CAFB 96

DEPARTMENT OF THE AIR FORCE

AIR COMBAT COMMAND CIVIL ENGINEER SQUADRON
LANGLEY AIR FORCE BASE, VIRGINIA

12 FEB 1996

MEMORANDUM FOR Hazardous and Radioactive Waste Bureau (Mr. Pullen)
P.O. Box 26110 New Mexico Environment Department
Santa Fe NM 87502

FROM: ACC CES/ESVW
129 Andrews St Ste 102
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SUBJECT: Environmental Restoration and Compliance Guidance Manuals

1. Enclosed is a copy of the Air Combat Command (ACC) Installation Restoration Program (IRP) Remedial Project Manager's Guide. This program is designed to identify, investigate, and clean up past (prior to 1984) waste disposal/release sites that are causing or are expected to cause environmental contamination. This document is a guide rather than an all-inclusive manual.

2. Also enclosed is the Environmental Compliance Managers Handbook. Its intent is to provide policies and directives to enable each ACC installation the opportunity to fully comply with the law. It provides a summary of the experience and expertise of the Command in environmental compliance. Addressed within this program guidance document are directives and specific suggestions on how ACC plans to deal with some of the regulatory complexities. Specific topics are addressed and Command guidance is provided to assist base environmental managers in the execution of their responsibilities. Environmental topics are not rigorously addressed. Each regulatory program is presented within the Act from which it is governed. Specific topics relative to the Command's mission effectiveness and accomplishment are reviewed. Each wing must decide what is best for their specific problem or issue, but must adhere to the concepts and principles presented. Deviations from this guidance must be requested from HQ ACC/CEV. The wing commander is responsible for all environmental compliance. This policy is provided to support him/her in their environmental stewardship role. The Command environmental programs division is committed to doing everything within its resources to ensure the wing commander has every possible tool at his/her disposal to ensure the wing, the Command, and the Air Force's full environmental compliance while simultaneously sustaining the Air Combat Command Fly and Fight Mission

3. Please direct any questions related to the Restoration Program to Ms. Margaret Calvert, ACC CES/ESVW, at (804) 764-6249/4613. Any questions related to the Compliance Program may be addressed by Mr. Russ Shannon, HQ ACC/CEVCM, at (804) 764-3668.

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Restoration Program Manager
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Global Power For America

Rational National Standards Initiative
Project # MUHJ 93-7059

RATIONAL NATIONAL STANDARDS INITIATIVE
AIR COMBAT COMMAND

PATHWAYS, PARAMETERS, AND EQUATIONS REPORT

Prepared for:

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Acronym List

ACC	Air Combat Command
ACP	Accelerated Cleanup Program
ADEQ	Arizona Department of Environmental Quality
AFB	Air Force Base
AFR	Air Force Range
ARAR	Applicable or Relevant and Appropriate Requirement
ARSD	Administrative Rules of South Dakota
AWQC	Ambient Water Quality Criteria
BCP	Base Comprehensive Plan
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
DAF	Dilution and Attenuation Factor
DBCP	1,2-Dibromo-3-chloropropane
DOE	Department of Energy
DPM	Defense Priority Model
DRO	Diesel Range Organics
EA	Environmental Assessment
EAG	Exposure Assessment Group
EPA	Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FFA	Federal Facility Agreement
FS	Feasibility Study
FTA	Fire Training Area
HBGL	Health-Based Guidance Levels
HQ	Hazard Quotient
HSWA	Hazardous and Solid Waste Amendments of 1984

Acronym List (con't)

IEUBK	Integrated Exposure Uptake Biokinetic Model
IRA	Interim Remedial Action
IRP	Installation Restoration Program
MAP	Management Action Plan
MCL	Maximum Contaminant Level
MSC	Medium Specific Concentrations
NAS	National Academy of Sciences
NCP	National Contingency Plan
NPL	National Priority List
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PA/SI	Preliminary Assessment/Sight Inspection
PEF	Particulate Emission Factor
POL	Petroleum, Oil, and Lubricant
PPE	Pathways, Parameters, and Equations
PRGs	Preliminary Remediation Goal
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RACER	Remedial Action Cost, Engineering, and Requirements System
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act of 1976
RESRAD	Residual Radioactivity Software
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RNSI	Rational National Standards Initiative
SARA	Superfund Amendments and Reauthorization Act of 1986
SDCL	South Dakota Codified Law

Acronym List (con't)

SDDENR	South Dakota Department of Environmental and Natural Resources
SLG	Soil Level Goal
TNRCC	Texas Natural Resource Conservation Commission
TPH	Total Petroleum Hydrocarbons
TR	Target Risk
TRRS	Texas Risk Reduction Standards
TSCA	Toxic Substance Control Act
UCL	Upper Confidence Limit
USAF	United States Air Force
UST	Underground Storage Tank
WWII	World War II
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

Trends in the environmental industry, including the Environmental Protection Agency (EPA) Superfund program, are to take a proactive approach toward the use of risk assessments to establish cleanup goals at contaminated sites. Recent activity shows that these programs are moving toward the use of risk-based cleanup goals and the recognition that differing cleanup goals should be established depending on future use of the property. This approach focuses on the fact that human exposure to soil and groundwater in a residential setting is more frequent and of greater duration than exposure in an open space, commercial, or industrial setting. Therefore, cleanup levels for contaminated sites whose future land uses are open space, commercial, and industrial purposes are expected to be less restrictive than current regulatory cleanup standards being applied to clean up Air Force Installation Restoration Program (IRP) sites. Sites that are remediated to designated land use criteria will be deed restricted or another similar mechanism will be used to insure that the land use does not change without prior evaluation of cleanup criteria.

The Air Force has chosen to apply this philosophy to the cleanup of IRP sites. This approach has been documented in this and two other reports, the Management Action Plan Revisions and a new Attachment to Appendix A of the Management Action Plan (MAP).

The process of implementing this philosophy began by contacting the various EPA and state agencies to identify those equations that will be used to calculate risk that EPA has agreed are acceptable for use in risk evaluations. Appropriate exposure factors and assumptions were then documented for each future land use scenario, and conceptual site models were developed for each active IRP site. Potential future land uses of IRP sites, accepted EPA algorithms, exposure factors, and conceptual site models are documented in the Pathways, Parameters, and Equations (PPE) report.

The first section of the PPE report explains the general technical approach that will be used to determine the risk-based screening levels for each of four future land use categories; industrial, commercial, residential, and open space land uses.

The subsequent chapters of the report apply this general approach to the 18 individual Air Combat Command (ACC) Air Force Bases (AFBs) using site-specific data.

Once the equations and methods were documented, the exposure factors shown in the PPE report were applied to the EPA and state accepted algorithms used for risk evaluation. From this, screening levels were developed for soil and groundwater for each future use scenario at each active IRP site. Constituents exceeding risk-based screening levels were retained for remedy selection and cost analysis. Constituents below risk-based screening levels were eliminated from further consideration. An explanation of the development of the future use screening levels, remedy selection process, and cost analysis is displayed in the MAP Revisions (bound separately). In addition, summary tables displaying the screening levels and cost comparisons of the application of remedial technologies required to cleanup sites to those concentrations is documented in the MAP as well. Calculations supporting the development of future use risk-based screening levels, drawings noting the area and type of contamination requiring cleanup for each land use scenario, and detailed Remedial Action Cost, Engineering, and Requirements System (RACER) estimates supporting the cost impact on each future land use scenario are displayed in a new Attachment to Appendix A of the MAP (bound separately).

This approach is important in that it is currently in keeping with environmental regulatory trends. Its success depends on Air Force, community, and regulatory involvement. Air Force environmental project teams will meet with the regulators and community planners to work together to make decisions regarding the reuse of land at ACC installations that meets the needs of both the community and Air Force. This will serve as a springboard for restoration activities at each installation by restricting the use of the property and initiating only those cleanup actions required to provide a safe environment for inhabitants of the land

in the future. If the land use should be reassigned, then the cleanup actions/criteria would be reopened and reviewed by the Base and regulatory agency at that time.

1.0 INTRODUCTION

1.1 Project Objectives

The U.S. Air Force (USAF) has developed Management Action Plans (MAPs) for each of the Air Combat Command (ACC) bases. A portion of each plan was dedicated to identifying current regulatory cleanup standards and estimating costs and timeframes to remediate each Air Force Installation Restoration Program (IRP) site to meet current regulatory requirements. This document will provide a risk management tool for establishing risk-based criteria to screen out waste constituents that pose risks below the target risk to human health and development of risk-based screening levels based on proposed land use, for those chemicals that potentially could pose risk. The Pathways, Parameters, and Equations (PPE) Report represents the initial stage of this project. The objectives of this work effort are to:

- Evaluate current land use/future reuse options for active IRP sites;
- Develop conceptual site models for active IRP sites that define onsite and offsite exposure pathways for the probable future land use;
- Select exposure equations and default assumptions for each pathway based on land use;
- Identify a method to determine chemicals of potential concern that may drive risks at active IRP sites where analytical data exist; and
- Develop risk-based screening levels for chemicals of potential concern based on probable land uses.

Subsequent stages of this work reported in the Management Action Plan (MAP) will:

- Identify chemicals of potential concern;
- Calculate screening levels based on equations and default exposure assumptions selected;

- Evaluate and select potential remedial technologies to accomplish risk-based screening levels;
- Estimate costs to remediate each IRP site for each probable land use; and
- Incorporate the results into the previously prepared MAPs.

The Rational National Standards Initiative (RNSI) establishes a consistent risk management paradigm, and the results of the RNSI process can be utilized in various stages of the IRP. During the early stages of site investigations, the RNSI process provides a consistent protocol for establishing screening levels. Utilizing the Base Comprehensive Plan (BCP) as a baseline, the future land use and potential exposure pathways may be identified. As sites become fully characterized, the RNSI process may provide chemical-specific remedial goals and remedial technology options.

In early phases of site study, this process also may provide insight that will focus sampling plans. For sites that require a formal baseline risk assessment under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA), the RNSI process provides conceptual site exposure models and preliminary remediation goals (PRGs) that are consistent with Environmental Protection Agency (EPA) guidance (EPA 1991c). As a screening tool, the RNSI screening levels may be used to eliminate chemicals of potential concern (COPCs), and IRP sites may be designated as requiring no further action when all chemical concentrations are below the RNSI screening levels for the chosen land use.

The first portion (Sections 2.0 through 7.0) of the PPE report provides information on the technical approach for establishing screening levels for existing contaminants based on risk and proposed land use. The PPE sections will include land use definitions, exposure factors, pathways to be considered, conceptual site models for the three most common types of sites at Air Force Bases (AFBs), and equations used to derive the screening

levels. The chapters following Section 7.0 of the PPE report present base-specific information on the following ACC bases:

- Avon Park AFR;
- Barksdale AFB;
- Beale AFB;
- Cannon AFB;
- Davis-Monthan AFB;
- Dyess AFB:
- Ellsworth AFB;
- Holloman AFB;
- Langley AFB;
- Little Rock AFB;
- Minot AFB;
- Moody AFB;
- Nellis AFB;
- Offutt AFB;
- Pope AFB;
- Seymour-Johnson AFB;
- Shaw AFB; and
- Whiteman AFB.

These chapters will include a regulatory overview of the bases followed by site-by-site evaluations.

2.0 LAND AND GROUNDWATER USE

This project is based on the premise that contaminated sites should be cleaned up to a level consistent with intended future use. All Air Force installations are required to have both a land use plan and a long-range facilities development plan (USAF 1992). Physical constraints, restrictions imposed by airfield or explosive safety criteria, and compatibility with the development of communities surrounding the base are considered during base comprehensive planning.

2.1 Land and Groundwater Use Definitions

There is a limited number of land uses that need to be considered at any given AFB. The range of reasonable future uses for a specific site will be determined by surrounding land uses and projections for likely development in the area of the site, and will be consistent with the Base Comprehensive Plan (BCP). Likely future uses of natural resources, such as soil and groundwater at each site, are a function of future land use. The exposure scenarios presented in this document and their corresponding assumptions have been developed within the context of the land use classifications and associated uses of soil and groundwater presented in Tables 2-1 and 2-2. The restrictions on land and natural resources are adapted from *Future Use Considerations in the Cleanup of Air Force Installations* (USAF 1992). Identification of future land use will focus expectations and decision making about future remedies.

2.2 Examples of Land Uses

Table 2-3 presents examples of facilities and operations included under future land use categories. The following sections describe these in more detail.

Table 2-1

RNSI Soil Use Definitions

Residential	Open Space	Commercial	Industrial
• Unrestricted surface and subsurface soil use • No commercial farming	• Unrestricted surface soil use • No subsurface soil use • Possible farming	• Unrestricted surface and subsurface soil use	• Unrestricted surface and subsurface soil use

USAF, 1992. Future Use Consideration In the Cleanup of Air Force Installations. Environmental Restoration Program, Department of the Air Force. October 1992.

Table 2-2

RNSI Groundwater Use Definitions

Residential	Industrial [a]	Restricted [b]
Drinkable groundwater	Limited groundwater use	No groundwater use

[a] Water used for industrial processes only, with potential for dermal contact and inhalation. Exceptions where water is used for drinking, the contact rate is equivalent to residential.

[b] Water is considered to be non-potable due to natural conditions, or there is no potential for the groundwater to be affected by the IRP site.

Table 2-3

Example Facilities and Operations Included Under Land Use Categories

Industrial	Commercial	Open Space	Residential
Airfield	**Administrative**	**Outdoor Recreation**	**Housing Accompanied**
Runways/Taxiways	Combined Base Personnel Office (CBPO)	Parks	Single Family Houses
Parking Aprons	Civilian Personnel	Athletic Fields	Apartment Buildings
Navigational Aids	Finance Buildings	Tennis Courts	Duplexes
Aircraft Operations/Maintenance	**Community Commercial**	Golf Courses	Mobile Homes
Row Hangar Complexes	Retail Stores	Hunting Areas	**Housing Unaccompanied**
Squadron and Flight Operations	Commissary	Running Tracks	Barracks
Maintenance Apron	Exchange Facilities	Fishable Waters	Bachelor Officers Quarters (BOQ)
Miscellaneous Industrial	Theaters	Swimmable Waters	
Rail Road Yards	Bowling Alleys	**Miscellaneous Open Space**	
Active Landfills	Agricultural Buildings	Undeveloped Land	
Fuel Storage Areas	Restaurants	Pastures	
Warehouses	Officers Clubs	Animal Fodder/Crop Lands	
Vehicle Storage/Maintenance	**Community Service**	Demolished Buildings	
Equipment Repair/Storage	Post Office	Explosive Ordnance Disposal (EOD) Practice Area	
Weapons Ranges	Library	Closed Landfills	
Tank Farms	Day Care Facilities		
USTs	Churches		
Drain Fields	Schools		

Table 2-3

(Continued)

Industrial	Commercial	Open Space	Residential
Burn Pits	**Medical**		
Pump Houses	Hospitals		
Fuel Hydrant Line Routes	Dental Clinics		
Radioactive Waste Areas	Veterinary Clinics		
Construction Debris Disposal Areas			
Pipeline Routes			
Waste Water Treatment Plants			
Chemical Storage Handling Facilities			

2.2.1 Industrial Land Use

Industrial land use options include areas of developed land used for manufacturing or industrial purposes. This category includes pavements and facilities which directly support the flying mission, those facilities required to operate and maintain aircraft in support of the flying mission, and maintenance and storage functions not directly related to the flying mission. Examples of facilities and operations included under the industrial land use category are presented in Table 2-3. Potentially significant exposure pathways for industrial land use include: 1) dermal contact or inhalation of constituents that volatilize from groundwater and surface water; 2) ingestion and dermal contact with soil; 3) inhalation of ambient air; and 4) ingestion, inhalation, and dermal contact with soils disturbed during intrusive actions. Justification for the inclusion of specific pathways for the industrial land use option is included in Section 3.0 (Conceptual Site Models).

2.2.2 Commercial Land Use

Commercial land use includes any structure of a commercial or institutional nature to which the general public, including children, the elderly, and other potentially sensitive populations, may have access. This category includes all office functions not directly associated with the flying mission, those facilities which provide for the sale of goods and services, those facilities which support morale and welfare, and physical and mental health facilities. Table 2-3 presents examples of facilities and operations included under the commercial land use category. Potentially significant exposure pathways for commercial land use include: 1) ingestion of and dermal contact with soil; 2) inhalation of ambient air; and 3) ingestion, inhalation, and dermal contact with soils during intrusive actions. Justification for the inclusion of specific pathways for commercial land use option is included in Section 3.0 (Conceptual Site Models).

2.2.3 Open Space Land Use

The open space category includes undeveloped lands that are barren or, where the naturally occurring vegetation includes grasses, shrubs, or trees, that are to be retained as buffer zone easements or clear zones. It also includes those areas to be retained for conservation or grazing purposes and outdoor sports fields and courts. Table 2-3 presents some specific examples of open space land use options. Potentially significant exposure pathways for open space land use include: 1) ingestion and dermal contact with soil; 2) inhalation of ambient air; and 3) ingestion and dermal contact with water. Justification for the inclusion of specific pathways for the open space land use option is included in Section 3.0 (Conceptual Site Models).

2.2.4 Residential Land Use

Residential land use is assumed when there are or may be occupied residences on or immediately adjacent to the site. The residential category includes family housing for permanent party or transient personnel and the associated support facilities, as well as all other forms of lodging for unmarried or unaccompanied personnel. Examples of residential structures are presented in Table 2-3. Potentially significant exposure pathways for residential land use include: 1) ingestion, inhalation, and dermal contact with groundwater; 2) ingestion and dermal contact with soil; 3) inhalation of ambient air; 4) ingestion and dermal contact with surface water; and 5) ingestion, inhalation, and dermal contact with soils during intrusive actions. Justification for the inclusion of specific pathways for the residential land use option is included in Section 3.0 (Conceptual Site Models).

3.0 CONCEPTUAL SITE MODELS

An exposure pathway describes the mechanism by which a population may be exposed to chemicals at or originating from a site. A primary condition for the use of health-based screening levels is that exposure pathways of concern and site conditions should match those taken into account in calculating the screening levels. The objective of the conceptual site model (CSM) is to provide the framework necessary to evaluate the potential human receptor pathways for calculation of screening levels. This framework is supported by site assessments to identify potential contaminants, source areas, release mechanisms, transport media, exposure routes and receptors. This information is also integrated with geologic and hydrologic data.

Available information has been gathered and analyzed in order to develop generic CSMs for the three main types of IRP sites at AFBs: Petroleum, Oil, and Lubricant (POL) sites; Landfills; and Fire Training Areas (FTAs). These generic models are presented in Figures 3-1, 3-2, and 3-3, respectively. Figure 3-4 represents a generic basewide conceptual site model. For the purpose of generic CSMs, pathways and routes denoted with a circle or triangle indicate that exposure is possible. Pathways and routes for the various land uses that have open boxes indicate that exposure is not considered probable at most AFBs. Closed circles indicate that the route is quantified, partially-filled circles indicate that some algorithms quantify that route, and open circles indicate the route is not quantified by any algorithms presented in Section 5 of this RNSI report.

3.1 Quantification of Exposure

Exposure routes for which standard Federal and Regional EPA algorithms are available for calculating screening levels are denoted in the conceptual site models by a filled circle. The algorithms were developed using protective exposure scenarios recommended by EPA (EPA 1991a). In some regions or states, certain exposures are not accounted for by available standard EPA algorithms for establishing screening levels and are denoted by empty

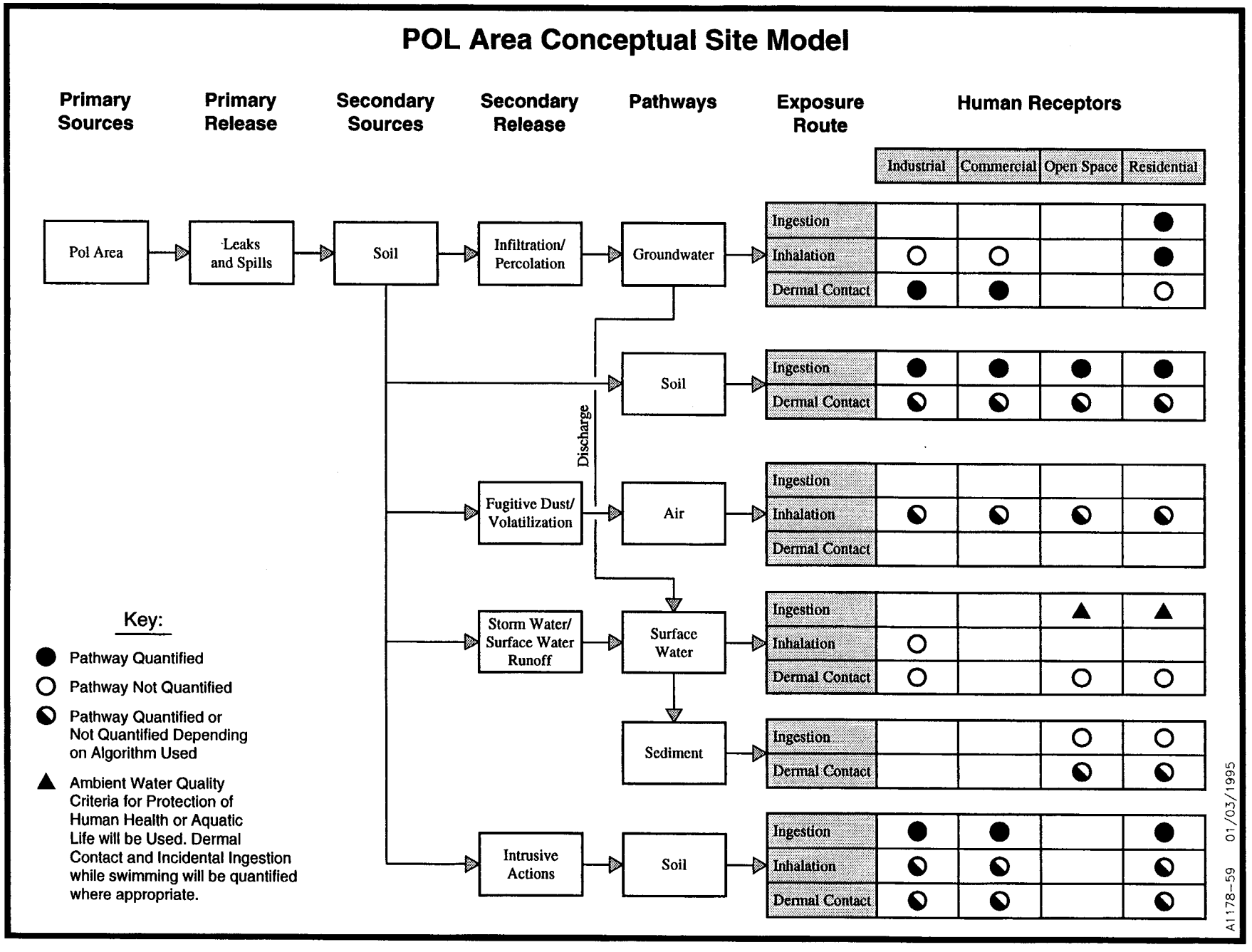

Figure 3-1. Example POl ea Conceptual Site Model

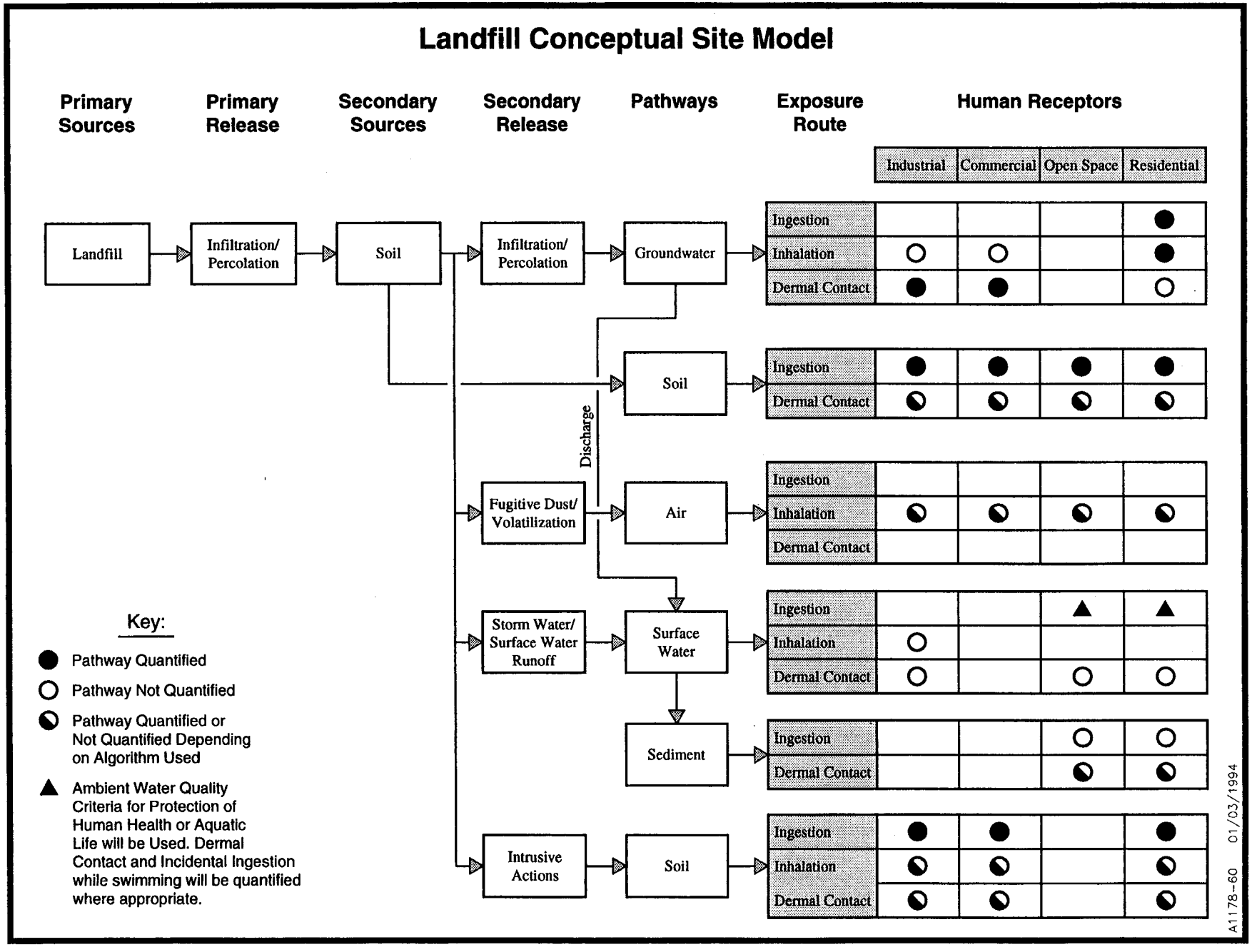

Figure 3-2. Example Landfill Conceptual Site Model

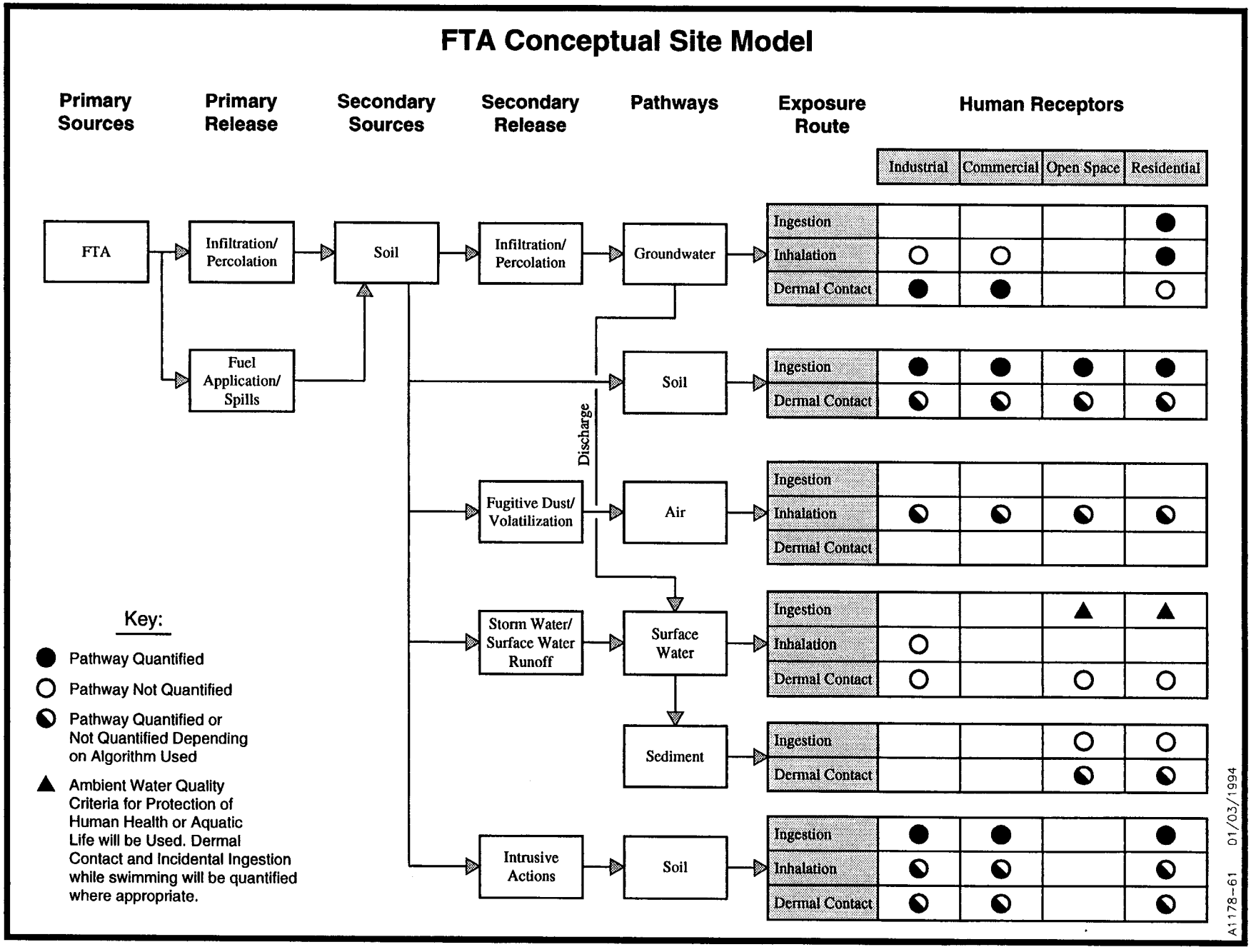

Figure 3-3. Example F Conceptual Site Model

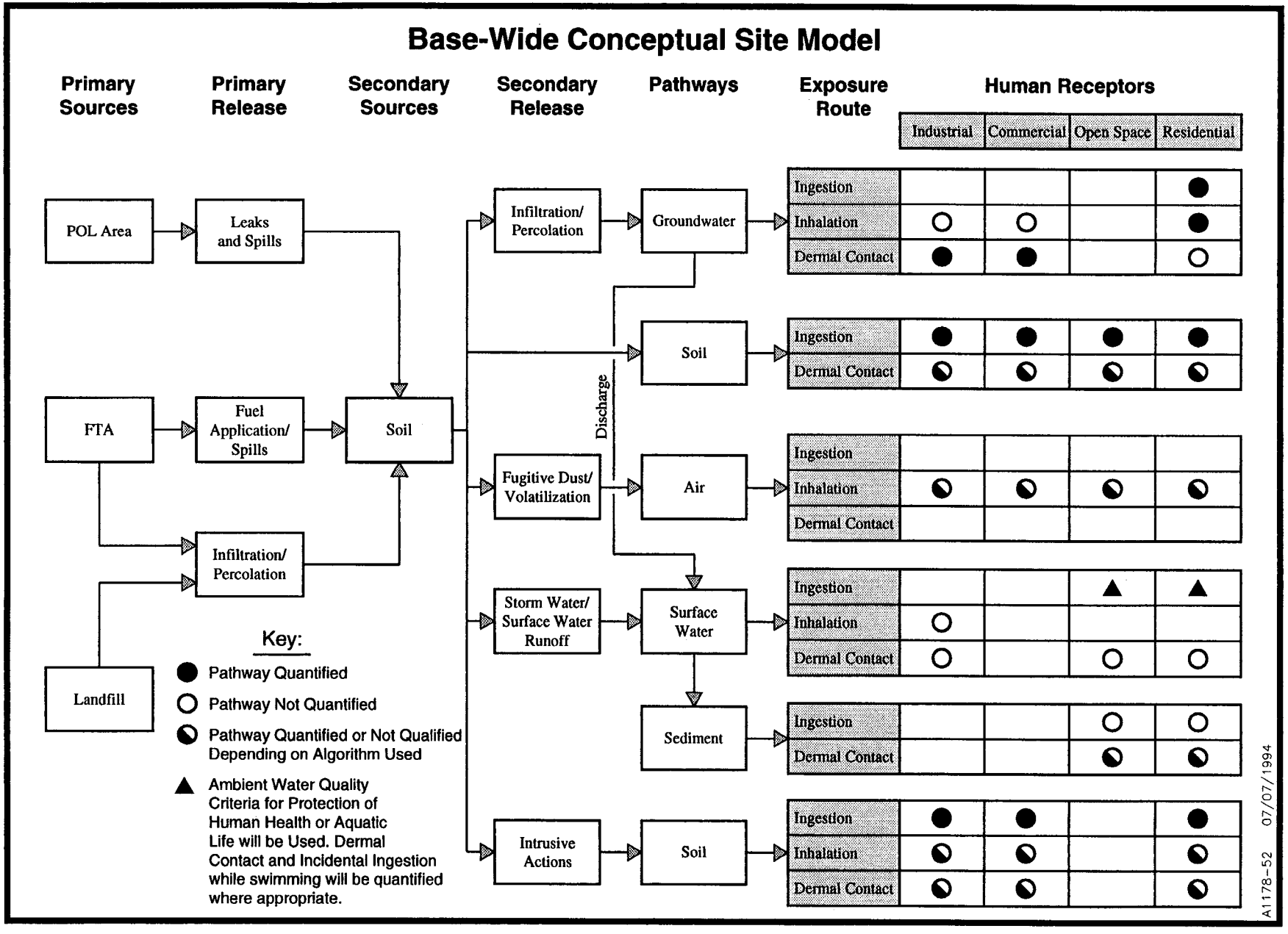

Figure 3-4. Example Base-Wide Conceptual Site Model

circles. This does not jeopardize the conservatism of the calculated screening levels since, in most cases, the primary pathway of concern is the overarching risk driver. Exposure routes with open circles generally contribute relatively minor risk, additional discussion about exposure routes is presented in Section 4.

The inhalation and dermal pathways are considered in some of the standard algorithms, but not all of them. Therefore, these pathways contain partially filled circles, indicating that it will be included in some, but not all cases. Screening levels associated with inhalation of volatiles and particulates in ambient air can be calculated using Preliminary Remediation Goals (PRGs) algorithms (EPA 1991c). In addition, screening levels associated with inhalation of volatiles and particulates in ambient air under residential settings can be calculated using Office of Solid Waste and Emergency Response (OSWER) algorithms (EPA 1994a). These exposures will be quantified at sites where use of PRG algorithms are appropriate. However, the OSWER algorithms are draft for review only and should not be used at this time. For those pathways that are not quantified but could be a significant risk, separate detailed risk analysis should be considered for such exposure scenarios where appropriate. Generally, for sites that are undisturbed with vegetative cover such as those for residential areas, the air pathway is a relatively minor contributor to risk.

EPA has established numerical health criteria for numerous toxic pollutants. The health criterion is an estimate of the ambient surface water concentration that will not result in adverse health effects in humans. These criteria are known as Ambient Water Quality Criteria (AWQC) for the protection of human health. For most chemicals, EPA water quality criteria to protect human health are available for two different exposure pathways: 1) lifetime ingestion of drinking water and aquatic organisms; and 2) lifetime ingestion of aquatic organisms alone (EPA 1990). The appropriate AWQC will be selected for a screening level based on probable use of the surface water body. Exposure routes for which AWQC will be used are denoted in the conceptual site models by a filled triangle. For chemicals without AWQCs where consumption of fish or shellfish is a possibility, an evaluation may be required to determine the need for development of site-specific PRGs based on

algorithms in Risk Assessment Guidance for Superfund (RAGS) (EPA 1989a) and the EPA document *Assessing Human Health Risks from Chemically Contaminated Fish or Shell Fish: A Guidance Manual* (EPA 1989c).

Similar to the AWQC for the protection of human health, EPA has also established numerical criteria for the protection of aquatic health. The aquatic criterion is an estimate of the ambient surface water concentration that will not result in adverse effects in aquatic species based on acute or chronic exposures. Chronic AWQC will be used to screen surface water quality at sites where injury to aquatic species is of concern.

If there is potential for swimming in surface water, risk-based screening levels will be derived using the RAGS Part A algorithms (EPA 1989a). These algorithms will consider incidental ingestion of water and dermal contact while swimming. Use of surface waters for drinking water at ACC Bases is not a likely scenario. However, if surface waters are used for drinking water the residential water algorithm will be used to derive screening levels.

3.2 Justification for Inclusion of Pathways

The generic CSMs presented in Figures 3-1 through 3-4 illustrate the pathways that will be considered initially for each of the four different land uses and type of site. The routes represented in the conceptual site models are those that are most likely to be of concern and pose notable risks for a particular type of site. Most sites are likely to have a fewer number of completed pathways; some sites may have additional pathways based on site-specific factors. For the purposes of generic conceptual site models, pathways and routes denoted with a circle or triangle indicate that exposure is possible. Pathways and routes for the various land uses that have open boxes indicate that exposure is not considered probable.

3.2.1 Industrial

Under the future industrial land use scenario, workers may be exposed to contaminants in groundwater via inhalation of volatile chemicals or dermal contact. It is assumed in most cases that groundwater is not potable but may be used in large volumes for industrial processes. However, in rare cases for some sites, groundwater may be used for drinking in the work place. In those cases, ingestion will be evaluated using residential exposure parameters. Residential standards are used because preliminary studies by the RNSI project team showed that utilizing industrial exposure parameters (i.e., ingestion of one rather than two liters per day) results in no significant change in screening levels. It is assumed that workers will incidentally ingest some amount of surface soil and dust in and around the workplace. This is based on adult soil ingestion studies that have application to the commercial/ industrial setting (EPA 1991a). It is also assumed that workers will have significant dermal contact with surface soils and may inhale volatiles and particulates in the ambient air during work-related activities. The potential may exist for exposure of construction workers via ingestion, inhalation, and dermal contact with subsurface soils during excavation or other types of intrusive actions under the industrial land use option.

3.2.2 Commercial

The use of groundwater for future commercial scenarios is generally assumed to be equivalent to the industrial scenario. Under the future commercial land use scenario, it is assumed that workers incidentally ingest soil in the workplace. This is based on adult soil ingestion studies that have application to the commercial/industrial setting (EPA 1991a). It is also assumed that workers may inhale volatiles and particulates in the ambient air during work-related activities. The potential may exist for exposure of construction workers via ingestion, inhalation, and dermal contact with subsurface soils during excavation or other types of intrusive actions under the commercial land use option. In some cases, children and sensitive members of subpopulations have access to commercial structures and may, therefore,

be exposed to contaminants on site. Under such scenarios, it will be assumed that children will ingest soil, inhale volatiles and particulates and have dermal contact while on site.

3.2.3 Open Space

Under the future open space land use scenario, agricultural workers, trespassers, and/or recreational users are assumed to incidentally ingest some amount of surface soil and dust while in the area. It is also assumed that individuals may have significant dermal contact with surface soils and may inhale volatiles and particulates in the ambient air during work-related or recreational activities. The potential also exists for ingestion and/or dermal contact with surface, sediment, and groundwater assuming that there is a water source available with unrestricted access on the site.

3.2.4 Residential

Under the future residential land use scenario, individuals are assumed to consume some amount of water each day. Residential receptors may also be exposed to contaminants in groundwater via dermal contact and inhalation while showering. It is also assumed that adults and children will incidentally ingest some amount of surface soil and dust, have dermal contact with soil, and may inhale volatiles and particulates in ambient air in and around the home. The potential also exists for ingestion and/or dermal contact with surface water and sediments assuming that there is a surface water body with unrestricted access near the home. The potential may exist for exposure of construction workers via ingestion, inhalation, and dermal contact with subsurface soils during excavation or other types of intrusive actions under the residential land use options.

