CAN127-1271-0004	8240	Acetone	U		Detected in Method Blank
031374-0004-SA	CAN127-1271-0004	8240	Methylene Chloride	U		Detected in Method Blank
031374-0006-SA	CAN127-1271-0008	8240	Acetone	U		Detected in Method Blank
031374-0006-SA	CAN127-1271-0008	8240	Methylene Chloride	U		Detected in Method Blank
031374-0005-SA	CAN127-1271-6004	8240	Acetone	U		Detected in Method Blank
031374-0005-SA	CAN127-1271-6004	8240	Methylene Chloride	U		Detected in Method Blank
031374-0007-SA	CAN127-1272-0000	8240	Acetone	U		Detected in Method Blank
031374-0007-SA	CAN127-1272-0000	8240	Methylene Chloride	U		Detected in Method Blank
031374-0008-SA	CAN127-1272-0002	8240	Acetone	U		Detected in Method Blank
031374-0008-SA	CAN127-1272-0002	8240	Methylene Chloride	U		Detected in Method Blank
031374-0009-SA	CAN127-1272-0004	8240	Acetone	U		Detected in Method Blank
031374-0009-SA	CAN127-1272-0004	8240	Methylene Chloride	U		Detected in Method Blank
031374-0010-SA	CAN127-1272-0008	8240	Acetone	U		Detected in Method Blank
031374-0010-SA	CAN127-1272-0008	8240	Methylene Chloride	U		Detected in Method Blank
031374-0011-SA	CAN127-1272-1251	8240	Acetone	U		Detected in Method Blank
031374-0011-SA	CAN127-1272-1251	8240	Methylene Chloride	U		Detected in Method Blank
031374-0001-SA	CAN127-1272-1262	8240	Acetone	U		Detected in Method Blank
031374-0001-SA	CAN127-1272-1262	8240	Methylene Chloride	U		Detected in Method Blank
031374-0012-SA	CAN127-1272-1271	8240	Methylene Chloride	U		Detected in Method Blank
031374-0013-SA	CAN127-1272-1281	8240	Methylene Chloride	U		Detected in Method Blank
031374-0014-SA	CAN127-1272-1291	8240	Methylene Chloride	U		Detected in Method Blank
031216-0001-SA	CAN127-1273-0000	8240	Acetone	U		Detected in Method Blank
031216-0001-SA	CAN127-1273-0000	8270	Di-n-butylphthalate	U		Detected in Method Blank
031216-0004-SA	CAN127-1273-0004	8240	Acetone	U		Detected in Method Blank
031216-0003-SA	CAN127-1273-0008	8240	Acetone	U		Detected in Method Blank
031216-0003-SA	CAN127-1273-0008	8240	Acetone	U		Detected in Method Blank
031216-0003SA	CAN127-1273-0008	8240	Acetone	U		Detected in Method Blank
031216-0005SA	CAN127-1273-0018	8240	Acetone	U		Detected in Method Blank
031216-0006-SA	CAN127-1273-0028	8240	Acetone	U		Detected in Method Blank

TABLE 4.10-1
QUALIFICATIONS BASED ON BLANK SAMPLE CONTAMINATION FOR SWMU 127

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031216-0008-SA	CAN127-1273-0048	8240	Acetone	U		Detected in Method Blank
031216-0009-SA	CAN127-1273-0058	8240	Acetone	U		Detected in Method Blank
031277-0001-SA	CAN127-1274-0000	8240	Acetone	U		Detected in Method Blank
031277-0003-SA	CAN127-1274-0004	8240	Acetone	U		Detected in Method Blank
031277-0003-SA	CAN127-1274-0004	8240	Methylene Chloride	U		Detected in Method Blank
031277-0004-SA	CAN127-1274-0008	8240	Acetone	U		Detected in Method Blank
031277-0004-SA	CAN127-1274-0008	8240	Methylene Chloride	U		Detected in Method Blank
031277-0005-SA	CAN127-1274-0018	8240	Methylene Chloride	U		Detected in Method Blank
031277-0007-SA	CAN127-1274-0028	8240	Acetone	U		Detected in Method Blank
031277-0008-SA	CAN127-1274-0038	8240	Acetone	U		Detected in Method Blank
031277-0009-SA	CAN127-1274-0048	8240	Acetone	U		Detected in Method Blank
031277-0006-SA	CAN127-1274-1263	8240	Acetone	U		Detected in Method Blank
031277-0011-SA	CAN127-1275-0000	8240	Acetone	U		Detected in Method Blank
031277-0012-SA	CAN127-1275-0002	8240	Acetone	U		Detected in Method Blank
031277-0014-SA	CAN127-1275-0008	8240	Acetone	U		Detected in Method Blank
031277-0014-SA	CAN127-1275-0008	8240	Methylene Chloride	U		Detected in Method Blank
031277-0016-SA	CAN127-1275-0028	8240	Acetone	U		Detected in Method Blank
031277-0017-SA	CAN127-1275-0038	8240	Methylene Chloride	U		Detected in Method Blank
031277-0019-SA	CAN127-1275-0058	8240	Methylene Chloride	U		Detected in Method Blank
031216-0012SA	CAN127-1276-0002	8240	Methylene Chloride	U		Detected in Method Blank
031216-0013-SA	CAN127-1276-0002	8240	Acetone	U		Detected in Method Blank
031215-0009-SA	CAN127-1276-0004	8240	Acetone	U		Detected in Method Blank
031215-0009-SA	CAN127-1276-0004	8240	Methylene Chloride	U		Detected in Method Blank
031215-0010-SA	CAN127-1276-0008	8240	Acetone	U		Detected in Method Blank
031215-0010-SA	CAN127-1276-0008	8240	Methylene Chloride	U		Detected in Method Blank
031215-0011-SA	CAN127-1276-0018	8240	Acetone	U		Detected in Method Blank
031215-0011-SA	CAN127-1276-0018	8240	Methylene Chloride	U		Detected in Method Blank
031215-0012-SA	CAN127-1276-0028	8240	Acetone	U		Detected in Method Blank
031215-0012-SA	CAN127-1276-0028	8240	Methylene Chloride	U		Detected in Method Blank
031215-0013-SA	CAN127-1276-0038	8240	Acetone	U		Detected in Method Blank
031215-0013-SA	CAN127-1276-0038	8240	Methylene Chloride	U		Detected in Method Blank
031215-0014-SA	CAN127-1276-0048	8240	Methylene Chloride	U		Detected in Method Blank
031184-0009-SA	CAN127-1277-0000	8240	Methylene Chloride	U		Detected in Method Blank
031184-0010-SA	CAN127-1277-0002	8240	Methylene Chloride	U		Detected in Method Blank
031184-0001-SA	CAN127-1278-0000	8240	Methylene Chloride	U		Detected in Method Blank
031184-0002-SA	CAN127-1278-0002	8240	Acetone	U		Detected in Method Blank
031184-0002-SA	CAN127-1278-0002	8240	Methylene Chloride	U		Detected in Method Blank

TABLE 4.10-1
QUALIFICATIONS BASED ON BLANK SAMPLE CONTAMINATION FOR SWMU 127

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031184-0004-SA	CAN127-1278-0004	8240	Methylene Chloride	U		Detected in Method Blank
031184-0005-SA	CAN127-1278-0008	8240	Methylene Chloride	U		Detected in Method Blank
031184-0006-SA	CAN127-1278-0018	8240	Acetone	U		Detected in Method Blank
031184-0006-SA	CAN127-1278-0018	8240	Methylene Chloride	U		Detected in Method Blank
031184-0007-SA	CAN127-1278-0028	8240	Methylene Chloride	U		Detected in Method Blank
031184-0008-SA	CAN127-1278-0038	8240	Methylene Chloride	U		Detected in Method Blank
031216-0011SA	CAN127-1278-0058	8240	2-Butanone	U		Detected in Method Blank
031216-0011SA	CAN127-1278-0058	8240	Acetone	U		Detected in Method Blank
031184-0003-SA	CAN127-1278-1264	8240	Methylene Chloride	U		Detected in Method Blank
031216-0007-SA	CAN127-1273-0038	8240	Acetone	U	12	Detected in Method Blank, Raise RL.
031277-0001-SA	CAN127-1274-0000	8240	Methylene Chloride	U	9.1	Detected in Method Blank, Raise RL.
031277-0002-SA	CAN127-1274-0002	8240	Acetone	U	14	Detected in Method Blank, Raise RL.
031277-0002-SA	CAN127-1274-0002	8240	Methylene Chloride	U	9	Detected in Method Blank, Raise RL.
031277-0011-SA	CAN127-1275-0000	8240	Methylene Chloride	U	6.5	Detected in Method Blank, Raise RL.
031277-0013-SA	CAN127-1275-0004	8240	Acetone	U	14	Detected in Method Blank, Raise RL.
031277-0015-SA	CAN127-1275-0018	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031277-0017-SA	CAN127-1275-0038	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031277-0018-SA	CAN127-1275-0048	8240	Acetone	U	17	Detected in Method Blank, Raise RL.
031277-0018-SA	CAN127-1275-0048	8240	Methylene Chloride	U	7.8	Detected in Method Blank, Raise RL.
031277-0019-SA	CAN127-1275-0058	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031216-0012SA	CAN127-1276-0002	8240	Acetone	U	12	Detected in Method Blank, Raise RL.
031216-0013-SA	CAN127-1276-0002	8240	Methylene Chloride	U	6.8	Detected in Method Blank, Raise RL.
031215-0014-SA	CAN127-1276-0048	8240	Acetone	U	16	Detected in Method Blank, Raise RL.
031184-0010-SA	CAN127-1277-0002	8240	Acetone	U	13	Detected in Method Blank, Raise RL.
031184-0011-SA	CAN127-1277-0004	6010	Lead	U	6.1	Detected in Method Blank, Raise RL.
031184-0012-SA	CAN127-1277-0008	6010	Chromium	U	4.2	Detected in Method Blank, Raise RL.
031184-0013-SA	CAN127-1277-0018	6010	Chromium	U	5.2	Detected in Method Blank, Raise RL.
031184-0013-SA	CAN127-1277-0018	8240	Acetone	U	20	Detected in Method Blank, Raise RL.
031184-0015-SA	CAN127-1277-0038	8240	Acetone	U	14	Detected in Method Blank, Raise RL.
031184-0016-SA	CAN127-1277-0048	6010	Chromium	U	4.9	Detected in Method Blank, Raise RL.
031184-0004-SA	CAN127-1278-0004	6010	Chromium	U	4	Detected in Method Blank, Raise RL.
031184-0005-SA	CAN127-1278-0008	6010	Chromium	U	4.9	Detected in Method Blank, Raise RL.
031184-0005-SA	CAN127-1278-0008	8240	Acetone	U	110	Detected in Method Blank, Raise RL.
031184-0006-SA	CAN127-1278-0018	6010	Chromium	U	6.7	Detected in Method Blank, Raise RL.
031184-0007-SA	CAN127-1278-0028	8240	Acetone	U	13	Detected in Method Blank, Raise RL.
031184-0008-SA	CAN127-1278-0038	6010	Chromium	U	4.7	Detected in Method Blank, Raise RL.
031184-0008-SA	CAN127-1278-0038	8240	Acetone	U	21	Detected in Method Blank, Raise RL.

TABLE 4.10-1
QUALIFICATIONS BASED ON BLANK SAMPLE CONTAMINATION FOR SWMU 127

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031216-0010SA	CAN127-1278-0048	8240	Acetone	U	16	Detected in Method Blank, Raise RL.
031184-0003-SA	CAN127-1278-1264	6010	Chromium	U	4.9	Detected in Method Blank, Raise RL.
031184-0003-SA	CAN127-1278-1264	8240	Acetone	U	42	Detected in Method Blank, Raise RL.

TABLE 4.10-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 127, CANNON AFB

LOCATOR			CAN127-1271-0000		CAN127-1271-1261			CAN127-1271-0004		CAN127-1271-1262		
COLLECT DATE			9/23/93		9/23/93			9/23/93		9/23/93		
SAMPLE DELIVERY GROUP			31374		31374			31374		31374		
		Units	Result	Qual	Result	Qual	RPD (2)(%)	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8270	Bis(2-ethylhexyl)phthalate	mg/kg	ND		85		NC	ND		130		NC
	Butylbenzylphthalate	mg/kg	ND		ND		NC	ND		110		NC
EPA 418.1	TPH	mg/kg	ND		65.9		NC	46.6		ND		NC
EPA 6010	Aluminum	mg/kg	9270		7530		20.71	5370	J	3150	J	52.11
EPA 7060	Arsenic	mg/kg	2		1.9		5.13	2.2	J	1.3	J	51.43
EPA 6010	Barium	mg/kg	91.7		98.8		7.45	285		284		0.35
	Beryllium	mg/kg	0.67		0.57		16.13	0.46		0.37		21.69
	Cadmium	mg/kg	ND	J	1	J	NC	2.1		2.5		17.39
	Calcium	mg/kg	19200	J	55100	J	96.64	137000		184000		29.28
	Chromium	mg/kg	9.9		8.4		16.39	6	J	2.3	J	89.16
	Cobalt	mg/kg	4.5		4.2		6.90	2.9	J	1.6	J	57.78
	Copper	mg/kg	8.9		8.1		9.41	5	J	1.6	J	103.03
	Iron	mg/kg	8610		7410		14.98	4940	J	2390	J	69.58
EPA 7421	Lead	mg/kg	7.3		5		37.40	3.2		2		46.15
EPA 6010	Magnesium	mg/kg	2030		2000		1.49	2830		3050		7.48
	Manganese	mg/kg	179		158		12.46	69.6	J	33.2	J	70.82
	Nickel	mg/kg	10.4		8.9		15.54	7.4	J	3.7	J	66.67
	Potassium	mg/kg	1680		1500		11.32	1010	J	495	J	68.44
	Silver	mg/kg	0.069		ND		NC	1.2		1.4		15.38
	Vanadium	mg/kg	17.9		15.7		13.10	19.8	J	9.6	J	69.39
	Zinc	mg/kg	21.9		18.2		18.45	11.8	J	5.4	J	74.42

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
There were no VOC detections. NC = Noncalculable
(2) RPD = Relative Percent Difference

TABLE 4.10-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 127, CANNON AFB

LOCATOR			CAN127-1274-0000		CAN127-1274-1263		
COLLECT DATE			9/14/93		9/14/93		
SAMPLE DELIVERY GROUP			31277-0001		31277-0006		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Toluene	µg/kg	2.3		3.5		41.38
	Xylenes	µg/kg	1.5		ND		NC
EPA 418.1	TPH	mg/kg	253	J	ND	UJ	NC
EPA 6010	Aluminum	mg/kg	7490		10200		30.64
EPA 7060	Arsenic	mg/kg	2.9		2.6		10.91
EPA 6010	Barium	mg/kg	125		113		10.08
	Beryllium	mg/kg	0.82		0.82		0.00
	Cadmium	mg/kg	0.49		ND		NC
	Calcium	mg/kg	7210	J	10900	J	40.75
	Chromium	mg/kg	9.4		11.3		18.36
	Cobalt	mg/kg	5.3		4.8		9.90
	Copper	mg/kg	8.5		8.7		2.33
	Iron	mg/kg	8420		10000		17.16
EPA 7421	Lead	mg/kg	12.6		17.9		34.75
EPA 6010	Magnesium	mg/kg	1800		2070		13.95
EPA 6010	Manganese	mg/kg	246		212		14.85
	Nickel	mg/kg	9.5		10		5.13
	Potassium	mg/kg	1390		1800		25.71
EPA 7740	Selenium	mg/kg	0.27		0.23		16.00
	Vanadium	mg/kg	23		21.3		7.67
	Zinc	mg/kg	20.4		25.6		22.61

(1) Duplicates were analyzed for VOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.10-4

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 127, CANNON AFB

LOCATOR			CAN127-1278-0008		CAN127-1278-1264		
COLLECT DATE			9/12/93		9/12/93		
SAMPLE DELIVERY GROUP			31184		31184		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	2-Butanone	mg/kg	6.6		3.3		66.67
EPA 8270	2-Methylnaphthalene	mg/kg	490		ND		N/C
EPA 418.1	TPH	mg/kg	170		210		21.05
EPA 6010	Aluminum	mg/kg	4500		4610		2.41
EPA 7060	Arsenic	mg/kg	1.7		1.2		34.48
EPA 6010	Barium	mg/kg	204		214		4.78
	Beryllium	mg/kg	0.46		0.48		4.26
	Cadmium	mg/kg	1.2		1.3		8.00
	Calcium	mg/kg	83100		86300		3.78
	Chromium	mg/kg	4.9		4.9		0.00
	Cobalt	mg/kg	4	J	2.1	J	62.30
	Copper	mg/kg	4		4		0.00
	Iron	mg/kg	4570		4630		1.30
EPA 7421	Lead	mg/kg	5.8		5.1		12.84
EPA 6010	Magnesium	mg/kg	2500		2540		1.59
	Manganese	mg/kg	71.6		77.5		7.91
	Nickel	mg/kg	6		5.9		1.68
	Potassium	mg/kg	1130		1160		2.62
	Silver	mg/kg	0.8		0.55		37.04
	Vanadium	mg/kg	15.2		14.8		2.67
	Zinc	mg/kg	11.1		11.5		3.54

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
There were no VOC detections. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.10-5

QUALIFICATIONS BASED ON LABORATORY CASE NARRATIVES FOR SWMU 127

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031374-0002-SA	CAN127-1271-0000	7740	Selenium	UJ		Low postdigestion spike recovery
031374-0002-SA	CAN127-1271-0000	7841	Thallium	UJ		Low postdigestion spike recovery
031374-0003-SA	CAN127-1271-0002	7740	Selenium	UJ		Low postdigestion spike recovery
031374-0004-SA	CAN127-1271-0004	7740	Selenium	UJ		Low postdigestion spike recovery
031374-0004-SA	CAN127-1271-0004	7841	Thallium	UJ		Low postdigestion spike recovery
031374-0006-SA	CAN127-1271-0008	7740	Selenium	UJ		Low postdigestion spike recovery
031374-0006-SA	CAN127-1271-0008	7841	Thallium	UJ		Low postdigestion spike recovery
031374-0007-SA	CAN127-1272-0000	7740	Selenium	UJ		Low postdigestion spike recovery
031374-0007-SA	CAN127-1272-0000	7841	Thallium	UJ		Low postdigestion spike recovery
031374-0008-SA	CAN127-1272-0002	7740	Selenium	UJ		Low postdigestion spike recovery
031374-0008-SA	CAN127-1272-0002	7841	Thallium	UJ		Low postdigestion spike recovery
031374-0009-SA	CAN127-1272-0004	7740	Selenium	UJ		Low postdigestion spike recovery
031374-0009-SA	CAN127-1272-0004	7841	Thallium	UJ		Low postdigestion spike recovery
031374-0010-SA	CAN127-1272-0008	7740	Selenium	UJ		Low postdigestion spike recovery
031374-0010-SA	CAN127-1272-0008	7841	Thallium	UJ		Low postdigestion spike recovery
031216-0002-SA	CAN127-1273-0002	7740	Selenium	J		Low postdigestion spike recovery
031216-0002-SA	CAN127-1273-0002	7740	Selenium	J		Low postdigestion spike recovery
031216-0004-SA	CAN127-1273-0004	7740	Selenium	J		Low postdigestion spike recovery
031216-0004-SA	CAN127-1273-0004	7841	Thallium	J		Low postdigestion spike recovery
031216-0003-SA	CAN127-1273-0008	7740	Selenium	J		Low postdigestion spike recovery
031216-0003-SA	CAN127-1273-0008	7740	Selenium	J		Low postdigestion spike recovery
031216-0003-SA	CAN127-1273-0008	7841	Thallium	J		Low postdigestion spike recovery
031216-0005-SA	CAN127-1273-0018	7740	Selenium	J		Low postdigestion spike recovery
031216-0005SA	CAN127-1273-0018	7841	Thallium	J		Low postdigestion spike recovery
031216-0006-SA	CAN127-1273-0028	7740	Selenium	J		Low postdigestion spike recovery
031216-0006-SA	CAN127-1273-0028	7841	Thallium	J		Low postdigestion spike recovery
031216-0007-SA	CAN127-1273-0038	7740	Selenium	J		Low postdigestion spike recovery
031216-0008-SA	CAN127-1273-0048	7740	Selenium	J		Low postdigestion spike recovery
031277-0002-SA	CAN127-1274-0002	7740	Selenium	J		Low postdigestion spike recovery
031277-0003-SA	CAN127-1274-0004	7740	Selenium	J		Low postdigestion spike recovery
031277-0003-SA	CAN127-1274-0004	7841	Thallium	J		Low postdigestion spike recovery
031277-0004-SA	CAN127-1274-0008	7740	Selenium	J		Low postdigestion spike recovery
031277-0004-SA	CAN127-1274-0008	7841	Thallium	UJ		Low postdigestion spike recovery
031277-0005-SA	CAN127-1274-0018	7740	Selenium	J		Low postdigestion spike recovery
031277-0005-SA	CAN127-1274-0018	7841	Thallium	J		Low postdigestion spike recovery
031277-0007-SA	CAN127-1274-0028	7740	Selenium	J		Low postdigestion spike recovery
031277-0007-SA	CAN127-1274-0028	7841	Thallium	J		Low postdigestion spike recovery

TABLE 4.10-5

QUALIFICATIONS BASED ON LABORATORY CASE NARRATIVES FOR SWMU 127

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031277-0008-SA	CAN127-1274-0038	7740	Selenium	J		Low postdigestion spike recovery
031277-0008-SA	CAN127-1274-0038	7841	Thallium	J		Low postdigestion spike recovery
031277-0009-SA	CAN127-1274-0048	7841	Thallium	UJ		Low postdigestion spike recovery
031277-0010-SA	CAN127-1274-0058	7740	Selenium	J		Low postdigestion spike recovery
031277-0010-SA	CAN127-1274-0058	7841	Thallium	J		Low postdigestion spike recovery
031277-0011-SA	CAN127-1275-0000	7740	Selenium	J		Low postdigestion spike recovery
031277-0012-SA	CAN127-1275-0002	7841	Thallium	J		Low postdigestion spike recovery
031277-0013-SA	CAN127-1275-0004	7841	Thallium	J		Low postdigestion spike recovery
031277-0014-SA	CAN127-1275-0008	7740	Selenium	J		Low postdigestion spike recovery
031277-0014-SA	CAN127-1275-0008	7841	Thallium	J		Low postdigestion spike recovery
031277-0015-SA	CAN127-1275-0018	7841	Thallium	UJ		Low postdigestion spike recovery
031277-0016-SA	CAN127-1275-0028	7740	Selenium	J		Low postdigestion spike recovery
031277-0016-SA	CAN127-1275-0028	7841	Thallium	J		Low postdigestion spike recovery
031277-0017-SA	CAN127-1275-0038	7841	Thallium	UJ		Low postdigestion spike recovery
031277-0018-SA	CAN127-1275-0048	7740	Selenium	J		Low postdigestion spike recovery
031277-0018-SA	CAN127-1275-0048	7841	Thallium	J		Low postdigestion spike recovery
031277-0019-SA	CAN127-1275-0058	7740	Selenium	J		Low postdigestion spike recovery
031277-0019-SA	CAN127-1275-0058	7841	Thallium	J		Low postdigestion spike recovery
031215-0008-SA	CAN127-1276-0000	7740	Selenium	J		Low postdigestion spike recovery
031215-0009-SA	CAN127-1276-0004	7740	Selenium	J		Low postdigestion spike recovery
031215-0009-SA	CAN127-1276-0004	7841	Thallium	J		Low postdigestion spike recovery
031215-0010-SA	CAN127-1276-0008	7740	Selenium	J		Low postdigestion spike recovery
031215-0010-SA	CAN127-1276-0008	7841	Thallium	J		Low postdigestion spike recovery
031215-0011-SA	CAN127-1276-0018	7740	Selenium	J		Low postdigestion spike recovery
031215-0011-SA	CAN127-1276-0018	7841	Thallium	J		Low postdigestion spike recovery
031215-0012-SA	CAN127-1276-0028	7740	Selenium	J		Low postdigestion spike recovery
031215-0012-SA	CAN127-1276-0028	7841	Thallium	J		Low postdigestion spike recovery
031215-0013-SA	CAN127-1276-0038	7740	Selenium	J		Low postdigestion spike recovery
031215-0013-SA	CAN127-1276-0038	7740	Selenium	J		Low postdigestion spike recovery
031215-0014-SA	CAN127-1276-0048	7740	Selenium	J		Low postdigestion spike recovery
031215-0015-SA	CAN127-1276-0058	7740	Selenium	J		Low postdigestion spike recovery
031184-0010-SA	CAN127-1277-0002	7740	Selenium	J		Low postdigestion spike recovery
031184-0011-SA	CAN127-1277-0004	7740	Selenium	J		Low postdigestion spike recovery
031184-0011-SA	CAN127-1277-0004	7841	Thallium	J		Low postdigestion spike recovery
031184-0012-SA	CAN127-1277-0008	7740	Selenium	J		Low postdigestion spike recovery
031184-0012-SA	CAN127-1277-0008	7841	Thallium	J		Low postdigestion spike recovery
031184-0013-SA	CAN127-1277-0018	7740	Selenium	J		Low postdigestion spike recovery

TABLE 4.10-5

QUALIFICATIONS BASED ON LABORATORY CASE NARRATIVES FOR SWMU 127

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031184-0014-SA	CAN127-1277-0028	7740	Selenium	J		Low postdigestion spike recovery
031184-0015-SA	CAN127-1277-0038	7740	Selenium	J		Low postdigestion spike recovery
031184-0015-SA	CAN127-1277-0038	7841	Thallium	J		Low postdigestion spike recovery
031184-0016-SA	CAN127-1277-0048	7740	Selenium	J		Low postdigestion spike recovery
031184-0017-SA	CAN127-1277-0058	7740	Selenium	J		Low postdigestion spike recovery
031184-0002-SA	CAN127-1278-0002	7740	Selenium	J		Low postdigestion spike recovery
031184-0004-SA	CAN127-1278-0004	7740	Selenium	J		Low postdigestion spike recovery
031184-0004-SA	CAN127-1278-0004	7841	Thallium	J		Low postdigestion spike recovery
031184-0005-SA	CAN127-1278-0008	7740	Selenium	J		Low postdigestion spike recovery
031184-0006-SA	CAN127-1278-0018	7740	Selenium	J		Low postdigestion spike recovery
031184-0006-SA	CAN127-1278-0018	7841	Thallium	J		Low postdigestion spike recovery
031184-0007-SA	CAN127-1278-0028	7740	Selenium	J		Low postdigestion spike recovery
031184-0007-SA	CAN127-1278-0028	7841	Thallium	J		Low postdigestion spike recovery
031184-0008-SA	CAN127-1278-0038	7740	Selenium	J		Low postdigestion spike recovery
031216-0010SA	CAN127-1278-0048	7740	Selenium	J		Low postdigestion spike recovery
031216-0010SA	CAN127-1278-0048	7841	Thallium	J		Low postdigestion spike recovery
031216-0011SA	CAN127-1278-0058	7740	Selenium	J		Low postdigestion spike recovery
031216-0011SA	CAN127-1278-0058	7841	Thallium	J		Low postdigestion spike recovery

TABLE 4.11-1

LEAD DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 055, CANNON AFB

LOCATOR			CAN055-0552-0000		CAN055-0552-5561			CAN055-0552-0008		CAN055-0552-5562		
COLLECT DATE			9/22/93		9/22/93			9/22/93		9/22/93		
SAMPLE DELIVERY GROUP			31382		31382			31382		31382		
		Units	Result	Qual	Result	Qual	RPD (2)(%)	Result	Qual	Result	Qual	RPD(2)(%)
EPA 7421	Lead	mg/kg	6.3		7.6		18.71	4.6		4.1		11.49

(1) Duplicates were analyzed for lead by graphite furnace
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.11-2

LEAD DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 055, CANNON AFB

LOCATOR			CAN055-0553-0003		CAN055-0553-5563		
COLLECT DATE			9/22/93		9/22/93		
SAMPLE DELIVERY GROUP			31382		31382		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 7421	Lead	mg/kg	3.9		3.6		8.00

(1) Duplicates were analyzed for lead by graphite furnace.
TABLE LISTS DETECTIONS ONLY. ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.12-1
SUMMARY OF QUALIFICATIONS BASED ON METHOD BLANK CONTAMINATION

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031181-0008-SA	CAN077-0771-7701	8240	Acetone	U		Detected in Method Blank
031181-0009-SA	CAN077-0771-7703	8240	Acetone	U		Detected in Method Blank
031181-0010-SA	CAN077-0771-7708	8240	Acetone	U		Detected in Method Blank
031189-0001-SA	CAN077-0772-0000	8240	Acetone	U		Detected in Method Blank
031189-0001-SA	CAN077-0772-0000	8240	Methylene Chloride	U		Detected in Method Blank
031189-0002-SA	CAN077-0772-0003	8240	Acetone	U		Detected in Method Blank
031189-0002-SA	CAN077-0772-0003	8240	Methylene Chloride	U		Detected in Method Blank
031189-0003-SA	CAN077-0772-0008	8240	Acetone	U		Detected in Method Blank
031189-0003-SA	CAN077-0772-0008	8240	Methylene Chloride	U		Detected in Method Blank
031189-0004-SA	CAN077-0772-0013	8240	Acetone	U		Detected in Method Blank
031189-0004-SA	CAN077-0772-0013	8240	Methylene Chloride	U		Detected in Method Blank
031189-0005-SA	CAN077-0772-0018	8240	Methylene Chloride	U		Detected in Method Blank
031379-0015-SA	CAN077-0773-0000	8240	Methylene Chloride	U		Detected in Method Blank
031379-0016-SA	CAN077-0773-0003	8240	Methylene Chloride	U		Detected in Method Blank
031379-0017-SA	CAN077-0773-0008	8240	Methylene Chloride	U		Detected in Method Blank
031379-0018-SA	CAN077-0773-0013	8240	Acetone	U		Detected in Method Blank
031379-0018-SA	CAN077-0773-0013	8240	Methylene Chloride	U		Detected in Method Blank
031379-0019-SA	CAN077-0773-0018	8240	Acetone	U		Detected in Method Blank
031379-0019-SA	CAN077-0773-0018	8240	Methylene Chloride	U		Detected in Method Blank
031379-0005-SA	CAN077-0774-0018	8240	Acetone	U		Detected in Method Blank
031189-0006-SA	CAN077-0775-0000	8240	Acetone	U		Detected in Method Blank
031189-0006-SA	CAN077-0775-0000	8240	Methylene Chloride	U		Detected in Method Blank
031189-0007-SA	CAN077-0775-0003	8240	Acetone	U		Detected in Method Blank
031189-0007-SA	CAN077-0775-0003	8240	Methylene Chloride	U		Detected in Method Blank
031189-0009-SA	CAN077-0775-0008	8240	Acetone	U		Detected in Method Blank
031189-0009-SA	CAN077-0775-0008	8240	Methylene Chloride	U		Detected in Method Blank
031189-0010-SA	CAN077-0775-0013	8240	Acetone	U		Detected in Method Blank
031189-0010-SA	CAN077-0775-0013	8240	Methylene Chloride	U		Detected in Method Blank
031189-0011-SA	CAN077-0775-0018	8240	Acetone	U		Detected in Method Blank
031189-0011-SA	CAN077-0775-0018	8240	Methylene Chloride	U		Detected in Method Blank
031181-0002-SA	CAN077-0776-0003	8240	Acetone	U		Detected in Method Blank
031181-0004-SA	CAN077-0776-0008	8240	Acetone	U		Detected in Method Blank
031181-0005-SA	CAN077-0776-0013	8240	Acetone	U		Detected in Method Blank
031181-0006-SA	CAN077-0776-0018	8240	Acetone	U		Detected in Method Blank
031189-0005-SA	CAN077-0772-0018	8240	Acetone	U	19	Detected in Method Blank, Raise RL.
031379-0015-SA	CAN077-0773-0000	8240	Acetone	U	16	Detected in Method Blank, Raise RL.
031379-0016-SA	CAN077-0773-0003	8240	Acetone	U	18	Detected in Method Blank, Raise RL.

TABLE 4.12-1
SUMMARY OF QUALIFICATIONS BASED ON METHOD BLANK CONTAMINATION

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031379-0017-SA	CAN077-0773-0008	8240	Acetone	U	16	Detected in Method Blank, Raise RL.
031379-0001-SA	CAN077-0774-0000	8240	Acetone	U	13	Detected in Method Blank, Raise RL.
031379-0002-SA	CAN077-0774-0003	8240	Acetone	U	19	Detected in Method Blank, Raise RL.
031379-0003-SA	CAN077-0774-0008	8240	Acetone	U	15	Detected in Method Blank, Raise RL.
031379-0004-SA	CAN077-0774-0013	8240	Acetone	U	13	Detected in Method Blank, Raise RL.

TABLE 4.12-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 077, CANNON AFB

LOCATOR			CAN077-0775-0003		CAN077-0775-7764		
COLLECT DATE			9/10/93		9/10/93		
SAMPLE DELIVERY GROUP			31189		31189		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Xylenes (total)	mg/kg	ND		1.9		N/C
EPA 8270	Phenanthrene	mg/kg	800	J	ND	UJ	N/C
	Anthracene	mg/kg	150		ND		N/C
	Fluoranthene	mg/kg	1100	J	ND	UJ	N/C
	Di-n-butylphthalate	mg/kg	ND		53		N/C
	Pyrene	mg/kg	820	J	ND	UJ	N/C
	Benzo(a)anthracene	mg/kg	370		ND		N/C
	Chrysene	mg/kg	500		ND		N/C
	Benzo(b)fluoranthene	mg/kg	630		ND		N/C
	Benzo(a)pyrene	mg/kg	350		ND		N/C
	Indeno(1,2,3-c,d)pyrene	mg/kg	150		ND		N/C
	Benzo(g,h,i)perylene	mg/kg	160		ND		N/C
	Carbazole	mg/kg	43		ND		N/C
EPA 418.1	TPH	mg/kg	ND		43.3		NC
EPA 6010	Aluminum	mg/kg	5890		4470		27.41
EPA 7060	Arsenic	mg/kg	2.1		2.4		13.33
EPA 6010	Barium	mg/kg	116	J	168	J	36.62
	Beryllium	mg/kg	0.37		0.28		NC
	Cadmium	mg/kg	0.62		1.2		0.00
	Calcium	mg/kg	48100	J	79800	J	49.57
	Chromium	mg/kg	6.6		4.7		NC
	Cobalt	mg/kg	3.2		2.6		20.69
	Copper	mg/kg	6.8		5.9		14.17
	Iron	mg/kg	6550		4980		27.23

TABLE 4.12-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 077, CANNON AFB

LOCATOR			CAN077-0775-0003		CAN077-0775-7764		
COLLECT DATE			9/10/93		9/10/93		
SAMPLE DELIVERY GROUP			31189		31189		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 7421	Lead	mg/kg	9.3		9.6		3.17
EPA 6010	Magnesium	mg/kg	1570		1600		1.89
	Manganese	mg/kg	206		215		4.28
	Nickel	mg/kg	6.9		5.5		22.58
	Potassium	mg/kg	1070		853		22.57
	Silver	mg/kg	0.69		0.68		0.00
	Vanadium	mg/kg	18.8		15.6		18.60
	Zinc	mg/kg	19.2		16.9		12.74

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
There were no VOC detections. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.12-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 077, CANNON AFB

LOCATOR			CAN077-0776-0003		CAN077-0776-7764		
COLLECT DATE			9/11/93		9/11/93		
SAMPLE DELIVERY GROUP			31181		31181		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 418.1	TPH	mg/kg	ND		43.3		NC
EPA 6010	Aluminum	mg/kg	5670		6630		15.61
	Antimony	mg/kg	5.9		ND		NC
EPA 7060	Arsenic	mg/kg	1.8		1.8		0.00
EPA 6010	Barium	mg/kg	106	J	320	J	100.47
	Beryllium	mg/kg	0.36		0.42		15.38
	Calcium	mg/kg	81300		86100		5.73
	Chromium	mg/kg	4.6		4.9		6.32
	Cobalt	mg/kg	2.6		2.8		7.41
	Copper	mg/kg	4.1		4.4		7.06
	Iron	mg/kg	5410		5780		6.61
EPA 7421	Lead	mg/kg	5.9		4		38.38
EPA 6010	Magnesium	mg/kg	1850		1980		6.79
	Manganese	mg/kg	74.9		84.6		12.16
	Nickel	mg/kg	5.9		6.4		8.13
	Potassium	mg/kg	1030		1150		11.01
	Vanadium	mg/kg	12.6		13.8		9.09
	Zinc	mg/kg	11.9		13.6		13.33

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals, herbicides, and pesticides/PCBs
There were no pesticide/PCB, SVOC, or herbicide detections. ND = Nondetect NA = Nonapplicable
(2) RPD = Relative Percent Difference

TABLE 4.12-4

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 077, CANNON AFB

LOCATOR			CAN077-0773-0003		CAN077-0773-7762		
COLLECT DATE			9/22/93		9/22/93		
SAMPLE DELIVERY GROUP			31379		31379		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Acetone	µg/kg	18		20		10.53
	Methylene Chloride	µg/kg	1.7		ND		NC
EPA 6010	Aluminum	mg/kg	7460	J	3540	J	71.27
EPA 7060	Arsenic	mg/kg	2.1		1.7		21.05
EPA 6010	Barium	mg/kg	60.2	J	121	J	67.11
	Beryllium	mg/kg	0.54	J	0.23	J	80.52
	Cadmium	mg/kg	ND	J	2.4	J	NA
	Calcium	mg/kg	17700	J	181000	J	164.37
	Chromium	mg/kg	7.6	J	2.4	J	104.00
	Cobalt	mg/kg	4	J	2.2	J	58.06
	Copper	mg/kg	7.2	J	2.3	J	103.16
	Iron	mg/kg	7780	J	3310	J	80.61
EPA 7421	Lead	mg/kg	7		5.2		29.51
EPA 6010	Magnesium	mg/kg	1820	J	3200	J	54.98
EPA 6010	Manganese	mg/kg	167	J	33.2	J	133.67
	Potassium	mg/kg	723		726		0.41
	Nickel	mg/kg	8.5	J	4.5	J	61.54
	Silver	mg//Kg	0.56		1.1		65.06
	Vanadium	mg/kg	16.9		12.8		27.61
	Zinc	mg/kg	17.3	J	8	J	73.52

(1) Duplicates were analyzed for VOCs, SVOCs, pesticides/PCBs, chlorinated herbicides, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NA = Nonapplicable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.12-5

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 077, CANNON AFB

LOCATOR			CAN077-0771-0000		CAN077-0771-7701		
COLLECT DATE			9/15/93		9/15/93		
SAMPLE DELIVERY GROUP			31279		31279		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Toluene	µg/kg	7.5		7.1		5.48
	Xylenes	µg/kg	6.8		3.3		69.31
EPA 8270	Phenanthrene	µg/kg	57		160		94.93
	Fluoranthene	µg/kg	130		280		73.17
	Pyrene	µg/kg	130		310		81.82
	Benzo(a)anthracene	µg/kg	69		130		61.31
	Chrysene	µg/kg	67		140		70.53
	Benzo(b)fluoranthene	µg/kg	110		220		66.67
	Benzo(a)pyrene	µg/kg	60		120		66.67
	Benzo(g,h,i)perylene	µg/kg	37		73		65.45
	Indeno(1,2,3-c,d)pyrene	µg/kg	ND		53		NC
EPA 418.1	TPH	mg/kg	129		174		29.70
EPA 6010	Aluminum	mg/kg	7100		6570		7.75
EPA 7060	Arsenic	mg/kg	2.3		2.3		0.00
EPA 6010	Barium	mg/kg	95.4		85		11.53
	Beryllium	mg/kg	0.47		0.44		6.59
	Calcium	mg/kg	10900		8870		20.54
	Chromium	mg/kg	8		8.6		7.23
	Cobalt	mg/kg	3.3		3.6		8.70
	Copper	mg/kg	9.7		8		19.21
	Iron	mg/kg	8820		7970		10.13
EPA 7421	Lead	mg/kg	19.6		26		28.07

TABLE 4.12-5

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 077, CANNON AFB

LOCATOR			CAN077-0771-0000		CAN077-0771-7701		
COLLECT DATE			9/15/93		9/15/93		
SAMPLE DELIVERY GROUP			31279		31279		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 6010	Magnesium	mg/kg	1380		1320		4.44
	Manganese	mg/kg	187		191		2.12
	Nickel	mg/kg	6.7		6.6		1.50
	Potassium	mg/kg	1440		1420		1.40
	Vanadium	mg/kg	17.6		17.6		0.00
	Zinc	mg/kg	39.8		30.7		25.82

(1) Duplicates were analyzed for VOCs, SVOCs, pesticides/PCBs, herbicides, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NA = Nonapplicable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.12-6

QUALIFICATIONS BASED ON LABORATORY CASE NARRATIVES FOR SWMU 77

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	BASIS FOR QUALIFICATION
031181-0007-SA	CAN077-0771-0000	7841	Thallium	UJ	Low postdigestion spike recovery
031181-0008-SA	CAN077-0771-7701	7841	Thallium	UJ	Low postdigestion spike recovery
031181-0009-SA	CAN077-0771-7703	7841	Thallium	UJ	Low postdigestion spike recovery
031181-0010-SA	CAN077-0771-7708	7440	Selenium	UJ	Low postdigestion spike recovery
031181-0010-SA	CAN077-0771-7708	7841	Thallium	UJ	Low postdigestion spike recovery
031181-0011-SA	CAN077-0771-7713	7440	Selenium	UJ	Low postdigestion spike recovery
031181-0011-SA	CAN077-0771-7713	7841	Thallium	UJ	Low postdigestion spike recovery
031189-0002-SA	CAN077-0772-0003	7740	Selenium	J	Low postdigestion spike recovery
031189-0002-SA	CAN077-0772-0003	7841	Thallium	J	Low postdigestion spike recovery
031189-0003-SA	CAN077-0772-0008	7740	Selenium	J	Low postdigestion spike recovery
031189-0003-SA	CAN077-0772-0008	7841	Thallium	J	Low postdigestion spike recovery
031189-0004-SA	CAN077-0772-0013	7740	Selenium	J	Low postdigestion spike recovery
031189-0004-SA	CAN077-0772-0013	7841	Thallium	J	Low postdigestion spike recovery
031189-0005-SA	CAN077-0772-0018	7740	Selenium	J	Low postdigestion spike recovery
031189-0005-SA	CAN077-0772-0018	7841	Thallium	J	Low postdigestion spike recovery
031189-0002-SA	CAN077-0772-6003	7740	Selenium	J	Low postdigestion spike recovery
031189-0002-SA	CAN077-0772-6003	7841	Thallium	J	Low postdigestion spike recovery
031379-0015-SA	CAN077-0773-0000	7740	Selenium	J	Low postdigestion spike recovery
031379-0016-SA	CAN077-0773-0003	7740	Selenium	J	Low postdigestion spike recovery
031379-0017-SA	CAN077-0773-0008	7740	Selenium	J	Low postdigestion spike recovery
031379-0017-SA	CAN077-0773-0008	7841	Thallium	J	Low postdigestion spike recovery
031379-0018-SA	CAN077-0773-0013	7740	Selenium	J	Low postdigestion spike recovery
031379-0018-SA	CAN077-0773-0013	7841	Thallium	J	Low postdigestion spike recovery
031379-0003-SA	CAN077-0774-0008	7740	Selenium	J	Low postdigestion spike recovery
031379-0003-SA	CAN077-0774-0008	7841	Thallium	J	Low postdigestion spike recovery
031379-0004-SA	CAN077-0774-0013	7740	Selenium	J	Low postdigestion spike recovery
031379-0004-SA	CAN077-0774-0013	7841	Thallium	J	Low postdigestion spike recovery
031379-0005-SA	CAN077-0774-0018	7740	Selenium	J	Low postdigestion spike recovery
031379-0019-SA	CAN077-0774-0018	7740	Selenium	J	Low postdigestion spike recovery
031379-0005-SA	CAN077-0774-0018	7841	Thallium	J	Low postdigestion spike recovery
031379-0019-SA	CAN077-0774-0018	7841	Thallium	J	Low postdigestion spike recovery
031189-0006-SA	CAN077-0775-0000	7841	Thallium	J	Low postdigestion spike recovery
031189-0006-SA	CAN077-0775-0000	7841	Thallium	J	Low postdigestion spike recovery
031189-0009-SA	CAN077-0775-0008	7740	Selenium	J	Low postdigestion spike recovery
031189-0009-SA	CAN077-0775-0008	7740	Selenium	J	Low postdigestion spike recovery
031181-0005-SA	CAN077-0776-0013	7440	Selenium	UJ	Low postdigestion spike recovery
031181-0005-SA	CAN077-0776-0013	7841	Thallium	UJ	Low postdigestion spike recovery
031181-0006-SA	CAN077-0776-0018	7440	Selenium	UJ	Low postdigestion spike recovery
031181-0006-SA	CAN077-0776-0018	7841	Thallium	UJ	Low postdigestion spike recovery

TABLE 4.13-1
QUALIFICATIONS BASED ON BLANK SAMPLE CONTAMINATION FOR SWMU 103

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031358-0001-SA	CAN103-1031-5001	8240	Acetone	U	110	Method blank contamination
031358-0001-SA	CAN103-1031-5001	8240	Carbon Disulfide	U		Rinsate blank contamination
031358-0001-SA	CAN103-1031-5001	8240	Methylene Chloride	U		Method blank contamination
031358-0003-SA	CAN103-1032-5001	8240	Acetone	U		Method blank contamination
031358-0003-SA	CAN103-1032-5001	8240	Carbon disulfide	U		Rinsate blank contamination
031358-0003-SA	CAN103-1032-5001	8240	Methylene chloride	U		Method blank contamination
031358-0001-SA	CAN103-1033-5001	8240	Acetone	U	190	Method blank contamination
031358-0001-SA	CAN103-1033-5001	8240	Carbon disulfide	U		Rinsate blank contamination
031358-0003-SA	CAN103-1034-5001	8240	Acetone	Q		Method blank contamination
031358-0003-SA	CAN103-1034-5001	8240	Carbon Disulfide	U		Rinsate blank contamination
031358-0006-SA	CAN103-1035-3000	8240	Acetone	U	12	Method blank contamination
031358-0006-SA	CAN103-1036-3000	8240	Acetone	U		Method blank contamination
031358-0006-SA	CAN103-1037-3000	8240	Acetone	U		Method blank contamination
031358-0006-SA	CAN103-1037-3000	8240	Methylene Chloride	U		Method blank contamination

TABLE 4.13-2

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SEDIMENT SAMPLES - SWMU 103, CANNON AFB

LOCATOR			CAN103-1031-5001		CAN103-1031-1061		
COLLECT DATE			9/21/93		9/21/93		
SAMPLE DELIVERY GROUP			31358		31358		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Bis(2-ethylhexyl)phthalate	µg/kg	2000		2100		4.88
EPA 8080	4,4'-DDD	µg/kg	220	J	420	J	62.50
	4,4'-DDT	µg/kg	ND	J	330	J	NC
EPA 418.1	TPH	mg/kg	2520		1980		24.00
EPA 6010	Aluminum	mg/kg	3450		3840		10.70
EPA 7060	Arsenic	mg/kg	2.4		1.7		34.15
EPA 6010	Barium	mg/kg	90.1		89.7		0.44
	Beryllium	mg/kg	ND		0.31		NC
	Cadmium	mg/kg	2.3		2.2		4.44
	Calcium	mg/kg	26200		19900		27.33
	Chromium	mg/kg	10.4		11		5.61
	Cobalt	mg/kg	ND	J	3	J	NC
	Copper	mg/kg	40.3		38.1		5.61
	Iron	mg/kg	3860		4740		20.47
EPA 7421	Lead	mg/kg	14.6		11.1		27.24
EPA 6010	Magnesium	mg/kg	1780		1790		0.56
EPA 6010	Manganese	mg/kg	38		51.4		29.98
	Mercury	mg/kg	0.5	J	0.31	J	46.91
	Nickel	mg/kg	5.3		6.4		18.80
	Potassium	mg/kg	968		1040		7.17
	Selenium	mg/kg	3.3		2.5		27.59
	Silver	mg/kg	9.8		9.5		3.11
	Sodium	mg/kg	3940		2960		28.41
	Vanadium	mg/kg	27.1		27.3		0.74
	Zinc	mg/kg	90.9		83.8		8.13

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.13-3

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR WATER SAMPLES - SWMU 103, CANNON AFB

LOCATOR			CAN103-1035-3000		CAN103-1035-1061		
COLLECT DATE			9/21/93		9/21/93		
SAMPLE DELIVERY GROUP			31358		31358		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 7060	Arsenic	mg/L	0.00371		0.0032		14.76
EPA 6010	Barium	mg/L	0.076		0.066		14.08
	Copper	mg/L	0.0069		0.0038		57.94
	Silver	mg/L	0.0092		0.0088		4.44
	Vanadium	mg/L	0.0089		0.0089		0.00
	Zinc	mg/L	0.019		0.015		23.53
EPA 9012	Cyanide	mg/L	0.014		0.016		13.33
EPA 9030	Total Sulfide	mg/L	0.8		0.78		2.53

(1) Duplicates were analyzed for Appendix IX compounds
(2) RPD = Relative Percent Difference

TABLE 4.14-1
QUALIFICATIONS BASED ON SAMPLE BLANK CONTAMINATION FOR SWMU 93

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031273-0009-SA	CAN093-0932-0058	8240	Methylene Chloride	U		Detected in method blank
031273-0009-SA	CAN093-0932-0058	8240	Acetone	U	14	Detected in method blank, Raise R/L.
031273-0015-SA	CAN093-0933-0028	8240	Acetone	U	20	Detected in method blank, Raise R/L.
031273-0015-SA	CAN093-0933-0028	8240	Methylene Chloride	U	6.4	Detected in method blank, Raise R/L.
031273-0017-SA	CAN093-0933-0048	8240	Acetone	U	29	Detected in method blank, Raise R/L.
031273-0018-SA	CAN093-0933-0058	8240	Acetone	U	15	Detected in method blank, Raise R/L.
031273-0019-SA	CAN093-0933-9362	8240	Acetone	U	28	Detected in method blank, Raise R/L.
031274-0004-SA	CAN093-0931-0004	8240	Acetone	U		Detected in method blank
031274-0004-SA	CAN093-0931-0004	8240	Methylene chloride	U		Detected in method blank
031274-0005-SA	CAN093-0931-0008	8240	Methylene chloride	U		Detected in method blank
031274-0007-SA	CAN093-0931-0028	8240	Methylene chloride	U		Detected in method blank
031274-0008-SA	CAN093-0931-0038	8240	Methylene chloride	U		Detected in method blank
031274-0010-SA	CAN093-0931-0058	8240	Methylene chloride	U		Detected in method blank
031273-0001-SA	CAN093-0932-0000	8240	Acetone	U		Detected in method blank
031273-0001-SA	CAN093-0932-0000	8240	Methylene Chloride	U		Detected in method blank
031273-0002-SA	CAN093-0932-0002	8240	Acetone	U		Detected in method blank
031273-0002-SA	CAN093-0932-0002	8240	Methylene Chloride	U		Detected in method blank
031273-0003-SA	CAN093-0932-0004	8240	Acetone	U		Detected in method blank
031273-0003-SA	CAN093-0932-0004	8240	Methylene Chloride	U		Detected in method blank
031273-0004-SA	CAN093-0932-0008	8240	Acetone	U		Detected in method blank
031273-0004-SA	CAN093-0932-0008	8240	Methylene Chloride	U		Detected in method blank
031273-0005-SA	CAN093-0932-0018	8240	Acetone	U	13	Detected in method blank
031273-0005-SA	CAN093-0932-0018	8240	Methylene Chloride	U		Detected in method blank
031273-0006-SA	CAN093-0932-0028	8240	Acetone	U		Detected in method blank
031273-0006-SA	CAN093-0932-0028	8240	Methylene Chloride	U		Detected in method blank
031273-0007-SA	CAN093-0932-0038	8240	Acetone	U		Detected in method blank
031273-0007-SA	CAN093-0932-0038	8240	Methylene Chloride	U		Detected in method blank
031273-0008-SA	CAN093-0932-0048	8240	Acetone	U	13	Detected in method blank
031273-0008-SA	CAN093-0932-0048	8240	Methylene Chloride	U		Detected in method blank
031273-0010-SA	CAN093-0933-0000	8240	Acetone	U		Detected in method blank
031273-0010-SA	CAN093-0933-0000	8240	Methylene Chloride	U		Detected in method blank
031273-0011-SA	CAN093-0933-0002	8240	Acetone	U		Detected in method blank
031273-0011-SA	CAN093-0933-0002	8240	Methylene Chloride	U		Detected in method blank
031273-0012-SA	CAN093-0933-0004	8240	Acetone	U	14	Detected in method blank
031273-0012-SA	CAN093-0933-0004	8240	Methylene Chloride	U		Detected in method blank
031273-0013-SA	CAN093-0933-0008	8240	Acetone	U		Detected in method blank
031273-0013-SA	CAN093-0933-0008	8240	Methylene Chloride	U		Detected in method blank

TABLE 4.14-1
QUALIFICATIONS BASED ON SAMPLE BLANK CONTAMINATION FOR SWMU 93

LAB ID	W-C ID	METHOD	ANALYTE	QUAL	RL	BASIS FOR QUALIFICATION
031273-0014-SA	CAN093-0933-0018	8240	Acetone	U		Detected in method blank
031273-0014-SA	CAN093-0933-0018	8240	Methylene Chloride	U		Detected in method blank
031273-0018-SA	CAN093-0933-0058	8240	Methylene Chloride	U		Detected in method blank
031273-0019-SA	CAN093-0933-9362	8240	Methylene Chloride	U		Detected in method blank
031274-0001-SA	CAN093-0931-0000	8240	Acetone	U	20	Detected in method blank, raise RL
031274-0003-SA	CAN093-0931-0002	8240	Acetone	U	11	Detected in method blank, raise RL
031274-0002-SA	CAN093-0931-9361	8240	Acetone	U	15	Detected in method blank, raise RL
031274-0005-SA	CAN093-0931-0008	8240	Acetone	U		Professional judgment not in assoc blk
031274-0006-SA	CAN093-0931-0018	8240	2-Butanone (MEK)	U		Professional judgment not in assoc blk
031274-0006-SA	CAN093-0931-0018	8240	Acetone	U		Professional judgment not in assoc blk
031274-0007-SA	CAN093-0931-0028	8240	2-Butanone (MEK)	U		Professional judgment not in assoc blk
031274-0007-SA	CAN093-0931-0028	8240	Acetone	U		Professional judgment not in assoc blk
031274-0008-SA	CAN093-0931-0038	8240	Acetone	U		Professional judgment not in assoc blk
031274-0009-SA	CAN093-0931-0048	8240	2-Butanone (MEK)	U		Professional judgment not in assoc blk
031274-0009-SA	CAN093-0931-0048	8240	Acetone	U		Professional judgment not in assoc blk
031274-0010-SA	CAN093-0931-0058	8240	2-Butanone (MEK)	U		Professional judgment not in assoc blk
031274-0010-SA	CAN093-0931-0058	8240	Acetone	U		Professional judgment not in assoc blk

TABLE 4.14-2

QUALIFICATIONS BASED ON OUTLYING DCS RECOVERIES FOR SWMU 93

LAB ID	W-C ID	METHOD	ANALYTE	QUAL
031403-0020-SA	CAN093-0932-0000	6010	Sodium	J
031403-0020-SA	CAN093-0932-0002	6010	Sodium	J
031403-0020-SA	CAN093-0932-0004	6010	Sodium	J
031403-0020-SA	CAN093-0932-0008	6010	Sodium	J
031403-0020-SA	CAN093-0932-0018	6010	Sodium	J
031403-0020-SA	CAN093-0932-0028	6010	Sodium	J
031403-0020-SA	CAN093-0932-0038	6010	Sodium	J
031403-0020-SA	CAN093-0932-0048	6010	Sodium	J
031403-0020-SA	CAN093-0932-0058	6010	Sodium	J
031403-0020-SA	CAN093-0933-0000	6010	Sodium	J
031403-0020-SA	CAN093-0933-0002	6010	Sodium	J
031403-0020-SA	CAN093-0933-0004	6010	Sodium	J
031358-0001-SA	CAN093-0933-0008	6010	Sodium	J
031358-0001-SA	CAN093-0933-0018	6010	Sodium	J
031358-0001-SA	CAN093-0933-0028	6010	Sodium	J

TABLE 4.14-3

QUALIFICATIONS BASED ON OUTLYING MS/MSD RECOVERIES FOR SWMU 93

LAB ID	W-C ID	METHOD	ANALYTE	QUAL
031273-0001-SA	CAN093-0932-0000	6010	Barium	J
031273-0001-SA	CAN093-0932-0000	6010	Silver	J
031273-0002-SA	CAN093-0932-0002	6010	Barium	J
031273-0002-SA	CAN093-0932-0002	6010	Silver	J
031273-0003-SA	CAN093-0932-0004	6010	Barium	J
031273-0003-SA	CAN093-0932-0004	6010	Silver	J
031273-0004-SA	CAN093-0932-0008	6010	Barium	J
031273-0004-SA	CAN093-0932-0008	6010	Silver	J
031273-0005-SA	CAN093-0932-0018	6010	Barium	J
031273-0005-SA	CAN093-0932-0018	6010	Silver	J
031273-0006-SA	CAN093-0932-0028	6010	Barium	J
031273-0006-SA	CAN093-0932-0028	6010	Silver	J
031273-0007-SA	CAN093-0932-0038	6010	Barium	J
031273-0007-SA	CAN093-0932-0038	6010	Silver	J
031273-0008-SA	CAN093-0932-0048	6010	Barium	J
031273-0008-SA	CAN093-0932-0048	6010	Silver	J
031273-0009-SA	CAN093-0932-0058	6010	Barium	J
031273-0009-SA	CAN093-0932-0058	6010	Silver	J
031273-0010-SA	CAN093-0933-0000	6010	Barium	J
031273-0010-SA	CAN093-0933-0000	6010	Silver	J
031273-0011-SA	CAN093-0933-0002	6010	Barium	J
031273-0011-SA	CAN093-0933-0002	6010	Silver	J
031273-0012-SA	CAN093-0933-0004	6010	Barium	J
031273-0012-SA	CAN093-0933-0004	6010	Silver	J
031273-0013-SA	CAN093-0933-0008	6010	Barium	J
031273-0013-SA	CAN093-0933-0008	6010	Silver	J
031273-0014-SA	CAN093-0933-0018	6010	Barium	J
031273-0014-SA	CAN093-0933-0018	6010	Silver	J
031273-0015-SA	CAN093-0933-0028	6010	Barium	J
031273-0015-SA	CAN093-0933-0028	6010	Silver	J
031273-0016-SA	CAN093-0933-0038	6010	Barium	J
031273-0016-SA	CAN093-0933-0038	6010	Silver	J
031273-0017-SA	CAN093-0933-0048	6010	Barium	J
031273-0017-SA	CAN093-0933-0048	6010	Silver	J
031273-0018-SA	CAN093-0933-0058	6010	Barium	J
031273-0018-SA	CAN093-0933-0058	6010	Silver	J
031273-0019-SA	CAN093-0933-9362	6010	Barium	J
031273-0019-SA	CAN093-0933-9362	6010	Silver	J
031274-0001-SA	CAN093-0931-0000	6010	Manganese	J
031274-0003-SA	CAN093-0931-0002	6010	Manganese	J
031274-0004-SA	CAN093-0931-0004	6010	Manganese	J
031274-0005-SA	CAN093-0931-0008	6010	Manganese	J
031274-0006-SA	CAN093-0931-0018	6010	Manganese	J
031274-0007-SA	CAN093-0931-0028	6010	Manganese	J
031274-0008-SA	CAN093-0931-0038	6010	Manganese	J
031274-0009-SA	CAN093-0931-0048	6010	Manganese	J
031274-0010-SA	CAN093-0931-0058	6010	Manganese	J
031274-0002-SA	CAN093-0931-9361	6010	Manganese	J
031274-0001-SA	CAN093-0931-0000	6010	Barium	J
031274-0003-SA	CAN093-0931-0002	6010	Barium	J
031274-0004-SA	CAN093-0931-0004	6010	Barium	J
031274-0005-SA	CAN093-0931-0008	6010	Barium	J

TABLE 4.14-3

QUALIFICATIONS BASED ON OUTLYING MS/MSD RECOVERIES FOR SWMU 93

LAB ID	W-C ID	METHOD	ANALYTE	QUAL
031274-0006-SA	CAN093-0931-0018	6010	Barium	J
031274-0007-SA	CAN093-0931-0028	6010	Barium	J
031274-0008-SA	CAN093-0931-0038	6010	Barium	J
031274-0009-SA	CAN093-0931-0048	6010	Barium	J
031274-0010-SA	CAN093-0931-0058	6010	Barium	J
031274-0002-SA	CAN093-0931-9361	6010	Barium	J

TABLE 4.14-4

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 093, CANNON AFB

LOCATOR			CAN093-0931-0000		CAN093-0931-9361		
COLLECT DATE			9/15/93		9/15/93		
SAMPLE DELIVERY GROUP			31274-0001		31274-0002		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Toluene	µg/kg	2.6		1.7		41.86
	Xylenes (total)	µg/kg	1.8		1.3		32.26
EPA 418.1	TPH	mg/kg	77.4		114		38.24
EPA 6010	Aluminum	mg/kg	5930		5350		10.28
EPA 7060	Arsenic	mg/kg	2.3		2.6		12.24
EPA 6010	Barium	mg/kg	99.9		131		26.94
	Beryllium		0.48		0.44		8.70
	Calcium	mg/kg	14700		11800		21.89
	Chromium	mg/kg	9.5	J	7.4	J	24.85
	Cobalt	mg/kg	3.9		3.4		13.70
	Copper	mg/kg	8.6		7.1		19.11
	Iron	mg/kg	6980		6210		11.68
EPA 7421	Lead	mg/kg	7.3		9		20.86
EPA 6010	Magnesium	mg/kg	1440		1280		11.76
	Manganese	mg/kg	155		147		5.30
	Nickel	mg/kg	7.2		6.3		13.33
	Potassium	mg/kg	1150		1050		9.09
	Silver	mg/kg	0.69		0.62		10.69
	Vanadium	mg/kg	17		16.2		4.82
	Zinc	mg/kg	25.4		20.2		22.81

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

TABLE 4.14-5

DUPLICATE RESULTS AND RELATIVE PERCENT DIFFERENCES FOR SOIL BORING SAMPLES - SWMU 093, CANNON AFB

LOCATOR			CAN093-0933-0008		CAN093-0922-9261		
COLLECT DATE			9/15/93		9/15/93		
SAMPLE DELIVERY GROUP			31273		31273		
		Units	Result	Qual	Result	Qual	RPD (2)(%)
EPA 8240	Toluene	µg/kg	ND		1.9		NC
EPA 418.1	TPH	mg/kg	ND		ND		0.00
EPA 6010	Aluminum	mg/kg	3910		4070		4.01
EPA 7060	Arsenic	mg/kg	1.3		1.3		0.00
EPA 6010	Barium	mg/kg	697		918		27.37
	Cadmium	mg/kg	3		ND		NC
	Calcium	mg/kg	221000		225000		1.79
	Cobalt	mg/kg	5		ND		NC
	Copper	mg/kg	3.2		ND		NC
	Iron	mg/kg	2800		2730		2.53
EPA 7421	Lead	mg/kg	1.9	J	2.9	J	41.67
EPA 6010	Magnesium	mg/kg	3930		4410		11.51
EPA 6010	Manganese	mg/kg	45.2	J	29.3	J	42.68
	Potassium	mg/kg	723		1010		33.12
	Silver	mg//kg	4.3		ND		NC
	Vanadium	mg/kg	10.5		9.7		7.92
	Zinc	mg/kg	9.9		ND		NC

(1) Duplicates were analyzed for VOCs, SVOCs, TPH, TAL metals
TABLE LISTS DETECTIONS ONLY. NC = Noncalculable ND = Nondetect
(2) RPD = Relative Percent Difference

5.0
DAILY QUALITY CONTROL REPORT CONSOLIDATION

Mobilization for the Appendix III SWMUs RFI occurred over three days (9/7-9/93) prior to sampling activity start up. The first day was travel and beginning the second day work included locating and staking proposed soil boring sites, receiving and setting up a field trailer and staging field equipment. Most proposed drill sites were cleared of utilities and approved. Where existing utilities such as gas lines, high-voltage power lines, sewer, water and telephone lines disallowed the original drilling location, alternative sites which would satisfy the objectives of the RFI were selected and approved.

9/10/93: Fieldwork start up. Personal and vehicle passes issued to field personnel. Construct decontamination pad and decontaminate all sampling equipment prior to intrusive activity. Additional utility clearances were sought for relocated borings. Power lines near SWMUs 92 and 93 still not marked on ground so borings sites still in question. Site safety briefing carried out by USAF CES/CEV and W-C personnel. Rig 1 proceeded to SWMU No. 77 to drill and sample one 20-foot boring before going down for one hour with broken hammer chain (from field notes). Rig 2 is missing an adapter for sampler, so crew started on two 10-foot hand borings at SWMU No. 47. Crews collect prescribed QA/QC samples as detailed on sample summary tables. Planned sampling of the Playa Lake water and sediments was postponed due to incorrect 1 liter bottles on hand (clear rather than recommended amber glass) and a misinterpretation of the total number of bottles required. No air monitoring instrument calibration as a span gas regulator valve was not supplied with air monitoring equipment or span gas. To minimize health risk, crews were sent to those SWMUs perceived to have lower risk from volatile contaminants. Samples dependent on headspace readings were selected based on relative response of PID and visual indications.

9/11/93 and 9/12/93: Fieldwork continued as planned. No Federal Express pick up on Saturday (9/11), so all samples placed on ice and coolers custody taped for storage until scheduled pick up. Rig 1 drilled and sampled three 20-foot borings in SWMU 77 and two 60-foot borings in SWMU 127. Rig 2 crew completes two 10-foot hand borings in SWMU 94 with the concrete pavement cut by drilling company personnel. Adapter for drill rig arrived on 9/11, allowing the drilling of four 10-foot borings in SWMU 31 on 9/12 while

operations in this facility were minimized. All four of these borings were grouted immediately on completion to minimize impact on operations. QA/QC samples collected as detailed on sample summary tables. Drilling equipment decontaminated by steam cleaning as required between boreholes. Samples dependent on headspace readings selected based on relative response of PID and visual indications.

9/13/93: Drilling as planned. Rig 1 drilled and sampled two 60-foot borings in SWMU 127 and grouted two 60-foot borings from previous day. Two hours down time by Rig 1 with broken drill bonnet connection. Part repaired at welding shop in town. Rig 2 drilled and sampled one 10-foot boring in SWMU 94, two 10-foot borings in SWMU 63, and two 10-foot borings in SWMU 92. QA/QC samples collected as detailed on sample summary tables. Drilling equipment decontaminated by steam cleaning as required between boreholes. Regulator valve arrived via Federal Express midday. PIDs calibrated in field with isobutylene gas to 70 ppm to provide 1:1 response factor to benzene.

An apparent discrepancy between the FSP and the sample summary tables created a question concerning field selection of SVOA samples. Clarification provided by W-C project manager: one SVOA is to be taken from surface, and one is to be taken from the heaviest observed contamination or at 10 feet if no contamination is observed.

9/14/93: Drilling as planned. Rig 1 drilled and sampled two 60-foot borings in SWMU 127, then moved to SWMU 70 to start one 60-foot boring. This boring abandoned at 8.5 feet due to concrete obstruction. Rig 1 pulled off SWMU pending further investigation and relocation of borings in this area. Rig 2 drilled and sampled two 20-foot borings in SWMU 70, one 10-foot boring in SWMU 51, and two 10-foot borings in SWMU 47. QA/QC samples collected as detailed on sample summary tables. Drilling equipment decontaminated by steam cleaning as required between boreholes. PIDs calibrated in field with isobutylene gas to 70 ppm to provide 1:1 response factor to benzene.

9/15/93: Drilling as planned. Rig 1 moved to SWMU 93 pending relocation of remaining borings in SWMU 70. Three 60-foot borings drilled and sampled in SWMU 93. Rig 2 drilled and sampled one 20-foot boring in SWMU 51, one 10-foot boring in SWMU 47, one 10-foot boring in SWMU 55, and three 10-foot borings in SWMU 57. QA/QC samples collected as detailed on sample summary tables. Drilling equipment decontaminated by steam

cleaning as required between boreholes. PIDs calibrated in field with isobutylene gas to 70 ppm to provide 1:1 response factor to benzene.

9/16/93: No drilling at analytical lab's request. Temporary shutdown of drilling and sampling required to allow lab to catch up on sample processing. All samples on site packed and shipped to analytical labs. Completed boreholes are grouted. Concrete coring contractor cuts six holes concrete pavement before mechanical problems stop progress. Plastic sheeting placed in resulting holes with concrete plugs to minimize chances of precipitation entering and affecting potential contamination under pavement. All personnel to leave site 9/17/93 and return 9/21/93.

9/21/93: Return to Cannon AFB. All field personnel fly into Clovis, N.M. to complete field investigation after temporary shutdown. Entire field crew works to collect surface water and sludge samples from SWMU 103 playa lake. Sampling equipment decontaminated prior to use and between samples. PID, pH and conductivity meters calibrated in accordance with applicable SOPs and manufacturers instructions. QA/QC samples collected as detailed in sample summary tables. All water and sludge samples collected upwind from outboard exhaust port to eliminate the potential of cross-contamination from this source.

9/22/93: Continue drilling as planned. Rig 1 drilled and sampled two 60-foot borings in SWMU 92. Rig 2 drilled and sampled two 20-foot borings in SWMU 77, two 20-foot borings in SWMU 51, and one 10-foot boring in SWMU 61. QA/QC samples collected as detailed on sample summary tables. Drilling equipment decontaminated by steam cleaning as required between boreholes. PIDs calibrated in field with isobutylene gas to 70 ppm to provide 1:1 response factor to benzene. Rig 1 had 1.5 hours of downtime due to a broken kelly chain and sprocket on drill table. Repairs made with spare parts on hand.

9/23/93: Continue drilling as planned. Rig 1 drilled and sampled one 60-foot boring in SWMU 92, and drilled and sampled one 60-foot boring to 48 feet in SWMU 70. Rig 2 drilled and sampled two 10-foot borings in SWMU 61 and 62, two 10-foot borings in SWMU 94, and two 10-foot borings in SWMU 127. QA/QC samples collected as detailed on sample summary tables. Drilling equipment decontaminated by steam cleaning as required between boreholes. PIDs calibrated in field with isobutylene gas to 70 ppm to provide 1:1 response factor to benzene.

Transient high air monitoring measurements (+1,200 ppm) on drill cuttings may indicate the need to upgrade to protection level "C" for hole completion and grouting. Cleared boring in SWMU 62 (CE Wash Rack) broke through sewer line connecting the two sand traps. Instructions were received from CES to drill hole to completion, but only grout to base of the broken pipe to allow future repair. Notification also received from Cannon AFB safety personnel that our field trailer and decon pad are within the clear zone for the Ordnance Depot and should be moved ASAP. While it is acceptable to use this area for short periods of time, we are not to permanently occupy this area due to the explosive hazard.

9/24/93: Complete all scheduled drilling for RFI. Rig 1 drilled and sampled from 48-60 feet in boring started previous day and one 60-foot boring in SWMU 70. One proposed 60-foot boring drilled and sampled to 20 foot depth, then abandoned free product in the soil at 18 feet. The last proposed 60-foot boring was not drilled at direction of USACE project manager. Rig 2 drilled and sampled two 10-foot borings in SWMU 46 and SWMU 62, respectively. One 10-foot hand boring drilled and sampled in SWMU 94. QA/QC samples collected as detailed on sample summary tables. Drilling equipment decontaminated by steam cleaning as required prior to leaving site. PIDs calibrated in field with isobutylene gas to 70 ppm to provide 1:1 response factor to benzene. Begin packing field equipment to demobilize from site. Dr. Janice Stowell and John Ekhoff came to the W-C trailer at about 5:30 PM to conduct a demobilization meeting with Bob Kuhn and Brian Ruby.

9/25/93: All completed borings grouted. Remaining equipment from field trailer packed, field trailer cleaned, final field check of work sites. Site demobilization by W-C.

Copies of the original DQCRs are attached for reference.

5.1 DAILY QUALITY CONTROL REPORT FORMAT (DQCR)

During the field investigation, DQCR's were completed daily and transmitted to the USACE on a weekly basis. Copies of all the DQCR's generated during the field activities are presented in the attachment C of this QCSR. Each DQCR contained the following headings:

- Date/Day
- Weather Conditions

- Subcontractors on Site
- Equipment on Site
- Work Performed (Including Sampling)
- Quality Control Activities (Including Field Calibrations)
- Health and Safety Levels and Activities
- Problems Encountered/Corrective Action Taken
- Special Notes

5.2 PERIOD OF PERFORMANCE OF FIELD ACTIVITIES

Field activities were completed in two phases. Phase I was conducted from September 10, 1993 through September 16, 1993. At the laboratory's request, drilling and sampling were temporarily suspended so as not to jeopardize the laboratory's ability to properly manage the sample load. Phase II was conducted from September 21, 1993 through September 25, 1993.

5.3 WEATHER CONDITIONS

Weather conditions were generally warm to hot and dry. Daily weather ranges are presented in Table 5.3-1. Skies were generally clear with low to moderate winds. A few days were overcast with moderate winds and moderated humidity.

5.4 SUBCONTRACTORS AND EQUIPMENT ON SITE

Soil drilling was subcontracted to Southwest Engineering, Inc. of Las Cruces, NM. Drilling equipment used included two drill rigs, a CME-55 with a modified 850 drill head and a CME-55, with associated support vehicles. Concrete and drilling was subcontracted to Concrete Coring Co. of Albuquerque, NM. Surveying to locate the boring sites and tie to the Base Coordinate System was subcontracted to Lydick Engineering of Clovis, NM.

5.5 WORK PERFORMED

Soil boring and sampling, sediment sampling, surface water and pond sediment sampling, and field surveying were the activities performed at Cannon AFB by W-C and their

subcontractors. Additional information on the sampling and analyses performed can be found in the project FSP and in the RFI report.

5.6 QUALITY CONTROL ACTIVITIES

In addition to the collection of field QC samples, QC activities included the calibration of the OVAs and other instruments used during sampling and other activities. On the first day of sampling (September 10th), it was discovered that the valve to the calibration gas for the OVA meters was not sent by the supplier. Since the OVAs were calibrated by the supplier immediately prior to shipping to the site, and the OVAs responded to known VOCs(i.e. magic marker), sampling continued; however, it was performed only at those areas at which low levels of contamination were anticipated. On September 14th the calibration gas valve was delivered and the OVAs were calibrated.

5.7 HEALTH AND SAFETY LEVELS AND ACTIVITIES

The primary level of personal protective equipment (PPE) for this field investigation was Level D. Due to the relative uncertainty of the OVA calibrations, field activities were designed to minimize potential exposure. On september 23rd, transient high readings during air monitoring for SWMU 70 required field personnel to go to Level C.

5.8 PROBLEMS ENCOUNTERED/CORRECTIVE ACTION TAKEN

No major problems were encountered during the field activities for Cannon AFB. The DCQRs report the typical drill rig mechanical problems and down time for repairs.

TABLE 5.3-1
SUMMARY OF WEATHER CONDITIONS DURING SAMPLING AT CANNON AFB

Date	Weather	Temp (F)	Wind	Humidity
9/8/93	Overcast	50-70	Moderate	Humid
9/9/93	Clear	70-85	Moderate	Moderate
9/10/93	Bright Sum	>85	Moderate	Moderate
9/11/93	Bright Sum	>85	Moderate	Dry
9/12/93	Clear/Overcast	70-85	Moderate	Moderate
9/13/93	Overcast	70-85	Moderate	Moderate
9/14/93	Overcast	32-50	Moderate	
9/15/93	Clear	70-85	Moderate	Moderate
9/16/93	Clear	70-85	Moderate	
9/17/93	Clear	50-70	Still	Moderate
9/21/93	Clear	>85	Moderate	Dry
9/22/93	Clear	>85	Moderate	Dry
9/23/93	Clear/Rain	>85	Moderate	Moderate
9/24/93	Clear	70-85	Moderate	Moderate
9/25/93	Clear	70-85	Still	Dry

6.0
LESSONS LEARNED - FIELD AND LABORATORY

- A rapid time schedule can impact the overall management of the field activities in many ways. It is a good practice to allow several extra days for setup and premobilization when the schedule is tight. An assistant site manager may be required on a rapid paced, multiple SWMU field sampling exercise.

- The use of preprinted sample labels is very helpful to the field team as it serves as a second check against the sampling plan for completeness.

- Frequent communication with the lab during sampling is vital to achieving a complete and accurate transmittal of instructions to the lab, and assuring the receipt of all samples.

- Acceleration of the sampling rate significantly above the rate anticipated by the lab will not work. Laboratory capacity must be matched with the sampling rate to avoid an overload that could cause problems with holding times and sample delivery and log-in (logistical) aspects of the project.

SEE VOLUME III
FOR ATTACHMENT A

ATTACHMENT B

REVIEW OF "FULL" VALIDATION OF SDG 31181, 31358, AND 31183

1.0
CANNON AFB SWMUs 077 & 094
USEPA SW-846 VOC, SVOC, PESTICIDES/PCBs, HERBICIDES, METALS, AND TPH ANALYSES
SDG 031181 - SOIL AND QC SAMPLES

1.1 INTRODUCTION

This report describes the full data validation for the VOC, SVOC, pesticides/PCBs, herbicides, TPH, and metals analyses contained in Enseco Rocky Mountain Analytical Laboratory's data package SDG 031181. All analyses were conducted in accordance with USEPA SW-846 protocols. The samples included in SDG 031181 consist of 20 soil samples and 1 field duplicate sample.

All sample data for SDG 031181 underwent a full validation as defined in the Cannon AFB Quality Assurance Project Plan (QAPP), (W-C October 1993). This document specified Quality Assessment/Quality Control (QC) evaluation criteria as established for the project or by SW-846 methodology. Additional guidance was taken from the "National Functional Guidelines for Organic Data Review" (USEPA, 12/90 rev. 6/91) for validation of VOC and SVOC data. Pesticide/PCB samples followed guidance from the "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses" (USEPA 2/88). The "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses" (USEPA, 2/88) were used for guidance in the validation of the metals data. These USEPA documents are referred to as the "Guidelines" in this report. While no guidance has been established, for herbicide and TPH analyses validation, these results were validated using guidance from the "Laboratory Data Validation Guidelines for Evaluating Organic Analyses" (USEPA 2-88) in conjunction with the QA/QC specified in the Cannon AFB QAPP (W-C 1993).

Criteria evaluated included the following method performance criteria:

VOCs and BNAs

Significant problems identified in Case Narrative
Holding times
GC/MS instrument performance - VOC, SVOC
GC instrument performance - Pest/PCBs, Herbicides
Initial and continuing calibration
Method blank, field blank contamination
Surrogate recoveries
Laboratory control samples
MS/MSD recoveries and RPD values
Internal standard areas and retention times
Compound identification and quantitation
Tentatively Identified Compounds (TICs)
System performance and overall assessment of data

Metals

Significant problems identified in Case Narrative
Holding times
Initial and continuing calibration
Blanks (preparation and calibration)
ICP interference check sample
Laboratory control sample
Matrix spike recoveries
Furnace atomic absorption (AA) QC
ICP serial dilution
Sample result verification

Pesticide/PCBs and Herbicides

Compound quantification and reported detection limits
Compound identification
Internal standard performance
Significant problems identified in Case Narrative
Holding times
Initial and continuing calibration
Blanks (preparation)
Laboratory control samples
Matrix spike recoveries
Sample result verification
Instrument performance
Surrogate recovery

TPH

Significant problems identified in Case Narrative
Holding times
Initial and continuing calibration
Blanks (calibration and preparation)
Laboratory control sample
Matrix spike recoveries
Sample result verification
Compound quantification

Validation of the data also included a check for potential transcription errors. Two transcription errors were discovered in SDG 031181. The surrogate result for toluene-d_8 sample CAN094-0945-0002 was reported as 101 percent, where the actual value was 104 percent. The percent recovery of the Duplicate Control Sample (DCS) for chlorobenzene in QC Lot 20 Sep 93-J was reported as 47.5, where the actual value was 47.9. These transcription errors were noted; however, they did not significantly impact the usability of the

data. No other transcription errors were discovered for the samples in SDG #031181, and no qualification of the data on the basis of transcription errors was judged necessary.

The following sections present the remaining results of the field data validation.

1.2 PROBLEMS IDENTIFIED IN CASE NARRATIVE

All problems noted in the Case Narrative are addressed in the appropriate sections of this validation report.

1.3 HOLDING TIMES

Review of the sample collection, extraction, and analysis dates involved comparing the chain-of-custodies, the sample preparation and extraction logs, the summary forms, and the raw data forms, and chromatograms for accuracy, consistency, and holding time compliance for 100% of the samples at this SDG. All samples in SDG 031181 were extracted/analyzed within evaluation criterion established in the Cannon AFB QAPP (W-C 1993) for VOC, SVOC, pesticide/PCB, herbicide, TPH, and metal analyses; therefore, no qualifications based on the exceedances of holding times were required.

1.4 INSTRUMENT PERFORMANCE

GC/MS instrument performance checks were performed to ensure mass resolution, identification, and instrument sensitivity. Criteria for evaluating instrument performance included possible transcription/calculation errors, adherence to instrument tuning frequency requirements, mass assignments, and ion abundance criteria. All instrument performance check samples associated with SDG 031181 were evaluated against criteria established by SW-846 methodology with guidance from the "Guidelines". All criteria for the instrument performance check compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP) for VOCs and SVOCs, respectively, were met; therefore, no qualifications based on GC/MS instrument performance were required for data in SDG 031181.

Instrument performance checks were also performed for pesticide/PCB analyses to ensure that adequate chromatographic resolution and instrument sensitivity were achieved by the chromatographic system. Criteria for instrument performance for pesticide/PCB data established by SW-816 methodology with guidance from the "Guidelines" were used in this evaluation. These criteria included the percent breakdown of endrin and 4,4′-DDT (<20%), evaluation of whether the DDT retention time was greater than 12 minutes and whether retention times for dibutylchlorendate (DBC) and other standards were within retention time windows. All criteria were met for the pesticide/PCB analyses, and qualification of data was not necessary.

1.5 INITIAL AND CONTINUING CALIBRATION (VOCs, SVOCs, PESTICIDE/PCBs, AND HERBICIDES)

Initial and continuing calibration criteria were established to assess whether the instrument was capable of producing acceptable qualitative and quantitative data for VOCs, SVOCs, pesticide/PCB, and herbicides analyses. All VOC, SVOC, pesticide/PCB, herbicide initial and continuing calibrations relative response factors (RRFs) were reviewed and determined to meet the acceptance criterion (>0.05) required for SW-846 methodology. All VOC, SVOC, pesticide/PCB, and herbicide continuing calibrations were analyzed at the SW-846 required frequency. No qualifications based on initial continuing calibration RRF values outside acceptance limits were required.

For pesticide/PCB, the percent relative standard deviation (%RSD) for initial calibration was within SW-846 acceptance criteria (<10). For the initial calibration for herbicide analyses, a weighted linear regression ($1/X^2$) was used to establish the calibration curve. The correlation coefficient to the curve was recalculated and met acceptance criteria (>0.995). The %D for 2,4,5-T, 2,4-D, and dinoseb (herbicides) exceeded the acceptance limit (<20%) for one or more of the continuing calibrations. Qualifications of 2,4-D and 2,4,5-T were judged not necessary because criteria was exceeded for only one of the two columns on the GC and quantitation was from the column that was in control. Dinoseb results were qualified estimated **UJ** because the %D was exceeded for both columns of the GC. For pesticide/PCB analyses, the %D for alpha-BHC exceeded the acceptance criteria for the quantitation column

(<15%) and the confirmation column (<20%). Alpha-BHC data were nondetect for all samples; therefore, no qualification of the data was judged necessary.

Review of VOC and SVOC initial calibration determined one VOC and one SVOC analyte each were outside SW-846 %RSD criterion for bromomethane (52.8%) for the initial calibration on Instrument E (9-09-93) and 2,4-dinitrophenol (38.07%). No %RSDs greater than the 30% were found for the other VOC initial calibration associated with SDG 031181. Per the "Guidelines", detected compounds having associated outlying %RSD (>30) values required qualification as estimated **J**, and nondetected results were qualified using professional judgement. Since the RRF for the lowest concentration standard was greater than 0.05 as required by SW-846 methodology, qualification of nondetected data was not considered necessary. All associated sample results were reported as nondetected for bromomethane and acenaphthene; therefore,no qualifications based on outlying initial calibrations were required.

The %Ds between initial and continuing calibration response factors were reported outside acceptable SW-846 methodology criteria for several VOC and SVOC continuing calibration analyses. Per the "Guidelines", compounds having outlying %D values require qualification as estimated (detects **J**, nondetects **UJ**).

No calculation or transcription errors were noted for the reported RRF values, %D values, and %RSD values.

Samples and applicable data qualifiers based on the outlying continuing calibration data are presented below:

Continuing Calibration VOCs

Date/Time	Compound	%D	Qualifier Detects/Nondetects
9-17-93 16:41	Carbon tetrachloride	30.96	J/UJ
	Chloromethane	30.63	J/UJ
	Carbon disulfide	49.43	J/UJ
	1,2-Dichloroethane	27.64	J/UJ
	Acetone	102.96	J/UJ
	1,2-Dichloroethane-d_4	35.37	J/UJ

The following associated samples were qualified based on the above VOC continuing calibration information:

CAN077-0776-0003	CAN077-0776-0008
CAN077-0776-0013	CAN077-0776-0018
CAN077-0771-7701	CAN077-0771-7703
CAN077-0771-7708	

Continuing Calibration VOCs

Date/Time	Compound	%D	Qualifier Detects/Nondetects
9-21-93 00:53	Carbon disulfide	32.93	J/UJ
	Methylene chloride	29.84	J/UJ
	1,2-dichloroethane	28.20	J/UJ
	trans-1,3-dichloropropene	29.26	J/UJ

The following associated samples were qualified based on the above VOC continuing calibration information:

CAN077-0776-0000	CAN077-0776-7764
CAN077-0771-0000	CAN077-0771-7713
CAN077-0771-7718	CAN094-0946-0002
CAN094-0946-0004	CAN077-0946-0008

Continuing Calibration SVOCs

Date/Time	Compound	%D	Qualifier
9-23-93 09:10	Bis(2-chloroethyl)ether	34.1	J/UJ
	2-Methylphenol	34.0	J/UJ
	Bis(2-chloroethyl)ether	65.9	J/UJ
	2,4-Dinitrophenol	33.4	J/UJ
	Carbazole	32.3	J/UJ
	3-3'-Dichlorobenzidine	32.7	J/UJ
	Bis(2-ethylhexyl)phthalate	30.4	J/UJ
	Benzo(k)fluoranthene	42.9	J/UJ
	Indeno(1,2,3-cd)pyrene	32.1	J/UJ
	Dibenzo(b,h)anthracene	31.7	J/UJ
	Benzo(g,h,i)perylene	52.7	J/UJ

The following associated samples were qualified based on the above SVOC continuing calibration information:

CAN077-0776-0000	CAN077-0776-0003
CAN077-0776-0013	CAN077-0776-0018
CAN077-0771-0000	CAN077-0771-7701
CAN077-0771-7703	CAN077-0771-7708
CAN077-0771-7713	CAN077-0771-7718
CAN094-0946-0008	CAN094-0945-0000

Continuing Calibration Herbicides

Date/Time	Compound	%D	Qualifier Detects/Nondetects
9-23-93 07:27	2,4,5-T	22.0	NR
	Dinoseb	58/71	UJ
9-23-93 14:50	2,4,5-T	23	NR
	Dinoseb	67/100	UJ
9-23-93 22:16	2,4,5-T	31	NR
	Dinoseb	82/113	UJ
	2,4-D	22	NR
9-24-94 07:31	2,4,5-T	29	NR
	Dinoseb	81/115	UJ
9-24-92 13:05	2,4,5-T	33	NR
	Dinoseb	22	NR
	2,4-D	90/123	UJ

The following associated samples were qualified based on the above herbicide continuing calibration information:

CAN077-0776-0000	CAN077-0771-0000
CAN077-0776-0003	CAN077-0771-7701
CAN077-0776-7764	CAN077-0771-7703
CAN077-0776-0008	CAN077-0771-7708
CAN077-0776-0013	CAN077-0771-7713
CAN077-0776-0018	CAN077-0771-7718

All sample results for dinoeb qualified **UJ**.

Continuing Calibration Pesticide/PCBs

Date/Time	Compound	%D	Qualifier Detects/Nondetects
9-25-93	α-BHC	31.00	NR

J = Estimated, detected compounds
UJ = Estimated quantitation limit, nondetects
NR = Not required

All associated samples results were nondetect; no qualifications.

Initial Calibration VOCs

Date/Time	Compound	%D
9-10-93 01:03	Bromomethane	52.85

All associated samples results were nondetect; no qualifications.

Initial Calibration SVOCs

Date/Time	Compound	%D
9-21-93 23:46	Acenaphthene	38.07

All associated samples results were nondetect; no qualifications.

1.6 INITIAL AND CONTINUING CALIBRATION (METALS AND TPH)

Initial calibration criteria were utilized to assess whether the instrument could produce acceptable quantitative data. Continuing calibrations evaluated whether the initial calibration was still valid. The initial calibrations for GFAA and mercury analyses met the frequency and linearity criteria(>0.995) required for SW-846 methodology. The initial calibration for ICP analyses meet the acceptance criteria required by SW-846 methodology. All initial calibration verification (ICV) analyses reported acceptable recoveries as required by SW-846 methodology except thallium. The ICV for thallium had a 52% recovery, which was outside the acceptance limits. All thallium results were nondetect and were qualified as estimated **UJ**. All continuing calibration verification (CCV) analyses reported acceptable recoveries except for the 87.2% recovery for beryllium (9-29-93). There were no associated samples; therefore, no qualifications were required. For the initial calibration of TPH, the correlation coefficient

was greater than 0.995. The TPH initial and continuing calibration verifications for TPH were 100% ±2%. No calculation or transcription errors were noted for metals and TPH data; therefore, no qualifications were necessary based on calibration and transcription errors.

Initial Calibration Metals

Compound	%D	Qualifier Detects/Nondetects
Thallium	52.00	J/UJ

The following associated samples were qualified based on the above VOC initial calibration information:

CAN077-0776-0000	CAN077-0771-0013
CAN077-0776-0003	CAN077-0771-0018
CAN077-0776-0008	CAN094-0946-0000
CAN077-0776-0013	CAN094-0946-0002
CAN077-0776-0018	CAN094-0946-0004
CAN077-0771-0000	CAN094-0946-0008
CAN077-0771-7701	CAN094-0945-0000
CAN077-0771-7703	CAN094-0945-0002
CAN077-0771-7708	

1.7 METHOD BLANK SAMPLES

The purpose of laboratory blank analyses was to evaluate the existence and magnitude of contamination problems resulting from laboratory activities. The metals method blank reported a detection of lead. Since all reported sample results were greater than 5 times the blank concentration, no qualification of sample data was required. The laboratory reported the qualifier **B** with all associated lead results to indicate that the associated method blank was contaminated. Since this contamination was judged not to impact the usability of the data, the **B** qualifier was removed for the associated samples in SDG 031181.

Acetone, 2-butanone, and methylene chloride were detected in several of the soil method blanks. The associated data required qualification if the reported sample concentration was less than 10 times the blank concentration. All 2-butanone data were either non detect (ND) or exceeded the 10 times criteria; therefore, no qualifications were required. Associated methylene chloride and acetone data and appropriate qualifications are presented as follows:

Sample	Dilution Factor	Analyte	Sample Conc.	Qualification
CAN077-0776-0003	1	Acetone	9.8 μg/kg	U
CAN077-0776-0008	1	Acetone	6.6 μg/kg	U
CAN077-0776-0013	1	Acetone	6.2 μg/kg	U
CAN077-0776-0018	1	Acetone	7.5 μg/kg	U
CAN077-0771-7701	1	Acetone	9.7 μg/kg	U
CAN077-0771-7703	1	Acetone	7.9 μg/kg	U
CAN077-0771-7708	1	Acetone	7.3 μg/kg	U
CAN094-0945-0000	1	Acetone	8.1μg/kg	U
CAN094-0945-0002	1	Acetone	13 μg/kg	U
CAN094-0945-0004	1	Acetone	11 μg/kg	U
CAN094-0945-0008	1	Acetone	9.2 μg/kg	U
	1	Methylene chloride	3.2 μg/kg	U

Method blank sample analyses were reported as nondetected for the remaining target VOC, target metals, and all target SVOC compounds, pesticide/PCBs, herbicides, TPH. No qualifications based on method blank contamination were required for these target compounds. Additionally, no transcription or calculation errors were noted in the method blank data for this SDG.

1.8 ICP INTERFERENCE CHECK SAMPLE (METALS)

The ICP interference check sample verified the laboratory's interelement and background correction factors. Concentrations for metals not in the ICS were evaluated with guidance from the "Guidelines" to determine if false negatives or false positives exist. No anomalies were noted. The frequency of the ICP interference check sample for SDG 031181 was within acceptable SW-846 criteria, and all percent recoveries met the 80% to 120% criteria established in the "Guidelines".

1.9 ICP SERIAL DILUTION

The ICP serial dilution determines whether significant physical or chemical interferences exist due to the sample matrix. The laboratory did not report results for an ICP serial dilution on any samples in this SDG, since it is recommended for SW-846 methods only for matrices of unknown or unusual characteristics. These matrices were not considered to be either unknown or unusual. Therefore, any effects due to the sample matrix could not be assessed for ICP analyses in this SWMU.

1.10 SURROGATE SPIKE RECOVERIES

Surrogate compounds were used to evaluate the accuracy of analytical measurement and matrix effects on a sample-specific basis. The "Guidelines" required all VOC, pesticide/PCBs, and herbicide surrogate recoveries to meet acceptance criteria and allow one SVOC surrogate recovery in each fraction to be outside acceptance criteria, provided the recovery was greater than or equal to 10 percent. All surrogate recoveries for SDG 031181 were within the acceptance limits defined in the Cannon AFB QAPP (W-C 1993); therefore, no qualifications based on outlying surrogate recovery were required.

1.11 DUPLICATE AND SINGLE CONTROL SAMPLE (DCS AND SCS)

Laboratory control samples were analyzed to assess the accuracy of the analytical method and demonstrate laboratory performance. Laboratory control for samples in SDG 031181 were analyzed for VOCs, SVOCs, pesticide/PCB, herbicides, metals, and TPH. For this project, the laboratory analyzed duplicate laboratory control samples (DCS) containing representative target analytes and a single laboratory control sample (SCS) containing the surrogate compounds. All VOC, SVOC, pesticide/PCB, herbicide, and metals DCS and SCS recoveries were within the specified Cannon AFB QAPP (W-C 1993) control limits; therefore, no qualifications based on outlying DCS or SCS recoveries were required.

1.12 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) SAMPLE

MS/MSD results were used to assess the potential for sample matrix interferences versus laboratory analytical errors, as well as to monitor the accuracy of the analysis. Sample CAN094-0946-6008 was used for MS/MSD analysis for VOCs, SVOCs, and metals. The reported VOC and SVOC MS/MSD recoveries met the acceptance criteria presented in the Cannon AFB QAPP(W-C 1993). Sample CAN094-0946-6008 had the following outlying metals MS/MSD recoveries:

		% Recovery			
Sample I.D.	Analyte	MS	MSD	Control RPD(1)	Percent Limits
CAN094-0946-6008	Barium	365	431	17(20)	76-124
	Manganese	200	185	8(20)	74-125
	Lead	163	167	2(20)	50-150
	Silver	66	75	12(20)	76-124

(1) RPD control limits in parenthesis

Per the Cannon AFB QAPP (W-C 1993), all associated samples required qualification of corresponding detected barium results as rejected (data qualifier **R**), detected manganese and lead results as estimated (data qualifier **J**), and silver data as estimated nondetect (data qualifiers **UJ**). Barium, manganese, and lead were reported as detected in all samples in this SDG, and silver was reported as nondetectable in all samples in this SDG. For the following samples, barium, manganese, lead, and silver data were qualified:

CAN077-0776-0000	CAN077-0776-0003	CAN077-0776-7764
CAN077-0776-0008	CAN077-0776-0013	CAN077-0776-0018
CAN077-0771-0000	CAN077-0771-7701	CAN077-0771-7703
CAN077-0771-7708	CAN077-0771-7713	CAN077-0771-7718
CAN094-0946-0000	CAN094-0946-0002	CAN094-0946-0004
CAN094-0946-0008	CAN094-0945-0000	CAN094-0945-0002
CAN094-0945-0004	CAN094-0945-0008	

All remaining metals MS/MSD recoveries and RPD values were within evaluation criteria. No transcription or calculation errors were noted in the MS/MSD data provided by the laboratory.

1.13 FURNACE ATOMIC ABSORPTION (AA) QC

Postdigestion spikes established the accuracy of the individual analyses by AA. Review of the postdigestion spike data provided by the laboratory indicated that selenium and thallium postdigestion spike recoveries for 21 samples were outside the acceptance criteria established in the Laboratory Quality Management Plan (LQMP). The associated data for analytes with a postdigestion spike recovery greater than 80% were qualified as estimated (**J** for detects, **UJ** for nondetects) to indicate a low bias. Detected data for analytes with a postdigestion spike recovery greater than 120% were qualified estimated **J** to indicate a high bias. These qualifications are listed below. All remaining post digestion spike recoveries were acceptable, therefore did not require qualification based on outlying post digestion spike recoveries. Additionally, no calculation errors were noted in the validation of the furnace AA QC data.

Sample	Method	Analyte	% Recovery
CAN094-0946-0004	7740	Selenium	74
CAN094-0946-0008	7740	Selenium	76
CAN094-0945-0004	7740	Selenium	74
CAN094-0945-0008	7740	Selenium	81
CAN077-0776-0013	7841	Thallium	55
CAN077-0776-0018	7841	Thallium	73
CAN077-0771-7703	7841	Thallium	72
CAN077-0771-7708	7841	Thallium	56
CAN077-0771-7713	7841	Thallium	65
CAN094-0946-0002	7841	Thallium	132
CAN094-0946-0004	7841	Thallium	70
CAN094-0945-0002	7841	Thallium	132

1.14 INTERNAL STANDARDS

Internal standard (I.S.) performance criteria ensured that GC/MS sensitivity and response were stable during each analytical run. All VOC and SVOC internal standard areas were within acceptance limits (-50 to +100% of the value from the continuing calibration) as established for SW-846 methodology; therefore, no qualification based on outlying internal standards areas were required. All internal standard retention times were within 30 seconds of that in the continuing calibration. Therefore, no qualifications based on I.S. retention time were required. Additionally, no transcription or calculation errors were noted.

1.15 FIELD DUPLICATE RESULTS

Control criteria for evaluating the results of field duplicate samples were defined in the Cannon AFB QAPP (W-C 1993). Field duplicate samples that do not meet these criteria may indicate unsatisfactory representativeness of the results, and are qualified as estimated (data qualifier **J**).

One field duplicate pair was associated with SDG 031181, CAN077-0776-0003/CAN077-0776-7764. Field duplicate results outside the QAPP criteria are as follows:

Sample	Compound/Analyte	Sample Result	Duplicate Result	%RPD
CAN077-0776-0003	Barium	106 mg/kg	320 mg/kg	100

The aforementioned sample results were qualified as estimated **J** based upon poor field duplicate precision. All remaining field duplicate sample parameters met the criteria presented in the Cannon AFB QAPP (W-C 1993).

1.16 COMPOUND IDENTIFICATION AND QUANTITATION

No anomalies, calculation, or transcription errors were noted during validation of the reported compound identifications and quantification. Samples CAN077-0771-0000, CAN077-0771-7701, and CAN077-0771-7708 for herbicide analyses, required dilutions due to matrix

interferences. Sample CAN077-0776-0000 for herbicide and pesticide/PCB analyses, required dilutions due to matrix interferences. Reporting limits have been elevated to adjust to the required dilutions.

1.17 TENTATIVELY IDENTIFIED COMPOUNDS (TICS)

Reported VOC and SVOC tentatively identified compounds (TICs) were reviewed on a ten percent basis to determine if proper identifications were performed. No anomalies were noted.

1.18 DATA ASSESSMENT

Based on the criteria outlined, the results reported for these analyses are considered to be acceptable for their intended use with the exception of the results for barium, which was rejected for all samples in this SDG based on matrix spike recoveries. Some of the data required qualification as estimated as described in this validation report.

2.0
CANNON AFB SWMU 103
USEPA SW-846 VOC, SVOC, PESTICIDE/PCB, HERBICIDE, METALS, AND TPH ANALYSES
SDG #31358 - SOIL AND QC SAMPLES

2.1 INTRODUCTION

This report describes the full data validation for the VOC, SVOC, pesticide/PCB, herbicide, metal, TPH, cyanide, and sulfide analyses contained in Enseco Rocky Mountain Analytical Laboratory's data package SDG 031358. All analyses were conducted in accordance with USEPA SW-846 protocols. The samples included in SDG #031358 consist of four soil samples, three water samples, one trip blank, one rinsate blank, two field duplicate sample sets and two MS/MSD sample sets. The field duplicate and MS/MSD sample sets consisted of one each for the soil and water matrixes. The water samples were analyzed for Appendix IX analytes, while the sediment samples were analyzed for the TAL and TCL lists.

All sample data for sample delivery group 31358 underwent a full validation as defined in the Cannon AFB Quality Assurance Project Plan (QAPP) (W-C October 1993). This document specified Quality Assessment/Quality Control (QC) evaluation criteria as established for the project or by SW-846 methodology. Additional guidance was taken from the "National Functional Guidelines for Organic Data Review" (USEPA 12/90 rev. 6/91) for validation of VOC and SVOC data. Pesticide/PCB samples utilized guidance from the "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses" (USEPA 2/88). The "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses" (USEPA, 2/88) were used for guidance in the validation of the metals and cyanide data. These USEPA documents are referred to as the "Guidelines" in this report. While no guidance has been established for herbicide, TPH, and sulfide sample validation, these results were validated using guidance from the "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses" (USEPA 2/88) in conjunction with the QA/QC specified in the Cannon AFB QAPP (W-C 1993).

Criteria evaluated included the following:

VOCs and SVOCs

Significant problems identified in Case Narrative
Holding times
GC/MS instrument performance
Initial and continuing calibration
Method blank, field blank contamination
Surrogate recoveries
Laboratory control samples
MS/MSD recoveries and RPD values
Internal standard areas and retention times
Compound identification and quantitation
Tentatively Identified Compounds (TICs)
System performance and overall assessment of data

Metals

Significant problems identified in Case Narrative
Holding times
Initial and continuing calibration
Blanks (preparation and calibration)
ICP interference check sample
Laboratory control sample
Matrix spike recoveries
Furnace atomic absorption (AA) QC
ICP serial dilution
Sample result verification

Herbicides & Pesticide/PCBs

Significant problems identified in Case Narrative
Holding times
Initial and continuing calibration
Blanks (preparation)

Laboratory control sample
Matrix spike recoveries
Surrogate recoveries
Sample result verification

TPH, Cyanide and Total Sulfide

Significant problems identified in Case Narrative
Holding times
Initial and continuing calibration
Blanks (calibration and preparation)
Laboratory control sample
Matrix spike recoveries
Sample result verification

Validation of the data also included a check for potential transcription errors.

Four sediment samples, the associated field duplicate, and an MS/MSD sample were collected from the playa and analyzed. These samples were reported to have moisture contents above 50%. The laboratory reported the results for these samples on a dry weight basis. The Cannon QAPP states that for soil samples which have a moisture content greater than 50% all analytical results for VOC, SVOC, pesticide/PCB and herbicide analyses should be qualified estimated **J**. Therefore, all of the data for these sediment samples was qualified **J**. The following are the associated samples and the corresponding moisture contents.

CAN103-1031-5001	74%
CAN103-1031-1061 (FD)	63%
CAN103-1032-5001 (MS/MSD)	95%
CAN103-1033-5001	73%
CAN103-1034-5001	80%

With CAN 103-1031-5001 as the original sample for the duplicate CAN103-1031-1061, there is a 16% relative percent difference in the moisture content between the original and duplicate samples.

Validation of the data also included a check for potential transcription and calculation errors.

The following sections present the remaining results of the full data validation.

2.2 PROBLEMS IDENTIFIED IN CASE NARRATIVE

For pesticide/PCB analyses, samples CAN103-1031-5001, CAN103-1032-5001, CAN103-1033-5001, and CAN103-1034-5001 were reanalyzed at a higher dilution. The samples were reanalyzed to retain instrument calibration for all compounds. The results from the reanalyses were reported. All other problems noted in the Case Narrative are addressed in the appropriate section of this validation report.

2.3 HOLDING TIMES

Review of the sample collection, extraction and/or analysis dates involved comparing the chain-of-custodies, the sample preparation and extraction logs, the summary forms, and the raw data forms and chromatograms for accuracy, consistency, and holding time compliance for 100% of the samples in the SDG. All samples in SDG 31358 were extracted and analyzed within evaluation criteria established in the Cannon AFB QAPP (W-C 1993) for VOC, SVOC, pesticide/PCB, herbicides, TPH, cyanide, sulfide, and metal analyses; therefore, no qualifications based on the exceedances of holding times were required.

2.4 INSTRUMENT PERFORMANCE

GC/MS instrument performance checks were performed to ensure mass resolution, identification, and instrument sensitivity. Criteria for evaluating instrument performance included possible transcription/calculation errors, adherence to instrument tuning frequency requirements, mass assignments, and ion abundance criteria. All instrument performance check samples associated with this SDG were evaluated against criteria established by SW-846 methodology with guidance from the "Guidelines". All criteria for instrument performance check compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP) for VOCs and SVOCs, respectively, were met. Therefore, no qualification of data based on GC/MS instrument performance was required in SDG 31358.

Instrument performance checks were also performed for pesticide/PCB analyses to ensure that adequate chromatographic resolution and instrument sensitivity are achieved by the chromatographic system. Criteria for instrument performance for pesticide/PCB data established by SW-846 methodology with guidance from the "Guidelines" were used in this evaluation.

These criteria included the percent breakdown of endrin and 4,4,4′-DDT must be less than 20%, evaluation of whether the DDT retention time was greater than 12 minutes, and whether retention times for dibutylchlorendate (DBC) and other standards were within retention time windows. All criteria were met for the pesticide/PCB analysis, and qualification of data was not necessary.

2.5 INITIAL AND CONTINUING CALIBRATION (VOCs, SVOCs, PESTICIDE/PCBs AND HERBICIDES)

Initial and continuing calibration criteria were established to ensure the instrument was capable of producing acceptable qualitative and quantitative data for VOCs and SVOCs. The data were evaluated to ensure the RRF, %RSD, and %D were within acceptable criteria established by SW-846 methodology. For both continuing and initial calibration of VOCs and SVOCs, the RRF must be greater than 0.05. The %RSD for VOC and SVOC initial calibration and the %D for SVOC continuing calibration must not exceed 30%. For VOC continuing calibration, the %D must not exceed 25%. All VOCs initial calibration mean relative response factors (RRFs) and %RSD were within acceptance criteria.

For SVOC initial calibration, one Appendix IX SVOC, 1,3,5-trinitrobenzene, did not meet the RRF evaluation criteria. All RRFs for the five standards and the average RRF were less than 0.05 for 1,3,5-trinitrobenzene. This indicates that the instrument was not responding sufficiently to this analyte. All associated data were nondetect, and following guidance from the "Guidelines", these data were rejected.

The %RSDs for initial calibration for two Appendix IX SVOCs, 2,4-dinitrophenol, and phorate were greater than 30%. For 2,4-dinitrophenol, the lowest concentration standard (20 μg/L, which did not meet the RRF criteria) was eliminated from the evaluation calibration curve linearity. This action restored the %RSD to be less than 30%. Because the analyte met

the %RSD criterion for a four-point calibration, no qualification of results greater than 20 μg/L was judged necessary. All positive results and nondetects were qualified or estimated for 2,4-dinitrophenol. This is an in-depth review which is established by the "Guidelines". The %RSD for phorate was 37%, exceeding the control limit. For phorate, all associated data were nondetect. Since the RRF for the lowest two calibration standards was greater than 0.05, the outlying %RSD value would have minimal effect on the ability of the instrument to detect the subject compounds. Therefore, qualification of the associated nondetected data was judged not necessary.

Initial Calibration SVOCs

Date	Analytes	Qualification
9-21-93	1,3,5-Trinitrobenzene	R
9-21-93	2,4-Dinitrophenol	J/UJ

The following associated samples were qualified based on the above VOC continuing calibration information:

CAN103-1036-3000 CAN103-1037-3000
CAN103-1035-3000 CAN103-1035-1061

All VOC and SVOC continuing calibration RRF values were within the acceptance criteria presented in the SW-846 (greater than 0.05), and all VOC and SVOC continuing calibrations were analyzed at the required frequency.

Percent differences (%Ds) between initial and continuing calibration response factors were reported outside control limits for both VOC and SVOC continuing calibration analyses. The VOC continuing calibration (10-2-93) reported %D greater than 25% for acetone, vinyl acetate, and 2-hexanone. For the SVOC continuing calibration (10-5-93), ten analytes were reported outside of the evaluation criterion. Per the "Guidelines", compounds having %D values greater than 30% require qualification as estimated for nondetect and detects. The following are samples and applicable data qualifiers based on the outlying continuing calibration data:

Continuing Calibration VOCs

Date	Compound	%D	Qualifier Detects/Nondetects
10-2-93	Acetone	27.35	J/UJ
	Vinyl acetate	25.36	J/UJ
	2-Hexanone	35.85	J/UJ

The following associated samples were qualified based on the above VOC continuing calibration information:

CAN103-1032-5001 CAN103-1031-5001

Continuing Calibration SVOCs

Date	Compound	%D	Qualifiers Detects/Nondetects
10-5-93	N-Nitrosodimethylamine	40.1	J/UJ
	Pyridine	41.4	J/UJ
	Bis(2-chloroisopropyl)ether	59.2	J/UJ
	4-Nitroaniline	39.3	J/UJ
	Carbazole	34.4	J/UJ
	3,3'-Dichlorobenzidine	33.9	J/UJ
	Benzo(k)fluoranthene	31.1	J/UJ
	Benzo(g,h,i)perylene	39.2	J/UJ
	Methylmethanesulfonate	35.4	J/UJ
	aa-Dimethylphenethylamine	48.4	J/UJ

The following associated samples were qualified based on the above SVOC continuing calibration information:

CAN103-1031-5001
CAN103-1032-5001
CAN103-1033-5001

For pesticide/PCB analyses, the initial calibration %RSD must not exceed 10% and the continuing calibration must be within 15% D for the quantitation column and within 20% D for the concentration column. All pesticide analytes met the %RSD criterion for initial calibration. The %D between the initial and continuing calibration for pesticide/PCB analyses was greater than 15% for 4,4'-DDD, 4,4'DDT, and methoxy chloride. The associated data

for these analytes were all nondetect. In accordance with guidance from the "Guidelines", qualification of the data was not necessary.

Continuing Calibration SVOCs

Date	Compound	%D	Qualifiers Detects/Nondetects
10-5-93	N-Nitrosodimethylamine	40.1	J/UJ
	Benzo(k)fluoranthene	31.1	J/UJ
	Benzo(g,h,i)perylene	39.2	J/UJ

The following associated samples were qualified based on the above SVOC continuing calibration information:

CAN103-1037-3000
CAN103-1036-3000
CAN103-1035-3000
CAN103-1035-1061

For the initial calibration for herbicide analyses, the RRF met the evaluation criterion (>0.05). A weighted linear regression of $1/X^2$ was used to establish the calibration curve for the herbicide analyses. The correlation coefficient for the herbicide calibration was recalculated and met the acceptance criterion (>0.995). The continuing calibration met the acceptance criterion (<20%D) except for 2,4-D. 2,4-D was above this criterion for one of the two columns for both of the continuing calibrations performed on 10-7-93 (28%D and 39%D). No qualifications based on calibration were judged necessary because the %D was greater than 20% for only one of the two columns, and all 2,4-D data were nondetect.

No calculation or transcription errors were noted for the reported RRF values, %RSD values, and %D values for initial and continuing calibrations.

2.6 INITIAL AND CONTINUING CALIBRATION (METALS, CN, TOTAL SULFIDE AND TPH)

Initial calibration criteria were utilized to assess whether the instrument could produce acceptable quantitative data. Continuing calibrations ensured that the initial calibration was still valid for metals, TPH, CN, and total sulfide analyses.

The initial calibrations for GFAA and mercury analyses met the frequency and linearity criteria (>0.995) required by SW-846 methodology except for thallium which did not meet the linearity criteria. The correlation of coefficient for thallium was 0.994. All associated data for thallium were nondetect. In accordance with the "Guidelines", all associated thallium data were qualified as estimated **UJ**. The initial calibration for ICP analyses meet the criteria required by SW-846 methodology. All initial calibration verification (ICV) and continuing calibration verification (CCV) analyses for ICP, GFAA, and mercury reported acceptable recoveries. The acceptance criteria were 90% to 110% for all metals except mercury and 80 to 120% for mercury.

Initial and continuing calibrations were evaluated for TPH, CN, and sulfide analyses. For all of these analyses, a blank and at least three standard were used to establish a calibration curve. The correlation coefficient of the calibration curves for all of the analytes were greater than 0.995. Initial and continuing calibration verifications for TPH and CN analyses were 100% ±3%. No qualification of CN, TPH, or sulfide data was required.

2.7 BLANK SAMPLES

The purpose of laboratory blank analyses was to evaluate the existence and magnitude of contamination problems resulting from laboratory activities. The method blanks for SVOC, pesticide/PCBs, herbicide, CN, TPH, total sulfide and metal analyses reported all target compounds as nondetect. Tentatively identified compounds (TICs) were, however, detected in the SVOC method blank.

For VOC analyses, acetone and methylene chloride were detected in method blanks associated with soil samples, and acetone was detected in the method blank associated with aqueous

samples. The associated data required qualification as nondetectable if the reported sample concentration was less than 10 times the blank concentration.

One rinsate and one trip blank sample were analyzed for VOCs to assess sampling equipment decontamination procedures. The rinsate blank (CAN103-1037-1091) and the trip blank (CAN103-1031-1071) were associated with samples in this SDG. Carbon disulfide (8.8 μg/L) was reported as detected in the rinsate blank. The associated data required qualification as nondetectable if the sample concentration for carbon disulfide was less than 5 times the blank concentration. Methylene chloride (1.2 μg/L) and acetone (4.4 μg/L) were detected in the trip blank. Samples associated with the trip blank were qualified if the sample concentration was less than 10 times the blank concentration.

Additionally, no transcription or calculation errors were noted in the method blank and field blank data for this SDG.

The following qualifications were made based on method and field blank contamination:

Sample	Dilution Factor	Analyte	Sample Conc.	Qualification
CAN103-1031-5001*		Acetone	110 μg/kg	U
		Methylene chloride	4.1 μg/kg	U
		Carbon disulfide	8.4 μg/kg	U
CAN103-1032-5001*		Acetone	200 μg/kg	U
		Carbon disulfide	22 μg/kg	U
		Methylene chloride	20 μg/kg	U
CAN103-1033-5001*		Acetone	190 μg/kg	U
		Carbon disulfide	18 μg/kg	U
CAN103-1034-5001*		Carbon disulfide	23 μg/kg	U
CAN103-1036-3000	1	Acetone	8.0 μg/kg	U
CAN103-1037-3000	1	Acetone	6.9 μg/kg	U
		Methylene chloride	1.0 μg/kg	
CAN103-1035-3000	1	Acetone	12 μg/kg	U
CAN103-1031-1061*		Acetone	72 μg/kg	U
		Carbon disulfide	4.3 μg/kg	U
		Methylene chloride	3.6 μg/kg	U
CAN103-1035-1061	1	Carbon disulfide	1.2 μg/kg	U

*Soil samples which had raised reporting limits due to percent moisture of the samples.

2.8 ICP INTERFERENCE CHECK SAMPLE (METALS)

The ICP interference check sample verifies the laboratory's interelement and background correction factors. Concentrations of metals not in the ICS were evaluated with guidance from the "Guidelines" to determine if false negatives or false positives exist. No anomalies were noted. The frequency of the ICP interference check sample was acceptable, and all percent recoveries met the 80% to 120% criteria established in the "Guidelines".

2.9 ICP SERIAL DILUTION

The ICP serial dilution determines whether significant physical or chemical interferences exist due to the sample matrix. The laboratory did not perform an ICP serial dilution on any samples in this SDG, since it is recommended in SW-846 methods only for matrices of unknown or unusual characteristics. Theses matrices were not considered to be either unknown or unusual. Therefore any effects due to the sample matrix, which could be determined by serial dilutions, could not be assessed for ICP analyses in this SWMU.

2.10 SURROGATE SPIKE RECOVERIES

Surrogate compounds were used to evaluate overall laboratory analysis accuracy on a per sample basis. The "Guidelines" required all VOC, herbicide and pesticide/PCB surrogate recoveries to meet acceptance criteria and allow one SVOC surrogate recovery in each fraction to be outside acceptance criteria, provided the recovery was greater than or equal to 10 percent. All surrogate % recovery acceptance criteria were defined in the Cannon AFB QAPP (W-C 1993). All VOC and pesticide/PCB surrogate recoveries met evaluation criteria.

For SVOC analyses, three samples (CAN103-1036-3000, CAN103-1037-3000, and CAN103-1035-3000) had outlying recoveries for terphenyl-d14. The laboratory performed duplicate analyses of the samples which did not improve the recovery of terphenyl-d14, indicating that the low recovery of the surrogate was due to a matrix effect. The results for the original analyses were reported for the samples. No qualification of the SVOC data was necessary because only one surrogate recovery was outside acceptance limits.

For herbicide analyses, DCAA recovery was reported below the acceptance criterion for CAN103-1032-5001, CAN103-1033-5001, and CAN103-1034-5001 (47%, 62% and 22%, respectively). All herbicide data for these samples were nondetect and qualified estimated nondetect **UJ**.

No calculation or transcription errors were noted during review of the VOC and BNA surrogate data.

2.11 DUPLICATE AND SINGLE CONTROL SAMPLES (DCS and SCS)

Duplicate control samples were analyzed to determine the accuracy of the analytical method and laboratory performance. For all analyses for SDG 31358, the laboratory analyzed a duplicate laboratory control sample (DCS) containing representative target analytes and a single control sample (SCS) containing the surrogate compounds. All SVOC, VOC, herbicide, pesticide/PCB, total sulfide, CN and TPH DCS recoveries were within the Cannon AFB QAPP (W-C 1993) specified control limits. The DCS recovery for sodium (35%) was reported below the acceptance criterion for the soil DCS. The following samples were qualified estimated **J** for sodium based on a low DCS recovery:

CAN103-1031-5001
CAN103-1032-5001
CAN103-1033-5001
CAN103-1034-5001

No transcription or calculation errors were noted in the DCS data.

2.12 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) SAMPLE

Samples CAN103-1032-5001 and CAN103-1036-3000 were used for MS/MSD analyses for SDG 31358. Evaluation criteria for MS/MSD recoveries were defined by the Cannon AFB QAPP (W-C 1993). All MS/MSD recoveries were within acceptance limits for the sediment sample. All VOC, herbicide, CN, and total sulfide spike recoveries met the evaluation criteria for the aqueous sample. The MS/MSD recoveries for the aqueous matrix for one SVOC (pyrene), three metals (arsenic, lead, and thallium) and TPH were reported below the

acceptance criteria. Associated data were qualified estimated J, to indicate a potential low bias. The outlying and MS/MSD recoveries are as follows:

Sample I.D.	Analyte	% Recovery MS	% Recovery MSD	Control RPD(1)	Percent Limits
CAN103-1036-3000	Arsenic	93	74		75-125
	Lead	74	54	30(20)	75-125
	Thallium	53	57		75-125
	Pyrene	20	19		75-125
	TPH	62	89		75-125

(1) RPD control limits in parenthesis

The following associated samples for metals were qualified based on the above information:

CAN103-1036-3000
CAN103-1037-3000
CAN103-1035-3000

The following associated samples for organics were qualified based on the above information:

CAN103-1036-3000

For pesticide/PCB analyses, the RPD was outside acceptance criteria for 2,4-D in CAN103-1036-3000; however, no qualifications were judged necessary for the associated data because the MS/MSD recoveries were both within criteria. In the MS/MSD sample (CAN103-1036-3000), aldrin, gamma-BHC, and heptachlor were not detected, which was reported in the laboratory case narrative, and percent recoveries of the spikes were not reported. Due to laboratory error, the pesticide compounds in this sample were destroyed due to acid washing of the sample. The sample was reanalyzed. Spikes were detected in the reanalyses, and the recoveries were within the evaluation criteria. The reported results for this sample were from the reanalyses.

No transcription or calculation errors were noted in the MS/MSD data provided by the laboratory.

2.13 FURNACE ATOMIC ABSORPTION (AA) QC

Postdigestion spikes established the accuracy of the individual analyses. Review of the post-digestion spike data provided by the laboratory indicated that postdigestion spike recoveries for selenium and arsenic were below the acceptance criteria in the Laboratory Quality Management Plan (LQMP) for several samples. The associated results were qualified as estimated to indicate a potential low bias (**J** for detects, **UJ** for nondetects). All remaining postdigestion spike recoveries were acceptable. Additionally, no calculation errors were noted in the validation of the furnace AA QC data. The following qualifications were made based on low postdigestion spike recoveries:

Sample	Analyte	% Recovery	Qualifier
CAN103-1033-5001	Selenium	82	J
	Arsenic	82	J
CAN103-1032-5001	Arsenic	83	J
CAN103-1034-5001	Selenium	82	J
CAN103-1037-3000	Selenium	74	J
CAN103-1035-3000	Selenium	84	J
CAN103-1036-3000	Selenium	63	J

2.14 INTERNAL STANDARDS

Internal standard (I.S.) performance criteria ensured that GC/MS sensitivity and response were stable during each analytical run. I.S. areas must be within -50% to +100% of the area for the standard in the daily calibration. I.S. retention time must be within 30 seconds of the retention time for the standard in the daily calibration. All VOC and SVOC internal standard areas and I.S. retention times were within acceptance criteria. Additionally, no transcription or calculation errors were noted.

2.15 FIELD DUPLICATE RESULTS

Control criteria for evaluating the results of field duplicate samples were defined in the Cannon AFB QAPP (W-C 1993). Associated data were qualified estimated **J**, if the results do not meet these acceptance criteria.

Two field duplicate pairs were associated with SWMU 103. CAN103-1032-1061 and CAN103-1035-1061 were duplicates of the original samples CAN103-1031-5001 and CAN103-1035-3000 respectively. Table 4.13-2 and Table 4.13-3 summarized chemicals detected in the duplicate samples and qualifications assigned based on field duplicate results. For CAN103-1031-5001, 4,4′-DDD, 4,4′-DDT, cobalt, and mercury data were qualified estimated **J** based on poor field duplicate precision. No other qualifications were required.

2.16 COMPOUND IDENTIFICATION AND QUANTITATION

Minor rounding errors were seen with the reporting of bis(2-ethylhexyl)phthalate in two of the samples. The rounding errors noted in SDG 31358 did not impact the usability of the data, and no qualification of the data was judged necessary based on transcription errors. No other anomalies, calculation, or transcription errors were noted during validation of the reported compound identifications and quantitations.

2.17 TENTATIVELY IDENTIFIED COMPOUNDS (TICS)

Reported VOC and SVOC tentatively identified compounds (TICs) were reviewed on a 10 percent basis to determine if proper identifications were performed. No anomalies were noted.

2.18 OVERALL DATA ASSESSMENT

Based on the criteria outlined, the results reported for these analyses are considered to be acceptable for their intended use with the exception of the results for 1,3,5-trinitrobenzene on aqueous samples, which were rejected. Some of the other data required qualification as extracted as described in this validation report.

3.0
CANNON AFB SWMU 031
USEPA SW-846 VOC, SVOC, METALS, AND TPH ANALYSES
SDG 031183 - SOIL AND QC SAMPLES

3.1 INTRODUCTION

This report describes the full data validation for the VOC, SVOC, metals, and TPH analyses contained in Enseco Rocky Mountain Analytical Laboratory's data package SDG 031183. All analyses were conducted in accordance with USEPA SW-846 protocols. The samples included in SDG 031183 consist of seventeen soil samples, two field duplicate samples, one trip blank sample, one ambient blank sample, one decontamination water blank sample, and one rinsate blank sample.

All sample data for SDG 31183 underwent a full validation as defined in the Cannon AFB Quality Assurance Project Plan (QAPP) (W-C October 1993). This document specified Quality Assessment/Quality Control (QC) evaluation criteria as established for the project or by SW-846 methodology. Additional guidance was taken from the "National Functional Guidelines for Organic Data Review" (USEPA 12/90 rev. 6/91) for validation of VOC and SVOC data. The "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses" (USEPA, 2/88) were used for guidance in the validation of the metals and cyanide data. These USEPA documents are referred to as the "Guidelines" in this report. While no guidance has been established for TPH sample validation, these results were validated using guidance for the "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses" (USEPA 2/88) in conjunction with the QA/QC specified in the Cannon AFB QAPP (W-C 1993).

Criteria evaluated included the following:

VOCs and SVOCs

Significant problems identified in Case Narrative
Holding times
GC/MS instrument performance
Initial and continuing calibration
Method blank, field blank contamination
Surrogate recoveries
Laboratory control samples
MS/MSD recoveries and RPD values
Internal standard areas and retention times
Compound identification and quantitation
Tentatively Identified Compounds (TICs)
System performance and overall assessment of data

Metals

Significant problems identified in Case Narrative
Holding times
Initial and continuing calibration
Blanks (preparation and calibration)
ICP interference check sample
Laboratory control sample
Laboratory duplicate sample results
Matrix spike recoveries
Furnace atomic absorption (AA) QC
ICP serial dilution
Sample result verification

TPH

Significant problems identified in Case Narrative
Holding times
Initial and continuing calibration
Blanks (calibration and preparation)
Laboratory control sample
Matrix spike recoveries
Sample result verification

Validation of the data also included a check for potential transcription errors. No transcription were noted during validation of this data package.

The following sections present the data validation.

3.2 PROBLEMS IDENTIFIED IN CASE NARRATIVE

All problems noted in the Case Narrative are addressed in the appropriate section of this validation report.

3.3 HOLDING TIMES

Review of the sample collection, extraction and/or analysis dates involved comparing the chain-of-custody forms, the sample preparation and extraction logs, the summary forms, and the raw data forms and chromatograms for accuracy, consistency, and holding time compliance for 100% of the samples in the SDG. All samples in SDG 31183 were extracted and analyzed within the holding time limits established in the Cannon AFB QAPP (W-C 1993) for VOC, SVOC, metals and TPH analyses; therefore, no qualifications based on the exceedances of holding times were required.

3.4 GC/MS INSTRUMENT PERFORMANCE

GC/MS instrument performance checks are performed to ensure mass resolution, identification, and instrument sensitivity. Criteria for instrument performance checks included evaluating possible transcription/calculation errors, adherence to instrument tuning frequency requirements, mass assignments, and ion abundance criteria. All instrument performance check samples associated with this SDG were evaluated against criteria established by SW-846 methodology with guidance from the "Guidelines". All criteria for instrument performance check compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP) for VOCs and SVOCs, respectively, were met. Therefore, no qualification of data based on GC/MS instrument performance was required in SDG 31183.

3.5 INITIAL AND CONTINUING CALIBRATION (VOCS AND SVOCS)

Initial and continuing calibration criteria are established to ensure the instrument is capable of producing acceptable qualitative and quantitative data for VOCs and SVOCs. The data were evaluated to ensure the RRF, %RSD and %D were within acceptance criteria established by SW-846 methodology. For both the continuing and initial calibrations, the RRF must be greater than 0.05 for VOCs and SVOCs. The %RSD for the SVOC and VOC initial calibration and the %D for the SVOC continuing calibration must not exceed 30%. For the VOC continuing calibration, the %D must not exceed 25%.

All VOC and SVOC initial continuing calibration relative response factors (RRFs) met the acceptance criteria presented in the "Guidelines". Also VOC and SVOC continuing calibrations were analyzed at the required frequency. No calculation or transcription errors were noted for the reported RRF values and %RSD values.

For initial calibrations for VOC and SVOC vinyl acetate (VOC) and 4-nitroaniline (SVOC) did not meet the %RSD acceptance criteria. Per the "Guidelines" detected compounds having associated outlying %RSD values require qualification as estimated and nondetected results are qualified using professional judgement. Since the RRFs for the low concentration standard had RRFs greater than 0.05, it was considered that the outlying %RSD value would have minimal effect on the ability of the instrument to detect the subject compounds.

Therefore, qualification of nondetected data was not considered necessary. All associated sample results were reported as nondetected for vinyl acetate and 4-nitroaniline; therefore, qualification of the associated data was judged not to be required.

Percent differences (%Ds) between initial and continuing calibration response factors were reported outside control limits for both VOC and SVOC continuing calibration analyses. Per the "Guidelines", compounds having outlying %D values require qualification as estimated (detects J, nondetects UJ). Presented as follows are samples and applicable data qualifiers based on the outlying continuing calibration data:

Continuing Calibration VOCs

Date/Time	Compound	%D	Qualifier Detects/Nondetects
9-24-93 12:06	2-Hexanone	27.4	J/UJ

The following associated sample results were qualified based on the above VOC continuing calibration information:

CAN031-0314-3151 CAN031-0314-3171
CAN031-0314-3181 CAN031-0314-3191

Continuing Calibration SVOCs

Date/Time	Compound	%D	Qualifier Detects/Nondetects
9-26-93 17:27	Bis(2-chloroethyl)ether	32.1	J/UJ
	2-Methylphenol	35.4	J/UJ
	Bis(2-chloroisopropyl)ether	75.0	J/UJ
	2,4-Dinitrophenol	28.7	J/UJ
	4-Nitroaniline	34.6	J/UJ
	3,3'-Dichlorobenzidine	34.6	J/UJ
	Bis(2-ethylhexyl)phthalate	48.0	J/UJ
	Benzo(k)fluoranthene	69.7	J/UJ
	Benzo(g,h,i)perylene	33.8	J/UJ

The following associated sample results were qualified based on the above SVOC continuing calibration information:

CAN031-0313-0002 CAN031-0314-3163
CAN031-0312-3162 CAN031-0312-0008
CAN031-0314-0008 CAN031-0312-0002
CAN031-0311-0000

Continuing Calibration SVOCs

Date/Time	Compound	%D	Qualifier Detects/Nondetects
9-30-93 11:20	Bis(2-chloroethyl)ether	31.7	J/UJ
	2-Methylphenol	30.6	J/UJ
	Bis(2-chloroisopropyl)ether	90.6	J/UJ
	N-nitroso-di-n-propylamine	31.4	J/UJ
	Benzoic acid	51.1	J/UJ
	4-Nitroaniline	47.2	J/UJ
	Carbazole	30.2	J/UJ
	Benzo(k)fluoranthene	49.5	J/UJ
	Indeno(1,2,3-cd)pyrene	32.7	J/UJ
	Benzo(g,h,i)perylene	55.6	J/UJ

Sample CAN031-0313-0000 was qualified based on the above SVOC continuing calibration information.

No calculation or transcription errors were noted for the reported RRF, %RSD and %D values.

3.6 INITIAL AND CONTINUING CALIBRATION (METALS AND TPH)

Initial calibration establishes that the instrument can produce acceptable quantitative data. Continuing calibrations ensure that the initial calibration is still valid. The initial calibrations for GFAA and mercury analyses met the frequency and linearity criteria (>0.995) required by SW-846 methodology. The initial calibration for ICP analyses met the criteria defined by SW-846 methodology. All initial calibration verification (ICV) and continuing calibration verification (CCV) analyses were within acceptance criteria, which is 90% to 110% for all metals except mercury and 80% to 120% for mercury. The TPH initial and continuing calibration verifications met the SW-846 method criteria (85% to 115%). No calculation errors were noted.

3.7 METHOD BLANK SAMPLES

The purpose of laboratory blank analyses is to evaluate the existence and magnitude of contamination problems resulting from laboratory activities. All SVOC and TPH target compounds were reported as nondetect in the method blanks. For the metals method blank calcium was reported as detected. Since all reported sample results were greater than five times the blank concentration, no qualification of sample data was required. However, the laboratory reported the qualifier **B** with all associated calcium results to indicate that the associated method blank was contaminated. The **B** qualifier was therefore removed for the associated samples.

For VOC analyses, acetone and methylene chloride were detected in the soil method blank, and acetone was detected in the aqueous method blank. The associated data required qualification if the reported sample concentration was less than 10 times the blank concentration. Also the reporting limit was raised if the qualified nondetect concentration was greater than the reporting limit.

All method blank samples were reported as nondetected for the remaining target VOC and all remaining target metals. Additionally, no transcription or calculation errors were noted in the method blank data for this SDG. The following qualifications were made based on method and field blank contamination:

Sample	Dilution Factor	Analyte	Sample Conc.	Qualification
CAN031-0311-0008	1	Acetone Methylene chloride	8.3 µg/kg 3.6 µg/kg	U
CAN031-0313-0008	1	Acetone Methylene chloride	10 µg/kg 4.9 µg/kg	U
CAN031-0314-3163	1	Acetone Methylene chloride	8.2 µg/kg 5.0 µg/kg	U
CAN031-0314-0002	1	Acetone Methylene chloride	27 µg/kg 4.6 µg/kg	U
CAN031-0312-0002	1	Acetone Methylene chloride	13 µg/kg 3.4 µg/kg	U
CAN031-0312-3162	1	Acetone Methylene chloride	10 µg/kg 3.7 µg/kg	U
CAN031-0312-0008	1	Acetone Methylene chloride	8.4 µg/kg 6.2 µg/kg	U
CAN031-0314-0008	1	Acetone Methylene chloride	6.1 µg/kg 3.5 µg/kg	U
CAN031-0314-3151	1	Acetone	7.6 µg/kg	U
CAN031-0314-3191	1	Acetone	1.8 µg/kg	U

One rinsate blank one trip blank, one ambient blank and decontamination water blank samples are analyzed for VOCs and are used to assess sampling equipment decontamination procedures or potential cross contamination during sample shipment. Carbon disulfide was the only target compound reported as detected in the rinsate blank and the ambient blank. Qualification was not required based on the carbon disulfide detection since all associated data were reported as non-detected. All target compounds were reported as nondetect for the trip blank and the decontamination water blank.

3.8 ICP INTERFERENCE CHECK SAMPLE (METALS)

The ICP interference check sample verifies the laboratory's interelement and background correction factors. Concentrations for metals not in the ICS were evaluated with guidance from the "Guidelines" to determine if false negative or false positives exist. No anomalies were noted. The frequency of the ICP interference check sample was acceptable, and all percent recoveries met the 80 to 120 percent criteria established in the "Guidelines".

3.9 ICP SERIAL DILUTION

The ICP serial dilution determines whether significant physical or chemical interferences exist due to the sample matrix. The laboratory did not perform an ICP serial dilution on any samples in this SDG, since it is recommended in SW-846 methods only for matrices of unknown or unusual characteristics. These matrices were not considered to be either unknown or unusual. Therefore any effects due to the sample matrix, which could be determined by serial dilutions, could not be assessed for ICP analyses in this SWMU.

3.10 SURROGATE SPIKE RECOVERIES

Surrogate compounds are used to evaluate overall laboratory sample preparation efficiency on a per sample basis. The "Guidelines" required all VOC surrogate recoveries to meet acceptance criteria and allow one SVOC surrogate recovery per fraction to be outside acceptance criteria provided the recovery is greater than or equal to 10 percent. All surrogate acceptance criteria were defined in the Cannon AFB QAPP (W-C 1993). Due to the necessity for sample dilution, the SVOC surrogate compounds were diluted out of samples CAN013-0313-0000 and CAN031-0311-0000. Therefore SVOC laboratory performance could not be assessed for these samples.

For sample CAN031-0314-3181, VOC surrogate toluene-d_8 recovery was below the acceptance limits. Per the "Guidelines", all VOC results for this sample require qualification as estimated (**J** for detects, **UJ** for nondetects). No other qualification of data based on surrogate criteria was required. No calculation or transcription errors were noted during review of the VOC and SVOC surrogate data.

3.11 DUPLICATE AND SINGLE CONTROL SAMPLE

Laboratory control samples are analyzed to determine the accuracy of the analytical method and laboratory performance. For VOCs, SVOCs, TPH and metals, the laboratory analyzed duplicate laboratory control samples (DCS) containing representative target analytes and a single control sample (SCS) containing the surrogate compounds. All VOC, TPH and metals DCS and SCS recoveries were within the QAPP specified control limits. The DCS result for

acenaphthene (SVOC) was reported below the acceptance criteria (57%). Acenaphthene data for the following associated samples were qualified estimated **J** based on the low DCS recovery:

CAN031-0313-0000	CAN031-0313-0002	CAN031-0314-3163
CAN031-0314-0002	CAN031-0312-0002	CAN031-0312-3162
CAN031-0312-0008	CAN031-0311-0000	CAN031-0314-0008

All remaining DCS recoveries were acceptable. No transcription or calculation errors were noted in the DCS data.

3.12 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) SAMPLE

Sample CAN031-0312-6008 was used for the MS/MSD analysis for VOCs, SVOCs, and metals. The reported VOC and SVOC MS/MSD recoveries and relative percent difference (RPD) values met the acceptance criteria presented in the QAPP. The laboratory analyzed an MS/MSD sample for metals, instead of a matrix spike/laboratory duplicate. This sample had the following outlying metals MS/MSD recoveries:

		% Recovery			
Sample I.D.	Analyte	MS	MSD	RPD(1)	Percent Control Limits
CAN031-0312-6008	Barium	133	184	32(20)	76-124
	Manganese	536	93	141(20)	74-125

(1) RPD control limits in parenthesis

Per the QAPP, for associated sa8mples all detected barium data results were qualified as estimated **J** to indicate a high bias. Detected manganese data were qualified as rejected **R** because the MS recovery was >200%. Barium and manganese data were qualified for the following samples:

CAN031-0311-0008	CAN031-0313-0000	CAN031-0313-0002
CAN031-0313-0004	CAN031-0313-0008	CAN031-0314-0000
CAN031-0314-3163	CAN031-0314-0002	CAN031-0314-0004
CAN031-0312-0000	CAN031-0312-0002	CAN031-0312-3161
CAN031-0312-0008	CAN031-0312-0004	CAN031-0311-0000
CAN031-0311-0002	CAN031-0311-0004	CAN031-0314-0008

All remaining metals MS/MSD recoveries and RPD values were acceptable. No transcription or calculation errors were noted in the MS/MSD data provided by the laboratory.

3.13 FURNACE ATOMIC ABSORPTION (AA) QC

Postdigestion spikes establish the accuracy of the individual analyses. Review of the postdigestion spike data provided by the laboratory indicated that postdigestion spike recoveries for selenium and thallium were below acceptance criteria established by the Laboratory Quality Management Plan (LQMP) for several samples. The associated results were qualified as estimated **J/UJ**, to indicate a potential low bias. All remaining post-digestion spike recoveries were acceptable. Additionally, no calculation errors were noted in the validation of the furnace AA QC data. The following qualifications were made based on low postdigestion spike recoveries:

Sample	Method	Analyte	% Recovery
CAN031-0311-0008	Selenium	54	J
	Thallium	83	J
CAN031-0313-0000	Selenium	68	J
	Thallium	64	J
CAN031-0313-0002	Selenium	46	J
	Thallium	63	J
CAN031-0313-0004	Selenium	46	J
	Thallium	64	J
CAN031-0313-0008	Selenium	69	J
	Thallium	78	J
CAN031-0314-0002	Thallium	78	J
CAN031-0314-0004	Selenium	58	J
	Thallium	65	J
CAN031-0312-0000	Selenium	63	J
	Thallium	79	J
CAN031-0312-0002	Selenium	55	J
	Thallium	72	J

Sample	Method	Analyte	% Recovery
CAN031-0312-0004	Selenium	52	J
	Thallium	60	J
CAN031-0312-0008	Selenium	57	J
	Thallium	77	J
CAN031-0311-0000	Selenium	74	J
CAN031-0311-0002	Selenium	47	J
	Thallium	67	J
CAN031-0311-0004	Selenium	60	J
CAN031-0311-0008	Selenium	44	J
	Thallium	60	J

3.14 INTERNAL STANDARDS

Internal standard (I.S.) performance criteria ensure that GC/MS sensitivity and response are stable during each analytical run. I.S. areas must be within -50% to +100% of the area for the standard in the daily calibration. I.S. retention time must be within 30 seconds of the retention time for the standard in the daily calibration. All VOC and SVOC internal standard areas and VOC and SVOC I.S. retention times were acceptable. Additionally, no transcription or calculation errors were noted.

3.15 FIELD DUPLICATE RESULTS

Evaluation criteria for the field duplicate sample sets were defined in the Cannon AFB QAPP (W-C 1993). Three field duplicate pairs are associated with SWMU 031, CAN031-0314-0002/CAN031-0314-3163, CAN031-0312-0002/CAN031-0312-3162, and CAN031-0312-0000/CAN031-0312-3161. Table 4.1-1 through Table 4.1-3 summarizes chemicals detected in the duplicate samples and qualifications made based on field duplicate results.

3.16 COMPOUND IDENTIFICATION AND QUANTITATION

No anomalies, calculation, or transcription errors were noted during validation of the reported compound identifications and quantitations.

3.17 TENTATIVELY IDENTIFIED COMPOUNDS (TICS)

Reported VOC and SVOC tentatively identified compounds (TICs) were reviewed on a ten percent basis to determine if proper identifications were performed. No anomalies were noted.

It was noted that the common laboratory contaminant 1,1,2-trichloro-1,2,2-trifluoroethane (freon 112) was reported as a TIC in the following VOC samples:

Sample	TIC	Concentration
CAN031-0312-0002	Freon 112	6.6 μg/kg
CAN031-0312-3162	Freon 112	11 μg/kg
CAN031-0314-0008	Freon 112	8.3 μg/kg

Per the "Guidelines" these identifications are rejected (data qualifier **R**). No other anomalies were noted in the TIC data.

3.18 OVERALL DATA ASSESSMENT

Based on the criteria outlined, the results reported for these analyses are considered to be acceptable for their intended use, with the exception of manganese results which were rejected for all samples in this SDG based on spike recoveries. The data required some qualification as described in this validation report.

ATTACHMENT C

DAILY QUALITY CONTROL REPORTS

Date 9/8/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
				X			

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	1	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III RFI
Project No. C3M11W
Contract No. _____

Subcontractors on Site: Woodward-Clyde

Equipment on Site: N/A

Visitors on Site: N/A

W-C Personnel on Site: Brian Ruby

Work Performed (including sampling): Mobilization - ~~5~~ Partial site clearance by base utilities, Kelly Blue Line & Intel com. Received office trailer and set up.

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Project Cannon AFB Appx III RFI
Project No. C3M11W

Report No. 1
Date 9/8/93

Quality Control Activities (including field calibrations):

N/A

Health and Safety Levels and Activities: N/A

Problems Encountered/Corrective Actions Taken: Not all base personnel required were available for site visit and clearances. Previous paperwork turned in by CES didn't help get any utilities marked on ground.
Add'l Requests to mark utilities

Downtime/Standby: N/A

Special Notes:

By Brian [illegible] Title Site Mgr

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Date 9/9/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
					X		

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	2	

COE Project Manager Marvin Taylor
Project Camron AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: Woodward-Clyde

Equipment on Site: N/A

Visitors on Site: Marvin Taylor

W-C Personnel on Site: Brian Ruby, Todd Fryzek

Work Performed (including sampling): Site Mobilization - Unload supplies Stage coolers and sample equipment. Stake 3/4 of sites Go to airport to pick up Todd Fryzek

Project Cannon AFB Apdx III RFI
Project No.

Report No. 2
Date 9/9/93

Quality Control Activities (including field calibrations):

N/A

Health and Safety Levels and Activities: N/A

Problems Encountered/Corrective Actions Taken: Some proposed boring locations were not cleared by base engineers due to utilities in Area. Made new appointment with Zone 1 (Tonya Thompson) to get some borings moved to acceptable locations with concurrence of Bill Hurlbutt (EPA) and Janice Stowell (Can. Env. Dept, CES)

Downtime/Standby:

Special Notes: Tremendous amount to accomplish in short time - Really need another person on-site to assist with mobilization to run errands, wait for phone hookup, etc.

By Brian D. Daly Title Site Manager

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Date 9/10/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
						X	

Weather	Bright Sun	Clear	Overcast Trace	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	3	

COE Project Manager Marvin Taylor
Project CANNON AFB Apdx III SWMUs
Project No. C3M11W
Contract No. _____

Subcontractors on Site: S.W. Engineering, Las Cruces N.M. Woodward-Clyde

Equipment on Site: 2 CME-55 Hollow-stem Auger Drilling Rigs

Visitors on Site: Marvin Taylor COE,

W-C Personnel on Site: Brian Ruby, Todd Fryzek, Dan Galde, Ryan Herold Dave Nicholson

Work Performed (including sampling): Rig 1 - Drilled one 20' Boring in SWMU #77, ~~07706~~ 07705

Rig 2 - Missing Adapter - Crew performed Hand Augering: 2-10' Borings in SWMU #47 - Auto Hobby Shop # 04704 & 04705

New personnel and contractors received site brieting. Drill rigs received prework decon, with augers and sampling equipment.

Prepped to sample lake water & Seds, but crew discovered incorrect or unusual bottles - Clear 1-liter vs. typical ambers, so we move on to other work.

Finish getting all sites cleared for Utilities by base personnel.

Project CJM11W Cannon AFB Apdx III ~~SWMU~~ RFI Report No. 3
Project No. Date 9/10/93

Quality Control Activities (including field calibrations):

Pre-work decon of all sampling equipment.
Calibration not possible as described below. Using relative response of PID to determine highest headspace for sample recovery when necessary, and for air monitoring.

Health and Safety Levels and Activities: D - Decon drilling & sampling

Problems Encountered/Corrective Actions Taken: PID supplier did not ship regulator valve for Cal. gas - We can't calibrate PIDs.
We ~~try to~~ BJR decide to go with the existing shop calibration and then post-cal in AM of Sat. After drilling to ck on relative response. Call W-C purchasing to get valve shipped down ASAP.

Downtime/Standby:

Special Notes: I found out at noon today (Friday!) that base electrical would not perform work to attach electrical to our trailer. Work Order had been in Week to 10 days earlier, and a more timely response would have allowed an alternative to be selected.

By Brian J. Pelly Title Site Manager

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Sheet 2 of 2

Date 9/11/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
							X

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	4	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III
Project No.
Contract No.

Subcontractors on Site: S.W. Engineering, Las Cruces N.M.

Equipment on Site: 2 - CME 55 Hollow-Stem Auger Rigs

Visitors on Site: N/A

W-C Personnel on Site: Brian Ruby, Todd Fryzek, Dan Falde, Ryan Herold, Dave Nicholson

Work Performed (including sampling): Rig 1: Drilled and sampled 3-20' borings: Ø77Ø1, Ø77Ø2 & Ø77Ø6.

Rig 2: Two 10' hand borings @ AFE carwash.

Project Cannon AFB ApAx III
Project No.

Report No.
Date 9/11/93

Quality Control Activities (including field calibrations):

Unable to calibrate field air monitoring instruments due to suppliers failure to include regulator valve with PIDs.

Ambient blanks & field duplicates being collected by drilling crews

Health and Safety Levels and Activities: Level D for drilling. Using the relative responses of the uncalibrated PIDs for headspace ~~cal~~ determinations.

Problems Encountered/Corrective Actions Taken: Due to lack of calibrated PIDs, we are keeping sampling activities to those areas where we expect minimum contamination or contamination by non-hazardous compounds.

Downtime/Standby: No Saturday pickup of samples by FedEx: We thoroughly ice down samples and change ice daily to maintain 4°C, for shipment on Monday 9/13/93.

Special Notes:

By Brian G. Kelly Title ~~9/11~~ Site Mgr

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Sheet 2 of 2

Date 9/12/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
	X						

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	5	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: Woodward-Clyde, Southwest Engineering

Equipment on Site: 2 CME-55 Drill Rigs.

Visitors on Site: ~~None~~ BJR Janice Stowell USAF CES Environ. Dept.

W-C Personnel on Site: Brian Ruby, Dave Nicholson, Todd Fryzek, Dan Galde, Ryan Herold

Work Performed (including sampling): Drill, sample and grout 4-10' borings in SWMU 31, AGE Maintenance shop.

Drill, sample 1-60' in POL leachfield (#12708) Drill #12707 to 58', Shut down for day

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Project Cannon AFB Apdx III RFI
Project No.

Report No.
Date 9/12

Quality Control Activities (including field calibrations): Ambient blanks, Field Duplicates ~~and~~ MRD duplicates and MS/MSD collected from both SWMUs, #127 & #71

No Air monitoring calibration due to missing regulator valve for span gas.

Health and Safety Levels and Activities: Level D - Drilling sampling & grouting.

Problems Encountered/Corrective Actions Taken: Continuing to work in those areas where I think potential contaminants have the lowest hazard to workers, using relative response of PID to select highest headspace.

Downtime/Standby: None

Special Notes: Regulator valve to be shipped in tomorrow, monday ~~9/14/9~~ 9/13/93

By Brian J. [illegible] Title Site Mgr.

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Sheet 2 of 2

Date 9/13/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
		X					

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	6	

COE Project Manager Marvin Taylor
Project Cannon AFB Apple III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: Woodward - Clyde, S. W. Engineering

Equipment on Site: 2 CME-55 Hollow stem Auger Drill Rigs

Visitors on Site: None

W-C Personnel on Site: Brian Ruby, Todd Fryzek, Ryan Herold, Dan Galde, Dave Nicholson

Work Performed (including sampling): 5 - 10' Borings drilled, sampled & grouted at O.W. seperators at AFE (service station - 1), CE Maint. Wash rack (#63 - 2) & #5120 Jet Engine test cells (2) by Rig 2.

Rig one completed #12707, then drilled and sampled 12706 & 12704. Holes 12707 & #12708 grouted.

Project Cannon AFB Apdx III RFI
Project No.

Report No.
Date 9/13/93

Quality Control Activities (including field calibrations): Continuing to collect QA samples per FSP Sample Summary Tables

Health and Safety Levels and Activities: Drilling, Sampling & trenching - Level D

Problems Encountered/Corrective Actions Taken: Questions arose from field crew on selection method of SVOC samples. Phone consultation with Bob Kohn clarified issue, and information was disseminated to both crews.

Downtime/Standby: Approximately 2 ~~two~~ hours down by Rig 1 when connecting rod weld to drill bonnet broke, requiring disassembly and repair at shop in Clovis.

Special Notes: Shipped All samples taken 9/10 - 9/12 via Fed Ex to Enseco & MRD.

By Brian A. Rady Title Site Manager

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Date 9/14/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
			X				

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	7	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: S.W. Engineering Co, Inc

Equipment on Site: 2 CME-55 Hollowstem Auger Drill Rigs. 6-wheel drive Decon Truck.

Visitors on Site: None

W-C Personnel on Site: Brian Ruby Dan Galde, Ryan Herald, Dave Nicholson, Todd Fryzek

Work Performed (including sampling):

Drill and sample 2-20' Borings in SWMU #70; 1-10' boring in SWMU #51; 2-10' Borings in SWMU #47.

Drill & sample 2-60' Borings in SWMU #127. Start 1-60' boring in SWMU #70.

Decon of Augers and split spoons thru day as required.

Project Cannon AFB Apd, III RFI
Project No.

Report No. 7
Date 9/14/93

Quality Control Activities (including field calibrations):

BJR performs field calibration on all microtips (PIDs)

Health and Safety Levels and Activities: Drilling and decon - Level D.

Problems Encountered/Corrective Actions Taken: On reaching 8.5' level in B7B03, sampler has rejection. Concrete material recovered from sampler. On attempting to clean out hole, augers shook violently, so hole was abandoned pending add'l research of site.

Downtime/Standby: None

Special Notes: Rig one pulled off OWS #326 (hole abandoned) in favor of SWMUS 92 & 93 to allow new locations to be staked in SWMU #70 for 60' Borings.

By Brian J. Rady Title Site Manager

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Sheet 2 of 2

Date 9/15/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
				X			

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No. BJR 78	
Humidity	Dry	Moderate	Humid		

COE Project Manager Marvin Taylor
Project Cannon AFB Appendix III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: Woodward-Clyde S.W. Engineering Co.

Equipment on Site: 2 CME-55, Hollowstem Auger Drill Rigs

Visitors on Site: None

W-C Personnel on Site: BRIAN RUBY, RYAN HEROLD, DAN GALDE, DAVE NICHOLSON, TODD FRIZAK

Work Performed (including sampling): Drill and sample 3-60' borings in SWMU #93, 1-20', 5-10' borings in SWMU's #55(1), #47(1) #51(1) and #57(3), respectively.

Decontamination of Augers and Grouting of boreholes drilled to date.

Project Cannon AFB
Project No. ~~CM~~ C3M11W

Report No. 8
Date 9/15/93

Quality Control Activities (including field calibrations):

All PIDs ~~in~~ calibrated by Dan Galde prior to field service except MP-1000, which shows no display in ~~battery~~ Unit after battery has been charged.

Health and Safety Levels and Activities: Level B for all drilling and grouting activities. Level D for decon.

Problems Encountered/Corrective Actions Taken: Possible powerlines (underground) in SWMU #93 not marked - Exterior Electric group contacted to mark them, which they did.

Boring #09205 located within 3' of marked, high voltage underground cable. Permission given by Site manager to move boring East to improve clearance.

Downtime/Standby: None

Special Notes:

By [signature] Title Site Manager

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Date 9/16/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
					X		

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	9	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: S.W. Engineering

Equipment on Site: 2 CME-55 Hollowstem Auger Drill Rigs.

Visitors on Site: None

W-C Personnel on Site: Brian Ruby, Dave Nicholson, Dan Galder Ryan Herold, Todd Fryzek

Work Performed (including sampling): No drilling activities due to special request by Enseco - R.M. Analytical Labs. Too many samples on hand.

Work performed includes packing and shipping of all samples, Cleanup and recopying of ~~all~~ BJR drill logs where required, grouting of all open boreholes and individual site cleanup.

Office work and errands run to facilitate re-startup of drilling.

Albuquerque Concrete Coring Co. onsite to cut Concrete to provide borehole access on washracks (6 Bores cut, Core placed in multilayered ~~plas~~ plastic then replaced in hole to minimize potential for precipitation entering open core holes along cuts.

Project Cannon AFB Apex III RFI
Project No.

Report No. 9
Date 9/16/93

Quality Control Activities (including field calibrations):

Placing of Plastic under concrete cores on their replacement in open cuts should minimize potential for precipitation or atmosphere to affect possible contaminants under pavement.
No PID calibrations.

Health and Safety Levels and Activities: Level D.

Problems Encountered/Corrective Actions Taken: Concrete core Co. has repeated problems with fuel pumps, both on truck and for electric generator for drill.
On notification from Bob Kuhn of temp. shutdown I send him back to Albq., with advice to fix his fuel pumps for trip out next week.

Downtime/Standby: Only downtime by Albq. Concrete Coring, but they are contracted on a per hole basis, so down time affects their profit on Job.

Special Notes: Temporary shutdown of drilling and sampling required to allow lab to catch-up on sample processing. All personnel fly-out 9/17, to return 9/21 to perform lake and sediment sampling.

By Brian J. Ruby Title Site Manager

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Date 9/17/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
						X	

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	10	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: S.W. Engineering

Equipment on Site: 2 CME-55 Hollowstem Augers Rigs on site

Visitors on Site: None

W-C Personnel on Site: None

Work Performed (including sampling): S.W. Engineering was directed to complete grouting of Boring # 093B1 before leaving site for break. Boring not grouted 9/16/93 as they ran out of grouting materials and it was too late to purchase more.

Project Cannon AFB Apdx III RFI
Project No.

Report No. 10
Date 9/17/93

Quality Control Activities (including field calibrations):

None

Health and Safety Levels and Activities: Grouting - D

Problems Encountered/Corrective Actions Taken: N/A

Downtime/Standby: N/A

Special Notes: W-C personnel not on site today, in transit to home offices

By [signature] Title Site Manager

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Date 9/~~22~~ 21/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
			X				

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	11	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: NONE

Equipment on Site: 2 CME 55 Hollow-stem Auger Rigs - Idle

Visitors on Site: None

W-C Personnel on Site: Brian Ruby Todd Fryzek, DAN Galde, Dave Nicholson
Ryan Herold

Work Performed (including sampling): Collection of Surface Water and Sludge samples from the Playa Lake (SWMU 103)

Project Cannon AFB Apdx III RFI
Project No.

Report No. 11
Date 9/21/97

Quality Control Activities (including field calibrations):

Field Calibration of MicroTip MP-100 to 70 ppm response w/ isobutylene.

Collected QA samples associated with the sludge & surface water sampling

Health and Safety Levels and Activities: All activities performed in Level D with Nitrile & Latex Gloves

Problems Encountered/Corrective Actions Taken: Stiff wind disallowed any attempt to not use a motor to get to sample sites. Solution was to point bow into wind and sample from front of boat. ~~Was~~ Wind & Wave action blew potential contaminants from motor at stern away.

Downtime/Standby: None

Special Notes: ~~FOR~~ Day included travel for all crew members, which makes for very long day for all.

By Brian G. Riley Title Site Manager

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Date 9/22/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
				X			

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	12	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: S.W. Engineering

Equipment on Site: 2 CME-55 Hollowstem Auger drill Rigs

Visitors on Site: None

W-C Personnel on Site: Brian Ruby, Todd Fryzek, Ryan Herold, Dan Galde, Dave Nicholson

Work Performed (including sampling): Drill & Sample 2-60' Borings in SWMU #92; Drill & Sample 4-20' Borings (2 in SWMU #77, 2 in SWMU #55); 1-10' boring in SWMU #61. Decon of augers and ~~Arrit~~ BJR sampling equipment

Project Cannon AFB Apdx III RFI
Project No.

Report No. 12
Date 9/22/93

Quality Control Activities (including field calibrations):

Calibrate 2 microtip MP-100 PID; w/ isobutylene

Health and Safety Levels and Activities: All activities in Level D.

Problems Encountered/Corrective Actions Taken:

Downtime/Standby: Rig 1 down for 1½ hours due to broken Kelly chain & sprocket. Repairs made with spare equipment on hand.

Special Notes:

By Brian J. [illegible] Title Site Manager

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Date 9/23/95

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
					X		

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	13	

COE Project Manager Marvin Taylor
Project Cannon AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: S.W. Engineering

Equipment on Site: 2 CME-55 Hollowstem Auger Drill Rigs

Visitors on Site: Bob Kuhn- WCFS

W-C Personnel on Site: BRian Ruby Ryan Herold, Todd Fryzek, Dave Nicholson Dan Galde

Work Performed (including sampling): 1-60' Boring drilled and sampled to T.D @ SWMU 92. 1-60' Boring Drilled and sampled to 48' in SWMU 70.

Six 10' borings drilled and sampled to T.D.: 2 in SWMUS 61 & 62; 2 in SWMU 94(?) Auto Service Station, 2 in POL depot washrack (#127) and one at SWMU 46.

~~Dec~~ Decon of drilling equipment.

Project Cannon AFB Apdx III RFI
Project No.

Report No. 13
Date 9/23/93

Quality Control Activities (including field calibrations):

Health and Safety Levels and Activities: Drilling and decon in Level D.

Problems Encountered/Corrective Actions Taken: Transient high readings (+1200 ppm) during air monitoring in SWMU 70 indicate the need to ~~upd~~ upgrade to Lev C.
"Cleared" hole on CE Wash rack (#62) hit sewer line from one sand trap to the other. CES decided that we should finish boring, grout to base of the pipe, and they will fix later.

Downtime/Standby:

Special Notes: 2 NCO's from base Safety Group (No Names) informed me that our trailer in the sewage Lagoons ~~in~~ is within the "clear zone" for the ordinance yard and should be moved ASAP, and not parked there any more. I asked them to notify Dr. Stowell of this.

By Brian A. [illegible] Title Site Manager

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Date 9/24/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
						X	

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	14	

COE Project Manager Marvin Taylor
Project Cannon AFB Addr III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: S.W. Engineering

Equipment on Site: 2 CME-55 Hollow stem Auger Drill Rigs

Visitors on Site:

W-C Personnel on Site: Brian Ruby, Bob Kuhn, Dave Nicholson, Ryan Herold, Todd Fryzek, Dan Galde.

Work Performed (including sampling): Complete drilling & sampling in SWMU's 46, 94, and 62. Attempt ~~of~~ to finish sampling and drilling SWMU # 70; Borings 07001 & 07002.

Decon drill equipment.

Pack equipment to demobilize site at completion of project.

Project Cannon AFB Apdx III RFI
Project No.

Report No. 14
Date 9/24/93

Quality Control Activities (including field calibrations):

B. Ruby Calibrated 2 MP-100 PIDs for intrusive activities.

Health and Safety Levels and Activities: All activities Level D, except for SWMU 70, which was level C.

Problems Encountered/Corrective Actions Taken: Free product (JP-4?) found @ 18-20' in ~~70~~ #07002; Temporary shut down to consult with Marvin Taylor (COE) and Karen Scudder (HQS-Denver) Bob Kuhn (WCFS). Marvin Taylor instructs us to stop drilling at this point and consider project completed.

Downtime/Standby:

Special Notes: High readings from free product in SWMU 70 may indicate some compound other than JP-4 is present.

By Brian J. Ruby Title Site Manager

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Sheet 2 of 2

Date 9/25/93

W-C DAILY QUALITY CONTROL REPORT

Day	S	M	T	W	TH	F	S
							X

Weather	Bright Sun	Clear	Overcast	Rain	Snow
		X			
Temp	To 32	32-50	50-70	70-85	85 up
Wind	Still	Moderate	High	Report No.	
Humidity	Dry	Moderate	Humid	15	

COE Project Manager Marvin Taylor
Project CANNON AFB Apdx III RFI
Project No. _____
Contract No. _____

Subcontractors on Site: S.W. Engineering

Equipment on Site: 2 - CME 55 Hollowstem Auger Rigs - Idle.

Visitors on Site: None

W-C Personnel on Site: Brian Ruby

Work Performed (including sampling): Sampling Completed - Remaining holes being grouted and surface completions in paved areas.

Final policing of sites and demob.

Project Cannon AFB Apdx III RFI
Project No.

Report No. 15
Date

Quality Control Activities (including field calibrations): Final Field check of sites.

Health and Safety Levels and Activities: "D"

Problems Encountered/Corrective Actions Taken: None.

Downtime/Standby: None.

Special Notes: Drillers leave site @ 11:00 AM.

By Brian Ruby Title Site Manager

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DRAFT BRA
VOLUME II
SECTIONS 7 - 10

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BASELINE RISK ASSESSMENT FOR APPENDIX III SWMUs - PHASE I

CANNON AIR FORCE BASE CLOVIS, NEW MEXICO

Prepared for:
Cannon Air Force Base
27 CES/CEVR
Environmental Flight

February 1994

7.0
OIL/WATER SEPARATOR NO. 5120 - SWMU NO. 92

7.1 SITE BACKGROUND

7.1.1 Site Description

OWS 5120 with an associated leach well is located in a grassy area east of Power Check Pad No. 5120 (Figure 7-1). The OWS is a two-compartment unit with a detached 100-gallon oil storage tank located south of the OWS. The OWS measures 4 feet by 6 feet at the surface. While the exact depths of the OWS and storage tank are unknown, they are believed to be less than 10 feet below ground level. The topography of this site is essentially flat, with evidence of surface improvements, such as grading and reseeding, visible on the ground surface.

7.1.2 Site History

The OWS reportedly received waste wash water generated from aircraft maintenance operations in Building 5120. The oils recovered in the OWS were directed to the 100-gallon oil holding tank and the wastewater was discharged to a leach well located approximately 40 feet east of the OWS. OWS 5120 was active from approximately 1957 to 1988 when Facility 5120 was dismantled. The OWS and leach well remain in place.

7.1.3 Current Use

Pad 5120 is currently used for surface storage of aircraft maintenance vehicles and equipment. The OWS system is not used.

7.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATION

7.2.1 Physical Results

The objective of sampling at the site of OWS 5120 and the associated leach well was to evaluate whether or not a release of SWMU-related chemicals that could pose a significant human health or environmental risk has occurred due to spillage or leakage from the OWS or seepage from the leach well. Two 10-foot deep borings (09202 and 09203) were drilled as close as possible to the north side of the OWS. Soil samples were collected at the surface and from the 1.5- to 3.5-foot, 4- to 6-foot, and 8- to 10-foot depth intervals.

Three 60-foot deep borings (09201, 09204, and 09205) were located in the vicinity of the leach well vent pipe. Soil samples were collected at the surface and at the 1.5- to 3.5-foot, 4- to 6-foot, 8- to 10-foot, 18- to 20-foot, 28- to 30-foot, 38- to 40-foot, 48- to 50-foot, and 58- to 60-foot depth intervals.

Target analytes for all borings include VOCs, SVOCs, metals, and TRPH. Surficial samples were collected approximately at the 0.2 to 0.5-foot depth interval in areas of soil cover to provide surface soil data for risk assessment purposes.

7.2.2 Chemical Investigation

Soil samples were collected from five borings (09201, 09202, 09203, 09204, and 09205). Sampling and analyses performed are summarized in Table 7-1. A summary of the analytical results for these soil samples are provided in Table 7-2a (surface soil) and 7-2b (subsurface soil). The tables provide results for analytes that were detected at least once in each sample group. Complete analytical summary results are provided in the QCSR (Appendix A) of the RFI Report.

7.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI report, and the data were deemed to be of adequate quality to meet the objectives of the RFI. However, data quality issues that may affect the risk assessment are more fully discussed here.

Elevated reporting limits resulting from sample dilution may limit the usability of the data if concentrations of some analytes are thereby diluted to levels below the reporting limit. That is, chemicals may be reported as nondetect when they are actually present in the sample at levels of potential concern. Section 4.8.6 of the QCSR (Appendix A of the RI report) presents a discussion of elevated reporting limits. Lead analyses for samples CAN092-0922-0000, CAN092-0925-0000, and CAN092-0921-0000 required dilutions of 10 times, 10 times, and 100 times, respectively. The elevated reporting limits for lead do not limit the usability of the data because lead was detected above the reporting limits in all the samples.

Barium data were rejected in three samples from one boring at this site (CAN092-0921). This does not affect the data usability at this site, because there are many other samples at this site in which barium has been properly quantified. Barium was not detected above background levels in any of these samples, and it is not likely to be associated with wastes discharged at the SWMU; therefore, there is no reason to believe it was present in the rejected samples at concentrations of concern.

7.2.4 Nature and Extent of Contamination

There was no visible evidence of spills or leaks in the vicinity of the SWMU; the entire area around the separator is unpaved. The chemical test results show trace levels of some volatile organic fuel constituents and several PAHs in surface soils ranging from <100 mg/kg to 2,100 mg/kg. Lead was slightly elevated above background in some samples. TPH concentrations were generally low, with a maximum of 674 mg/kg in surface soil at boring 09201 near the leach well.

7.3 HUMAN HEALTH RISK ASSESSMENT

7.3.1 Exposure Pathway Flow Chart

Figure 7-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways for OWS 5120. In the flow chart potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary sources are waste fluids (e.g., fuels, oils, and solvents) that have leaked from the separator system or have been discharged or spilled on surface soil. Chemicals from the primary source may be released to other media that may in turn act as secondary sources of chemical release or exposure. Mixing and infiltration of the wastes to soil is shown as a primary chemical release mechanism. Chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion, or result in exposure via direct contact (e.g., dermal contact or incidental ingestion).

Storm-water runoff is not considered to be a significant pathway for human exposures, because the SWMU covers only a small area, surface spills are not likely to be significant, and no developed drainageways are present near the SWMU.

As shown on the flow chart, surface soils may provide exposures to Base workers (occupational exposures), hypothetical future construction workers, or hypothetical future trespassers (if the Base is closed in the future). Future residential exposures were not considered for this SWMU because it is located in an industrialized area (i.e., near the jet engine facilities); therefore, residential is not a likely future land use. Air emissions (volatile and particulates) from surface soil may also provide exposures to Base workers, construction workers, and trespassers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Groundwater is used for domestic purposes on and off Base. In order to assess potential impacts to public health via groundwater pathways, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling (Section 7.3.5.2) indicate that

contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway was not be evaluated further.

In summary, potential complete human exposure pathways evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Trespassers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

7.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

Background levels were defined by the upper tolerance limit (UTL) of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in

Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; see Appendix A).

Tables 7-3 and 7-4 show the comparison of SWMU results to background levels.

The maximum detected concentrations of antimony cadmium, lead, silver and zinc in surface and total soils exceeded the UTL of the background data. Therefore, these metals were retained as chemicals of concern in surface and total soils.

7.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 92, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 7-2a and 7-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentrations of antimony, cadmium, lead, silver, and zinc detected in surface and total soils exceeded background ranges according to the comparison described in Section 7.3.2. These metals are, therefore, considered as chemicals of concern in soil. Organic contaminants detected in soils were retained as chemicals of concern for risk assessment. Chemicals of concern in surface soil and total soil are listed in Tables 7-5 and 7-6, respectively.

7.3.4 Environmental Fate and Transport

7.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

7.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (DOE 1991), describes the mass balance of a contaminant (based on average soil concentrations) in the contaminated soil volume at the SWMU. The DOE model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP] Model) and accounts for sorption to soils and degradation in the vadose zone. The model conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of chemicals of concern. The input parameters and estimated leachate concentrations are given in Section 7.3.5.2. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water in (Section 7.3.5.2). Since the RBCs were developed for drinking water (at the tap) and are based on very conservative exposure and health-protective (risk) assumptions, it can be concluded that modeled groundwater concentrations that do not exceed RBCs will pose no significant adverse health risk.

7.3.4.3 Air Modeling

RME air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using RME soil concentrations of chemicals of concern. The results of the air modeling are presented in Section 7.3.5.3. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use at hazardous waste sites to calculate soil cleanup levels (EPA 1991). Air concentrations were calculated for only those chemicals with inhalation toxicity factors. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

7.3.5 Exposure Point Concentrations

7.3.5.1 Soils

Tables 7-7 and 7-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils respectively at OWS 5120.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use of "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C. Tables 7-9 and 7-10 give the soil concentrations of organic compounds from surface and total soils, respectively, which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils. The absorbed

fraction (from Table C-26 Appendix C) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soil. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

For purposes of risk assessment, surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depth (i.e., XXXXX-XXXX-0002) were actually collected from a depth of 1.5 to 3.5 feet. These samples were not considered surface samples, but are included in the risk assessment for subsurface soil exposures.

7.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 92. Model results are included in Table 7-11. These modeled concentrations were then compared to EPA Region III tap-water RBCs (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 7-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap-water RBCs. No modeled concentrations exceeded the RBCs, so potential risks form the groundwater pathway are not expected to exceed 1×10^{-6}. Therefore, the groundwater pathway has been determined to be insignificant and was not evaluated further.

7.3.5.3 Air

RME air concentrations of volatile and particulate emissions from surface soil were calculated using RME concentrations of chemicals of concern. The results of the air modeling are shown in Tables 7-13 and 7-14. RME air concentrations of volatile and particulate emission from total soil were also calculated using RME concentrations of concern. The results of the air modeling from total soil are shown in Tables 7-15 and 7-16.

7.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the intake factors used to quantify chemical intake of SWMU-related contaminants in various environmental media soil and air. Table 7-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

7.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 7-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to contaminated surface soil at SWMU 92. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative, because there are no occupational receptors routinely working outdoors at SWMU. Furthermore, the surface area of the SWMU is extremely small (approximately 60 feet by 10 feet), and long-term exposures will not occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 92 via the dermal contact, inhalation, and ingestion pathways is 0.00006 and 0.007 in the average and RME cases, respectively. Neither hazard

index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk under the assumed chronic exposure conditions is 4×10^{-9} under the average exposure case and 2×10^{-6} under the RME case. These levels are within or below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). Ingestion of benzo(a)pyrene is the primary contributor to the carcinogenic risk estimate. The estimate of risks due to ingestion probably significantly overestimates actual risks, because it is assumed that the occupational worker will daily ingest the RME concentration of benzo(a)pyrene in a 10 x 60-foot area.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 92. Exposures were assumed to occur during excavation activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 92 via the dermal contact, inhalation, and ingestion pathways is 0.0002 and 0.002 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 9×10^{-10} in the average case and 2×10^{-8} in the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b), and demonstrates that carcinogenic risk is negligible for this exposure scenario.

Hypothetical Future Trespasser Exposure

Hypothetical trespassers were assumed to be exposed (via ingestion, dermal contact and inhalation) to surface soil at SWMU 92. Hypothetical trespassers were assumed to be exposed at SWMU 92 for 2 hours/day and 8 hours/day, for 26 and 52 days/year, over 6 years for the average and RME cases, respectively. These assumptions are very conservative, because Cannon AFB is likely to remain a military installation, making access to contaminants at SWMU 92 via a trespasser scenario.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to contaminants in surface soil at SWMU 92 via the dermal contact, ingestion and inhalation pathways is 0.00002 and 0.002 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed exposure conditions is 8×10^{-10} under the average exposure case and 1×10^{-7} under the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b), and demonstrate that carcinogenic risk is negligible for this exposure scenario.

7.3.8 Qualitative Assessment of Exposures to Lead

Lead exposures are not addressed in the quantitative risk assessment, because EPA withdrew the RfD for lead in 1989, primarily due to the lack of a discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggest a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. This level is supported by EPA's Uptake/Biokinetic (UBK) Lead Model which predicts that exposures of children ages 0 to 6 to soils with approximately this level will not result in blood lead levels that exceed a level of concern established by the Centers for Disease Control.

The maximum lead concentration measured in soils at SWMU 92 was 502 mg/kg detected in surface soil at 0921-0000. Lead was measured at 12.5 mg/kg to 64.3 mg/kg in other surface soil samples at SWMU 92. The mean lead concentration in four surface soil samples was 127.44 mg/kg. The maximum concentration detected at SWMU 92 is within the range suggested by EPA for residential soils. Therefore, lead detected in soils at SWMU 92 would not be expected to pose a threat to human health.

7.3.9 Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil and water samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available, and when the fuel product is known. The provisional values are under review and subject to revision. RBC's derived from them are used simply as a guide to potential health hazards.)

The toxicity factors and calculation of risk-based concentrations are shown in Table 7-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under

occupational exposure assumptions is 33,600 mg/kg. The maximum SWMU concentration of TPH is 674 mg/kg, well below the conservative RBC.

7.3.10 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 92 and their effect on the results and conclusions of the risk assessment are listed below.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens, such as benzo(a)pyrene, which can cause skin cancer through a direct action at the point of application. The exclusion of PAHs from quantitative evaluation in the dermal exposure pathway may underestimate the potential human health risk from dermal contact with soils at the SWMU. However, because exposures are likely to be low, any additional risk that might be hypothetically derived from this pathway is not likely to raise the total risk to a level of concern.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected, because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- Since the surface area of this SWMU is extremely small (0.01 acre), the exposure assumptions used will significantly overestimate actual exposures to contaminated soils and risk at this SWMU.

7.4 ECOLOGICAL RISK ASSESSMENT

7.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMUs 92 and 93 are located in the southeastern section of Cannon AFB in a relatively large area of moderate quality habitat for terrestrial wildlife. Existing ground cover is mainly mowed non-native grassland, with concrete pads and attached buildings and access ways. The grassland extends uninterrupted to the north, east, and south for some distance, and grades into unmowed native grassland to the east. About 80% of the land surface within the immediate vicinity (within 100 feet) of the SWMUs is mowed and native grassland. The SWMUs were active as OWS's from approximately 1957 to 1988; the pad is currently used for storage, and Building 5123 (the hush house) is used for jet engine testing.

Because of the extent of the surrounding grassland, it is expected that these areas will be used more regularly by terrestrial species than the more isolated SWMUs located within the developed portions of Cannon AFB. Noise associated with the jet engine testing may detract somewhat from wildlife usage immediately near SWMU 93. However, the relatively large area of grassland and the lack of surrounding development make the area more likely to be used by birds, small mammals, and raptors coming to hunt in the shorter grass. Crow (pers. comm.) reports that this area does support small mammals, including mice and rabbits, and hawks are known to hunt in the area.

The most common species are likely to be birds, such as robin (*Turdis migratorius*), house sparrow (*Passer domesticus*), and starling (*Sturnus vulgaris*), plus terrestrial species such as deer mice and cottontail rabbit. Raptors are expected to occur, hunting for both small birds and mammals more easily seen in the shorter grasses.

Given this assessment, three species were selected as key receptor species for the grassy area surrounding SWMUs 92 and 93. These include the robin (*Turdus migratorius*), deer mouse (*Peromyscus sp.*), and northern harrier (*Circus cyaneus*). Although the Mississippi kite (*Ictinia misisippiensis*), which was recently delisted as a state-protected species, is present on Cannon AFB golf course, its food preference is mostly large insects taken in flight, and it has not been reported in areas near SWMUs 92 and 93. Therefore, the northern harrier was

selected as the raptor indicator species because its prey includes mice and small birds and because it has been sighted in the southeastern area of Cannon AFB during field surveys.

7.4.2 Chemicals of Concern

The chemicals of concern (COCs) at SWMUs 92 and 93 were selected using validated data from sixteen soil samples collected at the two SWMUs which covered the interval between 0 and 2 feet deep. This interval was selected because most soil-dwelling organisms (e.g., earthworms and deer mice) live in this zone. Table 7-20 provides a summary of the chemicals detected in the sixteen samples considered for this ERA. A detailed description of the soil sampling program and chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the sixteen samples to be considered a possible COC. The following screening criteria were then applied, in the order shown, to determine if a chemical in the soil would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Exceedance of the normal range found in U.S. soils (nationwide)

The maximum detected concentration of the sixteen samples was used in the comparison to background criteria. If no background criteria were available for comparison, as was the case for the organic chemicals, the chemicals were retained as COCs. If the maximum detected concentration of a chemical exceeded the local (i.e., Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If it exceeded this criteria, it was likely retained as a COC, even if it fell within the normal range found in U.S. soils. This is because the normal U.S. range is widely variable and was included in the screening process primarily as an additional reference. In some cases however, the normal U.S. range was the only screening criteria available. Table 7-21 lists the maximum concentrations detected and shows the screening values used. The chemicals that were retained as COCs following the screening process include 1,2-dichloroethane,

ethylbenzene, toluene, xylenes, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, butyl benzyl phthalate, carbazole, chrysene, di-n-butyl phthalate, fluoranthene, ideno(1,2,3-cd)pyrene, pentachlorophenol, phenanthrene, pyrene, antimony, cadmium, chromium, copper, lead, manganese, zinc, and TPH.

7.4.3 Exposure Assessment

Figure 7-4 depicts the exposure pathway flow chart developed for SWMUs 92 and 93. As the flowchart indicates, chemicals could potentially be released through transport in runoff, infiltration to groundwater, volatilization or wind erosion, and direct contact by ecological receptors. Except for direct contact, these exposure pathways are incomplete or of minor importance for ecological receptors at SWMUs 92 and 93. Storm water runoff is a potentially complete but insignificant pathway, because the source of chemicals is below ground and any spillage during servicing would involve a relatively small area of level terrain. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization or wind erosion is not considered a significant pathway at this site. Although several of the COCs are volatile organic compounds (VOCs), the maximum concentrations were less than 0.01 mg/kg, and VOC concentrations of 100 mg/kg or greater in air are generally needed to induce toxic responses in laboratory rats and mice from inhalation (NIOSH 1987). Concentrations in soils would have to be many times greater than this to produce these toxic levels in air, even near the soil surface. Direct contact with subsurface soils (more than two feet deep) is also considered an insignificant or incomplete pathway because of the limited use of deeper soils at this site by wildlife.

Therefore, the only potentially complete and significant exposure pathway is direct contact with contaminated surface soil by species frequenting the SWMU area. Direct contact may include dermal absorption or ingestion. Dermal absorption is not considered a significant exposure route for the receptors at this site because the animals are assumed to be largely protected by their fur or feathers. Receptors at the SWMUs may ingest COCs either directly or indirectly. Direct ingestion usually occurs along the food/prey chain from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of COCs that have been transferred via food webs.

Figure 7-5 depicts the Conceptual Site Model developed from the exposure pathway analysis, the ecological characterization, and the identification of the key receptor species for SWMUs 92 and 93. As the figure indicates, the pathways of concern are from the surface soil to the robin and the deer mouse (with the earthworm as a primary food source for the robin), and the continued pathway from robin and mouse to the northern harrier. For all pathways leading to the identified key receptors, exposure is via both direct and indirect ingestion.

7.4.4 Risk Characterization

This section provides a characterization of potential risk to the selected key receptor species (robin, deer mouse, and northern Harrier) at SWMUs 92 and 93. For the purposes of this analysis, it was assumed that the robin's diet consists of earthworms and inadvertent consumption of soil and that the deer mouse diet consists of plant parts, seeds, and invertebrates; inadvertent consumption of soil during feedings; and consumption of soil from preening and cleaning. It was also assumed that the concentration of the COCs were the same in the earthworm and in the deer mouse's diet as in the soil, except for cadmium and selenium, for which BAFs of 4.6 and 12 were used based on Beyer and Stafford (1993). Therefore the risk characterization for the robin and the deer mouse consisted of comparing the concentration of COCs in the robin's and deer mouse's food (i.e., the chemical concentration in soil) to selected toxicity benchmark dietary levels for those chemicals (see Table 7-22). For the northern harrier, a qualitative assessment of potential risk due to chemicals known to bioaccumulate along food web pathways was conducted.

The assessment for the robin and deer mouse is somewhat conservative, because studies indicate that, for many chemicals, BAFs from soil to earthworm are less than one (Beyer and Stafford 1993), and the deer mouse diet consists of many things that may not bioaccumulate chemicals (e.g., plant parts), in addition to soil ingestion. However, the assessment takes into account the soil that would be clinging to food consumed by the robin and also accounts for inadvertent soil ingestion. The benchmark dietary levels were selected as explained in Appendix D, Section D.3 and D.4; these sections also provide background toxicological information about the COCs. The soil chemical concentration used was the arithmetic mean, as described in Appendix D (Section D.6.).

ROBIN AND DEER MOUSE:

Table7- 22 lists the COCs for SWMUs 92 and 93 and provides a comparison between the soil concentration (arithmetic mean) and the benchmark dietary level for the robin and the deer mouse. If the soil level exceeds the benchmark level, there is a possibility of risk, as noted in the table. The following discussion addresses those chemicals where a possibility of risk is indicated, specifically benzo(a)pyrene and selenium.

Benzo-a-pyrene (BaP):

The average concentration of BaP at SWMUs 92 and 93 was 0.29 mg/kg, compared to the benchmark dietary levels of 0.002 mg/kg and 0.003 mg/kg, for the robin and deer mouse, respectively, indicating a potential risk. The 0.29 mg/kg level is within the range of several reported BaP concentrations for various locations, as reported in the literature for both industrial and nonpolluted areas, and rural and agricultural soils (see Table A-6). Although there were no apparent BaP "hot spots" at SWMUs 92 and 93, there were four nondetects out of nine samples. Therefore, it is uncertain if the robin or deer mouse is exposed to a level of 0.29 mg/kg in all areas in which they feed. Also, the low toxicity benchmark level for BaP is a reflection of BaP's carcinogenic effects through the actio of its intermediate metabolites, as opposed to acute toxicity. In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, and therefore it is questionable if carcinogenesis is an important endpoint for relatively short-lived mammals and birds, such as the robin or deer mouse. Finally, the BaP found at SWMU 92 and 93 may not be completely bioavailable to robins. Goon et al. (1991) showed that BaP that had aged 6 months in soil was only 34 to 51% orally bioavailable for clayey and sandy soils, relative to BaP administered alone to rats. For all of these reasons, it is unlikely that BaP poses an unacceptable risk at SWMUs 92 and 93.

Selenium:

The average concentration of selenium in soils at SWMUs 92 and 93 was 0.39 mg/kg, which results in a dietary level of 4.68 mg/kg, using a BAF of 12. This compares to the toxicity benchmark value of 5 mg/kg for the robin, but 0.125 mg/kg for the deer mouse. Therefore, a potential risk to the deer mouse is indicated. No background concentration for selenium

is available for Cannon AFB, but a typical level for southwest U.S. soils is 0.3 mg/kg, and the normal range in U.S. soils is <0.1 to 4.3 mg/kg. Also, five out of six samples were nondetects, with selenium reported at an estimated 0.25 mg/kg in one soil sample. Therefore, it is unlikely that selenium at SWMUs 92/93 presents a risk to the deer mouse.

NORTHERN HARRIER:

An assessment of potential risk to the northern harrier was conducted by considering the bioaccumulation potential of those COCs at SWMUs 92 and 93 that are known to bioaccumulate and/or biomagnify along food web pathways. For SWMUs 92 and 93, these chemicals include cadmium, lead, and selenium. A comparison was made between the toxicity-based benchmark dietary levels for those chemicals in the northern harrier's diet (i.e., the chemical level in the robin or the deer mouse) and the potential dietary level that could occur in the robin or mouse. This potential level was estimated, given the chemical concentration detected in the soil, multiplied by bioaccumulation factors (BAFs) from soil to robin (via earthworm), or from soil to mouse. The BAFs used were ones found in the literature or estimated, based on literature values for similar species and professional judgement. Each of the metals of concern is described below.

Cadmium:

The benchmark dietary level for the northern harrier is 10.5 mg/kg. The average soil concentration is 0.83 mg/kg. Beyer and Stafford (1993) calculated a BAF of 4.6 for soil to earthworm for cadmium, but also reported that BAFs ranging from 13-66 have been reported in other soils. If the BAF is taken as 4.6, and another BAF of 5-10 is assumed from earthworm to robin, the resultant estimated dietary level in the robin is approximately 19-38 mg/kg, which exceeds the 10.5 mg/kg benchmark. Similar bioaccumulation/magnification might also be expected in the soil→deer mouse→northern harrier pathway, although specific BAFs were not found in the literature. Therefore, a potential risk to the northern harrier is indicated from the bioaccumulation and biomagnification of cadmium at SWMUs 92 and 93. However, the northern harrier is not likely to feed exclusively on birds and small mammals from the SWMUs 92 and 93 area, especially when one considers that other favorable feeding sites are nearby, such as the agricultural fields surrounding the base. Given that this area is likely only a very small part of the northern harrier's feeding range and that prey taken from

this area represents only a very small portion of the harrier's diet, it is unlikely that cadmium at these SWMUs represents a significant risk to the harrier.

Lead:

The benchmark dietary level for the Norther harrier is 87.5 mg/kg; the average soil concentration is 46.41 mg/kg. According to Eisler (1988), there is no evidence that lead is biomagnified in food chains, although bioaccumulation is reported in the literature. Therefore, a risk to the northern harrier would be indicated only if the earthworm or plant/ invertebrate diet of the mouse accumulated lead beyond the 87.5 mg/kg level. This is unlikely, for several reasons: 1) According to Beyer and Stafford (1993), the BAF from soil to earthworm for lead is less than one (0.45), indicating little accumulation in tissues; 2) The type of lead in the soil at Cannon AFB is probably not very bioavailable (lead oxides, e.g.); and 3) Eisler (1988) reports lack of evidence for biomagnification of lead. Therefore, it is unlikely that lead presents a risk to the northern harrier.

Selenium:

The benchmark dietary level for selenium in the northern harrier is 5 mg/kg, while the average soil concentration is 0.39 mg/kg at SWMUs 92 and 93. Very little information is available concerning BAFs for selenium, and quite different BAFs are reported in different sources. Lemly (1992) noted high BAFs in aquatic habitats, with most bioaccumulation occurring in the primary producer and primary consumer levels. Lemly states that biomagnification of selenium is not clearly indicated in laboratory studies, but that field studies have found BAFs from 2 to 6 through the food chain in a pattern suggestive of biomagnification. Beyer and Stafford (1993) did not include selenium in their studies of BAFs from soil to earthworm. Eisler (1985) reports a relatively large increase in selenium from sludge to earthworm, with BAFs in the 15-75 range, depending on rate of sludge application (Helmke et al. 1979). Yet another source reports a total BAF from soil to herbivore to carnivore of approximately 12 (EPA, May 1993). With a soil selenium level of 0.39 mg/kg, it depends on the selected BAF used as to whether selenium appears to constitute a risk at Cannon AFB. If a total BAF to robin or mouse of 12 is used, the estimated selenium dietary level for the raptor would be 4.68 mg/kg, just under the 5.0 mg/kg benchmark. If the 15-75 range for earthworm BAFs is considered valid, a risk would be

indicated, even for the intermediate receptors such as the robin. However, this assessment assumes that the entire dietary input for the northern harrier and robin is derived from the contaminated area around the SWMUs. Since each of these SWMUs covers an area of approximately 100 feet x 75 feet, they represent only a very small portion of the hunting ranges of these species. Therefore, even though prey taken from the SWMU area could potentially have tissue concentrations above the dietary benchmarks for these species, this represents only a small portion of the total diets and will likely not pose a significant risk to the northern harrier or robin.

Another important issue to consider is whether the average soil concentration of 0.39 mg/kg indicates the natural background level for selenium in these soils, since the southwest United States is known for its high selenium soils (Lemly 1992). No background calculation was available for selenium at Cannon AFB, but the 0.39 mg/kg level is approximately the same as that reported as typical for southwest U.S. soils (0.3 mg/kg) and is well within the normal range for U.S. soils (<0.1 to 4.3 mg/kg). Because the only detected selenium concentration of 0.27 mg/kg and the average selenium concentration of 0.39 mg/kg are generally within the range of natural soils levels it is unlikely that selenium at SWMUs 92 and 93 is resulting in risk to wildlife, regardless of the BAF selected for use in the analysis.

7.5 SUMMARY AND CONCLUSIONS

7.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at the SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 7-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU

7.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

TABLE 7-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0923-0000			CAN092-0923-0002			CAN092-0924-0000			CAN092-0924-0002			CAN092-0925-0000			CAN092-0925-0002		
LAB SAMPLE NUMBER	0314020019SA			0312140015SA			0314170001SA			0314170002SA			0313810014SA			0313810015SA		
COLLECT DATE	09/13/93			09/13/93			09/23/93			09/23/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Antimony				<	6.5	U	5.7	6.5	J	5.3	6.5	J	<	6.4	U	<	6.4	U
Arsenic				2.6	0.54		2.7	0.54		2.4	0.54		2.1	0.53		2.1	0.53	
Barium				101	1.1		228	1.1		184	1.1		<		R	<		R
Beryllium				0.54	0.22		0.5	0.22		0.51	0.22		0.42	0.21		0.4	0.21	
Cadmium				<	0.54	U	0.44	0.54	J	<	0.54	U	1.9	0.53		0.89	0.53	
Calcium				12700	21.6		78400	21.5		58700	21.7		53000	21.2		56800	21.2	
Chromium				8.1	1.1		9.1	1.1		5.7	1.1		13.9	1.1		5.3	1.1	
Cobalt				4.4	1.1		2.8	1.1		3.3	1.1		3.4	1.1		2.8	1.1	
Copper				6.9	2.2		7.5	2.2		6.2	2.2		9.8	2.1		5.7	2.1	
Iron				7890	10.8		5910	10.8		6650	10.8		6300	10.6		5800	10.6	
Lead				8.3	0.54		20.9	2.7		5.8	0.54		37.5	5.3		5.7	0.53	
Magnesium				1700	21.6		2650	21.5		2050	21.7		2220	21.2		2030	21.2	
Manganese				195	1.1		130	1.1		149	1.1		182	1.1		122	1.1	
Nickel				8	4.3		7.1	4.3		8	4.3		7.5	4.2		6.1	4.2	
Potassium				1520	540		1550	538		1570	542		1740	531		1270	531	
Silver				<	1.1	U	<	1.1	U	<	1.1	U	1	1.1	J	0.92	1.1	J
Vanadium				17.7	1.1		16.9	1.1		17.2	1.1		17	1.1		14.3	1.1	
Zinc				17.5	2.2		48.4	2.2		14.3	2.2		43.6	2.1		15.7	2.1	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons				49	43.2		159	43		61.5	43.3		295	42.5		120	42.5	
Water Quality (percent)																		
Water	5.6	0.1		7.4	0.1		7	0.1		7.7	0.1		5.8	0.1		5.8	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0004			CAN092-0921-0008			CAN092-0921-0018			CAN092-0921-0028			CAN092-0921-0038			CAN092-0921-0048		
LAB SAMPLE NUMBER	0313810003SA			0313810004SA			0313810005SA			0313810006SA			0313810007SA			0313810008SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Toluene	<	5.3	U	1.8	5.5	J	<	5.7	U	3.3	5.7	J	4.1	5.4	J	2.8	5.7	J
Semivolatile Organics (µg/kg)																		
Benzo(g,h,i)perylene																		
Metals (mg/kg)																		
Aluminum	6440	10.6		5160	11.1		4520	11.5		4540	11.4		2140	10.8		2320	22.7	
Antimony	<	6.4	U	<	6.6	U	<	6.9	U	<	6.9	U	<	6.5	U	<	13.6	U
Arsenic	1.9	0.53		2.2	0.55		1.4	0.57		0.56	1.1	J	0.58	0.54		0.53	1.1	J
Barium			R			R			R			R			R			R
Beryllium	0.44	0.21		0.43	0.22		0.36	0.23		0.27	0.23		<	0.22	U	<	0.45	U
Cadmium	1.3	0.53		1.2	0.55		1.6	0.57		0.67	0.57		1.1	0.54		2.3	1.1	
Calcium	79800	21.3		89200	22.1		103000	23		62800	22.9		72900	21.6		162000	45.4	
Chromium	6.8	1.1		5.7	1.1		3.4	1.1		3.5	1.1		1.3	1.1		4.8	2.3	
Cobalt	3.2	1.1		2.5	1.1		3	1.1		1.8	1.1		1	1.1	J	<	2.3	U
Copper	5.7	2.1		4.6	2.2		3.3	2.3		2.3	2.3		1.2	2.2	J	2.6	4.5	J
Iron	5980	10.6		4710	11.1		3540	11.5		3210	11.4		1640	10.8		1280	22.7	
Lead	5.5	0.53		5.4	0.55		4.3	0.57		3	0.57		1.9	0.54		2.4	0.57	
Magnesium	2570	21.3		2270	22.1		3350	23		4020	22.9		3180	21.6		12600	45.4	
Manganese	127	1.1		196	1.1		94.2	1.1		49.7	1.1		26.2	1.1		19.7	2.3	
Nickel	6	4.3		5.9	4.4		4.8	4.6		4.1	4.6	J	2.1	4.3	J	<	9.1	U
Potassium	1180	532		1060	553		1430	575		1080	571		498	540	J	221	1130	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0004			CAN092-0921-0008			CAN092-0921-0018			CAN092-0921-0028			CAN092-0921-0038			CAN092-0921-0048		
LAB SAMPLE NUMBER	0313810003SA			0313810004SA			0313810005SA			0313810006SA			0313810007SA			0313810008SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	0.63	1.1	J	0.74	1.1	J	0.91	1.1	J	1.1	1.1		0.73	1.1	J	1.5	2.3	J
Sodium	164	532	J	<	553	U	<	575	U	<	571	U	<	540	U	<	1130	U
Vanadium	15.5	1.1		15.5	1.1		13.1	1.1		10.5	1.1		5.3	1.1		11.2	2.3	
Zinc	13.8	2.1		15	2.2		10.4	2.3		8.7	2.3		7.3	2.2		3.3	4.5	J
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	64.2	42.6		<	44.3	U	<	46	U	<	45.7	U	<	43.2	U	<	45.4	U
Water Quality (percent)																		
Water	6	0.1		9.6	0.1		13	0.1		12	0.1		7.5	0.1		12	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
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TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0058			CAN092-0922-0004			CAN092-0922-0008			CAN092-0923-0004			CAN092-0923-0008			CAN092-0924-0004		
LAB SAMPLE NUMBER	0313810009SA			0312140012SA			0312140013SA			0312140016SA			0312140017SA			0314170003SA		
COLLECT DATE	09/22/93			09/13/93			09/13/93			09/13/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Toluene	<	5.7	U	28	5.6		<	5.4	U	<	5.4	U	<	5.6	U	<	5.4	U
Semivolatile Organics (µg/kg)																		
Benzo(g,h,i)perylene							<	360	U							37	360	J
Metals (mg/kg)																		
Aluminum	1890	11.4		8470	11.2		3370	10.8		7020	10.8		3850	22.3		6230	10.8	
Antimony	<	6.9	U	<	6.7	U	<	6.5	U	<	6.5	U	<	13.4	U	9.4	6.5	
Arsenic	0.31	0.57	J	2.3	0.56		1.9	0.54		2.1	0.54		2.2	0.56		2.5	0.54	
Barium			R	120	1.1		115	1.1		90.3	1.1		310	2.2		171	1.1	
Beryllium	<	0.23	U	0.6	0.22		0.3	0.22		0.54	0.22		0.3	0.45	J	0.41	0.22	
Cadmium	0.7	0.57		<	0.56	U	<	0.54	U	<	0.54	U	<	1.1	U	<	0.54	U
Calcium	52400	22.9		21100	22.3		54700	21.5		19400	21.6		131000	44.5		80400	21.6	
Chromium	2.6	1.1		8.5	1.1		2.8	1.1		7.4	1.1		2.1	2.2	J	5	1.1	
Cobalt	0.87	1.1	J	3.9	1.1		1.7	1.1		3.8	1.1		2.9	2.2		2.7	1.1	
Copper	1.2	2.3	J	6.2	2.2		2.2	2.2		6.4	2.2		2.8	4.5	J	5.5	2.2	
Iron	1700	11.4		8270	11.2		3460	10.8		7460	10.8		3800	22.3		6200	10.8	
Lead	2.1	0.57		7.4	1.1		2.5	0.54		6.3	1.1		3.1	0.56		5.5	0.54	
Magnesium	2300	22.9		1750	22.3		1530	21.5		1580	21.6		2550	44.5		2320	21.6	
Manganese	38.4	1.1		185	1.1		49.3	1.1		176	1.1		58.4	2.2		114	1.1	
Nickel	1.6	4.6	J	8.1	4.5		4.4	4.3		7.9	4.3		5.8	8.9	J	7.7	4.3	
Potassium	319	571	J	1610	559		785	538		1380	540		952	1110	J	1420	539	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0058			CAN092-0922-0004			CAN092-0922-0008			CAN092-0923-0004			CAN092-0923-0008			CAN092-0924-0004		
LAB SAMPLE NUMBER	0313810009SA			0312140012SA			0312140013SA			0312140016SA			0312140017SA			0314170003SA		
COLLECT DATE	09/22/93			09/13/93			09/13/93			09/13/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	0.96	1.1	J	<	1.1	U	<	1.1	U	<	1.1	U	<	2.2	U	<	1.1	U
Sodium	<	571	U	<	559	U	<	538	U	<	540	U	<	1110	U	<	539	U
Vanadium	6.3	1.1		16.6	1.1		12.3	1.1		16.6	1.1		14.6	2.2		17.8	1.1	
Zinc	4.4	2.3		18.5	2.2		8.3	2.2		16.3	2.2		9.1	4.5		13.6	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.7	U	<	44.7	U	<	43	U	<	43.2	U	<	44.5	U	44.8	43.1	
Water Quality (percent)																		
Water	12	0.1		11	0.1		7	0.1		7.3	0.1		10	0.1		7.2	0.1	

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A complete summary of chemical results are presented in Appendix A.
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R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0924-0008			CAN092-0924-0018			CAN092-0924-0028			CAN092-0924-0038			CAN092-0924-0048			CAN092-0924-0058		
LAB SAMPLE NUMBER	0314170004SA			0314170006SA			0314170007SA			0314170008SA			0314170009SA			0314170010SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Toluene	<	5.7	U	<	5.6	U	<	5.9	U	<	5.5	U	<	5.6	U	<	5.5	U
Semivolatile Organics (µg/kg)																		
Benzo(g,h,i)perylene																		
Metals (mg/kg)																		
Aluminum	3840	22.8		3930	11.1		4470	23.6		2730	11		3300	22.4		2780	11	
Antimony	12.2	13.7	J	6.2	6.7	J	<	14.1	U	<	6.6	U	<	13.4	U	6.2	6.6	J
Arsenic	1.8	0.57		1.7	0.56		1.1	0.59		0.96	0.55		0.93	0.56		0.59	0.55	
Barium	226	2.3		80.7	1.1		61.2	2.4		39.8	1.1		116	2.2		123	1.1	
Beryllium	0.38	0.46	J	0.23	0.22		<	0.47	U	<	0.22	U	<	0.45	U	<	0.22	U
Cadmium	<	1.1	U	<	0.56	U	<	1.2	U	<	0.55	U	<	1.1	U	<	0.55	U
Calcium	156000	45.5		62000	22.3		150000	47.1		71600	22.1		145000	44.7		77600	22	
Chromium	<	2.3	U	3	1.1		<	2.4	U	<	1.1	U	<	2.2	U	7.2	1.1	
Cobalt	2.4	2.3		1.5	1.1		<	2.4	U	<	1.1	U	1.6	2.2	J	0.78	1.1	J
Copper	3.7	4.6	J	2.5	2.2		2.8	4.7	J	1.8	2.2	J	5	4.5	J	3.1	2.2	
Iron	3740	22.8		3700	11.1		2740	23.6		2110	11		2190	22.4		2190	11	
Lead	4.4	0.57		3.8	0.56		2.1	0.59		1.5	0.55		1.8	0.56		1.3	0.55	
Magnesium	3470	45.5		2540	22.3		10100	47.1		5430	22.1		8960	44.7		6890	22	
Manganese	68.2	2.3		54.3	1.1		23.9	2.4		18.8	1.1		26.2	2.2		27.7	1.1	
Nickel	7.7	9.1	J	5.5	4.5		4.5	9.4	J	3.7	4.4	J	5.1	8.9	J	3.4	4.4	J
Potassium	1190	1140		1360	557		667	1180	J	628	552		611	1120	J	455	550	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0924-0008			CAN092-0924-0018			CAN092-0924-0028			CAN092-0924-0038			CAN092-0924-0048			CAN092-0924-0058		
LAB SAMPLE NUMBER	0314170004SA			0314170006SA			0314170007SA			0314170008SA			0314170009SA			0314170010SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	<	2.3	U	<	1.1	U	<	2.4	U	<	1.1	U	<	2.2	U	<	1.1	U
Sodium	<	1140	U	<	557	U	<	1180	U	<	552	U	<	1120	U	<	550	U
Vanadium	15.9	2.3		14.1	1.1		18.8	2.4		6.9	1.1		11.7	2.2		10.4	1.1	
Zinc	10	4.6		8.1	2.2		6	4.7		6.5	2.2		6.4	4.5		5.7	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.5	U	<	44.6	U	<	47.1	U	<	44.2	U	<	44.7	U	<	44	U
Water Quality (percent)																		
Water	12	0.1		10	0.1		15	0.1		9.5	0.1		11	0.1		9.1	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0925-0008			CAN092-0925-0018			CAN092-0925-0028			CAN092-0925-0038			CAN092-0925-0048			CAN092-0925-0058		
LAB SAMPLE NUMBER	0313810017SA			0313740015SA			0313740016SA			0313740017SA			0313740018SA			0313740019SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Toluene	<	5.7	U	<	5.7	U	<	5.8	U	<	5.5	U	<	5.6	U	<	5.4	U
Semivolatile Organics (µg/kg)																		
Benzo(g,h,i)perylene																		
Metals (mg/kg)																		
Aluminum	4730	22.9		4540	11.4		3640	11.6		3340	11		3180	11.2		2490	10.7	
Antimony	<	13.8	U	<	6.8	U	<	6.9	U	<	6.6	U	<	6.7	U	<	6.4	U
Arsenic	2.2	0.57		1.1	0.57		0.45	0.58	J	0.69	0.55		0.52	1.1	J	0.41	0.54	J
Barium			R	391	1.1		71	1.2		61.1	1.1		69	1.1	J	28.9	1.1	
Beryllium	0.46	0.46		0.43	0.23		0.19	0.23	J	0.2	0.22	J	0.21	0.22	J	0.14	0.21	J
Cadmium	1.9	1.1		0.98	0.57		1.3	0.58		0.63	0.55		0.97	0.56		<	0.54	U
Calcium	126000	45.9		59900	22.8		93100	23.1		89900	22		87100	22.5		32800	21.4	
Chromium	3.4	2.3		4.7	1.1		3.8	1.2		3.1	1.1		4.3	1.1		2.5	1.1	
Cobalt	2.6	2.3		1.8	1.1		1.4	1.2		0.58	1.1	J	1.1	1.1		0.97	1.1	J
Copper	3.4	4.6	J	3.5	2.3		1.9	2.3	J	1.2	2.2	J	1.7	2.2	J	1.2	2.1	J
Iron	3900	22.9		4450	11.4		2260	11.6		2370	11		2280	11.2		2550	10.7	
Lead	5.4	0.57		4.8	2.8		1.4	0.58		1.4	2.7	J	1.5	0.56		1.6	0.54	
Magnesium	3590	45.9		2880	22.8		9390	23.1		3880	22		8140	22.5		3130	21.4	
Manganese	81.1	2.3		76.3	1.1		22	1.2		21.4	1.1		26.1	1.1		32.5	1.1	
Nickel	5.5	9.2	J	5	4.6		3.5	4.6	J	2.6	4.4	J	2.8	4.5	J	2.3	4.3	J
Potassium	1100	1150	J	1360	569		601	579		669	549		463	562	J	428	536	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0925-0008			CAN092-0925-0018			CAN092-0925-0028			CAN092-0925-0038			CAN092-0925-0048			CAN092-0925-0058		
LAB SAMPLE NUMBER	0313810017SA			0313740015SA			0313740016SA			0313740017SA			0313740018SA			0313740019SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	2.3	2.3		0.65	1.1	J	0.64	1.2	J	0.78	1.1	J	0.41	1.1	J	0.75	1.1	J
Sodium	<	1150	U	<	569	U	<	579	U	<	549	U	<	562	U	<	536	U
Vanadium	15.9	2.3		15.1	1.1		10.9	1.2		6.5	1.1		12.4	1.1		8.1	1.1	
Zinc	10.5	4.6		10.6	2.3		5.8	2.3		6	2.2		5.8	2.2		5.1	2.1	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.9	U	<	45.6	U	<	46.3	U	<	43.9	U	<	45	U	<	42.8	U
Water Quality (percent)																		
Water	13	0.1		12	0.1		14	0.1		9	0.1		11	0.1		6.6	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SURFACE SOIL TO BACKGROUND(1)
SWMU 92, CANNON AFB
Oil/Water Separator No. 5120

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN092-0925-0000	Aluminum	6100	1410 - 11,000	10,540	N	50,000
CAN092-0924-0000	Antimony	5.7	<5 - < 13	*	Y	<1
CAN092-0924-0000	Arsenic	2.7	0.67 - 28	15.5	N	6.5
CAN092-0922-0000	Barium	198	14.5 - 1200	642	N	500
CAN092-0924-0000	Beryllium	0.5	0.17 - 0.77	0.73	N	1 - 2
CAN092-0925-0000	Cadmium	1.9	<0.51 - 4.2	*	Y	---
CAN092-0925-0000	Chromium	13.9	4 - 15.4	12.5	N**	30
CAN092-0921-0000	Cobalt	3.4	0.85 - 5.3	4.5	N	3 - 7
CAN092-0921-0000	Copper	14.2	<2 - 18.4	*	N**	20
CAN092-0921-0000	Lead	502	1.1 - 46	25.8	Y	15
CAN092-0923-0000	Nickel	8.5	1.3 - 9.8	9	N	15
CAN092-0925-0000	Silver	1	0.51 - 0.93	*	Y	---
CAN092-0921-0000	Vanadium	18.1	5.2 - 28.3	25.3	N	30 - 70
CAN092-0922-0000	Zinc	72.6	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background range and within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background.

TABLE 7-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN TOTAL SOILS TO BACKGROUND(1)
SWMU 92, CANNON AFB
Oil/Water Separator No. 5120

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN092-0922-0004	Aluminum	8470	1410 - 11,000	10,540	N	50,000
CAN092-0924-0008	Antimony	12.2	<5 - <13	*	Y	<1
CAN092-0924-0000	Arsenic	2.7	0.67 - 28	15.5	N	6.5
CAN092-0922-0000	Barium	198	14.5 - 1200	642	N	500
CAN092-0922-0002	Beryllium	0.63	0.17 - 0.77	0.73	N	1 - 2
CAN092-0921-0048	Cadmium	2.3	<0.51 - 4.2	*	Y	---
CAN092-0925-0000	Chromium	13.9	4 - 15.4	12.5	N**	30
CAN092-0922-0002	Cobalt	4.5	0.85 - 5.3	4.5	N	3 - 7
CAN092-0921-0000	Copper	14.2	<2 - 18.4	*	N**	20
CAN092-0921-0000	Lead	502	1.1 - 46	25.8	Y	15
CAN092-0923-0000	Nickel	8.5	1.3 - 9.8	9	N	15
CAN092-0925-0008	Silver	2.3	0.51 - 0.93	*	Y	---
CAN092-0922-0002	Vanadium	18.5	5.2 - 28.3	25.3	N	30 - 70
CAN092-0922-0000	Zinc	72.6	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background range and within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background.

TABLE 7-5

CHEMICALS OF CONCERN IN SURFACE SOIL

Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Carbazole
Chrysene
1,2-Dichloroethane
Ethylbenzene
Fluoranthene
Indeno(1,2,3-cd)pyrene
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Antimony
Cadmium
Lead*
Silver
Zinc

* No EPA-established toxicity factor.

TABLE 7-6

CHEMICALS OF CONCERN IN TOTAL SOIL

Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Carbazole
Chrysene
1,2-Dichloroethane
Ethylbenzene
Fluoranthene
Indeno(1,2,3-cd)pyrene
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Antimony
Cadmium
Lead*
Silver
Zinc

* No EPA-established toxicity factor.

TABLE 7-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5120 (SWMU 92)

	1,2-Dichloroethane (µg/kg)			Ethylbenzene (µg/kg)			Toluene (µg/kg)				Xylenes (total) (µg/kg)				Anthracene (µg/kg)		
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL
CAN092-0921-0000		U	5.3	1.5	J	5.3	7.5	2.015		5.3	7.2	1.974		5.3			
CAN092-0922-0000		U	5.4		U	5.4	2.7	0.993	U	5.4	2.7	0.993	U	5.4		U	360
CAN092-0923-0000		U	5.3		U	5.3	2.65	0.975	U	5.3	1.4	0.336	J	5.3		U	350
CAN092-0924-0000		U	5.4		U	5.4	1.6	0.470	J	5.4	2.5	0.916	J	5.4		U	350
CAN092-0925-0000	1.3	J	5.3		U	5.3	4.9	1.589	J	5.3	5.3	1.668		5.3	70.0	J	350
Number	1			1			5	5			5	5			1		
Minimum detected	1.3			1.50			1.6				1.4				70.		
Maximum detected	1.3			1.50			7.5				7.2				70.		
Average	1.3			1.50			3.9	1.21			3.8	1.18			70.		
H statistic								3.29				3.47					
Standard Deviation								0.60				0.65					
95% UCL								10.8				12.4					
RME	1.3			1.50			7.5				7.2				70.		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5120 (SWMU 92)

	Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)				Benzo(b)fluoranthene (µg/kg)				Butyl benzyl phthalate (µg/kg)			Carbazole (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN092-0921-0000																		
CAN092-0922-0000	190	5.247	J	360	210	5.347	J	360	460	6.131		360	140	J	360		U	360
CAN092-0923-0000	180	5.193	J	350	220	5.394	J	350	490	6.194		350	110	J	350		U	350
CAN092-0924-0000	440	6.087		350	640	6.461		350	1400	7.244		350		U	350	38	J	350
CAN092-0925-0000	800	6.685		350	940	6.846		350	2100	7.650		350		U	350	89	J	350
Number	4	4			4	4			4	4			2			2		
Minimum detected	180				210				460				110			38.0		
Maximum detected	800				940				2100				140			89.0		
Average	403	5.80			503	6.01			1113	6.80			125			63.5		
H statistic		5.10				5.40				5.40								
Standard Deviation		0.72				0.76				0.76								
95% UCL		3523				5773				12881								
RME	800				940				2100				140			89.0		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5120 (SWMU 92)

	Chrysene (µg/kg)			Fluoranthene (µg/kg)			Indeno(1,2,3-cd)pyrene (µg/kg)				Pyrene (µg/kg)				TPH (µg/kg)			
Field ID	Result	Log Result	Qual	Result	Log Result	Qual	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000															674	6.513		42.4
CAN092-0922-0000	300	5.704	J	490	6.194		130	4.868	J	360	450	6.109		360	278	5.628		43.2
CAN092-0923-0000	280	5.635	J	540	6.292		120	4.787	J	350	500	6.215		350	58.2	4.064		42.5
CAN092-0924-0000	560	6.328		600	6.397		340	5.829	J	350	1200	7.090		350	159	5.069		43
CAN092-0925-0000	940	6.846		1100	7.003		470	6.153		350	2000	7.601		350	295	5.687		42.5
Number	4	4		4	4		4	4			4	4			5	5		
Minimum detected	280			490			120				450				58.2			
Maximum detected	940			1100			470				2000				674			
Average	520	6.13		683	6.47		265	5.41			1038	6.75			293	5.39		
H statistic		4.15			3.18			4.78				5.10				4.48		
Standard Deviation		0.57			0.36			0.69				0.72				0.90		
95% UCL		2121			1348			1875				9101				2501		
RME	940			1100			470				2000				674			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5120 (SWMU 92)

	Antimony (mg/kg)				Cadmium (mg/kg)				Lead (mg/kg)				Silver (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000	3.2	1.163	U	6.4	1.6	0.470		0.53	502	6.219		53	0.76	-0.274	J	1.1
CAN092-0922-0000	3.25	1.179	U	6.5	1	0.000		0.54	64.3	4.164	J	5.4	0.55	-0.598	U	1.1
CAN092-0923-0000	3.2	1.163	U	6.4	0.265	-1.328	U	0.53	12.5	2.526		1.1	0.55	-0.598	U	1.1
CAN092-0924-0000	5.7	1.740	J	6.5	0.44	-0.821	J	0.54	20.9	3.040		2.7	0.55	-0.598	U	1.1
CAN092-0925-0000	3.2	1.163	U	6.4	1.900	0.642		0.53	37.5	3.624		5.3	1.000	0.000	J	1.1
Number	5	5			5	5			5	5			5	5		
Minimum detected	5.70				0.44				12.5				0.76			
Maximum detected	5.70				1.90				502				1.00			
Average	3.71	1.28			1.04	-0.21			127	3.91			0.68	-0.41		
H statistic		2.40				4.27				7.12				2.40		
Standard Deviation		0.26				0.84				1.43				0.27		
95% UCL		5.07				7.05				22343				0.95		
RME	5.70				1.90				502				1.00			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5120 (SWMU 92)

	Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL
CAN092-0921-0000	39.3	3.671		2.1
CAN092-0922-0000	72.6	4.285		2.2
CAN092-0923-0000	44.9	3.804		2.1
CAN092-0924-0000	48.4	3.879		2.2
CAN092-0925-0000	43.6	3.775		2.1
Number	5	5		
Minimum detected	39.3			
Maximum detected	72.6			
Average	49.8	3.88		
H statistic		2.40		
Standard Deviation		0.24		
95% UCL		66.4		
RME	72.6			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 5120 (SWMU 92)

	1,2-Dichloroethane (µg/kg)			Ethylbenzene (µg/kg)			Toluene (µg/kg)			
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000		U	5.3	1.5	J	5.3	7.5	2.015		5.3
CAN092-0921-0002		U	5.3		U	5.3	2.65	0.975	U	5.3
CAN092-0921-0004		U	5.3		U	5.3	2.65	0.975	U	5.3
CAN092-0921-0008		U	5.5		U	5.5	1.8	0.588	J	5.5
CAN092-0921-0018		U	5.7		U	5.7	2.85	1.047	U	5.7
CAN092-0921-0028		U	5.7		U	5.7	3.3	1.194	J	5.7
CAN092-0921-0038		U	5.4		U	5.4	4.1	1.411	J	5.4
CAN092-0921-0048		U	5.7		U	5.7	2.8	1.030	J	5.7
CAN092-0921-0058		U	5.7		U	5.7	2.85	1.047	U	5.7
CAN092-0922-0000		U	5.4		U	5.4	2.7	0.993	U	5.4
CAN092-0922-0002		U	5.6		U	5.6	1.1	0.095	J	5.6
CAN092-0922-0004		U	5.6		U	5.6	28	3.332		5.6
CAN092-0922-0008		U	5.4		U	5.4	2.7	0.993	U	5.4
CAN092-0923-0000		U	5.3		U	5.3	2.65	0.975	U	5.3
CAN092-0923-0002		U	5.4		U	5.4	2.7	0.993	U	5.4
CAN092-0923-0004		U	5.4		U	5.4	2.7	0.993	U	5.4
CAN092-0923-0008		U	5.6		U	5.6	2.8	1.030	U	5.6
CAN092-0924-0000		U	5.4		U	5.4	1.6	0.470	J	5.4
CAN092-0924-0002		U	5.4		U	5.4	2.7	0.993	U	5.4
CAN092-0924-0004		U	5.4		U	5.4	2.8	1.030	U	5.4
CAN092-0924-0008		U	5.7		U	5.7	2.85	1.047	U	5.7
CAN092-0924-0018		U	5.6		U	5.6	2.8	1.030	U	5.6
CAN092-0924-0028		U	5.9		U	5.9	2.95	1.082	U	5.9
CAN092-0924-0038		U	5.5		U	5.5	2.75	1.012	U	5.5
CAN092-0924-0048		U	5.6		U	5.6	2.8	1.030	U	5.6
CAN092-0924-0058		U	5.5		U	5.5	2.75	1.012	U	5.5
CAN0921-0925-0000	1.3	J	5.3		U	5.3	4.9	1.589	J	5.3
CAN092-0925-0002		U	5.3		U	5.3	1.5	0.405	J	5.3
CAN092-0925-0004		U	5.3		U	5.3	3.6	1.281	J	5.3
CAN092-0925-0008		U	5.7		U	5.7	2.85	1.047	U	5.7
CAN092-0925-0018		U	5.7		U	5.7	2.85	1.047	U	5.7
CAN092-0925-0028		U	5.8		U	5.8	2.9	1.065	U	5.8
CAN092-0925-0038		U	5.5		U	5.5	2.75	1.012	U	5.5
CAN092-0925-0048		U	5.6		U	5.6	2.8	1.030	U	5.6
CAN092-0925-0058		U	5.4		U	5.4	2.7	0.993	U	5.4
Number	1			1			35	35		
Minimum detected	1.3			1.5			1.1			
Maximum detected	1.3			1.5			28			
Average	1.3			1.5			3.62	1.08		
H statistic								1.92		
Standard Deviation								0.50		
95% UCL								3.94		
RME	1.3			1.5			28.00			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 5120 (SWMU 92)

	Xylenes (total) (µg/kg)				Anthracene (µg/kg)			Benzo(a)anthracene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000	7.2	1.974		5.3							
CAN092-0921-0002	2.65	0.975	U	5.3							
CAN092-0921-0004	2.65	0.975	U	5.3							
CAN092-0921-0008	2.75	1.012	U	5.5							
CAN092-0921-0018	2.85	1.047	U	5.7							
CAN092-0921-0028	2.85	1.047	U	5.7							
CAN092-0921-0038	2.7	0.993	U	5.4							
CAN092-0921-0048	2.85	1.047	U	5.7							
CAN092-0921-0058	2.85	1.047	U	5.7							
CAN092-0922-0000	2.7	0.993	U	5.4	190	J	360	190	5.247	J	360
CAN092-0922-0002	1.6	0.470	J	5.6							
CAN092-0922-0004	2.8	1.030	U	5.6							
CAN092-0922-0008	2.7	0.993	U	5.4		U	360	180	5.193	U	360
CAN092-0923-0000	1.4	0.336	J	5.3		U	350	180	5.193	J	350
CAN092-0923-0002	1.7	0.531	J	5.4		U	360	180	5.193	U	360
CAN092-0923-0004	2.7	0.993	U	5.4							
CAN092-0923-0008	2.8	1.030	U	5.6							
CAN092-0924-0000	2.5	0.916	J	5.4		U	350	440	6.087		350
CAN092-0924-0002	2.7	0.993	U	5.4							
CAN092-0924-0004	2.7	0.993	U	5.4		U	360	180	5.193	U	360
CAN092-0924-0008	2.85	1.047	U	5.7							
CAN092-0924-0018	2.8	1.030	U	5.6							
CAN092-0924-0028	2.95	1.082	U	5.9							
CAN092-0924-0038	2.75	1.012	U	5.5							
CAN092-0924-0048	2.8	1.030	U	5.6							
CAN092-0924-0058	2.75	1.012	U	5.5							
CAN0921-0925-0000	5.3	1.668		5.3	70	J	350	800	6.685		350
CAN092-0925-0002	2.65	0.975	U	5.3		U	350	175	5.165	U	350
CAN092-0925-0004	2.7	0.993	J	5.3							
CAN092-0925-0008	2.75	1.012	U	5.7							
CAN092-0925-0018	2.75	1.012	U	5.7							
CAN092-0925-0028	2.9	1.065	U	5.8							
CAN092-0925-0038	2.75	1.012	U	5.5							
CAN092-0925-0048	2.8	1.030	U	5.6							
CAN092-0925-0058	2.7	0.993	U	5.4							
Number	35	35			2			8	8		
Minimum detected	1.40				70.0			180			
Maximum detected	7.20				190			800			
Average	2.85	1.01			130			291	5.49		
H statistic		1.79							2.543		
Standard Deviation		0.26							0.57		
95% UCL		3.08							498		
RME	7.20				190			800			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOILS AT OWS 5120 (SWMU 92)

	Benzo(a)pyrene (µg/kg)				Benzo(b)fluoranthene (µg/kg)				Butyl benzyl phthalate (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL
CAN092-0921-0000											
CAN092-0921-0002											
CAN092-0921-0004											
CAN092-0921-0008											
CAN092-0921-0018											
CAN092-0921-0028											
CAN092-0921-0038											
CAN092-0921-0048											
CAN092-0921-0058											
CAN092-0922-0000	210	5.347	J	360	460	6.131		360	140	J	360
CAN092-0922-0002											
CAN092-0922-0004											
CAN092-0922-0008	180	5.193	U	360	180	5.193	U	360		U	360
CAN092-0923-0000	220	5.394	J	350	490	6.194		350	110	J	350
CAN092-0923-0002	180	5.193	U	360	180	5.193	U	360		U	360
CAN092-0923-0004											
CAN092-0923-0008											
CAN092-0924-0000	640	6.461		350	1400	7.244		350		U	350
CAN092-0924-0002											
CAN092-0924-0004	180	5.193	U	360	180	5.193	U	360		U	360
CAN092-0924-0008											
CAN092-0924-0018											
CAN092-0924-0028											
CAN092-0924-0038											
CAN092-0924-0048											
CAN092-0924-0058											
CAN0921-0925-0000	940	6.846		350	2100	7.650		350		U	350
CAN092-0925-0002	175	5.165	U	350	175	5.165	U	350		U	350
CAN092-0925-0004											
CAN092-0925-0008											
CAN092-0925-0018											
CAN092-0925-0028											
CAN092-0925-0038											
CAN092-0925-0048											
CAN092-0925-0058											
Number	8	8			8	8			2		
Minimum detected	210				460				460		
Maximum detected	940				2100				2100		
Average	341	5.60			646	6.00			125		
H statistic		2.75				3.44					
Standard Deviation		0.66				1.00					
95% UCL		671				2424					
RME	940				2100				2100		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOILS AT OWS 5120 (SWMU 92)

	Carbazole (µg/kg)			Chrysene (µg/kg)				Fluoranthene (µg/kg)			
Field ID	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000											
CAN092-0921-0002											
CAN092-0921-0004											
CAN092-0921-0008											
CAN092-0921-0018											
CAN092-0921-0028											
CAN092-0921-0038											
CAN092-0921-0048											
CAN092-0921-0058											
CAN092-0922-0000		U	360	300	5.704	J	360	490	6.194		360
CAN092-0922-0002											
CAN092-0922-0004											
CAN092-0922-0008		U	360	180	5.193	U	360	180	5.193	U	360
CAN092-0923-0000		U	350	280	5.635	J	350	540	6.292		350
CAN092-0923-0002		U	360	180	5.193	U	360	180	5.193	U	360
CAN092-0923-0004											
CAN092-0923-0008											
CAN092-0924-0000	38	J	350	560	6.328		350	600	6.397		350
CAN092-0924-0002											
CAN092-0924-0004		U	360	180	5.193	U	360	180	5.193	U	360
CAN092-0924-0008											
CAN092-0924-0018											
CAN092-0924-0028											
CAN092-0924-0038											
CAN092-0924-0048											
CAN092-0924-0058											
CAN0921-0925-0000	89	J	350	940	6.846		350	1100	7.003		350
CAN092-0925-0002		U	350	175	5.165	U	350	175	5.165	U	350
CAN092-0925-0004											
CAN092-0925-0008											
CAN092-0925-0018											
CAN092-0925-0028											
CAN092-0925-0038											
CAN092-0925-0048											
CAN092-0925-0058											
Number	2			8	8			8	8		
Minimum detected	38			280				490			
Maximum detected	89			940				1100			
Average	63.5			349	5.66			431	5.83		
H statistic					2.64				2.85		
Standard Deviation					0.63				0.73		
95% UCL				652	652			970	970		
RME	89			652				970			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 5120 (SWMU 92)

	Indeno(1,2,3-cd)pyrene (µg/kg)				Pyrene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000								
CAN092-0921-0002								
CAN092-0921-0004								
CAN092-0921-0008								
CAN092-0921-0018								
CAN092-0921-0028								
CAN092-0921-0038								
CAN092-0921-0048								
CAN092-0921-0058								
CAN092-0922-0000	130	4.868	J	360	450	6.109		360
CAN092-0922-0002								
CAN092-0922-0004								
CAN092-0922-0008	180	5.193	U	360	180	5.193	U	360
CAN092-0923-0000	120	4.787	J	350	500	6.215		350
CAN092-0923-0002	180	5.193	U	360	180	5.193	U	360
CAN092-0923-0004								
CAN092-0923-0008								
CAN092-0924-0000	340	5.829	J	350	1200	7.090		350
CAN092-0924-0002								
CAN092-0924-0004	180	5.193	U	360	180	5.193	U	360
CAN092-0924-0008								
CAN092-0924-0018								
CAN092-0924-0028								
CAN092-0924-0038								
CAN092-0924-0048								
CAN092-0924-0058								
CAN0921-0925-0000	470	6.153		350	2000	7.601		350
CAN092-0925-0002	175	5.165	U	350	175	5.165	U	350
CAN092-0925-0004								
CAN092-0925-0008								
CAN092-0925-0018								
CAN092-0925-0028								
CAN092-0925-0038								
CAN092-0925-0048								
CAN092-0925-0058								
Number	8	8			8	8		
Minimum detected	120				450			
Maximum detected	470				2000			
Average	222	5.30			608	5.97		
H statistic		2.36				3.44		
Standard Deviation		0.46				0.96		
95% UCL		337				2166		
RME	470				2000			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quali
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 5120 (SWMU 92)

	TPH (mg/kg)				Antimony (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000	674	6.513		42.4	3.2	1.163	U	6.4
CAN092-0921-0002	47.6	3.863		42.4	2.65	0.975	U	5.3
CAN092-0921-0004	64.2	4.162		42.6	3.2	1.163	U	6.4
CAN092-0921-0008	22.15	3.098	U	44.3	3.3	1.194	U	6.6
CAN092-0921-0018	23	3.135	U	46	3.45	1.238	U	6.9
CAN092-0921-0028	22.85	3.129	U	45.7	3.45	1.238	U	6.9
CAN092-0921-0038	21.6	3.073	U	43.2	3.25	1.179	U	6.5
CAN092-0921-0048	22.7	3.122	U	45.4	6.8	1.917	U	13.6
CAN092-0921-0058	22.85	3.129	U	45.7	3.45	1.238	U	6.9
CAN092-0922-0000	278	5.628		43.2	3.25	1.179	U	6.5
CAN092-0922-0002	22.45	3.111	U	44.9	2.8	1.030	U	5.6
CAN092-0922-0004	22.35	3.107	U	44.7	3.35	1.209	U	6.70
CAN092-0922-0008	21.5	3.068	U	43	3.25	1.179	U	6.50
CAN092-0923-0000	58.2	4.064		42.5	3.15	1.147	U	6.3
CAN092-0923-0002	49	3.892		43.2	3.25	1.179	U	6.5
CAN092-0923-0004	21.6	3.073	U	43.2	3.25	1.179	U	6.50
CAN092-0923-0008	22.25	3.102	U	44.5	6.70	1.902	U	13.40
CAN092-0924-0000	159	5.069		43	5.7	1.740	J	6.5
CAN092-0924-0002	61.5	4.119		43.3	5.30	1.668	J	6.50
CAN092-0924-0004	44.8	3.802		43.1	9.40	2.241		6.50
CAN092-0924-0008	22.75	3.125	U	45.5	12.20	2.501	J	13.70
CAN092-0924-0018	22.3	3.105	U	44.6	6.20	1.825	J	6.70
CAN092-0924-0028	23.55	3.159	U	47.1	7.05	1.953	U	14.10
CAN092-0924-0038	22.1	3.096	U	44.2	3.3	1.194	U	6.6
CAN092-0924-0048	22.35	3.107	U	44.7	6.70	1.902	U	13.40
CAN092-0924-0058	22	3.091	U	44	6.20	1.825	J	6.60
CAN0921-0925-0000	295	5.687		42.5	3.2	1.163	U	6.40
CAN092-0925-0002	120	4.787		42.5	3.2	1.163	U	6.4
CAN092-0925-0004	72.5	4.284		42.4	3.20	1.163	U	6.40
CAN092-0925-0008	22.95	3.133	U	45.9	6.90	1.932	U	13.80
CAN092-0925-0018	22.8	3.127	U	45.6	3.40	1.224	U	6.80
CAN092-0925-0028	23.15	3.142	U	46.3	3.45	1.238	U	6.90
CAN092-0925-0038	21.95	3.089	U	43.9	3.30	1.194	U	6.60
CAN092-0925-0048	22.5	3.114	U	45	3.35	1.209	U	6.70
CAN092-0925-0058	21.4	3.063	U	42.8	3.20	1.163	U	6.40
Number	35	35			35	35		
Minimum detected	44.8				5.30			
Maximum detected	674				12.2			
Average	69.7	3.64			4.49	1.42		
H statistic		2.29				1.85		
Standard Deviation		0.90				0.39		
95% UCL		81.2				5.03		
RME	674.0				12.20			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality c
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 5120 (SWMU 92)

	Cadmium (mg/kg)				Lead (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000	1.6	0.470		0.53	502	6.219		53
CAN092-0921-0002	0.59	-0.528		0.53	4.6	1.526		0.53
CAN092-0921-0004	1.3	0.262	J	5.3	5.4	1.686		0.55
CAN092-0921-0008	1.2	0.182		0.55	5.3	1.668		0.53
CAN092-0921-0018	1.6	0.470		0.57	4.3	1.459		0.57
CAN092-0921-0028	0.67	-0.400		0.57	3	1.099		0.57
CAN092-0921-0038	1.1	0.095		0.54	1.9	0.642		0.54
CAN092-0921-0048	2.3	0.833		1.1	2.4	0.875		0.57
CAN092-0921-0058	0.7	-0.357		0.57	2.1	0.742		0.57
CAN092-0922-0000	1	0.000		0.54	64.3	4.164	J	5.4
CAN092-0922-0002	0.28	-1.273	U	0.56	8.4	2.128		0.56
CAN092-0922-0004	0.28	-1.273	U	0.56	7.4	2.001		1.1
CAN092-0922-0008	0.27	-1.309	U	0.54	2.5	0.916		0.54
CAN092-0923-0000	0.265	-1.328	U	0.53	12.5	2.526		1.1
CAN092-0923-0002	0.27	-1.309	U	0.54	8.3	2.116		0.54
CAN092-0923-0004	0.27	-1.309	U	0.54	6.3	1.841		1.1
CAN092-0923-0008	0.55	-0.598	U	1.1	3.1	1.131		0.56
CAN092-0924-0000	0.44	-0.821	J	0.54	20.9	3.040		2.7
CAN092-0924-0002	0.27	-1.309	U	0.54	5.8	1.758		0.54
CAN092-0924-0004	0.27	-1.309	U	0.54	5.5	1.705		0.54
CAN092-0924-0008	0.55	-0.598	U	1.1	4.4	1.482		0.57
CAN092-0924-0018	0.28	-1.273	U	0.56	3.8	1.335		0.56
CAN092-0924-0028	0.6	-0.511	U	1.2	2.1	0.742		0.59
CAN092-0924-0038	0.225	-1.492	U	0.55	1.5	0.405		0.55
CAN092-0924-0048	0.55	-0.598	U	1.1	1.8	0.588		0.56
CAN092-0924-0058	0.275	-1.291	U	0.55	1.3	0.262		0.55
CAN0921-0925-0000	1.9	0.642		0.53	37.5	3.624		5.3
CAN092-0925-0002	0.89	-0.117		0.53	5.7	1.740		0.53
CAN092-0925-0004	0.81	-0.211		0.53	5.1	1.629		0.53
CAN092-0925-0008	1.9	0.642		1.1	5.4	1.686		0.57
CAN092-0925-0018	0.98	-0.020		0.57	4.8	1.569		2.8
CAN092-0925-0028	1.3	0.262		0.58	1.4	0.336		0.58
CAN092-0925-0038	0.63	-0.462		0.55	1.4	0.336	J	2.7
CAN092-0925-0048	0.97	-0.030		0.56	1.5	0.405		0.56
CAN092-0925-0058	0.27	-1.309	U	0.54	1.6	0.470		0.54
Number	35	35			35	35		
Minimum detected	0.23				1.30			
Maximum detected	2.30				502			
Average	0.78	-0.49			21.6	1.60		
H statistic		2.13				2.70		
Standard Deviation		0.71				1.21		
95% UCL		1.03				18.0		
RME	2.30				502.0			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quality crit
U = Not detected. Value result shown is one-h
Where no RL is shown, no analysis was performed.

TABLE 7-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT OWS 5120 (SWMU 92)

	Silver (mg/kg)				Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN092-0921-0000	0.76	-0.274	J	1.1	39.3	3.671		2.1
CAN092-0921-0002	0.73	-0.315	J	1.1	13.6	2.610		2.1
CAN092-0921-0004	0.63	-0.462	J	1.1	13.8	2.625		2.1
CAN092-0921-0008	0.74	-0.301	J	1.1	15	2.708		2.2
CAN092-0921-0018	0.91	-0.094	J	1.1	10.4	2.342		2.3
CAN092-0921-0028	1.1	0.095		1.1	8.7	2.163		2.3
CAN092-0921-0038	0.73	-0.315	J	1.1	7.3	1.988		2.2
CAN092-0921-0048	1.5	0.405	J	2.3	3.3	1.194	J	4.5
CAN092-0921-0058	0.96	-0.041	J	1.1	4.4	1.482		2.3
CAN092-0922-0000	0.55	-0.598	U	1.1	72.6	4.285		2.2
CAN092-0922-0002	0.55	-0.598	U	1.1	19.3	2.960		2.2
CAN092-0922-0004	0.55	-0.598	U	1.1	18.5	2.918		2.2
CAN092-0922-0008	0.55	-0.598	U	1.1	8.3	2.116		2.2
CAN092-0923-0000	0.55	-0.598	U	1.1	44.9	3.804		2.1
CAN092-0923-0002	0.55	-0.598	U	1.1	17.5	2.862		2.2
CAN092-0923-0004	0.55	-0.598	U	1.1	16.3	2.791		2.2
CAN092-0923-0008	1.1	0.095	U	2.2	9.1	2.208		4.5
CAN092-0924-0000	0.55	-0.598	U	1.1	48.4	3.879		2.2
CAN092-0924-0002	0.55	-0.598	U	1.1	14.3	2.660		2.2
CAN092-0924-0004	0.55	-0.598	U	1.1	13.6	2.610		2.2
CAN092-0924-0008	1.15	0.140	U	2.3	10	2.303		4.6
CAN092-0924-0018	0.55	-0.598	U	1.1	8.1	2.092		2.2
CAN092-0924-0028	1.2	0.182	U	2.4	6	1.792		4.7
CAN092-0924-0038	0.55	-0.598	U	1.1	6.5	1.872		2.2
CAN092-0924-0048	1.1	0.095	U	2.2	6.4	1.856		4.5
CAN092-0924-0058	0.55	-0.598	U	1.1	5.7	1.740		2.2
CAN0921-0925-0000	1	0.000	J	1.1	43.6	3.775		2.1
CAN092-0925-0002	0.92	-0.083	J	1.1	15.7	2.754		2.1
CAN092-0925-0004	0.88	-0.128	J	1.1	11.9	2.477		2.1
CAN092-0925-0008	2.3	0.833		2.3	10.5	2.351		4.6
CAN092-0925-0018	0.65	-0.431	J	1.1	10.6	2.361		2.3
CAN092-0925-0028	0.64	-0.446	J	1.2	5.8	1.758		2.3
CAN092-0925-0038	0.78	-0.248	J	1.1	6	1.792		2.2
CAN092-0925-0048	0.41	-0.892	J	1.1	5.8	1.758		2.2
CAN092-0925-0058	0.75	-0.288	J	1.1	5.1	1.629		2.1
Number	35	35			35	35		
Minimum detected	0.63				3.30			
Maximum detected	2.30				72.6			
Average	0.80	-0.29			15.9	2.46		
H statistic		1.85				2.13		
Standard Deviation		0.36				0.74		
95% UCL		0.90				20.1		
RME	2.30				72.6			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected. 95% UCL concentrations have not been calculated for sample sets with n < 3.
J = Estimated value below reporting limit or estimated based on data quali
U = Not detected. Value result shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 7-9
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SURFACE SOIL
SWMU 92

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
1,2-Dichloroethane	0.0013	0.0013	0.0005	6.50E-07	6.50E-07
Anthracene	0.07	0.07	0.1	0.007	0.007
Benzo(a)anthracene	0.40	0.80	0.1	0.04	0.08
Benzo(a)pyrene	0.50	0.94	0.1	0.05	0.094
Benzo(b)fluoranthene	1.10	2.10	0.1	0.11	0.21
Butyl benzyl phthalate	0.12	0.14	0.1	0.012	0.014
Carbazole	0.063	0.089	0.1	0.0063	0.0089
Chrysene	0.52	0.94	0.1	0.052	0.094
Ethylbenzene	0.001	0.001	0.03	3.00E-05	3.00E-05
Fluoranthene	0.68	1.10	0.1	0.068	0.11
Indeno(1,2,3-cd)pyrene	0.26	0.47	0.1	0.026	0.047
Pyrene	1.00	2.00	0.1	0.1	0.2
Toluene	0.004	0.008	0.03	1.20E-04	2.40E-04
Xylenes	0.004	0.007	0.03	1.20E-04	2.10E-04

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction.
(3) Adjusted RME concentration = RME concentration x absorbed fraction.

TABLE 7-10
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
TOTAL SOIL
SWMU 92

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
1,2-Dichloroethane	0.0013	0.0013	0.0005	6.50E-07	6.50E-07
Anthracene	0.13	0.19	0.1	0.013	0.019
Benzo(a)anthracene	0.29	0.50	0.1	0.029	0.05
Benzo(a)pyrene	0.34	0.67	0.1	0.034	0.067
Benzo(b)fluoranthene	0.65	2.10	0.1	0.065	0.21
Butyl benzyl phthalate	0.12	2.10	0.1	0.012	0.21
Carbozole	0.063	0.089	0.1	0.0063	0.0089
Chrysene	0.35	0.65	0.1	0.035	0.065
Ethylbenzene	0.001	0.001	0.03	3.00E-05	3.00E-05
Fluoranthene	0.43	0.97	0.1	0.043	0.097
Indeno(1,2,3-cd)pyrene	0.22	0.34	0.1	0.022	0.034
Pyrene	0.61	2.00	0.1	0.061	0.2
Toluene	0.004	0.004	0.03	1.20E-04	1.20E-04
Xylenes	0.003	0.003	0.03	9.00E-05	9.00E-05

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction.
(3) Adjusted RME concentration = RME concentration x absorbed fraction.

TABLE 7-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 92

	t (y)	Cs (µg/kg)	Co (g/m^3)	L (m)	W (m)	T (m)	VWC (L/L)	foc	Koc (ml/g)	Kd (ml/g)	Soil Half Life (y)	P (g/cm^3)	I (m/y)	H (m)	TOT (y)	Rd
1,2-Dichloroethane	0	1.3	2.08E-03	30	40	14.634	0.15	0.003	14	0.042	0.2	1.6	0.015	64.634	936	1.45E+00
Anthracene	0	190	3.04E-01	30	40	14.634	0.15	0.003	16000	48	1.26	1.6	0.015	64.634	331572	5.13E+02
Antimony	0	4490	7.18E+00	30	40	14.634	0.15	0.003	NA	3981	NA	1.6	0.015	64.634	27446828	4.25E+04
Benzo(a)anthracene	0	290.63	4.65E-01	30	40	14.634	0.15	0.003	1400000	4200	1.86	1.6	0.015	64.634	28956678	4.48E+04
Benzo(a)pyrene	0	340.63	5.45E-01	30	40	14.634	0.15	0.003	6500000	19500	1.45	1.6	0.015	64.634	134439366	2.08E+05
Benzo(b)fluoranthene	0	645.63	1.03E+00	30	40	14.634	0.15	0.003	550000	1650	1.67	1.6	0.015	64.634	11376230	1.76E+04
Benzylbutylphthalate	0	125	2.00E-01	30	40	14.634	0.15	0.003	68	0.204	0.2	1.6	0.015	64.634	2053	3.18E+00
Cadmium	0	780	1.25E+00	30	40	14.634	0.15	0.003	NA	7	NA	1.6	0.015	64.634	48906	7.57E+01
Carbazole	0	63.5	1.02E-01	30	40	14.634	0.15	0.003	5100	15.3	0.2	1.6	0.015	64.634	106129	1.64E+02
Chrysene	0	349.38	5.59E-01	30	40	14.634	0.15	0.003	250000	750	2.72	1.6	0.015	64.634	5171366	8.00E+03
Ethylbenzene	0	1.5	2.40E-03	30	40	14.634	0.15	0.003	1100	3.3	0.2	1.6	0.015	64.634	23398	3.62E+01
Fluoranthene	0	430.63	6.89E-01	30	40	14.634	0.15	0.003	1380	4.14	1.21	1.6	0.015	64.634	29189	4.52E+01
Indeno(1,2,3-c)pyrene	0	221.88	3.55E-01	30	40	14.634	0.15	0.003	31000000	93000	2	1.6	0.015	64.634	641169926	9.92E+05
Lead	0	21580	3.45E+01	30	40	14.634	0.15	0.003	NA	100	NA	1.6	0.015	64.634	690076	1.07E+03
Pyrene	0	608.13	9.73E-01	30	40	14.634	0.15	0.003	38000	114	5.2	1.6	0.015	64.634	786596	1.22E+03
Silver	0	800	1.28E+00	30	40	14.634	0.15	0.003	NA	100	NA	1.6	0.015	64.634	690076	1.07E+03
Toluene	0	3.62	5.79E-03	30	40	14.634	0.15	0.003	300	0.9	0.2	1.6	0.015	64.634	6851	1.06E+01
Xylenes	0	2.85	4.56E-03	30	40	14.634	0.15	0.003	830	2.49	0.2	1.6	0.015	64.634	17813	2.76E+01
Zinc	0	15890	2.54E+01	30	40	14.634	0.15	0.003	NA	100	NA	1.6	0.015	64.634	690076	1.07E+03

t = Time where leachate concentration is estimated
Cs Concentration of chemical in source soil
(average concentration from Table 7-8)
Co Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 7-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 92

	Leach Rate (y^-1)	Qo (g)	Q(t) (g)	qc (g/y)	Cl(1) (µg/l)	Cl(2) (µg/l)	K (m/s)	i (m/m)	b (m)	Qw (m^3/y)	Ql (m^3/yr)	Cw (µg/l)
1,2-Dichloroethane	4.72E-03	3.65E+01	3.65E+01	1.72E-01	9.58E+00	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Anthracene	1.33E-05	5.34E+03	5.34E+03	7.11E-02	3.95E+00	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Antimony	1.61E-07	1.26E+05	1.26E+05	2.03E-02	1.13E+00	1.13E+00	2.00E-04	0.0019	10	4793	18	4.22E-03
Benzo(a)anthracene	1.53E-07	8.17E+03	8.17E+03	1.25E-03	6.92E-02	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Benzo(a)pyrene	3.29E-08	9.57E+03	9.57E+03	3.14E-04	1.75E-02	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Benzo(b)fluoranthene	3.88E-07	1.81E+04	1.81E+04	7.04E-03	3.91E-01	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Benzylbutylphthalate	2.15E-03	3.51E+03	3.51E+03	7.56E+00	4.20E+02	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Cadmium	9.03E-05	2.19E+04	2.19E+04	1.98E+00	1.10E+02	1.10E+02	2.00E-04	0.0019	10	4793	18	4.11E-01
Carbazole	4.16E-05	1.78E+03	1.78E+03	7.43E-02	4.13E+00	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Chrysene	8.54E-07	9.82E+03	9.82E+03	8.38E-03	4.66E-01	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Ethylbenzene	1.89E-04	4.21E+01	4.21E+01	7.96E-03	4.42E-01	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Fluoranthene	1.51E-04	1.21E+04	1.21E+04	1.83E+00	1.02E+02	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Indeno(1,2,3-c)pyrene	6.89E-09	6.23E+03	6.23E+03	4.29E-05	2.39E-03	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Lead	6.40E-06	6.06E+05	6.06E+05	3.88E+00	2.16E+02	2.16E+02	2.00E-04	0.0019	10	4793	18	8.07E-01
Pyrene	5.61E-06	1.71E+04	1.71E+04	9.59E-02	5.33E+00	0.00E+00	2.00E-04	0.0019	10	4793	18	8.07E-01
Silver	6.40E-06	2.25E+04	2.25E+04	1.44E-01	7.99E+00	7.99E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Toluene	6.45E-04	1.02E+02	1.02E+02	6.56E-02	3.64E+00	0.00E+00	2.00E-04	0.0019	10	4793	18	2.99E-02
Xylenes	2.48E-04	8.01E+01	8.01E+01	1.99E-02	1.10E+00	0.00E+00	2.00E-04	0.0019	10	4793	18	0.00E+00
Zinc	6.40E-06	4.46E+05	4.46E+05	2.86E+00	1.59E+02	1.59E+02	2.00E-04	0.0019	10	4793	18	0.00E+00

t = Time where leachate concentration is estimated
Cs Concentration of chemical in source soil
(average concentration from Table 7-8)
Co Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 7-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 92

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
1,2-Dichloroethane	2.65	3.85E-03	45	2.25	2	20250000	7.90E+08	6.82E-02	0.35	0.09643
Ethylbenzene	2.65	1.25E-04	45	2.25	2	20250000	7.90E+08	5.00E-02	0.35	0.0707
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 7-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 7-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 92

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
1,2-Dichloroethane	30	4.31E-03	6.00E-01	0.295	2.20E+03	0.001	5.91E-07
Ethylbenzene	1100	6.60E-03	2.20E+01	0.012	1.29E+04	0.002	1.16E-07
Toluene	300	6.37E-03	6.00E+00	0.044	6.32E+03	0.008	1.19E-06

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 7-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 7-14
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM SURFACE SOILS AT SWMU 92

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Benzo(a)anthracene	0.80	4.63E+09	1.73E-10
Benzo(a)pyrene	0.94	4.63E+09	2.03E-10
Benzo(b)fluoranthene	2.10	4.63E+09	4.54E-10
Cadmium	1.90	4.63E+09	4.10E-10
Chrysene	0.94	4.63E+09	2.03E-10
Indeno(1,2,3-cd)pyrene	0.47	4.63E+09	1.02E-10

RME Soil Concentration from Table 7-7

PEF = Particulate Emission Factor default value from EPA (1991b)

Air Concentration = Soil concentration/PEF

TABLE 7-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 92

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
1,2-Dichloroethane	2.65	3.85E-03	45	2.25	2	20250000	7.90E+08	6.82E-02	0.35	0.09643
Ethylbenzene	2.65	1.25E-04	45	2.25	2	20250000	7.90E+08	5.00E-02	0.35	0.0707
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 7-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 7-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 92

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
1,2-Dichloroethane	30	4.31E-03	6.00E-01	2.95E-01	2.20E+03	0.001	5.91E-07
Ethylbenzene	1100	6.60E-03	2.20E+01	1.23E-02	1.29E+04	0.002	1.16E-07
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.004	6.17E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 7-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 7-16
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM TOTAL SOILS AT SWMU 92

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Benzo(a)anthracene	0.50	4.63E+09	1.08E-10
Benzo(a)pyrene	0.67	4.63E+09	1.45E-10
Benzo(b)fluoranthene	2.10	4.63E+09	4.54E-10
Cadmium	1.03	4.63E+09	2.22E-10
Chrysene	0.65	4.63E+09	1.41E-10
Indeno(1,2,3-cd)pyrene	0.34	4.63E+09	7.28E-11

RME Soil Concentration from Table 7-8
PEF = Particulate Emission Factor default value from EPA (1991b)
Air Concentration = Soil concentration/PEF

TABLE 7-17

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Inhalation (m^3/kg-d)		
Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
Carcinogenic	1.39×10^{-3}	6.99×10^{-2}
Construction Workers	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Inhalation (m^3/kg-d)		
Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
Carcinogenic	1.03×10^{-4}	4.47×10^{-4}
Trespasser	**Average**	**RME**
Dermal Contact Soil (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Soil Ingestion (kg/kg-d		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Inhalation (m^3/k-d)		
Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 7-18

SUMMARY OF HUMAN HEALTH RISKS AT SWMU 92

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Surface Soil)						
-- Dermal Contact	8×10^{-12}		3×10^{-8}	2×10^{-9}		2×10^{-6}
-- Ingestion	4×10^{-9}		6×10^{-5}	2×10^{-6}		7×10^{-3}
-- Inhalation of VOCs	7×10^{-11}		1×10^{-7}	4×10^{-9}		2×10^{-6}
-- Inhalation of Particulates	6×10^{-12}		0.00	3×10^{-10}		0.00
	4×10^{-9}		6×10^{-5}	2×10^{-6}		7×10^{-3}
Construction Worker (Total Soil)						
-- Dermal Contact	6×10^{-13}	2×10^{-9}		1×10^{-11}	5×10^{-7}	
-- Ingestion	9×10^{-10}	2×10^{-4}		2×10^{-8}	2×10^{-3}	
-- Inhalation of VOCs	6×10^{-12}	4×10^{-8}		2×10^{-11}	2×10^{-7}	
-- Inhalation of Particulates	3×10^{-13}	0.00		1×10^{-12}	0.00	
	9×10^{-10}	2×10^{-4}		2×10^{-8}	2×10^{-3}	
Trespasser (Surface Soil)						
-- Dermal Contact	2×10^{-12}	9×10^{-10}		2×10^{-10}	1×10^{-7}	
-- Ingestion	8×10^{-10}	2×10^{-5}		1×10^{-7}	2×10^{-3}	
-- Inhalation of VOCs	1×10^{-11}	4×10^{-8}		3×10^{-10}	6×10^{-7}	
-- Inhalation of Particulates	1×10^{-12}	0.00		2×10^{-11}	0.00	
	8×10^{-10}	2×10^{-5}		1×10^{-7}	2×10^{-3}	

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix C for nonrounded risk values.

TABLE 7-19

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies and are under review and subject to revision.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

TABLE 7-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMUs 92 AND 93 CANNON AFB (mg/kg)

Chemical	CAN092-0921-0000	CAN092-0921-0002	CAN092-0922-0000	CAN092-0922-0002	CAN092-0923-0000	CAN092-0923-0002	CAN092-0924-0000	CAN092-0924-0002	CAN092-0925-0000	CAN092-0925-0002	CAN093-0931-0000	CAN093-0931-0002
Volatile Organics												
1,2-Dichloroethane	0.0027 U	0.0027 U	0.0027 U	0.0028 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0013 J	0.0027 U		
Ethylbenzene	0.0015 J	0.0027 U	0.0027 U	0.0028 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U		
Toluene	0.0075	0.0027 U	0.0027 U	0.0011 J	0.0027 U	0.0027 U	0.0016 J	0.0027 U	0.0049 J	0.0015 J	0.0026 J	0.0027 U
Xylenes (total)	0.0072	0.0027 U	0.0027 U	0.0016 J	0.0014 J	0.0017 J	0.0025 J	0.0027 U	0.0053	0.0027 U	0.0018 J	0.0027 U
Semivolatile Organics												
Anthracene			0.18 U		0.175 U	0.18 U	0.175 U		0.07 J	0.175 U		
Benzo(a)anthracene			0.19 J		0.18 J	0.18 U	0.44		0.8	0.175 U	0.21 U	
Benzo(a)pyrene			0.21 J		0.22 J	0.18 U	0.64		0.94	0.175 U	0.21 U	
Benzo(b)fluoranthene			0.46		0.49	0.18 U	1.4		2.1	0.175 U	0.21 U	
Benzo(g,h,i)perylene			0.13 J		0.12 J	0.18 U	0.33 J		0.45	0.175 U	0.21 U	
Butyl benzyl phthalate			0.14 J		0.11 J	0.18 U	0.175 U		0.175 U	0.175 U		
Carbazole			0.18 U		0.175 U	0.18 U	0.038 J		0.089 J	0.175 U		
Chrysene			0.3 J		0.28 J	0.18 U	0.56		0.94	0.175 U	0.21 U	
Di-n-butyl phthalate			0.073 J		0.175 U	0.18 U	0.175 U		0.175 U	0.175 U		
Fluoranthene			0.49		0.54	0.18 U	0.6		1.1	0.175 U	0.21 U	
Ideno(1,2,3-cd)pyrene			0.13 J		0.12 J	0.18 U	0.34 J		0.47	0.175 U	0.21 U	
Pentachlorophenol											0.045 J	
Phenanthrene			0.22 J		0.34 J	0.18 U	0.28 J		0.47	0.175 U	0.21 U	
Pyrene			0.45		0.5	0.18 U	1.2		2	0.175 U	0.21 U	
Metals												
Aluminum	6080	5670	5070	8100	6040	7610	5420	6570	6100	6260	5930	3950
Antimony	3.2 U	3.2 U	3.3 U	3.4 U	3.2 U	3.3 U	5.7 J	5.3 J	3.2 U	3.2 U		
Arsenic	2.3	2	2.2	2.4	2.5	2.6	2.7	2.4	2.1	2.1	2.3	1.6
Barium	R	R	198	83.6	96.6	101	228	184	R	R	99.9 J	51.9 J
Beryllium	0.46	0.46	0.29	0.63	0.47	0.54	0.5	0.51	0.42	0.4	0.48	0.3
Cadmium	1.6	0.59	1	0.28 U	0.27 U	0.27 U	0.44 J	0.27 U	1.9	0.89	0.32 U	0.27 U
Calcium	58200	58300	72500	6450	17000	12700	78400	58700	53000	568000	14700	3710

TABLE 7-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMUs 92 AND 93 CANNON AFB (mg/kg)

Chemical	CAN092-0921-0000	CAN092-0921-0002	CAN092-0922-0000	CAN092-0922-0002	CAN092-0923-0000	CAN092-0923-0002	CAN092-0924-0000	CAN092-0924-0002	CAN092-0925-0000	CAN092-0925-0002	CAN093-0931-0000	CAN093-0931-0002
Chromium	12.3	5.9	13.8	8.7	9.3	8.1	9.1	5.7	13.9	5.3	9.5 J	5.3
Cobalt	3.4	3	2.9	4.5	3.3	4.4	2.8	3.3	3.4	2.8	3.9	2.4
Copper	14.2	5.7	6.9	6.7	6.7	6.9	7.5	6.2	9.8	5.7	8.6	4.5
Iron	6470	6020	12000	8560	7960	7890	5910	6650	6300	5800	6980	4560
Lead	502	4.6	64.3 J	8.4	12.5	8.3	20.9	5.8	37.5	5.7	7.3	5.2
Magnesium	2100	1890	2810	1640	1470	1700	2650	2050	2220	2030	1440	830
Manganese	216	122	135	210	199	195	130	149	182	122	155 J	102 J
Nickel	7.5	6.6	8.2	8.4	8.5	8	7.1	8	7.5	6.1	7.2	4.7
Potassium	1480	1130	1490	1630	1290	1520	1550	1570	1740	1270	1150	760
Selenium											0.32 U	0.27 U
Silver	0.76 J	0.73 J	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	1 J	0.92 J	0.69 J	0.57 J
Sodium											319 U	170 J
Vanadium	18.1	16	13.1	18.5	17.3	17.7	16.9	17.2	17	14.3	17	11.9
Zinc	39.3	13.6	72.6	19.3	44.9	17.5	48.4	14.3	43.6	15.7	25.4	13.1
TPH	674	47.6	278	22.5 U	58.2	49	159	61.5	295	120	77.4	21.6 U

* Between 0 and 2 feet deep

R Rejected

J Estimated value below reporting limit or estimated based on data quality criteria

U Nondetect. Value shown is one-half the reporting limit.

TABLE 7-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMUs 92 AND 93 CANNON AFB (mg/kg)

Chemical	CAN093-0932-0000	CAN093-0932-0002	CAN093-0933-0000	CAN093-0933-0002	N	Arithmetic Mean	95% UCL	Maximum
Volatile Organics								
1,2-Dichloroethane					10	0.0026	0.0028	0.0028
Ethylbenzene					10	0.0026	0.0028	0.0028
Toluene	0.0027 U	0.008	0.0049 J	0.0029 U	16	0.0034	0.0042	0.008
Xylenes (total)	0.0027 U	0.0028 U	0.0018 J	0.0029 U	16	0.0028	0.0034	0.0072
Semivolatile Organics								
Anthracene					6	0.16	0.19	0.18
Benzo(a)anthracene	0.074 J	0.185 U	0.077 J		10	0.25	0.37	0.8
Benzo(a)pyrene	0.062 J	0.185 U	0.084 J		10	0.29	0.44	0.94
Benzo(b)fluoranthene	0.073 J	0.185 U	0.14 J		10	0.54	0.91	2.1
Benzo(g,h,i)perylene	0.073 J	0.185 U	0.056 J		10	0.19	0.26	0.45
Butyl benzyl phthalate					6	0.16	0.18	0.18
Carbazole					6	0.14	0.19	0.18
Chrysene	0.095 J	0.185 U	0.12 J		10	0.30	0.45	0.94
Di-n-butyl phthalate					6	0.16	0.19	0.18
Fluoranthene	0.15 J	0.185 U	0.1 J		10	0.37	0.55	1.1
Ideno(1,2,3-cd)pyrene	0.055 J	0.185 U	0.038 J		10	0.19	0.26	0.47
Pentachlorophenol	0.85 U	0.9 U	0.85 U		4	0.66	1.08	0.9
Phenanthrene	0.13 J	0.185 U	0.1 J		10	0.23	0.29	0.47
Pyrene	0.19 J	0.185 U	0.12 J		10	0.52	0.86	2
Metals								
Aluminum	7130	8660	9380	10500	16	6779.38	7499.81	10500
Antimony					10	3.70	3.70	5.7
Arsenic	2.5	2	2.3	2.5	16	2.28	2.40	2.7
Barium	114 J	126 J	140 J	108 J	12	127.58	153.09	228
Beryllium	0.44	0.5	0.49	0.54	16	0.46	0.50	0.63
Cadmium	1.9	1.2	1	1	16	0.83	1.07	1.9
Calcium	26600	54300	37400	33400	16	72085	129102	568000

TABLE 7-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMUs 92 AND 93 CANNON AFB (mg/kg)

Chemical	CAN093-0932-0000	CAN093-0932-0002	CAN093-0933-0000	CAN093-0933-0002	N	Arithmetic Mean	95% UCL	Maximum
Chromium	7.7	8.1	12.9	11.8	16	9.21	10.47	13.9
Cobalt	3.6	3.1	3.4	3.9	16	3.38	3.63	4.5
Copper	158	7.4	8.4	8.5	16	16.98	32.97	158
Iron	7920	8220	8360	9110	16	7419.38	8157.65	12000
Lead	32.4	5.8	10	11.8	16	46.41	98.41	502
Magnesium	1740	2560	2220	2310	16	1978.75	2193.84	2810
Manganese	183	161	146	162	16	160.56	175.06	216
Nickel	8.2	7.5	7.8	8.4	16	7.48	7.91	8.5
Potassium	1340	1420	1630	1780	16	1421.88	1532.33	1780
Selenium	0.25 J	0.6 U	0.27 U	0.6 UJ	6	0.39	0.51	0.6
Silver	0.72 J	0.62 J	1 J	1.2	16	0.74	0.82	1.2
Sodium	270 U	279 U	424 J	285 U	6	291.17	352.85	424
Vanadium	16.3	17.9	18	18.9	16	16.63	17.46	18.9
Zinc	77.2	18.1	53.3	38	16	34.64	43.53	77.2
TPH	255	311	325	294	16	190.55	264.04	674

* Between 0 and 2 feet deep

R Rejected

J Estimated value below reporting limit or estimated based on data quality criteria

U Nondetect. Value shown is one-half the reporting limit.

TABLE 7-21

CHEMICALS OF CONCERN IN SOILS
SMWUs 92 AND 93
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Volatile Organics					
1,2-Dichloroethane	0.0028	---	---	---	Y
Ethylbenzene	0.0028	---	---	---	Y
Toluene	0.008	---	---	---	Y
Xylenes	0.0072	---	---	---	Y
Semivolatile Organics					
Anthracene	0.18	---	---	---	Y
Benzo(a)anthracene	0.8	---	---	---	Y
Benzo(a)pyrene	0.94	---	---	---	Y
Benzo(b)fluoranthene	2.1	---	---	---	Y
Benzo(g,h,i)perylene	0.45	---	---	---	Y
Butyl benzyl phthalate	0.18	---	---	---	Y
Carbazole	0.18	---	---	---	Y
Chrysene	0.94	---	---	---	Y
Di-n-butyl phthalate	0.18	---	---	---	Y
Fluoranthene	1.1	---	---	---	Y
Ideno(1,2,3-cd)pyrene	0.47	---	---	---	Y
Pentachlorophenol	0.9	---	---	---	Y
Phenanthrene	0.47	---	---	---	Y
Pyrene	2	---	---	---	Y
Metals					
Aluminum	10500	10540	5000	700 - 100000	N
Antimony	5.7	*	<1	0.2 - 10	Y
Arsenic	2.7	15.5	6.5	1.0 - 40	N
Barium	228	642	500	10 - 5,000	N
Beryllium	0.63	0.73	1 - 2	<1 - 15	N
Cadmium	1.9	*	---	0.01 - 2.0	Y
Calcium	568000	186400	---	---	N**
Chromium	13.9	12.5	30	5 -1,500	Y
Cobalt	4.5	4.5	3 - 7	0.5 - 65	N
Copper	158	*	20	1 - 700	Y
Iron	12000	8720	15000	100 - 100000	N
Lead	502	25.8	15	10 - 700	Y
Magnesium	28110	11790	---	---	N**
Manganese	216	164	500	20 - 10000	Y

TABLE 7-21

CHEMICALS OF CONCERN IN SOILS
SMWUs 92 AND 93
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Nickel	8.5	9	15	2 - 750	N
Potassium	1780	2572	---	---	N**
Selenium	0.6	*	0.3	<0.1 - 4.3	Y
Silver	1.2	*	---	0.01 - 8	N
Sodium	424	*	---	---	N**
Vanadium	18.9	25.3	---	---	N
Zinc	77.2	21.9	45	<5 - 2900	Y
TPH	674	---	---	---	Y

(1) Upper Tolerance Limit (UTL) of the mean = mean + 2 x standard deviation. This is for all practical purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k = 2.02 for n = 37
(2) USGS (1984)
(3) Values mainly from Bowen (1979). Values for copper, lead, selenium, and zinc from USGS (1984).
* Data insufficient to calculate UTL of background concentration.
** Essential nutrient natural to soils. Not expected to be of concern compared to other COCs.
Y = Yes
N = No
--- = Not available

TABLE 7-22
RISK CHARACTERIZATION SUMMARY - SWMUs 92/93

Chemical	Sample Number									
	CAN092-0921-0000	CAN092-0921-0002	CAN092-0922-0000	CAN092-0922-0002	CAN092-0923-0000	CAN092-0923-0002	CAN092-0924-0000	CAN092-0924-0002	CAN092-0925-0000	CAN092-0925-0002
Volatile Organics										
1,2-Dichloroethane	0.0027 U	0.0027 U	0.0027 U	0.0028 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0013 J	0.0027 U
Ethylbenzene	0.0015 J	0.0027 U	0.0027 U	0.0028 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U
Toluene	0.0075	0.0027 U	0.0027 U	0.0011 J	0.0027 U	0.0027 U	0.0016 J	0.0027 U	0.0049 J	0.0015 J
Xylenes (total)	0.0072	0.0027 U	0.0027 U	0.0016 J	0.0014 J	0.0017 J	0.0025 J	0.0027 U	0.0053	0.0027 U
Semivolatile Organics										
Anthracene			0.18 U		0.175 U	0.18 U	0.175 U		0.07 J	0.175 U
Benzo(a)anthracene			0.19 J		0.18 J	0.18 U	0.44		0.8	0.175 U
Benzo(a)pyrene			0.21 J		0.22 J	0.18 U	0.64		0.94	0.175 U
Benzo(b)fluoranthene			0.46		0.49	0.18 U	1.4		2.1	0.175 U
Benzo(g,h,i)perylene			0.13 J		0.12 J	0.18 U	0.33 J		0.45	0.175 U
Butyl benzyl phthalate			0.14 J		0.11 J	0.18 U	0.175 U		0.175 U	0.175 U
Carbazole			0.18 U		0.175 U	0.18 U	0.038 J		0.089 J	0.175 U
Chrysene			0.3 J		0.28 J	0.18 U	0.56		0.94	0.175 U
Di-n-butyl phthalate			0.073 J		0.175 U	0.18 U	0.175 U		0.175 U	0.175 U
Fluoranthene			0.49		0.54	0.18 U	0.6		1.1	0.175 U
Ideno(1,2,3-cd)pyrene			0.13 J		0.12 J	0.18 U	0.34 J		0.47	0.175 U
Pentachlorophenol										
Phenanthrene			0.22 J		0.34 J	0.18 U	0.28 J		0.47	0.175 U
Pyrene			0.45		0.5	0.18 U	1.2		2	0.175 U
Metals										
Antimony	3.2 U	3.2 U	3.3 U	3.4 U	3.2 U	3.3 U	5.7 J	5.3 J	3.2 U	3.2 U
Cadmium	1.6	0.59	1	0.28 U	0.27 U	0.27 U	0.44 J	0.27 U	1.9	0.89
Chromium	12.3	5.9	13.8	8.7	9.3	8.1	9.1	5.7	13.9	5.3
Copper	14.2	5.7	6.9	6.7	6.7	6.9	7.5	6.2	9.8	5.7
Lead	502	4.6	64.3 J	8.4	12.5	8.3	20.9	5.8	37.5	5.7
Manganese	216	122	135	210	199	195	130	149	182	122
Selenium										
Zinc	39.3	13.6	72.6	19.3	44.9	17.5	48.4	14.3	43.6	15.7
TPH	674	47.6	278	22.5 U	58.2	49	159	61.5	295	120

* Between 0 and 2 feet deep

** Mean soil concentration multiplied by BAF of 4.6 (Cd).

R Rejected

J Estimated value below reporting limit or estimated based on data quality criteria

U Non-detect, value shown i s one-half the reporting limit

TABLE 7-22
RISK CHARACTERIZATION SUMMARY - SWMUs 92/93

Chemical	Sample Number CAN093-0931-0000	CAN093-0931-0002	CAN093-0932-0000	CAN093-0932-0002	CAN093-0933-0000	CAN093-0933-0002	N	Arithmetic Mean (mg/kg)	Robin Threshold Dietary Level (mg/kg)	Risk?	Deer Mouse Threshold Dietary Level (mg/kg)	Risk?
Volatile Organics												
1,2-Dichloroethane							10	0.0026	312.5	--	520.8	--
Ethylbenzene							10	0.0026	485.5	--	809.2	--
Toluene	0.0026 J	0.0027 U	0.0027 U	0.008	0.0049 J	0.0029 U	16	0.0034	12500	--	20800	--
Xylenes (total)	0.0018 J	0.0027 U	0.0027 U	0.0028 U	0.0018 J	0.0029 U	16	0.0028	5000	--	8300	--
Semivolatile Organics												
Anthracene							6	0.16	5000	--	8333.3	--
Benzo(a)anthracene	0.21 U		0.074 J	0.185 U	0.077 J		10	0.25	0.4	--	0.67	--
Benzo(a)pyrene	0.21 U		0.062 J	0.185 U	0.084 J		10	0.29	0.002	Possible	0.003	Possible
Benzo(b)fluoranthene	0.21 U		0.073 J	0.185 U	0.14 J		10	0.54	8	--	13.3	--
Benzo(g,h,i)perylene	0.21 U		0.073 J	0.185 U	0.056 J		10	0.19	375	--	625	--
Butyl benzyl phthalate							6	0.16	470	--	780	--
Carbazole							6	0.14	250	--	417	--
Chrysene	0.21 U		0.095 J	0.185 U	0.12 J		10	0.30	12	--	20	--
Di-n-butyl phthalate							6	0.16	10500	--	17500	--
Fluoranthene	0.21 U		0.15 J	0.185 U	0.1 J		10	0.37	625	--	1041.7	--
Ideno(1,2,3-cd)pyrene	0.21 U		0.055 J	0.185 U	0.038 J		10	0.19	14.4	--	24	--
Pentachlorophenol	0.045 J		0.85 U	0.9 U	0.85 U		4	0.66	190	--	83.3	--
Phenanthrene	0.21 U		0.13 J	0.185 U	0.1 J		10	0.23	150	--	250	--
Pyrene	0.21 U		0.19 J	0.185 U	0.12 J		10	0.52	375	--	625	--
Metals												
Antimony							10	3.70	16.5	--	27.5	--
Cadmium	0.32 U	0.27 U	1.9	1.2	1	1	16	3.82**	10.5	--	166.7	--
Chromium	9.5 J	5.3	7.7	8.1	12.9	11.8	16	9.21	87.5 (VI)	--	92 (VI)	--
Copper	8.6	4.5	158	7.4	8.4	8.5	16	16.98	260	--	50	--
Lead	7.3	5.2	32.4	5.8	10	11.8	16	46.41	87.5	--	150	--
Manganese	155 J	102 J	183	161	146	162	16	160.56	1750	--	166	--
Selenium	0.32 U	0.27 U	0.25 J	0.6 U	0.27 U	0.6 UJ	6	4.68**	5	--	0.125	Possible
Zinc	25.4	13.1	77.2	18.1	53.3	38	16	34.64	875	--	625	--
TPH	77.4	21.6 U	255	311	325	294	16	190.55	241	--	401.7	--

* Between 0 and 2 feet deep

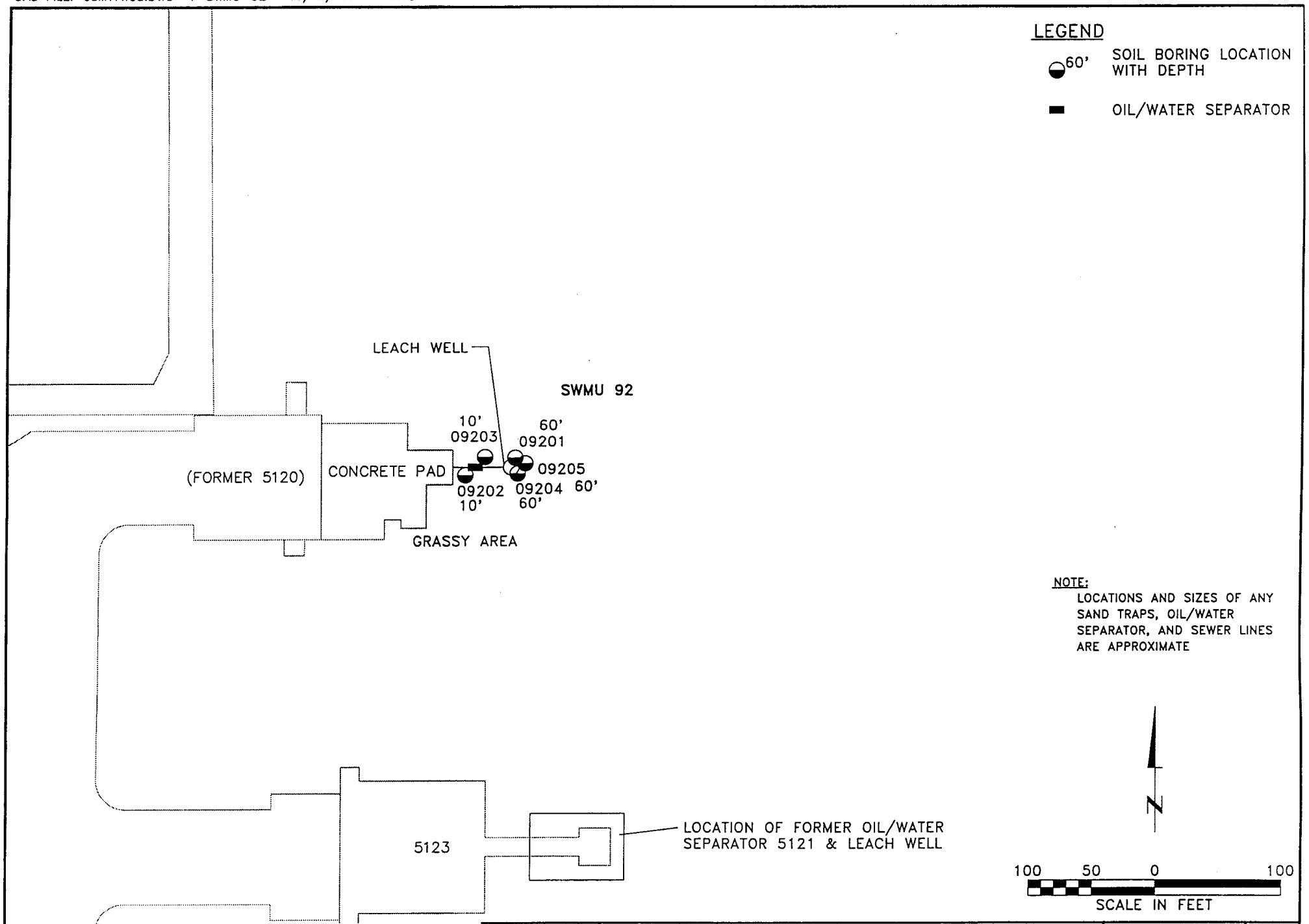
** Mean soil concentration multiplied by BAF of 4.6 (Cd).

R Rejected

J Estimated value below reporting limit or estimated based on data quality criteria

U Non-detect, value shown i s one-half the reporting limit

CAD FILE: C3M11W08.DWG V=SWMU-92 01/12/1994 14:54



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

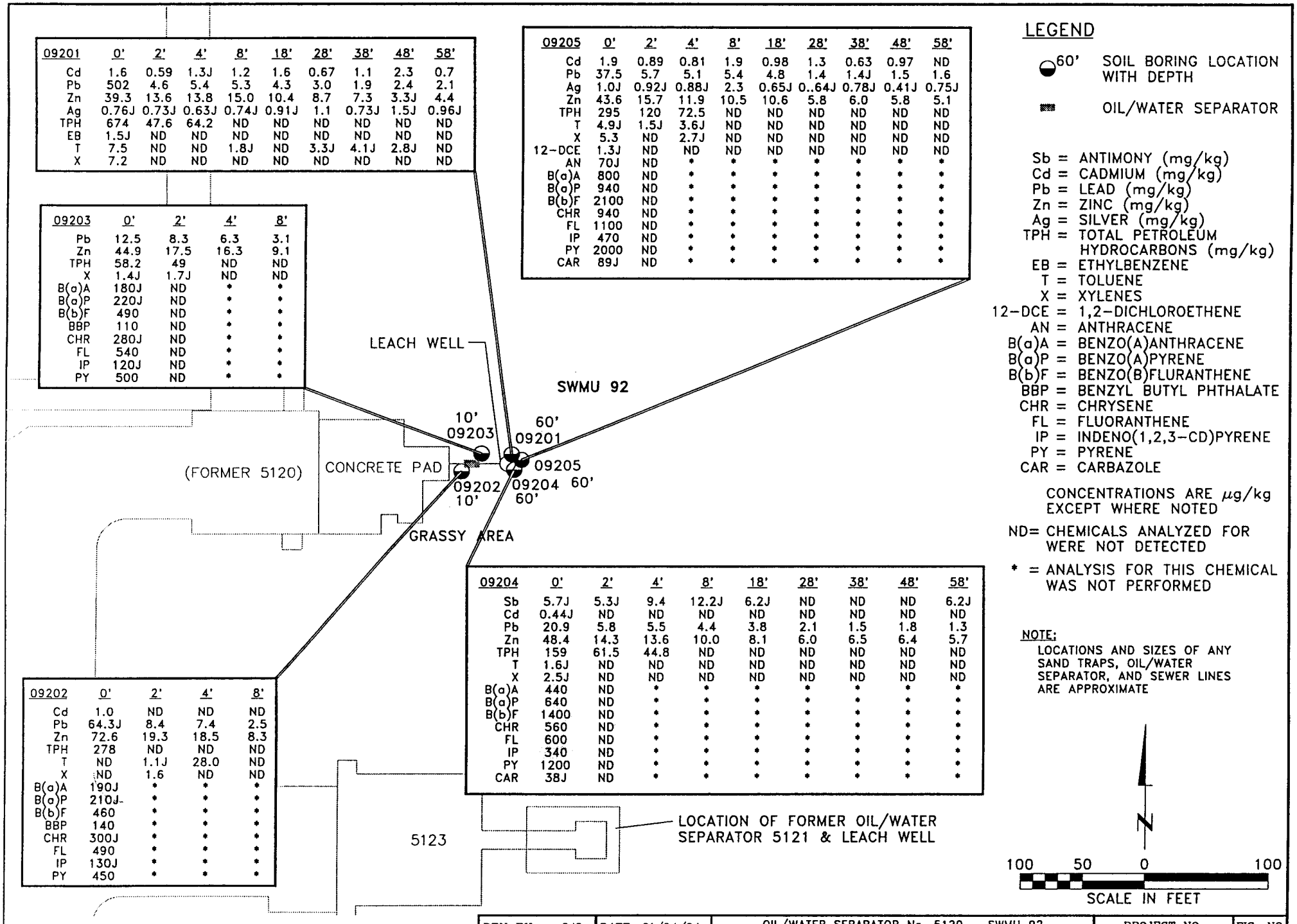
DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 5120 – SWMU 92 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 7-1

CAD FILE: C3M11W08.DWG V=HITS-92 02/15/94 15:38

09201	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cd	1.6	0.59	1.3J	1.2	1.6	0.67	1.1	2.3	0.7
Pb	502	4.6	5.4	5.3	4.3	3.0	1.9	2.4	2.1
Zn	39.3	13.6	13.8	15.0	10.4	8.7	7.3	3.3J	4.4
Ag	0.76J	0.73J	0.63J	0.74J	0.91J	1.1	0.73J	1.5J	0.96J
TPH	674	47.6	64.2	ND	ND	ND	ND	ND	ND
EB	1.5J	ND	ND	ND	ND	ND	ND	ND	ND
T	7.5	ND	ND	1.8J	ND	3.3J	4.1J	2.8J	ND
X	7.2	ND	ND	ND	ND	ND	ND	ND	ND

09203	0'	2'	4'	8'
Pb	12.5	8.3	6.3	3.1
Zn	44.9	17.5	16.3	9.1
TPH	58.2	49	ND	ND
X	1.4J	1.7J	ND	ND
B(a)A	180J	ND	*	*
B(a)P	220J	ND	*	*
B(b)F	490	ND	*	*
BBP	110	ND	*	*
CHR	280J	ND	*	*
FL	540	ND	*	*
IP	120J	ND	*	*
PY	500	ND	*	*

09205	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cd	1.9	0.89	0.81	1.9	0.98	1.3	0.63	0.97	ND
Pb	37.5	5.7	5.1	5.4	4.8	1.4	1.4J	1.5	1.6
Ag	1.0J	0.92J	0.88J	2.3	0.65J	0..64J	0.78J	0.41J	0.75J
Zn	43.6	15.7	11.9	10.5	10.6	5.8	6.0	5.8	5.1
TPH	295	120	72.5	ND	ND	ND	ND	ND	ND
T	4.9J	1.5J	3.6J	ND	ND	ND	ND	ND	ND
X	5.3	ND	2.7J	ND	ND	ND	ND	ND	ND
12-DCE	1.3J	ND	ND	ND	ND	ND	ND	ND	ND
AN	70J	ND	*	*	*	*	*	*	*
B(a)A	800	ND	*	*	*	*	*	*	*
B(a)P	940	ND	*	*	*	*	*	*	*
B(b)F	2100	ND	*	*	*	*	*	*	*
CHR	940	ND	*	*	*	*	*	*	*
FL	1100	ND	*	*	*	*	*	*	*
IP	470	ND	*	*	*	*	*	*	*
PY	2000	ND	*	*	*	*	*	*	*
CAR	89J	ND	*	*	*	*	*	*	*



09204	0'	2'	4'	8'	18'	28'	38'	48'	58'
Sb	5.7J	5.3J	9.4	12.2J	6.2J	ND	ND	ND	6.2J
Cd	0.44J	ND	ND	ND	ND	ND	ND	ND	ND
Pb	20.9	5.8	5.5	4.4	3.8	2.1	1.5	1.8	1.3
Zn	48.4	14.3	13.6	10.0	8.1	6.0	6.5	6.4	5.7
TPH	159	61.5	44.8	ND	ND	ND	ND	ND	ND
T	1.6J	ND	ND	ND	ND	ND	ND	ND	ND
X	2.5J	ND	ND	ND	ND	ND	ND	ND	ND
B(a)A	440	ND	*	*	*	*	*	*	*
B(a)P	640	ND	*	*	*	*	*	*	*
B(b)F	1400	ND	*	*	*	*	*	*	*
CHR	560	ND	*	*	*	*	*	*	*
FL	600	ND	*	*	*	*	*	*	*
IP	340	ND	*	*	*	*	*	*	*
PY	1200	ND	*	*	*	*	*	*	*
CAR	38J	ND	*	*	*	*	*	*	*

09202	0'	2'	4'	8'
Cd	1.0	ND	ND	ND
Pb	64.3J	8.4	7.4	2.5
Zn	72.6	19.3	18.5	8.3
TPH	278	ND	ND	ND
T	ND	1.1J	28.0	ND
X	ND	1.6	ND	ND
B(a)A	190J	*	*	*
B(a)P	210J	*	*	*
B(b)F	460	*	*	*
BBP	140	*	*	*
CHR	300J	*	*	*
FL	490	*	*	*
IP	130J	*	*	*
PY	450	*	*	*

LEGEND

60' SOIL BORING LOCATION WITH DEPTH

OIL/WATER SEPARATOR

Sb = ANTIMONY (mg/kg)
Cd = CADMIUM (mg/kg)
Pb = LEAD (mg/kg)
Zn = ZINC (mg/kg)
Ag = SILVER (mg/kg)
TPH = TOTAL PETROLEUM HYDROCARBONS (mg/kg)
EB = ETHYLBENZENE
T = TOLUENE
X = XYLENES
12-DCE = 1,2-DICHLOROETHENE
AN = ANTHRACENE
B(a)A = BENZO(A)ANTHRACENE
B(a)P = BENZO(A)PYRENE
B(b)F = BENZO(B)FLURANTHENE
BBP = BENZYL BUTYL PHTHALATE
CHR = CHRYSENE
FL = FLUORANTHENE
IP = INDENO(1,2,3-CD)PYRENE
PY = PYRENE
CAR = CARBAZOLE

CONCENTRATIONS ARE $\mu g/kg$ EXCEPT WHERE NOTED

ND= CHEMICALS ANALYZED FOR WERE NOT DETECTED

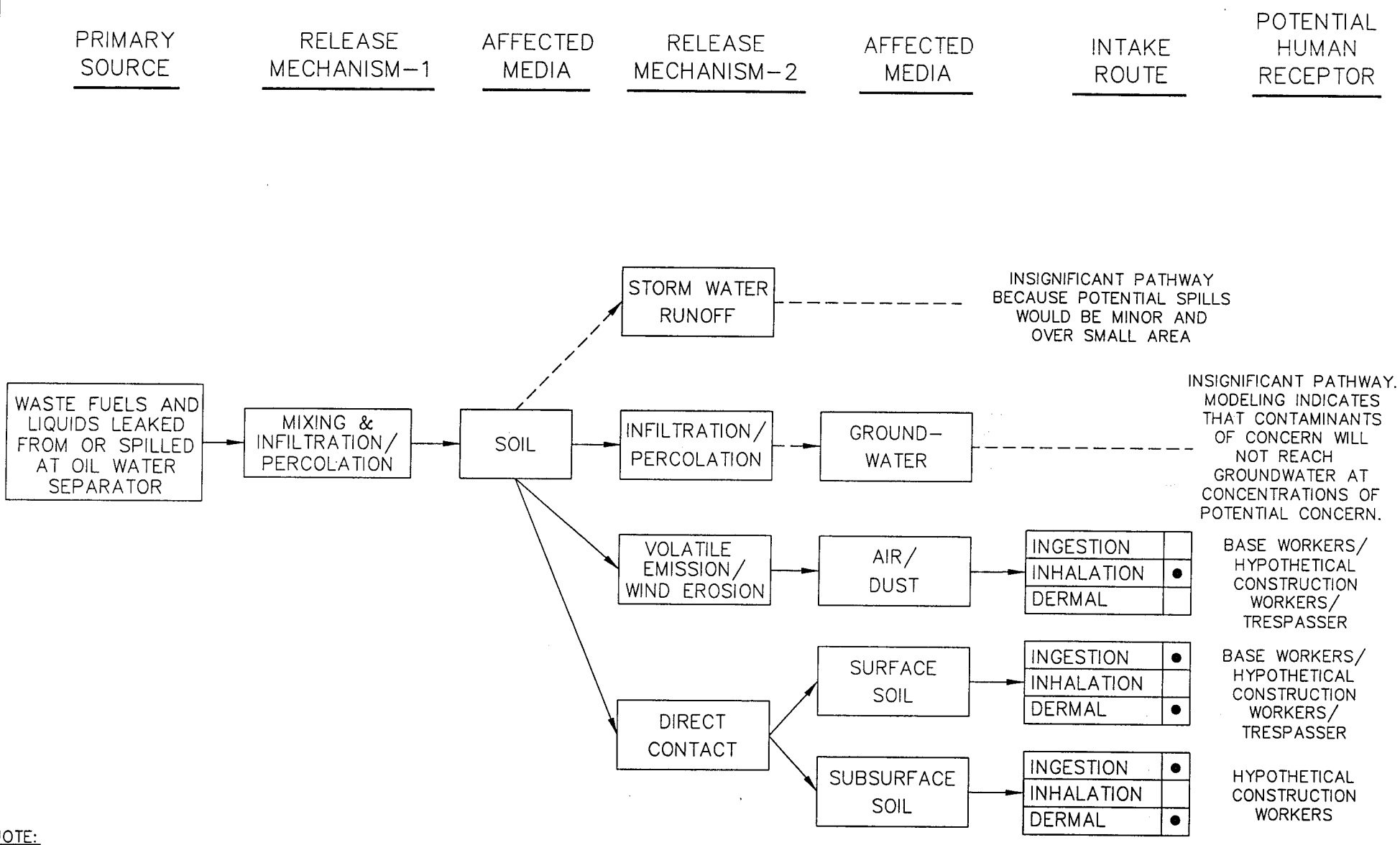
* = ANALYSIS FOR THIS CHEMICAL WAS NOT PERFORMED

NOTE:
LOCATIONS AND SIZES OF ANY SAND TRAPS, OIL/WATER SEPARATOR, AND SEWER LINES ARE APPROXIMATE

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/04/94	OIL/WATER SEPARATOR No. 5120 – SWMU 92 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 7-2
CHK'D BY: .	REVISION: 0			

CAD FILE: C3M11W20.DWG V=SWMU-92 01/17/1994 13:48



NOTE:

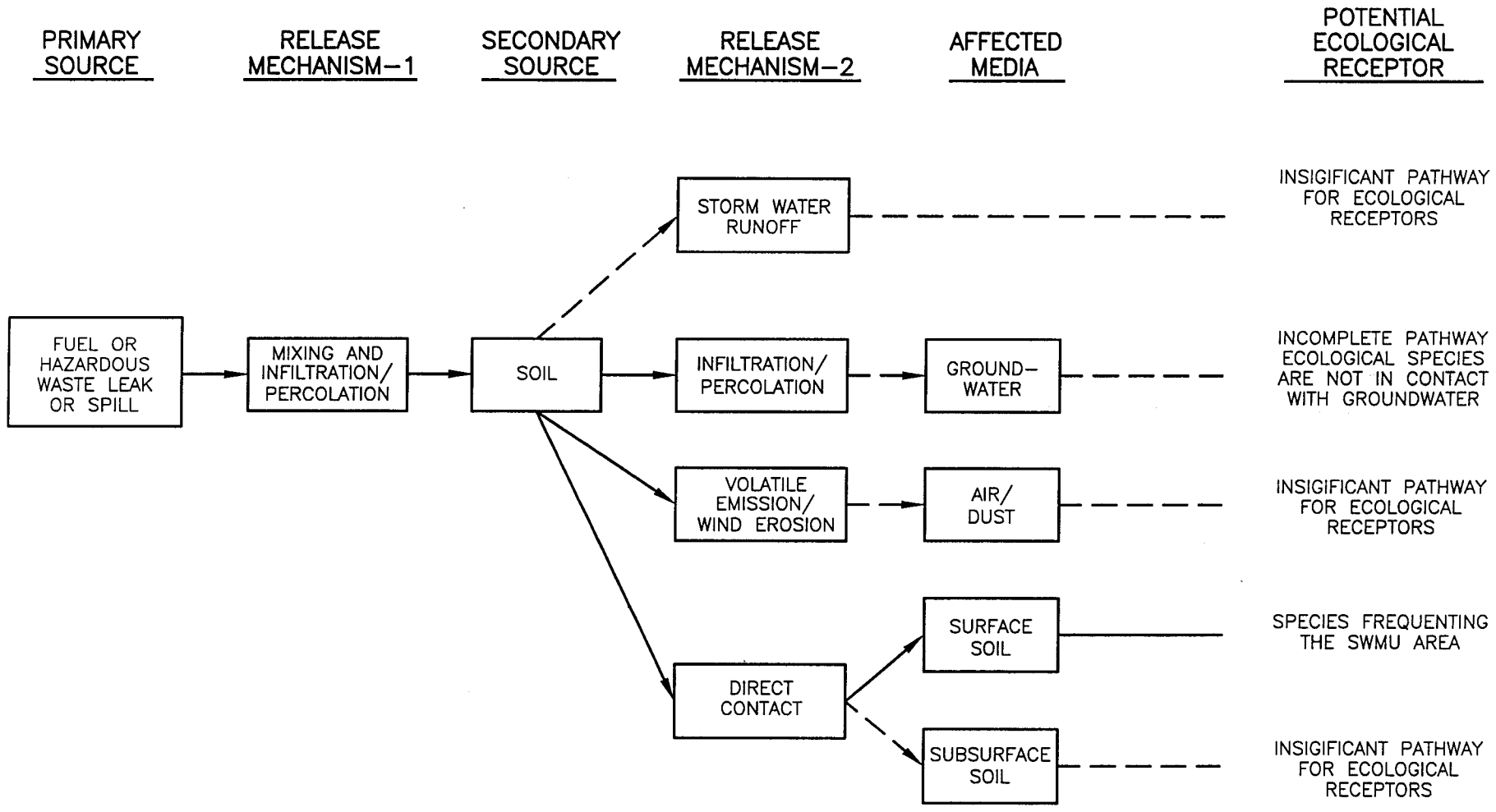
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART OIL WATER SEPARATOR No.5120 SWMU 92 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	7-3

C3M11W22.DWG V=SWMU-92-93 02/15/1994 8:00

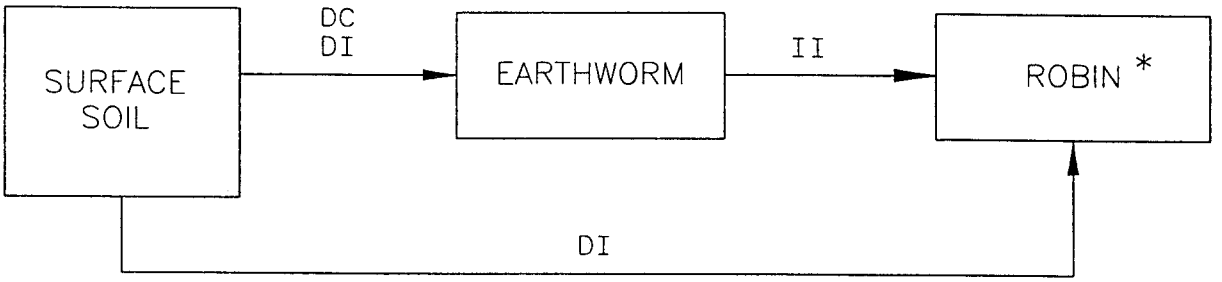


NOTES:

SOLID LINES REPRESENT POTENTIALLY COMPLETE AND SIGNIFICANT PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY NVD	DATE 12/30/93	EXPOSURE PATHWAY FLOW CHART FOR SWMU 92/93 ECOLOGICAL RECEPTORS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0		C3M11W	7-4



DC = DIRECT CONTACT

DI = DIRECT INGESTION

II = INDIRECT INGESTION
(i.e. SECONDARY, TERTIARY CONSUMPTION)

* = KEY RECEPTOR SPECIES

DRN BY NVD	DATE 12/30/93	CONCEPTUAL SITE MODEL SWMU 92/93	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0	CANNON AIR FORCE BASE NEW MEXICO	C3M11W	7-5

CAD FILE: C3M11W23.DWG V=SWMU-92-93 02/15/1994 9:30

8.0
OIL/WATER SEPARATOR NO. 5121 - SWMU NO. 93

8.1 SITE BACKGROUND

8.1.1 Site Description

SWMU 93 is the site of a former OWS that was associated with the old (now demolished) Power Check Pad No. 5121. The location of former OWS 5121 lies under the hush house portion of Building 5123, which houses a jet engine test facility (Figure 8-1). The ground surface around the hush house is non-native grasses and soils. The topography at this SWMU is essentially flat.

8.1.2 Site History

OWS 5121 was located on the east side of former Power Check Pad No. 5121. The OWS was a two-compartment underground unit with a detached 100-gallon oil storage tank which received wash water generated from aircraft engine testing and maintenance operations. The oils recovered by the OWS were directed to the 100-gallon oil holding tank and the wastewater was discharged to a leach well located approximately 40 feet east of the OWS. This facility was active from approximately 1957 to 1988, when OWS 5121 and the associated leach well were removed during the demolition of Building 5121. This building was replaced with Facility 5123, which was constructed over the location formerly occupied by OWS 5121.

8.1.3 Current Use

OWS 5121 and the associated leach well no longer exist. Building 5123 is currently used for the testing of jet engines from fighter aircraft.

8.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATIONS

8.2.1 Physical Investigation

Three 60-foot-deep soil borings were drilled as close as possible to the former location of the OWS and leach well to sample soils for indications of contaminants which may have leaked or seeped from these sources. Placement of these borings was governed by the presence of the Building 5123 foundation and hush house. Two borings were located on the north side of the hush house structure, and one boring was located on the south side to encompass the location of the former facility. Boring locations are shown on Figure 8-1.

Soil samples were collected at the surface and at the 1.5- to 3.5-foot, 4- to 6-foot, 8- to 10-foot, 18- to 20-foot, 28- to 30-foot, 38- to 40-foot, 48- to 50-foot, and 58- to 60-foot depth intervals.

Target analytes for all borings include VOCs, SVOCs, metals, and TRPH. Surficial samples in areas of soil cover were collected approximately at the 0.2- to 0.5-foot-depth interval to provide surface soil data for risk assessment purposes.

8.2.2 Chemical Investigation

A total of 27 samples, not counting QC samples, were collected and analyzed. Sampling and analyses performed are summarized in Table 8-1. A summary of the analytical results for these soil samples is provided in Table 8-2a (near-surface soil) and Table 8-2b (subsurface soil). The tables provide results for analytes that were detected at least once in each sample group (surface and subsurface). Complete analytical summary results are provided in the QCSR (Appendix A of the RFI report).

8.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI report, and the data were deemed to be of adequate quality to meet the objectives of the RFI. There were no data quality issues affecting usability of the data for risk assessment.

8.2.4 Nature and Extent of Contamination

In general, the samples had low levels of organic contamination including PAHs. There was no visible evidence of spills or leaks in the vicinity, and the entire area around the building was unpaved.

The primary contamination at the site included PAHs, which were detected in surface soils in two of the three soil borings at concentrations ranging to 140 μg/kg for benzo(b)fluoranthene. PAHs were not detected in subsurface soil samples from the same boring, indicating that they are not being transported vertically. Only very low levels of VOCs were detected (e.g., toluene was detected up to 8 μg/kg and xylenes were detected up to 3.5 μg/kg). Barium was detected at a maximum concentration of 1,110 mg/kg at a depth of 28 feet; however, no other barium results exceeded reported background ranges. Cadmium was reported at a maximum of 3.0 mg/kg at depths of 8 feet and 18 feet.

8.3 HUMAN HEALTH RISK ASSESSMENT

8.3.1 Exposure Pathway Flow Chart

Figure 8-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways for OWS 5121. In the flow chart potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary sources are waste fluids (e.g., fuels, oils, and solvents) that may have leaked from the former separator system into subsurface soils or have been discharged or spilled on surface soil.

Chemicals from the primary source may be released to other media that may in turn act as secondary sources of chemical release or exposure. Mixing and infiltration of the wastes to soil is shown as a primary chemical release mechanism. Chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion, or result in exposure via direct contact (e.g., dermal contact or incidental ingestion). Storm water runoff is not considered to be a significant

pathway for human exposures, because the SWMU covers only a small area which is now covered by a building, surface spills are not likely to be significant, and no developed drainageways are present near the SWMU.

As shown on the flow chart, surface soils may provide exposures to Base workers (occupational exposures), hypothetical future construction workers, and hypothetical future trespassers. Residential exposures were not considered to be a likely future scenario because the SWMU is located in an industrial area (beneath the jet engine test facility) of the Base. Air emissions (volatile and particulates) from surface soil may also provide exposures to Base workers and construction workers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Groundwater is used for domestic purposes on and off Base. Groundwater is probably an insignificant pathway for human exposure to chemicals of concern because little contamination was found in subsurface soils. Nevertheless, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling (Section 8.3.5.2) indicate that contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway ws not evaluated further.

In summary, potential complete human exposure pathways to be evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Trespassers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

8.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

Background levels were defined by the upper tolerance limit (UTL) of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; see Appendix A.)

Results of the comparison of metals concentrations in soil for SWMU 93 to background levels are given in Tables 8-3 and 8-4. A summary of the results of the comparison is presented here.

The maximum detected concentration of cadmium, chromium, copper, lead, silver, and zinc in surface soils exceeded the background levels. The maximum detected concentrations of antimony, barium, cadmium, copper, lead, silver, and zinc in total soils exceeded the background levels. Therefore, these metals were retained for further evaluation as potential chemicals of concern in surface soil and total soils.

Only one of 27 (3 percent) samples of antimony, barium, and lead exceeded the background ranges. This exceedance rate is expected for the 95 percent UTL of the background range. Therefore, these metals are probably naturally occurring and should not be evaluated as chemicals of concern (Klein and Hurlbut 1985). However, to be conservative, they will be retained as chemicals of concern in the risk assessment.

8.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 93, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 8-2a and 8-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentrations of cadmium, copper, lead, silver, and zinc detected in surface soil exceeded background ranges according to the comparison described in Section 8.3.2. These metals are, therefore, considered as chemicals of concern in surface soil. The concentrations of antimony, barium, cadmium, copper, lead, silver, and zinc detected in total (surface and subsurface) soil exceeded background ranges according to the comparison described in Section 8.3.2. These metals are, therefore, considered as chemicals of concern in total soil. Organic contaminants detected in soils were retained as chemicals of concern for risk assessment. The chemicals, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, 4-methyl-2-pentanone, benzene, bromodichloromethane, chlorobenzene, chloroform, ethylbenzene, styrene, tetrachloroethene, and trichloroethene were detected in subsurface soils. However, all of these target analytes were detected in fewer than 5 percent of the samples, were detected only at concentrations below reporting limits, and in most cases, were detected in one sample at a depth of 28 feet. The chemicals are not representative of contamination at the site and are present only at a depth where exposure is not likely. Therefore, these analytes are not retained as chemicals

of concern. Chemicals of concern in surface soil and total soil are listed in Tables 8-5 and 8-6, respectively.

8.3.4 Environmental Fate and Transport

8.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

8.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (DOE 1991), describes the mass balance of a contaminant (based on average soil concentrations) in the contaminated soil volume at the SWMU. The DOE model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP] Model) and accounts for sorption to soils and degradation in the vadose zone. The model conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of chemicals of concern. The input parameters and estimated leachate concentrations are given in Section 8.3.5.2. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water (Section 8.3.5.2). Since the RBCs were developed for drinking water (at the tap) and are based on very conservative exposure and health-protective (risk) assumptions, it can be concluded that modeled groundwater concentrations do not exceed RBCs will pose no significant health risk.

8.3.4.3 Air Modeling

RME air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using RME soil concentrations of chemicals of concern. The results of the air modeling are given in Section 8.3.5.2. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use at hazardous waste sites to calculate soil clean-up levels (EPA 1991). Air concentrations were calculated for only those chemicals with inhalation toxicity factors which were evaluated quantitatively in the risk assessment. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

8.3.5 Exposure Point Concentrations

8.3.5.1 Soils

Tables 8-7 and 8-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils, respectively, at OWS 5121.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use of "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C. Tables 8-9 and 8-10 give the soil concentrations of organic compounds from surface and total soils, respectively which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used

for calculating risks from dermal exposures to organic chemicals in soils. The absorbed fraction (from Table C-26 Appendix C) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soil. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

For purposes of risk assessment, surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depth (i.e., XXXXX-XXXX-0002) were actually from a depth of 1.5 to 3.5 feet. These samples were not considered surface samples, but are included in the risk assessment for subsurface soil exposures.

8.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 93. Model results are included in Table 8-11. These modeled concentrations were then compared to EPA Region III tap-water RBCs (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 8-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap-water RBCs. No modeled concentrations exceeded the RBCs, so significant risks are not expected from the groundwater pathway. Therefore, the groundwater pathway has been determined to be insignificant and was not evaluated further.

8.3.5.3 Air

RME air concentrations of volatile and particulate emissions from surface soil and from total soil were calculated using RME concentrations of chemicals of concern. The results of the air modeling from surface soil are shown in Tables 8-13 and 8-14. The results of the air modeling from total soil are shown in Tables 8-15 and 8-16.

8.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the intake

factors used to quantify chemical intake of SWMU-related contaminants in various environmental media soil and air. Table 8-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

8.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 8-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to contaminated surface soil at SWMU 93. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative, because there are no occupational receptors routinely working outdoors at SWMU. Furthermore, the surface area of the SWMU is small (approximately 110 feet by 50 feet or about 0.1 acre), and long-term exposures are not likely to occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 93 via the dermal contact, inhalation, and ingestion pathways is 0.00002 and 0.003 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk under the assumed chronic exposure conditions is 6×10^{-10} under the average exposure case and 2×10^{-7} under the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). Therefore, negligible risk is associated with exposure to surface soils at this SWMU.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 93. Exposures were assumed to occur during excavation activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 93 via the dermal contact, inhalation, and ingestion pathways is 0.0008 and 0.001 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 2×10^{-10} in the average case and 2×10^{-9} in the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991c).

Hypothetical Trespasser Exposure

Hypothetical future trespassers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface soil at SWMU 93. Hypothetical future trespassers were assumed to be exposed at SWMU 93 for 2 hours/day and 8 hours/day, for 26 and 52 days/year, over 6 years for the average and RME cases, respectively. These assumptions are very conservative, because Cannon AFB is likely to remain a military installation, making access to contaminants at SWMU 93 via a trespasser scenario unlikely.

The total hazard index calculated for noncarcinogenic health effects due to exposures to contaminants in surface soil at SWMU 93 via the dermal contact, ingestion, and inhalation pathways is 3×10^{-6} and 6×10^{-4} in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 1×10^{-10} under the average exposure case and 1×10^{-8} under the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b).

8.3.8 Qualitative Assessment of Exposures to Lead

Lead exposures are not addressed in the quantitative risk assessment, because EPA withdrew the RfD for lead in 1989, primarily due to the lack of a discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. This level is supported by EPA's Uptake/Biokinetic (UBK) Lead Model which predicts that exposures of children ages 0 to 6 to soils with approximately these levels will not result in blood lead levels that exceed a level of concern established by the Centers for Disease Control.

The maximum lead concentration measured in soils at SWMU 93 was 32.40 mg/kg detected in surface soil at 0932-0000. Lead was measured at 1.1 mg/kg to 10.0 mg/kg in other soil samples at SWMU 93. The maximum concentration detected at SWMU 93 is below the range suggested by EPA for residential soils. Lead detected in soils at SWMU 93 would not be expected to pose a threat to human health.

8.3.9 Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief

hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil and water samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks were well below levels of potential concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available, and when the fuel product is known. The provisional values are under review and subject to revision. The RBCs derived from them are used simply as a guide to potential health hazards).

The toxicity factors and calculation of risk-based concentrations are shown in Table 8-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,613 mg/kg. The maximum SWMU concentration of TPH is 325 mg/kg, well below the conservative RBC.

8.3.10 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 77 and their effect on the results and conclusions of the risk assessment are listed below.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens, such as benzo(a)pyrene, which can cause skin cancer through a direct action at the point of application. The exclusion of PAHs from quantitative evaluation in the dermal exposure pathway may underestimate the potential human health risk from dermal contact with soils at the SWMU. However, cumulative cancer risks at this SWMU were so low as to be negligible ($\leq 2 \times 10^{-7}$), that the uncertainty regarding dermal exposure to PAHs does not affect the results or conclusions of the risk assessment.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected, because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- Since the surface area of this SWMU is extremely small, the exposure assumptions used are likely to significantly overestimate actual exposures to contaminated soils and risks at this SWMU.

- Phenanthrene and benzo(g,h,i)perylene were not considered in the quantitative risk assessment, because they do not have EPA-established toxicity factors. Their exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results or conclusions of the risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

8.4 ECOLOGICAL RISK ASSESSMENT

Since SWMU 92 and SWMU 93 are located close together and the ecology around the two SWMUs is relatively homogeneous, the ecological risk assessments for these two SWMUs

were conducted together. The ecological risk assessment for SWMU 93 is discussed in Section 7.4 of this report.

8.5 SUMMARY AND CONCLUSIONS

8.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at the SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 8-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU.

- Results of the ecological risk assessment (see Section 7.4) show that there is a low potential for risks to predatory birds (i.e., *Northern harrier*) due to chemical releases at the SWMU. However, since the SWMU has a small surface area compared to the hunting range of the *harrier*, potential risks are not expected to be significant.

8.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

TABLE 8-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5121 (SWMU NO. 93)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09301	0 - 0.5	CAN093-0931-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN093-0931-9361	FD	Soil	X	X	X	X		2	1
	0 - 0.5	CAN093-0931-9301	MRD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN093-0931-0002		Soil	X		X	X		2	1
	4 - 6	CAN093-0931-0004		Soil	X	X	X	X		2	1
	4 - 6	CAN093-0931-6004	MS/MSD (SVOC only)	Soil		X					1
	8 - 10	CAN093-0931-0008		Soil	X		X	X		2	1
	8 - 10	CAN093-0931-6008	MS/MSD	Soil	X		X	X		2	2
	18 - 10	CAN093-0931-0018		Soil	X		X	X		2	1
	28 - 30	CAN093-0931-0028		Soil	X		X	X		2	1
	38 - 40	CAN093-0931-0038		Soil	X		X	X		2	1
	48 - 50	CAN093-0931-0048		Soil	X		X	X		2	1
	58 - 60	CAN093-0931-0058		Soil	X		X	X		2	1
Boring 09302	0 - 0.5	CAN093-0932-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN093-0932-0002		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN093-0932-6002	MS/MSD (SVOC only)	Soil		X					
	4 - 6	CAN093-0932-0004		Soil	X		X	X		2	1
	8 - 10	CAN093-0932-0008		Soil	X		X	X		2	1
	8 - 10	CAN093-0932-6008	MS/MSD	Soil	X	X	X	X		2	2
	18 - 20	CAN093-0932-0018		Soil	X		X	X		2	1
	28 - 30	CAN093-0932-0028		Soil	X		X	X		2	1
	38 - 40	CAN093-0932-0038		Soil	X		X	X		2	1
	48 - 50	CAN093-0932-0048		Soil	X		X	X		2	1
	58 - 60	CAN093-0932-0058		Soil	X		X	X		2	1
		CAN093-0932-9351	AB	Water	X				2		
		CAN093-0932-9371	RB	Water	X				2		
		CAN093-0932-9381	DW	Water	X				2		
		CAN093-0932-9391	TB	Water	X				2		

TABLE 8-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5121 (SWMU NO. 93)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09303	0 - 0.5	CAN093-0933-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN093-0933-0002		Soil	X		X	X		2	1
	4 - 6	CAN093-0933-0004		Soil	X		X	X		2	1
	8 - 10	CAN093-0933-0008		Soil	X		X	X		2	1
	8 - 10	CAN093-0933-9362	FD	Soil	X		X	X		2	1
	8 - 10	CAN093-0933-9302	MRD	Soil	X	X	X	X		2	1
	18 - 20	CAN093-0933-0018		Soil	X		X	X		2	1
	28 - 30	CAN093-0933-0028		Soil	X		X	X		2	1
	38 - 40	CAN093-0933-0038		Soil	X		X	X		2	1
	48 - 50	CAN093-0933-0048		Soil	X	X	X	X		2	1
	58 - 60	CAN093-0933-0058		Soil	X		X	X		2	1

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 14-1 for locations of the borings.

TABLE 8-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0000			CAN093-0931-0002			CAN093-0932-0000			CAN093-0932-0002			CAN093-0933-0000			CAN093-0933-0002		
LAB SAMPLE NUMBER	0312740001SA			0312740003SA			0312730001SA			0312730002SA			0312730010SA			0312730011SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Toluene	2.6	6.4	J	<	5.4	U	<	5.4	U	8	5.6		4.9	5.3	J	<	5.7	U
Xylenes (total)	1.8	6.4	J	<	5.4	U	<	5.4	U	<	5.6	U	1.8	5.3	J	<	5.7	U
Semivolatile Organics (µg/kg)																		
Benzo(a)anthracene	<	420	U				74	360	J	<	370	U	77	350	J			
Benzo(a)pyrene	<	420	U				62	360	J	<	370	U	84	350	J			
Benzo(b)fluoranthene	<	420	U				73	360	J	<	370	U	140	350	J			
Benzo(g,h,i)perylene	<	420	U				73	360	J	<	370	U	56	350	J			
Chrysene	<	420	U				95	360	J	<	370	U	120	350	J			
Fluoranthene	<	420	U				150	360	J	<	370	U	100	350	J			
Indeno(1,2,3-cd)pyrene	<	420	U				55	360	J	<	370	U	38	350	J			
Pentachlorophenol	45	2000	J				<	1700	U	<	1800	U	<	1700	U			
Phenanthrene	<	420	U				130	360	J	<	370	U	100	350	J			
Pyrene	<	420	U				190	360	J	<	370	U	120	350	J			
Metals (mg/kg)																		
Aluminum	5930	12.8		3950	10.8		7130	10.8		8660	11.1		9380	10.6		10500	11.4	
Arsenic	2.3	0.64		1.6	0.54		2.5	0.54		2	0.56		2.3	0.53		2.5	0.57	
Barium	99.9	1.3	J	51.9	1.1	J	114	1.1	J	126	1.1	J	140	1.1	J	108	1.1	J
Beryllium	0.48	0.26		0.3	0.22		0.44	0.22		0.5	0.22		0.49	0.21		0.54	0.23	
Cadmium	<	0.64	U	<	0.54	U	1.9	0.54		1.2	0.56		1	0.53		1	0.57	
Calcium	14700	25.5		3710	21.6		26600	21.5		54300	22.3		37400	21.1		33400	22.8	
Chromium	9.5	1.3	J	5.3	1.1		7.7	1.1		8.1	1.1		12.9	1.1		11.8	1.1	
Cobalt	3.9	1.3		2.4	1.1		3.6	1.1		3.1	1.1		3.4	1.1		3.9	1.1	
Copper	8.6	2.6		4.5	2.2		158	2.2		7.4	2.2		8.4	2.1		8.5	2.3	
Iron	6980	12.8		4560	10.8		7920	10.8		8220	11.1		8360	10.6		9110	11.4	
Lead	7.3	0.64		5.2	0.54		32.4	2.7		5.8	2.8		10	1.1		11.8	1.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0000			CAN093-0931-0002			CAN093-0932-0000			CAN093-0932-0002			CAN093-0933-0000			CAN093-0933-0002		
LAB SAMPLE NUMBER	0312740001SA			0312740003SA			0312730001SA			0312730002SA			0312730010SA			0312730011SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Magnesium	1440	25.5		830	21.6		1740	21.5		2560	22.3		2220	21.1		2310	22.8	
Manganese	155	1.3	J	102	1.1	J	183	1.1		161	1.1		146	1.1		162	1.1	
Nickel	7.2	5.1		4.7	4.3		8.2	4.3		7.5	4.5		7.8	4.2		8.4	4.6	
Potassium	1150	638		760	539		1340	539		1420	557		1630	528		1780	569	
Selenium	<	0.64	U	<	0.54	U	0.25	1.1	J	<	1.1	U	<	0.53	U	<	1.1	UJ
Silver	0.69	1.3	J	0.57	1.1	J	0.72	1.1	J	0.62	1.1	J	1	1.1	J	1.2	1.1	
Sodium	<	638	U	170	539	J	<	539	U	<	557	U	424	528	J	<	569	U
Vanadium	17	1.3		11.9	1.1		16.3	1.1		17.9	1.1		18	1.1		18.9	1.1	
Zinc	25.4	2.6		13.1	2.2		77.2	2.2		18.1	2.2		53.3	2.1		38	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	77.4	51		<	43.1	U	255	43.1		311	44.6		325	42.2		294	45.6	
Water Quality (percent)																		
Water	22	0.1		7.2	0.1		7.2	0.1		10	0.1		5.3	0.1		12	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0004			CAN093-0931-0008			CAN093-0931-0018			CAN093-0931-0028			CAN093-0931-0038			CAN093-0931-0048		
LAB SAMPLE NUMBER	0312740004SA			0312740005SA			0312740006SA			0312740007SA			0312740008SA			0312740009SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Bromodichloromethane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Carbon disulfide				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Chlorobenzene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Chloroform				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,1-Dichloroethane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,1-Dichloroethene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,2-Dichloroethene (total)				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,2-Dichloropropane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Ethylbenzene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
4-Methyl-2-pentanone (MIBK)				<	12	U	<	11	U	<	12	U	<	11	U	<	11	U
Styrene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Tetrachloroethene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Toluene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,1,1-Trichloroethane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,1,2-Trichloroethane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Trichloroethene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Xylenes (total)				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Metals (mg/kg)																		
Aluminum	3740	11.5		4300	12.3		4240	11.3		4550	24.5		2250	10.8		2040	11	
Antimony	<	0.69		<	7.4	U	2.3	6.8	J	<	14.7	U	<	6.5	U	<	6.6	U
Arsenic	2.4	0.58		2.1	0.62		1	0.56		1.5	0.61		0.77	0.54		0.44	1.1	JJ
Barium	115	1.2	J	243	1.2	J	76.9	1.1	J	1110	2.5	J	66.3	1.1	J	29.2	1.1	J
Beryllium	0.31	0.23		0.35	0.25		0.45	0.23		<	0.49	U	0.19	0.22	J	0.14	0.22	J
Cadmium	1.9	0.53		1.7	0.62		0.98	0.56		2.8	1.2		0.85	0.54		1.1	0.55	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0004			CAN093-0931-0008			CAN093-0931-0018			CAN093-0931-0028			CAN093-0931-0038			CAN093-0931-0048		
LAB SAMPLE NUMBER	0312740004SA			0312740005SA			0312740006SA			0312740007SA			0312740008SA			0312740009SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	107000	23.1		94000	24.6		76800	22.6		188000	49.1		69700	21.7		90000	22	
Chromium	4.1	1.2		3.8	1.2		3.3	1.1		5.2	2.5		1.8	1.1		2.1	1.1	
Cobalt	2.3	1.2		3.2	1.2		2.6	1.1		2.5	2.5		1.2	1.1		0.58	1.1	J
Copper	4.3	2.3		3.5	2.5		3.3	2.3		6.9	4.9		1.6	2.2	J	1.3	2.2	J
Iron	3690	11.5		3850	12.3		3390	11.3		2200	24.5		1600	10.8		1230	11	
Lead	3.5	0.58		3.8	0.62		5.1	0.56		0.92	0.61		1.3	0.54		1.1	0.55	
Magnesium	1750	23.1		2650	24.6		3160	22.6		33700	49.1		4520	21.7		4970	22	
Manganese	59.8	1.2	J	78.1	1.2	J	95.2	1.1	J	26.7	2.5	J	29.1	1.1	J	20.4	1.1	J
Nickel	5.3	4.6		6.2	4.9		4.9	4.5		<	9.8	U	3.1	4.3	J	2	4.4	J
Potassium	823	577		1030	616		1340	565		<	1230	U	653	542		384	549	J
Selenium	<	1.2	UJ	<	0.62	U	<	0.56	U	<	1.2	UJ	<	0.54	U	<	1.1	J
Silver	0.52	1.2	J	0.51	1.2	J	0.67	1.1	J	0.75	2.5	J	<	1.1	U	<	1.1	U
Sodium	<	577		259	616	J	229	565	J	472	1230	J	286	542	J	219	549	J
Vanadium	12.2	1.2		16.4	1.2		13.8	1.1		21.9	2.5		6.7	1.1		7	1.1	
Zinc	10	2.3		9.7	2.5		10	2.3		7.5	4.9		5.1	2.2		3.8	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons				<	49.3	U	<	45.2	U	<	49.1	U	<	43.4	U	<	43.9	U
Water Quality (percent)																		
Water				19	0.1		12	0.1		18	0.1		7.8	0.1		8.9	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0058			CAN093-0932-0004			CAN093-0932-0008			CAN093-0932-0018			CAN093-0932-0028		
LAB SAMPLE NUMBER	0312740010SA			0312730003SA			0312730004SA			0312730005SA			0312730006SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)															
Benzene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Bromodichloromethane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Carbon disulfide	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Chlorobenzene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Chloroform	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,1-Dichloroethane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,1-Dichloroethene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,2-Dichloroethene (total)	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,2-Dichloropropane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Ethylbenzene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
4-Methyl-2-pentanone (MIBK)	<	11	U	<	11	U	<	12	U	<	12	U	<	12	U
Styrene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Tetrachloroethene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Toluene	<	5.4	U	1.4	5.6	J	<	6.2	U	<	5.8	U	<	6.1	U
1,1,1-Trichloroethane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,1,2-Trichloroethane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Trichloroethene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Xylenes (total)	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Metals (mg/kg)															
Aluminum	2220	10.8		6410	11.2		5190	12.4		3710	57.6		5350	24.5	
Antimony	<	6.5	U	<	6.7	U	<	7.4	U	<	34.6	U	<	14.7	U
Arsenic	0.37	0.54	J	2	0.56		2	0.62		0.78	0.58		0.93	0.61	
Barium	33.6	1.1	J	66.5	1.1	J	200	1.2	J	320	5.8	J	438	2.5	J
Beryllium	0.11	0.22	J	0.44	0.22		0.48	0.25		<	1.2	U	<	0.49	U
Cadmium	0.79	0.54		<	0.56	U	1.1	0.62		3	2.9		1.2	1.2	

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A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0058			CAN093-0932-0004			CAN093-0932-0008			CAN093-0932-0018			CAN093-0932-0028		
LAB SAMPLE NUMBER	0312740010SA			0312730003SA			0312730004SA			0312730005SA			0312730006SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	55400	21.7		19300	22.4		107000	24.8		241000	115		137000	49.1	
Chromium	2.4	1.1		7	1.1		5	1.2		<	5.8	U	4.8	2.5	
Cobalt	0.85	1.1	J	2.8	1.1		2.9	1.2		<	5.8	U	1.4	2.5	J
Copper	0.97	2.2	J	5.9	2.2		5.8	2.5		1.7	11.5	J	8.2	4.9	
Iron	2070	10.8		6830	11.2		4640	12.4		2050	57.6		5300	24.5	
Lead	1.2	0.54		5.5	0.56		2.9	1.2		1.4	2.9	J	1.5	0.61	
Magnesium	2990	21.7		1530	22.4		2890	24.8		7460	115		24800	49.1	
Manganese	27.4	1.1	J	91	1.1		77.1	1.2		21.1	5.8		51.4	2.5	
Nickel	2	4.3	J	7.2	4.5		6.2	5		<	23	U	7.3	9.8	J
Potassium	429	542	J	1240	561		1150	620		426	2880	J	748	1230	J
Selenium	0.31	0.54	J	<	0.56	J	<	1.2	J	<	1.2	J	<	1.2	J
Silver	0.73	1.1	J	0.77	1.1	J	0.71	1.2	J	4.8	5.8	J	1.3	2.5	J
Sodium	270	542	J	<	561	U	<	620	J	<	2880	U	379	1230	J
Vanadium	8.9	1.1		14.8	1.1		17.3	1.2		10.8	5.8		17.7	2.5	
Zinc	4.7	2.2		13.7	2.2		13.6	2.5		5.2	11.5	J	14.7	4.9	
TPH (mg/kg)															
Total Petroleum Hydrocarbons	<	43.3	U	<	44.8	U	<	49.6	U	<	46.1	U	<	49.1	U
Water Quality (percent)															
Water	7.7	0.1		11	0.1		19	0.1		13	0.1		18	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0932-0038			CAN093-0932-0048			CAN093-0932-0058			CAN093-0933-0004			CAN093-0933-0008			CAN093-0933-0018		
LAB SAMPLE NUMBER	0312730007SA			0312730008SA			0312730009SA			0312730012SA			0312730013SA			0312730014SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Bromodichloromethane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Carbon disulfide	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Chlorobenzene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Chloroform	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,1-Dichloroethane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,1-Dichloroethene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,2-Dichloroethene (total)	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,2-Dichloropropane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Ethylbenzene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
4-Methyl-2-pentanone (MIBK)	<	11	U	<	12	U	<	11	U	<	12	U	<	12	U	<	12	U
Styrene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Tetrachloroethene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Toluene	16	5.5		8	5.8		1.6	5.5	J	<	5.8	U	<	5.9	U	<	5.9	U
1,1,1-Trichloroethane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,1,2-Trichloroethane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Trichloroethene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Xylenes (total)	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Metals (mg/kg)																		
Aluminum	7820	11.1		3380	11.5		3040	11		7490	11.7		3910	58.6		3660	23.4	
Antimony	<	6.6	U	<	6.9	U	<	6.6	U	<	7	U	<	35.2	U	<	14.1	U
Arsenic	0.85	0.55		0.55	1.2	J	0.63	0.55		2.6	0.58		1.3	0.59		1.4	0.59	
Barium	35.9	1.1	J	40.5	1.2	J	17.2	1.1	J	172	1.2	J	697	5.9	J	221	2.3	J
Beryllium	0.32	0.22		0.12	0.23	J	<	0.22	U	0.43	0.23		<	1.2	U	<	0.47	U
Cadmium	<	0.55	U	<	0.58	U	<	0.55	U	1.2	0.58		3	2.9		1.6	1.2	

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A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0932-0038			CAN093-0932-0048			CAN093-0932-0058			CAN093-0933-0004			CAN093-0933-0008			CAN093-0933-0018		
LAB SAMPLE NUMBER	0312730007SA			0312730008SA			0312730009SA			0312730012SA			0312730013SA			0312730014SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	37200	22.1		48100	23.1		13700	22		80300	23.4		221000	117		142000	46.9	
Chromium	4.9	1.1		2.9	1.2		3.6	1.1		5.8	1.2		<	5.9	U	<	2.3	U
Cobalt	1.5	1.1		0.94	1.2	J	1.2	1.1		2.8	1.2		5	5.9	J	2.4	2.3	
Copper	2.5	2.2		2.4	2.3		1.9	2.2	J	5.1	2.3		3.2	11.7	J	2.3	4.7	J
Iron	5050	11.1		2460	11.5		2490	11		6020	11.7		2800	58.6		2850	23.4	
Lead	4.6	0.55		1.8	1.2		1.9	0.55		4.7	2.9		1.9	2.9	J	3	2.9	
Magnesium	8180	22.1		12500	23.1		7340	22		2060	23.4		3930	117		3150	46.9	
Manganese	38.8	1.1		23.7	1.2		31.7	1.1		75.6	1.2		45.2	5.9	J	31.3	2.3	
Nickel	5.4	4.4		2.6	4.6	J	3	4.4	J	7.1	4.7		<	23.4	U	3.9	9.4	J
Potassium	1750	553		563	577	J	442	551	J	1370	585		723	2930	J	1010	1170	J
Selenium	<	1.1	UJ	<	1.2	UJ	<	0.55	U	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ
Silver	0.76	1.1	J	0.65	1.2	J	0.65	1.1	J	0.95	1.2	J	4.3	5.9	J	1.9	2.3	J
Sodium	304	553	J	210	577	J	<	551	U	<	585	U	<	2930	U	<	1170	U
Vanadium	11.8	1.1		13.6	1.2		12.3	1.1		14.1	1.2		10.5	5.9		11.9	2.3	
Zinc	9.4	2.2		4.9	2.3		4.6	2.2		13.6	2.3		9.9	11.7	J	7.4	4.7	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	44.2	U	<	46.1	U	<	44	U	<	46.8	U	<	46.9	U	<	46.9	U
Water Quality (percent)																		
Water	9.6	0.1		13	0.1		9.2	0.1		14	0.1		15	0.1		15	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0933-0028			CAN093-0933-0038			CAN093-0933-0048			CAN093-0933-0058		
LAB SAMPLE NUMBER	0312730015SA			0312730016SA			0312730017SA			0312730018SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)												
Benzene	<	5.8	U	<	5.4	U	<	5.5	U	<	5.4	U
Bromodichloromethane	1.3	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Carbon disulfide	1.3	5.8	J	<	5.4	U	1.6	5.5	J	<	5.4	U
Chlorobenzene	<	5.8	U	<	5.4	U	<	5.5	U	<	5.4	U
Chloroform	1.8	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,1-Dichloroethane	<	5.8	U	<	5.4	U	<	5.5	U	<	5.4	U
1,1-Dichloroethene	1.4	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,2-Dichloroethene (total)	3.1	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,2-Dichloropropane	1.6	5.8	J	<	5.4	U	1.5	5.5	J	2.8	5.4	J
Ethylbenzene	1.5	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
4-Methyl-2-pentanone (MIBK)	2.1	12	J	<	11	U	<	11	U	<	11	U
Styrene	1.5	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Tetrachloroethene	1.3	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Toluene	<	5.8	U	<	5.4	U	<	5.5	U	1.4	5.4	J
1,1,1-Trichloroethane	1.5	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,1,2-Trichloroethane	1.7	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Trichloroethene	<	5.8	U	<	5.4	U	<	5.5	U	<	5.4	U
Xylenes (total)	3.5	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Metals (mg/kg)												
Aluminum	4070	23.4		3440	21.8		3760	11		3730	10.8	
Antimony	<	14	U	<	13.1	U	<	6.6	U	<	6.5	U
Arsenic	1.1	0.58		0.88	0.54		0.54	1.1	J	0.57	0.54	
Barium	113	2.3	J	76.7	2.2	J	27.6	1.1	J	43.1	1.1	J
Beryllium	<	0.47	U	<	0.44	U	0.14	0.22	J	0.15	0.22	J
Cadmium	2.8	1.2		2.2	1.1		<	0.55	U	0.61	0.54	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0933-0028			CAN093-0933-0038			CAN093-0933-0048			CAN093-0933-0058		
LAB SAMPLE NUMBER	0312730015SA			0312730016SA			0312730017SA			0312730018SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	153000	46.7		130000	43.6		24500	22.1		41600	21.6	
Chromium	2.8	2.3		2	2.2	J	3.9	1.1		3.2	1.1	
Cobalt	2	2.3	J	1.8	2.2	J	1.2	1.1		1.3	1.1	
Copper	2.5	4.7	J	5.5	4.4		2	2.2	J	2	2.2	J
Iron	2380	23.4		2350	21.8		2890	11		3110	10.8	
Lead	1.1	1.2	J	1.2	1.1		1.3	0.55		1.4	0.54	
Magnesium	12600	46.7		4910	43.6		6800	22.1		5240	21.6	
Manganese	28.8	2.3		32.4	2.2		30.7	1.1		38.1	1.1	
Nickel	4.8	9.3	J	2.6	8.7	J	3.3	4.4	J	3.2	4.3	J
Potassium	590	1170	J	725	1090	J	736	552		670	539	
Selenium	<	1.2	UJ	<	1.1	UJ	<	1.1	UJ	<	1.1	UJ
Silver	2	2.3	J	1.1	2.2	J	0.58	1.1	J	0.5	1.1	J
Sodium	390	1170	J	<	1090	U	299	552	J	219	539	J
Vanadium	15.7	2.3		6.4	2.2		10.4	1.1		11.1	1.1	
Zinc	5.3	4.7		5.9	4.4		6	2.2		6.4	2.2	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	<	46.7	U	<	43.6	U	<	44.2	U	<	43.1	U
Water Quality (percent)												
Water	14	0.1		8.2	0.1		9.5	0.1		7.2	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SURFACE SOIL TO BACKGROUND(1)
SWMU 93, CANNON AFB
Oil/Water Separator No. 5121

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN093-0933-0000	Aluminum	9380	1410 - 11,000	10,540	N	50,000
CAN093-0932-0000	Arsenic	2.5	0.67 - 28	15.5	N	6.5
CAN093-0933-0000	Barium	140	14.5 - 1200	642	N	500
CAN093-0933-0000	Beryllium	0.49	0.17 - 0.77	0.73	N	1 - 2
CAN093-0932-0000	Cadmium	1.9	<0.51 - 4.2	*	Y	---
CAN093-0933-0000	Chromium	12.9	4 - 15.4	12.5	N**	30
CAN093-0931-0000	Cobalt	3.9	0.85 - 5.3	4.5	N	3 - 7
CAN093-0932-0000	Copper	158	<2 - 18.4	*	Y	20
CAN093-0932-0000	Lead	32.4	1.1 - 46	25.8	Y	15
CAN093-0932-0000	Nickel	8.2	1.3 - 9.8	9	N	15
CAN093-0932-0000	Selenium	0.25	<0.21 - 124	*	N**	0.15 - 0.30
CAN093-0933-0000	Silver	1	0.51 - 0.93	*	Y	---
CAN093-0933-0000	Vanadium	18	5.2 - 28.3	25.3	N	30 - 70
CAN093-0932-0000	Zinc	77.2	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly exceeds background range and is within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background.

TABLE 8-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN TOTAL SOILS TO BACKGROUND(1)
SWMU 93, CANNON AFB
Oil/Water Separator No. 5121

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN093-0933-0002	Aluminum	10500	1410 - 11,000	10,540	N	50,000
CAN093-0931-0018	Antimony	2.3	<4.9 - 5.1	*	Y	<1
CAN093-0933-0004	Arsenic	2.6	0.67 - 28	15.5	N	6.5
CAN093-0931-0028	Barium	1110	14.5 - 1200	642	Y	500
CAN093-0933-0002	Beryllium	0.54	0.17 - 0.77	0.73	N	1 - 2
CAN093-0933-0008	Cadmium	3	<0.51 - 4.2	*	Y	---
CAN093-0933-0000	Chromium	12.9	4 - 15.4	12.5	N**	30
CAN093-0933-0008	Cobalt	5	0.85 - 5.3	4.5	N**	3 - 7
CAN093-0932-0000	Copper	158	<2 - 18.4	*	Y	20
CAN093-0932-0000	Lead	32.4	1.1 - 46	25.8	Y	15
CAN093-0933-0002	Nickel	8.4	1.3 - 9.8	9	N	15
CAN093-0931-0058	Selenium	0.31	<0.21 - 124	*	N**	0.015 - 0.30
CAN093-0932-0048	Silver	4.8	0.51 - 0.93	*	Y	---
CAN093-0931-0028	Vanadium	21.9	5.2 - 28.3	25.3	N	30 - 70
CAN093-0932-0000	Zinc	77.2	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly exceeds Base-wide background range and is within naturally-occurring levels (USGS 1984); therefore, concentration is not considered to exceed background.

TABLE 8-5

CHEMICALS OF CONCERN IN SURFACE SOIL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Chrysene
Fluoranthene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Cadmium
Copper
Lead*
Silver
Zinc

* No EPA-established toxicity factor.

TABLE 8-6

CHEMICALS OF CONCERN IN TOTAL SOIL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Chrysene
1,2-Dichloropropane
Fluoranthene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene
Pentachlorophenol
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Antimony
Barium
Cadmium
Copper
Lead*
Silver
Zinc

* No EPA-established toxicity factor.

TABLE 8-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5121 (SWMU 93)

	Toluene (µg/kg)				Xylenes (total) (µg/kg)			Benzo(a)anthracene (µg/kg)			Benzo(a)pyrene (µg/kg)			Benzo(b)fluoranthene (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN093-0931-0000	2.6	0.956	J	6.4	1.8	J	6.4		U	420		U	420		U	420
CAN093-0932-0000	2.7	0.993	U	5.4		U	5.4	74	J	360	62	J	360	73	J	360
CAN093-0933-0000	4.9	1.589	J	5.3	1.8	J	5.3	77	J	350	84	J	350	140	J	350
Number	3	3			2			2			2			2		
Minimum detected	2.60				1.80			74.0			62.0			73.0		
Maximum detected	4.90				1.80			77.0			84.0			140		
Average	3.40	1.18			1.80			75.5			73.0			107		
H statistic		5.22														
Standard Deviation	1.30	0.36														
95% UCL	12.9	12.9														
RME	4.90				1.80			77.0			84.0			140		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 8-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5121 (SWMU 93)

	Chrysene (µg/kg)			Fluoranthene (µg/kg)			Indeno(1,2,3-cd)pyrene (µg/kg)			Pentachlorophenol (µg/kg)			Pyrene (µg/kg)			
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000		U	420		U	420		U	420	45	J	2000	210	5.347	U	420
CAN093-0932-0000	95	J	360	150	J	360	55	J	360		U	1700	190	5.247	J	360
CAN093-0933-0000	120	J	350	100	J	350	38	J	350		U	1700	120	4.787	J	350
Number	2			2			2			1			3	3		
Minimum detected	95.0			100			38.0			45.0			120			
Maximum detected	120			150			55.0			45.0			190			
Average	108			125			46.5			45.0			173	5.13		
H statistic														4.11		
Standard Deviation													47.26	0.30		
95% UCL													419	419		
RME	120			150			55.0			45.0			190			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 8-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5121 (SWMU 93)

	TPH (mg/kg)				Cadmium (mg/kg)				Copper (mg/kg)				Lead (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000	77.4	4.349		51	0.32	-1.139	U	0.6	8.6	2.152		2.6	7.3	1.988		0.6
CAN093-0932-0000	255	5.541		43	1.9	0.642		0.5	158	5.063		2.2	32.4	3.478		2.7
CAN093-0933-0000	325	5.784		42	1	0.000		0.5	8.4	2.128		2.1	10	2.303		1.1
Number	3	3			3	3			3	3			3	3		
Minimum detected	77.4				1.00				8.40				7.30			
Maximum detected	325				1.90				158				32.4			
Average	219	5.22			1.07	-0.17			58.3	3.11			16.6	2.59		
H statistic		10.43				11.74				22.87				10.43		
Standard Deviation	127.6	0.77			0.79	0.90			86.31	1.69			13.78	0.79		
95% UCL	71959	71959			2276	2276			6.63E+13	6.63E+13			5950	5950		
RME	325				1.90				158				32.4			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 8-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT OWS 5121 (SWMU 93)

	Silver (mg/kg)				Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000	0.69	-0.371	U	1.3	25.4	3.235		2.6
CAN093-0932-0000	0.72	-0.329	J	1.1	77.2	4.346		2.2
CAN093-0933-0000	1	0.000	J	1.1	53.3	3.976		2.1
Number	3	3			3	3		
Minimum detected	0.69				25.4			
Maximum detected	1.00				77.2			
Average	0.80	-0.23			52.0	3.85		
H statistic		3.30				7.81		
Standard Deviation	0.17	0.20			25.93	0.57		
95% UCL	1.30	1.30			1258	1258		
RME	1.00				77.2			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data qua
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT OWS 5121 (SWMU 93)

	1,2-Dichloropropane (µg/kg)				Toluene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000	3.2	1.163	U	6.4	2.6	0.956	J	6.4
CAN093-0931-0002	2.7	0.993	U	5.4	2.7	0.993	U	5.4
CAN093-0931-0004	2.9	1.065	U	5.8	2.9	1.065	U	5.8
CAN093-0931-0008	3.1	1.131	U	6.2	3.1	1.131	U	6.2
CAN093-0931-0018	2.8	1.030	U	5.6	2.8	1.030	U	5.6
CAN093-0931-0028	3.05	1.115	U	6.1	3.05	1.115	U	6.1
CAN093-0931-0038	2.7	0.993	U	5.4	2.7	0.993	U	5.4
CAN093-0931-0048	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN093-0931-0058	2.7	0.993	U	5.4	2.7	0.993	U	5.4
CAN093-0932-0000	2.7	0.993	U	5.4	2.7	0.993	U	5.4
CAN093-0932-0002	2.8	1.030	U	5.6	8	2.079		5.6
CAN093-0932-0004	2.8	1.030	U	5.6	1.4	0.336	J	5.6
CAN093-0932-0008	3.1	1.131	U	6.2	3.1	1.131	U	6.2
CAN093-0932-0018	2.9	1.065	U	5.8	2.9	1.065	U	5.8
CAN093-0932-0028	3.05	1.115	U	6.1	3.05	1.115	U	6.1
CAN093-0932-0038	2.75	1.012	U	5.5	16	2.773		5.5
CAN093-0932-0048	2.9	1.065	U	5.8	8	2.079		5.8
CAN093-0932-0058	2.75	1.012	U	5.5	1.6	0.470	J	5.5
CAN093-0933-0000	2.65	0.975	U	5.3	4.9	1.589	J	5.3
CAN093-0933-0002	2.85	1.047	U	5.7	2.85	1.047	U	5.7
CAN093-0933-0004	2.9	1.065	U	5.8	2.9	1.065	U	5.8
CAN093-0933-0008	2.95	1.082	U	5.9	2.95	1.082	U	5.9
CAN093-0933-0018	2.95	1.082	U	5.9	2.95	1.082	U	5.9
CAN093-0933-0028	1.6	0.470	J	5.8	1.9	0.642	J	5.8
CAN093-0933-0038	2.7	0.993	U	5.4	2.7	0.993	U	5.4
CAN093-0933-0048	1.5	0.405	J	5.5	2.75	1.012	U	5.5
CAN093-0933-0058	2.8	1.030	J	5.4	1.4	0.336	J	5.4
Number	27	27			27	27		
Minimum	1.50				1.40			
Maximum	2.80				16.0			
Average	2.76	1.00			3.61	1.12		
H statistic		1.75				1.99		
Standard Deviation	0.38	0.17			2.92	0.51		
95% UCL	2.94	2.94			4.26	4.26		
RME	2.80				4.26			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data qualit
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOIL AT OWS 5121 (SWMU 93)

	Xylenes (total) (µg/kg)				Benzo(a)anthracene (µg/kg)			Benzo(a)pyrene (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN093-0931-0000	1.8	0.588	J	6.4		U	420		U	420
CAN093-0931-0002	2.7	0.993	U	5.4						
CAN093-0931-0004	2.9	1.065	U	5.8		U	380		U	380
CAN093-0931-0008	3.1	1.131	U	6.2						
CAN093-0931-0018	2.8	1.030	U	5.6						
CAN093-0931-0028	3.05	1.115	U	6.1						
CAN093-0931-0038	2.7	0.993	U	5.4						
CAN093-0931-0048	2.75	1.012	U	5.5						
CAN093-0931-0058	2.4	0.875	U	5.4						
CAN093-0932-0000	2.7	0.993	U	5.4	74	J	360	62	J	360
CAN093-0932-0002	2.8	1.030	U	5.6		U	370		U	370
CAN093-0932-0004	2.8	1.030	U	5.6						
CAN093-0932-0008	3.1	1.131	U	6.2						
CAN093-0932-0018	2.9	1.065	U	5.8						
CAN093-0932-0028	3.05	1.115	U	6.1						
CAN093-0932-0038	2.75	1.012	U	5.5						
CAN093-0932-0048	2.9	1.065	U	5.8						
CAN093-0932-0058	2.75	1.012	U	5.5						
CAN093-0933-0000	1.8	0.588	J	5.3	77	J	350	84	J	350
CAN093-0933-0002	2.85	1.047	U	5.7						
CAN093-0933-0004	2.9	1.065	U	5.8						
CAN093-0933-0008	2.95	1.082	U	5.9						
CAN093-0933-0018	2.95	1.082	U	5.9						
CAN093-0933-0028	3.5	1.253		5.8						
CAN093-0933-0038	2.7	0.993	U	5.4						
CAN093-0933-0048	2.75	1.012	U	5.5		U	360		U	360
CAN093-0933-0058	2.7	0.993	U	5.4						
Number	27	27			2			2		
Minimum	1.80				74.0			62.0		
Maximum	3.50				77.0			84.0		
Average	2.78	1.01			75.5			73.0		
H statistic		1.75								
Standard Deviation	0.34	0.14								
95% UCL	2.92	2.92								
RME	2.92				77.0			84.0		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOIL AT OWS 5121 (SWMU 93)

	Benzo(b)fluoranthene (µg/kg)			Chrysene (µk/kg)			Fluoranthene (µg/kg)			
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000		U	420		U	420			U	420
CAN093-0931-0002										
CAN093-0931-0004		U	380		U	380	56	4.025	J	380
CAN093-0931-0008										
CAN093-0931-0018										
CAN093-0931-0028										
CAN093-0931-0038										
CAN093-0931-0048										
CAN093-0931-0058										
CAN093-0932-0000	73	J	360	95	J	360	150	5.011	J	360
CAN093-0932-0002		U	370		U	370			U	370
CAN093-0932-0004										
CAN093-0932-0008										
CAN093-0932-0018										
CAN093-0932-0028										
CAN093-0932-0038										
CAN093-0932-0048										
CAN093-0932-0058										
CAN093-0933-0000	140	J	350	120	J	350	100	4.605	J	350
CAN093-0933-0002										
CAN093-0933-0004										
CAN093-0933-0008										
CAN093-0933-0018										
CAN093-0933-0028										
CAN093-0933-0038										
CAN093-0933-0048		U	360		U	360			U	360
CAN093-0933-0058										
Number	2			2			3	3		
Minimum	73.0			95.0			56.0			
Maximum	140			120			150			
Average	107			108				4.55		
H statistic								6.50		
Standard Deviation							47.03	0.50		
95% UCL							1037	1037		
RME	140			120			150			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOIL AT OWS 5121 (SWMU 93)

	Indeno(1,2,3-cd)pyrene (µg/kg)			Pentachlorophenol (µg/kg)			Pyrene (µg/kg)			
Field ID	Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000		U	420	45	J	2000			U	420
CAN093-0931-0002										
CAN093-0931-0004		U	380		U	1800	40	3.689	J	380
CAN093-0931-0008										
CAN093-0931-0018										
CAN093-0931-0028										
CAN093-0931-0038										
CAN093-0931-0048										
CAN093-0931-0058										
CAN093-0932-0000	55	J	360		U	1700	190	5.247	J	360
CAN093-0932-0002		U	370		U	1800			U	370
CAN093-0932-0004										
CAN093-0932-0008										
CAN093-0932-0018										
CAN093-0932-0028										
CAN093-0932-0038										
CAN093-0932-0048										
CAN093-0932-0058										
CAN093-0933-0000	38	J	350		U	1700	120	4.787	J	350
CAN093-0933-0002										
CAN093-0933-0004										
CAN093-0933-0008										
CAN093-0933-0018										
CAN093-0933-0028										
CAN093-0933-0038										
CAN093-0933-0048		U	360		U	1800			U	360
CAN093-0933-0058										
Number	2			1			3	3		
Minimum	38.0			45.0			40.0			
Maximum	55.0			45.0			190			
Average	46.5			45.0			117	4.57		
H statistic								10.43		
Standard Deviation							75.06	0.80		
95% UCL							49002	49002		
RME	55.0			45.0			190			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOIL AT OWS 5121 (SWMU 93)

	TPH (mg/kg)				Antimony (mg/kg)			Barium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000	77.4	4.349		51		U	7.7	99.9	4.604	J	1.3
CAN093-0931-0002	21.55	3.070	U	43		U	6.5	51.9	3.949	J	1.1
CAN093-0931-0004	23.05	3.138	U	46		U	6.9	115	4.745	J	1.2
CAN093-0931-0008	24.65	3.205	U	49		U	7.4	243	5.493	J	1.2
CAN093-0931-0018	22.6	3.118	U	45	2.3	J	6.8	76.9	4.343	J	1.1
CAN093-0931-0028	24.55	3.201	U	49		U	14.7	1110	7.012	J	2.5
CAN093-0931-0038	21.7	3.077	U	43		U	6.5	66.3	4.194	J	1.1
CAN093-0931-0048	21.95	3.089	U	44		U	6.6	29.2	3.374	J	1.1
CAN093-0931-0058	21.65	3.075	U	43		U	6.5	33.6	3.515	J	1.1
CAN093-0932-0000	255	5.541		43		U	6.5	114	4.736	J	1.1
CAN093-0932-0002	311	5.740		45		U	6.7	126	4.836	J	1.1
CAN093-0932-0004	22.4	3.109	U	45		U	6.7	66.5	4.197	J	1.1
CAN093-0932-0008	24.9	3.215	U	50		U	7.4	200	5.298	J	1.2
CAN093-0932-0018	23.05	3.138	U	46		U	34.6	320	5.768	J	5.8
CAN093-0932-0028	24.55	3.201	U	49		U	14.7	438	6.082	J	2.5
CAN093-0932-0038	22.1	3.096	U	44		U	6.6	35.9	3.581	J	1.1
CAN093-0932-0048	23.05	3.138	U	46		U	6.9	40.5	3.701	J	1.2
CAN093-0932-0058	22	3.091	U	44		U	6.6	17.2	2.845	J	1.1
CAN093-0933-0000	325	5.784		42		U	6.3	140	4.942	J	1.1
CAN093-0933-0002	294	5.684		46		U	6.8	108	4.682	J	1.1
CAN093-0933-0004	23.4	3.153	U	47		U	7	172	5.147	J	1.2
CAN093-0933-0008	23.45	3.155	U	47		U	35.2	697	6.547	J	5.9
CAN093-0933-0018	23.45	3.155	U	47		U	14.1	221	5.398	J	2.3
CAN093-0933-0028	23.35	3.151	U	47		U	14	113	4.727	J	2.3
CAN093-0933-0038	21.8	3.082	U	44		U	13.1	76.7	4.340	J	2.2
CAN093-0933-0048	22.1	3.096	U	44		U	6.6	27.6	3.318	J	1.1
CAN093-0933-0058	21.55	3.070	U	43		U	6.5	43.1	3.764	J	1.1
Number	27	27			1			27	27		
Minimum	77.4				2.30			17.2			
Maximum	325.0				2.30			1110			
Average	65.4	3.55			2.30			177	4.63		
H statistic		2.40							2.63		
Standard Deviation	99.21	0.94						237.8	1.01		
95% UCL	84.4	84.4						288	288		
RME	84.4				2.3			288			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT OWS 5121 (SWMU 93)

	Cadmium (mg/kg)				Copper (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000	0.32	-1.139	U	0.64	8.6	2.152		2.6
CAN093-0931-0002	0.27	-1.309	U	0.54	4.5	1.504		2.2
CAN093-0931-0004	1.9	0.642		0.58	4.3	1.459		2.3
CAN093-0931-0008	1.7	0.531		0.62	3.5	1.253		2.5
CAN093-0931-0018	0.98	-0.020		0.56	3.3	1.194		2.3
CAN093-0931-0028	2.8	1.030		1.2	6.9	1.932		4.9
CAN093-0931-0038	0.85	-0.163		0.54	1.6	0.470	J	2.2
CAN093-0931-0048	1.1	0.095		0.55	1.3	0.262	J	2.2
CAN093-0931-0058	0.79	-0.236		0.54	0.97	-0.030	J	2.2
CAN093-0932-0000	1.9	0.642		0.54	158	5.063		2.2
CAN093-0932-0002	1.2	0.182		0.56	7.4	2.001		2.2
CAN093-0932-0004	0.28	-1.273	U	0.56	5.9	1.775		2.2
CAN093-0932-0008	1.1	0.095		0.62	5.8	1.758		2.5
CAN093-0932-0018	3	1.099		2.9	1.7	0.531	J	11.5
CAN093-0932-0028	1.2	0.182		1.2	8.2	2.104		4.9
CAN093-0932-0038	0.275	-1.291	U	0.55	2.5	0.916		2.2
CAN093-0932-0048	0.29	-1.238	U	0.58	2.4	0.875		2.3
CAN093-0932-0058	0.275	-1.291	U	0.55	1.9	0.642	J	2.2
CAN093-0933-0000	1	0.000		0.53	8.4	2.128		2.1
CAN093-0933-0002	1	0.000		0.57	8.5	2.140		2.3
CAN093-0933-0004	1.2	0.182		0.58	5.1	1.629		2.3
CAN093-0933-0008	3	1.099		2.9	3.2	1.163	J	11.7
CAN093-0933-0018	1.6	0.470		1.2	2.3	0.833	J	4.7
CAN093-0933-0028	2.8	1.030		1.2	2.5	0.916	J	4.7
CAN093-0933-0038	2.2	0.788		1.1	5.5	1.705		4.4
CAN093-0933-0048	0.275	-1.291	U	0.55	2	0.693	J	2.2
CAN093-0933-0058	0.61	-0.494		0.54	2	0.693	J	2.2
Number	27	27			27	27		
Minimum	0.61				0.97			
Maximum	3.00				158			
Average	1.26	-0.06			9.94	1.40		
H statistic		2.30				2.48		
Standard Deviation	0.89	0.83			29.69	0.97		
95% UCL	1.93	1.93			10.3	10.3		
RME	1.93				10.3			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data quality cr
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT OWS 5121 (SWMU 93)

	Lead (mg/kg)				Silver (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN093-0931-0000	7.3	1.988		0.64	0.69	-0.371	J	1.3
CAN093-0931-0002	5.2	1.649		0.54	0.57	-0.562	J	1.1
CAN093-0931-0004	3.5	1.253		0.58	0.52	-0.654	J	1.2
CAN093-0931-0008	3.8	1.335		0.62	0.51	-0.673	J	1.2
CAN093-0931-0018	5.1	1.629		0.56	0.67	-0.400	J	1.1
CAN093-0931-0028	0.92	-0.083		0.61	0.75	-0.288	J	2.5
CAN093-0931-0038	1.3	0.262		0.54	0.55	-0.598	U	1.1
CAN093-0931-0048	1.1	0.095		0.55	0.55	-0.598	U	1.1
CAN093-0931-0058	1.2	0.182		0.54	0.73	-0.315	J	1.1
CAN093-0932-0000	32.4	3.478		2.7	0.72	-0.329	J	1.1
CAN093-0932-0002	5.8	1.758		2.8	0.62	-0.478	J	1.1
CAN093-0932-0004	5.5	1.705		0.56	0.77	-0.261	J	1.1
CAN093-0932-0008	2.9	1.065		1.2	0.71	-0.342	J	1.2
CAN093-0932-0018	1.4	0.336	J	2.9	4.8	1.569	J	5.8
CAN093-0932-0028	1.5	0.405		0.61	1.3	0.262	J	2.5
CAN093-0932-0038	4.6	1.526		0.55	0.76	-0.274	J	1.1
CAN093-0932-0048	1.8	0.588		1.2	0.65	-0.431	J	1.2
CAN093-0932-0058	1.9	0.642		0.55	0.65	-0.431	J	1.1
CAN093-0933-0000	10	2.303		1.1	1	0.000	J	1.1
CAN093-0933-0002	11.8	2.468		1.1	1.2	0.182		1.1
CAN093-0933-0004	4.7	1.548		2.9	0.95	-0.051	J	1.2
CAN093-0933-0008	1.9	0.642	J	2.9	4.3	1.459	J	5.9
CAN093-0933-0018	3	1.099		2.9	1.9	0.642	J	2.3
CAN093-0933-0028	1.1	0.095	J	1.2	2	0.693	J	2.3
CAN093-0933-0038	1.2	0.182		1.1	1.1	0.095	J	2.2
CAN093-0933-0048	1.3	0.262		0.55	0.58	-0.545	J	1.1
CAN093-0933-0058	1.4	0.336		0.54	0.5	-0.693	J	1.1
Number	27	27			27	27		
Minimum	0.92				0.50			
Maximum	32.4				4.80			
Average	4.58	1.06			1.11	-0.13		
H statistic		2.36				2.04		
Standard Deviation	6.22	0.89			1.06	0.60		
95% UCL	6.47	6.47			1.34	1.34		
RME	6.47				1.34			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data quality
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT OWS 5121 (SWMU 93)

	Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL
CAN093-0931-0000	25.4	3.235		2.6
CAN093-0931-0002	13.1	2.573		2.2
CAN093-0931-0004	10	2.303		2.3
CAN093-0931-0008	9.7	2.272		2.5
CAN093-0931-0018	10	2.303		2.3
CAN093-0931-0028	7.5	2.015		4.9
CAN093-0931-0038	5.1	1.629		2.2
CAN093-0931-0048	3.8	1.335		2.2
CAN093-0931-0058	4.7	1.548		2.2
CAN093-0932-0000	77.2	4.346		2.2
CAN093-0932-0002	18.1	2.896		2.2
CAN093-0932-0004	13.7	2.617		2.2
CAN093-0932-0008	13.6	2.610		2.5
CAN093-0932-0018	5.2	1.649	J	11.5
CAN093-0932-0028	14.7	2.688		4.9
CAN093-0932-0038	9.4	2.241		2.2
CAN093-0932-0048	4.9	1.589		2.3
CAN093-0932-0058	4.6	1.526		2.2
CAN093-0933-0000	53.3	3.976		2.1
CAN093-0933-0002	38	3.638		2.3
CAN093-0933-0004	13.6	2.610		2.3
CAN093-0933-0008	9.9	2.293	J	11.7
CAN093-0933-0018	7.4	2.001		4.7
CAN093-0933-0028	5.3	1.668		4.7
CAN093-0933-0038	5.9	1.775		4.4
CAN093-0933-0048	6	1.792		2.2
CAN093-0933-0058	6.4	1.856		2.2
Number	27	27		
Minimum	3.80			
Maximum	77.20			
Average	14.7	2.33		
H statistic	2.24	2.24		
Standard Deviation	16.65	0.77		
95% UCL	19.37	19.4		
RME	19.4			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
95% UCL concentrations were not calculated for sample sets with N < 3.
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Nondetect. Value shown is one-half RL
Where no RL is shown, no analysis was performed.

TABLE 8-9
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SURFACE SOIL
SWMU 93

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2 (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
Benzo(a)anthracene	0.075	0.077	0.1	0.0075	0.0077
Benzo(a)pyrene	0.073	0.084	0.1	0.0073	0.0084
Benzo(b)fluoranthene	0.10	0.14	0.1	0.01	0.014
Chrysene	0.11	0.12	0.1	0.011	0.012
Fluoranthene	0.12	0.15	0.1	0.012	0.015
Indeno(1,2,3-cd)pyrene	0.046	0.055	0.1	0.0046	0.0055
Pentachlorophenol	0.045	0.045	0.1	0.0045	0.0045
Pyrene	0.17	0.19	0.1	0.017	0.019
Toluene	0.003	0.005	0.03	9.00E-05	1.50E-04
Xylenes	0.002	0.002	0.03	6.00E-05	6.00E-05

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 8-10
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
TOTAL SOIL
SWMU 93

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
1,2-Dichloropropane	0.003	0.003	0.03	9.00E-05	9.00E-05
Benzo(a)anthracene	0.075	0.077	0.1	0.01	0.0077
Benzo(a)pyrene	0.073	0.084	0.1	0.0073	0.0084
Benzo(b)fluoranthene	0.10	0.14	0.1	0.01	0.014
Chrysene	0.11	0.12	0.1	0.011	0.012
Fluoranthene	0.10	0.15	0.1	0.01	0.015
Indeno(1,2,3-cd)pyrene	0.046	0.055	0.1	0.0046	0.0055
Pentachlorophenol	0.045	0.045	0.1	0.0045	0.0045
Pyrene	0.12	0.19	0.1	0.012	0.019
Toluene	0.003	0.004	0.03	9.00E-05	1.20E-04
Xylenes	0.003	0.003	0.03	9.00E-05	9.00E-05

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 8-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 93

	t (y)	Cs (µg/kg)	Co (g/m^3)	L (m)	W (m)	T (m)	VWC (L/L)	foc	Koc (ml/g)	Kd (ml/g)	Soil Half Life (y)	P (g/cm^3)	I (m/y)	H (m)	TOT (y)
1,2-Dichloropropane	0	2.76	4.42E-03	25	55	17.683	0.15	0.003	14	0.042	3.5	1.6	0.015	61.585	892
Antimony	0	2300	3.68E+00	25	55	17.683	0.15	0.003	NA	3981	NA	1.6	0.015	61.585	26152070
Barium	0	177120	2.83E+02	25	55	17.683	0.15	0.003	NA	50	NA	1.6	0.015	61.585	329069
Benzo(a)anthracene	0	75.5	1.21E-01	25	55	17.683	0.15	0.003	1400000	4200	1.86	1.6	0.015	61.585	27590696
Benzo(a)pyrene	0	73	1.17E-01	25	55	17.683	0.15	0.003	6500000	19500	1.45	1.6	0.015	61.585	128097416
Benzo(b)fluoranthene	0	106.5	1.70E-01	25	55	17.683	0.15	0.003	550000	1650	1.67	1.6	0.015	61.585	10839576
Cadmium	0	1260	2.02E+00	25	55	17.683	0.15	0.003	NA	7	NA	1.6	0.015	61.585	46599
Chrysene	0	107.5	1.72E-01	25	55	17.683	0.15	0.003	250000	750	2.72	1.6	0.015	61.585	4927416
Copper	0	9940	1.59E+01	25	55	17.683	0.15	0.003	NA	20		1.6	0.015	61.585	131997
Fluoranthene	0	102	1.63E-01	25	55	17.683	0.15	0.003	1380	4.14	1.21	1.6	0.015	61.585	27812
Indeno(1,2,3-c)pyrene	0	46.5	7.44E-02	25	55	17.683	0.15	0.003	31000000	93000	2	1.6	0.015	61.585	610923816
Lead	0	4580	7.33E+00	25	55	17.683	0.15	0.003	NA	100	NA	1.6	0.015	61.585	657523
Pentachlorophenol	0	45	7.20E-02	25	55	17.683	0.15	0.003	891	2.673	0.5	1.6	0.015	61.585	18175
Pyrene	0	116.67	1.87E-01	25	55	17.683	0.15	0.003	38000	114	5.2	1.6	0.015	61.585	749489
Toluene	0	3.61	5.78E-03	25	55	17.683	0.15	0.003	300	0.9	0.2	1.6	0.015	61.585	6528
Xylenes	0	2.78	4.45E-03	25	55	17.683	0.15	0.003	830	2.49	0.2	1.6	0.015	61.585	16973
Zinc	0	14690	2.35E+01	25	55	17.683	0.15	0.003	NA	20	NA	1.6	0.015	61.585	131997

t = Time where leachate concentration is estimated
Cs = Concentration of chemical in source soil
(average concentration from Table 8-8)
Co = Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 8-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 93

	Rd	Leach Rate (y^-1)	Qo (g)	Q(t) (g)	qc (g/y)	Cl(1) (µg/l)	Cl(2) (µg/l)	K (m/s)	i (m/m)	b (m)	Qw (m^3/y)	Ql (m^3/yr)	Cw (µg/l)
1,2-Dichloropropane	1.45E+00	3.91E-03	1.07E+02	1.07E+02	4.19E-01	2.03E+01	4.23E-76	2.00E-04	0.0019	10	6591	21	1.32E-78
Antimony	4.25E+04	1.33E-07	8.95E+04	8.95E+04	1.19E-02	5.78E-01	5.78E-01	2.00E-04	0.0019	10	6591	21	1.80E-03
Barium	5.34E+02	1.06E-05	6.89E+06	6.89E+06	7.29E+01	3.54E+03	3.54E+03	2.00E-04	0.0019	10	6591	21	1.10E+01
Benzo(a)anthracene	4.48E+04	1.26E-07	2.94E+03	2.94E+03	3.71E-04	1.80E-02	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Benzo(a)pyrene	2.08E+05	2.72E-08	2.84E+03	2.84E+03	7.72E-05	3.74E-03	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Benzo(b)fluoranthene	1.76E+04	3.21E-07	4.14E+03	4.14E+03	1.33E-03	6.45E-02	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Cadmium	7.57E+01	7.47E-05	4.90E+04	4.90E+04	3.66E+00	1.78E+02	1.78E+02	2.00E-04	0.0019	10	6591	21	5.54E-01
Chrysene	8.00E+03	7.07E-07	4.18E+03	4.18E+03	2.96E-03	1.43E-01	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Copper	2.14E+02	2.64E-05	3.87E+05	3.87E+05	1.02E+01	4.95E+02	4.95E+02	2.00E-04	0.0019	10	6591	21	1.54E+00
Fluoranthene	4.52E+01	1.25E-04	3.97E+03	3.97E+03	4.97E-01	2.41E+01	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Indeno(1,2,3-c)pyrene	9.92E+05	5.70E-09	1.81E+03	1.81E+03	1.03E-05	5.00E-04	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Lead	1.07E+03	5.30E-06	1.78E+05	1.78E+05	9.44E-01	4.58E+01	4.58E+01	2.00E-04	0.0019	10	6591	21	1.43E-01
Pentachlorophenol	2.95E+01	1.92E-04	1.75E+03	1.75E+03	3.35E-01	1.63E+01	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Pyrene	1.22E+03	4.65E-06	4.54E+03	4.54E+03	2.11E-02	1.02E+00	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Toluene	1.06E+01	5.34E-04	1.40E+02	1.40E+02	7.49E-02	3.63E+00	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Xylenes	2.76E+01	2.05E-04	1.08E+02	1.08E+02	2.22E-02	1.08E+00	0.00E+00	2.00E-04	0.0019	10	6591	21	0.00E+00
Zinc	2.14E+02	2.64E-05	5.71E+05	5.71E+05	1.51E+01	7.31E+02	7.31E+02	2.00E-04	0.0019	10	6591	21	2.28E+00

t = Time where leachate concentration is estimated
Cs = Concentration of chemical in source soil
(average concentration from Table 8-8)
Co = Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 8-12

COMPARISON OF MODELED GROUNDWATER CONCENTRATIONS TO RBCs(1)

	Cw(2) (µg/L)	Tap Water RBC (1) (µg/L)	Does modeled concentration exceed RBC?
1,2-Dichloropropane	1.32E-78	0.16	No
Antimony	1.80E-03	15	No
Barium	1.10E+01	2600	No
Benzo(a)anthracene	0	0.092	No
Benzo(a)pyrene	0	0.0092	No
Benzo(b)fluoranthene	0	0.092	No
Cadmium	5.54E-01	18	No
Chrysene	0	9.2	No
Copper	1.54E+00	1400	No
Fluoranthene	0	1500	No
Indeno(1,2,3-c)pyrene	0	0.092	No
Lead	1.43E-01	15 (3)	No
Pentachlorophenol	0	0.56	No
Pyrene	0	1100	No
Toluene	0	750	No
Xylenes	0	12000	No
Zinc	2.28E+00	11000	No

(1) RBC is the EPA Region III risk-based concentration for residential tap water ingestion and inhalation.
(2) Cw is the modeled groundwater concentration as defined in Table 8-11.
(3) No Region III RBC is available for lead. Value is the action level defined in the May 1993 issue of Drinking Water Regulation and Health Advisories (EPA 1993).

Note: When modeled concentration is reported as zero; the actual value is less than 1E-300.

TABLE 8-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 93

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 8-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 8-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 93

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.005	7.76E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 8-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 8-14
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM SURFACE SOILS AT SWMU 93

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Benzo(a)anthracene	0.077	4.63E+09	1.66E-11
Benzo(a)pyrene	0.084	4.63E+09	1.81E-11
Benzo(b)fluoranthene	0.14	4.63E+09	3.02E-11
Cadmium	1.90	4.63E+09	4.10E-10
Chrysene	0.12	4.63E+09	2.59E-11
Indeno(1,2,3-cd)pyrene	0.055	4.63E+09	1.19E-11

RME Soil Concentration from Table 8-7

PEF = Particulate Emission Factor default value from EPA (1991b)

Air Concentration = Soil concentration/PEF

TABLE 8-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 93

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 8-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 8-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 93

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.004	6.74E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 8-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 8-16
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM TOTAL SOILS AT SWMU 93

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Barium	288	4.63E+09	6.22E-08
Benzo(a)anthracene	0.08	4.63E+09	1.66E-11
Benzo(a)pyrene	0.08	4.63E+09	1.81E-11
Benzo(b)fluoranthene	0.14	4.63E+09	3.02E-11
Cadmium	1.93	4.63E+09	4.17E-10
Chrysene	0.12	4.63E+09	2.59E-11
Indeno(1,2,3-cd)pyrene	0.06	4.63E+09	1.19E-11

RME Soil Concentration from Table 8-8

PEF = Particulate Emission Factor default value from EPA (1991b)

Air Concentration = Soil concentration/PEF

TABLE 8-17

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Inhalation (m^3/kg-d)		
Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
Carcinogenic	1.39×10^{-3}	6.99×10^{-2}
Construction Workers	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Inhalation (m^3/kg-d)		
Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
Carcinogenic	1.03×10^{-4}	4.47×10^{-4}
Trespasser	**Average**	**RME**
Dermal Contact Soil (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Soil Ingestion (kg/kg-d		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Inhalation (m^3/k-d)		
Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 8-18

SUMMARY OF HUMAN HEALTH RISKS AT SWMU 93

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Surface Soil)						
-- Dermal Contact	3×10^{-11}		7×10^{-8}	5×10^{-9}		4×10^{-6}
-- Ingestion	5×10^{-10}		2×10^{-5}	1×10^{-7}		3×10^{-3}
-- Inhalation of VOCs*	0.00		8×10^{-8}	0.00		1×10^{-6}
-- Inhalation of Particulates	4×10^{-12}		0.00	2×10^{-10}		0.00
	6×10^{-10}		2×10^{-5}	2×10^{-7}		3×10^{-3}
Construction Worker (Total Soil)						
-- Dermal Contact	2×10^{-12}	5×10^{-8}		4×10^{-11}	7×10^{-7}	
-- Ingestion	2×10^{-10}	8×10^{-5}		2×10^{-9}	1×10^{-3}	
-- Inhalation of VOCs*	0.00	4×10^{-8}		0.00	2×10^{-7}	
-- Inhalation of Particulates	3×10^{-13}	3×10^{-7}		1×10^{-12}	1×10^{-6}	
	2×10^{-10}	8×10^{-5}		2×10^{-9}	1×10^{-3}	
Future Trespasser						
-- Dermal Contact	6×10^{-12}	2×10^{-8}		7×10^{-10}	2×10^{-6}	
-- Ingestion	1×10^{-10}	3×10^{-6}		1×10^{-8}	7×10^{-4}	
-- Inhalation of VOCs*	0.00	2×10^{-8}		0.00	4×10^{-7}	
-- Inhalation of Particulates	7×10^{-13}	0.00		1×10^{-11}	0.00	
	1×10^{-10}	3×10^{-6}		1×10^{-8}	7×10^{-4}	

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix C for nonrounded risk values.

* No carcinogenic volatile organic compounds were detected at SWMU 93.

TABLE 8-19

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies. They are under review and subject to revision.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

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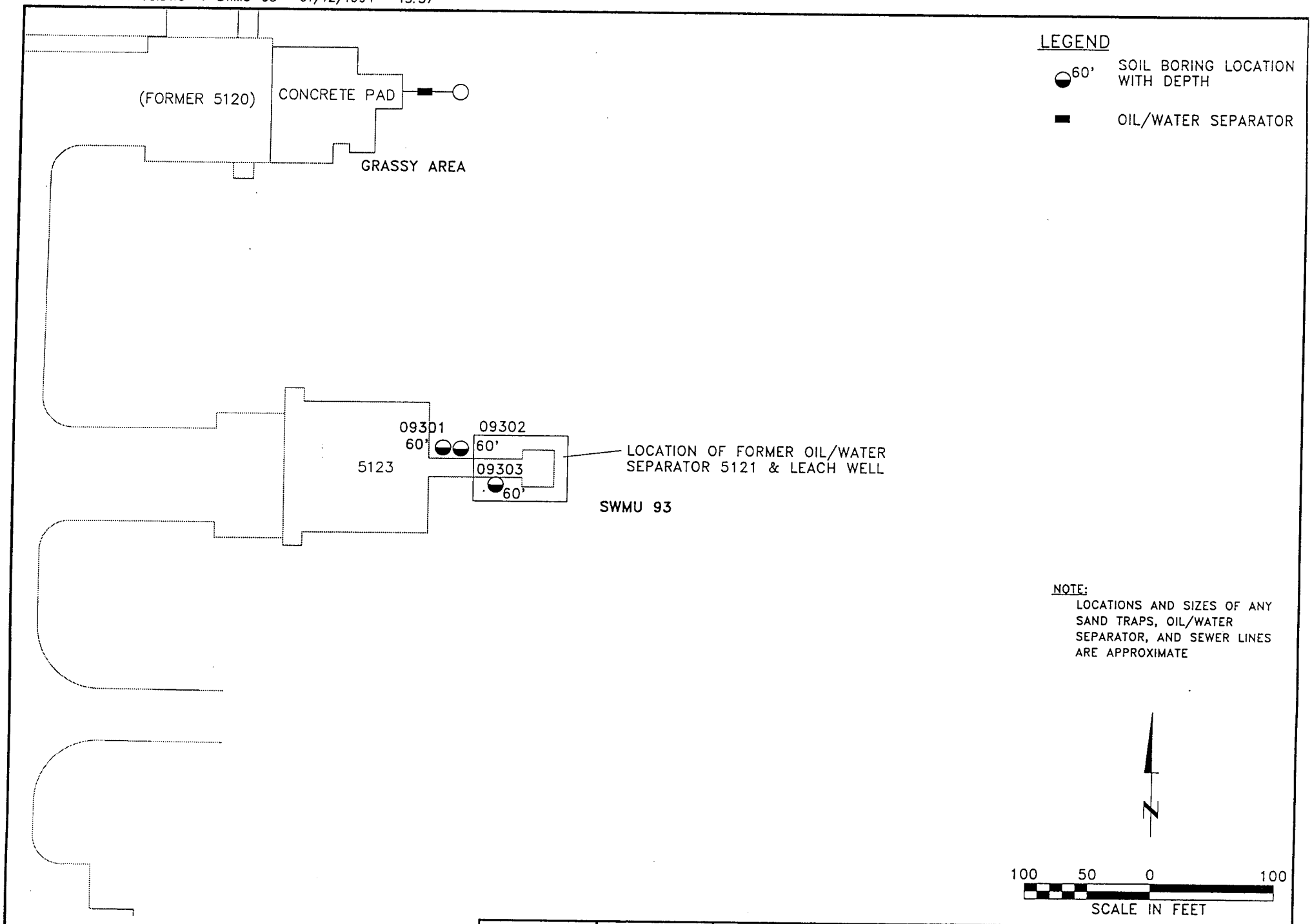

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 5121 – SWMU 93 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 8-1
CHK'D BY: .	REVISION: 0			

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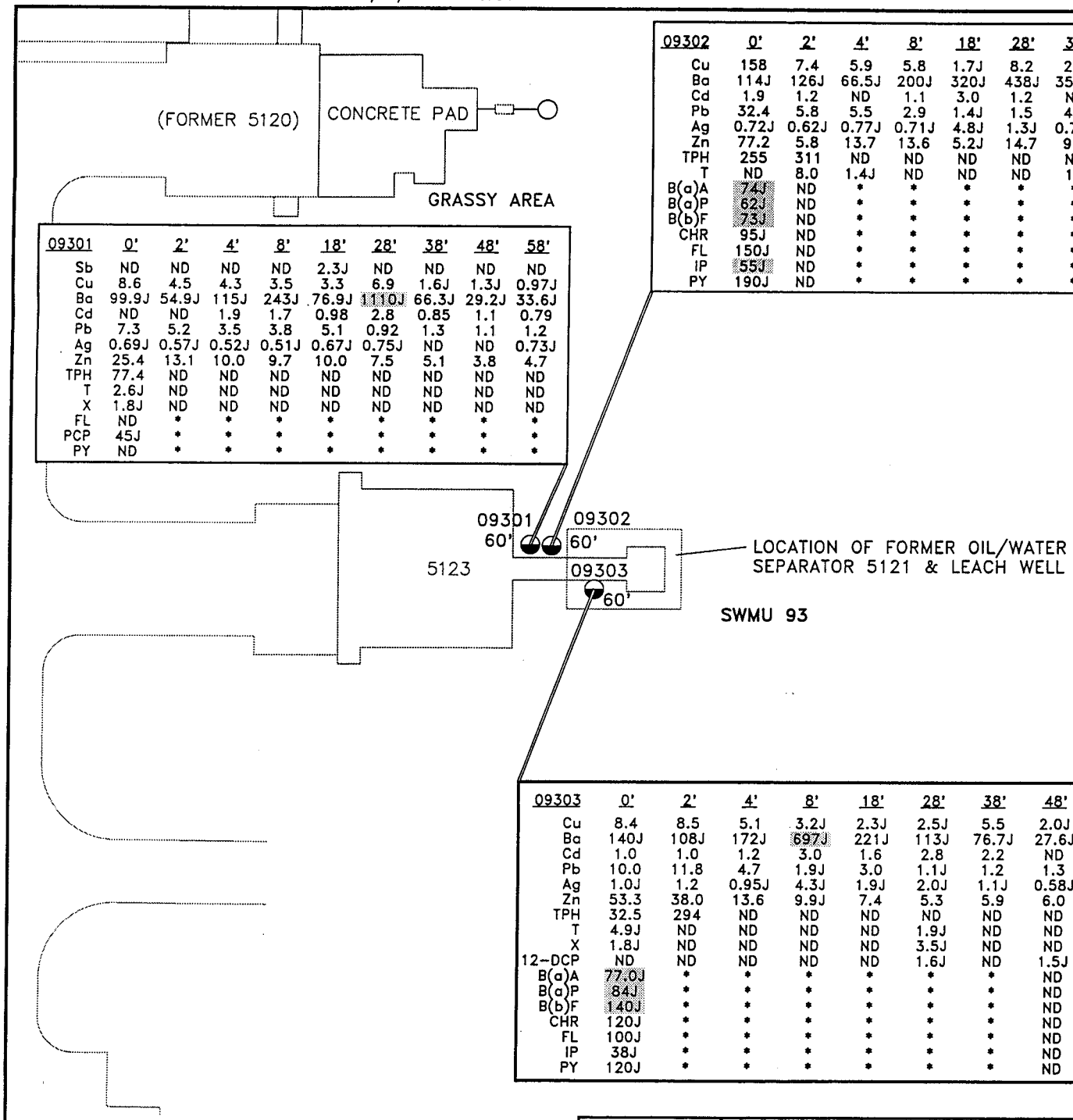


09301	0'	2'	4'	8'	18'	28'	38'	48'	58'
Sb	ND	ND	ND	ND	2.3J	ND	ND	ND	ND
Cu	8.6	4.5	4.3	3.5	3.3	6.9	1.6J	1.3J	0.97J
Ba	99.9J	54.9J	115J	243J	76.9J	1110J	66.3J	29.2J	33.6J
Cd	ND	ND	1.9	1.7	0.98	2.8	0.85	1.1	0.79
Pb	7.3	5.2	3.5	3.8	5.1	0.92	1.3	1.1	1.2
Ag	0.69J	0.57J	0.52J	0.51J	0.67J	0.75J	ND	ND	0.73J
Zn	25.4	13.1	10.0	9.7	10.0	7.5	5.1	3.8	4.7
TPH	77.4	ND	ND	ND	ND	ND	ND	ND	ND
T	2.6J	ND	ND	ND	ND	ND	ND	ND	ND
X	1.8J	ND	ND	ND	ND	ND	ND	ND	ND
FL	ND	*	*	*	*	*	*	*	*
PCP	45J	*	*	*	*	*	*	*	*
PY	ND	*	*	*	*	*	*	*	*

09302	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cu	158	7.4	5.9	5.8	1.7J	8.2	2.5	2.4	1.9J
Ba	114J	126J	66.5J	200J	320J	438J	35.9J	40.5J	17.2J
Cd	1.9	1.2	ND	1.1	3.0	1.2	ND	ND	ND
Pb	32.4	5.8	5.5	2.9	1.4J	1.5	4.6	1.8	1.9
Ag	0.72J	0.62J	0.77J	0.71J	4.8J	1.3J	0.76J	0.65J	0.65J
Zn	77.2	5.8	13.7	13.6	5.2J	14.7	9.4	1.8	4.6
TPH	255	311	ND	ND	ND	ND	ND	ND	ND
T	ND	8.0	1.4J	ND	ND	ND	16	8	1.6J
B(a)A	74J	ND	*	*	*	*	*	*	*
B(a)P	62J	ND	*	*	*	*	*	*	*
B(b)F	73J	ND	*	*	*	*	*	*	*
CHR	95J	ND	*	*	*	*	*	*	*
FL	150J	ND	*	*	*	*	*	*	*
IP	55J	ND	*	*	*	*	*	*	*
PY	190J	ND	*	*	*	*	*	*	*

09303	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cu	8.4	8.5	5.1	3.2J	2.3J	2.5J	5.5	2.0J	2.0J
Ba	140J	108J	172J	697J	221J	113J	76.7J	27.6J	43.1J
Cd	1.0	1.0	1.2	3.0	1.6	2.8	2.2	ND	0.61
Pb	10.0	11.8	4.7	1.9J	3.0	1.1J	1.2	1.3	1.4
Ag	1.0J	1.2	0.95J	4.3J	1.9J	2.0J	1.1J	0.58J	0.5J
Zn	53.3	38.0	13.6	9.9J	7.4	5.3	5.9	6.0	6.4
TPH	32.5	294	ND	ND	ND	ND	ND	ND	ND
T	4.9J	ND	ND	ND	ND	1.9J	ND	ND	1.4J
X	1.8J	ND	ND	ND	ND	3.5J	ND	ND	ND
12-DCP	ND	ND	ND	ND	ND	1.6J	ND	1.5J	2.8J
B(a)A	77.0J	*	*	*	*	*	*	ND	*
B(a)P	84J	*	*	*	*	*	*	ND	*
B(b)F	140J	*	*	*	*	*	*	ND	*
CHR	120J	*	*	*	*	*	*	ND	*
FL	100J	*	*	*	*	*	*	ND	*
IP	38J	*	*	*	*	*	*	ND	*
PY	120J	*	*	*	*	*	*	ND	*

LEGEND

60' SOIL BORING LOCATION WITH DEPTH

OIL/WATER SEPARATOR

Sb = ANTIMONY (mg/kg)
Cu = COPPER (mg/kg)
Ba = BARIUM (mg/kg)
Cd = CADMIUM (mg/kg)
Pb = LEAD (mg/kg)
Ag = SILVER (mg/kg)
Zn = ZINC (mg/kg)
TPH = TOTAL PETROLEUM HYDROCARBONS (mg/kg)
T = TOLUENE
X = XYLENES
12-DCP = 1,2-DICHLOROPROPANE
B(a)A = BENZO(A)ANTHRACENE
B(a)P = BENZO(A)PYRENE
B(b)F = BENZO(B)FLURANTHENE
CHR = CHRYSENE
FL = FLUORANTHENE
IP = INDENO(1,2,3-CD)PYRENE
PCP = PENTACHLOROPHENOL
PY = PYRENE

CONCENTRATIONS ARE $\mu g/kg$ EXCEPT WHERE NOTED

ND= CHEMICALS ANALYZED FOR WERE NOT DETECTED

* = ANALYSIS FOR THIS CHEMICAL WAS NOT PERFORMED

NOTE:
LOCATIONS AND SIZES OF ANY SAND TRAPS, OIL/WATER SEPARATOR, AND SEWER LINES ARE APPROXIMATE

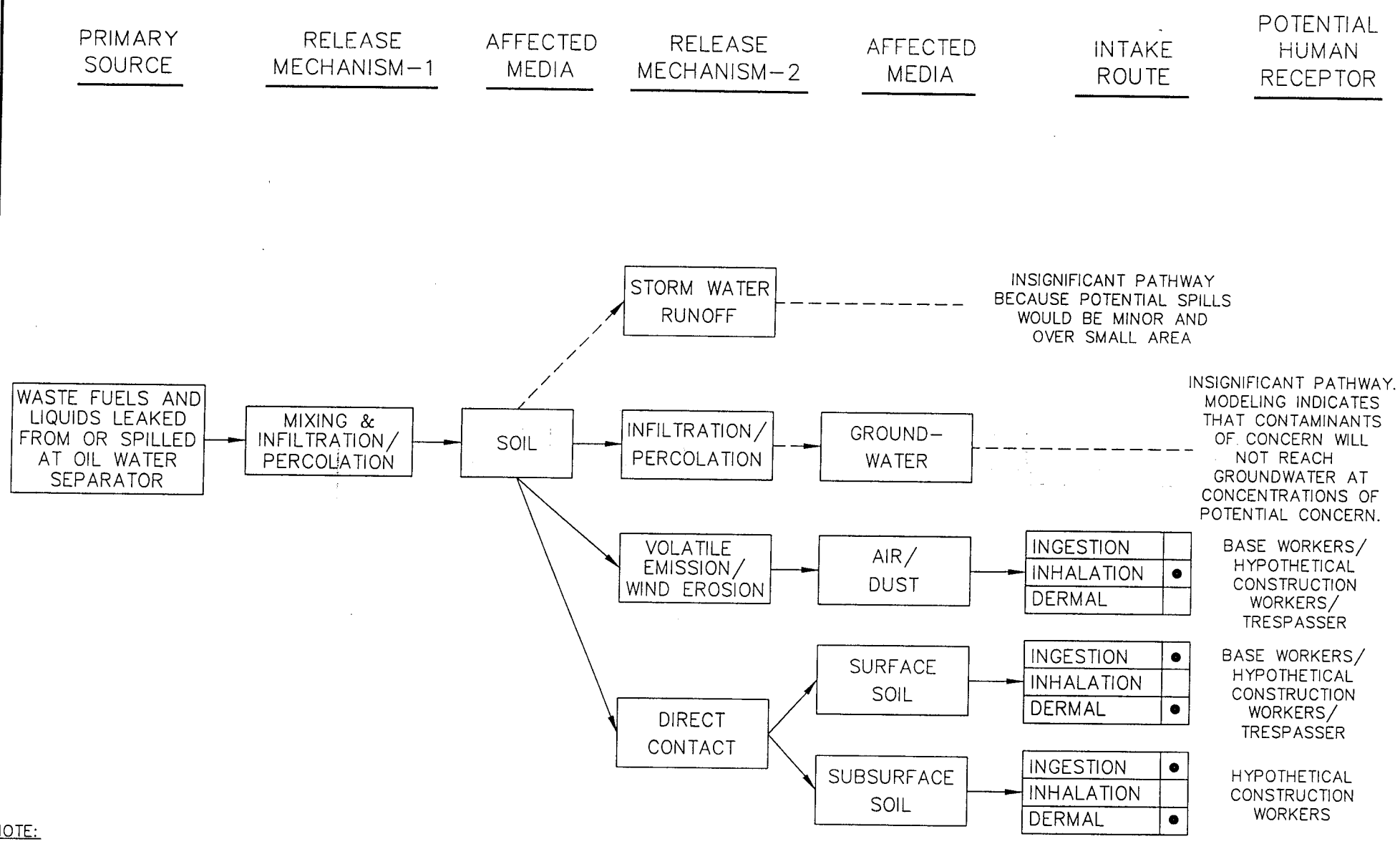
N

100 50 0 100
SCALE IN FEET

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/04/94	OIL/WATER SEPARATOR No. 5121 – SWMU 93 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY: .	REVISION: 0		C3M11W	8-2

CAD FILE: C3M11W20.DWG V=SWMU-93 01/17/1994 13:48



NOTE:

SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART OIL WATER SEPARATOR No.5121 SWMU 93 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	8-3

9.0
OIL/WATER SEPARATOR NO. 5144 - SWMU NO. 94

9.1 SITE BACKGROUND

9.1.1 Site Description

Facility 5144 is a two-bay vehicle wash rack located behind the Army, Air Force Exchange Service (AAFES) service station, east of the intersection of D.L. Ingram Street and Argentia Avenue. The facility has two sand traps within the limits of the concrete wash racks and a 1,700-gallon sand trap located in a grassy area northeast of the wash rack (Figure 9-1). The 1,700-gallon sand trap was mistakenly identified as an oil/water separator (OWS) in previous reports; however, to avoid confusion and because it functions partly as an OWS, this unit will be referred to as an OWS in this report. The sand traps in the wash rack measure about 3.5 feet by 8 feet in plan, and the OWS in the grassy area measures about 5 feet by 10 feet in plan. The exact depths of the units are not known, but are believed to be less than 10 feet. Drainage from the uncovered wash rack is collected in the sand trap and directed to the OWS. The covered wash rack receives no consistent runoff. The area of the OWS grades slightly to the east towards a large, northwest-trending surface ditch.