3.3 Ecological Screening

Technical guidance for conducting ecological risk assessment and calculation of PRGs is currently under development by EPA. However, EPA has accomplished the initial

phases toward development of such guidance by publishing a conceptual model for performance of ecological risk assessment entitled *Framework for Ecological Risk Assessment* (EPA 1992) and the *Wildlife Exposures Factors Handbook* (EPA 1993c). Therefore, due to the lack of definitive guidance for calculating risk and the complexity of ecological relationships, no clear methodology is currently available for routine calculation of ecologically-based screening levels. There are chronic AWQCs for the protection of aquatic species, and these will be used, as available, for screening surface water quality at sites where ecological issues are of concern. Similar numerical criteria have not been promulgated for terrestrial species.

Derivation of numerical water quality criteria for the protection of aquatic species uses information from many areas of aquatic toxicology. In cases where enough acceptable data is available on acute toxicity to a sufficiently diverse group of aquatic species, the highest 1-hour average concentration that should not result in unacceptable effects on aquatic organisms and their uses have been estimated. Data on the chronic toxicity of toxins to aquatic species have been used to estimate the highest 4-day average concentration that should not cause unacceptable toxicity during long-term exposure (EPA 1990).

3.4 Deviations from Standard EPA Protocol for Establishing Screening Levels

The exposure algorithms and corresponding exposure assumptions to be used in calculating screening levels for this initiative are primarily of EPA origin with the exception of a few states. Sections 4.0 and 5.0 provide a discussion of specific sources. However, the approach to be implemented in this work deviates from standard EPA protocol in several important ways. Exposure assessments frequently rest on assumptions and theories as opposed to site-specific data. Often these assumptions include exposure pathways that are eliminated through removal actions or containment before the final decision is made.

During the course of this work, risk-based screening levels were developed for probable future land uses. The concept of incorporating future land use in the calculation of screening levels is not new to Air Force installations (USAF 1992). Physical constraints,

restrictions imposed by airfield or explosive safety criteria, compatibility with development of communities surrounding the base, and the natural resource allocation associated with each land use will be considered.

This approach is expected to facilitate the cleanup process by establishing screening levels based on a screening risk assessment approach which uses less conservative exposure scenarios and assumptions. By including future land use considerations early, it is anticipated that the remedy selection process will be streamlined. However, the primary benefit of this process will be to illustrate the potential cleanup cost differential between industrial, commercial, open space, and residential land use scenarios and to gain regulatory and community acceptance for incorporating alternative land uses (i.e., non-residential) in establishing appropriate cleanup levels. The results of this work are intended to provide the Air Force with additional information on which to base informed decisions about future land use options and future remedial actions.

4.0 EXPOSURE FACTORS AND ASSUMPTIONS

4.1 Default Exposure Factors

In an effort to avoid inconsistencies among exposure assumptions used in Superfund risk assessments, the Exposure Assessment Group (EAG) of EPA's Office of Research and Development sponsors projects aimed at developing and refining techniques used in exposure assessments. As a result of the activities of the EAG, EPA has published several guidance documents which contain statistical data on the various factors used in assessing exposure. These documents include *Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part A)* (EPA 1989a), *Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part B)* EPA 1991c), *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (EPA 1991a), and *Exposure Assessment Handbook* (EPA 1989b).

A number of recommendations are provided by EPA for default parameter values to be used when other supportable data are not available. While the recommended default values are based solely on the EAG's interpretation of the data, they have typically been distributed to technical and management staff across EPA Regional Offices and within Headquarters and are considered appropriate for use in this project.

Most default exposure assumptions for this project were obtained from the EPA guidance documents cited above or from regional guidance documents. As stated in the *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (EPA 1991a), "these exposure factors are generally considered most appropriate and should be used in baseline risk assessments unless alternate or site-specific values can be clearly justified by supporting data". Therefore, these default values are generally used and are considered adequately conservative in establishing screening levels. When high quality alternate or site-specific data are available, those values may be used instead. In the absence of guidance, it was necessary to use professional judgement in establishing default assump-

tions for some parameters. For example, in contrast with residential or industrial use, no federal or regional guidance is available for open space land use, probably due to the great variation in exposure associated with different uses (e.g., open range versus golf course). Site-specific information will be used when available to tailor exposure assumptions to individual site characteristics.

Default exposure assumptions for industrial soils, commercial soils, open space soils, residential soils, industrial water, residential water, and surface water are presented in Tables 4-1, 4-2, 4-3, 4-4, 4-5, 4-6, and 4-7 respectively. Any changes to these default assumptions when deriving screening levels for individual IRP sites will be identified in the site specific factors table presented in the Base Specific PPE report. In addition, the State of Florida default assumptions are presented with the algorithms in Tables 5-9 and 5-10.

EPA has established human and aquatic health criteria for numerous toxic pollutants based on estimates of ambient surface water concentrations that would not result in adverse effects. These criteria will be used to evaluate surface water for potential health hazards. Where incidental ingestion or dermal contact with surfaces water may occur, algorithms presented in RAGS Part A will be used to derive screening levels.

In applying standard risk assessment methodologies to develop screening levels, it is important to establish a target residual risk to allow for screening assessment of human health regardless of the land use selected. A cancer risk of less than or equal to 10^{-6} or one in 1,000,000 represents the Superfund site remediation goal in the National Contingency Plan (NCP) and the target risk recommended by the Resource Conservation Recovery Act (RCRA). This target risk was adopted for use in this project unless regional guidance suggests otherwise. A non-cancer hazard quotient of less than or equal to one is recommended by both the NCP and RCRA for use in calculating non-cancer screening levels. A hazard quotient of 0.1 as used by EPA Region III for calculating non-cancer screening levels (EPA 1993a) will be used for this project.

Table 4-1

Default Exposure Assumptions for Industrial Soils

Exposure Variables	Default Assumptions
Target Cancer Risk (unitless)	1E-6 [a]
Averaging Time, Carcinogens (years)	70 [b]
Exposure Frequency (days/years)	250 [c]
Soil Ingestion Rate, Adult (mg/day)	50 [d]
Exposure Duration, Adult (years)	25 [e]
Slope Factor, Oral/Inhalation ($[mg/kg\text{-}day]^{-1}$)	Chemical-Specific
Hazard Quotient (unitless)	0.1 [f]
Reference Dose, Oral/Inhalation (mg/kg-day)	Chemical-Specific
Body Weight, Adult (kg)	70 [g]
Averaging Time, Non-Carcinogens (years)	25 [e]
Volatilization Factor, Soil (m^3/kg)	Chemical-Specific
Particulate Emission Factor (m^3/kg)	4.63E+9 [h]
Inhalation Rate (m^3/day)	20 [i]

a Point of departure recommended for carcinogenic risks (EPA, 1989a).
b Lifetime exposure duration (EPA, 1989a).
c Assumes that an individual is at work 5 days/week for 50 weeks/year (EPA 1991a).
d Recommended soil ingestion rate for typical workplace (EPA 1991a).
e Upper bound (95th percentile) time spent working at one location (EPA 1991a). May be changed with site-specific data.
f Hazard quotient accepted by most EPA Regions for screening purposes (EPA 1993a).
g Adult, average body weight (EPA, 1991a).
h Recommended default particulate emission factor (EPA, 1991c), see Table 4-8 of this report.
i Recommended inhalation rate for adults (EPA, 1991a).

Table 4-2

Default Exposure Assumptions for Commercial Soils

Exposure Variables	Default Assumptions
Target Cancer Risk (unitless)	1E-6 [a]
Averaging Time, Carcinogens (years)	70 [b]
Exposure Frequency (days/years)	250 [c], 250 [d]
Soil Ingestion Rate (mg/day)	25 [e], 100 [f], 50 [o]
Exposure Duration (years)	25 [g], 6 [h]
Slope Factor, Oral/Inhalation ([mg/kg-day]$^{-1}$)	Chemical-Specific
Hazard Quotient (unitless)	0.1 [i]
Reference Dose, Oral/Inhalation (mg/kg-day)	Chemical-Specific
Body Weight (kg)	70 [j], 15 [k]
Averaging Time, Non-Carcinogens (years)	25 [g], 6 [h]
Volatilization Factor, Soil (m^3/kg)	Chemical-Specific
Particulate Emission Factor (m^3/kg)	4.63E+9 [l]
Inhalation Rate (m^3/day)	20 [m], 7 [n]

[a] Point of departure recommended for carcinogenic risks (EPA, 1989a).
[b] Lifetime exposure duration (EPA, 1989a).
[c] Assumes that an individual is at work 5 days/week for 50 weeks/year (EPA 1991a).
[d] Assumes that a child is at day care/school 5 days/week for 50 weeks/year. This assumption may be inappropriate for facilities other than schools or day care centers. Site-specific information will be used when available.
[e] Recommended soil ingestion rate for an adult in the commercial workplace based on best professional judgement.
[f] Recommended soil ingestion rate for children between the age of 1 and 6 based on best professional judgement.
[g] Upper bound (95th percentile) time spent working at one location (EPA 1991a). May change with site-specific information.
[h] Birth to 6 years of age (EPA 1991a).
[i] Hazard quotient accepted by most EPA Regions (EPA 1993a) for screening purposes.
[j] Adult, average body weight (EPA, 1991a).
[k] Child, average body weight (EPA 1991a).
[l] Recommended default particulate emission factor (EPA, 1991c), see Table 4-8 of this report.
[m] Recommended inhalation rate for adults (EPA, 1991a).
[n] Inhalation rate for child, 8 hours at 0.8 m^3/hour (EPA, 1989b).

Table 4-3

Default Exposure Assumptions for Open Space Soil

Exposure Variables	Default Assumptions
Target Cancer Risk (unitless)	1E-6 [a]
Averaging Time, Carcinogenic (years)	70 [b]
Exposure Frequency (days/year)	14 [c]
Soil Ingestion Factor, Age Adjusted (mg-year/kg-day)	114 [d]
Exposure Duration, Child (years)	6 [e]
Slope Factor, Oral/Inhalation ($[mg/kg\text{-}day]^{-1}$)	Chemical-Specific
Hazard Quotient (unitless)	0.1 [f]
Reference Dose, Oral/Inhalation (mg/kg-day)	Chemical-Specific
Body Weight, Child (kg)	15 [g]
Averaging Time, Non-Carcinogenic (years)	6 [e]
Soil Ingestion, Age 1-6 (mg/day)	200 [h]
Soil Ingestion, Adult (mg/day)	100 [i]
Body Weight, Adult (kg)	70 [j]
Exposure Duration, Adult (years)	30 [k]
Volatilization Factor, Soil (m^3/kg)	Chemical-Specific
Particulate Emission Factor (m^3/kg)	4.63E+9 [l]
Inhalation Rates (m^3/day)	20 (adult), 7 (child) [n]

a Point of departure recommended for carcinogenic risks (EPA, 1989a).
b Lifetime exposure duration (EPA, 1989a).
c Best professional judgement based on recreational activities. Site-specific information will be used when available.
d Soil ingestion rate adjusted for age (EPA 1993b).
e Birth to 6 years of age (EPA 1991a).
f Hazard quotient accepted by most EPA Regions (EPA 1993a) for screening purposes.
g Child, average body weight (EPA 1991a).
h Recommended soil ingestion rate for children between age 1 and 6 (EPA 1991a).
i Recommended soil ingestion rate for adults (EPA 1991a).
j Adult, average body weight (EPA 1991a).
k National upper bound (90th percentile) time at one residence (EPA, 1989a). Site-specific information will be used when available.
l Recommended default particulate emission factor (EPA, 1991c), see Table 4-8 of this report.
m Recommended inhalation rate for adults (EPA, 1991a).
n Inhalation rate for children, 8 hours at 0.8 m^3/hour (EPA, 1989b).

Table 4-4

Default Exposure Assumptions for Residential Soil

Exposure Variables	Default Assumptions
Target Cancer Risk (unitless)	1E-6 [a]
Averaging Time, Carcinogenic (years)	70 [b]
Exposure Frequency (days/year)	350 [c]
Soil Ingestion Factor, Age Adjusted (mg-year/kg-day)	114 [d]
Exposure Duration, Child (years)	6 [e]
Slope Factor, Oral/Inhalation ([mg/kg-day]$^{-1}$)	Chemical-Specific
Hazard Quotient (unitless)	0.1 [f]
Reference Dose, Oral/Inhalation (mg/kg-day)	Chemical-Specific
Body Weight, Child (kg)	15 [g]
Averaging Time, Non-Carcinogenic (years)	30 [h], 6 [e], 70 [p]
Soil Ingestion, Age 1-6 (mg/day)	200 [i]
Soil Ingestion, Adult (mg/day)	100 [j], 120 [p]
Exposure Duration, Worker (years)	1 [k]
Body Weight, Adult/Worker (kg)	70 [l], 59 [p]
Exposure Duration, Adult (years)	30 [h]
Volatilization Factor, Soil (m^3/kg)	Chemical-Specific
Particulate Emission Factor (m^3/kg)	4.63E+9 [m]
Inhalation Rate (m^3/day)	20 [n], 12 [o]

a Point of departure recommended for carcinogenic risks (EPA, 1989a).
b Lifetime exposure duration (EPA, 1989a).
c Days/year spent at home (EPA, 1991a).
d Soil ingestion rate adjusted for age (EPA, 1993b).
e Birth to 6 years of age (EPA, 1991a).
f Hazard quotient accepted by most EPA Regions (EPA 1993a) for screening purposes.
g Child, average body weight (EPA, 1991a).
h National Upper bound (90th percentile) time at one residence (EPA, 1989a). Site-specific information will be used when available.
i Recommended soil ingestion rate for children between age 1 and 6 (EPA, 1991a).
j Recommended soil ingestion rate for adults (EPA, 1991a).
k Best professional judgement of construction work duration at residence.
l Adult, average body weight (EPA, 1991a).
m Recommended default particulate emission factor (EPA, 1991c), see Table 4-8 of this report.
n Recommended inhalation rate for adults (EPA, 1991a).
o EPA Region III uses 12 m^3/day inhalation rate for children.

Table 4-5

Default Exposure Assumptions for Industrial Water

Exposure Variables	Default Assumptions Commercial/Industrial
Target Cancer Risk (unitless)	1E-6 [a]
Averaging Time, Carcinogens (years)	70 [b]
Exposure Frequency (days/year)	250 [c]
Exposure Time (hours/day)	0.5 [d]
Slope Factor, Oral ([mg/kg-day]$^{-1}$)	Chemical-Specific
Hazard Quotient (unitless)	0.1 [e]
Body Weight, Adult (kg)	70 [f]
Averaging Time, Non-Carcinogens (years)	Exposure Duration
Exposure Duration, Adult (years)	25 [g]
Reference Dose, Oral (mg/kg-day)	Chemical-Specific
Absorption Factor (unitless)	Chemical-Specific
Permeability Coefficient (cm^2/hr)	Chemical-Specific
Surface Area Exposed (cm^2)	1980 [h]

[a] Point of departure recommended for carcinogenic risks (EPA 1989a).
[b] Lifetime exposure duration (EPA 1989a).
[c] Assumes that an individual is at work 5 days/week for 50 weeks/year (EPA 1991a).
[d] Best professional judgement.
[e] Hazard quotient accepted by most EPA Regions (EPA 1993a) for screening purposes.
[f] Adult, average body weight (EPA 1991a).
[g] Upper bound (95th percentile) spent working at one location (EPA 1991a). Site-specific information will be used when available.
[h] Upper bound (95th percentile) surface area for forearms and hands (EPA 1989c).

Table 4-6

Default Exposure Assumptions for Residential Water

Exposure Variables	Default Assumptions
Target Cancer Risk (unitless)	1E-6 [a]
Averaging Time, Carcinogens (years)	70 [b]
Exposure Frequency (days/year)	350 [c]
Volatilization Factor, Water (L/m^3)	0.5 [d]
Inhalation Factor, Age Adjusted (m^3-y/kg-day)	11.66 [e]
Slope Factor, Inhalation ($[mg/kg\text{-}day]^{-1}$)	Chemical-Specific
Tap Water Ingestion Factor, Age Adjusted (L-y/kg-day)	1.09 [f]
Slope Factor, Oral ($[mg/kg\text{-}day]^{-1}$)	Chemical-Specific
Hazard Quotient (unitless)	0.1 [g]
Body Weight (kg)	70 [h], 15 [i]
Averaging Time, Non-Carcinogens (years)	30 [j], 6 [k]
Exposure Duration, Adult (years)	30 [j]
Exposure Duration, Child (years)	6 [k]
Indoor Inhalation Rate (m^3/day), adult	20 [l]
Reference Dose, Inhalation (mg/kg-day)	Chemical-Specific
Tap Water Ingestion Rate, Adult (L/day)	2 [m]
Reference Dose, Oral (mg/kg-day)	Chemical-Specific

[a] Point of departure recommended for carcinogenic risks (EPA, 1989a).
[b] Lifetime exposure duration (EPA, 1989a).
[c] Days/year spent at home (EPA, 1991a).
[d] Recommended volatilization factor (EPA 1991c, EPA 1993a, and EPA, 1993b).
[e] Inhalation rate adjusted for age (EPA, 1993b).
[f] Tap water ingestion rate adjusted for age (EPA, 1993b).
[g] Hazard quotient accepted by most EPA Regions (EPA 1993a) for screening purposes.
[h] Adult, average body weight (EPA, 1991a).
[i] Child, average body weight (EPA 1991a).
[j] National upper bound time (90th percentile) at one residence (EPA, 1989a). Site-specific information will be used when available.
[k] Birth to 6 years of age (EPA, 1991a).
[l] Upper-bound inhalation rate for daily, indoor residential activities.
[m] National upper bound (90th percentile) drinking water ingestion (EPA 1991a).

Table 4-7

Default Exposure Assumptions for Surface Water Exposure While Swimming For Open Space and Residential Scenarios

Exposure Variables	Default Assumptions
Target Cancer Risk (unitless)	1E-6 [a]
Body Weight, Adult (kg)	70 [b]
Averaging Time, Carcinogens (years)	70 [c]
Slope Factor, Oral (mg/kg-day) $^{-1}$	Chemical-Specific
Contact Rate (L/hour)	0.05 [c]
Exposure Time (hours/day)	1.82 [d]
Exposure Frequency (days/year)	14 [e]
Exposure Duration (years)	30 [f]
Target Hazard Quotient (unitless)	0.1 [g]
Averaging Time Non-Carcinogen (years)	Exposure Duration
Reference Dose, Oral (mg/kg-day)	Chemical-Specific
Permeability Coefficient (cm/hr)	Chemical-Specific
Surface Area Exposure (cm ^{2})	19,400 [h]
Absorption Factor (unitless)	Chemical-Specific

a Point of departure recommended for carcinogenic risks (EPA, 1989a).
b Adult, average body weight (EPA, 1991a).
c Lifetime exposure duration (EPA, 1989a).
d Weighted mean hours per week for males 18-24 years of age spent participating in active sports (EPA, 1989b).
e Assume one exposure event of 1.82 hours during each week of the summer months of June, July, and August (i.e., 14 weeks results in 14 events).
f National upper bound (90th percentile) time at one residence (EPA, 19891). Site-specific information will be used when available.
g Hazard quotient accepted by most EPA Regions (EPA 1993a) for screening purposes.
h 50th percentile total body surface area for adult males (EPA, 1989a).

The averaging time selected depends on the type of toxic effect being assessed. When evaluating long-term exposure to noncarcinogenic toxicants, intakes are calculated by averaging intakes over the period of exposure. For carcinogens, intakes are calculated by prorating the total cumulative dose over a lifetime (70 years by convention) and are, therefore, not estimated for childhood exposures only. This distinction relates to the currently held opinion that the mechanisms of action for carcinogens and noncarcinogens are different (EPA 1989a).

4.1.1 Commercial and Industrial Soils

The standard default exposure assumptions recommended for use in calculating industrial and commercial soil screening levels are presented in Tables 4-1 and 4-2, respectively. Under the commercial and industrial land use scenarios, contaminant exposure of workers and individuals who frequent commercial facilities or industrial sites is assumed to occur. Workers and the general public (commercial scenario only) are expected to be routinely exposed to residually contaminated surface soils. Construction workers are the population primarily exposed to contaminated subsurface soils, since direct contact exposure with subsurface soils is not likely under most working conditions. Default exposure assumptions are available for both surface and subsurface soils, but for this project, the default exposure assumptions for surface soils will be used. This will ensure that the risk-based screening levels determined for industrial and commercial soils are conservative enough to account for all exposure scenarios. By using these values, the possibility of subsurface soils being unearthed for extended periods of time and the upward migration of contaminants in subsurface soils to surface soils are accounted for. Surface and subsurface soils will, therefore, be considered to be the same, and no distinction will be made between the two for calculating screening levels. The migration of contaminants in soils to an underlying aquifer also poses a potentially complete exposure pathway if groundwater is used for domestic purposes.

Exposure frequency for workers under the commercial and industrial scenarios is assumed to be limited to eight hours a day for 250 days per year (5 days/ week for 50

weeks/year) or other durations, depending on site-specific activities (EPA 1991a). The exposure frequency for children under the commercial scenario is also assumed to be limited to eight hours a day for 250 days per year. This value is based on the "worst-case" assumption that the child attends day care on site. The value represents a high-end estimate and will clearly be overly conservative for some sites, depending on the intended commercial use. For commercial uses other than educational, this value should be estimated using site-specific information about the intended use of the site.

Most studies available on soil ingestion focus on children in residential settings. The combined residential soil and indoor house dust ingestion rate is 200 mg/day for children aged one through six (EPA 1991a). Half of this value, 100 mg/day, is recommended to assess childhood soil ingestion under the commercial scenario. Two studies exist which address adult soil ingestion and have application to the commercial/industrial setting. A pilot study was conducted that measured soil ingestion at 50 mg/day for adults that worked outside the home. From these studies, 50 mg/day was chosen by EPA as the standard default value for adult soil ingestion in the workplace (EPA 1991a). This value is recommended for adults under the industrial land use scenario. A lower rate of 25 mg/day is recommended for the commercial worker scenarios because of the decreased probability for dust and soil ingestion under those circumstances.

National statistics are available on the upper bound (95th percentile) number of years (25) spent by an individual working at one location (EPA 1991a). Twenty-five years is the recommended exposure duration for industrial and commercial workers, unless site-specific data is available to alter this value. An exposure duration of six years for children under the commercial scenario is recommended to account for exposures which occur between birth and six years of age (EPA 1991a), during which time the child may attend day care.

The body weight value used is the average body weight over the exposure duration. A constant body weight over the period of exposure is used primarily by convention, but also because body weight is not always independent of other exposure variables

(most notably, intake). For pathways by which exposure occurs throughout the lifetime, it is assumed that the contact rate to body weight ratios are fairly constant over a lifetime, and a body weight of 70 kg is recommended for adults (EPA 1989a). A body weight of 15 kg is recommended for children, which represents the average body weight of a child over the standard exposure duration of six years (EPA 1991a).

A volatilization factor is used for defining the relationship between the concentration of contaminants in soil and the volatilized contaminants in air. This relationship was established as part of the Hwang and Falco (1986) model developed by the EAG. It is assumed that the contaminant concentration in 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. The method for calculating the chemical-specific volatilization factor is presented in Table 4-8. This volatilization factor was developed for specific use in equations in RAGS Part B (EPA 1991c) and was adopted for use in this project. Volatilization terms are calculated only for compounds having a Henry's Law constant greater than 10^{-5} atm-m^3/mol, which is the generally accepted cutoff for volatile organics.

The particulate emission factor (PEF) relates the contaminant concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from surface contamination sites. 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 (EPA 1991c). The equation presented in Table 4-9 is representative of a surface with "unlimited erosion potential" and was adopted for use in this project. This model was selected for use because it represents a conservative estimate for intake of particulates.

4.1.2 Open Space Soil

Default exposure assumptions for open space soil are presented in Table 4-3. However, because not all sites provide the same opportunities, exposure assumptions for the

Table 4-8

Soil-To-Air Volatilization Factor

$$VF\ (m^3/kg) = \frac{(LS \times V \times DH)}{A} \times \frac{(3.14 \times \alpha \times T)^{1/2}}{(2 \times D_{ei} \times E \times K_{as} \times 10^3\ kg/g)}$$

where:

$$\alpha\ (cm^2/s) = \frac{(D_{ei} \times E)}{E + (P_s)(1-E)/K_{as}}$$

Parameter		Definition (units)	Default
VF	=	Volatilization Factor (m^3/kg)	Chemical Specific
LS	=	Length of Side of Contaminated Area (m)	45
V	=	Wind Speed in Mixing Zone (m/s)	2.25
DH	=	Diffusion Height (m)	2
A	=	Area of Contamination (cm^2)	20,250,000
D_{ei}	=	Effective Diffusivity (cm^2/s)	$D_i \times E^{.33}$
E	=	True Soil Porosity (unitless)	0.35
K_{as}	=	Soil/Air Partition Coefficient (g soil/cm^3 air)	$(H/K_d) \times 41$
P_s	=	True Soil Density or Particulate Density (g/cm^3)	2.65
T	=	Exposure Interval (s)	7.9×10^8
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)	$K_{oc} \times OC$
K_{oc}	=	Organic Carbon Partition Coefficient (cm^3/g)	chemical specific
OC	=	Organic Carbon Content of Soil (fraction)	site-specific, or 0.02

EPA 1991c. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part B). PB92-963333. Office of Emergency and Remedial Response, Washington, D.C., December 1991.

Table 4-9

Particulate Emission Factor Equation

$$PEF\ (m^3/kg) = \frac{LS \times V \times DH \times 3600\ s/hr}{A} \times \frac{1000\ g/kg}{0.036 \times (1-G) \times (U_m/U_t)^3 \times F(x)}$$

Parameter		Definition (units)	Default
PEF	=	Particulate Emission Factor (m^3/kg)	4.63×10^9
LS	=	Width of Contaminated Area (m)	45
V	=	Wind Speed in Mixing Zone (m/s)	2.25
DH	=	Diffusion Height (m)	2
A	=	Area of Contamination (m^2)	2025
0.036	=	Respirable Fraction (g/m^2-hr)	0.036
G	=	Fraction of Vegetation Cover (unitless)	0
U_m	=	Mean Annual Wind Speed (m/s)	4.5
U_t	=	Equivalent Threshold Value of Wind Speed at 10 m (m/s)	12.8
F(x)	=	Function Dependent on U_m/U_t (unitless)	0.0497

EPA 1991c. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part B). PB92-963333. Office of Emergency and Remedial Response, Washington, D.C., December 1991.

open space land use option should be developed on a site-specific basis when possible. The open space scenario addresses exposure for agricultural workers and to people who spend a limited amount of time at or near a site while playing, fishing, hunting, hiking, or engaging in other outdoor activities. This scenario also includes trespassers or occasional site visitors.

The default exposure frequency assumed for individuals for the open space scenario is 14 days/year, but should be substituted with site-specific information. This value is loosely based on duck hunting frequency, assuming seven ducks per hunting season and an average hunting duration of two days per duck (Colorado Division of Wildlife 1974). However, the exposure frequency for the open space scenario is dependent on the activity assumed to occur on site and should be based on site-specific information. For example, the exposure frequency for agricultural workers would likely be higher (depending on crop type and growing season) than 14 days/year while the exposure frequency for hikers would likely be lower. Exposure duration is assumed to be six years for children to account for exposures that occur between one and six years of age. The adult exposure duration is conservatively assumed to be the upper bound time spent at a single residence (30 years) (EPA 1991a).

The combined residential soil and indoor house dust ingestion rate is 200 mg per day for children aged one through six (six years of exposure) and 100 mg per day for the remainder of the life span (EPA 1991a). These values are suggested for use in the open space scenario. These factors account for ingestion of both outdoor soil and indoor dust and are believed to represent upper bound values for soil and dust ingestion. Because the soil ingestion rate is different for adults and children, it may be necessary to calculate soil screening levels using an age-adjusted ingestion factor for carcinogenic risks. Age-adjusted ingestion rates take into account the differences in ingestion rates, body weights, and exposure duration for the two receptor populations (children, age 1-6 years and, adults). It is a time weighted soil intake normalized to body weight and results in a more protective risk-based concentration than the adult assumption, but a somewhat less protective value than would be obtained using the child assumption. Exposure frequency is assumed to be identical for the

two groups. The recommended age-adjusted soil ingestion factor is 114 mg-yr/kg-day (EPA 1991c; EPA 1993b).

If exposure occurs only during childhood, the average child body weight during the exposure period is used in calculating screening levels. The average child (age 1-6) body weight is 15 kg. The adult average body weight that is routinely used is 70 kg (EPA 1991a).

4.1.3 Residential Soils

Default exposure assumptions for residential soils are presented in Table 4-4. Under residential land use, residents are expected to be in frequent, repeated contact with contaminated soil. The assumptions in this case account for daily exposure over the long term and generally result in the highest potential exposures and corresponding risk.

National statistics are available on the upper bound (90th percentile) and average (50th percentile) number of years spent by individuals at one residence. Because of the data on which they are based, these values may underestimate or overestimate the actual time that an individual might live in one residence. Nevertheless, the upper bound value of 30 years can be used for reasonable maximum residential exposures. This upper bound value may be unrealistic for persons living on AFBs because of limited tours-of-duty and site-specific values will be used when available; however, the 30 years could be appropriate for an AFB if it is ever closed. The exposure frequency selected must be appropriate for the duration and contact rate selected. Since long-term average contact rates are assumed, a daily exposure frequency (350 days/year) which assumes the average person spends two weeks per year away from the home is used (EPA 1989a).

4.1.4 Commercial and Industrial Groundwater

Default exposure assumptions for industrial water are presented in Table 4-5. The industrial groundwater scenario assumes groundwater underlying an industrial area is not used for drinking; therefore, ingestion will not be considered a potential exposure pathway. In those cases where it is known that groundwater is used for ingestion the residential screening level will be used. Thus, dermal contact will be the primary pathway to be addressed, assuming that groundwater will be used as industrial process water or for washing work areas. Dermal exposure is assumed to be contact with forearms and hands for a total exposure time of 0.5 hours/day. This groundwater scenario addresses a 70 kg adult who is at work five days a week for 50 weeks/year or 250 days/year total. Workers are assumed to work 25 years at the same location which, according to the Bureau of Labor Statistics, is the 95th percentile time spent working at a single location (EPA 1991a). This value will be changed if site-specific data is available.

4.1.5 Residential Groundwater

Default exposure assumptions for residential water are presented in Table 4-6. Groundwater contamination may be on the site itself or may have migrated from a nearby site. The residential water scenario assumes that adult residents consume two liters of water per day, 350 days per year, for 30 years. The two liter per day value is currently used by the Office of Drinking Water in setting drinking water standards. It is also close to the 90th percentile for drinking water ingestion and is comparable to the eight glasses of water per day historically recommended by health officials (EPA 1991a). However, water ingestion rates are different for adults and children. It may, therefore, be necessary to calculate a water screening level using an age-adjusted water ingestion factor. The value recommended for use is 1.09 L-yr/kg-day (EPA 1993b). As with soil, the age-adjusted ingestion rate takes into account the differences in ingestion rates, body weights, and exposure duration for the two receptor populations and is a time-weighted water intake normalized to body weight. Use of

the age-adjusted ingestion factors results in a more protective risk-based concentration than the adult assumption. Exposure frequency is assumed to be identical for the two groups.

Inhalation of chemicals which volatilize from water during domestic water use is also accounted for in some of the standard EPA algorithms for calculating screening levels for water presented in Section 5.0. Activity-specific inhalation rates were combined with time-use/activity level data to derive daily inhalation rate values. An inhalation rate of 15 m^3/day was found to represent a reasonable upper bound inhalation rate for daily indoor residential activities (EPA 1991a). EPA Region III accepts a daily indoor inhalation rate of 20 m^3/day (EPA 1991a). This value will be used for this project. The age-adjusted inhalation factor recommended for use is 11.66 m^3-yr/kg-day (EPA 1993b). Again, volatilization terms are calculated only for compounds having a Henry's Law constant greater than 10^{-5} atm-m^3/mol.

4.1.6 Residential and Open Space Surface Water

Default exposure assumptions for surface water incidental ingestion and dermal contact while swimming for an open space or residential scenario are given in Table 4-7. Surface water contamination may be on the site itself or may have migrated from a nearby site. The exposure context is assumed to be residential. The exposure time of 1.82 hours per exposure event is based on the weighted mean hours per week for males (18-24 years of age) engaging in active sports. The exposure frequency of 14 days per year assumes one exposure event of 1.82 hours during each week of the summer months of June, July, and August (i.e., 14 weeks of results in 14 exposure events). Since most bases do not use natural water bodies as swimming areas, it is assumed that swimming occurs off-base in noninstitutionalized areas (e.g., ponds, lakes, or rivers that are not state or municipal designated swimming areas). For these same reasons, it is assumed that use of such areas by small children is minimal. These exposure assumptions may require modification based on site-specific factors.

Exposures to surface waters as drinking waters or process waters at industrial facilities are not likely at ACC Bases. However, should these scenarios exist, the exposure assumptions in Tables 4-5 and 4-6 will be used as appropriate.

4.2 Modifications to Default Exposure Assumptions

Some sites have unique characteristics that will require deviation from the default exposure assumptions presented in previous sections. The use of conservative parameters and exposure assumptions in calculating screening levels can result in screening levels that may be inappropriate for conditions at IRP sites. In addition, overly conservative screening levels may not be achievable with presently available remedial technology. The following subsections briefly discuss some modifications to default exposure assumptions that may be considered.

4.2.1 Land Use

Assumptions about how a site and surrounding land will be used in the future is probably the most important decision in the assessment of exposure. Current use of most sites can be classified as residential, industrial, open space, or recreational. Some sites may not fall into the land use categories outlined by the USAF (residential, commercial, industrial, and open space). Alternate land use determinations may need to be made on a site-specific basis.

4.2.2 Exposure Duration

Statistical data are available for the upper bound time spent at a single residence (30 years or the 90th percentile) or working at one location (25 years or the 95th percentile). The upper bound time spent at a single residence may be inappropriate at some AFBs. The national average (50th percentile) time spent at a single residence is nine years and will be used where appropriate. In cases where the average value is also overly conser-

vative (such as at temporary housing or bases with limited tours-of-duty), the term will be determined on a site-specific basis.

Depending on working conditions and the type of work being performed, it may be inappropriate to assume an exposure duration of 25 years. Therefore, these terms may require determination on a site-specific basis. Exposure may also be lower for workers than that under residential scenarios, because it is generally assumed that exposure is limited to eight hours a day. However, daily exposures of more or less than eight hours a day are also possible for workers and depend on site-specific characteristics. Exposure durations for sites that fall under the open space land use category will most likely have to be determined on a site-specific basis depending on projected activities at the site (e.g., agricultural, recreational, trespassing) and potentially exposed populations.

4.2.3 Exposure Frequency

Residential assumptions should be used for exposure frequency (350 days/year) when there are or may be occupied residences on or adjacent to the site. It is generally assumed that exposure to workers is limited to 250 days a year. With certain occupations (i.e., construction work), exposure frequency may be considerably less and this parameter should be determined on a site-specific basis. Similar to exposure duration, exposure frequency for sites that fall under the open space land use category will most likely be determined on a site-specific basis depending on projected activities at the site.

4.2.4 Contact Rates

Contact rate reflects the amount of contaminated medium contacted per unit time or event. In cases where statistical data are available for contact rate, the 95th percentile (occasionally the 90th percentile) will be used (i.e., 2 L water/day). If statistical data are not available, professional judgement will be used to estimate values. It is recognized that these estimates will not be precise, but they should reflect a reasonable estimate of an upper bound value, thus maintaining conservatism in the screening level calculations.

5.0 DEVELOPMENT OF RISK-BASED SCREENING LEVELS

5.1 Screening Level Approach

In most baseline risk assessments, the overall risk is driven by a relatively small number of contaminants and routes of exposure. These dominating risks are normally identified only after much time and effort is expended on many contaminants and exposure routes that do not make a significant contribution to the overall risk. Risk-based screening can be used to: 1) assess which chemicals need to be further evaluated (risk drivers), and 2) derive screening levels associated with a particular land use. The advantages of risk-based screening procedures are as follows:

- The number of chemicals of concern can be reduced to those contaminants with the potential to contribute significantly to risk.
- Risk-based screens also allow for the elimination of environmental media that do not contain contaminants at concentrations that could adversely affect public health and the environment.
- Without the use of this screening approach, much time and effort would be wasted in detailed evaluation of contaminants and routes of exposure that pose minimal risk.

Detailed procedures for evaluating data for the baseline risk assessment are given in Chapter 5 of *Risk Assessment Guidelines for Superfund Volume 1, Human Health Evaluation Manual, Part A* (EPA 1989a). Included in the data evaluation steps is a concentration toxicity screen. As cited in the EPA Region III technical guidance manual for risk assessment, *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening* (EPA 1993a), the RAGS procedure has two major limitations. First, the concentration toxicity screen comes late in the process, after much effort has been expended evaluating background levels, quantitation limits, etc. Second, the concentration toxicity screen in RAGS compares only relative risk among contaminants in a medium and does not address whether any particular contaminant may be above or below an absolute risk level.

To address this limitation, current risk-based screens are recommended for use on the data set immediately after data quality evaluation and validation. Additionally, screening is conducted on an absolute risk-based criterion rather than on a relative basis as suggested in RAGS. Based on these modifications, the risk-based screens are generally used as follows:

1) The maximum concentration of any detected contaminant in any medium is used for comparison to the risk-based concentration.

2) The risk-based concentration for a particular medium (surface/ subsurface soil, groundwater, air, etc.) is derived from an algorithm which incorporates selected exposure pathways, standard exposure factors, hazard/risk criteria, and chemical-specific toxicity values.

3) If the maximum concentration for any compound exceeds the risk-based concentration for a given medium, it is retained for further consideration. Otherwise, the contaminant is eliminated from further consideration for that medium.

4) If no contaminant exceeds the risk-based concentration for a particular medium, that medium would be removed from further consideration.

5) Results of risk-based screening should provide documentation of compounds removed by risk-based screening so they may be evaluated for reinclusion based on historical data, toxicity, mobility, persistence, bioaccumulation, applicable or relevant and appropriate requirements (ARAR) persistence or other reasons.

5.2 Comparison of Screening Criteria and Pathways for Risk-Based Screens

To date, three EPA regions have documented procedures for conducting risk-based screening: Regions III, IX, and X. Regions IV, VI and VIII follow EPA Region III guidance. In addition, Region VIII has published Superfund Technical Guidance for risk-based screening. While this guidance does not provide detailed documentation of algorithms to be used for screening, general procedural guidance is provided. Several states have also published screening methods. These include Texas, Arizona, and Florida. Louisiana has submitted for public comment a method to derive cleanup standards; however, these have not

been finalized. Screening methods have also been proposed for RCRA Subpart S, Preliminary Remediation Goals under RAGS Part B (EPA 1991c), and OSWER Soil Screening Levels (EPA 1994a). The methodologies vary in the pathways included in the algorithms and the threshold criteria for screening. Generally, standard exposure factors are utilized, but site-specific information can be included. A summary of pathways and decision criteria for the various EPA and State algorithms are given in Table 5-1. As the table shows, typical decision criteria for carcinogenic effects is a 10^{-6} target risk level, and for non-carcinogenic effects, a systemic hazard index of 0.1 (EPA 1993a). Also shown are the pathways included by each screening methodology for the media of interest. For example, the PRG algorithm includes ingestion of soil, and inhalation of dust and volatiles in its derivation of a surface soil screening level.

5.3 Selection Criteria for Screening Algorithms

At the present time, no particular procedure or set of screening algorithms have been approved by EPA for nation-wide use. The OSWER Soil Screening Levels (EPA 1994a) has been issued in draft form and is under review. The intent of this OSWER guidance was to establish a consistent methodology for screening out sites that require no further investigation or action. The PRG algorithms (EPA 1991c) have been widely used in feasibility studies at Superfund sites. In addition, several EPA regions and states have developed their own guidance for setting screening levels. Efforts are being undertaken to establish uniform procedures for deriving screening levels within the EPA, but at the present time, the acceptability of screening methodologies for a particular AFB would reside at the EPA Regional or State regulatory level.