9.1.2 Site History

Facility 5144 has been partially dismantled and is no longer used as a wash rack; however, the wash bays and sand traps remain in place. The SWMU reportedly received wash-down water from personal vehicle washing operations. Any oils recovered were collected in the 1,700-gallon OWS (sand trap), and the wastewater was discharged to the sanitary sewer line. The sand traps and OWS were active from 1960 to approximately 1988, and their present contents are unknown.

9.1.3 Current Use

The wash rack area is currently used to store rental moving trucks and trailers and as a covered parking area for employees in nearby buildings.

9.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATIONS

9.2.1 Physical Investigation

The objective of sampling at the site of the sand traps at SWMU 94 was to evaluate if a release of SWMU-related chemicals which could pose a significant risk to human health or the environment has occurred as a result of spillage or leakage from either the wash racks or the OWS in the grassy area (Figure 9-1).

Four 10-foot soil borings were drilled below the concrete wash racks to sample soils as close as possible to the sand traps. These borings were located on expansion joints in the wash rack to check for possible spillage entering the underlying soil and at the sand trap outlet pipe. Two additional 10-foot borings were located as close as possible to the inlet and outlet pipes for the OWS in the grassy area. Close overhead clearances in the covered wash rack and overhead utilities required that three borings be drilled with hand implements. Boring locations are shown on Figure 9-2.

Soil samples were collected at the surface and the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot-depth intervals to characterize the vertical distribution of potential contaminants which may have been released from the sand traps. Target analytes include VOCs, SVOCs, metals, and TRPH. Surficial samples in the grass-covered area were collected at approximately 0.2 to 0.5 feet. Samples from the 0.5- to 2-foot-depth interval were collected immediately below the concrete covering the wash rack. No surface staining of concrete or stressed vegetation was observed at this site.

9.2.2 Chemical Investigation

Twenty-four soil samples (not counting QC samples) were collected from the six borings (09401, 09402, 09403, 09404, 09405, and 09406). Sampling and analyses performed are summarized in Table 9-1. A summary of the analytical results for these soil samples are provided in Table 9-2a (near-surface soils) and Table 9-2b (subsurface soils). The tables provide results for analytes that were detected at least once in each sample group (near-surface and subsurface). Complete analytical summary results are provided in the QCSR (Appendix A of the RFI report).

9.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI report, and the data were deemed to be of adequate quality to meet the objectives of the RFI. However, data quality issues that may affect the risk assessment are more fully discussed here.

Elevated reporting limits may sometimes limit the usability of some analytical results. However, this was not a factor that affected data usability at this SWMU.

Barium was rejected in 8 of 24 samples at this SWMU. The rejected samples were all from Borings 09405 and 09406 at the southeast sand trap in the wash rack. Therefore, the barium concentration around one of the sand traps is unknown. Although this is a data gap, it is not viewed as crucial for the following reasons: first, the barium concentration in the other wash rack sand trap, which probably had the same type of use, is fully characterized and does not exceed background. In addition, the sand trap is from a vehicle washing facility; therefore, there is no reason to believe that barium is a chemical of concern. One sample at the OWS (sand trap) in the grassy area (which also collected waste from the gas station) had a barium concentration above background levels, but because of the high variability in naturally occurring barium concentrations, it is suspected that this sample is also naturally occurring. All other samples at this site were below background concentrations. Therefore, although barium has not been quantified in one area of this site, it is believed that this will not impact the conclusions of the risk assessment.

9.2.4 Nature and Extent of Contamination

There was no visible evidence of spills or leaks in the vicinity. Except for minor petroleum staining in the upper foot of soil around the sand traps, no visual evidence of contamination was encountered during sampling. The chemical test results show low levels of organic contamination, including PAHs and TPH, predominantly in the shallow samples.

The maximum detected PAH concentration was 550 μg/kg for benzo(b)fluoranthene in surface soil at the east sand trap. This sample also had 340 μg/kg of benzo(a)pyrene. TPH was detected at a maximum concentration of 862 mg/kg in surface soil at the east sand trap. Only very low levels of VOCs (toluene was detected at a maximum concentration of 49 μg/kg at a depth of 2 feet) were detected. Cadmium was detected in several samples at a maximum concentration of 2.9 mg/kg. Barium was detected at a maximum concentration of 1,640 mg/kg at a depth of 4 feet. Since barium was detected at much lower concentrations in other samples from the same boring, the barium is probably naturally occurring. No significant contamination was detected in the samples at a depth of 8 feet, which indicates that vertical transport is not occurring.

9.3 HUMAN HEALTH RISK ASSESSMENT

9.3.1 Exposure Pathway Flow Chart

Figure 9-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways for OWS 5144. In the flow chart, potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary sources are historic discharges of waste fluids (e.g., fuels, oils, and solvents) to the sand traps. Chemicals from the primary source may be released to other media (e.g., soils) that may, in turn, act as secondary sources of chemical release or exposure. Mixing and infiltration of the wastes to soil is shown as a primary chemical release mechanism. SWMU-related chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion, or result in exposure via direct contact (e.g., dermal contact or incidental ingestion). Storm water runoff

is not considered to be a significant pathway for human exposures because the SWMU covers only a small area, surface spills are not likely to be significant, and no developed drainageways are present near the SWMU.

As shown in the flow chart, surface soils may provide exposures to Base workers (occupational exposures), hypothetical future construction workers, or hypothetical future trespassers (if the Base is closed in the future). Air emissions (volatile and particulates) from surface soil may also provide exposures to Base workers, construction workers, and trespassers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Groundwater is used for domestic purposes on and off Base. In order to assess potential impacts to public health via groundwater pathways, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling (Section 9.3.5.2) indicate that contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway was not evaluated further. Residential exposures to soils are not considered for this SWMU because it is located in an industrial area, so even if the Base closes in the future, industrial rather than residential use is the reasonable future use of the site.

In summary, potential complete human exposure pathways evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Trespassers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

9.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

Background levels were defined by the upper tolerance limit (UTL) of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; see Appendix A.)

Results of the comparison of metals concentrations in soil for SWMU 94 to background levels are given in Tables 9-3 and 9-4. A summary of the results of the comparison is presented here.

The maximum detected concentrations of cadmium, lead, mercury, selenium, silver, and zinc in surface soil exceeded the background levels. The maximum detected concentrations of antimony, barium, cadmium, lead, mercury, selenium, silver, thallium, and zinc in total soils exceeded the background levels. Therefore, these metals were retained for further consideration as chemicals of concern in surface soils and total soils.

9.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 94, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels

and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 9-2a and 9-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentrations of cadmium, lead, mercury, selenium, silver, and zinc detected in surface soil exceeded background ranges according to the comparison described in Section 9.3.2. These metals are, therefore, considered as chemicals of concern in surface soil. The concentrations of antimony, barium, cadmium, lead, mercury, selenium, silver, thallium, and zinc detected in total (surface and subsurface) soil exceeded background ranges according to the comparison described in Section 9.3.2. These metals are, therefore, considered as chemicals of concern in total soil. The compounds 1,2-dichloroethane, 2-butanone, and tetrachloroethene were detected in fewer than 5 percent of the total soil samples; they were only detected at concentrations below reporting limits. Therefore, these compounds are not considered to be characteristic of the site, are not likely to pose a significant health risk, and are thus not considered chemicals of concern. Other organic contaminants detected in soils were retained as chemicals of concern for risk assessment. Chemicals of concern in surface soil and total soil are listed in Tables 9-5 and 9-6, respectively.

The chemicals 2-methylnaphthalene, benzo(g,h,i)perylene, dibenzofuran, lead, phenanthrene, and TPH, listed in Tables 9-5 and 9-6 as chemicals of concern, do not have EPA-established toxicity factors and, therefore, cannot be evaluated quantitatively in the risk assessment. However, their potential effects on the results of the risk assessment are addressed in Sections 9.3.8 through 9.3.10.

9.3.4 Environmental Fate and Transport

9.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary

importance to fate and transport of chemicals in the environment are water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

9.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (DOE 1991), describes the mass balance of a contaminant (based on average soil concentrations) in the contaminated soil volume at the SWMU. The DOE model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP] Model) and accounts for sorption to soils and degradation in the vadose zone. The model conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of chemicals of concern. The input parameters and estimated leachate concentrations are shown in Table 9-11. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water in Table 9-12. Since the RBCs were developed for drinking water (at the tap) and are based on very conservative exposure and health-protective (risk) assumptions, it can be concluded that modeled groundwater concentrations that do not exceed RBCs will pose no significant adverse health risk.

9.3.4.3 Air Modeling

RME air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using RME soil concentrations of chemicals of concern. The results of the air modeling are shown in Tables 9-13 through 9-16. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use

at hazardous waste sites to calculate soil clean-up levels (EPA 1991). Air concentrations were calculated for only those chemicals with inhalation toxicity factors which were evaluated quantitatively in the risk assessment. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

9.3.5 Exposure Point Concentrations

9.3.5.1 Soils

Tables 9-7 and 9-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils, respectively, at OWS 5144.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use of "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C. Tables 9-9 and 9-10 give the soil concentrations of organic compounds from surface and total soils, respectively, which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils. The absorbed fraction (from Table C-26, Appendix C) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soil. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

For purposes of risk assessment, surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depth (i.e., number reads XXXXX-XXXX-0002) were actually taken from a depth of 1.5 to 3.5 feet. These samples were not considered surface samples, but were included in the risk assessment for subsurface soil exposures.

9.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 94. A more detailed description of the groundwater modeling approach is provided in Appendix B. Model results are included in Table 9-11. These modeled concentrations were then compared to EPA Region III tap-water RBCs (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 9-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap-water RBCs. No modeled concentrations exceeded the RBCs, so potential risks from the groundwater pathway are not expected to exceed 1×10^{-6}. Therefore, the groundwater pathway has been determined to be insignificant and was not evaluated further.

9.3.5.3 Air

RME air concentrations of volatile and particulate emissions from surface soil and from total soil were calculated using RME concentrations of chemicals of concern. The results of the air modeling from surface soil are shown in Tables 9-13 and 9-14. The results of the air modeling from total soil are shown in Tables 9-15 and 9-16.

9.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the exposure assumptions and intake factors used to quantify chemical intake of SWMU-related contaminants in soil and air. Table 9-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

9.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 9-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface soils at SWMU 94. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative because there are no occupational receptors routinely working outdoors at the SWMU. Furthermore, the surface area of the SWMU is small (approximately 120 feet by 160 feet, or 0.4 acre), and long-term exposures are not likely to occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 94 via the dermal contact, inhalation, and ingestion pathways is 0.00001 and 0.002 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk under the assumed chronic exposure conditions is 2×10^{-9} under the average exposure case and 6×10^{-7} for the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} 1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). Therefore, risks from exposure to surface soils at this SWMU are negligible.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 94. Exposures were assumed to occur during construction activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 94 via the dermal contact, inhalation, and ingestion pathways is 0.0004 and 0.005 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 6×10^{-10} in the average case and 5×10^{-9} in the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b).

Hypothetical Future Trespasser Exposure

Hypothetical trespassers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface soil at SWMU 94. Hypothetical trespassers were assumed to be exposed at SWMU 94 for 2 and 8 hours/day, for 26 and 52 days/year, over 6 years for the average and RME cases, respectively. These assumptions are very conservative because Cannon AFB is likely to remain a military installation, making access to SWMU 94 by trespassers unlikely.

The total hazard index calculated for noncarcinogenic health effects due to exposures to contaminants in surface soil at SWMU 94 via the dermal contact, ingestion, and inhalation pathways is 0.000003 and 0.0005 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed exposure conditions is 3×10^{-10} under the average exposure case and 4×10^{-8} under the RME case. These levels are negligible.

9.3.8 Qualitative Assessment of Exposures to Lead

Lead exposures are not addressed in the quantitative risk assessment because EPA withdrew the RfD for lead in 1989, primarily due to the lack of a discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. This level is supported by EPA's Uptake/Biokinetic (UBK) Lead Model, which predicts that exposures of children ages 0 to 6 to soils with approximately this level will not result in blood lead levels that exceed a level of concern established by the Centers for Disease Control.

The maximum lead concentration measured in soils at SWMU 94 was 99.2 mg/kg detected in surface soil at 0942-0000. Lead was measured at 3.0 to 61.5 mg/kg in other soil samples at SWMU 94. The maximum concentration detected at SWMU 94 is well below the range suggested by EPA for residential soils. Therefore, lead in soils at this SWMU is not considered a health concern.

9.3.9 Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available and when the fuel product is known. The provisional values are under review and are subject to revision. The RBCs derived from them are used only as a guide to potential health hazards.)

The toxicity factors and calculation of risk-based concentrations are shown in Table 9-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,613 mg/kg. The maximum SWMU concentration of TPH is 3,600 mg/kg, well below the conservative RBC.

9.3.10 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 94 and their effect on the results and conclusions of the risk assessment are listed below.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens, such as benzo(a)pyrene, which cause skin cancer through a direct action at the point of application. The exclusion of PAHs from quantitative evaluation in the dermal exposure pathway may underestimate the potential human health risk from dermal contact with soil at the SWMU. Because of the low actual exposure potential and because

PAHs were detected in only a few samples analyzed, the uncertainty regarding direct contact risk is not likely to affect the conclusions of the risk assessment.

- Benzo(g,h,i)perylene, dibenzofuran, and phenanthrene were not considered in the quantitative risk assessment because they do not have EPA-established toxicity factors. Their exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results or conclusions of the risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected, because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- The surface area of this SWMU is less than one-half acre and is, therefore, not likely to support chronic use by workers. Therefore, the exposure assumptions used are likely to significantly overestimate actual exposures to contaminated soils and risks at this SWMU.

9.4 ECOLOGICAL RISK ASSESSMENT

9.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 94 is located in a small area of poor wildlife habitat quality, within the developed portion of Cannon AFB where existing ground cover is mostly asphalt paving, buildings, and areas of mowed non-native grasses. About 60% of the land surface within the immediate vicinity (within 100 feet) of SWMU 94 is concrete or asphalt paving and Buildings 374 and 368. A mowed grassy area is located immediately above and to the northeast of the SWMU. OWS No. 5144 was actively used from 1960 to approximately 1988, and the paved washrack area is currently used to store vehicles and for parking.

The most common species are likely to be birds, such as robin (*Turdis migratorius*), house sparrow (*Passer domesticus*), and the starling (*Sturnus vulgaris*). Seedeaters would be more limited, since the grass is maintained by mowing. Although the house mouse (*Mus musculus*) may occur in the area around the buildings, the grass habitat is probably too small, fragmented, and subject to human disturbance to be used regularly by terrestrial species such as house mice. Raptors are unlikely to use the area for similar reasons.

Given this assessment, the robin (*Turdus migratorius*) was selected as the key receptor species for the grassy area near SWMU 94.

9.4.2 Chemicals of Concern

The chemicals of concern (COCs) at SWMU 94 were selected using validated data from eight soil samples covering the interval between 0 and 2 feet deep. This interval was selected because most soil-dwelling organisms (e.g. earthworms and house mice) occur in this zone. Table 9-20 provides a summary of the chemicals detected in the eight samples considered for this ERA. A detailed description of the soil sampling program and chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the eight samples to be considered a possible COC. The following screening criteria were then applied, in the order shown, to determine if a chemical in the soil would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Exceedance of the normal range found in U.S. soils (nationwide)

The maximum detected concentration of the eight samples was used in the comparison to background criteria. If no background criteria were available for comparison, as was the case for the organic chemicals, the chemicals were retained as COCs. If the maximum detected concentration of a chemical exceeded the local (i.e. Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If it

exceeded this criteria, it was likely retained as a COC, even if it fell within the normal range found in U.S. soils. This is because the normal U.S. range is widely variable and was included in the screening process primarily as an additional reference. In some cases however, the normal U.S. range was the only screening criteria available. Table 9-21 lists the maximum concentrations detected and shows the screening values used. The chemicals that were retained as COCs following the screening process include 1,2-dichloroethane, ethylbenzene, tetrachloroethene, toluene, xylenes, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, butyl benzyl phthalate, chrysene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, pentachlorophenol, phenanthrene, pyrene, cadmium, lead, mercury, selenium, silver, thallium, zinc, and TPH.

9.4.3 Exposure Assessment

Figure 9-4 depicts the exposure pathway flow chart developed for SWMU 94. As the flowchart indicates, chemicals could potentially be released through transport in runoff, infiltration to groundwater, volatilization or wind erosion, and direct contact by ecological receptors. Except for direct contact, these exposure pathways are incomplete or of minor importance for ecological receptors at SWMU 94. Storm water runoff is a potentially complete but insignificant pathway, because the source of chemicals is below ground and any spillage during servicing would involve a relatively small area of level terrain. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization or wind erosion is not considered a significant pathway at this site. Although several of the COCs are volatile organic compounds (VOCs), the maximum concentration was 0.049 mg/kg, and VOC concentrations of 100 mg/kg or greater in air are generally needed to induce toxic responses in laboratory rats and mice from inhalation (NIOSH 1987). Concentrations in soils would have to be many times greater than this to produce these toxic levels in air, even near the soil surface. Direct contact with subsurface soils (more than two feet deep) is also considered an insignificant or incomplete pathway because of the limited use of deeper soils at this site by wildlife.

Therefore, the only potentially complete and significant exposure pathway is direct contact with contaminated surface soil by species frequenting the SWMU area. Direct contact may include dermal absorption or ingestion. Dermal absorption is not considered a significant

exposure route for the receptors at this site because the animals are assumed to be largely protected by their fur or feathers. Receptors at the SWMU may ingest COCs either directly or indirectly. Direct ingestion usually occurs along the food/prey chain from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of COCs that have been transferred via food webs.

Figure 9-5 depicts the Conceptual Site Model developed from the exposure pathway analysis, the ecological characterization, and the identification of the key receptor species for SWMU 94. As the figure indicates, the pathway of concern is from surface soil to the robin, via direct and indirect ingestion, with the earthworm identified as a main dietary component of the robin.

9.4.4 Risk Characterization

This section provides a characterization of potential risk to the selected key receptor species (robin) at SWMU 94. For the purposes of this analysis, it was assumed that the robin's diet consists of earthworms and inadvertent consumption of soil. It was also assumed that the concentration of the COCs were the same in the earthworm as in the soil, except for cadmium and selenium, for which BAFs of 4.6 and 12 were used based on Beyer and Stafford (1993). Therefore the analysis consisted of comparing the concentration of COCs in the robin's food (i.e., the chemical concentration in soil) to selected toxicity benchmark dietary levels for those chemicals (see Table 9-22).

This is a somewhat conservative approach, because studies indicate that, for many chemicals, BAFs from soil to earthworm are less than one (Beyer and Stafford 1993). However, this assumption takes into account the soil that would be clinging to the earthworm when consumed by the robin (that is not taken into account by the BAF studies) and also accounts for minor inadvertent soil ingestion by the robin. The benchmark dietary levels were selected as explained in Appendix D, Section D.3 and D.4; these sections also provide background toxicological information about the COCs. The soil chemical concentration used was the arithmetic mean, as described in Appendix D (Section D.6.).

Table 9-22 lists the COCs for SWMU 94 and provides a comparison between the soil concentration (arithmetic mean) and the benchmark dietary level for the robin. If the soil

level exceeds the benchmark level, there is a possibility of risk, as noted in the table. The following discussion addresses those chemicals where a possibility of risk is indicated.

Benzo-a-pyrene (BaP):

The average concentration of BaP at SWMU 94 was 0.23 mg/kg, compared to the benchmark dietary level of 0.002 mg/kg, indicating a potential risk. The 0.23 mg/kg level is within the range of many reported BaP concentrations for various locations, as reported in the literature for both industrial and non-polluted areas and for a range of rural to urban soils (see Table A-6). Also, BaP was detected in only two of four samples; the other two samples were nondetects. Therefore, it is unlikely that the robin is exposed to a level of 0.23 mg/kg in all areas in which it feeds, assuming it does not feed just at the "hot spots" in the SWMU area. In addition, the low toxicity benchmark level for BaP is a reflection of BaP's carcinogenic effects through the action of its intermediate metabolites, as opposed to acute toxicity. In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, and therefore it is questionable if carcinogenesis is an important endpoint for relatively short-lived mammals and birds, such as the robin. Finally, the BaP found at SWMU 94 may not be completely bioavailable to robins. Goon et al. (1991) showed that BaP that had aged 6 months in soil was only 34 to 51% orally bioavailable for clayey and sandy soils, relative to BaP administered alone to rats. For all these reasons, it is unlikely that BaP presents an unacceptable risk at SWMU 94.

TPH:

The average concentration of TPH at SWMU 94 was 1059.7 mg/kg, compared to the benchmark dietary level of 241 mg/kg, indicating a potential risk. However, TPH levels are very spotty at SWMU 94, with "hot spots" indicated by three samples (862-3600 mg/kg) and two non-detects out of eight samples. Also, it is not certain how much the robin is exposed to fresh TPH mixtures as opposed to aged products. As noted in Appendix D, the toxicity benchmarks for TPH are derived from experiments using fresh fuels, and the BTEX and PAH compounds are the compounds of primary concern in TPH mixtures in setting cleanup levels and characterizing risk. In older spills to surface soils, the volatile BTEX component may not be present or prevalent and the total TPH value may reflect less toxic constituents.

However, PAHs will still be present in older spills, and these may be of concern. At SWMU 94, PAHs were detected, but were determined unlikely to present an unacceptable risk.

9.5 SUMMARY AND CONCLUSIONS

9.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at the SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 9-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU.

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

9.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

TABLE 9-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5144 (SWMU NO. 94)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09401	0 - 0.5	CAN094-0941-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN094-0941-9461	FD	Soil	X	X	X	X		2	1
	0 - 0.5	CAN094-0941-9401	MRD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN094-0941-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0941-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN094-0941-0008		Soil	X		X	X		2	1
		CAN094-0941-9451	AB	Water	X				2		
		CAN094-0941-9471	RB	Water	X				2		
		CAN094-0941-9481	DW	Water	X				2		
		CAN094-0941-9491	TB	Water	X				2		
Boring 09402	0 - 0.5	CAN094-0942-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN094-0942-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0942-0004		Soil	X		X	X		2	1
	8 - 10	CAN094-0942-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN094-0942-9462	FD	Soil	X		X	X		2	1
	8 - 10	CAN094-0942-9402	MRD	Soil	X	X	X	X		2	1
Boring 09403	0.5 - 2	CAN094-0943-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN094-0943-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0943-0004		Soil	X		X	X		2	1
	8 - 10	CAN094-0943-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN094-0943-6008	MS/MSD SVOC only	Soil		X					1
Boring 09404	0.5 - 2	CAN094-0944-0000		Soil	X		X	X		2	1
	2 - 4	CAN094-0944-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0944-0004		Soil	X		X	X		2	1
	4 - 6	CAN094-0944-6004	MS/MSD	Soil	X		X	X		2	2
	8 - 10	CAN094-0944-0008		Soil	X		X	X		2	1

TABLE 9-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5144 (SWMU NO. 94)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09405	0.5 - 2	CAN094-0945-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN094-0945-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0945-0004		Soil	X		X	X		2	1
	8 - 10	CAN094-0945-0008		Soil	X		X	X		2	1
Boring 09406	0.5 - 2	CAN094-0946-0000		Soil	X		X	X		2	1
	2 - 4	CAN094-0946-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0946-0004		Soil	X		X	X		2	1
	8 - 10	CAN094-0946-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN094-0946-6008	MS/MSD	Soil	X	X	X	X		2	2

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 15-1 for locations of the borings.

TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0000			CAN094-0941-0002			CAN094-0942-0000			CAN094-0942-0000			CAN094-0942-0002			CAN094-0943-0000		
LAB SAMPLE NUMBER	0314020002SA			0314020003SA			0312160017SA			0314020006SA			0312160018SA			0314010009SA		
COLLECT DATE	09/24/93			09/24/93			09/24/93			09/24/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
1,2-Dichloroethane	<	5.1	U	2	5.3	J				<	5.3	U	<	5.6	U	<	5.9	U
Ethylbenzene	<	5.1	U	1.2	5.3	J				<	5.3	UJ	<	5.6	U	<	5.9	U
Tetrachloroethene	<	5.1	U	25	5.3	J				<	5.3	UJ	<	5.6	U	<	5.9	U
Toluene	6.1	5.1	J	49	5.3	J				10	5.3	J	<	5.6	U	1.4	5.9	J
Xylenes (total)	9.4	5.1		4.2	5.3	J				4.7	5.3	J	<	5.6	U	<	5.9	U
Semivolatile Organics (µg/kg)																		
Anthracene	<	340	U				37	360	J							<	390	U
Benzo(a)anthracene	110	340	J				230	360	J							<	390	U
Benzo(a)pyrene	170	340	J				340	360	J							<	390	U
Benzo(b)fluoranthene	230	340	J				550	360								<	390	U
Benzo(g,h,i)perylene	160	340	J				160	360	J							<	390	U
Butyl benzyl phthalate	48	340	J				<	360	U							<	390	U
Chrysene	180	340	J				350	360	J							<	390	U
Dibenzofuran	<	340	U				<	360	U							<	390	U
Fluoranthene	200	340	J				440	360								<	390	U
Fluorene	<	340	U				<	360	U							<	390	U
Indeno(1,2,3-cd)pyrene	110	340	J				140	360	J							<	390	U
2-Methylnaphthalene	<	340	U				<	360	U							<	390	U
Pentachlorophenol	<	1600	U				<	1800	U							74	1900	J
Naphthalene	<	340	U				<	360	U							<	390	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.

A complete summary of chemical results are presented in Appendix A

J = Estimated value below reporting limit or estimated based on data quality criteria.

R = Rejected value. QUAL=Qualification

U = Nondetected value. RL = Reporting Limit.

TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0000			CAN094-0941-0002			CAN094-0942-0000			CAN094-0942-0000			CAN094-0942-0002			CAN094-0943-0000		
LAB SAMPLE NUMBER	0314020002SA			0314020003SA			0312160017SA			0314020006SA			0312160018SA			0314010009SA		
COLLECT DATE	09/24/93			09/24/93			09/24/93			09/24/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Phenanthrene	150	340	J				240	360	J							<	390	U
Pyrene	410	340	J				360	360								<	390	U
Metals (mg/kg)																		
Aluminum	3630	10.3		3060	21.1		3830	11					8990	11.3		8670	11.8	
Arsenic	2.7	0.51		3.3	0.53		2.4	0.55					1.9	0.56		2.6	0.59	
Barium	246	1	J	511	2.1		166	1.1					131	1.1		104	1.2	
Beryllium	0.32	0.21		0.23	0.42	J	<	0.22	U				0.44	0.23		0.58	0.24	
Cadmium	1.8	0.51		2	1.1		0.91	0.55					<	0.56	U	<	0.59	U
Calcium	59100	20.5		106000	42.2		61000	22					70200	22.5		26400	23.5	
Chromium	11.5	1	J	3.7	2.1		5.9	1.1					6	1.1		7.9	1.2	
Cobalt	2.3	1		2.1	2.1		2.6	1.1					3.5	1.1		4.4	1.2	
Copper	11.2	2.1		7.7	4.2		10.1	2.2					6.6	2.3		8	2.4	
Iron	5200	10.3		3280	21.1		4510	11					6480	11.3		8290	11.8	
Lead	61.5	5.1		14.6	2.6		99.2	11					5.6	1.1		6.7	0.59	
Magnesium	2000	20.5		3290	42.2		1780	22					2540	22.5		1960	23.5	
Manganese	189	1	J	184	2.1		142	1.1					134	1.1		165	1.2	
Mercury	0.48	0.1		0.26	0.11		0.3	0.11					0.12	0.11		<	0.12	U
Nickel	5.6	4.1		6.3	8.4	J	5.8	4.4					7.9	4.5		8.9	4.7	
Potassium	1430	513	J	997	1060	J	1360	550					1790	564		1660	588	
Selenium	<	0.51	U	<	1.1	UJ	<	0.55	U				<	1.1	UJ	<	0.59	U
Silver	0.54	1	J	<	2.1	U	<	1.1	U				<	1.1	U	<	1.2	U
Sodium	210	513	J	332	1060	J	<	550	U				<	564	U	<	588	U
Thallium	<	0.51	U	<	1.1	UJ	<	0.55	U				<	1.1	UJ	<	0.59	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.

A complete summary of chemical results are presented in Appendix A

J=Estimated value below reporting limit or estimated based on data quality criteria.

R = Rejected value. QUAL=Qualification

U = Nondetected value. RL = Reporting Limit.

TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0000			CAN094-0941-0002			CAN094-0942-0000			CAN094-0942-0000			CAN094-0942-0002			CAN094-0943-0000		
LAB SAMPLE NUMBER	0314020002SA			0314020003SA			0312160017SA			0314020006SA			0312160018SA			0314010009SA		
COLLECT DATE	09/24/93			09/24/93			09/24/93			09/24/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Vanadium	13.5	1		12.8	2.1		11.1	1.1					13.4	1.1		23.9	1.2	
Zinc	56.3	2.1	J	21.5	4.2		84.8	2.2					18.9	2.3		19	2.4	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	862	82.1		3250	422		247	44					<	45.1	U	<	47	U
Water Quality (percent)																		
Water	2.6	0.1		5.2	0.1		9.1	0.1		5.2	0.1		11	0.1		15	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0943-0002			CAN094-0944-0000			CAN094-0944-0002			CAN094-0945-0000			CAN094-0945-0002			CAN094-0946-0000		
LAB SAMPLE NUMBER	0314010010SA			0314040007SA			0314040008SA			0311810017SA			0311810018SA			0311810013SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
1,2-Dichloroethane	<	5.8	U	<	5.9	U	<	5.9	U	<	6	U	<	5.8	U	<	6	U
Ethylbenzene	<	5.8	U	2.7	5.9	J	<	5.9	U	<	6	U	<	5.8	U	<	6	U
Tetrachloroethene	<	5.8	U	<	5.9	U	<	5.9	U	<	6	U	<	5.8	U	<	6	U
Toluene	<	5.8	U	<	5.9	U	1.2	5.9	J	<	6	U	<	5.8	U	1.4	6	J
Xylenes (total)	<	5.8	U	6.4	5.9		<	5.9	U	4	6	J	<	5.8	U	<	6	U
Semivolatile Organics (µg/kg)																		
Anthracene										<	400	U						
Benzo(a)anthracene										<	400	U						
Benzo(a)pyrene										<	400	U						
Benzo(b)fluoranthene										<	400	U						
Benzo(g,h,i)perylene										<	400	UJ						
Butyl benzyl phthalate										<	400	U						
Chrysene										<	400	UJ						
Dibenzofuran										160	400	J						
Fluoranthene										<	400	U						
Fluorene										320	400	J						
Indeno(1,2,3-cd)pyrene										<	400	UJ						
2-Methylnaphthalene										3800	400							
Pentachlorophenol										<	1900	U						
Naphthalene										430	400							

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TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0943-0002			CAN094-0944-0000			CAN094-0944-0002			CAN094-0945-0000			CAN094-0945-0002			CAN094-0946-0000		
LAB SAMPLE NUMBER	0314010010SA			0314040007SA			0314040008SA			0311810017SA			0311810018SA			0311810013SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Phenanthrene										240	400	J						
Pyrene										<	400	U						
Metals (mg/kg)																		
Aluminum	4500	23.1		7820	11.7		3710	58.9		8400	12		10500	11.5		7160	12	
Arsenic	2	0.58		2.6	0.59		1.8	0.59		2.9	0.6		2.3	0.58		2.6	0.6	
Barium	185	2.3		218	1.2	J	146	5.9	J			R			R			R
Beryllium	0.49	0.46		0.45	0.23		<	1.2	U	0.44	0.24		0.74	0.23		0.45	0.24	
Cadmium	<	1.2	U	0.8	0.59		2.9	2.9		<	0.6	U	<	0.58	U	<	0.6	U
Calcium	125000	46.2		38700	23.4		216000	118		12400	24		4840	23		7840	23.9	
Chromium	<	2.3	U	9.2	1.2		<	5.9	U	9.5	1.2		11.3	1.2		7.9	1.2	
Cobalt	3.1	2.3		1.7	1.2		<	5.9	U	3.2	1.2		5.4	1.2		2.5	1.2	
Copper	4.9	4.6		9.9	2.3		2.2	11.8	J	6.7	2.4		8.2	2.3		5.2	2.4	
Iron	4420	23.1		6280	11.7		3500	58.9		8890	12		10800	11.5		6680	12	
Lead	5.3	0.58		15.2	1.2		3.5	0.59		12.5	1.2	J	7.7	0.58	J	7.5	0.6	J
Magnesium	1880	46.2		2640	23.4		2480	118		1510	24		2250	23		1270	23.9	
Manganese	98.6	2.3		106	1.2		39.7	5.9		86.3	1.2	J	233	1.2	J	61.6	1.2	J
Mercury	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U
Nickel	7.1	9.2	J	5.8	4.7		<	23.5	U	7.1	4.8		11.3	4.6		5.4	4.8	
Potassium	1040	1150	J	1750	585		694	2940	J	1350	600		1830	575		1170	598	
Selenium	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ	0.34	0.6	J	0.26	0.58	J	0.27	0.6	J
Silver	<	2.3	U	0.52	1.2	J	3	5.9	J	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ
Sodium	<	1150	U	<	585	U	<	2940	U	<	600	U	<	575	U	<	598	U
Thallium	<	1.2	UJ	<	0.59	U	<	1.2	UJ	<	1.2	UJ	0.13	1.2	J	<	1.2	UJ

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TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0943-0002			CAN094-0944-0000			CAN094-0944-0002			CAN094-0945-0000			CAN094-0945-0002			CAN094-0946-0000		
LAB SAMPLE NUMBER	0314010010SA			0314040007SA			0314040008SA			0311810017SA			0311810018SA			0311810013SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Vanadium	12.9	2.3		13.4	1.2		11.7	5.9		18.5	1.2		21.4	1.2		15.3	1.2	
Zinc	12.9	4.6		23.6	2.3		11.2	11.8	J	27.2	2.4		23.6	2.3		17.3	2.4	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	61.3	46.2		221	46.8		<	47.1	U	3600	480		<	46	U	251	47.8	
Water Quality (percent)																		
Water	13	0.1		15	0.1		15	0.1		17	0.1		13	0.1		16	0.1	

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R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0946-0002		
LAB SAMPLE NUMBER	0311810014SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Volatile Organics (µg/kg)			
1,2-Dichloroethane	<	5.9	UJ
Ethylbenzene	<	5.9	U
Tetrachloroethene	<	5.9	U
Toluene	9	5.9	
Xylenes (total)	<	5.9	U
Semivolatile Organics (µg/kg)			
Anthracene			
Benzo(a)anthracene			
Benzo(a)pyrene			
Benzo(b)fluoranthene			
Benzo(g,h,i)perylene			
Butyl benzyl phthalate			
Chrysene			
Dibenzofuran			
Fluoranthene			
Fluorene			
Indeno(1,2,3-cd)pyrene			
2-Methylnaphthalene			
Pentachlorophenol			
Naphthalene			

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J=Estimated value below reporting limit or estimated based on data quality criteria.

R = Rejected value. QUAL=Qualification

U = Nondetected value. RL = Reporting Limit.

TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0946-0002		
LAB SAMPLE NUMBER	0311810014SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Phenanthrene			
Pyrene			
Metals (mg/kg)			
Aluminum	8090	11.7	
Arsenic	2.6	0.59	
Barium			R
Beryllium	0.63	0.23	
Cadmium	<	0.59	U
Calcium	14800	23.5	
Chromium	9	1.2	
Cobalt	4.6	1.2	
Copper	7.3	2.3	
Iron	8870	11.7	
Lead	8.2	0.59	J
Magnesium	2070	23.5	
Manganese	198	1.2	J
Mercury	<	0.12	U
Nickel	10	4.7	
Potassium	1530	587	
Selenium	<	0.59	U
Silver	<	1.2	UJ
Sodium	<	587	U
Thallium	0.14	1.2	J

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TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0946-0002		
LAB SAMPLE NUMBER	0311810014SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Vanadium	18	1.2	
Zinc	20.2	2.3	
TPH (mg/kg)			
Total Petroleum Hydrocarbons	<	46.9	U
Water Quality (percent)			
Water	15	0.1	

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TABLE 9-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0004			CAN094-0941-0008			CAN094-0942-0004			CAN094-0942-0008			CAN094-0943-0004			CAN094-0943-0008		
LAB SAMPLE NUMBER	0314020004SA			0314020005SA			0312160019SA			0312160020SA			0314010011SA			0314010012SA		
COLLECT DATE	09/24/93			09/24/93			09/13/93			09/13/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
1,2-Dichloropropane	<	5.8	U	<	5.6	U	<	6	U	<	6.3	U	<	5.7	U	<	5.6	U
Toluene	11	5.8		1.3	5.6	J	<	6	U	<	6.3	U	<	5.7	U	<	5.6	U
Metals (mg/kg)																		
Aluminum	2900	23.4		3250	22.5		3510	60.4		3400	25.1	J	6120	22.8		3950	11.3	
Antimony	<	14	U	<	13.5	U	<	36.2	U	<	15	U	<	13.7	U	<	6.8	U
Arsenic	1.9	0.58		1.5	0.56		1.4	0.6		1.5	0.63		1.9	0.57		1.6	0.56	
Barium	133	2.3		233	2.2		1640	6		296	2.5	J	117	2.3		472	1.1	
Beryllium	0.31	0.47	J	0.25	0.45	J	0.88	1.2	J	<	0.5	U	0.58	0.46		0.47	0.23	
Cadmium	2.4	1.2		1.4	1.1		<	3	U	<	1.3	U	<	1.1	U	<	0.56	U
Calcium	213000	46.7		118000	44.9		233000	121		178000	50.1	J	102000	45.7		83400	22.5	
Chromium	3.9	2.3		<	2.2	U	<	6	U	<	2.5	UJ	5.6	2.3		2.7	1.1	
Cobalt	2.4	2.3		<	2.2	U	<	6	U	2	2.5	J	3.7	2.3		2.6	1.1	
Copper	4.5	4.7	J	2.3	4.5	J	<	12.1	U	2.8	5	J	5.5	4.6		3.1	2.3	
Iron	2490	23.4		2940	22.5		2790	60.4		2900	25.1	J	6260	22.8		3650	11.3	
Lead	2.8	0.58		3.3	0.56		3.1	3		3	0.63		5.8	0.57		4.8	0.56	
Magnesium	2230	46.7		3160	44.9		3290	121		2780	50.1		2540	45.7		2880	22.5	
Manganese	37.7	2.3		48.5	2.2		31.2	6		38.4	2.5	J	141	2.3		113	1.1	
Nickel	4.3	9.3	J	4.7	9	J	<	24.2	U	4.8	10	J	9.3	9.1		6.4	4.5	
Potassium	533	1170	J	1010	1120	J	499	3020	J	842	1250	J	1310	1140		938	563	
Silver	1.2	2.3	J	<	2.2	U	<	6	U	<	2.5	U	<	2.3	U	<	1.1	U

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TABLE 9-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0004			CAN094-0941-0008			CAN094-0942-0004			CAN094-0942-0008			CAN094-0943-0004			CAN094-0943-0008		
LAB SAMPLE NUMBER	0314020004SA			0314020005SA			0312160019SA			0312160020SA			0314010011SA			0314010012SA		
COLLECT DATE	09/24/93			09/24/93			09/13/93			09/13/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Sodium	<	1170	U	316	1120	J	<	3020	U	<	1250	U	<	1140	U	<	563	U
Vanadium	9.4	2.3		13.8	2.2		10.8	6		9.6	2.5		16.9	2.3		14.3	1.1	
Zinc	8.6	4.7		8.5	4.5		7.4	12.1	J	9	5	J	16.1	4.6		10	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.7	U	<	44.9	U	<	48.3	U	51.4	50.1		86.2	45.7		91.7	45	
Water Quality (percent)																		
Water	14	0.1		11	0.1		17	0.1		20	0.1		12	0.1		11	0.1	

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TABLE 9-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0944-0004			CAN094-0944-0008			CAN094-0945-0004			CAN094-0945-0008			CAN094-0946-0004			CAN094-0946-0008		
LAB SAMPLE NUMBER	0314040009SA			0314040010SA			0311810019SA			0311810020SA			0311810015SA			0311810016SA		
COLLECT DATE	09/23/93			09/23/93			09/11/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
1,2-Dichloropropane	<	5.9	U	<	5.5	U	<	5.6	U	<	5.7	U	27	5.9		<	5.6	U
Toluene	4.3	5.9	J	<	5.5	U	<	5.6	U	<	5.7	U	1.9	5.9	J	6.2	5.6	
Metals (mg/kg)																		
Aluminum	4390	23.5		6090	10.9		3970	22.6		3930	22.6		3330	59.4		4880	11.2	
Antimony	<	14.1	U	<	6.6	U	<	13.6	U	10.6	13.6	J	<	35.6	U	<	6.7	U
Arsenic	1.9	0.59		1.8	0.55		1.5	0.56		1.3	0.57		1.7	0.59		2.2	0.56	
Barium	325	2.3	J	137	1.1	J			R			R			R			R
Beryllium	0.28	0.47	J	0.41	0.22		<	0.45	U	0.24	0.45	J	<	1.2	U	0.35	0.22	
Cadmium	2.2	1.2		1.4	0.55		<	1.1	U	<	1.1	U	<	3	U	<	0.56	U
Calcium	168000	46.9		65800	21.9		130000	45.2		105000	45.2		207000	119		58200	22.3	
Chromium	3.1	2.3		5.6	1.1		1.9	2.3	J	2.8	2.3		<	5.9	U	3.9	1.1	
Cobalt	1.8	2.3	J	2.4	1.1		1.9	2.3	J	2.5	2.3		<	5.9	U	2.4	1.1	
Copper	2.5	4.7	J	4.2	2.2		2.7	4.5	J	1.8	4.5	J	<	11.9	U	2.4	2.2	
Iron	3770	23.5		5720	10.9		4120	22.6		3990	22.6		3200	59.4		4760	11.2	
Lead	3.5	0.59		3.5	0.55	J	3.3	0.56	J	4.1	1.1	J	2.6	0.59	J	4.8	1.1	J
Magnesium	2690	46.9		3210	21.9		2030	45.2		3000	45.2		2190	119		2490	22.3	
Manganese	43.3	2.3		107	1.1		51	2.3	J	70.2	2.3	J	34	5.9	J	81.1	1.1	J
Nickel	4.7	9.4	J	6.2	4.4		4.2	9	J	5.6	9	J	<	23.8	U	4.9	4.5	
Potassium	813	1170	J	1400	547		700	1130	J	910	1130	J	<	2970	U	885	558	
Silver	0.51	2.3	J	<	1.1	J	<	2.3	UJ	<	2.3	UJ	<	5.9	UJ	<	1.1	UJ

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TABLE 9-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0944-0004			CAN094-0944-0008			CAN094-0945-0004			CAN094-0945-0008			CAN094-0946-0004			CAN094-0946-0008		
LAB SAMPLE NUMBER	0314040009SA			0314040010SA			0311810019SA			0311810020SA			0311810015SA			0311810016SA		
COLLECT DATE	09/23/93			09/23/93			09/11/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Sodium	<	1170	U	<	547	U	<	1130	U	<	1130	U	<	2970	U	<	558	U
Vanadium	13.5	2.3		19.4	1.1		10.6	2.3		10.7	2.3		8.7	5.9		17.5	1.1	
Zinc	9.3	4.7		14.4	2.2		9.4	4.5		22	4.5		<	11.9	U	10.8	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.9	U	<	43.8	U	<	45.2	U	<	45.2	U	<	47.5	U	<	44.7	U
Water Quality (percent)																		
Water	15	0.1		8.7	0.1		11	0.1		12	0.1		16	0.1		10	0.1	

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TABLE 9-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SURFACE SOIL TO BACKGROUND(1)
SWMU 94, CANNON AFB

Sand Traps. 5144

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN094-0943-0000	Aluminum	8670	1410 - 11,000	10,540	N	50,000
CAN094-0945-0000	Arsenic	2.9	0.67 - 28	15.5	N	6.5
CAN094-0941-0000	Barium	246	14.5 - 1200	642	N	500
CAN094-0943-0000	Beryllium	0.58	0.17 - 0.77	0.73	N	1-2
CAN094-0941-0000	Cadmium	1.8	<0.51 - 4.2	*	Y	---
CAN094-0941-0000	Chromium	11.5	4 - 15.4	12.5	N	30
CAN094-0943-0000	Cobalt	4.4	0.85 - 5.3	4.5	N	3 - 7
CAN094-0941-0000	Copper	11.2	<2 - 18.4	*	N**	20
CAN094-0942-0000	Lead	99.2	1.1 - 46	25.8	Y	15
CAN094-0941-0000	Mercury	0.48	<0.1 - <0.12	*	Y	0.032 - 0.085
CAN094-0943-0000	Nickel	8.9	1.3 - 9.8	9	N	15
CAN094-0944-0000	Selenium	0.34	<0.21 - 124	*	Y	0.15 - 0.30
CAN094-0941-0002	Silver	0.54	0.51 - 0.93	*	Y	---
CAN094-0943-0000	Vanadium	23.9	5.2 - 28.3	25.3	N	30 - 70
CAN094-0942-0000	Zinc	84.8	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background ranges and is within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background.

TABLE 9-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN TOTAL SOILS TO BACKGROUND(1)
SWMU 94, CANNON AFB
Sand Traps No. 5144

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed background	Typical Level in Clovis, NM Region (4)
CAN094-0945-0002	Aluminum	10500	1410 - 11,000	10,540	N	50,000
CAN094-0945-0008	Antimony	10.6	<4.9 - 5.1	*	Y	<1
CAN094-0941-0002	Arsenic	3.3	0.67 - 28	15.5	N	6.5
CAN094-0942-0004	Barium	1640	14.5 - 1200	642	Y	500
CAN094-0942-0004	Beryllium	0.88	0.17 - 0.77	0.73	N**	1 - 2
CAN094-0944-0002	Cadmium	2.9	<0.51 - 4.2	*	Y	---
CAN094-0941-0000	Chromium	11.5	4 - 15.4	12.5	N	30
CAN094-0945-0002	Cobalt	5.4	0.85 - 5.3	4.5	N**	3 - 7
CAN094-0941-0000	Copper	11.2	<2 - 18.4	*	N**	20
CAN094-0942-0000	Lead	99.2	1.1 - 46	25.8	Y	15
CAN094-0941-0000	Mercury	0.48	<0.1 - <0.12	*	Y	0.032 - 0.085
CAN094-0945-0002	Nickel	11.3	1.3 - 9.8	9	N**	15
CAN094-0945-0000	Selenium	0.34	<0.21 - 124	*	Y	0.15 - 0.30
CAN094-0944-0002	Silver	3	0.51 - 0.93	*	Y	---
CAN094-0946-0002	Thallium	0.14	0.14 - <0.23	*	Y	---
CAN094-0943-0000	Vanadium	23.9	5.2 - 28.3	25.3	N	30 - 70
CAN094-0942-0000	Zinc	84.8	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background range and is within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background

TABLE 9-5

CHEMICALS OF CONCERN IN SURFACE SOIL

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Chrysene
Dibenzofuran*
Ethylbenzene
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Naphthalene
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Cadmium
Lead*
Mercury
Selenium
Silver
Zinc

* No EPA-established toxicity factor.

TABLE 9-6

CHEMICALS OF CONCERN IN TOTAL SOIL

Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Chrysene
Dibenzofuran*
1,2-Dichloropropane
Ethylbenzene
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Naphthalene
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Antimony
Barium
Cadmium
Lead*
Mercury
Selenium
Silver
Thallium
Zinc

* No EPA-established toxicity factor.

TABLE 9-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAPS 5144 (SWMU 94)

	Ethylbenzene (µg/kg)			Toluene (µg/kg)				Xylenes (total) (µg/kg)				Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)			
Field ID	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000		U	5.1	6.1	1.808	J	5.1	9.4	2.241		5.1	110	4.700	J	340	170	5.136	J	340
CAN094-0942-0000		UJ	5.3	10	2.303	J	5.3	4.7	1.548	J	5.3	230	5.438	J	360	340	5.829	J	360
CAN094-0943-0000		U	5.9	1.4	0.336	J	5.9	2.95	1.082	U	5.9	195	5.273	U	390	195	5.273	U	390
CAN094-0944-0000	2.7	J	5.9	2.95	1.082	U	5.9	6.4	1.856		5.9								
CAN094-0945-0000		U	6	3	1.099	U	6	4	1.386	J	6	200	5.298	U	400	200	5.298	U	400
CAN094-0946-0000		U	6	1.4	0.336	J	6	3	1.099	U	6								
Number	1			6	6			6	6			4	4			4	4		
Minimum detected	2.70			1.40				4.00				110				170			
Maximum detected	2.70			10.0				9.40				230				340			
Average	2.70			4.14	1.16			5.08	1.54			184	5.18			226	5.38		
H statistic					3.24				2.41				3.18				2.99		
Standard Deviation				3.34	0.79			2.47	0.45			51.54	0.33			76.96	0.31		
95% UCL				13.6	13.6			8.35	8.35			340	340			387	387		
RME	2.70			10.0				8.35				230				340			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAPS 5144 (SWMU 94)

	Benzo(b)fluoranthene (µg/kg)				Butyl benzyl phthalate (µg/kg)			Chrysene (µg/kg)				Fluoranthene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	230	5.438	J	340	48	J	340	180	5.193	J	340	200	5.298	J	340
CAN094-0942-0000	550	6.310		360		U	360	350	5.858	J	360	440	6.087		360
CAN094-0943-0000	195	5.273	U	390		U	390	195	5.273	U	390	195	5.273	U	390
CAN094-0944-0000															
CAN094-0945-0000	200	5.298	U	400		U	400	200	5.298	UJ	400	200	5.298	U	400
CAN094-0946-0000															
Number	4	4			1			4	4			4	4		
Minimum detected	230				48.0			180				200			
Maximum detected	550				48.0			350				440			
Average	294	5.58			48.0			231	5.41			259	5.49		
H statistic		3.68							2.82				3.18		
Standard Deviation	171.53	0.49						79.62	0.30			120.9	0.40		
95% UCL	851	851						383	383			545	545		
RME	550				48.0			350				440			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAPS 5144 (SWMU 94)

	Fluorene (µg/kg)				Indeno(1,2,3-cd)pyrene (µg/kg)			Naphthalene (µg/kg)				TPH (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	170	5.136	U	340	110	J	340	170	5.136	U	340	862	6.759		82.1
CAN094-0942-0000	180	5.193	U	360	140	J	360	180	5.193	U	360	247	5.509		44
CAN094-0943-0000	195	5.273	U	390		U	390	195	5.273	U	390	26.45	3.275	U	47
CAN094-0944-0000												221	5.398		46.8
CAN094-0945-0000	320	5.768	J	400		UJ	400	430	6.064		400	3600	8.189		480
CAN094-0946-0000												251	5.525		47.8
Number	4	4			2			4	4			6	6		
Minimum detected	320				110			430				221			
Maximum detected	320				140			430				3600			
Average	216	5.34			125			244	5.42			868	5.78		
H statistic		2.82							3.43				5.85		
Standard Deviation	69.93	0.29						124.6	0.44			1368	1.63		
95% UCL	349	349						585	585			87158	87158		
RME	320				140			430				3600			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAPS 5144 (SWMU 94)

	Pyrene (µg/kg)				Cadmium (mg/kg)				Lead (mg/kg)				Mercury (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	410	6	J	340	1.8	0.588		0.51	61.5	4.119		5.1	0.48	-0.734		0.1
CAN094-0942-0000	360	6		360	0.91	-0.094		0.55	99.2	4.597		11	0.3	-1.204		0.11
CAN094-0943-0000	195	5	U	390	0.295	-1.221	U	0.59	6.7	1.902		0.6	0.06	-2.813	U	0.12
CAN094-0944-0000					0.8	-0.223		0.59	15.2	2.721		1.2	0.06	-2.813	U	0.12
CAN094-0945-0000	200	5	U	400	0.3	-1.204	U	0.6	12.5	2.526	J	1.2	0.06	-2.813	U	0.12
CAN094-0946-0000					0.3	-1.204	U	0.6	7.5	2.015	J	0.6	0.06	-2.813	U	0.12
Number	4	4			6	6			6	6			6	6		
Minimum detected	360				0.80				6.70				0.30			
Maximum detected	410				1.80				99.2				0.48			
Average	291	5.62			0.73	-0.56			33.8	2.98			0.17	-2.20		
H statistic		3.18				3.24				4.19				3.83		
Standard Deviation	110.2	0.39			0.59	0.76			38.13	1.12			0.18	0.96		
95% UCL	606	606			2.31	2.31			301	301			0.92	0.92		
RME	410				1.80				99.2				0.48			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT SAND TRAPS 5144 (SWMU 94)

	Selenium (mg/kg)				Silver (mg/kg)			Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	0.255	-1.366	U	0.51	0.54	J	1	56.3	4.031		2.1
CAN094-0942-0000	0.275	-1.291	U	0.55		U	1.1	84.8	4.440		2.2
CAN094-0943-0000	0.295	-1.221	U	0.59		U	1.2	19	2.944		2.4
CAN094-0944-0000	0.6	-0.511	JU	1.2	0.52	J	1.2	23.6	3.161		2.3
CAN094-0945-0000	0.34	-1.079	J	0.6		UJ	1.2	27.2	3.303		2.4
CAN094-0946-0000	0.27	-1.309	J	0.6		UJ	1.2	17.3	2.851		2.4
Number	6	6			2			6	6		
Minimum detected	0.27				0.52			17.3			
Maximum detected	0.34				0.54			84.8			
Average	0.34	-1.13			0.53			38.0	3.46		
H statistic		2.24							2.84		
Standard Deviation	0.13	0.32			0.01			26.98	0.64		
95% UCL	0.47	0.47						87	87		
RME	0.34				0.54			85			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	1,2-Dichloropropane (µg/kg)				Ethylbenzene (µg/kg)			Toluene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	2.05	0.718	U	5.1		U	5.1	6.1	1.808		5.1
CAN094-0941-0002	2.65	0.975	U	5.3	1.2	J	5.3	49	3.892	J	5.3
CAN094-0941-0004	2.9	1.065	U	5.8		U	5.8	11	2.398		5.8
CAN094-0941-0008	2.8	1.030	U	5.6		U	5.6	1.3	0.262	J	5.6
CAN094-0942-0000	2.65	0.975	U	5.3		UJ	5.3	10	2.303	J	5.3
CAN094-0942-0002	2.8	1.030	U	5.6		U	5.6	2.8	1.030	U	5.6
CAN094-0942-0004	3	1.099	U	6		U	6	3	1.099	U	6
CAN094-0942-0008	3.15	1.147	U	6.3		U	6.3	3.15	1.147	U	6.3
CAN094-0943-0000	2.95	1.082	U	5.9		U	5.9	1.4	0.336	J	5.9
CAN094-0943-0002	2.9	1.065	U	5.8		U	5.8	2.9	1.065	U	5.8
CAN094-0943-0004	2.85	1.047	U	5.7		U	5.7	2.85	1.047	U	5.7
CAN094-0943-0008	2.8	1.030	U	5.6		U	5.6	2.8	1.030	U	5.6
CAN094-0944-0000	2.95	1.082	U	5.9	2.7	J	5.9	2.95	1.082	U	5.9
CAN094-0944-0002	2.95	1.082	U	5.9		U	5.9	1.2	0.182	J	5.9
CAN094-0944-0004	2.95	1.082	U	5.9		U	5.9	4.3	1.459	J	5.9
CAN094-0944-0008	2.75	1.012	U	5.5		U	5.5	2.75	1.012	U	5.5
CAN094-0945-0000	3	1.099	U	6		U	6	3	1.099	U	6
CAN094-0945-0002	2.9	1.065	U	5.8		U	5.8	2.9	1.065	U	5.8
CAN094-0945-0004	2.8	1.030	U	5.6		U	5.6	2.8	1.030	U	5.6
CAN094-0945-0008	2.85	1.047	U	5.7		U	5.7	2.85	1.047	U	5.7
CAN094-0946-0000	3	1.099	U	6		U	6	1.4	0.336	J	6
CAN094-0946-0002	2.95	1.082	U	5.9		U	5.9	9	2.197		5.9
CAN094-0946-0004	27	3.296		5.9		U	5.9	1.9	0.642	J	5.9
CAN094-0946-0008	2.8	1.030	U	5.6		U	5.6	6.2	1.825		5.6
Number	24	24			2			24	24		
Minimum detected	27.0				1.20			1.20			
Maximum detected	27.0				2.70			49.0			
Average	3.85	1.14			1.95			5.73	1.27		
H statistic		1.97							2.33		
Standard Deviation	4.94	0.47						9.60	0.82		
95% UCL	4.21	4.21						7.43	7.43		
RME	4.21				2.70			7.43			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Xylenes (total) (µg/kg)				Anthracene (µg/kg)			Benzo(a)anthracene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	9.4	2.241		5.1		U	340	110	4.700	J	340
CAN094-0941-0002	4.2	1.435	J	5.3							
CAN094-0941-0004	2.9	1.065	U	5.8		U	390	195	5.273	U	390
CAN094-0941-0008	2.8	1.030	U	5.6							
CAN094-0942-0000	4.7	1.548	J	5.3	37	J	360	230	5.438	J	360
CAN094-0942-0002	2.8	1.030	U	5.6							
CAN094-0942-0004	3	1.099	U	6							
CAN094-0942-0008	3.15	1.147	U	6.3		U	410	205	5.323	U	410
CAN094-0943-0000	2.95	1.082	U	5.9		U	390	195	5.273	U	390
CAN094-0943-0002	2.9	1.065	U	5.8							
CAN094-0943-0004	2.85	1.047	U	5.7							
CAN094-0943-0008	2.8	1.030	U	5.6		U	370	185	5.220	U	370
CAN094-0944-0000	6.4	1.856		5.9							
CAN094-0944-0002	2.95	1.082	U	5.9							
CAN094-0944-0004	2.95	1.082	U	5.9							
CAN094-0944-0008	2.75	1.012	U	5.5							
CAN094-0945-0000	4	1.386	J	6		U	400	200	5.298	U	400
CAN094-0945-0002	2.9	1.065	U	5.8							
CAN094-0945-0004	2.8	1.030	U	5.6							
CAN094-0945-0008	2.85	1.047	U	5.7							
CAN094-0946-0000	3	1.099	U	6							
CAN094-0946-0002	2.95	1.082	U	5.9							
CAN094-0946-0004	2.95	1.082	U	5.9							
CAN094-0946-0008	2.8	1.030	U	5.6		U	370	185	5.220	U	370
Number	24	24			1			8	8		
Minimum detected	4.00				37.0			110			
Maximum detected	9.40				37.0			230			
Average	3.49	1.19			37.0			188	5.22		
H statistic		1.82							2.00		
Standard Deviation	1.51	0.30						34.63	0.22		
95% UCL	3.88	3.88						223	223		
RME	3.88				37.0			223			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Benzo(a)pyrene (µg/kg)				Benzo(b)fluoranthene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	170	5.136	J	340	230	5.438	J	340
CAN094-0941-0002								
CAN094-0941-0004	195	5.273	U	390	195	5.273	U	390
CAN094-0941-0008								
CAN094-0942-0000	340	5.829	J	360	550	6.310		360
CAN094-0942-0002								
CAN094-0942-0004								
CAN094-0942-0008	205	5.323	U	410	205	5.323	U	410
CAN094-0943-0000	195	5.273	U	390	195	5.273	U	390
CAN094-0943-0002								
CAN094-0943-0004								
CAN094-0943-0008	185	5.220	U	370	185	5.220	U	370
CAN094-0944-0000								
CAN094-0944-0002								
CAN094-0944-0004								
CAN094-0944-0008								
CAN094-0945-0000	200	5.298	U	400	200	5.298	U	400
CAN094-0945-0002								
CAN094-0945-0004								
CAN094-0945-0008								
CAN094-0946-0000								
CAN094-0946-0002								
CAN094-0946-0004								
CAN094-0946-0008	185	5.220	U	370	185	5.220	U	370
Number	8	8			8	8		
Minimum detected	170				230			
Maximum detected	340				550			
Average	209	5.32			243	5.42		
H statistic		2.00				2.20		
Standard Deviation	53.88	0.21			124.8	0.37		
95% UCL	246	246			327	327		
RME	246				327			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Butyl benzyl phthalate (µg/kg)			Chrysene (µg/kg)				Fluoranthene (µg/kg)			
Field ID	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	48	J	340	180	5.193	J	340	200	5.298	J	340
CAN094-0941-0002											
CAN094-0941-0004		U	390	195	5.273	U	390	195	5.273	U	390
CAN094-0941-0008											
CAN094-0942-0000		U	360	350	5.858	J	360	440	6.087		360
CAN094-0942-0002											
CAN094-0942-0004											
CAN094-0942-0008		U	410	205	5.323	U	410	205	5.323	U	410
CAN094-0943-0000		U	390	195	5.273	U	390	195	5.273	U	390
CAN094-0943-0002											
CAN094-0943-0004											
CAN094-0943-0008		U	370	185	5.220	U	370	185	5.220	U	370
CAN094-0944-0000											
CAN094-0944-0002											
CAN094-0944-0004											
CAN094-0944-0008											
CAN094-0945-0000		U	400	200	5.298	UJ	400	200	5.298	U	400
CAN094-0945-0002											
CAN094-0945-0004											
CAN094-0945-0008											
CAN094-0946-0000											
CAN094-0946-0002											
CAN094-0946-0004											
CAN094-0946-0008		U	370	185	5.220	UJ	370	185	5.220	U	370
Number	1			8	8			8	8		
Minimum detected	48.0			180				200			
Maximum detected	48.0			350				440			
Average	48.0			212	5.33			226	5.37		
H statistic					2.00				2.06		
Standard Deviation				56.44	0.22			86.91	0.29		
95% UCL				250	250			282	282		
RME	48.0			250				282			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Fluorene (µg/kg)				Indeno(1,2,3-cd)pyrene (µg/kg)			Naphthalene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	170	5.136	U	340	110	J	340	170	5.136	U	340
CAN094-0941-0002											
CAN094-0941-0004	195	5.273	U	390		U	390	195	5.273	U	390
CAN094-0941-0008											
CAN094-0942-0000	180	5.193	U	360	140	J	360	180	5.193	U	360
CAN094-0942-0002											
CAN094-0942-0004											
CAN094-0942-0008	205	5.323	U	410		U	410	205	5.323	U	410
CAN094-0943-0000	195	5.273	U	390		U	390	195	5.273	U	390
CAN094-0943-0002											
CAN094-0943-0004											
CAN094-0943-0008	185	5.220	U	370		U	370	185	5.220	U	370
CAN094-0944-0000											
CAN094-0944-0002											
CAN094-0944-0004											
CAN094-0944-0008											
CAN094-0945-0000	320	5.768	J	400		UJ	400	430	6.064		400
CAN094-0945-0002											
CAN094-0945-0004											
CAN094-0945-0008											
CAN094-0946-0000											
CAN094-0946-0002											
CAN094-0946-0004											
CAN094-0946-0008	185	5.220	U	370		UJ	370	185	5.220	U	370
Number	8	8			2			8	8		
Minimum detected	320				110			430			
Maximum detected	320				140			430			
Average	204	5.30			125			218	5.34		
H statistic		1.95							2.06		
Standard Deviation	47.92	0.20						86.27	0.30		
95% UCL	236	236						275	275		
RME	236				140			275			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Pyrene (µg/kg)				TPH (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	410	6.016	J	340	862	6.759		82.1
CAN094-0941-0002					3250	8.086		422
CAN094-0941-0004	195	5.273	U	390	23.35	3.151	U	46.7
CAN094-0941-0008					22.45	3.111	U	44.9
CAN094-0942-0000	360	5.886		360	247	5.509		44
CAN094-0942-0002					22.55	3.116	U	45.1
CAN094-0942-0004					44.15	3.788	U	48.3
CAN094-0942-0008	205	5.323	U	410	51.4	3.940		50.1
CAN094-0943-0000	195	5.273	U	390	23.5	3.157	U	47
CAN094-0943-0002					61.3	4.116		46.2
CAN094-0943-0004					86.2	4.457		45.7
CAN094-0943-0008	185	5.220	U	370	91.7	4.519		45
CAN094-0944-0000					221	5.398		46.8
CAN094-0944-0002					23.55	3.159	U	47.1
CAN094-0944-0004					23.45	3.155	U	46.9
CAN094-0944-0008					21.9	3.086	U	43.8
CAN094-0945-0000	200	5.298	U	400	3600	8.189		480
CAN094-0945-0002					23	3.135	U	46
CAN094-0945-0004					22.6	3.118	U	45.2
CAN094-0945-0008					22.6	3.118	U	45.2
CAN094-0946-0000					251	5.525		47.8
CAN094-0946-0002					23.45	3.155	U	46.9
CAN094-0946-0004					23.75	3.168	U	47.5
CAN094-0946-0008	185	5.220	U	370	22.35	3.107	U	44.7
Number	8	8			24	24		
Minimum detected	360				51.4			
Maximum detected	410				3600			
Average	242	5.44			378	4.21		
H statistic		2.13				3.43		
Standard Deviation	89.60	0.32			956.6	1.58		
95% UCL	313	313			732	732		
RME	313				732			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Antimony (mg/kg)				Barium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	3.1	1.131	U	6.2	246	5.505	J	1
CAN094-0941-0002	6.35	1.848	U	12.7	511	6.236		2.1
CAN094-0941-0004	7	1.946	U	14	133	4.890		2.3
CAN094-0941-0008	6.75	1.910	U	13.5	233	5.451		2.2
CAN094-0942-0000	3.3	1.194	U	6.6	166	5.112		1.1
CAN094-0942-0002	3.4	1.224	U	6.8	131	4.875		1.1
CAN094-0942-0004	18.1	2.896	U	36.2	1640	7.402		6
CAN094-0942-0008	7.5	2.015	U	15	296	5.690		2.5
CAN094-0943-0000	3.55	1.267	U	7.1	104	4.644		1.2
CAN094-0943-0002	6.95	1.939	U	13.9	185	5.220		2.3
CAN094-0943-0004	6.85	1.924	U	13.7	117	4.762		2.3
CAN094-0943-0008	3.4	1.224	U	6.8	472	6.157		1.1
CAN094-0944-0000	3.5	1.253	U	7	218	5.384	J	1.2
CAN094-0944-0002	17.65	2.871	U	35.3	146	4.984	J	5.9
CAN094-0944-0004	7.05	1.953	U	14.1	325	5.784	J	2.3
CAN094-0944-0008	3.3	1.194	U	6.6	137	4.920	J	1.1
CAN094-0945-0000	3.6	1.281	U	7.2				
CAN094-0945-0002	3.45	1.238	U	6.9				
CAN094-0945-0004	6.8	1.917	U	13.6				
CAN094-0945-0008	10.6	2.361	J	13.6				
CAN094-0946-0000	3.6	1.281	U	7.2				
CAN094-0946-0002	3.5	1.253	U	7				
CAN094-0946-0004	17.8	2.879	U	35.6				
CAN094-0946-0008	3.35	1.209	U	6.7				
Number	24	24			16	16		
Minimum detected	10.6				104			
Maximum detected	10.6				1640			
Average	6.69	1.72			316	5.44		
H statistic		2.06				2.35		
Standard Deviation	4.75	0.58			373.3	0.71		
95% UCL	8.46	8.46			455	455		
RME	8.46				455			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Cadmium (mg/kg)				Lead (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	1.8	0.588		0.51	61.5	4.119		5.1
CAN094-0941-0002	2	0.693		1.1	14.6	2.681		2.6
CAN094-0941-0004	2.4	0.875		1.2	2.8	1.030		0.58
CAN094-0941-0008	1.4	0.336		1.1	3.3	1.194		0.56
CAN094-0942-0000	0.91	-0.094		0.55	99.2	4.597		11
CAN094-0942-0002	0.28	-1.273	U	0.56	5.6	1.723		1.1
CAN094-0942-0004	1.5	0.405	U	3	3.1	1.131		3
CAN094-0942-0008	0.65	-0.431	U	1.3	3	1.099		0.63
CAN094-0943-0000	0.295	-1.221	U	0.59	6.7	1.902		0.59
CAN094-0943-0002	0.6	-0.511	U	1.2	5.3	1.668		0.58
CAN094-0943-0004	0.55	-0.598	U	1.1	5.8	1.758		0.57
CAN094-0943-0008	0.28	-1.273	U	0.56	4.8	1.569		0.56
CAN094-0944-0000	0.8	-0.223		0.59	15.2	2.721		1.2
CAN094-0944-0002	2.9	1.065		2.9	3.5	1.253		0.59
CAN094-0944-0004	2.2	0.788		1.2	3.5	1.253		0.59
CAN094-0944-0008	1.4	0.336		0.55	3.5	1.253		0.55
CAN094-0945-0000	0.3	-1.204	U	0.6	12.5	2.526	J	1.2
CAN094-0945-0002	0.29	-1.238	U	0.58	7.7	2.041	J	0.58
CAN094-0945-0004	0.55	-0.598	U	1.1	3.3	1.194	J	0.56
CAN094-0945-0008	0.55	-0.598	U	1.1	4.1	1.411	J	1.1
CAN094-0946-0000	0.3	-1.204	U	0.6	7.5	2.015	J	0.6
CAN094-0946-0002	0.295	-1.221	U	0.59	8.2	2.104	J	0.59
CAN094-0946-0004	1.5	0.405	U	3	2.6	0.956	J	0.59
CAN094-0946-0008	0.28	-1.273	U	0.56	4.8	1.569	J	1.1
Number	24	24			24	24		
Minimum detected	0.80				2.60			
Maximum detected	2.90				99.2			
Average	1.00	-0.31			12.2	1.87		
H statistic		2.44				2.44		
Standard Deviation	0.79	0.82			22.01	0.92		
95% UCL	1.55	1.55			15.8	15.8		
RME	1.55				15.8			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality c

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Mercury (mg/kg)				Selenium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN094-0941-0000	0.48	-0.734		0.1	0.255	-1.366	U	0.51
CAN094-0941-0002	0.26	-1.347		0.11			U	1.1
CAN094-0941-0004	0.06	-2.813	U	0.12			U	1.2
CAN094-0941-0008	0.055	-2.900	U	0.11			U	1.1
CAN094-0942-0000	0.3	-1.204		0.11	0.275	-1.291	U	0.55
CAN094-0942-0002	0.12	-2.120		0.11			U	1.1
CAN094-0942-0004	0.06	-2.813	U	0.12			U	1.2
CAN094-0942-0008	0.065	-2.733	U	0.13			U	1.3
CAN094-0943-0000	0.06	-2.813	U	0.12	0.295	-1.221	U	0.59
CAN094-0943-0002	0.06	-2.813	U	0.12			UJ	1.2
CAN094-0943-0004	0.055	-2.900	U	0.11			UJ	1.1
CAN094-0943-0008	0.055	-2.900	U	0.11			UJ	1.1
CAN094-0944-0000	0.06	-2.813	U	0.12			UJ	1.2
CAN094-0944-0002	0.06	-2.813	U	0.12			UJ	1.2
CAN094-0944-0004	0.06	-2.813	U	0.12			UJ	1.2
CAN094-0944-0008	0.055	-2.900	U	0.11			UJ	1.1
CAN094-0945-0000	0.06	-2.813	U	0.12	0.34	-1.079	J	0.6
CAN094-0945-0002	0.06	-2.813	U	0.12	0.26	-1.347	J	0.58
CAN094-0945-0004	0.055	-2.900	U	0.11			U	1.1
CAN094-0945-0008	0.055	-2.900	U	0.11			U	0.57
CAN094-0946-0000	0.06	-2.813	U	0.12	0.27	-1.309	J	0.6
CAN094-0946-0002	0.06	-2.813	U	0.12	0.295	-1.221	U	0.59
CAN094-0946-0004	0.06	-2.813	U	0.12			U	1.2
CAN094-0946-0008	0.055	-2.900	U	0.11			U	1.1
Number	24	24			7	7		
Minimum detected	0.12				0.26			
Maximum detected	0.48				0.34			
Average	0.10	-2.59			0.28	-1.26		
H statistic		2.11				1.89		
Standard Deviation	0.10	0.61			0.03	0.10		
95% UCL	0.12	0.12			0.31	0.31		
RME	0.12				0.31			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality c

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOILS AT SAND TRAPS 5144 (SWMU 94)

	Silver (mg/kg)				Thallium (mg/kg)			Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result		RL
CAN094-0941-0000	0.54	-0.616	J	1		U	0.51	56.3	4.031		2.1
CAN094-0941-0002	1.05	0.049	U	2.1		UJ	1.1	21.5	3.068		4.2
CAN094-0941-0004	1.2	0.182	J	2.3		UJ	1.2	8.6	2.152		4.7
CAN094-0941-0008	1.1	0.095	U	2.2		UJ	1.1	8.5	2.140		4.5
CAN094-0942-0000	0.55	-0.598	U	1.1		U	0.55	84.8	4.440		2.2
CAN094-0942-0002	0.55	-0.598	U	1.1		UJ	1.1	18.9	2.939		2.3
CAN094-0942-0004	3	1.099	U	6		UJ	1.2	7.4	2.001	J	12.1
CAN094-0942-0008	2.25	0.811	U	2.5		UJ	1.3	9	2.197		5
CAN094-0943-0000	0.6	-0.511	U	1.2		U	0.59	19	2.944		2.4
CAN094-0943-0002	1.15	0.140	U	2.3		UJ	1.2	12.9	2.557		4.6
CAN094-0943-0004	1.15	0.140	U	2.3		UJ	1.1	16.1	2.779		4.6
CAN094-0943-0008	0.55	-0.598	U	1.1		UJ	1.1	10	2.303		2.3
CAN094-0944-0000	0.52	-0.654	J	1.2		U	0.59	23.6	3.161		2.3
CAN094-0944-0002	3	1.099	J	5.9		UJ	1.2	11.2	2.416	J	11.8
CAN094-0944-0004	0.51	-0.673	J	2.3		UJ	1.2	9.3	2.230		4.7
CAN094-0944-0008	0.55	-0.598	UJ	1.1		U	0.55	14.4	2.667		2.2
CAN094-0945-0000	0.6	-0.511	UJ	1.2		UJ	1.2	27.2	3.303		2.4
CAN094-0945-0002	0.6	-0.511	UJ	1.2	0.13	J	1.2	23.6	3.161		2.3
CAN094-0945-0004	1.15	0.140	UJ	2.3		UJ	1.1	9.4	2.241		4.5
CAN094-0945-0008	1.15	0.140	UJ	2.3		U	0.57	22	3.091		4.5
CAN094-0946-0000	0.6	-0.511	UJ	1.2		UJ	1.2	17.3	2.851		2.4
CAN094-0946-0002	0.6	-0.511	UJ	1.2	0.14	J	1.2	20.2	3.006		2.3
CAN094-0946-0004	2.95	1.082	UJ	5.9		UJ	1.2	5.95	1.783		11.9
CAN094-0946-0008	0.55	-0.598	UJ	1.1		U	0.56	10.8	2.380		2.2
Number	24	24			2			24	24		
Minimum detected	0.51				0.13			7.40			
Maximum detected	3.00				0.14			84.8			
Average	1.10	-0.10			0.14			19.5	2.74		
H statistic		2.11							2.11		
Standard Deviation	0.83	0.61						17.36	0.63		
95% UCL	1.41	1.41						24.9	24.9		
RME	1.41				0.14			24.9			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with N < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Nondetect. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 9-9
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SURFACE SOIL
SWMU 94

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
Benzo(a)anthracene	0.18	0.23	0.1	0.018	0.023
Benzo(a)pyrene	0.23	0.34	0.1	0.023	0.034
Benzo(b)fluoranthene	0.29	0.55	0.1	0.029	0.055
Butyl benzyl phthalate	0.048	0.048	0.1	0.0048	0.0048
Chrysene	0.23	0.35	0.1	0.023	0.035
Ethylbenzene	0.003	0.003	0.03	9.0E-05	9.0E-05
Fluoranthene	0.26	0.44	0.1	0.026	0.044
Fluorene	0.22	0.32	0.1	0.022	0.032
Indeno(1,2,3-cd)pyrene	0.13	0.14	0.1	0.013	0.014
Mercury	0.17	0.48	0.01	0.0017	0.0048
Naphthalene	0.24	0.43	0.1	0.024	0.043
Pyrene	0.29	0.41	0.1	0.029	0.041
Toluene	0.004	0.01	0.03	1.2E-04	3.0E-04
Xylenes	0.005	0.008	0.03	1.5E-04	2.4E-04

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 9-10
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
TOTAL SOIL
SWMU 94

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
1,2-Dichloropropane	0.004	0.004	0.03	0.00012	0.00012
Anthracene	0.037	0.037	0.1	0.0037	0.0037
Benzo(a)anthracene	0.18	0.20	0.1	0.018	0.02
Benzo(a)pyrene	0.21	0.25	0.1	0.021	0.025
Benzo(b)fluoranthene	0.24	0.33	0.1	0.024	0.033
Butyl benzyl phthalate	0.048	0.48	0.1	0.0048	0.048
Chrysene	0.21	0.30	0.1	0.021	0.03
Ethylbenzene	0.002	0.003	0.03	6.0E-05	9.0E-05
Fluoranthene	0.22	0.28	0.1	0.022	0.028
Fluorene	0.20	0.24	0.1	0.02	0.024
Indeno(1,2,3-cd)pyrene	0.13	0.14	0.1	0.013	0.014
Mercury	0.10	0.10	0.01	0.001	0.001
Naphthalene	0.22	0.27	0.1	0.022	0.027
Pyrene	0.24	0.31	0.1	0.024	0.031
Toluene	0.006	0.007	0.03	0.00018	2.1E-04
Xylenes	0.004	0.004	0.03	0.00012	1.2E-04

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 9-11

VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 94

	t (y)	Cs (µg/kg)	Co (g/m^3)	L (m)	W (m)	T (m)	VWC (L/L)	foc	Koc (ml/g)	Kd (ml/g)	Soil Half Life (y)	P (g/cm^3)	I (m/y)	H (m)	TOT (y)	Rd
1,2-Dichloropropane	0	3.85	6.16E-03	60	80	2.44	0.15	0.003	51	0.153	3.5	1.6	0.015	76.829	2022	2.63E+00
Anthracene	0	37	5.92E-02	60	80	2.44	0.15	0.003	16000	48	1.26	1.6	0.015	76.829	394133	5.13E+02
Antimony	0	6690	1.07E+01	60	80	2.44	0.15	0.003	NA	3981	NA	1.6	0.015	76.829	32625435	4.25E+04
Barium	0	316250	5.06E+02	60	80	2.44	0.15	0.003	NA	50	NA	1.6	0.015	76.829	410523	5.34E+02
Benzo(a)anthracene	0	188.13	3.01E-01	60	80	2.44	0.15	0.003	1400000	4200	1.86	1.6	0.015	76.829	34420160	4.48E+04
Benzo(a)pyrene	0	209.38	3.35E-01	60	80	2.44	0.15	0.003	6500000	19500	1.45	1.6	0.015	76.829	159805088	2.08E+05
Benzo(b)fluoranthene	0	243.13	3.89E-01	60	80	2.44	0.15	0.003	550000	1650	1.67	1.6	0.015	76.829	13522672	1.76E+04
Benzylbutylphthalate	0	48	7.68E-02	60	80	2.44	0.15	0.003	68	0.204	0.2	1.6	0.015	76.829	2440	3.18E+00
Cadmium	0	1000	1.60E+00	60	80	2.44	0.15	0.003	NA	7	NA	1.6	0.015	76.829	58134	7.57E+01
Chrysene	0	211.88	3.39E-01	60	80	2.44	0.15	0.003	250000	750	2.72	1.6	0.015	76.829	6147088	8.00E+03
Ethylbenzene	0	1.95	3.12E-03	60	80	2.44	0.15	0.003	1100	3.3	0.2	1.6	0.015	76.829	27812	3.62E+01
Fluoranthene	0	225.63	3.61E-01	60	80	2.44	0.15	0.003	1380	4.14	1.21	1.6	0.015	76.829	34696	4.52E+01
Fluorene	0	204.38	3.27E-01	60	80	2.44	0.15	0.003	5010	15.03	0.2	1.6	0.015	76.829	123941	1.61E+02
Indeno(1,2,3-c)pyrene	0	125	2.00E-01	60	80	2.44	0.15	0.003	31000000	93000	2	1.6	0.015	76.829	762144448	9.92E+05
Lead	0	12170	1.95E+01	60	80	2.44	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278	1.07E+03
Mercury	0	100	1.60E-01	60	80	2.44	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278	1.07E+03
Naphthalene	0	218.13	3.49E-01	60	80	2.44	0.15	0.003	550	1.65	0.2	1.6	0.015	76.829	14290	1.86E+01
Pyrene	0	241.88	3.87E-01	60	80	2.44	0.15	0.003	38000	114	5.2	1.6	0.015	76.829	935009	1.22E+03
Selenium	0	490	7.84E-01	60	80	2.44	0.15	0.003	NA	3	NA	1.6	0.015	76.829	25354	3.30E+01
Silver	0	1100	1.76E+00	60	80	2.44	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278	1.07E+03
Thallium	0	140	2.24E-01	60	80	2.44	0.15	0.003	NA	2000	NA	1.6	0.015	76.829	16390955	2.13E+04
Toluene	0	5.73	9.17E-03	60	80	2.44	0.15	0.003	300	0.9	0.2	1.6	0.015	76.829	8144	1.06E+01
Xylenes	0	3.49	5.58E-03	60	80	2.44	0.15	0.003	830	2.49	0.2	1.6	0.015	76.829	21174	2.76E+01
Zinc	0	19500	3.12E+01	60	80	2.44	0.15	0.003	NA	100	NA	1.6	0.015	76.829	820278	1.07E+03

t = Time where leachate concentration is estimated
Cs = Concentration of chemical in source soil
(average concentration from Table 9-8)
Co = Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 9-11

VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 94

	Leach Rate (y^-1)	Qo (g)	Q(t) (g)	qc (g/y)	Cl(1) (µg/l)	Cl(2) (µg/l)	K (m/s)	i (m/m)	b (m)	Qw (m^3/y)	Ql (m^3/yr)	Cw (µg/l)
1,2-Dichloropropane	1.56E-02	7.21E+01	7.21E+01	1.12E+00	1.56E+01	2.04E-173	2.00E-04	0.0019	10	9587	72	1.52E-175
Anthracene	7.99E-05	6.93E+02	6.93E+02	5.54E-02	7.69E-01	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Antimony	9.66E-07	1.25E+05	1.25E+05	1.21E-01	1.68E+00	1.68E+00	2.00E-04	0.0019	10	9587	72	1.25E-02
Barium	7.67E-05	5.92E+06	5.92E+06	4.55E+02	6.31E+03	6.31E+03	2.00E-04	0.0019	10	9587	72	4.71E+01
Benzo(a)anthracene	9.15E-07	3.52E+03	3.52E+03	3.23E-03	4.48E-02	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Benzo(a)pyrene	1.97E-07	3.92E+03	3.92E+03	7.73E-04	1.07E-02	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Benzo(b)fluoranthene	2.33E-06	4.55E+03	4.55E+03	1.06E-02	1.47E-01	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Benzylbutylphthalate	1.29E-02	8.99E+02	8.99E+02	1.16E+01	1.61E+02	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Cadmium	5.42E-04	1.87E+04	1.87E+04	1.01E+01	1.41E+02	1.41E+02	2.00E-04	0.0019	10	9587	72	1.05E+00
Chrysene	5.12E-06	3.97E+03	3.97E+03	2.03E-02	2.82E-01	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Ethylbenzene	1.13E-03	3.65E+01	3.65E+01	4.14E-02	5.75E-01	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Fluoranthene	9.08E-04	4.23E+03	4.23E+03	3.84E+00	5.33E+01	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Fluorene	2.54E-04	3.83E+03	3.83E+03	9.73E-01	1.35E+01	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Indeno(1,2,3-c)pyrene	4.13E-08	2.34E+03	2.34E+03	9.68E-05	1.34E-03	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Lead	3.84E-05	2.28E+05	2.28E+05	8.75E+00	1.22E+02	1.22E+02	2.00E-04	0.0019	10	9587	72	9.06E-01
Mercury	3.84E-05	1.87E+03	1.87E+03	7.19E-02	9.99E-01	9.99E-01	2.00E-04	0.0019	10	9587	72	7.45E-03
Naphthalene	2.20E-03	4.09E+03	4.09E+03	9.01E+00	1.25E+02	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Pyrene	3.37E-05	4.53E+03	4.53E+03	1.53E-01	2.12E+00	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Selenium	1.24E-03	9.18E+03	9.18E+03	1.14E+01	1.58E+02	1.58E+02	2.00E-04	0.0019	10	9587	72	1.18E+00
Silver	3.84E-05	2.06E+04	2.06E+04	7.91E-01	1.10E+01	1.10E+01	2.00E-04	0.0019	10	9587	72	8.19E-02
Thallium	1.92E-06	2.62E+03	2.62E+03	5.04E-03	7.00E-02	7.00E-02	2.00E-04	0.0019	10	9587	72	5.22E-04
Toluene	3.87E-03	1.07E+02	1.07E+02	4.15E-01	5.77E+00	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Xylenes	1.49E-03	6.54E+01	6.54E+01	9.73E-02	1.35E+00	0.00E+00	2.00E-04	0.0019	10	9587	72	0.00E+00
Zinc	3.84E-05	3.65E+05	3.65E+05	1.40E+01	1.95E+02	1.95E+02	2.00E-04	0.0019	10	9587	72	1.45E+00

t = Time where leachate concentration is estimated
Cs = Concentration of chemical in source soil
(average concentration from Table 9-8)
Co = Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 9-12

COMPARISON OF MODELED GROUNDWATER CONCENTRATIONS TO RBCs(1)

	Cw(2) (µg/L)	Tap Water RBC (1) (µg/L)	Does modeled concentration exceed RBC?
1,2-Dichloropropane	1.52E-175	0.16	No
Anthracene	0	11000	No
Antimony	1.25E-02	15	No
Barium	4.71E+01	2600	No
Benzo(a)anthracene	0	0.092	No
Benzo(a)pyrene	0	0.0092	No
Benzo(b)fluoranthene	0	0.092	No
Benzylbutylphthalate	0	7300	No
Cadmium	1.05E+00	18	No
Chrysene	0	9.2	No
Ethylbenzene	0	1300	No
Fluoranthene	0	1500	No
Fluorene	0	1500	No
Indeno(1,2,3-c)pyrene	0	0.092	No
Lead	9.06E-01	15 (3)	No
Mercury	7.45E-03	11	No
Naphthalene	0	1500	No
Pyrene	0	1100	No
Selenium	1.18E+00	180	No
Silver	8.19E-02	180	No
Thallium	0.000521772	2.9	No
Toluene	0	750	No
Xylenes	0	12000	No
Zinc	1.45E+00	11000	No

(1) RBC is the EPA Region III risk-based concentration for residential tap water ingestion and inhalation.
(2) Cw is the modeled groundwater concentration as defined in Table 9-11.
(3) No Region III RBC is available for lead. Value is the action level defined in the May 1993 issue of Drinking Water Regulation and Health Advisories (EPA 1993).

Note: When modeled concentration is reported as zero; the actual value is less than 1E-300.

TABLE 9-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 94

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
Ethylbenzene	2.65	1.25E-04	45	2.25	2	20250000	7.90E+08	5.00E-02	0.35	0.0707
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 9-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 9-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 94

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
Ethylbenzene	1100	6.60E-03	2.20E+01	1.23E-02	1.29E+04	0.003	2.09E-07
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.010	1.58E-06

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 9-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 9-14
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM SURFACE SOILS AT SWMU 94

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Benzo(a)anthracene	0.23	4.63E+09	4.97E-11
Benzo(a)pyrene	0.34	4.63E+09	7.34E-11
Benzo(b)fluoranthene	0.55	4.63E+09	1.19E-10
Cadmium	1.80	4.63E+09	3.89E-10
Chrysene	0.35	4.63E+09	7.56E-11
Indeno(1,2,3-cd)pyrene	0.14	4.63E+09	3.02E-11
Mercury	0.48	4.63E+09	1.04E-10

RME Soil Concentration from Table 9-7

PEF = Particulate Emission Factor default value from EPA (1991b)

Air Concentration = Soil concentration/PEF

TABLE 9-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 94

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
1,2-Dichloropropane	2.65	1.11E-03	45	2.25	2	20250000	7.90E+08	5.99E-02	0.35	0.08473
Ethylbenzene	2.65	1.25E-04	45	2.25	2	20250000	7.90E+08	5.00E-02	0.35	0.0707
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 9-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 9-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 94

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
1,2-Dichloropropane	51	2.31E-03	1.02E+00	9.29E-02	4.26E+03	0.004	9.86E-07
Ethylbenzene	1100	6.60E-03	2.20E+01	1.23E-02	1.29E+04	0.003	2.09E-07
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.007	1.17E-06

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 9-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 9-16
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM TOTAL SOILS AT SWMU 94

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Barium	455	4.63E+09	9.83E-08
Benzo(a)anthracene	0.22	4.63E+09	4.82E-11
Benzo(a)pyrene	0.25	4.63E+09	5.31E-11
Benzo(b)fluoranthene	0.33	4.63E+09	7.06E-11
Cadmium	1.55	4.63E+09	3.35E-10
Chrysene	0.25	4.63E+09	5.40E-11
Indeno(1,2,3-cd)pyrene	0.14	4.63E+09	3.02E-11
Mercury	0.12	4.63E+09	2.59E-11

RME Soil Concentration from Table 9-8

PEF = Particulate Emission Factor default value from EPA (1991b)

Air Concentration = Soil concentration/PEF

TABLE 9-17

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Inhalation (m^3/kg-d)		
Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
Carcinogenic	1.39×10^{-3}	6.99×10^{-2}
Construction Workers	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Inhalation (m^3/kg-d)		
Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
Carcinogenic	1.03×10^{-4}	4.47×10^{-4}
Trespasser	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Inhalation (m^3/kg-d)		
Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 9-18

SUMMARY OF HUMAN HEALTH RISKS AT OWS 5144 - SWMU 94

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Surface Soil)						
-- Dermal Contact	0.00		3×10^{-6}	0.00		4×10^{-4}
-- Ingestion	2×10^{-9}		9×10^{-6}	6×10^{-7}		2×10^{-3}
-- Inhalation of VOCs	0.00		2×10^{-7}	0.00		3×10^{-6}
-- Inhalation of Particulates	4×10^{-12}		1×10^{-8}	2×10^{-10}		2×10^{-7}
	2×10^{-9}		1×10^{-5}	6×10^{-7}		2×10^{-3}
Construction Worker (Total Soil)						
-- Dermal Contact	4×10^{-14}	1×10^{-6}		5×10^{-13}	2×10^{-5}	
-- Ingestion	5×10^{-10}	4×10^{-4}		5×10^{-9}	4×10^{-3}	
-- Inhalation of VOCs	0.00	2×10^{-7}		0.00	9×10^{-6}	
-- Inhalation of Particulates	3×10^{-13}	5×10^{-7}		1×10^{-12}	2×10^{-6}	
	5×10^{-10}	4×10^{-4}		5×10^{-9}	5×10^{-3}	
Trespasser (Surface Soil)						
-- Dermal Contact	0.00	8×10^{-7}		0.00	2×10^{-4}	
-- Ingestion	3×10^{-10}	2×10^{-6}		4×10^{-8}	3×10^{-4}	
-- Inhalation of VOCs	0.00	5×10^{-8}		0.00	8×10^{-7}	
-- Inhalation of Particulates	8×10^{-13}	4×10^{-9}		1×10^{-11}	7×10^{-8}	
	4×10^{-10}	2×10^{-6}		4×10^{-8}	5×10^{-4}	

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix C for nonrounded risk values.

TABLE 9-19

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies. They are under review and are subject to revision.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

TABLE 9-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 94
CANNON AFB
(mg/kg)

Chemical	Sample Number CAN094-0941-0000	CAN094-0941-0002	CAN094-0942-0000	CAN094-0942-0002	CAN094-0943-0000	CAN094-0944-0000	CAN094-0945 0000	CAN094-0946-0000	N	Arithmetic Mean	95% UCL	Maximum
Volatile Organics												
1,2-Dichloroethane	0.0026 U	0.002 J	0.0027 U	0.0028 U	0.003 U	0.003 U	0.003 U	0.003 U	8	0.00	0.003	0.003
Ethylbenzene	0.0026 U	0.001 J	0.0027 UJ	0.0028 U	0.003 U	0.003 J	0.003 U	0.003 U	8	0.00	0.003	0.003
Tetrachloroethene	0.0026 U	0.025 J	0.0027 UJ	0.0028 U	0.003 U	0.003 U	0.003 U	0.003 U	8	0.01	0.011	0.025
Toluene	0.0061 J	0.049 J	0.01 J	0.0028 U	0.0014 J	0.003 U	0.003 U	0.001 J	8	0.01	0.020	0.049
Xylenes (total)	0.0094	0.004 J	0.0047 J	0.0028 U	0.003 U	0.003	0.004 J	0.003 U	8	0.00	0.006	0.0094
Semivolatile Organics												
Anthracene	0.17 U		0.037 J		0.195 U		0.2 U		4	0.15	0.23	0.2
Benzo(a)anthracene	0.11 J		0.23 J		0.195 U		0.2 U		4	0.18	0.24	0.23
Benzo(a)pyrene	0.17 J		0.34 J		0.195 U		0.2 U		4	0.23	0.30	0.34
Benzo(b)fluoranthen	0.23 J		0.55		0.195 U		0.2 U		4	0.29	0.47	0.55
Benzo(g,h,i)perylene	0.16 J		0.16 J		0.195 U		0.2 UJ		4	0.18	0.20	0.2
Butyl benzyl phthala	0.048 J		0.18 U		0.195 U		0.2 U		4	0.16	0.23	0.2
Chrysene	0.18 J		0.35 J		0.195 U		0.2 UJ		4	0.23	0.31	0.35
Dibenzofuran	0.17 U		0.18 U		0.195 U		0.16 J		4	0.18	0.19	0.195
Fluoranthene	0.2 J		0.44		0.195 U		0.2 U		4	0.26	0.38	0.44
Fluorene	0.17 U		0.18 U		0.195 U		0.32 J		4	0.22	0.29	0.32
Ideno(1,2,3-cd)pyre	0.11 J		0.14 J		0.195 U		0.2 UJ		4	0.16	0.21	0.2
2-Methylnaphthalen	0.17 U		0.18 U		0.195 U		3.8		4	1.09	2.93	3.8
Naphthalene	0.17 U		0.18 U		0.195 U		0.43		4	0.37	0.77	0.95
Pentachlorophenol	0.8 U		0.9 U		0.074 J		0.95 U		3	0.68	1.16	0.95
Phenanthrene	0.15 J		0.24 J		0.195 U		0.24 J		4	0.21	0.25	0.24
Pyrene	0.41 J		0.36		0.195 U		0.2 U		4	0.29	0.40	0.41

TABLE 9-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 94
CANNON AFB
(mg/kg)

Chemical	Sample Number CAN094-0941-0000	CAN094-0941-0002	CAN094-0942-0000	CAN094-0942-0002	CAN094-0943-0000	CAN094-0944-0000	CAN094-0945 0000	CAN094-0946-0000	N	Arithmetic Mean	95% UCL	Maximum
Metals												
Aluminum	3630	3060	3830	8990	8670	7820	8400	7160	8	6445.00	8013.97	8990
Arsenic	2.7	3.3	2.4	1.9	2.6	2.6	2.9	2.6	8	2.63	2.88	3.3
Barium	246 J	511	166	131	104	218 J	R	R	6	229.33	340.28	511
Beryllium	0.32	0.23 J	0.11 U	0.44	0.58	0.45	0.44	0.45	8	0.38	0.47	0.58
Cadmium	1.8	2	0.91	0.28 U	0.3 U	0.8	0.3 U	0.3 U	8	0.84	1.28	2
Calcium	59100	106000	61000	70200	26400	38700	12400	7840	8	47705.00	68330.26	106000
Chromium	11.5 J	3.7	5.9	6	7.9	9.2	9.5	7.9	8	7.70	9.24	11.5
Cobalt	2.3	2.1	2.6	3.5	4.4	1.7	3.2	2.5	8	2.79	3.33	4.4
Copper	11.2	7.7	10.1	6.6	8	9.9	6.7	5.2	8	8.18	9.46	11.2
Iron	5200	3280	4510	6480	8290	6280	8890	6680	8	6201.25	7368.97	8890
Lead	61.5	14.6	99.2	5.6	6.7	15.2	12.5 J	7.5 J	8	27.85	49.24	99.2
Magnesium	2000	3290	1780	2540	1960	2640	1510	1270	8	2123.75	2538.50	3290
Manganese	189 J	184	142	134	165	106	86.3 J	61.6 J	8	133.49	162.35	189
Mercury	0.48	0.26	0.3	0.12	0.06 U	0.06 U	0.06 U	0.06 U	8	0.18	0.27	0.48
Nickel	5.6	6.3 J	5.8	7.9	8.9	5.8	7.1	5.4	8	6.60	7.39	8.9
Potassium	1430	997 J	1360	1790	1660	1750	1350	1170	8	1438.38	1614.16	1790
Selenium	0.26 U	0.6 J	0.28 U	0.6 J	0.3 U	0.6 J	0.34 J	0.27 J	8	0.41	0.56	0.6
Silver	0.54 J	1.1 U	0.6 U	0.6 U	0.6 U	0.52 J	0.6 UJ	0.6 UJ	8	0.65	0.76	1.1
Sodium	210	332 J	275 U	282 U	294 U	293 U	300 U	299 U	8	285.63	319.00	332
Thallium	0.26 U	0.6 J	0.28 U	0.6 U	0.3 U	0.3 U	0.6 UJ	0.6 UJ	8	0.44	0.66	0.6
Vanadium	13.5	12.8	11.1	13.4	23.9	13.4	18.5	15.3	8	15.24	21.90	23.9
Zinc	56.3 J	21.5	84.8	18.9	19	23.6	27.2	17.3	8	33.58	80.87	84.8
TPH	862	3250	247	22.6 U	24 U	221	3600	251	8	1059.70	1990.95	3600

* Between 0 and 2 feet deep

J Estimated value below reporting limit or estimated based on data quality criteria

TABLE 9-21
CHEMICALS OF CONCERN IN SOIL
SWMU 94, CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Volatile Organics					
1,2-Dichloroethane	0.003	---	---	---	Y
Ethylbenzene	0.003	---	---	---	Y
Tetrachloroethene	0.025	---	---	---	Y
Toluene	0.049	---	---	---	Y
Xylenes	0.0094	---	---	---	Y
Semivolatile Organics					
Anthracene	0.2	---	---	---	Y
Benzo(a)anthracene	0.23	---	---	---	Y
Benzo(a)pyrene	0.34	---	---	---	Y
Benzo(b)fluoranthene	0.55	---	---	---	Y
Benzo(g,h,i)perylene	0.2	---	---	---	Y
Butyl benzyl phthalate	0.2	---	---	---	Y
Chrysene	0.35	---	---	---	Y
Dibenzofuran	0.195	---	---	---	Y
Fluoranthene	0.44	---	---	---	Y
Fluorene	0.32	---	---	---	Y
Indeno(1,2,3-cd)pyrene	0.2	---	---	---	Y
2-Methylnaphthalene	3.8	---	---	---	Y
Naphthalene	0.95	---	---	---	Y
Pentachlorophenol	0.95	---	---	---	Y
Phenanthrene	0.24	---	---	---	Y
Pyrene	0.41	---	---	---	Y
Metals					
Aluminum	8990	10540	5000	700 - 100000	N
Arsenic	3.3	15.5	6.5	1.0 - 40	N
Barium	511	642	500	10 - 5,000	N
Beryllium	0.58	0.73	1 - 2	<1 - 15	N
Cadmium	2	*	---	0.01 - 2.0	Y
Calcium	106000	186400	---	---	N**
Chromium	11.5	12.5	30	5 -1,500	N
Cobalt	4.4	4.5	3 - 7	0.5 - 65	N
Copper	11.2	*	20	1 - 700	N
Iron	8890	8720	15000	100 - 100000	N
Lead	99.2	25.8	15	10 - 700	Y

TABLE 9-21
CHEMICALS OF CONCERN IN SOIL
SWMU 94, CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Magnesium	3290	11790	---	---	N**
Manganese	189	164	500	20 - 10000	N
Mercury	0.48	*	0.32	<0.01 - 4.6	Y
Nickel	8.9	9	15	2 - 750	N
Potassium	1790	2572	---	---	N**
Selenium	0.6	*	0.3	<0.1 - 4.3	Y
Silver	1.1	*	---	0.01 - 8	Y
Sodium	332	*	---	---	N**
Thallium	0.6	*	---	---	Y
Vanadium	23.9	25.3	---	---	N
Zinc	84.8	21.9	45	<5 - 2900	Y
TPH	3600	---	---	---	Y

(1) Upper Tolerance Limit (UTL) of the mean = mean + 2 x standard deviation. This is for all practical purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k = 2.02 for n = 37

(2) Shacklette and Boerngen (1984)

(3) Values mainly from Bowen (1979). Values for copper, lead, selenium, and zinc from Shacklette and Boerngen (1984).

* Data insufficient to calculate UTL of background concentration.

** Essential nutrient natural to soils. Not expected to be of concern compared to other COCs.

Y = Yes

N = No

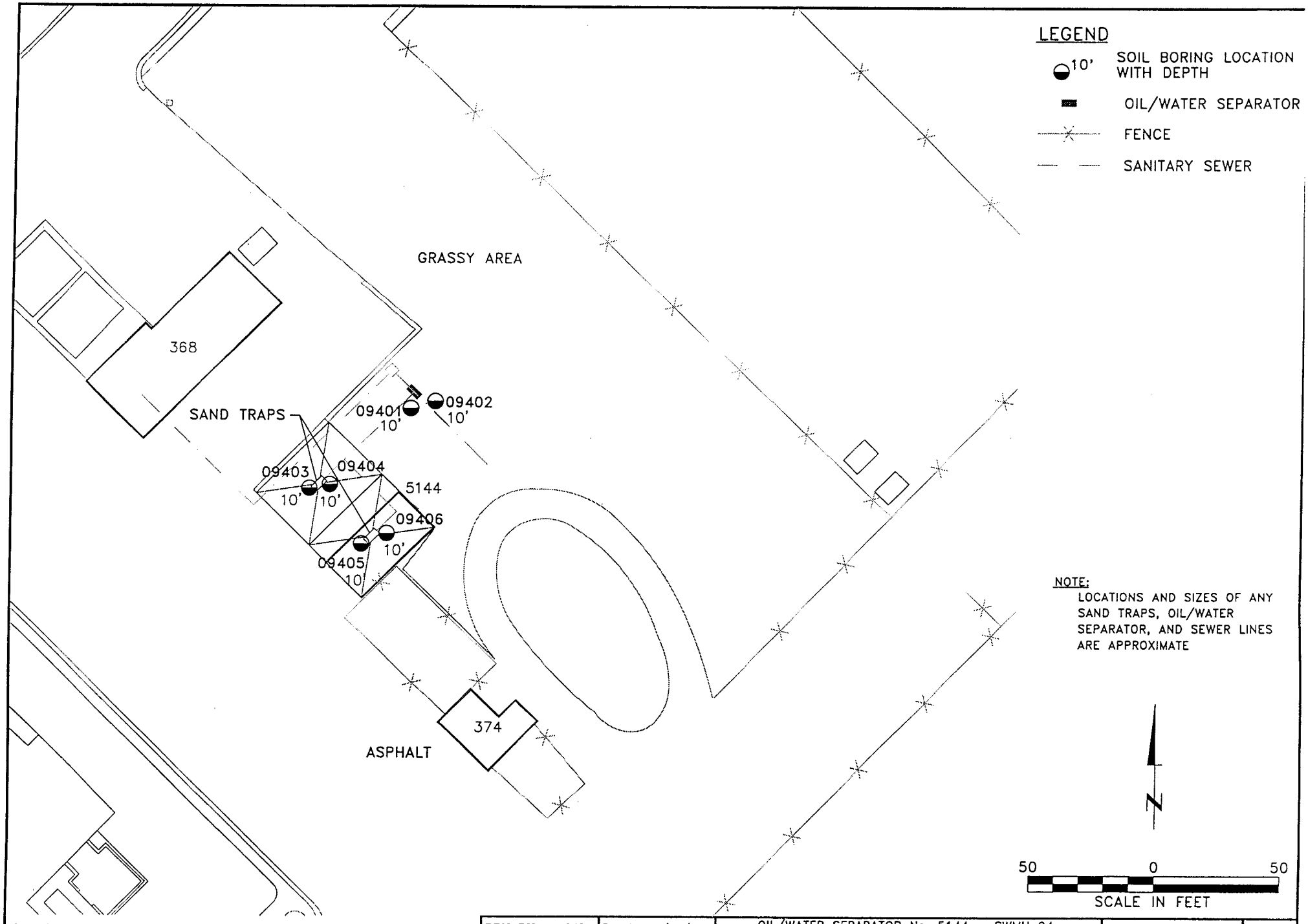
--- = Not available

TABLE 9-22
RISK CHARACTERIZATION SUMMARY - SWMU 94

Chemical	Sample Number CAN094-0941-0000	CAN094-0941-0002	CAN094-0942-0000	CAN094-0942-0002	CAN094-0943-0000	CAN094-0944-0000	CAN094-0945 0000	CAN094-0946-0000	N	Arithmetic Mean (mg/kg)	Robin Benchmark Dietary Threshold (mg/kg)	Risk?
Volatile Organics												
1,2-Dichloroethane	0.0026 U	0.002 J	0.0027 U	0.0028 U	0.003 U	0.003 U	0.003 U	0.003 U	8	0.00	312.5	--
Ethylbenzene	0.0026 U	0.001 J	0.0027 UJ	0.0028 U	0.003 U	0.0027 J	0.003 U	0.003 U	8	0.00	485.5	--
Tetrachloroethene	0.0026 U	0.025 J	0.0027 UJ	0.0028 U	0.003 U	0.003 U	0.003 U	0.003 U	8	0.01	5000	--
Toluene	0.0061 J	0.049 J	0.01 J	0.0028 U	0.0014 J	0.003 U	0.003 U	0.0014 J	8	0.01	12500	--
Xylenes (total)	0.0094	0.004 J	0.0047 J	0.0028 U	0.003 U	0.0032	0.004 J	0.003 U	8	0.00	5000	--
Semivolatile Organics												
Anthracene	0.17 U		0.037 J		0.195 U		0.2 U		4	0.15	5000	--
Benzo(a)anthracene	0.11 J		0.23 J		0.195 U		0.2 U		4	0.18	0.4	--
Benzo(a)pyrene	0.17 J		0.34 J		0.195 U		0.2 U		4	0.23	0.002	Possible
Benzo(b)fluoranthene	0.23 J		0.55		0.195 U		0.2 U		4	0.29	8	--
Benzo(g,h,i)perylene	0.16 J		0.16 J		0.195 U		0.2 UJ		4	0.18	375	--
Butyl benzyl phthalate	0.048 J		0.18 U		0.195 U		0.2 U		4	0.16	470	--
Chrysene	0.18 J		0.35 J		0.195 U		0.2 UJ		4	0.23	12	--
Dibenzofuran	0.17 U		0.18 U		0.195 U		0.16 J		4	0.18	3.3	--
Fluoranthene	0.2 J		0.44		0.195 U		0.2 U		4	0.26	625	--
Fluorene	0.17 U		0.18 U		0.195 U		0.32 J		4	0.22	625	--
Indeno(1,2,3-cd)pyrene	0.11 J		0.14 J		0.195 U		0.2 UJ		4	0.16	14.4	--
2-Methylnaphthalene	0.17 U		0.18 U		0.195 U		3.8		4	1.09	815	--
Naphthalene	0.17 U		0.18 U		0.195 U		0.43		4	0.37	267.5	--
Pentachlorophenol	0.8 U		0.9 U		0.074 J		0.95 U		3	0.68	190	--
Phenanthrene	0.15 J		0.24 J		0.195 U		0.24 J		4	0.21	150	--
Pyrene	0.41 J		0.36		0.195 U		0.2 U		4	0.29	375	--
Metals												
Cadmium	1.8	2	0.91	0.28 U	0.3 U	0.8	0.3 U	0.3 U	8	3.87**	10.5	--
Lead	61.5	14.6	99.2	5.6	6.7	15.2	12.5 J	7.5 J	8	27.85	87.5	--
Mercury	0.48	0.26	0.3	0.12	0.06 U	0.06 U	0.06 U	0.06 U	8	0.18	0.3	--
Selenium	0.26 U	0.6 J	0.28 U	0.6 J	0.3 U	0.6 J	0.34 J	0.27 J	8	4.92**	5	--
Silver	0.54 J	1.1 U	0.6 U	0.6 U	0.6 U	0.52 J	0.6 UJ	0.6 UJ	8	0.65	41	--
Thallium	0.26 U	0.6 J	0.28 U	0.6 U	0.3 U	0.3 U	0.6 UJ	0.6 UJ	8	0.44	2.6	--
Zinc	56.3 J	21.5	84.8	18.9	19	23.6	27.2	17.3	8	33.58	875	--
TPH	862	3250	247	22.6 U	24 U	221	3600	251	8	1059.70	241	Possible

* Between 0 and 2 feet deep
** Mean soil concentration multiplied by BAF of 4.6 for Cd and 12 for Se.
J Estimated value below limit or estimated based on data quality criteria.
U Non-detect, value shown i s one-half the reporting limit

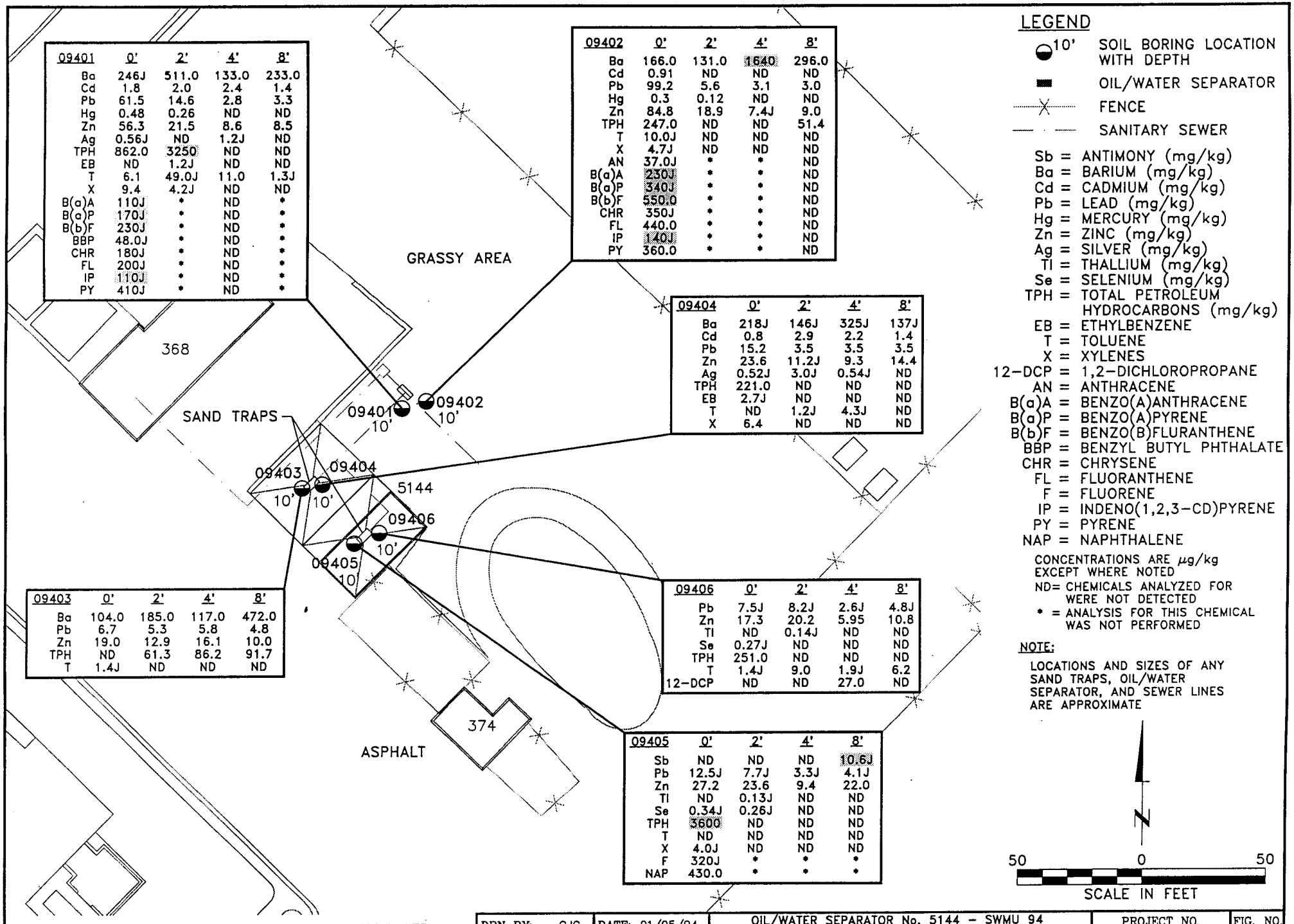
CAD FILE: C3M11W09.DWG V=SITE 01/12/1994 15:58



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 5144 – SWMU 94 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 9–1

CAD FILE: C3M11W09.DWG V=HITS 02/15/1994 14:40



09401	0'	2'	4'	8'
Ba	246J	511.0	133.0	233.0
Cd	1.8	2.0	2.4	1.4
Pb	61.5	14.6	2.8	3.3
Hg	0.48	0.26	ND	ND
Zn	56.3	21.5	8.6	8.5
Ag	0.56J	ND	1.2J	ND
TPH	862.0	3250	ND	ND
EB	ND	1.2J	ND	ND
T	6.1	49.0J	11.0	1.3J
X	9.4	4.2J	ND	ND
B(a)A	110J	*	ND	*
B(a)P	170J	*	ND	*
B(b)F	230J	*	ND	*
BBP	48.0J	*	ND	*
CHR	180J	*	ND	*
FL	200J	*	ND	*
IP	110J	*	ND	*
PY	410J	*	ND	*

09402	0'	2'	4'	8'
Ba	166.0	131.0	1640	296.0
Cd	0.91	ND	ND	ND
Pb	99.2	5.6	3.1	3.0
Hg	0.3	0.12	ND	ND
Zn	84.8	18.9	7.4J	9.0
TPH	247.0	ND	ND	51.4
T	10.0J	ND	ND	ND
X	4.7J	ND	ND	ND
AN	37.0J	*	*	ND
B(a)A	230J	*	*	ND
B(a)P	340J	*	*	ND
B(b)F	550.0	*	*	ND
CHR	350J	*	*	ND
FL	440.0	*	*	ND
IP	140J	*	*	ND
PY	360.0	*	*	ND

09404	0'	2'	4'	8'
Ba	218J	146J	325J	137J
Cd	0.8	2.9	2.2	1.4
Pb	15.2	3.5	3.5	3.5
Zn	23.6	11.2J	9.3	14.4
Ag	0.52J	3.0J	0.54J	ND
TPH	221.0	ND	ND	ND
EB	2.7J	ND	ND	ND
T	ND	1.2J	4.3J	ND
X	6.4	ND	ND	ND

09403	0'	2'	4'	8'
Ba	104.0	185.0	117.0	472.0
Pb	6.7	5.3	5.8	4.8
Zn	19.0	12.9	16.1	10.0
TPH	ND	61.3	86.2	91.7
T	1.4J	ND	ND	ND

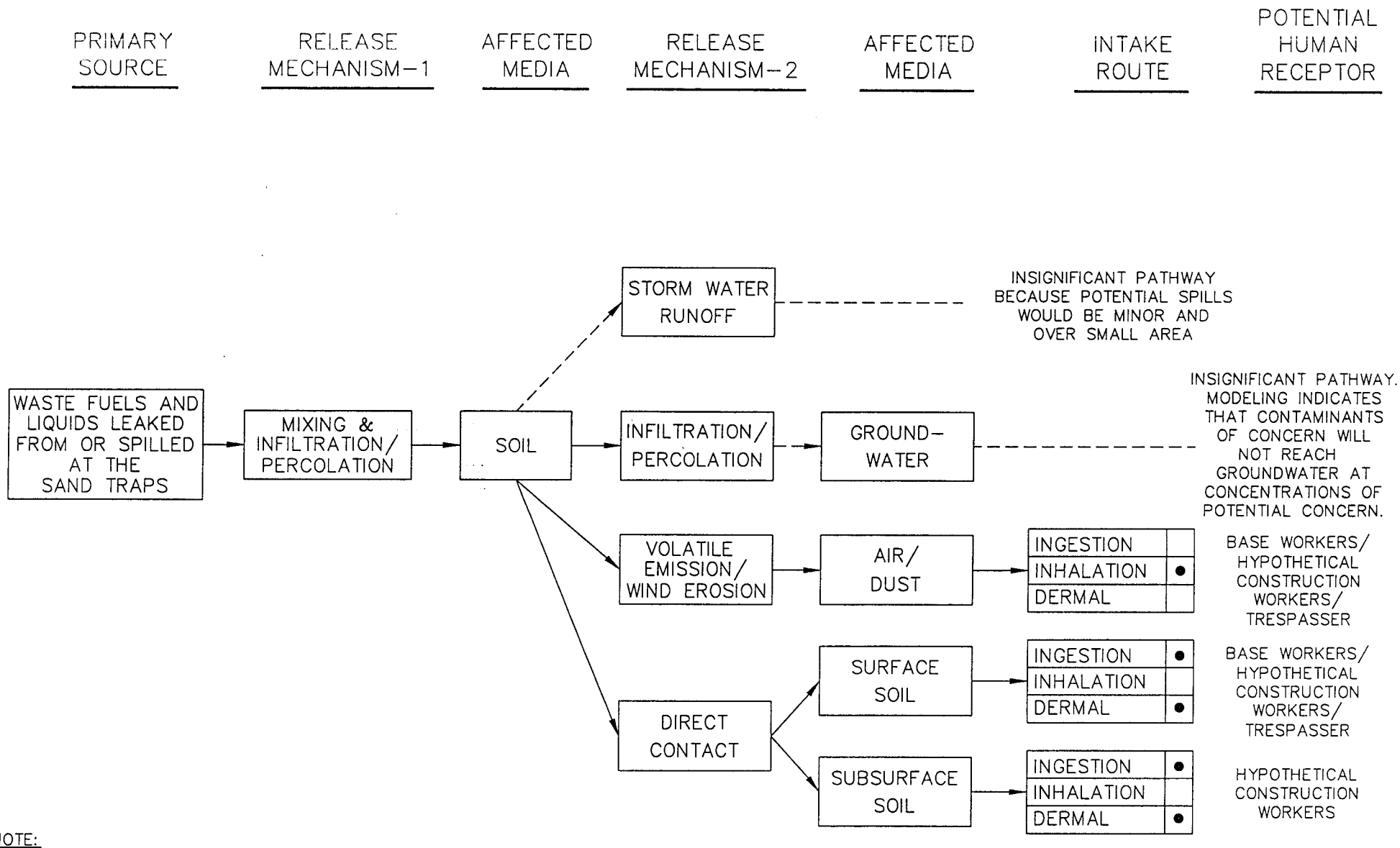
09406	0'	2'	4'	8'
Pb	7.5J	8.2J	2.6J	4.8J
Zn	17.3	20.2	5.95	10.8
Tl	ND	0.14J	ND	ND
Se	0.27J	ND	ND	ND
TPH	251.0	ND	ND	ND
T	1.4J	9.0	1.9J	6.2
12-DCP	ND	ND	27.0	ND

09405	0'	2'	4'	8'
Sb	ND	ND	ND	10.6J
Pb	12.5J	7.7J	3.3J	4.1J
Zn	27.2	23.6	9.4	22.0
Tl	ND	0.13J	ND	ND
Se	0.34J	0.26J	ND	ND
TPH	3600	ND	ND	ND
T	ND	ND	ND	ND
X	4.0J	ND	ND	ND
F	320J	*	*	*
NAP	430.0	*	*	*

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/05/94	OIL/WATER SEPARATOR No. 5144 – SWMU 94 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY: .	REVISION: 0		C3M11W	9-2

CAD FILE: C3M11W20.DWG V=SWMU-94 01/17/1994 13:28



NOTE:

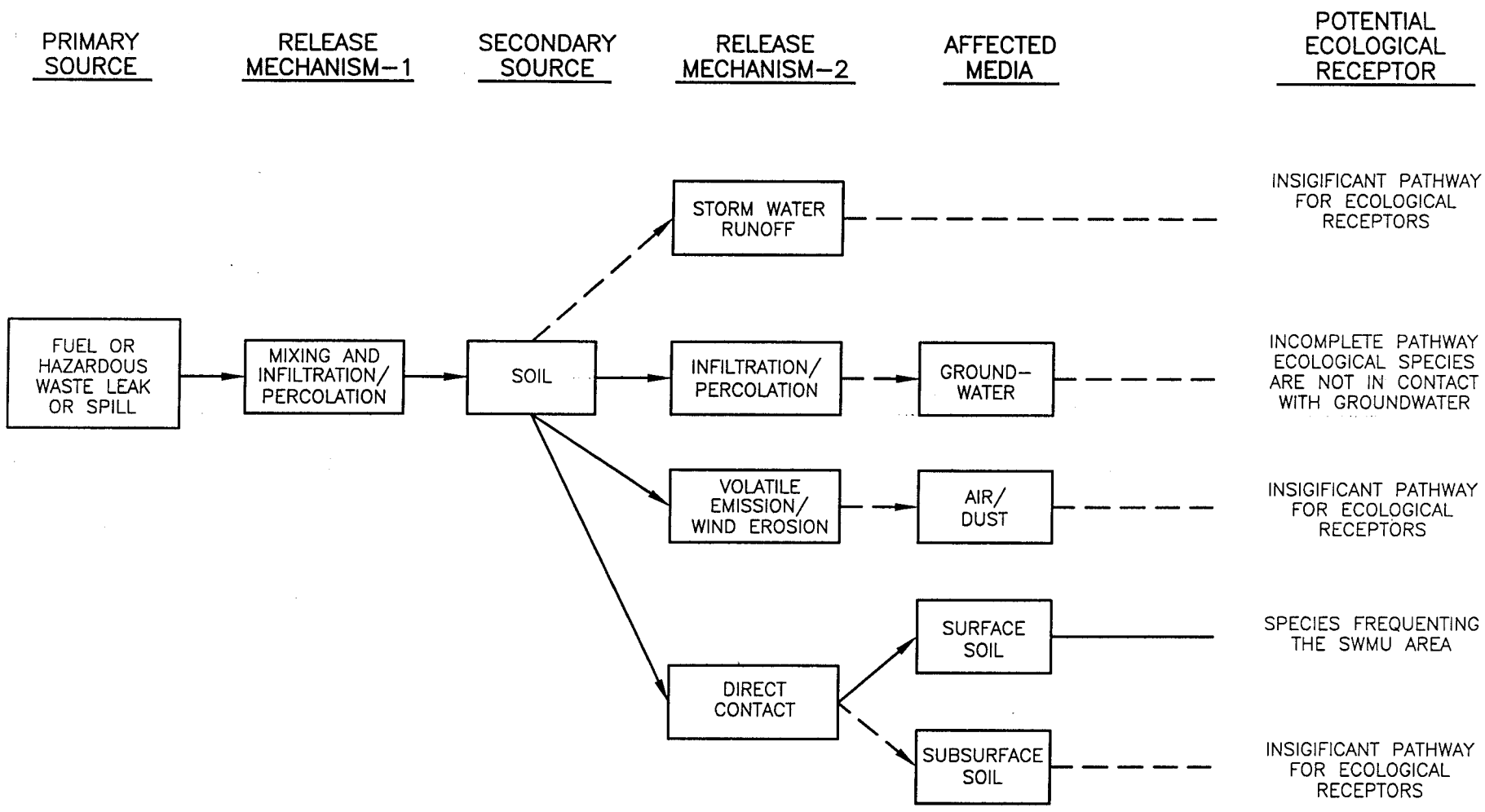
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART OIL WATER SEPARATOR No.5144 SWMU 94 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	9-3

C3M11W22.DWG V=SWMU-94 02/15/1994 8:00

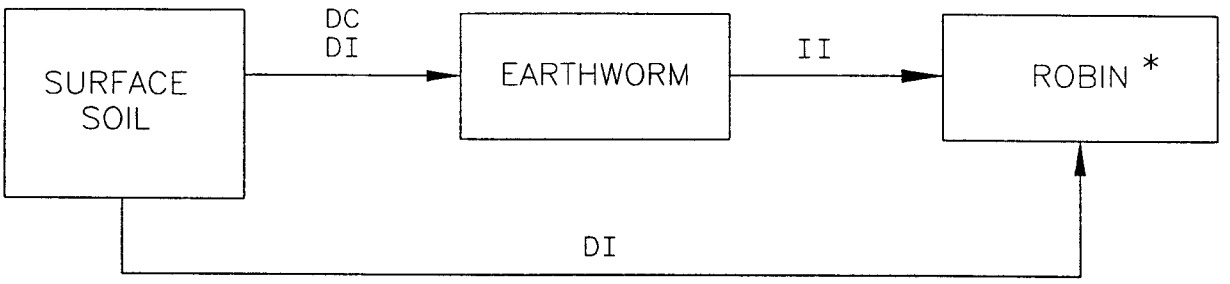


NOTES:

SOLID LINES REPRESENT POTENTIALLY COMPLETE AND SIGNIFICANT PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY NVD	DATE 12/30/93	EXPOSURE PATHWAY FLOW CHART FOR SWMU 94 ECOLOGICAL RECEPTORS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0		C3M11W	9-4



DC = DIRECT CONTACT

DI = DIRECT INGESTION

II = INDIRECT INGESTION
(i.e. SECONDARY, TERTIARY CONSUMPTION)

* = KEY RECEPTOR SPECIES

DRN BY NVD	DATE 12/30/93	CONCEPTUAL SITE MODEL SWMU 94	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0	CANNON AIR FORCE BASE NEW MEXICO	C3M11W	9-5

CAD FILE: C3M11W23.DWG V=SWMU-94 02/15/1994 9:30

10.0
SAND TRAP AND LEACH FIELDS AT THE PETROLEUM, OIL, AND LUBRICANTS (POL) WASH RACK - SWMU NO. 127

10.1 SITE BACKGROUND

10.1.1 Site Description

This SWMU is a 135-gallon concrete sand trap and leach field that receives wash water from the POL refueling truck wash rack at Facility 4095 (Figure 10-1). The sand trap measures 2.5 feet by 4.5 feet in plan and extends about 3.5 feet below the pavement. This unit has been active since 1977. Drainage from the wash rack flows into the sand trap and an oil/water separator (OWS). (The OWS was installed in the early 1990s. It is a three-compartment steel tank, with clean-out access for each compartment. Site inspection showed no evidence of leaks or spills, and the OWS is not part of the SWMU 127 investigation.) Water from the OWS is discharged to a leach field to the east of the OWS, and oil collected in the OWS is periodically removed by pumping. The surface of the leach field is grass-covered and essentially flat with no discernable gradient, and the area around and west of the sand trap (wash rock) is paved with asphalt.

10.1.2 Site History

The sand trap received wash water from fuel truck cleaning operations. Historically, this wastewater was discharged directly to a leach field located approximately 60-feet northeast of the wash rack. The leach field ceased to function in the late 1980s. An OWS enclosed in a concrete vault was installed in May 1991 to recover petroleum products which may be released during wash rack operations. The OWS discharges wastewater to a new leach field which was installed approximately 20 feet northeast of the original. The original leach field remains in place, but is bypassed and not used.

10.1.3 Current Use

The wash rack sand trap continues to receive heavy use. The wastewater from the recently installed OWS discharges to the new leach field located northeast of the former leach field and oils recovered are temporarily stored in the separator for future recycling.

10.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATIONS

10.2.1 Physical Investigation

The objective of soil sampling at the wash rack sand trap and the associated leach fields was to evaluate whether or not a release of SWMU-related chemicals that could pose a significant risk to human health or the environment has occurred from the sand trap or the two leach fields.

A total of eight borings were installed (boring locations are shown on Figure 10-1). Two 10-foot borings were drilled through holes cut in the concrete wash rack to sample the soil below the pad. Soil samples were collected at the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals to characterize the vertical distribution of possible contaminants. Minor visual and olfactory indications of contamination, probably attributable to spillage of JP-4 jet fuel on the wash rack, was found in soils directly below the concrete pad.

One 60-foot boring was drilled adjacent to the OWS and five 60-foot borings were drilled within the new and abandoned leach fields. Samples were collected at the surface and at the 1.5- to 3.5-foot, 4- to 6-foot, 8- to 10-foot, 18- to 20-foot, 28- to 30-foot, 38- to 40-foot, 48- to 50-foot, and 58- to 60-foot depth intervals to characterize the vertical distribution of possible leachate contaminants percolating into the soil. At Boring 12708, located in the new leach field, odors were encountered indicating subsurface contamination beyond the wash rack.

Target analytes for all borings include VOCs, SVOCs, metals, and TRPH. Surficial samples were collected directly under the concrete wash rack and approximately at the 0.2- to 0.5-foot depth interval in areas of plant cover to provide surface soil data for risk assessment purposes.

10.2.2 Chemical Investigation

Sixty-two soil samples (not counting QC samples) were collected from the eight borings. Sampling and analyses performed are summarized in Table 10-1. Summaries of the analytical results for these soil samples is provided in Table 10-2a (near-surface) and Table 10-26 (subsurface soil). The tables provide results for analytes that were detected at least once in each sample group (near-surface and subsurface). Complete analytical summary results are provided in the QCSR (Appendix A of the RFI report).

10.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI report, and the data were deemed to be of adequate quality to meet the objectives of the RFI. There were no data quality issues affecting usability of the data for risk assessment.

10.2.4 Nature and Extent of Contamination

There was no visible evidence of spills or leaks in the vicinity. Minor petroleum staining was observed in the upper two feet of soil around the sand trap and in a few of the samples from Boring 12708 in the leach field; otherwise no physical evidence of contamination was encountered during sampling. The chemical test results show low levels of organic contamination, including PAHs and TPH predominantly in the shallow samples. The primary contamination detected at the SWMU includes PAHs which were detected at significant concentrations in six of eight surface soil samples. The surface soil sample at Boring 12705 had the highest PAH concentration including benzo(a)pyrene at 8,600 µg/kg. PAH concentrations in the other surface samples were approximately an order of magnitude lower. PAHs were not detected in subsurface soil samples indicating that they are not being transported vertically. Only very low concentrations of VOCs were detected (e.g., toluene was detected at a maximum concentration of 18 µg/kg at a depth of 8 feet). VOCs were not found at significant concentrations in the deeper samples indicating that vertical transport is not occurring. Maximum metals concentrations detected at the SWMU include copper at 54.9 mg/kg, barium at 971 mg/kg, and lead at 48.2 mg/kg.

10.3 HUMAN HEALTH RISK ASSESSMENT

10.3.1 Exposure Pathway Flow Chart

Figure 10-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways for OWS 4095. In the flow chart potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary sources are waste fluids (e.g., wash water containing fuels, oils, and solvents) that were discharged to the sand trap and leach fields. Chemicals from the primary source may be released to other media that may in turn act as secondary sources of chemical release or exposure. Mixing and infiltration of the wastes to soil is shown as a primary chemical release mechanism. Chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion, or result in exposure via direct contact (e.g., dermal contact or incidental ingestion). Storm water runoff is not

considered to be a significant pathway for human exposures, because the SWMU covers only a small area, surface spills are not likely to be significant, and no developed drainageways are present near the SWMU.

As shown on the flow chart, surface soils may provide exposures to Base workers (occupational exposures), hypothetical future construction workers, and hypothetical future trespassers. Air emissions (volatile and particulates) from surface soil may also provide exposures to Base workers, construction workers, and trespassers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Construction workers are unlikely to encounter soils at depths greater than 20 feet; however, to be conservative, exposures will be evaluated to contaminants at all depths of the borings. Groundwater is used for domestic purposes on and off Base. In order to assess potential impacts to public health via groundwater pathways, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling (Section 10.3.5.2) indicate that contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway was not evaluated further.

In summary, potential complete human exposure pathways evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Future Trespassers

- Ingestion of and dermal contact with surface soils
- Inhalation of volatile emissions and airborne particulate matter from surface soils

10.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern, and are not evaluated further.

Background levels were detected by the upper tolerance limit (UTL) of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; see Appendix A.)

Results of the comparison of metals concentrations in soil for SWMU 127 to background levels are given in Tables 10-3 and 10-4. A summary of the results of the comparison is presented here.

The maximum concentrations of antimony, cadmium, copper, lead, mercury, silver, and zinc in surface soil exceeded the UTL of the background data. The maximum detected concentrations of antimony, barium, cadmium, copper, lead, mercury, silver, thallium, and zinc in total soils exceeded the UTL of the background data. Therefore, these metals were retained for further evaluation as potential chemicals of concern in surface and total soils.

Antimony and mercury were only detected in one of 62 samples (<2 percent), and thallium was detected in two of 62 samples (3 percent). This rate of exceedance of the 95 percent UTL of the background population is expected; therefore, these metals are probably within naturally-occurring levels. However, to be conservative, they are evaluated in the risk assessment as chemicals of concern.

10.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 127, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 10-2a and 10-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentrations of several metals detected in surface and subsurface soil exceeded background ranges according to the comparison described in Section 10.3.2. These metals are, therefore, considered as chemicals of concern in soil. The compounds 1,1,1-trichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, 1,2-dichloroethene, 2-butanone, benzene, carbon tetrachloride, chlorobenzene, ethylbenzene, and tetrachloroethene were reported in fewer than 5 percent of the total soil samples, were only reported at concentrations below reporting limits, and were only detected at depth. Therefore, these compounds are not considered to be characteristic of the site, are not likely to pose a significant risk, and thus are not considered to be chemicals of concern at this SWMU. Other organic contaminants detected in soils were retained as chemicals of concern for risk assessment. Chemicals of concern in surface soil and total soil are listed in Tables 10-5 and 10-6, respectively. Benzo(g,h,i)perylene, 2-methylnaphthalene, phenanthrene, aluminum, cobalt, lead, and TPH, listed in Tables 10-5 and 10-6 as chemicals of concern, do not have EPA-established toxicity factors and, therefore, cannot be evaluated quantitatively in the risk assessment. However, their potential effects on the results of the risk assessment are addressed in Sections 10.3.8 through 10.3.10.

10.3.4 Environmental Fate and Transport

10.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are: water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

10.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (DOE 1991), describes the mass balance of a contaminant (based on average soil concentrations) in the contaminated soil volume at the SWMU. The DOE model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP] Model) and accounts for sorption to soils and degradation in the vadose zone. The model conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of SWMU-related chemicals of concern. The input parameters and estimated leachate concentrations are given in Section 10.3.5.2. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water (Section 10.3.5.2). Since the RBCs were developed for drinking water (at the tap) and were based on conservative exposure and health-protective (risk) assumptions, it can be concluded that modeled groundwater concentrations that do not exceed RBCs will pose no significant adverse health risk.

10.3.4.3 Air Modeling

RME air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using RME soil concentrations of chemicals of concern. The results of the air modeling are given in Section 10.3.5.3. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use at hazardous waste sites to calculate soil cleanup levels (EPA 1991). Air concentrations were calculated for only those chemicals with inhalation toxicity factors which were evaluated quantitatively in the risk assessment. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

10.3.5 Exposure Point Concentrations

10.3.5.1 Soils

Tables 10-7 and 10-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils, respectively, at OWS 4095.

In accordance with EPA guidance (EPA 1989d) and explained in Appendix C of the Baseline Risk Assessment for Appendix III Solid Waste Management Units – Phase I (W-C 1994b), the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use lf "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C (W-C 1994b). Tables 10-9 and 10-10 give the soil concentrations of organic compounds from surface and total soils, respectively, which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils The absorbed fraction (from Table C-26, Appendix C [W-C 1994b]) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soils. As explained in Appendix C (W-C 1994b), dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

Surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depth (i.e., were actually taken from depths of 1.5 to 3.5 feet). These samples were not considered surface samples, but are included in the risk assessment for subsurface soil exposure.

10.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 127. A more detailed description of the groundwater modeling approach is provided in Appendix B. Model results are included in Table 10-11. These modeled concentrations were then compared to EPA Region III tap water risk-based concentrations (RBCs) (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 10-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap water RBCs. No modeled concentrations exceeded the RBCs, so significant risks are not expected from the groundwater pathway. Therefore, the groundwater pathway has been determined to be insignificant and was not further evaluated.

10.3.5.3 Air

RME air concentrations of volatile and particulate emissions from surface soil and total soil were calculated using RME concentrations of chemicals of concern. The results of the air modeling from surface soil are shown in Tables 10-13 and 10-14. The results of the air modeling from total soil are shown in Tables 10-15 and 10-16.

10.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C (W-C 1994b). Appendix C (W-C 1994b) includes discussions of the exposure assumptions and intake factors used to quantify chemical intake of SWMU-related contaminants in soil and air. Table 10-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

10.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C (W-C 1994b). Detailed risk calculations are shown in Appendix C (W-C 1994b) and summarized in Table 10-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface soils at SWMU 127. Occupational receptors were assumed to be exposed for two 8 hour/days, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative because there are no occupational receptors routinely working outdoors at the SWMU for the assumed durations. Furthermore, the surface area of the SWMU is small (approximately 180 feet by 70 feet or one-third acre), and long-term exposures are not likely to occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 127 via the dermal contact, inhalation, and ingestion pathways is 0.00007 and 0.007 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk for the assumed chronic exposure conditions is 1×10^{-8} for the average exposure case and 2×10^{-5} for the RME case. These levels are within or below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). Ingestion of PAHs is the primary contributor to the carcinogenic risk estimate. The RME estimate of risks due to ingestion probably significantly overestimates actual risks because it is based on the maximum concentrations of several PAHs. From Table 10-7, it can be seen that PAHs are detected in relatively high concentrations (up to 17 mg/kg) in only one of eight surface soil samples. Furthermore, it can be seen from Figure 10-1 that this contaminated area occupies only a small area of the SWMU and that it would be very unlikely that a worker would be exposed consistently to this area of maximum PAH concentrations. Therefore, the use of these maximum PAH concentrations significantly overestimates potential health risks, and the 1×10^{-8} cancer risk estimate based on the average surface soil concentrations (which correspond to exposures that might reasonably be expected across the SWMU) is a much more appropriate guide to expected risks at this SWMU.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 127. Exposures were assumed to occur during construction activities for 8 hours/day for 20 and 40 days for the average and RME cases.

respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 127 via the dermal contact, inhalation, and ingestion pathways is 0.0003 and 0.003 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated even to sensitive individuals.

The estimated lifetime excess cancer risk for the assumed subchronic exposure conditions is 2×10^{-9} in the average case and 2×10^{-8} in the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b) and show that risks for this exposure scenario are negligible.

Trespasser Exposure

Hypothetical trespassers were assumed to be exposed via ingestion, dermal contact, and inhalation) to surface soils at SWMU 127. Trespassers were assumed to be exposed for 26 and 52 days/year over a period of 6 years for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to contaminants in surface soils at SWMU 127 via the dermal contact, inhalation, and ingestion pathways is 0.00002 and 0.002 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk for the assumed subchronic exposure conditions 2×10^{-9} for the average exposure case and 1×10^{-6} for the RME case. The estimated risk for the average case is with the EPA target risk range of 1×10^{-6} and 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990; 1991b). The RME estimate of risk probably significantly overestimates actual risks because it is based on the maximum concentrations of several PAHs. From Table 10-7, it can be seen that PAH concentrations are elevated in one of eight (1275-0000) surface soil samples. Furthermore, it can be seen from Figure 10-1 that this contaminated area occupies only a small area of the SWMU and that it would be very unlikely that a receptor would be exposed consistently to this area of maximum PAH concentrations. Therefore, the use of these maximum PAH concentrations probably significantly overestimate potential health risks, and the risk estimate based on the average concentrations (which correspond to exposures that might reasonably be expected across the SWMU) is a much more appropriate value for this SWMU.

Qualitative Assessment of Exposures to Lead

Lead exposures are not addressed in the quantitative risk assessment because EPA withdrew the RfD for lead in 1989, primarily due to the lack of discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. These levels are supported by EPA's Uptake Biokinetic (UBK) Lead Model which predicts that exposures of children ages 0 to 6 to soils with approximately these levels will not result in blood lead levels that exceed a level of concern established by the Centers of Disease Control.

The maximum lead concentration measured in soils at SWMU 127 was 48.2 mg/kg. This is well below the acceptable level for residential soils, and it can be concluded that lead detected in soils at SWMU 127 would not be expected to pose a threat to human health.

Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In this RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil samples collected at the SWMU and included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available, and when the fuel product is known. The provisional toxicity values are under review and subject to revision. The RBCs derived from them are used only as a guide to potential health hazards.)

The toxicity factors and calculation of risk-based concentrations are shown in Table 10-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure

assumptions is 33,600 mg/kg. The maximum SWMU concentration of TPH is 344 mg/kg, well below the conservative RBC.

10.3.8 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C (W-C 1994b). The chief uncertainties specific to risk assessment for SWMU 127 and their effect on the results and conclusions of the risk assessment are listed below.

- A single surface soil sample contained the maximum concentrations of all of the PAHs detected. Most PAHs were detected at levels 1 or 2 orders of magnitude lower in the other samples. Risks were calculated based on RME concentrations equivalent to the maximum concentrations detected in the one sample and an assumed 25-year exposure duration, including daily contact. These exposure assumptions significantly overstate the likelihood of exposure to the contaminated area. Therefore, the RME risk of 2×10^{-5} is probably a significant overestimate of actual risk associated with exposure to soils at the SWMU.

- Direct physical contact with contaminated soils was assumed to occur routinely for several hours/day, 9 to 12 months of the year, for 9 to 25 years. These assumptions overstate current and likely future exposure conditions to soils at this site.

- Benzo(g,h,i)perylene, 2-methylnaphthalene and phenanthrene were not considered in the quantitative risk assessment because they do not have EPA-established toxicity factors. Their exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results or conclusions of the risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens such as benzo(a)pyrene, which cause skin cancer through a direct action at the point of application. The exclusion of this exposure pathway from the risk assessment may underestimate the potential human health risk at the SWMU.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their

exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected, because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- The surface area of this SWMU is only one-third acre, and the long-term daily exposures are not likely to be confined to an industrial area this small. Therefore, the exposure assumptions used significantly overestimate actual exposures to contaminated soils and associated risk at this SWMU.

10.4 ECOLOGICAL RISK ASSESSMENT

10.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 127, the Sand Trap and associated leach fields at the POL Washrack, is located in a small area of poor wildlife habitat quality, within the developed portion of Cannon AFB where existing ground cover is mostly asphalt paving, roadway, and an area of mowed non-native grasses. About 60 percent of the land surface within the immediate vicinity (within 100 feet) of SWMU 127 is asphalt or concrete paving and Building 223. The mowed grassy area is located immediately above and surrounding the leach field, and extends to the northwest and south. This grassy area is more extensive than the more isolated grassy strips associated with other OWS-type SWMUs at Cannon AFB, but is still surrounded by development. The sandtrap continues to be actively used.

The most common species are likely to be birds, such as robin (*Turdus migratorius*), house sparrow (*Passer domesticus*), and the starling (*Sturnus vulgaris*). Seedeaters would be more limited, since the grass is maintained by mowing. Although the house mouse (*Mus musculus*) may occur in the area around the buildings, the grass habitat is probably too small and subject to human disturbance to be used regularly by terrestrial species such as deer mice. Raptors are unlikely to use the area for similar reasons.

Given this assessment, the robin (*Turdus migratorius*) was selected as the key receptor species for the grassy area around SWMU 127.

10.4.2 Chemicals of Concern

The chemicals of concern (COCs) at SWMU 127 were selected using validated data from fourteen soil samples covering the interval between 0 and 2 feet deep. This interval was selected because most soil-dwelling organisms (e.g. earthworms and deer mice) occur in this zone. Table 10-20 provides a summary of the chemicals detected in the fourteen samples

considered for this ERA. A detailed description of the soil sampling program and chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the fourteen samples to be considered a possible COC. The following screening criteria were then applied, in the order shown, to determine if a chemical in the soil would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Exceedance of the normal range found in U.S. soils (nationwide)

The maximum detected concentration of the fourteen samples was used in the comparison to background criteria. If no background criteria were available for comparison, as was the case for the organic chemicals, the chemicals were retained as COCs. If the maximum detected concentration of a chemical exceeded the local (i.e. Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If it exceeded this criteria, it was likely retained as a COC, even if it fell within the normal range found in U.S. soils. This is because the normal U.S. range is widely variable and was included in the screening process primarily as an additional reference. In some cases however, the normal U.S. range was the only screening criteria available. Table 10-21 lists the maximum concentrations detected and shows the screening values used. The chemicals that were retained as COCs following the screening process are 1,2-dichloroethane, 1,2-dichloropropane, toluene, xylenes, acenaphthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, carbazole, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene, pyrene, aluminum, antimony, cadmium, copper, lead, selenium, silver, thallium, and TPH.

10.4.3 Exposure Assessment

Figure 10-4 depicts the exposure pathway flow chart developed for SWMU 127. As the flowchart indicates, chemicals could potentially be released through transport in runoff, infiltration to groundwater, volatilization or wind erosion, and direct contact by ecological receptors. Except for direct contact, these exposure pathways are incomplete or of minor importance for ecological receptors. Storm water runoff is a potentially complete but insignificant pathway, because the source of chemicals is below ground and any spillage during servicing would involve a relatively small area of level terrain. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization or wind erosion is not considered a significant pathway at this site. Although one of the COCs is a volatile organic compound (VOC), the maximum concentrations were equal or less than 0.015 mg/kg, and VOC concentrations of 100 mg/kg or greater in air are generally needed to induce toxic responses in laboratory rats and mice from inhalation (NIOSH 1987). Concentrations in soils would have to be many times greater than this to produce these toxic levels in air, even near the soil surface. Direct contact with subsurface soils (more than two feet deep) is also considered an insignificant or incomplete pathway because of the limited use of deeper soils at this site by wildlife.

Therefore, the only potentially complete and significant exposure pathway is direct contact with contaminated surface soil by species frequenting the SWMU area. Direct contact may include dermal absorption or ingestion. Dermal absorption is not considered a significant exposure route for the receptors at this site because the animals are assumed to be largely protected by their fur or feathers. Receptors at the SWMU may ingest COCs either directly or indirectly. Direct ingestion usually occurs along the food/prey chain from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of COCs that have been transferred via food webs.

Figure 10-5 depicts the Conceptual Site Model developed from the exposure pathway analysis, the ecological characterization, and the identification of the key receptor species for SWMU 127. As the figure indicates, the pathway of concern is from surface soil to the robin, via direct and indirect ingestion, with the earthworm identified as a main dietary component of the robin.

10.4.4 Risk Characterization

This section provides a characterization of potential risk to the selected key receptor species (robin) at SWMU 127. For the purposes of this analysis, it was assumed that the robin's diet consists of earthworms and inadvertent consumption of soil. It was also assumed that the concentration of the COCs were the same in the earthworm as in the soil, except for cadmium and selenium, for which bioaccumulation factors of 4.6 and 12 were used (see Section 7.4.4). Therefore the analysis consisted of comparing the concentration of COCs in the robin's food (i.e., the chemical concentration in soil) to selected toxicity benchmark dietary levels for those chemicals (see Table 10-22).

This is a somewhat conservative approach, because studies indicate that, for many chemicals, BAFs from soil to earthworm are less than one (Beyer and Stafford 1993). However, this assumption takes into account the soil that would be clinging to the earthworm when consumed by the robin (that is not taken into account by the BAF studies) and also accounts for minor inadvertent soil ingestion by the robin. The benchmark dietary levels were selected as explained in Appendix D, Section D.3 and D.4; these sections also provide background toxicological information about the COCs. The soil chemical concentration used was the arithmetic mean, as described in Appendix D (Section D.6.).

Table 10-22 lists the COCs for SWMU 127 and provides a comparison between the soil concentration (arithmetic mean) and the benchmark dietary level for the robin. If the soil level exceeds the benchmark level, there is a possibility of risk, as noted in the table. The following discussion addresses those chemicals where a possibility of risk is indicated.

Benzo-a-pyrene (BaP)

The average concentration of BaP at SWMU 127 was 1.159 mg/kg, compared to the benchmark dietary level of 0.02 mg/kg, indicating a potential risk. The 1.159 mg/kg level is above reported BaP concentrations for various locations, as reported in the literature, but within the range reported for "rural soils" by ATSDR (1990) (see Table A-6). BaP was detected in six of nine samples; the other three samples were non-detects. Also, there was one "hot spot" at 8.6 mg/kg; the other detects were in the 0.1-0.2 mg/kg range. Therefore, it is unlikely that the robin is exposed to a level of 1.159 mg/kg in all areas in which it feeds, assuming it does not feed just at the "hot spots" in the SWMU area. Also, the low toxicity benchmark for BaP is a reflection of BaP's carcinogenic effects through the action of its intermediate metabolites, as opposed to acute toxicity. In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, and therefore it is questionable if carcinogenesis is an important endpoint for relatively short-lived mammals and birds, such as the robin. Finally, the BaP found at

SWMU 127 may not be completely bioavailable to robins. Goon et al. (1991) showed that BaP that had aged 6 months in soil was only 34 percent to 51 percent orally bioavailable for clayey and sandy soils, relative to BaP administered alone to rats. For these reasons, it is unlikely that BaP presents an unacceptable risk at SWMU 127.

Aluminum

The average concentration of aluminum at SWMU 127 was 8267 mg/kg, compared to the benchmark toxicity level of 1500 mg/kg, indicating a potential risk. However, it is unlikely that aluminum from SWMU 127 constitutes a risk to the robin, because the background concentration of aluminum in the soils at Cannon AFB is high (UTL=10,540 mg/kg), and the maximum concentration found at SWMU 127 was only slightly higher this background level (11,600 mg/kg). Normal range for aluminum in U.S. soils can vary from 700-100,000 mg/kg (see Table 10-21). It is unlikely that SWMU 127 is the source of the high aluminum, it is also likely that much of the aluminum found in the soil is present as insoluble salts (oxides and phosphates), which are not toxic (NAS 1980). Therefore, it is expected that the wildlife in this area is not at risk from the naturally high aluminum soils.

10.5 SUMMARY AND CONCLUSIONS

10.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at this SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 10-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU.

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

10.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

10.0 SAND TRAP AND LEACH FIELDS AT THE PETROLEUM, OIL, AND LUBRICANTS (POL) WASH RACK - SWMU NO. 127

10.1 SITE BACKGROUND

10.1.1 Site Description

This SWMU is a 135-gallon concrete sand trap and leach field that receives wash water from the POL refueling truck wash rack at Facility 4095 (Figure 10-1). The sand trap measures 2.5 feet by 4.5 feet in plan and extends about 3.5 feet below the pavement. This unit has been active since 1977. Drainage from the wash rack flows into the sand trap and an oil/water separator (OWS). (The OWS was installed in the early 1990s. It is a three-compartment steel tank, with clean-out access for each compartment. Site inspection showed no evidence of leaks or spills, and the OWS is not part of the SWMU 127 investigation.) Water from the OWS is discharged to a leach field to the east of the OWS, and oil collected in the OWS is periodically removed by pumping. The surface of the leach field is grass-covered and essentially flat with no discernable gradient, and the area around and west of the sand trap (wash rock) is paved with asphalt.

10.1.2 Site History

The sand trap received wash water from fuel truck cleaning operations. Historically, this wastewater was discharged directly to a leach field located approximately 60-feet northeast of the wash rack. The leach field ceased to function in the late 1980s. An OWS enclosed in a concrete vault was installed in May 1991 to recover petroleum products which may be released during wash rack operations. The OWS discharges wastewater to a new leach field which was installed approximately 20 feet northeast of the original. The original leach field remains in place, but is bypassed and not used.

10.1.3 Current Use

The wash rack sand trap continues to receive heavy use. The wastewater from the recently installed OWS discharges to the new leach field located northeast of the former leach field and oils recovered are temporarily stored in the separator for future recycling.

10.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATIONS

10.2.1 Physical Investigation

The objective of soil sampling at the wash rack sand trap and the associated leach fields was to evaluate whether or not a release of SWMU-related chemicals that could pose a significant risk to human health or the environment has occurred from the sand trap or the two leach fields.

A total of eight borings were installed (boring locations are shown on Figure 10-1). Two 10-foot borings were drilled through holes cut in the concrete wash rack to sample the soil below the pad. Soil samples were collected at the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals to characterize the vertical distribution of possible contaminants. Minor visual and olfactory indications of contamination, probably attributable to spillage of JP-4 jet fuel on the wash rack, was found in soils directly below the concrete pad.

One 60-foot boring was drilled adjacent to the OWS and five 60-foot borings were drilled within the new and abandoned leach fields. Samples were collected at the surface and at the 1.5- to 3.5-foot, 4- to 6-foot, 8- to 10-foot, 18- to 20-foot, 28- to 30-foot, 38- to 40-foot, 48- to 50-foot, and 58- to 60-foot depth intervals to characterize the vertical distribution of possible leachate contaminants percolating into the soil. At Boring 12708, located in the new leach field, odors were encountered indicating subsurface contamination beyond the wash rack.

Target analytes for all borings include VOCs, SVOCs, metals, and TRPH. Surficial samples were collected directly under the concrete wash rack and approximately at the 0.2- to 0.5-foot depth interval in areas of plant cover to provide surface soil data for risk assessment purposes.

10.2.2 Chemical Investigation

Sixty-two soil samples (not counting QC samples) were collected from the eight borings. Sampling and analyses performed are summarized in Table 10-1. Summaries of the analytical results for these soil samples is provided in Table 10-2a (near-surface) and Table 10-26 (subsurface soil). The tables provide results for analytes that were detected at least once in each sample group (near-surface and subsurface). Complete analytical summary results are provided in the QCSR (Appendix A of the RFI report).

10.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI report, and the data were deemed to be of adequate quality to meet the objectives of the RFI. There were no data quality issues affecting usability of the data for risk assessment.

10.2.4 Nature and Extent of Contamination

There was no visible evidence of spills or leaks in the vicinity. Minor petroleum staining was observed in the upper two feet of soil around the sand trap and in a few of the samples from Boring 12708 in the leach field; otherwise no physical evidence of contamination was encountered during sampling. The chemical test results show low levels of organic contamination, including PAHs and TPH predominantly in the shallow samples. The primary contamination detected at the SWMU includes PAHs which were detected at significant concentrations in six of eight surface soil samples. The surface soil sample at Boring 12705 had the highest PAH concentration including benzo(a)pyrene at 8,600 μg/kg. PAH concentrations in the other surface samples were approximately an order of magnitude lower. PAHs were not detected in subsurface soil samples indicating that they are not being transported vertically. Only very low concentrations of VOCs were detected (e.g., toluene was detected at a maximum concentration of 18 μg/kg at a depth of 8 feet). VOCs were not found at significant concentrations in the deeper samples indicating that vertical transport is

not occurring. Maximum metals concentrations detected at the SWMU include copper at 54.9 mg/kg, barium at 971 mg/kg, and lead at 48.2 mg/kg.

10.3 HUMAN HEALTH RISK ASSESSMENT

10.3.1 Exposure Pathway Flow Chart

Figure 10-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways for OWS 4095. In the flow chart potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary sources are waste fluids (e.g., wash water containing fuels, oils, and solvents) that were discharged to the sand trap and leach fields. Chemicals from the primary source may be released to other media that may in turn act as secondary sources of chemical release or exposure. Mixing and infiltration of the wastes to soil is shown as a primary chemical release mechanism. Chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion, or result in exposure via direct contact (e.g., dermal contact or incidental ingestion). Storm water runoff is not considered to be a significant pathway for human exposures, because the SWMU covers only a small area, surface spills are not likely to be significant, and no developed drainageways are present near the SWMU.

As shown on the flow chart, surface soils may provide exposures to Base workers (occupational exposures), hypothetical future construction workers, and hypothetical future trespassers. Air emissions (volatile and particulates) from surface soil may also provide exposures to Base workers, construction workers, and trespassers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Construction workers are unlikely to encounter soils at depths greater than 20 feet; however, to be conservative, exposures will be evaluated to contaminants at all depths of the borings. Groundwater is used for domestic purposes on and off Base. In order to assess potential impacts to public health via groundwater pathways, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling

(Section 10.3.5.2) indicate that contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway was not evaluated further.

In summary, potential complete human exposure pathways evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Future Trespassers

- Ingestion of and dermal contact with surface soils
- Inhalation of volatile emissions and airborne particulate matter from surface soils

10.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern, and are not evaluated further.

Background levels were detected by the upper tolerance limit (UTL) of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in

Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; see Appendix A.)

Results of the comparison of metals concentrations in soil for SWMU 127 to background levels are given in Tables 10-3 and 10-4. A summary of the results of the comparison is presented here.

The maximum concentrations of antimony, cadmium, copper, lead, mercury, silver, and zinc in surface soil exceeded the UTL of the background data. The maximum detected concentrations of antimony, barium, cadmium, copper, lead, mercury, silver, thallium, and zinc in total soils exceeded the UTL of the background data. Therefore, these metals were retained for further evaluation as potential chemicals of concern in surface and total soils.

Antimony and mercury were only detected in one of 62 samples (<2 percent), and thallium was detected in two of 62 samples (3 percent). This rate of exceedance of the 95 percent UTL of the background population is expected; therefore, these metals are probably within naturally-occurring levels. However, to be conservative, they are evaluated in the risk assessment as chemicals of concern.

10.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 127, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 10-2a and 10-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentrations of several metals detected in surface and subsurface soil exceeded background ranges according to the comparison described in Section 10.3.2. These metals

are, therefore, considered as chemicals of concern in soil. The compounds 1,1,1-trichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, 1,2-dichloroethene, 2-butanone, benzene, carbon tetrachloride, chlorobenzene, ethylbenzene, and tetrachloroethene were reported in fewer than 5 percent of the total soil samples, were only reported at concentrations below reporting limits, and were only detected at depth. Therefore, these compounds are not considered to be characteristic of the site, are not likely to pose a significant risk, and thus are not considered to be chemicals of concern at this SWMU. Other organic contaminants detected in soils were retained as chemicals of concern for risk assessment. Chemicals of concern in surface soil and total soil are listed in Tables 10-5 and 10-6, respectively. Benzo(g,h,i)perylene, 2-methylnaphthalene, phenanthrene, aluminum, cobalt, lead, and TPH, listed in Tables 10-5 and 10-6 as chemicals of concern, do not have EPA-established toxicity factors and, therefore, cannot be evaluated quantitatively in the risk assessment. However, their potential effects on the results of the risk assessment are addressed in Sections 10.3.8 through 10.3.10.

10.3.4 Environmental Fate and Transport

10.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are: water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

10.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (DOE 1991), describes the mass balance of a contaminant (based on average soil concentrations) in the contaminated soil volume at the SWMU. The DOE model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP]

Model) and accounts for sorption to soils and degradation in the vadose zone. The model conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of SWMU-related chemicals of concern. The input parameters and estimated leachate concentrations are given in Section 10.3.5.2. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water (Section 10.3.5.2). Since the RBCs were developed for drinking water (at the tap) and were based on conservative exposure and health-protective (risk) assumptions, it can be concluded that modeled groundwater concentrations that do not exceed RBCs will pose no significant adverse health risk.

10.3.4.3 Air Modeling

RME air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using RME soil concentrations of chemicals of concern. The results of the air modeling are given in Section 10.3.5.3. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use at hazardous waste sites to calculate soil cleanup levels (EPA 1991). Air concentrations were calculated for only those chemicals with inhalation toxicity factors which were evaluated quantitatively in the risk assessment. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

10.3.5 Exposure Point Concentrations

10.3.5.1 Soils

Tables 10-7 and 10-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils, respectively, at OWS 4095.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use lf "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C. Tables 10-9 and 10-10 give the soil concentrations of organic compounds from surface and total soils, respectively, which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils The absorbed fraction (from Table C-26, Appendix C) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soils. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

Surface soil was defined as soils to a depth of 2 feet. Some samples with field identification indicating 2-foot depth (i.e., were actually taken from depths of 1.5 to 3.5 feet). These samples were not considered surface samples, but are included in the risk assessment for subsurface soil exposure.

10.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 127. A more detailed description of the groundwater modeling approach is provided in Appendix B. Model results are included in Table 10-11. These modeled concentrations were then compared to EPA Region III tap water risk-based concentrations (RBCs) (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 10-12 summarizes the comparison of the modeled

concentration in groundwater to the conservative tap water RBCs. No modeled concentrations exceeded the RBCs, so significant risks are not expected from the groundwater pathway. Therefore, the groundwater pathway has been determined to be insignificant and was not further evaluated.

10.3.5.3 Air

RME air concentrations of volatile and particulate emissions from surface soil and total soil were calculated using RME concentrations of chemicals of concern. The results of the air modeling from surface soil are shown in Tables 10-13 and 10-14. The results of the air modeling from total soil are shown in Tables 10-15 and 10-16.

10.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the exposure assumptions and intake factors used to quantify chemical intake of SWMU-related contaminants in soil and air. Table 10-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

10.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 10-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface soils at SWMU 127. Occupational receptors were assumed to be exposed for two 8 hour/days, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative because there are no occupational receptors routinely working outdoors at the SWMU for the assumed durations. Furthermore, the surface area of the SWMU is small (approximately 180 feet by 70 feet or one-third acre), and long-term exposures are not likely to occur there. Therefore, the exposure assumptions overestimate current and future exposure conditions at the SWMU.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 127 via the dermal contact, inhalation, and ingestion pathways is 0.00007 and 0.007 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk for the assumed chronic exposure conditions is 1×10^{-8} for the average exposure case and 2×10^{-5} for the RME case. These levels are within or below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). Ingestion of PAHs is the primary contributor to the carcinogenic risk estimate. The RME estimate of risks due to ingestion probably significantly overestimates actual risks because it is based on the maximum concentrations of several PAHs. From Table 10-7, it can be seen that PAHs are detected in relatively high concentrations (up to 17 mg/kg) in only one of eight surface soil samples. Furthermore, it can be seen from Figure 10-1 that this contaminated area occupies only a small area of the SWMU and that it would be very unlikely that a worker would be exposed consistently to this area of maximum PAH concentrations. Therefore, the use of these maximum PAH concentrations significantly overestimates potential health risks, and the 1×10^{-8} cancer risk estimate based on the average surface soil concentrations (which correspond to exposures that might reasonably be expected across the SWMU) is a much more appropriate guide to expected risks at this SWMU.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 127. Exposures were assumed to occur during construction activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 127 via the dermal contact, inhalation, and ingestion pathways is 0.0003 and 0.003 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated even to sensitive individuals.

The estimated lifetime excess cancer risk for the assumed subchronic exposure conditions is 2×10^{-9} in the average case and 2×10^{-8} in the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b) and show that risks for this exposure scenario are negligible.

Trespasser Exposure

Hypothetical trespassers were assumed to be exposed via ingestion, dermal contact, and inhalation) to surface soils at SWMU 127. Trespassers were assumed to be exposed for 26 and 52 days/year over a period of 6 years for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to contaminants in surface soils at SWMU 127 via the dermal contact, inhalation, and ingestion pathways is 0.00002 and 0.002 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk for the assumed subchronic exposure conditions 2×10^{-9} for the average exposure case and 1×10^{-6} for the RME case. The estimated risk for the average case is with the EPA target risk range of 1×10^{-6} and 1×10^{-4} for exposure to

chemicals released from hazardous waste sites (EPA 1990; 1991b). The RME estimate of risk probably significantly overestimates actual risks because it is based on the maximum concentrations of several PAHs. From Table 10-7, it can be seen that PAH concentrations are elevated in one of eight (1275-0000) surface soil samples. Furthermore, it can be seen from Figure 10-1 that this contaminated area occupies only a small area of the SWMU and that it would be very unlikely that a receptor would be exposed consistently to this area of maximum PAH concentrations. Therefore, the use of these maximum PAH concentrations probably significantly overestimate potential health risks, and the risk estimate based on the average concentrations (which correspond to exposures that might reasonably be expected across the SWMU) is a much more appropriate value for this SWMU.

Qualitative Assessment of Exposures to Lead

Lead exposures are not addressed in the quantitative risk assessment because EPA withdrew the RfD for lead in 1989, primarily due to the lack of discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. These levels are supported by EPA's Uptake Biokinetic (UBK) Lead Model which predicts that exposures of children ages 0 to 6 to soils with approximately these levels will not result in blood lead levels that exceed a level of concern established by the Centers of Disease Control.

The maximum lead concentration measured in soils at SWMU 127 was 48.2 mg/kg. This is well below the acceptable level for residential soils, and it can be concluded that lead detected in soils at SWMU 127 would not be expected to pose a threat to human health.

Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In this RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene)

were analyzed for individually in the soil samples collected at the SWMU and included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). (These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH [primarily BTEX] are not available, and when the fuel product is known. The provisional toxicity values are under review and subject to revision. The RBCs derived from them are used only as a guide to potential health hazards.)

The toxicity factors and calculation of risk-based concentrations are shown in Table 10-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,600 mg/kg. The maximum SWMU concentration of TPH is 344 mg/kg, well below the conservative RBC.

10.3.8 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 127 and their effect on the results and conclusions of the risk assessment are listed below.

- A single surface soil sample contained the maximum concentrations of all of the PAHs detected. Most PAHs were detected at levels 1 or 2 orders of magnitude lower in the other samples. Risks were calculated based on RME concentrations equivalent to the maximum concentrations detected in the one

sample and an assumed 25-year exposure duration, including daily contact. These exposure assumptions significantly overstate the likelihood of exposure to the contaminated area. Therefore, the RME risk of 2×10^{-5} is probably a significant overestimate of actual risk associated with exposure to soils at the SWMU.

- Direct physical contact with contaminated soils was assumed to occur routinely for several hours/day, 9 to 12 months of the year, for 9 to 25 years. These assumptions overstate current and likely future exposure conditions to soils at this site.

- Benzo(g,h,i)perylene, 2-methylnaphthalene and phenanthrene were not considered in the quantitative risk assessment because they do not have EPA-established toxicity factors. Their exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results or conclusions of the risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens such as benzo(a)pyrene, which cause skin cancer through a direct action at the point of application. The exclusion of this exposure pathway from the risk assessment may underestimate the potential human health risk at the SWMU.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected, because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- The surface area of this SWMU is only one-third acre, and the long-term daily exposures are not likely to be confined to an industrial area this small. Therefore, the exposure assumptions used significantly overestimate actual exposures to contaminated soils and associated risk at this SWMU.

10.4 ECOLOGICAL RISK ASSESSMENT

10.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 127, the Sand Trap and associated leach fields at the POL Washrack, is located in a small area of poor wildlife habitat quality, within the developed portion of Cannon AFB where existing ground cover is mostly asphalt paving, roadway, and an area of mowed non-native grasses. About 60 percent of the land surface within the immediate vicinity (within 100 feet) of SWMU 127 is asphalt or concrete paving and Building 223. The mowed grassy area is located immediately above and surrounding the leach field, and extends to the northwest and south. This grassy area is more extensive than the more isolated grassy strips associated with other OWS-type SWMUs at Cannon AFB, but is still surrounded by development. The sandtrap continues to be actively used.

The most common species are likely to be birds, such as robin (*Turdus migratorius*), house sparrow (*Passer domesticus*), and the starling (*Sturnus vulgaris*). Seedeaters would be more limited, since the grass is maintained by mowing. Although the house mouse (*Mus musculus*) may occur in the area around the buildings, the grass habitat is probably too small and subject to human disturbance to be used regularly by terrestrial species such as deer mice. Raptors are unlikely to use the area for similar reasons.

Given this assessment, the robin (*Turdus migratorius*) was selected as the key receptor species for the grassy area around SWMU 127.

10.4.2 Chemicals of Concern

The chemicals of concern (COCs) at SWMU 127 were selected using validated data from fourteen soil samples covering the interval between 0 and 2 feet deep. This interval was selected because most soil-dwelling organisms (e.g. earthworms and deer mice) occur in this

zone. Table 10-20 provides a summary of the chemicals detected in the fourteen samples considered for this ERA. A detailed description of the soil sampling program and chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the fourteen samples to be considered a possible COC. The following screening criteria were then applied, in the order shown, to determine if a chemical in the soil would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Exceedance of the normal range found in U.S. soils (nationwide)

The maximum detected concentration of the fourteen samples was used in the comparison to background criteria. If no background criteria were available for comparison, as was the case for the organic chemicals, the chemicals were retained as COCs. If the maximum detected concentration of a chemical exceeded the local (i.e. Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If it exceeded this criteria, it was likely retained as a COC, even if it fell within the normal range found in U.S. soils. This is because the normal U.S. range is widely variable and was included in the screening process primarily as an additional reference. In some cases however, the normal U.S. range was the only screening criteria available. Table 10-21 lists the maximum concentrations detected and shows the screening values used. The chemicals that were retained as COCs following the screening process are 1,2-dichloroethane, 1,2-dichloropropane, toluene, xylenes, acenaphthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, carbazole, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene, pyrene, aluminum, antimony, cadmium, copper, lead, selenium, silver, thallium, and TPH.

10.4.3 Exposure Assessment

Figure 10-4 depicts the exposure pathway flow chart developed for SWMU 127. As the flowchart indicates, chemicals could potentially be released through transport in runoff, infiltration to groundwater, volatilization or wind erosion, and direct contact by ecological

receptors. Except for direct contact, these exposure pathways are incomplete or of minor importance for ecological receptors. Storm water runoff is a potentially complete but insignificant pathway, because the source of chemicals is below ground and any spillage during servicing would involve a relatively small area of level terrain. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization or wind erosion is not considered a significant pathway at this site. Although one of the COCs is a volatile organic compound (VOC), the maximum concentrations were equal or less than 0.015 mg/kg, and VOC concentrations of 100 mg/kg or greater in air are generally needed to induce toxic responses in laboratory rats and mice from inhalation (NIOSH 1987). Concentrations in soils would have to be many times greater than this to produce these toxic levels in air, even near the soil surface. Direct contact with subsurface soils (more than two feet deep) is also considered an insignificant or incomplete pathway because of the limited use of deeper soils at this site by wildlife.

Therefore, the only potentially complete and significant exposure pathway is direct contact with contaminated surface soil by species frequenting the SWMU area. Direct contact may include dermal absorption or ingestion. Dermal absorption is not considered a significant exposure route for the receptors at this site because the animals are assumed to be largely protected by their fur or feathers. Receptors at the SWMU may ingest COCs either directly or indirectly. Direct ingestion usually occurs along the food/prey chain from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of COCs that have been transferred via food webs.

Figure 10-5 depicts the Conceptual Site Model developed from the exposure pathway analysis, the ecological characterization, and the identification of the key receptor species for SWMU 127. As the figure indicates, the pathway of concern is from surface soil to the robin, via direct and indirect ingestion, with the earthworm identified as a main dietary component of the robin.

10.4.4 Risk Characterization

This section provides a characterization of potential risk to the selected key receptor species (robin) at SWMU 127. For the purposes of this analysis, it was assumed that the robin's diet consists of earthworms and inadvertent consumption of soil. It was also assumed that the

concentration of the COCs were the same in the earthworm as in the soil, except for cadmium and selenium, for which bioaccumulation factors of 4.6 and 12 were used (see Section 7.4.4). Therefore the analysis consisted of comparing the concentration of COCs in the robin's food (i.e., the chemical concentration in soil) to selected toxicity benchmark dietary levels for those chemicals (see Table 10-22).

This is a somewhat conservative approach, because studies indicate that, for many chemicals, BAFs from soil to earthworm are less than one (Beyer and Stafford 1993). However, this assumption takes into account the soil that would be clinging to the earthworm when consumed by the robin (that is not taken into account by the BAF studies) and also accounts for minor inadvertent soil ingestion by the robin. The benchmark dietary levels were selected as explained in Appendix D, Section D.3 and D.4; these sections also provide background toxicological information about the COCs. The soil chemical concentration used was the arithmetic mean, as described in Appendix D (Section D.6.).

Table 10-22 lists the COCs for SWMU 127 and provides a comparison between the soil concentration (arithmetic mean) and the benchmark dietary level for the robin. If the soil level exceeds the benchmark level, there is a possibility of risk, as noted in the table. The following discussion addresses those chemicals where a possibility of risk is indicated.

Benzo-a-pyrene (BaP)

The average concentration of BaP at SWMU 127 was 1.159 mg/kg, compared to the benchmark dietary level of 0.02 mg/kg, indicating a potential risk. The 1.159 mg/kg level is above reported BaP concentrations for various locations, as reported in the literature, but within the range reported for "rural soils" by ATSDR (1990) (see Table A-6). BaP was detected in six of nine samples; the other three samples were non-detects. Also, there was one "hot spot" at 8.6 mg/kg; the other detects were in the 0.1-0.2 mg/kg range. Therefore, it is unlikely that the robin is exposed to a level of 1.159 mg/kg in all areas in which it feeds, assuming it does not feed just at the "hot spots" in the SWMU area. Also, the low toxicity benchmark for BaP is a reflection of BaP's carcinogenic effects through the action of its intermediate metabolites, as opposed to acute toxicity. In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, and therefore it is questionable if carcinogenesis is an important endpoint for relatively short-lived mammals

and birds, such as the robin. Finally, the BaP found at SWMU 127 may not be completely bioavailable to robins. Goon et al. (1991) showed that BaP that had aged 6 months in soil was only 34 percent to 51 percent orally bioavailable for clayey and sandy soils, relative to BaP administered alone to rats. For these reasons, it is unlikely that BaP presents an unacceptable risk at SWMU 127.

Aluminum

The average concentration of aluminum at SWMU 127 was 8267 mg/kg, compared to the benchmark toxicity level of 1500 mg/kg, indicating a potential risk. However, it is unlikely that aluminum from SWMU 127 constitutes a risk to the robin, because the background concentration of aluminum in the soils at Cannon AFB is high (UTL=10,540 mg/kg), and the maximum concentration found at SWMU 127 was only slightly higher this background level (11,600 mg/kg). Normal range for aluminum in U.S. soils can vary from 700-100,000 mg/kg (see Table 10-21). It is unlikely that SWMU 127 is the source of the high aluminum, it is also likely that much of the aluminum found in the soil is present as insoluble salts (oxides and phosphates), which are not toxic (NAS 1980). Therefore, it is expected that the wildlife in this area is not at risk from the naturally high aluminum soils.

10.5 SUMMARY AND CONCLUSIONS

10.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at this SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 10-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU.

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU.

10.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

TABLE 10-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP AT POL WASH RACK (SWMU NO. 127)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 12701	0.5 - 2	CAN127-1271-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN127-1271-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1271-0004		Soil	X	X	X	X		2	1
	4 - 6	CAN127-1271-6004	MS/MSD	Soil	X	X	X	X		2	2
	8 - 10	CAN127-1271-0008		Soil	X		X	X		2	1
Boring 12702	0.5 - 2	CAN127-1272-0000		Soil	X	X	X	X		2	1
	0.5 - 2	CAN127-1272-1261	FD	Soil	X	X	X	X		2	1
	0.5 - 2	CAN127-1272-1201	MRD	Soil	X	X	X	X		2	1
	2 - 4	CAN127-1272-0002		Soil	X	X	X	X		2	1
	4 - 6	CAN127-1272-0004		Soil	X		X	X		2	1
	4 - 6	CAN127-1272-1262	FD	Soil	X		X	X		2	1
	4 - 6	CAN127-1272-1202	MRD	Soil	X	X	X	X		2	1
	8 - 10	CAN127-1272-0008		Soil	X		X	X		2	1
		CAN127-1272-1251	AB	Water	X				2		
		CAN127-1272-1271	RB	Water	X				2		
		CAN127-1272-1281	DW	Water	X				2		
		CAN127-1272-1291	TB	Water	X				2		
Boring 12703	0 - 0.5	CAN127-1273-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1273-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1273-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1273-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN127-1273-6008	MS/MSD	Soil	X	X	X	X		2	2
	18 - 20	CAN127-1273-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1273-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1273-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1273-0048		Soil	X		X	X		2	1
	58 - 60	CAN127-1273-0058		Soil	X		X	X		2	1

TABLE 10-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP AT POL WASH RACK (SWMU NO. 127)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 12704	0 - 0.5	CAN127-1274-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN127-1274-1263	FD	Soil	X		X	X		2	1
	0 - 0.5	CAN127-1274-1203	MRD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1274-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1274-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1274-0008		Soil	X		X	X		2	1
	18 - 20	CAN127-1274-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1274-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1274-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1274-0048		Soil	X	X	X	X		2	1
	58 - 60	CAN127-1274-0058		Soil	X		X	X		2	1
Boring 12705	0 - 0.5	CAN127-1275-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1275-0002		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1275-6002	MS/MSD SVOC only	Soil		X					1
	4 - 6	CAN127-1275-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1275-0008		Soil	X		X	X		2	1
	8 - 10	CAN127-1275-6008	MS/MSD	Soil	X		X	X		2	2
	18 - 20	CAN127-1275-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1275-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1275-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1275-0048		Soil	X		X	X		2	1
	58 - 60	CAN127-1275-0058		Soil	X		X	X		2	1
Boring 12706	0 - 0.5	CAN127-1276-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1276-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1276-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1276-0008		Soil	X		X	X		2	1
	18 - 20	CAN127-1276-0018		Soil	X	X	X	X		2	1
	28 - 30	CAN127-1276-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1276-0038		Soil	X		X	X		2	1

TABLE 10-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP AT POL WASH RACK (SWMU NO. 127)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 12706	48 - 50	CAN127-1276-0048		Soil	X		X	X		2	1
cont.	58 - 60	CAN127-1276-0058		Soil	X		X	X		2	1
Boring 12707	0 - 0.5	CAN127-1277-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1277-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1277-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1277-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN127-1277-6008	MS/MSD	Soil	X	X	X	X		2	2
	18 - 20	CAN127-1277-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1277-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1277-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1277-0048		Soil	X		X	X		2	1
	58 - 60	CAN127-1277-0058		Soil	X		X	X		2	1
Boring 12708	0 - 0.5	CAN127-1278-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1278-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1278-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1278-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN127-1278-1264	FD	Soil	X	X	X	X		2	1
	18 - 20	CAN127-1278-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1278-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1278-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1278-0048		Soil	X		X	X		2	1
	58 - 60	CAN127-1278-0058		Soil	X		X	X		2	1

AB = Ambient Blank
DW = Decontamination Water
FD = Field duplicate
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank
See Figure 16-1 for locations of the borings.

TABLE 10-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1271-0000			CAN127-1271-0002			CAN127-1272-0000			CAN127-1272-0002			CAN127-1273-0000			CAN127-1273-0002		
LAB SAMPLE NUMBER	0313740003SA			0313740004SA			0313740007SA			0313740008SA			0312160001SA			0312160002SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
1,2-Dichloroethane	<	5.8	U	<	5.8	U	<	5.8	U	<	6	U	<	5.2	U	<	5.5	U
1,2-Dichloropropane	<	5.8	U	<	5.8	U	<	5.8	U	<	6	U	<	5.2	U	<	5.5	U
Toluene	<	5.8	U	<	5.8	U	<	5.8	U	<	6	U	12	5.2		<	5.5	U
Xylenes (total)	<	5.8	U	<	5.8	U	<	5.8	U	<	6	U	3.4	5.2	J	<	5.5	U
Semivolatile Organics (µg/kg)																		
Acenaphthene	<	380	U				<	380	U	<	400	U	<	350	U			
Anthracene	<	380	U				<	380	U	<	400	U	48	350	J			
Benzo(a)anthracene	<	380	U				<	380	U	<	400	U	510	350				
Benzo(a)pyrene	<	380	U				<	380	U	<	400	U	550	350				
Benzo(b)fluoranthene	<	380	U				<	380	U	<	400	U	960	350				
Benzo(g,h,i)perylene	<	380	U				<	380	U	<	400	U	470	350				
Carbazole	<	380	U				<	380	U	<	400	U	46	350	J			
Chrysene	<	380	U				<	380	U	<	400	U	720	350				
Fluoranthene	<	380	U				<	380	U	<	400	U	1500	350				
Fluorene	<	380	U				<	380	U	<	400	U	<	350	U			
Indeno(1,2,3-cd)pyrene	<	380	U				<	380	U	<	400	U	390	350				
2-Methylnaphthalene	<	380	U				<	380	U	<	400	U	<	350	U			
Phenanthrene	<	380	U				<	380	U	<	400	U	570	350				
Pyrene	<	380	U				<	380	U	<	400	U	1400	350				
Metals (mg/kg)																		
Aluminum	9270	11.5		3830	23.1		7220	11.6		3110	60.5		7650	10.5		11600	10.9	
Antimony	<	6.9	U	<	13.8	U	<	6.9	U	<	36.3	U	<	6.3	U	<	6.5	U
Arsenic	2	0.58		2.1	0.58		1.9	0.58		1.6	0.6		2.2	0.52		2.4	0.55	
Barium	91.7	1.2		971	2.3		91.9	1.2		206	6		115	1		99	1.1	
Beryllium	0.67	0.23		0.33	0.46	J	0.53	0.23		<	1.2	U	0.46	0.21		0.7	0.22	

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J = Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. QUAL=Qualification
U = Not detected. RL = Reporting Limit.

TABLE 10-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1271-0000			CAN127-1271-0002			CAN127-1272-0000			CAN127-1272-0002			CAN127-1273-0000			CAN127-1273-0002		
LAB SAMPLE NUMBER	0313740003SA			0313740004SA			0313740007SA			0313740008SA			0312160001SA			0312160002SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cadmium	<	0.58	UJ	3	1.2		1.1	0.58		4.2	3		<	0.52	U	<	0.55	U
Calcium	19200	23.1	J	191000	46.1		56900	23.1		247000	121		10300	20.9		14000	21.8	
Chromium	9.9	1.2		4.5	2.3		7.3	1.2		7	6		16.9	1		10.3	1.1	
Cobalt	4.5	1.2		2.5	2.3		3.7	1.2		<	6	U	3.4	1		4.8	1.1	
Copper	8.9	2.3		2.8	4.6	J	7.3	2.3		2.6	12.1	J	6.8	2.1		7.9	2.2	
Iron	8610	11.5		3350	23.1		6380	11.6		2760	60.5		7770	10.5		10500	10.9	
Lead	7.3	0.58		2.7	2.9	J	4.4	2.9		1.6	6	J	30.8	10.5		8	1.1	
Magnesium	2030	23.1		2690	46.1		1890	23.1		2930	121		1570	20.9		2360	21.8	
Manganese	179	1.2		46.9	2.3		138	1.2		37.4	6		166	1		206	1.1	
Mercury	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U	<	0.1	U	<	0.11	U
Nickel	10.4	4.6		5.8	9.2	J	8	4.6		5.1	24.2	J	7	4.2		11.4	4.4	
Potassium	1680	577		744	1150	J	1410	579		468	3020	J	1910	523		2400	545	
Selenium	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ	<	0.52	UJ	<	1.1	UJ
Silver	0.69	1.2	J	1.1	2.3	J	0.68	1.2	J	3.6	6	J	<	1	U	<	1.1	U
Thallium	<	2.3	U	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ	<	0.52	U	0.13	0.55	J
Vanadium	17.9	1.2		14.8	2.3		14.2	1.2		12.4	6		17.6	1		21.4	1.1	
Zinc	21.9	2.3		12.3	4.6		17.4	2.3		6.3	12.1	J	25.4	2.1		24.4	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.1	U	<	46.1	U	93.2	46.3		48.7	48.4		66.8	41.9		<	43.6	U
Water Quality (percent)																		
Water	13	0.1		13	0.1		14	0.1		17	0.1		4.5	0.1		8.3	0.1	

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R = Rejected value. QUAL=Qualification
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TABLE 10-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1274-0000			CAN127-1274-0002			CAN127-1275-0000			CAN127-1275-0002			CAN127-1276-0000			CAN127-1276-0002		
LAB SAMPLE NUMBER	0312770001SA			0312770002SA			0312770011SA			0312770012SA			0312160012SA			0312160013SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
1,2-Dichloroethane	<	5.5	U	<	5.5	U	<	5.2	U	<	5.8	U	1.9	5.2	J	<	5.4	U
1,2-Dichloropropane	<	5.5	U	<	5.5	U	4.6	5.2	J	<	5.8	U	<	5.2	U	<	5.4	U
Toluene	2.3	5.5	J	2.8	5.5	J	5.2	5.2		<	5.8	U	15	5.2		<	5.4	U
Xylenes (total)	1.5	5.5	J	<	5.5	U	<	5.2	U	<	5.8	U	12	5.2		<	5.4	U
Semivolatile Organics (µg/kg)																		
Acenaphthene	<	370	U				150	1400	J	<	380	U	<	340	U			
Anthracene	<	370	U				<	1400	U	<	380	U	<	340	U			
Benzo(a)anthracene	83	370	J				8000	1400		<	380	U	160	340	J			
Benzo(a)pyrene	120	370	J				8600	1400		<	380	U	230	340	J			
Benzo(b)fluoranthene	270	370	J				17000	1400		<	380	U	410	340				
Benzo(g,h,i)perylene	72	370	J				5100	1400		<	380	U	190	340	J			
Carbazole	<	370	U				1500	1400		<	380	U	<	340	U			
Chrysene	210	370	J				14000	1400		<	380	U	300	340	J			
Fluoranthene	300	370	J				17000	1400		<	380	U	570	340				
Fluorene	<	370	U				290	1400	J	<	380	U	<	340	U			
Indeno(1,2,3-cd)pyrene	68	370	J				5100	1400		<	380	U	160	340	J			
2-Methylnaphthalene	<	370	U				<	1400	U	<	380	U	<	340	U			
Phenanthrene	120	370	J				8100	1400		<	380	U	210	340	J			
Pyrene	230	370	J				17000	1400		<	380	U	550	340				
Metals (mg/kg)																		
Aluminum	7490	11.1		9560	11		6530	10.5		8570	23		7170	10.4		11400	10.8	
Antimony	<	6.6	U	<	6.6	U	7.8	6.3		<	13.8	U	<	6.2	U	<	6.5	U
Arsenic	2.9	0.55		2.3	0.55		2.1	0.52		2.1	0.58		2	0.52		2.4	0.54	
Barium	125	1.1	J	75.7	1.1	J	245	1	J	104	2.3	J	74.3	1		105	1.1	
Beryllium	0.82	0.22		0.83	0.22		0.45	0.21		0.65	0.46		0.43	0.21		0.7	0.22	

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U = Not detected. RL = Reporting Limit.

TABLE 10-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1274-0000			CAN127-1274-0002			CAN127-1275-0000			CAN127-1275-0002			CAN127-1276-0000			CAN127-1276-0002		
LAB SAMPLE NUMBER	0312770001SA			0312770002SA			0312770011SA			0312770012SA			0312160012SA			0312160013SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cadmium	0.49	0.55	J	<	0.55	U	0.53	0.52		<	1.2	U	<	0.52	U	<	0.54	U
Calcium	7210	22.2		4820	22		45300	21		106000	46.1		6630	20.8		4740	21.6	
Chromium	9.4	1.1		10	1.1		15.3	1		5.8	2.3		9.9	1		9.3	1.1	
Cobalt	5.3	1.1		5.2	1.1		2.8	1		4.3	2.3		2.9	1		4.9	1.1	
Copper	8.5	2.2		8	2.2		25.9	2.1		5.9	4.6		6.3	2.1		8.4	2.2	
Iron	8420	11.1		9250	11		7650	10.5		7920	23		5990	10.4		8990	10.8	
Lead	12.6	2.8		8.4	0.55		29.2	5.2		6.7	0.58		48.2	10.4		9.2	1.1	
Magnesium	1800	22.2		2180	22		1850	21		2640	46.1		1300	20.8		2510	21.6	
Manganese	246	1.1		213	1.1		332	1		127	2.3		141	1		218	1.1	
Mercury	<	0.11	U	<	0.11	U	<	0.1	U	<	0.12	U	<	0.1	U	<	0.11	U
Nickel	9.5	4.4		12.4	4.4		6.8	4.2		10.1	9.2		6.2	4.2		10.5	4.3	
Potassium	1390	554		1760	550		1180	524		1550	1150		2060	519		2520	540	
Selenium	0.27	0.55	J	<	0.55	UJ	<	0.52	UJ	<	1.2	UJ	<	0.52	UJ	<	0.54	UJ
Silver	<	1.1	U	<	1.1	U	<	1	U	<	2.3	U	<	1	U	<	1.1	U
Thallium	<	0.55	U	<	0.55	U	<	0.52	U	<	0.58	UJ	<	0.52	U	0.14	0.54	J
Vanadium	23	1.1		19.2	1.1		16.5	1		15.8	2.3		12.9	1		17.7	1.1	
Zinc	20.4	2.2		21.7	2.2		38.5	2.1		18	4.6		25.3	2.1		24	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	253	44.3	J	<	44	U	344	83.9		<	46.1	U	80.5	41.6		<	43.2	U
Water Quality (percent)																		
Water	9.7	0.1		9.1	0.1		4.6	0.1		13	0.1		3.8	0.1		7.4	0.1	

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TABLE 10-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1277-0000			CAN127-1277-0002			CAN127-1278-0000			CAN127-1278-0002		
LAB SAMPLE NUMBER	0311840009SA			0311840010SA			0311840001SA			0311840002SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)												
1,2-Dichloroethane	<	5.3	U	<	5.4	U	<	5.3	U	<	5.4	U
1,2-Dichloropropane	<	5.3	U	<	5.4	U	<	5.3	U	<	5.4	U
Toluene	5.5	5.3	J	3.8	5.4	J	<	5.3	U	<	5.4	U
Xylenes (total)	5.9	5.3		1.5	5.4	J	<	5.3	U	<	5.4	U
Semivolatile Organics (µg/kg)												
Acenaphthene	<	350	U				<	1400	U			
Anthracene	<	350	U				<	1400	U			
Benzo(a)anthracene	190	350	J				150	1400	J			
Benzo(a)pyrene	180	350	J				180	1400	J			
Benzo(b)fluoranthene	390	350					380	1400	J			
Benzo(g,h,i)perylene	91	350	J				<	1400	U			
Carbazole	<	350	U				<	1400	U			
Chrysene	240	350	J				260	1400	J			
Fluoranthene	470	350					440	1400	J			
Fluorene	<	350	U				<	1400	U			
Indeno(1,2,3-cd)pyrene	93	350	J				<	1400	U			
2-Methylnaphthalene	250	350	J				<	1400	U			
Phenanthrene	190	350	J				190	1400	J			
Pyrene	440	350					360	1400	J			
Metals (mg/kg)												
Aluminum	5640	10.5		8800	10.8		6790	10.5		8050	10.9	
Antimony	<	6.3	U	<	6.5	U	<	6.3	U	<	6.5	U
Arsenic	2.2	0.53		2.8	0.54		2.3	0.53		2.6	1.1	
Barium	84.1	1.1		102	1.1		83.8	1.1		79.4	1.1	
Beryllium	0.49	0.21		0.72	0.22		0.45	0.21		0.68	0.22	

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TABLE 10-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1277-0000			CAN127-1277-0002			CAN127-1278-0000			CAN127-1278-0002		
LAB SAMPLE NUMBER	0311840009SA			0311840010SA			0311840001SA			0311840002SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cadmium	<	0.53	U	<	0.54	U	<	0.53	U	<	0.54	U
Calcium	18200	21		16700	21.6		5730	21.1		43500	21.8	
Chromium	9.9	1.1		9.5	1.1		11.3	1.1		8.8	1.1	
Cobalt	3.4	1.1		4.8	1.1		3.3	1.1		4.4	1.1	
Copper	7.1	2.1		9.9	2.2		7.3	2.1		9.1	2.2	
Iron	6260	10.5		8960	10.8		7060	10.5		7800	10.9	
Lead	43.2	5.3		9.2	1.1		42.4	5.3		7.5	0.54	
Magnesium	1340	21		2270	21.6		1220	21.1		2300	21.8	
Manganese	154	1.1		189	1.1		151	1.1		168	1.1	
Mercury	<	0.11	U	<	0.11	U	0.11	0.11		<	0.11	U
Nickel	6.6	4.2		10.4	4.3		6.9	4.2		9.8	4.4	
Potassium	1540	526		1760	539		1630	527		1650	545	
Selenium	<	0.53	UJ	<	1.1	UJ	<	0.53	U	<	1.1	UJ
Silver	0.43	1.1	J	0.47	1.1	J	0.53	1.1	J	0.45	1.1	J
Thallium	<	0.53	U	<	0.54	U	<	0.53	U	<	0.54	U
Vanadium	14.6	1.1		18.6	1.1		14.6	1.1		16.9	1.1	
Zinc	24.1	2.1		21	2.2		22.1	2.1		19.4	2.2	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	44.1	42.1		<	43.1	U	<	42.2	U	<	43.6	U
Water Quality (percent)												
Water	4.9	0.1		7.2	0.1		5.2	0.1		8.2	0.1	

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J=Estimated value below reporting limit or estimated based on data quality criteria.
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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1271-0004			CAN127-1271-0008			CAN127-1272-0004			CAN127-1272-0008			CAN127-1273-0004			CAN127-1273-0008		
LAB SAMPLE NUMBER	0313740005SA			0313740006SA			0313740009SA			0313740010SA			0312160004SA			0312160003SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
2-Butanone (MEK)	<	12	U	<	11	U	<	12	U	<	12	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Chlorobenzene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
1,1-Dichloroethene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
1,2-Dichloroethene (total)	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
1,2-Dichloropropane	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Ethylbenzene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Tetrachloroethene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Toluene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
1,1,1-Trichloroethane	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Trichloroethene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Xylenes (total)	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate	110	380	J													<	360	U
Metals (mg/kg)																		
Aluminum	5370	23.1	J	4000	22.8		4240	58.8		4180	23.8		7780	21.8		4420	11	
Arsenic	2.2	0.58	J	1.1	0.57		1.3	0.59		1.1	0.59		2.3	0.55		1.5	0.55	
Barium	285	2.3		163	2.3		435	5.9		98.4	2.4		255	2.2		93.9	1.1	
Beryllium	0.46	0.46		0.28	0.46	J	<	1.2	U	0.34	0.48	J	0.35	0.44	J	0.3	0.22	
Cadmium	2.1	1.2		2	1.1		2.9	2.9		1.8	1.2		<	1.1	U	<	0.55	U
Calcium	137000	46.2		132000	45.7		248000	118		148000	47.5		135000	43.7		85200	22	
Chromium	6	2.3	J	3.5	2.3		<	5.9	U	3.9	2.4		4	2.2		3.4	1.1	
Cobalt	2.9	2.3	J	1.8	2.3	J	<	5.9	U	1.3	2.4	J	3.6	2.2		2	1.1	
Copper	5	4.6	J	2.2	4.6	J	1.9	11.8	J	2.2	4.8	J	5.2	4.4		2.6	2.2	

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U = Not detected RL = Reporting Limit.

TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1271-0004			CAN127-1271-0008			CAN127-1272-0004			CAN127-1272-0008			CAN127-1273-0004			CAN127-1273-0008		
LAB SAMPLE NUMBER	0313740005SA			0313740006SA			0313740009SA			0313740010SA			0312160004SA			0312160003SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	4940	23.1	J	3360	22.8		3180	58.8		3210	23.8		6370	21.8		3360	11	
Lead	3.2	1.2		2.5	2.9	J	2.4	2.9	J	2.4	3	J	4.2	0.55		3.2	0.55	
Magnesium	2830	46.2		3330	45.7		4110	118		3370	47.5		3270	43.7		2570	22	
Manganese	69.6	2.3	J	41.4	2.3		43.9	5.9		42.5	2.4		93	2.2		55.8	1.1	
Nickel	7.4	9.2	J	5.2	9.1	J	<	23.5	U	5.2	9.5	J	8.3	8.7	J	4.5	4.4	
Potassium	1010	1160	J	999	1140	J	695	2940	J	1060	1190	J	1740	1090		1270	549	
Silver	1.2	2.3	J	0.84	2.3	J	2.6	5.9	J	1.4	2.4	J	<	2.2	U	<	1.1	U
Vanadium	19.8	2.3	J	11.8	2.3		11.3	5.9		11.2	2.4		17.9	2.2		12.4	1.1	
Zinc	11.8	4.6	J	10	4.6		11.2	11.8	J	9.9	4.8		15.8	4.4		9	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	46.6	46.2		48.6	45.7		50.1	47.1		<	47.5	U	<	43.7	U	<	43.9	U
Water Quality (percent)																		
Water	14	0.1		12	0.1		15	0.1		16	0.1		8.5	0.1		8.9	0.1	

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U = Not detected RL = Reporting Limit.

TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1273-0018			CAN127-1273-0028			CAN127-1273-0038			CAN127-1273-0048			CAN127-1273-0058			CAN127-1274-0004		
LAB SAMPLE NUMBER	0312160005SA			0312160006SA			0312160007SA			0312160008SA			0312160009SA			0312770003SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93			09/13/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Chlorobenzene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
1,1-Dichloroethene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
1,2-Dichloroethene (total)	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
1,2-Dichloropropane	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Ethylbenzene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Tetrachloroethene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Toluene	3.5	5.6	J	<	5.5	U	<	5.5	U	<	5.5	U	1.2	5.4	J	<	5.5	U
1,1,1-Trichloroethane	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Trichloroethene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Xylenes (total)	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate																		
Metals (mg/kg)																		
Aluminum	5740	22.4		6020	11.1		6610	11.1		5830	11		3840	10.7		3650	22.1	
Arsenic	1.2	0.56		1.3	0.55		1.7	0.55		1.3	0.55		1.1	0.54		2.5	0.55	
Barium	110	2.2		137	1.1		61.9	1.1		106	1.1		12.9	1.1		517	2.2	
Beryllium	0.24	0.45	J	0.23	0.22		0.29	0.22		0.17	0.22	J	0.16	0.21	J	0.4	0.44	J
Cadmium	<	1.1	U	<	0.55	U	<	0.55	U	<	0.55	U	<	0.54	U	<	1.1	U
Calcium	135000	44.8		77500	22.1		50100	22.1		45000	21.9		6730	21.4		149000	44.1	
Chromium	2.8	2.2		2.9	1.1		6.3	1.1		6.2	1.1		3.3	1.1		2.3	2.2	
Cobalt	2.4	2.2		1.2	1.1		1.9	1.1		1.4	1.1		1.4	1.1		2.7	2.2	
Copper	2.3	4.5	J	2	2.2	J	2.2	2.2		1.5	2.2	J	1.3	2.1	J	2.5	4.4	J

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1273-0018			CAN127-1273-0028			CAN127-1273-0038			CAN127-1273-0048			CAN127-1273-0058			CAN127-1274-0004		
LAB SAMPLE NUMBER	0312160005SA			0312160006SA			0312160007SA			0312160008SA			0312160009SA			0312770003SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93			09/13/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	4290	22.4		3310	11.1		4680	11.1		4100	11		3020	10.7		3780	22.1	
Lead	4	0.56		3.1	2.8		2.9	0.55		2.3	0.55		1.6	0.54		4.6	0.55	
Magnesium	5250	44.8		6820	22.1		6550	22.1		4660	21.9		2630	21.4		2630	44.1	
Manganese	60.9	2.2		30.5	1.1		58.6	1.1		45.9	1.1		28.7	1.1		62	2.2	
Nickel	5.2	9	J	3.6	4.4	J	4.3	4.4	J	3.7	4.4	J	2.8	4.3	J	6	8.8	J
Potassium	1910	1120		1530	553		1730	553		1470	548		957	535		741	1100	J
Silver	<	2.2	U	<	1.1	U	<	1.1	U	<	1.1	U	<	1.1	U	<	2.2	U
Vanadium	11.2	2.2		13.7	1.1		17.8	1.1		14.6	1.1		13	1.1		15.8	2.2	
Zinc	11.2	4.5		9.8	2.2		11.3	2.2		9.3	2.2		6.8	2.1		8.7	4.4	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	44.8	U	<	44.2	U	<	44.2	U	<	43.9	U	<	42.8	U	<	44.1	U
Water Quality (percent)																		
Water	11	0.1		9.6	0.1		9.6	0.1		8.8	0.1		6.6	0.1		9.3	0.1	

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1274-0008			CAN127-1274-0018			CAN127-1274-0028			CAN127-1274-0038			CAN127-1274-0048			CAN127-1274-0058		
LAB SAMPLE NUMBER	0312770004SA			0312770005SA			0312770007SA			0312770008SA			0312770009SA			0312770010SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Chlorobenzene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
1,1-Dichloroethene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
1,2-Dichloroethene (total)	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
1,2-Dichloropropane	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	5.7	5.5		13	5.4	
Ethylbenzene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Tetrachloroethene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Toluene	<	5.7	U	<	5.5	U	<	5.6	U	2	5.6	J	3.3	5.5	J	1.6	5.4	J
1,1,1-Trichloroethane	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Trichloroethene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Xylenes (total)	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate													<	360	U			
Metals (mg/kg)																		
Aluminum	3730	22.7		6270	11		4710	22.3		4730	11.2		4870	11		3310	10.8	
Arsenic	1.1	0.57		2.1	0.55		1.3	0.56		1.1	0.56		1.3	0.55		1	0.54	
Barium	100	2.3	J	68.2	1.1	J	74.4	2.2	J	42.6	1.1	J	56.1	1.1	J	17.1	1.1	J
Beryllium	0.35	0.45	J	0.39	0.22		0.26	0.45	J	0.29	0.22		0.22	0.22		0.18	0.22	J
Cadmium	<	1.1	U	<	0.55	U	<	1.1	U	<	0.56	U	<	0.55	U	<	0.54	U
Calcium	154000	45.3		71700	22		102000	44.7		61000	22.4		38100	22		16100	21.6	
Chromium	<	2.3	U	5	1.1		1.9	2.2	J	4.8	1.1		4.8	1.1		3.3	1.1	
Cobalt	2	2.3	J	2.6	1.1		2	2.2	J	1.3	1.1		1.5	1.1		1.5	1.1	
Copper	1.1	4.5	J	3	2.2		1.3	4.5	J	1.3	2.2	J	1.2	2.2	J	1.1	2.2	J

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1274-0008			CAN127-1274-0018			CAN127-1274-0028			CAN127-1274-0038			CAN127-1274-0048			CAN127-1274-0058		
LAB SAMPLE NUMBER	0312770004SA			0312770005SA			0312770007SA			0312770008SA			0312770009SA			0312770010SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3260	22.7		5510	11		3450	22.3		3820	11.2		4150	11		3750	10.8	
Lead	3.2	0.57		4.4	1.1		2.9	0.56		2.4	0.56		2.3	0.55		2	0.54	
Magnesium	3390	45.3		3810	22		4490	44.7		5530	22.4		4410	22		3450	21.6	
Manganese	47.8	2.3		78.7	1.1		39.4	2.2		37.9	1.1		56.9	1.1		48.6	1.1	
Nickel	5.3	9.1	J	5.7	4.4		5.6	8.9	J	4	4.5	J	3.7	4.4	J	3.5	4.3	J
Potassium	874	1130	J	1740	550		910	1120	J	856	561		951	549		562	539	
Silver	<	2.3	U	<	1.1	U	<	2.2	U	<	1.1	U	<	1.1	U	<	1.1	U
Vanadium	10.4	2.3		20.1	1.1		15.8	2.2		18.3	1.1		17.3	1.1		16.2	1.1	
Zinc	7.2	4.5		11.1	2.2		7.1	4.5		8.6	2.2		9.2	2.2		6.1	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.3	U	<	44	U	<	44.7	U	<	44.9	U	<	43.9	U	<	43.1	U
Water Quality (percent)																		
Water	12	0.1		9.1	0.1		10	0.1		11	0.1		9	0.1		7.3	0.1	

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1275-0004			CAN127-1275-0008			CAN127-1275-0018			CAN127-1275-0028			CAN127-1275-0038			CAN127-1275-0048		
LAB SAMPLE NUMBER	0312770013SA			0312770014SA			0312770015SA			0312770016SA			0312770017SA			0312770018SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene	<	5.7	U	<	5.8	U	1.2	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
2-Butanone (MEK)	<	11	U	<	12	U	<	12	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.7	U	<	5.8	U	2.7	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Chlorobenzene	<	5.7	U	<	5.8	U	1.3	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
1,1-Dichloroethene	<	5.7	U	<	5.8	U	1.9	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
1,2-Dichloroethene (total)	<	5.7	U	<	5.8	U	1.3	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
1,2-Dichloropropane	<	5.7	U	<	5.8	U	<	5.8	U	<	5.6	U	7.7	5.5		<	5.6	U
Ethylbenzene	<	5.7	U	<	5.8	U	1.3	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Tetrachloroethene	<	5.7	U	<	5.8	U	2.9	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Toluene	5.4	5.7	J	18	5.8		6.2	5.8		<	5.6	U	7.2	5.5		12	5.6	
1,1,1-Trichloroethane	<	5.7	U	<	5.8	U	1.8	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Trichloroethene	<	5.7	U	<	5.8	U	2.3	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Xylenes (total)	<	5.7	U	<	5.8	U	2.4	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate																		
Metals (mg/kg)																		
Aluminum	5030	57.2		3630	23.3		10100	57.7		4470	22.5		4860	11.1		4570	11.1	
Arsenic	1.5	0.57		1.3	0.58		1.7	0.58		1	0.56		1	0.55		1.1	0.56	
Barium	435	5.7	J	167	2.3	J	445	5.8	J	65.4	2.2	J	148	1.1	J	36.6	1.1	J
Beryllium	<	1.1	U	0.28	0.47	J	<	1.2	U	0.27	0.45	J	0.33	0.22		0.29	0.22	
Cadmium	<	2.9	U	<	1.2	U	<	2.9	U	<	1.1	U	<	0.55	U	<	0.56	U
Calcium	238000	114		181000	46.6		238000	115		150000	44.9		58900	22.1		76300	22.3	
Chromium	<	5.7	U	<	2.3	U	<	5.8	U	2.1	2.2	J	4.3	1.1		3.4	1.1	
Cobalt	<	5.7	U	2.4	2.3		<	5.8	U	1.5	2.2	J	1.6	1.1		1.5	1.1	
Copper	<	11.4	U	1.8	4.7	J	3.2	11.5	J	1.7	4.5	J	2.7	2.2		1.9	2.2	J

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1275-0004			CAN127-1275-0008			CAN127-1275-0018			CAN127-1275-0028			CAN127-1275-0038			CAN127-1275-0048		
LAB SAMPLE NUMBER	0312770013SA			0312770014SA			0312770015SA			0312770016SA			0312770017SA			0312770018SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	4210	57.2		3300	23.3		5960	57.7		3200	22.5		3900	11.1		3770	11.1	
Lead	3	0.57		2.7	0.58		3.1	0.58		1.7	0.56		1.9	0.55		2.2	0.56	
Magnesium	3940	114		3590	46.6		11900	115		4840	44.9		5590	22.1		5470	22.3	
Manganese	51.4	5.7		34	2.3		46.4	5.8		28	2.2		42.1	1.1		43.1	1.1	
Nickel	<	22.9	U	6.1	9.3	J	7.9	23.1	J	3.5	9	J	4.7	4.4		3.3	4.5	J
Potassium	612	2860	J	854	1160	J	2080	2880	J	700	1120	J	916	554		810	556	
Silver	<	5.7	U	<	2.3	U	<	5.8	U	<	2.2	U	<	1.1	U	<	1.1	U
Vanadium	11.2	5.7		11.1	2.3		18.2	5.8		14.4	2.2		17.2	1.1		19	1.1	
Zinc	5.2	11.4	J	7.3	4.7		<	11.5	U	6.4	4.5		8.2	2.2		8.5	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.8	U	<	46.6	U	<	46.1	U	<	44.9	U	<	44.3	U	<	44.5	U
Water Quality (percent)																		
Water	13	0.1		14	0.1		13	0.1		11	0.1		9.7	0.1		10	0.1	

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J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected RL = Reporting Limit.

TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1275-0058			CAN127-1276-0004			CAN127-1276-0008			CAN127-1276-0018			CAN127-1276-0028			CAN127-1276-0038		
LAB SAMPLE NUMBER	0312770019SA			0312150009SA			0312150010SA			0312150011SA			0312150012SA			0312150013SA		
COLLECT DATE	09/14/93			09/13/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Chlorobenzene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
1,1-Dichloroethene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
1,2-Dichloroethene (total)	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
1,2-Dichloropropane	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Ethylbenzene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Tetrachloroethene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Toluene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
1,1,1-Trichloroethane	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Trichloroethene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Xylenes (total)	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate										<	360	U						
Metals (mg/kg)																		
Aluminum	4270	11.2		6670	21.6		3640	22.1		4530	11		4370	10.9		4500	11	
Arsenic	1.2	0.56		2.5	0.54		1.1	0.55		1.8	0.55		1.9	0.55		1.3	0.55	
Barium	545	1.1	J	107	2.2		95.7	2.2		302	1.1		96.4	1.1		23.7	1.1	
Beryllium	0.3	0.22		0.29	0.43	J	<	0.44	U	0.47	0.22		0.3	0.22		0.23	0.22	
Cadmium	<	0.56	U	<	1.1	U	<	1.1	U	<	0.55	U	<	0.55	U	<	0.55	U
Calcium	73800	22.3		113000	43.3		152000	44.1		68500	21.9		76500	21.8		39300	22.1	
Chromium	2.6	1.1		3.9	2.2		<	2.2	U	2.9	1.1		3	1.1		3.4	1.1	
Cobalt	1.1	1.1		3.3	2.2		2.1	2.2	J	1.9	1.1		1.7	1.1		1.2	1.1	
Copper	1.5	2.2	J	4.8	4.3		1.5	4.4	J	2.7	2.2		2.8	2.2		1.8	2.2	J

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1275-0058			CAN127-1276-0004			CAN127-1276-0008			CAN127-1276-0018			CAN127-1276-0028			CAN127-1276-0038		
LAB SAMPLE NUMBER	0312770019SA			0312150009SA			0312150010SA			0312150011SA			0312150012SA			0312150013SA		
COLLECT DATE	09/14/93			09/13/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3020	11.2		6140	21.6		3050	22.1		3620	11		3250	10.9		3280	11	
Lead	2.5	0.56		5.8	1.1		3.1	1.1		4.5	1.1		3.1	0.55		2.5	1.1	
Magnesium	4490	22.3		3020	43.3		2710	44.1		3320	21.9		5100	21.8		6940	22.1	
Manganese	43.2	1.1		98.5	2.2		31.1	2.2		47.2	1.1		42.5	1.1		32.6	1.1	
Nickel	2.9	4.5	J	9.7	8.7		5.8	8.8	J	4.4	4.4		3.9	4.4	J	3.9	4.4	J
Potassium	787	559		1540	1080		1150	1100		1510	549		1130	546		967	552	
Silver	<	1.1	U	<	2.2	U	<	2.2	U	<	1.1	U	<	1.1	U	<	1.1	U
Vanadium	17.5	1.1		16.4	2.2		10	2.2		12.6	1.1		12.8	1.1		16	1.1	
Zinc	7.9	2.2		14.5	4.3		6.8	4.4		7.8	2.2		7.1	2.2		8.3	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	44.7	U	<	43.3	U	<	44.1	U	<	43.9	U	<	43.7	U	<	44.1	U
Water Quality (percent)																		
Water	10	0.1		7.6	0.1		9.3	0.1		8.8	0.1		8.4	0.1		9.4	0.1	

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1276-0048			CAN127-1276-0058			CAN127-1277-0004			CAN127-1277-0008			CAN127-1277-0018			CAN127-1277-0028		
LAB SAMPLE NUMBER	0312150014SA			0312150015SA			0311840011SA			0311840012SA			0311840013SA			0311840014SA		
COLLECT DATE	09/13/93			09/13/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Chlorobenzene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
1,1-Dichloroethene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
1,2-Dichloroethene (total)	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
1,2-Dichloropropane	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Ethylbenzene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Tetrachloroethene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Toluene	<	5.5	U	2.5	5.4	J	2.1	5.5	J	<	5.5	U	<	5.7	U	<	5.6	U
1,1,1-Trichloroethane	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Trichloroethene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Xylenes (total)	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate										<	360	U						
Metals (mg/kg)																		
Aluminum	4660	11		3630	10.8		6130	10.9		3780	11		6250	11.3		5360	11.1	
Arsenic	1.5	0.55		1.1	0.54		2.8	0.55		1.5	0.55		2.4	0.57		1.4	0.56	
Barium	27.8	1.1		20.6	1.1		72.9	1.1		98.4	1.1		101	1.1		157	1.1	
Beryllium	0.22	0.22		0.16	0.22	J	0.49	0.22		0.37	0.22		0.71	0.23		0.38	0.22	
Cadmium	<	0.55	U	<	0.54	U	1.5	0.55		0.92	0.55		1.1	0.57		1.2	0.56	
Calcium	37000	22		8970	21.6		103000	21.8		104000	22.1		91000	22.7		76300	22.3	
Chromium	3.1	1.1		3.6	1.1		6.1	1.1		4.2	1.1	U	5.2	1.1	U	5.6	1.1	
Cobalt	2.9	1.1		1.4	1.1		3.2	1.1		2.3	1.1		3.2	1.1		1.4	1.1	
Copper	2	2.2	J	2.7	2.2		5.4	2.2		2.8	2.2		5.5	2.3		2.4	2.2	

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1276-0048			CAN127-1276-0058			CAN127-1277-0004			CAN127-1277-0008			CAN127-1277-0018			CAN127-1277-0028		
LAB SAMPLE NUMBER	0312150014SA			0312150015SA			0311840011SA			0311840012SA			0311840013SA			0311840014SA		
COLLECT DATE	09/13/93			09/13/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3760	11		3430	10.8		5800	10.9		3540	11		5200	11.3		3780	11.1	
Lead	2.6	1.1		2.6	1.1		6.1	2.7		4.6	0.55		7.4	1.1		3.1	0.56	
Magnesium	5240	22		3760	21.6		2630	21.8		2370	22.1		3970	22.7		6170	22.3	
Manganese	111	1.1		30.6	1.1		78.5	1.1		58.3	1.1		93	1.1		35	1.1	
Nickel	4.6	4.4		3.8	4.3	J	7.8	4.4		5.2	4.4		6.7	4.5		4.6	4.5	
Potassium	1010	549		816	540	J	1310	545		1050	552		2010	567		1050	557	
Silver	<	1.1	U	<	1.1	U	0.47	1.1	J	0.54	1.1	J	<	1.1	U	0.43	1.1	J
Vanadium	18.2	1.1		16.3	1.1		18.7	1.1		12.1	1.1		16.2	1.1		15	1.1	
Zinc	8.8	2.2		6.4	2.2		14.4	2.2		9.4	2.2		12.8	2.3		9	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	43.9	U	<	43.2	U	<	43.6	U	<	44.2	U	<	45.4	U	<	44.6	U
Water Quality (percent)																		
Water	8.9	0.1		7.4	0.1		8.3	0.1		9.4	0.1		12	0.1		10	0.1	

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1277-0038			CAN127-1277-0048			CAN127-1277-0058			CAN127-1278-0004			CAN127-1278-0008			CAN127-1278-0018		
LAB SAMPLE NUMBER	0311840015SA			0311840016SA			0311840017SA			0311840004SA			0311840005SA			0311840006SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Benzene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	6.6	11	J	<	11	U
Carbon tetrachloride	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Chlorobenzene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	J	<	5.7	U
1,1-Dichloroethene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
1,2-Dichloroethene (total)	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
1,2-Dichloropropane	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Ethylbenzene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	J	<	5.7	U
Tetrachloroethene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	J	<	5.7	U
Toluene	1.7	5.5	J	2	5.5	J	2.6	5.5	J	<	5.5	U	<	5.6	J	<	5.7	U
1,1,1-Trichloroethane	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Trichloroethene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Xylenes (total)	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate													<	370	U			
Metals (mg/kg)																		
Aluminum	4470	11		4580	11		4370	11.1		4270	21.8		4500	11.1		5730	22.9	
Arsenic	1.3	0.55		1.1	0.55		1.2	0.55		2	0.55		1.7	0.56		2.2	0.57	
Barium	158	1.1		41.7	1.1		84.6	1.1		227	2.2		204	1.1		242	2.3	
Beryllium	0.31	0.22		0.28	0.22		0.27	0.22		0.42	0.44	J	0.46	0.22		0.44	0.46	J
Cadmium	0.86	0.55		<	0.55	U	1.1	0.55		2.6	1.1		1.2	0.56		2.4	1.1	
Calcium	77800	22		58200	22		68400	22.1		166000	43.6		83100	22.2		154000	45.7	
Chromium	6.1	1.1		4.9	1.1	U	6.3	1.1		4	2.2	U	4.9	1.1	U	6.7	2.3	U
Cobalt	1.5	1.1		1.2	1.1		1.7	1.1		2.6	2.2		2.2	1.1	J	2.7	2.3	
Copper	2.2	2.2		2.1	2.2	J	54.9	2.2		4.1	4.4	J	4	2.2		3.7	4.6	J

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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1277-0038			CAN127-1277-0048			CAN127-1277-0058			CAN127-1278-0004			CAN127-1278-0008			CAN127-1278-0018		
LAB SAMPLE NUMBER	0311840015SA			0311840016SA			0311840017SA			0311840004SA			0311840005SA			0311840006SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3430	11		3570	11		3370	11.1		4170	21.8		4570	11.1		4780	22.9	
Lead	3.4	0.55		3	0.55		3.9	0.55		4.9	0.55		5.8	0.56		5.1	0.57	
Magnesium	4870	22		5890	22		5920	22.1		2460	43.6		2500	22.2		4940	45.7	
Manganese	40.3	1.1		47.5	1.1		41.3	1.1		57.1	2.2		71.6	1.1		71.1	2.3	
Nickel	4.3	4.4	J	4	4.4	J	4.6	4.4		6.4	8.7	J	6	4.4		7.6	9.1	J
Potassium	891	551		917	550		812	553		850	1090	J	1130	555		1540	1140	
Silver	0.51	1.1	J	0.48	1.1	J	0.35	1.1	J	1.2	2.2	J	0.8	1.1	J	1.6	2.3	J
Vanadium	14.9	1.1		18.2	1.1		20.9	1.1		15.4	2.2		15.2	1.1		17	2.3	
Zinc	7.9	2.2		8.8	2.2		11	2.2		11.1	4.4		11.1	2.2		10.4	4.6	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	44.1	U	<	44	U	<	44.2	U	<	43.6	U	170	44.4		55.9	45.7	
Water Quality (percent)																		
Water	9.2	0.1		9.2	0.1		9.5	0.1		8.3	0.1		10	0.1		13	0.1	

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R = Rejected value. Qual=Qualification
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TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1278-0028			CAN127-1278-0038			CAN127-1278-0048			CAN127-1278-0058		
LAB SAMPLE NUMBER	0311840007SA			0311840008SA			0312160010SA			0312160011SA		
COLLECT DATE	09/12/93			09/12/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)												
Benzene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	7.1	11	J
Carbon tetrachloride	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Chlorobenzene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
1,1-Dichloroethene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
1,2-Dichloroethene (total)	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
1,2-Dichloropropane	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Ethylbenzene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Tetrachloroethene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Toluene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
1,1,1-Trichloroethane	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Trichloroethene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Xylenes (total)	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Semivolatile Organics (µg/kg)												
Butyl benzyl phthalate												
Metals (mg/kg)												
Aluminum	7380	11.2		4530	11.1		4490	11.1		4430	11.3	
Arsenic	1.9	0.56		1.3	0.55		1.1	0.56		1.2	0.56	
Barium	189	1.1		74.4	1.1		113	1.1		31.6	1.1	
Beryllium	0.46	0.22		0.31	0.22		<	0.22	U	0.17	0.23	J
Cadmium	0.71	0.56		0.88	0.55		<	0.56	U	<	0.56	U
Calcium	89600	22.5		64200	22.1		58900	22.2		30800	22.6	
Chromium	5.6	1.1		4.7	1.1	U	3.2	1.1		2.7	1.1	
Cobalt	2.4	1.1		1.6	1.1		1.5	1.1		1.4	1.1	
Copper	3.1	2.2		2	2.2	J	1.6	2.2	J	1.8	2.3	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1278-0028			CAN127-1278-0038			CAN127-1278-0048			CAN127-1278-0058		
LAB SAMPLE NUMBER	0311840007SA			0311840008SA			0312160010SA			0312160011SA		
COLLECT DATE	09/12/93			09/12/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	5230	11.2		3430	11.1		2990	11.1		2840	11.3	
Lead	4	0.56		4.2	0.55		2.1	0.56		2.3	0.56	
Magnesium	4850	22.5		3730	22.1		4960	22.2		4400	22.6	
Manganese	68.5	1.1		37.4	1.1		37	1.1		39.5	1.1	
Nickel	6.6	4.5		4.5	4.4		3.7	4.4	J	3.6	4.5	J
Potassium	1580	561		925	553		987	555		1000	564	
Silver	0.48	1.1	J	0.62	1.1	J	<	1.1	U	<	1.1	U
Vanadium	19.8	1.1		14.5	1.1		16.3	1.1		15.7	1.1	
Zinc	11.7	2.2		7.3	2.2		7.2	2.2		7.3	2.3	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	<	44.9	U	<	44.2	U	<	44.4	U	<	45.1	U
Water Quality (percent)												
Water	11	0.1		9.6	0.1		10	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected RL = Reporting Limit.

TABLE 10-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SURFACE SOILS TO BACKGROUND(1)
SWMU 127, CANNON AFB

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Typical Level in Clovis, NM Region (4)	Does maximum detected exceed background
CAN127-1271-0000	Aluminum	9270	1410 - 11,000	10,540	50,000	N
CAN127-1275-0000	Antimony	7.8	<4.9 - 5.1	*	<1	Y
CAN127-1274-0000	Arsenic	2.9	0.67 - 28	15.5	6.5	N
CAN127-1275-0000	Barium	245	14.5 - 1200	642	500	N
CAN127-1274-0000	Beryllium	0.82	0.17 - 0.77	0.73	1 - 2	N**
CAN127-1272-0000	Cadmium	1.1	<0.51 - 4.2	*	---	Y
CAN127-1273-0000	Chromium	16.9	4 - 15.4	12.5	30	N**
CAN127-1274-0000	Cobalt	5.3	0.85 - 5.3	4.5	3 - 7	N**
CAN127-1275-0000	Copper	25.9	<2 - 18.4	*	20	Y
CAN127-1276-0000	Lead	48.2	1.1 - 46	25.8	15	Y
CAN127-1278-0000	Mercury	0.11	<0.1 - <0.12	*	0.032 - 0.085	Y
CAN127-1274-0002	Nickel	10.4	1.3 - 9.8	9	15	N**
CAN127-1274-0000	Selenium	0.27	<0.21 - 124	*	0.15 - 30	N**
CAN127-1272-0002	Silver	0.69	0.51 - 0.93	*	---	Y
CAN127-1274-0000	Vanadium	23	5.2 - 28.3	25.3	30 - 70	N
CAN127-1275-0000	Zinc	38.5	<4.3 - 27.5	21.9	45	N**

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward -lyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background range and is within naturally-occurring levels (USGS 1984); therefore concentration is not considered to exceed background.

TABLE 10-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN TOTAL SOILS TO BACKGROUND(1)
SWMU 127, CANNON AFB

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Typical Level in Clovis, NM Region (4)	Does maximum detected exceed background
CAN127-1273-0002	Aluminum	11600	1410 - 11,000	10,540	50,000	N**
CAN127-1275-0000	Antimony	7.8	<4.9 - 5.1	*	<1	Y
CAN127-1274-0000	Arsenic	2.9	0.67 - 28	15.5	6.5	N
CAN127-1271-0002	Barium	971	14.5 - 1200	642	500	Y
CAN127-1274-0002	Beryllium	0.83	0.17 - 0.77	0.73	1 - 2	N**
CAN127-1272-0002	Cadmium	4.2	<0.51 - 4.2	*	---	Y
CAN127-1273-0000	Chromium	16.9	4 - 15.4	12.5	30	N**
CAN127-1274-0000	Cobalt	5.3	0.85 - 5.3	4.5	3 - 7	N**
CAN127-1277-0058	Copper	54.9	<2 - 18.4	*	20	Y
CAN127-1276-0000	Lead	48.2	1.1 - 46	25.8	15	Y
CAN127-1278-0000	Mercury	0.11	<0.1 - <0.12	*	0.032 - 0.085	Y
CAN127-1274-0002	Nickel	12.4	1.3 - 9.8	9	15	N**
CAN127-1274-0000	Selenium	0.27	<0.21 - 124	*	0.15 - 0.30	N**
CAN127-1272-0002	Silver	3.6	0.51 - 0.93	*	---	Y
CAN127-1276-0002	Thallium	0.14	0.14 - <0.23	*	---	Y
CAN127-1274-0000	Vanadium	23	5.2 - 28.3	25.3	30 - 70	N
CAN127-1275-0000	Zinc	38.5	<4.3 - 27.5	21.9	45	N**

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward -Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background range and is within naturally-occurring levels (USGS 1984); therefore concentration is not not considered to exceed background.

TABLE 10-5

CHEMICALS OF CONCERN IN SURFACE SOIL

Acenaphthene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Carbazole
Chrysene
1,2-Dichloroethane
1,2-Dichloropropane
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Antimony
Cadmium
Copper
Lead*
Mercury
Silver

* No EPA-established toxicity factor.

TABLE 10-6

CHEMICALS OF CONCERN IN TOTAL SOIL

Acenaphthene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Carbazole
Chrysene
1,2-Dichloropropane
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene*
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Antimony
Barium
Cadmium
Copper
Lead*
Mercury
Silver
Thallium

* No EPA-established toxicity factor.

TABLE 10-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT POL WASH RACK (SWMU 127)

	1,2-Dichloroethane (µg/kg)			1,2-Dichloropropane (µg/kg)				Toluene (µg/kg)				Xylenes (total) (µg/kg)				Acenaphthene (µg/kg)		
Field ID	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL
CAN127-1271-0000		U	5.8	2.9	1.065	U	5.8	2.9	1.065	U	5.8	2.9	1.065	U	5.8		U	380
CAN127-1272-0000		U	5.8	2	0.693	U	5.8	2.9	1.065	U	5.8	2.9	1.065	U	5.8		U	380
CAN127-1273-0000		U	5.2	2.6	0.956	U	5.2	12	2.485		5.2	3.4	1.224		5.2		U	350
CAN127-1274-0000		U	5.5	2.75	1.012	U	5.5	2.3	0.833	J	5.5	1.5	0.405	J	5.5		U	370
CAN127-1275-0000		U	5.2	4.6	1.526		5.2	5.2	1.649		5.2	2.6	0.956	U	5.2	150	J	1400
CAN127-1276-0000	1.9	J	5.2	2.6	0.956	U	5.2	15	2.708		5.2	12	2.485		5.2		U	340
CAN127-1277-0000		U	5.3	2.65	0.975	U	5.3	5.5	1.705	J	5.3	5.9	1.775		5.3		U	350
CAN127-1278-0000		U	5.3	2.65	0.975	U	5.3	2.65	0.975	U	5.3	2.65	0.975	U	5.3		U	1400
Number	1			8	8			8	8			8	8			1		
Minimum detected	1.90			4.60				2.30				1.50				150		
Maximum detected	1.90			4.60				15.0				12.0				150		
Average	1.90			2.84	1.02			6.06	1.56			4.23	1.24			150		
H statistic					2.00				2.85				2.64					
Standard Deviation				0.76	0.23			4.81	0.71			3.38	0.63					
95% UCL				3.39	3.39			13.3	13.3			7.89	7.89					
RME	1.9			3.39				13.3				7.89				150		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed

TABLE 10-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT POL WASH RACK (SWMU 127)

	Anthracene (µg/kg)			Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)				Benzo(b)fluoranthene (µg/kg)				Carbazole (µg/kg)			
Field ID	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000		U	380	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN127-1272-0000		U	380	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN127-1273-0000	48	J	350	510	6.234		350	550	6.310		350	960	6.867		350	46	3.829	J	350
CAN127-1274-0000		U	370	83	4.419	J	370	120	4.787	J	370	270	5.598	J	370	185	5.220	U	370
CAN127-1275-0000		U	1400	8000	8.987		1400	8600	9.060		1400	17000	9.741		1400	1500	7.313		1400
CAN127-1276-0000		U	340	160	5.075	J	340	230	5.438	J	340	410	6.016		340	170	5.136	U	340
CAN127-1277-0000		U	350	190	5.247	J	350	180	5.193	J	350	390	5.966		350	175	5.165	U	350
CAN127-1278-0000		U	1400	150	5.011	J	1400	180	5.193	J	1400	380	5.940	J	1400	700	6.551	U	1400
Number	1			8	8			8	8			8	8			8	8		
Minimum detected	48.0			83.0				120				270				46.0			
Maximum detected	48.0			8000				8600				17000				1500			
Average	48.0			1184	5.68			1280	5.81			2474	6.33			395	5.46		
H statistic					4.77				4.43				4.77				3.74		
Standard Deviation				2757	1.42			2961	1.38			5875	1.47			487.4	1.04		
95% UCL				10587	10587			8781	8781			23580	23580			1780	1780		
RME	48.0			8000				8600				17000				1500			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed

TABLE 10-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT POL WASH RACK (SWMU 127)

	Chrysene (µg/kg)				Fluoranthene (µg/kg)				Fluorene (µg/kg)				Indeno(1,2,3-cd)pyrene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380	190	5.24702407	U	380
CAN127-1272-0000	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380	190	5.24702407	U	380
CAN127-1273-0000	720	6.579		350	1500	7.313		350	175	5.165	U	350	390	5.96614674		350
CAN127-1274-0000	210	5.347	J	370	300	5.704	J	370	185	5.220	U	370	68	4.21950771	J	370
CAN127-1275-0000	14000	9.547		1400	17000	9.741		1400	290	5.670	J	1400	5100	8.53699582		1400
CAN127-1276-0000	300	5.704	J	340	570	6.346		340	170	5.136	U	340	160	5.07517382	J	340
CAN127-1277-0000	240	5.481	J	350	470	6.153		350	175	5.165	U	350	93	4.53259949	J	350
CAN127-1278-0000	260	5.561	J	1400	440	6.087	J	1400	700	6.551	U	1400	700	6.55108034	U	1400
Number	8	8			8	8			8	8			8	8		
Minimum detected	210				300				290				68.0			
Maximum detected	14000				17000				290				5100			
Average	2014	6.09			2583	6.48			259	5.43			861	5.67		
H statistic		4.77				4.77				2.36				4.43		
Standard Deviation	4846	1.46			5841	1.48			182	0.49			1725	1.37		
95% UCL	17920	17920			27726	27726			394	394			7420	7420		
RME	14000				17000				290				5100			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed

TABLE 10-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT POL WASH RACK (SWMU 127)

	Pyrene (mg/kg)				TPH (mg/kg)				Antimony (mg/kg)				Cadmium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	190	5.247	U	380	23.05	3.138	U	46.1	3.45	1.238	U	6.9	0.29	-1.238	UJ	0.58
CAN127-1272-0000	190	5.247	U	380	93.2	4.535		46.3	3.45	1.238	U	6.9	1.1	0.095		0.58
CAN127-1273-0000	1400	7.244		350	66.8	4.202		41.9	3.45	1.238	U	6.3	0.26	-1.347	U	0.52
CAN127-1274-0000	230	5.438	J	370	253	5.533		44.3	3.3	1.194	U	6.6	0.49	-0.713	J	0.55
CAN127-1275-0000	17000	9.741		1400	344	5.841		83.9	7.8	2.054		6.3	0.53	-0.635		0.52
CAN127-1276-0000	550	6.310		340	80.5	4.388		41.6	3.1	1.131	U	6.2	0.26	-1.347	U	0.52
CAN127-1277-0000	440	6.087		350	44.1	3.786		42.1	3.15	1.147	U	6.3	0.265	-1.328	U	0.53
CAN127-1278-0000	360	5.886	J	1400	21.1	3.049	U	42.2	3.15	1.147	U	6.3	0.265	-1.328	U	0.53
Number	8	8			8	8			8	8			8	8		
Minimum detected	230				44.1				7.80				0.49			
Maximum detected	17000				344				7.80				1.10			
Average	2545	6.40			116	4.31			3.86	1.30			0.43	-0.98		
H statistic		4.77				3.74				2.13			2.45	2.45		
Standard Deviation	5854	1.50			118	1.01			1.60	0.31			0.29	0.52		
95% UCL	28051	28051			517	517			4.93	4.93			0.70	0.70		
RME	17000				344				4.93				0.70			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed

TABLE 10-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT POL WASH RACK (SWMU 127)

	Copper (mg/kg)				Lead (mg/kg)				Mercury (mg/kg)				Silver (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	8.9	2.186		2.3	7.3	1.988		0.58	0.06	-2.813	U	0.12	0.69	-0.371	J	1.2
CAN127-1272-0000	7.3	1.988		2.3	4.4	1.482		2.9	0.06	-2.813	U	0.12	0.68	-0.386	J	1.2
CAN127-1273-0000	6.8	1.917		2.1	30.8	3.428		10.5	0.05	-2.996	U	0.1	0.5	-0.693	U	1
CAN127-1274-0000	8.5	2.140		2.2	12.6	2.534		2.8	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1
CAN127-1275-0000	25.9	3.254		2.1	29.2	3.374		5.2	0.05	-2.996	U	0.1	0.5	-0.693	U	1
CAN127-1276-0000	6.3	1.841		2.1	48.2	3.875		10.4	0.05	-2.996	U	0.1	0.5	-0.693	U	1
CAN127-1277-0000	7.1	1.960		2.1	43.2	3.766		5.3	0.055	-2.900	U	0.11	0.43	-0.844	J	1.1
CAN127-1278-0000	7.3	1.988		2.1	42.4	3.747		5.3	0.11	-2.207		0.11	0.53	-0.635	J	1.1
Number	8	8			8	8			8	8			8	8		
Minimum detected	6.30				4.40				0.11				0.43			
Maximum detected	25.9				48.2				0.11				0.69			
Average	9.76	2.16			27.3	3.02			0.06	-2.83			0.55	-0.61		
H statistic		2.36				3.30				2.06				1.95		
Standard Deviation	6.58	0.46			17.21	0.91			0.02	0.26			0.09	0.16		
95% UCL	14.5	14.5			96.4	96.4			0.08	0.08			0.62	0.62		
RME	14.5				48.2				0.08				0.62			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	1,2-Dichloropropane (ug/kg)				Toluene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	2.9	1.065	U	5.8	2.9	1.065	U	5.8
CAN127-1271-0002	2.9	1.065	U	5.8	2.9	1.065	U	5.8
CAN127-1271-0004	2.9	1.065	U	5.8	2.9	1.065	U	5.8
CAN127-1271-0008	2.85	1.047	U	5.7	2.85	1.047	U	5.7
CAN127-1272-0000	2.9	1.065	U	5.8	2.9	1.065	U	5.8
CAN127-1272-0002	3	1.099	U	6	3	1.099	U	6
CAN127-1272-0004	2.95	1.082	U	5.9	2.95	1.082	U	5.9
CAN127-1272-0008	2.95	1.082	U	5.9	2.95	1.082	U	5.9
CAN127-1273-0000	2.6	0.956	U	5.2	12	2.485		5.2
CAN127-1273-0002	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1273-0004	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1273-0008	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1273-0018	2.8	1.030	U	5.6	3.5	1.253	J	5.6
CAN127-1273-0028	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1273-0038	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1273-0048	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1273-0058	2.7	0.993	U	5.4	1.2	0.182	J	5.4
CAN127-1274-0000	2.75	1.012	U	5.5	2.3	0.833	J	5.5
CAN127-1274-0002	2.75	1.012	U	5.5	2.8	1.030	J	5.5
CAN127-1274-0004	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1274-0008	2.85	1.047	U	5.7	2.85	1.047	U	5.7
CAN127-1274-0018	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1274-0028	2.8	1.030	U	5.6	2.8	1.030	U	5.6
CAN127-1274-0038	2.8	1.030	U	5.6	2	0.693	J	5.6
CAN127-1274-0048	5.7	1.740		5.5	3.3	1.194	J	5.5
CAN127-1274-0058	13	2.565		5.4	1.6	0.470	J	5.4
CAN127-1275-0000	4.6	1.526	J	5.2	5.2	1.649		5.2
CAN127-1275-0002	2.9	1.065	U	5.8	2.9	1.065	U	5.8
CAN127-1275-0004	2.85	1.047	U	5.7	5.4	1.686	J	5.7
CAN127-1275-0008	2.9	1.065	U	5.8	18	2.890		5.8
CAN127-1275-0018	2.9	1.065	U	5.8	6.2	1.825		5.8
CAN127-1275-0028	2.8	1.030	U	5.6	2.9	1.065	U	5.6
CAN127-1275-0038	7.7	2.041		5.5	7.2	1.974		5.5
CAN127-1275-0048	2.8	1.030	U	5.6	12	2.485		5.6
CAN127-1275-0058	2.8	1.030	U	5.6	2.8	1.030	U	5.6
CAN127-1276-0000	2.6	0.956	U	5.2	15	2.708		5.2
CAN127-1276-0002	2.7	0.993	U	5.4	2.7	0.993	U	5.4
CAN127-1276-0004	2.7	0.993	U	5.4	2.7	0.993	U	5.4
CAN127-1276-0008	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1276-0018	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1276-0028	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1276-0038	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1276-0048	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1276-0058	2.7	0.993	U	5.4	2.5	0.916	J	5.4
CAN127-1277-0000	2.65	0.975	U	5.3	5.5	1.705	J	5.3
CAN127-1277-0002	2.7	0.993	U	5.4	3.8	1.335	J	5.4
CAN127-1277-0004	2.75	1.012	U	5.5	2.1	0.742	J	5.5

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	1,2-Dichloropropane (ug/kg)				Toluene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1277-0008	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1277-0018	2.85	1.047	U	5.7	2.85	1.047	U	5.7
CAN127-1277-0028	2.8	1.030	U	5.6	2.8	1.030	U	5.6
CAN127-1277-0038	2.75	1.012	U	5.5	1.7	0.531	J	5.5
CAN127-1277-0048	2.75	1.012	U	5.5	2	0.693	J	5.5
CAN127-1277-0058	2.75	1.012	U	5.5	2.6	0.956	J	5.5
CAN127-1278-0000	2.65	0.975	U	5.3	2.65	0.975	U	5.3
CAN127-1278-0002	2.7	0.993	U	5.4	2.7	0.993	U	5.4
CAN127-1278-0004	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1278-0008	2.8	1.030	U	5.6	2.8	1.030	UJ	5.6
CAN127-1278-0018	2.85	1.047	U	5.7	2.85	1.047	U	5.7
CAN127-1278-0028	2.8	1.030	U	5.6	2.8	1.030	U	5.6
CAN127-1278-0038	2.75	1.012	U	5.5	2.75	1.012	U	5.5
CAN127-1278-0048	2.8	1.030	U	5.6	2.8	1.030	U	5.6
CAN127-1278-0058	2.8	1.030	U	5.6	2.8	1.030	U	5.6
Number	62	62			62	62		
Minimum	4.60				1.20			
Maximum	13.0				18.0			
Average	3.10	1.084			3.71	1.152		
H statistic	1.73	1.733				1.830		
Standard Deviation	1.48	0.256			3.02	0.483		
95% UCL	3.23	3.235			3.98	3.982		
RME	3.23				3.98			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Xylenes (total) (µg/kg)				Acenaphthene (µg/kg)			Anthracene (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN127-1271-0000	2.9	1.065	U	5.8		U	380		U	380
CAN127-1271-0002	2.9	1.065	U	5.8						
CAN127-1271-0004	2.9	1.065	U	5.8		U	380		U	380
CAN127-1271-0008	2.85	1.047	U	5.7						
CAN127-1272-0000	2.9	1.065	U	5.8		U	380		U	380
CAN127-1272-0002	3	1.099	U	6		U	400		U	400
CAN127-1272-0004	2.95	1.082	U	5.9						
CAN127-1272-0008	2.95	1.082	U	5.9						
CAN127-1273-0000	3.4	1.224	J	5.2		U	350	48	J	350
CAN127-1273-0002	2.75	1.012	U	5.5						
CAN127-1273-0004	2.75	1.012	U	5.5						
CAN127-1273-0008	2.75	1.012	U	5.5		U	360		U	360
CAN127-1273-0018	2.8	1.030	U	5.6						
CAN127-1273-0028	2.75	1.012	U	5.5						
CAN127-1273-0038	2.75	1.012	U	5.5						
CAN127-1273-0048	2.75	1.012	U	5.5						
CAN127-1273-0058	2.7	0.993	U	5.4						
CAN127-1274-0000	1.5	0.405	J	5.5		U	370		U	370
CAN127-1274-0002	2.75	1.012	U	5.5						
CAN127-1274-0004	2.75	1.012	U	5.5						
CAN127-1274-0008	2.85	1.047	U	5.7						
CAN127-1274-0018	2.75	1.012	U	5.5						
CAN127-1274-0028	2.8	1.030	U	5.6						
CAN127-1274-0038	2.8	1.030	U	5.6						
CAN127-1274-0048	2.75	1.012	U	5.5		U	360		U	360
CAN127-1274-0058	2.7	0.993	U	5.4						
CAN127-1275-0000	2.6	0.956	U	5.2	150	J	1400		U	1400
CAN127-1275-0002	2.9	1.065	U	5.8		U	380		U	380
CAN127-1275-0004	2.85	1.047	U	5.7						
CAN127-1275-0008	2.9	1.065	U	5.8						
CAN127-1275-0018	2.4	0.875	J	5.8						
CAN127-1275-0028	2.8	1.030	U	5.6						
CAN127-1275-0038	2.75	1.012	U	5.5						
CAN127-1275-0048	2.8	1.030	U	5.6						
CAN127-1275-0058	2.8	1.030	U	5.6						
CAN127-1276-0000	12	2.485		5.2		U	340		U	340
CAN127-1276-0002	2.7	0.993	U	5.4						
CAN127-1276-0004	2.7	0.993	U	5.4						
CAN127-1276-0008	2.75	1.012	U	5.5						
CAN127-1276-0018	2.75	1.012	U	5.5		U	360		U	360
CAN127-1276-0028	2.75	1.012	U	5.5						
CAN127-1276-0038	2.75	1.012	U	5.5						
CAN127-1276-0048	2.75	1.012	U	5.5						
CAN127-1276-0058	2.7	0.993	U	5.4						
CAN127-1277-0000	5.9	1.775		5.3		U	350		U	350
CAN127-1277-0002	1.5	0.405	J	5.4						
CAN127-1277-0004	2.75	1.012	U	5.5						

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Xylenes (total) (µg/kg)				Acenaphthene (µg/kg)			Anthracene (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Qual	RL
CAN127-1277-0008	2.75	1.012	U	5.5		U	360		U	360
CAN127-1277-0018	2.85	1.047	U	5.7						
CAN127-1277-0028	2.8	1.030	U	5.6						
CAN127-1277-0038	2.75	1.012	U	5.5						
CAN127-1277-0048	2.75	1.012	U	5.5						
CAN127-1277-0058	2.75	1.012	U	5.5						
CAN127-1278-0000	2.65	0.975	U	5.3		U	1400		U	1400
CAN127-1278-0002	2.7	0.993	U	5.4						
CAN127-1278-0004	2.75	1.012	U	5.5						
CAN127-1278-0008	2.8	1.030	U	5.6		U	370		U	370
CAN127-1278-0018	2.85	1.047	U	5.7						
CAN127-1278-0028	2.8	1.030	U	5.6						
CAN127-1278-0038	2.75	1.012	U	5.5						
CAN127-1278-0048	2.8	1.030	U	5.6						
CAN127-1278-0058	2.8	1.030	U	5.6						
Number	62	62			1			1		
Minimum	1.50				150			48.0		
Maximum	12.0				150			48.0		
Average	2.95	1.041			150			48.0		
H statistic		1.714								
Standard Deviation	1.26	0.241								
95% UCL	3.07	3.074								
RME	3.07				150			48.0		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	190	5.247	U	380	190	5.247	U	380
CAN127-1271-0002								
CAN127-1271-0004	190	5.247	U	380	190	5.247	U	380
CAN127-1271-0008								
CAN127-1272-0000	190	5.247	U	380	190	5.247	U	380
CAN127-1272-0002	200	5.298	U	400	200	5.298	U	400
CAN127-1272-0004								
CAN127-1272-0008								
CAN127-1273-0000	510	6.234		350	550	6.310		350
CAN127-1273-0002								
CAN127-1273-0004								
CAN127-1273-0008	180	5.193	U	360	180	5.193	U	360
CAN127-1273-0018								
CAN127-1273-0028								
CAN127-1273-0038								
CAN127-1273-0048								
CAN127-1273-0058								
CAN127-1274-0000	83	4.419	J	370	120	4.787	J	370
CAN127-1274-0002								
CAN127-1274-0004								
CAN127-1274-0008								
CAN127-1274-0018								
CAN127-1274-0028								
CAN127-1274-0038								
CAN127-1274-0048	180	5.193	U	360	180	5.193	U	360
CAN127-1274-0058								
CAN127-1275-0000	8000	8.987		1400	8600	9.060		1400
CAN127-1275-0002	190	5.247	U	380	190	5.247	U	380
CAN127-1275-0004								
CAN127-1275-0008								
CAN127-1275-0018								
CAN127-1275-0028								
CAN127-1275-0038								
CAN127-1275-0048								
CAN127-1275-0058								
CAN127-1276-0000	160	5.075	J	340	230	5.438	J	340
CAN127-1276-0002								
CAN127-1276-0004								
CAN127-1276-0008								
CAN127-1276-0018	180	5.193	U	360	180	5.193	U	360
CAN127-1276-0028								
CAN127-1276-0038								
CAN127-1276-0048								
CAN127-1276-0058								
CAN127-1277-0000	190	5.247	J	350	180	5.193	J	350
CAN127-1277-0002								
CAN127-1277-0004								

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1277-0008	180	5.193	U	360	180	5.193	U	360
CAN127-1277-0018								
CAN127-1277-0028								
CAN127-1277-0038								
CAN127-1277-0048								
CAN127-1277-0058								
CAN127-1278-0000	150	5.011	J	1400	180	5.193	J	1400
CAN127-1278-0002								
CAN127-1278-0004								
CAN127-1278-0008	185	5.220	U	370	185	5.220	U	370
CAN127-1278-0018								
CAN127-1278-0028								
CAN127-1278-0038								
CAN127-1278-0048								
CAN127-1278-0058								
Number	16	16			16	16		
Minimum	83.0				120			
Maximum	8000				8600			
Average	685	5.453			733	5.516		
H statistic		2.713				2.713		
Standard Deviation	1953	1.002			2100	0.992		
95% UCL	779	778.748			816	815.564		
RME	779				816			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Benzo(b)fluoranthene (µg/kg)				Butyl benzyl phthalate (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL
CAN127-1271-0000	190	5.247	U	380		U	380
CAN127-1271-0002							
CAN127-1271-0004	190	5.247	U	380	110	J	380
CAN127-1271-0008							
CAN127-1272-0000	190	5.247	U	380		U	380
CAN127-1272-0002	200	5.298	U	400		U	400
CAN127-1272-0004							
CAN127-1272-0008							
CAN127-1273-0000	960	6.867		350		U	350
CAN127-1273-0002							
CAN127-1273-0004							
CAN127-1273-0008	180	5.193	U	360		U	360
CAN127-1273-0018							
CAN127-1273-0028							
CAN127-1273-0038							
CAN127-1273-0048							
CAN127-1273-0058							
CAN127-1274-0000	270	5.598	J	370		U	370
CAN127-1274-0002							
CAN127-1274-0004							
CAN127-1274-0008							
CAN127-1274-0018							
CAN127-1274-0028							
CAN127-1274-0038							
CAN127-1274-0048	180	5.193	U	360		U	360
CAN127-1274-0058							
CAN127-1275-0000	17000	9.741		1400		U	1400
CAN127-1275-0002	190	5.247	U	380		U	380
CAN127-1275-0004							
CAN127-1275-0008							
CAN127-1275-0018							
CAN127-1275-0028							
CAN127-1275-0038							
CAN127-1275-0048							
CAN127-1275-0058							
CAN127-1276-0000	410	6.016		340		U	340
CAN127-1276-0002							
CAN127-1276-0004							
CAN127-1276-0008							
CAN127-1276-0018	180	5.193	U	360		U	360
CAN127-1276-0028							
CAN127-1276-0038							
CAN127-1276-0048							
CAN127-1276-0058							
CAN127-1277-0000	390	5.966		350		U	350
CAN127-1277-0002							
CAN127-1277-0004							

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Benzo(b)fluoranthene (µg/kg)				Butyl benzyl phthalate (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL
CAN127-1277-0008	180	5.193	U	360		U	360
CAN127-1277-0018							
CAN127-1277-0028							
CAN127-1277-0038							
CAN127-1277-0048							
CAN127-1277-0058							
CAN127-1278-0000	380	5.940	J	1400		U	1400
CAN127-1278-0002							
CAN127-1278-0004							
CAN127-1278-0008	185	5.220	U	370		U	370
CAN127-1278-0018							
CAN127-1278-0028							
CAN127-1278-0038							
CAN127-1278-0048							
CAN127-1278-0058							
Number	16	16			1		
Minimum	270				110		
Maximum	17000				110		
Average	1330	5.775			110		
H statistic		3.121					
Standard Deviation	4183	1.157					
95% UCL	1599	1599					
RME	1599				110		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Carbazole (µg/kg)				Chrysene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	190	5.247	U	380	190	5.247	U	380
CAN127-1271-0002								
CAN127-1271-0004	190	5.247	U	380	190	5.247	U	380
CAN127-1271-0008								
CAN127-1272-0000	190	5.247	U	380	190	5.247	U	380
CAN127-1272-0002	200	5.298	U	400	200	5.298	U	400
CAN127-1272-0004								
CAN127-1272-0008								
CAN127-1273-0000	46	3.829	J	350	720	6.579		350
CAN127-1273-0002								
CAN127-1273-0004								
CAN127-1273-0008	180	5.193	U	360	180	5.193	U	360
CAN127-1273-0018								
CAN127-1273-0028								
CAN127-1273-0038								
CAN127-1273-0048								
CAN127-1273-0058								
CAN127-1274-0000	185	5.220	U	370	210	5.347	J	370
CAN127-1274-0002								
CAN127-1274-0004								
CAN127-1274-0008								
CAN127-1274-0018								
CAN127-1274-0028								
CAN127-1274-0038								
CAN127-1274-0048	180	5.193	U	360	180	5.193	U	360
CAN127-1274-0058								
CAN127-1275-0000	1500	7.313		1400	14000	9.547		1400
CAN127-1275-0002	190	5.247	U	380	190	5.247	U	380
CAN127-1275-0004								
CAN127-1275-0008								
CAN127-1275-0018								
CAN127-1275-0028								
CAN127-1275-0038								
CAN127-1275-0048								
CAN127-1275-0058								
CAN127-1276-0000	170	5.136	U	340	300	5.704	J	340
CAN127-1276-0002								
CAN127-1276-0004								
CAN127-1276-0008								
CAN127-1276-0018	180	5.193	U	360	180	5.193	U	360
CAN127-1276-0028								
CAN127-1276-0038								
CAN127-1276-0048								
CAN127-1276-0058								
CAN127-1277-0000	175	5.165	U	350	240	5.481	J	350
CAN127-1277-0002								
CAN127-1277-0004								

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Carbazole (µg/kg)				Chrysene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1277-0008	180	5.193	U	360	180	5.193	U	360
CAN127-1277-0018								
CAN127-1277-0028								
CAN127-1277-0038								
CAN127-1277-0048								
CAN127-1277-0058								
CAN127-1278-0000	700	6.551	U	1400	260	5.561		1400
CAN127-1278-0002								
CAN127-1278-0004								
CAN127-1278-0008	185	5.220	U	370	185	5.220	U	370
CAN127-1278-0018								
CAN127-1278-0028								
CAN127-1278-0038								
CAN127-1278-0048								
CAN127-1278-0058								
Number	16	16			16	16		
Minimum	46.0				210			
Maximum	1500				14000			
Average	290	5.343			1100	5.656		
H statistic		2.351				2.899		
Standard Deviation	350	0.724			3443	1.095		
95% UCL	422	422			1181	1181		
RME	422				1181			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Fluoranthene (µg/kg)				Fluorene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	190	5.247	U	380	190	5.247	U	380
CAN127-1271-0002								
CAN127-1271-0004	190	5.247	U	380	190	5.247	U	380
CAN127-1271-0008								
CAN127-1272-0000	190	5.247	U	380	190	5.247	U	380
CAN127-1272-0002	200	5.298	U	400	200	5.298	U	400
CAN127-1272-0004								
CAN127-1272-0008								
CAN127-1273-0000	1500	7.313		350	175	5.165	U	350
CAN127-1273-0002								
CAN127-1273-0004								
CAN127-1273-0008	180	5.193	U	360	180	5.193	U	360
CAN127-1273-0018								
CAN127-1273-0028								
CAN127-1273-0038								
CAN127-1273-0048								
CAN127-1273-0058								
CAN127-1274-0000	300	5.704	J	370	175	5.165	U	370
CAN127-1274-0002								
CAN127-1274-0004								
CAN127-1274-0008								
CAN127-1274-0018								
CAN127-1274-0028								
CAN127-1274-0038								
CAN127-1274-0048	180	5.193	U	360	180	5.193	U	360
CAN127-1274-0058								
CAN127-1275-0000	17000	9.741		1400	290	5.670	J	1400
CAN127-1275-0002	190	5.247	U	380	190	5.247	U	380
CAN127-1275-0004								
CAN127-1275-0008								
CAN127-1275-0018								
CAN127-1275-0028								
CAN127-1275-0038								
CAN127-1275-0048								
CAN127-1275-0058								
CAN127-1276-0000	570	6.346		340	170	5.136	U	340
CAN127-1276-0002								
CAN127-1276-0004								
CAN127-1276-0008								
CAN127-1276-0018	180	5.193	U	360	180	5.193	U	360
CAN127-1276-0028								
CAN127-1276-0038								
CAN127-1276-0048								
CAN127-1276-0058								
CAN127-1277-0000	470	6.153		350	175	5.165	U	350
CAN127-1277-0002								
CAN127-1277-0004								

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Fluoranthene (µg/kg)				Fluorene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1277-0008	180	5.193	U	360	180	5.193	U	360
CAN127-1277-0018								
CAN127-1277-0028								
CAN127-1277-0038								
CAN127-1277-0048								
CAN127-1277-0058								
CAN127-1278-0000	440	6.087	J	1400	700	6.551	U	1400
CAN127-1278-0002								
CAN127-1278-0004								
CAN127-1278-0008	185	5.220	U	370	185	5.220	U	370
CAN127-1278-0018								
CAN127-1278-0028								
CAN127-1278-0038								
CAN127-1278-0048								
CAN127-1278-0058								
Number	16	16			16	16		
Minimum	300				290			
Maximum	17000				290			
Average	1384	5.851			222	5.321		
H statistic		3.121				1.914		
Standard Deviation	4178	1.199			130	0.350		
95% UCL	1876	1876			259	259		
RME	1876				259			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was perform

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Indeno(1,2,3-cd)pyrene (µg/kg)				Pyrene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	190	5.247	U	380	190	5.247	U	380
CAN127-1271-0002								
CAN127-1271-0004	190	5.247	U	380			U	380
CAN127-1271-0008								
CAN127-1272-0000	190	5.247	U	380	190	5.247	U	380
CAN127-1272-0002	200	5.298	U	400	200	5.298	U	400
CAN127-1272-0004								
CAN127-1272-0008								
CAN127-1273-0000	390	5.966		350	1400	7.244		350
CAN127-1273-0002								
CAN127-1273-0004								
CAN127-1273-0008	180	5.193	U	360	180	5.193	U	360
CAN127-1273-0018								
CAN127-1273-0028								
CAN127-1273-0038								
CAN127-1273-0048								
CAN127-1273-0058								
CAN127-1274-0000	68	4.220	J	370	230	5.438	J	370
CAN127-1274-0002								
CAN127-1274-0004								
CAN127-1274-0008								
CAN127-1274-0018								
CAN127-1274-0028								
CAN127-1274-0038								
CAN127-1274-0048	180	5.193	U	360	180	5.193	U	360
CAN127-1274-0058								
CAN127-1275-0000	5100	8.537		1400	17000	9.741		1400
CAN127-1275-0002	190	5.247	U	380	190	5.247	U	380
CAN127-1275-0004								
CAN127-1275-0008								
CAN127-1275-0018								
CAN127-1275-0028								
CAN127-1275-0038								
CAN127-1275-0048								
CAN127-1275-0058								
CAN127-1276-0000	160	5.075	J	340	550	6.310		340
CAN127-1276-0002								
CAN127-1276-0004								
CAN127-1276-0008								
CAN127-1276-0018	180	5.193	U	360	180	5.193	U	360
CAN127-1276-0028								
CAN127-1276-0038								
CAN127-1276-0048								
CAN127-1276-0058								
CAN127-1277-0000	93	4.533	J	350	440	6.087		350
CAN127-1277-0002								
CAN127-1277-0004								

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN
IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Indeno(1,2,3-cd)pyrene (µg/kg)				Pyrene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1277-0008	180	5.193	U	360	180	5.193	U	360
CAN127-1277-0018								
CAN127-1277-0028								
CAN127-1277-0038								
CAN127-1277-0048								
CAN127-1277-0058								
CAN127-1278-0000	700	6.551	U	1400	360	5.886	J	1400
CAN127-1278-0002								
CAN127-1278-0004								
CAN127-1278-0008	185	5.220	U	370	185	5.220	U	370
CAN127-1278-0018								
CAN127-1278-0028								
CAN127-1278-0038								
CAN127-1278-0048								
CAN127-1278-0058								
Number	16	16			15	15		
Minimum	68.0				230			
Maximum	5100				17000			
Average	524	5.448			1444	5.849		
H statistic		2.713				3.163		
Standard Deviation	1229	0.966			4315	1.226		
95% UCL	729	729			2073	2073		
RME	729				2073			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	TPH (mg/kg)				Antimony (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	23.05	3.138	U	46.1	3.45	1.238	U	6.9
CAN127-1271-0002	23.05	3.138	U	46.1	6.9	1.932	U	13.8
CAN127-1271-0004	46.6	3.842		46.2	6.95	1.939	U	13.9
CAN127-1271-0008	48.6	3.884		45.7	6.85	1.924	U	13.7
CAN127-1272-0000	93.2	4.535		46.3	3.45	1.238	U	6.9
CAN127-1272-0002	48.7	3.886		48.4	18.15	2.899	U	36.3
CAN127-1272-0004	50.1	3.914		47.1	17.65	2.871	U	35.3
CAN127-1272-0008	23.75	3.168	U	47.5	7.15	1.967	U	14.3
CAN127-1273-0000	66.8	4.202		41.9	3.15	1.147	U	6.3
CAN127-1273-0002	21.8	3.082	U	43.6	3.25	1.179	U	6.5
CAN127-1273-0004	21.85	3.084	U	43.7	6.55	1.879	U	13.1
CAN127-1273-0008	21.95	3.089	U	43.9	3.3	1.194	U	6.6
CAN127-1273-0018	22.4	3.109	U	44.8	6.75	1.910	U	13.5
CAN127-1273-0028	22.1	3.096	U	44.2	3.3	1.194	U	6.6
CAN127-1273-0038	22.1	3.096	U	44.2	3.3	1.194	U	6.6
CAN127-1273-0048	21.95	3.089	U	43.9	3.3	1.194	U	6.6
CAN127-1273-0058	21.4	3.063	U	42.8	3.2	1.163	U	6.4
CAN127-1274-0000	253	5.533		44.3	3.3	1.194	U	6.6
CAN127-1274-0002	22	3.091	U	44	3.3	1.194	U	6.6
CAN127-1274-0004	22.05	3.093	U	44.1	6.6	1.887	U	13.2
CAN127-1274-0008	22.65	3.120	U	45.3	6.8	1.917	U	13.6
CAN127-1274-0018	22	3.091	U	44	3.3	1.194	U	6.6
CAN127-1274-0028	22.35	3.107	U	44.7	6.7	1.902	U	13.4
CAN127-1274-0038	22.45	3.111	U	44.9	3.35	1.209	U	6.7
CAN127-1274-0048	21.95	3.089	U	43.9	3.3	1.194	U	6.6
CAN127-1274-0058	21.55	3.070	U	43.1	3.25	1.179	U	6.5
CAN127-1275-0000	344	5.841		83.9	7.8	2.054		6.3
CAN127-1275-0002	23.05	3.138	U	46.1	6.9	1.932	U	13.8
CAN127-1275-0004	22.9	3.131	U	45.8	17.15	2.842	U	34.3
CAN127-1275-0008	23.3	3.148	U	46.6	7	1.946	U	14
CAN127-1275-0018	23.05	3.138	U	46.1	17.3	2.851	U	34.6
CAN127-1275-0028	22.45	3.111	U	44.9	6.75	1.910	U	13.5
CAN127-1275-0038	22.15	3.098	U	44.3	3.3	1.194	U	6.6
CAN127-1275-0048	22.25	3.102	U	44.5	3.35	1.209	U	6.7
CAN127-1275-0058	22.35	3.107	U	44.7	3.35	1.209	U	6.7
CAN127-1276-0000	80.5	4.388		41.6	3.1	1.131	U	6.2
CAN127-1276-0002	21.6	3.073	U	43.2	3.25	1.179	U	6.5
CAN127-1276-0004	21.65	3.075	U	43.3	6.5	1.872	U	13
CAN127-1276-0008	22.05	3.093	U	44.1	6.6	1.887	U	13.2
CAN127-1276-0018	21.95	3.089	U	43.9	3.3	1.194	U	6.6
CAN127-1276-0028	21.85	3.084	U	43.7	3.25	1.179	U	6.5
CAN127-1276-0038	22.05	3.093	U	44.1	3.3	1.194	U	6.6
CAN127-1276-0048	21.95	3.089	U	43.9	3.3	1.194	U	6.6
CAN127-1276-0058	21.6	3.073	U	43.2	3.25	1.179	U	6.5
CAN127-1277-0000	44.1	3.786		42.1	3.15	1.147	U	6.3
CAN127-1277-0002	21.55	3.070	U	43.1	3.25	1.179	U	6.5
CAN127-1277-0004	21.8	3.082	U	43.6	3.25	1.179	U	6.5

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	TPH (mg/kg)				Antimony (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1277-0008	22.1	3.096	U	44.2	3.3	1.194	U	6.6
CAN127-1277-0018	22.7	3.122	U	45.4	3.4	1.224	U	6.8
CAN127-1277-0028	22.3	3.105	U	44.6	3.35	1.209	U	6.7
CAN127-1277-0038	22.05	3.093	U	44.1	3.3	1.194	U	6.6
CAN127-1277-0048	22	3.091	U	44	3.3	1.194	U	6.6
CAN127-1277-0058	22.1	3.096	U	44.2	3.3	1.194	U	6.6
CAN127-1278-0000	21.1	3.049	U	42.2	3.15	1.147	U	6.3
CAN127-1278-0002	21.8	3.082	U	43.6	3.25	1.179	U	6.5
CAN127-1278-0004	21.8	3.082	U	43.6	6.55	1.879	U	13.1
CAN127-1278-0008	170	5.136		44.4	3.35	1.209	U	6.7
CAN127-1278-0018	55.9	4.024		45.7	6.85	1.924	U	13.7
CAN127-1278-0028	21.45	3.066	U	44.9	3.35	1.209	U	6.7
CAN127-1278-0038	22.1	3.096	U	44.2	3.3	1.194	U	6.6
CAN127-1278-0048	22.2	3.100	U	44.4	3.35	1.209	U	6.7
CAN127-1278-0058	22.55	3.116	U	45.1	3.4	1.224	U	6.8
Number	62	62			62	62.		
Minimum	46.6				7.80			
Maximum	344				7.80			
Average	38.9	3.353			5.18	1.500		
H statistic		1.925				1.830		
Standard Deviation	53.8	0.605			3.64	0.486		
95% UCL	39.9	39.9			5.65	5.65		
RME	39.9				5.65			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Barium (mg/kg)				Cadmium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	91.7	4.519		1.2	0.29	-1.238	U	0.58
CAN127-1271-0002	971	6.878		2.3	3	1.099		1.2
CAN127-1271-0004	285	5.652		2.3	2.1	0.742		1.2
CAN127-1271-0008	163	5.094		2.3	2	0.693		1.1
CAN127-1272-0000	91.9	4.521		1.2	1.1	0.095		0.58
CAN127-1272-0002	206	5.328		6	4.2	1.435		3
CAN127-1272-0004	435	6.075		5.9	2.9	1.065		2.9
CAN127-1272-0008	98.4	4.589		2.4	1.8	0.588		1.2
CAN127-1273-0000	115	4.745		1	0.26	-1.347	U	0.52
CAN127-1273-0002	99	4.595		1.1	0.275	-1.291	U	0.55
CAN127-1273-0004	255	5.541		2.2	0.55	-0.598	U	1.1
CAN127-1273-0008	93.9	4.542		1.1	0.275	-1.291	U	0.55
CAN127-1273-0018	110	4.700		2.2	0.55	-0.598	U	1.1
CAN127-1273-0028	137	4.920		1.1	0.275	-1.291	U	0.55
CAN127-1273-0038	61.9	4.126		1.1	0.275	-1.291	U	0.55
CAN127-1273-0048	106	4.663		1.1	0.275	-1.291	U	0.55
CAN127-1273-0058	12.9	2.557		1.1	0.27	-1.309	U	0.54
CAN127-1274-0000	125	4.828	J	1.1	0.49	-0.713	J	0.55
CAN127-1274-0002	75.7	4.327	J	1.1	0.275	-1.291	U	0.55
CAN127-1274-0004	517	6.248		2.2	0.55	-0.598	U	1.1
CAN127-1274-0008	100	4.605	J	2.3	0.55	-0.598	U	1.1
CAN127-1274-0018	68.2	4.222	J	1.1	0.275	-1.291	U	0.55
CAN127-1274-0028	74.4	4.309	J	2.2	0.55	-0.598	U	1.1
CAN127-1274-0038	42.6	3.752	J	1.1	0.28	-1.273	U	0.56
CAN127-1274-0048	56.1	4.027	J	1.1	0.275	-1.291	U	0.55
CAN127-1274-0058	17.1	2.839	J	1.1	0.27	-1.309	U	0.54
CAN127-1275-0000	245	5.501	J	1	0.53	-0.635		0.52
CAN127-1275-0002	104	4.644	J	2.3	0.6	-0.511	U	1.2
CAN127-1275-0004	435	6.075	J	5.7	1.45	0.372	U	2.9
CAN127-1275-0008	167	5.118	J	2.3	0.6	-0.511	U	1.2
CAN127-1275-0018	445	6.098	J	5.8	1.45	0.372	U	2.9
CAN127-1275-0028	65.4	4.181	J	2.2	0.55	-0.598	U	1.1
CAN127-1275-0038	148	4.997	J	1.1	0.275	-1.291	U	0.55
CAN127-1275-0048	36.6	3.600	J	1.1	0.28	-1.273	U	0.56
CAN127-1275-0058	545	6.301	J	1.1	0.28	-1.273	U	0.56
CAN127-1276-0000	74.3	4.308		1	0.26	-1.347	U	0.52
CAN127-1276-0002	105	4.654		1.1	0.27	-1.309	U	0.54
CAN127-1276-0004	107	4.673		2.2	0.55	-0.598	U	1.1
CAN127-1276-0008	95.7	4.561		2.2	0.55	-0.598	U	1.1
CAN127-1276-0018	302	5.710		1.1	0.275	-1.291	U	0.55
CAN127-1276-0028	96.4	4.569		1.1	0.275	-1.291	U	0.55
CAN127-1276-0038	23.7	3.165		1.1	0.275	-1.291	U	0.55
CAN127-1276-0048	27.8	3.325		1.1	0.275	-1.291	U	0.55
CAN127-1276-0058	20.6	3.025		1.1	0.27	-1.309	U	0.54
CAN127-1277-0000	84.1	4.432		1.1	0.265	-1.328	U	0.53
CAN127-1277-0002	102	4.625		1.1	0.27	-1.309	U	0.54
CAN127-1277-0004	72.9	4.289		1.1	1.5	0.405		0.55

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Barium (mg/kg)				Cadmium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1277-0008	98.4	4.589		1.1	0.92	-0.083		0.55
CAN127-1277-0018	101	4.615		1.1	1.1	0.095		0.57
CAN127-1277-0028	157	5.056		1.1	1.2	0.182		0.56
CAN127-1277-0038	158	5.063		1.1	0.86	-0.151		0.55
CAN127-1277-0048	41.7	3.731		1.1	0.275	-1.291	U	0.55
CAN127-1277-0058	84.6	4.438		1.1	1.1	0.095		0.55
CAN127-1278-0000	83.8	4.428		1.1	0.265	-1.328	U	0.53
CAN127-1278-0002	79.4	4.374		1.1	0.27	-1.309	U	0.54
CAN127-1278-0004	227	5.425		2.2	2.6	0.956		1.1
CAN127-1278-0008	204	5.318		1.1	1.2	0.182		0.56
CAN127-1278-0018	242	5.489		2.3	2.4	0.875		1.1
CAN127-1278-0028	189	5.242		1.1	0.71	-0.342		0.56
CAN127-1278-0038	74.4	4.309		1.1	0.88	-0.128		0.55
CAN127-1278-0048	113	4.727		1.1	0.28	-1.273	U	0.56
CAN127-1278-0058	31.6	3.453		1.1	0.28	-1.273	U	0.56
Number	62	62			62	62		
Minimum	12.90				0.49			
Maximum	971				4.20			
Average		4.683			0.80	-0.605		
H statistic	2.08	2.075				2.075		
Standard Deviation	159.5	0.849			0.83	0.812		
95% UCL	194	194			0.94	0.94		
RME	194				0.94			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Copper (mg/kg)				Lead (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1271-0000	8.9	2.186		2.3	7.3	1.988		0.58
CAN127-1271-0002	2.8	1.030	J	4.6	2.7	0.993	J	2.9
CAN127-1271-0004	5	1.609	J	4.6	3.2	1.163		1.2
CAN127-1271-0008	2.2	0.788	J	4.6	2.5	0.916	J	2.9
CAN127-1272-0000	7.3	1.988		2.3	4.4	1.482		2.9
CAN127-1272-0002	2.6	0.956	J	12.1	1.6	0.470	J	6
CAN127-1272-0004	1.9	0.642	J	11.8	2.4	0.875	J	2.9
CAN127-1272-0008	2.2	0.788	J	4.8	2.4	0.875	J	3
CAN127-1273-0000	6.8	1.917		2.1	30.8	3.428		10.5
CAN127-1273-0002	7.9	2.067		2.2	8	2.079		1.1
CAN127-1273-0004	5.2	1.649		4.4	4.2	1.435		0.55
CAN127-1273-0008	2.6	0.956		2.2	3.2	1.163		0.55
CAN127-1273-0018	2.3	0.833	J	4.5	4	1.386		0.56
CAN127-1273-0028	2	0.693	J	2.2	3.1	1.131		2.8
CAN127-1273-0038	2.2	0.788		2.2	2.9	1.065		0.55
CAN127-1273-0048	1.5	0.405	J	2.2	2.3	0.833		0.55
CAN127-1273-0058	1.3	0.262	J	2.1	1.6	0.470		0.54
CAN127-1274-0000	8.5	2.140		2.2	12.6	2.534		2.8
CAN127-1274-0002	8	2.079		2.2	8.4	2.128		0.55
CAN127-1274-0004	2.5	0.916	J	4.4	4.6	1.526		0.55
CAN127-1274-0008	1.1	0.095	J	4.5	3.2	1.163		0.57
CAN127-1274-0018	3	1.099		2.2	4.4	1.482		1.1
CAN127-1274-0028	1.3	0.262	J	4.5	2.9	1.065		0.56
CAN127-1274-0038	1.3	0.262	J	2.2	2.4	0.875		0.56
CAN127-1274-0048	1.2	0.182	J	2.2	2.3	0.833		0.55
CAN127-1274-0058	1.1	0.095	J	2.2	2	0.693		0.54
CAN127-1275-0000	25.9	3.254		2.1	29.2	3.374		5.2
CAN127-1275-0002	5.9	1.775		4.6	6.7	1.902		0.58
CAN127-1275-0004	5.7	1.740	U	11.4	3	1.099		0.57
CAN127-1275-0008	1.8	0.588	J	4.7	2.7	0.993		0.58
CAN127-1275-0018	3.2	1.163	J	11.5	3.1	1.131		0.58
CAN127-1275-0028	1.7	0.531	J	4.5	1.7	0.531		0.56
CAN127-1275-0038	2.7	0.993		2.2	1.9	0.642		0.55
CAN127-1275-0048	1.9	0.642	J	2.2	2.2	0.788		0.56
CAN127-1275-0058	1.5	0.405	J	2.2	2.5	0.916		0.56
CAN127-1276-0000	6.3	1.841		2.1	48.2	3.875		10.4
CAN127-1276-0002	8.4	2.128		2.2	9.2	2.219		1.1
CAN127-1276-0004	4.8	1.569		4.3	5.8	1.758		1.1
CAN127-1276-0008	1.5	0.405	J	4.4	3.1	1.131		1.1
CAN127-1276-0018	2.7	0.993		2.2	4.5	1.504		1.1
CAN127-1276-0028	2.8	1.030		2.2	3.1	1.131		0.55
CAN127-1276-0038	1.8	0.588	J	2.2	2.5	0.916		1.1
CAN127-1276-0048	2	0.693	J	2.2	2.6	0.956		1.1
CAN127-1276-0058	2.7	0.993		2.2	2.6	0.956		1.1
CAN127-1277-0000	7.1	1.960		2.1	43.2	3.766		5.3
CAN127-1277-0002	9.9	2.293		2.2	9.2	2.219		1.1
CAN127-1277-0004	5.4	1.686		2.2	3.05	1.115	U	6.1

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Copper (mg/kg)				Lead (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN127-1277-0008	2.8	1.030		2.2	4.6	1.526		0.55
CAN127-1277-0018	5.5	1.705		2.3	7.4	2.001		1.1
CAN127-1277-0028	2.4	0.875		2.2	3.1	1.131		0.56
CAN127-1277-0038	2.2	0.788		2.2	3.4	1.224		0.55
CAN127-1277-0048	2.1	0.742	J	2.2	3	1.099		0.55
CAN127-1277-0058	54.9	4.006		2.2	3.9	1.361		0.55
CAN127-1278-0000	7.3	1.988		2.1	42.4	3.747		5.3
CAN127-1278-0002	9.1	2.208		2.2	7.5	2.015		0.54
CAN127-1278-0004	4.1	1.411	J	4.4	4.9	1.589		0.55
CAN127-1278-0008	4	1.386		2.2	5.8	1.758		0.56
CAN127-1278-0018	3.7	1.308	J	4.6	5.1	1.629		0.57
CAN127-1278-0028	3.1	1.131		2.2	4	1.386		0.56
CAN127-1278-0038	2	0.693	J	2.2	4.2	1.435		0.55
CAN127-1278-0048	1.6	0.470	J	2.2	2.1	0.742		0.56
CAN127-1278-0058	1.8	0.588	J	2.3	2.3	0.833		0.56
Number	62	62			62	62		
Minimum	1.10				1.60			
Maximum	54.9				48.2			
Average	4.92	1.198			6.83	1.459		
H statistic		2.035				2.035		
Standard Deviation	7.45	0.769			10.01	0.800		
95% UCL	5.44	5.44			7.29	7.29		
RME	5.44				7.29			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Mercury (mg/kg)				Silver (mg/kg)				Thallium (mg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL
CAN127-1271-0000	0.06	-2.813	U	0.12	0.69	-0.371	J	1.2		U	2.3
CAN127-1271-0002	0.06	-2.813	U	0.12	1.1	0.095	J	2.3		UJ	1.2
CAN127-1271-0004	0.06	-2.813	U	0.12	1.2	0.182	J	2.3		UJ	1.2
CAN127-1271-0008	0.055	-2.900	U	0.11	0.84	-0.174	J	2.3		UJ	1.1
CAN127-1272-0000	0.06	-2.813	U	0.12	0.68	-0.386	J	1.2		UJ	1.2
CAN127-1272-0002	0.06	-2.813	U	0.12	3.6	1.281	J	6		UJ	1.2
CAN127-1272-0004	0.06	-2.813	U	0.12	2.6	0.956	J	5.9		UJ	1.2
CAN127-1272-0008	0.06	-2.813	U	0.12	1.4	0.336	J	2.4		UJ	1.2
CAN127-1273-0000	0.05	-2.996	U	0.1	0.5	-0.693	U	1		U	0.52
CAN127-1273-0002	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1	0.13	J	0.55
CAN127-1273-0004	0.055	-2.900	U	0.11	1.1	0.095	U	2.2		UJ	1.1
CAN127-1273-0008	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	1.1
CAN127-1273-0018	0.055	-2.900	U	0.11	1.1	0.095	U	2.2		UJ	1.1
CAN127-1273-0028	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	1.1
CAN127-1273-0038	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.55
CAN127-1273-0048	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.55
CAN127-1273-0058	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.54
CAN127-1274-0000	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.55
CAN127-1274-0002	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.55
CAN127-1274-0004	0.055	-2.900	U	0.11	1.1	0.095	U	2.2		UJ	1.1
CAN127-1274-0008	0.055	-2.900	U	0.11	1.15	0.140	U	2.3		UJ	1.1
CAN127-1274-0018	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	0.55
CAN127-1274-0028	0.055	-2.900	U	0.11	1.1	0.095	U	2.2		UJ	0.56
CAN127-1274-0038	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	0.56
CAN127-1274-0048	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	0.55
CAN127-1274-0058	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	0.54
CAN127-1275-0000	0.05	-2.996	U	0.1	0.5	-0.693	U	1		U	0.52
CAN127-1275-0002	0.06	-2.813	U	0.12	1.15	0.140	U	2.3		UJ	0.58
CAN127-1275-0004	0.055	-2.900	U	0.11	2.85	1.047	U	5.7		UJ	1.1
CAN127-1275-0008	0.06	-2.813	U	0.12	1.15	0.140	U	2.3		UJ	1.2
CAN127-1275-0018	0.06	-2.813	U	0.12	2.9	1.065	U	5.8		UJ	1.2
CAN127-1275-0028	0.055	-2.900	U	0.11	1.1	0.095	U	2.2		UJ	1.1
CAN127-1275-0038	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	0.55
CAN127-1275-0048	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	0.56
CAN127-1275-0058	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	1.1
CAN127-1276-0000	0.05	-2.996	U	0.1	0.5	-0.693	U	1		U	0.52
CAN127-1276-0002	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1	0.14	J	0.54
CAN127-1276-0004	0.055	-2.900	U	0.11	1.1	0.095	U	2.2		UJ	1.1
CAN127-1276-0008	0.055	-2.900	U	0.11	1.1	0.095	U	2.2		UJ	1.1
CAN127-1276-0018	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	1.1
CAN127-1276-0028	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	1.1
CAN127-1276-0038	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.55
CAN127-1276-0048	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.55
CAN127-1276-0058	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.54
CAN127-1277-0000	0.055	-2.900	U	0.11	0.43	-0.844	J	1.1		U	0.53
CAN127-1277-0002	0.055	-2.900	U	0.11	0.47	-0.755	J	1.1		U	0.54
CAN127-1277-0004	0.055	-2.900	U	0.11	0.47	-0.755	J	1.1		UJ	1.1

TABLE 10-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT POL WASH RACK (SWMU 127)

	Mercury (mg/kg)				Silver (mg/kg)				Thallium (mg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL
CAN127-1277-0008	0.055	-2.900	U	0.11	0.54	-0.616	J	1.1		UJ	1.1
CAN127-1277-0018	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		U	0.57
CAN127-1277-0028	0.055	-2.900	U	0.11	0.43	-0.844	J	1.1		U	0.56
CAN127-1277-0038	0.055	-2.900	U	0.11	0.51	-0.673	J	1.1		UJ	1.1
CAN127-1277-0048	0.055	-2.900	U	0.11	0.48	-0.734	J	1.1		U	0.55
CAN127-1277-0058	0.055	-2.900	U	0.11	0.35	-1.050	J	1.1		U	0.55
CAN127-1278-0000	0.11	-2.207		0.11	0.53	-0.635	J	1.1		U	0.53
CAN127-1278-0002	0.055	-2.900	U	0.11	0.45	-0.799	J	1.1		U	0.54
CAN127-1278-0004	0.055	-2.900	U	0.11	1.2	0.182	J	2.2		UJ	1.1
CAN127-1278-0008	0.055	-2.900	U	0.11	0.8	-0.223	J	1.1		U	0.56
CAN127-1278-0018	0.055	-2.900	U	0.11	1.6	0.470	J	2.3		UJ	1.1
CAN127-1278-0028	0.055	-2.900	U	0.11	0.48	-0.734	J	1.1		UJ	1.1
CAN127-1278-0038	0.055	-2.900	U	0.11	0.62	-0.478	J	1.1		U	0.55
CAN127-1278-0048	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	0.56
CAN127-1278-0058	0.055	-2.900	U	0.11	0.55	-0.598	U	1.1		UJ	0.56
Number	62	62			62	62.000			2		
Minimum	0.11				0.35				0.13		
Maximum	0.11				3.00				0.14		
Average	0.06	-2.880			0.86	-0.319			0.14		
H statistic		1.670				1.860					
Standard Deviation	0.01	0.096			0.64	0.516					
95% UCL	0.06	0.06			0.94	0.94					
RME	0.06				0.94				0.14		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 10-9
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SURFACE SOIL
SWMU 127

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
1,2-Dichloroethane	0.0019	0.0019	0.0005	9.50E-07	9.50E-07
1,2-Dichloropropane	0.0028	0.0034	0.03	8.40E-05	1.02E-04
Acenaphthene	0.15	0.15	0.1	0.015	0.015
Anthracene	0.048	0.048	0.1	0.0048	0.0048
Benzo(a)anthracene	1.20	8.00	0.1	0.12	0.8
Benzo(a)pyrene	1.30	8.60	0.1	0.13	0.86
Benzo(b)fluoranthene	2.50	17.0	0.1	0.25	1.7
Carbozole	0.39	1.50	0.1	0.039	0.15
Chrysene	2.00	14.0	0.1	0.2	1.4
Fluoranthene	2.60	17.0	0.1	0.26	1.7
Fluorene	0.26	0.29	0.1	0.026	0.029
Indeno(1,2,3-cd)pyrene	0.86	5.10	0.1	0.086	0.51
Mercury	0.06	0.08	0.01	0.0006	0.0008
Pyrene	2.50	17.0	0.1	0.25	1.7
Toluene	0.006	0.013	0.03	1.80E-04	3.90E-04
Xylenes	0.004	0.008	0.03	1.20E-04	2.40E-04

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 10-10
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
TOTAL SOIL
SWMU 127

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
1,2-Dichloropropane	0.0031	0.0032	0.03	0.00009	0.000096
Acenaphthene	0.15	0.15	0.1	0.015	0.015
Anthracene	0.048	0.048	0.1	0.0048	0.0048
Benzo(a)anthracene	0.69	0.817	0.1	0.07	0.0817
Benzo(a)pyrene	0.73	0.816	0.1	0.073	0.0816
Benzo(b)fluoranthene	1.30	1.60	0.1	0.13	0.16
Butyl benzyl phthalate	0.11	0.11	0.1	0.011	0.011
Carbozole	0.29	0.42	0.1	0.029	0.042
Chrysene	1.10	1.18	0.1	0.11	0.118
Fluoranthene	1.40	1.88	0.1	0.14	0.188
Fluorene	0.22	0.23	0.1	0.022	0.023
Indeno(1,2,3-cd)pyrene	0.52	0.73	0.1	0.052	0.073
Mercury	0.06	0.06	0.01	0.0006	0.0006
Pyrene	1.40	2.07	0.1	0.14	0.207
Toluene	0.0037	0.004	0.03	0.0001	0.00012
Xylenes	0.003	0.003	0.03	0.00009	0.00009

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 10-11

VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 127

	t (y)	Cs (µg/kg)	Co (g/m^3)	L (m)	W (m)	T (m)	VWC (L/L)	foc	Koc (ml/g)	Kd (ml/g)	Soil Half Life (y)	P (g/cm^3)	I (m/y)	H (m)	TOT (y)
1,2-Dichloropropane	0	3.1	4.96E-03	40	165	17.683	0.15	0.003	51	0.153	3.5	1.6	0.015	61.585	1621
Acenaphthene	0	150	2.40E-01	40	165	17.683	0.15	0.003	18	0.054	0.3	1.6	0.015	61.585	971
Anthracene	0	48	7.68E-02	40	165	17.683	0.15	0.003	16000	48	1.26	1.6	0.015	61.585	315931
Antimony	0	5180	8.29E+00	40	165	17.683	0.15	0.003	NA	3981	NA	1.6	0.015	61.585	26152070
Barium	0	154780	2.48E+02	40	165	17.683	0.15	0.003	NA	50	NA	1.6	0.015	61.585	329069
Benzo(a)anthracene	0	684.88	1.10E+00	40	165	17.683	0.15	0.003	1400000	4200	1.86	1.6	0.015	61.585	27590696
Benzo(a)pyrene	0	732.81	1.17E+00	40	165	17.683	0.15	0.003	6500000	19500	1.45	1.6	0.015	61.585	128097416
Benzo(b)fluoranthene	0	1329.69	2.13E+00	40	165	17.683	0.15	0.003	550000	1650	1.67	1.6	0.015	61.585	10839576
Benzylbutylphalate	0	110	1.76E-01	40	165	17.683	0.15	0.003	68	0.204	0.2	1.6	0.015	61.585	1956
Cadmium	0	800	1.28E+00	40	165	17.683	0.15	0.003	NA	7	NA	1.6	0.015	61.585	46599
Carbazole	0	290.06	4.64E-01	40	165	17.683	0.15	0.003	5100	15.3	0.2	1.6	0.015	61.585	101123
Chrysene	0	1099.69	1.76E+00	40	165	17.683	0.15	0.003	250000	750	2.72	1.6	0.015	61.585	4927416
Copper	0	4920	7.87E+00	40	165	17.683	0.15	0.003	NA	20	NA	1.6	0.015	61.585	131997
Fluoranthene	0	1384.06	2.21E+00	40	165	17.683	0.15	0.003	1380	4.14	1.21	1.6	0.015	61.585	27812
Fluorene	0	221.88	3.55E-01	40	165	17.683	0.15	0.003	5010	15.03	0.2	1.6	0.015	61.585	99349
Indeno(1,2,3-c)pyrene	0	523.5	8.38E-01	40	165	17.683	0.15	0.003	31000000	93000	2	1.6	0.015	61.585	610923816
Lead	0	6830	1.09E+01	40	165	17.683	0.15	0.003	NA	100	NA	1.6	0.015	61.585	657523
Mercury	0	60	9.60E-02	40	165	17.683	0.15	0.003	NA	100	NA	1.6	0.015	61.585	657523
Pyrene	0	1443.67	2.31E+00	40	165	17.683	0.15	0.003	38000	114	5.2	1.6	0.015	61.585	749489
Silver	0	860	1.38E+00	40	165	17.683	0.15	0.003	NA	100	NA	1.6	0.015	61.585	657523
Thallium	0	140	2.24E-01	40	165	17.683	0.15	0.003	NA	2000	NA	1.6	0.015	61.585	13138749
Toluene	0	3.71	5.94E-03	40	165	17.683	0.15	0.003	300	0.9	0.2	1.6	0.015	61.585	6528
Xylenes	0	2.95	4.72E-03	40	165	17.683	0.15	0.003	830	2.49	0.2	1.6	0.015	61.585	16973

t = Time where leachate concentration is estimated
Cs Concentration of chemical in source soil
(average concentration from Table 7-8)
Co Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 10-11

VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT SWMU 127

	Rd	Leach Rate (y^-1)	Qo (g)	Q(t) (g)	qc (g/y)	Cl(1) (µg/L)	Cl(2) (µg/L)	K (m/s)	i (m/m)	b (m)	Qw (m^3/y)	Ql (m^3/yr)	Cw (µg/L)
1,2-Dichloropropane	2.63E+00	2.15E-03	5.79E+02	5.79E+02	1.24E+00	1.26E+01	5.20E-139	2.00E-04	0.0019	10	19773	99	2.59E-141
Acenaphthene	1.58E+00	3.59E-03	2.80E+04	2.80E+04	1.01E+02	1.02E+03	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Anthracene	5.13E+02	1.10E-05	8.96E+03	8.96E+03	9.88E-02	9.98E-01	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Antimony	4.25E+04	1.33E-07	9.67E+05	9.67E+05	1.29E-01	1.30E+00	1.30E+00	2.00E-04	0.0019	10	19773	99	6.48E-03
Barium	5.34E+02	1.06E-05	2.89E+07	2.89E+07	3.06E+02	3.09E+03	3.09E+03	2.00E-04	0.0019	10	19773	99	1.54E+01
Benzo(a)anthracene	4.48E+04	1.26E-07	1.28E+05	1.28E+05	1.61E-02	1.63E-01	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Benzo(a)pyrene	2.08E+05	2.72E-08	1.37E+05	1.37E+05	3.72E-03	3.76E-02	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Benzo(b)fluoranthene	1.76E+04	3.21E-07	2.48E+05	2.48E+05	7.98E-02	8.06E-01	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Benzylbutylphalate	3.18E+00	1.78E-03	2.05E+04	2.05E+04	3.66E+01	3.69E+02	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Cadmium	7.57E+01	7.47E-05	1.49E+05	1.49E+05	1.12E+01	1.13E+02	1.13E+02	2.00E-04	0.0019	10	19773	99	5.62E-01
Carbazole	1.64E+02	3.44E-05	5.42E+04	5.42E+04	1.87E+00	1.88E+01	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Chrysene	8.00E+03	7.07E-07	2.05E+05	2.05E+05	1.45E-01	1.47E+00	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Copper	2.14E+02	2.64E-05	9.19E+05	9.19E+05	2.42E+01	2.45E+02	2.45E+02	2.00E-04	0.0019	10	19773	99	1.22E+00
Fluoranthene	4.52E+01	1.25E-04	2.58E+05	2.58E+05	3.24E+01	3.27E+02	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Fluorene	1.61E+02	3.51E-05	4.14E+04	4.14E+04	1.45E+00	1.47E+01	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Indeno(1,2,3-c)pyrene	9.92E+05	5.70E-09	9.78E+04	9.78E+04	5.57E-04	5.63E-03	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Lead	1.07E+03	5.30E-06	1.28E+06	1.28E+06	6.76E+00	6.82E+01	6.82E+01	2.00E-04	0.0019	10	19773	99	3.40E-01
Mercury	1.07E+03	5.30E-06	1.12E+04	1.12E+04	5.93E-02	5.99E-01	5.99E-01	2.00E-04	0.0019	10	19773	99	2.99E-03
Pyrene	1.22E+03	4.65E-06	2.70E+05	2.70E+05	1.25E+00	1.27E+01	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Silver	1.07E+03	5.30E-06	1.61E+05	1.61E+05	8.51E-01	8.59E+00	8.59E+00	2.00E-04	0.0019	10	19773	99	4.28E-02
Thallium	2.13E+04	2.65E-07	2.61E+04	2.61E+04	6.93E-03	7.00E-02	7.00E-02	2.00E-04	0.0019	10	19773	99	3.49E-04
Toluene	1.06E+01	5.34E-04	6.93E+02	6.93E+02	3.70E-01	3.73E+00	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00
Xylenes	2.76E+01	2.05E-04	5.51E+02	5.51E+02	1.13E-01	1.14E+00	0.00E+00	2.00E-04	0.0019	10	19773	99	0.00E+00

t = Time where leachate concentration is estimated
Cs Concentration of chemical in source soil
(average concentration from Table 7-8)
Co Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 10-12

COMPARISON OF MODELED GROUNDWATER CONCENTRATIONS TO RBCs(1)

	Cw(2) (µg/L)	Tap Water RBC (1) (µg/L)	Does modeled concentration exceed RBC?
1,2-Dichloropropane	2.5902E-141	0.16	No
Acenaphthene	0	2200	No
Anthracene	0	11000	No
Antimony	6.48E-03	15	No
Barium	1.54E+01	2600	No
Benzo(A)Anthracene	0	0.092	No
Benzo(A)pyrene	0	0.0092	No
Benzo(b)fluoranthene	0	0.092	No
Benzylbutylphalate	0	7300	No
Cadmium	5.62E-01	18	No
Carbazole	0	3.4	No
Chrysene	0	9.2	No
Copper	1.22E+00	1400	No
Fluoranthene	0	1500	No
Fluorene	0	1500	No
Indeno(1,2,3-C)pyrene	0	0.092	No
Lead	3.40E-01	15 (3)	No
Mercury	2.99E-03	11	No
Pyrene	0	1100	No
Silver	4.28E-02	180	No
Thallium	3.49E-04	2.9	No
Toluene	0	750	No
Xylenes	0	12000	No

(1) RBC is the EPA Region III risk-based concentration for residential tap water ingestion and inhalation.
(2) Cw is the modeled concentration as defined in table 10-11.
(3) No Region III RBC is available for lead. 15 is the action level defined in the May 1993 issue of Drinking water regulation and health advisories (EPA 1993).
The modeled concentration, zero is a value less than 1E-300.

TABLE 10-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 127

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
1,2-Dichloroethane	2.65	3.85E-03	45	2.25	2	20250000	7.90E+08	6.82E-02	0.35	0.09643
1,2-Dichloropropane	3.65	8.10E-04	45	2.25	2	20250000	7.90E+08	5.99E-02	0.35	0.08473
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 10-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 10-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 127

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
1,2-Dichloroethane	30	4.31E-03	6.00E-01	2.95E-01	2.20E+03	0.002	8.64E-07
1,2-Dichloropropane	51	2.31E-03	1.02E+00	9.29E-02	3.64E+03	0.003	8.24E-07
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.013	2.06E-06

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 10-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 10-14
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM SURFACE SOILS AT SWMU 127

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Benzo(a)anthracene	8.00	4.63E+09	1.73E-09
Benzo(a)pyrene	8.60	4.63E+09	1.86E-09
Benzo(b)fluoranthene	17.0	4.63E+09	3.67E-09
Cadmium	0.70	4.63E+09	1.51E-10
Chrysene	14.0	4.63E+09	3.02E-09
Indeno(1,2,3-cd)pyrene	5.10	4.63E+09	1.10E-09
Mercury	0.08	4.63E+09	1.73E-11

RME Soil Concentration from Table 10-7
PEF = Particulate Emission Factor default value from EPA (1991b)
Air Concentration = Soil concentration/PEF

TABLE 10-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 127

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
1,2-Dichloropropane	3.65	8.10E-04	45	2.25	2	20250000	7.90E+08	5.99E-02	0.35	0.08473
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 10-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 10-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 127

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
1,2-Dichloropropane	51	2.31E-03	1.02E+00	9.29E-02	3.64E+03	0.003	8.79E-07
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.004	6.33E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 10-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 10-16
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM TOTAL SOILS AT SWMU 127

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
Barium	194	4.63E+09	4.19E-08
Benzo(a)anthracene	0.82	4.63E+09	1.76E-10
Benzo(a)pyrene	0.82	4.63E+09	1.76E-10
Benzo(b)fluoranthene	1.60	4.63E+09	3.46E-10
Cadmium	0.94	4.63E+09	2.03E-10
Chrysene	1.18	4.63E+09	2.55E-10
Indeno(1,2,3-cd)pyrene	0.73	4.63E+09	1.57E-10
Mercury	0.06	4.63E+09	1.30E-11

RME Soil Concentration from Table 10-7
PEF = Particulate Emission Factor default value from EPA (1991b)
Air Concentration = Soil concentration/PEF

TABLE 10-17

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Inhalation (m^3/kg-d)		
Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
Carcinogenic	1.39×10^{-3}	6.99×10^{-2}
Construction Workers	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Inhalation (m^3/kg-d)		
Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
Carcinogenic	1.03×10^{-4}	4.47×10^{-4}
Trespasser	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Inhalation (m^3/kg-d)		
Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 10-18

SUMMARY OF HUMAN HEALTH RISKS AT SWMU 127

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Surface Soil)						
-- Dermal Contact	5×10^{-11}		9×10^{-7}	3×10^{-8}		7×10^{-5}
-- Ingestion	1×10^{-8}		6×10^{-5}	2×10^{-5}		7×10^{-3}
-- Inhalation of VOCs	1×10^{-10}		8×10^{-6}	6×10^{-9}		2×10^{-4}
-- Inhalation of Particulates	2×10^{-11}		2×10^{-9}	1×10^{-9}		4×10^{-8}
	1×10^{-8}		7×10^{-5}	2×10^{-5}		7×10^{-3}
Construction Worker (Total Soil)						
-- Dermal Contact	3×10^{-12}	6×10^{-7}		6×10^{-11}	9×10^{-6}	
-- Ingestion	2×10^{-9}	3×10^{-4}		2×10^{-8}	3×10^{-3}	
-- Inhalation of VOCs	0.00	2×10^{-6}		0.00	8×10^{-6}	
-- Inhalation of Particulates	3×10^{-13}	2×10^{-7}		1×10^{-12}	9×10^{-7}	
	2×10^{-9}	3×10^{-4}		2×10^{-8}	3×10^{-3}	
Trespasser (Surface Soil)						
-- Dermal Contact	9×10^{-12}	3×10^{-7}		4×10^{-9}	4×10^{-5}	
-- Ingestion	2×10^{-9}	2×10^{-5}		1×10^{-6}	2×10^{-3}	
-- Inhalation of VOCs	2×10^{-11}	8×10^{-7}		4×10^{-10}	1×10^{-5}	
-- Inhalation of Particulates	5×10^{-12}	7×10^{-10}		8×10^{-11}	1×10^{-8}	
	2×10^{-9}	2×10^{-5}		1×10^{-6}	2×10^{-3}	

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix C for nonrounded risk values.

TABLE 10-19

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies. They are under review and subject to change.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

TABLE 10-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 127 CANNON AFB (mg/kg)

Chemical	CAN127-1271-0000	CAN127-1272-0000	CAN127-1273-0000	CAN127-1273-0002	CAN127-1274-0000	CAN127-1274-0002	CAN127-1275-0000	CAN127-1275-0002	CAN127-1276-0000	CAN127-1276-0002	CAN127-1277-0000	CAN127-1277-0002
Volatile Organics												
1,2-Dichloroethane	0.0029 U	0.0029 U	0.0026 U	0.0028 U	0.0028 U	0.0028 U	0.0026 U	0.0029 U	0.0019 J	0.0027 U	0.0027 U	0.0027 U
1,2-Dichloropropane	0.0029 U	0.0029 U	0.0026 U	0.0028 U	0.0028 U	0.0028 U	0.0046 J	0.0029 U	0.0026 U	0.0027 U	0.0027 U	0.0027 U
Toluene	0.0029 U	0.0029 U	0.012	0.0028 U	0.0023 J	0.0028 J	0.0052	0.0029 U	0.015	0.0027 U	0.0055 J	0.0038 J
Xylenes (total)	0.0029 U	0.0029 U	0.0034 J	0.0028 U	0.0015 J	0.0028 U	0.0026 U	0.0029 U	0.012	0.0027 U	0.0059	0.0015 J
Semivolatile Organics												
Acenaphthene	0.19 U	0.19 U	0.175 U		0.185 U		0.15 J	0.19 U	0.17 U		0.175 U	
Anthracene	0.19 U	0.19 U	0.048 J		0.185 U		0.7 U	0.19 U	0.17 U		0.175 U	
Benzo(a)anthracene	0.19 U	0.19 U	0.51		0.083 J		8	0.19 U	0.16 J		0.19 J	
Benzo(a)pyrene	0.19 U	0.19 U	0.55		0.12 J		8.6	0.19 U	0.23 J		0.18 J	
Benzo(b)fluoranthene	0.19 U	0.19 U	0.96		0.27 J		17	0.19 U	0.41		0.39	
Benzo(g,h,i)perylene	0.19 U	0.19 U	0.47		0.072 J		5.1	0.19 U	0.19 J		0.091 J	
Carbazole	0.19 U	0.19 U	0.046 J		0.185 U		1.5	0.19 U	0.17 U		0.175 U	
Chrysene	0.19 U	0.19 U	0.72		0.21 J		14	0.19 U	0.3 J		0.24 J	
Fluoranthene	0.19 U	0.19 U	1.5		0.3 J		17	0.19 U	0.57		0.47	
Fluorene	0.19 U	0.19 U	0.175 U		0.185 U		0.29 J	0.19 U	0.17 U		0.175 U	
Ideno(1,2,3-cd)pyrene	0.19 U	0.19 U	0.39		0.068 J		5.1	0.19 U	0.16 J		0.093 J	
2-Methylnaphthalene	0.19 U	0.19 U	0.175 U		0.185 U		0.7 U	0.19 U	0.17 U		0.25 J	
Phenanthrene	0.19 U	0.19 U	0.57		0.12 J		8.1	0.19 U	0.21 J		0.19 J	
Pyrene	0.19 U	0.19 U	1.4		0.23 J		17	0.19 U	0.55		0.44	
Metals												
Aluminum	9270	7220	7650	11600	7490	9560	6530	8570	7170	11400	5640	8800
Antimony	3.5 U	3.5 U	3.2 U	3.3 U	3.3 U	3.3 U	7.8	6.9 U	3.1 U	3.3 U	3.2 U	3.3 U
Arsenic	2	1.9	2.2	2.4	2.9	2.3	2.1	2.1	2	2.4	2.2	2.8
Barium	91.7	91.9	115	99	125 J	75.7 J	245 J	104 J	74.3	105	84.1	102
Beryllium	0.67	0.53	0.46	0.7	0.82	0.83	0.45	0.65	0.43	0.7	0.49	0.72
Cadmium	0.29 UJ	1.1	0.26 U	0.28 U	0.49 J	0.28 U	0.53	0.6 U	0.26 U	0.27	0.27 U	0.27 U
Calcium	19200 J	56900	10300	14000	7210	4820	45300	106000	6630	4740	18200	16700
Chromium	9.9	7.3	16.9	10.3	9.4	10	15.3	5.8	9.9	9.3	9.9	9.5
Cobalt	4.5	3.7	3.4	4.8	5.3	5.2	2.8	4.3	2.9	4.9	3.4	4.8
Copper	8.9	7.3	6.8	7.9	8.5	8	25.9	5.9	6.3	8.4	7.1	9.9
Iron	8610	6380	7770	10500	8420	9250	7650	7920	5990	8990	6260	8960

TABLE 10-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 127 CANNON AFB (mg/kg)

Chemical	CAN127-1271-0000	CAN127-1272-0000	CAN127-1273-0000	CAN127-1273-0002	CAN127-1274-0000	CAN127-1274-0002	CAN127-1275-0000	CAN127-1275-0002	CAN127-1276-0000	CAN127-1276-0002	CAN127-1277-0000	CAN127-1277-0002
Lead	7.3	4.4	30.8	8	12.6	8.4	29.2	6.7	48.2	9.2	43.2	9.2
Magnesium	2030	1890	1570	2360	1800	2180	1850	2640	1300	2510	1340	2270
Manganese	179	138	166	206	246	213	332	127	141	218	154	189
Mercury	0.06 U	0.06 U	0.05 U	0.06 U	0.06 U	0.06 U	0.05 U	0.06 U	0.05 U	0.06 U	0.06 U	0.06 U
Nickel	10.4	8	7	11.4	9.5	12.4	6.8	10.1	6.2	10.5	6.6	10.4
Potassium	1680	1410	1910	2400	1390	1760	1180	1550	2060	2520	1540	1760
Selenium	0.6 UJ	0.6 UJ	0.26 UJ	0.6 UJ	0.27 J	0.28 UJ	0.26 UJ	0.6 UJ	0.26 UJ	0.27 UJ	0.27 UJ	0.06 UJ
Silver	0.69 J	0.68 J	0.5 U	0.6 U	0.6 U	0.6 U	0.5 U	1.15 U	0.5 U	0.6 U	0.43 J	0.47 J
Thallium	1.2 U	0.6 UJ	0.26 U	0.13 J	0.28 U	0.28 U	0.26 U	0.29 UJ	0.26 U	0.14 J	0.27 U	0.27 U
Vanadium	17.9	14.2	17.6	21.4	23	19.2	16.5	15.8	12.9	17.7	14.6	18.6
Zinc	21.9	17.4	25.4	24.4	20.4	21.7	38.5	18	25.3	24	24.1	21
TPH	23.1 U	93.2	66.8	21.8 U	253 J	22 U	344	23.1 U	80.5	21.6 U	44.1	21.6 U

* Between 0 and 2 feet deep

R Rejected

J Estimated value below reporting limit or estimated based on data quality criteria

U Non-detect, value shown i s one-half the reporting limit

TABLE 10-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 127 CANNON AFB (mg/kg)

Chemical	CAN127-1278-0000	CAN127-1278-0002	N	Arithmetic Mean	95% UCL	Maximum
Volatile Organics						
1,2-Dichloroethane	0.0027 U	0.0027 U	14	0.003	0.003	0.003
1,2-Dichloropropane	0.0027 U	0.0027 U	14	0.003	0.003	0.005
Toluene	0.0027 U	0.0027 U	14	0.005	0.006	0.015
Xylenes (total)	0.0027 U	0.0027 U	14	0.004	0.005	0.012
Semivolatile Organics						
Acenaphthene	0.7 U		9	0.236	0.34	0.70
Anthracene	0.7 U		9	0.283	0.43	0.70
Benzo(a)anthracene	0.15 J		9	1.074	2.62	8.00
Benzo(a)pyrene	0.18 J		9	1.159	2.82	8.60
Benzo(b)fluoranthene	0.38 J		9	2.220	5.52	17.00
Benzo(g,h,i)perylene	0.7 U		9	0.799	1.77	5.10
Carbazole	0.7 U		9	0.372	0.65	1.50
Chrysene	0.26 J		9	1.811	4.54	14.00
Fluoranthene	0.44 J		9	2.317	5.60	17.00
Fluorene	0.7 U		9	0.252	0.35	0.70
Ideno(1,2,3-cd)pyrene	0.7 U		9	0.787	1.76	5.10
2-Methylnaphthalene	0.7 U		9	0.306	0.44	0.70
Phenanthrene	0.19 J		9	1.106	2.67	8.10
Pyrene	0.36 J		9	2.283	5.58	17.00
Metals						
Aluminum	6790	8050	14	8267	9061.27	11600
Antimony	3.2 U	3.3 U	14	3.9	4.55	7.80
Arsenic	2.3	2.6	14	2.3	2.44	2.90
Barium	83.8	79.4	14	105.4	124.95	245.00
Beryllium	0.45	0.68	14	0.61	0.68	0.83
Cadmium	0.27 U	0.27 U	14	0.39	0.50	1.10
Calcium	5730	43500	14	25659	38717	106000
Chromium	11.3	8.8	14	10.3	11.55	16.90
Cobalt	3.3	4.4	14	4.1	4.51	5.30
Copper	7.3	9.1	14	9.1	11.36	25.90
Iron	7060	7800	14	7969	8548.91	10500

TABLE 10-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 127 CANNON AFB (mg/kg)

Chemical	CAN127-1278-0000	CAN127-1278-0002	N	Arithmetic Mean	95% UCL	Maximum
Lead	42.4	7.5	14	19.1	26.38	48.20
Magnesium	1220	2300	14	1947	2156.92	2640
Manganese	151	168	14	188	212.33	332
Mercury	0.11	0.06 U	14	0.06	0.07	0.11
Nickel	6.9	9.8	14	9.0	9.92	12.40
Potassium	1630	1650	14	1746	1916.40	2520
Selenium	0.27 U	0.6 UJ	14	0.4	0.46	0.60
Silver	0.53 J	0.45 J	14	0.59	0.67	1.15
Thallium	0.27 U	0.27 U	14	0.34	0.46	1.20
Vanadium	14.6	16.9	14	17.2	18.48	23.00
Zinc	22.1	19.4	14	23.1	25.44	38.50
TPH	21.2 U	21.8 U	14	75.6	120.79	344.00

* Between 0 and 2 feet deep

R Rejected

J Estimated value below reporting limit or estimated based on data quality criteria

U Non-detect, value shown i s one-half the reporting limit

TABLE 10-21

CHEMICALS OF CONCERN IN SOILS SWMU 127
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Volatile Organics					
1,2-Dichloroethane	0.0029	---	---	---	Y
1,2-Dichloropropane	0.0046	---	---	---	Y
Toluene	0.015	---	---	---	Y
Xylenes	0.012	---	---	---	Y
Semivolatile Organics					
Acenaphthene	0.7	---	---	---	Y
Anthracene	0.7	---	---	---	Y
Benzo(a)anthracene	8	---	---	---	Y
Benzo(a)pyrene	8.6	---	---	---	Y
Benzo(b)fluoranthene	17	---	---	---	Y
Benzo(g,h,i)perylene	5.1	---	---	---	Y
Carbazole	1.5	---	---	---	Y
Chrysene	14	---	---	---	Y
Fluoranthene	17	---	---	---	Y
Fluorene	0.7	---	---	---	Y
Ideno(1,2,3-cd)pyrene	5.1	---	---	---	Y
2-Methylnaphthalene	0.7	---	---	---	Y
Phenanthrene	8.1	---	---	---	Y
Pyrene	17	---	---	---	Y
Metals					
Aluminum	11600	10540	5000	700 - 100000	Y
Antimony	7.8	*	<1	0.2 - 10	Y
Arsenic	2.9	15.5	6.5	1.0 - 40	N
Barium	245	642	500	10 - 5,000	N
Beryllium	0.83	0.73	1 - 2	<1 - 15	N
Cadmium	1.1	*	---	0.01 - 2.0	Y
Calcium	106000	186400	---	---	N**
Chromium	16.9	12.5	30	5 -1,500	N
Cobalt	5.3	4.5	3 - 7	0.5 - 65	N
Copper	25.9	*	20	1 - 700	Y
Iron	105000	8720	15000	100 - 100000	N
Lead	48.2	25.8	15	10 - 700	Y
Magnesium	2640	11790	---	---	N**
Manganese	332	164	500	20 - 10000	N

TABLE 10-21

CHEMICALS OF CONCERN IN SOILS SWMU 127
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Mercury	0.11	*	0.32	<0.01 - 4.6	N
Nickel	12.4	9	15	2 - 750	N
Potassium	2520	2572	---	---	N**
Selenium	0.6	*	0.3	<0.1 - 4.3	Y
Silver	1.15	*	---	0.01 - 8	Y
Thallium	1.2	*	---	---	Y
Vanadium	23	25.3	---	---	N
Zinc	38.5	21.9	45	<5 - 2900	N
TPH	344	---	---	---	Y

(1) Upper Tolerance Limit (UTL) of the mean = mean + 2 x standard deviation. This is for all practical purposes the same the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k = 2.02 for n =

(2) USGS (1984)

(3) Values mainly from Bowen (1979). Values for copper, lead, selenium, and zinc from USGS (1984).

* Data insufficient to calculate UTL of background concentration.

** Essential nutrient natural to soils. Not expected to be of concern compared to other COCs.

Y = Yes

N = No

--- = Not available

TABLE 10-22
RISK CHARACTERIZATION SUMMARY - SWMU 127

Chemical	Sample Number											
	CAN127-1271-0000	CAN127-1272-0000	CAN127-1273-0000	CAN127-1273-0002	CAN127-1274-0000	CAN127-1274-0002	CAN127-1275-0000	CAN127-1275-0002	CAN127-1276-0000	CAN127-1276-0002	CAN127-1277-0000	CAN127-1277-0002
Volatile Organics												
1,2-Dichloroethane	0.0029 U	0.0029 U	0.0026 U	0.0028 U	0.0028 U	0.0028 U	0.0026 U	0.0029 U	0.0019 J	0.0027 U	0.0027 U	0.0027 U
1,2-Dichloropropane	0.0029 U	0.0029 U	0.0026 U	0.0028 U	0.0028 U	0.0028 U	0.0046 J	0.0029 U	0.0026 U	0.0027 U	0.0027 U	0.0027 U
Toluene	0.0029 U	0.0029 U	0.012	0.0028 U	0.0023 J	0.0028 J	0.0052	0.0029 U	0.015	0.0027 U	0.0055 J	0.0038 J
Xylenes (total)	0.0029 U	0.0029 U	0.0034 J	0.0028 U	0.0015 J	0.0028 U	0.0026 U	0.0029 U	0.012	0.0027 U	0.0059	0.0015 J
Semivolatile Organics												
Acenaphthene	0.19 U	0.19 U	0.175 U		0.185 U		0.15 J	0.19 U	0.17 U		0.175 U	
Anthracene	0.19 U	0.19 U	0.048 J		0.185 U		0.7 U	0.19 U	0.17 U		0.175 U	
Benzo(a)anthracene	0.19 U	0.19 U	0.51		0.083 J		8	0.19 U	0.16 J		0.19 J	
Benzo(a)pyrene	0.19 U	0.19 U	0.55		0.12 J		8.6	0.19 U	0.23 J		0.18 J	
Benzo(b)fluoranthene	0.19 U	0.19 U	0.96		0.27 J		17	0.19 U	0.41		0.39	
Benzo(g,h,i)perylene	0.19 U	0.19 U	0.47		0.072 J		5.1	0.19 U	0.19 J		0.091 J	
Carbazole	0.19 U	0.19 U	0.046 J		0.185 U		1.5	0.19 U	0.17 U		0.175 U	
Chrysene	0.19 U	0.19 U	0.72		0.21 J		14	0.19 U	0.3 J		0.24 J	
Fluoranthene	0.19 U	0.19 U	1.5		0.3 J		17	0.19 U	0.57		0.47	
Fluorene	0.19 U	0.19 U	0.175 U		0.185 U		0.29 J	0.19 U	0.17 U		0.175 U	
Ideno(1,2,3-cd)pyrene	0.19 U	0.19 U	0.39		0.068 J		5.1	0.19 U	0.16 J		0.093 J	
2-Methylnaphthalene	0.19 U	0.19 U	0.175 U		0.185 U		0.7 U	0.19 U	0.17 U		0.25 J	
Phenanthrene	0.19 U	0.19 U	0.57		0.12 J		8.1	0.19 U	0.21 J		0.19 J	
Pyrene	0.19 U	0.19 U	1.4		0.23 J		17	0.19 U	0.55		0.44	
Metals												
Aluminum	9270	7220	7650	11600	7490	9560	6530	8570	7170	11400	5640	8800
Antimony	3.5 U	3.5 U	3.2 U	3.3 U	3.3 U	3.3 U	7.8	6.9 U	3.1 U	3.3 U	3.2 U	3.3 U
Cadmium	0.29 UJ	1.1	0.26 U	0.28 U	0.49 J	0.28 U	0.53	0.6 U	0.26 U	0.27	0.27 U	0.27 U
Copper	8.9	7.3	6.8	7.9	8.5	8	25.9	5.9	6.3	8.4	7.1	9.9
Lead	7.3	4.4	30.8	8	12.6	8.4	29.2	6.7	48.2	9.2	43.2	9.2
Selenium	0.6 UJ	0.6 UJ	0.26 UJ	0.6 UJ	0.27 J	0.28 UJ	0.26 UJ	0.6 UJ	0.26 UJ	0.27 UJ	0.27 UJ	0.06 UJ
Silver	0.69 J	0.68 J	0.5 U	0.6 U	0.6 U	0.6 U	0.5 U	1.15 U	0.5 U	0.6 U	0.43 J	0.47 J
Thallium	1.2 U	0.6 UJ	0.26 U	0.13 J	0.28 U	0.28 U	0.26 U	0.29 UJ	0.26 U	0.14 J	0.27 U	0.27 U
TPH	23.1 U	93.2	66.8	21.8 U	253 J	22 U	344	23.1 U	80.5	21.6 U	44.1	21.6 U

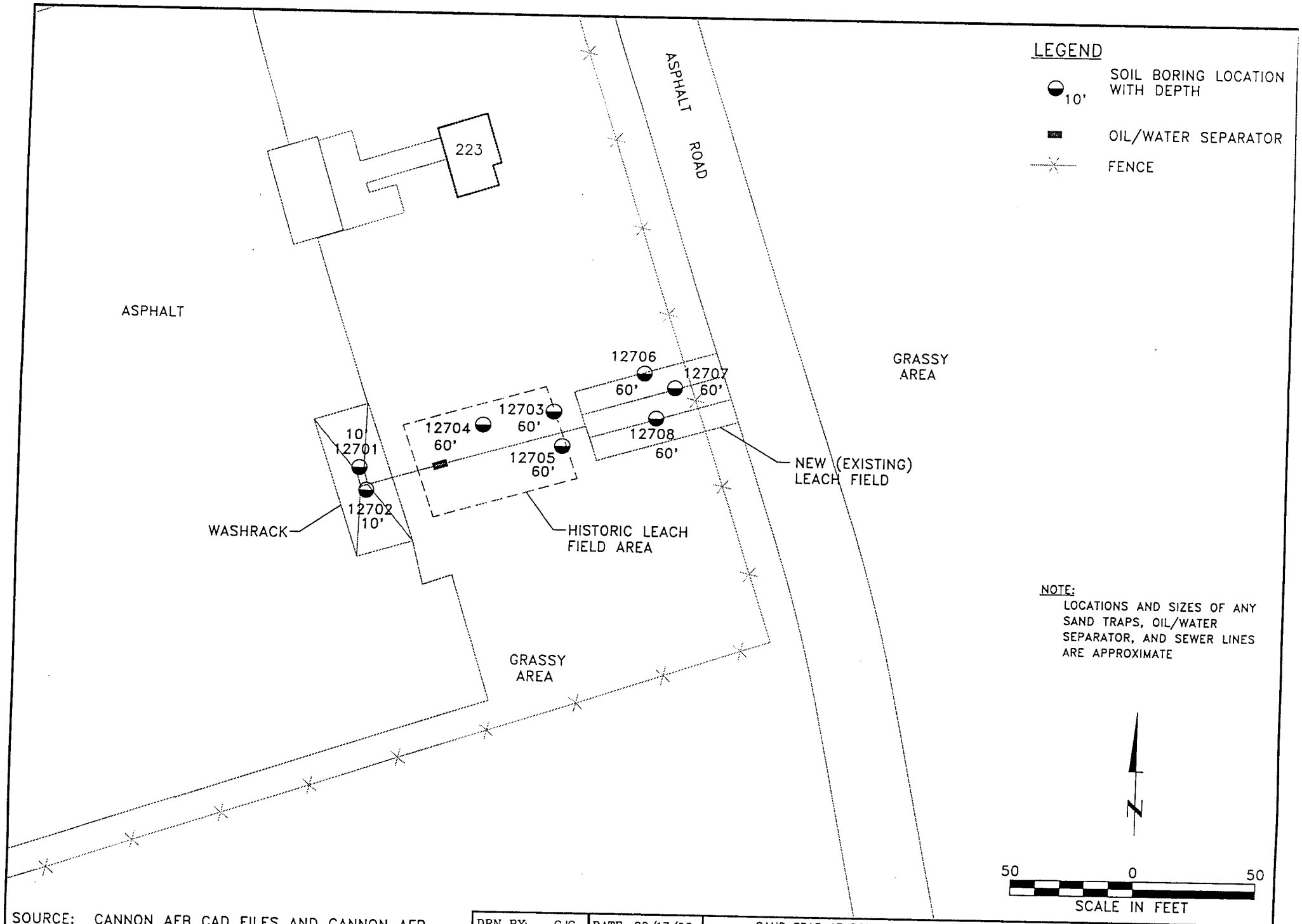
** Mean soil concentration multiplied by BAF of 4.6 (Cd) and 12 (Se).
R Rejected
J Estimated value below reporting limit or estimated based on data quality criteria
U Non-detect, value shown is one-half the reporting limit

TABLE 10-22
RISK CHARACTERIZATION SUMMARY - SWMU 127

Chemical	CAN127-1278-0000	CAN127-1278-0002	N	Arithmetic Mean (mg/kg)	Robin Benchmark Dietary Level (mg/kg)	Risk?
Volatile Organics						
1,2-Dichloroethane	0.0027 U	0.0027 U	14	0.003	312.5	--
1,2-Dichloropropane	0.0027 U	0.0027 U	14	0.003	1000	--
Toluene	0.0027 U	0.0027 U	14	0.005	12500	--
Xylenes (total)	0.0027 U	0.0027 U	14	0.004	5000	--
Semivolatile Organics						
Acenaphthene	0.7 U		9	0.236	0.4	--
Anthracene	0.7 U		9	0.283	5000	--
Benzo(a)anthracene	0.15 J		9	1.074	0.4	--
Benzo(a)pyrene	0.18 J		9	1.159	0.002	Possible
Benzo(b)fluoranthene	0.38 J		9	2.220	8	--
Benzo(g,h,i)perylene	0.7 U		9	0.799	375	--
Carbazole	0.7 U		9	0.372	250	--
Chrysene	0.26 J		9	1.811	12	--
Fluoranthene	0.44 J		9	2.317	625	--
Fluorene	0.7 U		9	0.252	625	--
Ideno(1,2,3-cd)pyrene	0.7 U		9	0.787	14.4	--
2-Methylnaphthalene	0.7 U		9	0.306	815	--
Phenanthrene	0.19 J		9	1.106	150	--
Pyrene	0.36 J		9	2.283	375	--
Metals						
Aluminum	6790	8050	14	8267	1500	Possible
Antimony	3.2 U	3.3 U	14	3.9	16.5	--
Cadmium	0.27 U	0.27 U	14	1.79**	10.5	--
Copper	7.3	9.1	14	9.1	260	--
Lead	42.4	7.5	14	19.1	87.5	--
Selenium	0.27 U	0.6 UJ	14	4.8**	5	--
Silver	0.53 J	0.45 J	14	0.59	41	--
Thallium	0.27 U	0.27 U	14	0.34	600	--
TPH	21.2 U	21.8 U	14	75.6	241	--

* Between 0 and 2 feet deep
** Mean soil concentration multiplied by BAF of 4.6 (Cd) and 12 (Se).
R Rejected
J Estimated value below reporting limit or estimated based on data quality criteria
U Non-detect, value shown i s one-half the reporting limit

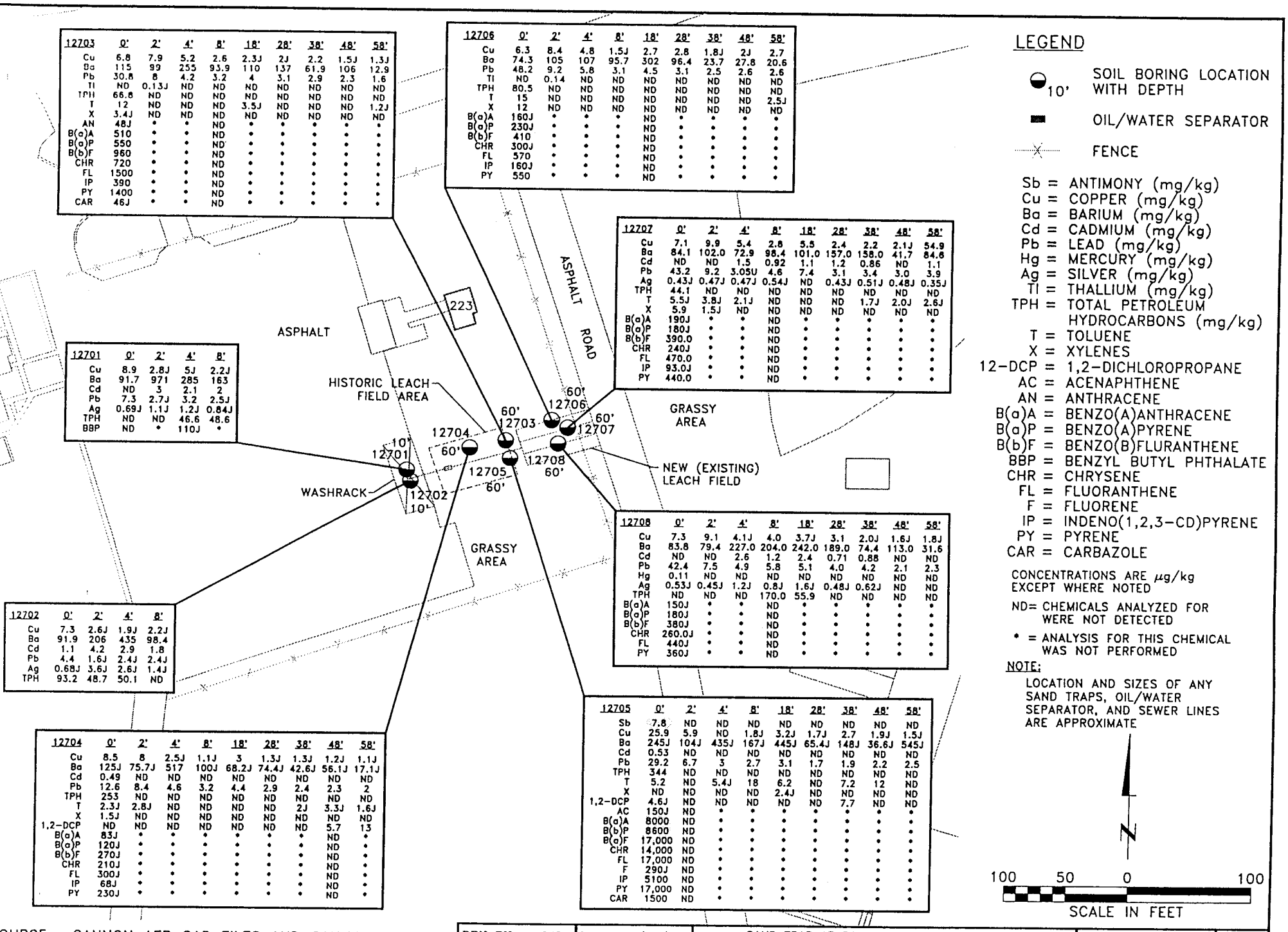
CAD FILE: C3M11W10.DWG V=SITE 01/12/1994 15:10



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	SAND TRAP AT POL WASHRACK – SWMU 127 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 10-1

CAD FILE: C3M11W10.DWG V=HITS 02/15/1994 14:21



12703	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cu	6.8	7.9	5.2	2.6	2.3J	2J	2.2	1.5J	1.3J
Ba	115	99	255	93.9	110	137	61.9	106	12.9
Pb	30.8	8	4.2	3.2	4	3.1	2.9	2.3	1.6
Tl	ND	0.13J	ND	ND	ND	ND	ND	ND	ND
TPH	66.8	ND	ND	ND	ND	ND	ND	ND	ND
T	12	ND	ND	ND	3.5J	ND	ND	ND	1.2J
X	3.4J	ND	ND	ND	ND	ND	ND	ND	ND
AN	48J	*	*	ND	*	*	*	*	*
B(a)A	510	*	*	ND	*	*	*	*	*
B(a)P	550	*	*	ND	*	*	*	*	*
B(b)F	960	*	*	ND	*	*	*	*	*
CHR	720	*	*	ND	*	*	*	*	*
FL	1500	*	*	ND	*	*	*	*	*
IP	390	*	*	ND	*	*	*	*	*
PY	1400	*	*	ND	*	*	*	*	*
CAR	46J	*	*	ND	*	*	*	*	*

12706	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cu	6.3	8.4	4.8	1.5J	2.7	2.8	1.8J	2J	2.7
Ba	74.3	105	107	95.7	302	96.4	23.7	27.8	20.6
Pb	48.2	9.2	5.8	3.1	4.5	3.1	2.5	2.6	2.6
Tl	ND	0.14	ND	ND	ND	ND	ND	ND	ND
TPH	80.5	ND	ND	ND	ND	ND	ND	ND	ND
T	15	ND	ND	ND	ND	ND	ND	ND	2.5J
X	12	ND	ND	ND	ND	ND	ND	ND	ND
B(a)A	160J	*	*	*	ND	*	*	*	*
B(a)P	230J	*	*	*	ND	*	*	*	*
B(b)F	410	*	*	*	ND	*	*	*	*
CHR	300J	*	*	*	ND	*	*	*	*
FL	570	*	*	*	ND	*	*	*	*
IP	160J	*	*	*	ND	*	*	*	*
PY	550	*	*	*	ND	*	*	*	*

12707	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cu	7.1	9.9	5.4	2.8	5.5	2.4	2.2	2.1J	54.9
Ba	84.1	102.0	72.9	98.4	101.0	157.0	158.0	41.7	84.6
Cd	ND	ND	1.5	0.92	1.1	1.2	0.86	ND	1.1
Pb	43.2	9.2	3.05U	4.6	7.4	3.1	3.4	3.0	3.9
Ag	0.43J	0.47J	0.47J	0.54J	ND	0.43J	0.51J	0.48J	0.35J
TPH	44.1	ND	ND	ND	ND	ND	ND	ND	ND
T	5.5J	3.8J	2.1J	ND	ND	ND	1.7J	2.0J	2.6J
X	5.9	1.5J	ND	ND	ND	ND	ND	ND	ND
B(a)A	190J	*	*	ND	*	*	*	*	*
B(a)P	180J	*	*	ND	*	*	*	*	*
B(b)F	390.0	*	*	ND	*	*	*	*	*
CHR	240J	*	*	ND	*	*	*	*	*
FL	470.0	*	*	ND	*	*	*	*	*
IP	93.0J	*	*	ND	*	*	*	*	*
PY	440.0	*	*	ND	*	*	*	*	*

12701	0'	2'	4'	8'
Cu	8.9	2.8J	5J	2.2J
Ba	91.7	971	285	163
Cd	ND	3	2.1	2
Pb	7.3	2.7J	3.2	2.5J
Ag	0.69J	1.1J	1.2J	0.84J
TPH	ND	ND	46.6	48.6
BBP	ND	*	110J	*

12708	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cu	7.3	9.1	4.1J	4.0	3.7J	3.1	2.0J	1.6J	1.8J
Ba	83.8	79.4	227.0	204.0	242.0	189.0	74.4	113.0	31.6
Cd	ND	ND	2.6	1.2	2.4	0.71	0.88	ND	ND
Pb	42.4	7.5	4.9	5.8	5.1	4.0	4.2	2.1	2.3
Hg	0.11	ND	ND	ND	ND	ND	ND	ND	ND
Ag	0.53J	0.45J	1.2J	0.8J	1.6J	0.48J	0.62J	ND	ND
TPH	ND	ND	ND	170.0	55.9	ND	ND	ND	ND
B(a)A	150J	*	*	ND	*	*	*	*	*
B(a)P	180J	*	*	ND	*	*	*	*	*
B(b)F	380J	*	*	ND	*	*	*	*	*
CHR	260.0J	*	*	ND	*	*	*	*	*
FL	440J	*	*	ND	*	*	*	*	*
PY	360J	*	*	ND	*	*	*	*	*

12702	0'	2'	4'	8'
Cu	7.3	2.6J	1.9J	2.2J
Ba	91.9	206	435	98.4
Cd	1.1	4.2	2.9	1.8
Pb	4.4	1.6J	2.4J	2.4J
Ag	0.68J	3.6J	2.6J	1.4J
TPH	93.2	48.7	50.1	ND

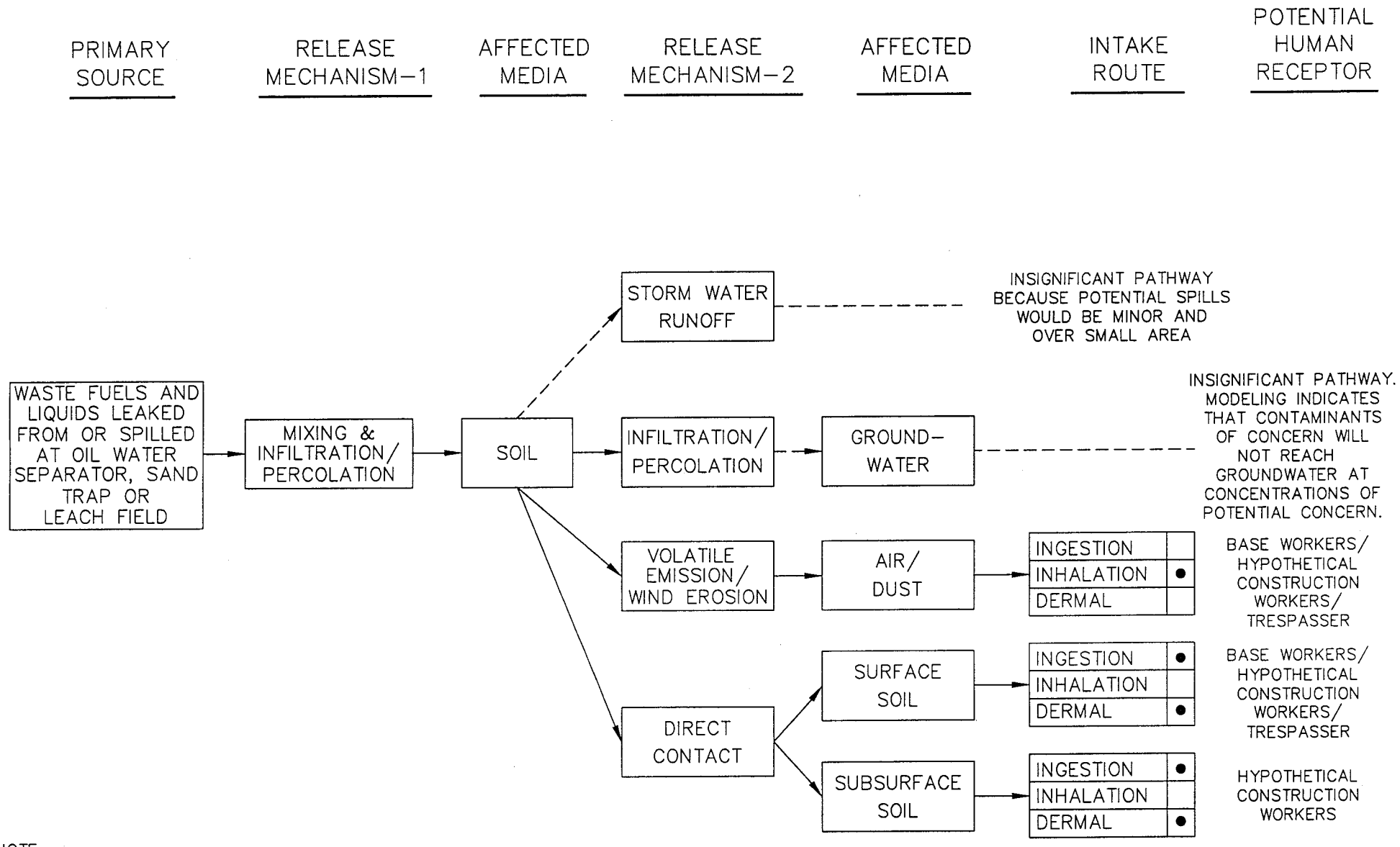
12704	0'	2'	4'	8'	18'	28'	38'	48'	58'
Cu	8.5	8	2.5J	1.1J	3	1.3J	1.3J	1.2J	1.1J
Ba	125J	75.7J	517	100J	68.2J	74.4J	42.6J	56.1J	17.1J
Cd	0.49	ND	ND	ND	ND	ND	ND	ND	ND
Pb	12.6	8.4	4.6	3.2	4.4	2.9	2.4	2.3	2
TPH	253	ND	ND	ND	ND	ND	ND	ND	ND
T	2.3J	2.8J	ND	ND	ND	ND	2J	3.3J	1.6J
X	1.5J	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DCP	ND	ND	ND	ND	ND	ND	ND	5.7	13
B(a)A	83J	*	*	*	*	*	*	ND	*
B(a)P	120J	*	*	*	*	*	*	ND	*
B(b)F	270J	*	*	*	*	*	*	ND	*
CHR	210J	*	*	*	*	*	*	ND	*
FL	300J	*	*	*	*	*	*	ND	*
IP	68J	*	*	*	*	*	*	ND	*
PY	230J	*	*	*	*	*	*	ND	*

12705	0'	2'	4'	8'	18'	28'	38'	48'	58'
Sb	7.8	ND	ND	ND	ND	ND	ND	ND	ND
Cu	25.9	5.9	ND	1.8J	3.2J	1.7J	2.7	1.9J	1.5J
Ba	245J	104J	435J	167J	445J	65.4J	148J	36.6J	545J
Cd	0.53	ND	ND	ND	ND	ND	ND	ND	ND
Pb	29.2	6.7	3	2.7	3.1	1.7	1.9	2.2	2.5
TPH	344	ND	ND	ND	ND	ND	ND	ND	ND
T	5.2	ND	5.4J	18	6.2	ND	7.2	12	ND
X	ND	ND	ND	ND	2.4J	ND	ND	ND	ND
1,2-DCP	4.6J	ND	ND	ND	ND	ND	7.7	ND	ND
AC	150J	ND	*	*	*	*	*	*	*
B(a)A	8000	ND	*	*	*	*	*	*	*
B(b)P	8600	ND	*	*	*	*	*	*	*
B(a)F	17,000	ND	*	*	*	*	*	*	*
CHR	14,000	ND	*	*	*	*	*	*	*
FL	17,000	ND	*	*	*	*	*	*	*
F	290J	ND	*	*	*	*	*	*	*
IP	5100	ND	*	*	*	*	*	*	*
PY	17,000	ND	*	*	*	*	*	*	*
CAR	1500	ND	*	*	*	*	*	*	*

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/05/94	SAND TRAP AT POL WASHRACK - SWMU 127 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 10-2

CAD FILE: C3M11W20.DWG **V=SWMU-127** 01/19/1994 16:16



NOTE:

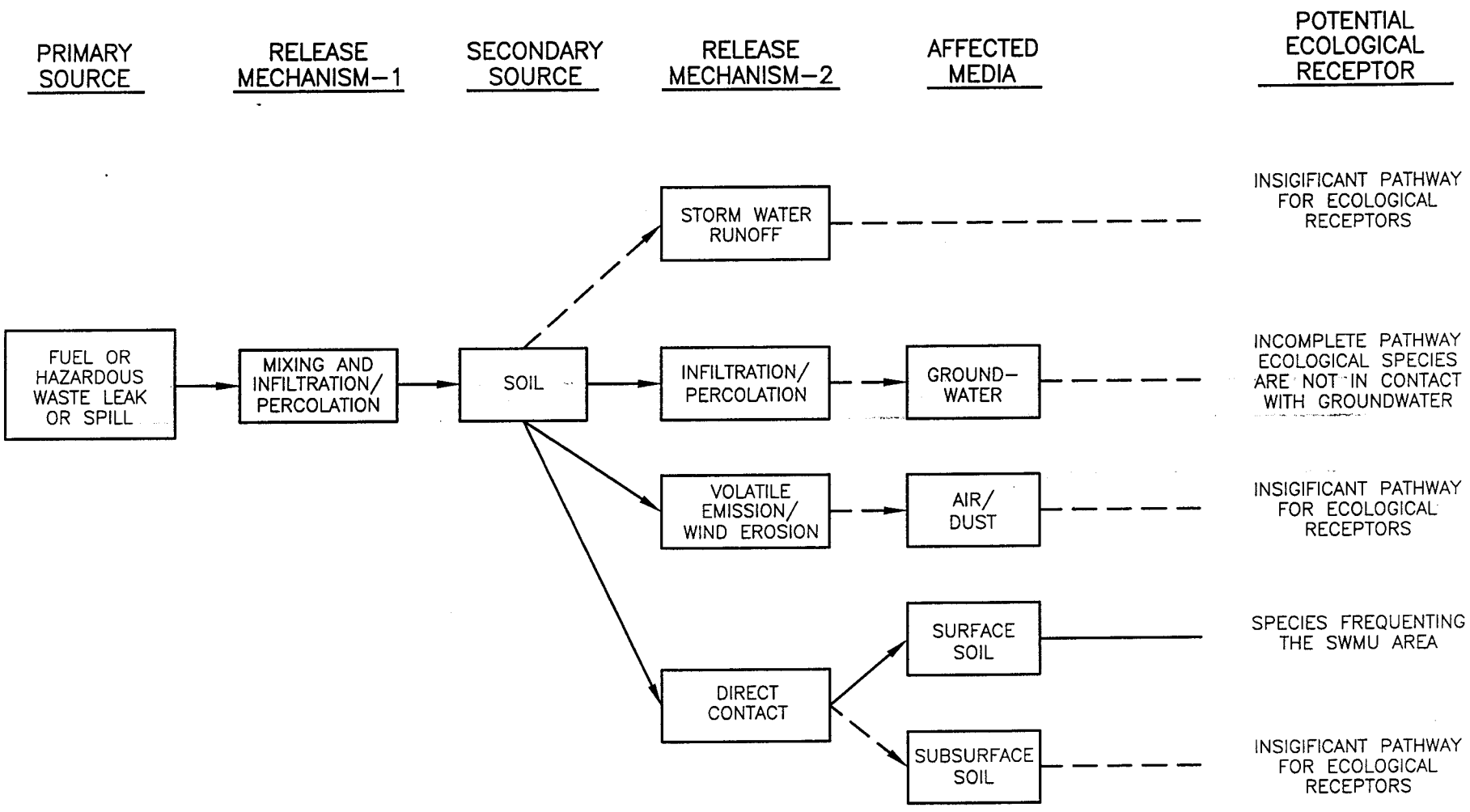
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART SAND TRAP AT POL WASHRACK, LEACH FIELD SWMU 127 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	10-3

C3M11W22.DWG V=SWMU-127 02/15/1994 8:00

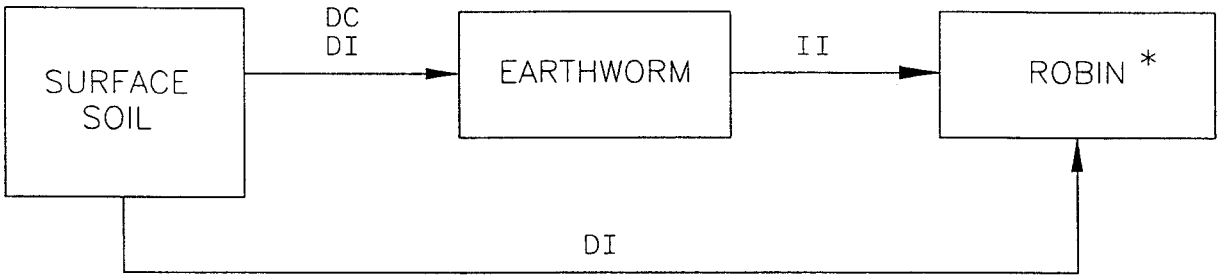


NOTES:

SOLID LINES REPRESENT POTENTIALLY COMPLETE AND SIGNIFICANT PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY NVD	DATE 12/30/93	EXPOSURE PATHWAY FLOW CHART FOR SWMU 127 ECOLOGICAL RECEPTORS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 10-4
CHK'D BY	REVISIONS: 0			



DC = DIRECT CONTACT

DI = DIRECT INGESTION

II = INDIRECT INGESTION
(i.e. SECONDARY, TERTIARY CONSUMPTION)

* = KEY RECEPTOR SPECIES

CAD FILE: C3M11W23.DWG V=SWMU-127 02/15/1994 9:30

DRN BY NVD	DATE 12/30/93	CONCEPTUAL SITE MODEL SWMU 127	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0	CANNON AIR FORCE BASE NEW MEXICO	C3M11W	10-5

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VOLUME III
SECTIONS 11, 12, AND 13
APPENDIXES A AND B

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BASELINE RISK ASSESSMENT FOR APPENDIX III SWMUs - PHASE I

CANNON AIR FORCE BASE CLOVIS, NEW MEXICO

Prepared for:
Cannon Air Force Base
27 CES/CEVR
Environmental Flight

February 1994

11.0
CIVIL ENGINEERING CONTAINER STORAGE AREA - SWMU NO. 77

11.1 SITE BACKGROUND

11.1.1 Site Description

The Civil Engineering Container Storage Area (Facility No. 4038) is an open concrete pad measuring approximately 100 feet by 200 feet located east of Building 252 and south of the north boundary fence of the base (Figure 11-1). The concrete pad is secured by an 8-foot high fence with a locked gate. The pad is the remaining floor of the old Portair Airfield Hangar dating back to the 1930s. The concrete storage pad is nearly flat, so that precipitation runs off on all sides. Ground surface in the area has no discernable gradient.

11.1.2 Site History

This facility was a passenger terminal for Portair Field during the 1930s and was removed by the Army in 1942. According to historical photographs, the concrete foundation slab had been vacant until the 1970s, and it appears to have been used for storage since that time. Approximately 100 55-gallon drums were stored at the facility during the RFA Visual Site Inspection (Kearney 1987). A preliminary inspection referenced in the A.T. Kearney report indicated that the drums contained varying amounts of water, oil, solvents, and asphaltic material.

11.1.3 Current Use

The Civil Engineering Squadron currently stores supplies and used materials on the concrete pad. The stored items include used transformers, street lights and street signs, PVC piping, and heavy equipment parts.

11.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATIONS

11.2.1 Physical Investigation

The objective of sampling at the Civil Engineering Container Storage Area was to determine if a release of SWMU-related chemicals that could pose a significant risk to human health or the environment has occurred due to leakage of stored materials and equipment. To meet this objective, six 20-foot soil borings were drilled to sample soils within and at the perimeter of the Storage Area. Borings were located where it appeared that the likelihood of encountering contamination was maximized, such as channels and low spots where storage pad runoff would flow and collect. Boring locations are shown on Figure 11-1. Surficial samples were collected from the 0.2- to 0.5-foot depth interval in areas of soil cover to provide surface soil data for risk assessment purposes. The 0.5- to 2-foot depth interval was collected immediately under the concrete pad. Subsurface samples were collected from the 3- to 5-foot, 8- to 10-foot, 13- to 15-foot, and 18- to 20-foot depth intervals. Target analytes for all borings include VOCs, SVOCs, metals, TRPH, PCBs, pesticides, and herbicides.

11.2.2 Chemical Investigation

Thirty soil samples were collected from the six borings (07701, 07702, 07703, 07704, 07705, and 07706). Sampling and analyses performed are summarized in Table 11-1. Summaries of the analytical results for these soil samples are provided in Table 11-2a (near-surface soil) and Table 11-2b (subsurface soil). The tables provide results for analytes that were detected at least once in each sample group (near-surface and subsurface). Complete analytical summary results are provided in the QCSR (Appendix A) of the RFI report.

11.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI report, and the data were deemed to be of adequate quality to meet the objectives of the RFI. However, data quality issues that may affect the risk assessment are more fully discussed here.

Elevated reporting limits resulting from sample dilution may limit the usability of the data if concentrations of some analytes are thereby diluted to levels below the reporting limit. That is, chemicals may be reported as nondetect when they are actually present in the sample at levels of potential concern. Section 4.12.6 of the QCSR (Appendix A of the RFI report) presents a discussion of elevated reporting limits. Three analyses for lead, one for SVOCs, and four for herbicides had elevated reporting limits. The elevated reporting limits did not impact on the usability of the associated data for the following reasons:

- The one sample with elevated semivolatile reporting limits does not create a data gap at this site, because soil samples directly above and below this sample (in the same boring) were analyzed and properly quantified for semivolatiles. Semivolatiles were not detected in these samples. Therefore, there is no reason to believe that there are significant concentrations of semivolatiles in the sample with elevated reporting limits.

- The samples with elevated herbicide reporting limits do not create a data gap at this site, because no herbicides were detected in any of the 30 samples at this site. Therefore, herbicides are not a likely contaminant of concern at this site, and there is no reason to believe they are present at elevated concentrations in the four samples with elevated reporting limits.

- Barium was rejected in 10 of 36 samples at this SWMU. Although this is a data gap, it is not viewed as crucial for the following reasons. Barium was properly quantified in the remaining samples and did not exceed the background UTL concentration (642 mg/kg) in any of these samples. There is no reason to believe that barium is present at significant concentrations (i.e., that it is associated with past waste disposal) in the rejected samples. Furthermore, barium is not particularly toxic (a concentration of 20,000 mg/kg is associated with a hazard quotient of 1 for residential exposures). Therefore, although barium has not been quantified in one area of this site, the absence of these data will not affect the conclusions of the risk assessment.

- Lead was detected above reporting limits in all samples. Therefore, the elevated reporting limits are of not consequence.

11.2.4 Nature and Extent of Contamination

There was no visible evidence of contamination during the field investigation. Chemical testing found generally low levels of PAHs and TPH in the shallow soil samples (0 to 3 feet). However, the 3-foot sample from Boring 07704 (in the middle of the concrete pad) had a TPH concentration of 10,000 mg/kg. No other evidence of significant TPH contamination was found. Subsurface soils below the 3-foot sampling interval were free of contamination.

11.3 HUMAN HEALTH RISK ASSESSMENT

11.3.1 Exposure Pathway Flow Chart

Figure 11-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways for civil engineering container storage area. In the flow chart, potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines. The primary sources are waste fluids (e.g., fuels, oils, and solvents) that may have leaked or been spilled from storage containers or equipment on surface soil.

Chemicals from the primary source may be released to other media that may in turn act as secondary sources of chemical release or exposure. Mixing and infiltration of the wastes to soil is shown as a primary chemical release mechanism. Chemicals in soils may infiltrate/percolate through the soil and be released to groundwater, be released to the air via volatile emissions or wind erosion, or result in exposure via direct contact (e.g., dermal contact or incidental ingestion). Storm water runoff is not considered to be a significant pathway for human exposures, because the SWMU covers only a small area, and no developed drainageways are present near the SWMU.

As shown on the flow chart, surface soils may provide exposures to Base workers (occupational exposures), and hypothetical future construction workers, or hypothetical future trespassers (if the Base is closed in the future). Future residential exposures were not evaluated at this SWMU, because it is located in an industrialized area of the Base (i.e., between the railroad and the runway); therefore, residential development is not a likely future land use. Air emissions (volatile and particulates) from surface soil may also provide

exposures to Base workers, construction workers, and trespassers. Subsurface soils and air emissions from subsurface soil (i.e., during excavation) may provide exposures to construction workers. Groundwater is used for domestic purposes on and off Base. In order to assess potential impacts to public health via groundwater pathways, fate and transport modeling was conducted to determine if contaminants of concern in soils at the SWMU could reach groundwater at concentrations of concern. Results of the fate and transport modeling (Section 11.3.5.2) indicate that contaminants will not reach groundwater at concentrations of potential concern. Therefore, this pathway was not evaluated further.

In summary, potential complete human exposure pathways evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

Hypothetical Construction Workers

- Ingestion of and dermal contact with surface and subsurface soil
- Inhalation of volatile emissions and airborne particulate matter from surface and subsurface soil

Hypothetical Trespassers

- Ingestion of and dermal contact with surface soil
- Inhalation of volatile emissions and airborne particulate matter from surface soil

11.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

Background levels were defined by the UTL of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in Appendix A. (The background UTL was defined as the mean plus two times the standard deviation; see Appendix A.)

Results of the comparison of metals concentrations in soil for SWMU 77 to background levels are given in Tables 11-3 and 11-4. A summary of the results of the comparison is presented here.

The maximum concentrations of cadmium, lead, silver, and zinc in surface soil exceeded the background levels. The maximum detected concentrations of antimony, cadmium, lead, silver, and zinc in total soils exceeded the background levels. Therefore, these metals were retained for further evaluation as chemicals of concern.

11.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 77, have been detected in soil at the SWMU, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 11-2a and 11-2b present the analytical results for all chemicals detected in W-C samples for soils. Of these, chemicals of concern were identified as described below.

The concentrations of several metals (Table 11-3) detected in surface and subsurface soil exceeded background ranges according to the comparison described in Section 11.3.2. These metals are, therefore, considered as chemicals of concern in soil. The compounds 4-nitrophenol and tetrachloroethene were reported in fewer than 5 percent of total soil samples, and were only reported at concentrations below reporting limits. Therefore, these compounds not considered to be characteristic of the site, are not likely to pose a significant risk, and thus are not considered to be chemicals of concern at this SWMU. Other organic contaminants detected in soils were retained as chemicals of concern for risk assessment. Chemicals of concern in surface soil and total soil are listed in Tables 11-5 and 11-6, respectively. Benzo(g,h,i)perylene, phenanthrene, TPH, and lead, listed in Tables 11-5 and 11-6 as chemicals of concern, do not have EPA-established toxicity factors and, therefore, cannot be evaluated quantitatively in the risk assessment. However, their potential effects on the results of the risk assessment are addressed in Sections 11.3.8 through 11.3.10.

11.3.4 Environmental Fate and Transport

11.3.4.1 General

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

11.3.4.2 Vadose Zone Fate and Transport Modeling

A partitioning leachate model was used to estimate potential leachate generation from contaminants in the soil at the SWMU and to estimate the transport of the leachate to groundwater. The analytical model, developed at the Idaho National Engineering Laboratory (DOE 1991), describes the mass balance of a contaminant (based on average soil concentrations) in the contaminated soil volume at the SWMU. The DOE model assumes a constant infiltration rate (based on the Hydrologic Evaluation of Landfill Performance [HELP] Model) and accounts for sorption to soils and degradation in the vadose zone. The model

conservatively considers dilution of the leachate as it reaches the groundwater to estimate potential groundwater concentrations of SWMU-related chemicals of concern. The input parameters and estimated leachate concentrations are given in Section 11.3.5.2. A complete description of the model is given in Appendix B.

The modeled groundwater concentrations are compared to conservative risk-based concentrations (RBCs) for drinking water (Section 11.3.5.2). If the modeled groundwater concentrations do not exceed RBCs, it is concluded that no adverse health risk is expected, and the groundwater pathway is not considered further. If the modeled concentrations exceed RBCs, the groundwater pathway is evaluated quantitatively in the risk assessment.

11.3.4.3 Air Modeling

RME air concentrations of volatile and particulate emissions from surface soil and total (surface and subsurface) soil were calculated using RME soil concentrations of chemicals of concern. The results of the air modeling are given in Section 11.3.5.3. Air concentrations of VOCs released from soil were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991). Air concentrations of SVOCs that may be bound to airborne particulates (dust) were estimated using a PEF approach developed by Cowherd (1985) and adopted by EPA for use at hazardous waste sites to calculate soil cleanup levels (EPA 1991). Air concentrations were calculated for only those chemicals with inhalation toxicity factors which were evaluated quantitatively in the risk assessment. The methodologies used in the air modeling are discussed in more detail in Appendix B.

The air modeling approach is conservative because it uses default values recommended by EPA for establishing preliminary remediation goals at hazardous waste sites, and it assumes that potential receptors are consistently exposed to air concentrations predicted immediately at the source (i.e., it does not account for dilution in the air during transport from the SWMU source to potential receptors).

11.3.5 Exposure Point Concentrations

11.3.5.1 Soils

Tables 11-7 and 11-8 show the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in surface soils and total soils respectively at the CE Container Storage Area.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use of "nondetect" values (U-qualified data) in calculating exposure point concentrations is also explained in Appendix C. Tables 11-9 and 11-10 give the soil concentrations of organic compounds from surface and total soils, respectively which have been adjusted for dermally absorbed fraction. These adjusted concentrations were used for calculating risks from dermal exposures to organic chemicals in soils. The absorbed fraction (from Table C-26 Appendix C) is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is applied to the skin in soil. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

11.3.5.2 Groundwater

A leachate partitioning model was used to evaluate current leaching from the average total soil concentration at SWMU 77. A more detailed description of the groundwater modeling approach is provided in Appendix B. Model results are included in Table 11-11. These modeled concentrations were then compared to EPA Region III tap-water RBCs (EPA 1993b). These concentrations are calculated assuming residential groundwater ingestion and inhalation and are based on an excess cancer risk of 1×10^{-6} or hazard quotient equal to one. Table 11-12 summarizes the comparison of the modeled concentration in groundwater to the conservative tap-water RBCs. No modeled concentrations exceeded the RBCs, so significant risks are not expected from the groundwater pathway. Therefore, the groundwater pathway has been determined to be insignificant and was not further evaluated.

11.3.5.3 Air

RME air concentrations of volatile and particulate emissions from surface soil and from total soil were calculated using RME concentrations of chemicals of concern. The results of the air modeling from surface soil are shown in Tables 11-13 and 11-14. The results of the air modeling from total soil are shown in Tables 11-15 and 11-16. Air concentrations of VOCs were estimated using a VF approach developed by Hwang and Falco (1986) and adopted by EPA for use at hazardous waste sites (EPA 1991b).

11.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the intake factors used to quantify chemical intake of SWMU-related contaminants in various environmental media soil and air. Table 11-17 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in soil and air to obtain estimates of chemical intake by each exposure pathway.

11.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, and hypothetical future trespassers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 11-18. A summary of the results of the risk assessment is given here.

Occupational Exposure

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion, dermal contact, and inhalation) to contaminated surface soil at SWMU 77. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and

RME cases, respectively. These assumptions are very conservative, because there are no occupational receptors routinely working outdoors at the SWMU. Therefore, the exposure assumptions overestimate current and future conditions at the SWMU.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in surface soils at SWMU 77 via the dermal contact, inhalation, and ingestion pathways is 0.00001 and 0.002 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk under the assumed chronic exposure conditions is 2×10^{-9} under the average exposure case and 6×10^{-7} under the RME case. These levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b), and indicate that risk from exposure to surface soils at this SWMU is negligible.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface and subsurface soils at SWMU 77. Exposures were assumed to occur during excavation activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in soils at SWMU 77 via the dermal contact, inhalation, and ingestion pathways is 0.0003 and 0.003 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed subchronic exposure conditions is 7×10^{-10} in the average case and 6×10^{-9} in the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991c), and are so low as to be negligible.

Hypothetical Future Trespasser Exposure

Hypothetical future trespassers were assumed to be exposed (via ingestion, dermal contact, and inhalation) to surface soil at the SWMU. Hypothetical future trespassers were assumed to be exposed at the SWMU 2 and 8 hours/day, for 26 and 52 days/year, over 9 and 30 years for the average and RME cases, respectively. These assumptions are very conservative, because Cannon AFB is likely to remain a military installation (increasing in size), making access to contaminants at the area of SWMU 77 by trespassers unlikely.

The total hazard index calculated for noncarcinogenic health effects due to exposures to contaminants in surface soil at the SWMU via the dermal contact, inhalation, and ingestion pathways is 2×10^{-6} and 0.0004 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed exposure conditions is 3×10^{-10} under the average exposure case and 4×10^{-8} under the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b).

11.3.8 Qualitative Assessment of Exposures to Lead

Lead exposures are not addressed in the quantitative risk assessment, because EPA withdrew the RfD for lead in 1989, primarily due to the lack of a discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. This level is supported by EPA's Uptake/Biokinetic (UBK) Lead Model which predicts that exposures of children ages 0 to 6 to soils with approximately this level will not result in blood lead levels that exceed a level of concern established by the Centers for Disease Control.

The maximum lead concentration measured in soils at SWMU 77 was 41 mg/kg detected in surface soil. The maximum value is below a range considered acceptable for childhood exposures, lead detected in soils at SWMU 77 would not be expected to pose a threat to human health.

11.3.9 Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the soil and water samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH (primarily BTEX) are not available, and when the fuel product is known. The provisional toxicity values are under review and subject to revision. RBCs derived from them are used simply as a guide to potential health hazards.

The toxicity factors and calculation of risk-based concentrations are shown in Table 11-19. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,600 mg/kg. The maximum SWMU concentration of TPH is 10,000 mg/kg (detected in the 3- to 5-foot sampling interval beneath the concrete pad). This concentration is well below the conservative RBC. TPH was detected in much

lower concentrations in other samples (nondetect to 321 mg/kg). Therefore, it is concluded that TPH does not pose a health hazard via direct exposures to soil.

11.3.10 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 77 and their effect on the results and conclusions of the risk assessment are listed below.

- Dermal absorption of PAHs was not evaluated quantitatively in the risk assessment. EPA guidance (EPA RAGS 1989a) states that it is inappropriate to use the oral slope factor to evaluate the risks associated with dermal exposure to carcinogens, such as benzo(a)pyrene, which can cause skin cancer through a direct action at the point of application. The exclusion of PAHs from quantitative evaluation in the dermal exposure pathway may underestimate the potential human health risk from dermal contact with soils at the SWMU. However, the risk estimated at this SWMU is so low (6×10^{-7}) that additional risk that might hypothetically be derived from this pathway would not likely raise the total risk to a level of concern.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected, because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- Benzo(g,h,i)perylene and phenanthrene were not considered in the quantitative risk assessment, because they do not have EPA-established toxicity factors. Their exclusion from the quantitative analysis may underestimate risk at the SWMU. However, it is not likely to affect the results or conclusions of the

risk assessment relative to the chemicals with known toxic or carcinogenic effects detected at the SWMU.

11.4 ECOLOGICAL RISK ASSESSMENT

11.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 77, the Civil Engineering Container Storage Area, is located at the northern property boundary of Cannon AFB in a relatively small area of moderate quality habitat for terrestrial wildlife. Existing ground cover is mainly the concrete storage pad and paved driveway and a surrounding area of mowed non-native grasses. A layer of non-mowed native grassy area is located immediately to the north, across the Cannon AFB fenced property line, and south of the railroad tracks. About 50 percent of the land surface within the immediate vicinity (within 100 feet) of the SWMU is grassy area (mowed and unmowed off site), with the remainder comprised of access roads, adjacent buildings and hangar (to the west), and the concrete pad itself. The pad has been used for storage since the 1970s.

Because of the proximity of the SWMU to off-site native grassland, it is expected that the grassy areas surrounding the pad will be used more regularly by terrestrial species than the more isolated SWMUs located within the developed portions of Cannon AFB. The most common species are likely to be birds, such as the robin (*Turdus migratorius*), house sparrow (*Passer domesticus*), and the starling (*Sturnus vulgaris*). The grass habitat also supports terrestrial species such as deer mice, and raptors are likely to use the area for hunting small mammals and birds.

Given this assessment, several species were selected as the key receptor species for the grassy area of SWMU 77. These include the robin (*Turdus migratorius*), deer mouse (*Peromyscus sp.*), and northern harrier (*Circus cyaneus*). Although the Mississippi kite (*Ictinia misisippiensis*), which was recently delisted as a state-protected species, is present on Cannon AFB golf course, its food preference is mostly large insects taken in flight, and it has not been reported in areas near SWMU 77 (Crow, pers. comm). The harrier was selected as the raptor indicator species because its prey includes mice and small birds and because it has been sighted in and around grassy areas of Cannon AFB during field surveys.

11.4.2 Chemicals of Concern

The chemicals of concern (COCs) at SWMU 77 were selected using validated data from six soil samples covering the interval between 0 and 2 feet deep. This interval was selected because most soil-dwelling organisms (e.g. earthworms and deer mice) occur in this zone. Table 11-20 provides a summary of the chemicals detected in the six samples considered for this ERA. A detailed description of the soil sampling program and chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the six samples to be considered a possible COC. The following screening criteria were then applied, in the order shown, to determine if a chemical in the soil would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Exceedance of the normal range found in U.S. soils (nationwide)

The maximum detected concentration of the six samples was used in the comparison to background criteria. If no background criteria were available for comparison, as was the case for the organic chemicals and the pesticides, the chemicals were retained as COCs. If the maximum detected concentration of a chemical exceeded the local (i.e. Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If it exceeded this criteria, it was likely retained as a COC, even if it fell within the normal range found in U.S. soils. This is because the normal U.S. range is widely variable and was included in the screening process primarily as an additional reference. In some cases however, the normal U.S. range was the only screening criteria available. Table 11-21 lists the maximum concentrations detected and shows the screening values used. The chemicals that were retained as COCs for this ERA include the following: toluene, xylenes, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, butyl benzyl phthalate, carbazole, chrysene, di-n-octyl phthalate, dibenz(a,h)anthracene,fluoranthene,indeno(1,2,3-cd)pyrene,pentachlorophenol,phenanthrene, pyrene, 4,4′-DDT, 4,4′-DDE, alpha-chlordane, gamma-chlordane, cadmium, lead, zinc, and TPH.

11.4.3 Exposure Assessment

Figure 11-4 depicts the exposure pathway flow chart developed for SWMU 77. As the flowchart indicates, chemicals could potentially be released through transport in runoff, infiltration to groundwater, volatilization or wind erosion, and direct contact by ecological receptors. Except for direct contact, these exposure pathways are incomplete or of minor importance for ecological receptors at SWMU 77. Storm water runoff is a potentially complete but insignificant pathway, because runoff from the storage area would immediately enter the soil and can be considered as part of direct contact with surface soil; also any spillage would involve a relatively small area of level terrain. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization or wind erosion is not considered a significant pathway at this site. Although two of the COCs are volatile organic compounds (VOCs), the maximum concentration were less than 0.01 mg/kg, and VOC concentrations of 100 mg/kg or greater in air are generally needed to induce toxic responses in laboratory rats and mice from inhalation (NIOSH 1987). Concentrations in soils would have to be many times greater than this to produce these toxic levels in air, even near the soil surface. Direct contact with subsurface soils (more than two feet deep) is also considered an insignificant or incomplete pathway because of the limited use of deeper soils at this site by wildlife.

Therefore, the only potentially complete and significant exposure pathway is direct contact with contaminated surface soil by species frequenting the SWMU area. Direct contact may include dermal absorption or ingestion. Dermal absorption is not considered a significant exposure route for the receptors at this site because the animals are assumed to be largely protected by their fur or feathers. Receptors at the SWMU may ingest COCs either directly or indirectly. Direct ingestion usually occurs along the food/prey chain from soil adhered to the surface of food or from preening/cleaning or burrowing activities. Indirect ingestion includes ingestion of COCs that have been transferred via food webs.

Figure 11-5 depicts the Conceptual Site Model developed from the exposure pathway analysis, the ecological characterization, and the identification of the key receptor species for SWMU 77. As the figure indicates, the pathways of concern are from the surface soil to the robin and the deer mouse (with the earthworm as a primary food source for the robin), and

the continued pathway from robin and mouse to the Northern harrier. For all pathways leading to the identified key receptors, exposure is via both direct and indirect ingestion.

11.4.4 Risk Characterization

This section provides a characterization of potential risk to the selected key receptor species (robin), deer mouse, Norther harrier at SWMU 77. For the purposes of this analysis, it was assumed that the robin's diet consists of earthworms and inadvertent consumption of soil and that the deer mouse diet consists of plant parts, seeds, and invertebrates; inadvertent consumption of soil during feeding; and consumption of soil from preening and cleaning. It was also assumed that the concentration of the COCs were the same in the earthworm and in the deer mouse's diet as in the soil, except for cadmium and selenium, for which bioaccumulation factors of 4.6 and 12 were used (see Section 7.4.4). Therefore the risk characterization for the robin and the deer mouse consisted of comparing the concentration of COCs in the robin's and deer mouse's food (i.e., the chemical concentration in soil) to selected toxicity benchmark dietary levels for those chemicals (see Table 11-22). For the Northern harrier, a qualitative assessment of potential risk due to chemicals known to bioaccumulate along food web pathways was conducted.

The assessment for the robin and deer mouse is somewhat conservative, because studies indicate that, for many chemicals, BAFs from soil to earthworm are less than one (Beyer and Stafford 1993) and the deer mouse diet consists of many things that may not accumulate chemicals (e.g., plant parts), in addition to soil ingestion. However, the assessment takes into account the soil that would be clinging to food consumed by the robin or the deer mouse and also accounts for inadvertent soil ingestion. The benchmark dietary levels were selected as explained in Appendix D, Section D.3 and D.4; these sections also provide background toxicological information about the COCs. The soil chemical concentration used was the arithmetic mean, as described in Appendix D (Section D.6.).

<u>Robin and Deer Mouse</u>

Table 11-22 lists the COCs for SWMU 77 and provides a comparison between the soil concentration (arithmetic mean) and the benchmark dietary level for the robin and the deer mouse. If the soil level exceeds the benchmark level, there is a possibility of risk, as noted

in the table. The following discussion addresses those chemicals where a possibility of risk is indicated.

Benzo-a-pyrene (BaP)

The average concentration of BaP at SWMU 77 was 0.16 mg/kg, compared to the benchmark dietary level of 0.02 mg/kg, and 0.03 mg/kg for the robin and deer mouse, respectively, indicating a potential risk. The 0.16 mg/kg level is within the range of several reported BaP concentrations for various locations, as reported in the literature for both industrial and unpolluted areas, as well as rural, agricultural, and urban soils (see Table A-6). Also, the low toxicity benchmark level for BaP is a reflection of BaP's carcinogenic effects through the action of its intermediate metabolites, as opposed to acute toxicity. In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, and therefore it is questionable if carcinogenesis is an important endpoint for relatively short-lived mammals and birds, such as the robin or deer mouse. Finally, the BaP found at SWMU 77 may not be completely bioavailable to robins. Goon et al. (1991) showed that BaP that had aged 6 months in soil was only 34 percent to 51 percent orally bioavailable for clayey and sandy soils, relative to BaP administered alone to rats. For these reasons, BaP is unlikely to pose an unacceptable risk at SWMU 77.

Dibenzo(a,h)anthracene

The average concentration of dibenzo(a,h)anthracene at SWMU 77 was 0.163 mg/kg, compared to benchmark dietary levels of 0.006 mg/kg for the robin and 0.01 mg/kg for the deer mouse, indicating a potential risk to both. However, dibenzo(a,h)anthracene was detected only once in six samples, at 0.073 mg/kg. Because of this, and because the PAH toxicity benchmarks are generally established because of carcinogenicity, (see BaP discussion, above), it is unlikely that this level of dibenzo(a,h)anthracene represents a risk to the robin or deer mouse.

Northern Harrier

An assessment of potential risk to the Northern harrier was conducted by considering the bioaccumulation potential of those COCs at SWMU 77 that are known to bioaccumulate and/biomagnify along food web pathways. For SWMUs 77, these chemicals include cadmium, lead, and the pesticides 4,4'-DDT, 4,4'-DDE, alpha-chlordane, and gamma-chlordane. A comparison was made between the toxicity-based benchmark dietary level for these chemicals in the harrier's diet (i.e., the chemical level in the robin or the deer mouse) and the potential dietary level that could occur in the robin or mouse. This potential level was estimated, given the chemical concentration detect in the soil, multiplied by bioaccumulation factor (BAFs) from soil to robin (via earthworm), or from soil to mouse. The BAFs used were ones found in the literature or estimated, based on literature values for similar species and professional judgement. Each of the metals of concern is described below.

Cadmium

The benchmark dietary level for the Northern harrier is 10.5 mg/kg. The average soil concentration is 0.626 mg/kg. Beyer and Stafford (1993) calculated a BAF of 4.6 for soil to earthworm, but also reported that BAFs ranging from 13-66 have been reported in other soils. If the BAF is taken as 4.6, and another BAF of 5-10 is assumed from earthworm to robin, the resultant estimated dietary level in the robin is approximately 14-29 mg/kg, which exceeds the 10.5 mg/kg benchmark. Similar bioaccumulation/magnification might also be expected in the soil→deer mouse→harrier pathway, although specific BAFs were not found in the literature. Therefore, a potential risk to the harrier is indicated from the bioaccumulation and biomagnification of cadmium at SWMU 77.

Lead

The benchmark dietary level for the Norther harrier is 87.5 mg/kg; the average soil concentration is 18.85 mg/kg. According to Eisler (1988), there is no evidence that lead is biomagnified in food chains, although bioaccumulation is reported in the literature. Therefore, a risk to the Northern harrier would be indicated only if the earthworm or plant/invertebrate diet of the mouse accumulated lead beyond the 87.5 mg/kg level. This is

unlikely, for several reasons: 1) According to Beyer and Stafford (1992), the BAF from soil to earthworm for lead is less than one (0.45), indicating little accumulation in tissues; 2) The type of lead in the soil at Cannon AFB is probably not very bioavailable (lead oxides, e.g.); and 3) Eisler (1988) reports lack of evidence for biomagnification. Therefore, it is unlikely that lead presents a risk to the Northern harrier.

DDT/DDE

The benchmark dietary level for the Northern harrier is 0.2 mg/kg for both DDT and DDE. The average soil concentrations at SWMU 77 are 0.007 mg/kg DDT and 0.03 mg/kg for DDE. A BAF of 5 has been reported for DDT from soil to earthworm (Beyer and Gish 1980), and BAFs of 3.8 and 6.4 have been reported for shows (Forsyth 1983). Therefore, assuming BAFs of 5 and 6.4 for soil to earthworm to robin as a worst case, the predicted dietary level for DDT would be 0.224 mg/kg, very close to the benchmark level of 0.2 mg/kg. For DDE, assuming it behaves similar to DDT, the estimated dietary level could be 0.096. Therefore, the risk from the DDE and DDT compounds at SWMU 77 appears slight.

Chlordane

The benchmark dietary level for the Northern harrier is 0.1 mg/kg for either (alpha or gamma) chlordane compound. The average soil concentrations are 0.002 and 0.003 mg/kg. Eisler (1990) reports that food chain biomagnification of chlordane compounds is low, except in some marine mammals, although specific BAF information is lacking. BAFs of 33 to 50 would be needed to result in a potential risk to the raptor at the dietary benchmark level of 0.1 mg/kg. Assuming BAFs in the 5-10 range (similar to DDT/DDE), a dietary level above the 0.1 mg/kg benchmark could result at the raptor level, and the potential for ecological risk at this site cannot be ruled out. However, because chlordane is especially toxic to earthworms and soil invertebrates, dietary prey for the robin and deer mouse may not be very prevalent in locations where chlordane exceeds toxicological benchmarks, and the exposure pathway to the raptor may be limited.

11.5 SUMMARY AND CONCLUSIONS

11.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors and all appropriate exposure pathways was completed for this SWMU. Analytical data were collected for soils at the SWMU, and fate and transport modeling was conducted to evaluate the air and groundwater pathways. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 11-18) show that no unacceptable health risks due to chemical releases are expected at the SWMU

- Results of the ecological risk assessment show that no unacceptable ecological risks due to chemical releases are expected at the SWMU

11.5.2 Conclusions

Since no unacceptable human health or ecological risks due to chemical releases are expected from this SWMU, no further action is recommended for this SWMU.

TABLE 11-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
CIVIL ENGINEERING CONTAINER STORAGE AREA (SWMU NO. 77)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters						Sample Containers		
					VOCs	SVOCs	Metals	TRPH	PCBs/Pest	Herbicides	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 07701	0 - 0.5	CAN077-0771-0000		Soil	X	X	X	X	X	X		2	2
	0 - 0.5	CAN077-0771-7701	FD	Soil	X	X	X	X	X	X		2	2
	0 - 0.5	CAN077-0771-7761	MRD	Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0771-7703		Soil	X	X	X	X	X	X		2	2
	8 - 10	CAN077-0771-7708		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0771-7713		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0771-7718		Soil	X	X	X	X	X	X		2	2
Boring 07702	0 - 0.5	CAN077-0772-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0772-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0772-6003	MS/MSD	Soil	X	X	X	X	X	X		2	3
	8 - 10	CAN077-0772-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0772-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0772-0018		Soil	X	X	X	X	X	X		2	2
		CAN077-0772-7751	AB	Water	X						2		
		CAN077-0772-7771	RB	Water	X	X	X				2'		
		CAN077-0772-7781	DW	Water	X						2		
		CAN077-0772-7791	TB	Water	X						2		
Boring 07703	0.5 - 2	CAN077-0773-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0773-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0773-7762	FD	Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0773-7702	MRD	Soil	X	X	X	X	X	X		2	2
	8 - 10	CAN077-0773-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0773-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0773-0018		Soil	X	X	X	X	X	X		2	2
Boring 07704	0.5 - 2	CAN077-0774-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0774-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0774-6003	MS/MSD	Soil	X	X	X	X	X	X		2	3
Boring 07704,	8 - 10	CAN077-0774-0008		Soil	X	X	X	X	X	X		2	2

TABLE 11-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
CIVIL ENGINEERING CONTAINER STORAGE AREA (SWMU NO. 77)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters						Sample Containers		
					VOCs	SVOCs	Metals	TRPH	PCBs/Pest	Herbicides	40 ml VOA vials	4 oz. jars	8 oz. jars
cont.	13 - 15	CAN077-0774-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0774-0018		Soil	X	X	X	X	X	X		2	2
Boring 07705	0 - 0.5	CAN077-0775-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0775-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0775-7764	FD	Soil	X	X	X	X	X	X		2	1
	8 - 10	CAN077-0775-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0775-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0775-0018		Soil	X	X	X	X	X	X		2	2
Boring 07706	0 - 0.5	CAN077-0776-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0776-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0776-7764	FD	Soil	X	X	X	X	X	X		2	2
	8 - 10	CAN077-0776-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0776-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0776-0018		Soil	X	X	X	X	X	X		2	2

AB = Ambient blank
DW = Decontamination water
FD = Field Duplicate
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

' The following additional containers are needed:
2 - 32-oz. jars for SVOC tests
1 - 16-oz. jar for metals tests

See Figure 18-1 for locations of the borings.

TABLE 11-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-0000			CAN077-0771-7703			CAN077-0772-0000			CAN077-0772-0003			CAN077-0773-0000			CAN077-0773-0003		
LAB SAMPLE NUMBER	0311810007SA			0311810009SA			0311890001SA			0311890002SA			0313790015SA			0313790016SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Tetrachloroethene	<	5.2	U	<	5.7	U	<	5.4	U	<	5.9	U	<	5.8	U	<	5.6	U
Toluene	7.5	5.2		<	5.7	U	<	5.4	U	<	5.9	U	3.2	5.8	J	<	5.6	U
Xylenes (total)	6.8	5.2		<	5.7	U	1.9	5.4	J	<	5.9	U	6.1	5.8		<	5.6	U
Semivolatile Organics (µg/kg)																		
Anthracene	<	340	U	<	380	U	67	360	J	<	390	U	<	380	U	<	370	U
Benzo(a)anthracene	69	340	J	<	380	U	330	360	J	<	390	U	<	380	U	<	370	U
Benzo(a)pyrene	60	340	J	<	380	U	260	360	J	<	390	U	<	380	U	<	370	U
Benzo(b)fluoranthene	110	340	J	<	380	U	510	360		<	390	U	<	380	U	<	370	U
Benzo(g,h,i)perylene	37	340	J	<	380	UJ	140	360	J	<	390	U	<	380	U	<	370	U
Butyl benzyl phthalate	<	340	U	<	380	U	39	360	J	<	390	U	<	380	U	<	370	U
Carbazole	<	340	UJ	<	380	UJ	<	360	U	<	390	U	<	380	U	<	370	U
Chrysene	67	340	J	<	380	UJ	350	360	J	<	390	U	<	380	U	<	370	U
Di-n-octyl phthalate	<	340	U	<	380	U	160	360	J	<	390	U	<	380	U	<	370	U
Dibenz(a,h)anthracene	<	340	U	<	380	U	73	360	J	<	390	U	<	380	U	<	370	U
Fluoranthene	130	340	J	<	380	U	610	360		<	390	U	<	380	U	<	370	U
Indeno(1,2,3-cd)pyrene	<	340	UJ	<	380	UJ	120	360	J	<	390	U	<	380	U	<	370	U
Pentachlorophenol	<	1700	U	<	1800	U	<	1700	U	<	1900	U	<	1800	U	<	1800	U
Phenanthrene	57	340	J	<	380	U	410	360		<	390	U	<	380	U	<	370	U
Pyrene	130	340	J	<	380	U	750	360		<	390	U	<	380	U	<	370	U
Pesticides/PCB's (µg/kg)																		
4,4'-DDE	<	3.4	U	<	3.8	U	<	14	U	<	3.9	U	<	3.8	U	<	3.7	U
4,4'-DDT	<	3.4	U	<	3.8	U	<	14	U	<	3.9	U	<	3.8	U	<	3.7	U
alpha-Chlordane	<	1.8	U	<	1.9	U	7.8	7.4		<	2	U	<	2	U	<	1.9	U
gamma-Chlordane	<	1.8	U	<	1.9	U	6.5	7.4	J	<	2	U	<	2	U	<	1.9	U

Results presented here are chemicals which were detected at least once in near-surface soils at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A of the RFI report.
J=Estimated value below reporting limit or estimated based on data quality criteria.
U = Not detected Qual =Qualification
RL = Reporting Limit.

TABLE 11-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-0000			CAN077-0771-7703			CAN077-0772-0000			CAN077-0772-0003			CAN077-0773-0000			CAN077-0773-0003		
LAB SAMPLE NUMBER	0311810007SA			0311810009SA			0311890001SA			0311890002SA			0313790015SA			0313790016SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	7100	10.4		7050	22.9		4140	10.8		3240	23.4		7410	11.5		7460	11.2	J
Antimony	<	6.2	U	<	13.7	U	<	6.5	U	3.1	14	J	<	6.9	U	<	6.7	U
Arsenic	2.3	0.52		2.9	0.57		1.7	0.54		2.2	0.59		2.5	0.58		2.1	0.56	
Barium			R			R	135	1.1		130	2.3		79.3	1.2		60.2	1.1	J
Beryllium	0.47	0.21		0.48	0.46		0.25	0.22		<	0.47	U	0.58	0.23		0.54	0.22	J
Cadmium	<	0.52	U	<	1.1	U	<	0.54	U	3	1.2		<	0.58	U	<	0.56	J
Calcium	10900	20.8		115000	45.8		15000	21.7		175000	46.8		2080	23.1		17700	22.5	J
Chromium	8	1		4.1	2.3		6.9	1.1		<	2.3	U	9.5	1.2		7.6	1.1	J
Cobalt	3.3	1		3.5	2.3		2.2	1.1		1.7	2.3	J	4.4	1.2		4	1.1	J
Copper	9.7	2.1		4.2	4.6	J	11	2.2		3.1	4.7	J	8.2	2.3		7.2	2.2	J
Iron	8820	10.4		6900	22.9		6450	10.8		2990	23.4		9330	11.5		7780	11.2	J
Lead	19.6	2.6	J	5.5	0.57	J	27.8	2.7		3.5	0.59		7.5	0.58		7	0.56	
Magnesium	1380	20.8		2940	45.8		1170	21.7		2340	46.8		1360	23.1		1820	22.5	J
Manganese	187	1	J	116	2.3	J	196	1.1		40.2	2.3		244	1.2	J	167	1.1	J
Nickel	6.7	4.2		7.8	9.2	J	5.1	4.3		4.3	9.4	J	7.9	4.6		8.5	4.5	J
Potassium	1440	520		1330	1140		979	541		621	1170	J	1440	577		1500	562	
Silver	<	1	UJ	<	2.3	UJ	0.6	1.1	J	2	2.3	J	0.72	1.2	J	0.56	1.1	J
Vanadium	17.6	1		21.3	2.3		13.7	1.1		10.2	2.3		20.9	1.2		16.9	1.1	
Zinc	38.9	2.1		15	4.6		73.8	2.2		7.5	4.7		19.6	2.3		17.3	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	129	41.6		<	45.8	U	158	43.3		<	46.8	U	<	46.1	U	<	45	U
Water Quality (percent)																		
Water	3.8	0.1		13	0.1		7.7	0.1		15	0.1		13	0.1		11	0.1	

NOTE:
Results presented here are chemicals which were detected at least once in near-surface soils at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A of the RFI report.
J = Estimated value below reporting limit or estimated based on data quality criteria.
U = Not detected Qual=Qualification
RL = Reporting Limit.