Therefore, the general selection rank ordering of screening methodology should be as follows:

- Screening method guidance for EPA Region/State where Base is located;

Table 5-1

Comparison of Screening Criteria and Pathways for Risk-Based Screens

Regulatory Agency	Screening Criteria						Scenarios		Pathways in Algorithms								Other Comments
	Soil		Water		Air				Soil				Water		Air		
	Carc. Risk	Syst. Index	Carc. Risk	Syst. Index	Carc. Risk	Syst. Index	Resid.	Ind.	Ingestion	Dermal Contact	Vol. Inhal.	Part. Inhal.	Ingestion	Vol. Inhal.	Vol. Inhal.	Part. Inhal.	
EPA PRGs	10^{-6}	1	10^{-6}	1	10^{-6}	1	X	X	X		X	X	X	X	X	X	RAGS Part B
OSWER Soil (Proposed 1994)	10^{-6}	1			10^{-6}	1	X		X		X	X			X	X	MCLs, Cross- Media Leaching
EPA Region III	10^{-6}	0.1	10^{-6}	0.1	10^{-6}	0.1	X	X[a]	X				X	X	X		Extensive listing of compounds and toxicity values
EPA Region IV	10^{-6}	0.1	10^{-6}	0.1	10^{-6}	0.1	X		X				X	X	X		
FDEP	10^{-6}	1					X[a]	X[a]	X	X	X	X					
EPA Region VI	10^{-6}	0.1	10^{-6}	0.1	10^{-6}	0.1	X	X[a]	X				X	X	X		Accepts Region III
TNRCC	10^{-6} [b] 10^{-5} [c]		10^{-6} [b] 10^{-5} [c]				X	X[d]	X		X	X	X				Texas Risk Reduction Standard 2
EPA Region VIII	10^{-6}	0.1	10^{-6}	0.1	10^{-6}	0.1	X	X[a]	X				X	X	X		Accepts Region III
EPA Region IX [f]	10^{-6}	Safe RfD	10^{-6}	Safe RfD	10^{-6}	Safe RfD	X	X[c]	X	X	X	X	X	X	X	X	
ADEQ	10^{-6}		10^{-6}						X				X				Also uses Region IX
EPA Region X	10^{-7}	0.1	10^{-6}	0.1			X		X				X	X			Comprehensive Risk Assessment Guidance
RCRA Subpart S	10^{-6} [b] 10^{-5} [c]	1	10^{-6} [b] 10^{-5} [c]	1	10^{-6} [b] 10^{-5} [c]	1	X		X				X		X	X	FR 30798-30884, July 27, 1990 Proposed

[a] For soils only.
[b] Class A and B carcinogens.
[c] Class C carcinogens.
[d] Industrial exposure to soils may be considered if certain requirements are met (Rules, 1993).
[e] Industrial concentrations for soil may be used as an alternate goal, but should not be used for screening a site (EPA, 1994)
[f] Uses the lower of the 1×10^{-6} cancer risk or a "safe" RfD (EPA, 1994).
ADEQ = Arizona Department of Environmental Quality. FDEP = Florida Department of Environmental Protection. TNRCC = Texas Natural Resource Conservation Commission.

- If EPA Region doesn't have guidance, consult with EPA Regional officials to determine which methodology is considered most acceptable for use in that EPA Region;

- PRGs (EPA 1991c) due to widespread feasibility study use and broadest coverage of pathways and media; and

- Proposed RCRA Subpart S procedures should only be used for comparative purposes.

For exposure to groundwater in an industrial setting, it is assumed that dermal contact with process water is the primary exposure pathway. Exceptions are those cases where it is known that groundwater is, or will be, used for ingestion. In those cases, residential screening levels will be used. No Federal or State screening algorithms have been derived for the industrial, dermal groundwater exposure scenario or exposures to surface water while swimming. Therefore, algorithms were derived based on the dermal exposure equations found in EPA RAGs Part A (1989a).

5.4 Screening Algorithms

5.4.1 Preliminary Remediation Goals Screening Algorithms (PRGs)

The algorithms used to calculate PRG derived screening levels are given in Tables 5-2 to 5-5. Default exposure assumptions are presented in Tables 4-1 to 4-6. By applying industrial exposure factors, one can calculate screening levels for industrial or commercial scenarios versus the standard residential default levels. Screening level calculations can be performed for residential, commercial, and industrial soils and groundwater.

5.4.2 EPA Regions III, IV, VI, and VIII Screening Algorithms

The screening algorithms for EPA Region III are given in Tables 5-6 to 5-8. These were the first algorithms presented by a EPA Regional office and have since been utilized, either directly or with some modifications, in other EPA Regional offices, including

Table 5-2

Preliminary Remediation Goals Screening Algorithms for Industrial Soils

[a]Carcinogens:

$$C\ (mg/kg) = \frac{Risk \times BWa \times 365\ days/yr \times ATc}{EF \times EDa \times [(SFo \times \frac{IRSa}{10^6\ mg/kg}) + (SFi \times IRAw \times [1/VFs + 1/PEF])]}$$

[a]Non-Carcinogens:

$$C\ (mg/kg) = \frac{HQ \times BWa \times 365\ days/yr \times ATn}{EF \times EDa \times [((1/RfDo) \times \frac{IRSa}{10^6\ mg/kg}) + ((1/RfDi) \times IRAw \times (1/VFs + 1/PEF))]}$$

Exposure Variables		Definitions (units)
C	=	Risk-Based Concentration (mg/kg)
Risk	=	Target Cancer Risk (unitless)
ATc	=	Averaging Time Carcinogens (y)
EF	=	Exposure Frequency (d/y)
IRSa	=	Soil Ingestion Rate, Adult (mg/day)
EDa	=	Exposure Duration, Adult (y)
SFi	=	Chemical-Specific Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$
SFo	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
HQ	=	Target Hazard Quotient (unitless)
RfDi	=	Chemical-Specific Inhaled Reference Dose (mg/kg-d)
RfDo	=	Chemical-Specific Oral Reference Dose Oral (mg/kg-d)
BWa	=	Body Weight, Adult (kg)
ATn	=	Averaging Time Non-Carcinogens (y)
IRAw	=	Workday Inhalation Rate (m^3/d)
VFs	=	Volatilization Factor (m^3/kg)
PEF	=	Particulate Emission Factor (m^3/kg)

[a] Equations are based on adult exposures only.

EPA, 1991c. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part B). PB92-963333. Office of Emergency and Remedial Response, Washington D.C. December 1991.

Table 5-3

Preliminary Remediation Goals Screening Algorithms for Commercial Soils

[a]Carcinogens:

$$C\ (mg/kg) = \frac{Risk \times BWa \times 365\ days/yr \times ATc}{EF \times EDa \times [(SFo \times \frac{IRSa}{10^6\ mg/kg}) + (SFi \times IRAw \times [1/VFs + 1/PEF])]}$$

[a]Non-Carcinogens:

$$C\ (mg/kg) = \frac{HQ \times BW \times 365\ days/yr \times AT}{EF \times ED \times [((1/RfDo) \times \frac{IRS}{10^6\ mg/kg}) + ((1/RfDi) \times IR \times (1/VFs + 1/PEF))]}$$

Exposure Variables		Definitions (units)
C	=	Risk-Based Concentration (mg/kg)
Risk	=	Target Cancer Risk (unitless)
ATc	=	Averaging Time Carcinogens (y)
EF	=	Exposure Frequency (d/y)
IRS[b]	=	Soil Ingestion Rate (mg/d)
ED[b]	=	Exposure Duration (y)
SFi	=	Chemical-Specific Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$
SFo	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
HQ	=	Target Hazard Quotient (unitless)
RfDi	=	Chemical-Specific Inhaled Reference Dose (mg/kg-d)
RfDo	=	Chemical-Specific Oral Reference Dose Oral (mg/kg-d)
BW[b]	=	Body Weight (kg)
ATn[b]	=	Averaging Time Non-Carcinogens (y)
IR[b]	=	Inhalation Rate (m^3/d)
VFs	=	Volatilization Factor (m^3/kg)
PEF	=	Particulate Emission Factor (m^3/kg)

[a] Modified from EPA, 1991c. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part B). PB92-963333. Office of Emergency and Remedial Response, Washington D.C. December 1991.

[b] Generally adult based values used, but child based values may be appropriate for certain uses such as hospitals, day care centers, and schools.

Table 5-4

Preliminary Remediation Goals Screening Algorithms for Residential Soils

[a]**Carcinogens:**

$$C\ (mg/kg) = \frac{Risk \times 365\ days/yr \times ATc}{EF \times \frac{IFSadj}{10^6\ mg/kg} \times SFo}$$

[a]**Non-Carcinogens:**

$$C\ (mg/kg) = \frac{HQ \times RfDo \times 365\ days/yr \times ATn}{EF \times \frac{IFSadj}{10^6\ mg/kg}}$$

Exposure Variables		Definitions (units)
C	=	Risk-Based Concentration (mg/kg)
Risk	=	Target Cancer Risk (unitless)
ATc	=	Averaging Time Carcinogens (y)
EF	=	Exposure Frequency (d/y)
IFSadj	=	Soil Ingestion Factor, Age Adjusted (mg-y/kg-d)
SFo	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
HQ	=	Target Hazard Quotient (unitless)
RfDo	=	Chemical-Specific Oral Reference Dose (mg/kg-d)
ATn	=	Averaging Time Non-Carcinogens (y)

[a] Equations are based on combined childhood and adult exposure.

EPA, 1991c. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part B). PB92-96333. Office of Emergency and Remedial Response, Washington, D.C. December 1991.

Table 5-5

Preliminary Remediation Goals Screening Algorithms for Water

[a]Carcinogens:

$$C\ (mg/L) = \frac{Risk \times 365\ days/yr \times ATc \times BWa}{EF \times EDa \times [(SFi \times VFw \times IRAa) + (SFo \times IRWa)]}$$

[a]Non-Carcinogens:

$$C\ (mg/L) = \frac{HQ \times BWa \times 365\ days/yr \times ATn}{EF \times EDa \times [(1/RfDi \times VFw \times IRAa) + (1/RfDo \times IRWa)]}$$

Exposure Variables		Definitions (units)
C	=	Risk-Based Concentration (mg/L)
Risk	=	Target Cancer Risk (unitless)
ATc	=	Averaging Time Carcinogens (y)
EF	=	Exposure frequency (d/y)
VFw	=	Volatilization factor (L/m^3)
SFi	=	Chemical-Specific Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$
SFo	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
HQ	=	Target Hazard Quotient (unitless)
BWa	=	Body Weight, Adult (kg)
ATn	=	Averaging Time Non-carcinogens (y)
EDa	=	Exposure Duration, Adult (y)
IRAa	=	Inhalation Rate, Adult (m^3/d)
RfDi	=	Chemical-Specific Inhaled Reference Dose (mg/kg-d)
IRWa	=	Tap Water Ingestion, Adult (L/d)
RfDo	=	Chemical-Specific Oral Reference Dose (mg/kg-d)

[a] Equations are based on adult exposures only.

EPA, 1991c. Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part B). PB92-96333. Office of Emergency and Remedial Response, Washington D.C. December 1991.

Table 5-6

EPA Region III Screening Algorithms for Commercial/Industrial Soils

[a] **Carcinogens:**

$$C\ (mg/kg) = \frac{Risk \times BWa \times 365\ days/yr \times ATc}{EF \times EDa \times \frac{IRSa}{10^6\ mg/kg} \times FI \times SFo}$$

Non-Carcinogens:

$$C\ (mg/kg) = \frac{HQ \times RfDo \times BW \times 365\ days/yr \times ATn}{EF \times EDa \times \frac{IRS}{10^6\ mg/kg}}$$

Exposure Variables		Definitions (units)
C	=	Risk-Based Concentration (mg/kg)
Risk	=	Target Cancer Risk (unitless)
ATc	=	Averaging Time Carcinogens (y)
EF	=	Exposure Frequency (d/y)
IRSa	=	Soil Ingestion Rate, Adult (mg/d)
EDa	=	Exposure Duration, Adult (y)
SFo	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
HQ	=	Target Hazard Quotient (unitless)
RfDo	=	Chemical-Specific Oral Reference Dose Oral (mg/kg-d)
BWa	=	Body Weight, Adult (kg)
ATn	=	Averaging Time Non-Carcinogens (y)
IRSc	=	Soil Ingestion Rate, Age 1-6 (mg/d)
FI	=	Fraction of Contaminated Soil Ingested (unitless)

[a] Equations are based on adult exposures only.

EPA 1993a. Region III Technical Guidance Manual, Risk Assessment: Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening. Hazardous Waste Management Division, Office of Superfund Programs, Philadelphia, PA, January 1993.

EPA 1995. Region III Risk-Based Concentration Table, First Quarter 1995. Hazardous Waste Management Division, Office of Superfund Programs, Philadelphia, PA. February 1995.

Table 5-7

EPA Region III Screening Algorithms for Residential Soils

[a]Carcinogens:

$$C\ (mg/kg) = \frac{Risk \times 365\ days/yr \times ATc}{EF \times \frac{IFSadj}{10^6\ mg/kg} \times SFo}$$

[b]Non-Carcinogens:

$$C\ (mg/kg) = \frac{HQ \times RfDo \times BWc \times 365\ days/yr \times ATn}{EF \times EDc \times \frac{IRSc}{10^6\ mg/kg}}$$

Exposure Variables		Definitions (units)
C	=	Risk-Based Concentration (mg/kg)
Risk	=	Target Cancer Risk (unitless)
ATc	=	Averaging Time Carcinogens (y)
EF	=	Exposure Frequency (d/y)
IFSadj	=	Soil Ingestion Factor, Age Adjusted (mg-y/kg-d)
EDc	=	Exposure Duration, age 1-6 (y)
SFo	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
HQ	=	Target Hazard Quotient (unitless)
RfDo	=	Chemical-Specific Oral Reference Dose Oral (mg/kg-d)
BWc	=	Body Weight, Age 1-6 (kg)
ATn	=	Averaging Time Non-Carcinogens (y)
IRSc	=	Soil Ingestion, Age 1-6 (mg/d)

[a] Carcinogenic calculations are based on combined child and adult exposure.
[b] Non-carcinogenic calculations are based on childhood exposure only.

EPA 1993a. Region III Technical Guidance Manual, Risk Assessment: Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening. Hazardous Waste Management Division, Office of Superfund Programs, Philadelphia, PA, January 1993.

EPA 1995. EPA 1995. Region III Risk-Based Concentration Table, First Quarter 1995. Hazardous Waste Management Division, Office of Superfund Programs, Philadelphia, PA. February 1995.

Table 5-8

EPA Region III Screening Algorithms for Residential Water

[a]Carcinogens:

$$C(mg/L) = \frac{Risk \times 365\ days/yr \times ATc}{EF \times ([VFw \times IFAadj \times SFi] + [IFWadj \times SFo])}$$

[b]Non-Carcinogens:

$$C\ (mg/L) = \frac{HQ \times BWa \times 365\ days/yr \times ATn}{EF \times EDa \times (VFw \times IRAa/RfDi + IRWa/RfDo)}$$

Exposure Variables		Definitions (units)
C	=	Risk-Based Concentration (mg/L)
Risk	=	Target Cancer Risk
ATc	=	Averaging Time Carcinogens (y)
EF	=	Exposure frequency (d/y)
VFw	=	Volatilization factor (L/m^3)
IFAadj	=	Inhalation Factor, Age-adjusted (m^3-y/kg-d)
SFi	=	Chemical-Specific Inhalation Slope Factor $(mg/kg\text{-}d)^{-1}$
IFWadj	=	Tap Water Ingestion Factor, Age-Adjusted (L-y/kg-d)
SFo	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
HQ	=	Target Hazard Quotient
BWa	=	Body Weight, Adult (kg)
ATn	=	Averaging Time Non-carcinogens (y)
EDa	=	Exposure Duration, Adult (yr)
IRAa	=	Inhalation Rate, Adult (m^3/d)
RfDi	=	Reference Dose Inhaled (mg/kg-d)
IRWa	=	Tap Water Ingestion, Adult (L/d)
RfDo	=	Reference Dose Oral (mg/kg-d)

[a] Carcinogenic calculations are based on combined childhood and adult exposure.
[b] Non-carcinogenic calculations are based on adult exposure only.

EPA 1993a. Region III Technical Guidance Manual, Risk Assessment: Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening. Hazardous Waste Management Division, Office of Superfund Programs, Philadelphia, PA, January 1993.

EPA 1995. Region III Risk-Based Concentration Table, First Quarter 1995. Hazardous Waste Management Division, Office of Superfund Programs, Philadelphia, PA. February 1995.

EPA Regions IV, VI, and VIII. Screening levels can be derived using standard EPA Region III algorithms for commercial/industrial and residential scenarios for soil, residential groundwater, and air. The residential equations can be used to calculate screening levels for open space land use by substituting the appropriate exposure assumptions. The default exposure assumptions used with the Region III algorithms are presented in Tables 4-1 through 4-6.

5.4.3 Florida Department of Environmental Protection Screening Algorithms

The Florida Department of Environmental Protection (FDEP) located in EPA Region IV has derived algorithms to be used in calculating soil screening levels for direct exposure (top two feet of surface soil) in residential and commercial/industrial land uses. These algorithms consider incidental ingestion, dermal contact and inhalation. Intakes from all routes are assumed to contribute to toxic endpoints. For toxic endpoints that are route-specific (e.g., carcinogenicity from inhalation of hexavalent chromium), only the relevant intake pathway is included in the calculation of the soil cleanup goal. The target risk for carcinogens is 10^{-6}, and the noncarcinogen hazard index is 1.

For situations in which there is evidence that soil may be serving as a source of contamination for groundwater, soil screening levels for organic chemicals based on leaching from soil to groundwater also can be calculated if the necessary physical-chemical characteristics are available.

The screening algorithms are presented in Tables 5-9 and 5-10. The default exposure assumptions used with these algorithms are presented in Tables 4-1 through 4-6.

5.4.4 Texas Natural Resource Conservation Commission Screening Algorithms

The Texas Natural Resource Conservation Commission (TNRCC) located in EPA Region VI has established its own site cleanup criteria which are found in the Texas Risk Reduction Standards (TRRS). The screening algorithms for Standard 2 of TRRS are

Table 5-9

Florida Soil Cleanup Goal Algorithms and Default Assumptions for Soil Not Contaminating the Groundwater

Carcinogens:

$$C_s = \frac{TR \times BW \times AT_{carc}}{EF \times ED \times FC \times [(SF_o \times IR_o \times 10^{-6}\frac{kg}{mg}) + (SF_d \times SA \times AF \times DA \times 10^{-6}\frac{kg}{mg}) + (SF_i \times IR_i \times (\frac{1}{VF} + \frac{1}{PEF}))]}$$

Non-Carcinogens:

$$C_s = \frac{TR \times BW \times AT_{noncarc}}{EF \times ED \times FC \times [(\frac{1}{RfD_o} \times IR_o \times 10^{-6}\frac{kg}{mg}) + (\frac{1}{RfD_d} \times SA \times AF \times DA \times 10^{-6}\frac{kg}{mg}) + (\frac{1}{RfD_i} \times IR_i \times (\frac{1}{VF} + \frac{1}{PEF}))]}$$

Exposure Variables		Definitions (units)	Default
C_s	=	Soil Level Goal (mg/kg)	
TR	=	Target Risk (unitless)	1.0(noncarc) 1E-6 (carc)
BW	=	Body Weight (kg)	15 (child) 59(R) 70 (I,C,O)
AT_{carc}	=	Averaging Time Carcinogens	25,550 (I,C,O,R)
DA	=	Dermal Absorption	0.01(org) 0.001 (inorganics)
AT-non carc	=	Averaging Time (days)	2,190 (child) 10,950(R) 9,125 (I,C,O)
EF	=	Exposure Frequency (days/yr)	350(R) 250 (I,C,O)
ED	=	Exposure Duration (yrs)	6(child) 30(R) 25(I,C,O)
FC	=	Fraction from Contaminated Source	1.0
SF_o	=	Slope Factor, oral $(mg/kg\text{-}d)^{-1}$	Chemical specific
SF_d	=	Slope Factor, dermal $(mg/kg\text{-}d)^{-1}$	Chemical specific
SF_i	=	Slope Factor, inhalation $(mg/kg\text{-}d)^{-1}$	Chemical specific
IR_i	=	Inhalation Rate (m^3/day)	10(child) 15(R) 20(I,C,O)
IR_o	=	Ingestion Rate (mg/kg)	200(child) 120(R) 50(I,C,O)
SA	=	Surface Area of Skin Exposed (cm^2/day)	1,800(child) 4,855(R) 2,300(I,C,O)
AF	=	Adherence Factor (mg/cm^2)	0.2(R) 0.6(I,C,O)
RfD_o	=	Reference Dose, Oral (mg/kg-d)	Chemical specific
RfD_d	=	Reference Dose, Dermal (mg/kg-d)	Chemical specific
RfD_i	=	Reference Dose, Inhalation (mg/kg-d)	Chemical specific
VF	=	Volatilization Factor	Chemical specific
PEF	=	Particulate Emission Factor (m^3/kg)	1.24 E+09

Florida Department of Environmental Protection, John M. Ruddell, Director of Division Waste Management, "Soil Cleanup Goals for Florida, Based on Direct Exposure and Migration to Groundwater," September 27, 1995.

R = Residential
I = Industrial
C = Commercial
O = Open Space

Table 5-10

Florida Soil Cleanup Goal Algorithm and Default Assumptions for Organic Constituents in Soils that are Potentially Contaminating the Groundwater

$$C_s = Cw \times [K_d + \frac{(\Theta_w + \Theta_a H')}{P_b}$$

Exposure Variables		Definitions (units)	Default
C_s	=	Soil Cleanup goal (mg/L)	--
C_w	=	Target soil lechate concentration (mg/L)	Chemical specific
K_d (K_{oc} x f_{oc})	=	Soil-water partition coefficient (cm^3/g)	Chemical specific
Θ_w	=	Water-filled soil porosity (L_{water}/L_{soil})	0.3
Θ_a	=	Air-filled soil porosity (L_{air}/L_{soil})	0.13
H'	=	Henry's Law constant (dimensionless)	Chemical specific
P_b	=	Dry Soil Bulk Density (kg/L)	1.5
K_{oc}	=	Organic Carbon Partition Coefficient (cm^3/g)	Chemical specific
f_{oc}	=	Organic Carbon Content of Soil (g/g)	0.002

Florida Department of Environmental Protection, John M. Ruddell, Director of Division Waste Management, "Soil Cleanup Goals for Florida, Based on Direct Exposure and Migration to Groundwater," September 27, 1995.

presented in Tables 5-11 through 5-13. The algorithms are used to derive medium specific concentrations (MSCs) for residential water ingestion, residential soil exposure, and occupational soil exposure. The default exposure assumptions used with the TRRS screening algorithms are presented in Tables 4-1 through 4-6. MSCs address a single contaminant in a medium and considers water ingestion and soil ingestion pathways. The inhalation of volatiles and particulates from soils along with the ingestion of soil are used to derive the soil screening level. TRRS recommends using accepted EPA guidance for addressing cross-media contamination as well as other exposure pathways if they are not appropriately addressed by the MSCs (TNRCC 1993).

5.4.5 EPA Region IX Screening Algorithms

The algorithms for EPA Region IX are given in Tables 5-14 through 5-17. EPA Region IX PRG concentrations are based on direct exposures (i.e., ingestion, dermal contact, and inhalation) for specific land-use conditions, and do not consider the impact to groundwater or ecological receptors (EPA 1994b) at this time. The default exposure assumptions used with EPA Region IX algorithms are presented in Tables 4-1 through 4-6.

EPA Region IX PRGs develop initial cleanup goals for residential land use (soil and water) and industrial land use (soils only). EPA Region IX recommends that industrial concentrations for soil be considered as an alternative goal and not be used for screening a site. Industrial concentrations are meant to provide the base RPM with an alternative preliminary goal for sites that are zoned heavy industry (EPA 1994b).

When screening IRP sites located in California, specific soil values should be used for cadmium, chromium, nickel, and 1,2-Dibromo-3-chloropropane (DBCP) (EPA 1994b). These four analytes are considered by Cal-EPA's Department of Toxic Substances Control as having significantly different soil values compared to those values accepted by EPA Region IX as a whole. These Cal-modified PRGs are based on EPA (1994b) guidance.

Table 5-11

Texas Risk Reduction Standard 2 Algorithms for Residential Water

Carcinogen:

$$MSC\ (mg/L) = \frac{TR \times BW \times AT(c) \times 365\ days/yr}{SF(o) \times IR(w) \times EF \times ED \times A}$$

Noncarcinogen:

$$MSC\ (mg/L) = \frac{THI \times RfD(o) \times BW \times AT(s) \times 365\ days/yr}{IR(w) \times EF \times ED \times A}$$

Exposure Variables		Definitions (units)
MSC	=	Medium Specific Concentration (mg/kg)
TR	=	Target excess individual lifetime cancer risk (unitless)
THI	=	Target hazard index (unitless)
SF(o)	=	Oral cancer slope factor $(mg/kg\text{-}d)^{-1}$
RfD(o)	=	Oral chronic reference dose (mg/kg-d)
BW	=	Adult body weight (kg)
AT(c)	=	Averaging time for carcinogens (yr)
AT(s)	=	Averaging time for systemic toxicants (yr)
EF	=	Exposure frequency (d/yr)
ED	=	Exposure duration (yr)
IR(w)	=	Daily water ingestion rate (L/d)
A	=	Absorption factor (unitless)

TNRCC 1993. Texas Risk Reduction Standard. Title 30. Environmental Quality Part I. Texas Natural Resources Conservation Commission, Chapter 335. Industrial Solid Waste and Municipal Hazardous Waste. June 28, 1993.

Table 5-12

Texas Risk Reduction Standard 2 Algorithms for Residential Soils

Carcinogen:

$$MSC\ (mg/kg) = \frac{TR \times BW \times AT(c) \times 365\ days/yr}{EF\ [(BW \times SF(o) \times 10^{-6}\ Kg/mg \times IF(soil/adj.)) + (SF(i) \times ED \times IR(air) \times [1 / VF + 1 / PEF])]}$$

Noncarcinogen:

$$MSC\ (mg/kg) = \frac{THI \times BW \times AT(s) \times 365\ days/yr}{EF\ [((1 / RfD(o)) \times BW \times 10^{-6}\ Kg/mg \times IF(soil/adj.)) + ((1/RfD(i)) \times ED \times IR(air)\ [1 / VF + 1 / PEF])]}$$

Exposure Variables		Definitions (units)
MSC	=	Medium Specific Concentration (mg/kg)
TR	=	Target excess individual lifetime cancer risk (unitless)
THI	=	Target hazard index (unitless)
SF(o)	=	Oral cancer slope factor $(mg/kg\text{-}d)^{-1}$
SF(i)	=	Inhalation cancer slope factor $(mg/y/d)^{-1}$
RfD(o)	=	Oral chronic reference dose (mg/kg-d)
RfD(i)	=	Inhalation chronic reference dose (mg/kg-d)
BW	=	Adult body weight (kg)
AT(c)	=	Averaging time for carcinogens (yr)
AT(s)	=	Averaging time for systemic toxicants (yr)
EF	=	Exposure frequency (d/yr)
ED	=	Exposure duration (yr)
IF(soil/adj)	=	Age-adjusted ingestion factor (mg - yr / kg - d)
IR(air)	=	Daily indoor inhalation rate (m^3/d)
PEF	=	Particulate emission factor (m^3/kg)
VF	=	Soil-to-air volatilization factor (m^3/kg)

TNRCC 1993. Texas Risk Reduction Standard. Title 30. Environmental Quality Part I. Texas Natural Resources Conservation Commission, Chapter 335. Industrial Solid Waste and Municipal Hazardous Waste. June 28, 1993.

Table 5-13

Texas Risk Reduction Standard 2 Algorithms for Industrial/Commercial Soils

Carcinogen:

$$MSC\ (mg/kg) = \frac{TR \times BW \times AT(c) \times 365\ days/yr}{EF \times ED \times [(SF(o) \times 10^{-6}\ kg/mg \times IR(soil)) + (SF(i) \times IR(air) \times [1 / VF + 1 / PEF])]}$$

Noncarcinogen:

$$MSC\ (mg/kg) = \frac{THI \times BW \times AT(s) \times 365\ days/yr}{EF \times ED \times [((1 / RfD(o)) \times 10^{-6}\ kg/mg \times IR(soil)) + ((1 / RfD(i)) \times IR(air) \times (1 / VF + 1 / PEF))]}$$

Exposure Variables		Definitions (Units)
MSC	=	Medium Specific Concentration (mg/kg)
TR	=	Target excess individual lifetime cancer risk (unitless)
THI	=	Target hazard index (unitless)
SF(o)	=	Oral cancer slope factor (mg/kg -d) $^{-1}$
SF(i)	=	Inhalation cancer slope factor (mg/kg - d) $^{-1}$
RfD(o)	=	Oral chronic reference dose (mg/kg-d)
RfD(i)	=	Inhalation chronic reference dose (mg/kg-d)
AT(s)	=	Averaging time for systemic toxicants (yr)
BW	=	Adult body weight (kg)
AT(c)	=	Averaging time for carcinogens (yr)
EF	=	Exposure frequency (d/yr)
ED	=	Exposure duration (yr)
IR(soil)	=	Workday soil ingestion rate (mg/d)
IR(air)	=	Daily indoor inhalation rate (m^3/d)
PEF	=	Particulate emission factor (m^3/kg)
VF	=	Soil-to-air volatilization factor (m^3/kg)

TNRCC 1993. Texas Risk Reduction Standard. Title 30. Environmental Quality Part I. Texas Natural Resources Conservation Commission, Chapter 335. Industrial Solid Waste and Municipal Hazardous Waste. June 28, 1993.

Table 5-14

EPA Region IX Preliminary Remediation Goals Screening Algorithms for Industrial Soils [a]

[b] Carcinogen:

$$C(mg/kg) + \frac{TR \times BW_a \times AT \times 365\ days/yr}{EF_o \times ED_o \left[\left(\frac{IRS_o \times CSF_o}{10^6\ mg/kg}\right) + \left(\frac{SA_a \times SL \times ABS \times CSF_o}{10^6\ mg/kg}\right) + \left(\frac{IRA_a \times CSF_i}{VF_s^d}\right)\right]}$$

[c] Noncarcinogen:

$$C(mg/kg) + \frac{THQ \times BW_a \times ED_o \times 365\ days/yr}{EF_o \times ED_o \left[\left(\frac{1\ IRS_o}{RfD_o \times 10^6\ mg/kg}\right) + \left(\frac{SA_a \times SL \times ABS}{RfD_o \times 10^6\ mg/kg}\right) + \left(\frac{IRA_a}{RfD_i \times VF_s^d}\right)\right]}$$

Exposure Variables		Definitions (units)
ABS	=	Skin absorption (unitless)
AT	=	Averaging time-cancer (years)
BW_a	=	Body weight, adult (kg)
CSF_i	=	Cancer slope factor, inhaled $(mg/kg\text{-}d)^{-1}$
CSF_o	=	Cancer slope factor, oral $(mg/kg\text{-}d)^{-1}$
ED_o	=	Exposure duration-occupational (years)
EF_o	=	Exposure frequency-occupational (d/yr)
IRA_a	=	Inhalation rate-adult (m^3/d)
IRS_o	=	Soil ingestion-occupational (mg/d)
RfD_i	=	Reference dose inhaled (mg/kg-d)
RfD_o	=	Reference dose oral (mg/kg-d)
SA_a	=	25% surface area, adult (cm^2/day)
SL	=	Soil adherence factor (mg/cm^2)
THQ	=	Target hazard quotient
TR	=	Target cancer risk
VF_s	=	Volatilization factor for soil (m^3/kg)

a When considering PRGs as initial cleanup goals, residential concentrations should be used for maximum beneficial uses of property. Industrial concentrations for soils only are included in the table as an alternative goal, but industrial goals should not be used for screening at a site.

b Equations are based on age-adjusted factors.

c For soils only, noncarcinogenic contaminants are evaluated for children separately from adults.

d Use VF for volatile chemicals (defined as having a Henry's Law Constant [atm-m^3/mol] greater than 10^{-5} and a molecular weight less than 200 grams/mol) or PEF for non-volatile chemicals.

EPA 1994b. Region IX Preliminary Remediation Goals (PRGs). Second Half 1994. Stanford J. Smucker, PhD., Regional Toxicologist (H-9-3), Technical Support Section, August 1, 1994.

Table 5-15

EPA Region IX Preliminary Remediation Goals Screening Algorithms for Residential Soils

[a] **Carcinogen:**

$$C(mg/kd) = \frac{TRA \times AT \times 365\ days/yr}{EF_r \left[\left(\frac{IFS_{adj} \times CSF_o}{10^6\ mg/kg} \right) + \left(\frac{SFS_{adj} \times ABS \times CSF_o}{10^6\ mg/kg} \right) + \left(\frac{InhF_{adj} \times CSF_i}{VF_i^c} \right) \right]}$$

[b] **Noncarcinogen:**

$$C(mg/kg) = \frac{THQ \times BW_c \times ED_r \times 365\ days/yr}{EF_r \times ED_c \left[\left(\frac{1}{RfD_o} \times \frac{IRS_c}{10^6\ mg/kg} \right) + \left(\frac{1}{RfD_o} \times \frac{SA_c \times SL \times ABS}{10^6\ mg/kg} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_c}{VF^c} \right) \right]}$$

Exposure Variables		Definitions (units)
ABS	=	Skin absorption (unitless)
AT	=	Averaging time-cancer (years)
BWc	=	Body weight, child (kg)
CSF_i	=	Cancer slope factor, inhaled $(mg/kg\text{-}d)^{-1}$
CSF_o	=	Cancer slope factor, oral $(mg/kg\text{-}d)^{-1}$
ED_c	=	Exposure duration-child (years)
ED_r	=	Exposure duration-residential (years)
EF_r	=	Exposure frequency-residential (d/yr)
IFS_{adj}	=	Ingestion factor-soils ([mg-y]/kg-d])
$InhF_{adj}$	=	Inhalation factor ([m^3-yr]/[kg-d])
IRA_c	=	Inhalation rate-child (m^3/d)
IRS_c	=	Soil ingestion-child (mg/d)
RfD_i	=	Reference dose inhaled (mg/kg-d)
RfD_o	=	Reference dose oral (mg/kg-d)
SA_c	=	25% surface area, child (cm^2/day)
SFS_{adj}	=	Skin contact factor-soils ([mg-yr]/[kg-d])
SL	=	Soil adherence factor (mg/cm^2)
THQ	=	Target hazard quotient
TR	=	Target cancer risk
VF_s	=	Volatilization factor for soil (m^3/kg)

a Equations are based on age-adjusted factors.

b For soils only, noncarcinogenic contaminants are evaluated for children separately from adults.

c Use VF for volatile chemicals (defined as having a Henry's Law Constant [atm-m^3/mol] greater than 10^{-5} and a molecular weight less than 200 grams/mol) or PEF for non-volatile chemicals.

EPA 1994b. Region IX Preliminary Remediation Goals (PRGs). Second Half 1994. Stanford J. Smucker, PhD., Regional Toxicologist (H-9-3), Technical Support Section, August 1, 1994.

Table 5-16

EPA Region IX Preliminary Remediation Goals Screening Algorithms for Residential Water

Carcinogen:

$$C(\mu g/L) = \frac{TR \times AT \times 365\ days/yr \times 1000\ \mu g/mg}{EF_r\,[(IFW_{adj} \times CSF_o) + (VF_w \times InhF_{adj} \times CSF_i)]}$$

Noncarcinogen:

$$C(\mu g/L) = \frac{THQ \times BW_a \times ED_r \times 365\ days/yr \times 1000\ \mu g/mg}{EF_r \times ED_r\,[\frac{(IRW_a)}{RfD_o} + \frac{(VF_w \times IRA_a)}{RfD_i}]}$$

Exposure Variables		Definitions (units)
AT	=	Averaging time-cancer (years)
BW_a	=	Body weight, adult (kg)
CSF_i	=	Cancer slope factor inhaled $(mg/kg\text{-}d)^{-1}$
CSF_o	=	Cancer slope w factor oral $(mg/kg\text{-}d)^{-1}$
ED_r	=	Exposure duration-residential (years)
EF_r	=	Exposure frequency-residential (d/year)
IFW_{adj}	=	Ingestion factor-water (L-y/kg-d)
$InhF_{adj}$	=	Inhalation factor ($[m^3\text{-}yr]/[kg\text{-}d]$)
IRA_a	=	Inhalation rate-adult (m^3/d)
IRW_a	=	Drinking water ingestion-adult (L/d)
RfD_i	=	Reference dose inhaled (mg/kg-d)
RfD_o	=	Reference dose oral (mg/kg-d)
THQ	=	Target hazard quotient
TR	=	Target cancer risk
VF_w	=	Volatilization factor for water (L/m^3)

EPA 1994b. Region IX Preliminary Remediation Goals (PRGs). Second Half 1994. Stanford J. Smucker, PhD., Regional Toxicologist (H-9-3), Technical Support Section, August 1, 1994.

Table 5-17

EPA Region IX Preliminary Remediation Goals Screening Algorithms for Air

Carcinogen:

$$C(\mu g/m^3) = \frac{TR \times AT \times 365\ days/yr \times 1000\ \mu g/mg}{EF_r \times InhF_{adj} \times CSF_i}$$

Noncarcinogen:

$$C(\mu g/m^3) = \frac{THQ \times RfD_i \times BW_a \times ED_r \times 365\ days/yr \times 1000\ \mu g/mg}{EF_r \times ED_r \times IRA_a}$$

Exposure Variables		Definitions (units)
AT	=	Averaging time-cancer (years)
BW_a	=	Body weight, adult (kg)
CSF_i	=	Cancer slope factor, inhaled $(mg/kg\text{-}d)^{-1}$
ED_r	=	Exposure duration-residential (years)
EF_r	=	Exposure frequency-residential (days/year)
$InhF_{adj}$	=	Inhalation factor ($[m^3\text{-}yr]/[kg\text{-}d]$)
IRA_a	=	Inhalation rate-adult (m^3/d)
RfD_i	=	Reference dose inhaled (mg/kg-d)
THQ	=	Target hazard quotient
TR	=	Target cancer risk

EPA 1994b. Region IX Preliminary Remediation Goals (PRGs). Second Half 1994. Stanford J. Smucker, PhD., Regional Toxicologist (H-9-3), Technical Support Section, August 1, 1994.

5.4.6 Arizona Department of Environmental Quality Screening Algorithms

The Arizona Department of Environmental Quality (ADEQ) screening algorithms are given in Tables 5-18 and 5-19. The default exposure assumptions used with the ADEQ screening algorithms are presented in Tables 4-1 to 4-6. The screening concentrations derived are referred to as Health-Based Guidance Levels (HBGLs). The ADEQ algorithms are based only on ingestion of drinking water and soils. The HBGLs do not apply to inhalation or direct contact with contaminants, nor are they applicable to aquatic systems or wildlife. In addition, the soil ingestion HBGLs do not take into account a contaminant's ability to leach into groundwater.

5.4.7 EPA Region X Screening Algorithms

The screening algorithms for EPA Region X are given in Tables 5-20 and 5-21. PRG algorithms were developed only for residential soil and water. These can be modified by inputting industrial exposure factors to derive industrial screening levels. The default exposure assumptions used with the EPA Region X algorithms are presented in Tables 4-1 through 4-6.

5.4.8 RCRA Proposed Subpart S Screening Algorithms

The proposed RCRA corrective action rule in Subpart S (FR 30798-30884, July 27, 1990) contains methodology and criteria for calculating action levels for contaminants in soil, water, and air. The proposed rule also provides the assumptions to be used for calculating action levels. The algorithms used to calculate RCRA Proposed Subpart S media action levels are presented in Tables 5-22 and 5-23. However, since RCRA Proposed Subpart S has not been promulgated as a final rulemaking, Subpart S media action levels will only be used for comparative purposes as opposed to being used as screening levels.

Table 5-18

State of Arizona HBGL Screening Algorithms for Drinking Water Ingestion

Groups A and B Carcinogen:

$$HBGLDW\ (\mu g/L) = \frac{BW \times LRF}{SF \times Iw} \times 1000\ \mu g/mg$$

Noncarcinogen:

$$HBGLDW\ (\mu g/L) = \frac{BW \times RfD}{Iw} \times RSC \times 1000\ \mu g/mg$$

Group C Carcinogen:

$$HBGLDW\ (\mu g/L) = \frac{\frac{BW \times RfD}{Iw} \times RSC \times 1000 \mu g/mg}{10}$$

Exposure Variables		Definitions (units)
BW	=	Body weight (70 kg)
HBGLDW	=	Health-based ingestion guidance level for drinking water (µg/L)
Iw	=	Water ingestion rate (L/d)
LRF	=	Lifetime risk factor or Target Risk
RfD	=	Reference dose (mg/kg-d)
RSC	=	Relative source contribution (unitless)
SF	=	Slope factor $(mg/kg\text{-}d)^{-1}$

Safety Factor of 10 for Group C carcinogens was added for drinking water HBGLs. It was adopted by ADEQ from the EPA method used in deriving PMCLs and MCLs. It adds a margin of prudence to the drinking water HBGLs for chemicals exhibiting only limited evidence of carcinogenicity in animals.