TABLE 11-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0000			CAN077-0774-0003			CAN077-0775-0000			CAN077-0775-0003			CAN077-0776-0000			CAN077-0776-0003		
LAB SAMPLE NUMBER	0313790001SA			0313790002SA			0311890006SA			0311890007SA			0311810001SA			0311810002SA		
COLLECT DATE	09/22/93			09/22/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Tetrachloroethene	<	5.9	U	<	5.8	U	<	5.2	U	1.3	5.4	J	<	5.4	U	<	5.6	U
Toluene	<	5.9	U	<	5.8	U	<	5.2	U	<	5.4	U	<	5.4	U	<	5.6	U
Xylenes (total)	<	5.9	U	<	5.8	U	<	5.2	U	<	5.4	U	<	5.4	U	<	5.6	U
Semivolatile Organics (µg/kg)																		
Anthracene	<	390	U	<	3800	U	<	340	U	150	360	J	57	360	J	<	370	U
Benzo(a)anthracene	<	390	U	<	3800	U	56	340	J	370	360		280	360	J	<	370	U
Benzo(a)pyrene	<	390	U	<	3800	U	54	340	J	350	360	J	200	360	J	<	370	U
Benzo(b)fluoranthene	<	390	U	<	3800	U	120	340	J	630	360		500	360		<	370	U
Benzo(g,h,i)perylene	<	390	U	<	3800	U	<	340	U	160	360	J	110	360	J	<	370	UJ
Butyl benzyl phthalate	<	390	U	<	3800	U	<	340	U	<	360	U	<	360	U	<	370	U
Carbazole	<	390	U	<	3800	U	<	340	U	43	360	J	41	360	J	<	370	UJ
Chrysene	<	390	U	<	3800	U	68	340	J	500	360		420	360	UJ	<	370	UJ
Di-n-octyl phthalate	<	390	U	<	3800	U	<	340	U	<	360	U	<	360	U	<	370	U
Dibenz(a,h)anthracene	<	390	U	<	3800	U	<	340	U	<	360	U	<	360	U	<	370	U
Fluoranthene	<	390	U	<	3800	U	140	340	J	1100	360		830	360		<	370	U
Indeno(1,2,3-cd)pyrene	<	390	U	<	3800	U	<	340	U	150	360	J	99	360	J	<	370	UJ
Pentachlorophenol	<	1900	U	<	18000	UJ	<	1700	U	<	1700	U	63	1700	J	<	1800	U
Phenanthrene	<	390	U	<	3800	U	94	340	J	800	360		400	360		<	370	U
Pyrene	<	390	U	<	3800	U	120	340	J	820	360		900	360		<	370	U
Pesticides/PCB's (µg/kg)																		
4,4'-DDE	<	3.9	U	<	3.8	U	2.3	3.4	J	<	3.6	U	3.8	7.1	J	<	3.7	U
4,4'-DDT	<	3.9	U	<	3.8	U	<	3.4	U	<	3.6	U	30	7.1		<	3.7	U
alpha-Chlordane	<	2	U	<	2	U	<	1.8	U	<	1.8	U	3.3	3.7	J	<	1.9	U
gamma-Chlordane	<	2	U	<	2	U	<	1.8	U	<	1.8	U	10	3.7		<	1.9	U

Results presented here are chemicals which were detected at least once in near-surface soils at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A of the RFI report.
J=Estimated value below reporting limit or estimated based on data quality criteria.
U = Not detected Qual =Qualification
RL = Reporting Limit.

TABLE 11-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR SURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0000			CAN077-0774-0003			CAN077-0775-0000			CAN077-0775-0003			CAN077-0776-0000			CAN077-0776-0003		
LAB SAMPLE NUMBER	0313790001SA			0313790002SA			0311890006SA			0311890007SA			0311810001SA			0311810002SA		
COLLECT DATE	09/22/93			09/22/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	9860	11.7		8330	11.6		2300	20.8		5890	10.8		5420	10.8		5670	11.2	
Antimony	<	7	U	<	6.9	U	<	12.5	U	<	6.5	U	<	6.5	U	5.9	6.7	J
Arsenic	2	0.59		1.5	0.58		2.5	0.52		2.1	0.54		2.3	0.54		1.8	0.56	
Barium	85.6	1.2		73.4	1.2		400	2.1		116	1.1	J			R			R
Beryllium	0.66	0.23		0.6	0.23		<	0.42	U	0.37	0.22		0.37	0.22		0.36	0.22	
Cadmium	<	0.59	U	<	0.58	U	2.4	1		0.62	0.54		<	0.54	U	<	0.56	U
Calcium	2090	23.4		1910	23.1		130000	41.7		48100	21.6	J	12300	21.6		81300	22.4	J
Chromium	10.4	1.2		9.3	1.2		2.1	2.1		6.6	1.1		8.6	1.1		4.6	1.1	
Cobalt	4.8	1.2		4.3	1.2		1.4	2.1	J	3.2	1.1		2.7	1.1		2.6	1.1	
Copper	8.4	2.3		8.2	2.3		4.4	4.2		6.8	2.2		7.3	2.2		4.1	2.2	
Iron	10800	11.7		9340	11.6		4430	20.8		6550	10.8		6490	10.8		5410	11.2	
Lead	8.1	0.59		8	0.58		9.1	1		9.3	1.1		41	2.7	J	5.9	0.56	J
Magnesium	1770	23.4		1670	23.1		1780	41.7		1570	21.6		1070	21.6		1850	22.4	
Manganese	252	1.2	J	228	1.2	J	410	2.1		206	1.1		182	1.1	J	74.9	1.1	J
Nickel	8.6	4.7		8.2	4.6		4	8.3	J	6.9	4.3		5.2	4.3		5.9	4.5	
Potassium	1770	586		1610	578		517	1040	J	1070	541		1010	539		1030	561	
Silver	0.8	1.2	J	0.78	1.2	J	1.6	2.1	J	0.69	1.1	J	<	1.1	UJ	<	1.1	UJ
Vanadium	22.5	1.2		17.9	1.2		11.1	2.1		18.8	1.1		14.4	1.1		12.6	1.1	
Zinc	22.9	2.3		23.6	2.3		17.3	4.2		19.2	2.2		6.2	2.2		11.9	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.9	U	10000	925		64	41.7		<	43.3	U	321	43.1		<	44.9	U
Water Quality (percent)																		
Water	15	0.1		14	0.1		4	0.1		7.5	0.1		7.2	0.1		11	0.1	

Results presented here are chemicals which were detected at least once in near-surface soils at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A of the RFI report.
J=Estimated value below reporting limit or estimated based on data quality criteria.
U = Not detected Qual =Qualification
RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-7708			CAN077-0771-7713			CAN077-0771-7718			CAN077-0772-0008			CAN077-0772-0013		
LAB SAMPLE NUMBER	0311810010SA			0311810011SA			0311810012SA			0311890003SA			0311890004SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)															
Toluene	<	5.8	U	2.6	5.5	J	<	5.6	U	<	5.5	U	<	5.8	U
Semivolatile Organics (µg/kg)															
Butyl benzyl phthalate	<	380	U	<	360	U	<	370	U	<	370	U	83	380	J
4-Nitrophenol	<	1800	U	<	1800	U	<	1800	U	<	1800	U	<	1800	U
Metals (mg/kg)															
Aluminum	3910	57.7		4910	21.9		4520	22.2		4740	11.1		5680	23	
Antimony	<	34.6	U	15.2	13.1		<	13.3	U	<	6.7	U	<	13.8	U
Arsenic	1.6	0.58		1.3	0.55		1.1	0.56		1.7	0.55		1.7	0.58	
Barium			R			R			R	503	1.1		372	2.3	
Beryllium	<	1.2	U	<	0.44	U	<	0.44	U	0.34	0.22		<	0.46	U
Cadmium	<	2.9	U	<	1.1	U	<	1.1	U	1.3	0.55		1.5	1.2	
Calcium	252000	115		154000	43.8		119000	44.4		98500	22.2		156000	46	
Chromium	<	5.8	U	<	2.2	U	1.3	2.2	J	3.1	1.1		<	2.3	U
Cobalt	<	5.8	U	1.7	2.2	J	2	2.2	J	1.7	1.1		2.4	2.3	
Copper	<	11.5	U	<	4.4	U	1.2	4.4	J	3	2.2		2.3	4.6	J
Iron	2980	57.7		3610	21.9		3460	22.2		3040	11.1		3990	23	
Lead	2.9	0.58	J	3.3	0.55	J	2.7	0.56	J	5.2	0.55		3.8	0.58	
Magnesium	5070	115		5530	43.8		5710	44.4		3410	22.2		6300	46	
Manganese	35.3	5.8	J	46.6	2.2	J	52.9	2.2	J	62.2	1.1		48.6	2.3	
Nickel	<	23.1	U	5.1	8.8	J	4.3	8.9	J	3.8	4.4	J	6.2	9.2	J
Potassium	703	2880	J	1050	1090	J	761	1110	J	959	555		1320	1150	
Silver	<	5.8	UJ	<	2.2	UJ	<	2.2	UJ	0.6	1.1	J	1.3	2.3	J
Sodium	<	2880	U	<	1090	U	<	1110	U	<	555	U	<	1150	U
Vanadium	11.6	5.8		11.6	2.2		12.6	2.2		8	1.1		15	2.3	
Zinc	6.8	11.5	J	8.3	4.4	J	7.5	4.4		8.6	2.2		7.4	4.6	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual= Qualification
U = Not detected. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-7708			CAN077-0771-7713			CAN077-0771-7718			CAN077-0772-0008			CAN077-0772-0013		
LAB SAMPLE NUMBER	0311810010SA			0311810011SA			0311810012SA			0311890003SA			0311890004SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Water Quality (percent)															
Water	13	0.1		8.6	0.1		9.9	0.1		9.9	0.1		13	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0772-0018			CAN077-0773-0008			CAN077-0773-0013			CAN077-0773-0018			CAN077-0774-0008			CAN077-0774-0013		
LAB SAMPLE NUMBER	0311890005SA			0313790017SA			0313790018SA			0313790019SA			0313790003SA			0313790004SA		
COLLECT DATE	09/11/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Toluene	<	5.7	U	<	5.6	U	<	5.4	U	<	5.6	U	<	5.7	U	<	5.6	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate	<	380	U	<	370	U	<	360	U	<	370	U	<	370	U	<	370	U
4-Nitrophenol	58	1800	J	<	1800	U	<	1700	U	<	1800	U	<	1800	U	<	1800	U
Metals (mg/kg)																		
Aluminum	5540	22.8		3670	22.5		3010	10.8		5110	11.2		4030	22.7		5450	22.5	
Antimony	<	13.7	U	<	13.5	U	<	6.5	U	<	6.7	U	<	13.6	U	<	13.5	U
Arsenic	1.6	0.57		1.1	0.56		1	0.54		2.2	0.56		1.2	0.57		0.99	0.56	
Barium	341	2.3		190	2.3		38.9	1.1		106	1.1		597	2.3		454	2.3	
Beryllium	<	0.46	U	0.37	0.45	J	0.26	0.22		0.46	0.22		0.37	0.45	J	0.37	0.45	J
Cadmium	2.1	1.1		2.7	1.1		0.73	0.54		0.92	0.56		2.2	1.1		1.6	1.1	
Calcium	167000	45.6		183000	45.1		43700	21.6		66000	22.5		162000	45.4		158000	45.1	
Chromium	3.2	2.3		2.5	2.3		3.2	1.1		4	1.1		<	2.3	U	3.5	2.3	
Cobalt	1.8	2.3	J	2.1	2.3	J	2.1	1.1		3.1	1.1		2.2	2.3	J	2.7	2.3	
Copper	2.5	4.6	J	2.6	4.5	J	2.2	2.2		4.2	2.2		2.2	4.5	J	2.4	4.5	J
Iron	3660	22.8		2870	22.5		3190	10.8		4330	11.2		2970	22.7		4190	22.5	
Lead	3	0.57		3.4	5.6	J	3.7	2.7		5.6	0.56		3.2	5.7	J	3	0.56	
Magnesium	7820	45.6		4160	45.1		1920	21.6		4180	22.5		4170	45.4		5370	45.1	
Manganese	41.9	2.3		62.9	2.3	J	62.4	1.1	J	124	1.1	J	70.1	2.3	J	54.9	2.3	J
Nickel	4.2	9.1	J	4	9	J	3.9	4.3	J	5.6	4.5		4.7	9.1	J	6	9	J
Potassium	1160	1140		750	1130	J	944	541		1550	562		902	1130	J	1580	1130	
Silver	1.6	2.3	J	1.3	2.3	J	0.59	1.1	J	0.71	1.1	J	1.3	2.3	J	1.2	2.3	J
Sodium	<	1140	U	<	1130	U	171	541	J	336	562	J	<	1130	U	389	1130	J
Vanadium	17	2.3		10.6	2.3		10.2	1.1		18.4	1.1		10.9	2.3		13.1	2.3	
Zinc	5.9	4.6		8	4.5		8.2	2.2		12.4	2.2		8.8	4.5		10.6	4.5	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0772-0018			CAN077-0773-0008			CAN077-0773-0013			CAN077-0773-0018			CAN077-0774-0008			CAN077-0774-0013		
LAB SAMPLE NUMBER	0311890005SA			0313790017SA			0313790018SA			0313790019SA			0313790003SA			0313790004SA		
COLLECT DATE	09/11/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Water Quality (percent)																		
Water	12	0.1		11	0.1		7.6	0.1		11	0.1		12	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0018			CAN077-0775-0008			CAN077-0775-0013			CAN077-0775-0018			CAN077-0776-0008			CAN077-0776-0013		
LAB SAMPLE NUMBER	0313790005SA			0311890009SA			0311890010SA			0311890011SA			0311810004SA			0311810005SA		
COLLECT DATE	09/22/93			09/10/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)																		
Toluene	<	5.6	U	<	5.4	U	<	5.6	U	<	5.5	U	<	5.7	U	<	5.7	U
Semivolatile Organics (µg/kg)																		
Butyl benzyl phthalate	<	370	U	<	360	U	<	370	U	<	360	U	<	380	U	<	380	U
4-Nitrophenol	<	1800	U	<	1700	U	<	1800	U	<	1800	U	<	1800	U	<	1800	U
Metals (mg/kg)																		
Aluminum	5360	11.2		4940	10.8		4140	11.1		3110	11		7220	22.8		3080	56.9	
Antimony	<	6.7	U	<	6.5	U	<	6.7	U	<	6.6	U	<	13.7	U	<	34.1	U
Arsenic	1.3	0.56		2.1	0.54		1.6	0.56		1.3	0.55		1.7	0.57		1.1	0.57	
Barium	85.8	1.1		280	1.1		165	1.1		55.3	1.1				R			R
Beryllium	0.39	0.22		0.33	0.22		0.3	0.22		0.25	0.22		0.49	0.46		<	1.1	U
Cadmium	1.2	0.56		0.58	0.54		<	0.56	U	<	0.55	U	<	1.1	U	<	2.8	U
Calcium	105000	22.4		71700	21.7		42100	22.3		35300	22		102000	45.6		275000	114	
Chromium	3.8	1.1		6.1	1.1		3.4	1.1		3	1.1		4	2.3		<	5.7	U
Cobalt	2.4	1.1		2.5	1.1		2	1.1		1.9	1.1		2.1	2.3	J	<	5.7	U
Copper	2.6	2.2		6.4	2.2		7.9	2.2		2.8	2.2		4	4.6	J	<	11.4	U
Iron	3890	11.2		5170	10.8		4330	11.1		3610	11		5750	22.8		2040	56.9	
Lead	4.3	5.6	J	9.4	1.1		5.5	0.56		5.7	1.1		5.7	0.57	J	1.1	0.57	J
Magnesium	6270	22.4		1770	21.7		2090	22.3		1720	22		3320	45.6		5900	114	
Manganese	56.9	1.1	J	120	1.1		90.8	1.1		88.9	1.1		95	2.3	J	12.4	5.7	J
Nickel	5.5	4.5		5.6	4.3		5.2	4.5		3.6	4.4	J	5.7	9.1	J	<	22.8	U
Potassium	1460	561		883	542		892	557		790	551		1300	1140		383	2840	J
Silver	0.49	1.1	J	0.69	1.1	J	0.69	1.1	J	0.86	1.1	J	<	2.3	UJ	<	5.7	UJ
Sodium	349	561	J	<	542	U	<	557	U	<	551	U	<	1140	U	<	2840	U
Vanadium	16.2	1.1		14.9	1.1		17.1	1.1		10.6	1.1		13.7	2.3		10.2	5.7	
Zinc	10.4	2.2		16.2	2.2		10.5	2.2		8.4	2.2		14	4.6		<	11.4	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0018			CAN077-0775-0008			CAN077-0775-0013			CAN077-0775-0018			CAN077-0776-0008			CAN077-0776-0013		
LAB SAMPLE NUMBER	0313790005SA			0311890009SA			0311890010SA			0311890011SA			0311810004SA			0311810005SA		
COLLECT DATE	09/22/93			09/10/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Water Quality (percent)																		
Water	11	0.1		7.7	0.1		10	0.1		9.2	0.1		12	0.1		12	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0776-0018		
LAB SAMPLE NUMBER	0311810006SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Volatile Organics (µg/kg)			
Toluene	<	5.7	U
Semivolatile Organics (µg/kg)			
Butyl benzyl phthalate	<	380	U
4-Nitrophenol	<	1800	U
Metals (mg/kg)			
Aluminum	6310	22.8	
Antimony	<	13.7	U
Arsenic	0.95	0.57	
Barium			R
Beryllium	0.23	0.46	J
Cadmium	<	1.1	U
Calcium	91100	45.7	
Chromium	3.5	2.3	
Cobalt	1.7	2.3	J
Copper	<	4.6	U
Iron	4380	22.8	
Lead	3.2	0.57	J
Magnesium	6100	45.7	
Manganese	43.4	2.3	J
Nickel	4.7	9.1	J
Potassium	1140	1140	
Silver	<	2.3	UJ
Sodium	<	1140	U
Vanadium	13.7	2.3	
Zinc	10	4.6	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0776-0018		
LAB SAMPLE NUMBER	0311810006SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Water Quality (percent)			
Water	12	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J=Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual=Qualification
U = Not detected. RL = Reporting Limit.

TABLE 11-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SURFACE SOIL TO BACKGROUND(1)
SWMU 77, CANNON AFB

Civil Engineering Container Storage Area

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Typical Level in Clovis, NM Region (4)	Does maximum detected exceed UTL background
CAN077-0774-0000	Aluminum	9860	1410 - 11,000	10,540	50,000	N
CAN077-0775-0000	Arsenic	2.5	0.67 - 28	15.5	6.5	N
CAN077-0775-0000	Barium	400	14.5 - 1200	642	500	N
CAN077-0774-0000	Beryllium	0.66	0.17 - 0.77	0.73	1 - 2	N
CAN077-0775-0000	Cadmium	2.4	<0.51 - 4.2	*	---	Y
CAN077-0774-0000	Chromium	10.4	4 - 15.4	12.5	30	N
CAN077-0774-0000	Cobalt	4.8	0.85 - 5.3	4.5	3 - 7	N**
CAN077-0772-0000	Copper	11	<2 - 18.4	*	20	N**
CAN077-0776-0000	Lead	41	1.1 - 46	25.8	15	Y
CAN077-0774-0003	Nickel	8.6	1.3 - 9.8	9	15	N
CAN077-0775-0000	Silver	1.6	0.51 - 0.93	*	---	Y
CAN077-0774-0000	Vanadium	22.5	5.2 - 28.3	25.3	30 - 70	N
CAN077-0772-0000	Zinc	73.8	<4.3 - 27.5	21.9	45	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly exceeds Base-wide background rand and is within naturally-occurring levels (USGS 1984); therefore, concentration is not considered to exceed background.

TABLE 11-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN TOTAL SOILS TO BACKGROUND(1)
SWMU 77, CANNON AFB

Civil Engineering Contained Storage Area

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Typical Level in Clovis, NM Region (4)	Does maximum detected exceed UTL background
CAN077-0774-0000	Aluminum	9860	1410 - 11,000	10,540	50,000	N
CAN077-0776-0003	Antimony	5.9	<4.9 - 5.1	*	<1	Y
CAN077-0775-0000	Arsenic	2.5	0.67 - 28	15.5	6.5	N
CAN077-0772-0008	Barium	503	14.5 - 1200	642	500	N
CAN077-0774-0000	Beryllium	0.66	0.17 - 0.77	0.73	1 - 2	N
CAN077-0772-0003	Cadmium	3	<0.51 - 4.2	*	---	Y
CAN077-0774-0000	Chromium	10.4	4 - 15.4	12.5	30	N
CAN077-0774-0000	Cobalt	4.8	0.85 - 5.3	4.5	3 - 7	N**
CAN077-0772-0000	Copper	11	<2 - 18.4	*	20	N**
CAN077-0776-0000	Lead	41	1.1 - 46	25.8	15	Y
CAN077-0774-0003	Nickel	8.6	1.3 - 9.8	9	15	N
CAN077-0772-0003	Silver	2	0.51 - 0.93	*	---	Y
CAN077-0774-0000	Vanadium	22.5	5.2 - 28.3	25.3	30 - 70	N
CAN077-0772-0000	Zinc	73.8	<4.3 - 27.5	21.9	45	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly exceeds Base-wide background rand and is within naturally-occurring levels (USGS 1984); therefore, concentration is not considered to exceed background.

TABLE 11-5

CHEMICALS OF CONCERN IN SURFACE SOIL

Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Carbazole
Chlordane
Chrysene
4,4-DDE
4,4-DDT
Dibenzo(a,h)anthracene
Fluoranthene
Indeno(1,2,3-cd)pyrene
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Cadmium
Lead*
Silver
Zinc

* No EPA-established toxicity factor.

TABLE 11-6

CHEMICALS OF CONCERN IN TOTAL SOIL

Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene*
Butyl benzyl phthalate
Carbazole
Chlordane
Chrysene
4,4-DDE
4,4-DDT
Dibenzo(a,h)anthracene
Fluoranthene
Indeno(1,2,3-cd)pyrene
Pentachlorophenol
Phenanthrene*
Pyrene
Toluene
Xylenes
TPH*
Antimony
Cadmium
Lead*
Silver
Zinc

* No EPA-established toxicity factor.

TABLE 11-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT CE CONTAINER STORAGE AREA (SWMU 77)

	Toluene (µg/kg)				Xylenes (total) (µg/kg)				Anthracene (µg/kg)			Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN077-0771-0000	7.5	2.015		5.2	6.8	1.917		5.2		U	340	69	4.234	J	340	60	4.094	J	340
CAN077-0772-0000	2.7	0.993	U	5.4	1.9	0.642	J	5.4	67	J	360	330	5.799	J	360	260	5.561	J	360
CAN077-0773-0000	3.2	1.163	J	5.8	6.1	1.808		5.8		U	380	190	5.247	U	380	190	5.247	U	380
CAN077-0774-0000	2.95	1.082	U	5.9	2.95	1.082	U	5.9		U	390	195	5.273	U	390	195	5.273	U	390
CAN077-0775-0000	2.6	0.956	U	5.2	2.6	0.956	U	5.2		U	340	56	4.025	J	340	54	3.989	J	340
CAN077-0776-0000	2.7	0.993	U	5.4	2.7	0.993	U	5.4	57	J	360	280	5.635	J	360	200	5.298	J	360
Number	6	6			6	6			2			6	6			6	6		
Minimum	3.20				1.90				57.0			56.0				54.0			
Maximum	7.50				6.80				67.0			330				260			
Average	3.61	1.20			3.84	1.23			62.0			187	5.04			160	4.91		
H Statistic		2.405				2.604							3.099				2.965		
Standard Deviation	1.92	0.41			2.06	0.51						109.8	0.74			83.62	0.68		
95% UCL	5.58	5.58			7.09	7.09						559	559			424	424		
RME	5.58				6.80				67.0			330				260			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n<3

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT CE CONTAINER STORAGE AREA (SWMU 77)

	Benzo(b)fluoranthene (µg/kg)				Butyl benzyl phthalate (µg/kg)			Carbazole (µg/kg)			Chrysene (µg/kg)				Dibenzo(a,h)anthracene (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL
CAN077-0771-0000	110	4.700	J	340		U	340		UJ	340	67	4.205	J	340		U	340
CAN077-0772-0000	510	6.234		360	39	J	360		U	360	350	5.858	J	360	73	J	360
CAN077-0773-0000	190	5.247	U	380		U	380		U	380	190	5.247	U	380		U	380
CAN077-0774-0000	195	5.273	U	390		U	390		U	390	195	5.273	U	390		U	390
CAN077-0775-0000	120	4.787	J	340		U	340		U	340	68	4.220	J	340		U	340
CAN077-0776-0000	500	6.215		360		U	360	41	J	360	420	6.040		360		U	360
Number	6	6			1			1			6	6			1		
Minimum	110				39.0			41.0			67.0				73.0		
Maximum	510				39.0			41.0			420				73.0		
Average	271	5.41			39.0			41.0			215	5.14			73.0		
H Statistic		2.965										3.238					
Standard Deviation	184.7	0.67									144.8	0.78					
95% UCL	684	684									724	724					
RME	510				39.0			41.0			420				73.0		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n<3

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT CE CONTAINER STORAGE AREA (SWMU 77)

	Fluoranthene (µg/kg)				Indeno(1,2,3-cd)pyrene (µg/kg)			Pyrene (µg/kg)				4,4'-DDE (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN077-0771-0000	130	4.868	J	340		UJ	340	130	4.868	J	340	1.7	0.531	U	3.4
CAN077-0772-0000	610	6.413		360	120	J	360	750	6.620		360			U	14
CAN077-0773-0000	190	5.247	U	380		U	380	190	5.247	U	380	1.9	0.642	U	3.8
CAN077-0774-0000	195	5.273	U	390		U	390	195	5.273	U	390	1.95	0.668	U	3.9
CAN077-0775-0000	140	4.942	J	340		U	340	120	4.787	J	340	2.3	0.833	J	3.4
CAN077-0776-0000	830	6.721		360	99	J	360	900	6.802		360	3.8	1.335	J	7.1
Number	6	6			2			6	6			5	5		
Minimum	130				99.0			120				2.30			
Maximum	830				120			900				3.80			
Average	349	5.58			110			381	5.60			2.33	0.80		
H Statistic		3.238							3.528				2.521		
Standard Deviation	297	0.79						348.6	0.88			0.85	0.32		
95% UCL	1133	1133						1615	1615			3.50	3.50		
RME	830				120			900				3.50			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n<3

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT CE CONTAINER STORAGE AREA (SWMU 77)

	4,4'-DDT (µg/kg)				Chlordane (µg/kg)				TPH (mg/kg)				Cadmium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN077-0771-0000	1.7	0.531	U	3.4	0.9	-0.105	U	1.8	129	4.8598124		41.6	0.26	-1.347	U	0.52
CAN077-0772-0000	7	1.946	U	14	14.3	2.660		7.4	158	5.06259503		43.3	0.27	-1.309	U	0.54
CAN077-0773-0000	1.9	0.642	U	3.8	1	0.000	U	2	23.05	3.13766577	U	46.1	0.29	-1.238	U	0.58
CAN077-0774-0000	1.95	0.668	U	3.9	1	0.000	U	2	23.45	3.15487049	U	46.9	0.295	-1.221	U	0.59
CAN077-0775-0000	1.7	0.531	U	3.4	0.9	-0.105	U	1.8	64	4.15888308		41.7	2.4	0.875		1
CAN077-0776-0000	30	3.401		7.1	13.3	2.588		3.7	321	5.77144112		43.1	0.27	-1.309	U	0.54
Number	6	6			6	6			6	6			6	6		
Minimum	30.0				13.3				23.1				2.40			
Maximum	30.0				14.3				321				2.40			
Average	7.38	1.29			5.23	0.84			120	4.36			0.63	-0.92		
H Statistic		4.617				5.022				4.191				3.528		
Standard Deviation	11.28	1.17			6.64	1.38			112.9	1.07			0.87	0.88		
95% UCL	80.4	80.4			135	135			1028	1028			2.36	2.36		
RME	30.0				14.3				321				2.36			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected. 95% UCL concentrations were not calculated for sample sets with n<3

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-7

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SURFACE SOILS AT CE CONTAINER STORAGE AREA (SWMU 77)

	Lead (mg/kg)				Silver (mg/kg)				Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN077-0771-0000	19.6	2.976	J	2.6	0.5	-0.693	UJ	1	39.8	3.684		2.1
CAN077-0772-0000	27.8	3.325		2.7	0.6	-0.511	J	1.1	73.8	4.301		2.2
CAN077-0773-0000	7.5	2.015		0.58	0.56	-0.580	J	1.1	19.6	2.976		2.3
CAN077-0774-0000	8.1	2.092		0.59	0.8	-0.223	J	1.2	22.9	3.131		2.3
CAN077-0775-0000	9.1	2.208		1	1.6	0.470	J	2.1	17.3	2.851		4.2
CAN077-0776-0000	41	3.714	J	2.7	0.55	-0.598	UJ	1.1	62	4.127		2.2
Number	6	6			6	6			6	6		
Minimum	7.50				0.56				17.3			
Maximum	41.0				1.60				73.8			
Average	18.9	2.72			0.77	-0.36			39.2	3.51		
H Statistic		3.099				2.405				2.837		
Standard Deviation	13.5	0.72			0.42	0.44			23.9	0.62		
95% UCL	53.1	53.1			1.23	1.23			88.6	88.6		
RME	41.0				1.23				73.8			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected.

95% UCL concentrations were not calculated for sample sets with n<3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT CE CONTAINER STORAGE AREA (SWMU 77)

	Toluene (µg/kg)				Xylenes (total) (µg/kg)				Anthracene (µg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN077-0771-0000	7.5	2.015		5.2	6.8	1.917		5.2	170	5.136	U	340
CAN077-0771-7703	2.85	1.047	U	5.7	2.85	1.047	U	5.7			U	380
CAN077-0771-7708	2.9	1.065	U	5.8	2.9	1.065	U	5.8			U	380
CAN077-0771-7713	2.6	0.956	J	5.5	2.75	1.012	U	5.5	180	5.193	U	360
CAN077-0771-7718	2.8	1.030	U	5.6	2.8	1.030	U	5.6			U	370
CAN077-0772-0000	2.7	0.993	U	5.4	1.9	0.642	J	5.4	67	4.205	J	360
CAN077-0772-0003	2.95	1.082	U	5.9	2.95	1.082	U	5.9			U	390
CAN077-0772-0008	2.75	1.012	U	5.5	2.75	1.012	U	5.5			U	370
CAN077-0772-0013	2.9	1.065	U	5.8	2.9	1.065	U	5.8			U	380
CAN077-0772-0018	2.85	1.047	U	5.7	2.85	1.047	U	5.7			U	380
CAN077-0773-0000	3.2	1.163	J	5.8	6.1	1.808		5.8			U	380
CAN077-0773-0003	2.8	1.030	U	5.6	2.8	1.030	U	5.6			U	370
CAN077-0773-0008	2.8	1.030	U	5.6	2.8	1.030	U	5.6			U	370
CAN077-0773-0013	2.7	0.993	U	5.4	2.7	0.993	U	5.4	180	5.193	U	360
CAN077-0773-0018	2.8	1.030	U	5.6	2.8	1.030	U	5.6			U	370
CAN077-0774-0000	2.95	1.082	U	5.9	2.95	1.082	U	5.9			U	390
CAN077-0774-0003	2.9	1.065	U	5.8	2.9	1.065	U	5.8			U	3800
CAN077-0774-0008	2.85	1.047	U	5.7	2.85	1.047	U	5.7			U	370
CAN077-0774-0013	2.8	1.030	U	5.6	2.8	1.030	U	5.6			U	370
CAN077-0774-0018	2.8	1.030	U	5.6	2.8	1.030	U	5.6			U	370
CAN077-0775-0000	2.6	0.956	U	5.2	2.6	0.956	U	5.2	170	5.136	U	340
CAN077-0775-0003	2.7	0.993	U	5.4	2.7	0.993	U	5.4	150	5.011	J	360
CAN077-0775-0008	2.7	0.993	U	5.4	2.7	0.993	U	5.4	180	5.193	U	360
CAN077-0775-0013	2.8	1.030	U	5.6	2.8	1.030	U	5.6			U	370
CAN077-0775-0018	2.75	1.012	U	5.5	2.75	1.012	U	5.5	180	5.193	U	360
CAN077-0776-0000	2.7	0.993	U	5.4	2.7	0.993	U	5.4	57	4.043	J	360
CAN077-0776-0003	2.8	1.030	U	5.6	2.8	1.030	U	5.6			U	370
CAN077-0776-0008	2.85	1.047	U	5.7	2.85	1.047	U	5.7			U	380
CAN077-0776-0013	2.85	1.047	U	5.7	2.85	1.047	U	5.7			U	380
CAN077-0776-0018	2.85	1.047	U	5.7	2.85	1.047	U	5.7			U	380
Number	30	30			30	30			9	9		
Minimum detected	2.60				1.90				57.0			
Maximum detected	7.50				6.80				150			
Average	2.97	1.07			3.02	1.07			148	4.92		
H Statistic		1.75				1.769				2.279		
Standard Deviation	0.86	0.184			0.95	0.228			49.89	0.458		
95% UCL	3.13	3.13			3.24	3.24			221	221		
RME	3.13				3.24				150			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT CE CONTAINER STORAGE AREA (SWMU 77)

	Benzo(a)anthracene (µg/kg)				Benzo(a)pyrene (µg/kg)				Benzo(b)fluoranthene (µg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN077-0771-0000	69	4.234	J	340	60	4.094	J	340	110	4.700	J	340
CAN077-0771-7703	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN077-0771-7708	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN077-0771-7713	180	5.193	U	360	180	5.193	U	360	180	5.193	U	360
CAN077-0771-7718	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0772-0000	330	5.799	J	360	260	5.561	J	360	510	6.234		360
CAN077-0772-0003	195	5.273	U	390	195	5.273	U	390	195	5.273	U	390
CAN077-0772-0008	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0772-0013	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN077-0772-0018	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN077-0773-0000	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN077-0773-0003	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0773-0008	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0773-0013	180	5.193	U	360	180	5.193	U	360	180	5.193	U	360
CAN077-0773-0018	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0774-0000	195	5.273	U	390	195	5.273	U	390	195	5.273	U	390
CAN077-0774-0003			U	3800			U	3800			U	3800
CAN077-0774-0008	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0774-0013	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0774-0018	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0775-0000	56	4.025	J	340	54	3.989	J	340	120	4.787	J	340
CAN077-0775-0003	370	5.914		360	350	5.858	J	360	630	6.446		360
CAN077-0775-0008	180	5.193	U	360	180	5.193	U	360	180	5.193	U	360
CAN077-0775-0013	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0775-0018	180	5.193	U	360	180	5.193	U	360	180	5.193	U	360
CAN077-0776-0000	280	5.635	J	360	200	5.298	J	360	500	6.215		360
CAN077-0776-0003	185	5.220	U	370	185	5.220	U	370	185	5.220	U	370
CAN077-0776-0008	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN077-0776-0013	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
CAN077-0776-0018	190	5.247	U	380	190	5.247	U	380	190	5.247	U	380
Number	29	29			29	29			29	29		
Minimum detected	56.0				54.0				110			
Maximum detected	370				350				630			
Average	193	5.21			186	5.18			219	5.31		
H Statistic		1.831				1.831				1.865		
Standard Deviation	57.69	0.348			48.66	0.343			116.5	0.367		
95% UCL	220	220			213	213			245	245		
RME	220				213				245			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT CE CONTAINER STORAGE AREA (SWMU 77)

	Butyl benzyl phthalate (µg/kg)			Carbazole (µg/kg)			Chrysene (µg/kg)			
Field ID	Result	Qual	RL	Result	Qual	RL	Result	log Result	Qual	RL
CAN077-0771-0000		U	340		UJ	340	67	4.205	J	340
CAN077-0771-7703		U	380		UJ	380			UJ	380
CAN077-0771-7708		U	380		UJ	380			UJ	380
CAN077-0771-7713		U	360		UJ	360			UJ	360
CAN077-0771-7718		U	370		UJ	370			UJ	370
CAN077-0772-0000	39	J	360		U	360	350	5.858	J	360
CAN077-0772-0003		U	390		U	390			U	390
CAN077-0772-0008		U	370		U	370			U	370
CAN077-0772-0013	83	J	380		U	380			U	380
CAN077-0772-0018		U	380		U	380			U	380
CAN077-0773-0000		U	380		U	380			U	380
CAN077-0773-0003		U	370		U	370			U	370
CAN077-0773-0008		U	370		U	370			U	370
CAN077-0773-0013		U	360		U	360			U	360
CAN077-0773-0018		U	370		U	370			U	370
CAN077-0774-0000		U	390		U	390			U	390
CAN077-0774-0003		U	3800		U	3800			U	3800
CAN077-0774-0008		U	370		U	370			U	370
CAN077-0774-0013		U	370		U	370			U	370
CAN077-0774-0018		U	370		U	370			U	370
CAN077-0775-0000		U	340		U	340	68	4.220	J	340
CAN077-0775-0003		U	360	43	J	360	500	6.215		360
CAN077-0775-0008		U	360		U	360			U	360
CAN077-0775-0013		U	370		U	370			U	370
CAN077-0775-0018		U	360		U	360			U	360
CAN077-0776-0000		U	360	41	J	360	420	6.040		360
CAN077-0776-0003		U	370		UJ	370			UJ	370
CAN077-0776-0008		U	380		UJ	380			UJ	380
CAN077-0776-0013		U	380		UJ	380			UJ	380
CAN077-0776-0018		U	380		UJ	380			UJ	380
Number	2			2			5	5		
Minimum detected	39.0			41.0			67.0			
Maximum detected	83.0			43.0			500			
Average	61.0			42.0			281	5.31		
H Statistic								5.41		
Standard Deviation							202.0	1.01		
95% UCL							5122	5122		
RME	83.0			43.0			500			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT CE CONTAINER STORAGE AREA (SWMU 77)

	Dibenz(a,h)anthracene (µg/kg)			Fluoranthene (µg/kg)				Indeno(1,2,3-cd)pyrene (µg/kg)			
Field ID	Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN077-0771-0000		U	340	130	4.868	J	340			UJ	340
CAN077-0771-7703		U	380			U	380			UJ	380
CAN077-0771-7708		U	380			U	380			UJ	380
CAN077-0771-7713		U	360			U	360			UJ	360
CAN077-0771-7718		U	370			U	370			UJ	370
CAN077-0772-0000	73	J	360	610	6.413		360	120	4.787	J	360
CAN077-0772-0003		U	390			U	390			U	390
CAN077-0772-0008		U	370			U	370			U	370
CAN077-0772-0013		U	380			U	380			U	380
CAN077-0772-0018		U	380			U	380			U	380
CAN077-0773-0000		U	380			U	380			U	380
CAN077-0773-0003		U	370			U	370			U	370
CAN077-0773-0008		U	370			U	370			U	370
CAN077-0773-0013		U	360			U	360			U	360
CAN077-0773-0018		U	370			U	370			U	370
CAN077-0774-0000		U	390			U	390			U	390
CAN077-0774-0003		U	3800			U	3800			U	3800
CAN077-0774-0008		U	370			U	370			U	370
CAN077-0774-0013		U	370			U	370			U	370
CAN077-0774-0018		U	370			U	370			U	370
CAN077-0775-0000		U	340	140	4.942	J	340			U	340
CAN077-0775-0003		U	360	1100	7.003		360	150	5.011	J	360
CAN077-0775-0008		U	360			U	360			U	360
CAN077-0775-0013		U	370			U	370			U	370
CAN077-0775-0018		U	360			U	360			U	360
CAN077-0776-0000		U	360	830	6.721		360	99	4.595	J	360
CAN077-0776-0003		U	370			U	370			UJ	370
CAN077-0776-0008		U	380			U	380			UJ	380
CAN077-0776-0013		U	380			U	380			UJ	380
CAN077-0776-0018		U	380			U	380			UJ	380
Number	1			5	5			3	3		
Minimum detected	73.0			130				99.0			
Maximum detected	73.0			1100				150			
Average	73.0			562	5.99			123	4.80		
H Statistic					5.41				3.667		
Standard Deviation				426.7	1.01			25.63	0.21		
95% UCL				10305	10305			212	212		
RME	73.0			1100				150			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT CE CONTAINER STORAGE AREA (SWMU 77)

	Pentachlorophenol (µg/kg)			Pyrene (µg/kg)				4,4'-DDE (µg/kg)			
Field ID	Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN077-0771-0000		U	1700	130	4.868	J	340	1.7	0.531	U	3.4
CAN077-0771-7703		U	1800			U	380	1.9	0.642	U	3.8
CAN077-0771-7708		U	1800			U	380	1.9	0.642	U	3.8
CAN077-0771-7713		U	1800			U	360	1.8	0.588	U	3.6
CAN077-0771-7718		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0772-0000		U	1700	750	6.620		360	7	1.946	U	14
CAN077-0772-0003		U	1900			U	390	1.95	0.668	U	3.9
CAN077-0772-0008		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0772-0013		U	1800			U	380	1.9	0.642	U	3.8
CAN077-0772-0018		U	1800			U	380	1.9	0.642	U	3.8
CAN077-0773-0000		U	1800			U	380	1.9	0.642	U	3.8
CAN077-0773-0003		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0773-0008		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0773-0013		U	1700			U	360	1.8	0.588	U	3.6
CAN077-0773-0018		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0774-0000		U	1900			U	390	1.95	0.668	U	3.9
CAN077-0774-0003		UJ	18000			U	3800	1.9	0.642	U	3.8
CAN077-0774-0008		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0774-0013		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0774-0018		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0775-0000		U	1700	120	4.787	J	340	2.3	0.833	J	3.4
CAN077-0775-0003		U	1700	820	6.709		360	1.8	0.588	U	3.6
CAN077-0775-0008		U	1700			U	360	1.8	0.588	U	3.6
CAN077-0775-0013		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0775-0018		U	1800			U	360	1.8	0.588	U	3.6
CAN077-0776-0000	63	J	1700	900	6.802		360	3.8	1.335	J	7.1
CAN077-0776-0003		U	1800			U	370	1.85	0.615	U	3.7
CAN077-0776-0008		U	1800			U	380	1.9	0.642	U	3.8
CAN077-0776-0013		U	1800			U	380	1.9	0.642	U	3.8
CAN077-0776-0018		U	1800			U	380	1.9	0.642	U	3.8
Number	1			5	5			30	30		
Minimum detected	63.0			120				2.3			
Maximum detected	63.0			900				3.8			
Average	63.0			544	5.96			2.11	0.69		
H Statistic					5.410			1.77	1.769		
Standard Deviation				386.2	1.034			0.99	0.273		
95% UCL				10809	10809			2.28	2.28		
RME	63.0			900				2.28			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT CE CONTAINER STORAGE AREA (SWMU 77)

	4,4'-DDT (µg/kg)				Chlordane (µg/kg)				TPH (mg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN077-0771-0000	1.7	0.531	U	3.4	0.9	-0.105	U	1.8	129	4.860		41.6
CAN077-0771-7703	1.9	0.642	U	3.8	0.95	-0.051	U	1.9	22.9	3.131	U	45.8
CAN077-0771-7708	1.9	0.642	U	3.8	1	0.000	U	2	23.05	3.138	U	46.1
CAN077-0771-7713	1.8	0.588	U	3.6	0.95	-0.051	U	1.9	21.9	3.086	U	43.8
CAN077-0771-7718	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.2	3.100	U	44.4
CAN077-0772-0000	7	1.946	U	14	14.3	2.660		7.4	158	5.063		43.3
CAN077-0772-0003	1.95	0.668	U	3.9	1	0.000	U	2	23.4	3.153	U	46.8
CAN077-0772-0008	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.2	3.100	U	44.4
CAN077-0772-0013	1.9	0.642	U	3.8	1	0.000	U	2	23	3.135	U	46
CAN077-0772-0018	1.9	0.642	U	3.8	0.95	-0.051	U	1.9	22.8	3.127	U	45.6
CAN077-0773-0000	1.9	0.642	U	3.8	1	0.000	U	2	23.05	3.138	U	46.1
CAN077-0773-0003	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.5	3.114	U	45
CAN077-0773-0008	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.55	3.116	U	45.1
CAN077-0773-0013	1.8	0.588	U	3.6	0.9	-0.105	U	1.8	21.65	3.075	U	43.3
CAN077-0773-0018	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.5	3.114	U	45
CAN077-0774-0000	1.95	0.668	U	3.9	1	0.000	U	2	23.45	3.155	U	46.9
CAN077-0774-0003	1.9	0.642	U	3.8	1	0.000	U	2	10000	9.210		925
CAN077-0774-0008	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.7	3.122	U	45.4
CAN077-0774-0013	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.55	3.116	U	45.1
CAN077-0774-0018	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.45	3.111	U	44.9
CAN077-0775-0000	1.7	0.531	U	3.4	0.9	-0.105	U	1.8	64	4.159		41.7
CAN077-0775-0003	1.8	0.588	U	3.6	0.9	-0.105	U	1.8	21.65	3.075	U	43.3
CAN077-0775-0008	1.8	0.588	U	3.6	0.9	-0.105	U	1.8	21.65	3.075	U	43.3
CAN077-0775-0013	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.3	3.105	U	44.6
CAN077-0775-0018	1.8	0.588	U	3.6	0.95	-0.051	U	1.9	22	3.091	U	44
CAN077-0776-0000	30	3.401		7.1	13.3	2.588		3.7	321	5.771		43.1
CAN077-0776-0003	1.85	0.615	U	3.7	0.95	-0.051	U	1.9	22.45	3.111	U	44.9
CAN077-0776-0008	1.9	0.642	U	3.8	0.95	-0.051	U	1.9	22.8	3.127	U	45.6
CAN077-0776-0013	1.9	0.642	U	3.8	0.95	-0.051	U	1.9	22.75	3.125	U	45.5
CAN077-0776-0018	1.9	0.642	U	3.8	0.95	-0.051	U	1.9	22.85	3.129	U	45.7
Number	30	30			30	30			30	30		
Minimum detected	30.0				13.3				64.0			
Maximum detected	30.0				14.3				10000			
Average	2.96	0.75			1.81	0.13			375	3.56		
H Statistic		2.017				2.110				2.923		
Standard Deviation	5.19	0.557			3.26	0.679			1819	1.261		
95% UCL	3.06	3.06			1.87	1.87			155	155		
RME	3.06				1.87				155			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT CE CONTAINER STORAGE AREA (SWMU 77)

	Antimony (mg/kg)				Cadmium (mg/kg)				Lead (mg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN077-0771-0000	3.1	1.131	U	6.2	0.26	-1.347	U	0.52	19.6	2.976	J	2.6
CAN077-0771-7703	6.85	1.924	U	13.7	0.55	-0.598	U	1.1	5.5	1.705	J	0.57
CAN077-0771-7708	17.3	2.851	U	34.6	1.95	0.668	U	2.9	2.9	1.065	J	0.58
CAN077-0771-7713	15.2	2.721		13.1	0.55	-0.598	U	1.1	3.3	1.194	J	0.55
CAN077-0771-7718	6.65	1.895	U	13.3	0.55	-0.598	U	1.1	2.7	0.993	J	0.56
CAN077-0772-0000	3.25	1.179	U	6.5	0.27	-1.309	U	0.54	27.8	3.325		2.7
CAN077-0772-0003	3.1	1.131	J	14	3	1.099		1.2	3.5	1.253		0.59
CAN077-0772-0008	3.35	1.209	U	6.7	1.3	0.262		0.55	5.2	1.649		0.55
CAN077-0772-0013	6.9	1.932	U	13.8	1.5	0.405		1.2	3.8	1.335		0.58
CAN077-0772-0018	6.85	1.924	U	13.7	2.1	0.742		1.1	3	1.099		0.57
CAN077-0773-0000	3.45	1.238	U	6.9	0.29	-1.238	U	0.58	7.5	2.015		0.58
CAN077-0773-0003	3.35	1.209	U	6.7	0.28	-1.273	U	0.56	7	1.946		0.56
CAN077-0773-0008	6.75	1.910	U	13.5	2.7	0.993		1.1	3.4	1.224	J	5.6
CAN077-0773-0013	3.25	1.179	U	6.5	0.73	-0.315		0.54	3.7	1.308		2.7
CAN077-0773-0018	3.35	1.209	U	6.7	0.92	-0.083		0.56	5.6	1.723		0.56
CAN077-0774-0000	3.5	1.253	U	7	0.295	-1.221	U	0.59	8.1	2.092		0.59
CAN077-0774-0003	3.45	1.238	U	6.9	0.29	-1.238	U	0.58	8	2.079		0.58
CAN077-0774-0008	6.8	1.917	U	13.6	2.2	0.788		1.1	3.2	1.163	J	5.7
CAN077-0774-0013	6.75	1.910	U	13.5	1.6	0.470		1.1	3	1.099		0.56
CAN077-0774-0018	3.35	1.209	U	6.7	1.2	0.182		0.56	4.3	1.459	J	5.6
CAN077-0775-0000	6.25	1.833	U	12.5	2.4	0.875		1	9.1	2.208		1
CAN077-0775-0003	3.25	1.179	U	6.5	0.62	-0.478		0.54	9.3	2.230		1.1
CAN077-0775-0008	3.25	1.179	U	6.5	0.58	-0.545		0.54	9.4	2.241		1.1
CAN077-0775-0013	3.35	1.209	U	6.7	0.28	-1.273	U	0.56	5.5	1.705		0.56
CAN077-0775-0018	3.3	1.194	U	6.6	0.275	-1.291	U	0.55	5.7	1.740		1.1
CAN077-0776-0000	3.25	1.179	U	6.5	0.27	-1.309	U	0.54	41	3.714	J	2.7
CAN077-0776-0003	5.9	1.775	J	6.7	0.28	-1.273	U	0.56	5.9	1.775	J	0.56
CAN077-0776-0008	6.85	1.924	U	13.7	0.55	-0.598	U	1.1	5.7	1.740	J	0.57
CAN077-0776-0013	17.05	2.836	U	34.1	1.4	0.336	U	2.8	1.1	0.095	J	0.57
CAN077-0776-0018	6.85	1.924	U	13.7	0.55	-0.598	U	1.1	3.2	1.163	J	0.57
Number	30	30			30	30			30	30		
Minimum detected	3.10				0.58				1.10			
Maximum detected	15.2				3.00				41.0			
Average	5.86	1.61			0.99	-0.35			7.57	1.71		
H Statistic		1.974				2.266				2.160		
Standard Deviation	3.97	0.524				0.838			8.24	0.729		
95% UCL	6.98	6.98			1.43	1.43			9.67	9.67		
RME	6.98				1.43				9.67			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-8
CONCENTRATIONS OF CHEMICALS OF CONCERN IN TOTAL SOIL AT CE CONTAINER STORAGE AREA (SWMU 77)

	Silver (mg/kg)				Zinc (mg/kg)			
Field ID	Result	log Result	Qual	RL	Result	log Result	Qual	RL
CAN077-0771-0000	0.5	-0.693	UJ	1	39.8	3.684		2.1
CAN077-0771-7703	1.15	0.140	UJ	2.3	15	2.708		4.6
CAN077-0771-7708	2.9	1.065	UJ	5.8	6.8	1.917	J	11.5
CAN077-0771-7713	1.1	0.095	UJ	2.2	8.3	2.116	J	4.4
CAN077-0771-7718	1.1	0.095	UJ	2.2	7.5	2.015		4.4
CAN077-0772-0000	0.6	-0.511	J	1.1	73.8	4.301		2.2
CAN077-0772-0003	2	0.693	J	2.3	7.5	2.015		4.7
CAN077-0772-0008	0.6	-0.511	J	1.1	8.6	2.152		2.2
CAN077-0772-0013	1.3	0.262	J	2.3	7.4	2.001		4.6
CAN077-0772-0018	1.6	0.470	J	2.3	5.9	1.775		4.6
CAN077-0773-0000	0.72	-0.329	J	1.2	19.6	2.976		2.3
CAN077-0773-0003	0.56	-0.580	J	1.1	17.3	2.851		2.2
CAN077-0773-0008	1.3	0.262	J	2.3	8	2.079		4.5
CAN077-0773-0013	0.59	-0.528	J	1.1	8.2	2.104		2.2
CAN077-0773-0018	0.71	-0.342	J	1.1	12.4	2.518		2.2
CAN077-0774-0000	0.8	-0.223	J	1.2	22.9	3.131		2.3
CAN077-0774-0003	0.78	-0.248	J	1.2	23.6	3.161		2.3
CAN077-0774-0008	1.3	0.262	J	2.3	8.8	2.175		4.5
CAN077-0774-0013	1.2	0.182	J	2.3	10.6	2.361		4.5
CAN077-0774-0018	0.49	-0.713	J	1.1	10.4	2.342		2.2
CAN077-0775-0000	1.6	0.470	J	2.1	17.3	2.851		4.2
CAN077-0775-0003	0.69	-0.371	J	1.1	19.2	2.955		2.2
CAN077-0775-0008	0.69	-0.371	J	1.1	16.2	2.785		2.2
CAN077-0775-0013	0.69	-0.371	J	1.1	10.5	2.351		2.2
CAN077-0775-0018	0.86	-0.151	J	1.1	8.4	2.128		2.2
CAN077-0776-0000	0.55	-0.598	UJ	1.1	62	4.127		2.2
CAN077-0776-0003	0.55	-0.598	UJ	1.1	11.9	2.477		2.2
CAN077-0776-0008	1.15	0.140	UJ	2.3	14	2.639		4.6
CAN077-0776-0013	2.85	1.047	UJ	5.7	5.7	1.740	U	11.4
CAN077-0776-0018	1.15	0.140	UJ	2.3	10	2.303		4.6
Number	30	30			30	30		
Minimum detected	0.49				5.90			
Maximum detected	2.00				73.8			
Average	1.07	-0.06			16.6	2.56		
H Statistic		1.934				2.062		
Standard Deviation	0.62	0.490			15.72	0.642		
95% UCL	1.27	1.27			20.3	20.3		
RME	1.27				20.3			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

95% UCL concentrations were not calculated for sample sets with n < 3.

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where no RL is shown, no analysis was performed.

TABLE 11-9
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SURFACE SOIL
SWMU 77

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
4,4'-DDE	0.002	0.003	0.03	0.000006	0.00009
4,4'-DDT	0.007	0.03	0.03	0.00021	0.0009
Anthracene	0.06	0.07	0.1	0.006	0.007
Benzo(a)anthracene	0.19	0.33	0.1	0.02	0.033
Benzo(a)pyrene	0.16	0.26	0.1	0.016	0.026
Benzo(b)fluoranthene	0.27	0.51	0.1	0.027	0.051
Butyl benzyl phthalate	0.04	0.04	0.1	0.004	0.004
Carbozole	0.04	0.04	0.1	0.004	0.004
Chlordane	0.005	0.01	0.1	0.0005	0.001
Chrysene	0.22	0.42	0.1	0.022	0.042
Dibenzo(a,h)anthracene	0.07	0.07	0.1	0.007	0.007
Fluoranthene	0.35	0.83	0.1	0.035	0.083
Indeno(1,2,3-cd)pyrene	0.11	0.12	0.1	0.011	0.012
Pyrene	0.38	0.90	0.1	0.038	0.09
Toluene	0.004	0.006	0.03	0.00012	0.00018
Xylenes	0.004	0.007	0.03	0.00012	0.00021

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 11-10
SOIL CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
TOTAL SOIL
SWMU 77

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration (2) (mg/kg)	Adjusted RME Concentration (3) (mg/kg)
4,4'-DDE	0.002	0.002	0.03	0.00006	0.00006
4,4'-DDT	0.003	0.003	0.03	0.00009	0.00009
Anthracene	0.15	0.15	0.1	0.015	0.015
Benzo(a)anthracene	0.19	0.20	0.1	0.019	0.02
Benzo(a)pyrene	0.19	0.20	0.1	0.019	0.02
Benzo(b)fluoranthene	0.22	0.25	0.1	0.022	0.025
Butyl benzyl phthalate	0.06	0.08	0.1	0.006	0.008
Carbozole	0.04	0.04	0.1	0.004	0.004
Chlordane	0.002	0.002	0.1	0.0002	0.0002
Chrysene	0.28	0.50	0.1	0.028	0.05
Dibenzo(a,h)anthracene	0.07	0.07	0.1	0.007	0.007
Fluoranthene	0.56	1.10	0.1	0.056	0.11
Indeno(1,2,3-cd)pyrene	0.12	0.15	0.1	0.012	0.015
Pentachlorophenol	0.06	0.06	0.1	0.006	0.006
Pyrene	0.54	0.9	0.1	0.054	0.09
Toluene	0.003	0.003	0.03	0.0001	0.0001
Xylenes	0.003	0.003	0.03	0.00009	0.00009

(1) Absorbed fraction from Table C-25, Appendix C.
(2) Adjusted average concentration = average concentration x absorbed fraction
(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 11-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT 77 CECSA

	t (y)	Cs (µg/kg)	Co (g/m^3)	L (m)	W (m)	T (m)	VWC (L/L)	foc	Koc (ml/g)	Kd (ml/g)	Soil Half Life (y)	P (g/cm^3)	I (m/y)	H (m)	TOT (y)	Rd
DDT	0	2.96	4.74E-03	130	300	3.963	0.15	0	138000	414	15.6	1.6	0.015	75.305	3326222	4.42E+03
DDE	0	2.11	3.38E-03	130	300	3.963	0.15	0	24300	72.9	15.6	1.6	0.015	75.305	586325	7.79E+02
Anthracene	0	148.22	2.37E-01	130	300	3.963	0.15	0	16000	48	1.26	1.6	0.015	75.305	386315	5.13E+02
Antimony	0	5860	9.38E+00	130	300	3.963	0.15	0	NA	3981	NA	1.6	0.015	75.305	31978268	4.25E+04
Benzo(a)anthracene	0	192.59	3.08E-01	130	300	3.963	0.15	0	1400000	4200	1.86	1.6	0.015	75.305	33737393	4.48E+04
Benzo(a)pyrene	0	186.34	2.98E-01	130	300	3.963	0.15	0	6500000	19500	1.45	1.6	0.015	75.305	156635153	2.08E+05
Benzo(b)fluoranthene	0	218.97	3.50E-01	130	300	3.963	0.15	0	550000	1650	1.67	1.6	0.015	75.305	13254433	1.76E+04
Benzylbutylphthalate	0	61	9.76E-02	130	300	3.963	0.15	0	68	0.204	0.2	1.6	0.015	75.305	2392	3.18E+00
Cadmium	0	990	1.58E+00	130	300	3.963	0.15	0	NA	7	NA	1.6	0.015	75.305	56981	7.57E+01
Carbazole	0	42	6.72E-02	130	300	3.963	0.15	0	5100	15.3	0.2	1.6	0.015	75.305	123651	1.64E+02
Chlordane		1.81	2.90E-03	130	300	3.963	0.15	0	140000	420	3.8	1.6	0.015	75.305	3374417	4.48E+03
Chrysene	0	281	4.50E-01	130	300	3.963	0.15	0	250000	750	2.72	1.6	0.015	75.305	6025153	8.00E+03
Dibenzo(a,h)anthracene	0	73	1.17E-01	130	300	3.963	0.15	0	1700000	5100	2.86	1.6	0.015	75.305	40966673	5.44E+04
Fluoranthene	0	562	8.99E-01	130	300	3.963	0.15	0	1380	4.14	1.21	1.6	0.015	75.305	34008	4.52E+01
Indeno(1,2,3-c)pyrene	0	123	1.97E-01	130	300	3.963	0.15	0	31000000	93000	2	1.6	0.015	75.305	747026353	9.92E+05
Lead	0	7570	1.21E+01	130	300	3.963	0.15	0	NA	100	NA	1.6	0.015	75.305	804006	1.07E+03
Pentachlorophenol	0	63	1.01E-01	130	300	3.963	0.15	0	53000	159	0.5	1.6	0.015	75.305	1277926	1.70E+03
Pyrene	0	544	8.70E-01	130	300	3.963	0.15	0	38000	114	5.2	1.6	0.015	75.305	916462	1.22E+03
Silver	0	1070	1.71E+00	130	300	3.963	0.15	0	NA	100	NA	1.6	0.015	75.305	804006	1.07E+03
Toluene	0	2.97	4.75E-03	130	300	3.963	0.15	0	300	0.9	0.2	1.6	0.015	75.305	7982	1.06E+01
Xylenes	0	3.02	4.83E-03	130	300	3.963	0.15	0	830	2.49	0.2	1.6	0.015	75.305	20754	2.76E+01
Zinc	0	16590	2.65E+01	130	300	3.963	0.15	0	NA	20	NA	1.6	0.015	75.305	161404	2.14E+02

t = Tim
Cs = Concentration of chemical in source soil
(average concentration from Table 11-8)
Co = Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 11-11
VADOSE ZONE FATE AND TRANSPORT MODELING FROM TOTAL SOILS AT 77 CECSA

	Leach Rate (y^-1)	Qo (g)	Q(t) (g)	qc (g/y)	Cl(1) (µg/l)	Cl(2) (µg/l)	K (m/s)	i (m/m)	b (m)	Qw (m^3/y)	Ql (m^3/yr)	Cw (µg/l)
DDT	5.71E-06	7.32E+02	7.32E+02	4.18E-03	7.15E-03	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
DDE	3.24E-05	5.22E+02	5.22E+02	1.69E-02	2.89E-02	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Anthracene	4.92E-05	3.67E+04	3.67E+04	1.80E+00	3.08E+00	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Antimony	5.94E-07	1.45E+06	1.45E+06	8.61E-01	1.47E+00	1.47E+00	2.00E-04	0.0019	10	35951	585	2.36E-02
Benzo(a)anthracene	5.63E-07	4.76E+04	4.76E+04	2.68E-02	4.59E-02	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Benzo(a)pyrene	1.21E-07	4.61E+04	4.61E+04	5.59E-03	9.56E-03	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Benzo(b)fluoranthene	1.43E-06	5.41E+04	5.41E+04	7.76E-02	1.33E-01	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Benzylbutylphthalate	7.95E-03	1.51E+04	1.51E+04	1.20E+02	2.05E+02	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Cadmium	3.33E-04	2.45E+05	2.45E+05	8.16E+01	1.40E+02	1.40E+02	2.00E-04	0.0019	10	35951	585	2.23E+00
Carbazole	1.54E-04	1.04E+04	1.04E+04	1.60E+00	2.73E+00	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Chlordane	5.63E-06	4.48E+02	4.48E+02	2.52E-03	4.31E-03	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Chrysene	3.15E-06	6.95E+04	6.95E+04	2.19E-01	3.75E-01	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Dibenzo(a,h)anthracene	4.64E-07	1.81E+04	1.81E+04	8.37E-03	1.43E-02	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Fluoranthene	5.59E-04	1.39E+05	1.39E+05	7.77E+01	1.33E+02	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Indeno(1,2,3-c)pyrene	2.54E-08	3.04E+04	3.04E+04	7.74E-04	1.32E-03	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Lead	2.36E-05	1.87E+06	1.87E+06	4.42E+01	7.56E+01	7.56E+01	2.00E-04	0.0019	10	35951	585	1.21E+00
Pentachlorophenol	1.49E-05	1.56E+04	1.56E+04	2.32E-01	3.96E-01	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Pyrene	2.07E-05	1.35E+05	1.35E+05	2.79E+00	4.77E+00	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Silver	2.36E-05	2.65E+05	2.65E+05	6.25E+00	1.07E+01	1.07E+01	2.00E-04	0.0019	10	35951	585	1.71E-01
Toluene	2.38E-03	7.34E+02	7.34E+02	1.75E+00	2.99E+00	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Xylenes	9.16E-04	7.47E+02	7.47E+02	6.84E-01	1.17E+00	0.00E+00	2.00E-04	0.0019	10	35951	585	0.00E+00
Zinc	1.18E-04	4.10E+06	4.10E+06	4.83E+02	8.26E+02	8.26E+02	2.00E-04	0.0019	10	35951	585	1.32E+01

t = Time where leachate concentration is estimated
Cs = Concentration of chemical in source soil
(average concentration from Table 11-8)
Co = Concentration of chemical in source soil (calculated)
L = Length of site in direction of groundwater flow
W = Width of site perpendicular to groundwater flow
T = Thickness of source area
VWC = Volumetric water content of soil
foc = Fraction of organic carbon
Koc = Organic carbon partition coefficient
TOT = Total vadose zone transit time
Kd = Soil/water partition coefficient (values estimated as
Koc*foc or from INEL (1991) study, if available)
P = bulk density of soil
I = Infiltration rate

H = Depth to groundwater (approx. 79.3 m) - depth of contaminated area
Rd = Retardation factor
Leach Rate = Leaching-rate constant
Qo = Present mass of chemical in source soil
Q(t) = Mass of contaminant in soil at time of leachate concentration prediction
qc = Yearly flux of chemical from source soil in leachate
Cl(1) = Concentration of chemical in leachate leaving source soil
Cl(2) = Concentration of chemical in leachate entering groundwater considering degradation in vadose zone
i = Groundwater hydraulic gradient
b = Mixing thickness in aquifer (equal to screen length)
Qw = Groundwater volumetric flow rate through cross section defined by WP and b
Ql = Volumetric flow rate of leachate
Cw(2) = Concentration of chemical in groundwater considering degradation and dilution
(Note: concentrations shown as 0.00E+00 are less than 1.00E-300 µg/L)
Soil half-life (from the Soil Chemistry of Hazardous Materials [1988]) =
time required for one-half the amount of chemical to be degraded in soil.

TABLE 11-12

COMPARISON OF MODELED GROUNDWATER CONCENTRATIONS TO RBCs(1)

	Cw (2) (µg/L)	Tap Water RBC (1) (µg/L)	Does modeled concentration exceed RBC?
DDT	0	0.2	No
DDE	0	0.2	No
Anthracene	0	11000	No
Antimony	2.36E-02	15	No
Benzo(a)anthracene	0	0.092	No
Benzo(a)pyrene	0	0.0092	No
Benzo(b)fluoranthene	0	0.092	No
Benzylbutylphthalate	0	7300	No
Cadmium	2.23E+00	18	No
Carbazole	0	3.4	No
Chlordane	0	0.052	No
Chrysene	0	9.2	No
Dibenzo(a,h)anthracene	0	0.0092	No
Fluoranthene	0	1500	No
Indeno(1,2,3-c)pyrene	0	0.092	No
Lead	1.21E+00	15 (3)	No
Pentachlorophenol	0	0.56	No
Pyrene	0	1100	No
Silver	1.71E-01	180	No
Toluene	0	750	No
Xylenes	0	12000	No
Zinc	1.32E+01	11000	No

(1) RBC is the EPA Region III risk-based concentration for residential tap water ingestion and inhalation.
(2) Cw is the modeled groundwater concentration as defined in Table 11-11.
(3) No Region III RBC is available for lead. Value is the action level defined in the May 1993 issue of Drinking water regulation and health advisories (EPA 1993).
Note: When modeled concentration is reported as zero; the actual value is less than 1E-300.

TABLE 11-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 77

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 11-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 11-13
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM SURFACE SOILS AT SWMU 77

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.006	8.86E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 11-7)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 11-14
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM SURFACE SOILS AT SWMU 77

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
4,4'-DDT	0.03	4.63E+09	6.48E-12
Cadmium	2.36	4.63E+09	5.10E-10
Chlordane	0.014	4.63E+09	3.02E-12
Benzo(a)anthracene	0.33	4.63E+09	7.13E-11
Benzo(a)pyrene	0.26	4.63E+09	5.62E-11
Benzo(b)fluoranthene	0.51	4.63E+09	1.10E-10
Chrysene	0.42	4.63E+09	9.07E-11
Dibenzo(a,h)anthracene	0.073	4.63E+09	1.58E-11
Indeno(1,2,3-cd)pyrene	0.12	4.63E+09	2.59E-11

RME Soil Concentration from Table 11-7
PEF = Particulate Emission Factor default value from EPA (1991b)
Air Concentration = Soil concentration/PEF

TABLE 11-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 77

	ps (g/cm3)	alpha (cm2/s)	LS (m)	V (m/s)	DH (m)	A (cm2)	T (s)	Dei (cm2/s)	E (unitless)	Di cm2/s)
Toluene	2.65	5.15E-04	45	2.25	2	20250000	7.90E+08	5.87E-02	0.35	0.08301

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 11-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 11-15
RME AIR CONCENTRATIONS OF VOLATILE COMPOUNDS FROM TOTAL SOILS AT SWMU 77

	Koc (ml/g)	H (atm-m3/mol)	Kd (cm3/g)	Kas g soil/cm3 air)	VF (m3/kg)	C soil (mg/kg)	C air (mg/m3)
Toluene	300	6.37E-03	6.00E+00	4.35E-02	6.32E+03	0.003	4.91E-07

Method and default values from EPA (1991b) Risk Assessment Guidance for Superfund: Part B.
The method and equation are discussed in detail in Appendix B.
ps = soil density
alpha = (Dei*E)/(E+(ps(1-E)/Kas))
LS = Length of the SWMU in direction of wind (default value)
V = Wind velocity (default value)
DH = Diffusion height; height of box into which volatilization occurs (default value)
A = Surface area of SWMU (default value: 45m x 45m)
Time = Time of exposure (25 years; equivalent to default RME occupational exposure period)
Dei = Effective diffusivity (Di * E^0.33)
E = True soil porosity (default value)
Di = Molecular diffusivity (EPA 1988) Superfund Exposure Assessment Manual
Koc = organic carbon partition coefficient (from Appendix A, Table A-1)
H = Henry's Law constant (from Appendix A, Table A-1)
Kd = Soil/water partitioning coefficient (Koc * OC)
OC = Organic carbon fraction in soil (0.02 default value)
Kas = Soil/air partition coefficient (H/Kd * 41)
VF = Volatilization Factor = (LS x V x DH/A) + (3.14 alpha x T)^0.5/(2 x Dei x E x Kas x 0.001 kg/g)
Csoil = RME concentration of compound in soil (Table 11-8)
Cair = RME concentration of compound in air (Csoil/VF)
Note: Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in this table.

TABLE 11-16
RME AIR CONCENTRATIONS OF PARTICULATE-BOUND CHEMICALS FROM TOTAL SOILS AT SWMU 77

	RME Soil Concentration (mg/kg)	PEF (m3/kg)	Air Concentration (mg/m3)
4,4'-DDT	0.003	4.63E+09	6.61E-13
Benzo(a)anthracene	0.22	4.63E+09	4.75E-11
Benzo(a)pyrene	0.21	4.63E+09	4.60E-11
Benzo(b)fluoranthene	0.25	4.63E+09	5.29E-11
Cadmium	1.43	4.63E+09	3.09E-10
Chrysene	0.50	4.63E+09	1.08E-10
Chlordane	0.002	4.63E+09	4.32E-13
Dibenzo(a,h)anthracene	0.07	4.63E+09	1.58E-11
Indeno(1,2,3-cd)pyrene	0.15	4.63E+09	3.24E-11

RME Soil Concentration from Table 11-8
PEF = Particulate Emission Factor default value from EPA (1991b)
Air Concentration = Soil concentration/PEF

TABLE 11-17

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Inhalation (m^3/kg-d)		
Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
Carcinogenic	1.39×10^{-3}	6.99×10^{-2}
Construction Workers	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Inhalation (m^3/kg-d)		
Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
Carcinogenic	1.03×10^{-4}	4.47×10^{-4}
Future Trespasser	**Average**	**RME**
Dermal Contact with Soil (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Soil Ingestion (kg/kg-d)		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Inhalation (m^3/kg-d)		
Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 11-18

SUMMARY OF HUMAN HEALTH RISKS AT SWMU 77

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Surface Soil)						
-- Dermal Contact	5×10^{-11}		4×10^{-6}	2×10^{-8}		5×10^{-4}
-- Ingestion	2×10^{-9}		6×10^{-6}	6×10^{-7}		2×10^{-3}
-- Inhalation of VOCs	0.00		9×10^{-8}	0.00		2×10^{-6}
-- Inhalation of Particulates	5×10^{-12}		0.00	3×10^{-10}		0.00
	2×10^{-9}		1×10^{-5}	6×10^{-7}		2×10^{-3}
Construction Worker (Total Soil)						
-- Dermal Contact	5×10^{-12}	1×10^{-6}		7×10^{-11}	2×10^{-5}	
-- Ingestion	6×10^{-10}	3×10^{-4}		6×10^{-9}	3×10^{-3}	
-- Inhalation of VOCs	0.00	3×10^{-8}		0.00	1×10^{-7}	
-- Inhalation of Particulates	2×10^{-13}	0.00		1×10^{-12}	0.00	
	7×10^{-10}	3×10^{-4}		6×10^{-9}	3×10^{-3}	
Future Resident						
-- Dermal Contact	1×10^{-11}	1×10^{-6}		2×10^{-9}	3×10^{-4}	
-- Ingestion	3×10^{-10}	7×10^{-7}		4×10^{-8}	1×10^{-4}	
-- Inhalation of VOCs	0.00	3×10^{-8}		0.00	5×10^{-7}	
-- Inhalation of Particulates	1×10^{-12}	0.00		2×10^{-11}	0.00	
	3×10^{-10}	2×10^{-6}		4×10^{-8}	4×10^{-2}	

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix H for nonrounded risk values.

*No carcinogenic volatile organic compounds were detected in soil at SWMU 77.

TABLE 11-19

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies. They are under review and subject to change.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

TABLE 11-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 77
CANNON AFB
(mg/kg)

Chemical	CAN077-0771-0000	CAN077-0772-0000	CAN077-0773 0000	CAN077-0774 0000	CAN077-0775-0000	CAN077-0776-0000	N	Arithmetic Mean	95% UCL	Maximum
Volatile Organics										
Toluene	0.0075	0.0027 U	0.0032 J	0.003 U	0.0026 U	0.0027 U	6	0.004	0.005	0.0068
Xylenes	0.0068	0.0019 J	0.0061	0.003 U	0.0026 U	0.0027 U	6	0.004	0.005	0.0061
Semivolatile Organics										
Anthracene	0.17 U	0.067 J	0.19 U	0.195 U	0.17 U	0.057 J	6	0.142	0.19	0.195
Benzo(a)anthracene	0.069 J	0.33 J	0.19 U	0.195 U	0.056 J	0.28 J	6	0.187	0.27	0.33
Benzo(a)pyrene	0.06 J	0.26 J	0.19 U	0.195 U	0.054 J	0.2 J	6	0.160	0.22	0.26
Benzo(b)fluoranthene	0.11 J	0.51	0.19 U	0.195 U	0.12 J	0.5	6	0.271	0.42	0.51
Benzo(g,h,i)perylene	0.037 J	0.14 J	0.19 U	0.195 U	0.17 U	0.11 J	6	0.140	0.16	0.195
Butyl benzyl phthalate	0.17 U	0.039 J	0.19 U	0.195 U	0.17 U	0.18 U	6	0.157	0.20	0.195
Carbazole	0.17 UJ	0.18 U	0.19 U	0.195 U	0.17 U	0.041 J	6	0.158	0.21	0.195
Chrysene	0.067 J	0.35 J	0.19 U	0.195 U	0.068 J	0.42 UJ	6	0.215	0.31	0.42
Di-n-octyl phthalate	0.17 U	0.16 J	0.19 U	0.195 U	0.17 U	0.18 U	6	0.178	0.19	0.195
Dibenz(a,h)anthracene	0.17 U	0.073 J	0.19 U	0.195 U	0.17 U	0.18 U	6	0.163	0.20	0.195
Fluoranthene	0.13 J	0.61	0.19 U	0.195 U	0.14 J	0.83	6	0.349	0.57	0.83
Ideno(1,2,3-cd)pyrene	0.17 UJ	0.12 J	0.19 U	0.195 U	0.17 U	0.099 J	6	0.157	0.37	0.85
Pentachlorophenol	0.85 U	0.85 U	0.9 U	0.95 U	0.85 U	0.063 J	6	0.744	1.07	0.95
Phenanthrene	0.057 J	0.41	0.19 U	0.195 U	0.094 J	0.4	6	0.224	0.33	0.41
Pyrene	0.13 J	0.75	0.19 U	0.195 U	0.12 J	0.9	6	0.381	0.65	0.9
Pesticides/PCB's										
4,4-DDE	0.0017 U	0.007 U	0.0019 U	0.002 U	0.0023 J	0.0038 J	6	0.003	0.005	0.007
4,4-DDT	0.0017 U	0.007 U	0.0019 U	0.002 U	0.0017 U	0.03	6	0.007	0.02	0.03
alpha-Chlordane	0.0009 U	0.0078	0.001 U	0.001 U	0.0009 U	0.0033 J	6	0.002	0.005	0.0078
gamma-Chlordane	0.0009 U	0.0065 J	0.001 U	0.001 U	0.0009 U	0.01	6	0.003	0.01	0.01

TABLE 11-20

SUMMARY OF CHEMICALS REPORTED IN SURFACE SOILS* AT SWMU 77
CANNON AFB
(mg/kg)

Chemical	CAN077-0771-0000	CAN077-0772-0000	CAN077-0773 0000	CAN077-0774 0000	CAN077-0775-0000	CAN077-0776-0000	N	Arithmetic Mean	95% UCL	Maximum
Metals										
Aluminum	7100	4140	7410	9860	2300	5420	6	6038.333	8041.40	9860
Arsenic	2.3	1.7	2.5	2	2.5	2.3	6	2.217	2.57	2.5
Barium	R	135	79.3	85.6	400	R	4	174.975	439.36	400
Beryllium	0.47	0.25	0.58	0.66	0.21 U	0.37	6	0.423	0.76	0.66
Cadmium	0.26 U	0.27 U	0.26 U	0.295 U	2.4	0.27 U	6	0.626	2.57	2.4
Calcium	10900	15000	2080	2090	130000	12300	6	28728.333	159193.36	130000
Chromium	8	6.9	9.5	10.4	2.1	8.6	6	7.583	16.38	10.4
Cobalt	3.3	2.2	4.4	4.8	1.4 J	2.7	6	3.133	7.51	4.8
Copper	9.7	11	8.2	8.4	4.4	7.3	6	8.167	16.57	11
Iron	8820	6450	9330	10800	4430	6490	6	7720.000	17301.29	10800
Lead	19.6 J	27.8	7.5	8.1	9.1	41 J	6	18.850	79.28	41
Magnesium	1380	1170	1360	1770	1780	1070	6	1421.667	2864.26	1780
Manganese	187 J	196	244 J	252 J	410	182 J	6	245.167	694.53	410
Nickel	6.7	5.1	7.9	8.6	4 J	5.2	6	6.250	16.24	8.6
Potassium	1440	979	1440	1770	517 J	1010	6	1192.667	3850.07	1770
Silver	0.5 UJ	0.6 J	0.72 J	0.8 J	1.6 J	0.55 UJ	6	0.795	3.39	1.6
Vanadium	17.6	13.7	20.9	22.5	11.1	14.4	6	16.700	46.38	22.5
Zinc	38.9	73.8	19.6	22.9	17.3	6.2	6	29.783	199.97	73.8
TPH	129	158	23.1 U	23.5 U	64	321	6	119.767	212.59	321

* Between 0 and 2 feet deep

R Rejected

J Estimated value below reporting limit or estimated based on data quality criteria.

U Non-detect, value shown is one-half the reporting limit

TABLE 11-21

CHEMICALS OF CONCERN IN SOILS SWMU 77
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Volatile Organics					
Toluene	0.0068	---	---	---	Y
Xylenes	0.0061	---	---	---	Y
Semivolatile Organics					
Anthracene	0.195	---	---	---	Y
Benzo(a)anthracene	0.33	---	---	---	Y
Benzo(a)pyrene	0.26	---	---	---	Y
Benzo(b)fluoranthene	0.51	---	---	---	Y
Benzo(g,h,i)perylene	0.1995	---	---	---	Y
Butyl benzyl phthalate	0.195	---	---	---	Y
Carbazole	0.195	---	---	---	Y
Chrysene	0.42	---	---	---	Y
Di-n-octylphthalate	0.195	---	---	---	Y
Dibenz(a,h)anthracene	0.195	---	---	---	Y
Fluoranthene	0.83	---	---	---	Y
Ideno(1,2,3-cd)pyrene	0.85	---	---	---	Y
Pentachlorophenol	0.95	---	---	---	Y
Phenanthrene	0.41	---	---	---	Y
Pyrene	0.9	---	---	---	Y
Pesticides/PCBs					
4,4'-DDT	0.007	---	---	---	Y
4,4'-DDE	0.03	---	---	---	Y
alpha-Chlordane	0.0078	---	---	---	Y
gamma-Chlordane	0.01	---	---	---	Y
Metals					
Aluminum	9860	10540	5000	700 - 100000	N
Arsenic	2.5	15.5	6.5	1.0 - 40	N
Barium	400	642	500	10 - 5,000	N
Beryllium	0.66	0.73	1 - 2	<1 - 15	N
Cadmium	2.4	*	---	0.01 - 2.0	Y
Calcium	130000	186400	---	---	N**
Chromium	10.4	12.5	30	5 -1,500	N
Cobalt	4.8	4.5	3 - 7	0.5 - 65	N
Copper	11	*	20	1 - 700	N

TABLE 11-21

CHEMICALS OF CONCERN IN SOILS SWMU 77
CANNON AFB
(mg/kg)

Chemicals	Maximum Concentration	UTL Cannon Background Concentrations(1)	Levels in Southwestern U.S. Soils(2)	Normal Range In U.S. Soils (3)	Retained as a COC?
Iron	10800	8720	15000	100 - 100000	N
Lead	41	25.8	15	10 - 700	Y
Magnesium	1780	11790	---	---	N**
Manganese	410	164	500	20 - 10000	N
Nickel	8.6	9	15	2 - 750	N
Potassium	1770	2572	---	---	N**
Silver	1.6	*	---	0.01 - 8	N
Vanadium	22.5	25.3	---	---	N
Zinc	73.8	21.9	45	<5 - 2900	Y
TPH	321	---	---	---	Y

(1) Upper Tolerance Limit (UTL) of the mean = mean + 2 x standard deviation. This is for all practical purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k = 2.02 for n = 37
(2) USGS (1984)
(3) Values mainly from Bowen (1979). Values for copper, lead, selenium, and zinc from USGS (1984).
* Data insufficient to calculate UTL of background concentration.
** Essential nutrient natural to soils. Not expected to be of concern compared to other COCs.
Y = Yes
N = No
--- = Not available

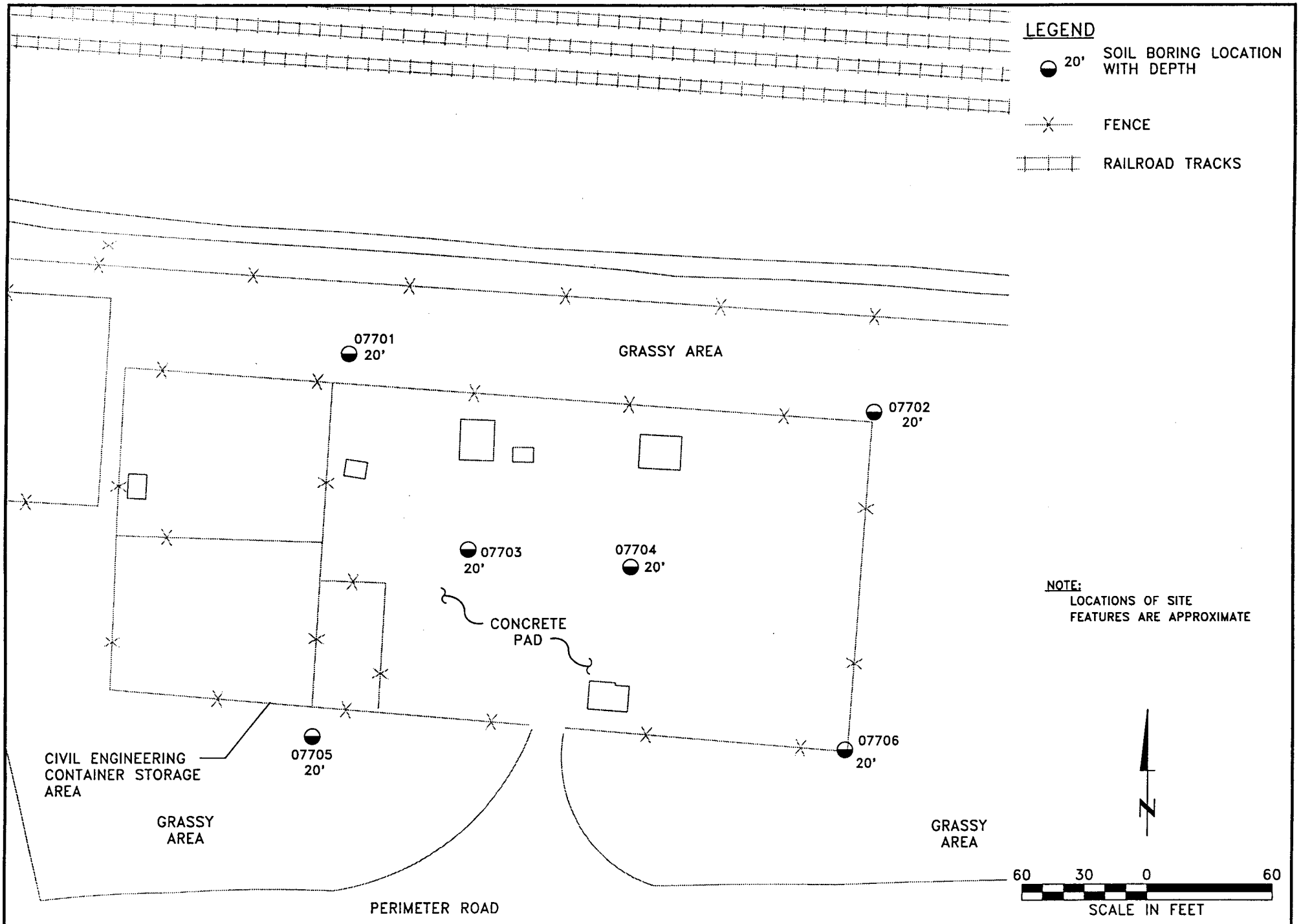
TABLE 11-22

RISK CHARACTERIZATION SUMMARY - SWMU 77

Chemical	Sample Number CAN077-0771-0000	CAN077-0772-0000	CAN077-0773 0000	CAN077-0774 0000	CAN077-0775-0000	CAN077-0776-0000	N	Arithmetic Mean (mg/kg)	Robin Benchmark Dietary Level (mg/kg)	Risk?	Deer Mouse Benchmark Dietary Level (mg/kg)	Risk?
Volatile Organics												
Toluene	0.0075	0.0027 U	0.0032 J	0.003 U	0.0026 U	0.0027 U	6	0.004	12500	--	20800	--
Xylenes	0.0068	0.0019 J	0.0061	0.003 U	0.0026 U	0.0027 U	6	0.004	5000	--	8300	--
Semivolatile Organics												
Anthracene	0.17 U	0.067 J	0.19 U	0.195 U	0.17 U	0.057 J	6	0.142	5000	--	8333.3	--
Benzo(a)anthracene	0.069 J	0.33 J	0.19 U	0.195 U	0.056 J	0.28 J	6	0.187	0.4	--	0.67	--
Benzo(a)pyrene	0.06 J	0.26 J	0.19 U	0.195 U	0.054 J	0.2 J	6	0.160	0.002	Possible	0.003	Possible
Benzo(b)fluoranthene	0.11 J	0.51	0.19 U	0.195 U	0.12 J	0.5	6	0.271	8	--	73.3	--
Benzo(g,h,i)perylene	0.037 J	0.14 J	0.19 U	0.195 U	0.17 U	0.11 J	6	0.140	375	--	625	--
Butyl benzyl phthalate	0.17 U	0.039 J	0.19 U	0.195 U	0.17 U	0.18 U	6	0.157	470	--	783	--
Carbazole	0.17 UJ	0.18 U	0.19 U	0.195 U	0.17 U	0.041 J	6	0.158	250	--	417	--
Chrysene	0.067 J	0.35 J	0.19 U	0.195 U	0.068 J	0.42 UJ	6	0.215	12	--	20	--
Di-n-octyl phthalate	0.17 U	0.16 J	0.19 U	0.195 U	0.17 U	0.18 U	6	0.178	3256.5	--	5427.5	--
Dibenz(a,h)anthracene	0.17 U	0.073 J	0.19 U	0.195 U	0.17 U	0.18 U	6	0.163	0.006	Possible	0.01	Possible
Fluoranthene	0.13 J	0.61	0.19 U	0.195 U	0.14 J	0.83	6	0.349	625	--	1041.7	--
Ideno(1,2,3-cd)pyrene	0.17 UJ	0.12 J	0.19 U	0.195 U	0.17 U	0.099 J	6	0.157	14.4	--	24	--
Pentachlorophenol	0.85 U	0.85 U	0.9 U	0.95 U	0.85 U	0.063 J	6	0.744	190	--	83.3	--
Phenanthrene	0.057 J	0.41	0.19 U	0.195 U	0.094 J	0.4	6	0.224	150	--	250	--
Pyrene	0.13 J	0.75	0.19 U	0.195 U	0.12 J	0.9	6	0.381	375	--	625	--
Pesticides/PCB's												
4,4-DDE	0.0017 U	0.007 U	0.0019 U	0.002 U	0.0023 J	0.0038 J	6	0.003	0.06	--	5	--
4,4-DDT	0.0017 U	0.007 U	0.0019 U	0.002 U	0.0017 U	0.03	6	0.007	0.06	--	5	--
alpha-Chlordane	0.0009 U	0.0078	0.001 U	0.001 U	0.0009 U	0.0033 J	6	0.002	0.1	--	0.46	--
gamma-Chlordane	0.0009 U	0.0065 J	0.001 U	0.001 U	0.0009 U	0.01	6	0.003	0.1	--	0.46	--
Metals												
Cadmium	0.26 U	0.27 U	0.26 U	0.295 U	2.4	0.27 U	6	288**	10.5	--	166.7	--
Lead	19.6 J	27.8	7.5	8.1	9.1	41 J	6	18.850	87.5	--	150	--
Zinc	38.9	73.8	19.6	22.9	17.3	6.2	6	29.783	875	--	625	--
TPH	129	158	23.1 U	23.5 U	64	321	6	119.767	241	--	401.7	--

* Between 0 and 2 feet deep
** Mean soil concentration multiplied by BAF of 4.6 (Cd).
R = Rejected
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Non-detect, value shown is one-half the reporting limit

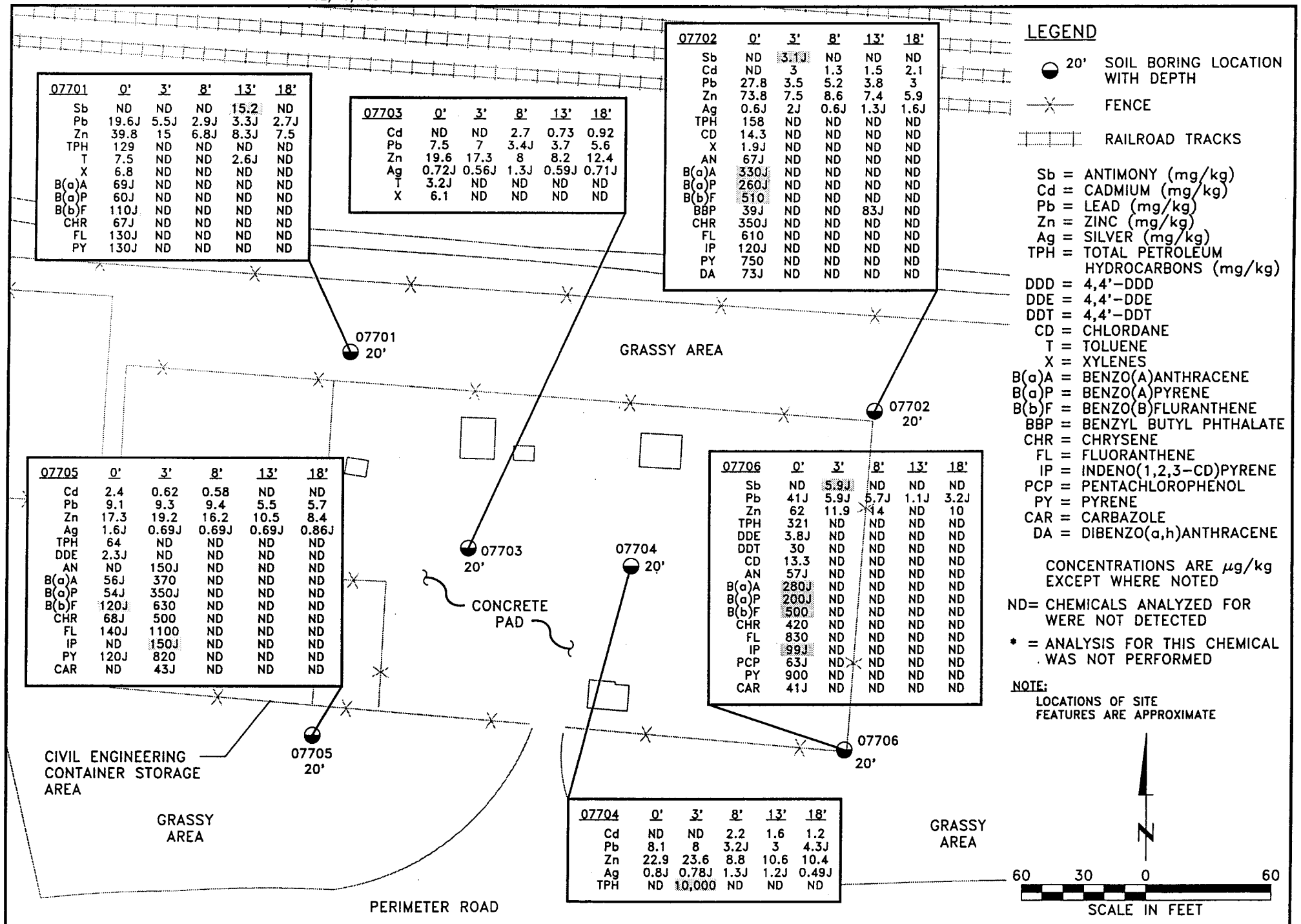
CAD FILE: C3M11W11.DWG V=SITE 02/15/1994 16:01



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	CIVIL ENGINEERING CONTAINER STORAGE AREA – SWMU 77 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 11–1
CHK'D BY: .	REVISION: 0			

CAD FILE: C3M11W11.DWG V=HITS 02/15/1994 10:27



07701	0'	3'	8'	13'	18'
Sb	ND	ND	ND	15.2	ND
Pb	19.6J	5.5J	2.9J	3.3J	2.7J
Zn	39.8	15	6.8J	8.3J	7.5
TPH	129	ND	ND	ND	ND
T	7.5	ND	ND	2.6J	ND
X	6.8	ND	ND	ND	ND
B(a)A	69J	ND	ND	ND	ND
B(a)P	60J	ND	ND	ND	ND
B(b)F	110J	ND	ND	ND	ND
CHR	67J	ND	ND	ND	ND
FL	130J	ND	ND	ND	ND
PY	130J	ND	ND	ND	ND

07703	0'	3'	8'	13'	18'
Cd	ND	ND	2.7	0.73	0.92
Pb	7.5	7	3.4J	3.7	5.6
Zn	19.6	17.3	8	8.2	12.4
Ag	0.72J	0.56J	1.3J	0.59J	0.71J
T	3.2J	ND	ND	ND	ND
X	6.1	ND	ND	ND	ND

07702	0'	3'	8'	13'	18'
Sb	ND	3.1J	ND	ND	ND
Cd	ND	3	1.3	1.5	2.1
Pb	27.8	3.5	5.2	3.8	3
Zn	73.8	7.5	8.6	7.4	5.9
Ag	0.6J	2J	0.6J	1.3J	1.6J
TPH	158	ND	ND	ND	ND
CD	14.3	ND	ND	ND	ND
X	1.9J	ND	ND	ND	ND
AN	67J	ND	ND	ND	ND
B(a)A	330J	ND	ND	ND	ND
B(a)P	260J	ND	ND	ND	ND
B(b)F	510	ND	ND	ND	ND
BBP	39J	ND	ND	83J	ND
CHR	350J	ND	ND	ND	ND
FL	610	ND	ND	ND	ND
IP	120J	ND	ND	ND	ND
PY	750	ND	ND	ND	ND
DA	73J	ND	ND	ND	ND

07705	0'	3'	8'	13'	18'
Cd	2.4	0.62	0.58	ND	ND
Pb	9.1	9.3	9.4	5.5	5.7
Zn	17.3	19.2	16.2	10.5	8.4
Ag	1.6J	0.69J	0.69J	0.69J	0.86J
TPH	64	ND	ND	ND	ND
DDE	2.3J	ND	ND	ND	ND
AN	ND	150J	ND	ND	ND
B(a)A	56J	370	ND	ND	ND
B(a)P	54J	350J	ND	ND	ND
B(b)F	120J	630	ND	ND	ND
CHR	68J	500	ND	ND	ND
FL	140J	1100	ND	ND	ND
IP	ND	150J	ND	ND	ND
PY	120J	820	ND	ND	ND
CAR	ND	43J	ND	ND	ND

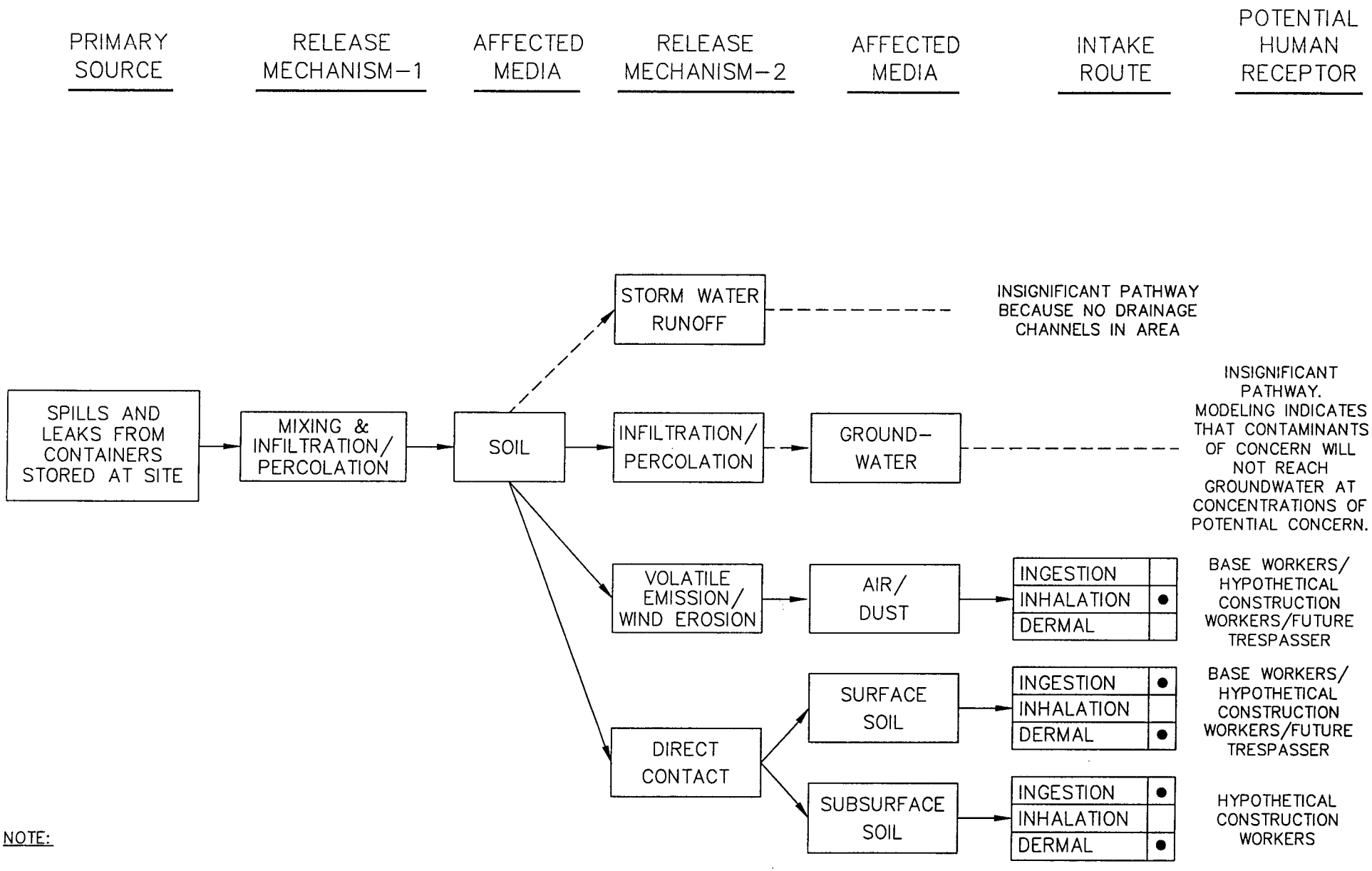
07706	0'	3'	8'	13'	18'
Sb	ND	5.9J	ND	ND	ND
Pb	41J	5.9J	5.7J	1.1J	3.2J
Zn	62	11.9	14	ND	10
TPH	321	ND	ND	ND	ND
DDE	3.8J	ND	ND	ND	ND
DDT	30	ND	ND	ND	ND
CD	13.3	ND	ND	ND	ND
AN	57J	ND	ND	ND	ND
B(a)A	280J	ND	ND	ND	ND
B(a)P	200J	ND	ND	ND	ND
B(b)F	500	ND	ND	ND	ND
CHR	420	ND	ND	ND	ND
FL	830	ND	ND	ND	ND
IP	99J	ND	ND	ND	ND
PCP	63J	ND	ND	ND	ND
PY	900	ND	ND	ND	ND
CAR	41J	ND	ND	ND	ND

07704	0'	3'	8'	13'	18'
Cd	ND	ND	2.2	1.6	1.2
Pb	8.1	8	3.2J	3	4.3J
Zn	22.9	23.6	8.8	10.6	10.4
Ag	0.8J	0.78J	1.3J	1.2J	0.49J
TPH	ND	10,000	ND	ND	ND

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/05/94	CIVIL ENGINEERING CONTAINER STORAGE AREA - SWMU 77 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 11-2
CHK'D BY: .	REVISION: 0			

CAD FILE: C3M11W15.DWG V=STORAGE 01/19/1994 16:23



NOTE:

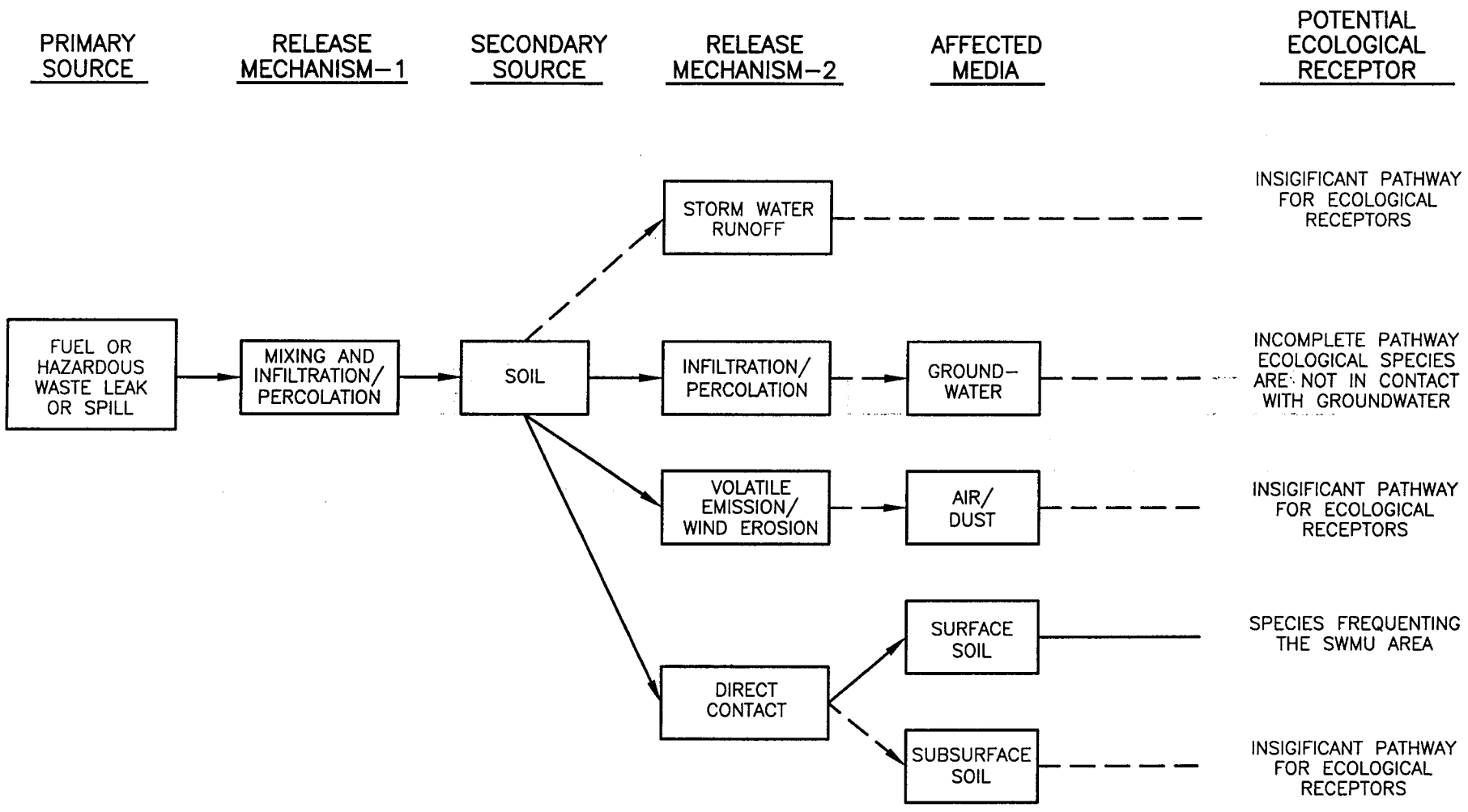
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART CIVIL ENGINEERING CONTAINER STORAGE AREA SWMU - 77 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	11-3

C3M11W22.DWG V=SWMU-77 02/15/1994 8:00

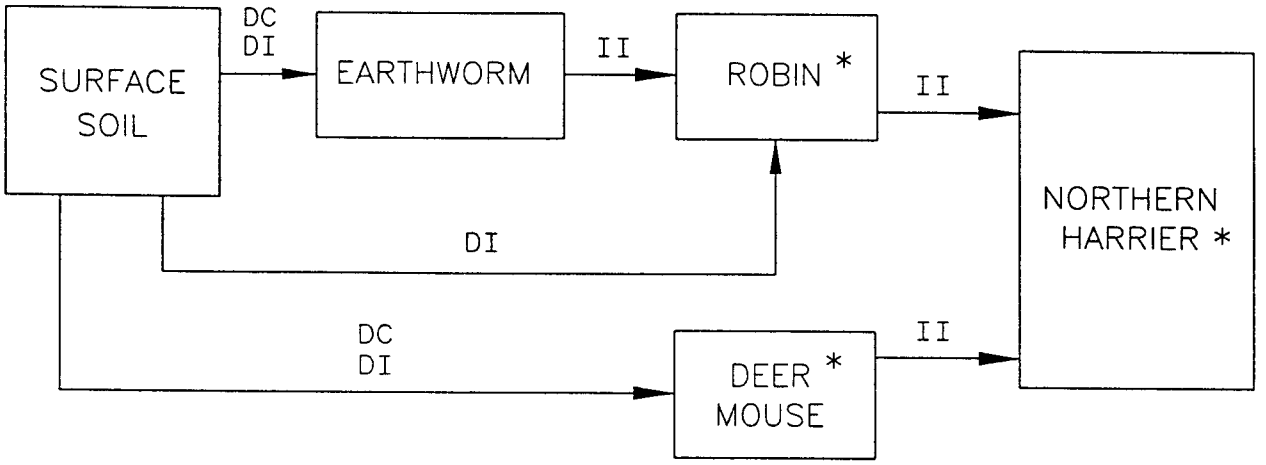


NOTES:

SOLID LINES REPRESENT POTENTIALLY COMPLETE AND SIGNIFICANT PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY NVD	DATE 12/30/93	EXPOSURE PATHWAY FLOW CHART FOR SWMU 77 ECOLOGICAL RECEPTORS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0		C3M11W	11-4



DC = DIRECT CONTACT

DI = DIRECT INGESTION

II = INDIRECT INGESTION
(i.e. SECONDARY, TERTIARY CONSUMPTION)

* = KEY RECEPTOR SPECIES

DRN BY NVD	DATE 12/30/93	CONCEPTUAL SITE MODEL SWMU 77	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0	CANNON AIR FORCE BASE NEW MEXICO	C3M11W	11-5

CAD FILE: C3M11W23.DWG V=SWMU-92 02/15/1994 9:30

12.1 SITE BACKGROUND

12.1.1 Site Description

The Playa Lake occupies approximately 13 acres within Cannon AFB near the ordnance area at the east-central edge of the Base (Figure 12-1). This shallow pond is maintained at approximately two-thirds total capacity by inflow from the wastewater treatment lagoons located to the west. The lake is an estimated 1,000 feet across the widest part and an estimated 5 feet deep at the deepest area with a gradually sloping bottom.

12.1.2 Site History

The Playa Lake received all of the Base sanitary and industrial wastewater from 1943 to 1966; a portion of the wastewater was treated with an Imhoff unit prior to discharge to the Playa Lake. In 1966, a lagoon system was placed in operation that provided aeration treatment of the wastewater prior to discharge of treated effluent to the Playa. The lake has received treated sanitary and industrial wastewater effluent from the wastewater treatment lagoons from 1966 to the present.

12.1.3 Current Use

The Playa Lake continues to receive treated effluent from the wastewater lagoons. Discharge occurs from the Playa Lake in the form of irrigation water which is mechanically pumped from the lake by a local farmer. Water also exits the lake via evaporation and possibly via infiltration.

12.2 SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL INVESTIGATIONS

12.2.1 Physical Investigation

The objective of sampling at the Playa Lake was to evaluate whether or not the lake water or sediments contain contaminants that could pose a significant risk to human or ecological receptors if exposure were to occur. To meet these sampling objectives, sediment samples from four locations and surface water samples from three locations were collected within the limits of the Playa Lake (Figure 12-1). These sample sites were spatially located around the lake to help estimate the relative distribution of potential contaminants in this SWMU.

Target analytes for the sediment (sludge) samples include VOCs, SVOCs, metals, TRPH, PCB/pesticides, and herbicides. Surface water samples were analyzed for the Appendix IX list of chemicals.

12.2.2 Chemical Investigation

A stainless-steel petite-ponar dredge was utilized to collect four sediment samples (sample location 10301, 10302, 10303, and 10304). Additionally, three surface water samples were collected (sample location 10305, 10306, and 10307). Sampling and analyses performed are summarized in Table 12-1. Summaries of the analytical results are provided in Table 12-2 for sediment samples and Table 12-3 for surface water samples. For each sample type (e.g., sediment or surface water), the tables provide results for all analytes that were detected in at least one sample of the group. Complete analytical summary results are provided in the QCSR (Appendix A of the RFI report).

12.2.3 Data Assessment

The quality of the analytical data was evaluated in the RFI report, and the data were deemed to be of adequate quality to meet the objectives of the RFI. However, data quality issues that may affect the risk assessment are more fully discussed here.

Elevated reporting limits resulting from sample dilution may limit the usability of the data if concentrations of some analytes are thereby diluted to levels below the reporting limit. That is, chemicals may be reported as nondetect when they are actually present in a sample at levels of potential concern. Section 4.13.6 of the QCSR (Appendix A of the RFI report) presents a discussion of elevated reporting limits.

In the RFI sediment analyses, three samples had slightly elevated reporting limits (up to five times), and one sample had a reporting limit twenty times the normal reporting limit for SVOCs, VOCs, and 6010 metals.

The SVOC analyses with elevated reporting limits should not significantly affect the risk assessment for the following reasons. The sample reporting limits were 1200, 1200, 1600, and 6500 μg/kg. The lab will report estimated ("J") concentrations of SVOCs down to one tenth of the reporting limit. Therefore, hypothetically some SVOCs could be present in the samples at concentrations of 120, 120, 160, and 650 μg/kg respectively without being reported. To determine if hypothetical concentrations of SVOCs could affect the conclusions of the risk assessment, a comparison of these hypothetical concentrations to risk-based concentrations was completed. The most toxic SVOCs as a group are polycyclic aromatic hydrocarbons (PAHs). To do the most conservative comparison, the more common PAHs were compared with risk-based concentrations in the following table.

Chemical	Maximum Reporting limit (μg/kg)	1/10th Maximum Reporting limit (μg/kg)	10^{-6} Risk-based Concentration (RBC) (1)	Does 1/10th reporting limit exceed 10^{-6} RBC
Acenaphthene	6500	650	61000000	N
Anthracene	6500	650	310000000	N
Benzo(a)anthracene	6500	650	3900	N
Benzo(b)fluoranthene	6500	650	3900	N
Benzo(k)fluoranthene	6500	650	3900	N
Benzo(a)pyrene	6500	650	390	Y
Chrysene	6500	650	390000	N
Dibenzo(a,h)anthracene	6500	650	390	Y
Fluoranthene	6500	650	41000000	N
Fluorene	6500	650	41000000	N
Indeno(1,2,3-cd)pyrene	6500	650	3900	N
Naphthalene	6500	650	41000000	N
Pyrene	6500	650	31000000	N

(1) Risk-Based concentration is from Region III industrial soil ingestion 1 x 10^{-6} excess cancer risk (EPA 1993b).

As demonstrated in the table, only two of the PAHs exceeded the very conservative 10^{-6} RBC. Even if both of these chemicals were present at the highest concentration possible without being reported (i.e., 650 μg/kg), their combined risk using the conservative industrial exposure assumptions would be 3×10^{-6}. This is a very unlikely scenario considering that they were not detected in any of the other samples that had lower reporting limits. Therefore, even though the risk from semivolatiles at this site could be slightly underestimated, the elevated reporting limits do not significantly affect the conclusions of the risk assessment.

Elevated reporting limits for VOCs are not likely to significantly affect the results of the risk assessment, because for three of the four samples, reporting limits were only elevated by a factor of five which could only potentially raise risk estimates by a factor of five (i.e., less than an order of magnitude). Furthermore, influent to the lake is discharge from the sewage lagoons. Most VOCs would be expected to be volatilized during the residence time in the sewage lagoons. That is, it is not expected that VOCs would be discharged to the lagoon at significant concentrations. This is supported by the fact that no VOCs were detected in the lake water.

All four sediment analyses for pesticides/PCBs had elevated reporting limits, representing dilutions by factors of 5 (for three samples) to 20 (for one sample). DDD was the only analyte detected in any of the samples, at a concentration of 220J μg/kg. All pesticides/PCBs were nondetect in the sample with the lowest reporting limit (RL) (16 μg/kg for most pesticides and 160 μg/kg for PCBs). All but DDD were nondetect in two samples with reporting limits of approximately 250 μg/kg for pesticides and 2,500 μg/kg for PCBs. No pesticides/PCBs were detected in the sample with the highest RLs (1,300 μg/kg for most pesticides and 13,000 μg/kg for PCBs. The elevated RLs do not permit a precise understanding of extent of contamination. However, three of the four samples have reasonable reporting limits that can support a qualitative evaluation of extent of contamination and potential magnitude of health risk. The fact that pesticides and PCBs were not detected in three of four samples with reporting limits of 250 μg/kg or lower (pesticides) or 2,500 μg/kg or lower (PCBs) indicates that these analytes are not significant contaminants in the sediment, and that they are probably not present in high concentrations in the remaining sample with the higher RLs. Furthermore, health risks associated with the typical elevated RL of 250 μg/kg for pesticides (or 2,500 μg/kg for PCBs) do not approach a level of concern. This is demonstrated in the following analysis, in which the typical elevated RLs (applying

to three of the four samples) are compared to RBCs for several common pesticides and PCBs. The RBCs are based on chronic industrial use and a 10^{-6} excess cancer risk level.

Pesticide/PCB	Typical High Reporting Limit mg/kg	10^{-6} RBC mg/kg[2]	Cancer Risk at Reporting Limit[3]
Aroclor-12	2.5	37	7×10^{-6}
DDD	0.25	1200	2×10^{-8}
DDE and DDT	0.25	840	3×10^{-8}
Dieldrin	0.25	18	1×10^{-6}
Endosulfan	0.25	5100	5×10^{-9}
Heptachlor epoxide	0.02	31	7×10^{-8}

(1) Three of four sediment samples had reporting limits at or below this level.
(2) Risk-based concentration for industrial use based on 10^{-6} excess cancer risk level EPA Region III (EPA 1993b).
(3) (RL/RBC) x 10^{-6}

As shown, none of the reporting limits for common pesticides exceed the 10^{-6} risk level. Even risk at the typical high reporting limits for PCBs is within EPA's target risk range of 1×10^{-6} to 1×10^{-4} (EPA 1990; 1991b). Therefore, the health risk associated with exposure to sediments in the Playa Lake are not likely to be significantly underestimated even if pesticides or PCBs are present below reporting limits in the sediment.

12.2.4 Nature and Extent of Contamination

The chemical test results revealed only minor contamination by organic target analytes, TPH (up to about 6,000 mg/kg), and several metals in excess of background levels. Figure 12-2 shows the location and concentrations of chemicals detected at the SWMU.

Water samples were nearly free of contamination. Isophorone was detected at 1.4 μg/L in one sample, but no other organic compounds were detected. Metals concentrations were low. As shown in Table 12-3, no concentration of any detected analyte exceeded federal Maximum Contaminants Levels or Lifetime Health Advisories for drinking water. In fact, concentrations were well below these criteria. Because the lake water meets drinking water criteria for target analytes, no further evaluation of surface water is performed in this risk assessment.

The scope of the RFI sampling program did not include investigating whether chemicals have been released from the Playa Lake into the soil column, where they could potentially be transported to groundwater depending upon contaminant concentrations, characteristics, and infiltration rate. Since playa lakes can act as significant sources of groundwater recharge (Stone 1990), and, therefore, may cause significant leaching of contaminants to the subsurface, the extent of contamination in the subsurface cannot be fully characterized.

12.3 HUMAN HEALTH RISK ASSESSMENT

12.3.1 Exposure Pathway Flow Chart

Figure 12-3 shows the exposure pathway flow chart of chemical sources and potential human exposure pathways associated with water and sediment in the Playa Lake. In the flow chart, potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines.

The primary sources are wastewater (historic) and treated wastewater effluent (current) that have been discharged into the lake. Chemicals from the primary source may be released to other media that may in turn act as secondary sources for chemical release or exposure. Mixing with sediments and surface water is shown as a primary chemical release mechanism. Chemicals in sediments may infiltrate through sediment or soil and be released to groundwater or may result in exposure via direct contact (e.g., dermal contact or incidental ingestion).

Sediments could provide exposures to Base workers (occupational exposures), hypothetical future construction workers, farmers involved in irrigation activities, or hypothetical future trespassers (if the Base is closed in the future). Surface water may provide exposures to Base workers, construction workers, farmers, and trespassers via dermal contact. As noted in Section 12.2.4, surface water met drinking water standards for the detected analytes; therefore, it is not an exposure medium of concern and is not evaluated further in the risk assessment. If SWMU-related chemicals are transported to groundwater, exposures could occur to Base workers or residents using the groundwater. Chemicals may be released from the Playa Lake into the soil column beneath the lake, where they could potentially be transported to groundwater. Evaluation of the groundwater pathway is deferred until this potential release

mechanism is evaluated in future subsurface soil sampling at this SWMU. Residential exposure to sediment is not considered for this SWMU, because it is located in an industrial area (i.e., next to the sewage lagoons), so even if the Base closes in the future, industrial rather than residential use is the reasonable future use of the site.

In summary, potential complete human exposure pathways evaluated in the risk assessment are:

Occupational Workers

- Ingestion of and dermal contact with sediment

Hypothetical Construction Workers

- Ingestion of and dermal contact with sediments

Hypothetical Trespassers

- Ingestion of and dermal contact with sediments

Farm Workers

- Ingestion of and dermal contact with sediments

12.3.2 Comparison of Metals Concentrations to Background

Metals are natural constituents of soils. Therefore, SWMU concentrations of metals of potential concern were evaluated to assess whether they exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

Background levels were defined by the UTL of concentrations from 37 background soil samples collected at Cannon AFB and by literature values for regional soils (USGS 1984). The background data and calculation of UTLs are presented in Appendix A. (The

background UTL was defined as the mean plus two times the standard deviation; see Appendix A.) The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data.

Results of the comparison of metals concentrations in the sediments for SWMU 103 to background levels are given in Table 12-4. A summary of the results of the comparison is presented here.

The maximum detected concentrations of cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, vanadium, and zinc in sediments exceeded the background levels. Therefore, these metals were retained for further evaluation as potential chemicals of concern.

12.3.3 Identification of Chemicals of Concern

Chemicals of concern are compounds that have been released from waste sources at SWMU 103, have been detected in lake sediment, and may be significant contributors to human health or environmental risks. In general, metals detected above background levels and organic compounds other than those shown to be laboratory or field contaminants are considered to be chemicals of concern for risk assessment. Chemicals of concern that do not have EPA-established toxicity factors are not evaluated quantitatively in the risk assessment, but their potential contribution to overall risk is addressed qualitatively.

Tables 12-2 and 12-3 present the analytical results for all chemicals detected in W-C samples for sediments and surface water, respectively. As shown in Table 12-3, concentrations in surface water do not exceed criteria for drinking water, and this medium is eliminated from further evaluation in the risk assessment. Chemicals of concern in sediment were identified as described below.

The concentrations of several metals (Table 12-4) detected in sediments exceeded background soil ranges according to the comparison described in Section 12.3.2. These metals and all detected organic compounds were considered as chemicals of concern in sediments. Chemicals of concern in sediment are listed in Table 12-5. Lead and TPH, listed as chemicals of concern in Table 12-5, do not have EPA-established toxicity factors and, therefore, cannot be evaluated quantitatively in the risk assessment. However, their potential

effects on the results of the risk assessment are addressed in Sections 12.3.8, 12.3.9, and 12.3.10.

12.3.4 Environmental Fate and Transport

The environmental fate of chemicals of concern is influenced by the physicochemical properties of each of the chemicals. Physicochemical properties that are generally of primary importance to fate and transport of chemicals in the environment are water solubility, soil adsorption, volatilization, and biodegradation. A more thorough discussion of these properties is provided in Appendix B. Physicochemical properties of the chemicals of concern reported at the SWMUs in this investigation are given in Table B-1.

As explained in Section 12.3.1, vadose zone fate and transport modeling is deferred pending further investigation of potential chemical releases to subsurface soil at this SWMU.

Air modeling was not conducted at SWMU 103, because the sediments are mostly covered by water, and neither volatile emissions nor wind erosion of dust particulates is considered a significant transport pathway.

12.3.5 Exposure Point Concentrations

Table 12-6 shows the calculation of the average (arithmetic mean) and RME concentrations of organic chemicals and metals of concern in sediment at the Playa Lake.

In accordance with EPA guidance (EPA 1989d) and as explained in Appendix C, the RME concentration is either the 95 percent UCL on the mean or the maximum concentration detected, whichever is lower. The use of "nondetect" values (U-qualified data) in calculating exposure points concentrations is also explained in Appendix C. Table 12-7 gives the sediment concentrations of organic compounds which have been adjusted for dermally absorbed fraction. The adjusted sediment concentrations were used for calculating risks from dermal exposures to organic chemicals. The adjusted sediment concentrations were determined from the adsorbed fraction from Table C-26 (Appendix C). The absorbed fraction is the ratio of the quantity of chemical that is absorbed through skin to the quantity that is

applied to the skin in soil. As explained in Appendix C, dermal absorption of metals (except mercury) adhered to soil is considered to be insignificant and is not evaluated.

12.3.6 Exposure Assumptions

The rationale and assumptions concerning potential human exposures considered in the risk assessment are described in Appendix C. Appendix C includes discussions of the exposure assumptions and intake factors used to quantify chemical intake of SWMU-related contaminants in soil and air. Table 12-8 shows a summary of the intake factors used in the exposure assessment. These factors are multiplied by chemical concentrations in sediment to obtain estimates of chemical intake by each exposure pathway.

12.3.7 Risk Characterization

Chemical intake is combined with chemical-specific toxicity factors to obtain an estimate of health risk. Noncarcinogenic hazards and carcinogenic risks to occupational workers, hypothetical future construction workers, hypothetical future trespassers, and current farm workers were estimated for all relevant exposure routes and chemicals of concern using the approach and exposure assumptions described in Appendix C. Detailed risk calculations are shown in Appendix C and summarized in Table 12-9. A summary of the results of the risk assessment is given here.

<u>Occupational Exposure</u>

Occupational receptors (Cannon AFB personnel and civilians working routinely on Cannon AFB) were assumed to be exposed (via ingestion and dermal contact) to sediment in the Playa Lake. Occupational receptors were assumed to be exposed for 2 and 8 hours/day, for 120 and 250 days/year, over 9 and 25 years for the average and RME cases, respectively. These assumptions are very conservative because one works at the Playa Lake or is likely to under probable future use of this facility.

The total hazard index calculated for noncarcinogenic health effects due to chronic exposures to contaminants in sediment via the dermal contact and ingestion pathways is 0.0002 and 0.02 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which

indicates that no adverse health effects are to be anticipated, even to sensitive individuals, with 25 years of exposure.

The estimated lifetime excess cancer risk for the assumed chronic exposure conditions is 3×10^{-10} for the average exposure case and 9×10^{-8} for the RME case. These levels are well below the EPA target risk range of 1×10^{-6} to 1×10^{-4} (1 in 1,000,000 to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1990; EPA 1991b). The results indicate negligible risk is associated even with long-term exposure to the sediment.

Construction Worker Exposure

Future construction workers were assumed to be exposed (via ingestion and dermal contact) to sediment at the Playa Lake. Exposures were assumed to occur during construction activities for 8 hours/day for 20 and 40 days for the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to subchronic exposures to chemicals of concern in sediment at SWMU 103 via the dermal contact and ingestion pathways is 0.0005 and 0.007 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk for the assumed subchronic exposure conditions is 4×10^{-11} in the average case and 7×10^{-10} in the RME case. These levels are negligible.

Hypothetical Future Trespasser

Hypothetical trespassers were assumed to be exposed (via ingestion and dermal contact) to sediments at the Playa Lake. Hypothetical trespassers were assumed to be exposed at the Playa Lake for 8 hours/day, for 26 and 52 days/year, over 6 years (age 10-16) for the average and RME cases, respectively. These assumptions are very conservative because it is not likely that there will be recreational exposures at the Playa Lake which is the outfall for the sewage treatment lagoons.

The total hazard index calculated for noncarcinogenic health effects due to exposures to contaminants in sediments at the SWMU via the dermal contact and ingestion pathways is 0.00006 and 0.006 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated, even to sensitive individuals.

The estimated lifetime excess cancer risk under the assumed exposure conditions is 6×10^{-11} under the average exposure case and 1×10^{-8} under the RME case. These levels are negligible.

Farmer (Irrigation) Exposure

Farm workers were assumed to be exposed (via ingestion and dermal contact) to sediment in the lake. Exposures were assumed to occur during pump installation and removal activities for 8 hours/day for 24 and 48 days per year for 9 and 30 years in the average and RME cases, respectively.

The total hazard index calculated for noncarcinogenic health effects due to exposure to chemicals of concern in sediments at the Playa Lake via the dermal contact and ingestion pathways is 0.00006 and 0.001 in the average and RME cases, respectively. Neither hazard index exceeds 1.0, which indicates that no adverse health effects are to be anticipated.

The estimated lifetime excess cancer risk under the assumed exposure conditions is 3×10^{-11} in the average case and 4×10^{-9} in the RME case. These levels are negligible.

12.3.8 Qualitative Assessment of Exposure to Lead

Lead exposures are not addressed in the quantitative risk assessment because EPA withdrew the RfD for lead in 1989, primarily due to the lack of a discernible threshold dose and the numerous sources of lead in the environment. Current EPA guidance (EPA 1989) suggests a soil lead concentration limit of 500 mg/kg to 1,000 mg/kg be considered for sites characterized as residential. This level is supported by EPA's Uptake/Biokinetic (UBK) Lead Model which predicts that exposures of children ages 0 to 6 to soils with approximately this

level will not result in blood lead levels that exceed a level of concern established by the Centers for Disease Control.

The maximum lead concentration measured in sediment SWMU 103 was 39 mg/kg. The maximum concentration detected at SWMU 103 is far below the value suggested by EPA for residential soils. Therefore, lead detected in sediments would not pose a health threat under even the most conservative exposure assumptions.

The maximum lead concentration detected in surface water was 0.006 mg/L. The federal action level for lead in drinking water at the tap is 0.015 mg/L (EPA 1993). Therefore, lead is not expected to pose adverse health effects at this SWMU.

12.3.9 Qualitative Assessment of TPH Exposures

Petroleum-derived fuel is a complex mixture of hundreds of branched, straight-chain, cyclic, and aromatic carbon compounds, most of which are not particularly toxic. However, a small fraction of fuel constituents are known to have toxic or carcinogenic properties. The primary toxic fuel constituents of concern are BTEX; benzene, because it is carcinogenic, is the chief hazardous constituent of fuels and the chief contributor to risk from exposure. In the RFI, BTEX and other potentially hazardous fuel constituents (such as naphthalene and pyrene) were analyzed for individually in the sediment and water samples collected at the SWMU and are included in the quantitative risk assessment. Cumulative risks did not exceed levels of concern. It is not likely that other hydrocarbon constituents of TPH, which are relatively innocuous, would add significantly to the resulting estimates of potential health risks.

This can be demonstrated by comparing SWMU concentrations of TPH to RBCs derived using target risk levels, occupational soil ingestion intake factors, and provisional EPA toxicity factors for JP-4 and gasoline (EPA 1992d). These provisional toxicity values are based on inhalation studies in animals using fresh fuel product. They are most appropriately used for evaluating exposures to fresh fuel spills when analytical results for the toxic constituents of TPH (primarily BTEX) are not available, and when the fuel product is known. The provisional values are under review and are subject to revision. The RBCs derived from them are used only as a guide to potential health hazards.

The toxicity factors and calculation of risk-based concentrations are shown in Table 12-10. Assuming that all the TPH at the SWMU is gasoline is the most conservative approach because its RBC is the lowest, based on evidence of carcinogenicity (probably due to benzene). The risk-based concentration of gasoline for oral exposures to TPH under occupational exposure assumptions is 33,613 mg/kg. The maximum SWMU concentration of TPH is 5,890 mg/kg, well below the conservative RBC. Therefore, TPH in sediments is not expected to pose a health hazard through direct exposure.

12.3.10 Uncertainties and Limitations

Throughout the human health risk assessment, conservative assumptions regarding exposure conditions, exposure concentrations, and chemical toxicity and carcinogenicity were used that combine to result in an upper-bound estimate of risk for the SWMU. The conservative features and other uncertainties inherent in the risk assessment process are outlined in Appendix C. The chief uncertainties specific to risk assessment for SWMU 103 and their effect on the results and conclusions of the risk assessment are listed below.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected, because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

- Direct physical contact with contaminated sediments was assumed to occur routinely (e.g., for several hours/day, 9 to 12 months of the year, for 9 to 25 years). These assumptions overstate current and likely future exposure conditions and risks at this site.

- Potential chemical releases to subsurface soils and groundwater have not yet been characterized.

- Reporting limits were elevated by a factor of 5 for three of the four sediment samples and by a factor of 20 for the fourth sample. Because of the elevated

reporting limits, the concentration of some analytes and resulting risk estimates may be underestimated. However, as discussed in Section 12.2.3, the elevated reporting limits are not likely to have a significant effect on the results of the risk assessment.

12.4 ECOLOGICAL RISK ASSESSMENT

12.4.1 Ecological Characterization and Key Receptor (Indicator) Species

SWMU 103 is located near the east-central edge of Cannon AFB, just southeast of the Ordinance Area and approximately 1,000 feet east of the two sewage treatment lagoons. The lake has received sanitary and industrial wastewater from these lagoons since 1966.

The Playa Lake occupies approximately 13 acres, is 4 to 5 feet deep at its greatest depth, and provides open water, limited wetland habitat, and grassy and weedy upland (mesic) areas surrounding the shoreline. The lake is maintained at approximately two-thirds total capacity by inflow from the lagoons. Water is withdrawn periodically by farmers for irrigation use, so water level varies for short periods of time, providing limited littoral area between the water and the high grass which generally grows right up to the water's edge. The lake is surrounded on the north, east, and south by tall native grasses. Mowed grassland lies across the perimeter road to the southwest, and agricultural fields are found off-base to the east.

Sampling conducted at the Playa Lake indicated that the water is algae-rich, with an olive green color, and notable suspended algal material. The pH was high, ranging from 9.6 to 10.0. Sediments were reportedly black and organic, with a fetid, sulfurous odor.

Because of the Playa Lake's extent and availability as a water resource in a water-limited area, it represents good quality habitat for ducks and some wading birds, and serves as a potential drinking water source and/or hunting ground for terrestrial species such as rabbits, mice, and coyote. However, because of its poor water quality, it represents poor quality habitat for many aquatic invertebrates and fish. According to the Bio-Environmental staff at Cannon AFB (Yung, pers. comm.), there are no fish in the Playa Lake.

Wildlife use of the Playa Lake has been described in previous baseline risk assessment documents (W-C 1992) and by various biological/wildlife staff of Cannon AFB and the New Mexico Game and Fish Department (Crow, pers. comm.; Robertson, per. comm.). Ducks represent the predominant wildlife of the lake, with most belonging to what is classified as the "prairie dabbler" group. Mallards (*Anas platrynchos)*, shovelers (*Anas clypeata*), pintails (*Anas acuta*), and widgeons (*Anas americana*) are the primary species that have been observed. According to Crow (pers. comm.), most of the ducks are migratory, but a few residents have been noted. Ducks present at the lake probably feed on the abundant algae and duckweed (*Lemna minor*), as well as grain in surrounding fields. Other aquatic vegetation is not particularly abundant; Wolffia and nutweed have been reported (Robertson, pers. comm.), but the shoreline also includes dense high grasses and upland (mesic) weeds. Wading birds, and shorebirds, particularly the black-crowned night heron (*Nycticorax nycticorax*), have also been reported along the shoreline in the shallows. These most likely feed on frogs, since there are no fish in the lake, and invertebrate populations may be limited by the anoxic conditions in the sediments. Large mammals are not reported as frequent users of Playa Lake; Crow (pers. comm.) reports that coyotes (*Canis latrans*) use the high grass cover near the lake to hunt for ducks, but that deer and antelope are not common around the lake. He also reports that hawks and owls use nearby trees to hunt in the area around the lake, but that ducks are not taken as food by raptors.

Based on the above assessment, several key receptor species were selected for the Playa Lake. These include the mallard, the black-crowned night heron (heron), and the coyote. The mallard was selected to represent the high dabbler duck use at the lake, which are of special concern because of their abundance, food habits, and potential for exposure to chemicals via several pathways. The heron represents wading bird use and is of concern because of its likely diet of frogs, snails, and accompanying sediment and invertebrates. The coyote reportedly hunts ducks at the lake and represents a top trophic (carnivore) level in this assessment.

12.4.2 Chemicals of Concern

Surface water and sediments were sampled at SWMU 103. The chemicals of concern (COCs) were selected using validated data from three water samples and four sediment samples. Table 12-11 provides a summary of the chemicals detected in the water and Table 12-12

provides a summary of the chemicals detected in the sediments. A detailed description of the sampling program at SWMU 103 and the chemical analysis and results can be found in the Cannon AFB RFI, Appendix III SWMUs (W-C 1993).

A chemical must have been detected in at least one of the surface water samples to be considered a possible COC in that media. No surface water background concentrations were collected; however, federal and state water quality criteria were used to determine if a chemical in the surface water would be retained as a COC. The maximum detected concentration was compared to the Federal Ambient Water Quality Criteria acute and chronic standards and the New Mexico Water Quality Standards for irrigation, warm water fisheries (acute and chronic values), and livestock and wildlife watering. If the maximum detected concentration exceeded any one of these standards, or if no standards were available, the chemical was retained as a COC (see Table 12-13). Because the water at the Playa Lake is primarily used for wildlife watering and irrigation, use of the federal ambient water quality standards, which are non-enforceable guidelines for protection of aquatic life, and the New Mexico warm water fisheries standards represents a conservative approach to the screening of COCs. In addition, many of the standards for metals are based on a hardness value of 100 mg/l as CaCO3. Hardness for the Playa Lake is unknown, however for many chemicals toxicity decreases as hardness increases and standards are typically adjusted for hardness when available. A hardness value of 100 mg/l as CaCO3 may be conservative. Also, the metal concentrations detected in the Playa Lake water were measured as total metals, whereas the federal criteria are primarily total recoverable metals and the New Mexico standards are primarily dissolved metals. Again, this represents a conservative comparison.

The chemicals that were retained as COCs in surface water following the screening process include barium, lead, silver, cyanide, and total sulfide.

As with water, a chemical must have been detected in at least one of the sediment samples to be considered a possible COC. No standardized sediment criteria are available, however the following background and threshold criteria were used as a screen to determine if a chemical in the sediment would be retained as a COC:

- Exceedance of Cannon AFB background soil concentrations
- Exceedance of average concentrations found in southwestern U.S. soils
- Comparison to Sediment Quality Guidelines, EPA Threshold Values, and NOAA Overall Apparent Effects Thresholds

The maximum detected concentration of the four sediment samples was used in the comparison to the background and threshold screening criteria. If no background or threshold screening criteria were available the chemical was retained as a COC. If the maximum detected concentration of a chemical exceeded the local (i.e., Cannon AFB) background concentration, it was then compared to the average concentration found in southwestern U.S. soils. If it exceeded this criteria, it was then compared to the sediment threshold values. The sediment threshold values are based on 1) known biological effects levels (e.g., NOAA Overall Apparent Effects Thresholds), 2) ambient water quality criteria converted to sediment criteria using partitioning coefficients and total organic carbon values (e.g., EPA Threshold Values), or 3) background sediment levels or screening level concentrations (e.g. Sediment Quality Guidelines). If the maximum detected concentration exceeded both background levels and one or more threshold levels, it was retained as a COC. Iron, potassium, and sodium exceeded background and/or sediment threshold values, but were not retained as COCs because they are essential nutrients natural to sediments, and are not expected to be of concern compared to the other COCs. Table 12-14 lists the maximum concentrations detected and shows the screening values used.

The chemicals that were retained as sediment COCs following the screening process (excluding nutrients as discussed above) include benzene, 2-butanone, carbon disulfide, chloromethane, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-butyl phthalate, aluminum, cadmium, chromium, cobalt, copper, mercury, selenium, silver, vanadium, zinc, and TPH.

12.4.3 Exposure Assessment

12.4.3.1 Exposure Pathways

Figure 12-14 depicts the exposure pathway flow chart developed for SWMU 103. As indicated by the diagram, chemicals could potentially be released through mixing and infiltration into surface water and sediment, infiltration to groundwater, volatilization, and direct contact by ecological receptors with the surface water and sediments. Ecological receptors are not in contact with groundwater, so this is an incomplete exposure pathway. Volatilization is not considered a significant pathway at this site. No VOCs were detected in the water samples, and only one semivolatile was detected at a very low level (0.005 mg/kg). Therefore, the two pathways that are considered potentially complete and significant for SWMU 103 are direct and indirect contact with surface water and sediments.

Direct contact may include dermal absorption or ingestion. In Playa Lake, the key receptors (coyote, duck, heron) are assumed to be exposed via direct and indirect ingestion of water, sediments (heron and duck only), and their food sources. Absorption is considered a significant, complete exposure route only for the frog/tadpole and the algae/duckweed, since the key receptors are assumed to be largely protected by their fur or feathers and limited time of exposure of skin to the water of Playa Lake. Also, when in ionic or elemental forms, metals are not readily absorbed into the skin. Direct ingestion pathways occur along the food/prey chain and include direct ingestion of water, sediments, algae, duckweed, and aquatic plants. Ducks at Playa Lake are dabbling ducks that sift through sediments in search of food, and any contamination that is adsorbed to the sediment can be ingested while feeding. The same is true of herons. Indirect ingestion includes consumption of the frog/tadpole and invertebrates by heron and ducks, and the coyote's consumption of the duck. However, not all of these pathways were selected as major or significant pathways for Playa Lake, as discussed further below.

Figure 12-5 presents the Conceptual Site Model developed for SWMU 103 from the exposure pathways analysis, the ecological characterization of Playa Lake, and the identification of the three key receptor species. The diagram indicates the major chemical sources for both the key receptors and the intermediate receptors and the ingestion pathways retained as significant

retained as significant for purpose of this analysis. Those pathways that were considered not significant are not shown on the model and include:

- Ingestion of aquatic macrophytes by the duck. Although there are some macrophytes reported along the border of Playa Lake, it is assumed that most of the duck's diet will be the abundant algae and duckweed, and that the occasional taking of macrophyte seed or other plant parts can be considered a minor pathway.

- Ingestion of invertebrates by the frog, heron, and duck. Although it is recognized that some invertebrates will be ingested along with sediment, this pathway is not being considered as a separate, significant pathway in this analysis because it is expected that invertebrate populations will be limited by the anoxic condition of the sediments and that the chemical source represented by invertebrates occasionally taken during feeding can be accounted for in the direct ingestion of sediment pathway.

- Ingestion of flies by the adult frog. It is unclear whether or not the flies that are assumed to be eaten by the frog are derived from the Playa Lake or from surrounding areas, given the limited environment for fly larvae in the lake sediments. Therefore, it is assumed that flies constitute a minor source of chemical contamination of the adult frog, compared to direct ingestion and adsorption of water and direct ingestion of sediments by the tadpole stage.

12.4.3.2 Exposure Concentrations

Following are descriptions of calculations and assumptions used to estimate exposure concentrations for the key receptors (mallard and heron) evaluated quantitatively in Section 12.4.4. These calculations and assumptions apply to the significant and complete pathways described above in Section 12.4.3.2.

Mallard

Ingestion of Water

Intake	Based on the equation 0.059(bw)^0.67 provided in Calder & Braun (1983) for birds
Body Weight	1.16 kg, as reported in Teres (1991) for mallards
Concentration	Average concentration (arithmetic mean) of COCs as presented in Table 12-11
Dose	Based on the equation: $\frac{\text{Concentration x Intake/Day}}{\text{Body Weight}}$
Benchmark Value	A "safe" concentration, described in Appendix D

Ingestion of Sediment

Food Intake	Assumed equal to 20% of body weight, as described in Newell et al. (1987) for piscivorous birds
Body Weight	1.16 kg, as reported in Teres (1991) for mallards
Percent Sediment in Diet	Assumed to be 30% of food intake
Sediment Intake	30% of food intake value
Concentration	Average concentration (arithmetic mean) of COCs as presented in Table 12-12
Dose	Based on the equation: $\frac{\text{Concentration x Intake/Day}}{\text{Body Weight}}$

Benchmark Value	A "safe" concentration, described in Appendix D

Ingestion of Food

Intake	Assumed equal to 20% of body weight, as described in Newell et al. (1978) for piscivorous birds
Body Weight	1.16 kg, as reported in Teres (1991) for mallards
Concentration	Since the primary food source for mallards at Playa Lake was assumed to be aquatic algae and duckweed, the COCs in water were assumed to be in the food at the same concentration, except for the case of lead which is known to bioconcentrate from water to algae by a factor of 725 (Eisler 1988). None of the other COCs are known to significantly bioconcentrate.
Dose	Based on the equation: $\frac{\text{Concentration x Intake/Day}}{\text{Body Weight}}$
Benchmark Value	A "safe" concentration, described in Appendix D

Heron

Ingestion of Water

Intake	Based on the equation 0.059(bw)^0.67 provided in Calder & Braun (1983) for birds
Body Weight	0.87 kg, as reported in Teres (1991) for herons
Concentration	Average concentration (arithmetic mean) of COCs as presented in Table 12-11

Dose	Based on the equation: $\frac{\text{Concentration x Intake/Day}}{\text{Body Weight}}$
Benchmark Value	A "safe" concentration, described in Appendix D

Ingestion of Sediment

Food Intake	Assumed equal to 20% of body weight, as described in Newell et al. (1987) for piscivorous birds
Body Weight	As reported in Teres (1991) for herons
Percent Sediment in Diet	Assumed to be 15% of food intake
Sediment Intake	15% of food intake value (based on the assumption stated above)
Concentration	Average concentration (arithmetic mean) of COCs as presented in Table 12-12
Dose	Based on the equation: $\frac{\text{Concentration x Intake/Day}}{\text{Body Weight}}$
Benchmark Value	A "safe" concentration, described in Appendix D

Ingestion of Food

Intake	Assumed equal to 20% of body weight, as described in Newell et al. (1978) for piscivorous birds
Body Weight	0.87 kg, as reported in Teres (1991) for herons

Concentration	The primary food source for herons at Playa Lake was assumed to be tadpoles and frogs. It was further assumed that COCs in the water and sediment that are known to bioaccumulate would be present in the tadpoles and frogs. This assumption is based on a basic understanding of the life cycle of the tadpole/frog which would include potential exposure to both the COCs in water and sediment. The COCs in the water and sediment that are known to bioaccumulate are cadmium and mercury in the sediment, and lead in the water. In order to estimate a concentration of these COCs in the tadpole/frog tissue, a BCF of 49 was applied to the lead concentration in water (EPA 1992). For the COCs in sediment, an estimation of COCs in tadpole/frog tissue was more difficult. BAFs from sediment to tadpole/frog tissue were not available in the literature. Sediment concentrations were partitioned to water concentrations using sediment water partition coefficients (Kd values), a BCF was then applied to the estimated waste concentration (EPA 1992) to obtain a tissue concentration in the tadpole/frog. This was presented as the high end of possible COC concentrations in tissue. Since neither cadmium nor mercury were detected in water, the method detection limits for cadmium and mercury (EPA 1992) were multiplied by the BCFs for cadmium and mercury to obtain a low end tissue concentration in the tadpole/frog. Table 12-15 shows the values used in this calculation.
Dose	Based on the equation: $\frac{\text{Concentration x Intake/Day}}{\text{Body Weight}}$
Benchmark Value	A "safe" concentration, described in Appendix D

12.4.4 Risk Characterization

Two approaches were used in the characterization of ecological risk at SWMU 103, Playa Lake. A quantitative approach, the Quotient Method (Barnthouse et al. 1986; EPA 1992), was used to evaluate potential risk to mallards and herons from direct ingestion of COCs (except TPH) in water, sediment, and food items (algae, duckweed, tadpole/frogs). The Quotient Method is described in Appendix D, Section D.6. A semi-quantitative assessment was used to evaluate potential risk to the coyote from direct ingestion of water and food items (mallards). This approach was used to better account for bioaccumulation and inherent uncertainties in evaluating higher trophic level species. TPH was addressed qualitatively due to the complex nature of TPH (see Section 12.4.4.4). Section D.7 in Appendix D lists uncertainties and limitations inherent to the risk characterization process.

12.4.4.1 Mallard

Table 12-16 presents the hazard quotient (HQ) and hazard index (HI) calculations for the mallard. As shown, the mallard is not likely to be a risk from the ingestion of water at SWMU 103. The COCs in the water included silver, barium, lead, cyanide, and sulfide. The HQs for these COCs were all well below one.

Some COCs in the sediment may pose a risk to mallards, specifically aluminum and vanadium, as indicated by HQs over 1 (Table 12-16). None of the other COCs in sediment are likely to impact mallards. The HQ calculations included the assumption that the sediment intake for mallards was equal to 30 percent of their food intake.

Although aluminum had an HQ of 2.468, the actual risk to mallards from aluminum in sediment is probably slight because aluminum exposure is generally considered non-toxic. Aluminum is the third most abundant element in the earth's crust and mammals and birds are known to effectively limit the adsorption of aluminum and effectively excrete any excess (Kehoe et al. 1984; Tipton et al. 1963). Ganort (1986) reports aluminum compounds are poorly absorbed via ingestion. Chronic exposure of orally ingested aluminum results in disruptive effects on calcium and phosphorous homeostasis (Scheuhammer 1987). No reproductive effects in birds, such as egg production, fertility, hatchability, or fledgling success, are reported (Carriere et al. 1986). Therefore, risk to mallards from aluminum in the

sediment at SWMU 103 is considered slight. Acute exposure is unlikely, and chronic exposure would result in minor effects to individuals or populations.

Like aluminum, the actual risk to mallards from vanadium in sediment is also probably slight, despite an HQ of 2.516. This is because vanadium is generally relatively non-toxic, and most toxic exposures to vanadium occur through inhalation, a very unlikely exposure pathway from sediment to mallards and considered insignificant as described in Section 12.4.3. Acute exposure to vanadium is most likely to affect the respiratory system; chronic exposure may result in slight weight loss, slight inhibition of immunologic function, increased lipid peroxidation, and decreased tubular resorption (Mountain et al. 1953; Cohen et al. 1986; Donaldson et al. 1985; Westenfelder et al. 1981). It has been reported that chronic ingestion of vanadium does not result in histopathologic effects, carcinogenic effects, or fertility or reproductive effects (Domingo et al. 1986; Schroeder and Balassa 1967). Therefore, risk to mallards from vanadium in the sediment at SWMU 103 is considered slight. Acute exposure is unlikely, and chronic exposure would result in minor effects to individuals or populations.

As shown in Table 12-16, the mallard is not likely to be at risk from the ingestion of food (algae and duckweed) at SWMU 103. The algae and duckweed were assumed to have the same COCs and concentrations as the water, except in the case of lead which is known to bioconcentration from water to algae by a factor of 725 (Eisler 1988). Therefore, the concentration of lead in food was assumed to be 725 times the concentration in water. The other COCs in water are not likely to significantly bioconcentrate. Only the COCs in water were considered as COCs in food because neither the algae nor duckweed (likely the most significant food items at Playa Lake for mallards) are rooted, and are therefore unlikely to be affected by COCs in the sediment. The HQs for COCs in food were all well below 1, even for lead.

The total HI index for mallards (which considers all pathways and all COCs) was 6.579. This value is primarily attributable to aluminum and vanadium, which are considered to pose only a slight risk to mallards as discussed above. In addition, the total HI is below 10, a level considered by Edmisten Watkin and Stelljes (1993) where ecological impacts are more probable to begin to occur (see Appendix D, Section D.6).

12.4.4.2 Black-crowned Night Heron

Table 12-17 presents the hazard quotient (HQ) and hazard index (HI) calculations for the black-crowned night heron. As shown, the heron, like the mallard, is not likely to be at risk from the ingestion of water at SWMU 103. The COCs in the water included silver, barium, lead, cyanide, and sulfide. The HQs for these COCs were all well below one.

Also similar to the mallard, the heron may be at some risk due to aluminum and vanadium in sediment, as indicated by HQs over one (1.234 and 1.258 respectively). None of the other COCs in sediment are likely to cause a risk. The HQ calculations included the assumption that the sediment intake for herons was equal to 15 percent of their food intake. Aluminum and vanadium in sediment at SWMU 103 may pose a slight risk to herons (see discussions in Section 12.4.4.1 for mallards). However, the risk to herons may be even less than that for mallards because the HQs were only slightly over 1, whereas the HQs for aluminum and vanadium for the mallard were approximately twice 1.

The heron may be at risk due to mercury in food (tadpole/frog), as indicated by an HQ ranging from 3.7 to 7.86. Section 12.4.3 and Table 12-15 present the assumptions that were used for calculating the HQ. This wide range of values reflects the difficulties and uncertainties in estimating tissue concentrations. The literature is generally lacking bioaccumulation factors, particularly for specific pathways such as from sediment to tadpole/frog to heron, and standardized methods for estimating tissue concentrations. Short of sampling biota tissue, it is unknown whether the actual concentration of mercury in tadpole/frog tissue is at the low end of the range presented in Table 12-15 or at the high end, or even if it falls within the range presented. It is known that mercury has a strong tendency to bioconcentrate and bioaccumulate and many factors play a role in the bioavailability and toxicity of mercury. The concentration level of mercury the organism is exposed to. While mercury in the environment is typically in the inorganic (less toxic) form, biomethylation of inorganic mercury to the more toxic methylmercury form can occur in the environment or the organism. It is unknown which form of mercury the herons may be exposed to in tadpole/frog tissue. Effects of mercury to birds from subchronic and chronic exposure are primarily reproductive effects (Scheuhammer 1987; Wiemeyer et al. 1984). The HQ values indicate the heron could be at risk from mercury in food at Playa Lake; the actual level of risk (e.g., slight or significant) is unknown, as evidenced by the wide range of HQ values.

It is important to note that this assessment did not include consideration of factors such as seasonal use of Playa Lake by the heron, or other food sources, which would decrease the risk. These factors and other uncertainties and limitations are discussed generally in Appendix D, Section D.7.

12.4.4.3 Coyote

Because the concentrations of COCs in water at SWMU 103 (silver, barium, lead, cyanide, and sulfide) were so low, and because the QM showed no risk to mallards and herons from the ingestion of Playa Lake water, it is assumed that the coyote also would not be at risk from ingestion of Playa Lake water.

An assessment of potential risk to the coyote from ingestion of ducks was conducted by considering the bioaccumulation potential of those COCs that are known to bioaccumulate and biomagnify along food web pathways. For SWMU 103, those COCs included cadmium and mercury from sediment and lead from water. A comparison was made between the toxicity-based benchmark dietary level for those chemicals in the coyote's diet (i.e., the chemical level in the duck) and the potential dietary level that could occur in the duck tissue. The potential level was estimated, given the chemical concentration in sediment and water, multiplied by BAFs from sediment and water to ducks. The BAFs used were found in the literature or estimated based on literature values for other species and professional judgement.

The benchmark dietary level for large mammals, such as the coyote, for cadmium is 560 mg/kg. The average concentration in sediment (cadmium was not detected in water) is 2.69 mg/kg. BAFs from sediment to ducks were not available in the literature; BAFs from soil to earthworms have been reported to range from 4.6 to 66 (Beyer and Stafford 1993). Assuming the soil-earthworm BAF is comparable to sediment-duck, and using the highest BAF reported (66), the resultant estimated dietary level in duck tissue is 178 mg/kg, well below the dietary benchmark of 560 mg/kg. Therefore, the coyote is not likely to be at risk from cadmium by ingesting ducks at SWMU 103.

The benchmark dietary level for large mammals, such as the coyote, for mercury is 3.2 mg/kg. The average concentration in sediment (mercury was not detected in water) is 0.6 mg/kg. BAFs from sediment to ducks were not available in the literature; a BAF from soil

to earthworms of 0.96 was reported in Beyer and Stafford (1993). If the BAF from sediment to ducks is as low as 0.96, mercury is not likely to cause a risk to coyotes since the resultant estimated dietary level in duck tissue of 0.576 mg/kg is well below the benchmark dietary level.

The benchmark dietary level for large mammals, such as the coyote, for lead is 720 mg/kg. The average concentration in water (lead was not detected in sediment) 0.004 mg/l. There is conflicting data in the literature on the bioaccumulation and biomagnification potential of lead in food chains. The BAF from soil to earthworms reported by Beyer and Stafford (1993) is 0.45, indicating little accumulation in tissues. A BAF of 180,000 would be necessary from sediment to ducks in order for the coyote to be at risk from lead. This is extremely unlikely and it is assumed that coyote is not at risk from lead by ingesting ducks at Playa Lake.

In summary, it is unlikely the coyote is at risk from ingestion of water or food (ducks) at Playa Lake. Bioaccumulation does not appear to be a problem for this top trophic level species, particularly from cadmium, lead, or mercury. This risk characterization did not take into account factors such as alternative food and water sources for the coyote, which would tend to reduce exposure and any possible risk. This and other uncertainties and limitations are addressed in Appendix D, Section D.7.

12.4.4.4 TPH

It was not possible to quantitatively address potential risk to key receptor species from TPH in sediments because it is not feasible to quantify or identify most of the specific chemicals in the mixtures. Depending on the product (crude oil, jet fuel, diesel fuel, gasoline, etc.), hundreds of branched or straight-chain, cyclic, and aromatic carbon compounds may be present. Many of the chemicals commonly measured as total petroleum hydrocarbons are common constituents of low-toxicity chemical mixtures such as mineral oil, paraffins, lubricating oils, and petroleum-derived chemicals that are also used as food additives.

Many toxicological and epidemiological studies have been performed on common petroleum hydrocarbon mixtures to predict general toxic properties. Petroleum hydrocarbon mixtures, and typical components of these mixtures, have low acute toxicities, with oral LD_{50}s in

experimental animals above 5 g/kg (5000 mg/kg). Compounds with LD_{50}s between 5 and 9 g/kg are considered non-toxic by toxicologists.

While available evidence suggests that typical TPH mixtures are not particularly toxic, certain constituents of petroleum products do have potential carcinogenic or toxic properties. The toxic fuel constituent of concern that was detected in sediments at Playa Lake (benzene), was at such a low concentration (0.01 mg/kg) the HQ that was calculated for benzene for both the mallard and heron was 0.000001. No other toxic fuel constituents were detected in sediments (e.g. no PAH constituents were detected). The bioaccumulation potential and potential risk to key receptors for the TPH constituents of concern is considered to be negligible. Section D.4.2.3 in Appendix D provides further information on TPH and the relative toxicity of TPH mixtures and constituents.

12.5 SUMMARY AND CONCLUSIONS

12.5.1 Summary

A human health and ecological risk assessment which considered both present and future receptors was completed for this SWMU. Analytical data were collected for sediment and surface water at the SWMU. The groundwater pathway was not evaluated in this risk assessment because concentrations of contaminants in soils beneath the lake (i.e., that may have been leached from the lake) have not been characterized. Therefore, vadose zone fate and transport modeling could not be completed. The results of the risk assessment are summarized here.

- Results of the human health risk assessment (Table 12-9 show that no unacceptable health risks due to chemical releases are expected at the SWMU. These risk results do not include an evaluation of the groundwater pathway.

- Results of the ecological risk assessment indicate that there could be a potential for risk to predatory birds (i.e., herons) exists due to chemical releases at the SWMU. However, as described in Section 12.4, there is much uncertainty regarding potential bioaccumulation of contaminants; therefore,

there is much uncertainty regarding estimated potential risks to ecological species at this SWMU.

12.5.2 Conclusions

No significant human health risks are posed by exposure to contamination in the lake water or sediments, and only a potential for risk (based on highly uncertain bioaccumulation assumptions) is predicted for ecological species at the lake.

However, because of the historical use of the lake as a wastewater lagoon, and since playa lakes can be significant sources for infiltration, there is a potential for contaminants to have leached into subsurface soils beneath the lake. Therefore, it is recommended that additional investigation of chemical concentrations in the subsurface soils be conducted to support evaluation of the groundwater pathway.

TABLE 12-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
WASTEWATER PLAYA LAKE (SWMU NO. 103)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters	Sample Containers		
					VOCs	40 ml VOA vials	4 oz. jars	8 oz. jars
10301		CAN103-1031-5001		Sludge	X		2	2
		CAN103-1031-1061	FD	Sludge	X		2	2
		CAN103-1031-1001	MRD	Sludge	X		2	2
		CAN103-1031-1051*	AB	Water	X	2		
		CAN103-1031-1071	RB	Water	X	2		
		CAN103-1031-1081	DW	Water	X	2		
		CAN103-1031-1091*	TB	Water	X	2		
10302		CAN103-1032-5001		Sludge	X		2	2
		CAN103-1032-6001	MS/MSD	Sludge	X		2	3
10303		CAN103-1033-5001		Sludge	X		2	2
10304		CAN103-1034-5001		Sludge	X		2	2

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank
* Sample not collected

TABLE 12-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
WASTEWATER PLAYA LAKE (SWMU NO. 103)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters	Sample Containers		
					Appendix IX	40 ml VOA vials	16 oz. poly	1-L bottles
10305	0	CAN103-1035-3000		Water	X	3	3[1]	5
		CAN103-1035-1061	FD	Water	X	3	3[1]	5
		CAN103-1035-1001	MRD	Water	X	3	3[1]	5
10306	0	CAN103-1036-3000		Water	X	3	3[1]	5
		CAM103-1036-7000	MS/MSD	Water	X	6	6[1]	10
10307	0	CAN103-1037-3000		Water	X	3	3[1]	5

FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate

[1] Each of 3 containers has a different preservative for metals tests.
See Figure 19-1 for approximate sampling locations.

TABLE 12-2
SUMMARY OF CHEMICALS REPORTED FOR SEDIMENT SAMPLES COLLECTED FROM SWMU 103

LOCATOR	CAN103-1031-5001			CAN103-1032-5001			CAN103-1033-5001			CAN103-1034-5001		
LAB SAMPLE NUMBER	0313580002SA			0313580003SA			0313580005SA			0313580006SA		
COLLECT DATE	09/21/93			09/21/93			09/21/93			09/21/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (µg/kg)												
Benzene	<	19	UJ	22	98	J	6.6	19	J	16	25	J
2-Butanone (MEK)	<	39	UJ	<	200	UJ	18	37	J	68	49	
Carbon disulfide	8.4	19	J	22	98	J	11	19	J	23	25	J
Chloromethane	4	39	J	<	200	UJ	<	37	UJ	<	49	UJ
Semivolatile Organics (µg/kg)												
bis(2-Ethylhexyl)phthalate	2000	1300		3900	6500	J	760	1200	J	1700	1600	
Butyl benzyl phthalate	<	1300	UJ	<	6500	UJ	320	1200	J	<	1600	U
Di-n-butyl phthalate	<	1300	UJ	<	6500	UJ	200	1200	J	<	1600	U
Pesticides (µg/kg)												
4,4'DDD	220	250	J	<	1300	UJ	<	250	UJ	<	16	UJ
Metals (mg/kg)												
Aluminum	3450	38.5		21300	196		12300	37.4		12300	49.2	
Arsenic	2.4	1.9		10.8	9.8		3.3	1.9		4.5	2.5	
Barium	90.1	3.9		231	19.6		119	3.7		150	4.9	
Beryllium	<	0.77	UJ	<	3.9	UJ	0.69	0.75	J	0.99	0.98	
Cadmium	2.3	1.9		<	9.8	UJ	<	1.9	UJ	2.6	2.5	
Calcium	26200	77		83400	393		46400	74.9		77400	98.4	
Chromium	10.4	3.9		35.5	19.6		13.5	3.7		19.8	4.9	
Cobalt	<	3.9	U	<	19.6	U	4	3.7		5.9	4.9	
Copper	40.3	7.7		102	39.3		29.4	7.5		44.3	9.8	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.

A complete summary of chemical results are presented in Appendix A

J=Estimated value below reporting limit or estimated based on data quality criteria.

R = Rejected value. Qual=Qualification

U = Nondetected value. RL = Reporting Limit.

TABLE 12-2
SUMMARY OF CHEMICALS REPORTED FOR SEDIMENT SAMPLES COLLECTED FROM SWMU 103

LOCATOR	CAN103-1031-5001			CAN103-1032-5001			CAN103-1033-5001			CAN103-1034-5001		
LAB SAMPLE NUMBER	0313580002SA			0313580003SA			0313580005SA			0313580006SA		
COLLECT DATE	09/21/93			09/21/93			09/21/93			09/21/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3860	38.5		18300	196		9990	37.4		13100	49.2	
Lead	14.6	1.9		39.3	9.8		16.5	1.9		16.7	2.5	
Magnesium	1780	77		8700	393		4140	74.9		5640	98.4	
Manganese	38	3.9		228	19.6		158	3.7		196	4.9	
Mercury	0.5	0.39		<	2	U	0.39	0.37		0.51	0.49	
Nickel	5.3	15.4	J	27.7	78.6	J	12.1	15	J	14.6	19.7	J
Potassium	968	1930	J	4640	9820	J	2580	1870		3380	2460	
Selenium	3.3	1.9		13.2	9.8		5.2	1.9		4.7	2.5	
Silver	9.8	3.9		33.7	19.6		9.9	3.7		11.5	4.9	
Sodium	3940	1930		18900	9820		4230	1870		4260	2460	
Vanadium	27.1	3.9		130	19.6		57.5	3.7		78.9	4.9	
Zinc	90.9	7.7		275	39.3		76.9	7.5		101	9.8	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	2520	154		5890	786		2200	150		2290	197	
Water Quality (percent)												
Water	74	0.1		95	0.1		73	0.1		80	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.

A complete summary of chemical results are presented in Appendix A

J=Estimated value below reporting limit or estimated based on data quality criteria.

R = Rejected value. Qual=Qualification

U = Nondetected value. RL = Reporting Limit.

TABLE 12-3
SUMMARY OF CHEMICALS REPORTED FOR WATER SAMPLES COLLECTED FROM SWMU 103

LOCATOR	CAN103-1035-3000			CAN103-1036-3000			CAN103-1037-3000			
LAB SAMPLE NUMBER	0313580011SA			0313580008SA			0313580009SA			
COLLECT DATE	09/21/93			09/21/93			09/21/93			MCL or
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Health History
Semivolatile Organics (µg/L)										
Isophorone	<	10	U	<	10	U	1.4	10	J	100(2)
Metals (mg/L)										
Arsenic	0.0031	0.005	J	0.0057	0.005		0.0034	0.005	J	0.05(3)
Barium	0.076	0.01		0.07	0.01		0.066	0.01		2(3)
Copper	0.0069	0.02	J	0.0051	0.02	J	0.0072	0.02	J	1.3(4)
Lead	<	0.005	U	0.006	0.005		<	0.005	U	0.015(at tap)
Silver	0.0092	0.01	J	0.0053	0.01	J	0.0052	0.01	J	0.1(2)
Vanadium	0.0089	0.01	J	0.0048	0.01	J	0.0081	0.01	J	--
Zinc	0.019	0.02	J	0.014	0.02	J	0.014	0.02	J	2(2)
Water Quality (mg/L)										
Cyanide	0.014	0.01		0.011	0.01		<	0.01	U	0.2(3)
Sulfide, Total	0.8	0.1		0.57	0.1		0.65	0.1		

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review. A complete summary of chemical results are presented in Appendix A of the RFI report
(2) Lifetime Health Advisory for drinking water (EPA Drinking Water Regulations and Health Advisories 1993)
(3)Maximum Contaminants Level for drinking water (EPA Drinking Water Regulations and Health Advisories 1993)
(4)Based on taste and odor.

J = Estimated value below reporting limit or estimated based on data quality criteria.
R = Rejected value. Qual= Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 12-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SEDIMENT TO BACKGROUND SOIL(1)
SWMU 103, CANNON AFB

Wastewater Playa Lake

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Typical Level in Clovis, NM Region (4)	Does maximum detected exceed background
CAN103-1032-5001	Aluminum	21300	1410 - 11,000	10,540	50,000	N**
CAN103-1032-5001	Arsenic	10.8	0.67 - 28	15.5	6.5	N
CAN103-1032-5001	Barium	231	14.5 - 1200	642	500	N
CAN103-1034-5001	Beryllium	0.99	0.17 - 0.77	0.73	1 - 2	N**
CAN103-1034-5001	Cadmium	2.6	<0.51 - 4.2	*	---	Y
CAN103-1032-5001	Chromium	35.5	4 - 15.4	12.5	30	Y
CAN103-1034-5001	Cobalt	5.9	0.85 - 5.3	4.5	3 - 7	N**
CAN103-1032-5001	Copper	102	<2 - 18.4	*	20	Y
CAN103-1032-5001	Lead	39.3	1.1 - 46	25.8	15	Y
CAN103-1034-5001	Mercury	0.51	<0.1 - <0.12	*	0.032 - 0.085	Y
CAN103-1032-5001	Nickel	27.7	1.3 - 9.8	9	15	Y
CAN103-1032-5001	Selenium	13.2	<0.21 - 124	*	0.15 - 0.30	Y
CAN103-1032-5001	Silver	33.7	0.51 - 0.93	*	---	Y
CAN103-1032-5001	Vanadium	130	5.2 - 28.3	25.3	30 - 70	Y
CAN103-1032-5001	Zinc	275	<4.3 - 27.5	21.9	45	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or slightly above Base-wide background range and within naturally-occurring levels (USGS 1984); therefore, concentration is not considered to exceed background.

TABLE 12-4

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS IN SEDIMENT TO BACKGROUND SOIL(1)
SWMU 103, CANNON AFB

Wastewater Playa Lake

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background	Typical Level in Clovis, NM Region (4)
CAN103-1032-5001	Aluminum	21300	1410 - 11,000	10,540	N**	50,000
CAN103-1032-5001	Arsenic	10.8	0.67 - 28	15.5	N	6.5
CAN103-1032-5001	Barium	231	14.5 - 1200	642	N	500
CAN103-1034-5001	Beryllium	0.99	0.17 - 0.77	0.73	N**	1 - 2
CAN103-1034-5001	Cadmium	2.6	<0.51 - 4.2	*	Y	---
CAN103-1032-5001	Chromium	35.5	4 - 15.4	12.5	Y	30
CAN103-1034-5001	Cobalt	5.9	0.85 - 5.3	4.5	N**	3 - 7
CAN103-1032-5001	Copper	102	<2 - 18.4	*	Y	20
CAN103-1032-5001	Lead	39.3	1.1 - 46	25.8	Y	15
CAN103-1034-5001	Mercury	0.51	<0.1 - <0.12	*	Y	0.032 - 0.085
CAN103-1032-5001	Nickel	27.7	1.3 - 9.8	9	Y	15
CAN103-1032-5001	Selenium	13.2	<0.21 - 124	*	Y	0.15 - 0.30
CAN103-1032-5001	Silver	33.7	0.51 - 0.93	*	Y	---
CAN103-1032-5001	Vanadium	130	5.2 - 28.3	25.3	Y	30 - 70
CAN103-1032-5001	Zinc	275	<4.3 - 27.5	21.9	Y	45

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward-Clyde for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM" (W-C 1993)
(3) Upper Tolerance Limit (UTL) = mean + 2 x standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37 .
(4) USGS 1984
* Data insufficient to calculate UTL of background concentration
** Maximum concentration is within or only slightly above Base-wide background range and is within naturally-occurring levels (USGS 1984); therefore concentrat considered to exceed background.

TABLE 12-5

CHEMICALS OF CONCERN IN SEDIMENT

Benzene
Bis(2-ethyl hexyl)phthalate
2-Butanone (MEK)
Butyl benzyl phthalate
Carbon disulfide
Chloromethane
4,4-DDD
Di-n-butyl phthalate
TPH*
Cadmium
Chromium
Copper
Lead*
Mercury
Nickel
Selenium
Silver
Vanadium
Zinc

* No EPA-established toxicity factor.

TABLE 12-6

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SEDIMENT AT PLAYA LAKE (SWMU 103)

	2-Butanone (MEK) (µg/kg)				Benzene (µg/kg)				Carbon disulfide (µg/kg)				Chloromethane (µg/kg)		
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Qual	RL
CAN103-1031-5001	19.5	2.970	UJ	39	9.5	2.251	UJ	19	8.4	2.128	J	19	4	J	39
CAN103-1032-5001	100	4.605	UJ	200	22	3.091	J	98	22	3.091	J	98		UJ	200
CAN103-1033-5001	18	2.890	J	37	6.6	1.887	J	19	11	2.398	J	19		UJ	37
CAN103-1034-5001	68	4.220		49	16	2.773	J	25	23	3.135	J	25		UJ	49
Number	4	4			4	4			4	4			1		
Minimum detected	18.0				6.60				8.40				4.00		
Maximum detected	68.0				22.0				23.0				4.00		
Average	51.4	3.67			13.5	2.50			16.1	2.69			4.00		
H statistic		5.95				3.91				3.68					
Standard Deviation	39.88	0.87			6.88	0.54			7.48	0.50					
95% UCL	1142	1142			47.1	47.1			48.6	48.6					
RME	68.0				22.0				23.0				4.00		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected detected

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where RL is shown, no analysis was performed.

TABLE 12-6

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SEDIMENT AT PLAYA LAKE (SWMU 103)

	bis(2-Ethylhexyl)phthalate (µg/kg)				Butyl benzyl phthalate (µg/kg)			Di-n-butyl phthalate (µg/kg)			4,4'-DDD (µg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Qual	RL	Result	Qual	RL	Result	Log Result	Qual	RL
CAN103-1031-5001	2000	7.601		1300		UJ	1300		UJ	1300	220	5.394	J	250
CAN103-1032-5001	3900	8.269	J	6500		UJ	6500		UJ	6500			UJ	1300
CAN103-1033-5001	760	6.633	J	1200	320	J	1200	200	J	1200	125	4.828	UJ	250
CAN103-1034-5001	1700	7.438		1600		U	1600		U	1600	8	2.079	UJ	16
Number	4	4			1			1			3	3		
Minimum detected	760				320			200			220			
Maximum detected	3900				320			200			220			
Average	2090	7.49			320			200			118	4.10		
H statistic		4.78										24.30		
Standard Deviation	1317	0.67									106	1.77		
95% UCL	14289	14289									4.94E+15	4.94E+15		
RME	3900				320			200			220			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value shown is one-half RL
Where RL is shown, no analysis was performed.

TABLE 12-6

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SEDIMENT AT PLAYA LAKE (SWMU 103)

	TPH (mg/kg)				Cadmium (mg/kg)				Chromium (mg/kg)				Copper (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN103-1031-5001	2520	7.832		154	2.3	0.833		1.9	10.4	2.342		3.9	40.3	3.696		7.7
CAN103-1032-5001	5890	8.681		786			UJ	9.8	35.5	3.570		19.6	102	4.625		39.3
CAN103-1033-5001	2200	7.696		150	0.95	-0.051	UJ	1.9	13.5	2.603		3.7	29.4	3.381		7.5
CAN103-1034-5001	2290	7.736		197	2.6	0.956		2.5	19.8	2.986		4.9	44.3	3.791		9.8
Number	4	4			3	3			4	4			4	4		
Minimum detected	2200				2.30				10.4				29.4			
Maximum detected	5890				2.60				35.5				102			
Average	3225	7.99			1.95	0.58			19.8	2.87			54.0	3.87		
H statistic		3.68				7.15				3.91				3.91		
Standard Deviation	1782	0.47			0.88	0.55			11.17	0.53			32.61	0.53		
95% UCL	8836	8836			33.3	33.3			68.0	68.0			183	183		
RME	5890				2.60				35.5				102			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected detected

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where RL is shown, no analysis was performed.

TABLE 12-6

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SEDIMENT AT PLAYA LAKE (SWMU 103)

	Lead (mg/kg)				Mercury (mg/kg)				Nickel (mg/kg)				Selenium (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN103-1031-5001	14.6	2.681		1.9	0.5	-0.693		0.39	5.3	1.668	J	15.4	3.3	1.194		1.9
CAN103-1032-5001	39.3	3.671		9.8			U	2	27.7	3.321	J	78.6	13.2	2.580		9.8
CAN103-1033-5001	16.5	2.803		1.9	0.39	-0.942		0.37	12.1	2.493	J	15	5.2	1.649		1.9
CAN103-1034-5001	16.7	2.815		2.5	0.51	-0.673		0.49	14.6	2.681	J	19.7	4.7	1.548		2.5
Number	4	4			3	3			4	4			4	4		
Minimum detected	14.6				0.39				5.30				3.30			
Maximum detected	39.3				0.51				27.7				13.2			
Average	21.8	2.99			0.47	-0.77			14.9	2.54			6.60	1.74		
H statistic		3.68				3.30				4.78				4.15		
Standard Deviation	11.72	0.46			0.07	0.15			9.38	0.68			4.47	0.59		
95% UCL	58.4	58.4			0.66	0.66			105	105			28.1	28.1		
RME	39.3				0.51				27.7				13.2			

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected detected

J = Estimated value below reporting limit or estimated based on data quality criteria

U = Not detected. Value shown is one-half RL

Where RL is shown, no analysis was performed.

TABLE 12-6

CONCENTRATIONS OF CHEMICALS OF CONCERN IN SEDIMENT AT PLAYA LAKE (SWMU 103)

	Silver (mg/kg)				Vanadium (mg/kg)				Zinc (mg/kg)			
Field ID	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL	Result	Log Result	Qual	RL
CAN103-1031-5001	9.8	2.282		3.9	27.1	3.300		3.9	90.9	4.510		7.7
CAN103-1032-5001	33.7	3.517		19.6	130	4.868		19.6	275	5.617		39.3
CAN103-1033-5001	9.9	2.293		3.7	57.5	4.052		3.7	76.9	4.343		7.5
CAN103-1034-5001	11.5	2.442		4.9	78.9	4.368		4.9	101	4.615		9.8
Number	4	4			4	4			4	4		
Minimum detected	9.80				27.1				77			
Maximum detected	33.7				130				275			
Average	16.2	2.63			73.4	4.15			136	4.77		
H statistic		4.15				4.783				4.15		
Standard Deviation	11.68	0.59			43.3	0.66			93.23	0.57		
95% UCL	68.9	68.9			482	482			552	552		
RME	33.7				130				275			

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected detected
J = Estimated value below reporting limit or estimated based on data quality criteria
U = Not detected. Value shown is one-half RL
Where RL is shown, no analysis was performed.

TABLE 12-7
SEDIMENT CONCENTRATIONS
ADJUSTED FOR DERMAL ABSORPTION
SWMU 103

	Average Concentration (mg/kg)	RME Concentration (mg/kg)	Absorbed Fraction (1)	Adjusted Average Concentration(2) (mg/kg)	Adjusted RME Concentration(3) (mg/kg)
2-Butanone (MEK)	0.05	0.068	0.0005	2.50E-05	3.40E-05
4,4'-DDD	0.12	0.22	0.03	0.0036	0.0066
Benzene	0.013	0.022	0.0005	6.50E-06	1.10E-05
bis(2-Ethylhexyl)phthalate	2.10	3.90	0.1	0.21	0.39
Butyl benzyl phthalate	1.30	3.20	0.1	0.13	0.32
Carbon disulfide	0.016	0.023	0.0005	8.00E-06	1.15E-05
Chloromethane	0.004	0.004	0.0005	2.00E-06	2.00E-06
Di-n-butyl phthalate	0.20	0.20	0.1	0.02	0.02
Mercury	0.47	0.51	0.01	0.0047	0.0051

(1) Absorbed fraction from Table C-25, Appendix C.

(2) Adjusted average concentration = average concentration x absorbed fraction

(3) Adjusted RME concentration = RME concentration x absorbed fraction

TABLE 12-8

SUMMARY OF INTAKE FACTORS[1]

Occupational (Base Workers)	Average	RME
Dermal Contact with Sediment (kg/kg-d)		
Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
Carcinogenic	6.04×10^{-8}	9.61×10^{-6}
Sediment Ingestion (kg/kg-d)		
Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
Carcinogenic	7.55×10^{-10}	1.75×10^{-7}
Construction Workers	**Average**	**RME**
Dermal Contact with Sediment (kg/kg-d)		
Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
Carcinogenic	4.47×10^{-9}	6.71×10^{-8}
Sediment Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
Carcinogenic	2.80×10^{-10}	2.24×10^{-9}
Trespasser	**Average**	**RME**
Dermal Contact with Sediment (kg/kg-d)		
Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
Carcinogenic	1.20×10^{-8}	1.27×10^{-6}
Sediment Ingestion (kg/kg-d)		
Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
Carcinogenic	1.50×10^{-10}	1.20×10^{-8}
Farm Workers	**Average**	**RME**
Dermal Contact with Sediment (kg/kg-d)		
Noncarcinogenic	3.10×10^{-8}	1.01×10^{-6}
Carcinogenic	3.99×10^{-9}	4.34×10^{-7}
Sediment Ingestion (kg/kg-d)		
Noncarcinogenic	1.96×10^{-9}	1.96×10^{-8}
Carcinogenic	2.52×10^{-10}	8.39×10^{-9}

[1] Exposure assumptions and intake factor calculations are shown in Tables C-1 through C-22 (Appendix C). Intake factors are multiplied by exposure point concentrations of chemicals of concern to estimate daily chemical intake in terms of mg chemical per kilogram body weight per day (mg/kg-d).

TABLE 12-9

SUMMARY OF HUMAN HEALTH RISKS AT SWMU 103

Receptor/Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
Occupational Worker (Sediment)						
-- Dermal Contact	2×10^{-10}		1×10^{-5}	7×10^{-8}		1×10^{-3}
-- Ingestion	5×11^{-11}		2×10^{-4}	2×10^{-8}		2×10^{-2}
	3×10^{-10}		2×10^{-4}	9×10^{-8}		2×10^{-2}
Construction Worker (Sediment)						
-- Dermal Contact	2×10^{-11}	7×10^{-6}		5×10^{-10}	2×10^{-4}	
-- Ingestion	2×10^{-11}	4×10^{-4}		2×10^{-10}	6×10^{-3}	
	4×10^{-11}	5×10^{-4}		7×10^{-10}	7×10^{-3}	
Trespasser (Sediment)						
-- Dermal Contact	5×10^{-11}	3×10^{-6}		9×10^{-9}	5×10^{-4}	
-- Ingestion	3×10^{-11}	4×10^{-5}		1×10^{-9}	6×10^{-3}	
	6×10^{-11}	5×10^{-5}		1×10^{-8}	6×10^{-3}	
Farm Worker (Sediment)						
-- Dermal Contact	2×10^{-11}		8×10^{-7}	3×10^{-9}		4×10^{-5}
-- Ingestion	2×10^{-11}		5×10^{-5}	9×10^{-10}		9×10^{-4}
	3×10^{-11}		6×10^{-5}	4×10^{-9}		1×10^{-3}

Note: Apparent inconsistencies in summation of risks are due to rounding of risk values. See Appendix C for nonrounded risk values.

TABLE 12-10

RISK-BASED CONCENTRATIONS (RBCs) FOR TPH IN SOIL[1]

Noncarcinogenic

Fuel	Oral RfD[2] mg/kg-d	RME Intake Factor[3] kg/kg-d	HI	Soil RBC[4] mg/kg
JP4	0.08	4.90E-07	1	163265
Unl. gasoline	0.2	4.90E-07	1	408163

Carcinogenic

Fuel	Oral SF[2] 1/(mg/kg-d)	RME Intake Factor[3] kg/kg-d	Target Cancer Risk Level	Soil RBC[4] mg/kg
Unl. gasoline	1.70E-03	1.75E-07	1.00E-05	33,613

[1] RBCs are based on occupational soil ingestion exposures

[2] RFDs and SFs from EPA 1992. Risk Assessment Issue Paper for Oral Systemic and Carcinogenic Toxicity for Multiple Fuels. From Joan S. Dollarhide, Superfund Health Risk Technical Support Center to Carol Sweeney, USEPA, Region X, March 24. The oral toxicity factors are based on extrapolation from inhalation studies and are under review and subject to revision.

[3] IFs for occupational soil ingestion from Table C-2.

[4] Noncarcinogenic RBC = RFD x HI/IF Carcinogenic RBC = Risk Level/(IF x SF)

TABLE 12-11

SUMMARY OF CHEMICALS REPORTED IN WATER AT SWMU 103
CANNON AFB
(mg/L)

Chemical	CAN103-1035-3000	CAN103-1036-3000	CAN103-1037-3000	N	Arithmetic Mean	95% UCL	Maximum
Semivolatile Organics							
Isophorone	0.005	0.005 U	0.0014 J	3	0.00	0.01	0.005
Metals							
Arsenic	0.0031 J	0.0057 J	0.0034 J	3	0.00	0.01	0.0057
Barium	0.076	0.07	0.066	3	0.07	0.08	0.076
Copper	0.0069 J	0.0051 J	0.0072 J	3	0.01	0.01	0.0072
Lead	0.003 UJ	0.006 J	0.003 UJ	3	0.004	0.01	0.006
Silver	0.0092 J	0.0053 J	0.0052 J	3	0.01	0.01	0.0092
Vanadium	0.0089 J	0.0048 J	0.0081 J	3	0.01	0.01	0.0089
Zinc	0.019 J	0.014 J	0.014 J	3	0.02	0.02	0.019
Cyanide	0.014	0.011	0.005 U	3	0.01	0.02	0.014
Sulfide, total	0.8	0.57	0.65	3	0.67	0.83	0.8

J Estimated value below limit or estimated based on data quality criteria.

U Nondetect, value shown i s one-half the reporting limit

TABLE 12-12

SUMMARY OF CHEMICALS REPORTED IN SEDIMENT AT SWMU 103
CANNON AFB
(mg/kg)

Chemical	CAN103-1031-5001	CAN103-1032-5001	CAN103-1033-5001	CAN103-1034-5001	N	Arithmetic Mean	95% UCL	Maximum
Volatile Organics								
Benzene	0.0095 J	0.022 J	0.0066 J	0.016 J	4	0.01	0.02	0.022
2-Butanone	0.0195 UJ	0.1 UJ	0.018 J	0.068 J	4	0.05	0.09	0.1
Carbon disulfide	0.0084 J	0.022 J	0.011 J	0.023 J	4	0.02	0.02	0.023
Chloromethane	0.004 J	0.1 J	0.0185 J	0.025 UJ	4	0.04	0.08	0.1
Semivolatile Organics								
bis(2-Ethylhexyl)phthalate	2 J	3.9 J	0.76 J	1.7 UJ	4	2.09	3.43	3.9
Butyl benzyl phthalate	0.65 J	3.25 J	0.32 J	0.8 UJ	4	1.26	2.63	3.25
Di-n-butyl phthalate	0.65 J	3.25 J	0.2 J	0.8 UJ	4	1.23	2.62	3.25
Metals								
Aluminum	3450	21300	12300	12300	4	12337.50	19762.44	21300
Arsenic	2.4	10.8 J	3.3 J	4.5	4	5.25	9.12	10.8
Barium	90.1	231	119	150	4	147.53	209.46	231
Beryllium	0.39 U	1.95 U	0.69 J	0.99	4	1.01	1.69	1.95
Cadmium	2.3	4.9 U	0.95 U	2.6	4	2.69	4.36	4.9
Calcium	26200	83400	46400	77400	4	58350.00	85732.58	83400
Chromium	10.4	35.5	13.5	19.8	4	19.80	31.18	35.5
Cobalt	1.95 UJ	9.8 U	4	5.9	4	5.41	8.82	9.8
Copper	40.3	102	29.4	44.3	4	54.00	87.23	102
Iron	3860	18300	9990	13100	4	11312.50	17462.71	18300
Lead	14.6	39.3	16.5	16.7	4	21.78	33.72	39.3
Magnesium	1780	8700	4140	5640	4	5065.00	8017.45	8700
Manganese	38	228	158	196	4	155.00	239.65	228
Mercury	0.5 UJ	1 U	0.39	0.51	4	0.60	0.88	1
Nickel	5.3 J	27.7 J	12.1 J	14.6 J	4	14.93	24.48	27.7
Potassium	968 J	4640 J	2580	3380	4	2892.00	4458.64	4640
Selenium	3.3	13.2	5.2 J	4.7 J	4	6.60	11.16	13.2
Silver	9.8	33.7	9.9	11.5	4	16.23	28.12	33.7
Sodium	3940 J	18900 J	4230 J	4260 J	4	7832.50	15351.57	18900
Vanadium	27.1	130	57.5	78.9	4	73.38	117.51	130
Zinc	90.9	275	76.9	101	4	135.95	230.94	275
TPH	2520	5890	2200	2290	4	3225.00	5040.41	5890

J Estimated value below limit or estimated based on data quality criteria.
U Non-detect, value shown i s one-half the reporting limit

TABLE 12-13

CHEMICALS OF CONCERN IN WATER
SWMU 103
CANNON AFB
(mg/l)

Chemical	Maximum Concentration	Federal Ambient Water Quality Standards(1)		New Mexico Water Quality Standards(2)				Retained as a COC?
					Warm Water Fishery		Livestock & Wildlife Watering	
		Acute	Chronic	Irrigation	Acute	Chronic		
Semivolatile								
Isophorone	0.005	117++	--	--	--	--	--	N
Metals								
Arsenic	0.0057 (T)	--	--	0.1 (D)	--	--	0.02 (D)	N Y
Barium	0.076 (T)	--	--	--	--	--	--	Y
Copper	0.0072 (T)	0.018+ (TR)	0.012+ (TR)	0.20 (D)	0.018+ (D)	0.012+ (D)	0.5 (D)	N Y
Lead	0.006 (T)	0.083+ (TR)	0.0032+ (TR)	5 (D)	0.082+ (D)	0.0032+ (D)	0.1 (D)	Y
Silver	0.0092 (T)	0.0041+ (TR)	0.00012 (TR)	--	0.0041+ (D)	0.00012 (D)	--	Y
Vanadium	0.0089 (T)	--	--	0.1 (D)	--	--	0.1 (D)	N
Zinc	0.019 (T)	0.12+ (TR)	0.11+ (TR)	2 (D)	0.117+ (D)	0.106+ (D)	25 (D)	N Y
Cyanide	0.014 (T)	0.022 (TR)	0.0052 (TR)	--	0.022 (T)	0.0052 (T)	--	Y
Sulfide, total	0.8 (T)	--	0.002+++ (TR	--	--	--	--	Y

(1) EPA (1991). Non-enforceable guidance numbers.
(2) Water Quality Standards for Interstate and Intrastate Streams in New Mexico, New Mexico Water Quality Control Commission, as amended through November 12, 1991.
+ hardness dependent criteria (100 mg/l CaCO^3 used)
++ Lowest observed effects level (LOEL)
+++ sulfide/hydrogen sulfide
D - dissolved
T - total
TR = Total Recoverable
--- = Not Available
Y = Yes
N = No

TABLE 12-14
CHEMICALS OF CONCERN IN SEDIMENTS
SWMU 103
CANNON AFB
(mg/kg)

Chemical	Maximum Detected Concentration	UTL Cannon Background Concentration[1]	Levels in Southwestern U.S. Soils[2]	Sediment Quality Guidelines[3]	EPA Threshold Values[4]	NOAA Overall Apparent Effects Thresholds[5]	Retained as a COC?
Volatile Organics							
Benzene	0.022	--	--	--	--	--	Y
2-Butanone	0.1	--	--	--	--	--	Y
Carbon Disulfide	0.023	--	--	--	--	--	Y
Chloromethane	0.1	--	--	--	--	--	Y
Semivolatile Organics							
bis(2-ethylhexyl)phthalate	3.9	--	--	--	--	--	Y
Butyl benzyl phthalate	3.25	--	--	--	--	--	Y
Di-n-butyl phthalate	3.25	--	--	--	--	--	Y
Metals							
Aluminum	21,300	10,540	5,000	--	--	--	Y
Arsenic	10.8	15.5	6.5	17 SLC	33 EQP	50 BIO	N
Barium	231	642	500		--	--	N
Beryllium	1.95	0.73	1-2	--	--	--	N
Cadmium	4.9	*	--	2.5 BIO	31 EQP	5 BIO	Y
Calcium	83,400	186,400	--	--	--	--	N**
Chromium	35.5	12.5	30	100 BIO	25 EQP	--	Y
Cobalt	9.8	4.5	3-7		--	--	Y
Copper	102	*	20	85 BIO	136 EQP	300 BIO	Y
Iron	18,300	8,720	15,000	5.9% BKG	--	--	N**
Lead	39.3	25.8	15	55 BKG	132 EQP	300 BIO	N
Magnesium	8,700	11,790	--	--	--	--	N**
Manganese	228	164	500	0.12% BKG	--	--	N
Mercury	1	*	0.32	0.6 BKG	0.8 EQP	1 BIO	Y
Nickel	27.7	9	15	92 SLC	20 EQP	--	N
Potassium	4,640	2,572	--	--	--	--	N**
Selenium	13.2	*	0.3	--	--	--	Y

TABLE 12-14
CHEMICALS OF CONCERN IN SEDIMENTS
SWMU 103
CANNON AFB
(mg/kg) (Continued)

Chemical	Maximum Detected Concentration	UTL Cannon Background Concentration[1]	Levels in Southwestern U.S. Soils[2]	Sediment Quality Guidelines[3]	EPA Threshold Values[4]	NOAA Overall Apparent Effects Thresholds[5]	Retained as a COC?
Silver	33.7	*	--	--	--	1.7 BIO	Y
Sodium	18,900	*	--	--	--	--	N**
Vanadium	130	25.3	--		--	--	Y
Zinc	275	21.9	45	143 BKG	760 EQP	260 BIO	Y
TPH	5890	--	--	--	--	--	Y

(1) Upper Tolerance Limit (UTL) of the mean=mean +2 x standard deviation. This is for all practical purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation x k, where k=2.02 for n=37.
(2) USGS (1984).
(3) Hart et al. (1988).
(4) EPA (1985).
(5) Long and Morgan (1990).

* Data insufficient to calculate UTL of background concentration
** Essential nutrient natural to sediments. Not expected to be of concern compared to other COCs.

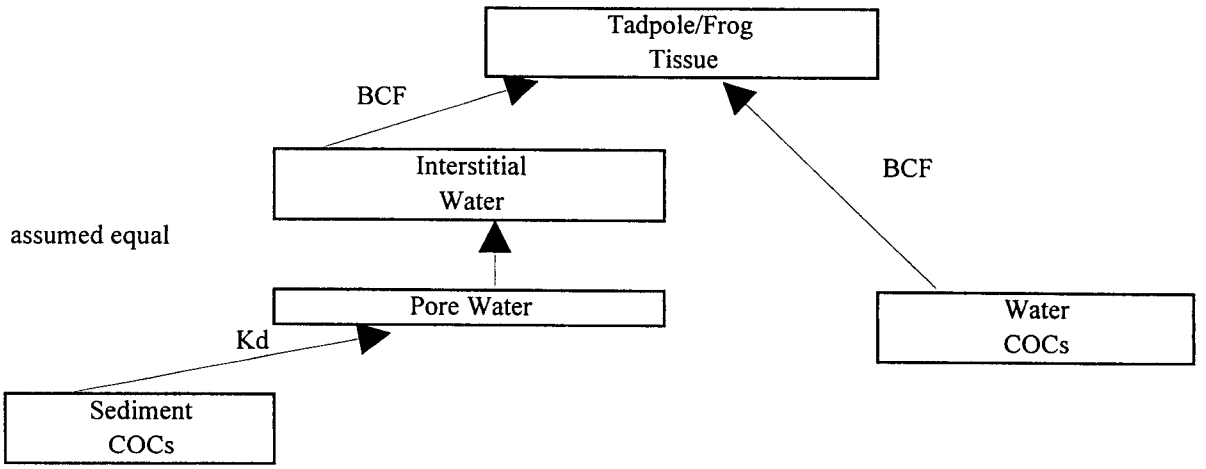
EQP = Equilibrium Partitioning Approach, assuming 4% total organic carbon
SLC = Screening Level Concentrations
BKG = Background Approach
BIO = Biological Approach

TABLE 12-15

ESTIMATE OF TISSUE CONCENTRATION IN TADPOLE/FROG (COCs which Bioacumulate)

COC	Concentration in Sediment	Kd Value	BCF	Concentration in Tadpole/Frog
Sediment*				
Cadmium	2.69	10000	64	0.017216
Mercury	0.6	1000	3760	2.256
Water**				
Lead	0.004		49	0.196

* Concentration in tadpole/frog = Concentration in Sediment * BCF / Kd
** Concentration in tadpole/frog = Concentration in water * BCF



Kd values were researched from Thompson and Mueller (1987), Schooner et al. (1987), and Lake Hills ERA. The largest Kd values were selected from the available range, assuming the tadpole/frog is in contact with pore water, rather contact is with the interstitial which is conservatively assumed to be equal to pore water. Larger Kd values provide smaller values in the water.

BCFs were selected from EPA (1992) which assumes an organism to have a 3% lipid content. This is assumed to be a conservative estimate for tadpole/frog tissue.

TABLE 12-16

HAZARD INDEX CALCULATION FOR MALLARD FROM WATER, SEDIMENT, AND FOOD (ALGAE/DUCKWEED) AT SWMU 103

		Metals											
	Water	Al	Ag	Ba	Cd	Co	Cr	Cu	Hg	Pb	Se	Va	Zn
Cedar & Braun (1983)	Intake (l/day)		0.063	0.063						0.063			
Teres (1991)	Body weight (kg)		1.16	1.16						1.16			
	Concentration (mg/l)		0.01	0.07						0.004			
	Dose (mg/kg-bw/day)		0.00054	0.0038						0.00022			
	Benchmark Value (mg/kg-bw/day)		8.2	250						17.5			
	Hazard Quotient	N/A	0.0001	0.00002	N/A	N/A	N/A	N/A	N/A	0.00001	N/A	N/A	N/A
	Sediment												
Newell et al. (1987)	Food Intake (kg/day)	0.232	0.232		0.232	0.232	0.232	0.232	0.232		0.232	0.232	0.232
Teres (1991)	Body weight (kg)	1.16	1.16		1.16	1.16	1.16	1.16	1.16		1.16	1.16	1.16
	Sediment in Diet (% of Food Intake)	30	30		30	30	30	30	30		30	30	30
	Sediment Intake (kg/day)	0.0696	0.0696		0.0696	0.0696	0.0696	0.0696	0.0696		0.0696	0.0696	0.0696
	Concentration (mg/kg)	12337.5	16.23		2.69	5.41	19.8	54	0.6		6.6	73.38	135.95
	Dose (mg/kg-bw/day)	740.25	8.2		0.1614	0.3246	1.188	3.24	0.036		0.396	4.4028	8.157
	Benchmark Value (mg/kg-bw/day)	300	100		2.1	1.75	17.5	52	0.06		1	1.75	175
	Hazard Quotient	2.468	0.082	N/A	0.077	0.185	0.068	0.062	0.6	N/A	0.396	2.516	0.047
	Food												
Newell et al. (1987)	Intake (kg/day)		0.232	0.232						0.232			
Teres (1991)	Body weight (kg)		1.16	1.16						1.16			
	Concentration (mg/kg)		0.01	0.07						0.004			
Eisler (1988)	Bioconcentration Factor		0	---						725			
	Dose (mg/kg-bw/day)		0.002	0.014						0.58			
	Benchmark Value (mg/kg-bw/day)		8.2	250						17.5			
	Hazard Quotient	N/A	0.0002	0.00006	N/A	N/A	N/A	N/A	N/A	0.03314	N/A	N/A	N/A
	Hazard Index	2.468	0.082	0.00007	0.077	0.185	0.068	0.062	0.6	0.03316	0.396	2.516	0.047
	Total Hazard Index												

Notes: N/A = not applicable to this medium

TABLE 12-16

HAZARD INDEX CALCULATION FOR MALLARD FROM WATER, SEDIMENT, AND FOOD (ALGAE/DUCKWEED) AT SWMU 103

		Semivolatile Organics			Volatile Organics				Other Chemicals	
	Water	bis(2-ethylhexyl)-phthalate	Butyl benzyl-phthalate	Di-n-butyl-phthalate	Benzene	2-Butanone	Carbon-Disulfide	Chloro-methane	Cyanide	Sulfide (total)
Cedar & Braun (1983)	Intake (l/day)								0.063	0.063
Teres (1991)	Body weight (kg)								1.16	1.160
	Concentration (mg/l)								0.01	0.670
	Dose (mg/kg-bw/day)								0.00054	0.036
	Benchmark Value (mg/kg-bw/day)								0.4	120
	Hazard Quotient	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.001	0.0003
	Sediment									
Newell et al. (1987)	Food Intake (kg/day)	0.232	0.232	0.232	0.232	0.232	0.232	0.232		
Teres (1991)	Body weight (kg)	1.16	1.16	1.16	1.16	1.16	1.16	1.16		
	Sediment in Diet (% of Food Intake)	30	30	30	30	30	30	30		
	Sediment Intake (kg/day)	0.0696	0.0696	0.0696	0.0696	0.0696	0.0696	0.0696		
	Concentration (mg/kg)	2.09	1.26	1.23	0.01	0.05	0.02	0.04		
	Dose (mg/kg-bw/day)	0.1254	0.0756	0.0738	0.0006	0.003	0.0012	0.0024		
	Benchmark Value (mg/kg-bw/day)	19	83.4	2100	480	40.5	212.5	180		
	Hazard Quotient	0.0066	0.001	0.00004	0.000001	0.00007	0.000006	0.00001	N/A	N/A
	Food									
Newell et al. (1987)	Intake (kg/day)								0.232	0.232
Teres (1991)	Body weight (kg)								1.16	1.160
	Concentration (mg/kg)								0.01	0.670
Eisler (1988)	Bioconcentration Factor								0	----
	Dose (mg/kg-bw/day)								0.002	0.134
	Benchmark Value (mg/kg-bw/day)								0.4	120
	Hazard Quotient	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.005	0.0011
	Hazard Index	0.0066	0.001	0.00004	0.000001	0.00007	0.000006	0.00001	0.006	0.001
	Total Hazard Index									6.549

Notes: N/A = not applicable to this medium

TABLE 12-17

HAZARD INDEX CALCULATION FOR BLACK CROWNED NIGHT HERON FROM WATER, SEDIMENT, AND FOOD (FROG/TADPOLE) AT SWMU 103

References		Metals											
	Water	Al	Ag	Ba	Cd	Co	Cr	Cu	Hg	Pb	Se	Va	Zn
Cedar & Braun (1983)	Intake (l/day)		0.054	0.054						0.054			
Teres (1991)	Body weight (kg)		0.870	0.870						0.870			
	Concentration (mg/l)		0.010	0.070						0.004			
	Dose (mg/kg-bw/day)		0.001	0.004						0.000			
	Benchmark Value (mg/kg-bw/day)		8.200	250.000						17.500			
	Hazard Quotient	N/A	0.00008	0.00002	N/A	N/A	N/A	N/A	N/A	0.00001	N/A	N/A	N/A
	Sediment												
Newell et al. (1987)	Food Intake (kg/day)	0.174	0.174		0.174	0.174	0.174	0.174	0.174		0.174	0.174	0.174
Teres (1991)	Body weight (kg)	0.87	0.87		0.87	0.87	0.87	0.87	0.87		0.87	0.87	0.87
Beyer et al. (1987)	Sediment in Diet (% of Food Intake)	15	15		15	15	15	15	15		15	15	15
	Sediment Intake (kg/day)	0.0261	0.0261		0.0261	0.0261	0.0261	0.0261	0.0261		0.0261	0.0261	0.0261
	Concentration (mg/kg)	12337.5	16.23		2.69	5.41	19.8	54	0.6		6.6	73.38	135.95
	Dose (mg/kg-bw/day)	370.125	0.4869		0.0807	0.1623	0.594	1.62	0.018		0.198	2.2014	4.0785
	Benchmark Value (mg/kg-bw/day)	300	8.2		2.1	1.75	17.5	52	0.06		1	1.75	175
	Hazard Quotient	1.234	0.059	N/A	0.038	0.093	0.034	0.031	0.300	N/A	0.198	1.258	0.023
	Food												
Newell et al. (1987)	Intake (kg/day)				0.174				0.174	0.174			
Teres (1991)	Body weight (kg)				0.870				0.870	0.870			
	Concentration (mg/kg)				0.0064-0.057				1.1-23.6	0.196			
	Dose (mg/kg/day)				0.001-0.011				0.22-4.7	0.039			
	Benchmark Value (mg/kg-bw/day)				2.100				0.060	17.500			
	Hazard Quotient	N/A	N/A	N/A	0.006-0.0054	N/A	N/A	N/A	3.7-78.6	0.002	N/A	N/A	N/A
	Hazard Index	1.234	0.059	0.000	0.044-0.043	0.093	0.034	0.031	4-78.9	0.002	0.198	1.258	0.023
	Total Hazard Index												

Notes: N/A = not applicable to this medium

TABLE 12-17

HAZARD INDEX CALCULATION FOR BLACK CROWNED NIGHT HERON FROM WATER, SEDIMENT, AND FOOD (FROG/TADPOLE) AT SWMU 103

References		Semivolatile Organics			Volatile Organics				Other Chemicals	
	Water	bis(2-ethylhexyl)-phthalate	Butyl benzyl-phthalate	Di-n-butyl-phthalate	Benzene	2-Butanone	Carbon-Disulfide	Chloro-methane	Cyanide	Sulfide (total)
Cedar & Braun (1983)	Intake (l/day)								0.054	0.054
Teres (1991)	Body weight (kg)								0.870	0.870
	Concentration (mg/l)								0.010	0.670
	Dose (mg/kg-bw/day)								0.001	0.042
	Benchmark Value (mg/kg-bw/day)								0.400	120.000
	Hazard Quotient	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.002	0.0003
	Sediment									
Newell et al. (1987)	Food Intake (kg/day)	0.174	0.174	0.174	0.174	0.174	0.174	0.174		
Teres (1991)	Body weight (kg)	0.87	0.87	0.87	0.87	0.87	0.87	0.87		
Beyer et al. (1987)	Sediment in Diet (% of Food Intake)	15	15	15	15	15	15	15		
	Sediment Intake (kg/day)	0.0261	0.0261	0.0261	0.0261	0.0261	0.0261	0.0261		
	Concentration (mg/kg)	2.09	1.26	1.23	0.01	0.05	0.02	0.04		
	Dose (mg/kg-bw/day)	0.0627	0.0378	0.0369	0.0003	0.0015	0.0006	0.0012		
	Benchmark Value (mg/kg-bw/day)	19	83.4	2100	480	40.5	212.5	180		
	Hazard Quotient	0.003	0.00045	0.00002	0.000001	0.00004	0.000003	0.00001	N/A	N/A
	Food									
Newell et al. (1987)	Intake (kg/day)									
Teres (1991)	Body weight (kg)									
	Concentration (mg/kg)									
	Dose (mg/kg/day)									
	Benchmark Value (mg/kg-bw/day)									
	Hazard Quotient	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Hazard Index	0.003	0.0005	0.00002	0.000001	0.00004	0.000003	0.00001	0.002	0.000
	Total Hazard Index									6.7-81.9

Notes: N/A = not applicable to this medium

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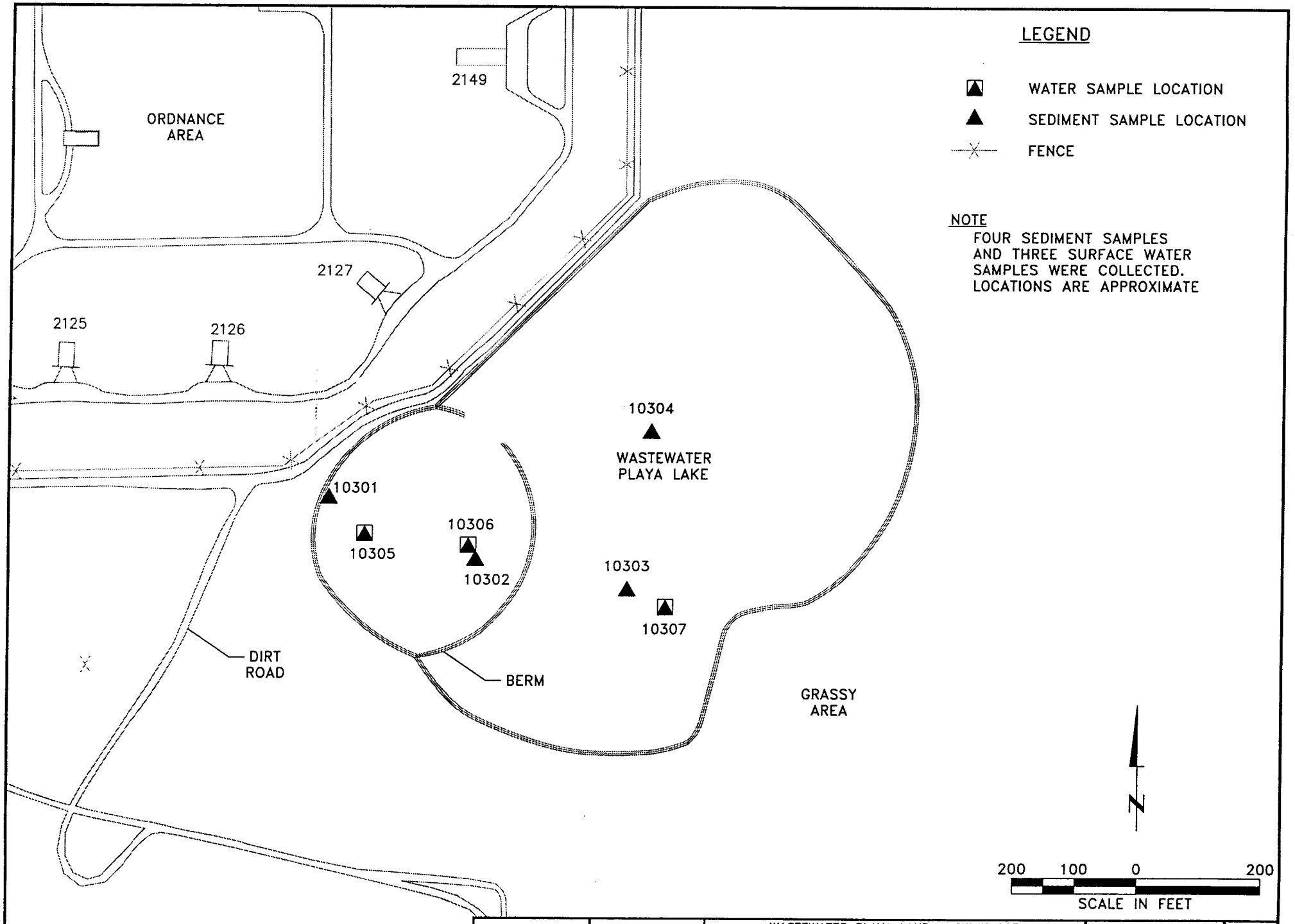

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	WASTEWATER PLAYA LAKE – SWMU 103 SITE PLAN AND SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 12–1

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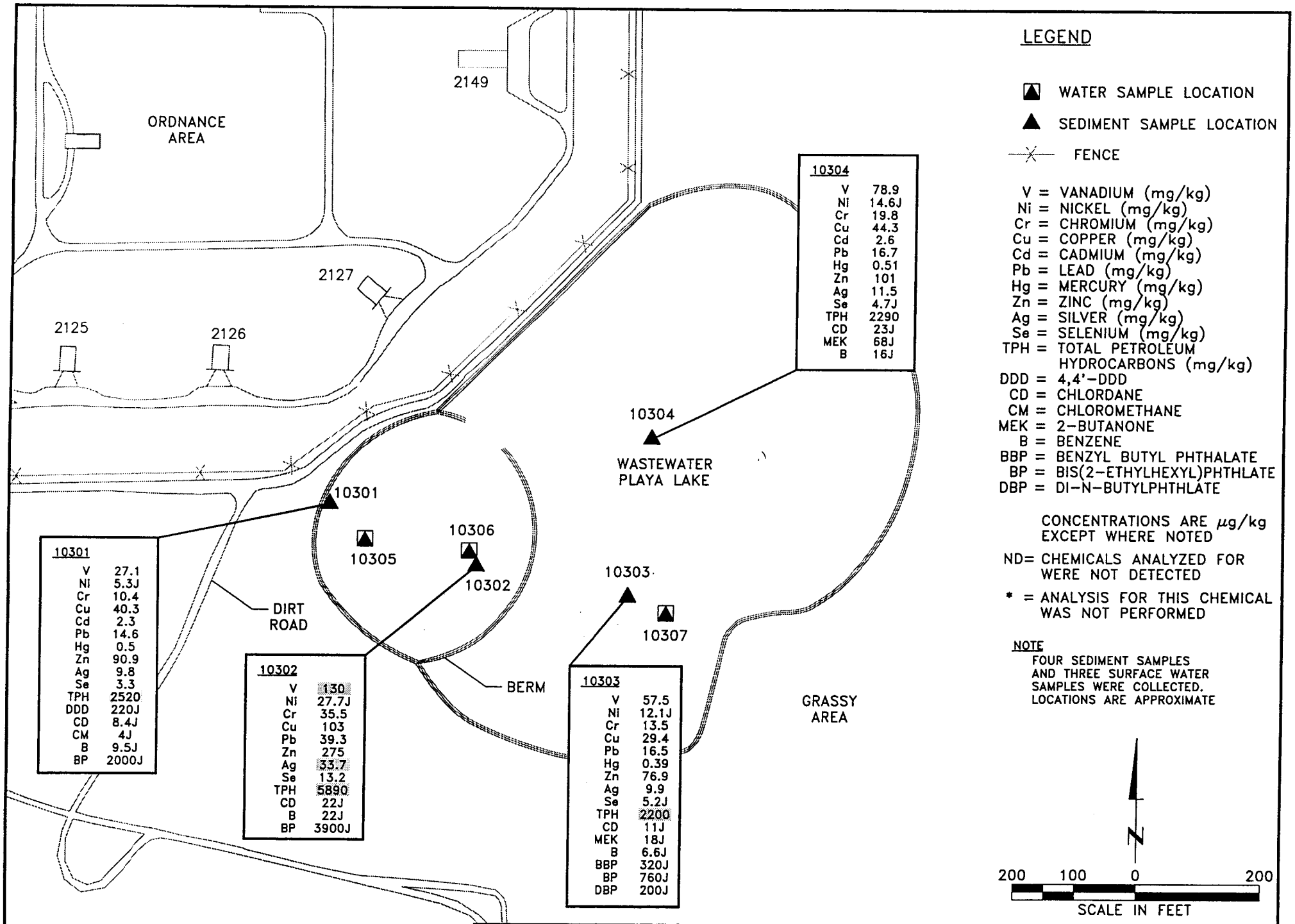

SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 01/04/94	WASTEWATER PLAYA LAKE – SWMU 103 CHEMICAL CONCENTRATIONS DETECTED IN SOIL CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY: .	REVISION: 0		C3M11W	12-2

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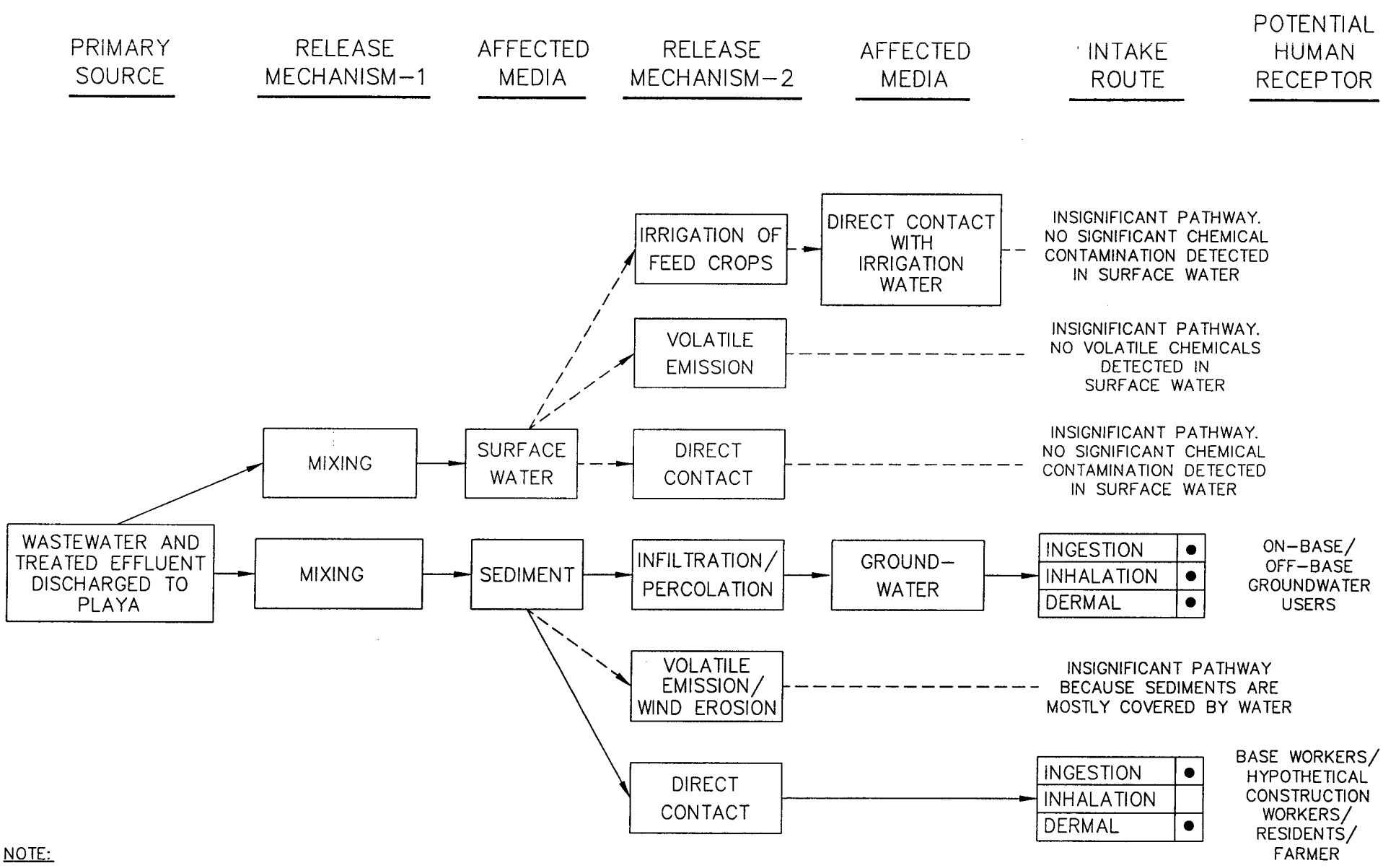
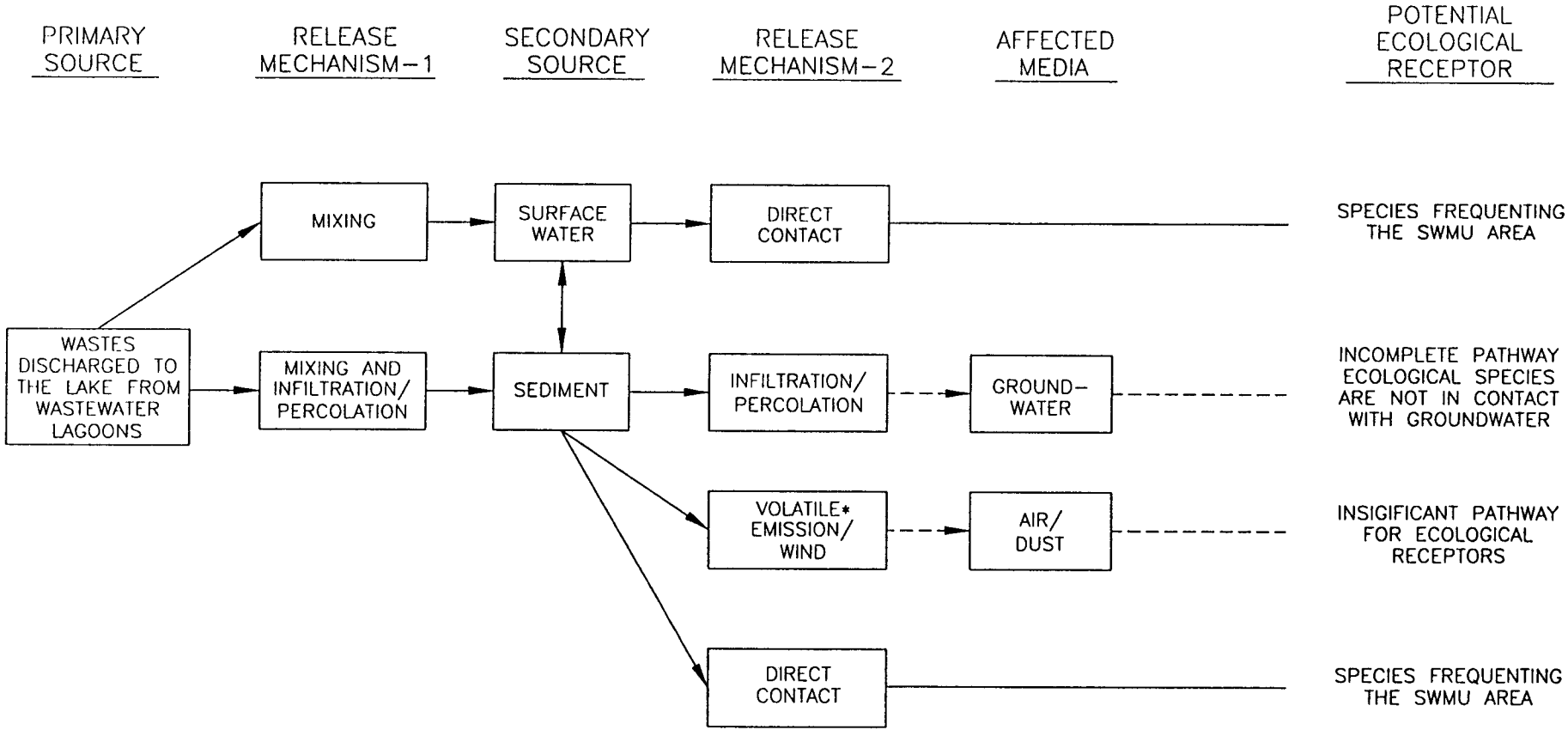


NOTE:

SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART WASTEWATER PLAYA LAKE SWMU – 103 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	12-3



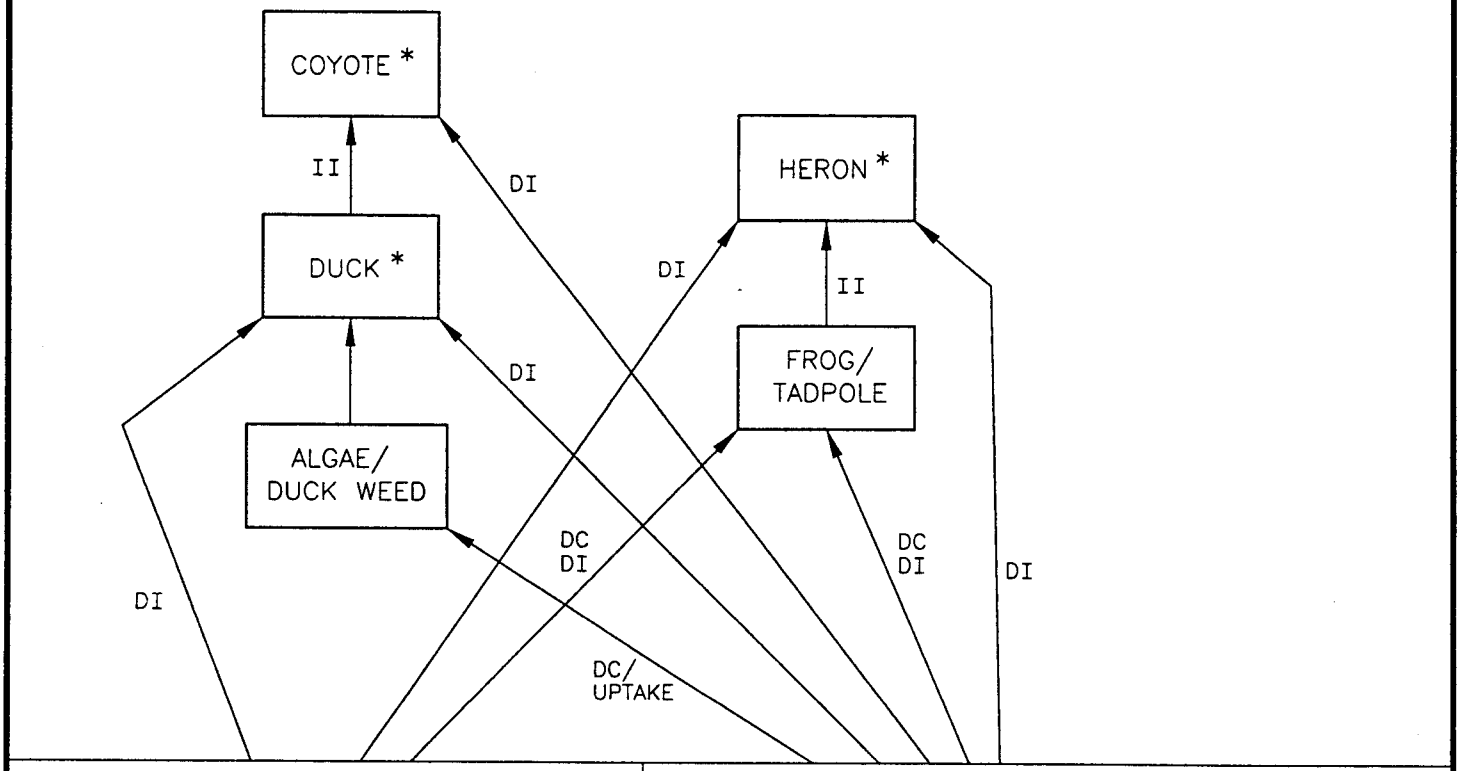
NOTES:

SOLID LINES REPRESENT POTENTIALLY COMPLETE AND SIGNIFICANT PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY NVD	DATE 12/30/93	EXPOSURE PATHWAY FLOW CHART FOR SWMU 103 (PLAYA LAKE) ECOLOGICAL RECEPTORS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0		C3M11W	12-4

CAN_442



KEY RECEPTOR SPECIES	MAJOR CHEMICAL SOURCES
* DUCK	SEDIMENT WATER ALGAE/DUCKWEED
* HERON	SEDIMENT WATER FROG/TADPOLE
* COYOTE	DUCK WATER
	(ALL VIA INGESTION)

INTERMEDIATE RECEPTORS	MAJOR CHEMICAL SOURCES	
ALGAE/DUCKWEED	WATER	(CONTACT/UPTAKE)
FROG/TADPOLE	WATER	(CONTACT,INGESTION)
	SEDIMENTS	(CONTACT,INGESTION)

KEY:

DC = DIRECT CONTACT

DI = DIRECT INGESTION

II = INDIRECT INGESTION
(i.e. SECONDARY, TERTIARY CONSUMPTION)

DRN BY NVD	DATE 12/30/93	CONCEPTUAL SITE MODEL SWMU 103 (PLAYA LAKE)	PROJECT NO.	FIG. NO.
CHK'D BY	REVISIONS: 0	CANNON AIR FORCE BASE NEW MEXICO	C3M11W	12-5

CAN_445

13.0
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APPENDIX A
BACKGROUND CONCENTRATIONS OF METALS AND PAHs IN SOILS

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A.0
BACKGROUND SOILS DATA

This section discusses regional background soils data and base-wide background soils data. Section A.1 describes data for the conterminous United States, the western United States, and the Clovis, New Mexico region. Section A.2 discusses background soil samples that were collected from off-site areas, along the sanitary sewer, at Landfill No. 2 (SWMU No. 82), and four background samples collected during the IRP investigation (Walk, Haydel & Associates 1990).

A.1 REGIONAL SOILS

Table A-1 presents a summary of data from a United States Geological Survey (USGS) study of naturally occurring concentrations of elements in soils in the United States (USGS 1984). For the USGS study, a soil sample was collected at each study site; study sites were approximately 80 kilometers apart along routes of travel by USGS personnel. Table A-1 presents the arithmetic mean concentration from all samples collected in the United States, the arithmetic mean concentration for samples collected in the western United States (west of the 96th meridian), and concentrations of metals in soil collected in the Clovis, New Mexico region.

There is little difference between mean concentrations of elements in Western United States soils compared to soils from the United States as a whole, except that mean calcium concentration appears higher in Western soils. Concentrations from the Clovis, New Mexico region are generally comparable to concentrations elsewhere, although reported concentrations of some of the major mineral-forming elements (e.g., Al, Fe, Mg) appear to be relatively low compared to mean concentrations for the Western United States.

A.2 BASE-WIDE SOILS

The following data and discussion of base-wide background concentrations have been adopted from a draft report "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, Clovis, NM" (W-C 1993a).

Tables A-2 through A-4 show the analytical results for background soil samples collected during previous investigations at various locations on and near Cannon AFB. Table A-2 shows the results from 2 off-site samples (OFS) and from 14 samples collected along the sanitary sewer line during the 1991 Remedial Investigation of 18 SWMUs (W-C 1992). Table A-3 shows the results from samples collected at uncontaminated areas near Landfill No. 2 (W-C 1993b). Table A-4 shows the results from 4 background surface soil samples collected during a Remedial Investigation conducted by Walk, Haydel & Associates (1990).

The following criteria were used to establish that the sampling locations were not impacted by Base activities and are appropriate for evaluating background conditions:

- Metals concentrations were within levels for this region
- No organic target analytes were detected in the samples
- No visible signs of contamination were present at the boring locations
- Subsurface samples were dry

Results from the 37 background samples were pooled to calculate arithmetic mean concentrations of each element and 95 percent tolerance limits for background concentrations (defined for this report as the mean plus or minus two standard deviations). These summary statistics are shown in Table A-5. The 95 percent tolerance limits describe the concentration range in which background concentrations will occur with 95 percent confidence. The upper tolerance limit of the background data are used in determining whether metals detected at the RFI sites evaluated in this report exceed background level.s Table A-5 also includes metals concentrations reported for the Clovis, New Mexico region (USGS 1984). These values are also used to compare to RFI site data.

It is interesting to compare the concentrations reported for the Clovis New Mexico region sample (USGS 1984) to the Cannon AFB background range (Table A-5). The Clovis region reported levels for magnesium and calcium are low compared to Cannon AFB background range, but the levels for aluminum, manganese, potassium, and sodium are high compared to Cannon AFB background levels. The Clovis New Mexico sample is also high compared to Cannon AFB background levels. The Clovis New Mexico sample is also high in chromium, nickel, vanadium, and zinc when compared to the Cannon background range. These differences undoubtedly reflect local variation in mineral content (for example, high calcium

is characteristic of soil conditions at Cannon AFB due to the presence of caliche (Klein and Hurlbut 1985), which may not have affected the sample collected for the USGS study).

A.3 TYPICAL PAH CONCENTRATIONS IN SOIL

PAHs are natural products of degradation of woody organic matter, and they are the products of incomplete combustion of fuels. Therefore, the presence of PAHs in soil may be the result of site-related contamination, deposition from combustion sources (e.g., automobile exhaust), or natural decay products of vegetable matter (e.g., leaves). Table A-6 presents typical levels of PAHs in soils from various settings and locations.

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TABLE A-1

ELEMENTAL CONCENTRATIONS IN U.S. SOILS (mg/kg)[1]

Element	Arithmetic Mean		Reported Levels in Clovis, NM Region
	Conterminous United States	Western United States	
Aluminum	72,000	74,000	50,000
Antimony	0.67	0.62	<1
Arsenic	7.2	7.0	6.5
Barium	580	670	500
Beryllium	0.92	0.97	1 - 1.5
Cadmium	---	---	---
Calcium	24,000	33,000	7,900 - 12,000
Chromium	54	56	30
Cobalt	9.1	9.0	3 - 5
Copper	25	27	20
Iron	26,000	26,000	100 - 10,000
Lead	19	20	15
Magnesium	9,000	10,000	2,000 - 3,000
Manganese	550	480	500
Mercury	0.089	0.065	0.032
Nickel	19	19	15
Potassium	15,000	18,000	16,000
Selenium	0.39	0.34	0.15 - 0.20
Silver	---	---	---
Sodium	12,000	12,000	7,000
Thallium	---	---	---
Vanadium	80	88	30 - 50
Zinc	60	65	45

(1) Source: USGS 1984

TABLE A-2

BACKGROUND ELEMENTAL CONCENTRATIONS (mg/kg) IN SOIL SAMPLES COLLECTED AT OFF-SITE AREAS AND ALONG THE SANITARY SEWER LINE (1) CANNON AFB, NEW MEXICO

Boring No.	OFS-1	OFS-2	9805	9805	9807	9819	9823	9826	9827	9828	9829	9834	9836	9841	9842	9843
Depth (ft-bgs	0	0	11	14	11	12	14	15	17	14	16	10	10	06	07	08
Aluminum	8670	8830	4910	8240	9370	5490	8810	8810	4280	4610	5120	5180	7790	6000J	4000J	4030
Antimony	5U	5U	5.1UJ	5.2UJ	5.2UJ	5.5UJ	5.3UJ	5.2UJ	5.1UJ	5.2UJ	5.3UJ	5.1UJ	5.1J	5.1UJ	5.2UJ	4.9UJ
Arsenic	1.8J	1.9J	1.1J	1.4J	1.8J	0.95J	1.3J	1.3J	0.67J	0.7J	0.85J	1J	0.76J	1.2J	1J	1.3J
Barium	67.2	62.3	140	1200	351	856	136J	79.1J	111J	70.4J	231J	241	14.9J	442J	67.1J	334J
Beryllium	0.49J	0.44U	0.44U	0.64J	0.46U	0.47U	0.47U	0.45U	0.45U	0.45U	0.46U	0.54J	0.77J	0.56J	0.45U	0.43U
Cadmium	0.87U	0.87U	0.88U	0.91U	0.91U	0.95U	0.93U	1.1	0.89U	0.9U	0.92U	0.89U	0.89U	0.89U	0.91U	0.86U
Calcium	2220	1910	101000J	40600J	62100J	154000	121000	57700	78500	51800	157000	89800J	4900	124000J	131000J	172000J
Chromium	8.6	8.7	5.1	7.6	8.3	4.6	5.7	6.3	4	4.5	4.1	4.8	8	6.2	4.5	4.8
Cobalt	2.7J	2.7J	2J	3.9J	3.3J	1.4J	3.2J	3J	1.3J	2.5J	2.5J	3.1J	3J	3.1J	3.3J	2.5J
Copper	18.3	15.3	6.6	6.8	9.3	4J	7.2	9.2U	2.8J	4.1J	4.4J	7.7U	5.4J	7U	6.5U	7U
Iron	7860	8010	3720	6390	7240	2750	5240	5950	3940	5390	4540	4600	7960	5900J	4040J	3930J
Lead	5.7	10	3.5J	6.5J	5.8J	1.5	5.6J	4.2J	3.9J	5.3J	4.1J	4.5J	5.8	5.8	5.6	5.4
Magnesium	1390	1410	2460	4410	4420	18300	5580	3950	3830	3030	4300	4420	4080	3070	2680	2830
Manganese	150	172	63.2	128	138	24.9	64.1	80.8	43.3	91	85.7	97.7	71.4	99.2J	54.4	62.4J
Mercury	0.11U	0.11U	0.11U	0.11U	0.11U	0.12U	0.12U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U
Nickel	6.9J	6.7J	3.8J	6.9J	8.2J	4.5J	5J	5.7J	4.4J	5.8J	5.8J	7.9J	7.5J	6.3J	5.9J	5.2J
Potassium	1760	1930	1150	1890	2100	986J	2060	2080	1300	1360	1570	1710	2770	1410	1020J	866J
Selenium	0.22U	0.22U	0.22UJ	0.23J	0.23UJ	0.24UJ	2.3UJ	0.22UJ	0.22UJ	0.23UJ	0.23UJ	0.22UJ	0.22UJ	0.22UJ	0.23UJ	0.2UJ
Silver	0.87U	0.87U	0.88U	0.91U	0.91U	0.95U	0.93U	0.9U	0.89U	0.9U	0.92U	0.89U	0.89U	0.89U	0.91U	0.86U
Sodium	286U	288U	290U	384U	301U	313U	307U	297U	295U	297U	302U	295U	615J	295U	532J	452J
Thallium	0.22	0.22U	0.22UJ	0.23UJ	0.23UJ	0.24UJ	0.23UJ	0.22UJ	0.22UJ	0.23UJ	0.23UJ	0.22UJ	0.22UJ	0.22UJ	0.23UJ	0.21UJ
Vanadium	17.7	17.6	8.5J	19.5	20.5	23.6	16.3	17.6	16.2	19.7	16.4	20.5	28.3	19.5	13.5	12.6
Zinc	18.6	21.4	10.3	17.4	19.5	5.5	13.3	14.4	7.9	11.6	11.3	10.7U	16.4	13.4	9.9U	9.6

(1) Woodward-Clyde 1992.

Ft-bgs = Feet below ground surface.

J = Estimated value below reporting limit or estimated based on data quality criteria.

U = Nondetect. Value shown is the reporting limit.

TABLE A-3

BACKGROUND ELEMENTAL CONCENTRATIONS (mg/kg) IN SOILS COLLECTED AT LANDFILL NO. 2 (1) CANNON AFB, NEW MEXICO

Boring No.					8201				
Depth (ft-bgs)	0	14	18	24	28	40	52	64	74
Aluminum	11000	7290	7030	5640	6590	4820	4100	1940	1410
Antimony	6.9 U	13.1 U	12.8 U	12.9 U	6.4 U	6.3 U	6.3 U	6.2 U	6.1 U
Arsenic	6	3.1	3.6	2 J	2.1	1.8 J	1.9	1.6	1.2
Barium	98.8	99	119	130	110	34	46.4	20.9	25.3
Beryllium	0.7	0.39 J	0.45	0.43	0.17 J	0.17 J	0.21	0.21 U	0.2 U
Cadmium	0.58 U	1.1 U	1.1 U	1.1 U	0.54 U	0.53 U	0.53 U	0.51 U	0.51 U
Calcium	2970	13100 J	169000 J	120000 J	87000 J	18700	24200	5870	13500
Chromium	11.4	6	6.2	6.2	8.4	8.5	6.3	4.5	3.9
Cobalt	5.3	3.9	2.8	3.6	1.8	2	1.8	1.3	1.1
Copper	10.1	4.4 U	4.3 U	4.3 U	2.3 U	2.6 U	2.1 U	2.1 U	2 U
Iron	11000	5630	4400	3550	4080	3770	3630	2110	1820
Lead	16.1 J	6 J	4.3 J	2.6 J	2.5 J	2.6 J	2.4 J	1.9 J	1.5 J
Magnesium	1850 J	5210 J	5450 J	6250 J	9050 J	6400 J	4670 J	1580 J	892 J
Manganese	216	99.6	55.5	46.7	35.6	39.4	47.6	23.3	25.6
Mercury	0.12 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U
Nickel	9.8	6.6 J	4.2 J	4.6 J	4 J	4.2	3 J	1.5 J	1.8 J
Potassium	2140	2120	1720	1050 J	1260	1050	890	397 J	302 J
Selenium	1.2 U	2.2 U	2.1 U	1.1 U	1.1 U	1.1 U	1.1 U	0.51 U	0.51 U
Silver	1.2 U	2.2 U	2.1 U	0.93 J	1.1 U	1.1 U	1.1 U	0.51 J	1 U
Sodium	576 U	1090 U	1060 U	1080 U	537 U	267 J	526 U	513 U	508 U
Thallium	0.58 U	0.55 U	1.1 U	1.1 U	1.1 U	0.53 U	0.53 U	0.51 U	0.51 U
Vanadium	21.5	13.2	14.2	12.2	15.5	12.6	14.7	7.9	5.2
Zinc	27.5	15.2 U	11.4 U	8.8 U	11.2 U	10.5 U	8.3 U	4.8 U	4.3 U

(1) Woodward-Clyde 1993b.
Ft-bgs = Feet below ground surface
U = Not detected. Value shown is reporting limit.
J = Estimated value below reporting limit or estimated based on data quality criteria.

TABLE A-3

BACKGROUND ELEMENTAL CONCENTRATIONS (mg/kg) IN SOILS COLLECTED AT LANDFILL NO. 2 (1) CANNON AFB, NEW MEXICO

Boring No.					8202			
Depth (ft-bgs)	14	18	24	28	40	52	64	74
Aluminum	4750	7810	5500	4950	4090	3680	1460	1850
Antimony	6.3 U	6.5 U	13 U	12.8 U	6.2 U	6.3 U	6.1 U	6.1 U
Arsenic	1.3 J	1.2 J	1.3 J	1.2 J	0.74 J	0.96 J	0.83 J	1 J
Barium	87.6	132	186	133	30.7	43.8	14.5	15.6
Beryllium	0.35	0.51	0.52	0.28	0.24	0.23	0.2 U	0.17
Cadmium	0.53 U	0.54 U	1.1 U	1.1 U	0.52 U	0.53 U	0.51 U	0.51 U
Calcium	41800 J	94800 J	167000 J	124000 J	17300	27600 J	6780	1490
Chromium	4.6	7.9	5.1	15.4	7.8	6.1	4.9	4.1
Cobalt	2.9	2.4	2.2 U	2.1 U	0.98	1.8	1 U	0.85
Copper	2.9 U	2.8 U	4.3 U	4.3 U	2.1 U	2.1 U	2 U	2 U
Iron	4930	5050	3280	4080	4160	3740	2170	2770
Lead	2.3 J	3.7 J	1.9 J	1.8 J	2.5 J	2.3 J	1.1 J	1.8 J
Magnesium	2570 J	7520 J	11800 J	10300 J	3450 J	4040 J	918 J	1250 J
Manganese	84.2	59.3	29.1	39.8	44.6	49.7	22.4	31.8
Mercury	0.11 U	0.11 U	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U
Nickel	3.9	4.3	3	7.6	2.7	2.8	4.1 U	1.3
Potassium	1580	1790	926	960	1060	720	354	442
Selenium	1.1 U	1.1 U	1.1 U	1.1 U	1 U	1.1 U	1 U	0.51 U
Silver	1.1 U	1.1 U	2.2 U	2.1 U	1 U	1.1 U	1 U	1 U
Sodium	529 U	544 U	1090 U	1070 U	518 U	526 U	507 U	510 U
Thallium	0.14 J	1.1 U	1.1 U	1.1 U	1 U	1.1 U	0.51 U	0.51 U
Vanadium	11.6	14.3	12.2	11.7	9.9	14.7	5.4	7.3
Zinc	11.4 U	12.6 U	6.9 U	7.7 U	7.9 U	6.8 U	4.3 U	5.1 U

(1) Woodward-Clyde 1993b.
Ft-bgs = Feet below ground surface
U = Not detected. Value shown is reporting limit.
J = Estimated value below reporting limit or estimated based on data quality criteria.

TABLE A-4

BACKGROUND ELEMENTAL CONCENTRATIONS (mg/kg) IN SOIL SAMPLES COLLECTED FROM PERIMETER AREAS [1] CANNON AFB, NEW MEXICO

Sample No. Depth (Ft-bgs)	BKGD-1 0.5	BKGD-2 0.5	BKGD-3 0.5	BKGD-4 0.5
Arsenic	<17	<15.8	28	17
Barium	52.6	350.9	90.3	44.8
Cadmium	3.1	4.2	3.6	2.7
Chromium	11.5	11.6	12.9	9
Lead	19.1	29.8	46	28
Mercury	<0.1	<0.1	<0.1	<0.1
Selenium	<48.1	58.0	123.9	50.1
Silver	<2	<2	<2	<2

(1) Walk, Haydel & Associates 1990
Ft-bgs Feet below ground surface

TABLE A-5

SUMMARY OF BACKGROUND ELEMENTAL CONCENTRATIONS IN SOIL (mg/kg) [1] CANNON AFB, NEW MEXICO

Element	Mean ($\bar{x}$)	Standard Deviation (SD)	95% Tolerance Limits ($\bar{x}$)±2SD	Reported Level in Clovis, NM Region[2]
Aluminum	5,700	2,420	860 - 10,540	50,000
Antimony	*	*	*	<1
Arsenic	3.5	6.0	0 - 15.5	6.5
Barium	166	238	0 - 642	500
Beryllium	0.41	0.16	0.09 - 0.73	1 - 2
Cadmium	*	*	*	---
Calcium	69,200	58,600	0 - 186,400	7,900 - 18,000
Chromium	6.98	2.78	1.42 - 12.5	30
Cobalt	2.5	1.0	0.5 - 4.5	3 - 7
Copper	*	*	*	20
Iron	4,780	1,970	840 - 8,720	100 - 15,000
Lead	7.12	9.35	0 - 25.8	15
Magnesium	4,650	3,570	0 - 11,790	2,000 - 5,000
Manganese	72.0	46.0	0 - 164	500
Mercury	*	*	*	0.032 - 0.082
Nickel	5.0	2.0	1.0 - 9.0	15
Potassium	1,360	606	148 - 2,572	16,000
Selenium	*	*	*	0.15 - 0.30
Silver	*	*	*	---
Sodium	514	264	0 - 1,042	7,000
Thallium	*	*	*	---
Vanadium	14.9	5.20	4.50 - 25.3	30 - 70
Zinc	11.3	5.29	0.72 - 21.9	45

(1) Compiled from data collected by W-C for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel & Associates for the IRP (Walk, Haydel & Associates 1990).

(2) USGS 1984

* Data insufficient to calculate mean or upper tolerance limit due to a large number of nondetects.

TABLE A-6

TYPICAL PAH CONCENTRATIONS IN SOILS (mg/kg)

Chemical	Soil Concentration	Location	Reference
Acenaphthene	0.002	Rural soils	ATSDR 1990
	0.006	Agricultural soils	ATSDR 1990
Acenaphthylene	0.005	Agricultural soils	ATSDR 1990
Anthracene	0.011 - 0.013	Agricultural soils	ATSDR 1990
Benz (a) anthracene	0.005 - 0.02	Rural soils	ATSDR 1990
	0.056 - 0.11	Agricultural soils	ATSDR 1990
	0.169 - 59	Urban soils	ATSDR 1990
Benzo (a) pyrene	0.004	Rural areas	Barnett 1976
	0.4	Industrial areas	
	up to 1	Non-polluted areas	Edwards 1983
	> 100	Near known sources	
	650	Near coal-tar pitch disposal site, Germany	Lee and Grant 1981
	0.0004	Near recreation area, USSR	Harrison et al. 1975
	0.0015 - 0.004	Forest soils	
	0.002 - 1.3	Rural soils	ATSDR 1990
	0.0046 - 0.9	Agricultural soils	ATSDR 1990
	0.165 - 0.22	Urban soils	ATSDR 1990
Benzo (b) fluoranthene	0.02 - 0.03	Rural soils	ATSDR 1990
	0.058 - 0.22	Agricultural soils	ATSDR 1990
	15 - 62	Urban soils	ATSDR 1990
Benzo (e) pyrene	0.053 - 0.13	Agricultural soils	ATSDR 1990
	0.06 - 14	Urban soils	ATSDR 1990
Benzo (g,h,i) perylene	0.01 - 0.07	Rural soils	ATSDR 1990
	0.066	Agricultural soils	ATSDR 1990
	0.9 - 47	Urban soils	ATSDR 1990
Benzo (k) fluoranthene	0.01 - 0.11	Rural soils	ATSDR 1990
	0.058 - 0.25	Agricultural soils	ATSDR 1990
	0.3 - 26	Urban soils	ATSDR 1990
Chrysene	0.0383	Rural soils	ATSDR 1990
	0.078 - 0.12	Agricultural soils	ATSDR 1990
	0.251 - 0.64	Urban soils	ATSDR 1990
Fluoranthene	0.06	0 - 2 cm depth, prior to burn at a slash burn site, OR	Sullivan and Mix 1985
	0.36	0 - 2 cm depth, 103 days after burn at a slash burn site, OR	
	0.08	0 - 2 cm depth, 365 days after burn at a slash burn site, OR	
	0.03	2 - 5 cm depth, 105 days after burn at a slash burn site, OR	
	Not detected	2 -5 cm depth, 365 days after burn at a slash burn site, OR	

TABLE A-6

TYPICAL PAH CONCENTRATIONS IN SOILS
(mg/kg)

Chemical	Soil Concentration	Location	Reference
	0.0003 - 0.04	Rural soils	ATSDR 1990
	0.12 - 0.21	Agricultural soils	ATSDR 1990
	0.2 - 166	Urban soils	ATSDR 1990
Fluorene	0.0097	Agricultural soils	ATSDR 1990
Indeno (1,2,3-cd) pyrene	0.01 - 0.015	Rural soils	ATSDR 1990
	0.063 - 0.1	Agricultural soils	ATSDR 1990
	8 - 61	Urban soils	ATSDR 1990
Phenanthrene	0.05	0 - 2 cm depth, prior to burn at a slash burn site, OR	Sullivan and Mix 1985
	0.98	0 - 2 cm depth, 103 days after burn at a slash burn site, OR	
	Not detected	0 - 2 cm depth, 365 days after burn at a slash burn site, OR	
	0.13	2 - 5 cm depth, 105 days after burn at a slash burn site, OR	
	Not detected	2 -5 cm depth, 365 days after burn at a slash burn site, OR	
	0.03	Rural soils	ATSDR 1990
	0.048 - 0.14	Agricultural soils	ATSDR 1990
Pyrene	0.001 - 0.0197	Rural soils	ATSDR 1990
	0.099 - 0.15	Agricultural soils	ATSDR 1990
	0.145 - 147	Urban soils	ATSDR 1990

APPENDIX B
ENVIRONMENTAL FATE AND TRANSPORT AND PHYSICAL AND CHEMICAL PROPERTIES OF DETECTED COMPOUNDS

APPENDIX B
ENVIRONMENTAL FATE AND TRANSPORT AND PHYSICAL AND CHEMICAL PROPERTIES OF DETECTED COMPOUNDS

B.1 FATE AND TRANSPORT OF CHEMICALS IN THE ENVIRONMENT

Chemicals of concern released to the environment may be adsorbed to soils, leached by the infiltration and percolation of water, dissolved in surface water, biodegraded, volatilized when exposed to the atmosphere, or transported by wind. The mobility of chemicals of concern in soil, groundwater, and air pathways is evaluated for each SWMU. At the SWMUs where it was considered appropriate, fate and transport of the chemicals of concern were modeled to groundwater and in air.

Environmental fate of chemicals in the identified pathways of release is influenced by each chemical's physicochemical properties. The environmental fate of the contaminants of concern is considered to be primarily influenced by their chemical-specific properties which affect water solubility, soil adsorption, volatilization, and biodegradation. The physicochemical properties of the chemicals of concern at Cannon AFB Appendix III SWMUs are listed in Table B-1.

Water Solubility

Chemicals that are soluble can be dissolved in infiltrating water and could potentially impact groundwater. Volatile Organic Compounds (VOCs) are generally highly soluble in water and are easily leached from sources into surface water or groundwater. The octanol/water partition coefficient, K_{ow}, measures the tendency of organic molecules to dissolve into aqueous solutions and is a general indication of the solubility of a chemical in water. K_{ow} is the ratio of the solute concentration in the n-Octanol phase to the solute concentration in the water phase at equilibrium, or:

$$K_{ow} = \frac{Solute\ concentration\ in\ n\text{-}octanol}{Solute\ concentration\ in\ water}$$

Typically, the higher the K_{ow} is for a chemical, the lower the water solubility will tend to be.

Semivolatiles (SVOCs), including polycylic aromatic hydrocarbons (PAHs), pesticides, and PCBs, are generally less soluble in water than VOCs (with the exception of phenol). SVOCs are usually not readily transported by surface water or groundwater because of their lower solubilities.

Total petroleum hydrocarbons (TPH) have a wide range of values for the physicochemical properties because of the wide range of hydrocarbons detected in a TPH analysis.

Metals are relatively insoluble in water of near-neutral pH (Lide 1990); but, without knowing Eh-pH conditions in soil or possible species in solution, it is generally difficult to characterize the solubility of metals in the environment.

Soil Adsorption

The organic carbon partition coefficient, K_{oc}, is a measure of the tendency of organic molecules to be adsorbed into the organic component of soil. K_{oc} is ratio of the amount of chemical adsorbed per unit weight of organic carbon in the soil to the concentration of the chemical in solution at equilibrium, or:

$$K_{oc} = \frac{\mu g\ adsorbed/g\ organic\ carbon}{\mu g/mL\ solution}$$

The soil/water partition coefficient, K_d, measures the tendency of chemicals to adsorb to soil. For organic chemicals, K_d, is the product of K_{oc} x total organic carbon (TOC) content in soil. For inorganics, K_d has been estimated from field experiments (USDOE 1991). K_{oc} values may range from 1 to 10,000,000 milliliters per gram (ml/g) or greater. Compounds with high K_{oc} and K_d values adsorb to soil more readily than compounds with low K_{oc} values. The high

water solubilities and low K_{oc} (less than 1,000 ml/g) values for most VOCs indicate that they do not readily adsorb to soil. Total organic carbon content of soils enhances soil adsorption potential and decreases mobility of organic chemicals.

The mobility of metals in soil and/or groundwater is a complex issue and is generally difficult to assess based on typically collected site data. Typically, metal complexes in soil form reaction products that become incorporated into soil minerals, precipitate as oxides or hydroxides, or form coatings on minerals (Oak Ridge National Laboratory 1989). The soil/water partition coefficient, K_d, is typically used to estimate the adsorption potential of metals. K_d values for metals range from 3 to over 1,000 ml/g (USDOE 1991). These values indicate transport of metals in soil and groundwater would be insignificant compared to VOCs. Although metals may not be very mobile, the soil particles they adsorb to can be transported by fugitive dust emissions.

High K_{oc} and K_d values reported for most SVOCs (with the exception of phenol), PAHs, pesticides, and PCBs indicate that they readily adsorb to soil. TPH have varying values for K_{oc} (65 to 5,500,000 ml/g). Thus, some TPH fractions are slightly mobile and other fractions adsorb to soil.

Volatilization

Volatility of a compound is indicated by the vapor pressure and Henry's Law Constant. VOCs have high vapor pressures and Henry's Law Constants; therefore, volatilization can be a significant fate process for VOCs in exposed soils. Chemicals with a Henry's Law Constant greater than 10^{-3} atmospheres-cubic meter per mole (atm-m^3/mole) generally volatilize rapidly (Lyman et al., 1982). Volatilization is usually not an important fate process for SVOCs, pesticides, and PCBs because of their low vapor pressures. Volatilization has little significance for most metals because they generally do not volatilize at normal temperatures.

Vapor pressures for TPH vary from 1.12 to 675 mm Hg. The Henry's Law Constant for TPH ranges from 5.9×10^{-5} to 10 atm-m^3/mole, indicating that some components are volatile.

Biodegradation

Biodegradation is the process by which chemicals are broken down by microorganisms. Biodegradation can be a significant fate process if there are sufficient microbes in the soil/groundwater system to break down a specific compound, and if conditions are favorable for growth of the microbial community. Biodegradation rates are typically measured in half-lives. Half-lives are defined as the time required to reduce a chemical concentration by one half. Biodegradation is commonly associated with organic chemicals and not metals. Although microorganisms can play a significant part in controlling reaction rates for metals, this process is less understood than organic biodegradation (Howard 1990).

Biodegradation half-life estimates for each chemical can vary greatly as a result of the differing field or laboratory conditions under which the half-lives were measured; therefore, they are commonly reported as half-life ranges. VOCs are generally more susceptible to biodegradation than the other organic chemicals. Estimated VOC half-lives range from a few days to 4.5 years (ORNL 1989; Howard 1990; Howard et al. 1991). Half-lives for most SVOCs (including PAHs) are not well understood as yet, but some of the heavier compounds are estimated to have half-lives as long as 10 years (Oak Ridge National Laboratory 1989; Howard 1990). Pesticides and PCBs are reported to have half-lives up to 30 years (ORNL 1989; Howard 1990).

B.2 VADOSE ZONE FATE AND TRANSPORT MODELING

Several conservative assumptions have been built into the modeling approach. Contaminants at areas of concern are assumed to be homogeneously distributed throughout the thickness of the overburden soils. Contaminants are also assumed to be partitioned from soils to infiltrating water and that partitioning can be described by an equilibrium, linear isotherm model. Partitioned contaminants are then transported downward with infiltrating water through vadose zone. During downward migration through the vadose zone, contaminants are subject to first-order degradation. Once contaminants reach groundwater, they are mixed and diluted throughout the entire thickness of the aquifer. Contaminants in the aquifer are then transported in the downgradient direction of groundwater flow.

MATHEMATICAL MODELING APPROACH

Several components were included as part of the screening model approach for the areas of concern. These included:

- A water balance model for estimating infiltration rates from the leachate generating overburden soil layer
- A soil-partitioning model for estimating contaminant concentrations in infiltrating water that drains from the overburden soil layer
- A transit time and degradation model for evaluating contaminant degradation during transport through the vadose zone to groundwater
- An aquifer dilution model for estimating resulting contaminant concentrations in groundwater accounting for dilution in the underlying aquifer

Water Balance Model

Infiltration Through Soil

The Hydrologic Evaluation of Landfill Performance (HELP) model was used to estimate the rate of infiltration that drains from the overburden soil layer, or the groundwater recharge rate. This model is described by Schroeder et al. (1988). The quasi-two-dimensional deterministic water-budget model was adapted from the HSSWDS (Hydrologic Simulation Model for Estimating Percolation at Solid Waste Disposal Sites) model of the U.S. Environmental Protection Agency and the CREAMS (Chemical Runoff and Erosion from Agricultural Management Systems) and SWRRB (Simulator for Water Resources in Rural Basins) models of the U.S. Agricultural Research Service. From daily climatological data, the HELP model computes daily runoff, evapotranspiration, percolation, and lateral drainage for the landfill (cap, waste cell, leachate collection system and liner). Results are expressed as daily, monthly, annual, and long-term average water budgets.

The infiltration model assumed that the soil was a sandy clay loam (based on soil boring logs). The porosity (n) was assumed to be 0.4, the field capacity was assumed to be 0.25, the wilting point was assumed to be 0.15, and the saturated hydraulic conductivity was assumed to be 1×10^{-4} cm/sec. These values were taken from Rawls and Brakensick (1989). A drainage layer thickness of 5 feet was used to estimate the infiltration rate with the HELP model compared to a depth to groundwater of approximately 260 feet. HELP model estimated infiltration rates decrease significantly with increasing drainage layer thickness. With the 5-foot thickness, the estimated infiltration rates are conservative. In addition, it was assumed that no runoff from the site occurred and that there was no plant cover. Precipitation was simulated using the model's synthetic rainfall data for Roswell, New Mexico. The output of the model estimated infiltration of 0.6 in/year (0.015 m/year). The model output is provided in Table B-3.

Soil-Partitioning Model

A soil-partitioning model developed for use at the Idaho National Engineering Laboratory (USDOE 1991) was used to estimate the concentration of partitioned contaminants in water that drains from contaminated soils overlying the basalt aquifer. The soil-partitioning model utilizes a source-term modeling approach in conjunction with a mass balance approach. The source term is modeled as a first order leaching process, which takes into account decay and sorption. The contaminant is assumed to be homogeneously mixed in a finite volume in the overburden soil layer. A steady state infiltration rate is also assumed. The leaching process is described mathematically by a first-order, equilibrium leach-rate constant. The differential equation that describes the mass balance of contaminant in the contaminated volume is given by

$$\frac{dQ}{dt} = -\lambda_L Q \qquad \textbf{(3)}$$

where λ_L is the leach rate constant (T^{-1}) and Q is the mass in the contaminated volume (M), and t is time (T). The solution to this differential equation is

$$Q(t) = Q_o e^{-\lambda_L t} \tag{4}$$

where Q_o is the initial mass in the contaminated volume (M) and $Q(t)$ is the mass of chemical in soil (M) at time t. The initial mass in the contaminated volume (Q_o) is given by

$$Q_o = C_o \, L \, W \, T \tag{5}$$

where L, W, and T are the length, width, and thickness (L) of the contaminated soil volume and C_o is the initial concentration (M/L^3).

The leach rate constant (λ_L) is given by

$$\lambda_L = \frac{I}{\theta_c R_d T} \tag{6}$$

where I is the net water infiltration rate (L/T), θ_c is the volumetric moisture content in the contaminated zone (L^3/L^3), and R_d is the retardation factor (-).

The retardation factor is given by

$$R_d = 1 + \frac{K_d \, \rho}{\theta_c} \tag{7}$$

where K_d is the adsorption distribution coefficient (L^3/M) and ρ is the bulk density of dry soil in the contaminated zone (M/L^3). For organic chemicals, the adsorption distribution coefficient is given by

$$K_d = K_{oc} \, foc \tag{8}$$

where K_{oc} is the soil-water organic carbon partition coefficient (M/L^3) and foc is the fraction of organic carbon in the soils (-). The contaminant flux out the bottom of the contaminated soil volume, q_c, (M/T) is then given by

$$q_c = \lambda_L Q(t) \tag{9}$$

The contaminant concentration in water infiltrating through contaminated soils is estimated as

$$C_l = \frac{q_c}{IWL} \tag{10}$$

where C_l is the contaminant concentration in infiltrating water that partitions contaminants and drains from overburden soils (M/L^3).

The input parameters and assumptions used in the soil-partitioning model were assumed from typical values for sandy clay loam (based on soil boring logs). The volumetric water content of the soil (VWC) is assumed to be 0.15, which is equivalent to a typical wilting point for these soils. The fraction of organic carbon (*foc*) in the subsurface soils was assumed to be 0.003, and the bulk density of the soils was assumed to be 1.6 g/cm^3. K_{oc} values used to estimate retardation factors (equation 15) were the lowest values cited by Montgomery and Welkom (1990).

Transit Time Model

The transit time and degradation model was used for all sites to estimate transit times from the soil or leachate-generating layer through unsaturated soils to the top of the regional groundwater table. Contaminant degradation was then accounted for and the concentrations at the time the infiltrating pulse of contaminated water reached groundwater were estimated.

The partial differential equation that describes transient, nondispersive, and reactive solute movement in the vertical or *z*-direction through an unsaturated porous medium is

$$\frac{\partial(C\theta)}{\partial t} = -\frac{1}{R_d}\frac{\partial(IC)}{\partial z} \tag{11}$$

where R_d is the contaminant retardation factor (-), C is the solute concentration, I is the infiltration or groundwater recharge rate (L/T), and θ is the volumetric water content (-) (Russo and Bresler 1981).

Equation (11) can be expanded with the continuity equation for unsaturated materials $(\partial\theta/\partial t)=-(\partial I/\partial z)$ to obtain

The propagation rate for a given solute concentration C is obtained from equation (12) as

$$\theta(z,t)\ \frac{\partial C}{\partial t} = -\ \frac{I(z,t)}{R_d}\ \frac{\partial C}{\partial z} \tag{12}$$

$$\frac{\partial z}{\partial t} = -\ \frac{1}{R_d}\ \frac{I(z,t)}{\theta(z,t)} \tag{13}$$

For steady-state infiltration, $\partial z/\partial t$ is the constant advective solute tracer velocity, u. If I and θ are relatively constant throughout the vadose zone and independent of time and position, equation (13) can be restated as

$$u = -\frac{1}{R_d}\ \frac{I}{\theta} \tag{14}$$

Equation (14) can be used to yield the expression for the vertical advective transit time (TOT) through an unsaturated protective layer of thickness H of

$$TOT = \frac{H\ \theta}{I}\ R_d \tag{15}$$

(Enfield et al. 1982; Wosten et al. 1986; Rood 1992). Equation (15) is most appropriate for predicting transport through thick unsaturated layers due to the fact that θ at greater depths remains relatively constant, even if precipitation may vary (Enfield et al. 1982). When infiltration rates are low, as would be expected in arid regions, θ can be approximated as the specific retention of the vadose zone materials (Bear 1979). For flow through an anisotropic, layered medium with a constant infiltration rate, equation (15) can be written as

$$TOT = \frac{1}{I}\ \sum_{i=1}^{n} h_i \theta_i R_{d_i} \tag{16}$$

where n is the number of layers which are denoted by the subscript i. Equations (15) and (16) describe reactive, nondispersive transport of a solute slug or pulse under steady-state conditions.

For this application, H for equation 15 was assumed to be 76.8 m (252 feet). This thickness is approximately the depth to groundwater (260 feet) minus the typical thickness of the contaminated soil layer (8 feet).

Degradation Model

The persistence of synthetic organic compounds (SOCs) in soil and groundwater is dependant upon chemical water solubilities (Zoeteman et al. 1981) and degradation rates. Degradation rates, in turn, are dependent upon factors including numbers and types of microorganisms present in the transport media, temperature, moisture, and the availability of oxygen (Zoeteman et al. 1981; Dragun 1988). Degradation rates in unsaturated materials can generally be expected to be greater than those in saturated materials due to the presence of oxygen (Dragun 1988). First-order, single-species degradation in groundwater can be described by

$$\frac{dC}{dt} = -\lambda_d C \tag{17}$$

where C is the chemical concentration (M/L^3), t is time (T), and λ_d is a degradation rate constant (T^{-1}). Equation (15) can be solved using the appropriate initial condition to yield

$$C = C_o \, e^{-(\lambda_d t)} \tag{18}$$

where C_o is the initial concentration (M/L^3). If the degradation half-life, $t_{1/2}$, of the chemical is known, the degradation rate constant can be calculated as

$$\lambda_d = \frac{0.693}{t_{1/2}} \tag{19}$$

Equation (18) can be used to calculate the leachate concentration at the time when it enters groundwater, $C_l(2)$, relative to the concentration at the time of release, $C_l(1)$, as

$$C_l(2) = C_l(1) \, e^{-(\lambda_d \, TOT)} \tag{20}$$

(Rood 1992).

Aquifer Dilution Model

An aquifer dilution model was used to estimate contaminant concentrations in groundwater resulting from leaching from the overburden soil layer. The concentration of a contaminant in the groundwater was calculated as

$$C_w(2) = \frac{C_l(2)\ Q_l}{Q_a + Q_l} \qquad \textbf{(21)}$$

where $C_w(2)$ is the concentration in groundwater accounting for degradation (M/L^3), $C_l(2)$ is the concentration in infiltrating water entering groundwater (M/L^3), Q_a is the groundwater flow through cross-sectional area (L^3/T), and Q_l is the flow rate of contaminated infiltrating water entering groundwater beneath contaminated zone (L^3/T).

The groundwater flow through the cross-sectional areas is estimated from:

$$Q_a = K * i * b * w$$

where the hydraulic conductivity (K) of the aquifer was assumed to be 2×10^{-7} cm/sec, which is a conservative estimate for production aquifers such as the Ogallala formation that underlies Cannon AFB. The hydraulic gradient (i) was estimated to be 0.001 m/m across Cannon AFB, based on measured water table elevations. The aquifer thickness (b) is the assumed thickness for mixing in the upper portion of the aquifer, and w is the width of the contaminated area of the SWMU.

B.3 AIR MODELING APPROACH

Air concentrations of volatile organic compounds (VOCs) released from soil by volatilization and of particulate matter (dust) less than 10 microns in diameter (PM_{10}) were estimated using screening-level methods recommended by EPA in Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual, Part B, Development of Risk-Based Preliminary Remediation Goals (EPA 1991) for estimating preliminary risk-based soil cleanup goals. EPA acknowledges that generally for undisturbed sites with vegetative cover, air pathways are relatively minor contributors to risk (EPA 1991 RAGS B). Default values for

some physical parameters (such as surface area, wind speed, and soil density) are used in the modeling approach. The default values provide a sufficiently conservative estimate of air concentrations to be used for screening purposes. If the screening-level modeling shows that the inhalation pathway could be a significant contributor to risk, further evaluation of site-specific conditions may be warranted. However, this was not the case at the SWMUs evaluated in this RFI.

Reasonable maximum exposure (RME) air concentrations at each site were estimated using the RME concentrations of chemicals of concern in soils. Surface soil sample results were used to estimate air concentrations for occupational exposures and surface and subsurface soil sample results were used to estimate air concentrations for construction worker exposures. Calculations of air concentrations of VOCs and particulate-bound chemicals of concern are given in spreadsheet form in each SWMU section in the report. The following sections of this Appendix describe the modeling approach and default values used.

B.3.1 VOLATILIZATION OF VOCS FROM SOILS

To estimate volatile emissions from soil, a volatilization factor (*VF*) is used to define the relationship between the concentration of contaminants in soil and the concentration of volatilized contaminants in air. The model assumes that the soil contaminant concentration is at or below saturation. Above saturation, pure liquid-phase contaminant is present in the soil, and the model is not appropriate. The model further assumes that the soil is homogeneous from the soil surface to the depth of concern and that the contaminated material is not covered by contaminant-free soil material. For the purpose of calculating VF, depth of concern is defined as the depth at which a near impenetrable layer or the permanent groundwater level is reached. Volatilization is an important pathway only for chemicals with a molecular weight of less than 200 g/mole and a Henry's Law constant of 1×10^{-5} or greater (EPA 1991). The *VF* is calculated using the following equation:

$$VF = \frac{LS * V * DH}{A} * \frac{\left(\pi * \frac{D_{ei} * E}{E + (\rho_s)(1-E)/K_{as}} * T\right)^{0.5}}{2 * D_{ei} * E * K_{as} * 10^{-3} kg/g}$$

where:		Default Value
VF	volatilization factor (m^3/kg)	—
LS	length of side of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (cm^2)	20,250,000 cm^2 (0.5 acre)
D_{ei}	effective diffusivity (cm^2/s)	$D_i * E^{0.33}$
E	true soil porosity (unitless)	0.35
K_{as}	soil/air partition coefficient (g soil/cm^3 air)	$(H/K_d)*41$ (where 41 is a conversion factor)
p_s	true soil density (g/cm^3)	2.65 g/cm^3
T	exposure interval (s)	7.9 x 10^8 s (25 years)
D_i	molecular diffusivity (cm^2/s)	chemical-specific
H	Henry's Law constant (atm-m^3/mol)	chemical-specific
K_d	soil-water partition coefficient (cm^3/g)	chemical-specific
K_{oc}	organic carbon partition coefficient (cm^3/g)	chemical-specific
OC	organic carbon content of soil (fraction) (used to estimate K_d)	0.02

The default values listed above assume a residential lot of one-half acre; reasonable estimates of annual average wind speed and soil characteristics, and a mixing height of 2 m (6 feet). The volatile organic emissions from soil are assumed to disperse in a volume determined by the surface area (45 m^2) times the mixing height (2 m). RME air concentrations of airborne volatile compounds are calculated by multiplying the VF by the RME soil concentration of each chemical of concern. Air concentrations of VOCs are probably overpredicted by this approach because it is assumed that VOCs are in the surface soil layer, that the entire area is contaminated by RME concentrations of VOCs, and that concentrations of VOCs remain constant in soils indefinitely.

B.3.2 PARTICULATE EMISSIONS FROM SOILS

Exposures to semivolatile chemicals and metals of concern may occur through inhalation of windborne PM_{10} emissions to which the chemicals may adhere. The equation used to estimate

long-term (annual) average particulate emissions from wind erosion is from Cowherd (1985) as cited in EPA 1991. The equation, which calculates a particle emission factor (*PEF*), is expressed as:

$$PEF\ (m^3/kg) = \frac{LS\ x\ V\ x\ DH\ x\ 3600\ s/hr}{A}\ x\ \frac{1000\ g/kg}{0.036\ x\ (1-G)\ x\ \left(\frac{U_m}{U_i}\right)^3\ x\ F(x)}$$

where:		Default Value
PEF	particulate emission factor (m^3/kg)	4.63 x 10^9 m^3/kg
LS	width of contaminated area (m)	45 m
V	wind speed in mixing zone (m/s)	2.25 m/s
DH	diffusion height (m)	2 m
A	area of contamination (cm^2)	2025 m^2 (0.5 acre)
0.036	respirable fraction (g/m^2-hr)	0.036 g/m^2-h
G	fraction of vegetative cover	0
U_m	mean annual wind speed	4.5 m/sec
U_i	equivalent threshold value of wind speed at 10 m	12.8 m/sec
F(x)	function dependent on $\frac{U_m}{U_i}$ (0.0497 determined using Cowherd 1985)	

The particulate emission factor (*PEF*) described in the equation relates the contaminant concentration in soil with the concentration of respirable particles (PM_{10}) in the air due to fugitive dust emissions from surface contamination sites. This relationship is derived by Cowherd (1985) for a rapid assessment procedure applicable to a typical hazardous waste site where the surface contamination provides a relatively continuous and constant potential for emission over an extended period of time (e.g., years). The particulate emissions from contaminated sites are due to wind erosion and therefore depend on the erodibility of the surface material. The equation presented above is representative of a surface with "unlimited erosion potential," which is characterized by bare surfaces of finely divided material such as sandy agricultural soil with a large number ("unlimited reservoir") of erodible particles. Such surfaces erode at low wind speeds. This model was selected by EPA because it represents a conservative estimate for intake of particulates.

RME air concentrations of particulate-bound semivolatiles and metals are calculated by multiplying the *PEF* by the RME soil concentration of each chemical of concern. The air concentrations calculated using this equation probably overpredict actual air concentrations at SWMUs because the equation assumes that there is no vegetative cover or pavement at the SWMU, that contaminants are in the surface soil layer, and that contaminant concentrations are constant for the exposure duration.

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TABLE B-1

PHYSICAL AND CHEMICAL PROPERTIES OF CHEMICALS OF CONCERN

Chemical	Molecular Formula	Molecular Weight (g/mole)	Water Solubility (mg/L)	Log K_{ow}	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m^3/mole)	K_{oc} (mL/g)	Estimated K_d (mL/g)
VOCs								
Benzene	C_6H_6	78	1,750[(A)]	2.11[(A)]	95.2[(A)]	5.59×10^{-3}[(A)]	83[(A)]	0.83
2-Butanone (MEK)[1]	C_4H_8O	72	268,000[(A)]	0.26[(A)]	8.85[(A)]	2.84×10^{-5}[(A)]	4.5[(A)]	0.045
Carbon disulfide	CS_2	76	2,940[(A)]	2.00[(A)]	360[(A)]	1.23×10^{-2}[(A)]	54[(A)]	0.54
Chloromethane	CH_3Cl	50	6,500[(A)]	0.95[(A)]	4,310[(A)]	4.40×10^{-2}[(A)]	35[(A)]	0.35
1,2-Dichloroethane	$C_2H_4Cl_2$	99	5,500[(A)]	1.79[(A)]	182[(A)]	4.31×10^{-7}[(A)]	30[(A)]	0.30
1,2-Dichloropropane	$C_3H_7Cl_2$	113	2,700[(A)]	2.00[(A)]	42[(A)]	2.31×10^{-3}[(A)]	51[(A)]	0.51
Ethylbenzene	C_8H_{10}	106	152[(A)]	3.15[(A)]	7.0[(A)]	6.43×10^{-3}[(A)]	1,100[(A)]	11
Tetrachloroethene	C_2Cl_4	166	150[(A)]	2.60[(A)]	17.8[(A)]	2.59×10^{-2}[(A)]	364[(A)]	3.64
Toluene	C_7H_8	92	535[(A)]	2.73[(A)]	28.1[(A)]	6.37×10^{-3}[(A)]	300[(A)]	3.0
Xylenes (Total)	C_8H_{10}	106	198[(A)]	3.26[(A)]	10.0[(A)]	7.04×10^{-3}[(A)]	240[(A)]	2.4
Semi-VOCs								
Acenaphthene	$C_{12}H_{10}$	154	3.42[(A)]	4.00[(A)]	1.55[(A)]	9.20×10^{-5}[(A)]	4,600[(A)]	46
Anthracene	$C_{14}H_{10}$	178	4.50×10^{-2}[(A)]	4.45[(A)]	1.95×10^{-4}[(A)]	1.02×10^{-3}[(A)]	14,000[(A)]	140
Benzo(a)anthracene	$C_{18}H_{12}$	228	5.70×10^{-3}[(A)]	5.60[(A)]	2.20×10^{-8}[(A)]	1.16×10^{-6}[(A)]	1,380,000[(A)]	13,800
Benzo(b)fluoranthene	$C_{20}H_{12}$	252	1.40×10^{-2}[(A)]	6.06[(A)]	5.00×10^{-7}[(A)]	1.19×10^{-5}[(A)]	550,000[(A)]	5,500
Benzo(a)pyrene	$C_{20}H_{12}$	252	1.20×10^{-3}[(A)]	6.06[(A)]	5.60×10^{-9}[(A)]	1.55×10^{-6}[(A)]	5,500,000[(A)]	55,000
Benzo(g,h,i)perylene	$C_{22}H_{12}$	276	7.00×10^{-4}[(A)]	6.51[(A)]	1.03×10^{-10}[(A)]	5.34×10^{-8}[(A)]	1,600,000[(A)]	1.6×10^4
Bis(2-ethylhexyl)phthalate[(1)]	$C_{24}H_{38}O_4$	391	4.00×10^{-1}[(B)]	9.61[(B)]	2.00×10^{-7}[(B)]	3.00×10^{-7}[(B)]	2×10^9[(B)]	2×10^7
Butylbenzylphthalate	$C_{19}H_{20}O_4$	312	2.90[(B)]	4.77[(B)]	8.60×10^{-6}[(B)]	1.20×10^{-6}[(B)]	28,400[(B)]	284
Carbazole	$C_{12}H_9N$	167	0(J)	NA	NA	NA	5,010(I)	50
Chrysene	$C_{18}H_{12}$	228	1.80×10^{-3}[(A)]	5.61[(A)]	6.30×10^{-9}[(A)]	1.05×10^{-6}[(A)]	200,000[(A)]	2,000

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Dibenzo(a,h)anthracene	$C_{22}H_{14}$	278	5.00×10^{-4} (A)	6.80 (A)	1.00×10^{-10} (A)	7.33×10^{-8} (A)	3,300,000 (A)	33,000
Dibenzofuran	$C_{12}H_8O$	168	10.0 (H)	4.17 (H)	NA (H)	ID (H)	8,100 (H)	81
Di-n-butylphthalate	$C_{16}H_{22}O_4$	278	1.30×10^{1} (A)	5.60 (A)	1.00×10^{-5} (A)	2.82×10^{-7} (A)	170,000 (A)	1,700
Fluoranthene	$C_{16}H_{10}$	202	0.206 (A)	4.90 (A)	5.00×10^{-6} (A)	6.46×10^{-6} (A)	38,000 (A)	380
Fluorene	$C_{13}H_{10}$	116	1.69 (A)	4.20 (A)	7.10×10^{-4} (A)	6.42×10^{-5} (A)	7,300 (A)	73
Indeno(1,2,3-c,d)pyrene	$C_{22}H_{12}$	276	5.30×10^{-4} (A)	6.50 (A)	1.00×10^{-10} (A)	6.86×10^{-8} (A)	1,600,000 (A)	16,000
Isophorone	$C_9H_{14}O$	138	12,000 (H)	1.70 (H)	0.38 (H)	5.8×10^{-6} (H)	31 (H)	0.31
2-Methylnaphthalene	$CH_3C_{10}H_7$	142	24.6 (H)	4.11 (H)	NA (H)	ID (H)	8,500 (H)	85
Naphthalene	$C_{10}H_8$	128	31.7 (B)	3.29 (B)	8.7×10^{-2} (B)	4.6×10^{-4} (B)	940 (B)	9.4
Pentachlorophenol[1]	C_6HCl_5O	266	14.0 (A)	5 (A)	1.10×10^{-4} (A)	2.75×10^{-6} (A)	53,000 (A)	530
Phenanthrene	$C_{14}H_{10}$	178	1.0 (A)	4.46 (A)	6.80×10^{-4} (A)	1.59×10^{-4} (A)	14,000 (A)	140
Pyrene	$C_{16}H_{10}$	202	1.32×10^{-1} (A)	4.88 (A)	2.50×10^{-6} (A)	5.04×10^{-6} (A)	38,000 (A)	380
Pesticides								
α-Chlordane	$C_{10}H_6Cl_8$	410	5.6×10^{-1} (A)	3.32 (A)	1×10^{-5} (A)	9.63×10^{-6} (A)	140,000 (A)	1,400
γ-Chlordane	$C_{10}H_6Cl_8$	410	1.85 (B)	3.32 (A)	1×10^{-5} (A)	9.36×10^{-6} (A)	140,000 (A)	1,400
4,4'-DDT	$C_{14}H_9Cl_5$	354.5	3.1×10^{-3} to 3.4×10^{-3} (D)	6.36 (D)	1.5×10^{-7} (D)	2.8×10^{-5} (D)	3.02×10^{-5} (D)	3,020
4,4'-DDE	$C_{14}H_8Cl_4$	318	4×10^{-2} (D)	5.69 (D)	6.2 to 6.6×10^{-5} (D)	1.9×10^{-4} (D)	2.57×10^{-4} (D)	2,570
TPH	--	--	Insoluble to 300 (D)	2.13 to 7.06 (D)	2.12 to 675 (D)	5.9×10^{-5} to 10 (D)	6.5 to 5.5×10^{6} (D)	0.065 to 55,000

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Metals								
Antimony	Sb	121.75	--	NA	1 at 886°C[G]	NA	NA	50 to 3,981[F]
Barium	Ba	137.34	--	NA	1 at 886°C[E]	NA	NA	50[F]
Cadmium	Cd	112.40	--	NA	1 at 392°C[E]	NA	NA	6[F]
Chromium	Cr	52.00	--	NA	1 at 1616°C[G]	NA	NA	40 to 70[F]
Copper	Cu	63.55	--	NA	1 at 1,628°C[E]	NA	NA	20(F)
Lead	Pb	207.19	--	NA	1 at 920°C[E]	NA	NA	100[F]
Mercury	Hg	200.59	--	NA	1 at 126.2°[G]	NA	NA	100 to 10,000[F]
Nickel	Ni	58.70	--	NA	1 at 1810° [G]	NA	NA	100 to 1,000[F]
Selenium	Se	78.96	--	NA	1 at 356°C[G]	NA	NA	3[F]
Silver	Ag	107.87	--	NA	1 at 1,357°C[G]	NA	NA	90-100[F]
Thallium	Tl	204.37	--	NA	1 at 825°C[G]	NA	NA	3[F]
Vandadium	V	50.94	--	NA	NA	NA	NA	1,000[F]
Zinc	Zn	65.37	--	NA	1 at 487°C[E]	NA	NA	16[F]

[1] Compound has been retained as a chemical of concern, but is suspected to be a laboratory contaminant.
NA No data available
ID Insufficient vapor pressure data for calculation at 25°C.
[A] Superfund Public Health Evaluation Manual (EPA 1986b)
[B] Aquatic Fate Process Data for Organic Priority Pollutants (EPA 1982)
[C] Howard (1990)
[D] Oak Ridge National Laboratory (1989)
[E] Lide (1990)
[F] USDOE (1991)
[G] Perry's Chemical Engineers' Handbook (1984)
[H] Groundwater Chemicals Desk Reference (1989)
[I] Groundwater Chemicals Desk Reference (1989). Because carbazole is structurally similar to fluorene, it was assumed that the K_{oc} for carbazole was equivalent to the K_{oc} for fluorene.
[J] Hawley's Condensed Chemical Dictionary (1987).

Note: Typical soil/water partition coefficient (K_d's) for the organic compounds were estimated using: $K_d = K_{oc}$ x TOC, assuming 1.0 percent total organic carbon (TOC) content in soil.

TABLE B-2

DEGRADATION HALF-LIVES USED FOR TRANSIT TIME AND DEGRADATION MODEL

Chemical	Half-Life In Soil (yrs)	Chemical	Half-Life In Soil (yrs)
Toluene	0.2[A,B]	Chrysene	2.72[A]
Ethylbenzene	0.2[A,B]	Carbon disulfide	100[C]
Xylenes	0.2[A,B]	Fluoranthene	1.21[A]
Tetrachloroethene	1.0[A]	Pyrene	5.2[A]
Benzene	0.3[A]	Phenanthrene	0.55[A]
2-Butanone	0.2[A,B]	Benzo(a)pyrene	1.45[A]
1,2-Dichloroethane	0.2[A,B]	DDT	15.6[A]
Bis(2-e,h)phthalate	0.2[A,B]	DDE	15.6[A]
Benz(a)anthracene	1.86[A]	Chlordane	3.8[A]
Indeno(1,2,3-c,d)pyrene	2[A]	Dibenzofuran	0.2[A,B]
Acenaphthene	0.3[A]	Fluorene	0.2([A,B]
Butyl benzyl phthalate	0.2[A,B]	Naphthalene	0.2[A,B]
Anthracene	1.25[A]	Pentachlorophenol	0.5[A]
2-Methylnaphthalene	0.5[A]	Di-n-butyl phthalate	0.2[A,B]
Dibenzo(a,h)anthracene	2.86[A]	Benzo(g,h,i)pyrene	1.8[A]
Carbazole	0.2[A,B]	Isophorone	0.2[A,B]
Benzo(b)fluoranthene	1.67[A]	1,2-Dichloropropane	3.5[A]
		Chloromethane	0.2[A,B]

(A) High value cited by Howard, P. H.; Boethling, R. S.; Jarvis, W. F.; Meylan, W. M.; and Michalenko, E. M. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. 725 p.

(B) Default value of 0.2 years used. Highest referenced value is below 0.2 years.

(C) Default value when no literature value was available.

(D) Assumed to have chemical properties similar to 2,4-D

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VOLUME IV
APPENDIXES C - D

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BASELINE RISK ASSESSMENT FOR APPENDIX III SWMUs - PHASE I

CANNON AIR FORCE BASE CLOVIS, NEW MEXICO

Prepared for:
Cannon Air Force Base
27 CES/CEVR
Environmental Flight

February 1994

APPENDIX C
HUMAN HEALTH RISK ASSESSMENT
METHODS AND EXPOSURE ASSUMPTIONS

APPENDIX C
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APPENDIX C
HUMAN HEALTH RISK ASSESSMENT
METHODS AND EXPOSURE ASSUMPTIONS

C.1 OBJECTIVES AND METHODOLOGY

The baseline human health risk assessment was performed to assess potential adverse health effects associated with exposure to hazardous substances released from identified solid waste management units (SWMUs) at Cannon AFB, assuming that no further action is taken to control or mitigate these releases (i.e., no corrective action). The results of the risk assessment are used to:

- Estimate the magnitude of potential health risk at each SWMU and to identify the primary causes of that risk
- Help determine whether remediation to protect public health is warranted at each SWMU
- Help support the selection of the "no action" alternative, where appropriate

The risk assessment methodology used in this study is based on the guidance provided by the U.S. EPA in Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (EPA 1989c). The EPA guidance was applied because it is the most appropriate and widely accepted guidance for such an assessment. The Superfund guidance is appropriate for use at a RCRA site because it is consistent with the risk-based approach outlined in the RCRA Facility Investigation (RFI) guidance (EPA 1989b), and it is consistent with the approach in RCRA's proposed Subpart S rules (Federal Register, July 27, 1990a). EPA cautions that their documents are intended to provide guidance only, and that considerable professional judgment must be exercised in applying the guidance to site-specific human health risk assessments.

The steps in the baseline risk assessment process are:

1. Identification of chemicals of concern
2. Exposure assessment
3. Toxicity assessment
4. Risk characterization (including an evaluation of uncertainties in the risk estimates)
5. Uncertainties and limitations

These steps are described in the following sections.

C.2 IDENTIFICATION OF CHEMICALS OF CONCERN

Chemicals of concern are chemicals that may be released from waste sources at the SWMU and may be significant contributors to health risks. The identification of chemicals of concern involves evaluating chemical analytical results from the sampling program conducted during the RFI and compiling a set of data that is usable for risk assessment purposes. Chemicals of concern at each SWMU are identified, and the basis for their selection is described in each individual section. As a general rule, chemicals of concern include all organic compounds that are detected, may be SWMU-related, and that could potentially pose a significant risk. Metals of concern are those that may be related to wastes disposed at the site, that are potentially hazardous, and that occur in concentrations greater than background levels. SWMU-related chemicals that do not have EPA-established toxicity factors are not evaluated in the quantitative risk assessment, but their potential impact on risk is evaluated qualitatively.

C.2.1 Chemical Data Evaluation

Prior to use in the risk assessment, all site data were reviewed and qualified following the QA/QC procedures described in the Quality Assurance Project Plan (QAPP) (W-C 1993, Appendix 3). The Quality Assurance review was performed in compliance with EPA laboratory data validation guidelines (EPA 1988; 1991c). Data of insufficient quality based on QA/QC criteria were rejected at this point and not used in the risk assessment. Sample results were assigned appropriate qualifiers at this stage (e.g., J - estimated).

Data were considered usable for risk assessment purposes if the data were unqualified or were estimated ("J" qualifier). Data were not used if the data were rejected or if a chemical was qualified as "nondetect" in the field sample based on its presence in corresponding laboratory or field blanks.

Results of the data review process are presented in the Data Evaluation Summaries for each SWMU in the RFI report.

Prior to selection of chemicals of concern, sample analytical results were evaluated and screened for usability in the risk assessment. The U.S. EPA has developed guidance on data usability for risk assessment in the Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (EPA 1989c) and in the Guidance for Data Usability in Risk Assessment (Directive 9285.7-05) (EPA 1990b). Data usability in risk assessment is discussed for each SWMU in the RFI report and in SWMU-specific sections of the risk assessment report.

C.2.2 Comparison of Site Data with Background Concentrations of Metals

Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc are considered metals of potential concern because of their possible association with materials (e.g., waste oils, plating operations, pesticides/herbicides, or paints) that may have been handled or disposed of at the SWMUs. To determine whether these metals detected in soils at the SWMUs are waste related or not, detected concentrations were compared to background concentrations. Metals that do not exceed background levels are not considered chemicals of concern. Background metals concentrations and the method used to compare concentrations detected at SWMUs to background levels are described in Appendix A. The results of the comparison are presented in each SWMU-specific section.

C.2.3 Availability of EPA Toxicity Criteria

Chemicals of potential concern for which EPA-published toxicity factors (i.e., reference doses or cancer slope factors) are not available are not evaluated quantitatively in the risk assessment since quantitative risk characterization is not possible without these factors. The

sources of toxicity values are EPA's IRIS database, the Health Effects Assessment Summary Tables (HEAST EPA 1992; 1993), or provisional values published by EPA in technical memoranda. Chemicals without toxicity factors are addressed qualitatively in the risk assessment.

C.2.4 Evaluation of Detection Frequency

Chemicals were eliminated as chemicals of concern if they were detected in fewer than 5 percent of samples in a sample set (e.g., soils) for a SWMU and there was no reason to believe that the chemical may be present at levels of concern. Only those chemicals that were only detected below reporting limits (J-qualified) were eliminated by this method.

C.3 EXPOSURE PATHWAY FLOW CHARTS

Information concerning waste sources, waste constituent release and transport mechanisms, and locations of potentially exposed individuals (receptors) is used to develop a conceptual understanding of the SWMU in terms of potential human exposure pathways. The exposure pathway flow chart (EPFC) is a schematic representation of the contaminant source areas, chemical release mechanisms, environmental transport media, potential human intake routes, and potential human receptors. The purpose of the EPFC is to provide a framework for problem definition, to identify exposure pathways that may result in human health risks, to aid in identifying data needed to evaluate those pathways, and to aid in identifying effective cleanup measures, if necessary, that are targeted at significant contaminant sources and exposure pathways.

An exposure pathway includes four necessary elements:

- A source of chemicals and a mechanism of chemical release
- An environmental transport medium (air, surface water, etc.)
- An exposure point
- A human intake route (inhalation, ingestion, etc.)

Each one of these four elements must be present for an exposure pathway to be complete. An incomplete pathway means that no human or ecological exposure can occur. Only potentially complete pathways are addressed in this risk assessment. Exposure pathways are considered to be potentially complete if there are potential chemical release and transport mechanisms and identified receptors for that exposure pathway. In the EPFCs, potentially complete exposure pathways are indicated with solid lines; incomplete or insignificant pathways are indicated with broken lines. EPFCs are developed for each SWMU and are presented in the respective SWMU-specific sections.

The primary sources of chemical release at each SWMU are waste materials that have been disposed, spilled, or leaked to soils. Soil is the chief environmental medium that may provide the means for human exposures. Other media (air, groundwater, and surface water/sediment) may be affected by release of chemicals from contaminated soil.

Humans who might be directly exposed to chemicals at each SWMU are Base employees (occupational receptors) who are assumed to work at the SWMU for 9 (average exposure) or 25 (reasonable maximum exposure) years. This is a conservative approach because the average tour of duty at Cannon AFB is less than 9 years and because most SWMUs are not current or likely future places of work. In addition, evaluating long-term occupational exposures is reasonable because Cannon AFB is likely to remain a military installation during the exposure periods quantified in the risk assessment. Future residential exposures are considered for those SWMUs located in areas of the Base where construction of residential homes is plausible. Those SWMUs located in industrial areas of the Base are not evaluated for future residential exposures because Cannon AFB is likely to remain a military installation (increasing in size) during the assumed exposure periods, and it is unlikely that houses will be constructed in the highly industrial areas of the Base when there is abundant real estate available in the area. Therefore, only SWMUs 77, 92, 93, and 127 will be evaluated for future residential exposures.

Exposures to future construction workers and trespassers are also evaluated. The construction workers are assumed to be engaged in excavation work at the SWMUs, during which they are exposed to surface and subsurface soils. If chemicals are transported to the Playa Lake, trespassers at the lake could be exposed to chemicals of concern in surface water and sediments. Occupational and construction workers may also be exposed to potentially

contaminated surface water and sediments. To evaluate these potential exposure pathways, trespassers (age 10 to 16 years) and occupational and construction workers will be assumed to be exposed to actual detected concentrations of SWMU-related contaminants at the lake. In addition, water in the Playa Lake is used to irrigate nearby cropland. Therefore, farm workers could potentially be exposed to chemicals of concern in surface water and sediments. Inhalation of volatile emissions from surface water in the Playa Lake (SWMU 103) is not considered a significant pathway, because no volatile organic compounds were detected in the surface water.

Groundwater beneath Cannon AFB is potable and is used for domestic purposes both on and off the Base. Therefore, potential exposure to groundwater by current and future residents will be evaluated if fate and transport modeling demonstrates that chemicals of concern could reach groundwater at concentrations of potential concern. Occupational exposures to groundwater will not be evaluated because residential exposures will be protective of occupational exposures.

Potential receptors to SWMU-related chemicals and the pathways through which they might be exposed are summarized below.

<u>Base workers</u>

- Incidental ingestion of surface soil or sediment
- Inhalation of volatile chemicals and chemicals bound to airborne particulates emitted from surface soil
- Dermal contact with surface soil or sediment
- Dermal contact with surface water
- Dermal contact with groundwater
- Inhalation of volatile emissions from groundwater
- Ingestion of groundwater

Hypothetical future construction workers

- Incidental ingestion of surface and subsurface soils or sediments (i.e., during excavation)
- Inhalation of volatile chemicals and chemicals bound to airborne particulates emitted from soil (surface and subsurface)
- Dermal contact with soil (surface and subsurface) or sediment
- Dermal contact with surface water

Hypothetical Future Residential Receptors

- Ingestion of surface soils
- Inhalation of volatile chemicals and chemicals bound to airborne particulates emitted from surface soils
- Dermal contact with surface soils
- Ingestion of groundwater
- Dermal contact with groundwater while showering
- Inhalation of volatile emissions from groundwater while showering

Off-Site Farm Workers

- Incidental ingestion of sediment
- Dermal contact with sediment
- Dermal contact with surface water

Hypothetical Trespassers

- Dermal contact with surface water
- Incidental ingestion of sediments and surface soils
- Dermal contact with sediments and surface soils
- Inhalation of volatile emissions or chemicals bound to airborne particulates emitted from surface soils

C.4 EXPOSURE POINT CONCENTRATIONS

C.4.1 Exposure Point Concentrations in Soil and Sediment

For each chemical of concern detected in soil or sediment, the arithmetic mean and 95 percent upper confidence limit (UCL) on the mean concentrations were calculated using chemical analytical results for each SWMU. The 95 percent UCL concentration is calculated in order to account for the uncertainty associated with the estimation of the mean and is used to represent the reasonable maximum exposure (RME) concentration. However, according to EPA guidance (EPA 1989c), if the calculated 95 percent UCL concentration exceeds the maximum detected concentration, the maximum detected concentration is used for the RME concentration.

In calculating exposure point concentrations in the risk assessment, one-half the sample reporting limit is used to represent the concentration of chemicals of concern that are not detected in a particular sample but that are detected in at least one other sample in the set. An exception to this rule is when the reporting limit is unusually high due to matrix or other factors effects that interfere with the analysis. This is not uncommon for soil samples, which may have to be diluted prior to analysis. The reporting limit for diluted samples can be one or more orders of magnitude higher than the maximum measured concentrations in other samples. According to EPA guidance, these samples are excluded from the data set if they cause the mean calculated concentration to exceed the maximum detected concentration in that sample set.

This same principle applies when a compound is detected in very few samples of a data set in estimated quantities well below the reporting limit. If using one-half the reporting limits to represent the concentrations in samples where the chemical was not detected causes the calculated exposure concentrations to exceed the maximum reported concentration, those samples are excluded from the data set.

C.4.2 Exposure Point Concentrations in Air

Screening-level air emissions and dispersion models recommended by EPA (1991d) were used to estimate concentrations of airborne emissions of chemicals of concern from soil at each SWMU. Airborne emissions from soils resulting from volatilization of volatile organic compounds (VOCs) and emissions of semivolatile compounds and metals associated with wind erosion of particulate matter (dust) less than 10 microns in diameter (PM_{10}) were evaluated. RME air concentrations were estimated using the reasonable maximum surface soil concentrations for occupational, residential, and trespasser exposures and RME concentrations from surface and subsurface soils for construction worker exposures.

The methods described below assume no decay in source concentrations and assume that the contaminated soil is the only source of emissions to the air space. At small SWMUs that are relatively small or insignificant sources of emissions, estimated air concentrations are likely to significantly overestimate actual concentrations.

For volatile emissions, a chemical-specific volatilization factor (VF) was used for defining the relationship between the concentration of volatile contaminants in soil and the concentration of volatilized contaminants in air. The equation used to calculate VF is presented and discussed in Appendix B. Volatilization is an important pathway only for chemicals with a molecular weight of less than 200 g/mole and a Henry's Law constant of 1×10^{-5} or greater (EPA 1991d). RME air concentrations of airborne volatile compounds are calculated by multiplying the inverse of VF by the RME soil concentrations of each chemical of concern.

The equation used to estimate long-term (annual) average particulate emissions from wind erosion is from Cowherd (1985) as cited in Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual, Part B, Development of Risk-based Preliminary Remediation Goals (EPA 1991d).

The particulate emission factor (PEF) relates the contaminant concentration in soil with the concentration of PM_{10} in the air due to fugitive dust emissions from surface soils. This relationship was derived for a rapid assessment procedure applicable to a typical hazardous waste site where the surface contamination provides a relatively continuous and constant

potential for emission over an extended period of time. The particulate emissions from contaminated sites are due to wind erosion and therefore depend on the erodibility of the surface material. The method assumes a surface with "unlimited erosion potential," which is characterized by bare surfaces of finely divided material, such as sandy agricultural soil, with a large number ("unlimited reservoir") of erodible particles. Such surfaces erode at low wind speeds. This model was selected by EPA because it represents a conservative estimate of particulates concentrations in air.

Reasonable maximum air concentrations of particulate-bound semivolatiles and metals are calculated by dividing the RME soil concentrations of each chemical of concern by a generic PEF calculated by EPA (1991d) using conservative default values. Appendix B presents more detail on the equations and methodology used to estimate air concentrations of chemicals of concern.

Air emissions from sediment were not calculated because the sediment is mostly covered by water; therefore, this pathway is not considered to be significant. Volatile emissions from surface water in the Playa Lake were not modeled because no volatile organic compounds were detected in the lake water.

Tables of air concentrations calculated using these methods are in each individual SWMU section.

C.4.3 Exposure Point Concentration in Groundwater

Groundwater concentrations are estimated using a conservative transport and dilution model described in Appendix B. The modeled concentrations are then compared to conservative drinking water risk-based concentrations (RBCs). Modeled groundwater concentrations that are below RBCs are not evaluated further. Modeled concentrations that exceed RBCs are evaluated for potential risk at receptor wells.

C.4.4 Exposure Point Concentration in Surface Water

For each chemical of concern detected in the Playa Lake, the arithmetic mean and 95 percent UCL on the mean concentrations were calculated using chemical analytical results.

C.5 ESTIMATING CHEMICAL INTAKES

Using the exposure point concentrations of chemicals of concern in soils, sediment, surface water, groundwater, and air, it is possible to estimate the potential human intake of those chemicals via each exposure pathway. Intakes are expressed in terms of mg chemical per kg body weight per day (mg/kg-day). Intakes are calculated following guidance in Risk Assessment Guidance for Superfund (EPA 1989c), Exposure Factors Handbook (EPA 1989a), other EPA guidance documents as appropriate, and professional judgment regarding probable exposure conditions. Intakes are estimated using reasonable estimates of body size, inhalation rates, ingestion rates, dermal absorption rates, soil matrix effects, and frequency and duration of exposure.

Intakes are estimated for both average and reasonable maximum exposure (RME) conditions. Estimates of exposure necessarily involve the use of professional judgment. Average exposure variables are those that, applying EPA guidance and professional judgment, represent the most likely estimates of exposure for an individual with normal activity patterns. The average (or most likely) exposure scenarios are conservative in that they assume that contact with contaminated media occurs routinely over the course of many years. The RME is estimated by selecting values for exposure variables so that the combination of all variables results in the maximum exposure that can reasonably be expected to occur at the site. In this risk assessment, the RME scenarios are developed using EPA's Standard Default Exposure Factors (SDEFs) (EPA 1991b), where appropriate. These factors probably significantly overestimate actual exposures at SWMUs at Cannon AFB.

The general equation for calculating intake in terms of mg/(kg-day) is:

$$Intake = \frac{chemical\ conc. * contact\ rate * exposure\ frequency * exposure\ duration}{body\ weight * averaging\ time}$$

The variable "averaging time" is expressed in days to calculate average daily intake. For noncarcinogenic chemicals, intakes are calculated by averaging over the period of exposure to yield an average daily intake. For carcinogens, intakes are calculated by averaging the total cumulative dose over a 70-year lifetime, yielding "lifetime average daily intake." Different averaging times are used for carcinogens and noncarcinogens because it is thought that their effects occur by different mechanisms. The approach for carcinogens assumes that a high dose received over a short period of time is equivalent to a corresponding low dose spread over a lifetime and that low doses have the potential, however small, to cause a carcinogenic response (scientific opinion is divided on this issue). Following current EPA guidance the intake of a carcinogen, for whatever duration, is averaged over a 70-year lifetime (EPA 1989c).

Omitting chemical concentrations from the intake equation yields a pathway-specific "intake factor." The intake factor can then be multiplied by the concentration of each chemical to obtain the pathway-specific intake of that chemical. Intake factors are calculated separately for each receptor and exposure pathway. The intake factors used in the risk assessment are presented in Tables C-1 through C-22. The assumptions used in deriving intake factors are discussed below.

C.5.1 Exposure Frequency, Duration, Body Weight, and Averaging Times

Several exposure parameters, such as exposure frequency and duration, body weight, and averaging times, have general application in all intake estimations, regardless of pathway. These general assumptions are detailed below.

- Base worker frequency of exposure at the SWMUs is estimated to be 3 days/week for 40 weeks (120 days) in the average (most likely) case. The RME occupational exposure frequency, 250 days/year, is the EPA Standard Default Exposure Factor (SDEF) (EPA 1991b). For exposure to surface water in the Playa Lake, an exposure frequency of 25 days/year for the average case

(1 day/week for 25 weeks/year) and 50 days/year for the RME case (1 day/week for 50 weeks/year) is used.

- Construction worker exposure frequency is assumed to be 20 days/year for the average case, which is the estimated duration for excavation activities for an average construction project (e.g., foundation construction). The RME exposure duration for construction workers is 40 days/year (8 work weeks), which is the estimated duration of excavation activities for a larger construction project.

- Farm worker exposure frequency to sediment at the Playa Lake is expected to be 2 days/year in the average case. The RME exposure frequency is 5 days/year. These assumptions are based on the estimated time it would take to install and remove an irrigation pump at the Playa Lake. Surface water exposure frequency is 24 days/year for the average case. The RME exposure frequency is 48 days/year. Surface water exposure assumptions are estimated from duration of the irrigating season (i.e., exposures for 2 or 4 days/week for an irrigation season of 3 months/year).

- Recreational (trespasser) receptor exposure frequency is assumed to be 26 days/year (one visit/week to a site over half of the year) for the average case and 52 days/year (one visit/week over the entire year) for the RME case.

- Exposure frequency for residential receptors is 275 days/year and 350 days/year (SDEF) for average and RME exposures, respectively. The average exposure frequency of 275 days/year is 75 percent of 365 days/year.

- Base worker exposure duration is 9 years (average) and 25 years (RME). Average occupational exposure duration is equivalent to the 50th percentile duration of residence at one location (EPA 1989a); this is a conservative estimate of occupational exposures at the Base because the average tour of duty is less than 9 years. The RME value (25 years) is the 95th percentile duration of work at the same location (EPA 1991b).

- Construction worker exposure duration is assumed to be one year for both the average and RME exposure. This assumes that a construction project will be completed within a one-year time span.

- Exposure duration for recreational (trespasser) receptors is assumed to be 6 years, the time from age 10 to age 16.

- Residential and farm receptor exposure duration is assumed to be 9 years for the average case and 30 years for the RME case. These are the 50th and 90th percentile duration of residence in the same location, respectively (EPA 1989a).

- Averaging time for noncarcinogenic effects is based on exposure duration. Occupational average and RME averaging time is 9 years (3285 days) and 25 years (9125 days), respectively. The RME averaging time for residential and farm receptors is 30 years (10,950 days). Averaging time for construction workers is 1 year (365 days), and averaging time for trespassers is 6 years (2,190 days).

- Averaging time for carcinogenic effects is 70 years (25,550 days) in both the average and reasonable maximum cases for all exposure scenarios (EPA 1989a).

- The average adult body weight is 70 kg (EPA 1989a). The body weight for recreational receptors age 10 to 16 is 51 kg (50th percentile male body weight for ages 12 to 15 [EPA 1989a]).

C.5.2 Inhalation Assumptions

Intake of chemicals of concern through inhalation is a function of the volume of air inhaled per day, the exposure frequency, and duration. Intake factors for exposure via inhalation were estimated for occupational, construction, recreational, and residential receptors. The following assumptions were used to estimate exposure to chemicals of concern through this route.

- The average inhalation rate for occupational, farm, and construction workers, and recreational receptors is 1.15 m^3/hr; the RME inhalation rate is 2.5 m^3/hr. The average rate assumes that one-half of the time is spent at activities equivalent to walking (0.8 m^3/hr) and 1/2 time at activities equivalent to pushing a wheelbarrow and simple construction (1.5 m^3/hr). The average rate is from EPA (1989a). The RME rate is the SDEF from EPA (1991b).

- Occupational receptors are assumed to be exposed at a SWMU for 2 hours/day in the average case and 8 hours/day in the RME case. These are conservative assumptions, because most SWMU are not routine work places.

- Construction workers are assumed to be exposed at the SWMU for 8 hours/day for both the average and RME cases. This is equivalent to a typical work day.

- Farm workers are expected to be exposed to surface water for 2 hours/day for the average and RME case, and to sediments for 8 hours/day for the average and RME case.

- Residential inhalation rate for inhalation of VOCs while showering is assumed to be 0.6 m^3/hour for both the average and RME cases which is the SDEF value for showering (EPA 1991b, Attachment A). Residential inhalation rate for inhalation of VOCs from soil is assumed to be 0.83 m^3/hour for both the average and RME cases. This rate is from EPA (1989a).

- Residential receptors are assumed to be exposed to VOCs while showering for 0.1 hrs/day in the average case and 0.2 hrs/day in the RME case. These values are equivalent to 6- and 12-minute showers (EPA 1989a). Residential receptors are assumed to be exposed to Vocs in soil for 16 hrs/day in the average case and 24 hrs/day in the RME case.

C.5.3 Soil/Sediment Ingestion Assumptions

Uptake of chemicals of concern via incidental ingestion of soil is a function of the ingestion rate, the fraction of ingested soil that is contaminated, the frequency and duration of exposure, and the bioavailability of the chemical adhered to the particulates. EPA-recommended soil ingestion rates include both outdoor soil and indoor house dust; i.e., a "soil" ingestion rate of 100 mg/day includes house dust as well as soil. Intake factors for exposure via soil/ sediment ingestion were calculated for Base workers, hypothetical construction workers, farm workers, future residents, and recreational receptors. The following assumptions were used in estimating intake from soil ingestion:

- Base workers and recreational receptors are assumed to ingest 10 mg/day and 50 mg/day of soil in the average and RME case, respectively. The rate of 50 mg/day is the RME default occupational soil ingestion rate recommended in EPA (1991b). The average ingestion rate (10 mg/day) is the adult soil ingestion rate from EPA (1989a).

- Construction and farm workers are assumed to ingest 50 mg/day and 100 mg/day for the average and RME cases, respectively. The 50 mg/day rate is the SDEF occupational soil ingestion rate (EPA 1991b). The RME rate is 2 times the SDEF value and is 10 times the adult rate reported in EPA (1989a).

- Residents are assumed to ingest 100 mg/day and 200 mg/day (for adults and children, respectively) for both the average and RME case (EPA 1991b).

- For Base workers and recreational receptors, the fraction ingested (FI) from the contaminated source is 0.25 in the average case and 1.0 in the RME case. The average fraction of 0.25 is equivalent to an average exposure time of 2 hours/workday and the RME fraction of 1.0 is equivalent to an exposure time of 8 hours/workday. This is a conservative assumption because (1) most of the SWMUs are not routine workplaces and therefore exposures for 8 hours/day are highly unlikely, and (2) this approach neglects the contribution

of house dust to the total daily soil intake (i.e., the daily intake with FI=1 is assumed to be all contaminated soil).

- For construction and farm workers, the fraction ingested from the contaminated source is assumed to be 1.0 for both the average and RME cases.

- For residents, the fraction ingested from the contaminated source is assumed to be 0.5 for the average case and 1.0 for the RME case.

- The matrix effect of soil on bioavailability of ingested contaminants is assumed to be 0.5 in the average case and 1.0 in the RME case. Many organic compounds and metals bind tightly to soil particles. The matrix effect describes the reduced availability due to adsorption of chemicals to soil compared to the same chemical dose administered in solution in laboratory experiments. A matrix effect of 1.0 indicates that all of the contaminant is bioavailable. This is a conservative assumption that probably overestimates the bioavailability of chemicals in the soil.

C.5.4 Dermal Absorption from Soil/Sediment

Uptake of chemicals of concern through dermal contact with soil is a function of exposed body surface area, absorbed fraction, an adherence factor that describes how much soil adheres to skin, the fraction of soil contacted that is from a contaminated source, and exposure frequency and duration.

Metals

Dermal uptake of metals is generally not an important route of uptake compared to inhalation and ingestion of particulate matter because the absorption of metals through the skin does not occur very readily. Absorption ranges from less than 1 percent to 5 percent have been reported for various metals in solution (USEPA 1992b). However, metals in solution behave quite differently than metals in soil. Most metals form strong, stable bonds with other soil constituents that greatly reduce bioavailability. Furthermore, due to polarity and solubility, metals are not absorbed well across the skin. For example, according to the dermal exposure

assessment guidance (EPA 1992c), the absorbed fraction (dose applied dermally/dose absorbed dermally) of cadmium chloride is 0.001. Experimental data on other metals and on cadmium in states other than as a chloride (e.g., other salts or metallic forms) are lacking. However, since dermal absorption is theoretically dependent on the rate that the compound dissolves in interstitial water (EPA 1992c), it is reasonable to assume that the absorbed fraction of a soluble compound such as cadmium chloride represents the upper range of absorbed fractions of all metal species.

Using the absorbed fraction for cadmium chloride to represent the absorbed fraction of all cadmium in soil (a conservative assumption) and the intake factors for noncarcinogenic dermal contact and soil ingestion (e.g., Tables C-1 and C-2), the daily intake of cadmium via dermal absorption would be more than two orders of magnitude below the daily intake via ingestion using the same exposure factors. Therefore, it is reasonable to assume that dermal absorption of metals from soil does not contribute significantly to the total intake or risk associated with exposure to metals in soil. Thus, relative to other exposure routes, dermal absorption of metals from soil is expected to be inconsequential and is not evaluated in this risk assessment. This approach has been adopted by EPA in EPA risk assessments performed at mining sites where metals are the chief chemicals of concern (Weston 1991). However, since mercury may be absorbed dermally (Amdar et al. 1991), it will be evaluated for this pathway. An absorbed fraction of 0.01 is adopted for mercury.

Organic Compounds

Chemical-specific values for dermal absorption of volatile organic chemicals from soil are shown in Table C-26. These are adopted from EPA guidance (EPA 1992b).

For purposes of this risk assessment, the absorption rate of semivolatile organic compounds adhered to soil particles is assumed to be 10 percent. This is an upperbound estimate based on experimental results using benzo(a)pyrene in acetone or in crude oil, and adjusting the absorption rate for shorter exposure duration and the observed retarding effect of the soil

medium.[1] Absorption rates range from 3 to 51 percent at 24 hours. The arithmetic mean absorption rate is 17 percent, and the 95 percent UCL on the mean rate is 26 percent. To adjust the upperbound experimental rate to account for site-specific exposure conditions, it is assumed that the exposed individual showers within 12 hours of exposure, and that absorption from soil is one-fifth that of the pure compound (Yang et al. 1989; Wester et al. 1990). Therefore, the 24-hour absorption rates of neat B(a)P are adjusted by a factor of 0.5 for the 12-hour exposure and 0.2 for the soil matrix effect. Resulting absorption rates are:

Upperbound Absorption: $26 \times 0.5 \times 0.2 = 2.6$ percent

It should be noted that B(a)P is one of the more lipophilic of the PAHs, and therefore, it may be absorbed at a higher rate than a number of other organic chemicals of concern. Also, the use of dermal absorption values obtained in experimental animal studies will almost always result in a conservative (i.e., higher) estimate of dermal absorbed dose in humans (EPA 1992b). Therefore, the dermal absorption rate used in this analysis (10 percent) is likely to significantly overestimate a dermal absorption of semivolatile organic compounds from soil. That is, 2.6 percent is a more likely upperbound estimate of absorption, and EPA Region IV suggests an absorption of 1.0 percent for organic compounds.

Dermal Contact Assumptions

The following assumptions were used to estimate exposure to organic chemicals of concern through the dermal contact with soil:

- For Base workers, the average body surface area exposed per day is 2,000 cm^2/day; the RME exposed area is 2,750 cm^2/day, based on values in EPA (1989a). Average surface area is equivalent to head and hands; RME surface area is a time-weighted average based on 0.25 x 5,000 cm^2 (forearms,

[1] In recent guidance on dermal exposure assessments (EPA 1992c), EPA has declined to recommend an absorption rate for B(a)P in soil because of the variability in experimental conditions and results and the difficulty in extrapolating from high soil loadings (e.g., tens of mg/cm^2) under experimental conditions to lower loadings (e.g., 1 mg/cm^2) typical of human exposures (EPA 1992a). In experiments using B(a)P at concentrations of 1 and 10 mg/kg and soil loadings of 40 to 56 mg/cm^2, experimental results for percent absorbed at 24 hours range from 1 percent (Yang et al. 1989) to 13 percent (Wester et al. 1990).

face, hands, and lower legs) during summer plus 0.75 x 2,000 cm^2 (head and hands) for winter, spring, and fall. The occupational worker is assumed to wear a uniform or civilian clothing appropriate to maintenance or other outdoor work.

- For construction workers exposures to soils/sediments, the body surface area exposed per day is 2,000 cm^2/day for the average case and 3,000 cm^2/day for the RME. The average value is equivalent to the head and hands; the RME value is equivalent to the head, forearms, and hands (EPA 1989a).

- For farm workers exposures to sediment (during installation of irrigation equipment in the Playa Lake), the body surface area exposed per day is 1,980 cm^2/day for the average case and 5,170 cm^2/day for the RME. The average is equivalent to the hands and forearms; the RME value is equivalent to the hands, forearms, lower legs, and feet (EPA 1989a).

- For residential receptors exposure to soils, the body surface area exposed per day is 2,000 cm^2/day for the average case; the RME value is 5,300 cm^2/day, based on values in EPA (1989a). Average surface area is equivalent to head and hands; the RME surface area is equivalent to head, hands, forearms, and lower legs.

- For recreational receptors exposure to soils/sediment, the body surface area exposed per day is 2,000 cm^2/day for the average case; the RME value is 5,300 cm^2/day, based on values suggested in EPA (1989a) for outdoor activity. The average value is equivalent to head and hands; the RME surface area is equivalent to head, hands, forearms, and lower legs.

- The absorbed fraction is the estimated fraction of organic compounds adhered to soil particles that partitions to and is absorbed through skin. Chemical-specific values for volatile organics were used (Table C-26). Absorbed fraction of semivolatile organics was assumed to be 10 percent as described previously. Mercury is assumed to be absorbed at a rate of 1 percent (0.01). Dermal absorption of other metals is negligible.

- The soil adherence factor is 0.2 mg/cm^2 in the average case and 1.0 mg/cm^2 in the RME case (EPA 1992c).

- For Base workers and recreational receptors, the fraction contacted from the contaminated source is 0.25 in the average case and 1.0 in the RME case. The average fraction is equivalent to an average exposure time of 2 hours/workday and the RME fraction is equivalent to an exposure time of 8 hours/workday. These are highly conservative estimates at areas that most SWMUs are not present or probable future work sites.

- For the construction and farm workers, the fraction contacted from the contaminated source is assumed to be 1.0 for both the average and the RME cases. This is equivalent to exposure times of 8 hours/day.

- For residential receptors, the fraction contacted from the contaminated source is 0.5 in the average case and 1.0 in the RME case. The average fraction of 0.5 is reasonable, because residential exposure to soil would occur over a larger area than that represented by most SWMUs.

C.5.5 Dermal Absorption from Surface Water

Uptake of chemicals of concern through dermal contact with water is a function of body surface area, a permeability constant that describes the rate at which chemicals permeate the skin, and exposure frequency and duration.

Dermal uptake of metals is generally not an important route of uptake compared to ingestion because metals do not permeate through the skin readily. Due to polarity and solubility, absorption ranges from less than 1 percent to 5 percent have been reported for various metals in solution (EPA, 1992b). However, as a conservative approach, dermal uptake of metals from water (if they are present at concentrations of concern) will be evaluated by considering appropriate permeability constants.

The following assumptions were used to estimate exposure to organic chemicals of concern through dermal contact with surface water:

- For the occupational worker, construction worker, and recreational receptor, the average body surface area exposed per day is 840 cm^2/day; the RME exposed area is 1,980 cm^2/day, based on values in EPA (1989a). The average surface area is equivalent to the hands; the RME value is equivalent to the forearms and hands. The receptors are assumed to wear a uniform or civilian clothing appropriate for outdoor activities.

- For the farm worker, the average body surface area exposed per day is 1,980 cm^2/day; the RME exposed area is 5,170 cm^2/day, based on values in EPA (1989a). The average surface area is equivalent to the hands and forearms; the RME value is equivalent to the hands, forearms, lower legs, and feet.

- For the residential receptor while showering, the average and RME body surface area exposed is 18,200 cm^2/day. This value is based on the average of the 50th percentile total body surfaces of 1.94 m^2 and 1.69 m^2 for men and women, respectively (EPA 1989a).

- The permeability constant is a chemical-specific parameter used to adjust chemical concentrations for use in calculating risks for the dermal contact route. Permeability constants are presented in the SWMU-specific sections, where they are used for assessing dermal exposures to water.

C.6 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to evaluate the toxicity of SWMU-related chemicals of concern and provide an estimate of the relationship between extent of exposure and extent of toxic injury (dose-response relationship) for each chemical.

EPA has performed toxicity assessments for hundreds of compounds associated with chemical releases from industrial sites. The assessments are based on qualitative and quantitative

toxicity information acquired through evaluation of relevant scientific literature. The most directly relevant data come from studies in humans. However, most of the usable information on the toxic effects of chemicals comes from controlled experiments in animals. The result of toxicity assessments performed by EPA is the development of chemical-specific toxicity factors for either the inhalation or oral exposure pathway. These toxicity factors are published in the Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (EPA 1992f; 1993). IRIS is an EPA database containing health risk and regulatory information for numerous chemicals. Only toxicity factors that have been verified by EPA science work groups are included in IRIS. HEAST contains interim and subchronic toxicity factors that do not appear in IRIS.

EPA toxicity factors are used to assess potential health risks resulting from the estimated chemical intakes. Toxicity factors for noncarcinogenic effects are called reference doses (RfDs); toxicity factors for carcinogenic effects are called slope factors (SFs). An RfD is the daily dose of a noncarcinogen that is unlikely to result in toxic effects to humans over a lifetime of exposure.

RfDs are expressed in terms of milligram chemical per kilogram body weight per day (mg/kg-day). RfDs are usually derived from the highest dose that produced no effect in the most sensitive animal species tested, divided by uncertainty factor of 10 to 10,000 to provide a large margin of safety for human exposures. Therefore, RfDs are very health-protective, and it is probable that higher doses of many chemicals could be well tolerated.

Slope factors and the EPA weight-of-evidence classification are used to estimate potential carcinogenic risks. The SF is a dose-response factor that is used to estimate the upperbound probability of an individual developing cancer as a result of exposure to a potential carcinogen. The EPA slope factors are upper 95th percentile confidence limits of the probability of response per unit intake of chemical over a lifetime. Slope factors are based on experimental animal data and epidemiological studies when available. EPA states that carcinogenic risks estimated using slope factors are upperbound estimates. This means that the actual risk is likely to be less than the predicted risk (EPA 1989c) and could be zero. The weight-of-evidence classification is an evaluation of the quality and quantity of carcinogenic potency data for a given chemical. Table C-23 presents the EPA weight-of-evidence

classification system. RfDs and SFs for each chemical of concern are presented in Tables C-24a and b.

Slope factors for polycyclic aromatic hydrocarbons (PAHs) in Table C-24b are derived using a relative potency approach based on the SF for benzo(a)pyrene (BaP). BaP is among the most carcinogenic of the PAHs, and the experimental evidence has permitted the development of SFs for this compound. SFs for other carcinogenic PAHs have not been established by EPA because of insufficient data for quantitative assessment. In order to assess potential risks due to exposures to carcinogenic PAHs other than BaP, SFs have been derived from the SFs for benzo(a)pyrene following the relative potency method of Clement Associates (1988). The oral slope factor for benzo(a)pyrene is 7.3 $(mg/kg\text{-}day)^{-1}$, and the inhalation slope factor is 6.1 $(mg/kg\text{-}day)^{-1}$ (EPA 1991a). Although the inhalation SF for BaP was withdrawn for further review by EPA in 1993, it is retained for use in this report to estimate inhalation risks. These SFs for BaP are multiplied by "relative potency values" to estimate SFs for the other carcinogenic PAHs. The relative potencies and derived relative SFs are shown in Table C-25. This relative potency method is consistent with Interim Guidance from EPA Region IV (EPA Region IV 1992g).

Since PAHs (i.e., benzo(a)pyrene) have been shown to cause skin cancer via dermal contact, the use of oral slope factors for PAHs to estimate risks due to dermal contact is not recommended (EPA 1989c). Therefore, dermal contact with PAHs will not be considered in the quantitative risk assessment, but will be evaluated qualitatively.

C.7 RISK CHARACTERIZATION

Risk characterization combines the outputs of the exposure and toxicity assessments to develop quantitative estimates of risks associated with assumed exposures to chemicals of concern released from each SWMU.

C.7.1 Hazard Index for Noncarcinogenic Effects

The potential for noncarcinogenic effects is characterized by comparing estimated chemical intakes with chemical-specific RfDs. The RfD is considered to be the average daily dose (in terms of mg chemical/kg body weight per day) that will not result in adverse effects even to

sensitive individuals over a lifetime of exposure. Chemical intake is the chemical concentration in the exposure medium multiplied by the pathway-specific intake factor (Tables C-1 through C-22). The ratio of the estimated intake to the RfD is called a hazard quotient, which is calculated as follows:

$$\textit{Noncancer Hazard Quotient} = \frac{\textit{Chemical Intake (mg/kg-day)}}{\textit{RfD (mg/kg-day)}}$$

If the average daily intake exceeds the RfD (that is, if the hazard quotient exceeds 1), there may be cause for concern for noncancer health effects. It should be noted, however, that the level of concern does not increase linearly as the RfD is approached or exceeded. This is because all RfDs are not equally accurate and are not based on the same severity of toxic effects. Furthermore, the hazard quotient does not represent a statistical probability of an effect occurring.

For each receptor category (i.e., Base workers, hypothetical construction workers, farm workers, hypothetical future residents, and recreational users), hazard quotients are summed for all chemical intakes and all relevant exposure pathways to yield a total hazard index (HI). A hazard index equal to or less than 1 indicates that no adverse noncarcinogenic health effects are expected to occur even to sensitive individuals over a lifetime of exposure. A hazard index above 1 indicates a potential cause for concern for noncarcinogenic health effects and the need for further evaluation of assumptions about exposure and toxicity (for example, effects of several different chemicals are not necessarily additive, although the hazard index approach assumes additivity).

The assumption of additive effects reflected in the cumulative HI is most properly applied to substances that induce the same effect by the same mechanism (EPA 1986b). Consequently, application of the equation to a mixture of substances that are not expected to induce the same type of effects could overestimate the potential for adverse health effects. The HI provides a rough measure of potential toxicity, but it is conservative and dependent on the quality of the experimental evidence. Since the HI does not define dose-response relationships, its numerical value cannot be construed as a direct estimate of risk (EPA 1986b).

C.7.2 Carcinogenic Risk

Potential carcinogenic effects are characterized in terms of the excess probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Excess probability means the increased probability over and above the normal probability of getting cancer which, in the United States, is 1 in 3 (American Cancer Society 1990). Excess cancer risks from exposure to chemicals released from hazardous waste sites are often below 1 in 10,000.

Excess lifetime cancer risk is calculated by multiplying the average daily chemical intake by the cancer SF, which is a risk per unit chemical intake:

$$\textit{Risk} = \textit{Chemical Intake (mg/kg-day)} \times \textit{SF (mg/kg-day)}^{-1}$$

For each receptor category (Base workers, hypothetical construction workers, farm workers, hypothetical future residents, and recreational users), cancer risks are calculated separately for each carcinogen and each exposure pathway, and then summed to yield a total upperbound estimate of cancer risk due to multiple exposures. This is a conservative approach that can result in an artificially elevated estimate of cancer risk, especially if several carcinogens are present, because 95th percentile estimates are not strictly additive (EPA 1989c). RME cancer risks are likely to be overestimated significantly because they are calculated by multiplying together 95th percentile estimates of cancer potency and reasonable maximum estimates of concentration and exposure.

EPA policy must be considered in order to interpret the significance of the cancer risk estimates. In the National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1990c), EPA states that: "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upperbound lifetime cancer risk to an individual of between 1×10^{-4} and 1×10^{-6}." These values are equivalent to a 1 in 10,000 to 1 in 1,000,000 chance of getting cancer from the exposure. These risk levels are extremely low and would not be measurable or discernible in individuals or even in a large population. For example, a risk level of 1 in 10,000 would increase an individual's chance of getting cancer from 1 in 3 to 1.0001 in 3. EPA guidance further states that: "Where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both

current and future land use is less than 10^{-4}, and the noncarcinogenic hazard quotient is less than 1, action is generally not warranted ..." (EPA 1991e). The Guidance on Risk Characterization for Risk Managers and Risk Assessors (EPA 1992e) and RCRA Subpart S proposed rules (EPA 1990a) concur with the 1×10^{-6} to 1×10^{-4} target risk range.

C.8 UNCERTAINTIES AND LIMITATIONS

Throughout the human health risk assessment, conservative assumptions are used that probably overestimate actual risks at each SWMU. Although some uncertainties may exist, the conservative features of the risk assessment process compensate for them and yield an upperbound estimate of potential risk. The important factors that tend to over- or underestimate risk are discussed below. SWMU-specific uncertainties and limitations are discussed for each SWMU in relevant sections of the report.

C.8.1 Factors That Tend to Overestimate Risk

- Direct physical contact with soils is assumed to occur routinely for several hours/day, 120 to 250 days per year, for 9 to 25 years. These assumptions overstate current and probable future occupational exposure conditions to soils at these SWMUs.

- No source decay of organic compounds in soil was assumed to occur over a 25-year period. This assumption is likely to result in overestimation of exposure point concentrations and risks due to inhalation of volatile compounds, dermal contact, and soil ingestion.

- The air modeling used to estimate on-site air concentrations assumed no vegetative cover, no source decay, and no dilution of air concentrations by upwind sources. The modeling also assumed the SWMU surface area to be 45 m x 45 m, which overestimates the exposed area at most SWMUs by an order of magnitude. These assumptions are likely to overestimate on-site air concentrations of volatile compounds and particulate matter.

- Chemicals adhered to soil particles were assumed to be 100 percent available for absorption in the gut (matrix effect = 1) in the RME scenarios. This is likely to overestimate risk due to soil ingestion because the soil matrix can interfere with available dose compared to a liquid vehicle used in laboratory experiments.

- EPA RfDs are based on conservative estimates of the potential for adverse noncarcinogenic effects. Most RfDs are developed by reducing the dose at which no adverse effects were observed in the most sensitive animal species by uncertainty factors ranging from 10 to 10,000. This extrapolation method provides a considerable level of conservatism in the RfDs used to estimate the potential for noncarcinogenic health effects and could result in an overestimate of potential hazards by several orders of magnitude.

- EPA slope factors are highly conservative estimates of dose-response relationships and probably result in a significant overstatement of actual cancer risk. Cancer SFs are calculated using the 95 percent UCL on a dose-response curve estimated by a linear mathematical model that extrapolates from short-term, high-dose animal exposures to long-term, low-dose human exposures. EPA guidance states that the cancer SFs are upperbound estimates of potency, and actual potency is likely to be lower.

- The assumption that the effects of exposure to multiple noncarcinogens are additive may result in an overestimate of health hazard. This approach neglects the fact that different toxicants may have different mechanisms of action and different target organ specificities and that their effects are not necessarily additive. The assumption that risks for carcinogens are additive may similarly lead to an overestimate of carcinogenic risk.

- RME cancer risks are estimated by multiplying together a series of conservative (often upper 95th percentile) estimates of carcinogenicity, concentration, and exposure factors. This practice can result in a significant overestimate of potential risk.

C.8.2 Factors That Tend to Underestimate Risk

- A few potential chemicals of concern were not evaluated in the quantitative risk assessments because they do not have EPA-established toxicity factors. EPA has established toxicity factors for hundreds of potentially hazardous compounds associated with waste materials, and detected analytes without toxicity factors often have no known adverse affects or data are inadequate for quantitative risk assessment. Their exclusion from the quantitative analysis is not likely to affect the results or conclusions of the risk assessment relative to the chemicals with known toxicities detected at the SWMU.

- Health risks due to exposures to TPH were not addressed quantitatively in the risk assessment. Exclusion of TPH is expected to have little effect on the risk results because the major toxic constituents of fuels (benzene, ethylbenzene, toluene, and xylene) were evaluated quantitatively, and other constituents of TPH are not likely to contribute significantly to health risk.

- Chemicals of concern that do not have EPA-established inhalation toxicity factors were not included in the calculation of potential risk from the inhalation pathway. While their exclusion may underestimate the risk at the SWMU, it is unlikely that the total calculated risk will be significantly affected, because ingestion and dermal contact, rather than inhalation, are generally the major contributors to the total risk.

C.8.3 Factors That May Over- or Underestimate Risk

- Rates of soil ingestion, soil matrix effects, gut absorption, dermal adherence, and dermal absorption are selected to bracket "best estimate" (average) and "reasonable maximum" rates. The values may overestimate or underestimate actual rates. However, values used in the RME scenario are selected to proved an upperbound estimate of the maximum exposure (and risk) that could reasonably be expected to occur at this site.

- Cumulative noncarcinogenic and carcinogenic health risks are estimated assuming that effects of individual chemicals are additive. This approach does not account for potential synergism, antagonism, or differences in target-organ specificity and mechanism of action. This approach may over- or underestimate actual health risks.

APPENDIX C
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TABLE C-1

DERMAL CONTACT WITH SOIL/SEDIMENT INTAKE ASSUMPTIONS (OCCUPATIONAL)

$$Intake\ Factor = \frac{SA \times AB \times AF \times FC \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2/day)[1]	2,000	2,750
AB:	Absorbed fraction[2]	Chemical-specific	Chemical-specific
AF:	Adherence factor (mg/cm^2)[3]	0.2	1.0
FC:	Fraction contacted from contaminated source[4]	0.25	1.0
EF:	Exposure frequency (days/year)[5]	120	250
ED:	Exposure duration (years)[6]	9	25
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[7]		
	Noncarcinogenic	3,285	9,125
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-d)			
	Noncarcinogenic	4.70×10^{-7}	2.69×10^{-5}
	Carcinogenic	6.04×10^{-8}	9.61×10^{-6}

1. SA: The worker is assumed to wear a uniform or civilian clothing appropriate to maintenance or other outdoor work. Average surface area is equivalent to head and hands (EPA 1989); RME surface area is 0.25 x 5,000 cm^2 (head, forearms, hands, and lower legs; summer) plus 0.75 x 2,000 (head and hands; winter, spring, and fall) (EPA 1989a).
2. AB: Chemical-specific absorbed fractions are given in Table C-26. They are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using AB=1.0.
3. AF: Soil adherence factors are from EPA 1992c.
4. FC: Average fraction of 0.25 is equivalent to average exposure time of 2 hrs/workday at the SWMU: 1.0 is equivalent to an exposure time of 8 hrs/workday.
5. EF: The average exposure frequency is estimated to be 120 days/year (3 days/week for 40 weeks) and assumes that outdoor activities are modified by the weather and that the worker does not work outdoors at the SWMU every day. The RME exposure frequency, 250 days/year, is the standard default exposure factor (SDEF).
6. ED: Average exposure duration is taken to be equivalent to the 50th percentile duration of residence in one location (EPA 1989a); RME is the 95th percentile duration of work at the same location (EPA 1991b).
7. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-2

INGESTION OF SOIL/SEDIMENT INTAKE ASSUMPTIONS (OCCUPATIONAL)

$$Intake\ Factor = \frac{IR \times FC \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Ingestion rate (mg/day)[1]	10	50
FC:	Fraction ingested from contaminated source[2]	0.25	1.0
ME:	Matrix effect[3]	0.5	1.0
EF:	Exposure frequency (days/year)[4]	120	250
ED:	Exposure duration (years)[5]	9	25
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[6]		
	Noncarcinogenic	3,285	9,125
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-day)			
	Noncarcinogenic	5.87×10^{-9}	4.89×10^{-7}
	Carcinogenic	7.55×10^{-10}	1.75×10^{-7}

1. IR: Average ingestion rate is adult rate from EPA 1989a. RME rate is the standard default exposure factor (SDEF) for occupational exposure soil ingestion rate of 50 mg/day is recommended in EPA 1991b.
2. FC: Average fraction of 0.25 is equivalent to average exposure time of 2 hrs/workday; 1.0 assumes 100% of ingested soil is from contaminated source (SWMU).
3. ME: Compounds adhered to soil are commonly less available for absorption than the same compound ingested in solution in laboratory experiments. The soil matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent available for absorption.
4. EF: The average exposure frequency is estimated to be 120 days/year (3 days/week for 40 weeks) and assumes that outdoor activities are modified by the weather and that the worker does not work outdoors at the SWMU every day. The RME exposure frequency, 250 days/year is the SDEF (EPA 1991b).
5. ED: Average exposure duration is taken to be equivalent to the 50th percentile duration of residence in one location (EPA 1989a); RME is the 95th percentile duration of work at the same location (EPA 1991b).
6. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-3

DERMAL CONTACT WITH SURFACE WATER INTAKE ASSUMPTIONS (OCCUPATIONAL WORKER AT THE PLAYA LAKE)

$$Intake\ Factor = \frac{SA\ x\ PC\ x\ ET\ x\ EF\ x\ ED\ x\ CF}{BW\ x\ AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2)[1]	840	1,980
PC:	Permeability constant (cm/hr)[2]	chemical-specific	chemical-specific
ET:	Exposure time (hours/day)	2	8
EF:	Exposure frequency (days/year)[3]	25	50
ED:	Exposure duration (years)[4]	9	25
CF:	Conversion factor (l/cm^3)	10^{-3}	10^{-3}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[5]		
	Noncarcinogenic	3,285	9,125
	Carcinogenic	25,550	25,550
IF:	Intake Factor (kg/kg-d)[6]		
	Noncarcinogenic	1.64×10^{-3}	3.10×10^{-2}
	Carcinogenic	2.11×10^{-4}	1.11×10^{-2}

1. SA: The worker is assumed to wear a uniform or civilian clothing appropriate to outdoor work. Average surface area is equivalent to hands (EPA 1989); RME surface area is equivalent to forearms and hands (EPA 1989a).
2. PC: Chemical-specific permeability constants are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using PC = 1.0.
3. EF: Equivalent to 1 day/week for 25 weeks/year for the average case, or 1 day/week for 50 weeks/year for the RME case.
4. ED: Average exposure duration is taken to be equivalent to the 50th percentile duration of residence in one location (EPA 1989a); RME is the 95th percentile duration of work at the same location (EPA 1991b).
5. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.
6. IF: Intake factors are calculated using PC = 1. See footnote 2.

TABLE C-4

INHALATION INTAKE ASSUMPTIONS (OCCUPATIONAL)

$$Intake\ Factor = \frac{IR \times ET \times EF \times ED}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Intake rate (m^3/hr)[1]	1.15	2.5
ET:	Exposure time (hrs/day)[2]	2	8
EF:	Exposure frequency (days/year)[3]	120	250
ED:	Exposure duration (years)[4]	9	25
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[5]		
	Noncarcinogenic	3,285	9,125
	Carcinogenic	25,550	25,550
Intake Factor (m^3/kg-day)			
	Noncarcinogenic	1.08×10^{-2}	1.96×10^{-1}
	Carcinogenic	1.39×10^{-3}	6.99×10^{-2}

1. IR: Average rate (calculated from EPA 1989a) assumes 1/2 time is spent at activities equivalent to walking (0.8 m^3/hr) and 1/2 time at activities equivalent to pushing a wheelbarrow and simple construction (1.5 m^3/hr). RME rate is standard default exposure factor (SDEF) equivalent to digging trenches (EPA 1991b).
2. ET: Both the average and reasonable maximum exposure times are conservative estimates of the amount of time a worker would spend on the site each day. Most sites do not have routine current on-site occupational exposures.
3. EF: The average exposure frequency is estimated to be 120 days/year (3 days/week for 40 weeks) and assumes that outdoor activities are modified by the weather and that the worker does not work outdoors at the SWMU every day. The RME exposure frequency, 250 days/year is the SDEF.
4. ED: Average exposure duration is taken to be equivalent to the 50th percentile duration of residence in one location (EPA 1989a); RME is the 95th percentile duration of work at the same location (EPA 1991b).
5. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-5

DERMAL CONTACT WITH SOIL/SEDIMENT INTAKE ASSUMPTIONS (CONSTRUCTION)

$$Intake\ Factor = \frac{SA \times AB \times AF \times FC \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2/day)[1]	2,000	3,000
AB:	Absorbed fraction[2]	Chemical-specific	Chemical-specific
AF:	Adherence factor (mg/cm^2)[3]	0.2	1.0
FC:	Fraction contacted from contaminated source[4]	1.0	1.0
EF:	Exposure frequency (days/year)[5]	20	40
ED:	Exposure duration (years)[6]	1	1
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[7]		
	Noncarcinogenic	365	365
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-d)			
	Noncarcinogenic	3.13×10^{-7}	4.70×10^{-6}
	Carcinogenic	4.47×10^{-9}	6.71×10^{-8}

1. SA: The worker is assumed to wear a uniform or civilian clothing appropriate to maintenance or other outdoor work. Average surface area, 2,000 cm^2 is equivalent to head and hands; RME surface area (3,000 cm^2) is equivalent to head, forearms, and hands (EPA 1989a).
2. AB: Chemical-specific absorbed fractions are given in Table C-26. They are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using AB=1.0.
3. AF: Soil adherence factors are from EPA 1992c.
4. FC: Value of 1.0 assumes all contacted soil is from contaminated area (SWMU).
5. EF: Estimated duration of construction activities.
6. ED: Construction activities are assumed to be completed within one year.
7. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-6

INGESTION OF SOIL/SEDIMENT INTAKE ASSUMPTIONS (CONSTRUCTION)

$$Intake\ Factor = \frac{IR \times FC \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Ingestion rate (mg/day)[1]	50	100
FC:	Fraction ingested from contaminated source[2]	1.0	1.0
ME:	Matrix effect[3]	0.5	1.0
EF:	Exposure frequency (days/year)[4]	20	40
ED:	Exposure duration (years)[5]	1	1
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[6]		
	Noncarcinogenic	365	365
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-day)			
	Noncarcinogenic	1.96×10^{-8}	1.57×10^{-7}
	Carcinogenic	2.80×10^{-10}	2.24×10^{-9}

1. IR: 50 mg/day is the default occupational soil ingestion rate recommended in EPA 1991b. RME rate is 2 times the default value and is 10 times the adult rate reported in EPA 1989a.
2. FC: 1.0 assumes 100% of ingested soil is from contaminated source (SWMU).
3. ME: Compounds adhered to soil are commonly less available for absorption than the same compound ingested in solution in laboratory experiments. The soil matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent available for absorption.
4. EF: Estimated duration of construction activities.
5. ED: Construction activities are assumed to be completed within one year.
6. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-7

INHALATION INTAKE ASSUMPTIONS (CONSTRUCTION)

$$Intake\ Factor = \frac{IR \times ET \times EF \times ED}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Intake rate (m^3/hr)[1]	1.15	2.5
ET:	Exposure time (hrs/day)	8	8
EF:	Exposure frequency (days/year)[2]	20	40
ED:	Exposure duration (years)[3]	1	1
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[4]		
	Noncarcinogenic	365	365
	Carcinogenic	25,550	25,550
Intake Factor (m^3/kg-day)			
	Noncarcinogenic	7.20×10^{-3}	3.13×10^{-2}
	Carcinogenic	1.03×10^{-4}	4.47×10^{-4}

1. IR: Average rate (calculated from EPA 1989a) assumes 1/2 time is spent at activities equivalent to walking (0.8 m^3/hr) and 1/2 time at activities equivalent to pushing a wheelbarrow and simple construction (1.5 m^3/hr). RME rate is standard default exposure factor (SDEF) (EPA 1991b).
2. EF: Estimated duration of construction earth-moving activities.
3. ED: Construction activities assumed to be completed within 1 year.
4. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-8

DERMAL CONTACT WITH SURFACE WATER INTAKE ASSUMPTIONS (CONSTRUCTION)

$$Intake\ Factor = \frac{SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2/day)[1]	840	1,980
PC:	Permeability constant (cm/hr)[2]	Chemical-specific	Chemical-specific
ET:	Exposure time (hours/day)	8	8
EF:	Exposure frequency (days/year)[3]	20	40
ED:	Exposure duration (years)[4]	1	1
CF:	Conversion factor (L/cm^3)	10^{-3}	10^{-3}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[5]		
	Noncarcinogenic	365	365
	Carcinogenic	25,550	25,550
IF:	Intake Factor (L/kg-d)[6]		
	Noncarcinogenic	5.26×10^{-3}	2.48×10^{-2}
	Carcinogenic	7.51×10^{-5}	3.54×10^{-4}

1. SA: The worker is assumed to wear a uniform or civilian clothing appropriate to outdoor work. Average surface area is equivalent to hands; RME surface area is equivalent to forearms and hands (EPA 1989a).
2. PC: Chemical-specific permeability constants are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using PC=1.
3. EF: Estimated duration of construction/earth-moving activities.
4. ED: It is assumed that construction activities will be completed within one year.
5. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.
6. IF: Intake factors are calculated using PC = 1. See footnote 2.

TABLE C-9

DERMAL CONTACT WITH SEDIMENT INTAKE ASSUMPTIONS (FARMER)

$$Intake\ Factor = \frac{SA \times AB \times AF \times FC \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2/day)[1]	1,980	5,170
AB:	Absorbed fraction[2]	Chemical-specific	Chemical-specific
AF:	Adherence factor (mg/cm^2)[3]	0.2	1.0
FC:	Fraction contacted from contaminated source[4]	1.0	1.0
EF:	Exposure frequency (days/year)[5]	2	5
ED:	Exposure duration (years)[6]	9	30
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[7]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-d)			
	Noncarcinogenic	3.10×10^{-8}	1.01×10^{-6}
	Carcinogenic	3.99×10^{-9}	4.34×10^{-7}

1. SA: The worker is assumed to wear civilian clothing appropriate to maintenance or other outdoor work. Average surface area, 1,980 cm^2 is equivalent to hands and forearms; RME surface area (cm^2) is equivalent to forearms, hands, lower legs, and feet (EPA 1989a).
2. AB: Chemical-specific absorbed fractions are given in Table C-26. They are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using AB=1.0.
3. AF: Soil adherence factors are from EPA 1992c.
4. FC: Value of 1.0 assumes all contacted soil is from contaminated area (SWMU).
5. EF: Estimated duration of pump installation and removal.
6. ED: 50th and 90th percentile duration of residence in a single location (EPA 1989a).
7. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-10

INGESTION OF SEDIMENT INTAKE ASSUMPTIONS (FARMER)

$$Intake\ Factor = \frac{IR \times FC \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Ingestion rate (mg/day)[1]	50	100
FC:	Fraction ingested from contaminated source[2]	1.0	1.0
ME:	Matrix effect[3]	0.5	1.0
EF:	Exposure frequency (days/year)[4]	2	5
ED:	Exposure duration (years)[5]	9	30
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[6]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-day)			
	Noncarcinogenic	1.96×10^{-9}	1.96×10^{-8}
	Carcinogenic	2.52×10^{-10}	8.39×10^{-9}

1. IR: 50 mg/day is the default occupational soil ingestion rate recommended in EPA 1991b. RME rate is 2 times the default value and is 10 times the adult rate reported in EPA 1989a.
2. FC: 1.0 assumes 100% of ingested soil is from contaminated source (SWMU).
3. ME: Compounds adhered to soil are commonly less available for absorption than the same compound ingested in solution in laboratory experiments. The soil matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent available for absorption.
4. EF: Estimated duration of pump installation and removal.
5. ED: 50th and 90th percentile duration of residence in a single location (EPA 1989a).
6. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-11

DERMAL CONTACT WITH SURFACE WATER INTAKE ASSUMPTIONS (FARMER)

$$Intake\ Factor = \frac{SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2/day)[1]	1,980	5,170
PC:	Permeability constant (cm/hr)[2]	Chemical-specific	Chemical-specific
ET:	Exposure time (hours/day)	2	2
EF:	Exposure frequency (days/year)[3]	24	48
ED:	Exposure duration (years)[4]	9	30
CF:	Conversion factor (L/cm^3)	10^{-3}	10^{-3}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[5]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
IF:	Intake Factor (L/kg-d)[6]		
	Noncarcinogenic	3.72×10^{-3}	1.94×10^{-2}
	Carcinogenic	4.78×10^{-4}	8.33×10^{-3}

1. SA: The worker is assumed to wear civilian clothing appropriate to outdoor work. Average surface area is equivalent to forearms and hands; RME surface area is equivalent to forearms, hands, lower legs, and feet (EPA 1989a).
2. PC: Chemical-specific permeability constants are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using PC=1.
3. EF: Estimated duration of irrigation equipment maintenance while in use.
4. ED: 50th and 90th percentile duration of residence in a single location.
5. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.
6. IF: Intake factors are calculated using PC = 1. See footnote 2.

TABLE C-12

INHALATION INTAKE ASSUMPTIONS (FARMER)

$$Intake\ Factor = \frac{IR \times ET \times EF \times ED}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Intake rate (m^3/hr)[1]	1.15	2.5
ET:	Exposure time (hrs/day)	2	2
EF:	Exposure frequency (days/year)[2]	24	48
ED:	Exposure duration (years)[3]	9	30
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[4]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
Intake Factor (m^3/kg-day)			
	Noncarcinogenic	2.16×10^{-3}	9.39×10^{-3}
	Carcinogenic	2.78×10^{-4}	4.03×10^{-3}

1. IR: Average rate (calculated from EPA 1989a) assumes 1/2 time is spent at activities equivalent to walking (0.8 m^3/hr) and 1/2 time at activities equivalent to pushing a wheelbarrow and simple construction (1.5 m^3/hr). RME rate is standard default exposure factor (SDEF) (EPA 1991b).
2. EF: Estimated duration of irrigation equipment maintenance while in use.
3. ED: 50th and 90th percentile duration of residence in a single location.
4. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-13

SOIL INGESTION INTAKE FACTORS (ADULT AND CHILD RESIDENTIAL)

$$Intake\ Factor = \frac{IR_{adj}\ x\ FC\ x\ ME\ x\ EF\ x\ CF}{AT}$$

	Parameter	Average		RME	
		Adult	Child	Adult	Child
IR:	Ingestion rate (mg/day)[1]	100	200	100	200
FC:	Fraction ingested from contaminated source[2]	0.5	0.5	1.0	1.0
ME:	Matrix effect[3]	0.5	0.5	1	1
EF:	Exposure frequency (days/year)[4]	275	275	350	350
ED:	Exposure duration (years)[5]	7.2	1.8	24	6
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}	10^{-6}	10^{-6}
BW:	Body weight (kg)	70	15	70	15
AT:	Averaging time (days)[6]				
	Noncarcinogenic	3,285		10,950	
	Carcinogenic	25,550		25,550	
Intake Factor (kg/kg-day)					
	Noncarcinogenic*	7.18×10^{-7}		3.65×10^{-6}	
	Carcinogenic**	9.23×10^{-8}		1.56×10^{-6}	

1. EPA 1991b

Time-weighted ingestion rate:

$$IR_{adj}\ (Average) = \frac{200\ mg/d\ x 1.8y}{15\ kg} + \frac{100\ mg/d\ x\ 7.2y}{70\ kg}$$

$$IR_{adj}\ (RME) = \frac{200\ mg/d\ x\ 6y}{15\ kg} + \frac{100\ mg/d\ x\ 24y}{70\ kg}$$

2. FC: Value of 0.5 assumes that one-half of the soil contacted at the residence is contaminated; 1.0 assumes that 100 percent of the soil at the residence is contaminated.
3. ME: Soil matrix has the effect of reducing the available dose of a compound compared to ingestion of compounds in solution in laboratory experiments.
4. EF: 275 days/year assumes direct contact with soils 75 percent of days spent at residence; 350 days/year is standard default value (EPA 1991b).
5. ED: Exposure duration: 30 years for RME is SDEF. Six years is assumed as child and 24 years is assumed as adult (EPA 1991b). Average ED is 9 years which is the 50th percentile duration of; 1.8 years as a child and 7.2 years as an adult. Ratio of 1.8y/7.2y is equal to 6y/24y.
6. AT: Averaging time for noncarcinogens equals ED * 365 d/y; AT for carcinogens is 70y * 365 d/y.

TABLE C-14

DERMAL CONTACT WITH SOIL INTAKE ASSUMPTIONS (ADULT RESIDENTIAL)

$$Intake\ Factor = \frac{SA \times AB \times AF \times FC \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum[1]
SA:	Surface area (cm^2/day)[2]	2,000	5,300
AB:	Absorbed fraction[3]	Chemical-specific	Chemical-specific
AF:	Adherence factor (mg/cm^2)[4]	0.2	1.0
FC:	Fraction contacted from contaminated source[5]	0.5	1.0
EF:	Exposure frequency (days/year)[6]	275	350
ED:	Exposure duration (years)[7]	9	30
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[8]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-d)			
	Noncarcinogenic	2.15×10^{-6}	7.26×10^{-5}
	Carcinogenic	2.77×10^{-7}	3.11×10^{-5}

1. EPA (1991b) does not provide standard default values for dermal exposures. Values used here are a combination of maximum and reasonable maximum values.
2. SA: Average and RME exposed surface areas are EPA "suggested values" for outdoor activities (EPA 1989a).
3. AB: Chemical-specific absorbed fractions are given in Table C-26. They are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using AB=1.0.
4. AF: Soil adherence factors are from EPA 1992c.
5. FC: 0.5 assumes that 1/2 soil contacted is from the contaminated source; 1.0 assumes that 100 percent of the soil at the residence is contaminated.
6. EF: 275 days/year assumes direct contact with soils 75 percent of days spent at residence; 350 days/year is standard default value (EPA 1991b).
7. ED: 50th and 90th percentile duration of residence in a single location (EPA 1989a).
8. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-15

INHALATION INTAKE ASSUMPTIONS (ADULT RESIDENTIAL)

$$Intake\ Factor = \frac{IR \times ET \times EF \times ED}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Intake rate (m^3/hr)[1]	0.83	0.83
ET:	Exposure time (hrs/day)	16	24
EF:	Exposure frequency (days/year)[2]	275	350
ED:	Exposure duration (years)[3]	9	30
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[4]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
Intake Factor (m^3/kg-day)			
	Noncarcinogenic	1.43×10^{-1}	2.73×10^{-1}
	Carcinogenic	1.84×10^{-2}	1.17×10^{-1}

1. IR:20 m^3/day. EPA 1989a.
2. EF: The rate assumes outdoor exposures to soil are dictated by the weather and would be prevented by precipitation, snow cover, frozen soil, or cold one-fourth of the year.
3. ED: 50th and 90th percentile duration of residence in a single location. EPA 1989a.
4. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-16

DERMAL CONTACT WHILE SHOWERING INTAKE ASSUMPTIONS (RESIDENTIAL)

$$Intake\ Factor = \frac{SA\ x\ PC\ x\ ET\ x\ EF\ x\ ED\ x\ CF}{BW\ x\ AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2/day)[1]	18,200	18,200
PC:	Permeability Constant (cm/hr)[2]	Chemical-specific	Chemical-specific
ET:	Exposure time (hours/day)[3]	0.1	0.2
EF:	Exposure frequency (days/year)[4]	275	350
ED:	Exposure duration (years)[5]	9	30
CF:	Conversion factor (L/cm^3)	10^{-3}	10^{-3}
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[6]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
IF:	Intake Factor (L/kg-d)[7]		
	Noncarcinogenic	1.96×10^{-2}	4.99×10^{-2}
	Carcinogenic	2.52×10^{-3}	2.14×10^{-2}

1. SA: Average of 50th percentile total body surfaces of 1.94 m^2 and 1.69 m^2 for men and women, respectively (EPA 1989a).
2. PC: Chemical-specific permeability constants are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using PC=1.
3. ET: Equivalent to 6- and 12-minute showers, which represent the 50th and 90th percentile values (EPA 1989a).
4. EF: RME rate of 350 days/year (EPA 1991b). Average rate (75% of 365 days/year) accounts for a frequency of less than one shower a day at the residence.
5. ED: 50th and 90th percentile duration of residence in a single location (EPA 1989a).
6. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.
7. IF: Intake factors are calculated using PC = 1. See footnote 2.

TABLE C-17

WATER INGESTION INTAKE ASSUMPTIONS (RESIDENTIAL)

$$Intake\ Factor = \frac{IR \times FC \times EF \times ED}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Ingestion rate (L/day)[1]	1.4	2.0
FC:	Fraction ingested from contaminated source[2]	0.75	1.0
EF:	Exposure frequency (days/year)[3]	350	350
ED:	Exposure duration (years)[4]	9	30
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[5]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-day)			
	Noncarcinogenic	1.44×10^{-2}	2.74×10^{-2}
	Carcinogenic	1.85×10^{-3}	1.17×10^{-2}

1. IR: Adult 50th and 90th percentile total fluid ingestion rates (EPA 1989a).
2. FC: RME assumes 100 percent of ingested fluid is from contaminated source. Average assumes 75 percent of ingested fluid is from contaminated source and 25 percent is from other sources, such as commercially bottled beverages.
3. EF: Average and RME rate of 350 days/year (EPA 1991b).
4. ED: 50th and 90th percentile duration of residence in a single location (EPA 1989a).
5. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-18

INHALATION OF VOCs WHILE SHOWERING INTAKE ASSUMPTIONS (RESIDENTIAL)

$$Intake\ Factor = \frac{IR \times ET \times EF \times ED}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Intake rate (m^3/hr)[1]	0.6	0.6
ET:	Exposure time (hrs/day)[2]	0.1	0.2
EF:	Exposure frequency (days/year)[3]	275	350
ED:	Exposure duration (years)[4]	9	30
BW:	Body weight (kg)	70	70
AT:	Averaging time (days)[5]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	25,550	25,550
Intake Factor (m^3/kg-day)			
	Noncarcinogenic	6.46×10^{-4}	1.64×10^{-3}
	Carcinogenic	8.30×10^{-5}	7.05×10^{-4}

1. IR: Average and RME inhalation rates are Standard Default Exposure Factors (SDEF) for showering (EPA 1991b, Attachment A).
2. ET: Equivalent to 6- and 12-minute showers, which are the 50th and 90th percentile values (EPA 1989a).
3. EF: RME rate of 350 days/year is the SDEF (EPA 1991b). Average rate (75% of 365 days/year) accounts for a frequency of less than one shower a day at the residence.
4. ED: 50th and 90th percentile duration of residence in a single location (EPA 1989a).
5. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-19

DERMAL CONTACT WITH SOIL/SEDIMENT INTAKE ASSUMPTIONS (TRESPASSER)

$$Intake\ Factor = \frac{SA \times AB \times AF \times FC \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2/day)[1]	2,000	5,300
AB:	Absorbed fraction[2]	Chemical-specific	Chemical-specific
AF:	Adherence factor (mg/cm^2)[3]	0.2	1.0
FC:	Fraction contacted from contaminated source[4]	0.25	1.0
EF:	Exposure frequency (days/year)[5]	26	52
ED:	Exposure duration (years)[6]	6	6
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)	51	51
AT:	Averaging time (days)[7]		
	Noncarcinogenic	2,190	2,190
	Carcinogenic	25,550	25,550
Intake Factor (kg/kg-d)			
	Noncarcinogenic	1.40×10^{-7}	1.48×10^{-5}
	Carcinogenic	1.20×10^{-8}	1.27×10^{-6}

1. SA: Average surface area is equivalent to hands (EPA 1989); RME surface area is equivalent to forearms, hands, and lower legs (EPA 1989a).
2. AB: Chemical-specific absorbed fractions are given in Table C-26. They are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using AB=1.0.
3. AF: Soil adherence factors are from EPA 1992c.
4. FC: Average fraction of 0.25 is equivalent to average exposure time of 2 hrs/day at the SWMU: 1.0 is equivalent to an exposure time of 8 hrs/day.
5. EF: Average value of 26 days/year assumes one visit per week to the site over half of the year. RME value of 52 days/year assumes one visit to the site per week over the entire year.
6. ED: Average and RME values assume visits to site from age 10 to age 16.
7. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-20

INGESTION OF SOIL/SEDIMENT INTAKE ASSUMPTIONS (TRESPASSER)

$$Intake\ Factor = \frac{IR \times FC \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Ingestion rate (mg/day)[1]	10	50
FC:	Fraction ingested from contaminated source[2]	0.25	1.0
ME:	Matrix effect[3]	0.5	1.0
EF:	Exposure frequency (days/year)[4]	26	52
ED:	Exposure duration (years)[5]	6	6
CF:	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW:	Body weight (kg)[6]	51	51
AT:	Averaging time (days)[7]		
	Noncarcinogenic	2,190	2,190
	Carcinogenic	25,550	25,550
Intake	Factor (kg/kg-day)		
	Noncarcinogenic	1.75×10^{-9}	1.40×10^{-7}
	Carcinogenic	1.50×10^{-10}	1.20×10^{-8}

1. IR: The average value of 10 mg/d is the rate reported in EPA (1989a) for ages 5 - 18 years. The RME value of 50 mg/day is the default occupational soil ingestion rate recommended in EPA (1991b).
2. FC: Average fraction of 0.25 is equivalent to average exposure time of 2 hours/day at the SWMU. Value of 1.0 assumes 100% of ingested soil is from contaminated source (SWMU).
3. ME: Compounds adhered to soil or food are commonly less available for absorption than the same compound ingested in solution. The soil or food matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent absorption.
4. EF: Average value of 26 days/year assumes one visit per week to the site over half of the year. RME value of 52 days/year assumes one visit to the site per week over the entire year.
5. ED: Average and RME values assume visits to site from age 10 to age 16.
6. BW: Average and RME values are 50th percentile of body weight for male children, ages 12-15 years.
7. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.

TABLE C-21

DERMAL CONTACT WITH SURFACE WATER INTAKE ASSUMPTIONS (TRESPASSER)

$$Intake\ Factor = \frac{SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
SA:	Surface area (cm^2/day)[1]	840	1,980
PC:	Permeability constant (cm/hr)[2]	Chemical-specific	Chemical-specific
ET:	Exposure time (hours/day)	2	8
EF:	Exposure frequency (days/year)[3]	26	52
ED:	Exposure duration (years)[4]	6	6
CF:	Conversion factor (L/cm^3)	10^{-3}	10^{-3}
BW:	Body weight (kg)[5]	51	51
AT:	Averaging time (days)[6]		
	Noncarcinogenic	2,190	2,190
	Carcinogenic	25,550	25,550
IF:	Intake Factor (L/kg-d)[7]		
	Noncarcinogenic	2.35×10^{-3}	4.42×10^{-2}
	Carcinogenic	2.01×10^{-4}	3.79×10^{-3}

1. SA: The recreational receptor is assumed to wear clothing appropriate for outdoor activities. Average surface area is equivalent to hands; RME surface area is equivalent to hands and forearms (EPA 1989a).
2. PC: Chemical-specific permeability constants are used to adjust chemical concentrations for use in calculating risks for the dermal contact route. The intake factors shown here are calculated using PC=1.0.
3. EF: Average value of 26 days/year assumes one visit per week to the site over half of the year. RME value of 52 days/year assumes one visit to the site per week over the entire year.
4. ED: Average and RME values assume visits to site from age 10 to age 16.
5. BW: Average and RME values are 50th percentile of body weight for male children, ages 12-15 years.
6. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.
7. IF: Intake factors are calculated using PC = 1. See footnote 2.

TABLE C-22

INHALATION INTAKE ASSUMPTIONS (TRESPASSER)

$$Intake\ Factor = \frac{IR \times ET \times EF \times ED}{BW \times AT}$$

	Parameter	Average	Reasonable Maximum
IR:	Intake rate (m^3/hr)[1]	1.15	2.5
ET:	Exposure time (hrs/day)	2	8
EF:	Exposure frequency (days/year)[2]	26	52
ED:	Exposure duration (years)[3]	6	6
BW:	Body weight (kg)	51	51
AT:	Averaging time (days)[4]		
	Noncarcinogenic	2,190	2,190
	Carcinogenic	25,550	25,550
Intake Factor (m^3/kg-day)			
	Noncarcinogenic	3.21×10^{-3}	5.59×10^{-2}
	Carcinogenic	2.75×10^{-4}	4.79×10^{-3}

1. IR: Average rate (calculated from EPA 1989a) assumes 1/2 time is spent at activities equivalent to walking (0.8 m^3/hr) and 1/2 time at activities equivalent to pushing a wheelbarrow and simple construction (1.5 m^3/hr). RME rate is standard default exposure factor (SDEF) for industrial activities (EPA 1991b).
2. EF: Average value of 26 days/year assumes one visit per week to the site over half of the year. RME value of 52 days/year assumes one visit to the site per week over the entire year.
3. ED: Average and RME values assume visits to site from age 10 to age 16.
4. BW: Average and RME values are 50th percentile of body weight for male children, ages 12-15 years.
5. AT: ED x 365 days/year for noncarcinogens; 70 years x 365 days/year for carcinogens.
6. IF: Intake factors are calculated using PC = 1. See footnote 2.

TABLE C-23

EPA CARCINOGENICITY WEIGHT-OF-EVIDENCE CLASSIFICATIONS

Group A	Human carcinogen (sufficient evidence of carcinogenicity in humans).
Group B	Probably human carcinogen. B1 Limited evidence of carcinogenicity in humans. B2 Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C	Possible human carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D	Not classifiable as a human carcinogen (inadequate or no evidence).
Group E	Evidence of noncarcinogen for humans (no evidence of carcinogenicity in adequate studies).

TABLE C-24a
REFERENCE DOSES FOR NONCARCINOGENIC CHEMICALS OF CONCERN

Chemical	Noncarcinogenic RfD (mg/kg/d)				Uncertainty Factor		Confidence Level	Critical Effect	Species/Experiment Length/Target Organ
	Inhalation	Source	Oral	Source	Inhal	Oral			
Acenaphthene								Liver toxicity	Mouse, 175 mg/kg/day, gavage, 90 days
Subchronic	ND		6×10^{-1}	2		300			
Chronic	ND		6×10^{-2}	1		3000			
Anthracene							Low	None observed	Mouse, 1,000 mg/kg/d, 90 days.
Subchronic	ND		3×10^{0}	2	NA	300			
Chronic	ND		3×10^{-1}	1	NA	3000			
Antimony							Low	Increased mortality, altered chemistries.	Mouse, 0.35 mg/kg/day, lifetime
Subchronic	ND		4×10^{-4}	2	NA	1000			
Chronic	ND		4×10^{-4}	1	NA	1000			
Barium							Medium	Increased blood pressure; fetotoxicity	Human, 0.21 mg/kg/d, 10 weeks, oral; cardiovascular system; rat, 0.8 mg/m^3, inhalation, 4 months.
Subchronic	1.4×10^{-3}	4	7×10^{-2}	2	100	3			
Chronic	1.4×10^{-4}	4	7×10^{-2}	1	1000	3			
bis-(2-Ethylhexyl)phthalate							Medium	Increased relative weight of liver	Guinea pig, 19 mg/kg/d diet, 1 year; liver.
Subchronic	ND		2×10^{-2}	2	NA	1000			
Chronic*	ND		2×10^{-2}	1	NA	1000			
Butyl benzyl phthalate							Low	Increased liver-to-body weight and liver to brain weight ratios	Rat, 159 mg/kg/day, diet, 6 months, liver
Subchronic	ND		2×10^{0}	2	NA	1000			
Chronic	ND		2×10^{-1}	1	NA	1000			
Cadmium							High	Kidney damage, significant proteinuria	Human, 0.055 mg/kg/d - water, 0.01 mg/kg/d - food; chronic exposure, kidney.
Subchronic	ND		ND		NA				
Chronic*	ND		5×10^{-4} (water)	1	NA	10			
			1×10^{-3} (food)	1		10			
Carbon disulfide							Medium	Fetal toxicity and malformations	Rabbit, inhalation, 62.3 mg/m^3 (oral - 11 mg/kg/day); fetus.
Subchronic	2.86×10^{-3}	2	1×10^{-1}	10	NA				
Chronic	2.86×10^{-3}	2	1×10^{-1}	1	NA	100			
Chlordane							Low	Regional liver hypertrophy in females	Rat, 0.055 mg/kg/d, oral 30 months; liver.
Subchronic	ND		6×10^{-5}	2	NA	1000			
Chronic*	ND		6×10^{-5}	1	NA	1000			

*See slope factor table C-24b
ND = No data
NA = Not applicable

1 Verifiable in IRIS
2 HEAST 1993 and supplements
3 HEAST 1992
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9 HEAST 1992 - Converted from 1.3 mg/L.
10 Chronic oral RfD adopted as subchronic RfD.

TABLE C-24a
REFERENCE DOSES FOR NONCARCINOGENIC CHEMICALS OF CONCERN

Chemical	Noncarcinogenic RfD (mg/kg/d)				Uncertainty Factor		Confidence Level	Critical Effect	Species/Experiment Length/Target Organ
	Inhalation	Source	Oral	Source	Inhal	Oral			
Chromium III							Low	None observed	Rat, 5% diet, 840 days
Subchronic	ND	5	1×10^{0}	2	NA	1000			
Chronic	ND	5	1×10^{0}	1	NA	1000			
Chromium IV							Low	None observed	Rat, 2.4 mg/kg/day; drinking water, 1 year
Subchronic	ND	5	2×10^{-2}	2	NA	100			
Chronic	ND	5	5×10^{-3}	1	NA	500			
Copper								Intestinal irritation	Human, 5.3 mg oral, single dose; gastrointestinal system.
Subchronic	ND		3.7×10^{-2}	9	NA				
Chronic	ND		3.7×10^{-2}	9	NA				
1,2-Dichloropropane							Medium	Hyperplasia of nasal mucosa	Rat, inhalation, 69.3 mg/m^3, 13 weeks; respiratory system (nasal)
Subchronic	3.7×10^{-3}	2	ND			NA			
Chronic	1.1×10^{-3}	1	ND		300				
4,4'-DDT							Medium	Liver Lesions	Rats, 0.05 mg/kg/d oral, 27 weeks; liver
Subchronic	ND		5×10^{-4}	2	NA	100			
Chronic*	ND		5×10^{-4}	1	NA	100			
Di-n-butylphthalate							Low	Increased mortality; fetotoxicity, degeneration of seminiferous tubules	Rat, 125 mg/kg/day, oral, 52 weeks, whole body Mice, 2100 mg/kg/day, oral, throughout gestation.
Subchronic	ND		1×10^{0}	2	NA				
Chronic	ND	2	1×10^{-1}	1	NA	1000			
Ethylbenzene							Low	Developmental toxicity; liver/kidney toxicity	Rabbit, rat, 434 mg/m^3 intermittent inhalation; rabbit-24 days, rat-19 days; fetus; rat, 97.1 mg/kg/d, diet, 182 days; liver, kidney
Subchronic	2.9×10^{-1}	3	1×10^{0}	3	300	100			
Chronic	2.9×10^{-1}	1	1×10^{-1}	1	300	1000			
Fluoranthene							Low	Kidney - nephropathy; liver - increased weight; blood - hematological changes	Mouse, 125 mg/kg/d oral gavage, 90 days; kidney, liver, blood.
Subchronic	ND		4×10^{-1}	2	NA	300			
Chronic	ND		4×10^{-2}	1	NA	3000			

*See slope factor table C-24b
ND = No data
NA = Not applicable

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10 Chronic oral RfD adopted as subchronic RfD.

TABLE C-24a
REFERENCE DOSES FOR NONCARCINOGENIC CHEMICALS OF CONCERN

Chemical	Noncarcinogenic RfD (mg/kg/d)				Uncertainty Factor		Confidence Level	Critical Effect	Species/Experiment Length/Target Organ
	Inhalation	Source	Oral	Source	Inhal	Oral			
Fluorene								Blood - decreased red blood cells	Mouse, 125 mg/kg/day, gavage, 13 weeks
Subchronic	ND		4×10^{-1}	2	NA	300			
Chronic	ND		4×10^{-2}	1	NA	3000			
Isophorone							Low	Kidney, tubular and epithelial cell hyperplasia, mineralization of medullary collecting ducts	Rat, 250 mg/kg/day, oral gavage, 103 weeks; kidney
Subchronic	ND	1,5	2×10^{0}	2	NA	100			
Chronic	ND	1,5	2×10^{-1}	1	NA	1000			
Lead							Low	Altered blood enzyme levels; altered neurobehavioral development - children	
Subchronic					NA	NA			
Chronic*					NA	NA			
Mercury							Low	Neurotoxicity. Kidney effects	Human, 0.009 mg/m^3, intermittent inhalation, nervous system; Rat, parenteral, kidney.
Subchronic	8.6×10^{-5}	2	3×10^{-4}	2,6	30	1000			
Chronic	8.6×10^{-5}	2,6	3×10^{-4}	2,6	30	1000			
Methyl ethyl ketone (MEK)							Low	Decreased fetal birth weight	Rat, 693 mg/m^3, intermittent inhalation, 12 weeks; mouse, 1010 ppm, intermittent inhalation, 10 days, fetus.
Subchronic	3×10^{-1}	2	2×10^{-1}	2	3000	100			
Chronic	3×10^{-1}	1	6×10^{-2}	1,6	3000	1000			
Naphthalene								Decreased weight	Rat, 50 mg/kg/d oral gavage, 13 weeks; whole body.
Subchronic	ND		4×10^{-2}	3,6	NA	1000			
Chronic	ND		4×10^{-2}	3,6	NA	1000			
Nickel							Medium	Decreased body and organ weight	Rat, 100 ppm, diet 2 years; whole body, major organs.
Subchronic	ND		2×10^{-2}	2	NA	300			
Chronic	ND		2×10^{-2}	1	NA	300			
Pentachlorophenol							Medium	Liver and kidney pathology, fetotoxicity	Rat, 3 mg/kg/d oral gavage; liver, kidney.
Subchronic	ND		3×10^{-2}	2	NA	100			
Chronic*	ND		3×10^{-2}	1	NA	100			
Pyrene							Low	Renal tubular pathology, decreased kidney weight	Mouse, 75 mg/kg/d oral gavage, 13 weeks, kidney.
Subchronic	ND		3×10^{-2}	2	NA	300			
Chronic	ND		3×10^{-2}	1	NA	3000			

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10 Chronic oral RfD adopted as subchronic RfD.

TABLE C-24a
REFERENCE DOSES FOR NONCARCINOGENIC CHEMICALS OF CONCERN

Chemical	Noncarcinogenic RfD (mg/kg/d)				Uncertainty Factor		Confidence Level	Critical Effect	Species/Experiment Length/Target Organ
	Inhalation	Source	Oral	Source	Inhal	Oral			
Selenium								Clinical selenosis	Human, 0.853 mg/d diet; whole body.
Subchronic	ND		5×10^{-3}	2		3			
Chronic	ND		5×10^{-3}	1					
Silver							Medium	Argyria	Human, 0.014 mg/kg, orally, 2 to 9 years, skin
Subchronic	ND		5×10^{-3}	2		3			
Chronic	ND		5×10^{-3}	1		3			
Tetrachloroethene							Low	Hepatotoxicity, increased liver weight	Rats, mice, 100-1000 mg/kg/d, oral gavage; 6 weeks.
Subchronic	ND		1×10^{-1}	2	NA	100			
Chronic	ND		1×10^{-2}	1	NA	1000			
Thallium acetate							Low	Liver and blood - increased levels of serum glutamic oxaloacetic transaminase and lactate dehydrogenase	Rat, 0.26 mg/kg/g, oral gavage, 90 days; liver, blood
Subchronic	ND		9×10^{-4}	2		300			
Chronic	ND		9×10^{-5}	1		3000			
Toluene							Medium	Liver/kidney altered weight; CNS neurological effects; eyes/nose irritation	Rats, 223 mg/kg/d oral gavage, 13 weeks, liver, kidney; human, 40 ppm inhalation; human, 80 ppm, inhalation, CNS, eyes, nose
Subchronic	1.1×10^{-1}	7	2×10^{0}	2	300	100			
Chronic	1.1×10^{-1}	1	2×10^{-1}	1	300	1000			
Vanadium								None observed	Rat, 5 ppm, drinking H_2O; lifetime.
Subchronic	ND		7×10^{-3}	2		100			
Chronic	ND		7×10^{-3}	2		100			
Xylenes							Medium	Decreased weight, hyperactivity, increased mortality (males)	Rat, 500 mg/kg/d oral gavage, 13 weeks; whole body.
Subchronic	ND		4×10^{0}	3		100			
Chronic	ND	5	2×10^{0}	1		100			
Zinc (metallic)							Medium	Anemia	Human, 2.14 mg/kg/d; oral, blood.
Subchronic	ND		3×10^{-1}	7		3			
Chronic	ND		3×10^{-1}	1		3			

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9 HEAST 1992 - Converted from 1.3 mg/L.
10 Chronic oral RfD adopted as subchronic RfD.

TABLE C-24b

SLOPE FACTORS FOR CARCINOGENIC CHEMICALS OF CONCERN

Chemical	Carcinogenic Slope Factor $(mg/kg\text{-}d)^{-1}$				EPA Class	Critical Effect	Species/Experiment Length/Target Organs
	Inhalation	Source	Oral	Source			
Benzene	2.9×10^{-2}	1	2.9×10^{-2}	1	A	Leukemia (nonlymphocytic)	Human, inhalation, occupational; blood
Benzo(a)anthracene	6.1×10^{-1}	4	7.3×10^{-1}	4	B2		
Benzo(a)pyrene	6.1	4	7.3×10^{0}	1, 4	B2	Forestomach neoplasia, respiratory neoplasia	Oral - rat, mouse, diet; GI tract; inhalation - hamster 96.4 weeks (intermittent); respiratory tract
Benzo(b)fluoranthene	6.1×10^{-1}	4	7.3×10^{-1}	4	B2	Tumors	Mice
bis(2-Ethylhexyl)phthalate	ND		1.4×10^{-2}	1	B2	Liver carcinoma, adenoma	Rat, oral, diet, 103 weeks; liver
Cadmium	6.1×10^{0}	1	ND		B1	Respiratory system neoplasia	Human, inhalation, occupational; respiratory system
Carbazole	ND		2×10^{-2}	2	B2	Liver tumors	Mouse, diet, 96 weeks; liver
Chlordane	1.3×10^{0}	1	1.3×10^{0}	1	B2	Carcinoma	Mouse, oral, diet; liver
Chloromethane	6.3×10^{-3}	2	1.3×10^{-2}	2	C	Kidney, tumors	Mouse, 24 months; kidney
Chromium (VI)	41	2	ND		A	Respiratory system neoplasia	Human, inhalation, occupational; respiratory system
Chrysene	6.1×10^{-2}	4	7.3×10^{-2}	4	B2		
4,4'-DDE	ND	1	3.4×10^{-1}	1	B2	Thyroid and liver carcinoma, neoplasia	Mouse, rat, hamsters, oral; thyroid, liver
4,4'-DDT	3.4×10^{-1}	1	3.4×10^{-1}	1	B2	Neoplasia	Mouse, rat, diet; liver
Dibenzo(a,h)anthracene	6.1×10^{0}	4	7.3×10^{0}	4	B2		

ND = No data
NA = Not applicable
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3 HEAST 1992
4 EPA 1992h - Region IV Guidance
5 HEAST 1991 - Withdrawn from IRIS. Under review.
6 Calculated from unit risk, see IRIS.

TABLE C-24b

SLOPE FACTORS FOR CARCINOGENIC CHEMICALS OF CONCERN

Chemical	Carcinogenic Slope Factor $(mg/kg\text{-}d)^{-1}$				EPA Class	Critical Effect	Species/Experiment Length/Target Organs
	Inhalation	Source	Oral	Source			
1,2-Dichloroethane	9.1×10^{-2}	2	9.1×10^{-2}	1	B2	Neoplasia of the respiratory, digestive, circulatory, and reproductive systems	Mouse, rat, oral gavage; approximately 100 to 300 mg/kg/day, 78 weeks; whole body
1,2-Dichloropropane			6.8×10^{-2}	2	B2	Liver Tumors	Mouse, oral gavage, 12 months; liver
Indeno(1,2,3-cd)pyrene	6.1×10^{-1}	4	7.3×10^{-1}	4	B2		
Isophorone	ND		9.5×10^{-4}	1	C	Preputial gland carcinoma	Rat, oral gavage, 500 mg/kg/day for 103 weeks
Lead (inorganic)	ND		ND	1	B2	Bilateral renal carcinoma	Rats, diet; kidney
Nickel	8.4×10^{-1}	2			C	Respiratory system tumors	Human, occupational; respiratory system
Pentachlorophenol			1.2×10^{-1}	1	B2	Multiple tumor types	Mice, diet; whole body
Tetrachloroethene	1.8×10^{-3}	5	5.0×10^{-2}	5	B2	Leukemia, liver tumors	Rat, inhalation; mouse, gavage

ND = No data
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4 EPA 1992h - Region IV Guidance
5 HEAST 1991 - Withdrawn from IRIS. Under review.
6 Calculated from unit risk, see IRIS.

TABLE C-25

SUMMARY OF RELATIVE POTENCY ESTIMATES FOR CARCINOGENIC PAHs

	Slope Factor		Relative Potency Factors[2]	Derived Slope Factors[3]	
	Oral	Inhalation[1]		Oral	Inhalation
Benzo(a)pyrene	7.3	6.1	1.0	7.3	6.1
Benzo(a)anthracene			0.1	1.1	0.9
Benzo(b)fluoranthene			0.1	1.0	0.8
Benzo(k)fluoranthene			0.1	0.5	0.4
Chrysene			0.01	0.03	0.03
Dibenz(a,h)anthracene			1.0	8.1	6.8
Indeno(1,2,3-cd)pyrene			0.1	1.7	1.4

[1] The inhalation SF for BaP was withdrawn for further review by EPA in 1993. The value is retained for use in this report to assess inhalation risks.
[2] Source: EPA 1992
[3] BaP SF x Relative Potency Factor

TABLE C-26

DERMAL ABSORBED FRACTION FROM SOIL

Chemical	Soil Absorbed Fraction	Source	Chemical	Soil Absorbed Fraction	Source
Volatile Organics			Semivolatile Organics		
Benzene	0.0005	2	bis(2-Ethylhexyl)phthalate	0.1	3
2-Butanone	0.0005	5	Butyl benzyl phthalate	0.1	3
Carbon disulfide	0.0005	5	Carbazole	0.1	3
Chloromethane	0.0005	5	Di-n-butylphthalate	0.1	3
1,2-Dichloroethane	0.0005	5	Di-n-octyl phthalate	0.1	3
1,2-Dichloropropane	0.03	6	Isophorone	0.1	3
Ethylbenzene	0.03	2	Pentachlorophenol	0.1	3
Tetrachloroethene	0.03	2	Pesticides/PCBs		
Toluene	0.03	2	Chlordane	0.1	3
Trichloroethene	0.0005	2	4,4-DDD	0.03	9
Xylenes	0.03	2	4,4-DDE	0.03	9
Metals			4,4-DDT	0.03	8
Mercury	0.01	7			

1. EPA 1992b. Dermal Absorption Factors for Multiple Chemicals (Union Carbide Corporation, Marietta, Ohio). From Joan S. Dollarhide, Superfund Health Risk Technical Support Center, to Kathleen Warren, USEPA Region V.
2. Ten percent is considered a maximum estimate: See accompanying text. Note that EPA Region IV guidance recommends 1 percent for all organic compounds.
3. Estimated value based on vapor pressure similar to benzene.
4. Estimated value based on vapor pressure similar to ethylbenzene.
5. Dermal absorption of metals in soil other than mercury is considered insignificant compared to direct ingestion; see text. A 1 percent dermal absorbed fraction is adopted as a conservative estimate for mercury adhered to soil.
6. Experimentally measured. EPA 1992c Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, Table 6-1.
7. Assumed to be similar to 4,4-DDT.

APPENDIX D
ECOLOGICAL RISK ASSESSMENT
APPROACH AND METHODOLOGY

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APPENDIX D
ECOLOGICAL RISK ASSESSMENT APPROACH AND METHODOLOGY

D.1 INTRODUCTION

The overall objectives of this ecological risk assessment (ERA) were to assess actual or potential adverse impacts to biota species from SWMU-related chemical constituents in abiotic media (i.e. soil, surface water, and sediments). The results of the ERA are used to support risk management decisions and selection of remedies protective of the environment.

The analysis of ecological risk was on a SWMU-by-SWMU basis or, in a few cases, similar SWMUs in close proximity to each other were combined for analysis (e.g., SWMUs 61, 62, and 63 and SWMUs 92 and 93). Potential receptors, chemical exposure pathways, and risks from each SWMU were addressed. Potential ecological risks off-base were not evaluated.

The data relating to the nature and extent of contamination, and chemical fate and transport were collected to be used for both ecological and human health evaluations. This data is presented in the RCRA Facility Investigation (RFI) Appendix III SWMUs report for Cannon AFB (W-C 1993). The chemicals of concern (COCs) at each SWMU included chemicals with concentrations above background levels and other screening criteria.

The ERA was conducted in accordance with EPA guidance presented in Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual (EPA 1989) and other relevant guidance (EPA 1992a; Sesso and Price 1990).

The scope of the ERA consisted of: an ecological reconnaissance and literature review to identify species and habitats; a review of the chemical data on nature and extent of contamination collected during the site investigation; a review of available literature for toxicity values or other criteria relevant to estimating environmental threat to individuals and populations of a species; evaluation of potential exposure to ecological receptors based on ecological considerations and professional judgement; characterization of risk using available toxicity benchmarks; and a discussion of uncertainties and limitations.

Tissue sampling and toxicity sampling were not within the scope of the ERA. Sufficient sampling of soils, surface water, and sediments was completed during investigation of source areas to satisfy the needs of the ERA site characterization and exposure assessment.

D.2 ECOLOGICAL CHARACTERIZATION AND SELECTION OF KEY RECEPTOR SPECIES

An ecological reconnaissance and literature review were completed to characterize the base-wide and SWMU-specific environments and to identify potential ecological receptors, sensitive habitats, and species of special concern. Previous summary descriptions of Cannon AFB ecology were available in previous baseline risk assessment documents (W-C 1992). No comprehensive ecological survey of Cannon AFB was available. Additional contacts were made with relevant agency personnel, including representatives of New Mexico Game and Fish Department, U.S. Fish and Wildlife Service, and Cannon AFB. A field reconnaissance of Cannon AFB was conducted by a qualified ecologist in October, 1991.

Once an understanding of the ecology of each SWMU was obtained, key receptor species were selected by considering the following criteria:

- Known or likely occurrence in the vicinity of a SWMU
- Potential exposure to SWMU-related chemicals
- Availability of toxicological information for the species or a surrogate species (e.g., mallards as a surrogate for ducks)
- Listing as threatened, endangered, or of special concern by a government agency
- Game or commercially important species
- A key component within a food web
- Habitat and food preferences
- Behavioral characteristics

Selection of key receptors relied in part on professional judgement (e.g. identifying key components of a food web) as well as objective judgements (e.g. listing as a special concern species). Table D-1 lists the key receptor species for each SWMU.

D.3 CHEMICALS OF CONCERN

Ecological chemicals of concern (COCs) are compounds that are likely to be released from a SWMU and may pose a risk to ecological receptors. The process of selecting COCs involves evaluating the maximum detected concentration of each chemical at each SWMU against screening criteria appropriate for each medium to separate concentrations considered safe or background to the area from chemicals that might be released from a SWMU and pose an ecological risk.

D.4 TOXICITY ASSESSMENT

The toxicological characteristics of each COC were evaluated, based on published literature, to identify chemical concentrations in the various media that could potentially result in adverse impacts to individuals or populations. This included assessment of concentrations associated with both acute and chronic effects. Since information on species other than laboratory test animals (e.g. rats and mice) were not available for most COCs, these species were often used as surrogates for identification of potential toxic concentrations for key receptor species occurring at Cannon AFB. Evaluation of toxicity included review of no effect levels (NOELs or NOAELs) and lowest effect levels (LOELs or LOAELs); "toxic" intake levels such as lowest toxic doses (TDLOs), lethal doses causing 50% mortality (LD_{50}s), and lethal concentrations causing 50% mortality (LC_{50}s); and recommended criteria for maximum soils concentrations and animal ingestion. Table D-1 lists the COCs for each SWMU, and Tables D-2 through D-57 present the toxicity information for each COC.

Many published studies present toxicity data as a dietary level. To convert this value to a dose, the dietary level was multiplied by the organism's food consumption rate, and the product was divided by the organism's body weight:

$$\text{dose (mg/kg-bw/day)} = \frac{\text{dietary level (mg/kg-food) x consumption (kg-food/day)}}{\text{body weight (bw) (kg)}}$$

where: consumption/bw is the conversion factor from dietary level to dose.