Arizona Department of Environmental Quality, June 1992. Human Health-Based Guidance Levels for the Ingestion of Contaminants in Drinking Water and Soil.

Table 5-19

State of Arizona HBGL Algorithms for Soil Ingestion

Carcinogen:

$$HBGLS\ (mg/kg) = \frac{AT \times BW \times LRF}{IS30 \times ED \times SF} \times 1000\ mg/g$$

Noncarcinogen:

$$HBGLS\ (mg/kg) = \frac{Iw \times HBGLDW}{IS30} \times \frac{1000\ g/kg}{1000\ \mu g/mg}$$

Exposure Variables		Definitions (units)
AT	=	70-year lifetime
BW	=	Body weight (kg)
ED	=	30-year exposure duration
HBGLS	=	Health-based ingestion guidance level for soil (mg/kg)
HBGLDW	=	Health-based ingestion guidance level for drinking water (μg/L)
IS30	=	Soil ingestion rate during the first 30 years of life (g/d)
Iw	=	Water ingestion rate (L/d)
LRF	=	Lifetime risk factor or Target Risk
RfD	=	Reference dose (mg/kg-d)
SF	=	Slope factor $(mg/kg\text{-}d)^{-1}$

Arizona Department of Environmental Quality, June 1992. Human Health-Based Guidance Levels for the Ingestion of Contaminants in Drinking Water and Soil.

Table 5-20

EPA Region X Screening Algorithms for Residential Soils

[a]**Carcinogens:**

$$C\ (mg/kg) = \frac{Risk \times 10^{6}\ (mg/kg)}{[((IRSc \times EF \times EDc)/(BWc \times 365\ days/yr)+(IRSa \times EF \times EDa)/(BWa \times 365\ days/yr))/AT) \times SFo]}$$

[a]**Non-Carcinogens:**

$$C\ (mg/kg) = \frac{HQ \times 10^{6}(mg/kg)}{[((IRSc \times EF \times EDc)/(BWc \times 365\ days/yr)+(IRSa \times EF \times EDa)/(BWa \times 365\ days/yr))/AT)/RfDo2]}$$

Exposure Variables:		Definitions (units)
C	=	Risk-Based Concentration (mg/kg)
HQ	=	Target Hazard Quotient (unitless)
Risk	=	Target Cancer Risk (unitless)
IRSa	=	Soil Ingestion Rate, Adult (mg/d)
EF	=	Exposure Frequency (d/y)
EDa	=	Exposure Duration, Adult (y)
BWa	=	Body Weight, Adult (kg)
ATn	=	Averaging Time Non-Carcinogen (y)
RfDo	=	Chemical-Specific Oral Reference Dose (mg/kg-d)
SFo	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
ATc	=	Averaging Time Carcinogen (y)
IRSc	=	Soil Ingestion Rate, Age 1-6 (mg/d)
BWc	=	Body Weight, Age 1-6 (kg)
EDc	=	Exposure Duration, Age 1-6 (y)

[a] Equations are based on combined childhood and adult exposures.

EPA 1991b. Memorandum: Supplemental Guidance for Superfund Risk Assessments in Region X. Health and Environmental Assessment Section. Seattle, WA. August 1991.

Table 5-21

EPA Region X Screening Algorithms for Residential Water

[a]**Carcinogens:**

$$C\ (mg/L) = \frac{Risk}{\left[\frac{(IRW_a \times EF \times ED_a)}{(BW_a \times 365\ days/yr \times AT_c)} \times SF_o + \frac{(VF_w \times IRA_a \times EF \times ED_a)}{(BW_a \times 365\ days/yr \times AT_c)} \times SF_i\right]}$$

[a]**Non-Carcinogens:**

$$C\ mg/L) = \frac{HQ}{\left[\left(\frac{(IRW_a \times EF \times ED_a)}{(BW_a \times 365\ days/yr \times AT_n) \times (RfD_o)} + \frac{(VF_w \times IRA_a \times EF \times ED_a)}{(BW_a \times 365\ days/yr \times AT_n) \times RFD_i}\right)\right]}$$

Exposure Variables:		Definitions (units)
C	=	Risk-Based Concentration (mg/L)
HQ	=	Hazard Quotient (unitless)
Risk	=	Target Cancer Risk (unitless)
IRW_a	=	Tap Water Ingestion, Adult (L/d)
IRA_a	=	Inhalation Rate, Adult (m^3/d)
EF	=	Exposure Frequency (d/y)
ED_a	=	Exposure Duration, Adult (y)
BW_a	=	Body Weight, Adult (kg)
AT_c	=	Averaging Time Carcinogens (y)
AT_n	=	Averaging Time Non-Carcinogens (y)
RfD_o	=	Chemical-Specific Oral Reference Dose (mg/kg-d)
RfD_i	=	Chemical-Specific Inhalation Reference Dose (mg/kg-d)
SF_o	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
SF_i	=	Chemical-Specific Inhalation Factor $(mg/kg\text{-}d)^{-1}$
VF_w	=	Volatilization Factor (L/m3)

[a] Equations are based on adult exposures only.

EPA 1991b. Memorandum: Supplemental Guidance for Superfund Risk Assessments in Region X. Health and Environmental Assessment Section. Seattle, WA. August 1991.

Table 5-22

RCRA Proposed Subpart S Screening Algorithms for Soils

[a]Carcinogens:

$$C\ (mg/kg) = \frac{Risk \times BW_a \times AT_c}{[SF_o \times IRS_a \times 0.001\ kg/g \times a \times ED_a]}$$

[b]Non-Carcinogens:

$$C\ (mg/kg) = \frac{RfD_o \times BW_c}{IRS_c \times A \times 0.001\ kg/g}$$

Exposure Variables:		Definitions (units)
C	=	Risk-Based Concentration (mg/kg)
Risk	=	Target Cancer Risk (unitless)
BW_a	=	Body Weight, Adult (kg)
AT_c	=	Averaging Time Carcinogens (y)
SF_o	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
IRS_a	=	Soil Ingestion Rate, Adult (g/d)
A	=	Absorption Factor (1; dimensionless)
ED_a	=	Exposure Duration, Adult (y)
RfD_o	=	Chemical-Specific Oral Reference Dose (mg/kg-d)
BW_c	=	Body Weight, Child (kg)
IRS_c	=	Soil Ingestion Rate, Child (g/d)

[a] Equations are based on adult exposures only.
[b] Equations are based on child exposures only.

RCRA Corrective Action Rule in Subpart S, *Federal Register* 30798-30884. July 27, 1990.

Table 5-23

RCRA Proposed Subpart S Screening Algorithms for Water

[a]Carcinogens:

$$C\ (mg/L) = \frac{Risk \times BW_a \times AT_c}{[SF_o \times IRW_a \times A \times ED_a]}$$

[a]Non-Carcinogens:

$$C\ (mg/L) = \frac{RfD_o \times BW_a}{IRW_a \times A}$$

Exposure Variables		Definitions (units)
C	=	Risk-Based Concentration (mg/L)
Risk	=	Target Cancer Risk (unitless)
BW_a	=	Body Weight, Adult (kg)
AT_c	=	Averaging Time Carcinogens (y)
SF_o	=	Chemical-Specific Oral Slope Factor $(mg/kg\text{-}d)^{-1}$
IRW_a	=	Water Ingestion Rate, Adult (L/d)
A	=	Absorption Factor (1; dimensionless)
ED_a	=	Exposure Duration, Adult (y)
RfD_o	=	Chemical-Specific Oral Reference Dose (mg/kg-d)

[a] Equations are based on adult exposures only.

RCRA Corrective Action Rule in Subpart S, *Federal Register* 30798-30884. July 27, 1990.

5.4.9 Industrial Groundwater Screening Algorithm

The algorithm for determining risk-based screening levels based on dermal exposure to process water in an industrial setting is shown in Table 5-24. The basis of this algorithm is the dermal exposure equation found in EPA RAGs Part A (1989a).

5.4.10 Residential and Open Space Surface Water Screening Algorithm

The screening algorithms for deriving surface water screening levels are presented in Table 5-25. These algorithms were derived from surface water dermal and ingestion equations presented in EPA RAGS Part A (EPA 1989a). These algorithms will be applied for open space and residential scenarios where incidental ingestion and dermal contact may occur while swimming in a surface water.

Table 5-24

Risk-Based Screening Algorithm for Industrial Water

[a] **Carcinogen:**

$$C\ (mg/L) = \frac{Risk \times BW_a \times 365\ days/yr \times AT_c \times 1000cm^3/L}{EF \times ED_a \times (SF_o/ABS) \times PC \times SA \times ET}$$

[a] **Noncarcinogen:**

$$C\ (mg/L) = \frac{HQ \times BW_a \times 365\ days/yr \times AT_n \times 1000\ cm^3/L \times RFD \times ABS}{PC \times SA \times EF \times ED_a \times ET}$$

Exposure Variables		Definitions (units)
Risk	=	Target Cancer Risk (unitless)
ATc	=	Averagaging Time Carcinogens (y)
EF	=	Exposure frequency (d/y)
SF(o)	=	Chemical-Specific Oral Slope Factor (mg/kg-day) $^{-1}$
HQ	=	Target Hazard Quotient (unitless)
BWa	=	Body Weight, Adult (kg)
ATn	=	Averaging Time Non-carcinogens (y)
EDa	=	Exposure Duration, Adult (y)
RfDo	=	Reference Dose Oral (mg/kg-d)
ABS	=	Absorption Factor (unitless)
PC	=	Permeability Coefficient (cm/hour)
SA	=	Surface Area Exposed (cm ^{2})
ET	=	Exposure Time (hours/day)

[a] Equations are based on adult exposure only.

Source: EPA (1989a) Risk Guidance for Superfund Volume I, Human Health Evaluation Manual (Part A).

Table 5-25

EPA Screening Algorithms for Surface Water Incidental Ingestion and Dermal Contact While Swimming

Carcinogen:

$$\frac{TR \times BW_a \times 365\ days/yr \times AT_c}{EF \times ED \times ET \times SF_o} \times \left[\frac{1000\ cm^3/L}{PC \times SA/ABS} + \frac{1}{CR}\right]$$

Noncarcinogen:

$$\frac{HQ \times BW_a \times AT_n \times RFD_o \times 365\ days/yr}{ET \times EF \times ED} \times \left[\frac{1}{CR} + \frac{1000\ cm^3/L}{PC \times SA}\right]$$

Exposure Variables		Definitions (units)
C	=	Chemical concentration in water (mg/L)
TR	=	Target Cancer Risk (unitless)
BW_a	=	Body Weight, Adult (kg)
AT_c	=	Averaging Time Carcinogens (years)
SF_o	=	Chemical Specific Oral Slope Factor $(mg/kg\text{-}day)^{-1}$
CR	=	Contact Rate (L/hour)
ET	=	Exposure Time (hours/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
HQ	=	Target Hazard Quotient (unitless)
AT_n	=	Averaging Time Non-Carcinogen (years)
RfDo	=	Chemical-Specific Oral Reference Dose (mg/kg-day)
PC	=	Permeability Coefficient (cm/hr)
SA	=	Surface Area Exposure (cm^2)
ABS	=	Absorption Factor (unitless)

Source: EPA (1989a) Risk Guidance for Superfund Volume I, Human Health Evaluation Manual (Part A).

6.0 DERIVATION OF RISK-BASED SCREENING LEVELS

The overall process for determining the chemicals of potential concern (COPCs) which are potential risk drivers and calculating risk-based screening levels for the probable land use is given in Figure 6-1. The overall process proceeds in the following sequence:

1) Reduction of COPCs by comparison to field and laboratory blanks.

2) If possible, reduction of COPCs by comparison to background levels for each medium.

3) Selection of maximum detected concentrations for each medium.

4) Derive land-use-based screening levels based on EPA Regional or state approved algorithms and exposure parameters.

5) Develop final list of COPCs by determining the set of analyte maximum detects that exceed the screening levels.

The first step involves collecting and analyzing data. The laboratory results then go into a central database. Before the data can be extracted for COPC determination, the data should undergo a quality assurance/quality control (QA/QC) check. As part of the QA/QC, comparisons are made between site sample results and levels of the same chemicals detected in associated trip, field, and laboratory blank samples (see EPA 1989a). Analytes exceeding required blank criteria concentrations are retained for further data analyses. These comparisons are performed as part of the Remedial Investigation/Feasibility Study (RI/FS) or RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) process for IRP sites.

The second step involves statistical comparison of naturally occurring inorganic constituent levels (background) to concentrations of inorganics detected at the site. The sample concentration must be significantly greater (e.g., 95% confidence) than background concentrations of the same constituent to be retained as a COPC (EPA 1989a). Depending on the amount of site-related and background data available, the statistical analysis may

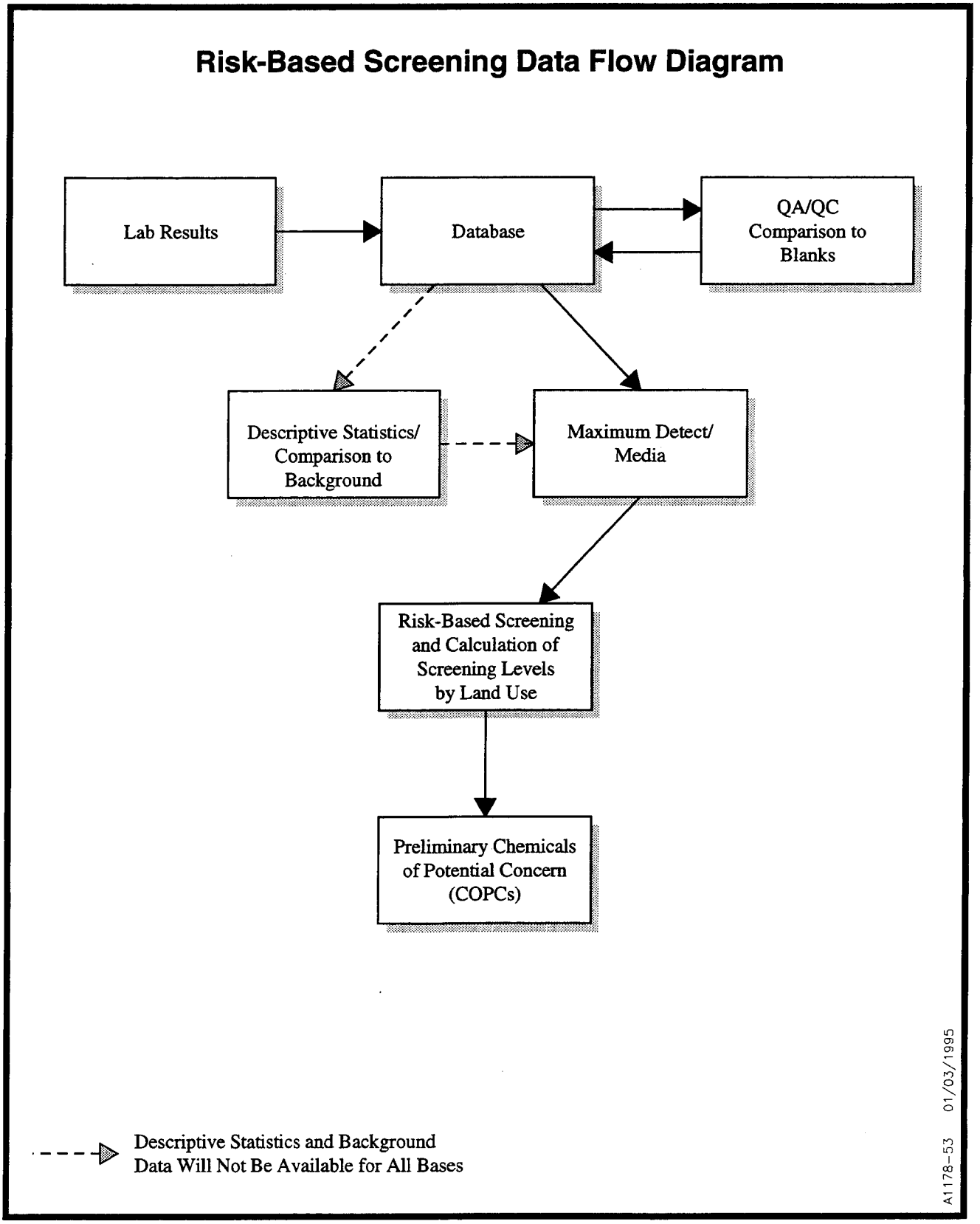

Figure 6-1. Risk-Based Screening Data Flow Diagram

not be possible at all sites. If such statistical analyses have been previously performed, the results will be utilized in the RNSI process. The third step is selection of the maximum detected concentration of each COPC for each medium. Once the land-use-based screening levels have been derived (step four), the final list of COPCs are those with maximum detects above the screening levels.

6.1 Risk Assessment Data Considerations

In order to conduct risk-based screening, data will be organized and utilized in the following general format. These represent general guidelines and will be determined based on the data available from each individual base.

6.1.1 Media Segregation

The following are general guidelines for media segregation and will be adjusted by base-specific requirements for data. For example, in some EPA Regions or states, surface soils are considered to be in 0-2" depths while in others, surface soil may extend to 2 feet. However, as stated previously in Section 4.1.1, all soils, for purposes of this initiative, will be considered surface soils.

Soils

- Surface Soils (Range 0-2 ft.)
- Subsurface Soils (>2 ft)

Sediments

Water

- Surface Water (Type)
- Perched Aquifer
- Shallow Aquifer
- Deeper Aquifers

6.1.2 Descriptive Statistics

The screening of chemicals to determine which COPCs should be further evaluated can be conducted with maximum detect values, as they are for this project. However, descriptive statistics which are useful for each compound by media segregation are as follows:

- Maximum Detect
- Arithmetic Means
- Standard Deviation
- 95% Upper Confidence Limit (UCL) of Arithmetic Mean
- Frequency of Detect
- Range of Detected Values
- Sample Quantitation Limit

The use of these statistics are as follows. The maximum detect can be compared to the arithmetic mean and UCL to assess whether the data as a whole are above or below the screening values or whether the maximum detect is an extreme outlier. The range of detected levels is also used for this purpose. The frequency of detect can aid in the evaluation of whether a contaminant is rarely or generally detected, giving some idea of its distribution. Lastly, in some cases, the risk-based value may be below the practical quantitation

limit so the possibility of a proxy value result, which is not an actual detection of a contaminant, above a risk-based value may exist. In summary, descriptive statistics give a better understanding of the data as a whole rather than relying only on the maximum detect for comparisons.

6.2 Decision Logic Flow Charts for COPC Eliminations

Figures 6-2 and 6-3 give the decision logic for reducing the COPCs from those simply detected in various media to those which may be risk drivers. The maximum detected values for contaminants by media are compared to the risk-based screening level calculated according to the algorithm chosen and the land use exposure factors. If the maximum detect exceeds the regulatory ratio value of one as explained below, it is retained as a COPC.

Table 6-1 presents an example of risk screening for soils. The contaminants are rank ordered by regulatory ratio, which is the ratio of the maximum detect over the screening level. Those with a regulatory ratio of 1 or greater are retained; those below 1 are deleted from the COPC list and those that have no toxicity value are listed separately for possible qualitative assessment or deletion. A benefit of this presentation is an early identification of risk drivers in rank order, at least by maximum detect. If statistically analyzed data are available, additional rank ordering could be done by comparison of the statistical mean or upper confidence limit. Table 6-2 presents an example summary of COPCs and chemicals without toxicity values.

6.3 Screening Levels for DRO and TPH

Diesel, kerosene, JP-4, and JP-5 are common fuels found to have contributed to contamination of soils and groundwater at Air Force bases. Typically, these fuels are measured by field sampling for gross parameters such as DRO and TPH. These gross parameters cannot identify which type of fuel was spilled, but would indicate if there has been fuel contamination in the area. Using historical information about the use of an area, it can be

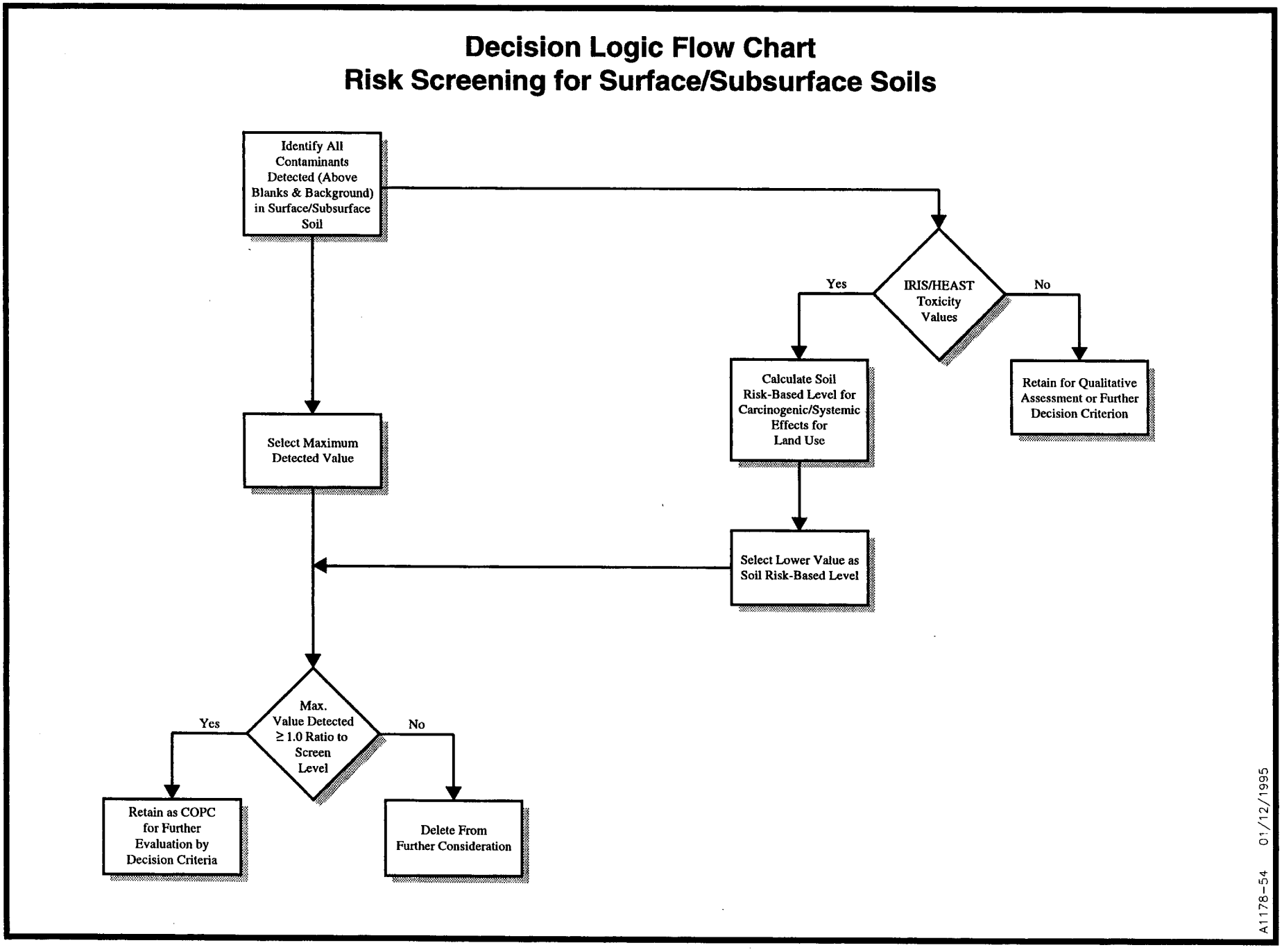

Figure 6-2. Decision Logic Flow Chart: Risk Screening for Surface/Subsurface Soils

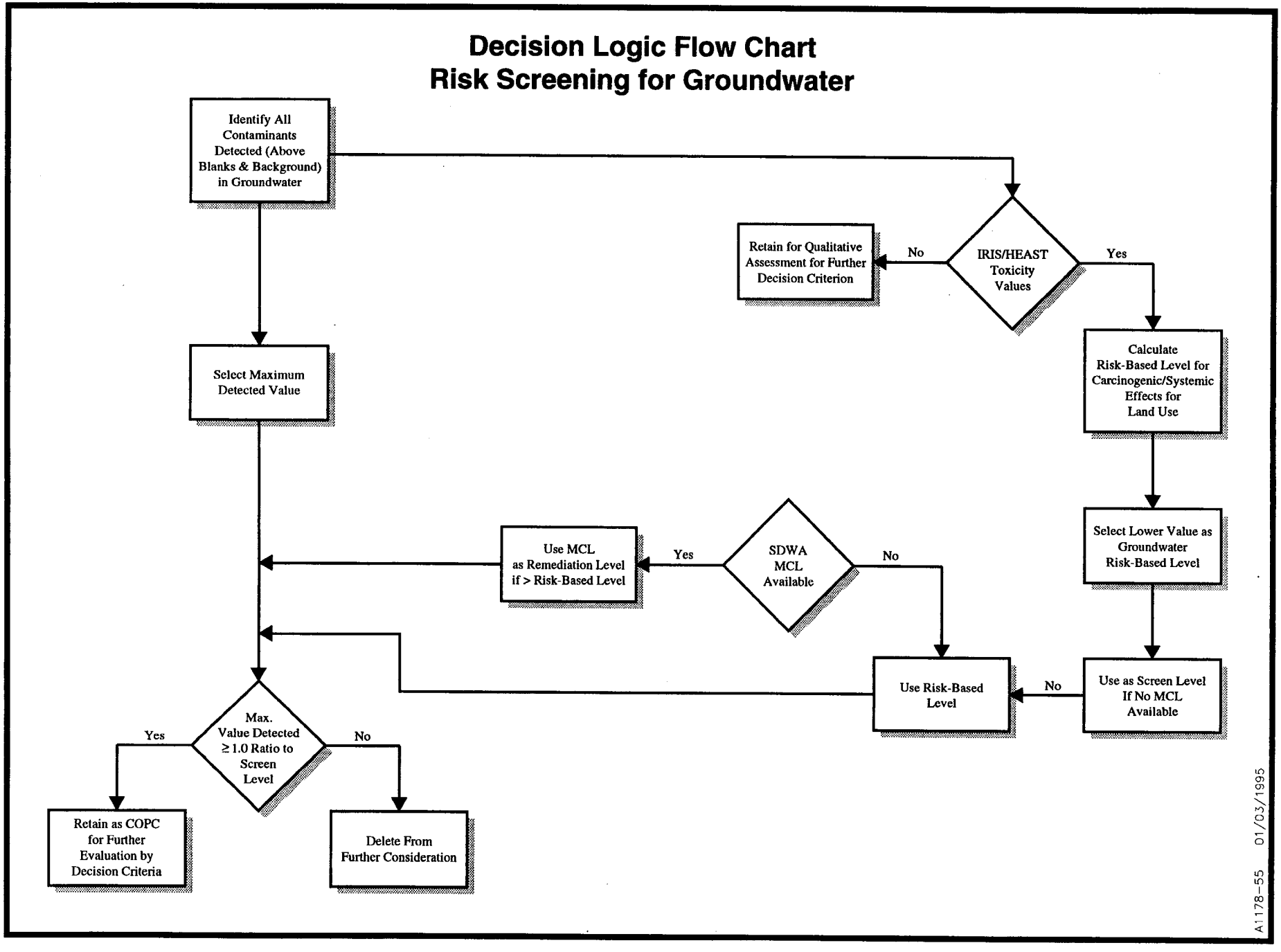

Figure 6-3. Decision Logic Flow Chart: Risk Screening for Groundwater

Table 6-1

Soil Risk Screening

Compound	CAS #	Toxicity Values		Analytical Data (mg/kg)	Screen Level (mg/kg)	Reg. Ratio	Verdict [1]
		RfD	CSF	Det. Max			
Thallium	7440-28-0	0.00000	0.00000	79.00000	0.20000	395.00000	YES
Antimony	7440-36-0	0.00040	0.00000	43.00000	0.60000	71.66667	YES
Lead	7439-92-1	0.00000	0.00000	16.00000	1.50000	10.66667	YES
Barium	7440-39-3	0.07000	0.00000	830.00000	200.00000	4.15000	YES
Beryllium	7440-41-7	0.00500	4.30000	1.40000	0.40000	3.50000	YES
Arsenic	7440-38-2	0.00030	1.75000	10.00000	5.00000	2.00000	YES
Nickel	7440-02-0	0.02000	0.00000	19.00000	10.00000	1.90000	YES
Chromium	16065-83-1	1.00000	0.00000	19.00000	10.00000	1.90000	YES
Cadmium	7440-43-9F	0.00100	0.00000	0.92000	0.50000	1.84000	YES
alpha-BHC	319.84-6	0.00000	6.30000	0.00480	0.00454	1.05727	YES
Selenium	7782-49-2	0.00500	0.00000	3.43200	5.00000	0.68640	NO
Vanadium	7440-62-2	0.00700	0.00000	40.00000	71.50000	0.55944	NO
Copper	7440-50-8	0.03700	0.00000	15.00000	130.00000	0.11538	NO
Silver	7440-22-4	0.00500	0.00000	3.40000	51.10000	0.06654	NO
Strontium	7440-24-6	0.60000	0.00000	290.00000	6132.00000	0.04729	NO
Nitrate-Nitrite as N	SUR-00-1	0.10000	0.00000	4.00000	100.00000	0.04000	NO
Methylene chloride	75-09-2	0.06000	0.00750	0.00990	0.50000	0.01980	NO
Zinc	7440-66-6	0.30000	0.00000	52.00000	3070.00000	0.01694	NO
Di-n-octylphthalate	117-84-0	0.02000	0.00000	0.40000	204.00000	0.00196	NO
Dibutylphthalate	84-74-2	0.10000	0.00000	0.39000	1020.00000	0.00038	NO
Acetone	67-64-1	0.10000	0.00000	0.12000	1020.00000	0.00012	NO
Cyclohexene B		0.00000	0.00000	38.00000	0.00000	0.00000	NV
Nonanal B		0.00000	0.00000	0.00560	0.00000	0.00000	NV
Decanal B		0.00000	0.00000	0.00560	0.00000	0.00000	NV
Cobalt	7440-48-4	0.00000	0.00000	8.70000	0.00000	0.00000	NV
Acrolein	107-02-8	0.02000	0.00000	0.00000	204.00000	0.00000	ND
Hexachlorocyclopentadiene	77-47-4	0.00700	0.00000	0.00000	71.54000	0.00000	ND

1 YES - Compounds Exceeding Screening Levels NO - Below Screening Level NV - No Toxicity Value ND - Non-Detect

Table 6-2

Compounds Retained Following Risk-Based Screen, Compounds With No Toxicity Values, and Tentatively Identified Compounds

Exceeds Industrial Criteria	No Toxicity Value	Tentatively Identified Compounds (TICs)[a]
Alpha-BHC	Cyclohexene B	Acrolein
Antimony	Nonanal B	Hexachloropentadiene
Arsenic	Decanol B	
Barium	Cobalt	
Beryllium		
Cadmium		
Chromium		
Lead		
Nickel		
Thallium		

[a]TICs are reported in this table but are not carried as COPCs.

assumed that a certain type of fuel is the cause of contamination, and screening levels can be calculated based on the type of fuel (i.e., diesel, JP-4, JP-5, gasoline, kerosene). Screening levels will be derived for these gross parameters only when there is no chemical-specific data available to determine if a potential risk to human health exists.

The Installation Restoration Program Toxicology Guide (H.G. Armstrong Aerospace Medical Research Laboratory, 1989) provides guidance for assigning a proxy toxicity value for fuel oils (e.g., DRO). This guidance recommends use of a reference dose for n-hexane as a proxy value.

6.4 Screening Levels for Surface Water

No EPA Regional or state screening algorithms are available for deriving surface water screening levels. One method of evaluating the surface water data is to compare the results to federal or state AWQC for the protection of human health. In addition, AWQC for the protection of aquatic life are available for use in evaluating the possible ecological impacts of surface water. An algorithm was derived based on RAGS Part A (EPA 1989a) for incidental ingestion and dermal contact with surface water while swimming for this project. If AWQC is not accepted as a screening level for drinking water scenarios, the residential groundwater algorithm may be used.

6.5 Screening Levels for Lead

Lead is commonly found in nearly all media of the environment and in most biological systems. In addition, lead has been found at Air Force Bases due to contamination from lead-based paints in old dwellings, auto exhaust (e.g., roadside exhaust deposits), lead-based fuel spills, industrial emissions, and spent munitions. EPA has not developed an oral reference dose (RfD) for lead. The EPA RfD Work Group considered it inappropriate to develop an RfD for inorganic lead because the adverse effects resulting from lead exposure occurred at levels low enough to be essentially without a threshold (EPA 1994c). Therefore,

EPA has developed the Integrated Exposure Uptake Biokinetic Model (IEUBK) which factors in the multimedia nature of lead exposures; incorporates important absorption and pharmocokinetic information; and allows the model user to consider the potential distributions of exposure and risk likely to occur at the site.

Through using the IEUBK model and the collective experience of the Superfund, RCRA Corrective Action, and Toxic Substance Control Act (TSCA) Section 403 programs, the EPA recommends a residential screening level for Superfund and RCRA sites of 400 ppm in soil (EPA 1994d). This 400 ppm value will be used as the soil screening level for all land uses in this project.

7.0 SITE-SPECIFIC FACTORS

Ideally, site screening levels should take site-specific factors into consideration and should establish consistency in the levels of protection provided for persons living and working near contaminated sites. For many sites, a great deal of site-specific information may be available from DPM (Defense Priority Model) scoring information, Department of Defense Relative Risk Site Evaluations, MAPs (Management Action Plans), BCPs (Base Comprehensive Plans), and RI (Remedial Investigation) documents. Information concerning site operations, waste types and quantities, and regulatory history, may be located in these documents. Available site information from these sources will be reviewed to determine basic site characteristics, identify potential exposure pathways and exposure points, and help determine any additional data needs when available.

7.1 Site-Specific Parameters

Characterizing the site and contaminant sources is a critical task in developing screening levels. Field measurements for physical characteristics of a site, medium, or contamination source are a critical data source whose omission can significantly affect the development of valid screening levels. The use of default options and routines to estimate missing values allows the derivation of screening levels but generally increases the conservatism and uncertainty associated with them. Table 7-1 presents examples of site-specific parameters that may affect the development of screening levels. Whenever possible, information associated with the site characteristics listed in Table 7-1 will be utilized if available information exists.

7.2 Unique Characteristics/Environmental Factors

Some sites have unique characteristics that will require deviation from the standard protocols outlined in previous sections. Table 7-2 presents examples of unique

Table 7-1

Site-Specific Parameters

General Site Characteristics	Site-Specific Parameters	Importance
Hydrology	Local Hydrology as it pertains to Contaminant Migration	Contaminant Fate and Transport
	Presence of Potable Water and/or Agricultural Wells in Vicinity and Distance from Site	Receptor Identification Environmental Fate and Transport
	Depth to Aquifer and Groundwater Gradient	Receptor Identification Environmental Fate and Transport
	Surface Water Bodies in Vicinity and their Use	Receptor Identification Environmental Fate and Transport
	Drainage Patterns	Receptor Identification Environmental Fate and Transport
	Flood Frequency	Environmental Fate and Transport
Geology	Local Geology as it Pertains to Contaminant Migration	Site Characterization Environmental Fate and Transport
	Soil Information including Particle Size, Organic Carbon and Clay Content, Bulk Density	Environmental Fate and Transport
Ecology	Flora/Fauna Specific to Area	Receptor Identification
	Sensitive Habitats	Receptor Identification
	Rare or Endangered Species	Receptor Identification
Atmospheric Conditions	Annual Precipitation	Environmental Fate and Transport
	Wind Speed and Prevailing Direction	Receptor Identification Environmental Fate and Transport
Physical Setting	General Setting of Site and Surroundings	Receptor Identification Identify Areas of Access to Site Site Characterization
	Geographic Setting	Site Characterization
	Groundcover	Site Characterization Environmental Fate and Transport

Table 7-1

(Continued)

General Site Characteristics	Site-Specific Parameters	Importance
Waste Source Characteristics	Sources including Type, Location, Dimensions, and Evidence of Containment	Site Characterization Receptor Identification Environmental Fate and Transport
	Hazardous Substances Disposed	Identification of Chemicals of Concern
	Signs of Contaminant Migration	Receptor Identification Environmental Fate and Transport
	Depth of Waste	Site Characterization Receptor Identification Environmental Fate and Transport
Land Use	Current Land Use	Site Characterization Receptor Identification Exposure Assessment
	Future Land Use	Site Characterization Receptor Identification Exposure Assessment
	Deed Restrictions	Receptor Identification Exposure Assessment
	Compatible Use Zones	Site Characterization Receptor Identification Exposure Assessment

Table 7-2

Examples of Unique Characteristics

Unique Characteristics	Options
Wetlands/Floodplains	EPA guidance document *Methods for Assessing Exposure to Chemical Substances, Vol 4 Methods for Enumerating and Characterizing Populations Exposed to Chemical Substances* provides guidance on calculating ecological risk and cleanup standards for wetlands. At a minimum, ecological concerns will be documented for future use when more quantitative guidance becomes available.
Low-level radioactive waste	Chapter 10 of the USEPA *Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A)* provides guidance for calculating risk associated with low-level radioactive wastes. Methodology for developing screening levels for radioactive wastes is presented in Section 7.2.2, and follows the Residual Radioactivity Software developed by the Department of Energy.
Bodies of water	EPA guidance documents *Methods for Assessing Exposure to Chemical Substances, Vol 5 Methods for Assessing Exposure to Chemical Substances in Drinking Water, Assessing Human Health Risks from Chemically Contaminated Fish and Shellfish*, and *Corrective Measures for Releases to Surface Waters* provide guidance on calculating ecological risk and cleanup standards for bodies of water. Federal and State Ambient Water Quality Criteria can also be used to make semi-quantitative assessments of risks associated with surface water bodies and will be used to set action levels/cleanup standards when available.
Sensitive ecosystems	The EPA *Framework for Ecological Risk Assessment* provides conceptual guidance for performing ecological risk assessments. EPA guidance document *Ecological Risk Assessment Methods: A Review and Evaluation of Past Practices in the Superfund and RCRA Programs* provides assistance. *A Proposed Approach to Quantitatively Assess Potential Ecological Impacts to Terrestrial Receptors from Chemical Exposure* by Watkin and Stelljes provides guidance on calculating ecological risk to terrestrial receptors. The *General Guidance for Ecological Risk Assessment at Air Force Installations* by DeSesso and Price also provides further guidance. At a minimum, ecological concerns will be documented for future use when more quantitative guidance becomes available.

Table 7-2

(Continued)

Unique Characteristics	Options
Endangered/threatened species	Ambient Water Quality Criteria will be incorporated into the Risk-Based Screen to perform semi-qualitative analyses for aquatic receptors. The EPA *Framework for Ecological Risk Assessment* provides conceptual guidance for performing ecological risk assessments. In addition, *A Proposed Approach to Quantitatively Assess Potential Ecological Impacts to Terrestrial Receptors from Chemical Exposure* by Watkin and Stelljes provides guidance on calculating ecological risk to terrestrial receptors. At a minimum, ecological concerns for terrestrial species will be documented for future use when more quantitative guidance becomes available.
Herbicide/pesticide spills	EPA guidance document *Pesticide Assessment Guidelines for Applicator Exposure Monitoring* provides guidance on calculating risk associated with pesticide/herbicide spill sites.
Basewide groundwater OU	EPA guidance documents *Methods for Assessing Exposure to Chemical Substance, Vol 5, Methods for Assessing Exposure to Chemical Substances in Drinking Water, Corrective Measures for Release to Groundwater from SWMUs* provide guidance on calculating ecological risk and cleanup standards for groundwater.
Solvent waste	*Applied Toxicology of Petroleum Hydrocarbons* (Princeton Scientific, Princeton, NJ), *Toxicological Profile for Perchloroethylene* (Department of Public Health), and *Addendum to Health Assessment Document for Trichloroethylene: Updated Carcinogenicity Assessment* (EPA) may provide useful information.
Subsurface Soil Contamination	A construction worker scenario will be evaluated when appropriate. Leachability of constituents into groundwater using region-specific dilution and leachate attenuation factors. *Exposure Factors Handbook* (EPA), *Soil Sampling Quality Assurance: User's Guide* (EPA), *Corrective Measures for Releases to Soil from SWMU* (EPA), and *Dermal Exposure Assessment: Principals and Applications* (EPA) provide guidance on exposure assumptions for construction scenarios.
Data gaps	EPA *Guidance for Data Useability in Risk Assessment, Part A* provides guidance on assessing data sufficiency.
Sites located above Karst formations.	Region-specific dilution and attenuation factors should be used where appropriate.
Shallow groundwater beneath the site.	Region-specific dilution and attenuation factors should be used where appropriate.
Deep groundwater beneath the site.	Region-specific dilution and attenuation factors should be used where appropriate.

characteristics that may be encountered on a site-specific basis at AFBs. Ecological risks are of concern at many bases and may be the overarching concern at some. Calculation of screening levels for ecological receptors and radioactive waste sites also present unique challenges. Sections 7.2.1, and 7.2.2 provide brief discussions of these issues.

7.2.1 Ecological Receptors

Specific guidance on assessing ecological risk and establishing screening levels is not well developed at this time. Currently, EPA has published a draft conceptual framework (EPA 1992b) for development of a specific ecological risk assessment guidance. Therefore, ecological risk will only be evaluated qualitatively as part of the RNSI approach. This qualitative information will be carried forward for future use when more guidance on calculating ecological risks and screening levels becomes available. Where site-specific conditions warrant, a quantitative ecological assessment may be conducted as part of a more detailed investigation.

7.2.2 Derivation of Screening Levels for Radioactive Waste Sites

Site-specific residual radioactive material guidelines, analogous to risk-based preliminary remediation goals, can be derived with the use of the Residual Radioactivity Software (RESRAD®) computer code developed at Argonne National Laboratory for the U.S. Department of Energy (DOE). A guideline is a radionuclide concentration or level of radioactivity that is acceptable if a site is to be used without radiological restrictions. Guidelines are expressed as (1) concentrations of residual radionuclides in soil, (2) concentrations of airborne radon decay products, (3) levels of external gamma radiation, (4) levels of radioactivity from surface contamination, and (5) concentrations of residual radionuclides in air and water.

The family farm scenario is the default exposure scenario, although exposure pathways and parameter values can be adjusted if other exposure scenarios are considered

more likely for a particular site. Nine exposure pathways are considered: external irradiation, dust inhalation, radon inhalation, and ingestion of plant foods, meat, milk, aquatic foods, water, and soil. Any of the pathways can be suppressed, so guidelines can be derived on the basis of any one pathway or any combination of pathways. Any of the numerous default values (e.g., soil ingestion rates) in the code can be replaced with site-specific values.

For this project, screening levels will be calculated (i.e., guidelines for soil) for four land use categories: industrial, commercial, residential, and open space. The industrial land use scenario will include the exposure pathways of external irradiation, dust inhalation, radon inhalation, and soil ingestion. The commercial land use scenario will include the exposure pathways of external irradiation, dust inhalation, soil ingestion, and radon inhalation. The residential land use scenario will include the exposure pathways of external irradiation, dust inhalation, radon inhalation, and ingestion of water and soil. The open space land use scenario will include the exposure pathways of external irradiation, dust inhalation, radon inhalation, soil ingestion, and ingestion of plant and aquatic foods.

Guidelines (e.g., soil screening levels) for any single radionuclide or mixture of radionuclides are derived based on a target radiation dose limit. For example, it is the DOE's policy that the effective dose equivalent to any member of the public not exceed 100 mrem/year, but any other dose limit can be chosen by the user of RESRAD®. Radiation doses from the radioactive decay products of the initial radionuclide(s) are considered in RESRAD®'s derivation of guidelines. In this case, 100 mrem/year will be used as the radiation dose limit.

Numerous calculations are contained in RESRAD®, but the overall approach used to derive guidelines is as follows:

A single-radionuclide soil concentration guideline for a uniformly contaminated zone is defined as

$$G_i(t) = H_{EL}/DSR_i(t)$$

where

H_{EL} = basic dose limit (mrem/yr),

$DSR_i(t) = \sum_p DSR_{ip}(t)$ = dose/soil-concentration ratio for the ith principal radionuclide in the contaminated zone at time t [(mrem/yr)/(pCi/g)], and

$DSR_{ip}(t)$ = dose/soil-concentration ratio for the ith principal radionuclide and p^{th} environmental pathway [(mrem/yr)/(pCi/g)].

The dose/soil-concentration ratio for individual principal radionuclides and pathways are defined as

$$DSR_{ip}(t) = H_{E,ip}(t)/S_i(0)$$

where

$H_{E,ip}(t)$ = average annual effective dose equivalent received at time t by a member of the critical population group from the ith principal radionuclide transported through the pth environmental pathway together with its associated decay products (mrem/yr), and

$S_i(0)$ = initial concentration of the ith principal radionuclide in a uniformly contaminated zone (pCi/g).

Radionuclide-specific dose conversion factors are used by RESRAD® to translate unit intake of the radionuclide into dose equivalent, since the degree of biological damage varies among radionuclides.

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Rational National Standards Initiative
Project # MUHJ 93-7059

RATIONAL NATIONAL STANDARDS INITIATIVE
AIR COMBAT COMMAND

PATHWAYS, PARAMETERS, AND EQUATIONS REPORT
CANNON AIR FORCE BASE

Prepared for:

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
ARARs	Applicable or Relevant and Appropriate Requirements
BCP	Base Comprehensive Plan
DPM	Defense Priority Model
EPA	Environmental Protection Agency
IRP	Installation Restoration Program
MAP	Management Action Plan
NMED	New Mexico Environment Department
O/WS	Oil/Water Separator
PPE	Pathways, Parameters, and Equations
RCRA	Resource Conservation and Recovery Act
SWMU	Solid Waste Management Unit

1.0 CANNON AIR FORCE BASE

1.1 Introduction to Pathways, Parameters, and Equations Report

The Pathways, Parameters, and Equations (PPE) report provides an organized method for determining risk-based screening/cleanup levels for Installation Restoration Program (IRP)-site remediation at Cannon Air Force Base (AFB). The purpose of this report is to identify land use/reuse options for active IRP sites and SWMUs and to select screening/cleanup levels (based on the scientific data and site-specific factors) that would achieve a prudent level of safety commensurate with the risk associated with that particular land use/reuse. This report will lead to the development of a site screening/cleanup strategy that addresses the major concerns of the federal, state, and local environmental officials.

The PPE report combines information from the Base Comprehensive Plan (BCP), investigative reports, and the Management Action Plan (MAP) to provide a risk-based approach to base planning and development of the IRP sites. This was accomplished by developing screening/cleanup standards based on the future land use of each IRP site.

Section 1.2 provides a brief description of the regulatory background and current IRP at Cannon AFB. Section 1.3 discusses the Applicable or Relevant and Appropriate Requirements (ARARs) associated with the IRP sites covered in this report. Finally, Section 1.4 discusses the site specific evaluation approach.

1.2 Brief Description and Regulatory Information

Cannon AFB is located in eastern New Mexico, about 8 miles west of Clovis on 3,806 acres (Figure 1-1, Location of Cannon AFB). The base is bounded to the north by U.S. Highway 60/84. Scattered residences, light commercial, and farmland are located along the highway in the vicinity of the base. The base maintains one satellite facility: the Melrose

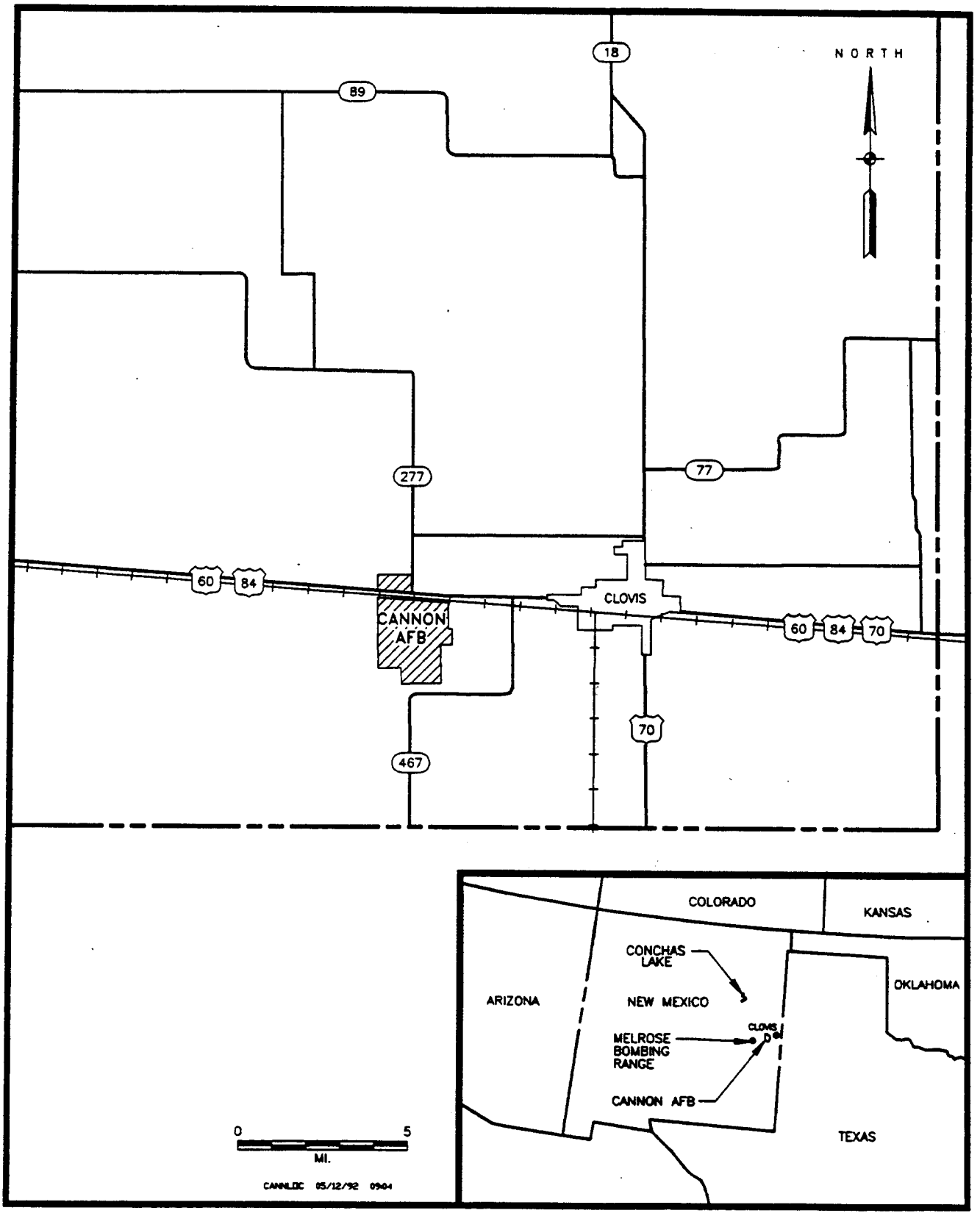

Figure 1-1. Location of Cannon AFB, Clovis, New Mexico

Air Force Range, which is located on 74,000 acres approximately 25 miles west of the main base. Roads, building, runways, and other features of Cannon AFB are shown in Figure 1-2.

On November 14, 1989, U.S. Environmental Protection Agency (EPA) Region VI issued Cannon AFB a Hazardous Waste Storage Permit [Resource Conservation and Recovery Act of 1976 (RCRA) hazardous waste permit] under the 1984 Hazardous and Solid Waste Amendments of RCRA. The permit was issued to the Defense Reutilization and Marketing Office, a tenant organization on-base, to allow the storage of hazardous waste on-base for up to one year prior to disposal. The RCRA hazardous waste permit also stipulates that 76 Solid Waste Management Units (SWMUs) are to be investigated by Cannon AFB for environmental releases. These SWMUs were identified in the Preliminary Review/VSI Report, RCRA Facility Assessment, Cannon AFB (A.T. Kearney, Inc., 1987). EPA grouped the SWMUs into three parts called appendices and included them in the RCRA hazardous waste permit to indicate the preferred order of investigation and remediation. The New Mexico Environment Department (NMED) and the EPA granted a RCRA Sub-part X permit (December 1994) for Melrose Air Force Range that includes SWMUs for investigation. Pertinent regulatory dates and actions pertaining to Cannon AFB are included in Table 1-1. Table 1-2 summarizes descriptive, regulatory, and Defense Priority Modeling (DPM) scoring information for sites at Cannon AFB. Figures 1-3a and 1-3b show all IRP sites and SWMUs at Cannon AFB and Melrose Air Force Range, respectively.

1.3 Applicable or Relevant and Appropriate Requirements (ARARs)

Potential chemical-, action-, and location-specific ARARs for environmental media at Cannon AFB have been identified. These ARARs pertain to drinking water, surface water, groundwater, soils, and USTs. Those ARARs pertaining to drinking water have been promulgated pursuant to the New Mexico Drinking Water Regulations (NMED 1995) and the Federal Safe Drinking Water Act (EPA 1994). Language addressing more specific rules and regulations that pertain to these ARARs are found in 20 NMAC 7.1 and 40 CFR 141.61. Standards for New Mexico drinking water contaminants are listed in Table 1-3.

Table 1-1

Key Regulatory Dates/Actions, Cannon AFB

Date	Regulatory Action
1983	Phase I Records Search identified 19 SWMUs as IRP sites.
1988	RCRA Facility Assessment (RFA) completed, identifying 128 SWMUs. Seventy-three were designed for further investigation.
1989	Region VI issued Cannon AFB a Hazardous Waste Storage Permit (RCRA Permit). This permit stipulated the investigation of the 76 SWMUs identified in the RFA for environmental releases.
1990	Draft Decision Documents submitted for 20 SWMUs.
1991-1992	Remedial Investigation (RI) for 18 Appendix I SWMUs submitted.
1992-1993	RCRA Facility Investigations (RFIs) submitted for Landfills 1 and 2.
1993	RFI for 16 Appendix II SWMUs submitted.
1994	RFI for 16 Appendix III SWMUs submitted.
1994	RCRA Subpart X permit issued for three SWMUs at Melrose Air Force Range.
1994-1995	Phase II investigations for Appendix II and III are in progress. Investigations are also in progress for Landfills 3,4, 5, and 25 along with the Old Entomology Rinse Area.

Sources: Radian Corporation. Management Action Plan, Cannon AFB. 1992.
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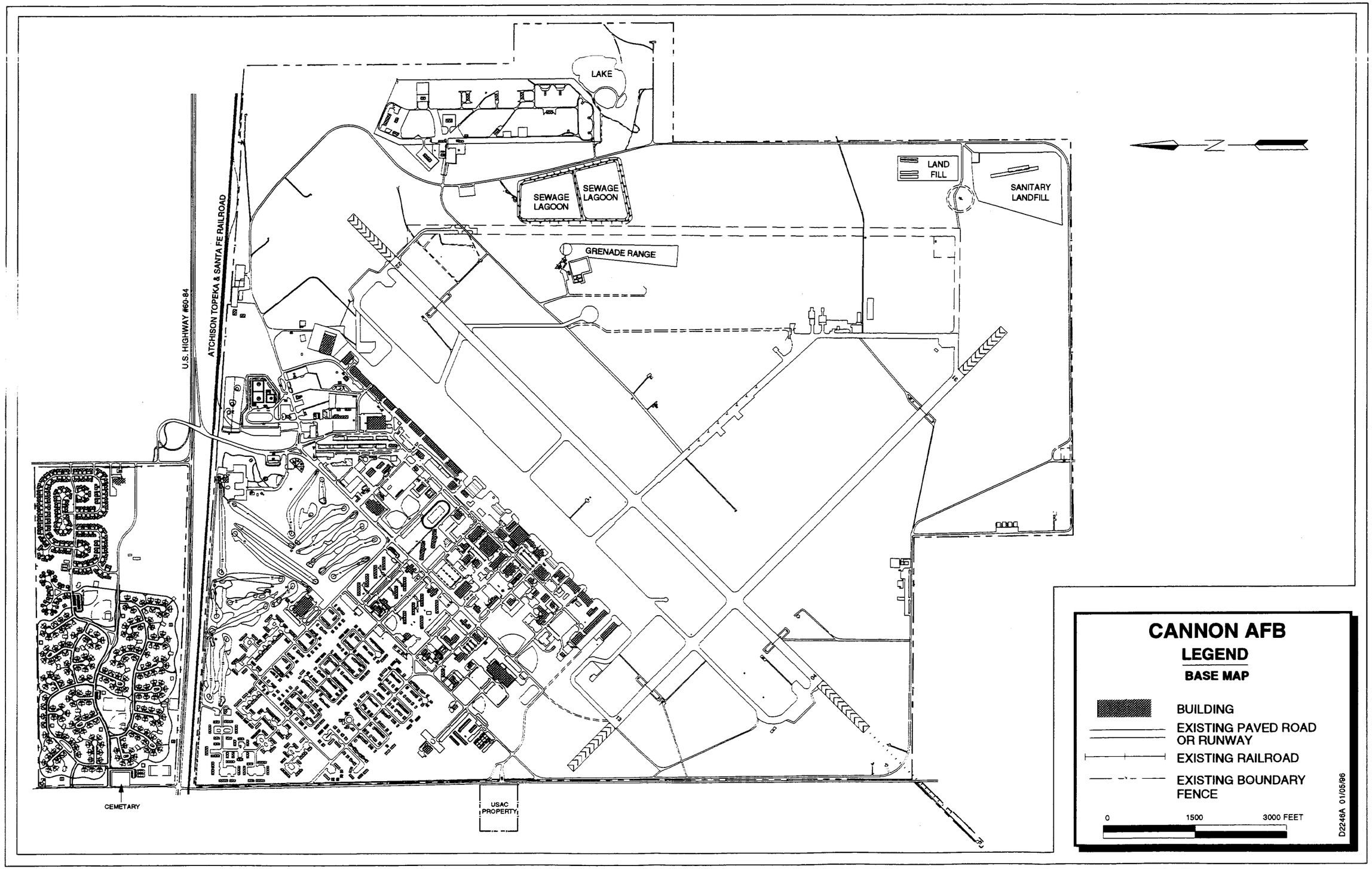

Figure 1-2. Base Map, Cannon AFB

Table 1-2

Site Summary Table

SWMU Site No.	IRP ID	Description	Material Disposed Of	Date of Operation	Status	Regulatory Mechanism	DPM Score	Relative Risk Rank
1	-	Oil/Water Separator No. 119	Recovered wastewater from aircraft maintenance operation	1963 to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]
3	-	Oil/Water Separator No. 108	Recovered diesel fuel from wastewater generated by aircraft maintenance operations	1943 to 1989 Removed 1989	Appendix II RFI Phase 2	RCRA	NA[1]	NA[1]
5	-	Oil/Water Separator No. 121	Recovered diesel fuel from wastewater generated by aircraft maintenance operations	1943 to 1989 Removed 1989	Appendix II RFI Phase 2	RCRA	NA[1]	NA[1]
7	-	Oil/Water Separator No. 129	Recovered diesel fuel from aircraft wastewater operations	1943 to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]
8	-	Oil/Water Separator No. 165	Recovered fuels and greases in runoff from the aircraft washrack	1963 to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]
9	-	Aircraft Washrack Drain System	Solvents, fuels, greases	1966 to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]
11	-	Oil/Water Separator No. 170	Recovered fuels and greases from aircraft wastewater operations	Unknown to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]
16	-	Oil/Water Separator No. 680	Recovered fuels and greases from aircraft maintenance operations	1965 to present	Appendix II RFI Phase 2	RCRA	NA[1]	NA[1]
31	-	AGE Maintenance Shop Pad	Solvents, fuels, greases	1971 to present	Appendix III RFI Phase 2	RCRA	NA[1]	NA[1]
32a	-	Oil/Water Separator No. 186 (#1)	Recovered fuels and greases from equipment maintenance operations	1971 to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]

Table 1-2

(Continued)

SWMU Site No.	IRP ID	Description	Material Disposed Of	Date of Operation	Status	Regulatory Mechanism	DPM Score	Relative Risk Rank
33b	-	Oil/Water Separator No. 186 (#2)	Recovered fuels and greases from equipment maintenance operations	1971 to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]
38	-	Oil/Water Separator No. 194	Recovered fuels and greases from aircraft maintenance operations	1971 to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]
39	-	Oil/Water Separator No. 195	Recovered fuels and greases from aircraft maintenance operations	1969 to present	Appendix II Remove/Replace	RCRA	NA[1]	NA[1]
46	-	Oil/Water Separator No. 196	Recovered fuels and greases from aircraft maintenance operations	1969 to present	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]
47	-	Oil/Water Separator No. 494	Recovered fuels and greases from the Auto Hobby Shop run-off	1982 to present	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]
48a	SD-26	Underground Waste Oil Tank	Waste oils, solvents, paint thinners, fuels	1965 to 1984 Removed 1988	Appendix II RFI Phase 2	RCRA	0.8	NA[2]
48b	SD-26	Aboveground Overflow Capacity Tank	Waste oils, solvents, paint thinners, fuels	1965 to 1984 Removed 1988	Appendix II RFI Phase 2	RCRA	0.8	NA[2]
51	-	Oil/Water Separator No. 375	Recovered fuels and greases from vehicle maintenance operations	1968 to present	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]
55	-	Lead Acid Battery Accumulation Point	Storage area for waste lead acid batteries	1965 to present	Appendix III RFI Phase 2	RCRA	NA[1]	NA[1]
57	-	Oil/Water Separator No. 379	Recovered fuels and greases from vehicle maintenance operations	1965 to present	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]

Table 1-2

(Continued)

SWMU Site No.	IRP ID	Description	Material Disposed Of	Date of Operation	Status	Regulatory Mechanism	DPM Score	Relative Risk Rank
61	-	Oil/Water Separator No. 5077a	Receives wash water from a motor vehicle washrack	1957 to present	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]
62	-	Oil/Water Separator No. 5077b	Actually a sandtrap in washrack floor drain upstream of SWMU No. 61	1957 to present	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]
63	-	Oil/Water Separator No. 5077c	Actually a sandtrap in wash-rack flood drain upstream of SWMU No. 61	1957 to present	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]
70	-	Oil/Water Separator No. 326 and Leach Field	Recovered fuels and greases from vehicle maintenance operations	1960 to present	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]
74	LF-01	Landfill No. 1	Domestic solid waste, waste oils and solvents, paint strippers and thinners, pesticide containers, and empty cans/drums	1943 to 1946	RCRA Facility Investigation Appendix I Phase II F.Y. 95	RCRA	0.88	Low
77	-	Civil Engineering Container Storage Area, Facility No. 4038	Waste oils and solvents, fuels, PCBs, pesticides	1943 to present	Appendix III RFI Phase 2	RCRA	NA[1]	NA[1]
83	ST-27	Sump	Wastewater from flight apron	Unknown to present	Appendix II RFI Phase 2	RCRA	0.57	NA[2]
85	SD-12	Storm Water Collection Point	Received Storm water runoff from flightline	1943 to present	RCRA Facility Investigation Appendix I (removed from Part B permit September 1990) NFA	RCRA	6.9	Low

Table 1-2

(Continued)

SWMU Site No.	IRP ID	Description	Material Disposed Of	Date of Operation	Status	Regulatory Mechanism	DPM Score	Relative Risk Rank
86	SD-11	Engine Test Cell	Fuel from aircraft engine cleaning operations (Building 5114)	1965 to 1988	RCRA Facility Investigation Appendix I Phase III F.Y. 95	RCRA	0.6	Low
87	SD-11	Overflow Pit	Overflow from Engine Test Cell, SWMU No. 86	1982 to 1985	RCRA Facility Investigation Appendix I Phase III F.Y. 95	RCRA	0.6	Low
88	SD-11	Leach Field	Wastewater from Oil/Water Separator SWMU No. 90 (attached to Engine Test Cell, SWMU No. 86)	1965 to 1985	RCRA Facility Investigation Appendix I Phase III F.Y. 95	RCRA	0.6	Low
89	SD-11	Evaporation Pond	Engine Test Cell wastewater/fuel	1985 to present	RCRA Facility Investigation Appendix I Phase III F.Y. 95	RCRA	0.6	Low
90	SD-11	Oil/Water Separator No. 5114	Engine Test Cell, SWMU No. 86, wastewater/fuel	1965 to 1988	RCRA Facility Investigation Appendix I Phase III F.Y. 95	RCRA	0.6	Low
92	-	Oil/Water Separator No. 5120	Recovered fuels and greases from aircraft maintenance operations	1957 to 1988	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]

Table 1-2

(Continued)

SWMU Site No.	IRP ID	Description	Material Disposed Of	Date of Operation	Status	Regulatory Mechanism	DPM Score	Relative Risk Rank
93	-	Oil/Water Separator No. 5121	Recovered fuels and greases from aircraft maintenance operations	1960 to 1988	Appendix III RFI Phase 2	RCRA	NA[1]	NA[1]
94	-	Oil/Water Separator No. 5144	Recovered fuels and greases from vehicle washrack	1960 to 1988	Appendix III Remove/Replace	RCRA	NA[1]	NA[1]
95	SD-20	NE Storm water Drainage Area	Storm water runoff from flight line and effluent from flight line oil/water separators	1943 to present	RCRA Facility Investigation Appendix I Phase II	RCRA	0.9	Low
97	LF-25	Concrete Rubble Pile	Building demolition material, asphalt rubble	Late 1950s to early 1960s	Appendix III RFI Phase 2	RCRA	4.4	Low
101	SD-21	Wastewater Treatment System-Lagoons	Sanitary and industrial wastewater	1965 to present	RCRA Facility Investigation Appendix I Phase III Groundwater Monitoring	RCRA	1.2	NA[2]
102	SD-21	Wastewater Treatment Effluent Discharge	Sanitary and industrial wastewater (sewage lagoons' outfall)	1965 to present	RCRA Facility Investigation Appendix I Phase III Groundwater Monitoring	RCRA	1.2	NA[2]
103	-	Wastewater Playa Lake	Sanitary and industrial wastewater (sewage lagoons' outfall)	1942 to present	Appendix III RFI Phase 2	RCRA	NA[1]	NA[1]
104	LF-04	Landfill No. 4	Domestic solid waste, waste oils and solvents, paint strippers and thinners, pesticide containers, empty cans/drums	1967 to 1968	RCRA Facility Investigation Appendix I Phase II	RCRA	1.51	Low

Table 1-2

(Continued)

SWMU Site No.	IRP ID	Description	Material Disposed Of	Date of Operation	Status	Regulatory Mechanism	DPM Score	Relative Risk Rank
105	LF-03	Landfill No. 3	Solid waste, waste oils and solvents, paint strippers and thinners, pesticide containers, empty cans/drums	1959 to 1967	RCRA Facility Investigation Appendix I Phase II	RCRA	1.72	Low
108	-	Explosive Ordnance Disposal Activities Area	Munitions training site (5-lb explosive limit)	1942 to present	Appendix II RFI Phase 2	RCRA	NA[1]	NA[1]
109	FT-09	Fire Department Training Area No. 4	Waste fuels, oils, and solvents burned	1974 to present	RCRA Facility Investigation Appendix I Phase II C.Y.95	RCRA	31	NA[2]
110	-	Underground Waste Oil Tank No. 2336	Waste fuels, oils, and solvents (at SWMU No. 109)	1975 to 1988	Appendix II	RCRA	NA[1]	NA[1]
112	-	Oil/Water Separator No. 2336	Unburned fuel runoff from SWMU No. 109	1985 to present	RCRA Facility Investigation Appendix I Phase II C.Y. 95	RCRA	NA[1]	NA[1]
113	LF-05	Landfill No. 5	Domestic solid waste, waste oils and solvents, paint strippers and thinners, pesticide containers, and empty cans/drums	1968 to 1988	Compliance Order; RCRA Facility Investigation Appendix I Phase II State Lead	RCRA	16.03	Med
127	-	Oil/Water Separator Near Tank 4095 (#1) and Leach Field	Wastewater water contaminated with JP-4, grease, and oils	1977 to present	Appendix III RFI Phase 2	RCRA	NA[1]	NA[1]

Table 1-2

(Continued)

SWMU Site No.	IRP ID	Description	Material Disposed Of	Date of Operation	Status	Regulatory Mechanism	DPM Score	Relative Risk Rank
AOC A	SS-19	MOGAS Spill	Approximately 2000 to 3000 gal of leaded gasoline	Early 1960s	Appendix III	RCRA	9.2	NA[2]
AOC B	SS-18	JP-4 Fuel Spill	Approximately 400 gal of JP-4	1980	Appendix III	RCRA	0.4	NA[2]
AOC C	OT-10	Blown Capacitors Site	Approximately 6 gal of oil thought to contain PCB	1978	Removal action completed in 1988 Appendix III	RCRA	3.1	Low
AOC D		Nonfriable Asbestos Burial Pit	Asbestos Siding Material	Unknown	Pending	RCRA	NA[1]	NA[1]
NA	DP-33	Disposal Pit	Possible fluids from aircraft engine maintenance shop	Late 1940s to early 1950s	Pending	IRP	NA[2]	NA[2]
114 (MAFR)	-	Melrose Air Force Range Expended Ordnance Burial Site	Scrap metal from practice bombs and munitions	1952 to present	Possible identification as an SWMU in OB/OD permit	RCRA	NA[1]	NA[1]
115 (MAFR)	-	Melrose Air Force Range Explosives Contaminated Burial Site	Unexploded ammunition; existence not confirmed	Unknown	Possible identification as an SWMU in OB/OD permit	RCRA	NA[1]	NA[1]
117 (MAFR)	-	Melrose Air Force Range Domestic Waste Pile	Domestic waste from range support activities	Unknown	Possible identification as an SWMU in OB/OD permit	RCRA	NA[1]	NA[1]

Notes:
[1] Information has not or will not be established
[2] Information not available

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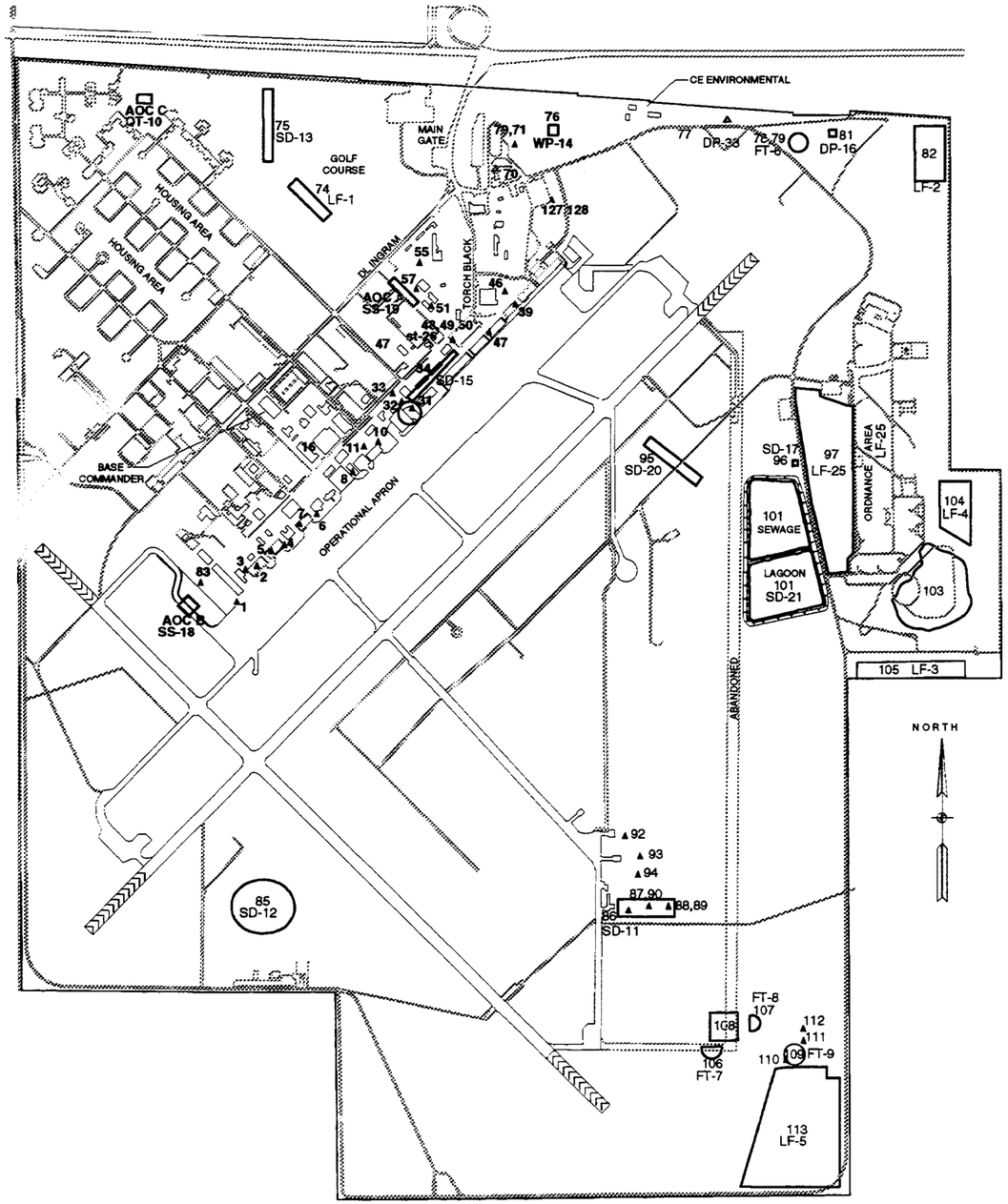

SWMU No.	IRP No.	Site
1		Oil/Water Separator No. 119
2	ST-28	Recovered Diesel Tank No. 108
3		Oil/Water Separator No. 108
4	ST-29	Recovered Diesel Tank No. 121
5		Oil/Water Separator No. 121
6		POL Tank No. 129
7		Oil/Water Separator No. 129
8		Oil/Water Separator No. 165
9		POL Aircraft Washrack Drain System
10		POL Tank No. 170
11		Oil/Water Separator No. 170
16		Oil/Water Separator No. 680
31		AGE Maintenance Shop Pad
32		Oil/Water Separator No. 186 (#1)
33		Oil/Water Separator No. 186 (#2)
34	SD-15	AGE Drainage Ditch
38		Oil/Water Separator No. 194
39		Oil/Water Separator No. 195
46		Oil/Water Separator No. 196
47		Oil/Water Separator No. 494
48a	ST-26	Underground Waste Oil Tank
48b	ST-26	Aboveground Overflow Capacity Tank
49	ST-26	Inactive POL Storage Tank No. 4028a
50	ST-26	Inactive POL Storage Tank No. 4028b
51		Oil/Water Separator No. 375
55		Lead Acid Battery Accumulation Point
57		Oil/Water Separator No. 379
61		Oil/Water Separator No. 5077a
62		Oil/Water Separator No. 5077b
63		Oil/Water Separator No. 5077c
70		Oil/Water Separator No. 326 and Leach Field
71		Recovered JP-4 Fuel Tank No 390
72		Oil/Water Separator No. 390
74	LF-1	Landfill No. 1
75	SD-13	Sanitary Sewage Lift Station Overflow Pit
76	WP-14	Sludge Weathering Pit
77		Civil Engineering Container Storage Area
78	FT-6	Fire Department Training Area No. 1
79		Underground Tank

SWMU No.	IRP No.	Site
81	DP-16	Solvent Disposal Site
82	LF-2	Landfill No. 2
83	ST-27	Sump
85	SD-12	Stormwater Collection Point
86	SD-11	Engine Test Cell
87	SD-11	Former Overflow Pit
88	SD-11	Former Leaching Field
89	SD-11	Evaporation Pond
90	SD-11	Oil/Water Separator No. 5114
91		Recovered Fuel Tank No. 5114
92		Oil/Water Separator No. 5120
93		Oil/Water Separator No. 5121
94		Oil/Water Separator No. 5144
95	SD-20	NE Stormwater Drainage Area
96	SD-17	Old Entomology Rinse Area
97	LF-25	Concrete Rubble Pile
98		Sanitary Sewerage Line
101	WP-21	Wastewater Treatment System-Lagoons
102	WP-21	Wastewater Treatment System Effluent Discharge
103		Wastewater Playa Lake
104	LF-4	Landfill No. 4
105	LF-3	Landfill No. 3
106	FT-7	Fire Department Training Area No. 2
107		Fire Department Training Area No. 3
108		Explosive Ordinance Disposal Activities Area
109	FT-9	Fire Department Training Area No. 4
110		Underground Waste Oil Tank No. 2336
111		Unlined Pit
112		Oil/Water Separator No. 2336
113	LF-5	Landfill No. 5
124	ST-30	Inactive Underground Tank 1
125	ST-31	Inactive Underground Tank 2
126	ST-32	Inactive Underground Tank 3
127		Oil/Water Separator No. 4095 (#1) and Leach Field
128		Oil/Water Separator No. 4095 (#2) and Leach Field
AOC A	SS-19	MOGAS Spill
AOC B	SS-18	JP-4 Fuel Spill
AOC C	OT-10	Blown Capacitors Site

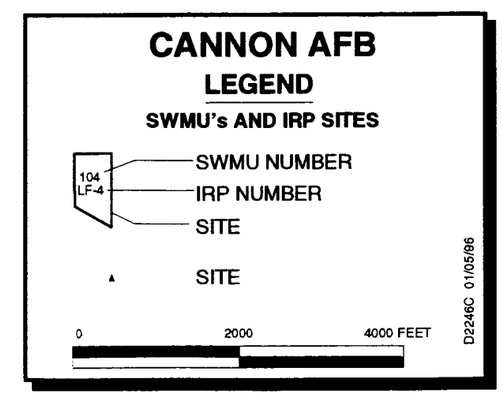

Figure 1-3a. Location of SWMUs and IRP Sites at Cannon AFB

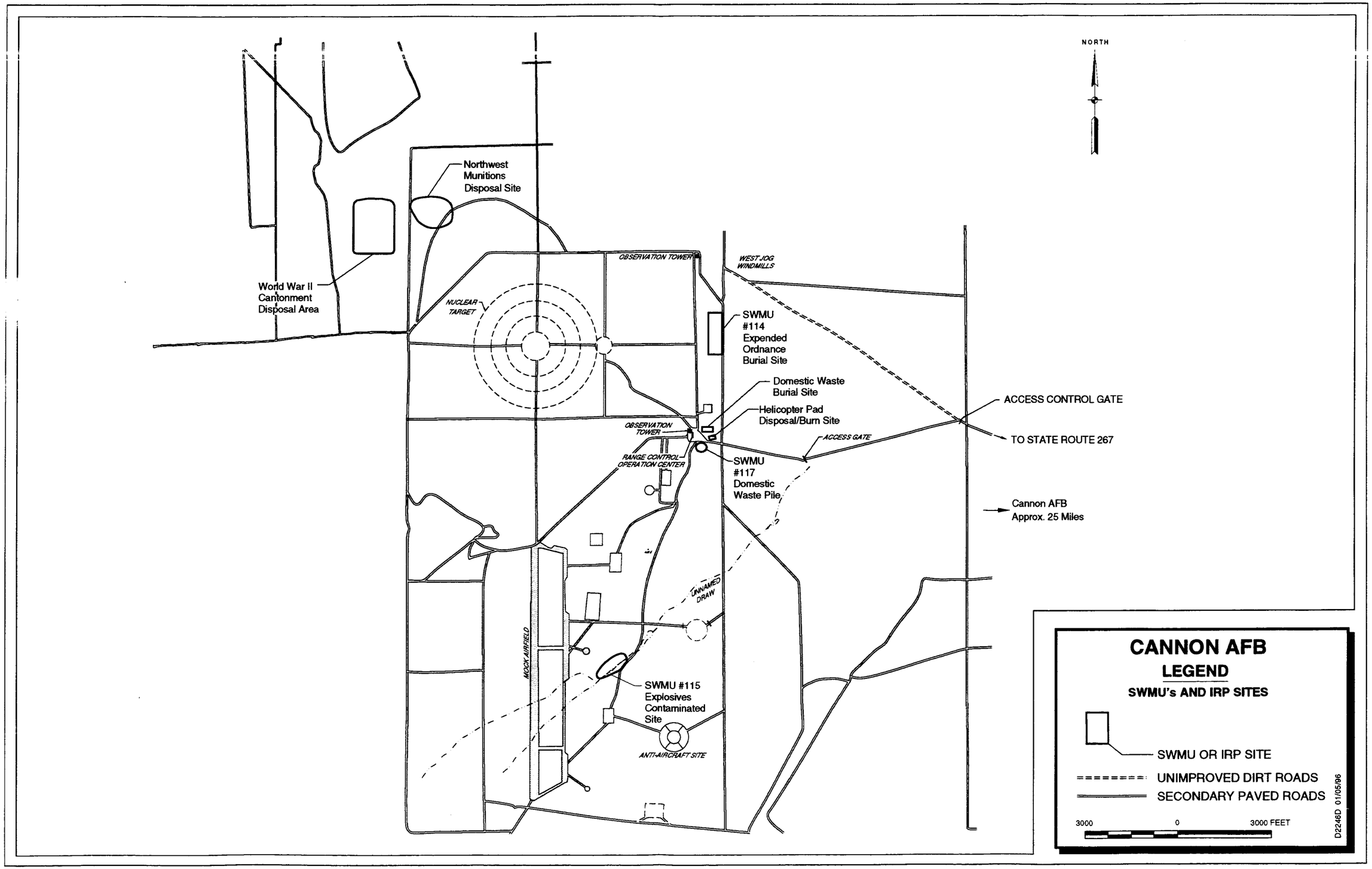

Figure 1-3b. Location of SWMUs and IRP Sites at Melrose Air Force Range

Table 1-3

New Mexico Drinking Water Standards

Contaminant	Maximum Contaminant Level (mg/L)
Inorganic Contaminants	
Antimony	0.006
Asbestos	7 million fibers/liter (longer than 10 μm)
Arsenic	0.05
Barium	2
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Cyanide	0.2
Fluoride	4.0
Mercury	0.002
Nickel	0.1
Nitrate (as N)	10
Nitrite (as N)	1
Total Nitrate and Nitrite (as N)	10
Selenium	0.05
Thallium	0.002
Organic Contaminants	
Apply to community and non-transient, non-community water systems	
Alachlor	0.002
Atrazine	0.003
Carbofuran	0.04
Chlordane	0.002
Dibromochloropropane	0.0002
2,4-D	0.07
Ethylene dibromide	0.00005
Heptachlor	0.0004
Heptachlor epoxide	0.0002
Lindane	0.0002
Methoxychlor	0.04
Polychlorinated biphenyls	0.0005
Pentachlorophenol	0.001
Toxaphene	0.003
2,4,5-TP	0.05
Benzo(a)pyrene	0.0002
Dalapon	0.2
Di(2-ethylhexyl)adipate	0.4
Di(2-ethylhexyl)phthalate	0.006

Table 1-3

(Continued)

Contaminant	Maximum Contaminant Level (mg/L)
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Endrin	0.002
Glyphosate	0.7
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
Oxamyl (Vydate)	0.2
Picloram	0.5
Simazine	0.004
2,3,7,8-TCDD (Dioxin)	0.00000003
Vinyl Chloride	0.002
Benzene	0.005
Carbon Tetrachloride	0.005
1,2-Dichloroethane	0.005
Trichloroethylene	0.005
para-Dichlorobenzene	0.075
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.2
cis-1,2-Dichloroethylene	0.07
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
o-Dichlorobenzene	0.6
Styrene	0.1
Tetrachloroethylene	0.005
Toluene	1
trans-1,2-Dichloroethylene	0.1
Xylenes (total)	10
Dichloromethane	0.005
1,2,4-Trichlorobenzene	0.07
1,1,2-Trichloroethane	0.005
Apply to water systems which serve 10,000 or more individuals and add a disinfectant to the water	
Total Trihalomethanes	0.10

Source: New Mexico Drinking Water Regulations, New Mexico Environmental Department, Santa Fe, New Mexico, January 1, 1995.