D.4.1 TOXICITY OVERVIEWS

The following sections provide an overview of the general ecotoxicological nature of some of the principal COC groups, specifically pesticides, total petroleum hydrocarbons (TPH), and metals.

D.4.1.1 Toxicity Overview - Pesticides and PCBs

Pesticides and PCBs are extremely stable compounds and slow to degrade under environmental conditions. The toxicological properties of individual PCBs and pesticides are influenced primarily by two factors: the partition coefficient based on solubility in N-octanol/water (Kow), and steric factors, resulting from different patterns of chlorine substitution. The more highly chlorinated forms of PCBs and pesticides tend to be more persistent, more strongly sorbed, less volatile, and less bioavailable (O'Connor et al. 1990; Sawhney 1988; Strek et al. 1981).

PCBs and pesticides are strongly sorbed in soils, sediments, and particulates in the environment, with levels usually highest in aquatic sediments containing microparticulates (Eisler 1986). Uptake of PCBs and pesticides from contaminated soils and sediments is governed by processes that include both direct incidental ingestion of contaminated soil/sediment particles and indirect ingestion via food webs or from parents to the fetus or embryo. Toxicity reports based on plant (terrestrial) uptake of pure PCBs and pesticides can be misleading because these chemicals are often added to the exposure medium at unreasonably high concentrations to facilitate analysis or they are added to coarse-textured soils extremely low in organic matter (O'Connor 1989).

Retention of PCBs and pesticides in tissues is highly species-specific (Eisler 1986). Since PCBs and pesticides are highly lipophilic, the greatest concentrations occur in fatty tissues. For this reason, PCBs and pesticides are of greatest concern to top trophic level predators. In mammals, PCBs and pesticides are readily absorbed through the gut, respiratory system, and skin. PCBs and pesticides can be transferred to young mammals either transplacentally or in breast milk. In birds, a reduction in eggshell thickness is the endpoint of greatest concern from pesticides, particularly for endangered raptors. At present, however, the evidence implicating PCBs as a major source of eggshell thinning is inconclusive (Eisler

1986). Consideration of the potential effects of PCBs and pesticides is important in the selection of assessment and measurement endpoints for various ecological receptors.

D.4.1.2 Toxicity Overview - Total Petroleum Hydrocarbons

Petroleum hydrocarbons originate from a variety of petroleum-derived fuels including jet fuel, fuel oils, and gasoline. Determination of the actual source material (gasoline versus fuel oil) is not always possible, particularly where site history is unknown. Composition of any given fuel will also vary depending on the source of the crude oil, refinery processes, and product specifications. Also, due to differential volatilization and biodegradation, the composition of the original fuel mixture in the environment is altered over time. Therefore, the toxicity of the insoluble and nonvolatile components remaining some time after a spill is of more interest than the volatile compounds. The impacts of TPH on terrestrial ecosystems are not as well documented as the impacts on aquatic ecosystems. For this reason, and because TPH is a common COC at military installations, an ecotoxicological profile on TPH is presented.

TPH detections may result from a release of gasoline, fuel oils, or kerosene at a site. Each of these TPH types is briefly summarized below from information presented in the ATSDR documents (1993a,b,c):

<u>Gasoline</u>

Typically, gasoline contains more than 150 chemicals including small amounts of benzene, toluene, xylene, and sometimes lead. It is a mixture of relatively volatile hydrocarbons, including alkanes, cycloalkanes, alkenes, and aromatics. Aviation gasoline, which is similar to automotive gasoline, is a mixture of relatively volatile hydrocarbons (primarily C_4-C_{12} paraffins (66-69%), olefins (6-8%) and aromatics (24-27%) including benzene (0.5-5%) to which additives such as dye, tetraethyllead, and antioxidant may be added (IARC 1989a). The volatile hydrocarbon fraction, which consists primarily of short-chain (C_4-C_5) alkanes and alkenes and some aromatics, partitions to the atmosphere, where photochemical oxidation is the primary removal process. Upon release to the environment, gasoline is not transported as a mixture; rather, the various components of the mixture selectively partition to the atmosphere, soil, or water according to their individual physical/chemical properties.

Fuel Oils

Fuels oils are distinguished from each other based primarily on their boiling point ranges, chemical additives, and uses. The basic types of fuels oils are:

- Fuel oil #1 (a straight-run distillate that is basically the same as kerosene) is the most widely used fuel oil and is comparable to JP-5; it is a light distillate that consists primarily of C_9-C_{16} paraffins (53%), cycloparaffins (31%), aromatics (16%), and olefins (0.5%). The benzene content of JP-5 is typically less than 0.02% (IARC 1989b; NTP 1986)

- Fuel oil #1-D = diesel fuel or diesel fuel oil no. 1. Diesel fuels contain predominantly a mixture of C_{10} through C_{19} hydrocarbons, which include approximately 64% aliphatic hydrocarbons, 1-2% olefinic hydrocarbons, and 35% aromatic hydrocarbons.

- Fuel oil #2 = home heating oil, gas oil, or number 2 burner oil. It is a blended distillate with hydrocarbons in the C_{11}-C_{20} range.

- Diesel fuel #2 = a blend of diesel fuel #1 with higher-boiling components. Diesel fuel #2 may contain as much as 5-10% PAHs (IARC 1989c).

- Diesel fuel #4 or marine diesel fuel (a blend of diesel fuel #2 with up to 15% high-boiling residual process streams) (IARC 1989c). Marine diesel fuel may contain roughly 13% paraffins, 44% aromatics, and 44% naphthalene (NTP 1986). Marine diesel fuel may also contain greater than 10% PAHs (IARC 1989c). Residual fuel oils are generally more complex in composition and impurities than distillate fuel oils; therefore, a specific composition cannot be determined (USAF 1989). Sulfur content in residual fuel oils has been reported to be from 0.18% to 4.36% by weight.

Jet Fuels (JP-4 and JP-7)

Jet fuels are typically made by blending and refining various crude oil petroleum products such as naphtha, gasoline or kerosene in order to meet specific military or commercial specifications. Therefore, there are many types of jet fuel and each jet fuel is not specified by chemical composition. JP-4 is made from the distillation products obtained over a wide range of temperatures and has a broad spectrum of hydrocarbon chain lengths varying from C_4 to C_{16}. JP-4 is also made by blending and refining shale oil distillate streams. JP-7 is made by blending kerosene distillate in order to achieve a product containing a maximum of 5% aromatics by volume and a maximum total weight of 0.1% sulfur (CRC 1984; IARC 1989d).

The individual components of jet fuels can be categorized into basic groups: paraffins (saturated straight-chain hydrocarbons), cyclo-paraffins (saturated cyclic hydrocarbons), aromatics (fully unsaturated six-carbon ring compounds), and olefins (unsaturated straight-chain and cyclic hydrocarbons). Paraffins and cycloparaffins are the major components and comprises about 90% by volume (79% by weight) of JP-4. Aromatics make up 10-25% by volume of JP-4 but only about 5% of JP-7. Fate and transport of jet fuels are ultimately related to chemical properties of the component hydrocarbons (e.g., benzene, toluene, xylene, naphthalene, etc.). Jet fuels may also contain low levels of nonhydrocarbon contaminants as additives, such as sulfur compounds, gums, alcohols, naphtheic acids, antioxidants metal deactivators, and icing and corrosion inhibitors (CRC 1984; IARC 1989d).

D.4.1.2.1 Relevant Toxicity of TPH Mixtures

Many toxicological and epidemiological studies have been performed on common petroleum hydrocarbon mixtures to predict general toxic properties. Petroleum hydrocarbon mixtures, and typical components of these mixtures, have low acute toxicities, with oral LD_{50}s in experimental animals above 5 g/kg-bw/day. Compounds with LD_{50}s between 5 and 9 g/kg-bw/day are generally considered nontoxic by toxicologists. However, some lethal and adverse effects values less than 5 g/kg-bw/day (5,000 mg/kg-bw/day) are reported in recent literature (ATSDR 1993a,b,c). These are described briefly below.

- Oral exposure to 4000 mg/kg-bw/day kerosene was lethal to 10-day old rats.

- A significant increase in number of deaths was noted in female mice following chronic dermal exposure to marine diesel fuel or JP-5 at doses of 250 and 500 mg/kg-bw/day for 1 to 2 weeks. Acute (24-hour) dermal application of 2000 mg/kg shale-derived JP-4 or petroleum-derived JP-4 did not result in mortality to rabbits after a 24-hour, 14-day regimen.

- Dermatosis from dermal exposure occurred at 13-week exposure to 4,000 mg/kg-bw/day in rodents for marine diesel fuel.

- Chronic exposure to 500 (but not 250) mg/kg-bw/day JP-5 and 250 and 500 mg/kg-bw/day marine diesel fuel in rodents induced body weight reduction relative to controls.

- Adverse gastrointestinal effects were noted in rats administered 2000 mg/kg-bw/day unleaded gasoline by gavage for 4 weeks.

In a recent EPA memorandum (EPA 1992b), provisional oral reference doses for gasoline, JP-4, JP-5, and diesel fuel were developed for human health based on rat and mouse inhalation studies (these reference doses are under current review and subject to revision). Assuming the derivation of oral ingestion dose values from inhalation studies is an appropriate and acceptable methodology (i.e., absorption by inhalation and oral routes are equal), one may use these provisional dose values, without the human health safety factors applied, as a basis for estimating "effects" and "no-effects" levels in small mammals. When using the experimental doses to evaluate the potential for adverse effects, however, it should be kept in mind that they are derived from experiments using fresh fuels, which differ in composition from the weathered products at an old spill. The provisional EPA dose values for various fuels are presented in Table D-57 (EPA 1992b). No-effects dose and dietary levels are estimated for each of the constituents based on reduction factors of 5 for toxic effects and 10 for lethal effects (EPA 1986). The no-effects and effects dose values presented in Table D-57 were used in selecting benchmarks in the Cannon ERA.

Male laboratory rats are unusual compared to other laboratory animals because they exhibit renal histopathic changes (male rat hyaline droplet nephropathy and its sequelae, including renal tumors) at substantially lower oral dose levels of TPH than those reported in the preceding paragraphs and Table D-57 for gasoline and other fuel mixtures. The LOAEL for rats from oral exposure to gasoline is reported at 30 mg/kg-bw/day (9 days), which is an order of magnitude lower than effects dose levels for the JP-4 and JP-5 fuel oils and gasoline (Olson et al. 1987). This effect only occurs in male rats and has been found to be related to the presence of a low-molecular weight protein called $alpha_{2u}$-globulin in these animals. Available evidence suggests that humans are not likely to experience these effects as it is genetically based (EPA 1991a). It is not known whether this effect may occur in small rodents in the wild. This lowest LOAEL value was not used as a toxicological benchmark in the Cannon ERA.

D.4.1.2.2 Relevant Toxicity of TPH Constituents

The potential toxicity of TPH is frequently assessed based on the toxicity of individual constituents, rather then by assessing the whole mixture. The primary constituents of petroleum components, such as paraffins and naphthenes, are generally not considered to be highly toxic (Amdur et al. 1991; Clayton and Clayton 1981) and are typically not included as COCs in standard risk assessments. Aromatic constituents such as benzene and xylene and the carcinogenic PAH compounds are the primary COCs for risk assessments. Noncarcinogenic compounds, such as toluene, ethylbenzene, xylenes, naphthalene, and other noncarcinogenic PAH compounds, may be of concern because of their potential acute toxic effects. The BTEX and PAH compounds are currently used in characterizing potential risks and cleanup requirements for TPH because these chemical groups include the most toxic known TPH constituents and represent a broad range of physical and chemical properties influencing environmental mobility.

While available evidence suggests that typical TPH mixtures are not particularly toxic, certain constituents of petroleum products do have potential carcinogenic or toxic properties. TPH mixtures do not bioaccumulate in terrestrial food chains per se. However, the individual components comprising the mixture may bioaccumulate depending on their individual properties. In general, the alkene (e.g., pentene, butene, hexene) will not tend to

bioaccumulate, the aromatics have a moderate tendency to bioaccumulate, and the higher molecular weight alkanes will tend to bioaccumulate.

PAHs can accumulate to some extent in terrestrial plants. Atmospheric deposition on leaves, however, is likely to be a more significant pathway than uptake from soil by roots (Vaughn 1984). Uptake of PAHs by plant roots are dependent on numerous factors including concentration, solubility, molecular weight of the PAH, and on the plant species (Edwards 1983). Ratios of PAH concentrations in vegetation to those in soil ranged from 0.001 to 0.18 for total PAHs and from 0.002 to 0.33 for benxo(a)pyrene (Edwards 1983).

Small mammals which burrow and ingest soil are likely to be the ecological receptors with the greatest potential exposure and risk from PAHs. Data are generally lacking on the acute and chronic toxicity of PAHs on avian wildlife (Eisler 1987). Eisler (1987) reports PAHs show little tendency for bioconcentration or biomagnification, particularly in terrestrial ecosystems, probably because most PAHs are rapidly metabolized. Beyer and Stafford (1993) also found PAH concentrations in earthworms to be well below soil levels. Gile et al. (1982), however, report fairly high bioaccumulation factors for terrestrial species. In their 3-month mesocosm experiment using creosote coal tar distillate (which contained 21% phenanthrene and 9% acenapthene), PAH concentrations in various animals were found to be elevated over average PAH in soil concentrations of 0.6 ppm phenanthrene and 1.19 ppm acenaphthene. Bioaccumulation factors for phenanthrene were as follows: snail = 5; pill bugs = 3; earthworm = 30; and vole = 12. Bioaccumulation factors for acenaphthene were as follows: snail = 3; pill bugs = 1; earthworm = 15; and vole = 31.

In general, PAHs are rapidly metabolized and considered unlikely to biomagnify despite their high lipid solubility (Eisler 1987). The intermediate metabolites, however, have been identified as mutagenic, carcinogenic, and teratogenic agents (Sims and Overcash 1983). In most cases, the process of carcinogenesis occurs over a period of many months in experimental animals, although for some PAHs, malignancies may be induced by acute exposures to microgram quantities. Amphibians, are reported as quite resistant to PAH carcinogenesis when compared to mammals due the amphibian's inability to produce mutagenic metabolites of benzo(a)pyrene and perylene. (Anderson et al. 1982).

As noted above, the toxicity of aged TPH mixtures may be based on individual constituents. Oral toxicity values in laboratory rodents for the major constituents are presented in Table D-58. No-effects levels are estimated for each of the constituents based on reduction factors of 5 for toxic effects and 10 for lethal effects (EPA 1986). These effects and no-effects dose values were used in the selection of benchmark values in the Cannon ERA. It should be noted, however, that some petroleum products, such as the fuel oils, appear to be eye and skin irritants in both animals and humans following direct contact. It is possible that such effects may serve as a deterrent for animals in the wild and preclude exposure at potentially toxic levels.

D.4.1.2.3 Fate and Transport of TPH in Terrestrial Ecosystems

The environmental fate of TPH is based on the environmental partitioning of the major hydrocarbon fractions. For low molecular weight alkanes, volatilization followed by photooxidation are the primary degradation processes; for larger aliphatics, sorption to organic matter and biodegradation are the primary mechanisms affecting fate (Gearing et al. 1980; Oviatt et al. 1982). Aromatic hydrocarbons can be dissolved in the aqueous phase in both soil and water and may undergo volatilization. The extent of absorption by inhalation, dermal, and/or oral routes to organisms depends on the volatility, solubility, lipophilicity, and other properties of the specific TPH components.

While TPH will generally biodegrade, the amount of time required depends on numerous environmental factors such as soil/sediment and aerobic conditions. Evaporation is the primary fate process for the aliphatics (USAF 1989). Microbial degradation in soils is greater for the aromatic fractions of fuel oils, while the biodegradation of the aliphatic hydrocarbons decreases with increasing carbon chain length. Hydrocarbons with condensed ring structures such as the PAHs and cycloalkanes are relatively resistant to biodegradation. Isoalkanes and 1,3,5-trimethylbenzene have also been reported to be resistant to biodegradation (ATSDR 1993c).

Many of the hydrocarbon components of gasoline have been found to undergo aerobic biodegradation in surface water, sediment, and soil. Microbial activity becomes important about 1 week after the spill, after initial hydrocarbon losses have occurred through volatilization and photooxidation. Of the hydrocarbon components of gasoline, only xylene,

trisubstituted benzenes, and naphthalene have been reported to undergo photolysis and photooxidation in aqueous solution. Alkanes, benzenes, and monosubstituted benzenes have been found to be resistant to photolytic breakdown in aqueous systems.

A number of experiments have been conducted to determine biodegradation times and delayed effects for TPH spills in terrestrial systems. Seed germination studies using contaminated soil 1 year after a spill (0.34%= 3400 ppm) showed that kerosene delayed seed germination, but that percent germination was unaffected (Dibble and Bartha 1979). Landfarming techniques (tillage of soil using agricultural implements) developed in the Netherlands to enhance biodegradation of contaminants, demonstrated that after one growing season, kerosene (initial concentration of 1,000-10,000 mg/kg dry matter) was significantly degraded (final concentration of 500 mg/kg dry matter in 40 cm of soil (Soczo and Staps 1988). Seven years after the dumping of sludge containing kerosene at two sites, vegetation at each site showed little recovery. Although the bacterial biomass had declines at both sites, microbial activity, as determined by carbon dioxide evaluation, was greater at the site that had received more precipitation and had more aerated soils (Jones 1977). Biodegradation may also be limited by available nitrogen in a system (ATSDR 1993b).

In one fuel oil spill in Massachusetts, aromatics such as naphthalene and phenanthrene were still present in marsh sediments at concentrations above background 6.5 years after the spill (Teal et al. 1978). Even 8 years after the spill, some sediments contained over 1200 ppm TPH with naphthalene and heavier aromatics expected to persist for many years (Burns and Teal 1979).

D.4.1.3 Toxicity Overview - Metals

Several metals, while potentially toxic, are also essential elements for plants and animals, e.g., zinc. The toxicity of the element depends foremost on its chemical form. For example, chromium (+3) occurs naturally and is common in the environment and has a relatively low toxicity. Chromium (+6) is largely related to anthropogenic releases and is very toxic, but is readily reduced in the environment to chromium +3. Much of the literature does not specify the chemical form of an element when discussing its toxicity to biota. It was assumed in these instances that only the total concentration of the metal was known.

To be toxic an element must be "available" to the receptors. In order for this to occur, the chemical must exist in a form that can enter tissues of the organisms. Total amounts of a chemical in the environment are not relevant to an adequate estimation of toxicity hazard unless it can be shown that the element exists in or is likely to assume, an available form under the environmental conditions in which it occurs and animals or plants are likely to contact this form either directly of indirectly (Gough et al. 1980).

The toxicity of a substance is generally determined in aquatic systems by the lethal concentration (in the water or sediment) and in terrestrial systems by either the lethal concentration in the media or by the lethal dose (in relation to body weight). Lethal concentrations and doses are also usually expressed in terms of an exposure duration. Amounts of a chemical in relation to body weight are typically expressed as ingested amounts on a daily basis, i.e., milligram per kilogram per body weight per day (mg/kg-bw/day). Exposure concentrations for aquatic organisms and dietary concentrations for terrestrial organisms are expressed as mg/l or mg/kg diet. Exposure duration for terrestrial studies is usually expressed in terms of acute (14 days or less), intermediate (15-364 days) or chronic exposure (365 days or more). Dietary concentrations are reported on a wet weight basis in most toxicological studies. Comparison with dry weight dietary concentrations may be ignored as the moisture content of laboratory diets is typically less than 10 percent (Beyer and Stafford 1993).

Plants

Plants are intermediate reservoirs through which trace metals from primary sources move to other living things. Plants may be passive receptors of trace metals, as in root adsorption, or they may accumulate and store metals in nontoxic forms for later distribution and use (Tiffin 1977). A mechanism of tolerance in some plants apparently involves binding of potential toxic metals at the cell walls of roots and leaves, away from sensitive sites within the cell. The metal forms which occur in plants appear to have a decisive role in metal transfers to other organisms (Tiffin 1977).

There are a large number of processes that operate to regulate metal cycling, including ion exchange, adsorption, formation of organic complexes, and precipitation. All these have different, and often opposing effects; and all are very dependent on pH, Eh, and soil/sediment

characteristics. Since site conditions vary so much in these respects, both spatially and temporally, metal reactions and fates often vary. In addition to environmental variability, there are differences due to plant physiology and genotype (Outridge and Noller 1991). Therefore, it is very difficult to extrapolate from one study location or plant to another.

As described in Dunbabin and Bowmer (1992), there are some general trends that have been noted. Potential bioavailability generally increases with increases in acidity, reducing power, salinity, and concentration of organic ligands. However, if sulfur is present, a reducing environment will result in the production of insoluble metal sulfides. Other specific factors that influence bioavailability include sediment size (clay provides more surface area for adsorption and reactions), presence of hydrous iron and manganese oxides (which adsorb metals), and the nutrient regime (which, for example, affects the ability of microbes to transform elemental mercury to methylmercury) (Stewart et al. 1992).

Terrestrial Fauna

All metals, whether essential or nonessential, can adversely affect terrestrial organisms, if included in the diet at excessively high levels. Considerable information is available on the tolerance levels and toxicity of metals to domestic animals. Information on the toxicity of a few metals (cadmium, chromium, selenium, and mercury) to aquatic and terrestrial wildlife is summarized in a series of contaminant hazard reviews by Eisler (1985-1989). In general, tolerance levels vary from animal to animal and even from day to day in a single animal (NAS 1980). Many factors, such as age and physiological status of the animal (growth, lactation, etc.), nutritional status, levels of various dietary components, duration and route of exposure, and biological availability of the compound, influence the level at which a metal may cause an adverse effect in the organism (NAS 1980). Exposure of animals to excessively high concentrations of metals can result in acute signs of toxicosis, which may be quite different from the chronic effects displayed after the metal has been ingested at higher than normal levels over an extended period of time. Adverse chronic effects such as changes in behavior or reproduction potential are often difficult to measure, if they can be measured at all, particularly in wild populations. Such adverse chronic effects are not necessarily important unless they affect the reproductive potential of a population, particularly for those species which are threatened or endangered.

D.4.2 BENCHMARK VALUES

Benchmark values were selected for each COC based on the toxicity assessments mentioned above (Tables D-2 through D-57). Benchmark values represent concentrations key receptors could intake without experiencing toxicological effects. Benchmark values were selected for small mammals, large mammals, and birds representing the key receptor species at all SWMUs (i.e., deer mouse, coyote, robin, northern harrier, mallard, and black-crowned night heron). To select benchmark values, the following criteria were used in the order shown:

- Highest chronic or intermediate NOAEL, if available
- Lowest chronic or intermediate LOAEL, times a reduction factor of 1/5, if available
- Lowest acute LOAEL or LD_{50}, times a reduction factor of 1/10

Reduction factors were applied to convert LOAELs and LD_{50}s to levels assumed comparable to NOAELs. The reduction factors do not account for inter-species differences or other uncertainties, which are discussed in Section D.7. Table D-59 presents the benchmark values that were selected for each COC.

For several of the COCs, especially some of the metals, the selection of benchmark values was more complex than as described above due to factors such as the various forms in which a chemical might occur in the environment, bioavailability, and interspecies variabilities. Following are detailed explanations of the selection of benchmark values for the COCs where it was felt necessary to incorporate these factors, to the best extent possible, into the benchmark values.

Aluminum

The direct toxic potential of aluminum is low compared to that of many other metals (Scheuhammer 1987). The main factors that can either increase or decrease the severity of aluminum toxicity are the phosphorous level in the diet and the solubility of the aluminum source (NAS 1980). The chronic toxicity of orally ingested aluminum is probably more a function of its disruptive effects on calcium (Ca) and phosphorous (P) homeostasis than a direct toxicity of aluminum itself (Scheuhammer 1987). Levels of aluminum below 0.1%

(1,000 mg/kg) of the diet are generally without adverse effects on Ca and P metabolism of the overall health of the animal, but higher levels may result in decreased growth rates and muscle weakness and concurrent disturbance of Ca and P metabolism (Scheuhammer 1987).

A benchmark dose of 300 mg/kg-bw/day for birds was selected based on a chronic dietary NOAEL of 1500 mg/kg aluminum sulfate for juvenile ring doves (Scheuhammer 1987). A benchmark dose of 197 mg/kg-bw/day was selected for small mammals based on a NOAEL in water of 1579 mg/l of aluminum sulfate for rats (Berlyne et al. 1972). Selection of these benchmarks assumes the solubility, and therefore toxicity, of the aluminum form is low.

Barium

The recommended maximum tolerable level of barium in a domestic animal's diet is 20 mg/kg (NAS 1980). The toxicity of orally ingested soluble barium salts in various mammals is low compared to other elements such as lead, cadmium, and mercury. There appears to be a wide variability in the lethal dose of soluble barium among species. Even though the barium ion, Ba^{+2}, is toxic when absorbed, barium sulfate ($BaSO_4$), the form commonly found in the environment, is so slightly soluble that it is nontoxic (API 1970).

The benchmarks for birds and small mammals are based on the soluble forms of barium. A benchmark of 250 mg/kg-bw/day for birds was selected based on a NOAEL level of 1000 mg/kg barium acetate in drinking water of chickens (Johnson et al. 1986 in EPA 1990). A benchmark for small mammals of 31 mg/kg-bw/day was selected based on a chronic NOAEL of barium chloride in drinking water of rats (Tardiff et al. 1980).

Cadmium

Toxicity benchmark values for cadmium have a high degree of uncertainty as there is little evidence that cadmium has caused toxic effects in wild terrestrial animals (Beyer and Stafford 1993). Chemical form for cadmium is not as important a consideration with respect to bioavailability as compared to lead. Mice were found to retain about as much cadmium from a diet of oysters, which contain metallothionein-bound cadmium, as from a diet of $CdCl_2$, the form commonly used in toxicity tests (Sullivan et al. 1984). However, among small laboratory mammals, it appears that physiologically bound cadmium is more effective than

$CdCl_2$ in producing metabolic iron irregularities (Eisler 1985). Ducklings may be more sensitive to cadmium than adult ducks.

A benchmark dose of 0.42 mg/kg-bw/day for birds was selected based on dietary levels of 12 mg/kg (estimated dose of 2.1 mg/kg-bw/day) in chickens that resulted in decreased egg production and eggshell thickness. Although no adverse effects were reported at dietary levels of 200 mg/kg (approximate dose of 40 mg/kg-bw/day) in mallard adults (White and Finley 1978), reproductive effects may not have been evaluated. A benchmark value of 0.4 mg/kg-bw/day was selected for small mammals based on a chronic LOAELs reported by Schroeder and Mitchener (1971a,b).

Chromium

Chromium (Cr) is an essential element to mammals (Eisler 1986). Cr^{+3}, which is typically found in the environment, has a low order of toxic effects. Doses of up to 650 mg/kg-bw/day Cr^{+3} in rats have produced no overt toxicosis and levels of up to 1000 mg/kg supplementary Cr^{+3} in diets produced no effects in chicks (NAS 1980). Maximum tolerable dietary level for domestic animals are set at 3000 mg/kg chromium as the oxide and 1000 mg/kg as the chloride (NAS 1980). The current RfD for Cr^{+6} for humans is based on a no-effects dose level of up to 11 mg/kg-bw/day in drinking water of rats.

Benchmark dose values for birds of 17.5 mg/kg-bw/day for Cr^{+6} and 175 mg/kg-bw/day for Cr^{+3} were selected based on studies reviewed in NAS (1980). Benchmark dose values for small mammals of 11 mg/kg-bw/day for Cr^{+6} (IRIS 1993) and 650 mg/kg-bw/day for Cr^{+3} were selected (NAS 1980).

Cobalt

Cobalt is an essential element, particularly for ruminants, and a deficiency of cobalt is more likely to occur than toxic effects (NAS 1980). Poultry are able to tolerate 10 mg/kg in diet (NAS 1980). A benchmark dose of 1.75 mg/kg-bw/day was selected for poultry based on this tolerable dietary level.

Copper

Maximum recommended tolerable levels of dietary copper for domestic animals are: poultry 300 mg/kg; rabbits 200 mg/kg; rats 1000 mg/kg; sheep 25 mg/kg; cattle 100 mg/kg; swine 250 mg/kg; and horses 800 mg/kg (NAS 1980). The levels of dietary copper that are toxic are somewhat species-dependent and usually positively correlate with dietary levels of molybdenum and inorganic sulfur (NAS 1980).

A benchmark dose level of 52 mg/kg-bw/day was selected based on the recommended maximum tolerable dietary level of 300 mg/kg for chickens and the chronic NOAEL dietary level of 300 mg/kg for turkeys (NAS 1980). A benchmark dose of 6 mg/kg-bw/day was selected for small mammals based on a maximum tolerable dietary level of 200 mg/kg in rabbits (NAS 1980).

Cyanides

Cyanides are highly toxic compounds that are readily absorbed and cause death by preventing the use of oxygen by tissues (Wiemeyer et al. 1986). The fate of cyanide in aquatic systems varies widely. In general, the cyanides occur in water as (1) free hydrocyanic acid (HCN), (2) simple cyanides (alkali and earth cyanides), (3) easily decomposable complex cyanides such as $Zn(Cn)_2$, and (4) relatively stable iron-complex cyanides.

A benchmark dose of 0.4 mg/kg-bw/day was selected for birds based on the single dose LD_{50} of 3.0-5.3 mg/kg-bw/day sodium cyanide for American kestrels (Wiemeyer et al. 1986). A benchmark dose of 0.06 mg/kg-bw/day for mammals was selected based on the LDLo (lethal dose low) for hamsters of 0.57 mg/kg-bw/day HCN (Lewis 1992). A benchmark for coyote of 0.4 mg/kg-bw/day was also available based on the LDLo for dogs of 4 mg/kg-bw/day HCN (Lewis 1992). It should be noted that these selected benchmarks are each well below the NOAEL dose of 10.8 mg/kg-bw/day for HCN and rats, the dose value used as the basis for the human reference dose (RfD).

Lead

The chemical form of lead at the Cannon SWMUs are unknown. Although organic lead forms (such as tetraethyl, tetramethyl, or triethyllead from leaded fuels) are generally more toxic (LD_{100} = 28 mg/kg-bw for triethyllead) and bioavailable than lead acetate forms, chemical lead forms in soils at Cannon AFB are probably aged or oxidized and therefore less toxic or bioavailable than lead acetate.

For birds, 17.5 mg/kg-bw/day lead acetate (Damron et al. 1969) is the highest chronic NOAEL or highest serious non-lethal chronic LOAEL (enzyme effects such as ALAD depression are not considered as a serious adverse effect). Chronic metallic lead and biologically incorporated lead NOAEL/LOAELs are higher because of low bioavailability; i.e., 44.8 mg/kg-bw/day for biologically incorporated lead and 72 mg/kg-bw/day for metallic lead. However, as mentioned above, these forms of lead are not expected to occur at the Cannon SWMUs. A benchmark value of 18 mg/kg-bw/day was selected for small mammals (mice) based on a chronic LOAEL of 90 mg/kg-bw/day for lead acetate in rats (Chowdbury et al. 1984). The benchmark value for small mammals was also used for larger omnivorous mammals such as the coyote.

Mercury

The suggested maximum tolerable dietary level for mercury in domestic animals is 2 mg/kg (approximate dose level of 0.4 mg/kg-bw/day for birds and 0.24 mg/kg-bw/day for small mammals) for both the organic and inorganic forms (NAS 1980). The toxicity and concentration of mercury in living organisms, however, depends on the type of organism and the form of mercury to which the organism is exposed. Dietary mercury levels as low as 13 mg/kg can be lethal to kestrels, but approximately 10 mg/kg caused no death or weight loss in pheasants (Scheuhammer 1987). Biomethylation and biomagnification of inorganic mercury occurs in the environment or the animal and increases the potential for toxicity. In a salt marsh study by Gardner et al. (1978 in Scheuhammer 1987), total mercury in sediment samples ranged from 0.06 to 1.7 mg/kg (dry weight) and none of the samples contained measurable methylmercury. Various invertebrates contained total mercury concentrations in the range of 0.3 to 9.4 mg/kg and a significant proportion was methylated (0.1 to 0.6 mg/kg). In several fish species, total mercury in muscle tissue ranged from 0.3 to 2.4 mg/kg and a high proportion, often close to 100%, was methyl mercury.

A benchmark dose of 0.06 mg/kg-bw/day for birds was selected based on hatchling mortality and adverse reproductive effects from organic mercury in mallards at dietary levels of 3 mg/kg (approximate dose of 0.6 mg/kg-bw/day)(Heinz 1976 in Beyer and Stafford 1993; Scheuhammer 1987) and 0.5 mg/kg (approximate dose of 0.1 mg/kg-bw/day) for 3 generations in mallards (Heinz 1979). The benchmark dose of 0.08 mg/kg-bw/day for mammals was based on dietary studies with mink (100% mortality at 5 mg/kg; approximate dose of 0.78 mg/kg-bw/day) (Sheffy and St. Amant 1982).

Selenium

Food-chain organisms such as zooplankton, benthic invertebrates, and certain forage fishes can accumulate up to 30 mg/kg dry weight selenium (some taxa up to 370 mg/kg) with no apparent effect on survivability or reproduction (Lemly 1993). However, the dietary toxicity threshold for wildlife may be as low as 3 mg/kg; thus, food-chain organisms may supply a toxic dose of selenium while being unaffected themselves (Lemly 1993).

A benchmark dose of 1.0 mg/kg-bw/day was selected for birds based on a chronic dietary LOAEL (reproductive impairment) of 10 mg/kg (estimated dose of 2 mg/kg-bw/day) for mallard ducks (Heinz et al. 1987 in EPA 1993). A benchmark dose of 0.015 mg/kg-bw/day was selected for small mammals based on a chronic dietary LOAEL (selenosis) in rats of 1 mg/kg (approximate dose of 0.075 mg/kg-bw/day) (Harr 1978).

Zinc

Zinc is an important nutrient for birds and mammals. For most species, overt toxic effects of zinc first appears when levels around 1000 mg/kg are incorporated into a natural-ingredient diet with many nutrients above required levels (NAS 1980). With diets containing marginal levels of nutrients, less zinc may produce adverse health effects. Maximum tolerable levels of 300 to 1000 mg/kg in diet appear to be safe depending on the species (NAS 1980).

Based on the toxicity literature reviewed, dose levels at and above 250 mg/kg-bw/day are required before adverse effects begin to occur. Mortality may occur at dose levels at or above 525 mg/kg-bw/day. A benchmark dose for birds of 175 mg/kg-bw/day was selected based on a chronic dietary NOAEL of 1000 mg/kg for chickens (Gassaway and Buss 1972).

Adverse effects in domestic mammals (sheep, pigs) are generally seen at dietary levels of 1000 mg/kg (approximate dose level of 40 mg/kg-bw/day) (NAS 1980). Higher no-effects levels for rats (2500 mg/kg in diet; approximate dose of 188 mg/kg-bw/day) are reported (Underwood 1971). Based on the recommended maximum tolerable level of 1000 mg/kg in diet of domestic animals (NAS 1980), a benchmark dose level of 75 mg/kg-bw/day for small mammals was selected using food intake and weight of a rat.

D.5 EXPOSURE ASSESSMENT

The exposure assessment included an evaluation of each potential source-receptor pathway for completeness and significance, including completion of conceptual site models (CSMs) for ecological exposures at each SWMU; review of exposure points and concentrations; evaluation of chemical intake by key receptors; and estimation of exposure duration, frequency, and area.

A CSM is a schematic representation of exposure pathways from the chemical source media through potential intake routes to potential receptors. A complete exposure pathway requires five basic elements:

- A source of chemicals
- A mechanism of chemical release
- An environmental transport medium
- An exposure point where receptors are present
- An intake route (e.g. ingestion, direct contact)

If one of these elements is missing, the pathway is not complete and ecological exposure cannot occur. Only pathways considered complete were considered in the risk characterization.

D.6 RISK CHARACTERIZATION

Toxicity of chemicals to individual organisms (receptors) can have consequences at the population, community, and ecosystem level. Population level effects may determine the nature of changes in community structure and function, such as reduction in species diversity,

simplification of food webs, and shifts in competitive advantages among species sharing a limited resource. Ecosystem functions may also be affected by chemicals, which can cause changes in productivity or disruption of key processes such as litter decomposition. Most ecological assessments focus on population measures as endpoints, because population responses are more well-defined and predictable with available data than are community and ecosystem responses. In general, this ERA evaluated impacts to receptor populations resulting from mortality, morbidity, and reproductive effects. Toxicological data for effects on individuals and laboratory populations were evaluated for relevance to wild populations of similar species. Ecological receptors used in the analysis included species with habitat preferences and feeding strategies consistent with conditions found at each SWMU.

The characterization of ecological risks or threats to ecological receptors from chemical exposures entails the integration of abiotic exposure concentrations with the information developed during the ecological, exposure, and toxicity evaluations. The average concentration of the samples for each SWMU was used as the exposure concentration because the average concentration is considered to be representative of the concentration that would be contacted at each SWMU over time. The calculation of the average concentration included a value of half the reporting limit for those samples where the concentration was less than the detection limit. The risk characterization largely focused on the oral ingestion exposure route; inhalation and dermal contact were not specifically addressed as these exposure routes were considered less significant and difficult to evaluate given the lack of ecotoxicological data.

For most SWMUs, a semi-quantitative evaluation was completed based on a comparison of potential exposure concentrations to benchmark values for key receptor species. This included an assessment of the potential for COCs to bioaccumulate or biomagnify.

For SWMU 103, Playa Lake, the Quotient Method was used to calculate potential risk from each COC to ducks and herons; for the coyote, a semi-quantitative evaluation, as described above, was used. The Quotient Method involves calculation of a hazard quotient (HQ). HQ is a ratio of the estimated dose key receptors intake to a dose they can tolerate with no adverse effects (benchmark values). An HQ was calculated separately for water, sediment, and food pathways. The HQs for all pathways were then summed to obtain a hazard index (HI) for each COC. The HIs for all COCs were then summed to obtain a total HI for the mallard and the black-crowned night heron.

An HQ or HI of 1 or below indicates a "low probability" for an impact to occur. HQ or HI values from 1 to 10 indicate a "possibility" for ecological impacts. While this is still a relatively low value, it needs to be interpreted in light of the uncertainty in the benchmark values and exposure doses. HQ or HI values greater than 10 indicate that it is "more probable" that ecological impacts may occur due to the presence of chemicals in the environment (Edmisten Watkin and Stelljes, 1993). Values greater than 1 or 10 are cause for further detailed consideration of the uncertainties and limitations involved in the calculation of the HQ and HI and the nature of the potential hazardous effects, as represented in the HQ by the benchmark value. Correct interpretation and usage of the QM is highly dependent on professional judgement and an understanding of the assumptions and uncertainties involved in the calculations (EPA 1992).

Use of the QM assumes the chemical effects are additive. This is likely to be an overly conservative assumption, as different classes of chemicals tend to affect different target organs. Additionally, it is not known, nor does the QM account for, various interactions that may take place in the chemical mixtures found in Playa Lake. Such interactions can either increase or decrease overall risk. These interactions and their impact on overall risk are largely unknown and were therefore not evaluated.

D.7 UNCERTAINTIES AND LIMITATIONS

It is necessary to make assumptions for any risk assessment. Identification of assumptions and subsequent uncertainties and their effect on estimated risks helps to place the risk estimates in perspective. In the absence of adequate information, the approach used in this ERA was to make conservative assumptions to ensure that risks are not underestimated.

Assumptions for this ERA were made in the compilation of environmental media data, the selection of key receptors, the exposure evaluation and development of toxicity benchmark values, and the risk characterization. These assumptions or other factors that tend to overestimate, underestimate, or have an unknown effect on the ERA are presented below with a discussion of their uncertainty.

D.7.1 FACTORS THAT MAY OVERSTATE RISK

Several assumptions were made that may result in overstating potential risks. The major assumptions contributing to a conservative assessment are discussed below.

Exposure Duration

Actual exposure durations for receptor species may or may not exceed the test duration periods upon which the toxic benchmark values are based. Because birds, in particular, are likely to be visiting and feeding at other habitats in the area, their daily dose, if averaged over time, is less than that used for estimating risk in this assessment.

Toxic Benchmark Values

Toxicity benchmark values for laboratory organisms are likely to be substantially lower than those for wildlife due to the sensitive strains of laboratory animals used and the direct means by which they are dosed. The LD_{50} studies are usually designed to promote maximum exposure (absorption) because less of the chemical complexes with dietary material. The LD_{LO} dietary studies probably give a better indication of the toxicity of the chemical tested, while no-observed-effect levels from longer studies are the best (although still imperfect) laboratory studies to use as predictors of field effects. The potential for wildlife species to be more or less sensitive than test species and the toxicological benchmarks used does exist.

The toxicity benchmark values were derived from available toxicity studies with varying but generally chronic (several weeks to several months) exposure durations. Comparison of tissue, dietary, or dose concentrations to such toxicity benchmarks provides for an overestimation of potential risk.

Bioaccumulation Method

Information on bioaccumulation factors is generally lacking in the available literature. As reported in the published literature, dietary concentrations of chlordane (Eisler 1990) resulted in much lower tissue concentrations than would be predicted based on a bioaccumulation approach. Any conclusions based on this approach are thus uncertain.

D.7.2 FACTORS THAT MAY UNDERSTATE RISK

Various aspects of the ERA may also result in an understatement of potential risks. Some of the major assumptions or data characteristics that could contribute to an understatement are discussed below.

Evaluation of Individual Ecological COCs

The evaluation of risks for individual COCs may understate the cumulative risk to the receptors by not considering additive or synergistic effects, particularly for mercury. It is also possible, however, that certain combinations of chemicals counteract each others toxicity resulting in antagonistic effects.

Receptor Species

The scope of this evaluation was limited. It is possible that receptors considered in this ERA are not those receptors that have the greatest likelihood of being at risk or would be of the greatest concern. A thorough biological survey was not conducted at Cannon. Receptor selection was broadly based on general habitat considerations. Potential adverse impacts on ecosystem integrity and functioning were not specifically considered in this evaluation.

Exposure Pathways

This risk assessment was limited to an evaluation of the oral ingestion pathway for ecological receptors. Information on other exposure pathways (inhalation, dermal absorption) that may be applied to wildlife are generally lacking. By not considering these additional exposure pathways, exposure concentrations may be underestimated for some COCs.

Population Level Effects

Most toxicity data are based on individual or population effects. This approach assumes that population level effects are valid surrogates for ecosystem health; that is, injury to the basic biotic components of an ecosystem decreases the ecosystem's stability, functional integrity, quality, and/or likelihood of survival. This approach to risk assessment does not adequately

account for other ecosystem effects such as predator-prey relationships, community metabolism, or structural shifts.

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TABLE D-1

KEY RECEPTORS AND CHEMICALS OF CONCERN BY SWMU
CANNON AFB

	SWMU 31	SWMUs 61,62,63	SWMUs 92&93	SWMU 94	SWMU 127	SWMU 77	SWMU 103
Key Receptor							
Robin	X	X	X	X	X	X	
Deer Mouse			X			X	
Northern Harrier			X			X	
Mallard							X
Black-crowned Night Heron							X
Coyote							X
Chemical							
Volatile Organics							
2-Butanone							X
1,2-Dichloroethane		X	X	X	X		
1,2-Dichloropropane					X		
2-Hexanone		X					
4-Methyl-2-pentanone		X					
1,1,2,2-Tetrachloroethane		X					
Benzene							X
Bromoform		X					
Carbon disulfide							X
Chloromethane							X
Ethylbenzene			X	X			
Tetrachloroethene	X			X			
Toluene		X	X	X	X	X	
Xylenes		X	X	X	X	X	
Semivolatile Organics							
Acenaphthene		X			X		
Anthracene	X	X	X	X	X	X	
Benzo(a)anthracene	X	X	X	X	X	X	
Benzo(a)pyrene	X	X	X	X	X	X	
Benzo(b)fluoranthene	X	X	X	X	X	X	
Benzo(g,h,i)perylene	X	X	X	X	X	X	
bis(2-ethylhexyl)phthalate							X
Butyl benzyl phthalate		X	X	X		X	X
Carbazole	X	X	X		X	X	
Chrysene	X	X	X	X	X	X	
Dibenz(a,h)anthracene						X	
Dibenzofuran		X		X			
Di-n-butyl phthalate			X				X
Di-n-octyl phthalate						X	
Fluoranthene	X	X	X	X	X	X	

TABLE D-1

KEY RECEPTORS AND CHEMICALS OF CONCERN BY SWMU
CANNON AFB

	SWMU 31	SWMUs 61,62,63	SWMUs 92&93	SWMU 94	SWMU 127	SWMU 77	SWMU 103
Fluorene		X		X	X		
Ideno(1,2,3-cd)pyrene	X	X	X	X	X	X	
2-Methylnaphthalene	X	X		X	X		
Naphthalene		X		X			
Pentachlorophenol			X	X		X	
Phenanthrene	X	X	X	X	X	X	
Pyrene	X	X	X	X	X	X	
Pesticides/PCBs							
4,4'-DDE						X	
4,4'-DDT						X	
alpha-Chlordane						X	
gamma-Chlordane						X	
Metals							
Aluminum					X		X
Antimony	X		X		X		
Barium	X						X
Cadmium	X		X	X	X	X	X
Chromium	X		X				X
Cobalt	X						X
Copper	X		X		X		X
Cyanide							X
Lead	X	X	X	X	X	X	X
Manganese			X				
Mercury				X			X
Selenium	X		X	X	X		X
Silver				X	X		X
Sulfide, total							X
Thallium				X	X		
Vanadium							X
Zinc	X	X	X	X		X	X
Total Petroleum Hydrocarbons	X	X	X	X	X	X	X

TABLE D-2

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BENZENE
CANNON AFB

EST SPECIE	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat		Acute	1 day	Mortality		930			Cornish and Ryan 1965
Rat		Acute	1 day	Central nervous system depression, narcosis		352 (L)			Cornish and Ryan 1965
Mouse		Acute	6-15 day	Effects on embryo or fetus		900 (TDLo) (L)			NIOSH 1987
Mouse		Acute	6-15 day	Effects on fertility		12000 (TDLo) (L)			NIOSH 1987
Mouse		Chronic	2 yr.	Tumorigenic				18250 (TDLo) (L)	NIOSH 1987
Mouse		Intermediate	8 wks.	Tumorigenic				2400 (L)	NIOSH 1987
Mouse		Acute		Mortality		4700			NIOSH 1987
Dog		Acute		Mortality		2000 (LDLo)			NIOSH 1987

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-3

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BROMOFORM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat		Acute		Mortality		1147			NIOSH 1987
Mouse		Acute		Mortality		1400			NIOSH 1987
Rat		Intermediate	13 weeks	No observable adverse effects				50 (N)	IRIS 1993

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-4

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
2-BUTANONE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat		Acute		Mortality		4050			NIOSH 1987
Rat		Chronic	Multi-generation	No observable adverse effects		1711 in drinking water			HEAST 1993

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-5

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CARBON DISULFIDE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat		Acute		Mortality		3188			Lewis 1992
Rat		Acute		Effects on embryo or fetus		0.2 (TDLo)			NIOSH 1987
Guinea Pig		Acute		Mortality		2125			NIOSH 1987
Mouse		Acute		Mortality		2780			NIOSH 1987
Rat		Acute		Mortality		3188			NIOSH 1987

TDLo = Toxic dose low

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-6

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CHLOROMETHANE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat				Mortality		1800			Lewis 1992

TABLE D-7

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
1,2-DICHLOROETHANE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATIO	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat						1120			Lewis 1992
Rat						625			Lewis 1992

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-8

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
1,2-DICHLOROPROPANE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat				Mortality		2196			NIOSH 1987
Dog				Mortality		5000 (LDLO)			NIOSH 1987
Guinea Pig				Mortality		2000			NIOSH 1987

LDLO = Lethal Dose Low

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-9

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
ETHYLBENZENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat				Mortality		3500	4655 e	350 e	Lewis 1992
Rat		Intermed.	192 days	No observable adverse effects				97.1 (N)	IRIS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-10

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
2-HEXANONE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat		Acute		Mortality		2590			NIOSH 1987
Guinea pig		Acute		Mortality		914 (LDLO)			NIOSH 1987
Mouse		Acute		Mortality		2430			NIOSH 1987

LDLO = Lethal Dose Low

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-11

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
4-METHYL-2-PENTANONE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat		Acute		Mortality		2080			NIOSH 1987
Mouse		Acute		Mortality		2671			NIOSH 1987
Rat		Intermed.	13 weeks	No observable adverse effects				50 (N)	HEAST 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-12

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
1,1,2,2-TETRACHLOROETHANE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat		Acute		Mortality		800			NIOSH 1987
Dog		Acute		Mortality		300 (LDlo)			NIOSH 1987
Mouse		Intermed.	2 years	Turmorigenic				0.129 (TDlo)	NIOSH 1987
Mouse		Intermed.	2 years	Turmorigenic				0.258 (TD)	NIOSH 1987
Mouse		Intermed.	78 weeks	Turmorigenic				0.055 (TDlo)	NIOSH 1987
Mouse		Intermed.	78 weeks	Turmorigenic				0.11 (TD)	NIOSH 1987
Rat		Intermed.	78 weeks	Turmorigenic				0.042 (TDlo)	NIOSH 1987

LDlo = Lethal dose low
TDlo = Toxic dose low
TD = Toxic dose

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-13

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
TETRACHLOROETHENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat				Mortality		3005			NIOSH 1987
Rat, Mouse		Intermediate	6 weeks	No observable adverse effects				100-1,000 (N)	IRIS 1993
Mouse				Mortality		8100			NIOSH 1987
Dog				Mortality		400 (LDLO)			NIOSH 1987
Rabbit				Mortality		5000 (LDLO)			NIOSH 1987

LDLO = Lethal Dose Low

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-14

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
TOLUENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat				Mortality		5000	6650 (L) e	500 (L) e	Lewis 1992
Mouse		Intermed.	76 days	Impaired motor coordination				3.0 (L)	Kostas & Hotchin 1981 in USDHHS 1992
Mouse		Intermed.	76 days	Decreased open field activity				76 (L)	Kostas & Hotchin 1981 in USDHHS 1992
Mouse		Intermed.	13 weeks	No reproductive effects				2500 (N)	NTP 1990 in USDHHS 1992
Rat		Intermed.	13 weeks	10% females and 80% males died				2500 (L)	NTP 1990 in USDHHS 1992
Mouse		Intermed.	13 weeks	5% mortality				1250 (L)	NTP 1990 in USDHHS 1992
Hamster				Mortality		50	41.5 (L) e	5 (L) e	Lewis 1992
Rat		Intermed.	13 weeks					223 (N)	IRIS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-15

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
XYLENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat				Mortality		4300	5719 (L) e	430 (L) e	Lewis 1992
Rat		Intermed.	13 weeks	No observable adverse effects				500 (N)	IRIS 1993
Mice (pregnant)		Intermed.	15 days	Fetal malformation, resorption; decreased fetal body weight			3420 (L)	412 (L)	Marks et al., 1982
Mice (pregnant)		Acute to Intermed.	6-15 days	No effect			8549 (N)	1030 (N)	Marks et al., 1982
Hamster				Unknown		50	41.5 (L)e	5 (L)e	Lewis 1992
Rat		Intermed.	13 weeks	No reproductive effects				1000 (N)	NTP 1986 in USDHHS 1993
Rat		Chronic	103 weeks	No reproductive effects				500 (N)	NTP 1986 in USDHHS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-16

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
ACENAPHTHENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat				Tumorigenic (lungs, thorax)		13 (TDLO)**			NIOSH 1987
Rat		Intermed.	32 days	Body weight loss; changes in peripheral blood; bronchitis			2 (L)		EPA 1980
Mouse		Intermed.	90 days					350 (L)	IRIS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

**TDLO = Toxic Dose Low - This value is not an oral concentration; compound was administered intratracheally.

TABLE D-17

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
ANTHRACENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rodent				Carcinogenicity				3300 (L)	Lo and Sandi 1978; Sims and Overcash 1983 in Eisler 1987
Mouse		Intermed.	90 days	No observable adverse effects				1000 (N)	IRIS 1993

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-18

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BENZO(A)ANTHRACENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rodents				Carcinogenic effects				2 (TDLO)**	Eisler 1987
Rodents				Carcinogenic effects			3 (L)	0.4 (L)	Eisler 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

**TDLO = Toxic Dose Low

TABLE D-19

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BENZO(A)PYRENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rodents				Mortality		50	41 (L) e	5 (L) e	Eisler 1987
Rodents				Carcinogenic effects			0.003 (L) e	0.0004 (L) e	Eisler 1987
Rodents				Carcinogenic effects				0.002 (TDLO)** (L)	Eisler 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

**TDLO = Toxic Dose Low

TABLE D-20

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BENZO(B)FLUORANTHENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rodents				Carcinogenic effects				40 (TDLO)** (L)	Eisler 1987
Rodents				Carcinogenic effects			66 (L)	8 (L)	Eisler 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

**TDLO = Toxic Dose Low

TABLE D-21

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BENZO(G,H,I)PERYLENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse		Intermediate	13 weeks	No observable adverse effects				75+ (N)	IRIS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

+Based on NOAEL for pyrene

TABLE D-22

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BIS(2-ETHYLHEXYL)PHTHALATE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Guinea pig		Chronic	1 year	No observable adverse effects				19 (N)	IRIS 1993
Guinea pig (female)		Chronic	1 year	Liver weights significantly increased			0.4% diet		NRC 1986
Guinea pig (female)		Chronic	1 year	Liver weights significantly increased			0.13% diet		NRC 1986
Mouse		Acute		Mortality	250000 e	30,000			NIOSH 1987
Rat		Acute		Mortality	407000 e	30,600			NIOSH 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-23

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BUTYL BENZYL PHTHALATE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mice					4170				Lewis 1992
Rats					2330				Lewis 1992
Rat		Intermediate	6 months					470 (L)	IRIS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-24

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CARBAZOLE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat						500 (LDLO)**			Lewis 1992

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

**LDLO = Lethal Dose Low

TABLE D-25

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CHRYSENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rodents				Carcinogenic effects			99 (L)	12 (L) e	Eisler 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-26

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DIBENZ(A,H)ANTHRACENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rodents				Carcinogenicity				0.006 (L)	Lo and Sandi 1978; Sims and Overcash 1983 in Eisler 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-27

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DIBENZOFURAN
CANNON AFB

TEST SPECIES	FORM	TEST TYPE	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse				Oral protective level, based on ECAO's interim human oral RfD of 0.004 mg/kg-bw/day			3.3 (L)		EPA's Environmental Criteria Assessment Office (ECAO)

TABLE D-28

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DI-N-BUTYL PHTHALATE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse				Mortality	44,000	5289			NIOSH 1987
Rat				Mortality	106,400	8000			NIOSH 1987
Rat		Chronic	1 year	No observable adverse effects				125 (N)	IRIS 1993
Mouse		Intermediate	Gestation	No observable adverse effects				2100 (N)	IRIS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-29

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DI-N-OCTYL PHTHALATE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Mouse				Mortality		6513			NIOSH 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-30

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
FLOURANTHENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rodent				Carcinogenic effects				72 (L)	Eisler 1987
Mouse		Intermediate	90 days	No observable adverse effects				125 (N)	IRIS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-31

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
FLUORENE
CANNON AFB

EST SPECIE	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse		Intermediate	13 weeks	No observable adverse effects				125 (N)	IRIS 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-32

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
IDENO(1,2,3-CD)PYRENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/ day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/ kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/ day) e = estimated	REFERENCE
SMALL MAMMALS									
Rodent								72 (TDLO)** (L)	Eisler 1987
Rodent				Carcinogenic effects			119 (L)	14.4 (L)	Eisler 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

**TDLO = Toxic Dose Low

TABLE D-33

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
2-METHYLNAPHTHALENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat				Mortality		1630			NIOSH 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-34

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
NAPHTHALENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse				Mortality		533	267.5 (N) e	53.3 (N) e	NIOSH 1987
Rodents				Mortality		1780	1477 (N) e	178 (N) e	Eisler 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-35

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
PENTACHLOROPHENOL
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Mouse						65 to 252			Knudsen et al. 1974; Borzelleca et al. 1985; Choudhury et al. 1986 in Eisler 1989
Mouse (male)		Chronic	22 months	No measurable effect				10 (N)	EPA 1980 in Eisler 1989
White rabbit		Intermed.	90 days	No signs of intoxication				1 to 3 (N)	EPA 1980 in Eisler 1989
White rabbit				Mortality		100 to 130			Knudson et al. 1974; Choudhury et al. 1986 in Eisler 1989
Rat		Chronic	2 years	No significant adverse effects on growth, survival, reproduction, or development			50 (N)	3 (N)	Schwetz et al. 1978; EPA 1980; McConnell et al. 1980 in Eisler 1989
Rat				Mortality		27 to 300			Knudsen et al. 1974; McConnell et al. 1980; Borzelleca et al. 1985; Choudhury et al. 1986; St. Omer and Gadusek 1987 in Eisler 1989
Rat		Chronic	13 wks.	No observable adverse effects				3 (N)	IRIS 1993
Eastern chipmunk				Mortality		138			Ege 1985 in Eisler 1989

TABLE D-35

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
PENTACHLOROPHENOL
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Eastern chipmunk		Intermed.	14 days	Weight loss due to food avoidance; enlarged livers			250 - 500 (L)		Ege 1985 in Eisler 1989
BIRDS									
Mallard				Mortality		380			Hudson et al. 1984 in Eisler 1989
Japanese quail		Acute	8 days	No deaths			3100 (L)		Hill & Camardese 1986 in Eisler 1989
Japanese quail		Acute	8 days	50% mortality	5139				Hill & Camardese 1986 in Eisler 1989
Ring-necked pheasant				Mortality		504			Hudson et al. 1984 in Eisler 1989

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-36

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
PHENANTHRENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse				Mortality		700			Eisler 1987
Rat		Acute	Single Dose	Altered blood chemistry nephrotoxicity			1250 (TD) (L) e	150 (TD) (L)	Eisler 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TD = Toxic dose

TABLE D-37

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
PYRENE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse				Mortality	6640	800			NIOSH 1987
Mouse		Intermediate	13 weeks	No observable adverse effects				75 (N)	IRIS 1993
Rat				Mortality		2700			NIOSH 1987

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-38

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DDT, DDE, DDD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat	DDT	Acute		Mortality		100 to 500			Hayes 1959
Rat	DDT	Intermed.	90 days	Mortality		46			Gaines 1969
Mouse	DDT			Decreased ovary and testis size			200 to 300 (L)		Cannon and Holcomb 1968
Rat	DDT			Mortality		100-400			Negerbon 1959 in ESE 1989 Hayes 1963 in ESE 1989
Rabbit	DDT			Mortality		250-400			Pimentel 1971 in ESE 1989
Mouse	DDT			Mortality		200			Pimentel 1971 in ESE 1989
Rat	DDT			No effects			0.05 (N)		Lehman 1951, 1952 in HPT
Rat	DDT	Chronic	2 years	No effects			25 (N)	0.63 to 1.26 (N)	Lehman 1951, 1952 in HPT
Mouse	DDT	Chronic	2 years	2.9-fold increased risk of liver tumors			50 (L)	6 to 10 (L)	Wayland and Laws 1991
Rat	p,p'-DDT			Severe illness; mortality	150				Wayland and Laws 1991
Rat	Oil solution			Mortality		113 to 450			Lehman 1951, 1952 in HPT

TABLE D-38

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DDT, DDE, DDD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Rat	DDT, Water suspension or powder			Mortality		500 to 2500			Lehman 1951, 1952 in HPT
Mouse	DT, Oil solution			Mortality		100 to 800			Lehman 1951, 1952 in HPT
Mouse	DDT, Water suspension or powder			Mortality		300 to 1600			Lehman 1951, 1952 in HPT
Rabbit	DT, Oil solution			Mortality		300 to 1770			Lehman 1951, 1952 in HPT
Rabbit	DDT, Water suspension or powder			Mortality		275			Lehman 1951, 1952 in HPT
Rat	DDT			Non-lethal effect; increased enzyme induction			5 (L)	0.375 (L)	Chadwick et al. 1975 in Newell et al. 1987
Rat (male)	DDE			Mortality		800			Wayland and Laws 1991
Rat (female)	DDE			Mortality		1240			Wayland and Laws 1991
Mouse	DDE			Mortality		700 to 1000			Wayland and Laws 1991
Rat	DDD	Intermed.	32 weeks	Effects not specified				4680 (L)	Lewis 1992

TABLE D-38

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DDT, DDE, DDD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Rat	DDD			Mortality		1195			Lewis 1992
Rat	DDD			Mortality		>4000			Wayland and Laws 1991
Rat	DDT	Intermed.	125-175 days	No developmental effects				0.6 (N)	Wren et al. 1971 in USDHHS 1992
Rat	DDT	Intermed.	7 months	Decreased growth				10 (L)	Clement and Okey 1974 in USDHHS 1992
Rat	DDT	Intermed.	7 months	Death by 10 days after birth				25 (L)	Clement and Okey 1974 in USDHHS 1992
Rat	DDT	Intermed.	17 weeks	No developmental effects				2.0 (N)	Wrenn et al. 1971 in USDHHS 1992
Rat	DDT	Intermed.	175 days	Decreased uterine weight				0.75 (L)	Duby et al. 1971 in USDHHS 1992
Rat	DDT	Intermed.	36 weeks	No reproductive effects				3.75 (N)	Johnson et al. 1976 in USDHHS 1992
Rat	DDT	Intermed.	36 weeks	Sterility				7.5 (L)	Johnson et al. 1976 in USDHHS 1992

TABLE D-38

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DDT, DDE, DDD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Rat	DDE	Intermed.	9 weeks	No reproductive effects				10 (N)	Kornburst et al. 1986 in USDHHS 1992
Mouse	DDT	Intermed.	86 days	No reproductive effects				2.6 (N)	Ledoux et al. 1977 in USDHHS 1992
Mouse	DDT	Intermed.	72 days	Increased estrus decreased implants				1.67 (L)	Lundberg 1973/1974 in USDHHS 1992
Mouse	DDT	Intermed.	120 days	Decreased litter size				0.91 (L)	Ware and Good 1967 in USDHHS 1992
Mouse	DDT	Chronic	70 weeks	Decreased survival				13 (L)	Del Pup et al. 1978 in USDHHS 1992
Dog	DDT	Chronic	14 months	Maternal and fetal death				12 (L)	Deichmann et al. 1971 in USDHHS 1992
Rat	DDT	Chronic	Life	No reproductive effects				10 (N)	Ottoboni 1969 in USDHHS 1992
Mouse	DDT	Chronic	15 months	No reproductive effects				2.4 (N)	Wolfe et al. 1979 in USDHHS 1992
Mouse	DDT	Chronic	Life	No reproductive effects				6.5 (N)	Turusov et al. 1973 in USDHHS 1992

TABLE D-38

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DDT, DDE, DDD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Mouse	DDT	Chronic	Life	Increase in preweening death				32.5 (L)	Turusov et al. 1973 in USDHHS 1992
Rat	DDT	Intermed.	27 wks.	No observable adverse effects				0.05 (N)	IRIS 1993
BIRDS									
Mallard	DDE			Eggshell thinning			10 (L) e	2 (L)	Heath et al. 1969
Mallard	DDT			Mortality		72,240			58CFR72 1993
Mallard/black duck	DDT			No effects			2 (N)		U.S.E.P.A. 1976
Mallard	DDT	Intermed.	90 days	Not lethal			30 (N)		Hudson et al. 1984
Ring-necked pheasant	DDT			Mortality		1334			Hudson et al. 1984
Rock dove	DDT			Mortality		>4000			Hudson et al. 1984
Rock dove	DDT			Mortality		74,000			58CFR72 1993
California quail	DDT			Mortality		595			Hudson et al. 1984

TABLE D-38

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DDT, DDE, DDD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Japanese quail	DDT			10% decrease in eggshell thickness			40 (L)	8.0 (L) e	Stickel and Rhodes 1970
Japanese quail	DDT			No effects on reproduction			40 (N)	8.0 (N) e	Davison et al. 1976
Japanese quail	DDT			Mortality	841				58CFR72 1993
Bobwhite quail	DDT	Intermed.	90 days	Not lethal			30 (N)		Hudson et al. 1984
Raptors	DDE	Intermed.		Eggshell thinning			10 (L)	0.6 (L) e	Beyer & Stafford 1993
Bald eagle	DDT			No visible intoxication; (eggshell thinning not evaluated)			5 (N) fw assume FI/BW = 0.06	0.3 (N)	Stickel et al. 1976
Bald eagle	DDT	Intermed.		Mortality; gross intoxication			> 83 (L)	5 (e) assume FI/BW=0.06	Stickel et al. 1976
Bald eagle	DDT			No effects			1.5 to 5 (N)		EPA 1976
Brown pelican	DDT			No effects on eggshell thinning (estimated based on 10-fold increase from food to NOEL in eggs of 2 ppm based on data of Bluset et al. 1972)			0.2 (N)	0.012 (N) e	Newell et al. 1987

TABLE D-38

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
DDT, DDE, DDD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Screech owl	DDE			10-13% egg shell thinning			2.8 (L)	0.17 (L) e assume FI/BW=.06	Ellis et al. 1989
American kestrel	DDE			10-13% egg shell thinning			2.8 (L)		Ellis et al. 1989
Peregrine falcon	DDE (in egg)			Thinning eggshells			15-20 (L)		Steidl et al. 1991

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

FI=Food Intake
BW=Body Weight
fw=fresh weight

TABLE D-39

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CHLORDANE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat				Mortality		200			BEIA 1989
Rat		Chronic	30 mos.	No observable adverse effect			0.73 (N) e	0.055 (N)	IRIS 1993
Rat				No effects			5 (N)	0.375 (N) e	BEIA 1989
Mouse				No effects			25 (N)	3 (N) e	BEIA 1989
BIRDS									
Starlings		Acute		Mortality		150			ESE 1989
Sensitive birds				Adverse effects			1.5 (L)	0.09 (L) e; using FI/bw = 0.06	Eisler 1990
Mallard				Mortality		1,200			58CFR72 1993
Barn owl		Intermed.	90 days	Mortality			75 (L)	4.5 (L) e; using FI/bw = 0.06	Eisler 1990
Barn owl		Intermed.	17 days	Mortality			150		Eisler 1990
California quail				Mortality		14.1			58CFR72 1993
Birds		Chronic		Recommended acceptable range, but producing slight elevation in tissue conc.			0.1 - 0.3 (N)	0.006 (N) e for raptors 0.02 (N) e	Eisler 1990

TABLE D-39

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CHLORDANE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
							for ducks		
Pheasant						24.0-72.0			58CFR72 1993

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-40

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
ALUMINUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat	AN	Acute		Mortality		261			Llobet et al. 1987
Rat	AC	Acute		Mortality		770			Ondreicka et al. 1987
Rat (weanling)	AH	Intermed.	4 wks.	Reduced growth rate			1,100 (L)	330 (L) e	Thurston et al. 1972 in NAS 1980
Rat (pregnant)	AC (0.1%) in water	Intermed.	day 6 to day 19 of gestation	No observed effects of offspring			0.1% ACl		Shepard 1980
Rat	AS	Intermed.	3 wks.	No adverse effects			1,579 in water (N)	197 (N) e	Berlyne et al. 1972 in NAS 1980
Rat	AC	Acute		Mortality	3730	280 e			Lewis 1992
Rat	AN	Acute		Mortality	4280	321 e			ACGIH 1986
Mouse	AC	Intermed.	40 days	No adverse effects			180 (N)	21.6 (N) e	Ondreicka et al. 1966 in NAS 1980
Mouse	AH		Gestation	No teratogenic effects			92		Domingo et al. 1987b
Dog (beagle)	NaAl3H14 (PO4)8·4H2O	Intermed.	90 days	No adverse effects			2600 (N)	65(N) e	NAS 1980

TABLE D-40

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
ALUMINUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
BIRDS									
Ring doves	AS	Intermed.	63 days	No effect on egg production, fertility, hatchability, or fledging success.			1000 (N)	200 (N) e	Carriere et al. 1986 in Scheuhammer 1989
Dove (juvenile)	AS	Intermed.	63 days	No effect on egg production, fertility, hatchability, or fledging success.			1500 (N)	300 (N) e	Carriere et al. 1986 in Scheuhammer 1989
Chicken	AS	Intermed.	28 days	No adverse effects			486 (N)	85 (N) e	Cakir et al. 1978 in NAS 1980
Chicken	AC	Acute	2 wks.	Reduced growth rate			500 (L)	85 (N) e	Storer & Nelson 1968 in NAS 1980

FORM
AN = Aluminum nitrate = $Al(NO3)3 \cdot 9H2O$
AC = Aluminum chloride
AH = Aluminum hydroxide = $Al(OH3)$
AS = Aluminum sulfate = $Al2(SO4)3 \cdot 18H2O$

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-41

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
ANTIMONY
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/ day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/ day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat		Acute		Mortality		700			NIOSH 1987
Rat		Chronic		No observable adverse effects				0.35 (N)	IRIS 1993
Rat	Metallic	Acute		Mortality		100			Venugopal & Luckey 1978
Rat	Sb2O3	Acute		Mortality		>16700			Venugopal & Luckey 1978
Rat	SbCl3	Acute		Mortality		675			Venugopal & Luckey 1978
Rabbit	Metallic	Chronic		Maximum tolerable level			110 (N) (70 - 150)	3.3 (N) e	NAS 1980

FORM
Sb2O3 = Antimony trioxide
SbCl3 = Antimony trichloride

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-42

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
BARIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat (weanling)	BCL			Mortality		220			Tardiff et al. 1980
Rat (adult)	BCL			Mortality		132			Tardiff et al. 1980
Rat (wild, Norway)	BCA	Acute	1 - 8.5 days	Mortality		1480			Dieke and Richter 1946
Rat	BCA			Lethal effects			666 (L)	50 (L)	Miner 1969 in EPA 1990
Rat	BCL	Intermediate	8 - 12 mos.	No clinical signs of toxicity			250 (N) in water	31 (N) e	Tardiff et al. 1980 in EPA 1990
Mammals (unspecified)	BCL			Mortality		150			Venugopal and Luckey 1978
Mouse	BCL			Lethal effects			575 (L) e	69 (L)	Miner 1969 in EPA 1990
Mouse	BS			Toxic effects			>1000 (L)	>120 (L)e	API 1970
BIRDS									
Chicken	BA	Intermediate	3 wks.	No effects			1000 (N) in water	250 (N) e	Johnson et al. 1986 in EPA 1990

BCL= barium chloride
BCA = barium carbonate
BS = barium sulfate
BA = barium acetate

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-43

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CADMIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/ day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (m kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/ day) e = estimated	REFERENCE
SMALL MAMMALS									
Shrews		Chronic	Smelter Field Study	Critical renal loading; sublethal symptoms of metal intoxication			42 e, based on bw=7g; FI=2.5g	15 (L)	Ma et al. 1991
Vole		Chronic	Smelter Field Study	No effects			0.7 (e) using w = 20g; FI = 12 g	0.4 (N)	Ma et al. 1991
Rat		Chronic	7 - 12 mo.	No effects				14 (N)	Viau et al. 1984 in ATSDR 1991
Rat		Acute	Single dose	Mortality at 24 hours		330			Shimizu and Morita 1990 in ATSDR 1991
Rat		Acute	Single dose	Serious reproductive effects testicular necrosis				100 (L)	Bomhard et al. 1987 in ATSDR 1991
Rat		Acute	Single dose	No effects				50 (N)	Bomhard et al. 1987 in ATSDR 1991
Rat		Acute	10 days	Serious reproductive effects testicular necrosis				66 (L)	Borzelleca et al. 1989 in ATSDR 1991
Rat		Acute	10 days	No effects				31 (N)	Borzelleca et al. 1989 in ATSDR 1991
Rat	CO	Acute	Single Dose	Mortality 50%		63			Fairchild et al. 1977 in NAS 1980
Rat		Acute	Single dose	Mortality at 14 days		225			Kotsonis & Klaasen 1977 in ATSDR 1991

TABLE D-43

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CADMIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Rat	CC	Intermed.	4 wks.	No effects			30 (N)	2.25 (N) e	Groten et al. 1991
Rat	CC	Intermed.	5 wks.	No effects on survivorship or fertility			53 (N)	4 (N)	Baranski et al. 1983
Mouse		Intermed.	6 months	Reproductive failure				1.9 (L)	Schroeder and Mitchener 1971b in ATSDR 1991
Mouse		Acute	Single dose	Mortality at 8 days		112			Basinger et al. 1988 in ATSDR 1991
Mouse		Acute	Single dose	Mortality at 96 hours		95.5			Baer and Benson 1987 in ATSDR 1991
Mouse		Chronic	2 gen.	Some deaths in F1 and F2 generations; decreased number of offspring			10 in water	2 (L) e	Schroeder and Mitchener 1971a in NAS 1980
Mouse	CC	Acute	Single dose	Mortality 50%		107			Fairchild et al. 1977 in NAS 1980
Rabbit	CC	Intermed.	200 days	Decreased growth; advance renal effects			160 (L)		Stowe et al. 1972 in NAS 1980
Rabbit	CC	Acute	Single dose	Mortality		43 (L)			Fairchild et al. 1977 in NAS 1980
Guinea pig	CC	Acute	Single dose	Mortality	650 e	39			Fairchild et al. 1977 in NAS 1980
LARGE MAMMALS									
Domestic animals	TC	Chronic	Various	Gross adverse effects			5		NAS 1980
Dog	CS	Acute	Single dose	Mortality 50%	4200 e	105			Fairchild et al. 1977 in NAS 1980

TABLE D-43

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CADMIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
BIRDS									
Mallard ducklings		Chronic	8-12 weeks	Mild to severe kidney lesions			20 (L)	20 (L) e	Cain et al. 1983 in Eisler 1985
Japanese quail	CC	Intermed.	28 days	Decreased weight gain; elevated tissue concentrations; testicular hypoplasia			75 (L)	15 (L) e, using FI = 20% bw	Jacobs et al. 1969 in NAS 1980; Richardson et al. 1974 in NAS 1980
Mallard adult		Intermed.	90 days	No adverse effects			200	40 (N) e, using FI = 20% bw	White & Finley 1978 in Eisler 1985
Mallard adult		Intermed.	90 days	Decline in egg production			200 (L)	40 (L) e, using FI = 20% bw	Scheuhammer 1991 a,b
Black duck		Intermed.	4 months	Altered avoidance behavior			4 (L) in water	0.8 (L) e, using FI = 20% bw	Eisler 1985
Chicken	CS	Chronic	48 wks.	Decreased egg production, decreased egg shell thickness			12 (L)	2.1 (L) e	Leach et al. 1979 in NAS 1980

TC = total cadmium
CC = cadmium chloride ($CdCl_2$)
CS = cadmium sulfate ($CdSO_4$)
CO = cadmium oxide

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

Domestic duck (NIOSH 1987)
food intake (FI) = 0.25 kg/day
wgt = 2.5 kg

Quail (NIOSH 1987)
FI = 0.013 kg (using allometric equation from Nagy 1987)
wgt = 0.1 kg (NIOSH 1987)

TABLE D-44

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CHROMIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat	Cr III	Chronic		No overt toxicosis			8660 (N) e	650 (N)	NAS 1980
Rat	Cr VI	Chronic	1 year	No observable adverse effects			146 (N) e	11 (N) in water	IRIS 1993
Mouse	KC	Chronic	180 days	No effects			500 (N) in water	100 (N) e	Gross & Heller 1946 in NAS 1980
BIRDS									
Black ducks	Cr III			No effects			10 to 50	0.56 - 2.79	Eisler 1986
Chickens	Cr VI			No effects			100 (N)	17.5 (N) e	Rosomer et al. 1961
Chicks	Cr III			No effects			1000 (N)	175 (N) e	NAS 1980

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

Cr III = Chromium III
Cr VI = Chromium VI
KC = K2CrO4

TABLE D-45

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
COBALT
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/ day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (m kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/ day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat	Metal	Acute		Mortality		1500 (MLD)			
Rat	CoO	Acute		Mortality		1337			
Rat	CoCl3	Acute		Mortality		180			
Mouse	CoCl3	Acute		Mortality		80			
Guinea pig	CoCl3	Acute		Mortality		55			
Rabbit	Co(NO3)2	Acute		Mortality		400 (LD100)			
Rabbit	Metal	Acute		Mortality		700 (MLD)			
BIRDS									
Chicks				No observed effect			4.7 (N)	0.82 (N)	Turk and Kratzer 1960
Chicks				Severe toxicosis			50 (L)	8.75 (L) e	Turk and Kratzer 1960
Poultry and swine				Tolerable level			10 (N)	1.75 (N), using wgt = 0.8 and FI=0.14 kg/d	NAS 1980

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

FI = food intake
MLD = Minimum lethal dose

CoO = Cobaltous oxide
CoCl3 = Cobalt chloride
Co(NO3)2 = Cobalt nitrate

TABLE D-46

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
COPPER
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/ day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (m kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/ day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat	CS	Chronic	7-70 days	No effect			1000 (N)	75 (N) e	Boyden et al. 1938 in NAS 1980
Rat	CS	Acute		Mortality	4000 e	300			Lewis 1992
Rat	C	Chronic		Toxic dose			2026 (L) e	152 (L) TDLO	Lewis 1992
Hamster	CS	Chronic		Toxis dose			91 (L) e	11 (L) TDLO	Lewis 1992
Rabbit				No effect on growth			200		NAS 1980
LARGE MAMMALS									
Sheep				Hepatic accumulation; sudden hemolytic crisis			10 to 15		Smith and Rongstad 1982
Sheep				Mortality			> 15 ppm in forage		Hemkes and Hartmans 1973
Sheep				Maximum recorded tolerance level			25 (N)	1 (N) e	NAS 1980
Pig				No adverse effects			250 (N)	10.2 (N) e	Underwood 1971; Fleming & Trevors 1989

TABLE D-46

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
COPPER
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/ day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/ day) e = estimated	REFERENCE
BIRDS									
Duck	CS	Intermed.	8 wks.	No effect			100 (N)	10 (N)	King 1975 in NAS 1980
Mallard				No effect			250 (N)	29	NRC 1977
Chicken	CS	Intermed.	4 wks.	Growth retardation muscular dystrophy			324 (L)	56.7 (L) e	Mayo et al. 1956 in NAS 1980
Chicken	CO	Intermed.	10 wks.	Minimal toxic level			500 (L)	87.5 (L) e	Mehring et al. 1960 in NAS 1980
Turkey poult	CS	Intermed.	21 wks.	No effect			400 (N)	80 (N) e	Vohra & Kratzer 1968 in NAS 1980
Turkey	CS	Chronic	3 wks.	No effects			300 (N)	52.5 (N) e	Supplee 1964 in NAS 1980

FORM
CC = copper carbonate
CS = copper sulfate CuSO4
CO = CuO3
C = Copper

*TEST TYPE
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-47

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
CYANIDE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat	HCN	Chronic	1 year	No observable adverse effects				10.8 (N)	IRIS 1993
Rat	NaCN	Acute		Mortality		6.44			Lewis 1992
Hamster	HCN			Mortality				0.57 (LDLO)	Lewis 1992
Mouse	HCN	Acute		Mortality		3.7			Lewis 1992
Dog	HCN			Mortality				4 (LDLO)	Lewis 1992
BIRDS									
Rock dove	HCN	Acute	Single dose	Toxicity unspecified			1.5	0.3 e, using wgt. = 0.25 g FI = 0.05g	Hunt-Boston 1923
Black vulture	NaCN	Acute	Single dose	Mortality		4.4 - 5.3			Wiemeyer et al. 1986
American kestrel	NaCn	Acute	Single dose	Mortality		3.0 - 5.3			Wiemeyer et al. 1986
Japanese quail	NaCN	Acute	Single dose	Mortality		8.5 - 9.4			Wiemeyer et al. 1986
Eastern screech-owl	NaCN	Acute	Single dose	Mortality		8.6			Wiemeyer et al. 1986
European starling	NaCN	Acute	Single dose	Mortality		17			Wiemeyer et al. 1986
Chicken	NaCN	Acute		Mortality		21			Wiemeyer et al. 1986

FORM
- HCN = hydrogen cyanide
- NaCN = sodium cyanide

TEST TYPE*
- Acute = 14 days or less
- Intermediate = 15 to 364 days
- Chronic = more than 364 days

FI = food intake

TABLE D-48

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
LEAD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse	LA	Intermed.	3 months	Irreversible inhibition of ALAD activity in bone marrow and red blood cells				0.05 (N)	Schlick et al. 1983 in Eisler 1988
Mouse	TE	Chronic	Multi-gen-erations	Reproduction effects				2.2 (L)	Clark et al. in 1983 Eisler 1988
Shrew	TL	Chronic	Smelter Field Study	Critical renal load; sublethal symptoms of intoxication			56 (L) e, using W = 7 g; FI = 2.5 g	20 (L)	Ma et al. 1991
Vole	TL	Chronic	Smelter Field Study	No effects			17.5 (N) e, using W = 20g; FI = 12g	10 (N)	Ma et al. 1991
Rat	LN	Intermed.	3 weeks	Some mortality				100 (L)	Clark 1979 in Eisler 1988
Rat	TM	Acute	Single dose	Mortality		108			Branica and Konrad 1980 in Eisler 1988
Rat	TE	Acute	Single dose	Mortality		12			Branica and Konrad 1980 in Eisler 1988
Rat	U	Intermed.	3 weeks	Mortality (50%)		200	25		Clark 1979 in Eisler 1988

TABLE D-48

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
LEAD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Rat	LA	Intermed.	60 days	Testicular atrophy, cellular degeneration				90 (L)	Cnowdbury et al. 1984 in ATSDR 1991
Rabbit	U			Reduced blood ALAD				0.005 (L)	Barth et al. 1973 in Eisler 1988
Dog	LA	Chronic	2 yrs.	No neurologic effects				12.5 (N)	Azar et al. 1973 in ATSDR 1991
BIRDS									
American kestrel nestling	ML	Acute	10 days	Mortality	625	625			Hoffman et al. 1985 in Eisler 1988
American kestrel nestling	ML	Acute	10 days	Reduced growth, ALAD depression, abnormal skeleton			125 (L)	125 (L)	Hoffman et al. 1985 in Eisler 1988
Red-tailed hawk	LA	Intermed.	11 weeks	No adverse effects				6.6 (N)	Lawler et al. 1991
American kestrel	ML	Intermed.	5 months	ALAD reduction				10 (N) e, using FI = 20% bw	Franson et al. 1983 in Eisler 1988
American kestrel	ML	Intermed.	5 months	No adverse effects			10 (N)	2 (N) e, using FI = 20% bw	Franson et al. 1983 in Eisler 1988
American kestrel	ML	Intermed.	6 months	No adverse effects; elevated residues			50 (N)	10 (N) e, using FI = 20 % bw	Pattee 1984 in Eisler 1988
American kestrel	ML	Intermed.	6 months	No adverse effects; elevated residues			10 (N)	2 (N) e, using FI = 20% bw	Pattee 1984 in Eisler 1988

TABLE D-48

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
LEAD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Bald eagle nestlings	ML	Acute	10 days	ALAD depression				25 (N)	Hoffman et al. 1985b
Mallard	LN	Intermed.	12 weeks	Reduced ALAD			25 (N)	2.5 (N) e using FI and W of domestic duck	Finley et al. 1986 in Eisler 1988
Mallard	LS	Acute	1 dose	Mortality		151 (205 mg)			Dieter and Finley 1978 in Eisler 1988
Mallard	TE	Acute	1 dose	Mortality		107			Hudson et al. 1984
Japanese quail	ML	Acute	5 days	No adverse effects			5000 (N)	650 (N) e using FI and W of quail	Hill and Camardese 1986 in Eisler 1988
Japanese quail	LA	Acute	5 days	Mortality	2761	359 e, using FI and W of quail			Hill and Camardese 1986 in Eisler 1988
Ringed turtle doves	LA	Acute	Single dose	Mortality		75			Kendall and Scanlon 1985
Cockerels	BL	Intermed.	60 days	No adverse effects; elevated residue levels			448 (N)	89.6 (N) e using FI = 20% bw	Custer et al. 1984
European starling	TR	Acute	6 days	100 % mortality		28			Osborn et al. 1983 in Eisler 1988

TABLE D-48

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
LEAD
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
European starling	TR	Acute	11 days	Reduced food consumption; hyperactivity				2.8 (L)	Osborn et al. 1983 in Eisler 1988
Red-winged blackbird	LA	Chronic	7 wks.	Lethal to some chronically exposed birds			150 (N) (dw)	30 (L) e, using FI = 20% bw	Beyer & Stafford 1993
Chicken	LA	Intermed.	28 days	No effects			100 (N)	17.5 (N) e	Damron et al. 1969

ML = Metallic Lead
LA = Lead Acetate
LN = Lead Nitrate
TM = Tetramethyl Lead
TE = Tetraethyl Lead
TR = Triethyl Lead
LS = Lead Shot
BL = Biologically Incorporated Lead
TL = Total Lead; Form Unspecified
U = Form Unspecified

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

Domestic duck (NIOSH 1987)
food intake (FI) = 0.25 kg/day
wgt = 2.5 kg

Quail (NIOSH 1987)
FI = 0.013 kg (using allometric equation from Nagy 1987)
wgt = 0.1 kg

(1) ALAD reduction is considered a no adverse effect

TABLE D-49

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
MANGANESE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/ day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/ day) e = estimated	REFERENCE
MAMMALS									
Rat	KMnO4	Acute		Mortality		1090			
Rat	M2(C2H3O2)2·4H2O	Acute		Mortality		3730			
Guinea pig	MnF2	Acute		Mortality		200 (MLD)			
Cattle				No effects	1000 (MTL)	20 (MTL)			NAS 1980
Sheep				No effects	1000 (MTL)	40 (MTL)			NAS 1980
BIRDS									
Chicken				No observable effect			3000 (N)	525 (N) e; using wgt=800g; FI= 149g	Hurley and Keen 1985
Poultry				No effects	2000 (MTL)	350 (MTL)			NAS 1980

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

MLD = Minimum lethal dose
MTL = Maximum tolerable level

TABLE D-50

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
MERCURY
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mammals (general)	U			Mortality	1 to 5				Eisler 1987
Rats	U	Chronic						0.01 - 0.38 (L)	Sax 1984
Mink	MM	Chronic	3 generations	Sublethal effects			0.5 (L)	0.078 (L) e	Heinz 1979 in Beyer & Stafford 1993
Mink	MM	Intermed.	30-37 days	Mortality (100%)	5.0	0.78			Sheffy and St. Amant 1982; Aulerich et al. 1974 in Beyer & Stafford 1993
Mink	MCL	Chronic	5 months	No observable adverse effects			10 (L)	1.56 (L) e	Beyer & Stafford 1993
Mouse				Unspecified			1.7 (L) e	0.2 (L)	Eisler 1987
BIRDS									
Mallards (breeding)	MM	Intermed.	21 wks.	Reduced egg output; reduced hatching success; early mortality in hatchlings			3 (L)	0.6 (L) e	Scheuhammer 1987
Mallard (female)	MM	Chronic	3 genera-tions	Increased egg laying outside nest boxes; lower clutches; fewer young raised.			0.5 (L)	0.1 (L) e	Heinz 1979
Loons (breeding)	TM	Chronic	Field study	Egg laying and territorial fidelity impaired			0.3 - 0.4 (L) in prey (ww)	0.06 - 0.08 (L) e	Burr 1986 in Scheuhammer 1987
Ringed-neck pheasant	MM	Intermed.	12 wks.	Shell-less eggs			2 - 3 (L)	0.4 - 0.6 (L) e	Finreite 1971 in Scheuhammer 1987
Ringed-neck pheasants	MM	Intermed.		Decreased reproduction				0.64 (L)	McEwen et al. 1973

TABLE D-50

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
MERCURY
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Raptors				Unspecified "lethal effects"	7.0 - 10.0				Fimreite and Karstad 1971 in ESE 1989
Quail	IM			Mortality		42			Hill 1984
Quail	OM			Mortality		18			Hill 1984
Quail	IM	Acute	5-day	Mortality	5086				Hill 1984
Quail	OM	Acute	5-day	Mortality	47				Hill 1984
Ten different bird species	OM			Mortality		11.5 - 80			McEwan 1968
Chicken	In water			Mortality				31.25** (L)	Soares et al. 1973
Chicken	IM in water	Intermed.	35 days	Decreased growth; death	250 mg/L				Parkhurst and Thaxton 1973

FORM
- U = Uspecified
- MM = methylmercury
- OM = organic mercury
- IM = inorganic mercury
- MCL = mercuric chloride
- TM = total mercury

*TEST TYPE
- Acute = 14 days or less
- Intermediate = 15 to 364 days
- Chronic = more than 364 days

**Based on a water ingestion rate of 0.25 L/kg bw day (Sax 1984) and the highest NOEL in ingested water of 125 ppm.

TABLE D-51

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
SELENIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse		Acute		Toxic dose		134 (L)			Lewis 1992
Rat		Acute		Toxic dose		6700 (L)			Lewis 1992
Rat		Chronic		Chronic selenosis			0.001 (L) in feed	0.075 (L) e	Harr 1978
Rat		Chronic		Chronic selenosis			0.5 mg/l (L) in water	0.0625 (L) e	Harr 1978
BIRDS									
Mallard	Selnometh-ionine	Chronic		Reproductive impairment			10 (L)	2 (L) e; using FI=20% bw	Heinz et al. 1987 in EPA 1993
Chicken	Sodium selenite	Chronic		Reduced hatching success			5 (N)	0.875 (N) e; using FI=17.5% bw	Ort & Latshau 1978 in EPA 1993

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-52

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
SILVER
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Mouse	SN	Intermed.	125 days	Decreased activity			95 ppm in drinking water	19 (L) e	Rungby and Danscher 1984
Mouse	Metal calloidal	Acute		Mortality - 50%		100			Venugopal & Luckey 1978
Mouse	SN	Acute		Mortality - 50%		82			Venugopal & Luckey 1978
Rat		Acute		Mortality - 10%		330 (LD10)			USDHHS 1987
BIRDS									
Poultry		Chronic		Maximum tolerable level			100 (N)	17.5 (N) e	NAS 1980
Chicken		Intermed.	3 weeks	No adverse effects			10 to 100		Hill et al. 1964
Turkey		Intermed.	28 days	No adverse effects			300 (N)		Jensen et al. 1974
Turkey		Intermed.	28 days	Decreased weight gain			300 (L)		Jensen et al. 1974

FORM
SN = silver nitrate

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-53

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
SULFIDE
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat	Sulfer			Optimal total sulfer in diet			6900 (L) 0.69% diet		NAS 1980
Dog	Ammonium persulfate			Optimal total sulfer in diet			2800 (L) 0.28% diet		NAS 1980
Dog	Sulfate			Diarrhea; weakened conditon; death				3590 in water	McKee & Wolf 1963
Most animals	Inorganic sulfur			Toxic dietary level			3000 - 5000		NAS 1980

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-54

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
THALLIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Guinea pig				Mortality	20	1.2 (L) e			Gough et al. 1980
Guinea pig	Tl2O3	Acute		Mortality		5.2 (MLD)			Venugopal & Luckey 1978
Dog	Tl2O	Acute		Mortality		31.2 (MLD)			Venugopal & Luckey 1978
Dog	TlNO3	Acute		Mortality - 100%		45 (LD100)			Venugopal & Luckey 1978
Dog				Mortality	1400 (L) e	35 (L)			Gough et al. 1980
Mouse	TlCl	Acute		Mortality		24			Venugopal & Luckey 1978
Mouse	TlNO3	Acute		Mortality		32.5			Venugopal & Luckey 1978
Mouse	Tl2SO4	Acute		Mortality		29			Venugopal & Luckey 1978
Rat	Tl2O	Acute		Mortality		40.6			Venugopal & Luckey 1978
Rat	Tl2O	Acute		Mortality		20.8 (MLD)			Venugopal & Luckey 1978
Rat	Tl2SO4	Acute		Mortality - 100%		25 (LD100)			Venugopal & Luckey 1978
Rat	Tl2SeO3	Acute		Mortality		50 (MLD)			Venugopal & Luckey 1978
Rat		Intermed.	90 days	No observable adverse effects			3.06 (N) e	0.23 (N)	IRIS 1993

TABLE D-54

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
THALLIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Mammals (various)				Suggested level at which toxic effects detrimental to individual survival occur			0.003 (L)		Gough et al. 1980
BIRDS									
Mallard ducks		Acute		Mortality	625 e	125 (MLD)			Gough et al. 1980
Quail (starved)		Acute		Mortality	60 e	12 (MLD)			Gough et al. 1980

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

FORM
TL2O = Thallium oxide
Tl2O3 = Thallic oxide
TlCl = Thallium chloride
TlNO3 = Thallium nitrate
Tl2SO4 = Thallous sulfate
Tl2SeO3 = Thallium selenite

TABLE D-55

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
VANADIUM
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat	NaVO3	Intermed.	Chronic	No adverse effects			40 (N)	3 (N) e	Hansard 1975 in NAS 1980
Rat		Chronic	Lifetime	No observable adverse effects			5 (N) in water	0.625 (N) e	HEAST 1993
Mouse	VOSO4	Chronic	Lifetime	No adverse effects			5 (N)	0.6 (N) e	Schroder & Mitchener 1975 in NAS 1980
Cattle				Maximum tolerable level			50 (N)	1 (N) e	NAS 1980
Sheep				Maximum tolerable level			10 (N)	0.4 (N) e	NAS 1980
BIRDS									
Chick				Mortality		35			Nelson et al. 1962
Chick				Mortality		20			Romoser et al. 1961
Poultry		Chronic		Maximum tolerable level			10 (N)	1.75 (N) e	NAS 1980
Duck	VOSO4	Intermed.	84 days	No adverse effects			1 (N)	0.2 (N) e	White & Dieter 1978 in NAS 1980

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-56

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
ZINC
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
SMALL MAMMALS									
Rat				No adverse effects			2500 (N)	187.5 (N) e	Underwood 1971
Rat				Growth depression; anemia			4000 to 5000 (L)	300 (L) e	Underwood 1971
Rat				Mortality			10000 (L)	750 (L) e	Underwood 1971
Rat	ZS	Intermed.	1 - 18 days	Toxic effects			4440 (L) e	333 (L)	NIOSH 1987
Mouse				Cancellation of cancer-protecting effect of selenium			200 mg/L in drinking water	25 (L) e	Taylor et al. 1982
DOMESTIC ANIMALS									
Domestic animals				No effects			300		NAS 1980
Sheep	ZnO	Intermed.	10 wks.	No effects			500 (N)	20 (N) e	
Sheep	ZnO	Intermed.	10 wks	Decreased feed intake			1000 (L)	40 (L) e	Ott et al. 1966 in NAS 1980
Pig	ZnC, ZO	Intermed.	69 d - 6 wks.	Decreased weight gain			2000 (L)	82 (L) e	Cox & Hale 1962, Brink et al. 1959 in NAS 1980
Pig	ZnC	Intermed.	6 wks.	No effect			1000 (N)	41 (N) e	Brink et al. 1959 in NAS 1980

TABLE D-56

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
ZINC
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or OAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
Beef cattle				No adverse effects			16.7 to 628.3		Taylor et al. 1982
Beef cattle				Potentially harmful			>1000		Taylor et al. 1982
BIRDS									
Chicken				No adverse effects			1000 (N)	175 (N) e	Gassaway and Buss 1972
Chicken	ZO	Intermed.	10 wks.	No effects			1784 (N)	312 (N) e	Johnson et al. 1962 in NAS 1980
Turkey	ZnO	Intermed.	3 wks.	No effects			2000 (N)	350 (N)	Vohra & Kratzer 1968
Poultry	ZC or ZS			Reduced growth			1500 (L)	262.5 (L) e	Taylor et al. 1982
Poultry	ZC			Weight loss followed by mortality			3000 (L)	525 (L) e	Gassaway and Buss 1972
Mallard duck		Intermed.	60 days	Weight loss; mortality			3000	600 (L) e; using FI=20% bw	Gassaway and Buss 1972

FORM
ZC = zinc carbonate
ZS = zinc sulfate

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-57

TOXICITY DATA FOR TERRESTRIAL ORGANISMS
TOTAL PETROLEUM HYDROCARBONS (TPH)
CANNON AFB

TEST SPECIES	FORM	TEST TYPE*	DURATION	EFFECT	ACUTE DIETARY LC50 (mg/kg)	ACUTE DOSE ORAL LD50 (mg/kg-bw/day)	CHRONIC DIETARY NOEL (N) or LOAEL (L) (mg/kg in diet) e = estimated	CHRONIC DOSE ORAL NOEL (N) or LOAEL (L) (mg/kgBW/day) e = estimated	REFERENCE
MAMMALS									
Rat	Gasoline	Chronic	103-113	Significant body weight			964	48.2 (N)e	EPA 1992
Mouse	JP-5 (kerosene)	Intermediate	90 days	Hepatocellular fatty change and vacuolization			407	48.8 (L)e	EPA 1992
Mouse	JP-4 jet fuel	Intermediate	90 days	Fatty change in livers			1355	163 (L)e	EPA 1992
Mouse	Marine diesel fuel	Intermediate	90 days	Fatty change in livers			135	16.2 (L)e	EPA 1992

TEST TYPE*
Acute = 14 days or less
Intermediate = 15 to 364 days
Chronic = more than 364 days

TABLE D-58

TOXICITY DOSE VALUES FOR TPH CONSTITUENTS
CANNON AFB

TPH Constituent	Dose Level (mg/kg-bw/day)	Effect Type	Safety Factor [1]	"No-effects" Dose (D) and Diet (mg/kg/day) (d) levels [3]	Test Time	Animal Type	Effect	Reference
xylene	2060	TDLO	0.2	412 D 3420 d	15 days	pregnant mice	fetal malformation, resorption; decreased fetal body weight	Marks et al. 1982
xylene	1030	NOEL	1	1030 D 8549 d	6-15 days	pregnant mice	no effect	Marks et al. 1982
xylene	50	LDLO	0.1	5 D 41.5 d		hamster		Lewis 1992
xylene	4300	LD50	0.1	430 D 5719 d		rat	lethal	Lewis 1992
xylene, m-	30	TDLO	0.2	6 D 50 d	6-15 days	pregnant mouse	reproductive effects	Lewis 1992
benzene	6500	TDLO	0.2	1300 D 10,790 d	8-12 D post	female mice	reproductive effects	Lewis 1992
benzene	3306	LD50	0.1	330.6 D 4397 d		rat	lethal	Lewis 1992
benzene	4700	LD50	0.1	470 D 3901 d		mouse	lethal	Lewis 1992
benzene	2000	LDLO	0.1	200 D 8000 d		dog		Lewis 1992
toluene	50	LDLO	0.1	5 D 41.5 d		hamster	lethal	Lewis 1992
toluene	5000	LD50	0.1	500 D 6650 d		rat	lethal	Lewis 1992

TABLE D-58
TOXICITY DOSE VALUES FOR TPH CONSTITUENTS
CANNON AFB
(Continued)

TPH Constituent	Dose Level (mg/kg-bw/day)	Effect Type	Safety Factor [1]	"No-effects" Dose (D) and Diet (mg/kg/day) (d) levels [3]	Test Time	Animal Type	Effect	Reference
ethylbenzene	3500	LD50	0.1	350 D 4655 d		rat	lethal	Lewis 1992
PAHS								
benzo(a)pyrene	50	LD50	0.1	5 D 41 d-mouse		rodents	lethal	Eisler 1987
benzo(a)pyrene	0.002	TDLO	0.2	0.0004 D 0.003 d-mouse	chronic	rodents	cancer	Eisler 1987
phenanthrene	700	LD50	0.1	70 D 581 d-mouse		rodents	lethal	Eisler 1987; NIOSH 1986
naphthalene	1780	LD50	0.1	178 D 1477 d-mouse		rodents	lethal	Eisler 1987
fluoranthene	2000	LD50	0.1	200 D 1660 d-mouse		rodents	lethal	Eisler 1987
7,12-dimethylbenz(a)anthracene	0.00004	TDLO	0.2	0.000008 D 0.00007 d-mouse	chronic	rodents	cancer	Eisler 1987
dibenz(a,h) anthracene	0.006	TDLO	0.2	0.0012 D 0.01 d-mouse	chronic	rodents	cancer	Eisler 1987
benz(a) anthracene	2	TDLO	0.2	0.4 D 3 d-mouse	chronic	rodents	cancer	Eisler 1987
benzo(b) fluoranthene	40	TDLO	0.2	8 D 66 d-mouse	chronic	rodents	cancer	Eisler 1987
indeno(1,2,3-cd)pyrene	72	TDLO	0.2	14.4 D 119 d-mouse	chronic	rodents	cancer	Eisler 1987

TABLE D-58
TOXICITY DOSE VALUES FOR TPH CONSTITUENTS
CANNON AFB
(Concluded)

TPH Constituent	Dose Level (mg/kg-bw/day)	Effect Type	Safety Factor (1)	"No-effects" Dose (D) and Diet (mg/kg/day) (d) levels (3)	Test Time	Animal Type	Effect	Reference
chrysene	99	TDLO	0.2	19.8 D 164 d-mouse	chronic	rodents	cancer	Eisler 1987
anthracene	3300	TDLO	0.2	660 D 5478 d-mouse	chronic	rodents	cancer	Eisler 1987

(1) safety factor of 0.2 applied to convert LOAEL or TDLO to NOEL (from Newell et al. 1987)
(2) although reported as a NOAEL due to no cancer or histopathological effects, significant body weight reduction may be considered a significant adverse effect for small wild mammals
(3) dietary levels calculated using standard weight and food intake values for laboratory animals (NIOSH 1978)

TABLE D-59

BENCHMARK TOXICITY VALUES FOR KEY RECEPTOR SPECIES
CANNON AFB

	Small Mammals			Large Mammals			Birds		
Chemical	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.
Volatile Organics									
Benzene				480	19200	NIOSH 1987	480	2400	NIOSH 1987
Bromoform							50	250	IRIS 1993
2-Butanone				405	16200	NIOSH 1987	405	2025	NIOSH 1987
Carbon disulfide				0.04	1.6	NIOSH 1987	0.04	0.2	NIOSH 1987
Chloromethane				180	7200	Lewis 1992	180	900	Lewis 1992
1,2-Dichloroethane	62.5	520.8	Lewis 1992				62.5	312.5	Lewis 1992
1,2-Dichloropropane							200	1000	NIOSH 1987
Ethylbenzene	97.1	809.2	IRIS 1993				97.1	485.5	IRIS 1993
2-Hexanone							91.4	457	NIOSH 1987
4-Methyl-2-pentanone							50	250	HEAST 1993
1,1,2,2-Tetrachloroethane							0.008	0.042	NIOSH 1987
Tetrachloroethene							1000	5000	IRIS 1993
Toluene	2500	20833.3	NTP 1990 in USDHHS 1992				2500	12500	NTP 1990 in USDHHS 1992
Xylenes	1000	8333.3	NTP 1986 in USDHHS 1993				1000	5000	NTP 1986 in USDHHS 1993
Semivolatile Organics									
Acenaphthene							0.08	0.4	EPA 1980
Anthracene	1000	8333.3	IRIS 1993				1000	5000	IRIS 1993
Benzo(a)anthracene	0.08	0.67	Eisler 1987				0.08	0.4	Eisler 1987
Benzo(a)pyrene	0.0004	0.003	Eisler 1987				0.0004	0.002	Eisler 1987
Benzo(b)fluoranthene	1.6	13.3	Eisler 1987				1.6	8	Eisler 1987
Benzo(g,h,i)perylene	75	625	IRIS 1993				75	375	IRIS 1993
bis(2-ethylhexyl)phthalate				19	760	IRIS 1993	19	95	IRIS 1993
Butyl benzyl phthalate	94	783.3	IRIS 1993	94	3760	IRIS 1993	94	470	IRIS 1993

TABLE D-59

BENCHMARK TOXICITY VALUES FOR KEY RECEPTOR SPECIES
CANNON AFB
(Continued)

	Small Mammals			Large Mammals			Birds		
Chemical	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.
Carbazole	50	417	Lewis 1992				50	250	Lewis 1992
Chrysene	2.4	20	IRIS 1993				2.4	12	IRIS 1993
Dibenz(a,h)anthracene	0.0012	0.01	Eisler 1987				0.0012	0.006	Eisler 1987
Dibenzofuran	0.396	3.3	EPA				0.66	3.3	EPA
Di-n-butyl phthalate	2100	17500	IRIS 1993	125	5000	IRIS 1993	2100	10500	IRIS 1993
Di-n-octyl phthalate	651.3	5427.5	NIOSH 1987				651.3	3256.5	NIOSH 1987
Fluoranthene	125	1041.7	IRIS 1993				125	625	IRIS 1993
Fluorene							125	625	IRIS 1993
Ideno(1,2,3-cd)pyrene	2.88	24	Eisler 1987				2.88	14.4	Eisler 1987
2-Methylnaphthalene							163	815	IRIS 1993
Naphthalene							53.3	267.5	NIOSH 1987
Pentachlorophenol	10	83.3	Eisler 1989				38	190	Eisler 1989
Phenanthrene	30	250	Eisler 1987				30	150	Eisler 1987
Pyrene	75	625	IRIS 1993				75	375	IRIS 1993
Pesticides/PCBs									
4,4'-DDE	0.6	5	Lehman 1951,				0.012	0.06 (duck)	Hudson et al. 1984
			Wren 1971					0.2 (raptor)	Beyer & Stafford 1993
4,4'-DDT	0.6	5	Lehman 1951,				0.012	0.06 (duck)	Hudson et al. 1984
			Wren 1971					0.2 (raptor)	Beyer & Stafford 1993
alpha-Chlordane	0.055	0.49	IRIS 1993				0.02 (duck)	0.1	Eisler 1990
							0.006 (raptor)		
gamma-Chlordane	0.055	0.49	IRIS 1993				0.02 (duck)	0.1	Eisler 1990
							0.006 (raptor)		

TABLE D-59

BENCHMARK TOXICITY VALUES FOR KEY RECEPTOR SPECIES
CANNON AFB
(Concluded)

	Small Mammals			Large Mammals			Birds		
Chemical	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.	Dose* (mg/kg-bw/day)	Dietary Level (mg/kg)	Ref.
Metals									
Aluminum				197	7880	NAS 1980	300	1500	Scheuhammer 1987
Antimony	3.3	27.5	NAS 1980				3.3	16.5	NAS 1980
Barium				31	1240	EPA 1990	250	1250	EPA 1990
Cadmium	14	166.7	ASTRD 1991	14	560	ASTRD 1991	2.1	10.5	NAS 1980
Chromium (III)	11	92	IRIS 1993	11	440	IRIS 1993	175	875	NAS 1980
(VI)	650	5416	NAS 1980	650	26000	NAS 1980	17.5	87.5	NAS 1980
Cobalt				1.75	70	NAS 1980	1.75	10	NAS 1980
Copper	6	50	NAS 1980	6	240	NAS 1980	52	260	NAS 1980
Cyanide				0.4	16	Lewis 1992	0.4	2	Wiemeyer et al. 1986
Lead	18	150	ATSDR 1991	18	720	ATSDR 1991	17.5	87.5	Damron et al. 1969
Manganese	20	166	NAS 1980				350	1750	NAS 1980
Mercury				0.08	3.2	Beyer & Stafford 1993	0.06	0.3	Scheuhammer 1987
Selenium	0.015	0.125	Harr 1978	0.015	0.6	Harr 1978	1	5	EPA 1993
Silver				8.2	328	Venogopal & Luckey 1978	8.2	41	Venogopal & Luckey 1978
Sulfide, total				15	600	NAS 1980	120	600	NAS 1980
Thallium							0.52	2.6	Venogopal & Luckey 1978
Vanadium				0.4	16	NAS 1980	1.75	10	NAS 1980
Zinc	75	625	Underwood 1971	75	3000	Underwood 1971	175	875	Gassaway & Buss 1972
TPH	48.2	401.7	EPA 1992	48.2	1928	EPA 1992	48.2	241	EPA 1992

*Doses were obtained from the literature and converted to dietary levels based on the following assumptions (NIOSH 1987):
Small mammal food intake = 3 g/day, small mammal body weight = 25 g; conversion ratio = 0.12
Large mammal food intake = 250 g/day, large mammal body weight = 10000 g; conversion ratio = 0.025
Bird food intake = 100 g/day, bird body weight = 500 g; conversion ratio = 0.2

AGE MAINTENANCE SHOP PAD
RISK CALCULATIONS

Receptor/Pathway Summary: CANNON AFB AGE PAD

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SURFACE SOIL	6.07E-11		4.70E-09	9.66E-09		2.69E-07
-- Ingestion of SURFACE SOIL	2.03E-08		1.50E-04	4.80E-06		3.12E-02
-- Inhalation of VOCS	2.55E-12		0.00E+00	1.28E-10		0.00E+00
-- Inhalation of PARTICS	1.62E-09		2.43E-05	8.17E-08		4.40E-04
	2.20E-08		1.74E-04	4.89E-06		3.17E-02
CONSTR WORKER						
-- Dermal Contact with TSOIL	2.17E-12	2.82E-10		4.86E-11	4.23E-09	
-- Ingestion of TSOIL	2.98E-09	1.25E-04		6.14E-08	1.15E-03	
-- Inhalation of TSOIL VOCS	1.70E-13	0.00E+00		7.39E-13	0.00E+00	
-- Inhalation of TSOIL PARTICS	2.09E-11	5.81E-07		9.07E-11	2.53E-06	
	3.01E-09	1.26E-04		6.16E-08	1.15E-03	
TRESPASSER						
-- Dermal Contact with SURFACE SOIL	1.20E-11	1.40E-10		1.28E-09	1.48E-08	
-- Ingestion of SURFACE SOIL	4.02E-09	2.65E-05		3.29E-07	4.94E-03	
-- Inhalation of VOCS	5.06E-13	0.00E+00		8.79E-12	0.00E+00	
-- Inhalation of PARTICS	3.22E-10	7.23E-07		5.60E-09	1.26E-05	
	4.36E-09	2.72E-05		3.36E-07	4.96E-03	

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Carbazole	5.00E-02	6.04E-08	3.02E-09	2.00E-02	6.04E-11	
Tetrachloroethene	1.00E-04	6.04E-08	6.04E-12	5.10E-02	3.08E-13	
						6.07E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	1.00E-04	4.70E-07	4.70E-11	1.00E-02	4.70E-09	
						4.70E-09

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Carbazole	5.00E-02	9.61E-06	4.81E-07	2.00E-02	9.61E-09	
Tetrachloroethene	1.00E-04	9.61E-06	9.61E-10	5.10E-02	4.90E-11	
						9.66E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	1.00E-04	2.69E-05	2.69E-09	1.00E-02	2.69E-07	
						2.69E-07

OCCUP WORKER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.40E+00	7.55E-10	1.81E-09	7.30E-01	1.32E-09	
Benzo(a)pyrene	2.70E+00	7.55E-10	2.04E-09	7.30E+00	1.49E-08	
Benzo(b)fluoranthene	4.80E+00	7.55E-10	3.62E-09	7.30E-01	2.64E-09	
Carbazole	5.00E-01	7.55E-10	3.77E-10	2.00E-02	7.55E-12	
Chrysene	3.10E+00	7.55E-10	2.34E-09	7.30E-02	1.71E-10	
Indeno(1,2,3-c,d)pyrene	2.30E+00	7.55E-10	1.74E-09	7.30E-01	1.27E-09	
Tetrachloroethene	3.60E-03	7.55E-10	2.72E-12	5.10E-02	1.39E-13	
						2.03E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	6.00E-01	5.87E-09	3.52E-09	3.00E-01	1.17E-08	
Antimony	1.90E+00	5.87E-09	1.12E-08	4.00E-04	2.79E-05	
Barium	4.90E+02	5.87E-09	2.88E-06	7.00E-02	4.11E-05	
Cadmium (food)	3.56E+00	5.87E-09	2.09E-08	1.00E-03	2.09E-05	
Chromium	4.40E+01	5.87E-09	2.58E-07	5.00E-03	5.17E-05	
Copper	2.43E+01	5.87E-09	1.43E-07	3.70E-02	3.85E-06	
Fluoranthene	4.80E+00	5.87E-09	2.82E-08	4.00E-02	7.05E-07	
Pyrene	4.30E+00	5.87E-09	2.52E-08	3.00E-02	8.41E-07	
Tetrachloroethene	3.60E-03	5.87E-09	2.11E-11	1.00E-02	2.11E-09	
Zinc	1.63E+02	5.87E-09	9.56E-07	3.00E-01	3.19E-06	
						1.50E-04

OCCUP WORKER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.40E+00	1.75E-07	4.19E-07	7.30E-01	3.06E-07	
Benzo(a)pyrene	2.70E+00	1.75E-07	4.72E-07	7.30E+00	3.44E-06	
Benzo(b)fluoranthene	5.60E+00	1.75E-07	9.78E-07	7.30E-01	7.14E-07	
Carbazole	5.00E-01	1.75E-07	8.74E-08	2.00E-02	1.75E-09	
Chrysene	3.10E+00	1.75E-07	5.42E-07	7.30E-02	3.95E-08	
Indeno(1,2,3-c,d)pyrene	2.30E+00	1.75E-07	4.02E-07	7.30E-01	2.93E-07	
Tetrachloroethene	3.60E-03	1.75E-07	6.29E-10	5.10E-02	3.21E-11	
						4.80E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	6.00E-01	4.89E-07	2.94E-07	3.00E-01	9.78E-07	
Antimony	1.90E+00	4.89E-07	9.30E-07	4.00E-04	2.32E-03	
Barium	1.46E+03	4.89E-07	7.14E-04	7.00E-02	1.02E-02	
Cadmium (food)	8.70E+00	4.89E-07	4.26E-06	1.00E-03	4.26E-03	
Chromium	1.30E+02	4.89E-07	6.36E-05	5.00E-03	1.27E-02	
Copper	6.14E+01	4.89E-07	3.00E-05	3.70E-02	8.12E-04	
Fluoranthene	5.60E+00	4.89E-07	2.74E-06	4.00E-02	6.85E-05	
Pyrene	4.60E+00	4.89E-07	2.25E-06	3.00E-02	7.50E-05	
Tetrachloroethene	3.60E-03	4.89E-07	1.76E-09	1.00E-02	1.76E-07	
Zinc	4.79E+02	4.89E-07	2.34E-04	3.00E-01	7.81E-04	
						3.12E-02

OCCUP WORKER
Inhalation of VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Tetrachloroethene	1.02E-06	1.39E-03	1.42E-09	1.80E-03	2.55E-12	
						2.55E-12

OCCUP WORKER
Inhalation of VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Tetrachloroethene	1.02E-06	6.99E-02	7.13E-08	1.80E-03	1.28E-10	
						1.28E-10

OCCUP WORKER
Inhalation of PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	5.18E-10	1.39E-03	7.19E-13	6.10E-01	4.39E-13	
Benzo(a)pyrene	5.83E-10	1.39E-03	8.10E-13	6.10E+00	4.94E-12	
Benzo(b)fluoranthene	1.21E-09	1.39E-03	1.68E-12	6.10E-01	1.03E-12	
Cadmium (food)	1.88E-09	1.39E-03	2.61E-12	6.10E+00	1.59E-11	
Chromium	2.81E-08	1.39E-03	3.90E-11	4.10E+01	1.60E-09	
Chrysene	6.70E-10	1.39E-03	9.31E-13	6.10E-02	5.68E-14	
Indeno(1,2,3-c,d)pyrene	4.97E-10	1.39E-03	6.90E-13	6.10E-01	4.21E-13	
						1.62E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	3.15E-07	1.08E-02	3.40E-09	1.40E-04	2.43E-05	
						2.43E-05

OCCUP WORKER
Inhalation of PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	5.18E-10	6.99E-02	3.62E-11	6.10E-01	2.21E-11	
Benzo(a)pyrene	5.83E-10	6.99E-02	4.07E-11	6.10E+00	2.49E-10	
Benzo(b)fluoranthene	1.21E-09	6.99E-02	8.46E-11	6.10E-01	5.16E-11	
Cadmium (food)	1.88E-09	6.99E-02	1.31E-10	6.10E+00	8.02E-10	
Chromium	2.81E-08	6.99E-02	1.96E-09	4.10E+01	8.05E-08	
Chrysene	6.70E-10	6.99E-02	4.68E-11	6.10E-02	2.86E-12	
Indeno(1,2,3-c,d)pyrene	4.97E-10	6.99E-02	3.47E-11	6.10E-01	2.12E-11	
						8.17E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	3.15E-07	1.96E-01	6.16E-08	1.40E-04	4.40E-04	
						4.40E-04

CONSTR WORKER
Dermal Contact with TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Carbazole	2.40E-02	4.47E-09	1.07E-10	2.00E-02	2.15E-12	
Tetrachloroethene	9.00E-05	4.47E-09	4.03E-13	5.10E-02	2.05E-14	
						2.17E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	9.00E-05	3.13E-07	2.82E-11	1.00E-01	2.82E-10	
						2.82E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	9.00E-05	3.13E-07	2.82E-11	1.00E-02	2.82E-09	
						2.82E-09

CONSTR WORKER
Dermal Contact with TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Carbazole	3.60E-02	6.71E-08	2.42E-09	2.00E-02	4.83E-11	
Tetrachloroethene	9.00E-05	6.71E-08	6.04E-12	5.10E-02	3.08E-13	
						4.86E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	9.00E-05	4.70E-06	4.23E-10	1.00E-01	4.23E-09	
						4.23E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	9.00E-05	4.70E-06	4.23E-10	1.00E-02	4.23E-08	
						4.23E-08

CONSTR WORKER
Ingestion of TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.05E+00	2.80E-10	2.94E-10	7.30E-01	2.14E-10	
Benzo(a)pyrene	1.09E+00	2.80E-10	3.05E-10	7.30E+00	2.23E-09	
Benzo(b)fluoranthene	1.49E+00	2.80E-10	4.17E-10	7.30E-01	3.04E-10	
Carbazole	2.42E-01	2.80E-10	6.76E-11	2.00E-02	1.35E-12	
Chrysene	1.15E+00	2.80E-10	3.21E-10	7.30E-02	2.35E-11	
Indeno(1,2,3-c,d)pyrene	1.04E+00	2.80E-10	2.90E-10	7.30E-01	2.11E-10	
Tetrachloroethene	2.98E-03	2.80E-10	8.33E-13	5.10E-02	4.25E-14	
						2.98E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	2.58E-01	1.96E-08	5.06E-09	3.00E+00	1.69E-09	
Antimony	1.90E+00	1.96E-08	3.72E-08	4.00E-04	9.30E-05	
Barium	3.27E+01	1.96E-08	6.41E-07	7.00E-02	9.15E-06	
Chromium	1.52E+01	1.96E-08	2.97E-07	2.00E-02	1.49E-05	
Copper	9.15E+00	1.96E-08	1.79E-07	3.70E-02	4.84E-06	
Fluoranthene	1.49E+00	1.96E-08	2.91E-08	4.00E-01	7.28E-08	
Pyrene	1.34E+00	1.96E-08	2.63E-08	3.00E-01	8.77E-08	
Tetrachloroethene	2.98E-03	1.96E-08	5.83E-11	1.00E-01	5.83E-10	
Zinc	5.05E+01	1.96E-08	9.89E-07	3.00E-01	3.30E-06	
						1.25E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	2.58E-01	1.96E-08	5.06E-09	3.00E-01	1.69E-08	
Antimony	1.90E+00	1.96E-08	3.72E-08	4.00E-04	9.30E-05	
Barium	3.27E+01	1.96E-08	6.41E-07	7.00E-02	9.15E-06	
Cadmium (food)	1.23E+00	1.96E-08	2.41E-08	1.00E-03	2.41E-05	
Chromium	1.52E+01	1.96E-08	2.97E-07	5.00E-03	5.95E-05	
Copper	9.15E+00	1.96E-08	1.79E-07	3.70E-02	4.84E-06	
Fluoranthene	1.49E+00	1.96E-08	2.91E-08	4.00E-02	7.28E-07	
Pyrene	1.34E+00	1.96E-08	2.63E-08	3.00E-02	8.77E-07	
Tetrachloroethene	2.98E-03	1.96E-08	5.83E-11	1.00E-02	5.83E-09	
Zinc	5.05E+01	1.96E-08	9.89E-07	3.00E-01	3.30E-06	
						1.95E-04

CONSTR WORKER
Ingestion of TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.40E+00	2.24E-09	5.37E-09	7.30E-01	3.92E-09	
Benzo(a)pyrene	2.70E+00	2.24E-09	6.04E-09	7.30E+00	4.41E-08	
Benzo(b)fluoranthene	5.60E+00	2.24E-09	1.25E-08	7.30E-01	9.14E-09	
Carbazole	3.64E-01	2.24E-09	8.13E-10	2.00E-02	1.63E-11	
Chrysene	3.10E+00	2.24E-09	6.93E-09	7.30E-02	5.06E-10	
Indeno(1,2,3-c,d)pyrene	2.30E+00	2.24E-09	5.14E-09	7.30E-01	3.76E-09	
Tetrachloroethene	3.23E-03	2.24E-09	7.22E-12	5.10E-02	3.68E-13	
						6.14E-08

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	4.34E-01	1.57E-07	6.80E-08	3.00E+00	2.27E-08	
Antimony	1.90E+00	1.57E-07	2.97E-07	4.00E-04	7.44E-04	
Barium	5.22E+01	1.57E-07	8.16E-06	7.00E-02	1.17E-04	
Chromium	2.20E+01	1.57E-07	3.45E-06	2.00E-02	1.73E-04	
Copper	1.52E+01	1.57E-07	2.38E-06	3.70E-02	6.43E-05	
Fluoranthene	5.60E+00	1.57E-07	8.77E-07	4.00E-01	2.19E-06	
Pyrene	4.60E+00	1.57E-07	7.20E-07	3.00E-01	2.40E-06	
Tetrachloroethene	3.23E-03	1.57E-07	5.06E-10	1.00E-01	5.06E-09	
Zinc	8.60E+01	1.57E-07	1.35E-05	3.00E-01	4.49E-05	
						1.15E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	4.34E-01	1.57E-07	6.80E-08	3.00E-01	2.27E-07	
Antimony	1.90E+00	1.57E-07	2.97E-07	4.00E-04	7.44E-04	
Barium	5.22E+01	1.57E-07	8.16E-06	7.00E-02	1.17E-04	
Cadmium (food	1.98E+00	1.57E-07	3.10E-07	1.00E-03	3.10E-04	
Chromium	2.20E+01	1.57E-07	3.45E-06	5.00E-03	6.90E-04	
Copper	1.52E+01	1.57E-07	2.38E-06	3.70E-02	6.43E-05	
Fluoranthene	5.60E+00	1.57E-07	8.77E-07	4.00E-02	2.19E-05	
Pyrene	4.60E+00	1.57E-07	7.20E-07	3.00E-02	2.40E-05	
Tetrachloroethene	3.23E-03	1.57E-07	5.06E-10	1.00E-02	5.06E-08	
Zinc	8.60E+01	1.57E-07	1.35E-05	3.00E-01	4.49E-05	
						2.02E-03

CONSTR WORKER
Inhalation of TSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Tetrachloroethene	9.18E-07	1.03E-04	9.44E-11	1.80E-03	1.70E-13	
						1.70E-13

CONSTR WORKER
Inhalation of TSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Tetrachloroethene	9.18E-07	4.47E-04	4.11E-10	1.80E-03	7.39E-13	
						7.39E-13

CONSTR WORKER
Inhalation of TSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	5.81E-10	1.03E-04	5.98E-14	6.10E-01	3.65E-14	
Benzo(a)pyrene	5.83E-10	1.03E-04	6.00E-14	6.10E+00	3.66E-13	
Benzo(b)fluoranthene	1.21E-09	1.03E-04	1.24E-13	6.10E-01	7.59E-14	
Cadmium (food)	4.28E-10	1.03E-04	4.40E-14	6.10E+00	2.69E-13	
Chromium	4.76E-09	1.03E-04	4.90E-13	4.10E+01	2.01E-11	
Chrysene	6.70E-10	1.03E-04	6.89E-14	6.10E-02	4.20E-15	
Indeno(1,2,3-c,d)pyrene	4.97E-10	1.03E-04	5.11E-14	6.10E-01	3.12E-14	
						2.09E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.13E-07	7.20E-03	8.14E-10	1.40E-03	5.81E-07	
						5.81E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.13E-07	7.20E-03	8.14E-10	1.40E-04	5.81E-06	
						5.81E-06

CONSTR WORKER
Inhalation of TSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	5.18E-10	4.47E-04	2.32E-13	6.10E-01	1.41E-13	
Benzo(a)pyrene	5.83E-10	4.47E-04	2.61E-13	6.10E+00	1.59E-12	
Benzo(b)fluoranthene	1.21E-09	4.47E-04	5.41E-13	6.10E-01	3.30E-13	
Cadmium (food)	4.28E-10	4.47E-04	1.91E-13	6.10E+00	1.17E-12	
Chromium	4.76E-09	4.47E-04	2.13E-12	4.10E+01	8.73E-11	
Chrysene	6.70E-10	4.47E-04	3.00E-13	6.10E-02	1.83E-14	
Indeno(1,2,3-c,d)pyrene	4.97E-10	4.47E-04	2.22E-13	6.10E-01	1.36E-13	
						9.07E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.13E-07	3.13E-02	3.54E-09	1.40E-03	2.53E-06	
						2.53E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.13E-07	3.13E-02	3.54E-09	1.40E-04	2.53E-05	
						2.53E-05

TRESPASSER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Carbazole	5.00E-02	1.20E-08	5.99E-10	2.00E-02	1.20E-11	
Tetrachloroethene	1.00E-04	1.20E-08	1.20E-12	5.10E-02	6.11E-14	
						1.20E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	1.00E-04	1.40E-07	1.40E-11	1.00E-01	1.40E-10	
						1.40E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	1.00E-04	1.40E-07	1.40E-11	1.00E-02	1.40E-09	
						1.40E-09

TRESPASSER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Carbazole	5.00E-02	1.27E-06	6.35E-08	2.00E-02	1.27E-09	
Tetrachloroethene	1.00E-04	1.27E-06	1.27E-10	5.10E-02	6.47E-12	
						1.28E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	1.00E-04	1.48E-05	1.48E-09	1.00E-01	1.48E-08	
						1.48E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	1.00E-04	1.48E-05	1.48E-09	1.00E-02	1.48E-07	
						1.48E-07

TRESPASSER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.40E+00	1.50E-10	3.59E-10	7.30E-01	2.62E-10	
Benzo(a)pyrene	2.70E+00	1.50E-10	4.04E-10	7.30E+00	2.95E-09	
Benzo(b)fluoranthene	4.80E+00	1.50E-10	7.18E-10	7.30E-01	5.24E-10	
Carbazole	5.00E-01	1.50E-10	7.48E-11	2.00E-02	1.50E-12	
Chrysene	3.10E+00	1.50E-10	4.64E-10	7.30E-02	3.39E-11	
Indeno(1,2,3-c,d)pyrene	2.30E+00	1.50E-10	3.44E-10	7.30E-01	2.51E-10	
Tetrachloroethene	3.60E-03	1.50E-10	5.39E-13	5.10E-02	2.75E-14	
						4.02E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	6.00E-01	1.75E-09	1.05E-09	3.00E+00	3.49E-10	
Antimony	1.90E+00	1.75E-09	3.32E-09	4.00E-04	8.29E-06	
Barium	4.90E+02	1.75E-09	8.55E-07	7.00E-02	1.22E-05	
Chromium	4.40E+01	1.75E-09	7.68E-08	2.00E-02	3.84E-06	
Copper	2.43E+01	1.75E-09	4.24E-08	3.70E-02	1.15E-06	
Fluoranthene	4.80E+00	1.75E-09	8.38E-09	4.00E-01	2.10E-08	
Pyrene	4.30E+00	1.75E-09	7.51E-09	3.00E-01	2.50E-08	
Tetrachloroethene	3.60E-03	1.75E-09	6.29E-12	1.00E-01	6.29E-11	
Zinc	1.63E+02	1.75E-09	2.84E-07	3.00E-01	9.48E-07	
						2.65E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	6.00E-01	1.75E-09	1.05E-09	3.00E-01	3.49E-09	
Antimony	1.90E+00	1.75E-09	3.32E-09	4.00E-04	8.29E-06	
Barium	4.90E+02	1.75E-09	8.55E-07	7.00E-02	1.22E-05	
Cadmium (food)	3.56E+00	1.75E-09	6.22E-09	1.00E-03	6.22E-06	
Chromium	4.40E+01	1.75E-09	7.68E-08	5.00E-03	1.54E-05	
Copper	2.43E+01	1.75E-09	4.24E-08	3.70E-02	1.15E-06	
Fluoranthene	4.80E+00	1.75E-09	8.38E-09	4.00E-02	2.10E-07	
Pyrene	4.30E+00	1.75E-09	7.51E-09	3.00E-02	2.50E-07	
Tetrachloroethene	3.60E-03	1.75E-09	6.29E-12	1.00E-02	6.29E-10	
Zinc	1.63E+02	1.75E-09	2.84E-07	3.00E-01	9.48E-07	
						4.46E-05

TRESPASSER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.40E+00	1.20E-08	2.87E-08	7.30E-01	2.10E-08	
Benzo(a)pyrene	2.70E+00	1.20E-08	3.23E-08	7.30E+00	2.36E-07	
Benzo(b)fluoranthene	5.60E+00	1.20E-08	6.70E-08	7.30E-01	4.89E-08	
Carbazole	5.00E-01	1.20E-08	5.99E-09	2.00E-02	1.20E-10	
Chrysene	3.10E+00	1.20E-08	3.71E-08	7.30E-02	2.71E-09	
Indeno(1,2,3-c,d)pyrene	2.30E+00	1.20E-08	2.75E-08	7.30E-01	2.01E-08	
Tetrachloroethene	3.60E-03	1.20E-08	4.31E-11	5.10E-02	2.20E-12	
						3.29E-07

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	6.00E-01	1.40E-07	8.38E-08	3.00E+00	2.79E-08	
Antimony	1.90E+00	1.40E-07	2.65E-07	4.00E-04	6.63E-04	
Barium	1.46E+03	1.40E-07	2.04E-04	7.00E-02	2.91E-03	
Chromium	1.30E+02	1.40E-07	1.82E-05	2.00E-02	9.08E-04	
Copper	6.14E+01	1.40E-07	8.58E-06	3.70E-02	2.32E-04	
Fluoranthene	5.60E+00	1.40E-07	7.82E-07	4.00E-01	1.96E-06	
Pyrene	4.60E+00	1.40E-07	6.42E-07	3.00E-01	2.14E-06	
Tetrachloroethene	3.60E-03	1.40E-07	5.03E-10	1.00E-01	5.03E-09	
Zinc	4.79E+02	1.40E-07	6.69E-05	3.00E-01	2.23E-04	
						4.94E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	6.00E-01	1.40E-07	8.38E-08	3.00E-01	2.79E-07	
Antimony	1.90E+00	1.40E-07	2.65E-07	4.00E-04	6.63E-04	
Barium	1.46E+03	1.40E-07	2.04E-04	7.00E-02	2.91E-03	
Cadmium (food	8.70E+00	1.40E-07	1.22E-06	1.00E-03	1.22E-03	
Chromium	1.30E+02	1.40E-07	1.82E-05	5.00E-03	3.63E-03	
Copper	6.14E+01	1.40E-07	8.58E-06	3.70E-02	2.32E-04	
Fluoranthene	5.60E+00	1.40E-07	7.82E-07	4.00E-02	1.96E-05	
Pyrene	4.60E+00	1.40E-07	6.42E-07	3.00E-02	2.14E-05	
Tetrachloroethene	3.60E-03	1.40E-07	5.03E-10	1.00E-02	5.03E-08	
Zinc	4.79E+02	1.40E-07	6.69E-05	3.00E-01	2.23E-04	
						8.92E-03

TRESPASSER
Inhalation of VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Tetrachloroethene	1.02E-06	2.75E-04	2.81E-10	1.80E-03	5.06E-13	
						5.06E-13

TRESPASSER
Inhalation of VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Tetrachloroethene	1.02E-06	4.79E-03	4.88E-09	1.80E-03	8.79E-12	
						8.79E-12

TRESPASSER
Inhalation of PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	5.18E-10	2.75E-04	1.43E-13	6.10E-01	8.70E-14	
Benzo(a)pyrene	5.83E-10	2.75E-04	1.61E-13	6.10E+00	9.79E-13	
Benzo(b)fluoranthene	1.21E-09	2.75E-04	3.33E-13	6.10E-01	2.03E-13	
Cadmium (food)	1.88E-09	2.75E-04	5.18E-13	6.10E+00	3.16E-12	
Chromium	2.81E-08	2.75E-04	7.74E-12	4.10E+01	3.17E-10	
Chrysene	6.70E-10	2.75E-04	1.84E-13	6.10E-02	1.13E-14	
Indeno(1,2,3-c,d)pyrene	4.97E-10	2.75E-04	1.37E-13	6.10E-01	8.35E-14	
						3.22E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	3.15E-07	3.21E-03	1.01E-09	1.40E-03	7.23E-07	
						7.23E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	3.15E-07	3.21E-03	1.01E-09	1.40E-04	7.23E-06	
						7.23E-06

TRESPASSER
Inhalation of PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	5.18E-10	4.79E-03	2.48E-12	6.10E-01	1.51E-12	
Benzo(a)pyrene	5.83E-10	4.79E-03	2.79E-12	6.10E+00	1.70E-11	
Benzo(b)fluoranthene	1.21E-09	4.79E-03	5.79E-12	6.10E-01	3.53E-12	
Cadmium (food)	1.88E-09	4.79E-03	9.00E-12	6.10E+00	5.49E-11	
Chromium	2.81E-08	4.79E-03	1.35E-10	4.10E+01	5.52E-09	
Chrysene	6.70E-10	4.79E-03	3.21E-12	6.10E-02	1.96E-13	
Indeno(1,2,3-c,d)pyrene	4.97E-10	4.79E-03	2.38E-12	6.10E-01	1.45E-12	
						5.60E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	3.15E-07	5.59E-02	1.76E-08	1.40E-03	1.26E-05	
						1.26E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	3.15E-07	5.59E-02	1.76E-08	1.40E-04	1.26E-04	
						1.26E-04

OIL/WATER SEPARATOR 375
RISK CALCULATIONS

Receptor/Pathway Summary: CANNON AFB OWS 375

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SURFACE SOIL	0.00E+00		2.89E-10	0.00E+00		2.91E-08
-- Ingestion of SURFACE SOIL	0.00E+00		6.93E-07	0.00E+00		6.07E-05
-- Inhalation of SSOIL VOCS	0.00E+00		1.03E-07	0.00E+00		1.86E-06
-- Inhalation of SSOIL PARTICS	0.00E+00		0.00E+00	0.00E+00		0.00E+00
	0.00E+00		7.96E-07	0.00E+00		6.26E-05
CONSTR WORKER						
-- Dermal Contact with TSOIL	7.55E-13	2.98E-10		1.13E-11	4.58E-09	
-- Ingestion of TSOIL	8.58E-10	2.41E-04		1.40E-08	3.82E-03	
-- Inhalation of TSOIL VOCS	1.38E-11	1.14E-06		6.00E-11	4.95E-06	
-- Inhalation of TSOIL PARTICS	5.77E-13	1.52E-06		2.51E-12	6.62E-06	
	8.73E-10	2.44E-04		1.41E-08	3.83E-03	
TRESPASSER						
-- Dermal Contact with SURFACE SOIL	0.00E+00	9.43E-12		0.00E+00	1.78E-09	
-- Ingestion of SURFACE SOIL	0.00E+00	2.06E-07		0.00E+00	1.73E-05	
-- Inhalation of SSOIL VOCS	0.00E+00	3.05E-08		0.00E+00	5.31E-07	
-- Inhalation of SSOIL PARTICS	0.00E+00	0.00E+00		0.00E+00	0.00E+00	
	0.00E+00	2.37E-07		0.00E+00	1.79E-05	

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Average Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.20E-04	4.70E-07	5.64E-11	2.00E-01	2.82E-10	
Xylenes, mixed	3.00E-05	4.70E-07	1.41E-11	2.00E+00	7.05E-12	
						2.89E-10

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	2.10E-04	2.69E-05	5.65E-09	2.00E-01	2.83E-08	
Xylenes, mixed	6.00E-05	2.69E-05	1.61E-09	2.00E+00	8.07E-10	
						2.91E-08

OCCUP WORKER
Ingestion of SURFACE SOIL
Average Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Silver	5.90E-01	5.87E-09	3.46E-09	5.00E-03	6.93E-07	
Toluene	3.85E-03	5.87E-09	2.26E-11	2.00E-01	1.13E-10	
Xylenes, mixed	1.45E-03	5.87E-09	8.51E-12	2.00E+00	4.26E-12	
						6.93E-07

OCCUP WORKER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Silver	6.20E-01	4.89E-07	3.03E-07	5.00E-03	6.07E-05	
Toluene	6.60E-03	4.89E-07	3.23E-09	2.00E-01	1.61E-08	
Xylenes, mixed	1.60E-03	4.89E-07	7.83E-10	2.00E+00	3.91E-10	
						6.07E-05

OCCUP WORKER
Inhalation of SSOIL VOCS
Average Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.04E-06	1.08E-02	1.13E-08	1.10E-01	1.03E-07	
						1.03E-07

OCCUP WORKER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.04E-06	1.96E-01	2.05E-07	1.10E-01	1.86E-06	
						1.86E-06

CONSTR WORKER
Dermal Contact with TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.50E-06	4.47E-09	6.71E-15	9.10E-02	6.11E-16	
1,2 Dichloropropane	6.00E-05	4.47E-09	2.68E-13	6.80E-02	1.82E-14	
Carbazole	8.00E-03	4.47E-09	3.58E-11	2.00E-02	7.16E-13	
Tetrachloroethene	9.00E-05	4.47E-09	4.03E-13	5.00E-02	2.01E-14	
						7.55E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	9.00E-05	3.13E-07	2.82E-11	1.00E-01	2.82E-10	
Toluene	9.00E-05	3.13E-07	2.82E-11	2.00E+00	1.41E-11	
Xylenes, mixed	3.00E-05	3.13E-07	9.39E-12	4.00E+00	2.35E-12	
						2.98E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	9.00E-05	3.13E-07	2.82E-11	1.00E-02	2.82E-09	
Toluene	9.00E-05	3.13E-07	2.82E-11	2.00E-01	1.41E-10	
Xylenes, mixed	3.00E-05	3.13E-07	9.39E-12	2.00E+00	4.70E-12	
						2.96E-09

CONSTR WORKER
Dermal Contact with TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.50E-06	6.71E-08	1.01E-13	9.10E-02	9.16E-15	
1,2 Dichloropropane	6.00E-05	6.71E-08	4.03E-12	6.80E-02	2.74E-13	
Carbazole	8.00E-03	6.71E-08	5.37E-10	2.00E-02	1.07E-11	
Tetrachloroethene	9.00E-05	6.71E-08	6.04E-12	5.00E-02	3.02E-13	
						1.13E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	9.00E-05	4.70E-06	4.23E-10	1.00E-01	4.23E-09	
Toluene	1.20E-04	4.70E-06	5.64E-10	2.00E+00	2.82E-10	
Xylenes, mixed	6.00E-05	4.70E-06	2.82E-10	4.00E+00	7.05E-11	
						4.58E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Tetrachloroethene	9.00E-05	4.70E-06	4.23E-10	1.00E-02	4.23E-08	
Toluene	1.20E-04	4.70E-06	5.64E-10	2.00E-01	2.82E-09	
Xylenes, mixed	6.00E-05	4.70E-06	2.82E-10	2.00E+00	1.41E-10	
						4.52E-08

CONSTR WORKER
Ingestion of TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	2.95E-03	2.80E-10	8.25E-13	9.10E-02	7.50E-14	
1,2 Dichloropropane	2.40E-03	2.80E-10	6.71E-13	6.80E-02	4.56E-14	
Benzo(a)anthracene	2.68E-01	2.80E-10	7.49E-11	7.30E-01	5.47E-11	
Benzo(a)pyrene	3.16E-01	2.80E-10	8.83E-11	7.30E+00	6.45E-10	
Benzo(b)fluoranthene	4.90E-01	2.80E-10	1.37E-10	7.30E-01	1.00E-10	
Carbazole	7.90E-02	2.80E-10	2.21E-11	2.00E-02	4.42E-13	
Chrysene	3.14E-01	2.80E-10	8.78E-11	7.30E-02	6.41E-12	
Indeno(1,2,3-c,d)pyrene	2.52E-01	2.80E-10	7.05E-11	7.30E-01	5.14E-11	
Tetrachloroethene	2.60E-03	2.80E-10	7.27E-13	5.00E-02	3.63E-14	
						8.58E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	4.70E-02	1.96E-08	9.20E-10	3.00E+00	3.07E-10	
Antimony	1.75E+00	1.96E-08	3.42E-08	4.00E-04	8.56E-05	
Barium	5.42E+02	1.96E-08	1.06E-05	7.00E-02	1.51E-04	
Fluoranthene	5.50E-01	1.96E-08	1.08E-08	4.00E-01	2.69E-08	
Pyrene	5.50E-01	1.96E-08	1.08E-08	3.00E-01	3.59E-08	
Silver	1.09E+00	1.96E-08	2.13E-08	5.00E-03	4.27E-06	
Tetrachloroethene	2.60E-03	1.96E-08	5.09E-11	1.00E-01	5.09E-10	
Toluene	3.29E-03	1.96E-08	6.44E-11	2.00E+00	3.22E-11	
Xylenes, mixed	1.43E-03	1.96E-08	2.80E-11	4.00E+00	7.00E-12	
						2.41E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	4.70E-02	1.96E-08	9.20E-10	3.00E-01	3.07E-09	
Antimony	1.75E+00	1.96E-08	3.42E-08	4.00E-04	8.56E-05	
Barium	5.42E+02	1.96E-08	1.06E-05	7.00E-02	1.51E-04	
Cadmium (food	1.55E+00	1.96E-08	3.03E-08	1.00E-03	3.03E-05	
Fluoranthene	5.50E-01	1.96E-08	1.08E-08	4.00E-02	2.69E-07	
Pyrene	5.50E-01	1.96E-08	1.08E-08	3.00E-02	3.59E-07	
Silver	1.09E+00	1.96E-08	2.13E-08	5.00E-03	4.27E-06	
Tetrachloroethene	2.60E-03	1.96E-08	5.09E-11	1.00E-02	5.09E-09	
Toluene	3.29E-03	1.96E-08	6.44E-11	2.00E-01	3.22E-10	
Xylenes, mixed	1.43E-03	1.96E-08	2.80E-11	2.00E+00	1.40E-11	
						2.72E-04

CONSTR WORKER
Ingestion of TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	3.15E-03	2.24E-09	7.05E-12	9.10E-02	6.41E-13	
1,2 Dichloropropane	2.40E-03	2.24E-09	5.37E-12	6.80E-02	3.65E-13	
Benzo(a)anthracene	6.00E-01	2.24E-09	1.34E-09	7.30E-01	9.80E-10	
Benzo(a)pyrene	5.82E-01	2.24E-09	1.30E-09	7.30E+00	9.50E-09	
Benzo(b)fluoranthene	1.59E+00	2.24E-09	3.56E-09	7.30E-01	2.60E-09	
Carbazole	7.90E-02	2.24E-09	1.77E-10	2.00E-02	3.53E-12	
Chrysene	9.70E-01	2.24E-09	2.17E-09	7.30E-02	1.58E-10	
Indeno(1,2,3-c,d)pyrene	4.77E-01	2.24E-09	1.07E-09	7.30E-01	7.79E-10	
Tetrachloroethene	2.60E-03	2.24E-09	5.81E-12	5.00E-02	2.91E-13	
						1.40E-08

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	4.70E-02	1.57E-07	7.36E-09	3.00E+00	2.45E-09	
Antimony	1.80E+00	1.57E-07	2.82E-07	4.00E-04	7.05E-04	
Barium	1.37E+03	1.57E-07	2.14E-04	7.00E-02	3.06E-03	
Fluoranthene	2.00E+00	1.57E-07	3.13E-07	4.00E-01	7.83E-07	
Pyrene	2.00E+00	1.57E-07	3.13E-07	3.00E-01	1.04E-06	
Silver	1.52E+00	1.57E-07	2.38E-07	5.00E-03	4.76E-05	
Tetrachloroethene	2.60E-03	1.57E-07	4.07E-10	1.00E-01	4.07E-09	
Toluene	4.04E-03	1.57E-07	6.32E-10	2.00E+00	3.16E-10	
Xylenes, mixed	1.60E-03	1.57E-07	2.50E-10	4.00E+00	6.26E-11	
						3.82E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	4.70E-02	1.57E-07	7.36E-09	3.00E-01	2.45E-08	
Antimony	1.80E+00	1.57E-07	2.82E-07	4.00E-04	7.05E-04	
Barium	1.37E+03	1.57E-07	2.14E-04	7.00E-02	3.06E-03	
Cadmium (food	3.40E+00	1.57E-07	5.32E-07	1.00E-03	5.32E-04	
Fluoranthene	2.00E+00	1.57E-07	3.13E-07	4.00E-02	7.83E-06	
Pyrene	2.00E+00	1.57E-07	3.13E-07	3.00E-02	1.04E-05	
Silver	1.52E+00	1.57E-07	2.38E-07	5.00E-03	4.76E-05	
Tetrachloroethene	2.60E-03	1.57E-07	4.07E-10	1.00E-02	4.07E-08	
Toluene	4.04E-03	1.57E-07	6.32E-10	2.00E-01	3.16E-09	
Xylenes, mixed	1.60E-03	1.57E-07	2.50E-10	2.00E+00	1.25E-10	
						4.37E-03

CONSTR WORKER
Inhalation of TSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.46E-06	1.03E-04	1.50E-10	9.10E-02	1.36E-11	
Tetrachloroethene	8.65E-07	1.03E-04	8.90E-11	1.80E-03	1.60E-13	
						1.38E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	5.63E-07	7.20E-03	4.06E-09	3.70E-03	1.10E-06	
Toluene	6.33E-07	7.20E-03	4.56E-09	1.10E-01	4.15E-08	
						1.14E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	5.63E-07	7.20E-03	4.06E-09	1.10E-03	3.69E-06	
Toluene	6.33E-07	7.20E-03	4.56E-09	1.10E-01	4.15E-08	
						3.73E-06

CONSTR WORKER
Inhalation of TSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.46E-06	4.47E-04	6.51E-10	9.10E-02	5.93E-11	
Tetrachloroethene	8.65E-07	4.47E-04	3.87E-10	1.80E-03	6.97E-13	
						6.00E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	5.63E-07	3.13E-02	1.76E-08	3.70E-03	4.77E-06	
Toluene	6.33E-07	3.13E-02	1.98E-08	1.10E-01	1.80E-07	
						4.95E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	5.63E-07	3.13E-02	1.76E-08	1.10E-03	1.60E-05	
Toluene	6.33E-07	3.13E-02	1.98E-08	1.10E-01	1.80E-07	
						1.62E-05

CONSTR WORKER
Inhalation of TSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.30E-10	1.03E-04	1.34E-14	6.10E-01	8.16E-15	
Benzo(a)pyrene	1.26E-10	1.03E-04	1.30E-14	6.10E+00	7.91E-14	
Benzo(b)fluoranthene	3.44E-10	1.03E-04	3.54E-14	6.10E-01	2.16E-14	
Cadmium (food)	7.34E-10	1.03E-04	7.55E-14	6.10E+00	4.61E-13	
Chrysene	2.10E-10	1.03E-04	2.16E-14	6.10E-02	1.32E-15	
Indeno(1,2,3-c,d)pyrene	1.03E-10	1.03E-04	1.06E-14	6.10E-01	6.46E-15	
						5.77E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	2.96E-07	7.20E-03	2.13E-09	1.40E-03	1.52E-06	
						1.52E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	2.96E-07	7.20E-03	2.13E-09	1.40E-04	1.52E-05	
						1.52E-05

CONSTR WORKER
Inhalation of TSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.30E-10	4.47E-04	5.81E-14	6.10E-01	3.55E-14	
Benzo(a)pyrene	1.26E-10	4.47E-04	5.64E-14	6.10E+00	3.44E-13	
Benzo(b)fluoranthene	3.44E-10	4.47E-04	1.54E-13	6.10E-01	9.39E-14	
Cadmium (food)	7.34E-10	4.47E-04	3.28E-13	6.10E+00	2.00E-12	
Chrysene	2.10E-10	4.47E-04	9.39E-14	6.10E-02	5.73E-15	
Indeno(1,2,3-c,d)pyrene	1.03E-10	4.47E-04	4.61E-14	6.10E-01	2.81E-14	
						2.51E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	2.96E-07	3.13E-02	9.27E-09	1.40E-03	6.62E-06	
						6.62E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	2.96E-07	3.13E-02	9.27E-09	1.40E-04	6.62E-05	
						6.62E-05

TRESPASSER
Dermal Contact with SURFACE SOIL
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.20E-04	1.40E-07	1.68E-11	2.00E+00	8.38E-12	
Xylenes, mixed	3.00E-05	1.40E-07	4.19E-12	4.00E+00	1.05E-12	
						9.43E-12

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.20E-04	1.40E-07	1.68E-11	2.00E-01	8.38E-11	
Xylenes, mixed	3.00E-05	1.40E-07	4.19E-12	2.00E+00	2.10E-12	
						8.59E-11

TRESPASSER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	2.10E-04	1.48E-05	3.11E-09	2.00E+00	1.55E-09	
Xylenes, mixed	6.00E-05	1.48E-05	8.88E-10	4.00E+00	2.22E-10	
						1.78E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	2.10E-04	1.48E-05	3.11E-09	2.00E-01	1.55E-08	
Xylenes, mixed	6.00E-05	1.48E-05	8.88E-10	2.00E+00	4.44E-10	
						1.60E-08

TRESPASSER
Ingestion of SURFACE SOIL
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Silver	5.90E-01	1.75E-09	1.03E-09	5.00E-03	2.06E-07	
Toluene	3.85E-03	1.75E-09	6.72E-12	2.00E+00	3.36E-12	
Xylenes, mixed	1.45E-03	1.75E-09	2.53E-12	4.00E+00	6.33E-13	
						2.06E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Silver	5.90E-01	1.75E-09	1.03E-09	5.00E-03	2.06E-07	
Toluene	3.85E-03	1.75E-09	6.72E-12	2.00E-01	3.36E-11	
Xylenes, mixed	1.45E-03	1.75E-09	2.53E-12	2.00E+00	1.27E-12	
						2.06E-07

TRESPASSER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Silver	6.20E-01	1.40E-07	8.66E-08	5.00E-03	1.73E-05	
Toluene	6.60E-03	1.40E-07	9.22E-10	2.00E+00	4.61E-10	
Xylenes, mixed	1.60E-03	1.40E-07	2.23E-10	4.00E+00	5.59E-11	
						1.73E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Silver	6.20E-01	1.40E-07	8.66E-08	5.00E-03	1.73E-05	
Toluene	6.60E-03	1.40E-07	9.22E-10	2.00E-01	4.61E-09	
Xylenes, mixed	1.60E-03	1.40E-07	2.23E-10	2.00E+00	1.12E-10	
						1.73E-05

TRESPASSER
Inhalation of SSOIL VOCS
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.04E-06	3.21E-03	3.36E-09	1.10E-01	3.05E-08	
						3.05E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.04E-06	3.21E-03	3.36E-09	1.10E-01	3.05E-08	
						3.05E-08

TRESPASSER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.04E-06	5.59E-02	5.84E-08	1.10E-01	5.31E-07	
						5.31E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	1.04E-06	5.59E-02	5.84E-08	1.10E-01	5.31E-07	
						5.31E-07

SAND TRAP 5077c
RISK CALCULATIONS

Receptor/Pathway Summary: CANNON AFB OWS 5077C

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SURFACE SOIL	1.00E-11		3.46E-06	1.92E-09		2.26E-04
-- Ingestion of SURFACE SOIL	5.12E-09		5.26E-05	1.57E-06		5.98E-03
-- Inhalation of SSOIL VOCS	8.62E-11		4.20E-08	4.34E-09		7.60E-07
-- Inhalation of SSOIL PARTICS	2.25E-12		1.20E-05	1.13E-10		2.17E-04
	5.22E-09		6.80E-05	1.58E-06		6.43E-03
CONSTR WORKER						
-- Dermal Contact with TSOIL	7.43E-13	1.05E-06		1.34E-11	2.82E-05	
-- Ingestion of TSOIL	1.20E-09	1.00E-04		2.01E-08	1.80E-03	
-- Inhalation of TSOIL VOCS	6.39E-12	2.80E-08		2.78E-11	1.22E-07	
-- Inhalation of TSOIL PARTICS	1.67E-13	8.37E-07		7.24E-13	3.64E-06	
	1.20E-09	1.02E-04		2.01E-08	1.83E-03	
TRESPASSER						
-- Dermal Contact with SSOIL	1.99E-12	1.02E-06		2.54E-10	1.23E-04	
-- Ingestion of SURFACE SOIL	1.02E-09	1.40E-05		1.08E-07	1.57E-03	
-- Inhalation of SSOIL VOCS	1.71E-11	1.25E-08		2.97E-10	2.17E-07	
-- Inhalation of SSOIL PARTICS	4.46E-13	3.58E-07		7.76E-12	6.22E-06	
	1.04E-09	1.54E-05		1.08E-07	1.70E-03	

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.00E-06	6.04E-08	6.04E-14	9.10E-02	5.50E-15	
Carbazole	8.30E-03	6.04E-08	5.01E-10	2.00E-02	1.00E-11	
						1.00E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	8.50E-03	4.70E-07	3.99E-09	2.00E-01	2.00E-08	
Mercury	2.20E-03	4.70E-07	1.03E-09	3.00E-04	3.44E-06	
Toluene	9.00E-05	4.70E-07	4.23E-11	2.00E-01	2.11E-10	
Xylenes, mixed	3.00E-05	4.70E-07	1.41E-11	2.00E+00	7.05E-12	
						3.46E-06

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.00E-06	9.61E-06	9.61E-12	9.10E-02	8.75E-13	
Carbazole	1.00E-02	9.61E-06	9.61E-08	2.00E-02	1.92E-09	
						1.92E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.20E-02	2.69E-05	3.23E-07	2.00E-01	1.61E-06	
Mercury	2.50E-03	2.69E-05	6.73E-08	3.00E-04	2.24E-04	
Toluene	9.00E-05	2.69E-05	2.42E-09	2.00E-01	1.21E-08	
Xylenes, mixed	3.00E-05	2.69E-05	8.07E-10	2.00E+00	4.04E-10	
						2.26E-04

OCCUP WORKER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.50E-03	7.55E-10	1.13E-12	9.10E-02	1.03E-13	
Benzo(a)anthracene	6.85E-01	7.55E-10	5.17E-10	7.30E-01	3.77E-10	
Benzo(a)pyrene	6.80E-01	7.55E-10	5.13E-10	7.30E+00	3.75E-09	
Benzo(b)fluoranthene	1.39E+00	7.55E-10	1.05E-09	7.30E-01	7.69E-10	
Carbazole	8.30E-02	7.55E-10	6.27E-11	2.00E-02	1.25E-12	
Chrysene	9.10E-01	7.55E-10	6.87E-10	7.30E-02	5.01E-11	
Indeno(1,2,3-c,d)pyrene	3.25E-01	7.55E-10	2.45E-10	7.30E-01	1.79E-10	
						5.12E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	8.90E-02	5.87E-09	5.23E-10	6.00E-02	8.71E-09	
Anthracene	1.53E-01	5.87E-09	8.98E-10	3.00E-01	2.99E-09	
Barium	4.98E+02	5.87E-09	2.92E-06	7.00E-02	4.18E-05	
Butyl Benzyl Phthalate	8.50E-02	5.87E-09	4.99E-10	2.00E-01	2.50E-09	
Cadmium (food)	8.30E-01	5.87E-09	4.87E-09	1.00E-03	4.87E-06	
Fluoranthene	1.30E+00	5.87E-09	7.63E-09	4.00E-02	1.91E-07	
Fluorene	7.95E-02	5.87E-09	4.67E-10	4.00E-02	1.17E-08	
Mercury	2.20E-01	5.87E-09	1.29E-09	3.00E-04	4.31E-06	
Naphthalene	8.00E-02	5.87E-09	4.70E-10	4.00E-02	1.17E-08	
Pyrene	1.65E+00	5.87E-09	9.69E-09	3.00E-02	3.23E-07	
Toluene	2.70E-03	5.87E-09	1.59E-11	2.00E-01	7.93E-11	
Xylenes, mixed	1.10E-03	5.87E-09	6.46E-12	2.00E+00	3.23E-12	
Zinc	5.46E+01	5.87E-09	3.20E-07	3.00E-01	1.07E-06	
						5.26E-05

OCCUP WORKER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.50E-03	1.75E-07	2.62E-10	9.10E-02	2.39E-11	
Benzo(a)anthracene	1.00E+00	1.75E-07	1.75E-07	7.30E-01	1.28E-07	
Benzo(a)pyrene	9.00E-01	1.75E-07	1.57E-07	7.30E+00	1.15E-06	
Benzo(b)fluoranthene	1.80E+00	1.75E-07	3.15E-07	7.30E-01	2.30E-07	
Carbazole	1.00E-01	1.75E-07	1.75E-08	2.00E-02	3.49E-10	
Chrysene	1.10E+00	1.75E-07	1.92E-07	7.30E-02	1.40E-08	
Indeno(1,2,3-c,d)pyrene	4.00E-01	1.75E-07	6.99E-08	7.30E-01	5.10E-08	
						1.57E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.20E-01	4.89E-07	5.87E-08	6.00E-02	9.78E-07	
Anthracene	2.10E-01	4.89E-07	1.03E-07	3.00E-01	3.42E-07	
Barium	7.17E+02	4.89E-07	3.51E-04	7.00E-02	5.01E-03	
Butyl Benzyl Phthalate	1.20E-01	4.89E-07	5.87E-08	2.00E-01	2.94E-07	
Cadmium (food	8.50E-01	4.89E-07	4.16E-07	1.00E-03	4.16E-04	
Fluoranthene	1.70E+00	4.89E-07	8.32E-07	4.00E-02	2.08E-05	
Fluorene	1.00E-01	4.89E-07	4.89E-08	4.00E-02	1.22E-06	
Mercury	2.50E-01	4.89E-07	1.22E-07	3.00E-04	4.08E-04	
Naphthalene	8.00E-02	4.89E-07	3.91E-08	4.00E-02	9.78E-07	
Pyrene	2.20E+00	4.89E-07	1.08E-06	3.00E-02	3.59E-05	
Toluene	2.70E-03	4.89E-07	1.32E-09	2.00E-01	6.60E-09	
Xylenes, mixed	1.10E-03	4.89E-07	5.38E-10	2.00E+00	2.69E-10	
Zinc	5.49E+01	4.89E-07	2.69E-05	3.00E-01	8.95E-05	
						5.98E-03

OCCUP WORKER
Inhalation of SSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.82E-07	1.39E-03	9.48E-10	9.10E-02	8.62E-11	
						8.62E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	1.08E-02	4.62E-09	1.10E-01	4.20E-08	
						4.20E-08

OCCUP WORKER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.82E-07	6.99E-02	4.77E-08	9.10E-02	4.34E-09	
						4.34E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	1.96E-01	8.36E-08	1.10E-01	7.60E-07	
						7.60E-07

OCCUP WORKER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.16E-10	1.39E-03	3.00E-13	6.10E-01	1.83E-13	
Benzo(a)pyrene	1.94E-10	1.39E-03	2.69E-13	6.10E+00	1.64E-12	
Benzo(b)fluoranthene	3.89E-10	1.39E-03	5.40E-13	6.10E-01	3.30E-13	
Chrysene	2.38E-10	1.39E-03	3.31E-13	6.10E-02	2.02E-14	
Indeno(1,2,3-c,d)pyrene	8.64E-11	1.39E-03	1.20E-13	6.10E-01	7.32E-14	
						2.25E-12

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.55E-07	1.08E-02	1.67E-09	1.40E-04	1.20E-05	
Mercury	5.40E-11	1.08E-02	5.83E-13	8.60E-05	6.78E-09	
						1.20E-05

OCCUP WORKER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.16E-10	6.99E-02	1.51E-11	6.10E-01	9.21E-12	
Benzo(a)pyrene	1.94E-10	6.99E-02	1.36E-11	6.10E+00	8.27E-11	
Benzo(b)fluoranthene	3.89E-10	6.99E-02	2.72E-11	6.10E-01	1.66E-11	
Chrysene	2.38E-10	6.99E-02	1.66E-11	6.10E-02	1.01E-12	
Indeno(1,2,3-c,d)pyrene	8.64E-11	6.99E-02	6.04E-12	6.10E-01	3.68E-12	
						1.13E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.55E-07	1.96E-01	3.03E-08	1.40E-04	2.17E-04	
Mercury	5.40E-11	1.96E-01	1.06E-11	8.60E-05	1.23E-07	
						2.17E-04

CONSTR WORKER
Dermal Contact with TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.00E-06	4.47E-09	4.47E-15	9.10E-02	4.07E-16	
Carbazole	8.30E-03	4.47E-09	3.71E-11	2.00E-02	7.43E-13	
						7.43E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	8.50E-03	3.13E-07	2.66E-09	2.00E+00	1.33E-09	
Mercury	1.00E-03	3.13E-07	3.13E-10	3.00E-04	1.04E-06	
Toluene	9.00E-05	3.13E-07	2.82E-11	2.00E+00	1.41E-11	
Xylenes, mixed	3.00E-05	3.13E-07	9.39E-12	4.00E+00	2.35E-12	
						1.05E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	8.50E-03	3.13E-07	2.66E-09	2.00E-01	1.33E-08	
Mercury	1.00E-03	3.13E-07	3.13E-10	3.00E-04	1.04E-06	
Toluene	9.00E-05	3.13E-07	2.82E-11	2.00E-01	1.41E-10	
Xylenes, mixed	3.00E-05	3.13E-07	9.39E-12	2.00E+00	4.70E-12	
						1.06E-06

CONSTR WORKER
Dermal Contact with TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.00E-06	6.71E-08	6.71E-14	9.10E-02	6.11E-15	
Carbazole	1.00E-02	6.71E-08	6.71E-10	2.00E-02	1.34E-11	
						1.34E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.20E-02	4.70E-06	5.64E-08	2.00E+00	2.82E-08	
Mercury	1.80E-03	4.70E-06	8.45E-09	3.00E-04	2.82E-05	
Toluene	9.00E-05	4.70E-06	4.23E-10	2.00E+00	2.11E-10	
Xylenes, mixed	3.00E-05	4.70E-06	1.41E-10	4.00E+00	3.52E-11	
						2.82E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.20E-02	4.70E-06	5.64E-08	2.00E-01	2.82E-07	
Mercury	1.80E-03	4.70E-06	8.45E-09	3.00E-04	2.82E-05	
Toluene	9.00E-05	4.70E-06	4.23E-10	2.00E-01	2.11E-09	
Xylenes, mixed	3.00E-05	4.70E-06	1.41E-10	2.00E+00	7.05E-11	
						2.85E-05

CONSTR WORKER
Ingestion of TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.50E-03	2.80E-10	4.19E-13	9.10E-02	3.82E-14	
Benzo(a)anthracene	4.35E-01	2.80E-10	1.22E-10	7.30E-01	8.88E-11	
Benzo(a)pyrene	4.33E-01	2.80E-10	1.21E-10	7.30E+00	8.84E-10	
Benzo(b)fluoranthene	7.90E-01	2.80E-10	2.21E-10	7.30E-01	1.61E-10	
Carbazole	8.30E-02	2.80E-10	2.32E-11	2.00E-02	4.64E-13	
Chrysene	5.48E-01	2.80E-10	1.53E-10	7.30E-02	1.12E-11	
Indeno(1,2,3-c,d)pyrene	2.55E-01	2.80E-10	7.13E-11	7.30E-01	5.20E-11	
						1.20E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	8.90E-02	1.96E-08	1.74E-09	6.00E-01	2.90E-09	
Anthracene	1.69E-01	1.96E-08	3.31E-09	3.00E+00	1.10E-09	
Barium	3.30E+02	1.96E-08	6.45E-06	7.00E-02	9.22E-05	
Butyl Benzyl Phthalate	8.50E-02	1.96E-08	1.66E-09	2.00E+00	8.32E-10	
Fluoranthene	7.43E-01	1.96E-08	1.45E-08	4.00E-01	3.64E-08	
Fluorene	7.95E-02	1.96E-08	1.56E-09	4.00E-01	3.89E-09	
Mercury	1.00E-01	1.96E-08	1.96E-09	3.00E-04	6.52E-06	
Naphthalene	8.00E-02	1.96E-08	1.57E-09	4.00E-02	3.91E-08	
Pyrene	9.18E-01	1.96E-08	1.80E-08	3.00E-01	5.99E-08	
Toluene	2.68E-03	1.96E-08	5.24E-11	2.00E+00	2.62E-11	
Xylenes, mixed	1.10E-03	1.96E-08	2.15E-11	4.00E+00	5.38E-12	
Zinc	2.45E+01	1.96E-08	4.79E-07	3.00E-01	1.60E-06	
						1.00E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	8.90E-02	1.96E-08	1.74E-09	6.00E-02	2.90E-08	
Anthracene	1.69E-01	1.96E-08	3.31E-09	3.00E-01	1.10E-08	
Barium	3.30E+02	1.96E-08	6.45E-06	7.00E-02	9.22E-05	
Butyl Benzyl Phthalate	8.50E-02	1.96E-08	1.66E-09	2.00E-01	8.32E-09	
Cadmium (food)	4.50E-01	1.96E-08	8.81E-09	1.00E-03	8.81E-06	
Fluoranthene	7.43E-01	1.96E-08	1.45E-08	4.00E-02	3.64E-07	
Fluorene	7.95E-02	1.96E-08	1.56E-09	4.00E-02	3.89E-08	
Mercury	1.00E-01	1.96E-08	1.96E-09	3.00E-04	6.52E-06	
Naphthalene	8.00E-02	1.96E-08	1.57E-09	4.00E-02	3.91E-08	
Pyrene	9.18E-01	1.96E-08	1.80E-08	3.00E-02	5.99E-07	

Toluene	2.68E-03	1.96E-08	5.24E-11	2.00E-01	2.62E-10	
Xylenes, mixed	1.10E-03	1.96E-08	2.15E-11	2.00E+00	1.08E-11	
Zinc	2.45E+01	1.96E-08	4.79E-07	3.00E-01	1.60E-06	
						1.10E-04

CONSTR WORKER
Ingestion of TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.50E-03	2.24E-09	3.35E-12	9.10E-02	3.05E-13	
Benzo(a)anthracene	1.00E+00	2.24E-09	2.24E-09	7.30E-01	1.63E-09	
Benzo(a)pyrene	9.00E-01	2.24E-09	2.01E-09	7.30E+00	1.47E-08	
Benzo(b)fluoranthene	1.80E+00	2.24E-09	4.03E-09	7.30E-01	2.94E-09	
Carbazole	1.00E-01	2.24E-09	2.24E-10	2.00E-02	4.47E-12	
Chrysene	1.10E+00	2.24E-09	2.46E-09	7.30E-02	1.80E-10	
Indeno(1,2,3-c,d)pyrene	4.00E-01	2.24E-09	8.95E-10	7.30E-01	6.53E-10	
						2.01E-08

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.20E-01	1.57E-07	1.88E-08	6.00E-01	3.13E-08	
Anthracene	2.10E-01	1.57E-07	3.29E-08	3.00E+00	1.10E-08	
Barium	7.51E+02	1.57E-07	1.18E-04	7.00E-02	1.68E-03	
Butyl Benzyl Phthalate	1.20E-01	1.57E-07	1.88E-08	2.00E+00	9.39E-09	
Fluoranthene	1.70E+00	1.57E-07	2.66E-07	4.00E-01	6.65E-07	
Fluorene	1.00E-01	1.57E-07	1.57E-08	4.00E-01	3.91E-08	
Mercury	1.80E-01	1.57E-07	2.82E-08	3.00E-04	9.39E-05	
Naphthalene	8.00E-02	1.57E-07	1.25E-08	4.00E-02	3.13E-07	
Pyrene	2.20E+00	1.57E-07	3.44E-07	3.00E-01	1.15E-06	
Toluene	2.70E-03	1.57E-07	4.23E-10	2.00E+00	2.11E-10	
Xylenes, mixed	1.10E-03	1.57E-07	1.72E-10	4.00E+00	4.31E-11	
Zinc	4.87E+01	1.57E-07	7.62E-06	3.00E-01	2.54E-05	
						1.80E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.20E-01	1.57E-07	1.88E-08	6.00E-02	3.13E-07	
Anthracene	2.10E-01	1.57E-07	3.29E-08	3.00E-01	1.10E-07	
Barium	7.51E+02	1.57E-07	1.18E-04	7.00E-02	1.68E-03	
Butyl Benzyl Phthalate	1.20E-01	1.57E-07	1.88E-08	2.00E-01	9.39E-08	
Cadmium (food	7.30E-01	1.57E-07	1.14E-07	1.00E-03	1.14E-04	
Fluoranthene	1.70E+00	1.57E-07	2.66E-07	4.00E-02	6.65E-06	
Fluorene	1.00E-01	1.57E-07	1.57E-08	4.00E-02	3.91E-07	
Mercury	1.80E-01	1.57E-07	2.82E-08	3.00E-04	9.39E-05	
Naphthalene	8.00E-02	1.57E-07	1.25E-08	4.00E-02	3.13E-07	
Pyrene	2.20E+00	1.57E-07	3.44E-07	3.00E-02	1.15E-05	

Toluene	2.70E-03	1.57E-07	4.23E-10	2.00E-01	2.11E-09	
Xylenes, mixed	1.10E-03	1.57E-07	1.72E-10	2.00E+00	8.61E-11	
Zinc	4.87E+01	1.57E-07	7.62E-06	3.00E-01	2.54E-05	
						1.93E-03

CONSTR WORKER
Inhalation of TSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.82E-07	1.03E-04	7.02E-11	9.10E-02	6.39E-12	
						6.39E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	7.20E-03	3.08E-09	1.10E-01	2.80E-08	
						2.80E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	7.20E-03	3.08E-09	1.10E-01	2.80E-08	
						2.80E-08

CONSTR WORKER
Inhalation of TSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.82E-07	4.47E-04	3.05E-10	9.10E-02	2.78E-11	
						2.78E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	3.13E-02	1.34E-08	1.10E-01	1.22E-07	
						1.22E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	3.13E-02	1.34E-08	1.10E-01	1.22E-07	
						1.22E-07

CONSTR WORKER
Inhalation of TSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.16E-10	1.03E-04	2.22E-14	6.10E-01	1.36E-14	
Benzo(a)pyrene	1.94E-10	1.03E-04	2.00E-14	6.10E+00	1.22E-13	
Benzo(b)fluoranthene	3.89E-10	1.03E-04	4.00E-14	6.10E-01	2.44E-14	
Chrysene	2.38E-10	1.03E-04	2.45E-14	6.10E-02	1.49E-15	
Indeno(1,2,3-c,d)pyrene	8.64E-11	1.03E-04	8.89E-15	6.10E-01	5.42E-15	
						1.67E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.62E-07	7.20E-03	1.17E-09	1.40E-03	8.33E-07	
Mercury	3.89E-11	7.20E-03	2.80E-13	8.60E-05	3.26E-09	
						8.37E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.62E-07	7.20E-03	1.17E-09	1.40E-04	8.33E-06	
Mercury	3.89E-11	7.20E-03	2.80E-13	8.60E-05	3.26E-09	
						8.34E-06

CONSTR WORKER
Inhalation of TSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.16E-10	4.47E-04	9.66E-14	6.10E-01	5.89E-14	
Benzo(a)pyrene	1.94E-10	4.47E-04	8.68E-14	6.10E+00	5.29E-13	
Benzo(b)fluoranthene	3.89E-10	4.47E-04	1.74E-13	6.10E-01	1.06E-13	
Chrysene	2.38E-10	4.47E-04	1.06E-13	6.10E-02	6.49E-15	
Indeno(1,2,3-c,d)pyrene	8.64E-11	4.47E-04	3.86E-14	6.10E-01	2.36E-14	
						7.24E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.62E-07	3.13E-02	5.07E-09	1.40E-03	3.62E-06	
Mercury	3.89E-11	3.13E-02	1.22E-12	8.60E-05	1.42E-08	
						3.64E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.62E-07	3.13E-02	5.07E-09	1.40E-04	3.62E-05	
Mercury	3.89E-11	3.13E-02	1.22E-12	8.60E-05	1.42E-08	
						3.62E-05

TRESPASSER
Dermal Contact with SSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.00E-06	1.20E-08	1.20E-14	9.10E-02	1.09E-15	
Carbazole	8.30E-03	1.20E-08	9.94E-11	2.00E-02	1.99E-12	
						1.99E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	8.50E-03	1.40E-07	1.19E-09	2.00E+00	5.94E-10	
Mercury	2.20E-03	1.40E-07	3.07E-10	3.00E-04	1.02E-06	
Toluene	9.00E-05	1.40E-07	1.26E-11	2.00E+00	6.29E-12	
Xylenes, mixed	3.00E-05	1.40E-07	4.19E-12	4.00E+00	1.05E-12	
						1.02E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	8.50E-03	1.40E-07	1.19E-09	2.00E-01	5.94E-09	
Mercury	2.20E-03	1.40E-07	3.07E-10	3.00E-04	1.02E-06	
Toluene	9.00E-05	1.40E-07	1.26E-11	2.00E-01	6.29E-11	
Xylenes, mixed	3.00E-05	1.40E-07	4.19E-12	2.00E+00	2.10E-12	
						1.03E-06

TRESPASSER
Dermal Contact with SSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.00E-06	1.27E-06	1.27E-12	9.10E-02	1.15E-13	
Carbazole	1.00E-02	1.27E-06	1.27E-08	2.00E-02	2.54E-10	
						2.54E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.20E-02	1.48E-05	1.78E-07	2.00E+00	8.88E-08	
Mercury	2.50E-03	1.48E-05	3.70E-08	3.00E-04	1.23E-04	
Toluene	9.00E-05	1.48E-05	1.33E-09	2.00E+00	6.66E-10	
Xylenes, mixed	3.00E-05	1.48E-05	4.44E-10	4.00E+00	1.11E-10	
						1.23E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.20E-02	1.48E-05	1.78E-07	2.00E-01	8.88E-07	
Mercury	2.50E-03	1.48E-05	3.70E-08	3.00E-04	1.23E-04	
Toluene	9.00E-05	1.48E-05	1.33E-09	2.00E-01	6.66E-09	
Xylenes, mixed	3.00E-05	1.48E-05	4.44E-10	2.00E+00	2.22E-10	
						1.24E-04

TRESPASSER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.50E-03	1.50E-10	2.24E-13	9.10E-02	2.04E-14	
Benzo(a)anthracene	6.85E-01	1.50E-10	1.03E-10	7.30E-01	7.48E-11	
Benzo(a)pyrene	6.80E-01	1.50E-10	1.02E-10	7.30E+00	7.43E-10	
Benzo(b)fluoranthene	1.39E+00	1.50E-10	2.09E-10	7.30E-01	1.52E-10	
Carbazole	8.30E-02	1.50E-10	1.24E-11	2.00E-02	2.48E-13	
Chrysene	9.10E-01	1.50E-10	1.36E-10	7.30E-02	9.94E-12	
Indeno(1,2,3-c,d)pyrene	3.25E-01	1.50E-10	4.86E-11	7.30E-01	3.55E-11	
						1.02E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	8.90E-02	1.75E-09	1.55E-10	6.00E-01	2.59E-10	
Anthracene	1.53E-01	1.75E-09	2.67E-10	3.00E+00	8.90E-11	
Barium	4.98E+02	1.75E-09	8.69E-07	7.00E-02	1.24E-05	
Butyl Benzyl Phthalate	8.50E-02	1.75E-09	1.48E-10	2.00E+00	7.42E-11	
Fluoranthene	1.30E+00	1.75E-09	2.27E-09	4.00E-01	5.67E-09	
Fluorene	7.95E-02	1.75E-09	1.39E-10	4.00E-01	3.47E-10	
Mercury	2.20E-01	1.75E-09	3.84E-10	3.00E-04	1.28E-06	
Naphthalene	8.00E-02	1.75E-09	1.40E-10	4.00E-02	3.49E-09	
Pyrene	1.65E+00	1.75E-09	2.88E-09	3.00E-01	9.60E-09	
Toluene	2.70E-03	1.75E-09	4.71E-12	2.00E+00	2.36E-12	
Xylenes, mixed	1.10E-03	1.75E-09	1.92E-12	4.00E+00	4.80E-13	
Zinc	5.46E+01	1.75E-09	9.53E-08	3.00E-01	3.18E-07	
						1.40E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	8.90E-02	1.75E-09	1.55E-10	6.00E-02	2.59E-09	
Anthracene	1.53E-01	1.75E-09	2.67E-10	3.00E-01	8.90E-10	
Barium	4.98E+02	1.75E-09	8.69E-07	7.00E-02	1.24E-05	
Butyl Benzyl Phthalate	8.50E-02	1.75E-09	1.48E-10	2.00E-01	7.42E-10	
Cadmium (food)	8.30E-01	1.75E-09	1.45E-09	1.00E-03	1.45E-06	
Fluoranthene	1.30E+00	1.75E-09	2.27E-09	4.00E-02	5.67E-08	
Fluorene	7.95E-02	1.75E-09	1.39E-10	4.00E-02	3.47E-09	
Mercury	2.20E-01	1.75E-09	3.84E-10	3.00E-04	1.28E-06	
Naphthalene	8.00E-02	1.75E-09	1.40E-10	4.00E-02	3.49E-09	
Pyrene	1.65E+00	1.75E-09	2.88E-09	3.00E-02	9.60E-08	

Toluene	2.70E-03	1.75E-09	4.71E-12	2.00E-01	2.36E-11	
Xylenes, mixed	1.10E-03	1.75E-09	1.92E-12	2.00E+00	9.60E-13	
Zinc	5.46E+01	1.75E-09	9.53E-08	3.00E-01	3.18E-07	
						1.56E-05

TRESPASSER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.50E-03	1.20E-08	1.80E-11	9.10E-02	1.63E-12	
Benzo(a)anthracene	1.00E+00	1.20E-08	1.20E-08	7.30E-01	8.74E-09	
Benzo(a)pyrene	9.00E-01	1.20E-08	1.08E-08	7.30E+00	7.87E-08	
Benzo(b)fluoranthene	1.80E+00	1.20E-08	2.15E-08	7.30E-01	1.57E-08	
Carbazole	1.00E-01	1.20E-08	1.20E-09	2.00E-02	2.39E-11	
Chrysene	1.10E+00	1.20E-08	1.32E-08	7.30E-02	9.61E-10	
Indeno(1,2,3-c,d)pyrene	4.00E-01	1.20E-08	4.79E-09	7.30E-01	3.50E-09	
						1.08E-07

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.20E-01	1.40E-07	1.68E-08	6.00E-01	2.79E-08	
Anthracene	2.10E-01	1.40E-07	2.93E-08	3.00E+00	9.78E-09	
Barium	7.17E+02	1.40E-07	1.00E-04	7.00E-02	1.43E-03	
Butyl Benzyl Phthalate	1.20E-01	1.40E-07	1.68E-08	2.00E+00	8.38E-09	
Fluoranthene	1.70E+00	1.40E-07	2.37E-07	4.00E-01	5.94E-07	
Fluorene	1.00E-01	1.40E-07	1.40E-08	4.00E-01	3.49E-08	
Mercury	2.50E-01	1.40E-07	3.49E-08	3.00E-04	1.16E-04	
Naphthalene	8.00E-02	1.40E-07	1.12E-08	4.00E-02	2.79E-07	
Pyrene	2.20E+00	1.40E-07	3.07E-07	3.00E-01	1.02E-06	
Toluene	2.70E-03	1.40E-07	3.77E-10	2.00E+00	1.89E-10	
Xylenes, mixed	1.10E-03	1.40E-07	1.54E-10	4.00E+00	3.84E-11	
Zinc	5.49E+01	1.40E-07	7.67E-06	3.00E-01	2.56E-05	
						1.57E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.20E-01	1.40E-07	1.68E-08	6.00E-02	2.79E-07	
Anthracene	2.10E-01	1.40E-07	2.93E-08	3.00E-01	9.78E-08	
Barium	7.17E+02	1.40E-07	1.00E-04	7.00E-02	1.43E-03	
Butyl Benzyl Phthalate	1.20E-01	1.40E-07	1.68E-08	2.00E-01	8.38E-08	
Cadmium (food	8.50E-01	1.40E-07	1.19E-07	1.00E-03	1.19E-04	
Fluoranthene	1.70E+00	1.40E-07	2.37E-07	4.00E-02	5.94E-06	
Fluorene	1.00E-01	1.40E-07	1.40E-08	4.00E-02	3.49E-07	
Mercury	2.50E-01	1.40E-07	3.49E-08	3.00E-04	1.16E-04	
Naphthalene	8.00E-02	1.40E-07	1.12E-08	4.00E-02	2.79E-07	
Pyrene	2.20E+00	1.40E-07	3.07E-07	3.00E-02	1.02E-05	

Toluene	2.70E-03	1.40E-07	3.77E-10	2.00E-01	1.89E-09	
Xylenes, mixed	1.10E-03	1.40E-07	1.54E-10	2.00E+00	7.68E-11	
Zinc	5.49E+01	1.40E-07	7.67E-06	3.00E-01	2.56E-05	
						1.71E-03

TRESPASSER
Inhalation of SSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.82E-07	2.75E-04	1.88E-10	9.10E-02	1.71E-11	
						1.71E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	3.21E-03	1.37E-09	1.10E-01	1.25E-08	
						1.25E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	3.21E-03	1.37E-09	1.10E-01	1.25E-08	
						1.25E-08

TRESPASSER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.82E-07	4.79E-03	3.27E-09	9.10E-02	2.97E-10	
						2.97E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	5.59E-02	2.39E-08	1.10E-01	2.17E-07	
						2.17E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.27E-07	5.59E-02	2.39E-08	1.10E-01	2.17E-07	
						2.17E-07

TRESPASSER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.16E-10	2.75E-04	5.95E-14	6.10E-01	3.63E-14	
Benzo(a)pyrene	1.94E-10	2.75E-04	5.34E-14	6.10E+00	3.26E-13	
Benzo(b)fluoranthene	3.89E-10	2.75E-04	1.07E-13	6.10E-01	6.53E-14	
Chrysene	2.38E-10	2.75E-04	6.55E-14	6.10E-02	4.00E-15	
Indeno(1,2,3-c,d)pyrene	8.64E-11	2.75E-04	2.38E-14	6.10E-01	1.45E-14	
						4.46E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.55E-07	3.21E-03	4.98E-10	1.40E-03	3.56E-07	
Mercury	5.40E-11	3.21E-03	1.73E-13	8.60E-05	2.02E-09	
						3.58E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.55E-07	3.21E-03	4.98E-10	1.40E-04	3.56E-06	
Mercury	5.40E-11	3.21E-03	1.73E-13	8.60E-05	2.02E-09	
						3.56E-06

TRESPASSER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.16E-10	4.79E-03	1.03E-12	6.10E-01	6.31E-13	
Benzo(a)pyrene	1.94E-10	4.79E-03	9.29E-13	6.10E+00	5.67E-12	
Benzo(b)fluoranthene	3.89E-10	4.79E-03	1.86E-12	6.10E-01	1.14E-12	
Chrysene	2.38E-10	4.79E-03	1.14E-12	6.10E-02	6.95E-14	
Indeno(1,2,3-c,d)pyrene	8.64E-11	4.79E-03	4.14E-13	6.10E-01	2.52E-13	
						7.76E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.55E-07	5.59E-02	8.66E-09	1.40E-03	6.19E-06	
Mercury	5.40E-11	5.59E-02	3.02E-12	8.60E-05	3.51E-08	
						6.22E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	1.55E-07	5.59E-02	8.66E-09	1.40E-04	6.19E-05	
Mercury	5.40E-11	5.59E-02	3.02E-12	8.60E-05	3.51E-08	
						6.19E-05

OIL/WATER SEPARATOR 5120
RISK CALCULATIONS

Receptor/Pathway Summary: CANNON AFB OWS 5120

January 19, 1994
18:55

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SURFACE SOIL	7.61E-12		2.86E-08	1.71E-09		1.93E-06
-- Ingestion of SURFACE SOIL	3.78E-09		6.26E-05	1.64E-06		7.38E-03
-- Inhalation of SSOIL VOCS	7.47E-11		1.23E-07	3.76E-09		2.22E-06
-- Inhalation of SSOIL PARTICS	5.83E-12		0.00E+00	2.93E-10		0.00E+00
	3.87E-09		6.28E-05	1.65E-06		7.38E-03
CONSTR WORKER						
-- Dermal Contact with TSOIL	5.64E-13	1.91E-09		1.19E-11	4.94E-07	
-- Ingestion of TSOIL	9.40E-10	2.24E-04		1.59E-08	2.01E-03	
-- Inhalation of TSOIL VOCS	5.53E-12	4.44E-08		2.41E-11	1.93E-07	
-- Inhalation of TSOIL PARTICS	3.12E-13	0.00E+00		1.36E-12	0.00E+00	
	9.46E-10	2.24E-04		1.59E-08	2.01E-03	
TRESPASSER						
-- Dermal Contact with SURFACE SOIL	1.51E-12	8.55E-10		2.26E-10	1.07E-07	
-- Ingestion of SURFACE SOIL	7.50E-10	1.67E-05		1.13E-07	1.83E-03	
-- Inhalation of SSOIL VOCS	1.48E-11	3.64E-08		2.58E-10	6.34E-07	
-- Inhalation of SSOIL PARTICS	1.16E-12	0.00E+00		2.01E-11	0.00E+00	
	7.67E-10	1.68E-05		1.13E-07	1.83E-03	

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.50E-07	6.04E-08	3.93E-14	9.10E-02	3.57E-15	
Carbazole	6.30E-03	6.04E-08	3.80E-10	2.00E-02	7.61E-12	
						7.61E-12

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.20E-02	4.70E-07	5.64E-09	2.00E-01	2.82E-08	
Ethylbenzene	3.00E-05	4.70E-07	1.41E-11	1.00E-01	1.41E-10	
Toluene	1.20E-04	4.70E-07	5.64E-11	2.00E-01	2.82E-10	
Xylenes, mixed	1.20E-04	4.70E-07	5.64E-11	2.00E+00	2.82E-11	
						2.86E-08

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.50E-07	9.61E-06	6.25E-12	9.10E-02	5.68E-13	
Carbazole	8.90E-03	9.61E-06	8.55E-08	2.00E-02	1.71E-09	
						1.71E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.40E-02	2.69E-05	3.77E-07	2.00E-01	1.88E-06	
Ethylbenzene	3.00E-05	2.69E-05	8.07E-10	1.00E-01	8.07E-09	
Toluene	2.40E-04	2.69E-05	6.46E-09	2.00E-01	3.23E-08	
Xylenes, mixed	2.10E-04	2.69E-05	5.65E-09	2.00E+00	2.83E-09	
						1.93E-06

OCCUP WORKER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.30E-03	7.55E-10	9.81E-13	9.10E-02	8.93E-14	
Benzo(a)anthracene	4.03E-01	7.55E-10	3.04E-10	7.30E-01	2.22E-10	
Benzo(a)pyrene	5.03E-01	7.55E-10	3.80E-10	7.30E+00	2.77E-09	
Benzo(b)fluoranthene	1.11E+00	7.55E-10	8.38E-10	7.30E-01	6.12E-10	
Carbazole	6.35E-02	7.55E-10	4.79E-11	2.00E-02	9.59E-13	
Chrysene	5.20E-01	7.55E-10	3.93E-10	7.30E-02	2.87E-11	
Indeno(1,2,3-c,d)pyrene	2.65E-01	7.55E-10	2.00E-10	7.30E-01	1.46E-10	
						3.78E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	5.87E-09	4.11E-10	3.00E-01	1.37E-09	
Antimony	3.71E+00	5.87E-09	2.18E-08	4.00E-04	5.45E-05	
Butyl Benzyl Phthalate	1.25E-01	5.87E-09	7.34E-10	2.00E-01	3.67E-09	
Cadmium (food)	1.04E+00	5.87E-09	6.11E-09	1.00E-03	6.11E-06	
Ethylbenzene	1.50E-03	5.87E-09	8.81E-12	1.00E-01	8.81E-11	
Fluoranthene	6.83E-01	5.87E-09	4.01E-09	4.00E-02	1.00E-07	
Pyrene	1.04E+00	5.87E-09	6.09E-09	3.00E-02	2.03E-07	
Silver	6.80E-01	5.87E-09	3.99E-09	5.00E-03	7.98E-07	
Toluene	3.87E-03	5.87E-09	2.27E-11	2.00E-01	1.14E-10	
Xylenes, mixed	3.82E-03	5.87E-09	2.24E-11	2.00E+00	1.12E-11	
Zinc	4.98E+01	5.87E-09	2.92E-07	3.00E-01	9.74E-07	
						6.26E-05

OCCUP WORKER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.30E-03	1.75E-07	2.27E-10	9.10E-02	2.07E-11	
Benzo(a)anthracene	8.00E-01	1.75E-07	1.40E-07	7.30E-01	1.02E-07	
Benzo(a)pyrene	9.41E-01	1.75E-07	1.64E-07	7.30E+00	1.20E-06	
Benzo(b)fluoranthene	2.10E+00	1.75E-07	3.67E-07	7.30E-01	2.68E-07	
Carbazole	8.90E-02	1.75E-07	1.56E-08	2.00E-02	3.11E-10	
Chrysene	9.40E-01	1.75E-07	1.64E-07	7.30E-02	1.20E-08	
Indeno(1,2,3-c,d)pyrene	4.70E-01	1.75E-07	8.21E-08	7.30E-01	5.99E-08	
						1.64E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	4.89E-07	3.42E-08	3.00E-01	1.14E-07	
Antimony	5.07E+00	4.89E-07	2.48E-06	4.00E-04	6.20E-03	
Butyl Benzyl Phthalate	1.40E-01	4.89E-07	6.85E-08	2.00E-01	3.42E-07	
Cadmium (food)	1.90E+00	4.89E-07	9.30E-07	1.00E-03	9.30E-04	
Ethylbenzene	1.50E-03	4.89E-07	7.34E-10	1.00E-01	7.34E-09	
Fluoranthene	1.10E+00	4.89E-07	5.38E-07	4.00E-02	1.35E-05	
Pyrene	2.00E+00	4.89E-07	9.78E-07	3.00E-02	3.26E-05	
Silver	9.50E-01	4.89E-07	4.65E-07	5.00E-03	9.30E-05	
Toluene	7.50E-03	4.89E-07	3.67E-09	2.00E-01	1.83E-08	
Xylenes, mixed	7.20E-03	4.89E-07	3.52E-09	2.00E+00	1.76E-09	
Zinc	6.64E+01	4.89E-07	3.25E-05	3.00E-01	1.08E-04	
						7.38E-03

OCCUP WORKER
Inhalation of SSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	5.91E-07	1.39E-03	8.21E-10	9.10E-02	7.47E-11	
						7.47E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	1.08E-02	1.74E-09	2.90E-01	6.00E-09	
Toluene	1.19E-06	1.08E-02	1.28E-08	1.10E-01	1.17E-07	
						1.23E-07

OCCUP WORKER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	5.91E-07	6.99E-02	4.13E-08	9.10E-02	3.76E-09	
						3.76E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	1.96E-01	3.15E-08	2.90E-01	1.09E-07	
Toluene	1.19E-06	1.96E-01	2.32E-07	1.10E-01	2.11E-06	
						2.22E-06

OCCUP WORKER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.73E-10	1.39E-03	2.40E-13	6.10E-01	1.47E-13	
Benzo(a)pyrene	2.03E-10	1.39E-03	2.82E-13	6.10E+00	1.72E-12	
Benzo(b)fluoranthene	4.54E-10	1.39E-03	6.31E-13	6.10E-01	3.85E-13	
Cadmium (food)	4.10E-10	1.39E-03	5.69E-13	6.10E+00	3.47E-12	
Chrysene	2.03E-10	1.39E-03	2.82E-13	6.10E-02	1.72E-14	
Indeno(1,2,3-c,d)pyrene	1.02E-10	1.39E-03	1.42E-13	6.10E-01	8.64E-14	
						5.83E-12

OCCUP WORKER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.73E-10	6.99E-02	1.21E-11	6.10E-01	7.38E-12	
Benzo(a)pyrene	2.03E-10	6.99E-02	1.42E-11	6.10E+00	8.65E-11	
Benzo(b)fluoranthene	4.54E-10	6.99E-02	3.17E-11	6.10E-01	1.94E-11	
Cadmium (food)	4.10E-10	6.99E-02	2.87E-11	6.10E+00	1.75E-10	
Chrysene	2.03E-10	6.99E-02	1.42E-11	6.10E-02	8.65E-13	
Indeno(1,2,3-c,d)pyrene	1.02E-10	6.99E-02	7.13E-12	6.10E-01	4.35E-12	
						2.93E-10