ARARs pertaining to surface water have been promulgated pursuant to the State of New Mexico Standards for Interstate and Intrastate Streams (WQCC 1995) and the EPA Quality Criteria for Water (EPA 1987). Language addressing more specific rules and regulations that pertain to these ARARs are found in 20 NMAC 6.1 and the Federal Clean Water Act. Standards for New Mexico surface water contaminants are listed in Table 1-4. This table includes the New Mexico standards that consider domestic water supplies, irrigation, fisheries, and livestock watering. Wildlife habitats are discussed in the text of the State of New Mexico Standards for Interstate and Intrastate Streams (WQCC 1995).

ARARs pertaining to groundwater have been promulgated pursuant to the New Mexico Water Quality Control Commission Regulations (WQCC 1993). The standards are adopted by the commission under the authority of Section 74-6-4, NMSA 1978 (The New Mexico Water Quality Act, Chapter 326, Laws of 1973, as amended). Regulations are adopted by the committee under the authority of Sections 74-6-4 and 74-6-5 NMSA 1978. The purpose of these regulations is to control discharges onto or below ground surface to protect all groundwater of the state of New Mexico which has an existing concentration of 10,000 mg/L or less TDS for present and potential future use as domestic and agricultural water supply. The standards also protect those segments of surface waters which gain because of groundwater inflow, for uses designated in the New Mexico Water Quality Standards. The New Mexico groundwater standards apply to the protection of human health, the use of groundwater for irrigation, and other domestic water supply uses. These standards are listed in Table 1-5.

Standards for groundwater and soils contaminated by leaking USTs are listed in the UST Soil/Water Sampling and Disposal Guidelines of the Underground Storage Tank Bureau of the State of New Mexico Environment Department (USTB 1995). These standards are presented in Table 1-6.

Table 1-4

New Mexico Surface Water Quality Standards

Contaminant	Standard[a]
Domestic Water Supplies	
Dissolved Arsenic	0.05 mg/L
Dissolved Barium	1.0 mg/L
Dissolved Cadmium	0.010 mg/L
Dissolved Chromium	0.05 mg/L
Dissolved Lead	0.05 mg/L
Total Mercury	0.002 mg/L
Dissolved Nitrate	10.0 mg/L
Dissolved Selenium	0.05 mg/L
Dissolved Silver	0.05 mg/L
Dissolved Cyanide	0.2 mg/L
Dissolved Uranium	5.0 mg/L
Radium-226 + Radium-228	30.0 pCi/L
Tritium	20,000 pCi/L
Gross alpha	15 pCi/L
Irrigation	
Dissolved Aluminum	5.0 mg/L
Dissolved Arsenic	0.10 mg/L
Dissolved Boron	0.75 mg/L
Dissolved Cadmium	0.01 mg/L
Dissolved Chromium	0.10 mg/L
Dissolved Cobalt	0.05 mg/L
Dissolved Copper	0.20 mg/L
Dissolved Lead	5.0 mg/L
Dissolved Molybdenum	1.0 mg/L
Dissolved Selenium	0.13 mg/L
Dissolved Selenium in presence of >500 mg/L SO_4	0.25 mg/L
Dissolved Vanadium	0.1 mg/L
Dissolved Zinc	2.0 mg/L
Fisheries	
Acute Standards[b]	
Dissolved Aluminum	750 µg/L
Dissolved Beryllium	130 µg/L
Total Mercury	2.4 µg/L

Table 1-4

(Continued)

Contaminant	Standard[a]
Total Recoverable Selenium	20.0 µg/L
Dissolved Silver[d,c]	$e^{(1.72[\ln(hardness)]-6.52)}$ µg/L
Cyanide, amenable to chlorination	22.0 µg/L
Total chlordane	2.4 µg/L
Dissolved Cadmium	$e^{(1.128[\ln(hardness)]-3.828)}$ µg/L
Dissolved Chromium[e,d]	$e^{(0.819[\ln(hardness)]+3.688)}$ µg/L
Dissolved Copper	$e^{(0.9422[\ln(hardness)]-1.464)}$ µg/L
Dissolved Lead	$e^{(1.273[\ln(hardness)]-1.46)}$ µg/L
Dissolved Nickel	$e^{(0.8460[\ln(hardness)]+3.3612)}$ µg/L
Dissolved Zinc	$e^{(0.8473[\ln(hardness)]+0.8604)}$ µg/L
Total Chlorine residual	19 µg/L
Chronic Standards[e]	
Dissolved Aluminum	87.0 µg/L
Dissolved Beryllium	5.3 µg/L
Total Mercury	0.012 µg/L
Total Recoverable Selenium	2.0 µg/L
Cyanide, amenable to chlorination	5.2 µg/L
Total Chlordane	0.0043 µg/L
Dissolved Cadmium[c]	$e^{(0.7852[\ln(hardness)]-3.49}$ µg/L
Dissolved Chromium[d]	$e^{(0.819[\ln(hardness)]+1.561)}$ µg/L
Dissolved Copper	$e^{(0.8545[\ln(hardness)]-1.465)}$ µg/L
Dissolved Lead	$e^{(1.273[\ln(hardness)]-4.705)}$ µg/L
Dissolved Nickel	$e^{(0.846[\ln(hardness)+1.1645)}$ µg/L
Dissolved Zinc	$e^{(0.8473[\ln(hardness)+0.7614)}$ µg/L
Total chlorine residual	11.0 µg/L
Livestock Watering	
Dissolved Aluminum	5.0 mg/L
Dissolved Arsenic	0.2 mg/L
Dissolved Boron	5.0 mg/L
Dissolved Cadmium	0.05 mg/L
Dissolved Chromium[d]	1.0 mg/L
Dissolved Cobalt	1.0 mg/L
Dissolved Copper	0.5 mg/L
Dissolved Lead	0.1 mg/L

Table 1-4

(Continued)

Contaminant	Standard[a]
Total Mercury	0.01 mg/L
Dissolved Selenium	0.05 mg/L
Dissolved Vanadium	0.1 mg/L
Dissolved Zinc	25.0 mg/L
Radium-226 + Radium-228	30.0 pCi/L
Tritium	20,000 pCi/L
Gross alpha	15 pCi/L

Source: Standards for Interstate and Intrastate Streams, New Mexico Water Quality Control Commission, Santa Fe, New Mexico, January 23, 1995.

[a] When a classified water of the State has more than a single designated use, the applicable numeric standards shall be the most stringent of those established for such classified water.

[b] The acute standards shall be applied to any single grab sample. Acute standards shall not be exceeded.

[c] For numeric standards dependent on hardness, hardness (as mg $CaCO_3$/l) shall be determined as needed from available verifiable data sources including, but not limited to, the U.S. Environmental Protection Agency's STORET water quality database.

[d] The standards for chromium shall be applied to an analysis which measures both the trivalent and hexavalent ions.

[e] The chronic standards shall be applied to the arithmetic mean of four samples collected on each of four consecutive days. Chronic standards shall not be exceeded more than once every three years.

Table 1-5

New Mexico Groundwater Standards

Contaminant	Standard[a]
Human Health Standards	
Arsenic	0.1
Barium	1.0
Cadmium	0.01
Chromium	0.05
Cyanide	0.2
Fluoride	1.6
Lead	0.05
Total Mercury	0.002
Nitrate	10.0
Selenium	0.05
Silver	0.05
Uranium	5.0
Radium-226 and -228	30.0 pCi/L
Benzene	0.01
Polychlorinated biphenyls	0.001
Toluene	0.75
Carbon Tetrachloride	0.01
1,2-dichloroethane	0.01
1,1-dichloroethylene	0.005
1,1,2,2-tetrachloroethylene	0.02
1,1,2-trichloroethylene	0.1
Ethylbenzene	0.75
Total Xylenes	0.62
Methylene chloride	0.1
Chloroform	0.1
1,1-dichloroethane	0.025
Ethylene dibromide	0.0001
1,1,1-Trichloroethane	0.06
1,1,2-Trichloroethane	0.01
1,1,2,2-tetrachloroethane	0.01
Vinyl chloride	0.001
PAHs: total naphthalene plus monomethylnaphthalenes	0.03

Table 1-5

(Continued)

Contaminant	Standard[a]
Benzo-a-pyrene	0.0007
Other Standards for Domestic Water Supply	
Chloride	250.0
Copper	1.0
Iron	1.0
Manganese	0.2
Phenols	0.005
Sulfate	600.0
Total Dissolved Solids	1000.0
Zinc	10.0
pH	between 6 and 9
Standards for Irrigation Use	
Aluminum	5.0
Boron	0.75
Cobalt	0.05
Molybdenum	1.0
Nickel	0.2

Source: Water Quality Control Commission Regulations, New Mexico Water Quality Control Commission, Santa Fe, New Mexico, November 18, 1993.

[a] All standards are in mg/L unless otherwise noted.

Table 1-6

New Mexico UST Standards for Soil and Groundwater

Contaminant	Action Level
Water	**µg/L**
Benzene	10
Ethylbenzene	750
Toluene	750
Xylenes	620
EDB	0.1
EDC	10
MTBE	100
Naphthalene	30
1,1,2 TCE	100
PCE	20
Benzo-a-pyrene	0.7
Lead	50
Iron	1000
Manganese	200
Soil	**mg/kg**
Benzene	10
Total BTEX	100 (field) 50 (lab)
Total Recoverable Pet. Hydrocar.	100

Source: UST Soil/Water Sampling and Disposal Guidelines, Underground Storage Tank Bureau, State of New Mexico Environmental Department, March 6, 1995.

1.4 Specific Site Evaluations

This section presents the site-specific evaluation approach taken for the Cannon AFB sites and addresses the potential for exposure to receptors posed by each site, based on its proposed future land use. Future land use/reuse options for sites will include industrial, commercial, open space, and residential. Figures 1-4 and 1-5 are the present and future land

use maps for Cannon AFB, respectively. Table 1-7 presents the potential exposure pathways posed by the current and future land use of the sites at Cannon AFB.

A table also is provided for each site (Tables 1-8 through 1-48) that discusses the site-specific factors that impact the selection of these potential pathways and routes for human receptors, as well as deviations from standard protocol for calculating screening levels. Data availability also is addressed in this section. A conceptual site model is provided for each site (Figures 1-6 through 1-46) showing potential pathways, exposure routes, and affected human receptors in relation to the site's proposed land use. The conceptual site models were developed based on probable future land use. However, screening/cleanup levels will be calculated for each of the four possible land uses (commercial, industrial, open space, residential) for comparative purposes. Some conceptual site models will identify exposures for land use scenarios which do not pertain directly to the site. In these cases, it is felt that contaminants have the potential to migrate off-site to areas that are defined as having land uses different from that of the site. These potential exposures must be quantified according to the land use where they will occur.

EPA Region VI does not officially use any screening methodology for site investigations. Therefore, Region III algorithms and any available guidance from the State of New Mexico will be used to calculate screening/cleanup levels for Cannon AFB. Region III screening methods use a target carcinogenic risk criteria of 10^{-6} and a target hazard index of 0.1. For some of the exposure routes identified in the conceptual site models, dermal and some inhalation exposures cannot be quantified by standard Region III algorithms. This does not jeopardize the conservatism of the calculated screening levels since, in most cases, the ingestion pathway is likely to be the overarching risk driver.

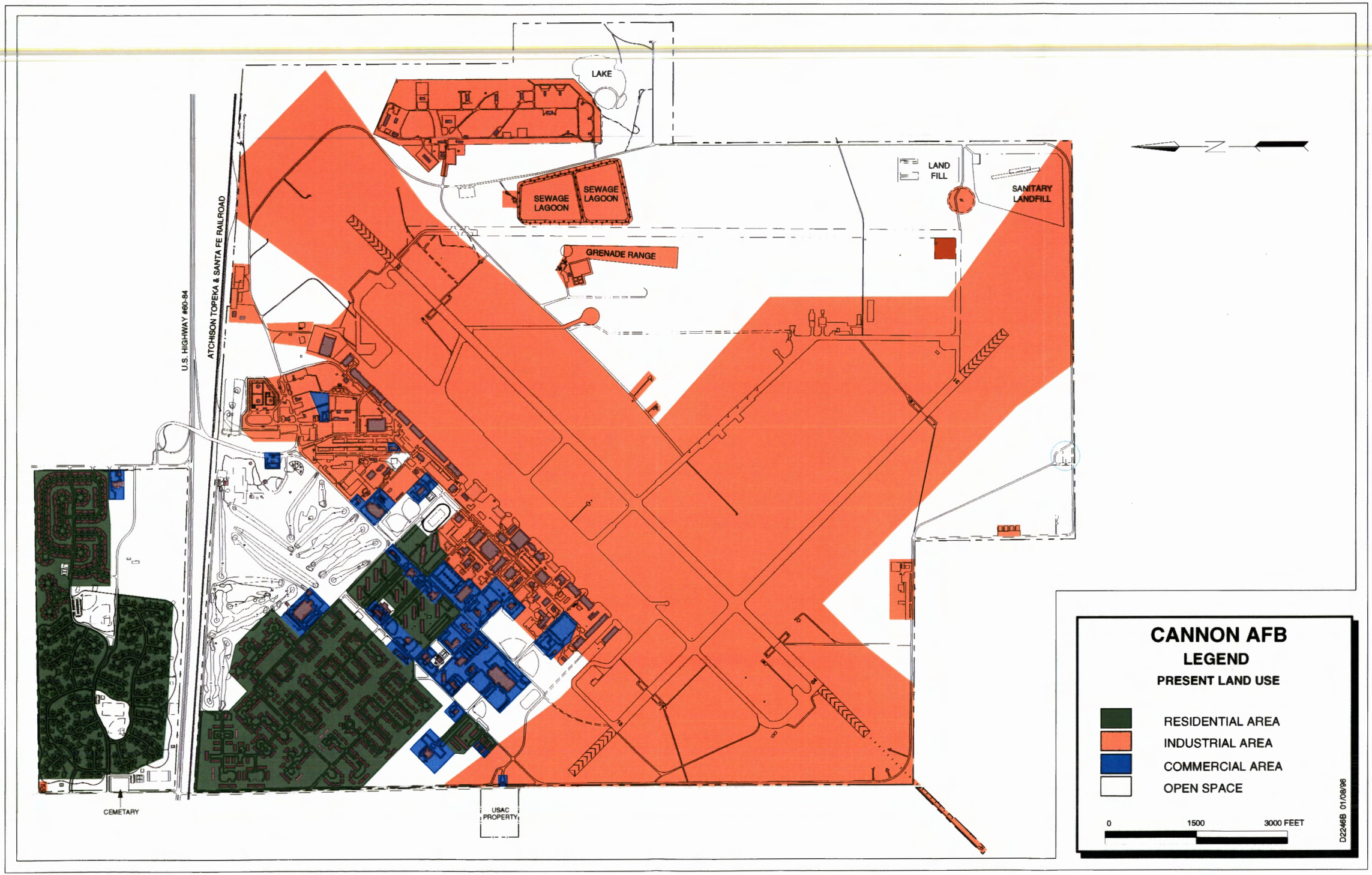

Figure 1-4. Present Land Use Map, Cannon AFB

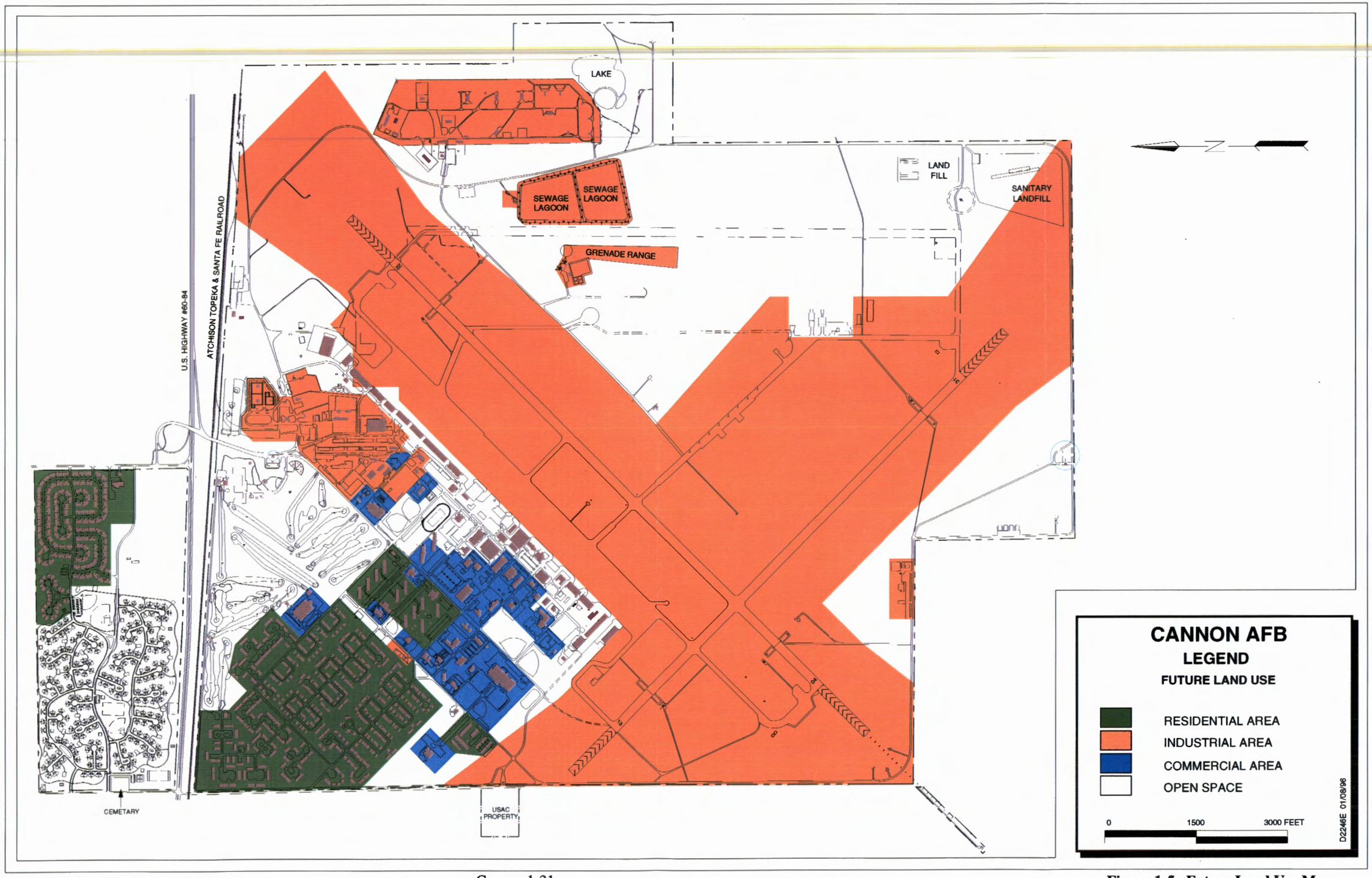

Figure 1-5. Future Land Use Map, Cannon AFB

Table 1-7

Future Land Use for IRP Sites at Cannon Air Force Base

Site ID	Potential Exposures	Current Use	Adjacent Uses	Likely Future Use
SWMU 1 Oil/Water Separator No. 119	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 3 Oil/Water Separator No. 108	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Commercial	Industrial
SWMU 5 Oil/Water Separator No. 121	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 7 Oil/Water Separator No. 129	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 8 Oil/Water Separator No. 165	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 9 Aircraft Washrack Drain System	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 11 Oil/Water Separator No. 170	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Industrial	Industrial
SWMU 16 Oil/Water Separator No. 680	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Commercial	Industrial
SWMU 31 AGE Maintenance Shop Pad	Ingestion and dermal direct contact with soil and contact through intrusive actions. Possible inhalation of fugitive dust.	Industrial	Recreational, Commercial	Industrial
SWMU 32 Oil/Water Separator No. 186 (No. 1)	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 33 Oil/Water Separator No. 186 (No. 2)	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 38 Oil/Water Separator No. 194	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Industrial	Industrial
SWMU 39 Oil/Water Separator No. 195	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Industrial	Industrial
SWMU 46 Oil/Water Separator No. 196	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Industrial	Industrial

Table 1-7

(Continued)

Site ID	Potential Exposures	Current Use	Adjacent Uses	Likely Future Use
SWMU 47 Oil/Water Separator No. 494	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Commercial	Recreational	Commercial
SWMU 48 (SD-26) Waste Oil and Overflow Tanks	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Industrial, Commercial	Industrial
SWMU 51 Oil/Water Separator No. 375	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Commercial	Industrial, Commercial	Industrial
SWMU 55 Lead Acid Battery Accumulation Point	Ingestion and dermal direct contact with soil and contact through intrusive actions. Inhalation of fugitive dust. Possibly inhalation and dermal contact with groundwater.	Industrial	NA	Industrial
SWMU 57 Oil/Water Separator No. 379	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 61 Oil/Water Separator No. 5077a	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 62 Oil/Water Separator No. 5077b	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 63 Oil/Water Separator No. 5077c	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMU 70 Oil/Water Separator No. 326 and Leach Field	Ingestion and dermal direct contact with soil and contact through intrusive actions. Possible dermal contact with groundwater.	Industrial	NA	Industrial
SWMU 77 Civil Engineering Container Storage Area (Facility 4038)	Ingestion and dermal contact with soil.	Open Space	NA	Open Space
SWMU 83 (ST-27) Sump for Flight Apron Washdown	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	NA	Industrial
SWMUs 86-90 (SD-11) Test Cell Area	Ingestion and dermal direct contact with soil and contact through intrusive actions. Inhalation of fugitive dust and vapors from surface water.	Industrial	Industrial	Industrial

Table 1-7

(Continued)

Site ID	Potential Exposures	Current Use	Adjacent Uses	Likely Future Use
SWMU 92 Oil/Water Separator No. 5120	Ingestion and dermal direct contact with soil and contact through intrusive actions. Possible inhalation of fugitive dust.	Industrial	Industrial	Industrial
SWMU 93 Oil/Water Separator No. 5121	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Industrial	Industrial
SWMU 94 Oil/Water Separator No. 5144	Ingestion and dermal direct contact with soil and contact through intrusive actions.	Industrial	Industrial	Industrial
SWMU 95 (SD-20) NE Stormwater Drainage Area	Ingestion and dermal direct contact with soil and contact through intrusive actions. Inhalation of fugitive dust. Possible ingestion and dermal contact with sediment. Possible ingestion, inhalation, and dermal contact with surface water.	Industrial	NA	Industrial, Open Space
SWMU 97 (LF-25) Concrete Rubble Pile	Ingestion and dermal direct contact with soil and contact through intrusive actions. Inhalation of fugitive dust. Possible ingestion, inhalation, and dermal contact with groundwater.	Open Space	Industrial	Open Space
SWMUs 101, 102 (SD-21) Wastewater Treatment System Lagoon/Discharge	Ingestion and dermal contact with soil through intrusive actions. Ingestion and dermal contact with surface water. Possible inhalation of fugitive dust and possible ingestion and dermal direct contact through soil.	Open Space	Industrial	Industrial
SWMU 103 Wastewater Playa Lake	Ingestion and dermal direct contact with soil and contact through intrusive actions. Inhalation of fugitive dust. Ingestion and dermal contact with sediment and surface water.	Open Space	Industrial	Open Space
SWMU 104 (LF-04) Landfill No. 4	Ingestion and dermal direct contact with soil. Inhalation of fugitive dust. Possible ingestion and dermal contact with surface water.	Open Space	NA	Open Space

Table 1-7

(Continued)

Site ID	Potential Exposures	Current Use	Adjacent Uses	Likely Future Use
SWMU 105 (LF-03) Landfill No. 3	Ingestion and dermal direct contact with soil. Inhalation of fugitive dust. Possible ingestion and dermal contact with surface water.	Open Space	NA	Open Space
SWMU 108 EOD Activities Area	Ingestion and dermal direct contact with soil and contact through intrusive actions. Inhalation of fugitive dust.	Industrial	Open Space	Industrial
SWMU 109 (FT-09) Fire Department Training Area No. 4	Ingestion and dermal direct contact with soil and contact through intrusive actions. Inhalation of fugitive dust.	Open Space	Industrial	Open Space
SWMU 110 Underground Waste Oil Tank No. 2336	Ingestion and dermal direct contact with soil.	Open Space	Industrial	Open Space
SWMU 113 (LF-05) Landfill No. 5	Ingestion and dermal direct contact with soil and contact through intrusive actions. Possible ingestion, inhalation, and dermal contact with surface water.	Industrial, Open Space	NA	Industrial, Open Space
SWMU 127 Oil/Water Separator No. 4095 and Leach Field	Ingestion and dermal direct contact with soil and contact through intrusive actions. Inhalation of fugitive dust. Inhalation of vapors and dermal contact with groundwater.	Industrial	NA	Industrial
SWMU 114 (MAFR)	Ingestion and dermal direct contact with soil. Inhalation of fugitive dust. Ingestion and dermal contact with sediment.	Open Space	NA	Open Space
SWMU 115 (MAFR)	Ingestion and dermal direct contact with soil. Inhalation of fugitive dust. Ingestion and dermal contact with sediment.	Open Space	NA	Open Space
SWMU 117 (MAFR)	Ingestion and dermal direct contact with soil. Inhalation of fugitive dust. Ingestion and dermal contact with sediment.	Open Space	Industrial	Open Space

Table 1-8

Cannon Air Force Base
SWMU 1 - Oil/Water Separator 119

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 119 is located on the southeast corner of Building 119 next to the aircraft parking ramp. The separator is a 3-compartment underground unit, with a 700 gallon main compartment and a 280 gallon oil compartment. The unit is underground, with its opening in a concrete pad. The entire unit is surrounded by asphalt. This separator is currently in use.	
Types of Waste: The facility discharging to the separator was historically used for x-rays of aircraft and parts, and other operations which did not use chemicals. The unit has and still receives wash water generated from aircraft maintenance operations. Past analysis of the O/WS indicated the presence of metals and organics, including cadmium, chromium, nickel, lead, benzene, bromoform, bis(2-ethylhexyl)phthalate and di-n-butylphthalate in the influent/effluent of this separator. Wastewater from the site is discharged to the storm drainage system which flows to the Stormwater Collection Point (SWMU 85).	
Groundwater: Depth to groundwater at Cannon AFB is approximately 250 ft or greater. Groundwater was not encountered during soil boring.	Groundwater is not considered a potential route of exposure due to its depth and small chance of contamination from soils.
Soil: Soils at the site consist of fine sandy loam interbedded with thin to moderately thin layers of caliche. Soil analysis indicates the presence of TCL VOCs and metals in the surface and subsurface soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water from the site enters the base storm water drainage system and flows to the Stormwater Collection Point (SWMU 85). SWMU 85 is an ephemeral lake basin located in the southwest corner of the base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	

Table 1-8

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Groundwater and soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase I, Cannon Air Force Base, New Mexico. Volume 1, November 1993.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator
TCL VOCs = Target Compound List Volatile Organic Compounds

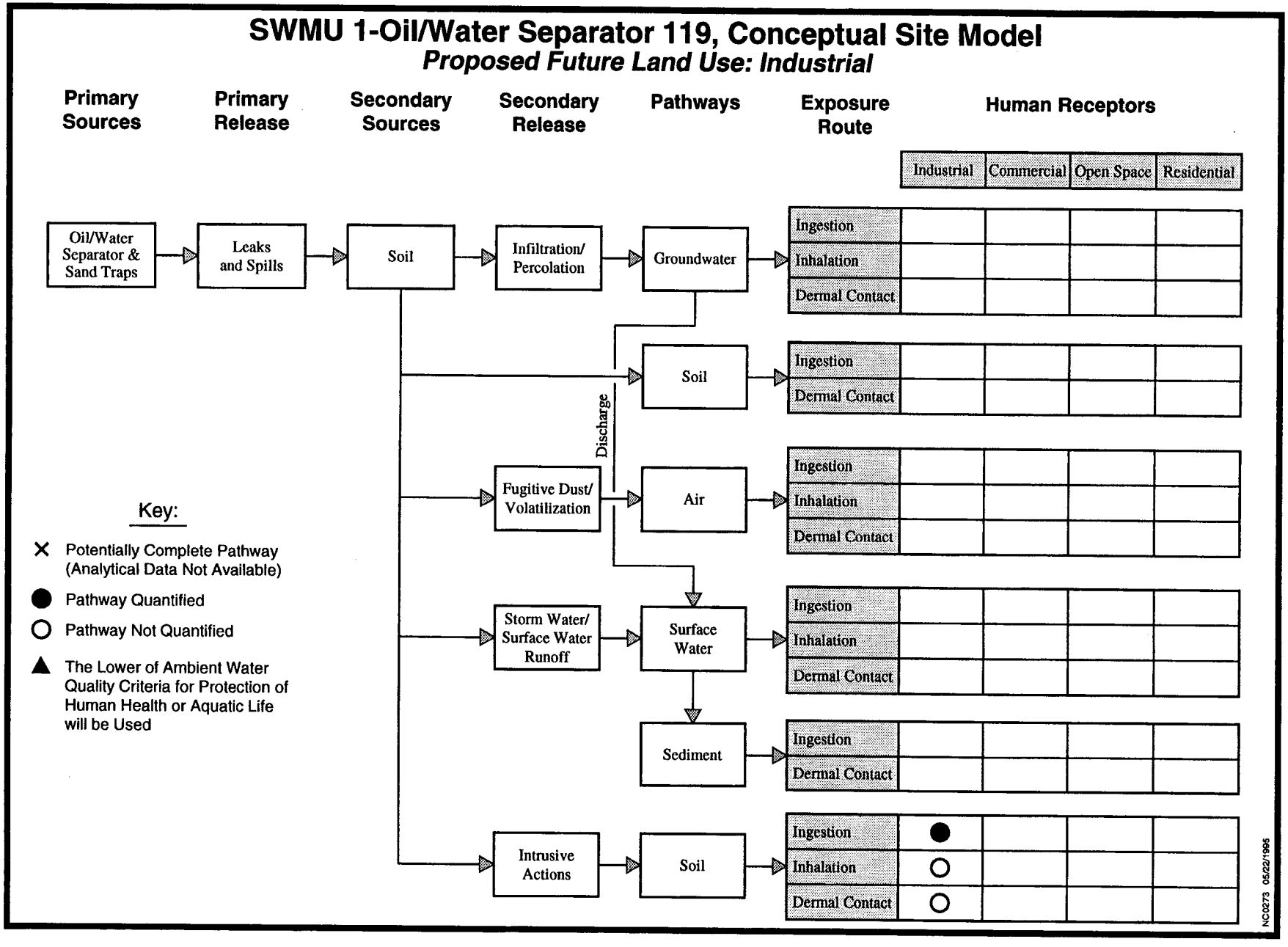

Figure 1-6. SWMU 1-Oil/Water Separator 119 Conceptual Site Model, Cannon AFB

Table 1-9

Cannon Air Force Base
SWMU 3 - Oil/Water Separator No. 108

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 108 was located on the west side of former hangar 125. Active since 1943, the unit was removed in 1990 during the demolition of Building 108. The site is covered with asphalt.	
Types of Waste: Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.	
Groundwater: Groundwater was not sampled at this site. Depth for groundwater is approximately 250 ft.	Groundwater is not considered a potential route of exposure due to its depth and small chance of contamination from soils.
Soil: Soils at the site consist of an alluvial material below the surface soils. This material is a loose to dense, reddish-brown, clayey silt with traces of caliche. Surface soils are a silty clay. TRPH and toluene were detected in the soils, but below residential RBCs. Barium and manganese were detected at concentrations that exceeded background, but these concentrations did not exceed the screening criteria for residential soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water from the site enters the base storm water drainage system and flows to the storm water collection point (SWMU 85). SWMU 85 is an ephemeral lake basin located in the southwest corner of the base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Commercial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs, Phase II, Cannon AFB, New Mexico, April, 1993.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator
TRPH = Total Recoverable Petroleum Hydrocarbons
RBCs = Risk-Based Concentrations

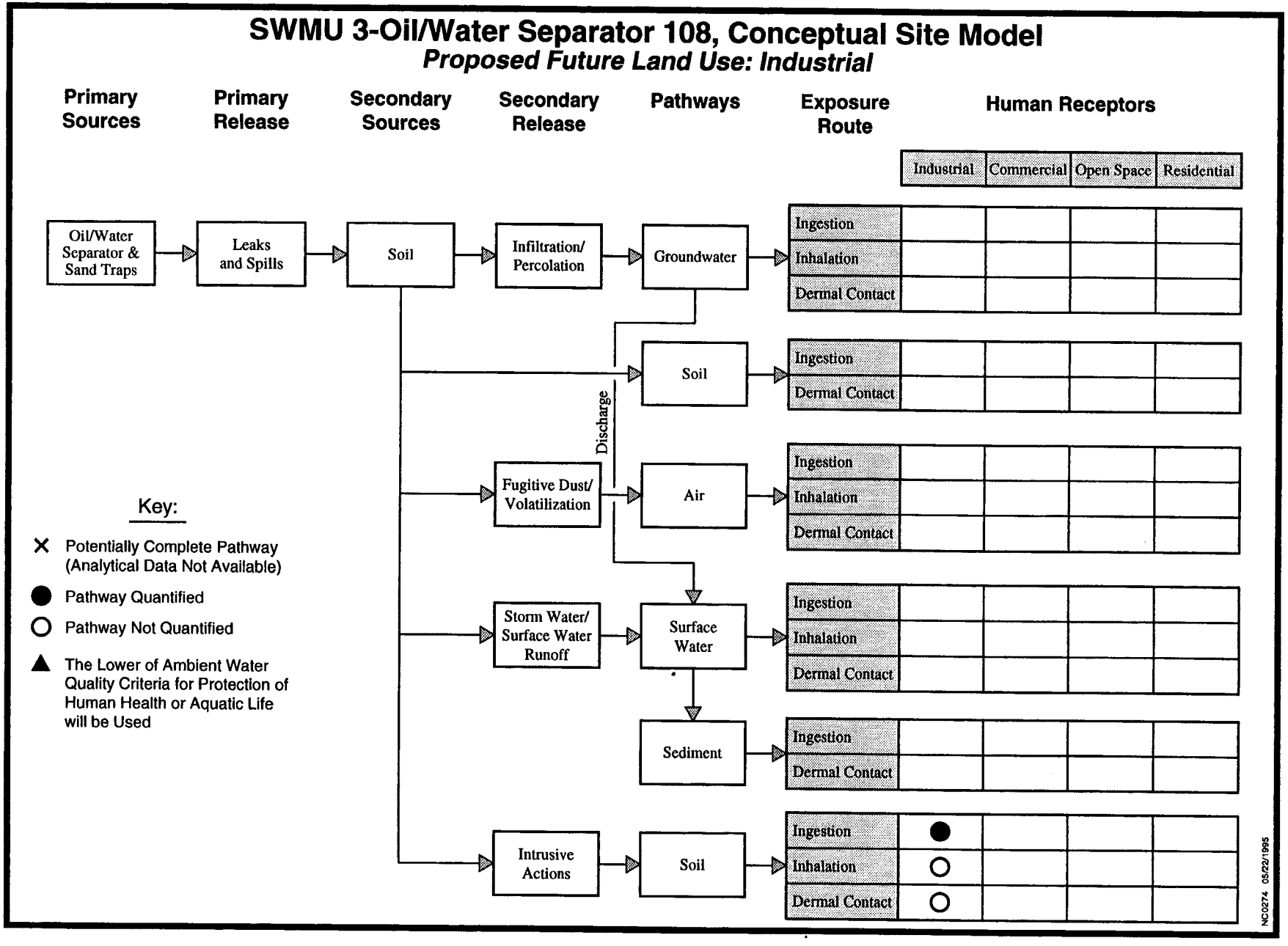

Figure 1-7. SWMU 3-Oil/Water Separator 108 Conceptual Site Model, Cannon AFB

Table 1-10

Cannon Air Force Base
SWMU 5 - Oil/Water Separator No. 121

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 121 was located on the west side of hangar 121 and was removed in 1990. This area is presently covered with asphalt. The exact location of the former oil/water separator is unknown.	
Types of Waste: Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.	
Groundwater: Depth to groundwater is approximately 250 ft. There is uncertainty associated with the vertical distribution of contaminants. Due to the low levels detected and the large depth to groundwater, this SWMU will not be further evaluated.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soils at this site consist of a silty clay alluvium below fill material. This silty clay contains varying amounts of calcium carbonate nodules and occasionally cemented caliche zones. TRPH and toluene were detected in the subsurface soils. Only manganese and nickel exceeded the background upper tolerance limit. None of the detected compounds exceeded the screening criteria for residential soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water drainage from the site enters the base storm water drainage system and flows to the Storm Water Collection Point (SWMU 85). SWMU 85 is an ephemeral lake basin located in the southwest corner of the base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs, Phase II, Cannon AFB, New Mexico, April, 1993.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator TRPH = Total Recoverable Petroleum Hydrocarbons