CONSTR WORKER
Dermal Contact with TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.50E-07	4.47E-09	2.91E-15	9.10E-02	2.65E-16	
Carbazole	6.30E-03	4.47E-09	2.82E-11	2.00E-02	5.64E-13	
						5.64E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.20E-02	3.13E-07	3.76E-09	2.00E+00	1.88E-09	
Ethylbenzene	3.00E-05	3.13E-07	9.39E-12	1.00E+00	9.39E-12	
Toluene	1.20E-04	3.13E-07	3.76E-11	2.00E+00	1.88E-11	
Xylenes, mixed	9.00E-05	3.13E-07	2.82E-11	4.00E+00	7.05E-12	
						1.91E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.20E-02	3.13E-07	3.76E-09	2.00E-01	1.88E-08	
Ethylbenzene	3.00E-05	3.13E-07	9.39E-12	1.00E-01	9.39E-11	
Toluene	1.20E-04	3.13E-07	3.76E-11	2.00E-01	1.88E-10	
Xylenes, mixed	9.00E-05	3.13E-07	2.82E-11	2.00E+00	1.41E-11	
						1.91E-08

CONSTR WORKER
Dermal Contact with TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	6.50E-07	6.71E-08	4.36E-14	9.10E-02	3.97E-15	
Carbazole	8.90E-03	6.71E-08	5.97E-10	2.00E-02	1.19E-11	
						1.19E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	2.10E-01	4.70E-06	9.86E-07	2.00E+00	4.93E-07	
Ethylbenzene	3.00E-05	4.70E-06	1.41E-10	1.00E+00	1.41E-10	
Toluene	1.20E-04	4.70E-06	5.64E-10	2.00E+00	2.82E-10	
Xylenes, mixed	9.00E-05	4.70E-06	4.23E-10	4.00E+00	1.06E-10	
						4.94E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	2.10E-01	4.70E-06	9.86E-07	2.00E-01	4.93E-06	
Ethylbenzene	3.00E-05	4.70E-06	1.41E-10	1.00E-01	1.41E-09	
Toluene	1.20E-04	4.70E-06	5.64E-10	2.00E-01	2.82E-09	
Xylenes, mixed	9.00E-05	4.70E-06	4.23E-10	2.00E+00	2.11E-10	
						4.94E-06

CONSTR WORKER
Ingestion of TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.30E-03	2.80E-10	3.63E-13	9.10E-02	3.31E-14	
Benzo(a)anthracene	2.91E-01	2.80E-10	8.14E-11	7.30E-01	5.94E-11	
Benzo(a)pyrene	3.41E-01	2.80E-10	9.53E-11	7.30E+00	6.96E-10	
Benzo(b)fluoranthene	6.46E-01	2.80E-10	1.81E-10	7.30E-01	1.32E-10	
Carbazole	6.40E-02	2.80E-10	1.79E-11	2.00E-02	3.58E-13	
Chrysene	3.50E-01	2.80E-10	9.78E-11	7.30E-02	7.14E-12	
Indeno(1,2,3-c,d)pyrene	2.22E-01	2.80E-10	6.21E-11	7.30E-01	4.53E-11	
						9.40E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	1.30E-01	1.96E-08	2.54E-09	3.00E+00	8.48E-10	
Antimony	4.49E+00	1.96E-08	8.79E-08	4.00E-04	2.20E-04	
Butyl Benzyl Phthalate	1.25E-01	1.96E-08	2.45E-09	2.00E+00	1.22E-09	
Ethylbenzene	1.50E-03	1.96E-08	2.94E-11	1.00E+00	2.94E-11	
Fluoranthene	4.31E-01	1.96E-08	8.43E-09	4.00E-01	2.11E-08	
Pyrene	6.08E-01	1.96E-08	1.19E-08	3.00E-01	3.97E-08	
Silver	8.00E-01	1.96E-08	1.57E-08	5.00E-03	3.13E-06	
Toluene	3.62E-03	1.96E-08	7.08E-11	2.00E+00	3.54E-11	
Xylenes, mixed	2.90E-03	1.96E-08	5.68E-11	4.00E+00	1.42E-11	
Zinc	1.59E+01	1.96E-08	3.11E-07	3.00E-01	1.04E-06	
						2.24E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	1.30E-01	1.96E-08	2.54E-09	3.00E-01	8.48E-09	
Antimony	4.49E+00	1.96E-08	8.79E-08	4.00E-04	2.20E-04	
Butyl Benzyl Phthalate	1.25E-01	1.96E-08	2.45E-09	2.00E-01	1.22E-08	
Cadmium (food	7.80E-01	1.96E-08	1.53E-08	1.00E-03	1.53E-05	
Ethylbenzene	1.50E-03	1.96E-08	2.94E-11	1.00E-01	2.94E-10	
Fluoranthene	4.31E-01	1.96E-08	8.43E-09	4.00E-02	2.11E-07	
Pyrene	6.08E-01	1.96E-08	1.19E-08	3.00E-02	3.97E-07	
Silver	8.00E-01	1.96E-08	1.57E-08	5.00E-03	3.13E-06	
Toluene	3.62E-03	1.96E-08	7.08E-11	2.00E-01	3.54E-10	
Xylenes, mixed	2.90E-03	1.96E-08	5.68E-11	2.00E+00	2.84E-11	
Zinc	1.59E+01	1.96E-08	3.11E-07	3.00E-01	1.04E-06	
						2.40E-04

CONSTR WORKER
Ingestion of TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.30E-03	2.24E-09	2.91E-12	9.10E-02	2.65E-13	
Benzo(a)anthracene	4.98E-01	2.24E-09	1.11E-09	7.30E-01	8.13E-10	
Benzo(a)pyrene	6.71E-01	2.24E-09	1.50E-09	7.30E+00	1.10E-08	
Benzo(b)fluoranthene	2.10E+00	2.24E-09	4.70E-09	7.30E-01	3.43E-09	
Carbazole	8.90E-02	2.24E-09	1.99E-10	2.00E-02	3.98E-12	
Chrysene	6.52E-01	2.24E-09	1.46E-09	7.30E-02	1.06E-10	
Indeno(1,2,3-c,d)pyrene	3.37E-01	2.24E-09	7.54E-10	7.30E-01	5.50E-10	
						1.59E-08

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	1.90E-01	1.57E-07	2.97E-08	3.00E+00	9.92E-09	
Antimony	5.03E+00	1.57E-07	7.87E-07	4.00E-04	1.97E-03	
Butyl Benzyl Phthalate	2.10E+00	1.57E-07	3.29E-07	2.00E+00	1.64E-07	
Ethylbenzene	1.50E-03	1.57E-07	2.35E-10	1.00E+00	2.35E-10	
Fluoranthene	9.70E-01	1.57E-07	1.52E-07	4.00E-01	3.80E-07	
Pyrene	2.00E+00	1.57E-07	3.13E-07	3.00E-01	1.04E-06	
Silver	9.00E-01	1.57E-07	1.41E-07	5.00E-03	2.82E-05	
Toluene	3.94E-03	1.57E-07	6.17E-10	2.00E+00	3.08E-10	
Xylenes, mixed	3.10E-03	1.57E-07	4.85E-10	4.00E+00	1.21E-10	
Zinc	2.01E+01	1.57E-07	3.15E-06	3.00E-01	1.05E-05	
						2.01E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	1.90E-01	1.57E-07	2.97E-08	3.00E-01	9.92E-08	
Antimony	5.03E+00	1.57E-07	7.87E-07	4.00E-04	1.97E-03	
Butyl Benzyl Phthalate	2.10E+00	1.57E-07	3.29E-07	2.00E-01	1.64E-06	
Cadmium (food)	1.03E+00	1.57E-07	1.61E-07	1.00E-03	1.61E-04	
Ethylbenzene	1.50E-03	1.57E-07	2.35E-10	1.00E-01	2.35E-09	
Fluoranthene	9.70E-01	1.57E-07	1.52E-07	4.00E-02	3.80E-06	
Pyrene	2.00E+00	1.57E-07	3.13E-07	3.00E-02	1.04E-05	
Silver	9.00E-01	1.57E-07	1.41E-07	5.00E-03	2.82E-05	
Toluene	3.94E-03	1.57E-07	6.17E-10	2.00E-01	3.08E-09	
Xylenes, mixed	3.10E-03	1.57E-07	4.85E-10	2.00E+00	2.43E-10	
Zinc	2.01E+01	1.57E-07	3.15E-06	3.00E-01	1.05E-05	
						2.18E-03

CONSTR WORKER
Inhalation of TSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	5.91E-07	1.03E-04	6.08E-11	9.10E-02	5.53E-12	
						5.53E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	7.20E-03	1.16E-09	2.90E-01	4.00E-09	
Toluene	6.17E-07	7.20E-03	4.44E-09	1.10E-01	4.04E-08	
						4.44E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	7.20E-03	1.16E-09	2.90E-01	4.00E-09	
Toluene	6.17E-07	7.20E-03	4.44E-09	1.10E-01	4.04E-08	
						4.44E-08

CONSTR WORKER
Inhalation of TSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	5.91E-07	4.47E-04	2.64E-10	9.10E-02	2.41E-11	
						2.41E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	3.13E-02	5.04E-09	2.90E-01	1.74E-08	
Toluene	6.17E-07	3.13E-02	1.93E-08	1.10E-01	1.76E-07	
						1.93E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	3.13E-02	5.04E-09	2.90E-01	1.74E-08	
Toluene	6.17E-07	3.13E-02	1.93E-08	1.10E-01	1.76E-07	
						1.93E-07

CONSTR WORKER
Inhalation of TSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.08E-10	1.03E-04	1.11E-14	6.10E-01	6.78E-15	
Benzo(a)pyrene	1.45E-10	1.03E-04	1.49E-14	6.10E+00	9.10E-14	
Benzo(b)fluoranthene	4.54E-10	1.03E-04	4.67E-14	6.10E-01	2.85E-14	
Cadmium (food)	2.22E-10	1.03E-04	2.28E-14	6.10E+00	1.39E-13	
Chrysene	1.41E-10	1.03E-04	1.45E-14	6.10E-02	8.85E-16	
Indeno(1,2,3-c,d)pyrene	7.28E-10	1.03E-04	7.49E-14	6.10E-01	4.57E-14	
						3.12E-13

CONSTR WORKER
Inhalation of TSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.08E-10	4.47E-04	4.83E-14	6.10E-01	2.95E-14	
Benzo(a)pyrene	1.45E-10	4.47E-04	6.49E-14	6.10E+00	3.96E-13	
Benzo(b)fluoranthene	4.54E-10	4.47E-04	2.03E-13	6.10E-01	1.24E-13	
Cadmium (food)	2.22E-10	4.47E-04	9.93E-14	6.10E+00	6.06E-13	
Chrysene	1.41E-10	4.47E-04	6.31E-14	6.10E-02	3.85E-15	
Indeno(1,2,3-c,d)pyrene	7.28E-10	4.47E-04	3.26E-13	6.10E-01	1.99E-13	
						1.36E-12

TRESPASSER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.30E-03	1.20E-08	1.56E-11	9.10E-02	1.42E-12	
Benzo(a)anthracene	4.03E-01	1.20E-08	4.82E-09	7.30E-01	3.52E-09	
Benzo(a)pyrene	5.03E-01	1.20E-08	6.02E-09	7.30E+00	4.40E-08	
Benzo(b)fluoranthene	1.11E+00	1.20E-08	1.33E-08	7.30E-01	9.70E-09	
Carbazole	6.35E-02	1.20E-08	7.60E-10	2.00E-02	1.52E-11	
Chrysene	5.20E-01	1.20E-08	6.23E-09	7.30E-02	4.54E-10	
Indeno(1,2,3-c,d)pyrene	2.65E-01	1.20E-08	3.17E-09	7.30E-01	2.32E-09	
						6.00E-08

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	1.40E-07	9.78E-09	3.00E+00	3.26E-09	
Antimony	3.71E+00	1.40E-07	5.18E-07	4.00E-04	1.30E-03	
Butyl Benzyl Phthalate	1.25E-01	1.40E-07	1.75E-08	2.00E+00	8.73E-09	
Ethylbenzene	1.50E-03	1.40E-07	2.10E-10	1.00E+00	2.10E-10	
Fluoranthene	6.83E-01	1.40E-07	9.54E-08	4.00E-01	2.38E-07	
Pyrene	1.04E+00	1.40E-07	1.45E-07	3.00E-01	4.83E-07	
Silver	6.80E-01	1.40E-07	9.50E-08	5.00E-03	1.90E-05	
Toluene	3.87E-03	1.40E-07	5.41E-10	2.00E+00	2.70E-10	
Xylenes, mixed	3.82E-03	1.40E-07	5.34E-10	4.00E+00	1.33E-10	
Zinc	4.98E+01	1.40E-07	6.95E-06	3.00E-01	2.32E-05	
						1.34E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	1.40E-07	9.78E-09	3.00E-01	3.26E-08	
Antimony	3.71E+00	1.40E-07	5.18E-07	4.00E-04	1.30E-03	
Butyl Benzyl Phthalate	1.25E-01	1.40E-07	1.75E-08	2.00E-01	8.73E-08	
Cadmium (food	1.04E+00	1.40E-07	1.45E-07	1.00E-03	1.45E-04	
Ethylbenzene	1.50E-03	1.40E-07	2.10E-10	1.00E-01	2.10E-09	
Fluoranthene	6.83E-01	1.40E-07	9.54E-08	4.00E-02	2.38E-06	
Pyrene	1.04E+00	1.40E-07	1.45E-07	3.00E-02	4.83E-06	
Silver	6.80E-01	1.40E-07	9.50E-08	5.00E-03	1.90E-05	
Toluene	3.87E-03	1.40E-07	5.41E-10	2.00E-01	2.70E-09	
Xylenes, mixed	3.82E-03	1.40E-07	5.34E-10	2.00E+00	2.67E-10	
Zinc	4.98E+01	1.40E-07	6.95E-06	3.00E-01	2.32E-05	
						1.49E-03

TRESPASSER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.30E-03	1.27E-06	1.65E-09	9.10E-02	1.50E-10	
Benzo(a)anthracene	8.00E-01	1.27E-06	1.02E-06	7.30E-01	7.41E-07	
Benzo(a)pyrene	9.41E-01	1.27E-06	1.19E-06	7.30E+00	8.72E-06	
Benzo(b)fluoranthene	2.10E+00	1.27E-06	2.66E-06	7.30E-01	1.95E-06	
Carbazole	8.90E-02	1.27E-06	1.13E-07	2.00E-02	2.26E-09	
Chrysene	9.40E-01	1.27E-06	1.19E-06	7.30E-02	8.71E-08	
Indeno(1,2,3-c,d)pyrene	4.70E-01	1.27E-06	5.96E-07	7.30E-01	4.35E-07	
						1.19E-05

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	1.48E-05	1.04E-06	3.00E+00	3.45E-07	
Antimony	5.07E+00	1.48E-05	7.51E-05	4.00E-04	1.88E-01	
Butyl Benzyl Phthalate	1.40E-01	1.48E-05	2.07E-06	2.00E+00	1.04E-06	
Ethylbenzene	1.50E-03	1.48E-05	2.22E-08	1.00E+00	2.22E-08	
Fluoranthene	1.10E+00	1.48E-05	1.63E-05	4.00E-01	4.07E-05	
Pyrene	2.00E+00	1.48E-05	2.96E-05	3.00E-01	9.87E-05	
Silver	9.50E-01	1.48E-05	1.41E-05	5.00E-03	2.81E-03	
Toluene	7.50E-03	1.48E-05	1.11E-07	2.00E+00	5.55E-08	
Xylenes, mixed	7.20E-03	1.48E-05	1.07E-07	4.00E+00	2.66E-08	
Zinc	6.64E+01	1.48E-05	9.83E-04	3.00E-01	3.28E-03	
						1.94E-01

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	1.48E-05	1.04E-06	3.00E-01	3.45E-06	
Antimony	5.07E+00	1.48E-05	7.51E-05	4.00E-04	1.88E-01	
Butyl Benzyl Phthalate	1.40E-01	1.48E-05	2.07E-06	2.00E-01	1.04E-05	
Cadmium (food)	1.90E+00	1.48E-05	2.81E-05	1.00E-03	2.81E-02	
Ethylbenzene	1.50E-03	1.48E-05	2.22E-08	1.00E-01	2.22E-07	
Fluoranthene	1.10E+00	1.48E-05	1.63E-05	4.00E-02	4.07E-04	
Pyrene	2.00E+00	1.48E-05	2.96E-05	3.00E-02	9.87E-04	
Silver	9.50E-01	1.48E-05	1.41E-05	5.00E-03	2.81E-03	
Toluene	7.50E-03	1.48E-05	1.11E-07	2.00E-01	5.55E-07	
Xylenes, mixed	7.20E-03	1.48E-05	1.07E-07	2.00E+00	5.33E-08	
Zinc	6.64E+01	1.48E-05	9.83E-04	3.00E-01	3.28E-03	
						2.23E-01

TRESPASSER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.30E-03	1.50E-10	1.95E-13	9.10E-02	1.77E-14	
Benzo(a)anthracene	4.03E-01	1.50E-10	6.03E-11	7.30E-01	4.40E-11	
Benzo(a)pyrene	5.03E-01	1.50E-10	7.53E-11	7.30E+00	5.49E-10	
Benzo(b)fluoranthene	1.11E+00	1.50E-10	1.66E-10	7.30E-01	1.21E-10	
Carbazole	6.35E-02	1.50E-10	9.50E-12	2.00E-02	1.90E-13	
Chrysene	5.20E-01	1.50E-10	7.78E-11	7.30E-02	5.68E-12	
Indeno(1,2,3-c,d)pyrene	2.65E-01	1.50E-10	3.97E-11	7.30E-01	2.89E-11	
						7.50E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	1.75E-09	1.22E-10	3.00E+00	4.07E-11	
Antimony	3.71E+00	1.75E-09	6.48E-09	4.00E-04	1.62E-05	
Butyl Benzyl Phthalate	1.25E-01	1.75E-09	2.18E-10	2.00E+00	1.09E-10	
Ethylbenzene	1.50E-03	1.75E-09	2.62E-12	1.00E+00	2.62E-12	
Fluoranthene	6.83E-01	1.75E-09	1.19E-09	4.00E-01	2.98E-09	
Pyrene	1.04E+00	1.75E-09	1.81E-09	3.00E-01	6.04E-09	
Silver	6.80E-01	1.75E-09	1.19E-09	5.00E-03	2.37E-07	
Toluene	3.87E-03	1.75E-09	6.76E-12	2.00E+00	3.38E-12	
Xylenes, mixed	3.82E-03	1.75E-09	6.67E-12	4.00E+00	1.67E-12	
Zinc	4.98E+01	1.75E-09	8.69E-08	3.00E-01	2.90E-07	
						1.67E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	1.75E-09	1.22E-10	3.00E-01	4.07E-10	
Antimony	3.71E+00	1.75E-09	6.48E-09	4.00E-04	1.62E-05	
Butyl Benzyl Phthalate	1.25E-01	1.75E-09	2.18E-10	2.00E-01	1.09E-09	
Cadmium (food	1.04E+00	1.75E-09	1.82E-09	1.00E-03	1.82E-06	
Ethylbenzene	1.50E-03	1.75E-09	2.62E-12	1.00E-01	2.62E-11	
Fluoranthene	6.83E-01	1.75E-09	1.19E-09	4.00E-02	2.98E-08	
Pyrene	1.04E+00	1.75E-09	1.81E-09	3.00E-02	6.04E-08	
Silver	6.80E-01	1.75E-09	1.19E-09	5.00E-03	2.37E-07	
Toluene	3.87E-03	1.75E-09	6.76E-12	2.00E-01	3.38E-11	
Xylenes, mixed	3.82E-03	1.75E-09	6.67E-12	2.00E+00	3.33E-12	
Zinc	4.98E+01	1.75E-09	8.69E-08	3.00E-01	2.90E-07	
						1.86E-05

TRESPASSER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.30E-03	1.20E-08	1.56E-11	9.10E-02	1.42E-12	
Benzo(a)anthracene	8.00E-01	1.20E-08	9.58E-09	7.30E-01	6.99E-09	
Benzo(a)pyrene	9.41E-01	1.20E-08	1.13E-08	7.30E+00	8.22E-08	
Benzo(b)fluoranthene	2.10E+00	1.20E-08	2.51E-08	7.30E-01	1.84E-08	
Carbazole	8.90E-02	1.20E-08	1.07E-09	2.00E-02	2.13E-11	
Chrysene	9.40E-01	1.20E-08	1.13E-08	7.30E-02	8.22E-10	
Indeno(1,2,3-c,d)pyrene	4.70E-01	1.20E-08	5.63E-09	7.30E-01	4.11E-09	
						1.13E-07

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	1.40E-07	9.78E-09	3.00E+00	3.26E-09	
Antimony	5.07E+00	1.40E-07	7.08E-07	4.00E-04	1.77E-03	
Butyl Benzyl Phthalate	1.40E-01	1.40E-07	1.96E-08	2.00E+00	9.78E-09	
Ethylbenzene	1.50E-03	1.40E-07	2.10E-10	1.00E+00	2.10E-10	
Fluoranthene	1.10E+00	1.40E-07	1.54E-07	4.00E-01	3.84E-07	
Pyrene	2.00E+00	1.40E-07	2.79E-07	3.00E-01	9.31E-07	
Silver	9.50E-01	1.40E-07	1.33E-07	5.00E-03	2.65E-05	
Toluene	7.50E-03	1.40E-07	1.05E-09	2.00E+00	5.24E-10	
Xylenes, mixed	7.20E-03	1.40E-07	1.01E-09	4.00E+00	2.51E-10	
Zinc	6.64E+01	1.40E-07	9.27E-06	3.00E-01	3.09E-05	
						1.83E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	7.00E-02	1.40E-07	9.78E-09	3.00E-01	3.26E-08	
Antimony	5.07E+00	1.40E-07	7.08E-07	4.00E-04	1.77E-03	
Butyl Benzyl Phthalate	1.40E-01	1.40E-07	1.96E-08	2.00E-01	9.78E-08	
Cadmium (food	1.90E+00	1.40E-07	2.65E-07	1.00E-03	2.65E-04	
Ethylbenzene	1.50E-03	1.40E-07	2.10E-10	1.00E-01	2.10E-09	
Fluoranthene	1.10E+00	1.40E-07	1.54E-07	4.00E-02	3.84E-06	
Pyrene	2.00E+00	1.40E-07	2.79E-07	3.00E-02	9.31E-06	
Silver	9.50E-01	1.40E-07	1.33E-07	5.00E-03	2.65E-05	
Toluene	7.50E-03	1.40E-07	1.05E-09	2.00E-01	5.24E-09	
Xylenes, mixed	7.20E-03	1.40E-07	1.01E-09	2.00E+00	5.03E-10	
Zinc	6.64E+01	1.40E-07	9.27E-06	3.00E-01	3.09E-05	
						2.11E-03

TRESPASSER
Inhalation of SSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	5.91E-07	2.75E-04	1.63E-10	9.10E-02	1.48E-11	
						1.48E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	3.21E-03	5.17E-10	2.90E-01	1.78E-09	
Toluene	1.19E-06	3.21E-03	3.81E-09	1.10E-01	3.47E-08	
						3.64E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	3.21E-03	5.17E-10	2.90E-01	1.78E-09	
Toluene	1.19E-06	3.21E-03	3.81E-09	1.10E-01	3.47E-08	
						3.64E-08

TRESPASSER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	5.91E-07	4.79E-03	2.83E-09	9.10E-02	2.58E-10	
						2.58E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	5.59E-02	8.99E-09	2.90E-01	3.10E-08	
Toluene	1.19E-06	5.59E-02	6.63E-08	1.10E-01	6.03E-07	
						6.34E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	1.61E-07	5.59E-02	8.99E-09	2.90E-01	3.10E-08	
Toluene	1.19E-06	5.59E-02	6.63E-08	1.10E-01	6.03E-07	
						6.34E-07

TRESPASSER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.73E-10	2.75E-04	4.76E-14	6.10E-01	2.91E-14	
Benzo(a)pyrene	2.03E-10	2.75E-04	5.59E-14	6.10E+00	3.41E-13	
Benzo(b)fluoranthene	4.54E-10	2.75E-04	1.25E-13	6.10E-01	7.63E-14	
Cadmium (food)	4.10E-10	2.75E-04	1.13E-13	6.10E+00	6.89E-13	
Chrysene	2.03E-10	2.75E-04	5.59E-14	6.10E-02	3.41E-15	
Indeno(1,2,3-c,d)pyrene	1.02E-10	2.75E-04	2.81E-14	6.10E-01	1.71E-14	
						1.16E-12

TRESPASSER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.73E-10	4.79E-03	8.28E-13	6.10E-01	5.05E-13	
Benzo(a)pyrene	2.03E-10	4.79E-03	9.72E-13	6.10E+00	5.93E-12	
Benzo(b)fluoranthene	4.54E-10	4.79E-03	2.17E-12	6.10E-01	1.33E-12	
Cadmium (food)	4.10E-10	4.79E-03	1.96E-12	6.10E+00	1.20E-11	
Chrysene	2.03E-10	4.79E-03	9.72E-13	6.10E-02	5.93E-14	
Indeno(1,2,3-c,d)pyrene	1.02E-10	4.79E-03	4.88E-13	6.10E-01	2.98E-13	
						2.01E-11

OIL/WATER SEPARATOR 5121
RISK CALCULATIONS

Receptor/Pathway Summary: CANNON AFB OWS 5121

January 19, 1994
17:46

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SURFACE SOIL	3.26E-11		7.07E-08	5.19E-09		4.06E-06
-- Ingestion of SURFACE SOIL	5.38E-10		1.76E-05	1.44E-07		2.85E-03
-- Inhalation of VOCS	0.00E+00		7.62E-08	0.00E+00		1.38E-06
-- Inhalation of PARTICS	3.68E-12		0.00E+00	1.85E-10		0.00E+00
	5.75E-10		1.77E-05	1.50E-07		2.86E-03
CONSTR WORKER						
-- Dermal Contact with TSOIL	2.44E-12	4.70E-08		3.66E-11	7.05E-07	
-- Ingestion of TSOIL	2.00E-10	8.00E-05		1.85E-09	9.99E-04	
-- Inhalation of TSOIL VOCS	0.00E+00	4.42E-08		0.00E+00	1.92E-07	
-- Inhalation of TSOIL PARTICS	2.77E-13	3.20E-07		1.20E-12	1.39E-06	
	2.02E-10	8.04E-05		1.89E-09	1.00E-03	
TRESPASSER						
-- Dermal Contact with SURFACE SOIL	6.46E-12	2.10E-08		6.85E-10	2.22E-06	
-- Ingestion of SURFACE SOIL	1.07E-10	3.34E-06		9.89E-09	6.61E-04	
-- Inhalation of VOCS	0.00E+00	2.27E-08		0.00E+00	3.94E-07	
-- Inhalation of PARTICS	7.29E-13	0.00E+00		1.27E-11	0.00E+00	
	1.14E-10	3.38E-06		1.06E-08	6.63E-04	

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Pentachlorophenol	4.50E-03	6.04E-08	2.72E-10	1.20E-01	3.26E-11	
						3.26E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	4.70E-07	2.11E-09	3.00E-02	7.05E-08	
Toluene	9.00E-05	4.70E-07	4.23E-11	2.00E-01	2.11E-10	
Xylenes, mixed	6.00E-05	4.70E-07	2.82E-11	2.00E+00	1.41E-11	
						7.07E-08

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Pentachlorophenol	4.50E-03	9.61E-06	4.32E-08	1.20E-01	5.19E-09	
						5.19E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	2.69E-05	1.21E-07	3.00E-02	4.04E-06	
Toluene	1.50E-04	2.69E-05	4.04E-09	2.00E-01	2.02E-08	
Xylenes, mixed	6.00E-05	2.69E-05	1.61E-09	2.00E+00	8.07E-10	
						4.06E-06

OCCUP WORKER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	7.55E-02	7.55E-10	5.70E-11	7.30E-01	4.16E-11	
Benzo(a)pyrene	7.30E-02	7.55E-10	5.51E-11	7.30E+00	4.02E-10	
Benzo(b)fluoranthene	1.07E-01	7.55E-10	8.08E-11	7.30E-01	5.90E-11	
Chrysene	1.08E-01	7.55E-10	8.15E-11	7.30E-02	5.95E-12	
Indeno(1,2,3-c,d)pyrene	4.65E-02	7.55E-10	3.51E-11	7.30E-01	2.56E-11	
Pentachlorophenol	4.50E-02	7.55E-10	3.40E-11	1.20E-01	4.08E-12	
						5.38E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Cadmium (food)	1.07E+00	5.87E-09	6.28E-09	1.00E-03	6.28E-06	
Copper	5.83E+01	5.87E-09	3.42E-07	3.70E-02	9.26E-06	
Fluoranthene	1.25E-01	5.87E-09	7.34E-10	4.00E-02	1.83E-08	
Pentachlorophenol	4.50E-02	5.87E-09	2.64E-10	3.00E-02	8.81E-09	
Pyrene	1.73E-01	5.87E-09	1.02E-09	3.00E-02	3.39E-08	
Silver	8.00E-01	5.87E-09	4.70E-09	5.00E-03	9.39E-07	
Toluene	3.40E-03	5.87E-09	2.00E-11	2.00E-01	9.98E-11	
Xylenes, mixed	1.80E-03	5.87E-09	1.06E-11	2.00E+00	5.28E-12	
Zinc	5.20E+01	5.87E-09	3.05E-07	3.00E-01	1.02E-06	
						1.76E-05

OCCUP WORKER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	7.70E-02	1.75E-07	1.35E-08	7.30E-01	9.82E-09	
Benzo(a)pyrene	8.40E-02	1.75E-07	1.47E-08	7.30E+00	1.07E-07	
Benzo(b)fluoranthene	1.40E-01	1.75E-07	2.45E-08	7.30E-01	1.79E-08	
Chrysene	1.20E-01	1.75E-07	2.10E-08	7.30E-02	1.53E-09	
Indeno(1,2,3-c,d)pyrene	5.50E-02	1.75E-07	9.61E-09	7.30E-01	7.02E-09	
Pentachlorophenol	4.50E-02	1.75E-07	7.86E-09	1.20E-01	9.44E-10	
						1.44E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Cadmium (food)	1.09E+00	4.89E-07	5.33E-07	1.00E-03	5.33E-04	
Copper	1.58E+02	4.89E-07	7.73E-05	3.70E-02	2.09E-03	
Fluoranthene	1.50E-01	4.89E-07	7.34E-08	4.00E-02	1.83E-06	
Pentachlorophenol	4.50E-02	4.89E-07	2.20E-08	3.00E-02	7.34E-07	
Pyrene	1.90E-01	4.89E-07	9.30E-08	3.00E-02	3.10E-06	
Silver	1.00E+00	4.89E-07	4.89E-07	5.00E-03	9.78E-05	
Toluene	4.90E-03	4.89E-07	2.40E-09	2.00E-01	1.20E-08	
Xylenes, mixed	1.80E-03	4.89E-07	8.81E-10	2.00E+00	4.40E-10	
Zinc	7.70E+01	4.89E-07	3.77E-05	3.00E-01	1.26E-04	
						2.85E-03

OCCUP WORKER
Inhalation of VOCS
Average Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	7.76E-07	1.08E-02	8.38E-09	1.10E-01	7.62E-08	
						7.62E-08

OCCUP WORKER
Inhalation of VOCS
Reasonable Maximum Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	7.76E-07	1.96E-01	1.52E-07	1.10E-01	1.38E-06	
						1.38E-06

OCCUP WORKER
Inhalation of PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.66E-11	1.39E-03	2.31E-14	6.10E-01	1.41E-14	
Benzo(a)pyrene	1.81E-11	1.39E-03	2.51E-14	6.10E+00	1.53E-13	
Benzo(b)fluoranthene	3.02E-11	1.39E-03	4.19E-14	6.10E-01	2.56E-14	
Cadmium (food)	4.10E-10	1.39E-03	5.69E-13	6.10E+00	3.47E-12	
Chrysene	2.59E-11	1.39E-03	3.60E-14	6.10E-02	2.19E-15	
Indeno(1,2,3-c,d)pyrene	1.19E-11	1.39E-03	1.65E-14	6.10E-01	1.01E-14	
						3.68E-12

OCCUP WORKER
Inhalation of PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.66E-11	6.99E-02	1.16E-12	6.10E-01	7.08E-13	
Benzo(a)pyrene	1.81E-11	6.99E-02	1.27E-12	6.10E+00	7.72E-12	
Benzo(b)fluoranthene	3.02E-11	6.99E-02	2.11E-12	6.10E-01	1.29E-12	
Cadmium (food)	4.10E-10	6.99E-02	2.87E-11	6.10E+00	1.75E-10	
Chrysene	2.59E-11	6.99E-02	1.81E-12	6.10E-02	1.10E-13	
Indeno(1,2,3-c,d)pyrene	1.19E-11	6.99E-02	8.32E-13	6.10E-01	5.07E-13	
						1.85E-10

CONSTR WORKER
Dermal Contact with TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	9.00E-05	4.47E-09	4.03E-13	6.80E-02	2.74E-14	
Pentachlorophenol	4.50E-03	4.47E-09	2.01E-11	1.20E-01	2.42E-12	
						2.44E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	3.13E-07	1.41E-09	3.00E-02	4.70E-08	
Toluene	9.00E-05	3.13E-07	2.82E-11	2.00E+00	1.41E-11	
Xylenes, mixed	9.00E-05	3.13E-07	2.82E-11	4.00E+00	7.05E-12	
						4.70E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	3.13E-07	1.41E-09	3.00E-02	4.70E-08	
Toluene	9.00E-05	3.13E-07	2.82E-11	2.00E-01	1.41E-10	
Xylenes, mixed	9.00E-05	3.13E-07	2.82E-11	2.00E+00	1.41E-11	
						4.71E-08

CONSTR WORKER
Dermal Contact with TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	9.00E-05	6.71E-08	6.04E-12	6.80E-02	4.11E-13	
Pentachlorophenol	4.50E-03	6.71E-08	3.02E-10	1.20E-01	3.62E-11	
						3.66E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	4.70E-06	2.11E-08	3.00E-02	7.05E-07	
Toluene	1.20E-04	4.70E-06	5.64E-10	2.00E+00	2.82E-10	
Xylenes, mixed	9.00E-05	4.70E-06	4.23E-10	4.00E+00	1.06E-10	
						7.05E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	4.70E-06	2.11E-08	3.00E-02	7.05E-07	
Toluene	1.20E-04	4.70E-06	5.64E-10	2.00E-01	2.82E-09	
Xylenes, mixed	9.00E-05	4.70E-06	4.23E-10	2.00E+00	2.11E-10	
						7.08E-07

CONSTR WORKER
Ingestion of TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	2.76E-03	2.80E-10	7.72E-13	6.80E-02	5.25E-14	
Benzo(a)anthracene	7.60E-02	2.80E-10	2.12E-11	7.30E-01	1.55E-11	
Benzo(a)pyrene	7.30E-02	2.80E-10	2.04E-11	7.30E+00	1.49E-10	
Benzo(b)fluoranthene	1.07E-01	2.80E-10	2.99E-11	7.30E-01	2.18E-11	
Chrysene	1.08E-01	2.80E-10	3.02E-11	7.30E-02	2.20E-12	
Indeno(1,2,3-c,d)pyrene	4.70E-02	2.80E-10	1.31E-11	7.30E-01	9.59E-12	
Pentachlorophenol	4.50E-02	2.80E-10	1.26E-11	1.20E-01	1.51E-12	
						2.00E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Antimony	2.30E-03	1.96E-08	4.50E-11	4.00E-04	1.13E-07	
Barium	1.77E+02	1.96E-08	3.47E-06	5.00E-02	6.93E-05	
Copper	9.94E+00	1.96E-08	1.95E-07	3.70E-02	5.26E-06	
Fluoranthene	1.02E-01	1.96E-08	2.00E-09	4.00E-01	4.99E-09	
Pentachlorophenol	4.50E-02	1.96E-08	8.81E-10	3.00E-02	2.94E-08	
Pyrene	1.17E-01	1.96E-08	2.29E-09	3.00E-01	7.63E-09	
Silver	1.11E+00	1.96E-08	2.17E-08	5.00E-03	4.34E-06	
Toluene	3.60E-03	1.96E-08	7.05E-11	2.00E+00	3.52E-11	
Xylenes, mixed	2.78E-03	1.96E-08	5.44E-11	4.00E+00	1.36E-11	
Zinc	1.47E+01	1.96E-08	2.87E-07	3.00E-01	9.58E-07	
						8.00E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Antimony	2.30E-03	1.96E-08	4.50E-11	4.00E-04	1.13E-07	
Barium	1.77E+02	1.96E-08	3.47E-06	5.00E-02	6.93E-05	
Cadmium (food)	1.26E+00	1.96E-08	2.47E-08	1.00E-03	2.47E-05	
Copper	9.94E+00	1.96E-08	1.95E-07	3.70E-02	5.26E-06	
Fluoranthene	1.02E-01	1.96E-08	2.00E-09	4.00E-02	4.99E-08	
Pentachlorophenol	4.50E-02	1.96E-08	8.81E-10	3.00E-02	2.94E-08	
Pyrene	1.17E-01	1.96E-08	2.29E-09	3.00E-02	7.63E-08	
Silver	1.11E+00	1.96E-08	2.17E-08	5.00E-03	4.34E-06	
Toluene	3.60E-03	1.96E-08	7.05E-11	2.00E-01	3.52E-10	
Xylenes, mixed	2.78E-03	1.96E-08	5.44E-11	2.00E+00	2.72E-11	
Zinc	1.47E+01	1.96E-08	2.87E-07	3.00E-01	9.58E-07	
						1.05E-04

CONSTR WORKER
Ingestion of TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	2.76E-03	2.24E-09	6.17E-12	6.80E-02	4.20E-13	
Benzo(a)anthracene	7.70E-02	2.24E-09	1.72E-10	7.30E-01	1.26E-10	
Benzo(a)pyrene	8.40E-02	2.24E-09	1.88E-10	7.30E+00	1.37E-09	
Benzo(b)fluoranthene	1.40E-01	2.24E-09	3.13E-10	7.30E-01	2.29E-10	
Chrysene	1.20E-01	2.24E-09	2.68E-10	7.30E-02	1.96E-11	
Indeno(1,2,3-c,d)pyrene	5.50E-02	2.24E-09	1.23E-10	7.30E-01	8.98E-11	
Pentachlorophenol	4.50E-02	2.24E-09	1.01E-10	1.20E-01	1.21E-11	
						1.85E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Antimony	2.30E-03	1.57E-07	3.60E-10	4.00E-04	9.00E-07	
Barium	2.88E+02	1.57E-07	4.51E-05	5.00E-02	9.01E-04	
Copper	1.04E+01	1.57E-07	1.63E-06	3.70E-02	4.40E-05	
Fluoranthene	1.50E-01	1.57E-07	2.35E-08	4.00E-01	5.87E-08	
Pentachlorophenol	4.50E-02	1.57E-07	7.05E-09	3.00E-02	2.35E-07	
Pyrene	1.90E-01	1.57E-07	2.97E-08	3.00E-01	9.92E-08	
Silver	1.34E+00	1.57E-07	2.10E-07	5.00E-03	4.20E-05	
Toluene	4.30E-03	1.57E-07	6.73E-10	2.00E+00	3.37E-10	
Xylenes, mixed	2.92E-03	1.57E-07	4.57E-10	4.00E+00	1.14E-10	
Zinc	1.94E+01	1.57E-07	3.03E-06	3.00E-01	1.01E-05	
						9.99E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Antimony	2.30E-03	1.57E-07	3.60E-10	4.00E-04	9.00E-07	
Barium	2.88E+02	1.57E-07	4.51E-05	5.00E-02	9.01E-04	
Cadmium (food)	1.93E+00	1.57E-07	3.02E-07	1.00E-03	3.02E-04	
Copper	1.04E+01	1.57E-07	1.63E-06	3.70E-02	4.40E-05	
Fluoranthene	1.50E-01	1.57E-07	2.35E-08	4.00E-02	5.87E-07	
Pentachlorophenol	4.50E-02	1.57E-07	7.05E-09	3.00E-02	2.35E-07	
Pyrene	1.90E-01	1.57E-07	2.97E-08	3.00E-02	9.92E-07	
Silver	1.34E+00	1.57E-07	2.10E-07	5.00E-03	4.20E-05	
Toluene	4.30E-03	1.57E-07	6.73E-10	2.00E-01	3.37E-09	
Xylenes, mixed	2.92E-03	1.57E-07	4.57E-10	2.00E+00	2.29E-10	
Zinc	1.94E+01	1.57E-07	3.03E-06	3.00E-01	1.01E-05	
						1.30E-03

CONSTR WORKER
Inhalation of TSOIL VOCS
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	6.74E-07	7.20E-03	4.86E-09	1.10E-01	4.42E-08	
						4.42E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	6.74E-07	7.20E-03	4.85E-09	1.10E-01	4.41E-08	
						4.41E-08

CONSTR WORKER
Inhalation of TSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	6.74E-07	3.13E-02	2.11E-08	1.10E-01	1.92E-07	
						1.92E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	6.74E-07	3.13E-02	2.11E-08	1.10E-01	1.92E-07	
						1.92E-07

CONSTR WORKER
Inhalation of TSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.66E-11	1.03E-04	1.71E-15	6.10E-01	1.04E-15	
Benzo(a)pyrene	1.81E-11	1.03E-04	1.86E-15	6.10E+00	1.14E-14	
Benzo(b)fluoranthene	3.02E-11	1.03E-04	3.11E-15	6.10E-01	1.90E-15	
Cadmium (food)	4.17E-10	1.03E-04	4.29E-14	6.10E+00	2.62E-13	
Chrysene	2.59E-11	1.03E-04	2.66E-15	6.10E-02	1.63E-16	
Indeno(1,2,3-c,d)pyrene	1.19E-11	1.03E-04	1.22E-15	6.10E-01	7.47E-16	
						2.77E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	6.22E-08	7.20E-03	4.48E-10	1.40E-03	3.20E-07	
						3.20E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	6.22E-08	7.20E-03	4.48E-10	1.40E-04	3.20E-06	
						3.20E-06

CONSTR WORKER
Inhalation of TSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.66E-11	4.47E-04	7.43E-15	6.10E-01	4.53E-15	
Benzo(a)pyrene	1.81E-11	4.47E-04	8.10E-15	6.10E+00	4.94E-14	
Benzo(b)fluoranthene	3.02E-11	4.47E-04	1.35E-14	6.10E-01	8.24E-15	
Cadmium (food)	4.17E-10	4.47E-04	1.87E-13	6.10E+00	1.14E-12	
Chrysene	2.59E-11	4.47E-04	1.16E-14	6.10E-02	7.07E-16	
Indeno(1,2,3-c,d)pyrene	1.19E-11	4.47E-04	5.32E-15	6.10E-01	3.25E-15	
						1.20E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	6.22E-08	3.13E-02	1.95E-09	1.40E-03	1.39E-06	
						1.39E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	6.22E-08	3.13E-02	1.95E-09	1.40E-04	1.39E-05	
						1.39E-05

TRESPASSER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Pentachlorophenol	4.50E-03	1.20E-08	5.39E-11	1.20E-01	6.46E-12	
						6.46E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	1.40E-07	6.29E-10	3.00E-02	2.10E-08	
Toluene	9.00E-05	1.40E-07	1.26E-11	2.00E+00	6.29E-12	
Xylenes, mixed	6.00E-05	1.40E-07	8.38E-12	4.00E+00	2.10E-12	
						2.10E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	1.40E-07	6.29E-10	3.00E-02	2.10E-08	
Toluene	9.00E-05	1.40E-07	1.26E-11	2.00E-01	6.29E-11	
Xylenes, mixed	6.00E-05	1.40E-07	8.38E-12	2.00E+00	4.19E-12	
						2.10E-08

TRESPASSER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Pentachlorophenol	4.50E-03	1.27E-06	5.71E-09	1.20E-01	6.85E-10	
						6.85E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	1.48E-05	6.66E-08	3.00E-02	2.22E-06	
Toluene	1.50E-04	1.48E-05	2.22E-09	2.00E+00	1.11E-09	
Xylenes, mixed	6.00E-05	1.48E-05	8.88E-10	4.00E+00	2.22E-10	
						2.22E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Pentachlorophenol	4.50E-03	1.48E-05	6.66E-08	3.00E-02	2.22E-06	
Toluene	1.50E-04	1.48E-05	2.22E-09	2.00E-01	1.11E-08	
Xylenes, mixed	6.00E-05	1.48E-05	8.88E-10	2.00E+00	4.44E-10	
						2.23E-06

TRESPASSER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	7.55E-02	1.50E-10	1.13E-11	7.30E-01	8.25E-12	
Benzo(a)pyrene	7.30E-02	1.50E-10	1.09E-11	7.30E+00	7.97E-11	
Benzo(b)fluoranthene	1.07E-01	1.50E-10	1.60E-11	7.30E-01	1.17E-11	
Chrysene	1.08E-01	1.50E-10	1.62E-11	7.30E-02	1.18E-12	
Indeno(1,2,3-c,d)pyrene	4.65E-02	1.50E-10	6.96E-12	7.30E-01	5.08E-12	
Pentachlorophenol	4.50E-02	1.50E-10	6.73E-12	1.20E-01	8.08E-13	
						1.07E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Copper	5.83E+01	1.75E-09	1.02E-07	3.70E-02	2.75E-06	
Fluoranthene	1.25E-01	1.75E-09	2.18E-10	4.00E-01	5.46E-10	
Pentachlorophenol	4.50E-02	1.75E-09	7.86E-11	3.00E-02	2.62E-09	
Pyrene	1.73E-01	1.75E-09	3.02E-10	3.00E-01	1.01E-09	
Silver	8.00E-01	1.75E-09	1.40E-09	5.00E-03	2.79E-07	
Toluene	3.40E-03	1.75E-09	5.94E-12	2.00E+00	2.97E-12	
Xylenes, mixed	1.80E-03	1.75E-09	3.14E-12	4.00E+00	7.86E-13	
Zinc	5.20E+01	1.75E-09	9.07E-08	3.00E-01	3.02E-07	
						3.34E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Cadmium (food)	1.07E+00	1.75E-09	1.87E-09	1.00E-03	1.87E-06	
Copper	5.83E+01	1.75E-09	1.02E-07	3.70E-02	2.75E-06	
Fluoranthene	1.25E-01	1.75E-09	2.18E-10	4.00E-02	5.46E-09	
Pentachlorophenol	4.50E-02	1.75E-09	7.86E-11	3.00E-02	2.62E-09	
Pyrene	1.73E-01	1.75E-09	3.02E-10	3.00E-02	1.01E-08	
Silver	8.00E-01	1.75E-09	1.40E-09	5.00E-03	2.79E-07	
Toluene	3.40E-03	1.75E-09	5.94E-12	2.00E-01	2.97E-11	
Xylenes, mixed	1.80E-03	1.75E-09	3.14E-12	2.00E+00	1.57E-12	
Zinc	5.20E+01	1.75E-09	9.07E-08	3.00E-01	3.02E-07	
						5.22E-06

TRESPASSER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	7.70E-02	1.20E-08	9.22E-10	7.30E-01	6.73E-10	
Benzo(a)pyrene	8.40E-02	1.20E-08	1.01E-09	7.30E+00	7.34E-09	
Benzo(b)fluoranthene	1.40E-01	1.20E-08	1.68E-09	7.30E-01	1.22E-09	
Chrysene	1.20E-01	1.20E-08	1.44E-09	7.30E-02	1.05E-10	
Indeno(1,2,3-c,d)pyrene	5.50E-02	1.20E-08	6.58E-10	7.30E-01	4.81E-10	
Pentachlorophenol	4.50E-02	1.20E-08	5.39E-10	1.20E-01	6.46E-11	
						9.89E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Copper	1.58E+02	1.40E-07	2.21E-05	3.70E-02	5.96E-04	
Fluoranthene	1.50E-01	1.40E-07	2.10E-08	4.00E-01	5.24E-08	
Pentachlorophenol	4.50E-02	1.40E-07	6.29E-09	3.00E-02	2.10E-07	
Pyrene	1.90E-01	1.40E-07	2.65E-08	3.00E-01	8.85E-08	
Silver	1.00E+00	1.40E-07	1.40E-07	5.00E-03	2.79E-05	
Toluene	4.90E-03	1.40E-07	6.84E-10	2.00E+00	3.42E-10	
Xylenes, mixed	1.80E-03	1.40E-07	2.51E-10	4.00E+00	6.29E-11	
Zinc	7.70E+01	1.40E-07	1.08E-05	3.00E-01	3.58E-05	
						6.61E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Cadmium (food	1.09E+00	1.40E-07	1.52E-07	1.00E-03	1.52E-04	
Copper	1.58E+02	1.40E-07	2.21E-05	3.70E-02	5.96E-04	
Fluoranthene	1.50E-01	1.40E-07	2.10E-08	4.00E-02	5.24E-07	
Pentachlorophenol	4.50E-02	1.40E-07	6.29E-09	3.00E-02	2.10E-07	
Pyrene	1.90E-01	1.40E-07	2.65E-08	3.00E-02	8.85E-07	
Silver	1.00E+00	1.40E-07	1.40E-07	5.00E-03	2.79E-05	
Toluene	4.90E-03	1.40E-07	6.84E-10	2.00E-01	3.42E-09	
Xylenes, mixed	1.80E-03	1.40E-07	2.51E-10	2.00E+00	1.26E-10	
Zinc	7.70E+01	1.40E-07	1.08E-05	3.00E-01	3.58E-05	
						8.14E-04

TRESPASSER
Inhalation of VOCS
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	7.76E-07	3.21E-03	2.49E-09	1.10E-01	2.27E-08	
						2.27E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	7.76E-07	3.21E-03	2.49E-09	1.10E-01	2.27E-08	
						2.27E-08

TRESPASSER
Inhalation of VOCS
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	7.76E-07	5.59E-02	4.34E-08	1.10E-01	3.94E-07	
						3.94E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	7.76E-07	5.59E-02	4.34E-08	1.10E-01	3.94E-07	
						3.94E-07

TRESPASSER
Inhalation of PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.66E-11	2.75E-04	4.57E-15	6.10E-01	2.79E-15	
Benzo(a)pyrene	1.81E-11	2.75E-04	4.98E-15	6.10E+00	3.04E-14	
Benzo(b)fluoranthene	3.02E-11	2.75E-04	8.32E-15	6.10E-01	5.07E-15	
Cadmium (food)	4.10E-10	2.75E-04	1.13E-13	6.10E+00	6.89E-13	
Chrysene	2.59E-11	2.75E-04	7.13E-15	6.10E-02	4.35E-16	
Indeno(1,2,3-c,d)pyrene	1.19E-11	2.75E-04	3.28E-15	6.10E-01	2.00E-15	
						7.29E-13

TRESPASSER
Inhalation of PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.66E-11	4.79E-03	7.95E-14	6.10E-01	4.85E-14	
Benzo(a)pyrene	1.81E-11	4.79E-03	8.67E-14	6.10E+00	5.29E-13	
Benzo(b)fluoranthene	3.02E-11	4.79E-03	1.45E-13	6.10E-01	8.82E-14	
Cadmium (food)	4.10E-10	4.79E-03	1.96E-12	6.10E+00	1.20E-11	
Chrysene	2.59E-11	4.79E-03	1.24E-13	6.10E-02	7.57E-15	
Indeno(1,2,3-c,d)pyrene	1.19E-11	4.79E-03	5.70E-14	6.10E-01	3.48E-14	
						1.27E-11

OIL/WATER SEPARATOR 5144
RISK CALCULATIONS

Receptor/Pathway Summary: CANNON AFB OWS 5144

January 19, 199
15:1

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SURFACE SOIL	0.00E+00		2.67E-06	0.00E+00		4.31E-04
-- Ingestion of SURFACE SOIL	1.59E-09		8.80E-06	5.55E-07		1.91E-03
-- Inhalation of SSOIL VOCS	0.00E+00		1.63E-07	0.00E+00		2.95E-06
-- Inhalation of SSOIL PARTICS	4.09E-12		1.31E-08	2.06E-10		2.37E-07
	1.59E-09		1.17E-05	5.56E-07		2.34E-03
CONSTR WORKER						
-- Dermal Contact with TSOIL	3.65E-14	1.04E-06		5.47E-13	1.57E-05	
-- Ingestion of TSOIL	5.44E-10	4.32E-04		5.18E-09	4.48E-03	
-- Inhalation of TSOIL VOCS	0.00E+00	2.00E-06		0.00E+00	8.70E-06	
-- Inhalation of TSOIL PARTICS	2.53E-13	5.08E-07		1.10E-12	2.21E-06	
	5.45E-10	4.36E-04		5.19E-09	4.51E-03	
TRESPASSER						
-- Dermal Contact with SURFACE SOIL	0.00E+00	7.92E-07		0.00E+00	2.37E-04	
-- Ingestion of SURFACE SOIL	3.15E-10	1.53E-06		3.81E-08	2.90E-04	
-- Inhalation of SSOIL VOCS	0.00E+00	4.85E-08		0.00E+00	8.43E-07	
-- Inhalation of SSOIL PARTICS	8.11E-13	3.88E-09		1.41E-11	6.76E-08	
	3.16E-10	2.37E-06		3.81E-08	5.27E-04	

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Average Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	4.70E-07	2.25E-09	2.00E-01	1.13E-08	
Ethylbenzene	9.00E-05	4.70E-07	4.23E-11	1.00E-01	4.23E-10	
Mercury	1.70E-03	4.70E-07	7.98E-10	3.00E-04	2.66E-06	
Toluene	1.20E-04	4.70E-07	5.64E-11	2.00E-01	2.82E-10	
Xylenes, mixed	1.50E-04	4.70E-07	7.05E-11	2.00E+00	3.52E-11	
						2.67E-06

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	2.69E-05	1.29E-07	2.00E-01	6.46E-07	
Ethylbenzene	9.00E-05	2.69E-05	2.42E-09	1.00E-01	2.42E-08	
Mercury	4.80E-03	2.69E-05	1.29E-07	3.00E-04	4.31E-04	
Toluene	3.00E-04	2.69E-05	8.07E-09	2.00E-01	4.04E-08	
Xylenes, mixed	2.40E-04	2.69E-05	6.46E-09	2.00E+00	3.23E-09	
						4.31E-04

OCCUP WORKER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.84E-01	7.55E-10	1.39E-10	7.30E-01	1.01E-10	
Benzo(a)pyrene`	2.26E-01	7.55E-10	1.71E-10	7.30E+00	1.25E-09	
Benzo(b)fluoranthene	2.94E-01	7.55E-10	2.22E-10	7.30E-01	1.62E-10	
Chrysene	2.31E-01	7.55E-10	1.74E-10	7.30E-02	1.27E-11	
Indeno(1,2,3-c,d)pyrene	1.25E-01	7.55E-10	9.44E-11	7.30E-01	6.89E-11	
						1.59E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-02	5.87E-09	2.82E-10	2.00E-01	1.41E-09	
Cadmium (food)	7.30E-01	5.87E-09	4.29E-09	1.00E-03	4.29E-06	
Ethylbenzene	2.70E-03	5.87E-09	1.59E-11	1.00E-01	1.59E-10	
Fluoranthene	2.59E-01	5.87E-09	1.52E-09	4.00E-02	3.80E-08	
Fluorene	2.16E-01	5.87E-09	1.27E-09	4.00E-02	3.17E-08	
Mercury	1.70E-01	5.87E-09	9.98E-10	3.00E-04	3.33E-06	
Naphthalene	2.44E-01	5.87E-09	1.43E-09	4.00E-02	3.58E-08	
Pyrene	2.91E-01	5.87E-09	1.71E-09	3.00E-02	5.69E-08	
Selenium	3.40E-01	5.87E-09	2.00E-09	5.00E-03	3.99E-07	
Silver	5.30E-01	5.87E-09	3.11E-09	5.00E-03	6.22E-07	
Toluene	4.10E-03	5.87E-09	2.41E-11	2.00E-01	1.20E-10	
Xylenes, mixed	5.10E-03	5.87E-09	2.99E-11	2.00E+00	1.50E-11	
Zinc	3.40E-01	5.87E-09	2.00E-09	3.00E-01	6.65E-09	
						8.80E-06

OCCUP WORKER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.30E-01	1.75E-07	4.02E-08	7.30E-01	2.93E-08	
Benzo(a)pyrene	3.40E-01	1.75E-07	5.94E-08	7.30E+00	4.34E-07	
Benzo(b)fluoranthene	5.50E-01	1.75E-07	9.61E-08	7.30E-01	7.02E-08	
Chrysene	3.50E-01	1.75E-07	6.12E-08	7.30E-02	4.46E-09	
Indeno(1,2,3-c,d)pyrene	1.40E-01	1.75E-07	2.45E-08	7.30E-01	1.79E-08	
						5.55E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-02	4.89E-07	2.35E-08	2.00E-01	1.17E-07	
Cadmium (food)	1.80E+00	4.89E-07	8.81E-07	1.00E-03	8.81E-04	
Ethylbenzene	2.70E-03	4.89E-07	1.32E-09	1.00E-01	1.32E-08	
Fluoranthene	4.40E-01	4.89E-07	2.15E-07	4.00E-02	5.38E-06	
Fluorene	3.20E-01	4.89E-07	1.57E-07	4.00E-02	3.91E-06	
Mercury	4.80E-01	4.89E-07	2.35E-07	3.00E-04	7.83E-04	
Naphthalene	4.30E-01	4.89E-07	2.10E-07	4.00E-02	5.26E-06	
Pyrene	4.10E-01	4.89E-07	2.01E-07	3.00E-02	6.69E-06	
Selenium	3.40E-01	4.89E-07	1.66E-07	5.00E-03	3.33E-05	
Silver	5.40E-01	4.89E-07	2.64E-07	5.00E-03	5.28E-05	
Toluene	1.00E-02	4.89E-07	4.89E-09	2.00E-01	2.45E-08	
Xylenes, mixed	8.40E-03	4.89E-07	4.11E-09	2.00E+00	2.05E-09	
Zinc	8.48E+01	4.89E-07	4.15E-05	3.00E-01	1.38E-04	
						1.91E-03

OCCUP WORKER
Inhalation of SSOIL VOCS
Average Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	2.09E-07	1.08E-02	2.26E-09	2.90E-01	7.79E-09	
Toluene	1.58E-06	1.08E-02	1.71E-08	1.10E-01	1.55E-07	
						1.63E-07

OCCUP WORKER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	2.09E-07	1.96E-01	4.09E-08	2.90E-01	1.41E-07	
Toluene	1.58E-06	1.96E-01	3.09E-07	1.10E-01	2.81E-06	
						2.95E-06

OCCUP WORKER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	4.97E-11	1.39E-03	6.90E-14	6.10E-01	4.21E-14	
Benzo(a)pyrene`	7.34E-11	1.39E-03	1.02E-13	6.10E+00	6.22E-13	
Benzo(b)fluoranthene	1.19E-10	1.39E-03	1.65E-13	6.10E-01	1.01E-13	
Cadmium (food)	3.89E-10	1.39E-03	5.40E-13	6.10E+00	3.30E-12	
Chrysene	7.56E-11	1.39E-03	1.05E-13	6.10E-02	6.40E-15	
Indeno(1,2,3-c,d)pyrene	3.02E-11	1.39E-03	4.19E-14	6.10E-01	2.56E-14	
						4.09E-12

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.04E-10	1.08E-02	1.12E-12	8.60E-05	1.31E-08	
						1.31E-08

OCCUP WORKER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	4.97E-11	6.99E-02	3.47E-12	6.10E-01	2.12E-12	
Benzo(a)pyrene	7.34E-11	6.99E-02	5.13E-12	6.10E+00	3.13E-11	
Benzo(b)fluoranthene	1.19E-10	6.99E-02	8.32E-12	6.10E-01	5.07E-12	
Cadmium (food)	3.89E-10	6.99E-02	2.72E-11	6.10E+00	1.66E-10	
Chrysene	7.56E-11	6.99E-02	5.28E-12	6.10E-02	3.22E-13	
Indeno(1,2,3-c,d)pyrene	3.02E-11	6.99E-02	2.11E-12	6.10E-01	1.29E-12	
						2.06E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.04E-10	1.96E-01	2.04E-11	8.60E-05	2.37E-07	
						2.37E-07

CONSTR WORKER
Dermal Contact with TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	1.20E-04	4.47E-09	5.37E-13	6.80E-02	3.65E-14	
						3.65E-14

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	3.13E-07	1.50E-09	2.00E+00	7.51E-10	
Ethylbenzene	6.00E-05	3.13E-07	1.88E-11	1.00E+00	1.88E-11	
Mercury	1.00E-03	3.13E-07	3.13E-10	3.00E-04	1.04E-06	
Toluene	1.80E-04	3.13E-07	5.64E-11	2.00E+00	2.82E-11	
Xylenes, mixed	1.20E-04	3.13E-07	3.76E-11	4.00E+00	9.39E-12	
						1.04E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	3.13E-07	1.50E-09	2.00E-01	7.51E-09	
Ethylbenzene	6.00E-05	3.13E-07	1.88E-11	1.00E-01	1.88E-10	
Mercury	1.00E-03	3.13E-07	3.13E-10	3.00E-04	1.04E-06	
Toluene	1.80E-04	3.13E-07	5.64E-11	2.00E-01	2.82E-10	
Xylenes, mixed	1.20E-04	3.13E-07	3.76E-11	2.00E+00	1.88E-11	
						1.05E-06

CONSTR WORKER
Dermal Contact with TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	1.20E-04	6.71E-08	8.05E-12	6.80E-02	5.47E-13	
						5.47E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	4.70E-06	2.25E-08	2.00E+00	1.13E-08	
Ethylbenzene	9.00E-05	4.70E-06	4.23E-10	1.00E+00	4.23E-10	
Mercury	1.00E-03	4.70E-06	4.70E-09	3.00E-04	1.57E-05	
Toluene	2.10E-04	4.70E-06	9.86E-10	2.00E+00	4.93E-10	
Xylenes, mixed	1.20E-04	4.70E-06	5.64E-10	4.00E+00	1.41E-10	
						1.57E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	4.70E-06	2.25E-08	2.00E-01	1.13E-07	
Ethylbenzene	9.00E-05	4.70E-06	4.23E-10	1.00E-01	4.23E-09	
Mercury	1.00E-03	4.70E-06	4.70E-09	3.00E-04	1.57E-05	
Toluene	2.10E-04	4.70E-06	9.86E-10	2.00E-01	4.93E-09	
Xylenes, mixed	1.20E-04	4.70E-06	5.64E-10	2.00E+00	2.82E-10	
						1.58E-05

CONSTR WORKER
Ingestion of TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	3.90E-03	2.80E-10	1.09E-12	6.80E-02	7.41E-14	
Benzo(a)anthracene	1.88E-01	2.80E-10	5.26E-11	7.30E-01	3.84E-11	
Benzo(a)pyrene	2.09E-01	2.80E-10	5.84E-11	7.30E+00	4.27E-10	
Benzo(b)fluoranthene	2.43E-01	2.80E-10	6.79E-11	7.30E-01	4.96E-11	
Chrysene	2.12E-01	2.80E-10	5.93E-11	7.30E-02	4.33E-12	
Indeno(1,2,3-c,d)pyrene	1.25E-01	2.80E-10	3.49E-11	7.30E-01	2.55E-11	
						5.44E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	3.70E-02	1.96E-08	7.24E-10	3.00E+00	2.41E-10	
Antimony	6.69E+00	1.96E-08	1.31E-07	4.00E-04	3.27E-04	
Barium	3.16E+02	1.96E-08	6.19E-06	7.00E-02	8.84E-05	
Butyl Benzyl Phthalate	4.80E-02	1.96E-08	9.39E-10	2.00E+00	4.70E-10	
Ethylbenzene	1.95E-03	1.96E-08	3.82E-11	1.00E+00	3.82E-11	
Fluoranthene	2.26E-01	1.96E-08	4.42E-09	4.00E-01	1.11E-08	
Fluorene	2.04E-01	1.96E-08	3.99E-09	4.00E-01	9.98E-09	
Mercury	1.00E-01	1.96E-08	1.96E-09	3.00E-04	6.52E-06	
Naphthalene	2.18E-01	1.96E-08	4.27E-09	4.00E-02	1.07E-07	
Pyrene	2.42E-01	1.96E-08	4.74E-09	3.00E-01	1.58E-08	
Selenium	2.80E-01	1.96E-08	5.48E-09	5.00E-03	1.10E-06	
Silver	1.10E+00	1.96E-08	2.15E-08	5.00E-03	4.31E-06	
Thallium	1.40E-01	1.96E-08	2.74E-09	9.00E-04	3.04E-06	
Toluene	5.73E-03	1.96E-08	1.12E-10	2.00E+00	5.61E-11	
Xylenes, mixed	3.49E-03	1.96E-08	6.83E-11	4.00E+00	1.71E-11	
Zinc	1.95E+01	1.96E-08	3.82E-07	3.00E-01	1.27E-06	
						4.32E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	3.70E-02	1.96E-08	7.24E-10	3.00E-01	2.41E-09	
Antimony	6.69E+00	1.96E-08	1.31E-07	4.00E-04	3.27E-04	
Barium	3.16E-01	1.96E-08	6.18E-09	7.00E-02	8.83E-08	
Butyl Benzyl Phthalate	4.80E-02	1.96E-08	9.39E-10	2.00E-01	4.70E-09	
Cadmium (food	1.00E+00	1.96E-08	1.96E-08	1.00E-03	1.96E-05	
Ethylbenzene	1.95E-03	1.96E-08	3.82E-11	1.00E-01	3.82E-10	
Fluoranthene	2.26E-01	1.96E-08	4.42E-09	4.00E-02	1.11E-07	

Fluorene	2.04E-01	1.96E-08	3.99E-09	4.00E-02	9.98E-08
Mercury	1.00E-01	1.96E-08	1.96E-09	3.00E-04	6.52E-06
Naphthalene	2.18E-01	1.96E-08	4.27E-09	4.00E-02	1.07E-07
Pyrene	2.42E-01	1.96E-08	4.74E-09	3.00E-02	1.58E-07
Selenium	2.80E-01	1.96E-08	5.48E-09	5.00E-03	1.10E-06
Silver	1.10E+00	1.96E-08	2.15E-08	5.00E-03	4.31E-06
Thallium	1.40E-01	1.96E-08	2.74E-09	9.00E-05	3.04E-05
Toluene	5.73E-03	1.96E-08	1.12E-10	2.00E-01	5.61E-10
Xylenes, mixed	3.49E-03	1.96E-08	6.83E-11	2.00E+00	3.41E-11
Zinc	1.95E+01	1.96E-08	3.82E-07	3.00E-01	1.27E-06
					3.91E-04

CONSTR WORKER
Ingestion of TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	4.20E-03	2.24E-09	9.39E-12	6.80E-02	6.39E-13	
Benzo(a)anthracene	2.23E-01	2.24E-09	4.99E-10	7.30E-01	3.64E-10	
Benzo(a)pyrene	2.46E-01	2.24E-09	5.50E-10	7.30E+00	4.02E-09	
Benzo(b)fluoranthene	3.27E-01	2.24E-09	7.31E-10	7.30E-01	5.34E-10	
Chrysene	2.50E-01	2.24E-09	5.59E-10	7.30E-02	4.08E-11	
Indeno(1,2,3-c,d)pyrene	1.40E-01	2.24E-09	3.13E-10	7.30E-01	2.29E-10	
						5.18E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	3.70E-02	1.57E-07	5.79E-09	3.00E+00	1.93E-09	
Antimony	8.46E+00	1.57E-07	1.32E-06	4.00E-04	3.31E-03	
Barium	4.55E+02	1.57E-07	7.12E-05	7.00E-02	1.02E-03	
Butyl Benzyl Phthalate	4.80E-02	1.57E-07	7.51E-09	2.00E+00	3.76E-09	
Ethylbenzene	2.70E-03	1.57E-07	4.23E-10	1.00E+00	4.23E-10	
Fluoranthene	2.82E-01	1.57E-07	4.41E-08	4.00E-01	1.10E-07	
Fluorene	2.36E-01	1.57E-07	3.69E-08	4.00E-01	9.24E-08	
Mercury	1.20E-01	1.57E-07	1.88E-08	3.00E-04	6.26E-05	
Naphthalene	2.75E-01	1.57E-07	4.31E-08	4.00E-02	1.08E-06	
Pyrene	3.13E-01	1.57E-07	4.90E-08	3.00E-01	1.63E-07	
Selenium	3.10E-01	1.57E-07	4.85E-08	5.00E-03	9.71E-06	
Silver	1.41E+00	1.57E-07	2.21E-07	5.00E-03	4.41E-05	
Thallium	1.40E-01	1.57E-07	2.19E-08	9.00E-04	2.44E-05	
Toluene	7.43E-03	1.57E-07	1.16E-09	2.00E+00	5.82E-10	
Xylenes, mixed	3.88E-03	1.57E-07	6.07E-10	4.00E+00	1.52E-10	
Zinc	2.49E+01	1.57E-07	3.90E-06	3.00E-01	1.30E-05	
						4.48E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Anthracene	3.70E-02	1.57E-07	5.79E-09	3.00E-01	1.93E-08	
Antimony	8.46E+00	1.57E-07	1.32E-06	4.00E-04	3.31E-03	
Barium	4.55E-01	1.57E-07	7.12E-08	7.00E-02	1.02E-06	
Butyl Benzyl Phthalate	4.80E-02	1.57E-07	7.51E-09	2.00E-01	3.76E-08	
Cadmium (food	1.55E+00	1.57E-07	2.43E-07	1.00E-03	2.43E-04	
Ethylbenzene	2.70E-03	1.57E-07	4.23E-10	1.00E-01	4.23E-09	
Fluoranthene	2.82E-01	1.57E-07	4.41E-08	4.00E-02	1.10E-06	

Fluorene	2.36E-01	1.57E-07	3.69E-08	4.00E-02	9.24E-07	
Mercury	1.20E-01	1.57E-07	1.88E-08	3.00E-04	6.26E-05	
Naphthalene	2.75E-01	1.57E-07	4.31E-08	4.00E-02	1.08E-06	
Pyrene	3.13E-01	1.57E-07	4.90E-08	3.00E-02	1.63E-06	
Selenium	3.10E-01	1.57E-07	4.85E-08	5.00E-03	9.71E-06	
Silver	1.41E+00	1.57E-07	2.21E-07	5.00E-03	4.41E-05	
Thallium	1.40E-01	1.57E-07	2.19E-08	9.00E-05	2.44E-04	
Toluene	7.43E-03	1.57E-07	1.16E-09	2.00E-01	5.82E-09	
Xylenes, mixed	3.88E-03	1.57E-07	6.07E-10	2.00E+00	3.04E-10	
Zinc	2.49E+01	1.57E-07	3.90E-06	3.00E-01	1.30E-05	
						3.93E-03

CONSTR WORKER
Inhalation of TSOIL VOCS
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	9.86E-07	7.20E-03	7.10E-09	3.70E-03	1.92E-06	
Ethylbenzene	2.09E-07	7.20E-03	1.51E-09	2.90E-01	5.19E-09	
Toluene	1.17E-06	7.20E-03	8.43E-09	1.10E-01	7.67E-08	
						2.00E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	9.86E-07	7.20E-03	7.10E-09	1.10E-03	6.46E-06	
Ethylbenzene	2.09E-07	7.20E-03	1.51E-09	2.90E-01	5.19E-09	
Toluene	1.17E-06	7.20E-03	8.43E-09	1.10E-01	7.67E-08	
						6.54E-06

CONSTR WORKER
Inhalation of TSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	9.86E-07	3.13E-02	3.09E-08	3.70E-03	8.34E-06	
Ethylbenzene	2.09E-07	3.13E-02	6.54E-09	2.90E-01	2.26E-08	
Toluene	1.17E-06	3.13E-02	3.67E-08	1.10E-01	3.33E-07	
						8.70E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	9.86E-07	3.13E-02	3.09E-08	1.10E-03	2.81E-05	
Ethylbenzene	2.09E-07	3.13E-02	6.54E-09	2.90E-01	2.26E-08	
Toluene	1.17E-06	3.13E-02	3.67E-08	1.10E-01	3.33E-07	
						2.84E-05

CONSTR WORKER
Inhalation of TSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	4.82E-11	1.03E-04	4.96E-15	6.10E-01	3.02E-15	
Benzo(a)pyrene	5.31E-11	1.03E-04	5.46E-15	6.10E+00	3.33E-14	
Benzo(b)fluoranthene	7.06E-11	1.03E-04	7.26E-15	6.10E-01	4.43E-15	
Cadmium (food)	3.35E-10	1.03E-04	3.45E-14	6.10E+00	2.10E-13	
Chrysene	5.40E-11	1.03E-04	5.56E-15	6.10E-02	3.39E-16	
Indeno(1,2,3-c,d)pyrene	3.02E-11	1.03E-04	3.11E-15	6.10E-01	1.90E-15	
						2.53E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	9.83E-08	7.20E-03	7.08E-10	1.40E-03	5.06E-07	
Mercury	2.59E-11	7.20E-03	1.87E-13	8.60E-05	2.17E-09	
						5.08E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	9.83E-08	7.20E-03	7.08E-10	1.40E-04	5.06E-06	
Mercury	2.59E-11	7.20E-03	1.87E-13	8.60E-05	2.17E-09	
						5.06E-06

CONSTR WORKER
Inhalation of TSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	4.82E-11	4.47E-04	2.16E-14	6.10E-01	1.32E-14	
Benzo(a)pyrene	5.31E-11	4.47E-04	2.38E-14	6.10E+00	1.45E-13	
Benzo(b)fluoranthene	7.06E-11	4.47E-04	3.16E-14	6.10E-01	1.93E-14	
Cadmium (food)	3.35E-10	4.47E-04	1.50E-13	6.10E+00	9.14E-13	
Chrysene	5.40E-11	4.47E-04	2.42E-14	6.10E-02	1.47E-15	
Indeno(1,2,3-c,d)pyrene	3.02E-11	4.47E-04	1.35E-14	6.10E-01	8.24E-15	
						1.10E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	9.83E-08	3.13E-02	3.08E-09	1.40E-03	2.20E-06	
Mercury	2.59E-11	3.13E-02	8.11E-13	8.60E-05	9.43E-09	
						2.21E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	9.83E-08	3.13E-02	3.08E-09	1.40E-04	2.20E-05	
Mercury	2.59E-11	3.13E-02	8.11E-13	8.60E-05	9.43E-09	
						2.20E-05

TRESPASSER
Dermal Contact with SURFACE SOIL
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	1.40E-07	6.70E-10	2.00E+00	3.35E-10	
Ethylbenzene	9.00E-05	1.40E-07	1.26E-11	1.00E+00	1.26E-11	
Mercury	1.70E-03	1.40E-07	2.37E-10	3.00E-04	7.91E-07	
Toluene	1.20E-04	1.40E-07	1.68E-11	2.00E+00	8.38E-12	
Xylenes, mixed	1.50E-04	1.40E-07	2.10E-11	4.00E+00	5.24E-12	
						7.92E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	1.40E-07	6.70E-10	2.00E-01	3.35E-09	
Ethylbenzene	9.00E-05	1.40E-07	1.26E-11	1.00E-01	1.26E-10	
Mercury	1.70E-03	1.40E-07	2.37E-10	3.00E-04	7.91E-07	
Toluene	1.20E-04	1.40E-07	1.68E-11	2.00E-01	8.38E-11	
Xylenes, mixed	1.50E-04	1.40E-07	2.10E-11	2.00E+00	1.05E-11	
						7.95E-07

TRESPASSER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	1.48E-05	7.11E-08	2.00E+00	3.55E-08	
Ethylbenzene	9.00E-05	1.48E-05	1.33E-09	1.00E+00	1.33E-09	
Mercury	4.80E-03	1.48E-05	7.11E-08	3.00E-04	2.37E-04	
Toluene	3.00E-04	1.48E-05	4.44E-09	2.00E+00	2.22E-09	
Xylenes, mixed	2.40E-04	1.48E-05	3.55E-09	4.00E+00	8.88E-10	
						2.37E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-03	1.48E-05	7.11E-08	2.00E-01	3.55E-07	
Ethylbenzene	9.00E-05	1.48E-05	1.33E-09	1.00E-01	1.33E-08	
Mercury	4.80E-03	1.48E-05	7.11E-08	3.00E-04	2.37E-04	
Toluene	3.00E-04	1.48E-05	4.44E-09	2.00E-01	2.22E-08	
Xylenes, mixed	2.40E-04	1.48E-05	3.55E-09	2.00E+00	1.78E-09	
						2.37E-04

TRESPASSER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.84E-01	1.50E-10	2.75E-11	7.30E-01	2.01E-11	
Benzo(a)pyrene	2.26E-01	1.50E-10	3.38E-11	7.30E+00	2.47E-10	
Benzo(b)fluoranthene	2.94E-01	1.50E-10	4.40E-11	7.30E-01	3.21E-11	
Chrysene	2.31E-01	1.50E-10	3.46E-11	7.30E-02	2.52E-12	
Indeno(1,2,3-c,d)pyrene	1.25E-01	1.50E-10	1.87E-11	7.30E-01	1.37E-11	
						3.15E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-02	1.75E-09	8.38E-11	2.00E+00	4.19E-11	
Ethylbenzene	2.70E-03	1.75E-09	4.71E-12	1.00E+00	4.71E-12	
Fluoranthene	2.59E-01	1.75E-09	4.52E-10	4.00E-01	1.13E-09	
Fluorene	2.16E-01	1.75E-09	3.77E-10	4.00E-01	9.43E-10	
Mercury	1.70E-01	1.75E-09	2.97E-10	3.00E-04	9.89E-07	
Naphthalene	2.44E-01	1.75E-09	4.26E-10	4.00E-02	1.07E-08	
Pyrene	2.91E-01	1.75E-09	5.08E-10	3.00E-01	1.69E-09	
Selenium	3.40E-01	1.75E-09	5.94E-10	5.00E-03	1.19E-07	
Silver	5.30E-01	1.75E-09	9.25E-10	5.00E-03	1.85E-07	
Toluene	4.10E-03	1.75E-09	7.16E-12	2.00E+00	3.58E-12	
Xylenes, mixed	5.10E-03	1.75E-09	8.90E-12	4.00E+00	2.23E-12	
Zinc	3.80E+01	1.75E-09	6.64E-08	3.00E-01	2.21E-07	
						1.53E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-02	1.75E-09	8.38E-11	2.00E-01	4.19E-10	
Cadmium (food	7.30E-01	1.75E-09	1.27E-09	1.00E-03	1.27E-06	
Ethylbenzene	2.70E-03	1.75E-09	4.71E-12	1.00E-01	4.71E-11	
Fluoranthene	2.59E-01	1.75E-09	4.52E-10	4.00E-02	1.13E-08	
Fluorene	2.16E-01	1.75E-09	3.77E-10	4.00E-02	9.43E-09	
Mercury	1.70E-01	1.75E-09	2.97E-10	3.00E-04	9.89E-07	
Naphthalene	2.44E-01	1.75E-09	4.26E-10	4.00E-02	1.07E-08	
Pyrene	2.91E-01	1.75E-09	5.08E-10	3.00E-02	1.69E-08	
Selenium	3.40E-01	1.75E-09	5.94E-10	5.00E-03	1.19E-07	
Silver	5.30E-01	1.75E-09	9.25E-10	5.00E-03	1.85E-07	
Toluene	4.10E-03	1.75E-09	7.16E-12	2.00E-01	3.58E-11	
Xylenes, mixed	5.10E-03	1.75E-09	8.90E-12	2.00E+00	4.45E-12	

Zinc	3.40E-01	1.75E-09	5.94E-10	3.00E-01	1.98E-09	2.62E-06

TRESPASSER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	2.30E-01	1.20E-08	2.75E-09	7.30E-01	2.01E-09	
Benzo(a)pyrene	3.40E-01	1.20E-08	4.07E-09	7.30E+00	2.97E-08	
Benzo(b)fluoranthene	5.50E-01	1.20E-08	6.58E-09	7.30E-01	4.81E-09	
Chrysene	3.50E-01	1.20E-08	4.19E-09	7.30E-02	3.06E-10	
Indeno(1,2,3-c,d)pyrene	1.40E-01	1.20E-08	1.68E-09	7.30E-01	1.22E-09	
						3.81E-08

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-02	1.40E-07	6.70E-09	2.00E+00	3.35E-09	
Ethylbenzene	2.70E-03	1.40E-07	3.77E-10	1.00E+00	3.77E-10	
Fluoranthene	4.40E-01	1.40E-07	6.15E-08	4.00E-01	1.54E-07	
Fluorene	3.20E-01	1.40E-07	4.47E-08	4.00E-01	1.12E-07	
Mercury	4.80E-01	1.40E-07	6.70E-08	3.00E-04	2.23E-04	
Naphthalene	4.30E-01	1.40E-07	6.01E-08	4.00E-02	1.50E-06	
Pyrene	4.10E-01	1.40E-07	5.73E-08	3.00E-01	1.91E-07	
Selenium	3.40E-01	1.40E-07	4.75E-08	5.00E-03	9.50E-06	
Silver	5.40E-01	1.40E-07	7.54E-08	5.00E-03	1.51E-05	
Toluene	1.00E-02	1.40E-07	1.40E-09	2.00E+00	6.98E-10	
Xylenes, mixed	8.40E-03	1.40E-07	1.17E-09	4.00E+00	2.93E-10	
Zinc	8.48E+01	1.40E-07	1.18E-05	3.00E-01	3.95E-05	
						2.90E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	4.80E-02	1.40E-07	6.70E-09	2.00E-01	3.35E-08	
Cadmium (food	1.80E+00	1.40E-07	2.51E-07	1.00E-03	2.51E-04	
Ethylbenzene	2.70E-03	1.40E-07	3.77E-10	1.00E-01	3.77E-09	
Fluoranthene	4.40E-01	1.40E-07	6.15E-08	4.00E-02	1.54E-06	
Fluorene	3.20E-01	1.40E-07	4.47E-08	4.00E-02	1.12E-06	
Mercury	4.80E-01	1.40E-07	6.70E-08	3.00E-04	2.23E-04	
Naphthalene	4.30E-01	1.40E-07	6.01E-08	4.00E-02	1.50E-06	
Pyrene	4.10E-01	1.40E-07	5.73E-08	3.00E-02	1.91E-06	
Selenium	3.40E-01	1.40E-07	4.75E-08	5.00E-03	9.50E-06	
Silver	5.40E-01	1.40E-07	7.54E-08	5.00E-03	1.51E-05	
Toluene	1.00E-02	1.40E-07	1.40E-09	2.00E-01	6.98E-09	
Xylenes, mixed	8.40E-03	1.40E-07	1.17E-09	2.00E+00	5.87E-10	

Zinc	8.48E+01	1.40E-07	1.18E-05	3.00E-01	3.95E-05	5.45E-04

TRESPASSER
Inhalation of SSOIL VOCS
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	2.09E-07	3.21E-03	6.71E-10	2.90E-01	2.32E-09	
Toluene	1.58E-06	3.21E-03	5.08E-09	1.10E-01	4.61E-08	
						4.85E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	2.09E-07	3.21E-03	6.71E-10	2.90E-01	2.32E-09	
Toluene	1.58E-06	3.21E-03	5.08E-09	1.10E-01	4.61E-08	
						4.85E-08

TRESPASSER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	2.09E-07	5.59E-02	1.17E-08	2.90E-01	4.03E-08	
Toluene	1.58E-06	5.59E-02	8.83E-08	1.10E-01	8.02E-07	
						8.43E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Ethylbenzene	2.09E-07	5.59E-02	1.17E-08	2.90E-01	4.03E-08	
Toluene	1.58E-06	5.59E-02	8.83E-08	1.10E-01	8.02E-07	
						8.43E-07

TRESPASSER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	4.97E-11	2.75E-04	1.37E-14	6.10E-01	8.35E-15	
Benzo(a)pyrene	7.34E-11	2.75E-04	2.02E-14	6.10E+00	1.23E-13	
Benzo(b)fluoranthene	1.19E-10	2.75E-04	3.28E-14	6.10E-01	2.00E-14	
Cadmium (food)	3.89E-10	2.75E-04	1.07E-13	6.10E+00	6.53E-13	
Chrysene	7.56E-11	2.75E-04	2.08E-14	6.10E-02	1.27E-15	
Indeno(1,2,3-c,d)pyrene	3.02E-11	2.75E-04	8.32E-15	6.10E-01	5.07E-15	
						8.11E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.04E-10	3.21E-03	3.34E-13	8.60E-05	3.88E-09	
						3.88E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.04E-10	3.21E-03	3.34E-13	8.60E-05	3.88E-09	
						3.88E-09

TRESPASSER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	4.97E-11	4.79E-03	2.38E-13	6.10E-01	1.45E-13	
Benzo(a)pyrene	7.34E-11	4.79E-03	3.51E-13	6.10E+00	2.14E-12	
Benzo(b)fluoranthene	1.19E-10	4.79E-03	5.70E-13	6.10E-01	3.48E-13	
Cadmium (food)	3.89E-10	4.79E-03	1.86E-12	6.10E+00	1.14E-11	
Chrysene	7.56E-11	4.79E-03	3.62E-13	6.10E-02	2.21E-14	
Indeno(1,2,3-c,d)pyrene	3.02E-11	4.79E-03	1.45E-13	6.10E-01	8.82E-14	
						1.41E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.04E-10	5.59E-02	5.81E-12	8.60E-05	6.76E-08	
						6.76E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.04E-10	5.59E-02	5.81E-12	8.60E-05	6.76E-08	
						6.76E-08

OIL/WATER SEPARATOR 4095
RISK CALCULATIONS

Receptor/Pathway Summary: CANNON AFB OWS 4095

January 19, 1994
15:1

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SURFACE SOIL	4.75E-11		9.40E-07	2.89E-08		7.18E-05
-- Ingestion of SURFACE SOIL	9.66E-09		6.35E-05	1.50E-05		7.24E-03
-- Inhalation of SSOIL VOCS	1.09E-10		8.30E-06	5.50E-09		1.50E-04
-- Inhalation of SSOIL PARTICS	2.28E-11		2.17E-09	1.15E-09		3.94E-08
	9.84E-09		7.27E-05	1.50E-05		7.47E-03
CONSTR WORKER						
-- Dermal Contact with TSOIL	2.62E-12	6.28E-07		5.68E-11	9.42E-06	
-- Ingestion of TSOIL	2.04E-09	3.10E-04		1.87E-08	2.76E-03	
-- Inhalation of TSOIL VOCS	0.00E+00	1.75E-06		0.00E+00	7.62E-06	
-- Inhalation of TSOIL PARTICS	2.82E-13	2.17E-07		1.23E-12	9.42E-07	
	2.04E-09	3.12E-04		1.87E-08	2.77E-03	
TRESPASSER						
-- Dermal Contact with SURFACE SOIL	9.41E-12	2.79E-07		3.82E-09	3.95E-05	
-- Ingestion of SURFACE SOIL	1.91E-09	1.79E-05		1.03E-06	1.84E-03	
-- Inhalation of SSOIL VOCS	2.17E-11	7.76E-07		3.77E-10	1.35E-05	
-- Inhalation of SSOIL PARTICS	4.52E-12	6.46E-10		7.86E-11	1.12E-08	
	1.95E-09	1.89E-05		1.03E-06	1.90E-03	

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	9.50E-07	6.04E-08	5.74E-14	9.10E-02	5.22E-15	
1,2 Dichloropropane	8.40E-05	6.04E-08	5.07E-12	6.80E-02	3.45E-13	
Carbazole	3.90E-02	6.04E-08	2.36E-09	2.00E-02	4.71E-11	
						4.75E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	6.00E-04	4.70E-07	2.82E-10	3.00E-04	9.39E-07	
Toluene	1.80E-04	4.70E-07	8.45E-11	2.00E-01	4.23E-10	
Xylenes, mixed	1.20E-04	4.70E-07	5.64E-11	2.00E+00	2.82E-11	
						9.40E-07

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	9.50E-07	9.61E-06	9.13E-12	9.10E-02	8.31E-13	
1,2 Dichloropropane	1.20E-04	9.61E-06	1.15E-09	6.80E-02	7.84E-11	
Carbazole	1.50E-01	9.61E-06	1.44E-06	2.00E-02	2.88E-08	
						2.89E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	8.00E-04	2.69E-05	2.15E-08	3.00E-04	7.18E-05	
Toluene	3.90E-04	2.69E-05	1.05E-08	2.00E-01	5.25E-08	
Xylenes, mixed	2.40E-04	2.69E-05	6.46E-09	2.00E+00	3.23E-09	
						7.18E-05

OCCUP WORKER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.90E-03	7.55E-10	1.43E-12	9.10E-02	1.31E-13	
1,2 Dichloropropane	2.84E-03	7.55E-10	2.14E-12	6.80E-02	1.46E-13	
Benzo(a)anthracene	1.18E+00	7.55E-10	8.94E-10	7.30E-01	6.52E-10	
Benzo(a)pyrene	1.28E+00	7.55E-10	9.66E-10	7.30E+00	7.05E-09	
Benzo(b)fluoranthene	2.47E+00	7.55E-10	1.86E-09	7.30E-01	1.36E-09	
Carbazole	3.95E-01	7.55E-10	2.98E-10	2.00E-02	5.96E-12	
Chrysene	2.01E+00	7.55E-10	1.52E-09	7.30E-02	1.11E-10	
Indeno(1,2,3-c,d)pyrene	8.61E-01	7.55E-10	6.50E-10	7.30E-01	4.74E-10	
						9.66E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	5.87E-09	8.81E-10	6.00E-02	1.47E-08	
Anthracene	4.80E-02	5.87E-09	2.82E-10	3.00E-01	9.39E-10	
Antimony	3.86E+00	5.87E-09	2.27E-08	4.00E-04	5.67E-05	
Cadmium (food)	4.30E-01	5.87E-09	2.52E-09	1.00E-03	2.52E-06	
Copper	9.76E+00	5.87E-09	5.73E-08	3.70E-02	1.55E-06	
Fluoranthene	2.58E+00	5.87E-09	1.51E-08	4.00E-02	3.79E-07	
Fluorene	2.59E-01	5.87E-09	1.52E-09	4.00E-02	3.80E-08	
Mercury	6.00E-02	5.87E-09	3.52E-10	3.00E-04	1.17E-06	
Pyrene	2.55E+00	5.87E-09	1.50E-08	3.00E-02	4.99E-07	
Silver	5.50E-01	5.87E-09	3.23E-09	5.00E-03	6.46E-07	
Toluene	6.06E-03	5.87E-09	3.56E-11	2.00E-01	1.78E-10	
Xylenes, mixed	4.23E-03	5.87E-09	2.48E-11	2.00E+00	1.24E-11	
						6.35E-05

OCCUP WORKER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.90E-03	1.75E-07	3.32E-10	9.10E-02	3.02E-11	
1,2 Dichloropropane	3.39E-03	1.75E-07	5.92E-10	6.80E-02	4.03E-11	
Benzo(a)anthracene	8.00E+00	1.75E-07	1.40E-06	7.30E-01	1.02E-06	
Benzo(a)pyrene	8.60E+00	1.75E-07	1.50E-06	7.30E+00	1.10E-05	
Benzo(b)fluoranthene	1.70E+01	1.75E-07	2.97E-06	7.30E-01	2.17E-06	
Carbazole	1.50E+00	1.75E-07	2.62E-07	2.00E-02	5.24E-09	
Chrysene	1.40E+01	1.75E-07	2.45E-06	7.30E-02	1.79E-07	
Indeno(1,2,3-c,d)pyrene	5.10E+00	1.75E-07	8.91E-07	7.30E-01	6.51E-07	
						1.50E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	4.89E-07	7.34E-08	6.00E-02	1.22E-06	
Anthracene	4.80E-02	4.89E-07	2.35E-08	3.00E-01	7.83E-08	
Antimony	4.93E+00	4.89E-07	2.41E-06	4.00E-04	6.03E-03	
Cadmium (food	7.00E-01	4.89E-07	3.42E-07	1.00E-03	3.42E-04	
Copper	1.44E+01	4.89E-07	7.07E-06	3.70E-02	1.91E-04	
Fluoranthene	1.70E+01	4.89E-07	8.32E-06	4.00E-02	2.08E-04	
Fluorene	2.90E-01	4.89E-07	1.42E-07	4.00E-02	3.55E-06	
Mercury	8.00E-02	4.89E-07	3.91E-08	3.00E-04	1.30E-04	
Pyrene	1.70E+01	4.89E-07	8.32E-06	3.00E-02	2.77E-04	
Silver	6.20E-01	4.89E-07	3.03E-07	5.00E-03	6.07E-05	
Toluene	1.33E-02	4.89E-07	6.49E-09	2.00E-01	3.24E-08	
Xylenes, mixed	7.89E-03	4.89E-07	3.86E-09	2.00E+00	1.93E-09	
						7.24E-03

OCCUP WORKER
Inhalation of SSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	8.64E-07	1.39E-03	1.20E-09	9.10E-02	1.09E-10	
						1.09E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.24E-07	1.08E-02	8.91E-09	1.10E-03	8.10E-06	
Toluene	2.06E-06	1.08E-02	2.23E-08	1.10E-01	2.02E-07	
						8.30E-06

OCCUP WORKER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	8.64E-07	6.99E-02	6.04E-08	9.10E-02	5.50E-09	
						5.50E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.24E-07	1.96E-01	1.61E-07	1.10E-03	1.47E-04	
Toluene	2.06E-06	1.96E-01	4.03E-07	1.10E-01	3.66E-06	
						1.50E-04

OCCUP WORKER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.73E-09	1.39E-03	2.40E-12	6.10E-01	1.47E-12	
Benzo(a)pyrene	1.86E-09	1.39E-03	2.58E-12	6.10E+00	1.58E-11	
Benzo(b)fluoranthene	3.67E-09	1.39E-03	5.10E-12	6.10E-01	3.11E-12	
Cadmium (food)	1.51E-10	1.39E-03	2.10E-13	6.10E+00	1.28E-12	
Chrysene	3.02E-09	1.39E-03	4.19E-12	6.10E-02	2.56E-13	
Indeno(1,2,3-c,d)pyrene	1.10E-09	1.39E-03	1.53E-12	6.10E-01	9.32E-13	
						2.28E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.73E-11	1.08E-02	1.87E-13	8.60E-05	2.17E-09	
						2.17E-09

OCCUP WORKER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.73E-09	6.99E-02	1.21E-10	6.10E-01	7.38E-11	
Benzo(a)pyrene	1.86E-09	6.99E-02	1.30E-10	6.10E+00	7.93E-10	
Benzo(b)fluoranthene	3.67E-09	6.99E-02	2.56E-10	6.10E-01	1.56E-10	
Cadmium (food)	1.51E-10	6.99E-02	1.06E-11	6.10E+00	6.44E-11	
Chrysene	3.02E-09	6.99E-02	2.11E-10	6.10E-02	1.29E-11	
Indeno(1,2,3-c,d)pyrene	1.10E-09	6.99E-02	7.69E-11	6.10E-01	4.69E-11	
						1.15E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.73E-11	1.96E-01	3.39E-12	8.60E-05	3.94E-08	
						3.94E-08

CONSTR WORKER
Dermal Contact with TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	9.00E-05	4.47E-09	4.03E-13	6.80E-02	2.74E-14	
Carbazole	2.90E-02	4.47E-09	1.30E-10	2.00E-02	2.59E-12	
						2.62E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.10E-02	3.13E-07	3.44E-09	2.00E+00	1.72E-09	
Mercury	6.00E-04	3.13E-07	1.88E-10	3.00E-04	6.26E-07	
Toluene	1.00E-04	3.13E-07	3.13E-11	2.00E+00	1.57E-11	
Xylenes, mixed	9.00E-05	3.13E-07	2.82E-11	4.00E+00	7.05E-12	
						6.28E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.10E-02	3.13E-07	3.44E-09	2.00E-01	1.72E-08	
Mercury	6.00E-04	3.13E-07	1.88E-10	3.00E-04	6.26E-07	
Toluene	1.00E-04	3.13E-07	3.13E-11	2.00E-01	1.57E-10	
Xylenes, mixed	9.00E-05	3.13E-07	2.82E-11	2.00E+00	1.41E-11	
						6.44E-07

CONSTR WORKER
Dermal Contact with TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	9.60E-05	6.71E-08	6.44E-12	6.80E-02	4.38E-13	
Carbazole	4.20E-02	6.71E-08	2.82E-09	2.00E-02	5.64E-11	
						5.68E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.10E-02	4.70E-06	5.17E-08	2.00E+00	2.58E-08	
Mercury	6.00E-04	4.70E-06	2.82E-09	3.00E-04	9.39E-06	
Toluene	1.20E-04	4.70E-06	5.64E-10	2.00E+00	2.82E-10	
Xylenes, mixed	9.00E-05	4.70E-06	4.23E-10	4.00E+00	1.06E-10	
						9.42E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Butyl Benzyl Phthalate	1.10E-02	4.70E-06	5.17E-08	2.00E-01	2.58E-07	
Mercury	6.00E-04	4.70E-06	2.82E-09	3.00E-04	9.39E-06	
Toluene	1.20E-04	4.70E-06	5.64E-10	2.00E-01	2.82E-09	
Xylenes, mixed	9.00E-05	4.70E-06	4.23E-10	2.00E+00	2.11E-10	
						9.65E-06

CONSTR WORKER
Ingestion of TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	3.10E-03	2.80E-10	8.67E-13	6.80E-02	5.89E-14	
Benzo(a)anthracene	6.85E-01	2.80E-10	1.92E-10	7.30E-01	1.40E-10	
Benzo(a)pyrene	7.33E-01	2.80E-10	2.05E-10	7.30E+00	1.50E-09	
Benzo(b)fluoranthene	1.33E+00	2.80E-10	3.72E-10	7.30E-01	2.71E-10	
Carbazole	2.90E-01	2.80E-10	8.11E-11	2.00E-02	1.62E-12	
Chrysene	1.10E+00	2.80E-10	3.08E-10	7.30E-02	2.24E-11	
Indeno(1,2,3-c,d)pyrene	5.24E-01	2.80E-10	1.46E-10	7.30E-01	1.07E-10	
						2.04E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	1.96E-08	2.94E-09	6.00E-01	4.89E-09	
Anthracene	4.80E-02	1.96E-08	9.39E-10	3.00E+00	3.13E-10	
Antimony	5.18E+00	1.96E-08	1.01E-07	4.00E-04	2.53E-04	
Barium	1.55E+02	1.96E-08	3.03E-06	7.00E-02	4.33E-05	
Butyl Benzyl Phthalate	1.10E-01	1.96E-08	2.15E-09	2.00E+00	1.08E-09	
Copper	4.92E+00	1.96E-08	9.63E-08	3.70E-02	2.60E-06	
Fluoranthene	1.38E+00	1.96E-08	2.70E-08	4.00E-01	6.75E-08	
Fluorene	2.21E-01	1.96E-08	4.32E-09	4.00E-01	1.08E-08	
Mercury	6.00E-02	1.96E-08	1.17E-09	3.00E-04	3.91E-06	
Pyrene	1.44E+00	1.96E-08	2.82E-08	3.00E-01	9.39E-08	
Silver	8.60E-01	1.96E-08	1.68E-08	5.00E-03	3.37E-06	
Thallium	1.40E-01	1.96E-08	2.74E-09	9.00E-04	3.04E-06	
Toluene	3.71E-03	1.96E-08	7.26E-11	2.00E+00	3.63E-11	
Xylenes, mixed	2.95E-03	1.96E-08	5.77E-11	4.00E+00	1.44E-11	
						3.10E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	1.96E-08	2.94E-09	6.00E-02	4.89E-08	
Anthracene	4.80E-02	1.96E-08	9.39E-10	3.00E-01	3.13E-09	
Antimony	5.18E+00	1.96E-08	1.01E-07	4.00E-04	2.53E-04	
Barium	1.55E+02	1.96E-08	3.03E-06	7.00E-02	4.33E-05	
Butyl Benzyl Phthalate	1.10E-01	1.96E-08	2.15E-09	2.00E-01	1.08E-08	
Cadmium (food	8.00E-01	1.96E-08	1.57E-08	1.00E-03	1.57E-05	
Copper	4.92E+00	1.96E-08	9.63E-08	3.70E-02	2.60E-06	
Fluoranthene	1.38E+00	1.96E-08	2.70E-08	4.00E-02	6.75E-07	

Fluorene	2.21E-01	1.96E-08	4.32E-09	4.00E-02	1.08E-07	
Mercury	6.00E-02	1.96E-08	1.17E-09	3.00E-04	3.91E-06	
Pyrene	1.44E+00	1.96E-08	2.82E-08	3.00E-02	9.39E-07	
Silver	8.60E-01	1.96E-08	1.68E-08	5.00E-03	3.37E-06	
Thallium	1.40E-01	1.96E-08	2.74E-09	9.00E-05	3.04E-05	
Toluene	3.71E-03	1.96E-08	7.26E-11	2.00E-01	3.63E-10	
Xylenes, mixed	2.95E-03	1.96E-08	5.77E-11	2.00E+00	2.89E-11	
						3.54E-04

CONSTR WORKER
Ingestion of TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloropropane	3.23E-03	2.24E-09	7.22E-12	6.80E-02	4.91E-13	
Benzo(a)anthracene	8.17E-01	2.24E-09	1.83E-09	7.30E-01	1.33E-09	
Benzo(a)pyrene	8.16E-01	2.24E-09	1.82E-09	7.30E+00	1.33E-08	
Benzo(b)fluoranthene	1.60E+00	2.24E-09	3.58E-09	7.30E-01	2.61E-09	
Carbazole	4.22E-01	2.24E-09	9.44E-10	2.00E-02	1.89E-11	
Chrysene	1.18E+00	2.24E-09	2.64E-09	7.30E-02	1.93E-10	
Indeno(1,2,3-c,d)pyrene	7.29E-01	2.24E-09	1.63E-09	7.30E-01	1.19E-09	
						1.87E-08

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	1.57E-07	2.35E-08	6.00E-01	3.91E-08	
Anthracene	4.80E-02	1.57E-07	7.51E-09	3.00E+00	2.50E-09	
Antimony	5.65E+00	1.57E-07	8.85E-07	4.00E-04	2.21E-03	
Barium	1.94E+02	1.57E-07	3.04E-05	7.00E-02	4.34E-04	
Butyl Benzyl Phthalate	1.10E-01	1.57E-07	1.72E-08	2.00E+00	8.61E-09	
Copper	5.44E+00	1.57E-07	8.52E-07	3.70E-02	2.30E-05	
Fluoranthene	1.88E+00	1.57E-07	2.94E-07	4.00E-01	7.36E-07	
Fluorene	2.27E-01	1.57E-07	3.55E-08	4.00E-01	8.88E-08	
Mercury	6.00E-02	1.57E-07	9.39E-09	3.00E-04	3.13E-05	
Pyrene	2.07E+00	1.57E-07	3.24E-07	3.00E-01	1.08E-06	
Silver	9.40E-01	1.57E-07	1.47E-07	5.00E-03	2.94E-05	
Thallium	1.40E-01	1.57E-07	2.19E-08	9.00E-04	2.44E-05	
Toluene	3.98E-03	1.57E-07	6.23E-10	2.00E+00	3.12E-10	
Xylenes, mixed	3.07E-03	1.57E-07	4.81E-10	4.00E+00	1.20E-10	
						2.76E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	1.57E-07	2.35E-08	6.00E-02	3.91E-07	
Anthracene	4.80E-02	1.57E-07	7.51E-09	3.00E-01	2.50E-08	
Antimony	5.65E+00	1.57E-07	8.85E-07	4.00E-04	2.21E-03	
Barium	1.94E+02	1.57E-07	3.04E-05	7.00E-02	4.34E-04	
Butyl Benzyl Phthalate	1.10E-01	1.57E-07	1.72E-08	2.00E-01	8.61E-08	
Cadmium (food	9.40E-01	1.57E-07	1.47E-07	1.00E-03	1.47E-04	
Copper	5.44E+00	1.57E-07	8.52E-07	3.70E-02	2.30E-05	
Fluoranthene	1.88E+00	1.57E-07	2.94E-07	4.00E-02	7.36E-06	

Fluorene	2.27E-01	1.57E-07	3.55E-08	4.00E-02	8.88E-07
Mercury	6.00E-02	1.57E-07	9.39E-09	3.00E-04	3.13E-05
Pyrene	2.07E+00	1.57E-07	3.24E-07	3.00E-02	1.08E-05
Silver	9.40E-01	1.57E-07	1.47E-07	5.00E-03	2.94E-05
Thallium	1.40E-01	1.57E-07	2.19E-08	9.00E-05	2.44E-04
Toluene	3.98E-03	1.57E-07	6.23E-10	2.00E-01	3.12E-09
Xylenes, mixed	3.07E-03	1.57E-07	4.81E-10	2.00E+00	2.40E-10
					3.14E-03

CONSTR WORKER
Inhalation of TSOIL VOCS
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.79E-07	7.20E-03	6.33E-09	3.70E-03	1.71E-06	
Toluene	6.33E-07	7.20E-03	4.56E-09	1.10E-01	4.14E-08	
						1.75E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.79E-07	7.20E-03	6.33E-09	1.10E-03	5.75E-06	
Toluene	6.33E-07	7.20E-03	4.56E-09	1.10E-01	4.14E-08	
						5.80E-06

CONSTR WORKER
Inhalation of TSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.79E-07	3.13E-02	2.75E-08	3.70E-03	7.44E-06	
Toluene	6.33E-07	3.13E-02	1.98E-08	1.10E-01	1.80E-07	
						7.62E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.79E-07	3.13E-02	2.75E-08	1.10E-03	2.50E-05	
Toluene	6.33E-07	3.13E-02	1.98E-08	1.10E-01	1.80E-07	
						2.52E-05

CONSTR WORKER
Inhalation of TSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.76E-10	1.03E-04	1.81E-14	6.10E-01	1.10E-14	
Benzo(a)pyrene	1.76E-10	1.03E-04	1.81E-14	6.10E+00	1.10E-13	
Benzo(b)fluoranthene	3.46E-10	1.03E-04	3.56E-14	6.10E-01	2.17E-14	
Cadmium (food)	2.03E-10	1.03E-04	2.09E-14	6.10E+00	1.27E-13	
Chrysene	2.55E-10	1.03E-04	2.62E-14	6.10E-02	1.60E-15	
Indeno(1,2,3-c,d)pyrene	1.57E-10	1.03E-04	1.62E-14	6.10E-01	9.85E-15	
						2.82E-13

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	4.19E-08	7.20E-03	3.02E-10	1.40E-03	2.16E-07	
Mercury	1.30E-11	7.20E-03	9.36E-14	8.60E-05	1.09E-09	
						2.17E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	4.19E-08	7.20E-03	3.02E-10	1.40E-04	2.16E-06	
Mercury	1.30E-11	7.20E-03	9.36E-14	8.60E-05	1.09E-09	
						2.16E-06

CONSTR WORKER
Inhalation of TSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.76E-10	4.47E-04	7.87E-14	6.10E-01	4.80E-14	
Benzo(a)pyrene	1.76E-10	4.47E-04	7.87E-14	6.10E+00	4.80E-13	
Benzo(b)fluoranthene	3.46E-10	4.47E-04	1.55E-13	6.10E-01	9.44E-14	
Cadmium (food)	2.03E-10	4.47E-04	9.08E-14	6.10E+00	5.54E-13	
Chrysene	2.55E-10	4.47E-04	1.14E-13	6.10E-02	6.96E-15	
Indeno(1,2,3-c,d)pyrene	1.57E-10	4.47E-04	7.02E-14	6.10E-01	4.28E-14	
						1.23E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	4.19E-08	3.13E-02	1.31E-09	1.40E-03	9.37E-07	
Mercury	1.30E-11	3.13E-02	4.07E-13	8.60E-05	4.73E-09	
						9.42E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Barium	4.19E-08	3.13E-02	1.31E-09	1.40E-04	9.37E-06	
Mercury	1.30E-11	3.13E-02	4.07E-13	8.60E-05	4.73E-09	
						9.38E-06

TRESPASSER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	9.50E-07	1.20E-08	1.14E-14	9.10E-02	1.03E-15	
1,2 Dichloropropane	8.40E-05	1.20E-08	1.01E-12	6.80E-02	6.84E-14	
Carbazole	3.90E-02	1.20E-08	4.67E-10	2.00E-02	9.34E-12	
						9.41E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	6.00E-04	1.40E-07	8.38E-11	3.00E-04	2.79E-07	
Toluene	1.80E-04	1.40E-07	2.51E-11	2.00E+00	1.26E-11	
Xylenes, mixed	1.20E-04	1.40E-07	1.68E-11	4.00E+00	4.19E-12	
						2.79E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	6.00E-04	1.40E-07	8.38E-11	3.00E-04	2.79E-07	
Toluene	1.80E-04	1.40E-07	2.51E-11	2.00E-01	1.26E-10	
Xylenes, mixed	1.20E-04	1.40E-07	1.68E-11	2.00E+00	8.38E-12	
						2.79E-07

TRESPASSER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	9.50E-07	1.27E-06	1.21E-12	9.10E-02	1.10E-13	
1,2 Dichloropropane	1.20E-04	1.27E-06	1.52E-10	6.80E-02	1.04E-11	
Carbazole	1.50E-01	1.27E-06	1.90E-07	2.00E-02	3.81E-09	
						3.82E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	8.00E-04	1.48E-05	1.18E-08	3.00E-04	3.95E-05	
Toluene	3.90E-04	1.48E-05	5.77E-09	2.00E+00	2.89E-09	
Xylenes, mixed	2.40E-04	1.48E-05	3.55E-09	4.00E+00	8.88E-10	
						3.95E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	8.00E-04	1.48E-05	1.18E-08	3.00E-04	3.95E-05	
Toluene	3.90E-04	1.48E-05	5.77E-09	2.00E-01	2.89E-08	
Xylenes, mixed	2.40E-04	1.48E-05	3.55E-09	2.00E+00	1.78E-09	
						3.95E-05

TRESPASSER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.90E-03	1.50E-10	2.84E-13	9.10E-02	2.59E-14	
1,2 Dichloropropane	2.84E-03	1.50E-10	4.25E-13	6.80E-02	2.89E-14	
Benzo(a)anthracene	1.18E+00	1.50E-10	1.77E-10	7.30E-01	1.29E-10	
Benzo(a)pyrene	1.28E+00	1.50E-10	1.92E-10	7.30E+00	1.40E-09	
Benzo(b)fluoranthene	2.47E+00	1.50E-10	3.70E-10	7.30E-01	2.70E-10	
Carbazole	3.95E-01	1.50E-10	5.91E-11	2.00E-02	1.18E-12	
Chrysene	2.01E+00	1.50E-10	3.01E-10	7.30E-02	2.20E-11	
Indeno(1,2,3-c,d)pyrene	8.61E-01	1.50E-10	1.29E-10	7.30E-01	9.41E-11	
						1.91E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	1.75E-09	2.62E-10	6.00E-01	4.36E-10	
Anthracene	4.80E-02	1.75E-09	8.38E-11	3.00E+00	2.79E-11	
Antimony	3.86E+00	1.75E-09	6.74E-09	4.00E-04	1.68E-05	
Copper	9.76E+00	1.75E-09	1.70E-08	3.70E-02	4.61E-07	
Fluoranthene	2.58E+00	1.75E-09	4.50E-09	4.00E-01	1.13E-08	
Fluorene	2.59E-01	1.75E-09	4.52E-10	4.00E-01	1.13E-09	
Mercury	6.00E-02	1.75E-09	1.05E-10	3.00E-04	3.49E-07	
Pyrene	2.55E+00	1.75E-09	4.45E-09	3.00E-01	1.48E-08	
Silver	5.50E-01	1.75E-09	9.60E-10	5.00E-03	1.92E-07	
Toluene	6.06E-03	1.75E-09	1.06E-11	2.00E+00	5.29E-12	
Xylenes, mixed	4.23E-03	1.75E-09	7.39E-12	4.00E+00	1.85E-12	
						1.79E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	1.75E-09	2.62E-10	6.00E-02	4.36E-09	
Anthracene	4.80E-02	1.75E-09	8.38E-11	3.00E-01	2.79E-10	
Antimony	3.86E+00	1.75E-09	6.74E-09	4.00E-04	1.68E-05	
Cadmium (food	4.30E-01	1.75E-09	7.51E-10	1.00E-03	7.51E-07	
Copper	9.76E+00	1.75E-09	1.70E-08	3.70E-02	4.61E-07	
Fluoranthene	2.58E+00	1.75E-09	4.50E-09	4.00E-02	1.13E-07	
Fluorene	2.59E-01	1.75E-09	4.52E-10	4.00E-02	1.13E-08	
Mercury	6.00E-02	1.75E-09	1.05E-10	3.00E-04	3.49E-07	
Pyrene	2.55E+00	1.75E-09	4.45E-09	3.00E-02	1.48E-07	
Silver	5.50E-01	1.75E-09	9.60E-10	5.00E-03	1.92E-07	

Toluene	6.06E-03	1.75E-09	1.06E-11	2.00E-01	5.29E-11	
Xylenes, mixed	4.23E-03	1.75E-09	7.39E-12	2.00E+00	3.69E-12	
						1.89E-05

TRESPASSER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	1.90E-03	1.20E-08	2.27E-11	9.10E-02	2.07E-12	
1,2 Dichloropropane	3.39E-03	1.20E-08	4.06E-11	6.80E-02	2.76E-12	
Benzo(a)anthracene	8.00E+00	1.20E-08	9.58E-08	7.30E-01	6.99E-08	
Benzo(a)pyrene	8.60E+00	1.20E-08	1.03E-07	7.30E+00	7.52E-07	
Benzo(b)fluoranthene	1.70E+01	1.20E-08	2.04E-07	7.30E-01	1.49E-07	
Carbazole	1.50E+00	1.20E-08	1.80E-08	2.00E-02	3.59E-10	
Chrysene	1.40E+01	1.20E-08	1.68E-07	7.30E-02	1.22E-08	
Indeno(1,2,3-c,d)pyrene	5.10E+00	1.20E-08	6.11E-08	7.30E-01	4.46E-08	
						1.03E-06

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	1.40E-07	2.10E-08	6.00E-01	3.49E-08	
Anthracene	4.80E-02	1.40E-07	6.70E-09	3.00E+00	2.23E-09	
Antimony	4.93E+00	1.40E-07	6.89E-07	4.00E-04	1.72E-03	
Copper	1.44E+01	1.40E-07	2.02E-06	3.70E-02	5.45E-05	
Fluoranthene	1.70E+01	1.40E-07	2.37E-06	4.00E-01	5.94E-06	
Fluorene	2.90E-01	1.40E-07	4.05E-08	4.00E-01	1.01E-07	
Mercury	8.00E-02	1.40E-07	1.12E-08	3.00E-04	3.72E-05	
Pyrene	1.70E+01	1.40E-07	2.37E-06	3.00E-01	7.91E-06	
Silver	6.20E-01	1.40E-07	8.66E-08	5.00E-03	1.73E-05	
Toluene	1.33E-02	1.40E-07	1.85E-09	2.00E+00	9.26E-10	
Xylenes, mixed	7.89E-03	1.40E-07	1.10E-09	4.00E+00	2.76E-10	
						1.84E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Acenaphthene	1.50E-01	1.40E-07	2.10E-08	6.00E-02	3.49E-07	
Anthracene	4.80E-02	1.40E-07	6.70E-09	3.00E-01	2.23E-08	
Antimony	4.93E+00	1.40E-07	6.89E-07	4.00E-04	1.72E-03	
Cadmium (food	7.00E-01	1.40E-07	9.78E-08	1.00E-03	9.78E-05	
Copper	1.44E+01	1.40E-07	2.02E-06	3.70E-02	5.45E-05	
Fluoranthene	1.70E+01	1.40E-07	2.37E-06	4.00E-02	5.94E-05	
Fluorene	2.90E-01	1.40E-07	4.05E-08	4.00E-02	1.01E-06	
Mercury	8.00E-02	1.40E-07	1.12E-08	3.00E-04	3.72E-05	
Pyrene	1.70E+01	1.40E-07	2.37E-06	3.00E-02	7.91E-05	
Silver	6.20E-01	1.40E-07	8.66E-08	5.00E-03	1.73E-05	

Toluene	1.33E-02	1.40E-07	1.85E-09	2.00E-01	9.26E-09	
Xylenes, mixed	7.89E-03	1.40E-07	1.10E-09	2.00E+00	5.51E-10	
						2.07E-03

TRESPASSER
Inhalation of SSOIL VOCS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	8.64E-07	2.75E-04	2.38E-10	9.10E-02	2.17E-11	
						2.17E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.24E-07	3.21E-03	2.65E-09	3.70E-03	7.16E-07	
Toluene	2.06E-06	3.21E-03	6.61E-09	1.10E-01	6.01E-08	
						7.76E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.24E-07	3.21E-03	2.65E-09	1.10E-03	2.41E-06	
Toluene	2.06E-06	3.21E-03	6.62E-09	1.10E-01	6.02E-08	
						2.47E-06

TRESPASSER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
1,2 Dichloroethane	8.64E-07	4.79E-03	4.14E-09	9.10E-02	3.77E-10	
						3.77E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.24E-07	5.59E-02	4.61E-08	3.70E-03	1.24E-05	
Toluene	2.06E-06	5.59E-02	1.15E-07	1.10E-01	1.05E-06	
						1.35E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
1,2 Dichloropropane	8.24E-07	5.59E-02	4.61E-08	1.10E-03	4.19E-05	
Toluene	2.06E-06	5.59E-02	1.15E-07	1.10E-01	1.05E-06	
						4.29E-05

TRESPASSER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.73E-09	2.75E-04	4.76E-13	6.10E-01	2.91E-13	
Benzo(a)pyrene	1.86E-09	2.75E-04	5.12E-13	6.10E+00	3.12E-12	
Benzo(b)fluoranthene	3.67E-09	2.75E-04	1.01E-12	6.10E-01	6.16E-13	
Cadmium (food)	1.51E-10	2.75E-04	4.16E-14	6.10E+00	2.54E-13	
Chrysene	3.02E-09	2.75E-04	8.32E-13	6.10E-02	5.07E-14	
Indeno(1,2,3-c,d)pyrene	1.10E-09	2.75E-04	3.03E-13	6.10E-01	1.85E-13	
						4.52E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.73E-11	3.21E-03	5.56E-14	8.60E-05	6.46E-10	
						6.46E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.73E-11	3.21E-03	5.56E-14	8.60E-05	6.46E-10	
						6.46E-10

TRESPASSER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	1.73E-09	4.79E-03	8.28E-12	6.10E-01	5.05E-12	
Benzo(a)pyrene	1.86E-09	4.79E-03	8.91E-12	6.10E+00	5.43E-11	
Benzo(b)fluoranthene	3.67E-09	4.79E-03	1.76E-11	6.10E-01	1.07E-11	
Cadmium (food)	1.51E-10	4.79E-03	7.23E-13	6.10E+00	4.41E-12	
Chrysene	3.02E-09	4.79E-03	1.45E-11	6.10E-02	8.82E-13	
Indeno(1,2,3-c,d)pyrene	1.10E-09	4.79E-03	5.27E-12	6.10E-01	3.21E-12	
						7.86E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.73E-11	5.59E-02	9.67E-13	8.60E-05	1.12E-08	
						1.12E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Mercury	1.73E-11	5.59E-02	9.67E-13	8.60E-05	1.12E-08	
						1.12E-08

CIVIL ENGINEERING CONTAINER STORAGE AREA RISK CALCULATIONS

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SURFACE SOIL	4.96E-11		4.12E-06	1.65E-08		4.97E-04
-- Ingestion of SURFACE SOIL	1.62E-09		6.10E-06	5.58E-07		1.57E-03
-- Inhalation of SSOIL VOCS	0.00E+00		8.70E-08	0.00E+00		1.58E-06
-- Inhalation of SSOIL PARTICS	5.17E-12		0.00E+00	2.60E-10		0.00E+00
	1.67E-09		1.03E-05	5.75E-07		2.07E-03
CONSTR WORKER						
-- Dermal Contact with TSOIL	4.97E-12	1.16E-06		7.45E-11	1.75E-05	
-- Ingestion of TSOIL	6.47E-10	2.93E-04		5.78E-09	2.79E-03	
-- Inhalation of TSOIL VOCS	0.00E+00	3.21E-08		0.00E+00	1.40E-07	
-- Inhalation of TSOIL PARTICS	2.37E-13	0.00E+00		1.05E-12	0.00E+00	
	6.52E-10	2.94E-04		5.86E-09	2.81E-03	
TRESPASSER						
-- Dermal Contact with SURFACE SOIL	9.84E-12	1.22E-06		2.18E-09	2.73E-04	
-- Ingestion of SURFACE SOIL	3.21E-10	6.79E-07		3.82E-08	1.11E-04	
-- Inhalation of SSOIL VOCS	0.00E+00	2.59E-08		0.00E+00	4.50E-07	
-- Inhalation of SSOIL PARTICS	1.02E-12	0.00E+00		1.78E-11	0.00E+00	
	3.31E-10	1.93E-06		4.04E-08	3.85E-04	

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	6.00E-05	6.04E-08	3.62E-12	3.40E-01	1.23E-12	
4,4'-DDT	2.10E-04	6.04E-08	1.27E-11	3.40E-01	4.31E-12	
Carbazole	4.00E-03	6.04E-08	2.42E-10	2.00E-02	4.83E-12	
Chlordane	5.00E-04	6.04E-08	3.02E-11	1.30E+00	3.93E-11	
						4.96E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	2.10E-04	4.70E-07	9.86E-11	5.00E-04	1.97E-07	
Butyl Benzyl Phthalate	4.00E-03	4.70E-07	1.88E-09	2.00E-01	9.39E-09	
Chlordane	5.00E-04	4.70E-07	2.35E-10	6.00E-05	3.91E-06	
Toluene	1.20E-04	4.70E-07	5.64E-11	2.00E-01	2.82E-10	
Xylenes, mixed	1.20E-04	4.70E-07	5.64E-11	2.00E+00	2.82E-11	
						4.12E-06

OCCUP WORKER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	9.00E-05	9.61E-06	8.65E-10	3.40E-01	2.94E-10	
4,4'-DDT	9.00E-04	9.61E-06	8.65E-09	3.40E-01	2.94E-09	
Carbazole	4.00E-03	9.61E-06	3.84E-08	2.00E-02	7.69E-10	
Chlordane	1.00E-03	9.61E-06	9.61E-09	1.30E+00	1.25E-08	
						1.65E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	9.00E-04	2.69E-05	2.42E-08	5.00E-04	4.84E-05	
Butyl Benzyl Phthalate	4.00E-03	2.69E-05	1.08E-07	2.00E-01	5.38E-07	
Chlordane	1.00E-03	2.69E-05	2.69E-08	6.00E-05	4.48E-04	
Toluene	1.80E-04	2.69E-05	4.84E-09	2.00E-01	2.42E-08	
Xylenes, mixed	2.10E-04	2.69E-05	5.65E-09	2.00E+00	2.83E-09	
						4.97E-04

OCCUP WORKER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	2.33E-03	7.55E-10	1.76E-12	3.40E-01	5.98E-13	
4,4'-DDT	7.38E-03	7.55E-10	5.57E-12	3.40E-01	1.89E-12	
Benzo(a)anthracene	1.87E-01	7.55E-10	1.41E-10	7.30E-01	1.03E-10	
Benzo(a)pyrene	1.60E-01	7.55E-10	1.21E-10	7.30E+00	8.82E-10	
Benzo(b)fluoranthene	2.71E-01	7.55E-10	2.05E-10	7.30E-01	1.49E-10	
Carbazole	4.10E-02	7.55E-10	3.09E-11	2.00E-02	6.19E-13	
Chlordane	5.23E-03	7.55E-10	3.95E-12	1.30E+00	5.13E-12	
Chrysene	2.15E-01	7.55E-10	1.62E-10	7.30E-02	1.18E-11	
Dibenzo(a,h)anthracene	7.30E-02	7.55E-10	5.51E-11	7.30E+00	4.02E-10	
Indeno(1,2,3-c,d)pyrene	1.09E-01	7.55E-10	8.27E-11	7.30E-01	6.03E-11	
						1.62E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	7.38E-03	5.87E-09	4.33E-11	5.00E-04	8.67E-08	
Anthracene	6.20E-02	5.87E-09	3.64E-10	3.00E-01	1.21E-09	
Butyl Benzyl Phthalate	3.90E-02	5.87E-09	2.29E-10	2.00E-01	1.14E-09	
Cadmium (food)	6.30E-01	5.87E-09	3.70E-09	1.00E-03	3.70E-06	
Chlordane	5.23E-03	5.87E-09	3.07E-11	6.00E-05	5.12E-07	
Fluoranthene	3.49E-01	5.87E-09	2.05E-09	4.00E-02	5.12E-08	
Pyrene	3.81E-01	5.87E-09	2.24E-09	3.00E-02	7.46E-08	
Silver	7.70E-01	5.87E-09	4.52E-09	5.00E-03	9.04E-07	
Toluene	3.61E-03	5.87E-09	2.12E-11	2.00E-01	1.06E-10	
Xylenes, mixed	3.84E-03	5.87E-09	2.25E-11	2.00E+00	1.13E-11	
Zinc	3.92E+01	5.87E-09	2.30E-07	3.00E-01	7.68E-07	
						6.10E-06

OCCUP WORKER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	3.50E-03	1.75E-07	6.12E-10	3.40E-01	2.08E-10	
4,4'-DDT	3.00E-02	1.75E-07	5.24E-09	3.40E-01	1.78E-09	
Benzo(a)anthracene	3.30E-01	1.75E-07	5.77E-08	7.30E-01	4.21E-08	
Benzo(a)pyrene	2.60E-01	1.75E-07	4.54E-08	7.30E+00	3.32E-07	
Benzo(b)fluoranthene	5.10E-01	1.75E-07	8.91E-08	7.30E-01	6.51E-08	
Carbazole	4.10E-02	1.75E-07	7.16E-09	2.00E-02	1.43E-10	
Chlordane	1.43E-02	1.75E-07	2.50E-09	1.30E+00	3.25E-09	
Chrysene	4.20E-01	1.75E-07	7.34E-08	7.30E-02	5.36E-09	
Dibenzo(a,h)anthracene	7.30E-02	1.75E-07	1.28E-08	7.30E+00	9.31E-08	
Indeno(1,2,3-c,d)pyrene	1.20E-01	1.75E-07	2.10E-08	7.30E-01	1.53E-08	
						5.58E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	3.00E-02	4.89E-07	1.47E-08	5.00E-04	2.94E-05	
Anthracene	6.70E-02	4.89E-07	3.28E-08	3.00E-01	1.09E-07	
Butyl Benzyl Phthalate	3.90E-02	4.89E-07	1.91E-08	2.00E-01	9.54E-08	
Cadmium (food)	2.36E+00	4.89E-07	1.15E-06	1.00E-03	1.15E-03	
Chlordane	1.43E-02	4.89E-07	7.00E-09	6.00E-05	1.17E-04	
Fluoranthene	8.30E-01	4.89E-07	4.06E-07	4.00E-02	1.02E-05	
Pyrene	9.00E-01	4.89E-07	4.40E-07	3.00E-02	1.47E-05	
Silver	1.23E+00	4.89E-07	6.02E-07	5.00E-03	1.20E-04	
Toluene	5.58E-03	4.89E-07	2.73E-09	2.00E-01	1.36E-08	
Xylenes, mixed	6.80E-03	4.89E-07	3.33E-09	2.00E+00	1.66E-09	
Zinc	7.38E+01	4.89E-07	3.61E-05	3.00E-01	1.20E-04	
						1.57E-03

OCCUP WORKER
Inhalation of SSOIL VOCS
Average Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	8.86E-07	1.08E-02	9.57E-09	1.10E-01	8.70E-08	
						8.70E-08

OCCUP WORKER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	8.86E-07	1.96E-01	1.73E-07	1.10E-01	1.58E-06	
						1.58E-06

OCCUP WORKER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	7.13E-11	1.39E-03	9.90E-14	6.10E-01	6.04E-14	
Benzo(a)pyrene	5.62E-11	1.39E-03	7.81E-14	6.10E+00	4.76E-13	
Benzo(b)fluoranthene	1.10E-10	1.39E-03	1.53E-13	6.10E-01	9.32E-14	
Cadmium (food)	5.10E-10	1.39E-03	7.08E-13	6.10E+00	4.32E-12	
Chlordane	3.09E-11	1.39E-03	4.29E-14	1.30E+00	5.58E-14	
Chrysene	9.07E-11	1.39E-03	1.26E-13	6.10E-02	7.68E-15	
Dibenzo(a,h)anthracene	1.58E-11	1.39E-03	2.19E-14	6.10E+00	1.34E-13	
Indeno(1,2,3-c,d)pyrene	2.59E-11	1.39E-03	3.60E-14	6.10E-01	2.19E-14	
						5.17E-12

OCCUP WORKER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	7.13E-11	6.99E-02	4.98E-12	6.10E-01	3.04E-12	
Benzo(a)pyrene	5.62E-11	6.99E-02	3.93E-12	6.10E+00	2.40E-11	
Benzo(b)fluoranthene	1.10E-10	6.99E-02	7.69E-12	6.10E-01	4.69E-12	
Cadmium (food)	5.10E-10	6.99E-02	3.56E-11	6.10E+00	2.17E-10	
Chlordane	3.09E-11	6.99E-02	2.16E-12	1.30E+00	2.81E-12	
Chrysene	9.07E-11	6.99E-02	6.34E-12	6.10E-02	3.87E-13	
Dibenzo(a,h)anthracene	1.58E-11	6.99E-02	1.10E-12	6.10E+00	6.74E-12	
Indeno(1,2,3-c,d)pyrene	2.59E-11	6.99E-02	1.81E-12	6.10E-01	1.10E-12	
						2.60E-10

CONSTR WORKER
Dermal Contact with TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	6.00E-05	4.47E-09	2.68E-13	3.40E-01	9.12E-14	
4,4'-DDT	9.00E-05	4.47E-09	4.03E-13	3.40E-01	1.37E-13	
Carbazole	4.00E-03	4.47E-09	1.79E-11	2.00E-02	3.58E-13	
Chlordane	2.00E-04	4.47E-09	8.95E-13	1.30E+00	1.16E-12	
Pentachlorophenol	6.00E-03	4.47E-09	2.68E-11	1.20E-01	3.22E-12	
						4.97E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	9.00E-05	3.13E-07	2.82E-11	5.00E-04	5.64E-08	
Butyl Benzyl Phthalate	6.00E-03	3.13E-07	1.88E-09	2.00E+00	9.39E-10	
Chlordane	2.00E-04	3.13E-07	6.26E-11	6.00E-05	1.04E-06	
Pentachlorophenol	6.00E-03	3.13E-07	1.88E-09	3.00E-02	6.26E-08	
Toluene	1.00E-04	3.13E-07	3.13E-11	2.00E+00	1.57E-11	
Xylenes, mixed	9.00E-05	3.13E-07	2.82E-11	4.00E+00	7.05E-12	
						1.16E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	9.00E-05	3.13E-07	2.82E-11	5.00E-04	5.64E-08	
Butyl Benzyl Phthalate	6.00E-03	3.13E-07	1.88E-09	2.00E-01	9.39E-09	
Chlordane	2.00E-04	3.13E-07	6.26E-11	6.00E-05	1.04E-06	
Pentachlorophenol	6.00E-03	3.13E-07	1.88E-09	3.00E-02	6.26E-08	
Toluene	1.00E-04	3.13E-07	3.13E-11	2.00E-01	1.57E-10	
Xylenes, mixed	9.00E-05	3.13E-07	2.82E-11	2.00E+00	1.41E-11	
						1.17E-06

CONSTR WORKER
Dermal Contact with TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	6.00E-05	6.71E-08	4.03E-12	3.40E-01	1.37E-12	
4,4'-DDT	9.00E-05	6.71E-08	6.04E-12	3.40E-01	2.05E-12	
Carbazole	4.00E-03	6.71E-08	2.68E-10	2.00E-02	5.37E-12	
Chlordane	2.00E-04	6.71E-08	1.34E-11	1.30E+00	1.74E-11	
Pentachlorophenol	6.00E-03	6.71E-08	4.03E-10	1.20E-01	4.83E-11	
						7.45E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	9.00E-05	4.70E-06	4.23E-10	5.00E-04	8.45E-07	
Butyl Benzyl Phthalate	8.00E-03	4.70E-06	3.76E-08	2.00E+00	1.88E-08	
Chlordane	2.00E-04	4.70E-06	9.39E-10	6.00E-05	1.57E-05	
Pentachlorophenol	6.00E-03	4.70E-06	2.82E-08	3.00E-02	9.39E-07	
Toluene	1.00E-04	4.70E-06	4.70E-10	2.00E+00	2.35E-10	
Xylenes, mixed	9.00E-05	4.70E-06	4.23E-10	4.00E+00	1.06E-10	
						1.75E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	9.00E-05	4.70E-06	4.23E-10	5.00E-04	8.45E-07	
Butyl Benzyl Phthalate	8.00E-03	4.70E-06	3.76E-08	2.00E-01	1.88E-07	
Chlordane	2.00E-04	4.70E-06	9.39E-10	6.00E-05	1.57E-05	
Pentachlorophenol	6.00E-03	4.70E-06	2.82E-08	3.00E-02	9.39E-07	
Toluene	1.00E-04	4.70E-06	4.70E-10	2.00E-01	2.35E-09	
Xylenes, mixed	9.00E-05	4.70E-06	4.23E-10	2.00E+00	2.11E-10	
						1.76E-05

CONSTR WORKER
Ingestion of TSOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	2.11E-03	2.80E-10	5.90E-13	3.40E-01	2.01E-13	
4,4'-DDT	2.96E-03	2.80E-10	8.28E-13	3.40E-01	2.81E-13	
Benzo(a)anthracene	1.93E-01	2.80E-10	5.40E-11	7.30E-01	3.94E-11	
Benzo(a)pyrene	1.86E-01	2.80E-10	5.20E-11	7.30E+00	3.80E-10	
Benzo(b)fluoranthene	2.19E-01	2.80E-10	6.12E-11	7.30E-01	4.47E-11	
Carbazole	4.20E-02	2.80E-10	1.17E-11	2.00E-02	2.35E-13	
Chlordane	1.81E-03	2.80E-10	5.06E-13	1.30E+00	6.58E-13	
Chrysene	2.81E-01	2.80E-10	7.86E-11	7.30E-02	5.73E-12	
Dibenzo(a,h)anthracene	7.30E-02	2.80E-10	2.04E-11	7.30E+00	1.49E-10	
Indeno(1,2,3-c,d)pyrene	1.23E-01	2.80E-10	3.44E-11	7.30E-01	2.51E-11	
Pentachlorophenol	6.30E-02	2.80E-10	1.76E-11	1.20E-01	2.11E-12	
						6.47E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	2.96E-03	1.96E-08	5.79E-11	5.00E-04	1.16E-07	
Anthracene	1.48E-01	1.96E-08	2.90E-09	3.00E+00	9.65E-10	
Antimony	5.86E+00	1.96E-08	1.15E-07	4.00E-04	2.87E-04	
Butyl Benzyl Phthalate	6.10E-02	1.96E-08	1.19E-09	2.00E+00	5.97E-10	
Chlordane	1.81E-03	1.96E-08	3.54E-11	6.00E-05	5.90E-07	
Fluoranthene	5.62E-01	1.96E-08	1.10E-08	4.00E-01	2.75E-08	
Pentachlorophenol	6.30E-02	1.96E-08	1.23E-09	3.00E-02	4.11E-08	
Pyrene	5.44E-01	1.96E-08	1.06E-08	3.00E-01	3.55E-08	
Silver	1.07E+00	1.96E-08	2.09E-08	5.00E-03	4.19E-06	
Toluene	2.97E-03	1.96E-08	5.81E-11	2.00E+00	2.91E-11	
Xylenes, mixed	3.02E-03	1.96E-08	5.91E-11	4.00E+00	1.48E-11	
Zinc	1.66E+01	1.96E-08	3.25E-07	3.00E-01	1.08E-06	
						2.93E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	2.96E-03	1.96E-08	5.79E-11	5.00E-04	1.16E-07	
Anthracene	1.48E-01	1.96E-08	2.90E-09	3.00E-01	9.65E-09	
Antimony	5.86E+00	1.96E-08	1.15E-07	4.00E-04	2.87E-04	
Butyl Benzyl Phthalate	6.10E-02	1.96E-08	1.19E-09	2.00E-01	5.97E-09	
Cadmium (food	9.90E-01	1.96E-08	1.94E-08	1.00E-03	1.94E-05	
Chlordane	1.81E-03	1.96E-08	3.54E-11	6.00E-05	5.90E-07	
Fluoranthene	5.62E-01	1.96E-08	1.10E-08	4.00E-02	2.75E-07	
Pentachlorophenol	6.30E-02	1.96E-08	1.23E-09	3.00E-02	4.11E-08	
Pyrene	5.44E-01	1.96E-08	1.06E-08	3.00E-02	3.55E-07	

Silver	1.07E+00	1.96E-08	2.09E-08	5.00E-03	4.19E-06	
Toluene	2.97E-03	1.96E-08	5.81E-11	2.00E-01	2.91E-10	
Xylenes, mixed	3.02E-03	1.96E-08	5.91E-11	2.00E+00	2.95E-11	
Zinc	1.66E+01	1.96E-08	3.25E-07	3.00E-01	1.08E-06	
						3.13E-04

CONSTR WORKER
Ingestion of TSOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	2.28E-03	2.24E-09	5.10E-12	3.40E-01	1.73E-12	
4,4'-DDT	3.06E-03	2.24E-09	6.84E-12	3.40E-01	2.33E-12	
Benzo(a)anthracene	2.20E-01	2.24E-09	4.92E-10	7.30E-01	3.59E-10	
Benzo(a)pyrene	2.13E-01	2.24E-09	4.76E-10	7.30E+00	3.48E-09	
Benzo(b)fluoranthene	2.45E-01	2.24E-09	5.48E-10	7.30E-01	4.00E-10	
Carbazole	4.30E-02	2.24E-09	9.62E-11	2.00E-02	1.92E-12	
Chlordane	1.87E-03	2.24E-09	4.18E-12	1.30E+00	5.44E-12	
Chrysene	5.00E-01	2.24E-09	1.12E-09	7.30E-02	8.16E-11	
Dibenzo(a,h)anthracene	7.30E-02	2.24E-09	1.63E-10	7.30E+00	1.19E-09	
Indeno(1,2,3-c,d)pyrene	1.50E-01	2.24E-09	3.35E-10	7.30E-01	2.45E-10	
Pentachlorophenol	6.30E-02	2.24E-09	1.41E-10	1.20E-01	1.69E-11	
						5.78E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	3.06E-03	1.57E-07	4.79E-10	5.00E-04	9.58E-07	
Anthracene	1.50E-01	1.57E-07	2.35E-08	3.00E+00	7.83E-09	
Antimony	6.98E+00	1.57E-07	1.09E-06	4.00E-04	2.73E-03	
Butyl Benzyl Phthalate	8.30E-02	1.57E-07	1.30E-08	2.00E+00	6.50E-09	
Chlordane	1.87E-03	1.57E-07	2.93E-10	6.00E-05	4.88E-06	
Fluoranthene	1.10E+00	1.57E-07	1.72E-07	4.00E-01	4.31E-07	
Pentachlorophenol	6.30E-02	1.57E-07	9.86E-09	3.00E-02	3.29E-07	
Pyrene	9.00E-01	1.57E-07	1.41E-07	3.00E-01	4.70E-07	
Silver	1.27E+00	1.57E-07	1.99E-07	5.00E-03	3.98E-05	
Toluene	3.13E-03	1.57E-07	4.90E-10	2.00E+00	2.45E-10	
Xylenes, mixed	3.24E-03	1.57E-07	5.07E-10	4.00E+00	1.27E-10	
Zinc	2.03E+01	1.57E-07	3.18E-06	3.00E-01	1.06E-05	
						2.79E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	3.06E-03	1.57E-07	4.79E-10	5.00E-04	9.58E-07	
Anthracene	1.50E-01	1.57E-07	2.35E-08	3.00E-01	7.83E-08	
Antimony	6.98E+00	1.57E-07	1.09E-06	4.00E-04	2.73E-03	
Butyl Benzyl Phthalate	8.30E-02	1.57E-07	1.30E-08	2.00E-01	6.50E-08	
Cadmium (food)	1.43E+00	1.57E-07	2.24E-07	1.00E-03	2.24E-04	
Chlordane	1.87E-03	1.57E-07	2.93E-10	6.00E-05	4.88E-06	
Fluoranthene	1.10E+00	1.57E-07	1.72E-07	4.00E-02	4.31E-06	
Pentachlorophenol	6.30E-02	1.57E-07	9.86E-09	3.00E-02	3.29E-07	
Pyrene	9.00E-01	1.57E-07	1.41E-07	3.00E-02	4.70E-06	

Silver	1.27E+00	1.57E-07	1.99E-07	5.00E-03	3.98E-05	
Toluene	3.13E-03	1.57E-07	4.90E-10	2.00E-01	2.45E-09	
Xylenes, mixed	3.24E-03	1.57E-07	5.07E-10	2.00E+00	2.54E-10	
Zinc	2.03E+01	1.57E-07	3.18E-06	3.00E-01	1.06E-05	
						3.02E-03

CONSTR WORKER
Inhalation of TSOIL VOCS
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.91E-07	7.20E-03	3.53E-09	1.10E-01	3.21E-08	
						3.21E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.91E-07	7.20E-03	3.54E-09	1.10E-01	3.21E-08	
						3.21E-08

CONSTR WORKER
Inhalation of TSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.91E-07	3.13E-02	1.54E-08	1.10E-01	1.40E-07	
						1.40E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	4.91E-07	3.13E-02	1.54E-08	1.10E-01	1.40E-07	
						1.40E-07

CONSTR WORKER
Inhalation of TSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDT	6.61E-13	1.03E-04	6.80E-17	3.40E-01	2.31E-17	
Benzo(a)anthracene	4.75E-11	1.03E-04	4.89E-15	6.10E-01	2.98E-15	
Benzo(a)pyrene	4.60E-11	1.03E-04	4.73E-15	6.10E+00	2.89E-14	
Benzo(b)fluoranthene	5.29E-11	1.03E-04	5.44E-15	6.10E-01	3.32E-15	
Cadmium (food)	3.01E-10	1.03E-04	3.10E-14	6.10E+00	1.89E-13	
Chlordane	4.32E-13	1.03E-04	4.44E-17	1.30E+00	5.78E-17	
Chrysene	1.08E-10	1.03E-04	1.11E-14	6.10E-02	6.78E-16	
Dibenzo(a,h)anthracene	1.58E-11	1.03E-04	1.63E-15	6.10E+00	9.92E-15	
Indeno(1,2,3-c,d)pyrene	3.24E-11	1.03E-04	3.33E-15	6.10E-01	2.03E-15	
						2.37E-13

CONSTR WORKER
Inhalation of TSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDT	6.61E-13	4.47E-04	2.96E-16	3.40E-01	1.01E-16	
Benzo(a)anthracene	4.75E-11	4.47E-04	2.12E-14	6.10E-01	1.30E-14	
Benzo(a)pyrene	4.60E-11	4.47E-04	2.06E-14	6.10E+00	1.26E-13	
Benzo(b)fluoranthene	5.29E-11	4.47E-04	2.37E-14	6.10E-01	1.44E-14	
Cadmium (food)	3.09E-10	4.47E-04	1.38E-13	6.10E+00	8.43E-13	
Chlordane	4.32E-13	4.47E-04	1.93E-16	1.30E+00	2.51E-16	
Chrysene	1.08E-10	4.47E-04	4.83E-14	6.10E-02	2.95E-15	
Dibenzo(a,h)anthracene	1.58E-11	4.47E-04	7.07E-15	6.10E+00	4.31E-14	
Indeno(1,2,3-c,d)pyrene	3.24E-11	4.47E-04	1.45E-14	6.10E-01	8.84E-15	
						1.05E-12

TRESPASSER
Dermal Contact with SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	6.00E-05	1.20E-08	7.18E-13	3.40E-01	2.44E-13	
4,4'-DDT	2.10E-04	1.20E-08	2.51E-12	3.40E-01	8.55E-13	
Carbazole	4.00E-03	1.20E-08	4.79E-11	2.00E-02	9.58E-13	
Chlordane	5.00E-04	1.20E-08	5.99E-12	1.30E+00	7.78E-12	
						9.84E-12

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	2.10E-04	1.40E-07	2.93E-11	5.00E-04	5.87E-08	
Butyl Benzyl Phthalate	4.00E-03	1.40E-07	5.59E-10	2.00E+00	2.79E-10	
Chlordane	5.00E-04	1.40E-07	6.98E-11	6.00E-05	1.16E-06	
Toluene	1.20E-04	1.40E-07	1.68E-11	2.00E+00	8.38E-12	
Xylenes, mixed	1.20E-04	1.40E-07	1.68E-11	4.00E+00	4.19E-12	
						1.22E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	2.10E-04	1.40E-07	2.93E-11	5.00E-04	5.87E-08	
Butyl Benzyl Phthalate	4.00E-03	1.40E-07	5.59E-10	2.00E-01	2.79E-09	
Chlordane	5.00E-04	1.40E-07	6.98E-11	6.00E-05	1.16E-06	
Toluene	1.20E-04	1.40E-07	1.68E-11	2.00E-01	8.38E-11	
Xylenes, mixed	1.20E-04	1.40E-07	1.68E-11	2.00E+00	8.38E-12	
						1.23E-06

TRESPASSER
Dermal Contact with SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	9.00E-05	1.27E-06	1.14E-10	3.40E-01	3.88E-11	
4,4'-DDT	9.00E-04	1.27E-06	1.14E-09	3.40E-01	3.88E-10	
Carbazole	4.00E-03	1.27E-06	5.08E-09	2.00E-02	1.02E-10	
Chlordane	1.00E-03	1.27E-06	1.27E-09	1.30E+00	1.65E-09	
						2.18E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	9.00E-04	1.48E-05	1.33E-08	5.00E-04	2.66E-05	
Butyl Benzyl Phthalate	4.00E-03	1.48E-05	5.92E-08	2.00E+00	2.96E-08	
Chlordane	1.00E-03	1.48E-05	1.48E-08	6.00E-05	2.47E-04	
Toluene	1.80E-04	1.48E-05	2.66E-09	2.00E+00	1.33E-09	
Xylenes, mixed	2.10E-04	1.48E-05	3.11E-09	4.00E+00	7.77E-10	
						2.73E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	9.00E-04	1.48E-05	1.33E-08	5.00E-04	2.66E-05	
Butyl Benzyl Phthalate	4.00E-03	1.48E-05	5.92E-08	2.00E-01	2.96E-07	
Chlordane	1.00E-03	1.48E-05	1.48E-08	6.00E-05	2.47E-04	
Toluene	1.80E-04	1.48E-05	2.66E-09	2.00E-01	1.33E-08	
Xylenes, mixed	2.10E-04	1.48E-05	3.11E-09	2.00E+00	1.55E-09	
						2.74E-04

TRESPASSER
Ingestion of SURFACE SOIL
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	2.33E-03	1.50E-10	3.49E-13	3.40E-01	1.19E-13	
4,4'-DDT	7.38E-03	1.50E-10	1.10E-12	3.40E-01	3.75E-13	
Benzo(a)anthracene	1.87E-01	1.50E-10	2.80E-11	7.30E-01	2.04E-11	
Benzo(a)pyrene	1.60E-01	1.50E-10	2.39E-11	7.30E+00	1.75E-10	
Benzo(b)fluoranthene	2.71E-01	1.50E-10	4.06E-11	7.30E-01	2.96E-11	
Carbazole	4.10E-02	1.50E-10	6.14E-12	2.00E-02	1.23E-13	
Chlordane	5.23E-03	1.50E-10	7.83E-13	1.30E+00	1.02E-12	
Chrysene	2.15E-01	1.50E-10	3.22E-11	7.30E-02	2.35E-12	
Dibenzo(a,h)anthracene	7.30E-02	1.50E-10	1.09E-11	7.30E+00	7.97E-11	
Indeno(1,2,3-c,d)pyrene	1.09E-01	1.50E-10	1.64E-11	7.30E-01	1.20E-11	
						3.21E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	7.38E-03	1.75E-09	1.29E-11	5.00E-04	2.58E-08	
Anthracene	6.20E-02	1.75E-09	1.08E-10	3.00E+00	3.61E-11	
Butyl Benzyl Phthalate	3.90E-02	1.75E-09	6.81E-11	2.00E+00	3.40E-11	
Chlordane	5.23E-03	1.75E-09	9.13E-12	6.00E-05	1.52E-07	
Fluoranthene	3.49E-01	1.75E-09	6.09E-10	4.00E-01	1.52E-09	
Pyrene	3.81E-01	1.75E-09	6.65E-10	3.00E-01	2.22E-09	
Silver	7.70E-01	1.75E-09	1.34E-09	5.00E-03	2.69E-07	
Toluene	3.61E-03	1.75E-09	6.30E-12	2.00E+00	3.15E-12	
Xylenes, mixed	3.84E-03	1.75E-09	6.70E-12	4.00E+00	1.68E-12	
Zinc	3.92E+01	1.75E-09	6.85E-08	3.00E-01	2.28E-07	
						6.79E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	7.38E-03	1.75E-09	1.29E-11	5.00E-04	2.58E-08	
Anthracene	6.20E-02	1.75E-09	1.08E-10	3.00E-01	3.61E-10	
Butyl Benzyl Phthalate	3.90E-02	1.75E-09	6.81E-11	2.00E-01	3.40E-10	
Cadmium (food	6.30E-01	1.75E-09	1.10E-09	1.00E-03	1.10E-06	
Chlordane	5.23E-03	1.75E-09	9.13E-12	6.00E-05	1.52E-07	
Fluoranthene	3.49E-01	1.75E-09	6.09E-10	4.00E-02	1.52E-08	
Pyrene	3.81E-01	1.75E-09	6.65E-10	3.00E-02	2.22E-08	
Silver	7.70E-01	1.75E-09	1.34E-09	5.00E-03	2.69E-07	
Toluene	3.61E-03	1.75E-09	6.30E-12	2.00E-01	3.15E-11	
Xylenes, mixed	3.84E-03	1.75E-09	6.70E-12	2.00E+00	3.35E-12	
Zinc	3.92E+01	1.75E-09	6.85E-08	3.00E-01	2.28E-07	
						1.81E-06

TRESPASSER
Ingestion of SURFACE SOIL
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDE	3.50E-03	1.20E-08	4.19E-11	3.40E-01	1.42E-11	
4,4'-DDT	3.00E-02	1.20E-08	3.59E-10	3.40E-01	1.22E-10	
Benzo(a)anthracene	3.30E-01	1.20E-08	3.95E-09	7.30E-01	2.88E-09	
Benzo(a)pyrene	2.60E-01	1.20E-08	3.11E-09	7.30E+00	2.27E-08	
Benzo(b)fluoranthene	5.10E-01	1.20E-08	6.11E-09	7.30E-01	4.46E-09	
Carbazole	4.10E-02	1.20E-08	4.91E-10	2.00E-02	9.82E-12	
Chlordane	1.43E-02	1.20E-08	1.71E-10	1.30E+00	2.23E-10	
Chrysene	4.20E-01	1.20E-08	5.03E-09	7.30E-02	3.67E-10	
Dibenzo(a,h)anthracene	7.30E-02	1.20E-08	8.74E-10	7.30E+00	6.38E-09	
Indeno(1,2,3-c,d)pyrene	1.20E-01	1.20E-08	1.44E-09	7.30E-01	1.05E-09	
						3.82E-08

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	3.00E-02	1.40E-07	4.19E-09	5.00E-04	8.38E-06	
Anthracene	6.70E-02	1.40E-07	9.36E-09	3.00E+00	3.12E-09	
Butyl Benzyl Phthalate	3.90E-02	1.40E-07	5.45E-09	2.00E+00	2.72E-09	
Chlordane	1.43E-02	1.40E-07	2.00E-09	6.00E-05	3.33E-05	
Fluoranthene	8.30E-01	1.40E-07	1.16E-07	4.00E-01	2.90E-07	
Pyrene	9.00E-01	1.40E-07	1.26E-07	3.00E-01	4.19E-07	
Silver	1.23E+00	1.40E-07	1.72E-07	5.00E-03	3.44E-05	
Toluene	5.58E-03	1.40E-07	7.79E-10	2.00E+00	3.90E-10	
Xylenes, mixed	6.80E-03	1.40E-07	9.50E-10	4.00E+00	2.37E-10	
Zinc	7.38E+01	1.40E-07	1.03E-05	3.00E-01	3.44E-05	
						1.11E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
4,4'-DDT	3.00E-02	1.40E-07	4.19E-09	5.00E-04	8.38E-06	
Anthracene	6.70E-02	1.40E-07	9.36E-09	3.00E-01	3.12E-08	
Butyl Benzyl Phthalate	3.90E-02	1.40E-07	5.45E-09	2.00E-01	2.72E-08	
Cadmium (food)	2.36E+00	1.40E-07	3.30E-07	1.00E-03	3.30E-04	
Chlordane	1.43E-02	1.40E-07	2.00E-09	6.00E-05	3.33E-05	
Fluoranthene	8.30E-01	1.40E-07	1.16E-07	4.00E-02	2.90E-06	
Pyrene	9.00E-01	1.40E-07	1.26E-07	3.00E-02	4.19E-06	
Silver	1.23E+00	1.40E-07	1.72E-07	5.00E-03	3.44E-05	
Toluene	5.58E-03	1.40E-07	7.79E-10	2.00E-01	3.90E-09	
Xylenes, mixed	6.80E-03	1.40E-07	9.50E-10	2.00E+00	4.75E-10	
Zinc	7.38E+01	1.40E-07	1.03E-05	3.00E-01	3.44E-05	
						4.47E-04

TRESPASSER
Inhalation of SSOIL VOCS
Average Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	8.86E-07	3.21E-03	2.85E-09	1.10E-01	2.59E-08	
						2.59E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	8.86E-07	3.21E-03	2.85E-09	1.10E-01	2.59E-08	
						2.59E-08

TRESPASSER
Inhalation of SSOIL VOCS
Reasonable Maximum Exposure

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	8.86E-07	5.59E-02	4.95E-08	1.10E-01	4.50E-07	
						4.50E-07

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Toluene	8.86E-07	5.59E-02	4.95E-08	1.10E-01	4.50E-07	
						4.50E-07

TRESPASSER
Inhalation of SSOIL PARTICS
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	7.13E-11	2.75E-04	1.96E-14	6.10E-01	1.20E-14	
Benzo(a)pyrene	5.62E-11	2.75E-04	1.55E-14	6.10E+00	9.44E-14	
Benzo(b)fluoranthene	1.10E-10	2.75E-04	3.03E-14	6.10E-01	1.85E-14	
Cadmium (food)	5.10E-10	2.75E-04	1.40E-13	6.10E+00	8.57E-13	
Chlordane	3.09E-11	2.75E-04	8.51E-15	1.30E+00	1.11E-14	
Chrysene	9.07E-11	2.75E-04	2.50E-14	6.10E-02	1.52E-15	
Dibenzo(a,h)anthracene	1.58E-11	2.75E-04	4.35E-15	6.10E+00	2.65E-14	
Indeno(1,2,3-c,d)pyrene	2.59E-11	2.75E-04	7.13E-15	6.10E-01	4.35E-15	
						1.02E-12

TRESPASSER
Inhalation of SSOIL PARTICS
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/m3)	Inhalation Intake Factor (m3/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
Benzo(a)anthracene	7.13E-11	4.79E-03	3.41E-13	6.10E-01	2.08E-13	
Benzo(a)pyrene	5.62E-11	4.79E-03	2.69E-13	6.10E+00	1.64E-12	
Benzo(b)fluoranthene	1.10E-10	4.79E-03	5.27E-13	6.10E-01	3.21E-13	
Cadmium (food)	5.10E-10	4.79E-03	2.44E-12	6.10E+00	1.49E-11	
Chlordane	3.09E-11	4.79E-03	1.48E-13	1.30E+00	1.92E-13	
Chrysene	9.07E-11	4.79E-03	4.34E-13	6.10E-02	2.65E-14	
Dibenzo(a,h)anthracene	1.58E-11	4.79E-03	7.57E-14	6.10E+00	4.62E-13	
Indeno(1,2,3-c,d)pyrene	2.59E-11	4.79E-03	1.24E-13	6.10E-01	7.57E-14	
						1.78E-11

PLAYA LAKE
RISK CALCULATIONS

Receptor/Pathway Summary: CANNON AFB WW PLAYA LAKE

January 19, 1994
15:54

Receptor / Pathway	Average Exposure			Reasonable Maximum Exposure		
	Cancer Risk	Subchronic H.I.	Chronic H.I.	Cancer Risk	Subchronic H.I.	Chronic H.I.
OCCUP WORKER						
-- Dermal Contact with SEDIMENT	2.30E-10		1.16E-05	6.77E-08		1.03E-03
-- Ingestion of SEDIMENT	5.23E-11		1.58E-04	1.79E-08		2.26E-02
	2.82E-10		1.70E-04	8.56E-08		2.36E-02
CONSTR WORKER						
-- Dermal Contact with SEDIMENT	1.70E-11	7.49E-06		4.73E-10	1.72E-04	
-- Ingestion of SEDIMENT	1.94E-11	4.44E-04		2.29E-10	6.47E-03	
	3.67E-11	4.61E-04		7.03E-10	6.70E-03	
TRESPASSER						
-- Dermal Contact with SEDIMENT	4.55E-11	3.34E-06		8.94E-09	5.43E-04	
-- Ingestion of SEDIMENT	1.04E-11	3.96E-05		1.23E-09	5.77E-03	
	5.67E-11	4.70E-05		1.02E-08	6.42E-03	
FARM WORKER						
-- Dermal Contact with SEDIMENT	1.52E-11		7.65E-07	3.05E-09		3.88E-05
-- Ingestion of SEDIMENT	1.74E-11		5.27E-05	8.60E-10		9.04E-04
	3.45E-11		5.80E-05	3.95E-09		9.74E-04

OCCUP WORKER

Dermal Contact with SEDIMENT DERMAL CONTACT

Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	3.60E-03	6.04E-08	2.17E-10	2.40E-01	5.22E-11	
Benzene	6.50E-06	6.04E-08	3.93E-13	2.90E-02	1.14E-14	
Bis(2 ethylhexyl)phthalate	2.10E-01	6.04E-08	1.27E-08	1.40E-02	1.78E-10	
Chloromethane	2.00E-06	6.04E-08	1.21E-13	1.30E-02	1.57E-15	
						2.30E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.10E-01	4.70E-07	9.86E-08	2.00E-02	4.93E-06	
Butyl Benzyl Phthalate	1.30E-01	4.70E-07	6.11E-08	2.00E-01	3.05E-07	
Carbon Disulfide	8.00E-06	4.70E-07	3.76E-12	1.00E-01	3.76E-11	
Di-n-butyl phthalate	2.00E-02	4.70E-07	9.39E-09	1.00E-01	9.39E-08	
Mercury	4.00E-03	4.70E-07	1.88E-09	3.00E-04	6.26E-06	
Methyl ethyl ketone (2 Butanon	2.50E-05	4.70E-07	1.17E-11	2.00E-02	5.87E-10	
						1.16E-05

OCCUP WORKER
Dermal Contact with SEDIMENT DERMAL CONTACT
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	6.60E-03	9.61E-06	6.34E-08	2.40E-01	1.52E-08	
Benzene	1.10E-05	9.61E-06	1.06E-10	2.90E-02	3.07E-12	
Bis(2 ethylhexyl)phthalate	3.90E-01	9.61E-06	3.75E-06	1.40E-02	5.25E-08	
Chloromethane	2.00E-06	9.61E-06	1.92E-11	1.30E-02	2.50E-13	
						6.77E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.90E-01	2.69E-05	1.05E-05	2.00E-02	5.25E-04	
Butyl Benzyl Phthalate	3.20E-01	2.69E-05	8.61E-06	2.00E-01	4.31E-05	
Carbon Disulfide	1.15E-05	2.69E-05	3.09E-10	1.00E-01	3.09E-09	
Di-n-butyl phthalate	2.00E-02	2.69E-05	5.38E-07	1.00E-01	5.38E-06	
Mercury	5.10E-03	2.69E-05	1.37E-07	3.00E-04	4.57E-04	
Methyl ethyl ketone (2 Butanon	3.40E-05	2.69E-05	9.15E-10	2.00E-02	4.57E-08	
						1.03E-03

OCCUP WORKER

Ingestion of SEDIMENT WASTEWATER PLAYA LAKE

Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	1.18E-01	7.55E-10	8.88E-11	2.40E-01	2.13E-11	
Benzene	1.35E-02	7.55E-10	1.02E-11	2.90E-02	2.96E-13	
Bis(2 ethylhexyl)phthalate	2.90E+00	7.55E-10	2.19E-09	1.40E-02	3.06E-11	
Chloromethane	4.00E-03	7.55E-10	3.02E-12	1.30E-02	3.93E-14	
						5.23E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.90E+00	5.87E-09	1.70E-08	2.00E-02	8.51E-07	
Butyl Benzyl Phthalate	3.20E+02	5.87E-09	1.88E-06	2.00E-01	9.39E-06	
Cadmium (food)	1.95E+00	5.87E-09	1.14E-08	1.00E-03	1.14E-05	
Carbon Disulfide	1.61E-02	5.87E-09	9.45E-11	1.00E-01	9.45E-10	
Chromium	1.98E+01	5.87E-09	1.16E-07	5.00E-03	2.32E-05	
Copper	5.40E+01	5.87E-09	3.17E-07	3.70E-02	8.57E-06	
Di-n-butyl phthalate	2.00E-01	5.87E-09	1.17E-09	1.00E-01	1.17E-08	
Mercury	4.70E-01	5.87E-09	2.76E-09	3.00E-04	9.20E-06	
Methyl ethyl ketone (2 Butanon	5.14E-02	5.87E-09	3.02E-10	2.00E-02	1.51E-08	
Nickel	1.49E+01	5.87E-09	8.77E-08	2.00E-02	4.38E-06	
Selenium	6.60E+00	5.87E-09	3.87E-08	5.00E-03	7.75E-06	
Silver	1.62E+01	5.87E-09	9.53E-08	5.00E-03	1.91E-05	
Vanadium	7.34E+01	5.87E-09	4.31E-07	7.00E-03	6.15E-05	
Zinc	1.36E+02	5.87E-09	7.98E-07	3.00E-01	2.66E-06	
						1.58E-04

OCCUP WORKER

Ingestion of SEDIMENT WASTEWATER PLAYA LAKE

Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	2.20E-01	1.75E-07	3.84E-08	2.40E-01	9.23E-09	
Benzene	2.20E-01	1.75E-07	3.84E-08	2.90E-02	1.11E-09	
Bis(2 ethylhexyl)phthalate	3.09E+00	1.75E-07	5.40E-07	1.40E-02	7.56E-09	
Chloromethane	4.00E-03	1.75E-07	6.99E-10	1.30E-02	9.09E-12	
						1.79E-08

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.09E+00	4.89E-07	1.51E-06	2.00E-02	7.56E-05	
Butyl Benzyl Phthalate	3.20E+02	4.89E-07	1.57E-04	2.00E-01	7.83E-04	
Cadmium (food)	2.60E+00	4.89E-07	1.27E-06	1.00E-03	1.27E-03	
Carbon Disulfide	2.30E-02	4.89E-07	1.13E-08	1.00E-01	1.13E-07	
Chromium	3.55E+01	4.89E-07	1.74E-05	5.00E-03	3.47E-03	
Copper	1.02E+02	4.89E-07	4.99E-05	3.70E-02	1.35E-03	
Di-n-butyl phthalate	2.00E-01	4.89E-07	9.78E-08	1.00E-01	9.78E-07	
Mercury	5.10E-01	4.89E-07	2.50E-07	3.00E-04	8.32E-04	
Methyl ethyl ketone (2 Butanon	6.80E-02	4.89E-07	3.33E-08	2.00E-02	1.66E-06	
Nickel	2.77E+01	4.89E-07	1.36E-05	2.00E-02	6.78E-04	
Selenium	1.32E+01	4.89E-07	6.46E-06	5.00E-03	1.29E-03	
Silver	3.37E+01	4.89E-07	1.65E-05	5.00E-03	3.30E-03	
Vanadium	1.30E+02	4.89E-07	6.36E-05	7.00E-03	9.09E-03	
Zinc	2.75E+02	4.89E-07	1.35E-04	3.00E-01	4.48E-04	
						2.26E-02

CONSTR WORKER
Dermal Contact with SEDIMENT DERMAL CONTACT
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	3.60E-03	4.47E-09	1.61E-11	2.40E-01	3.86E-12	
Benzene	6.50E-06	4.47E-09	2.91E-14	2.90E-02	8.43E-16	
Bis(2 ethylhexyl)phthalate	2.10E-01	4.47E-09	9.39E-10	1.40E-02	1.32E-11	
Chloromethane	2.00E-06	4.47E-09	8.95E-15	1.30E-02	1.16E-16	
						1.70E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.10E-01	3.13E-07	6.58E-08	2.00E-02	3.29E-06	
Butyl Benzyl Phthalate	1.30E-01	3.13E-07	4.07E-08	2.00E+00	2.04E-08	
Carbon Disulfide	8.00E-06	3.13E-07	2.50E-12	1.00E-01	2.50E-11	
Di-n-butyl phthalate	2.00E-02	3.13E-07	6.26E-09	1.00E+00	6.26E-09	
Mercury	4.00E-03	3.13E-07	1.25E-09	3.00E-04	4.17E-06	
Methyl ethyl ketone (2 Butanon	2.50E-05	3.13E-07	7.83E-12	2.00E-01	3.91E-11	
						7.49E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.10E-01	3.13E-07	6.58E-08	2.00E-02	3.29E-06	
Butyl Benzyl Phthalate	1.30E-01	3.13E-07	4.07E-08	2.00E-01	2.04E-07	
Carbon Disulfide	8.00E-06	3.13E-07	2.50E-12	1.00E-01	2.50E-11	
Di-n-butyl phthalate	2.00E-02	3.13E-07	6.26E-09	1.00E-01	6.26E-08	
Mercury	4.00E-03	3.13E-07	1.25E-09	3.00E-04	4.17E-06	
Methyl ethyl ketone (2 Butanon	2.50E-05	3.13E-07	7.83E-12	2.00E-02	3.91E-10	
						7.73E-06

CONSTR WORKER
Dermal Contact with SEDIMENT DERMAL CONTACT
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	6.60E-03	6.71E-08	4.43E-10	2.40E-01	1.06E-10	
Benzene	1.10E-05	6.71E-08	7.38E-13	2.90E-02	2.14E-14	
Bis(2 ethylhexyl)phthalate	3.90E-01	6.71E-08	2.62E-08	1.40E-02	3.66E-10	
Chloromethane	2.00E-06	6.71E-08	1.34E-13	1.30E-02	1.74E-15	
						4.73E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.90E-01	4.70E-06	1.83E-06	2.00E-02	9.16E-05	
Butyl Benzyl Phthalate	3.20E-01	4.70E-06	1.50E-06	2.00E+00	7.51E-07	
Carbon Disulfide	1.15E-05	4.70E-06	5.40E-11	1.00E-01	5.40E-10	
Di-n-butyl phthalate	2.00E-02	4.70E-06	9.39E-08	1.00E+00	9.39E-08	
Mercury	5.10E-03	4.70E-06	2.40E-08	3.00E-04	7.98E-05	
Methyl ethyl ketone (2 Butanon	3.40E-05	4.70E-06	1.60E-10	2.00E-01	7.98E-10	
						1.72E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.90E-01	4.70E-06	1.83E-06	2.00E-02	9.16E-05	
Butyl Benzyl Phthalate	3.20E-01	4.70E-06	1.50E-06	2.00E-01	7.51E-06	
Carbon Disulfide	1.15E-05	4.70E-06	5.40E-11	1.00E-01	5.40E-10	
Di-n-butyl phthalate	2.00E-02	4.70E-06	9.39E-08	1.00E-01	9.39E-07	
Mercury	5.10E-03	4.70E-06	2.40E-08	3.00E-04	7.98E-05	
Methyl ethyl ketone (2 Butanon	3.40E-05	4.70E-06	1.60E-10	2.00E-02	7.98E-09	
						1.80E-04

CONSTR WORKER
Ingestion of SEDIMENT WASTEWATER PLAYA LAKE
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	1.18E-01	2.80E-10	3.29E-11	2.40E-01	7.90E-12	
Benzene	1.35E-02	2.80E-10	3.78E-12	2.90E-02	1.10E-13	
Bis(2 ethylhexyl)phthalate	2.90E+00	2.80E-10	8.11E-10	1.40E-02	1.14E-11	
Chloromethane	4.00E-03	2.80E-10	1.12E-12	1.30E-02	1.45E-14	
						1.94E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.09E+00	1.96E-08	4.09E-08	2.00E-02	2.05E-06	
Butyl Benzyl Phthalate	3.20E+02	1.96E-08	6.26E-06	2.00E+00	3.13E-06	
Carbon Disulfide	1.61E-02	1.96E-08	3.15E-10	1.00E-01	3.15E-09	
Chromium	1.98E+01	1.96E-08	3.87E-07	2.00E-02	1.94E-05	
Copper	5.40E+01	1.96E-08	1.06E-06	3.70E-02	2.86E-05	
Di-n-butyl phthalate	2.00E-01	1.96E-08	3.91E-09	1.00E+00	3.91E-09	
Mercury	4.70E-01	1.96E-08	9.20E-09	3.00E-04	3.07E-05	
Methyl ethyl ketone (2 Butanon	5.14E-02	1.96E-08	1.01E-09	2.00E-01	5.03E-09	
Nickel	1.49E+01	1.96E-08	2.92E-07	2.00E-02	1.46E-05	
Selenium	6.60E+00	1.96E-08	1.29E-07	5.00E-03	2.58E-05	
Silver	1.62E+01	1.96E-08	3.18E-07	3.00E-03	1.06E-04	
Vanadium	7.34E+01	1.96E-08	1.44E-06	7.00E-03	2.05E-04	
Zinc	1.36E+02	1.96E-08	2.66E-06	3.00E-01	8.87E-06	
						4.44E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.90E+00	1.96E-08	5.68E-08	2.00E-02	2.84E-06	
Butyl Benzyl Phthalate	3.20E+02	1.96E-08	6.26E-06	2.00E-01	3.13E-05	
Cadmium (food)	1.95E+00	1.96E-08	3.82E-08	1.00E-03	3.82E-05	
Carbon Disulfide	1.61E-02	1.96E-08	3.15E-10	1.00E-01	3.15E-09	
Chromium	1.98E+01	1.96E-08	3.87E-07	5.00E-03	7.75E-05	
Copper	5.40E+01	1.96E-08	1.06E-06	3.70E-02	2.86E-05	
Di-n-butyl phthalate	2.00E-01	1.96E-08	3.91E-09	1.00E-01	3.91E-08	
Mercury	4.70E-01	1.96E-08	9.20E-09	3.00E-04	3.07E-05	
Methyl ethyl ketone (2 Butanon	5.14E-02	1.96E-08	1.01E-09	2.00E-02	5.03E-08	
Nickel	1.49E+01	1.96E-08	2.92E-07	2.00E-02	1.46E-05	
Selenium	6.60E+00	1.96E-08	1.29E-07	5.00E-03	2.58E-05	
Silver	1.62E+01	1.96E-08	3.18E-07	5.00E-03	6.35E-05	

Vanadium	7.34E+01	1.96E-08	1.44E-06	7.00E-03	2.05E-04	
Zinc	1.36E+02	1.96E-08	2.66E-06	3.00E-01	8.87E-06	
						5.27E-04

CONSTR WORKER
Ingestion of SEDIMENT WASTEWATER PLAYA LAKE
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	2.20E-01	2.24E-09	4.92E-10	2.40E-01	1.18E-10	
Benzene	2.20E-01	2.24E-09	4.92E-10	2.90E-02	1.43E-11	
Bis(2 ethylhexyl)phthalate	3.09E+00	2.24E-09	6.91E-09	1.40E-02	9.68E-11	
Chloromethane	4.00E-03	2.24E-09	8.95E-12	1.30E-02	1.16E-13	
						2.29E-10

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.90E+00	1.57E-07	6.11E-07	2.00E-02	3.05E-05	
Butyl Benzyl Phthalate	3.20E+02	1.57E-07	5.01E-05	2.00E+00	2.50E-05	
Carbon Disulfide	2.30E-02	1.57E-07	3.60E-09	1.00E-01	3.60E-08	
Chromium	3.55E+01	1.57E-07	5.56E-06	2.00E-02	2.78E-04	
Copper	1.02E+02	1.57E-07	1.60E-05	3.70E-02	4.32E-04	
Di-n-butyl phthalate	2.00E-01	1.57E-07	3.13E-08	1.00E+00	3.13E-08	
Mercury	5.10E-01	1.57E-07	7.98E-08	3.00E-04	2.66E-04	
Methyl ethyl ketone (2 Butanon	6.80E-02	1.57E-07	1.06E-08	2.00E-01	5.32E-08	
Nickel	2.77E+01	1.57E-07	4.34E-06	2.00E-02	2.17E-04	
Selenium	1.32E+01	1.57E-07	2.07E-06	5.00E-03	4.13E-04	
Silver	3.37E+01	1.57E-07	5.28E-06	3.00E-03	1.76E-03	
Vanadium	1.30E+02	1.57E-07	2.04E-05	7.00E-03	2.91E-03	
Zinc	2.75E+02	1.57E-07	4.31E-05	3.00E-01	1.44E-04	
						6.47E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.09E+00	1.57E-07	4.84E-07	2.00E-02	2.42E-05	
Butyl Benzyl Phthalate	3.20E+02	1.57E-07	5.01E-05	2.00E-01	2.50E-04	
Cadmium (food)	2.60E+00	1.57E-07	4.07E-07	1.00E-03	4.07E-04	
Carbon Disulfide	2.30E-02	1.57E-07	3.60E-09	1.00E-01	3.60E-08	
Chromium	3.55E+01	1.57E-07	5.56E-06	5.00E-03	1.11E-03	
Copper	1.02E+02	1.57E-07	1.60E-05	3.70E-02	4.32E-04	
Di-n-butyl phthalate	2.00E-01	1.57E-07	3.13E-08	1.00E-01	3.13E-07	
Mercury	5.10E-01	1.57E-07	7.98E-08	3.00E-04	2.66E-04	
Methyl ethyl ketone (2 Butanon	6.80E-02	1.57E-07	1.06E-08	2.00E-02	5.32E-07	
Nickel	2.77E+01	1.57E-07	4.34E-06	2.00E-02	2.17E-04	
Selenium	1.32E+01	1.57E-07	2.07E-06	5.00E-03	4.13E-04	
Silver	3.37E+01	1.57E-07	5.28E-06	5.00E-03	1.06E-03	

Vanadium	1.30E+02	1.57E-07	2.04E-05	7.00E-03	2.91E-03	
Zinc	2.75E+02	1.57E-07	4.31E-05	3.00E-01	1.44E-04	
						7.23E-03

TRESPASSER
Dermal Contact with SEDIMENT
Average Exposure

DERMAL CONTACT

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	3.60E-03	1.20E-08	4.31E-11	2.40E-01	1.03E-11	
Benzene	6.50E-06	1.20E-08	7.78E-14	2.90E-02	2.26E-15	
Bis(2 ethylhexyl)phthalate	2.10E-01	1.20E-08	2.51E-09	1.40E-02	3.52E-11	
Chloromethane	2.00E-06	1.20E-08	2.39E-14	1.30E-02	3.11E-16	
						4.55E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.10E-01	1.40E-07	2.93E-08	2.00E-02	1.47E-06	
Butyl Benzyl Phthalate	1.30E-01	1.40E-07	1.82E-08	2.00E+00	9.08E-09	
Carbon Disulfide	8.00E-06	1.40E-07	1.12E-12	1.00E-01	1.12E-11	
Di-n-butyl phthalate	2.00E-02	1.40E-07	2.79E-09	1.00E+00	2.79E-09	
Mercury	4.00E-03	1.40E-07	5.59E-10	3.00E-04	1.86E-06	
Methyl ethyl ketone (2 Butanon	2.50E-05	1.40E-07	3.49E-12	2.00E-01	1.75E-11	
						3.34E-06

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.10E-01	1.40E-07	2.93E-08	2.00E-02	1.47E-06	
Butyl Benzyl Phthalate	1.30E-01	1.40E-07	1.82E-08	2.00E-01	9.08E-08	
Carbon Disulfide	8.00E-06	1.40E-07	1.12E-12	1.00E-01	1.12E-11	
Di-n-butyl phthalate	2.00E-02	1.40E-07	2.79E-09	1.00E-01	2.79E-08	
Mercury	4.00E-03	1.40E-07	5.59E-10	3.00E-04	1.86E-06	
Methyl ethyl ketone (2 Butanon	2.50E-05	1.40E-07	3.49E-12	2.00E-02	1.75E-10	
						3.45E-06

TRESPASSER
Dermal Contact with SEDIMENT DERMAL CONTACT
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	6.60E-03	1.27E-06	8.38E-09	2.40E-01	2.01E-09	
Benzene	1.10E-05	1.27E-06	1.40E-11	2.90E-02	4.05E-13	
Bis(2 ethylhexyl)phthalate	3.90E-01	1.27E-06	4.95E-07	1.40E-02	6.93E-09	
Chloromethane	2.00E-06	1.27E-06	2.54E-12	1.30E-02	3.30E-14	
						8.94E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.90E-01	1.48E-05	5.77E-06	2.00E-02	2.89E-04	
Butyl Benzyl Phthalate	3.20E-01	1.48E-05	4.74E-06	2.00E+00	2.37E-06	
Carbon Disulfide	1.15E-05	1.48E-05	1.70E-10	1.00E-01	1.70E-09	
Di-n-butyl phthalate	2.00E-02	1.48E-05	2.96E-07	1.00E+00	2.96E-07	
Mercury	5.10E-03	1.48E-05	7.55E-08	3.00E-04	2.52E-04	
Methyl ethyl ketone (2 Butanon	3.40E-05	1.48E-05	5.03E-10	2.00E-01	2.52E-09	
						5.43E-04

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.90E-01	1.48E-05	5.77E-06	2.00E-02	2.89E-04	
Butyl Benzyl Phthalate	3.20E-01	1.48E-05	4.74E-06	2.00E-01	2.37E-05	
Carbon Disulfide	1.15E-05	1.48E-05	1.70E-10	1.00E-01	1.70E-09	
Di-n-butyl phthalate	2.00E-02	1.48E-05	2.96E-07	1.00E-01	2.96E-06	
Mercury	5.10E-03	1.48E-05	7.55E-08	3.00E-04	2.52E-04	
Methyl ethyl ketone (2 Butanon	3.40E-05	1.48E-05	5.03E-10	2.00E-02	2.52E-08	
						5.67E-04

TRESPASSER
Ingestion of SEDIMENT WASTEWATER PLAYA LAKE
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	1.18E-01	1.50E-10	1.76E-11	2.40E-01	4.23E-12	
Benzene	1.35E-02	1.50E-10	2.02E-12	2.90E-02	5.87E-14	
Bis(2 ethylhexyl)phthalate	2.90E+00	1.50E-10	4.34E-10	1.40E-02	6.08E-12	
Chloromethane	4.00E-03	1.50E-10	5.99E-13	1.30E-02	7.78E-15	
						1.04E-11

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.09E+00	1.75E-09	3.65E-09	2.00E-02	1.82E-07	
Butyl Benzyl Phthalate	3.20E+02	1.75E-09	5.59E-07	2.00E+00	2.79E-07	
Carbon Disulfide	1.61E-02	1.75E-09	2.81E-11	1.00E-01	2.81E-10	
Chromium	1.98E+01	1.75E-09	3.46E-08	2.00E-02	1.73E-06	
Copper	5.40E+01	1.75E-09	9.43E-08	3.70E-02	2.55E-06	
Di-n-butyl phthalate	2.00E-01	1.75E-09	3.49E-10	1.00E+00	3.49E-10	
Mercury	4.70E-01	1.75E-09	8.21E-10	3.00E-04	2.74E-06	
Methyl ethyl ketone (2 Butanon	5.14E-02	1.75E-09	8.97E-11	2.00E-01	4.49E-10	
Nickel	1.49E+01	1.75E-09	2.61E-08	2.00E-02	1.30E-06	
Selenium	6.60E+00	1.75E-09	1.15E-08	5.00E-03	2.30E-06	
Silver	1.62E+01	1.75E-09	2.83E-08	3.00E-03	9.45E-06	
Vanadium	7.34E+01	1.75E-09	1.28E-07	7.00E-03	1.83E-05	
Zinc	1.36E+02	1.75E-09	2.37E-07	3.00E-01	7.91E-07	
						3.96E-05

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.90E+00	1.75E-09	5.06E-09	2.00E-02	2.53E-07	
Butyl Benzyl Phthalate	3.20E+02	1.75E-09	5.59E-07	2.00E-01	2.79E-06	
Cadmium (food)	1.95E+00	1.75E-09	3.40E-09	1.00E-03	3.40E-06	
Carbon Disulfide	1.61E-02	1.75E-09	2.81E-11	1.00E-01	2.81E-10	
Chromium	1.98E+01	1.75E-09	3.46E-08	5.00E-03	6.91E-06	
Copper	5.40E+01	1.75E-09	9.43E-08	3.70E-02	2.55E-06	
Di-n-butyl phthalate	2.00E-01	1.75E-09	3.49E-10	1.00E-01	3.49E-09	
Mercury	4.70E-01	1.75E-09	8.21E-10	3.00E-04	2.74E-06	
Methyl ethyl ketone (2 Butanon	5.14E-02	1.75E-09	8.97E-11	2.00E-02	4.49E-09	
Nickel	1.49E+01	1.75E-09	2.61E-08	2.00E-02	1.30E-06	
Selenium	6.60E+00	1.75E-09	1.15E-08	5.00E-03	2.30E-06	
Silver	1.62E+01	1.75E-09	2.83E-08	5.00E-03	5.67E-06	

Vanadium	7.34E+01	1.75E-09	1.28E-07	7.00E-03	1.83E-05	
Zinc	1.36E+02	1.75E-09	2.37E-07	3.00E-01	7.91E-07	
						4.70E-05

TRESPASSER
Ingestion of SEDIMENT WASTEWATER PLAYA LAKE
Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	2.20E-01	1.20E-08	2.63E-09	2.40E-01	6.32E-10	
Benzene	2.20E-01	1.20E-08	2.63E-09	2.90E-02	7.64E-11	
Bis(2 ethylhexyl)phthalate	3.09E+00	1.20E-08	3.70E-08	1.40E-02	5.18E-10	
Chloromethane	4.00E-03	1.20E-08	4.79E-11	1.30E-02	6.23E-13	
						1.23E-09

Hazard Index -- Subchronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Subchronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.90E+00	1.40E-07	5.45E-07	2.00E-02	2.72E-05	
Butyl Benzyl Phthalate	3.20E+02	1.40E-07	4.47E-05	2.00E+00	2.23E-05	
Carbon Disulfide	2.30E-02	1.40E-07	3.21E-09	1.00E-01	3.21E-08	
Chromium	3.55E+01	1.40E-07	4.96E-06	2.00E-02	2.48E-04	
Copper	1.02E+02	1.40E-07	1.42E-05	3.70E-02	3.85E-04	
Di-n-butyl phthalate	2.00E-01	1.40E-07	2.79E-08	1.00E+00	2.79E-08	
Mercury	5.10E-01	1.40E-07	7.12E-08	3.00E-04	2.37E-04	
Methyl ethyl ketone (2 Butanon	6.80E-02	1.40E-07	9.50E-09	2.00E-01	4.75E-08	
Nickel	2.77E+01	1.40E-07	3.87E-06	2.00E-02	1.93E-04	
Selenium	1.32E+01	1.40E-07	1.84E-06	5.00E-03	3.69E-04	
Silver	3.37E+01	1.40E-07	4.71E-06	3.00E-03	1.57E-03	
Vanadium	1.30E+02	1.40E-07	1.82E-05	7.00E-03	2.59E-03	
Zinc	2.75E+02	1.40E-07	3.84E-05	3.00E-01	1.28E-04	
						5.77E-03

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.09E+00	1.40E-07	4.32E-07	2.00E-02	2.16E-05	
Butyl Benzyl Phthalate	3.20E+02	1.40E-07	4.47E-05	2.00E-01	2.23E-04	
Cadmium (food)	2.60E+00	1.40E-07	3.63E-07	1.00E-03	3.63E-04	
Carbon Disulfide	2.30E-02	1.40E-07	3.21E-09	1.00E-01	3.21E-08	
Chromium	3.55E+01	1.40E-07	4.96E-06	5.00E-03	9.92E-04	
Copper	1.02E+02	1.40E-07	1.42E-05	3.70E-02	3.85E-04	
Di-n-butyl phthalate	2.00E-01	1.40E-07	2.79E-08	1.00E-01	2.79E-07	
Mercury	5.10E-01	1.40E-07	7.12E-08	3.00E-04	2.37E-04	
Methyl ethyl ketone (2 Butanon	6.80E-02	1.40E-07	9.50E-09	2.00E-02	4.75E-07	
Nickel	2.77E+01	1.40E-07	3.87E-06	2.00E-02	1.93E-04	
Selenium	1.32E+01	1.40E-07	1.84E-06	5.00E-03	3.69E-04	
Silver	3.37E+01	1.40E-07	4.71E-06	5.00E-03	9.41E-04	

Vanadium	1.30E+02	1.40E-07	1.82E-05	7.00E-03	2.59E-03	
Zinc	2.75E+02	1.40E-07	3.84E-05	3.00E-01	1.28E-04	
						6.45E-03

FARM WORKER

Dermal Contact with SEDIMENT DERMAL CONTACT

Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	3.60E-03	3.99E-09	1.43E-11	2.40E-01	3.44E-12	
Benzene	6.50E-06	3.99E-09	2.59E-14	2.90E-02	7.51E-16	
Bis(2 ethylhexyl)phthalate	2.10E-01	3.99E-09	8.37E-10	1.40E-02	1.17E-11	
Chloromethane	2.00E-06	3.99E-09	7.97E-15	1.30E-02	1.04E-16	
						1.52E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.10E-01	3.10E-08	6.51E-09	2.00E-02	3.25E-07	
Butyl Benzyl Phthalate	1.30E-01	3.10E-08	4.03E-09	2.00E-01	2.01E-08	
Carbon Disulfide	8.00E-06	3.10E-08	2.48E-13	1.00E-01	2.48E-12	
Di-n-butyl phthalate	2.00E-02	3.10E-08	6.20E-10	1.00E-01	6.20E-09	
Mercury	4.00E-03	3.10E-08	1.24E-10	3.00E-04	4.13E-07	
Methyl ethyl ketone (2 Butanon	2.50E-05	3.10E-08	7.75E-13	2.00E-02	3.87E-11	
						7.65E-07

FARM WORKER

Dermal Contact with SEDIMENT DERMAL CONTACT

Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	6.60E-03	4.34E-07	2.86E-09	2.40E-01	6.87E-10	
Benzene	1.10E-05	4.34E-07	4.77E-12	2.90E-02	1.38E-13	
Bis(2 ethylhexyl)phthalate	3.90E-01	4.34E-07	1.69E-07	1.40E-02	2.37E-09	
Chloromethane	2.00E-06	4.34E-07	8.67E-13	1.30E-02	1.13E-14	
						3.05E-09

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Dermal Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.90E-01	1.01E-06	3.95E-07	2.00E-02	1.97E-05	
Butyl Benzyl Phthalate	3.20E-01	1.01E-06	3.24E-07	2.00E-01	1.62E-06	
Carbon Disulfide	1.15E-05	1.01E-06	1.16E-11	1.00E-01	1.16E-10	
Di-n-butyl phthalate	2.00E-02	1.01E-06	2.02E-08	1.00E-01	2.02E-07	
Mercury	5.10E-03	1.01E-06	5.16E-09	3.00E-04	1.72E-05	
Methyl ethyl ketone (2 Butanon	3.40E-05	1.01E-06	3.44E-11	2.00E-02	1.72E-09	
						3.88E-05

FARM WORKER
Ingestion of SEDIMENT WASTEWATER PLAYA LAKE
Average Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	1.18E-01	2.52E-10	2.96E-11	2.40E-01	7.11E-12	
Benzene	1.35E-02	2.52E-10	3.40E-12	2.90E-02	9.87E-14	
Bis(2 ethylhexyl)phthalate	2.90E+00	2.52E-10	7.30E-10	1.40E-02	1.02E-11	
Chloromethane	4.00E-03	2.52E-10	1.01E-12	1.30E-02	1.31E-14	
						1.74E-11

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	2.90E+00	1.96E-09	5.68E-09	2.00E-02	2.84E-07	
Butyl Benzyl Phthalate	3.20E+02	1.96E-09	6.26E-07	2.00E-01	3.13E-06	
Cadmium (food)	1.95E+00	1.96E-09	3.82E-09	1.00E-03	3.82E-06	
Carbon Disulfide	1.61E-02	1.96E-09	3.15E-11	1.00E-01	3.15E-10	
Chromium	1.98E+01	1.96E-09	3.87E-08	5.00E-03	7.75E-06	
Copper	5.40E+01	1.96E-09	1.06E-07	3.70E-02	2.86E-06	
Di-n-butyl phthalate	2.00E-01	1.96E-09	3.91E-10	1.00E-01	3.91E-09	
Mercury	4.70E-01	1.96E-09	9.20E-10	3.00E-04	3.07E-06	
Methyl ethyl ketone (2 Butanon	5.14E-02	1.96E-09	1.01E-10	2.00E-02	5.03E-09	
Nickel	1.49E+01	1.96E-09	2.92E-08	2.00E-02	1.46E-06	
Selenium	6.60E+00	1.96E-09	1.29E-08	5.00E-03	2.58E-06	
Silver	1.62E+01	1.96E-09	3.18E-08	5.00E-03	6.35E-06	
Vanadium	7.34E+01	1.96E-09	1.44E-07	7.00E-03	2.05E-05	
Zinc	1.36E+02	1.96E-09	2.66E-07	3.00E-01	8.87E-07	
						5.27E-05

FARM WORKER

Ingestion of SEDIMENT WASTEWATER PLAYA LAKE

Reasonable Maximum Exposure

Carcinogenic Risk

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day)-1	Carcinogenic Risk	Total Risk
4,4'-DDD	2.20E-01	8.39E-09	1.85E-09	2.40E-01	4.43E-10	
Benzene	2.20E-01	8.39E-09	1.85E-09	2.90E-02	5.35E-11	
Bis(2 ethylhexyl)phthalate	3.09E+00	8.39E-09	2.59E-08	1.40E-02	3.63E-10	
Chloromethane	4.00E-03	8.39E-09	3.35E-11	1.30E-02	4.36E-13	
						8.60E-10

Hazard Index -- Chronic

Chemical	Chemical Concentration (mg/kg)	Ingestion Intake Factor (kg/kg/day)	Daily Intake (mg/kg/day)	Chronic RFD (mg/kg/day)	Hazard Quotient	Hazard Index
Bis(2 ethylhexyl)phthalate	3.09E+00	1.96E-08	6.05E-08	2.00E-02	3.02E-06	
Butyl Benzyl Phthalate	3.20E+02	1.96E-08	6.26E-06	2.00E-01	3.13E-05	
Cadmium (food)	2.60E+00	1.96E-08	5.09E-08	1.00E-03	5.09E-05	
Carbon Disulfide	2.30E-02	1.96E-08	4.50E-10	1.00E-01	4.50E-09	
Chromium	3.55E+01	1.96E-08	6.95E-07	5.00E-03	1.39E-04	
Copper	1.02E+02	1.96E-08	2.00E-06	3.70E-02	5.39E-05	
Di-n-butyl phthalate	2.00E-01	1.96E-08	3.91E-09	1.00E-01	3.91E-08	
Mercury	5.10E-01	1.96E-08	9.98E-09	3.00E-04	3.33E-05	
Methyl ethyl ketone (2 Butanon	6.80E-02	1.96E-08	1.33E-09	2.00E-02	6.65E-08	
Nickel	2.77E+01	1.96E-08	5.42E-07	2.00E-02	2.71E-05	
Selenium	1.32E+01	1.96E-08	2.58E-07	5.00E-03	5.17E-05	
Silver	3.37E+01	1.96E-08	6.59E-07	5.00E-03	1.32E-04	
Vanadium	1.30E+02	1.96E-08	2.54E-06	7.00E-03	3.63E-04	
Zinc	2.75E+02	1.96E-08	5.38E-06	3.00E-01	1.79E-05	
						9.04E-04