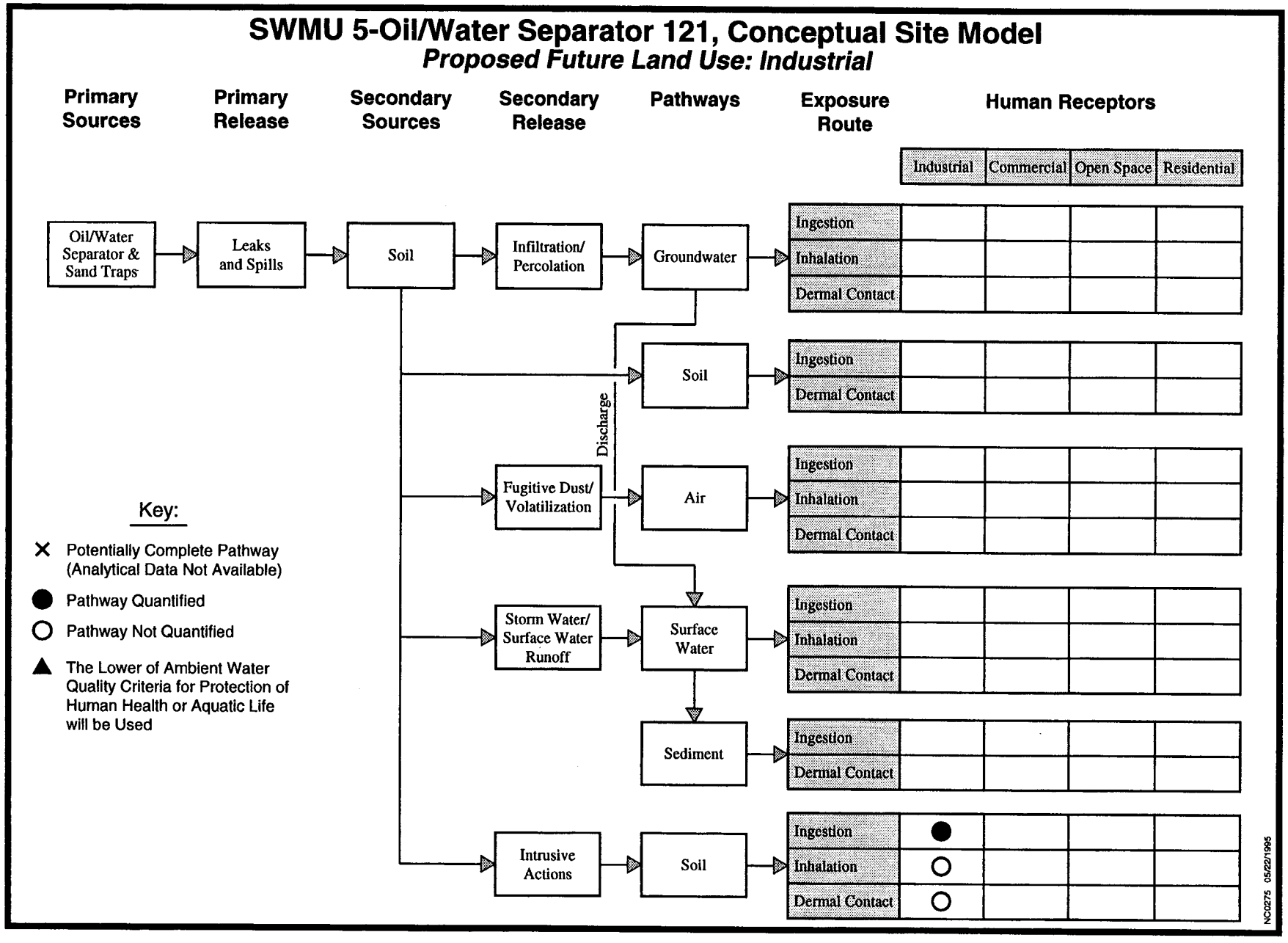

Figure 1-8. SWMU 5-Oil/Water Separator 121 Conceptual Site Model, Cannon AFB

Table 1-11

Cannon Air Force Base
SWMU 7 - Oil/Water Separator 129

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 129 is located on the northwest side of Building 129, approximately 33 ft east of the northwest corner. The separator is a 3-compartment underground unit, with a 700 gallon main compartment, a 280 gallon oil compartment, and a skimmer. The site is covered by asphalt. The O/WS is currently in use.	
Types of Waste: The O/WS receives wastewater from Building 129. Historically, the O/WS received washwater generated from aircraft washing and aircraft maintenance operations. Past analysis of the O/WS indicated the presence of metals and organics, including benzene, toluene, ethylbenzene, xylene, 2-hexanone, lead, cadmium, 2-methylnaphthalene, and several phthalates in the influent/effluent of this separator. Wastewater is discharged to the Sanitary Sewage Line (SWMU 98).	
Groundwater: Depth to groundwater at Cannon AFB is approximately 250 ft or greater. Groundwater was not encountered during soil boring.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soils at the site consist of fine sandy loam interbedded with thin to moderately thin layers of caliche. Samples indicate the presence of VOCs and metals in both surface and subsurface soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water drainage from the site enters the Base storm water drainage system and flows to the Stormwater Collection Point (SWMU 85). SWMU 85 is an ephemeral lake basin located in the southwest corner of the base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	

Table 1-11

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Groundwater and soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase 1, Cannon Air Force Base, New Mexico. Volume 1, November 1993.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator
VOCs = Volatile Organic Compounds

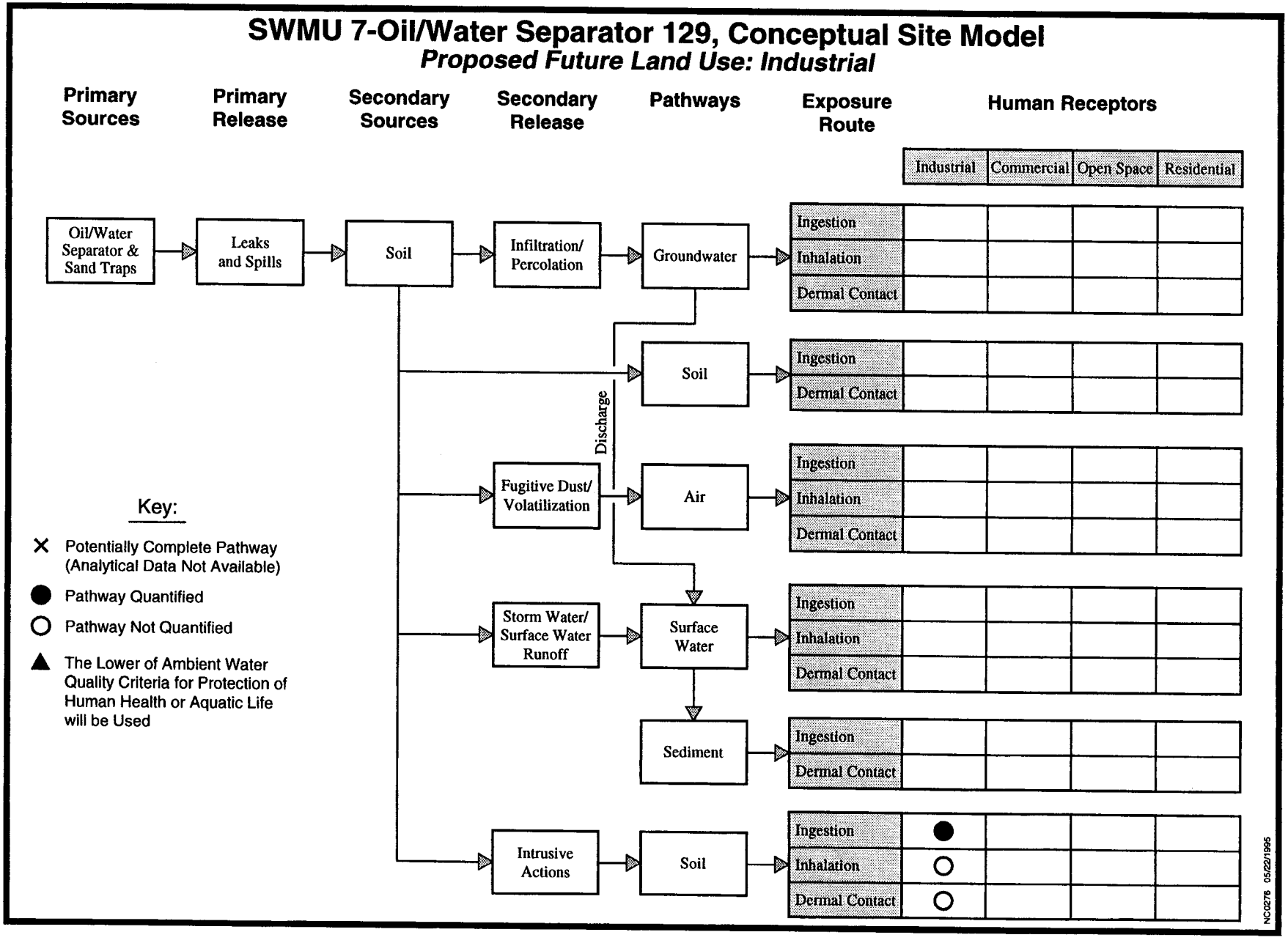

Figure 1-9. SWMU 7-Oil/Water Separator 129 Conceptual Site Model, Cannon AFB

Table 1-12

Cannon Air Force Base
SWMU 8 - Oil/Water Separator 165

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 165 is located on the south end of the aircraft washrack at Facility 165. The separator is a 3-compartment underground unit with a 4,500 gallon main compartment and a 710 gallon oil compartment. The site is covered with asphalt. The O/WS is currently in use.	
Types of Waste: The O/WS receives wastewater from the washing of aircraft. No previous investigations are available for this site; chemical compounds that may be in the influent/effluent of this site would be similar to those associated with SWMU 9 which is served by this separator. These compounds included ethylene glycol n-mono butyl ether and PD-680 constituents. Washrack components would include fuels, solvents, and lubricating oils. Wastewater from the site is discharged to the storm drainage system which flows to the Stormwater Collection Point (SWMU 85).	
Groundwater: Depth to groundwater at Cannon AFB is approximately 250 ft or greater. Groundwater was not encountered during soil boring.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soils at the site consist of fine sandy loam interbedded with thin to moderately thin layers of caliche. Soil analysis indicates the presence of xylenes and metals.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water from the site enters the base storm water drainage system and flows to the Stormwater Collection Point (SWMU 85). SWMU 85 is an ephemeral lake basin located in the southwest corner of the base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Groundwater and soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase I, Cannon Air Force Base, New Mexico. Volume 1, November 1993.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

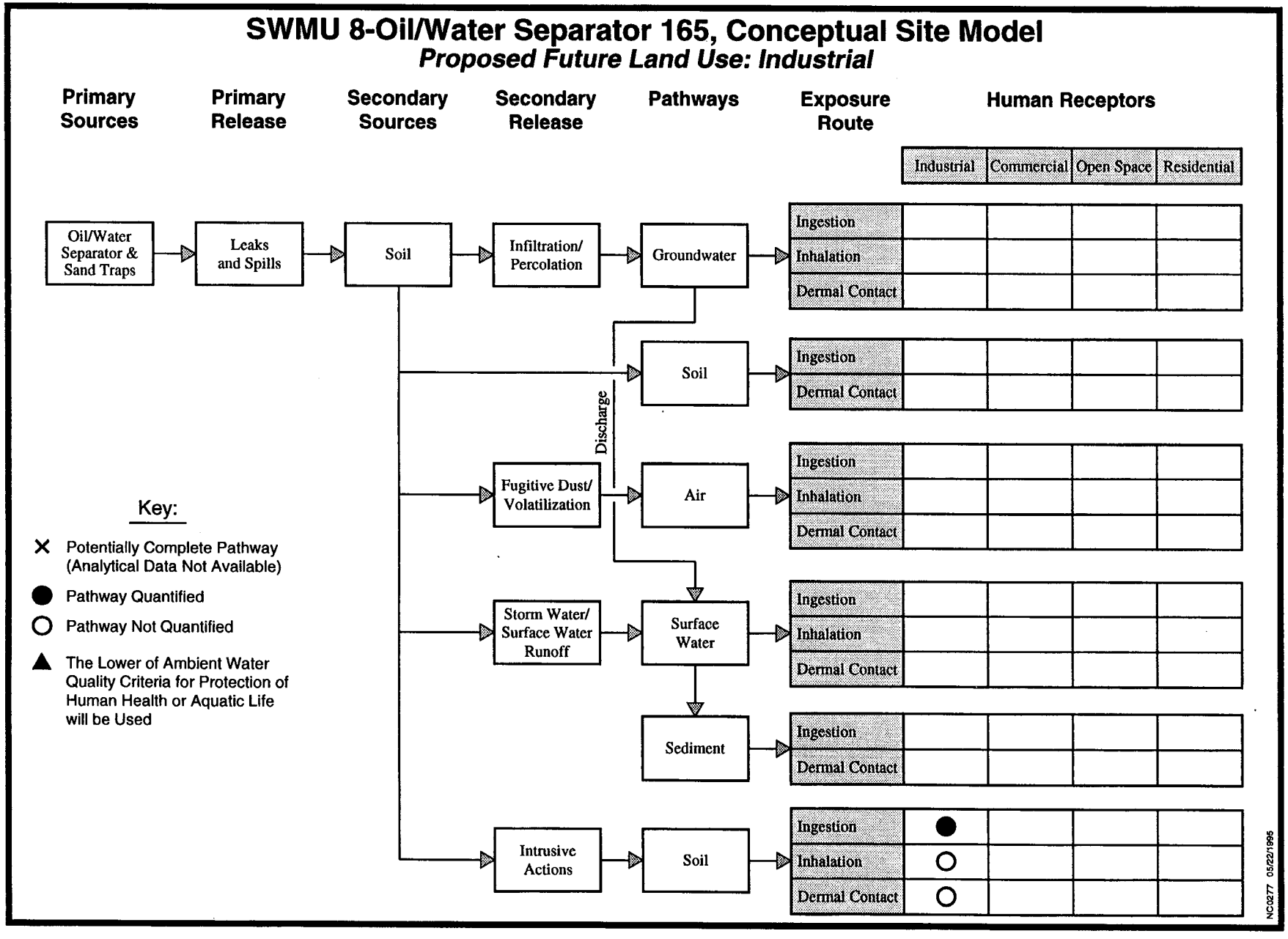

Figure 1-10. SWMU 8-Oil/Water Separator 165 Conceptual Site Model, Cannon AFB

Table 1-13

Cannon Air Force Base
SWMU 9 - Aircraft Washrack Drain System

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: SWMU 9 is a drain leading underground in the center of a concrete washrack pad used for cleaning aircraft. The drain discharges to O/WS 165 (SWMU 8). SWMU 9 is close to the flightline. The washrack pad is currently in use, with about four aircraft washed per week. The washrack also is currently used as a staging area for mobilization exercises and air shipments. The area is covered with asphalt.	
Types of Waste: Aircraft are washed on the pad associated with SWMU 9 with water and an aircraft cleaning compound solution. Since 1984, the cleaning compound solution used is biodegradable and consists of 5% by weight ethylene glycol n-mono butyl ether. Prior to 1984, approximately 3,600 gallons of PD-680 and 1,700 gallons of aircraft cleaning compound drained into O/WS 165 (SWMU 8) from SWMU 9. Wastewater from the site eventually drains into the Storm Water Drainage Area (SWMU 85).	
Groundwater: Depth to groundwater at Cannon AFB is approximately 250 ft or greater. Groundwater was not encountered during soil boring.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soils at the site consist of fine sandy loam interbedded with thin to moderately thin layers of caliche. Samples indicate the presence of VOCs and metals in both surface and subsurface soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water drainage from SWMU 9 flows through a series of ditches the Stormwater Collection Point (SWMU 85). SWMU 85 is an ephemeral lake basin located in the southwest corner of the base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	

Table 1-13

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase I, Cannon Air Force Base, New Mexico. Volume 1, November 1993.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator
VOCs = Volatile Organic Compounds

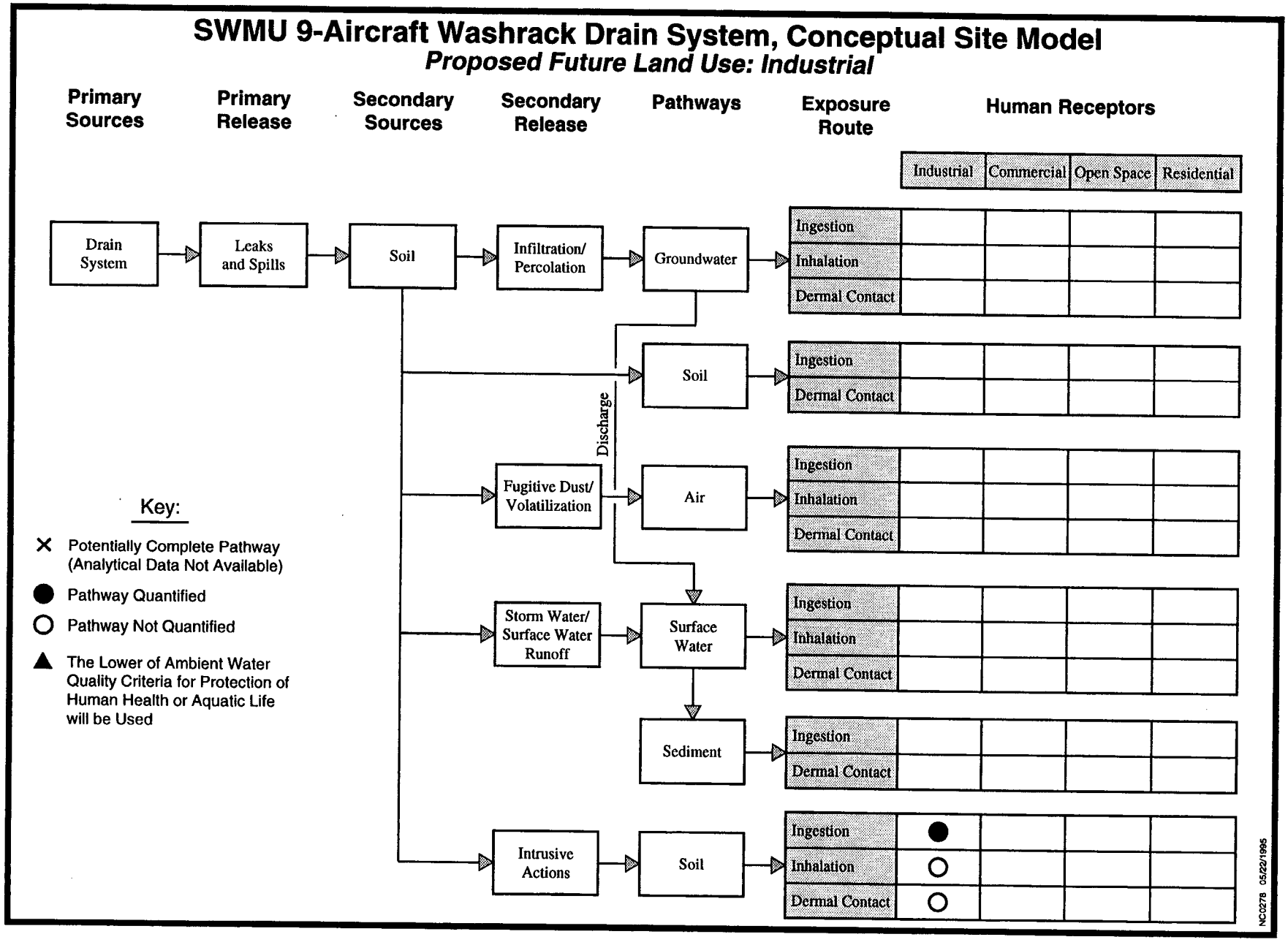

Figure 1-11. SWMU 9-Aircraft Washrack Drain System Conceptual Site Model, Cannon AFB

Table 1-14

Cannon Air Force Base
SWMU 11 - Oil/Water Separator 170

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 170 is located on the west side of Building 170. The O/WS is constructed of concrete and has a 3-compartment underground unit, with a 700-gallon main compartment and a 280-gallon oil compartment. The O/WS was active from 1963 until 1989. The separator has been removed and the area is currently covered with asphalt.	
Types of Waste: O/WS 170 received wash water from aircraft maintenance operations in Building 170. Potential contaminants include petroleum, synthetic lubricating oils and dirt.	
Groundwater: Depth to groundwater is greater than 200 ft at this site.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Low levels of methylene chloride and toluene were detected in surface soils at the site. No metals were detected above background at the surface, however, low levels of nickel were found at 2.5 ft. Low levels of mercury and methylene chloride were identified at 10 ft.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water drainage is directed topographically through a series of ditches to SWMU 85 (Stormwater Collection Point). SWMU 85 is an ephemeral lake basin (playa) located in the southwest corner of the Base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1, November 1993.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

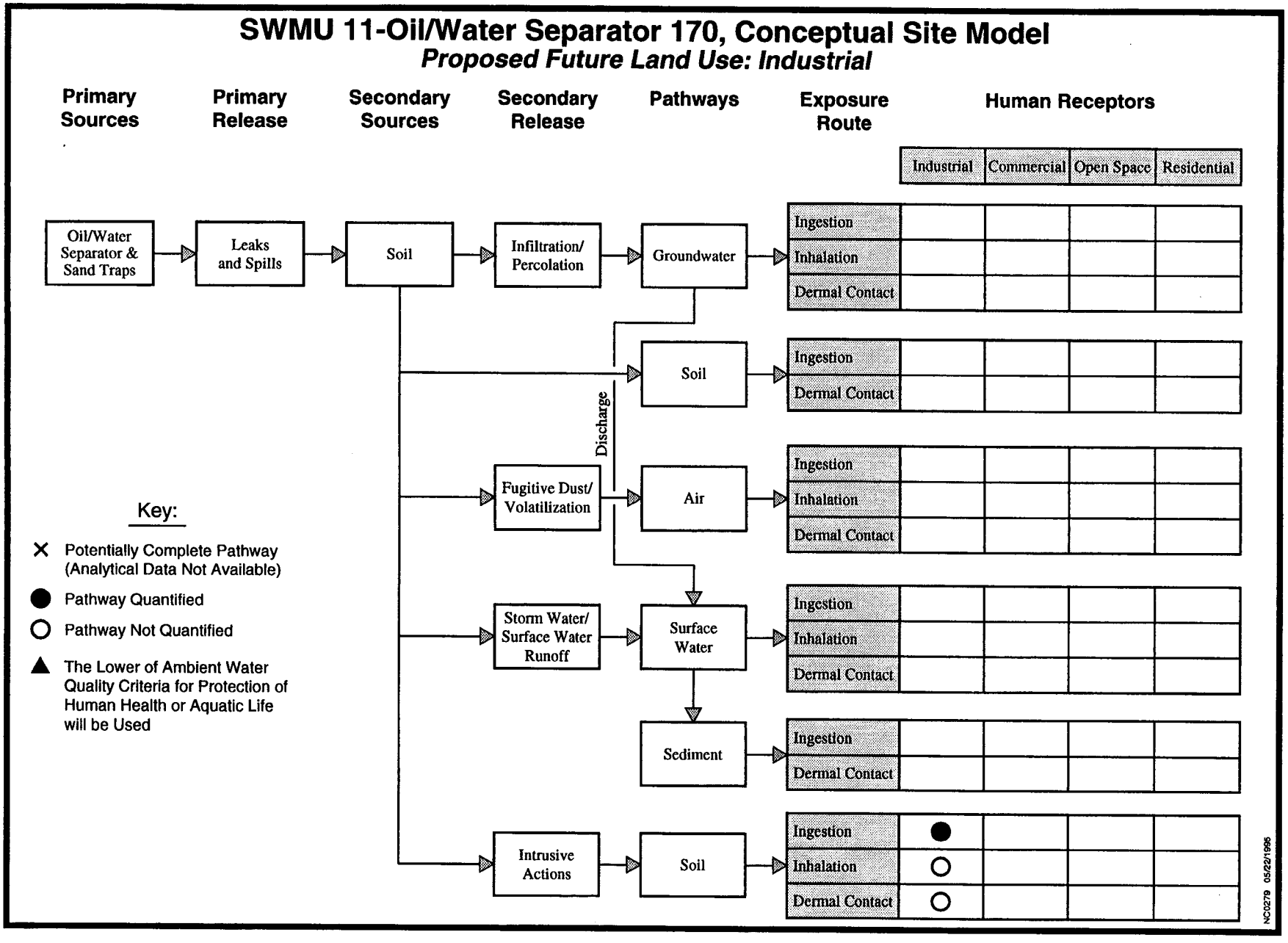

Figure 1-12. SWMU 11-Oil/Water Separator 165 Conceptual Site Model, Cannon AFB

Table 1-15

Cannon Air Force Base
SWMU 16 - Oil/Water Separator No. 680

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 680 was located near the southwest corner of building 690 inside and under a garage. The O/WS has been removed, and the area covered with concrete. This unit was active in 1965 to 1991.	
Types of Waste: Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.	
Groundwater: Groundwater was not sampled at this SWMU. The soil contamination does not pose a risk to the groundwater.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt	
Surface Water: Surface water bodies are not present at this SWMU. Surface water drainage is directed through a series of ditches to the Storm Water Collection Point (SWMU 85).	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix 11 SWMU-Phase II Cannon Air Force Base, New Mexico. Volume 1, April 1993.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator

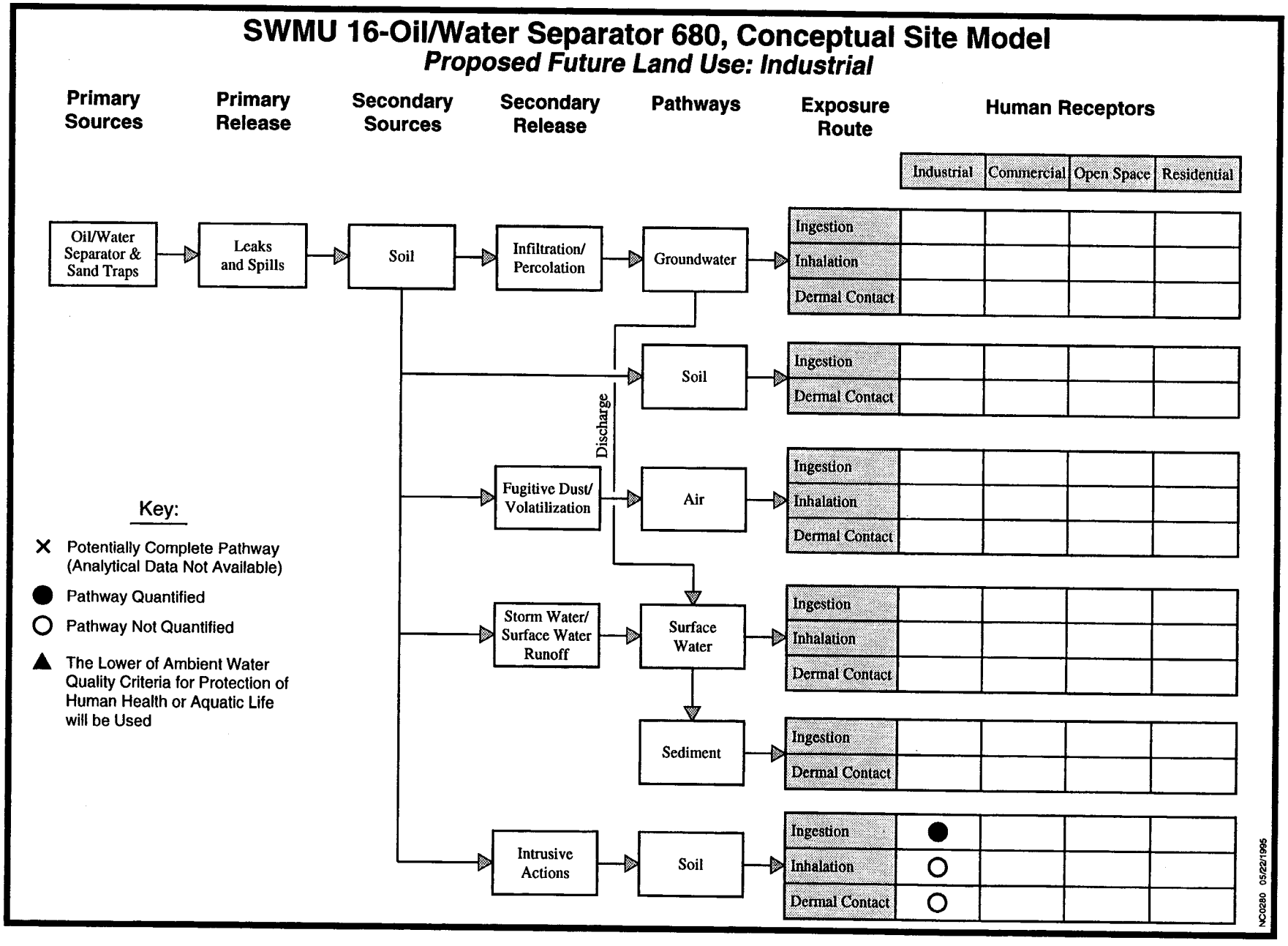

Figure 1-13. SWMU 16-Oil/Water Separator 680 Conceptual Site Model, Cannon AFB

Table 1-16

Cannon Air Force Base
SWMU 31 - AGE Maintenance Shop Pad

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: The AGE Maintenance Pad is an open concrete area approximately 70 ft wide by 240 ft long. The Maintenance Pad drains to the AGE Drainage Ditch. Much of the site is covered with concrete.	
Types of Waste: JP-4, synthetic and mineral oils, diesel fuel, and solvents.	
Groundwater: Fate and transport modeling for the Phase 1 investigation showed migration of contaminants to groundwater to be insignificant pathways. Groundwater is located 200-300 ft below ground surface.	Groundwater is not considered an exposure pathway due to its depth and the conclusions of fate and transport modeling.
Soil: Soils at the site consist of sandy clays and silts found 0.5-3.5 ft below ground surface. This layer is underlain by interbedded white sandy clay and reddish brown sandy clay. Visually contaminated surface soils were present in 2 borings, but only low levels of subsurface soil contamination were detected.	
Surface Water: Runoff from the northwest area of the Maintenance Pad is directed along an expansion joint offsite. Drainage for the rest of the area is carried by the AGE Drainage Ditch to the southeast. The AGE Drainage Ditch was investigated as part of the Appendix 1 RI and determined to be a candidate for NFA.	
Sediment: No sediment data is available for this site. Investigation of the drainage ditch showed negligible to nondetectable contaminant levels in the soils lining the ditch.	
Surrounding Land Use: Industrial	
Ecological Factors: An ecological risk assessment conducted in conjunction with the Phase 1 investigation showed that no unacceptable ecological risks were expected at this SWMU.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase II, Cannon Air Force Base, New Mexico, Pre-Draft, Volume 1A, April 1995.

AGE = Aerospace Ground Equipment

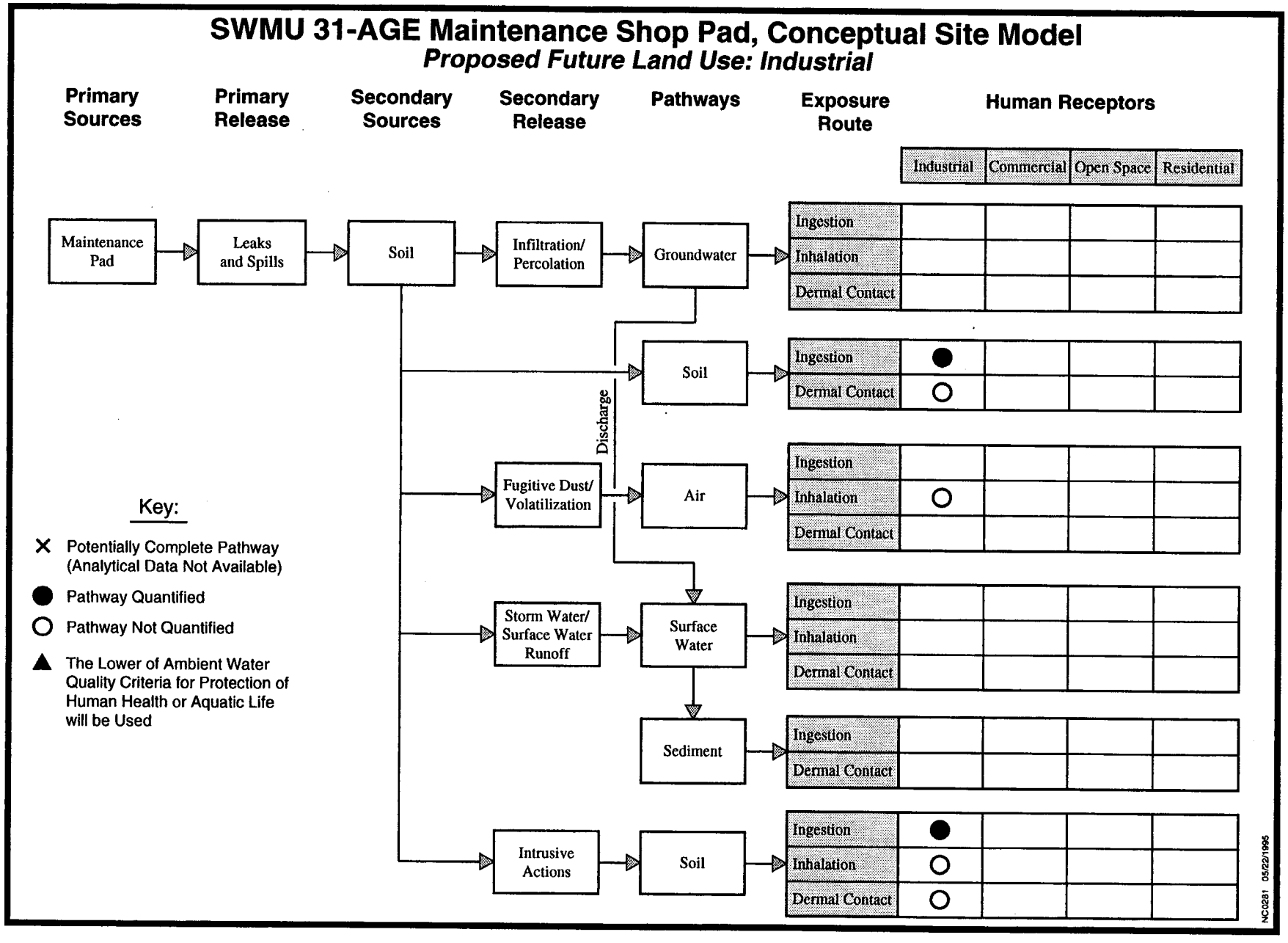

Figure 1-14. SWMU 31-AGE Maintenance Pad Conceptual Site Model, Cannon AFB

Table 1-17

Cannon Air Force Base
SWMU 32a - Oil/Water Separator 186 (#1-East)

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 186 (#1-East) is on the east side of Building 186, closest to the flightline and next to the washrack. The O/WS is constructed of concrete and is a 2-compartment underground unit, with a 300-gallon main compartment and a 300-gallon oil compartment. The O/WS has been active since 1971 and is still in use. Containers of used JP-4 and synthetic oil are stored nearby on carts. Two underground JP-4 filling tanks are located about 25 ft from the separator; these tanks were reportedly placed in vaults. The SWMU is underground and the area is currently covered with asphalt.	
Types of Waste: The O/WS receives wastewater from the cleaning of aircraft ground-support equipment at the washrack. Potential contaminants include petroleum, synthetic lubricating oils and dirt.	
Groundwater: Depth to groundwater is greater than 250 ft at this site.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Xylene was detected in one surface soil sample. Nickel, mercury, and barium were detected in subsurface soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water drainage is directed topographically through a series of ditches to SWMU 85 (Stormwater Collection Point). SWMU 85 is an ephemeral lake basin (playa) in the southwest corner of the Base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1, November 1993.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

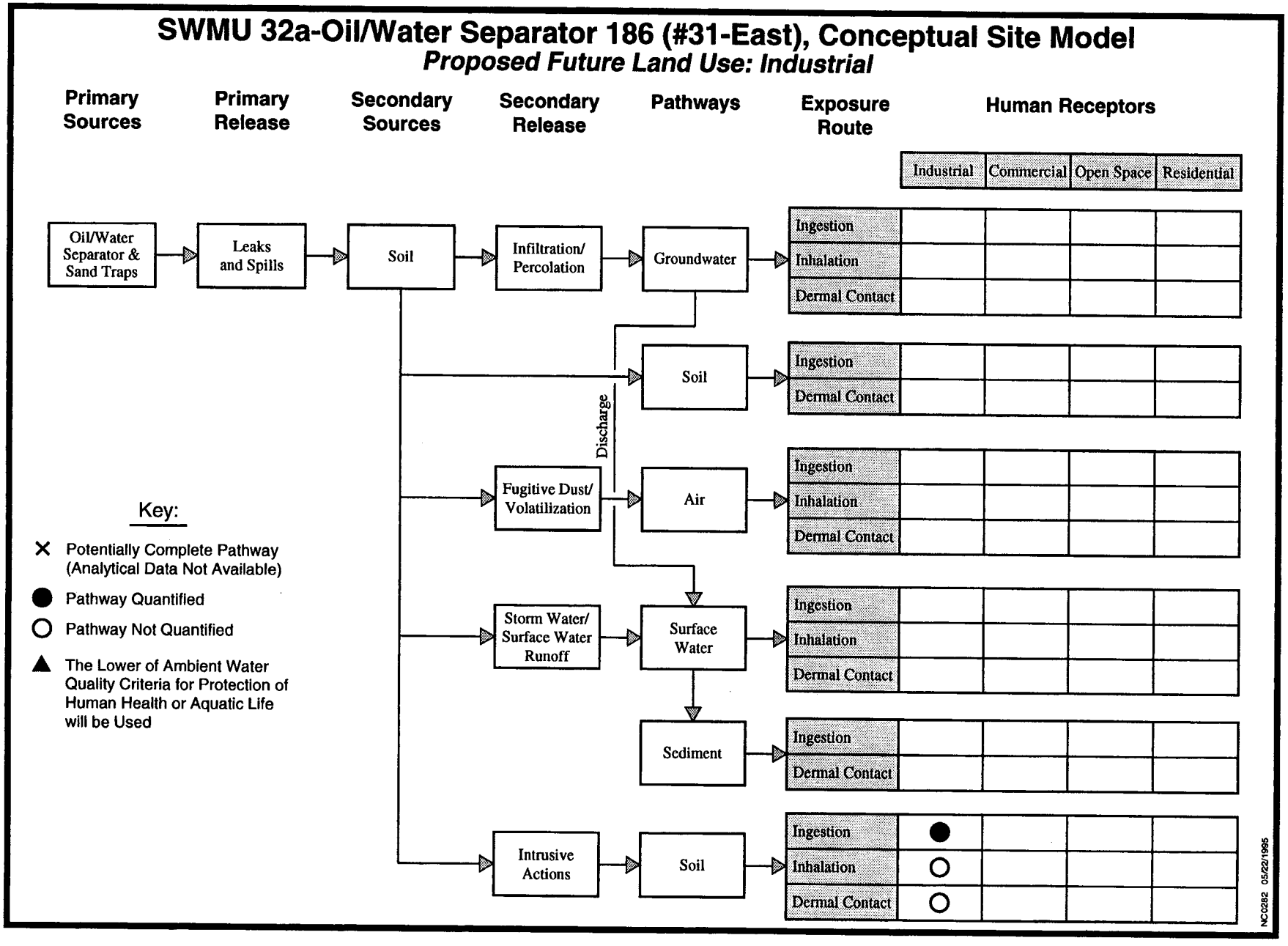

Figure 1-15. SWMU 32A-Oil/Water Separator 186 (31-East) Conceptual Site Model, Cannon AFB

Table 1-18

Cannon Air Force Base
SWMU 33b - Oil/Water Separator 186 (#2-West)

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 186 (#2-West) is on the southwest corner of Building 186. The O/WS is constructed of concrete and is a 2-compartment underground unit, with a 584-gallon main compartment and a 140-gallon oil compartment. The O/WS has been active since 1971 and is still in use. The SWMU is underground and the area is covered with asphalt.	
Types of Waste: The O/WS receives wastewater from the cleaning of aircraft ground-support equipment at the washrack. Potential contaminants include petroleum, synthetic lubricating oils and dirt.	
Groundwater: The depth to groundwater is greater than 250 ft.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Acetone, chromium, and nickel were detected in surface soils. Acetone, arsenic, and barium were detected in subsurface soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water drainage is directed topographically through a series of ditches to SWMU 85 (Stormwater Collection Point). SWMU 85 is an ephemeral lake basin (playa) in the southwest corner of the Base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1, November 1993.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator

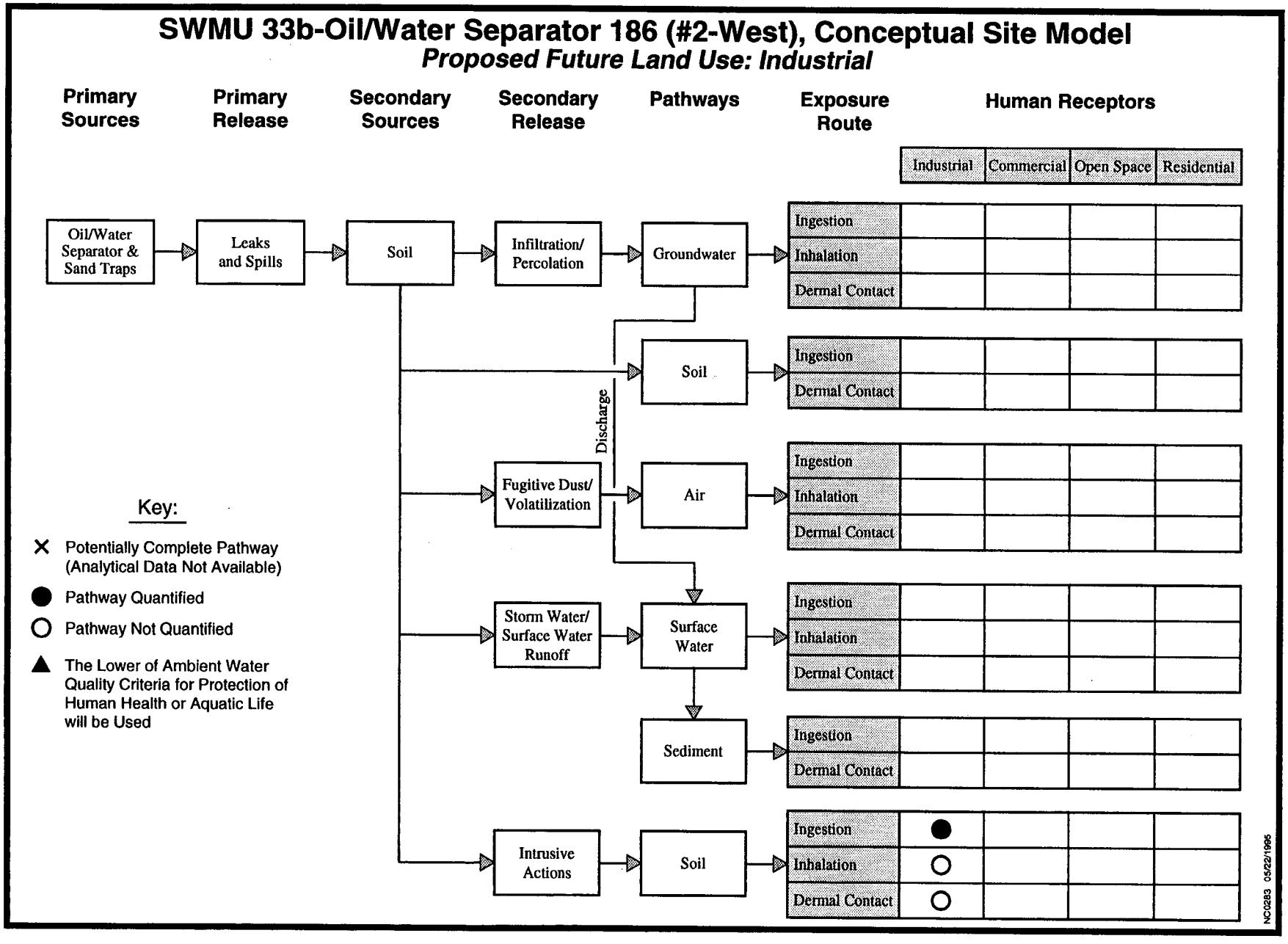

Figure 1-16. SWMU 33B-Oil/Water Separator 186 (#2-West) Conceptual Site Model, Cannon AFB

Table 1-19

Cannon Air Force Base
SWMU 38 - Oil/Water Separator 194

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 194 is located on the northeast corner of Building 194. The separator is an underground 3-compartment unit, with a 584-gallon main compartment and a 140-gallon oil compartment. The O/WS is currently in use. The site is covered with asphalt.	
Types of Waste: O/WS 194 receives washwater from aircraft maintenance operations. The facility that was historically served by this O/WS was a wheel and tire shop and an aircraft maintenance bay. The wheel and tire shop used PD-680, Turco stripping compound (containing 50% tetrachloroethylene), and Mirachem-100 for stripping and degreasing. The O/WS also received washwater from aircraft maintenance operations containing petroleum and synthetic lubricating oils. Past analysis of the O/WS indicated the presence of benzene, toluene, ethylbenzene, xylene, naphthalene, 2-methylnaphthalene, benzoic acid, di-n-butylphthalate, bis (2-ethylhexyl)phthalate, lead and other compounds in the influent/effluent. Wastewater from the site is discharged to the Storm Drainage System which flows to the Stormwater Collection Point (SWMU 95).	
Groundwater: Depth to groundwater at Cannon AFB is approximately 250 ft or greater. Groundwater was not encountered during soil boring.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soils at the site consist of fine sandy loam interbedded with thin to moderately thin layers of caliche. Samples indicate the presence of VOCs and metals in both surface and subsurface soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water drainage from SWMU 38 enters the base storm water drainage system and flows to the Stormwater Collection Point (SWMU 98). SWMU 95 is a stormwater collection ditch located east of the sewage lagoons.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	

Table 1-19

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase I, Cannon Air Force Base, New Mexico. Volume 1, November 1993.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator
VOCs = Volatile Organic Compounds

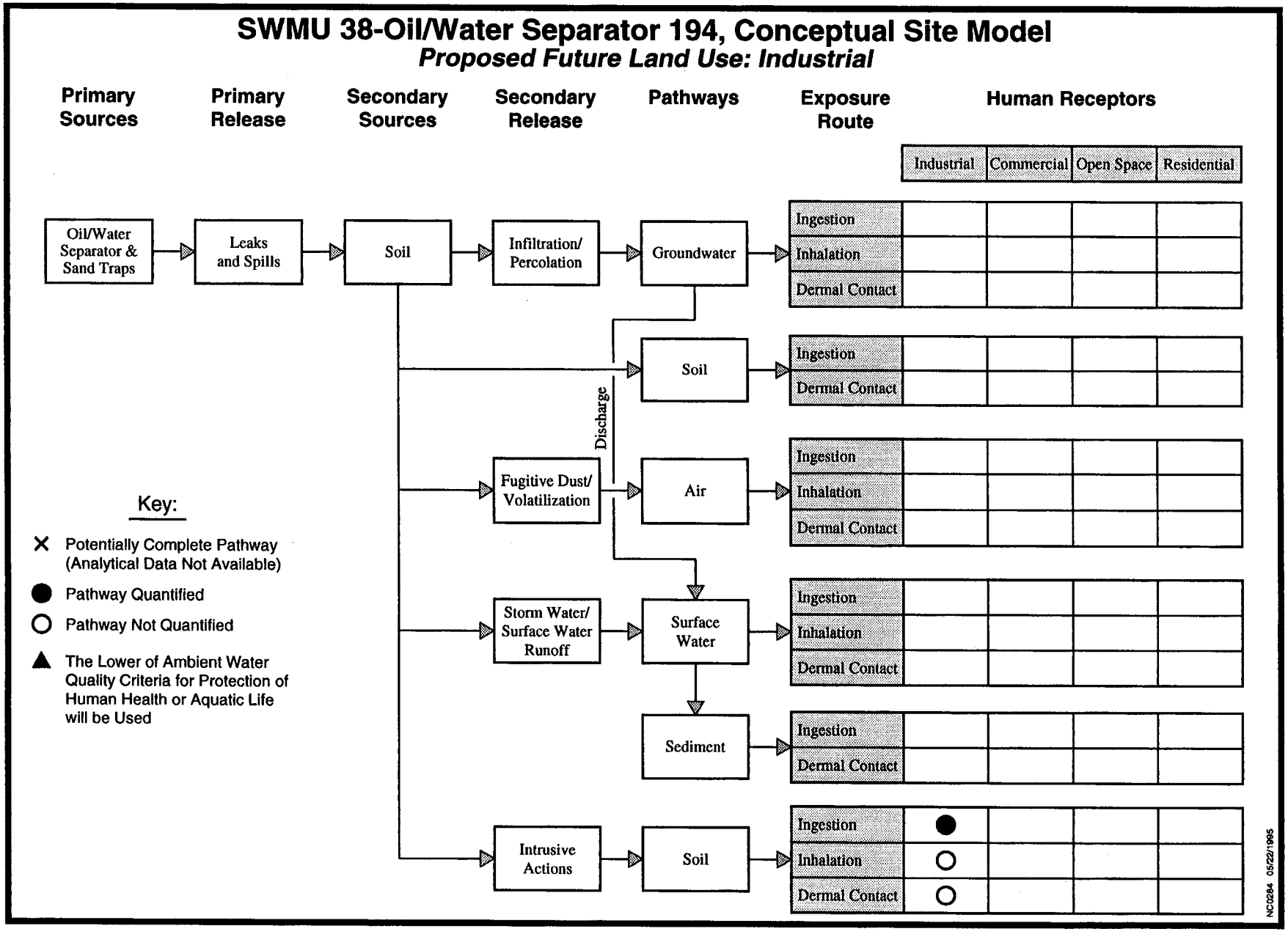

Figure 1-17. SWMU 38-Oil/Water Separator 194 Conceptual Site Model, Cannon AFB

Table 1-20

Cannon Air Force Base
SWMU 39 - Oil/Water Separator 195

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 195 is located on the northeast corner of Building 195. The separator is an underground 2-compartment unit, including a skimmer, with a 584 gallon main compartment and a 140 gallon oil compartment. The O/WS is currently in use. The site is covered with asphalt.	
Types of Waste: The O/WS receives washwater from aircraft maintenance operations. The effluent contains petroleum and synthetic lubricating oils and dirt. The O/WS historically served a munitions facility. Past analysis of O/WS indicated the presence of benzene, toluene, ethylbenzene, xylene, naphthalene, 2-methylnaphthalene, benzoic acid, bis (2-ethylhexyl)phthalate, phenol, 4-methylphenol, lead, and other compounds in the influent/effluent of this separator. Wastewater from the site is discharged to the Storm Drainage System which flows to Stormwater Collection Point (SWMU 95).	
Groundwater: Depth to groundwater at Cannon AFB is approximately 250 ft or greater. Groundwater was not encountered during soil boring.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soils at the site consist of fine sandy loam interbedded with thin to moderately thin layers of caliche. Soil analysis indicates the presence of TCL VOCs and metals in the surface and subsurface soils.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water drainage from the site enters the base stormwater drainage system and flows to the Stormwater Collection Point (SWMU 95). SWMU 95 is a stormwater collection ditch located east of the sewage lagoons.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase I, Cannon Air Force Base, New Mexico. Volume 1, November 1993.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator VOCs = Volatile Organic Compounds

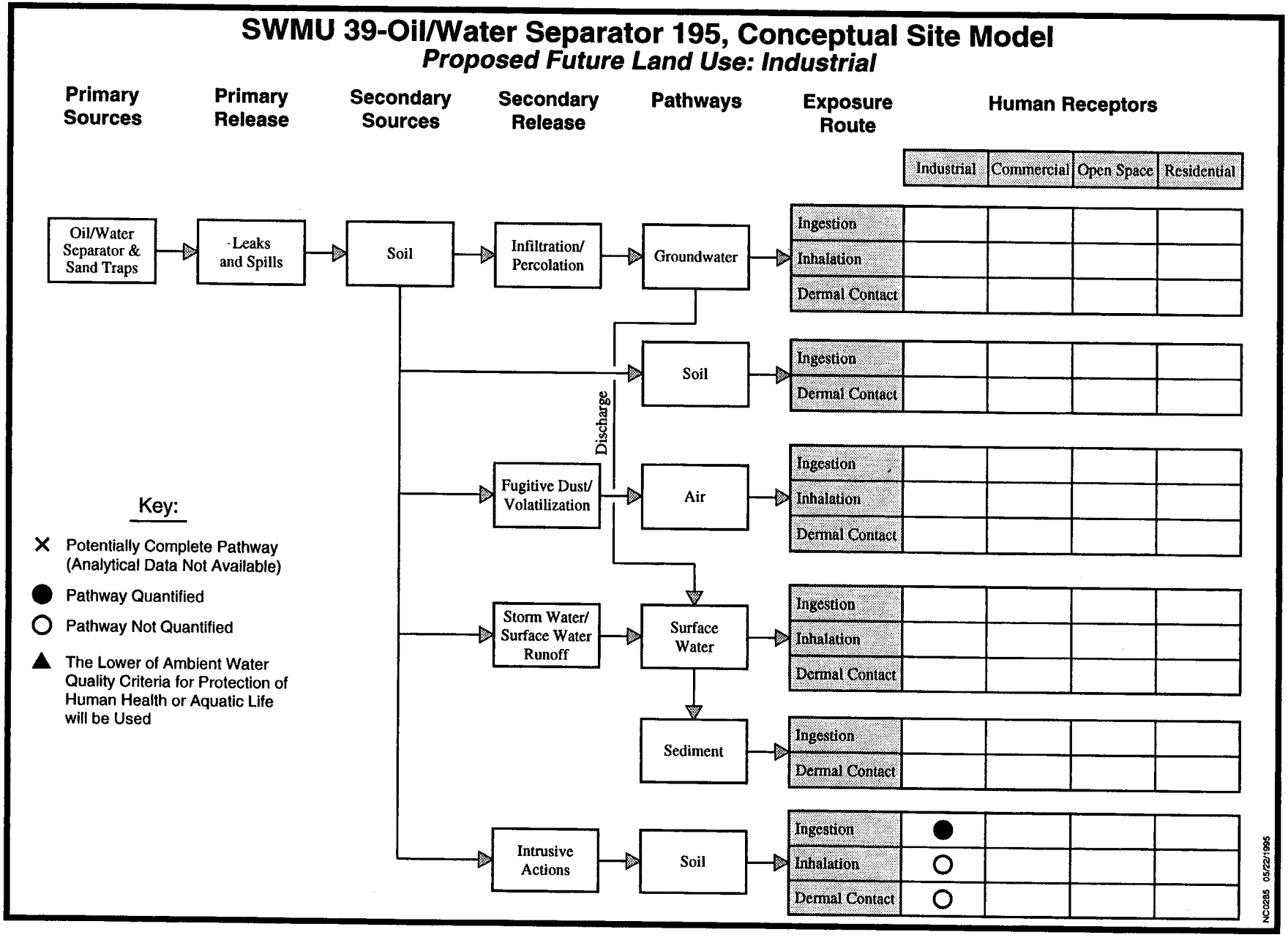

Figure 1-18. SWMU 39-Oil/Water Separator 195 Conceptual Site Model, Cannon AFB

Table 1-21

Cannon Air Force Base
SWMU 46 - Oil/Water Separator 196

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 196 is located between Buildings 195 and 196. The dimensions of the O/WS are approximately 7 ft by 9 ft extending about 7.5 ft below the surface of the pavement. The area around the O/WS is paved with asphalt.	
Types of Waste: O/WS 196 receives wash water generated from aircraft maintenance operations. Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.	
Groundwater: Depth to groundwater is greater than 200 ft.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soil sampling did not indicate the presence of organic contaminants at levels of concern. Inorganic chemicals were detected at levels of concern but were considered to be background concentrations.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Drainage from the site flows southeast toward the flight line, but no SWMU related contaminants would be carried in this drainage as the O/WS is below the surface.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial.	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1A, February 1994.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator

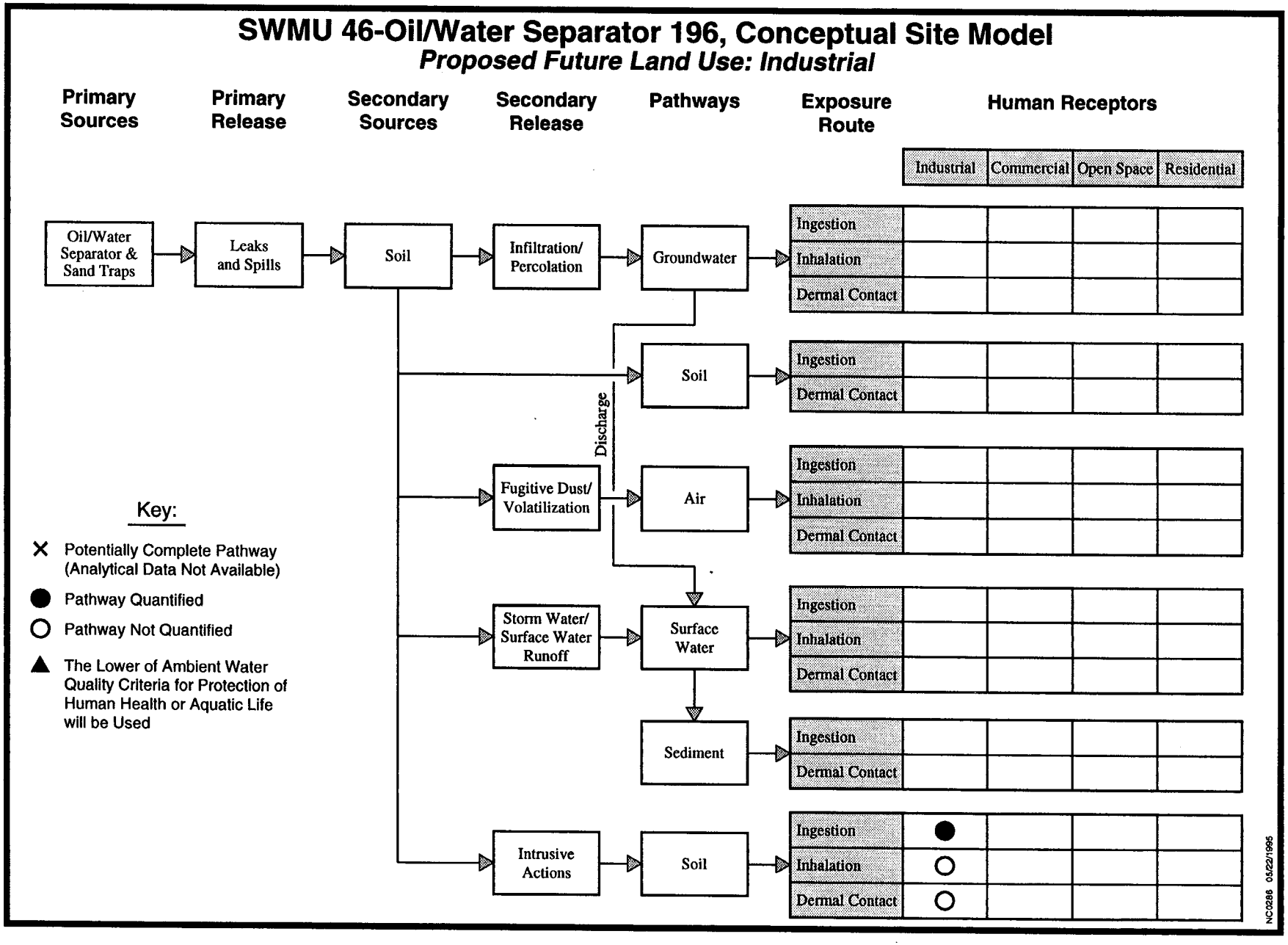

Figure 1-19. SWMU 46-Oil/Water Separator 196 Conceptual Site Model, Cannon AFB

Table 1-22

Cannon Air Force Base
SWMU 47 - Oil/Water Separator 494

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 494 is located beneath the asphalt drive adjacent to the northeast wall of Building 494. The dimensions of the O/WS are approximately 1 ft by 2.5 ft extending to a depth of less than 10 ft below the surface of the pavement. A sand trap is also associated with this SWMU.	
Types of Waste: O/WS 494 receives wash water from personal vehicle maintenance operations in the Auto Hobby Shop (Building 494). Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, paint chips and metals.	
Groundwater: Depth to groundwater is greater than 200 ft and detected levels of analytes are negligible.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soil sampling did not indicate the presence of contaminants at levels above screening criteria.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Drainage from this site flows to the northeast, but SWMU related contaminants are not expected to be carried in this drainage as the O/WS is below the surface.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: This SWMU is located in an industrial/commercial area. However, surrounding land west of the SWMU is recreational open space.	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Groundwater and soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1A, February 1994.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

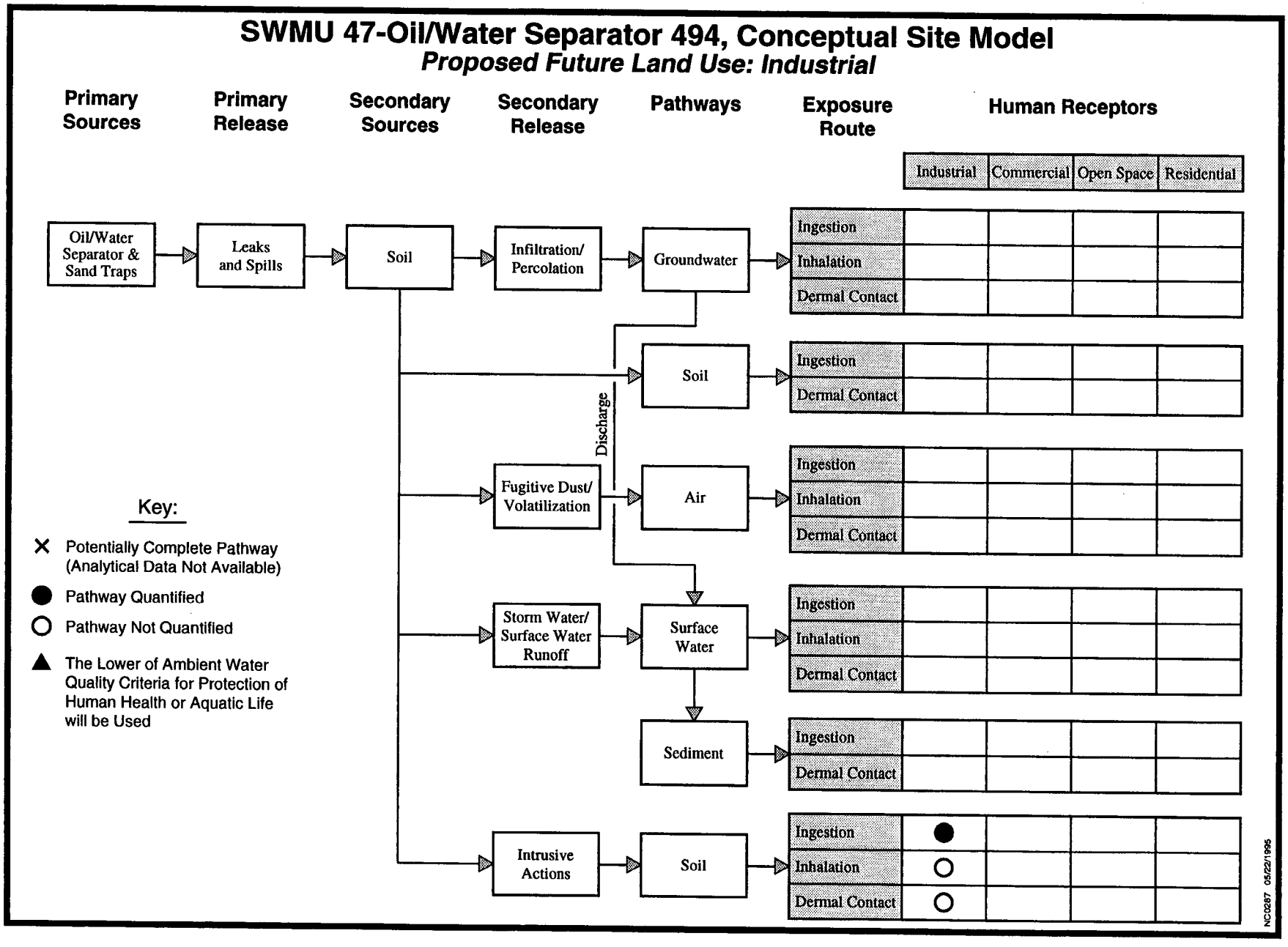

Figure 1-20. SWMU 47-Oil/Water Separator 494 Conceptual Site Model, Cannon AFB

Table 1-23

Cannon Air Force Base
SWMU 48a - Underground Waste Oil Tank

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: SWMU 48a was a 20,000-gallon underground storage tank located about 125 ft east of the intersection of Argentia and Torch. The tank and the associated piping were removed in 1988. The area is paved and is presently used as a parking lot. The tank was active from 1941 to 1985.	
Types of Waste: The tank was used to store waste products including waste oils, spent solvents, paint thinners, and recovered fuels. These products were periodically removed and placed elsewhere.	
Groundwater: Groundwater was not sampled at this SWMU. The soil contamination does not pose a risk to the groundwater.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: The asphalt pavement is underlain by a 5-7 inch layer of sandy gravel fill. Silty clay was encountered below the fill to depths ranging from 8-13 ft. Toluene was detected at concentrations that did not exceed the screening criteria (residential RBC). Under the silty clay present at 8-13 ft below ground surface lies zones of varying amounts of silts and sands, with some clays. VOCs, PAHs and other SVOCs, and metals were detected, but no exceedances of residential screening criteria used in the RFI were noted.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water is not present at this SWMU.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the site lies below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase II, Cannon Air Force Base, New Mexico. April 1993.

SWMU = Solid Waste Management Unit
VOCs = Volatile Organic Compounds
PAHs = Polycyclic Aromatic Hydrocarbons
SVOCs = Semivolatile Organic Compounds

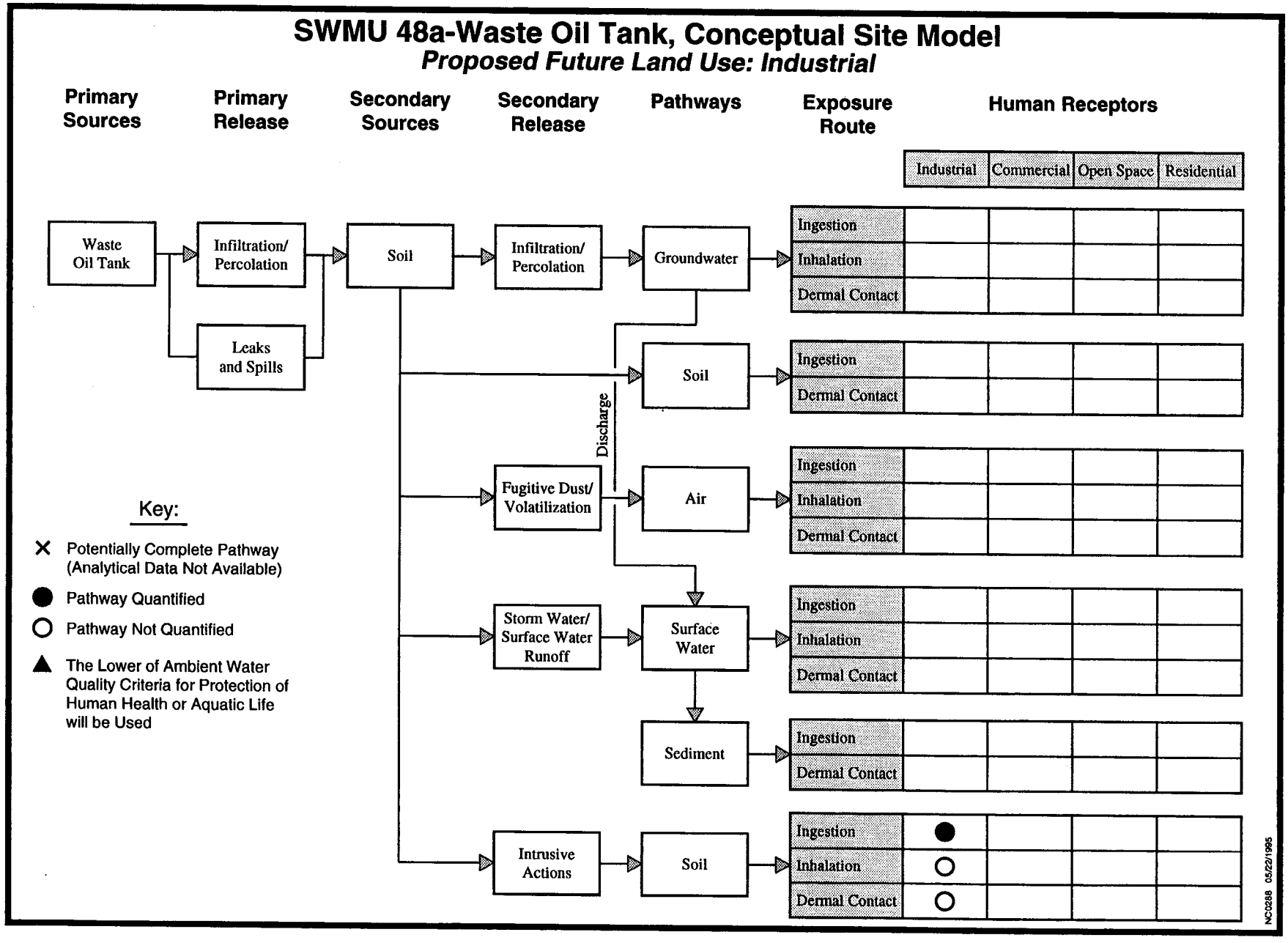

Figure 1-21. SWMU 48A-Waste Oil Tank Conceptual Site Model, Cannon AFB

Table 1-24

Cannon Air Force Base
SWMU 48b - Aboveground Overflow Capacity Tank

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: SWMU 48b was a 2,000 gallon aboveground storage tank located about 125 ft east of Argentia and Torch. The storage tank has been removed and the site covered with asphalt.	
Types of Waste: Potential contaminants include waste oils, spent solvents, paint thinners, and recovered fuels.	
Groundwater: Groundwater was not sampled at this SWMU. The soil contamination does not pose a risk to the groundwater.	Groundwater is not considered a potential route of exposure due to its depth and small chance of contamination from soils.
Soil: Under the silty clay present to 8-13 ft lies zones of varying amounts of silts and sands, with some clays. Toluene, bis(2-ethylhexyl)phthalate, fluoranthene, TRPH and metals were detected, but no exceedances of the screening criteria were noted.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water is not present at this SWMU.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the site lies below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Only soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase II, Cannon Air Force Base, New Mexico. April 1993.

SWMU = Solid Waste Management Unit
TRPH = Total Recoverable Petroleum Hydrocarbons

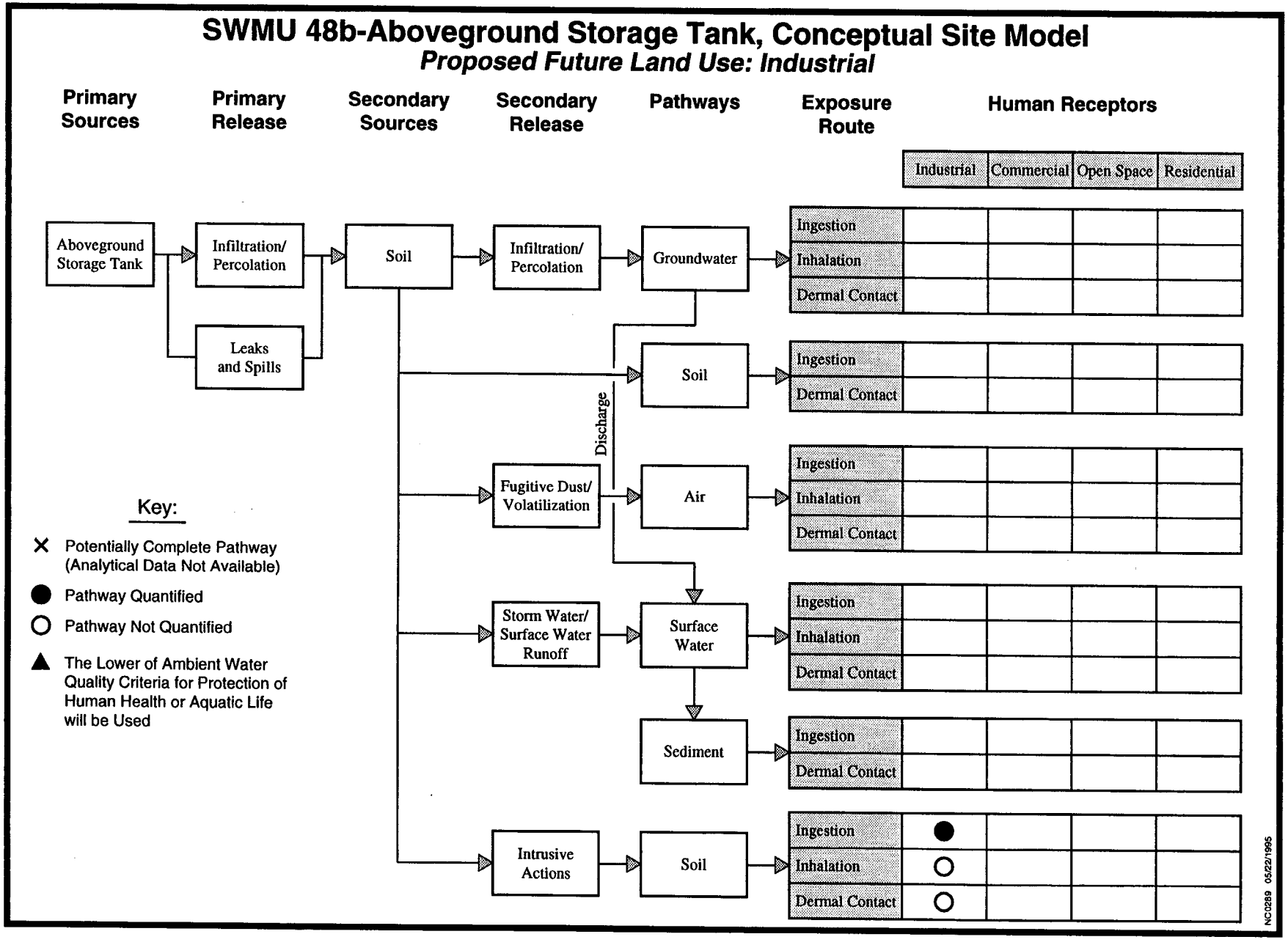

Figure 1-22. SWMU 48B-Aboveground Storage Tank Conceptual Site Model, Cannon AFB

Table 1-25

Cannon Air Force Base
SWMU 51 - Oil/Water Separator 375

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 375 is located within the motor pool compound adjacent to the northwest side of Building 375. The capacity of the O/WS is approximately, 1000 gallons and the unit extends to a depth of less than 5.5 ft below the surface of the pavement. The site is covered by asphalt.	
Types of Waste: O/WS 375 receives wash water from light vehicle maintenance operations in Building 375. Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents and metals.	
Groundwater: Depth to groundwater is greater than 200 ft and sampling has indicated contaminants are not being significantly transported vertically.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Soil sampling indicated that the highest concentrations of contaminants are in the near-surface soils. Concentrations decreased with depth and vertical extent of contamination has been characterized.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Drainage from the site flows northwest to a drainage channel that empties into a storm sewer. SWMU related contaminants are not expected to be carried in this drainage as the O/WS is below the surface.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat. An ecological risk assessment was initiated but no affected species were identified so the assessment was not carried through.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1A, February 1994.

Woodward-Clyde. Baseline Risk Assessment for Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume II, February 1994.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

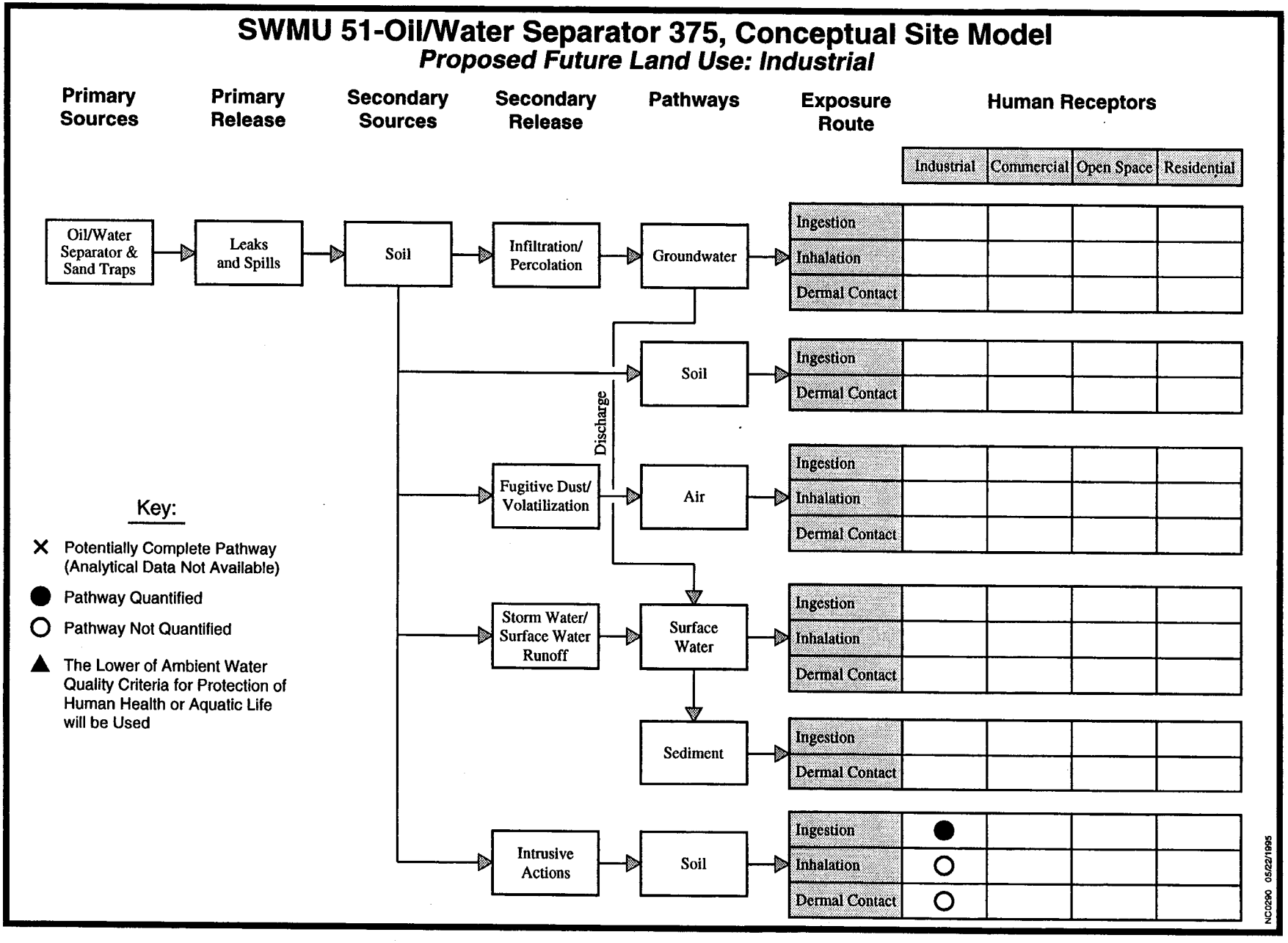

Figure 1-23. SWMU 51-Oil/Water Separator 375 Conceptual Site Model, Cannon AFB

Table 1-26

Cannon Air Force Base
SWMU 55 - Lead-Acid Battery Accumulation Point

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: Used lead-acid batteries are stored in an open 8-ft square asphalt area approximately 100 ft north of the Vehicle Maintenance Shop. The site is covered with asphalt.	
Types of Waste: Lead and sulfuric acid.	
Groundwater: Groundwater was not sampled.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: The soil under the SWMU is sandy clay/silt with occasional gravel. Some areas appeared to have been backfilled during construction activities. No visual contamination or odors were observed during sampling. A 3-4 inch asphalt cover was present at the surface.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: No surface water bodies are present on this site. Storm water runoff flows off site to the northwest over a parking lot and ultimately into a street drainage ditch.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial. This site is surrounded by asphalt parking areas and other industrial buildings.	
Ecological Factors: An ecological assessment has not been done at this site. It is unlikely that this SWMU would be a habitat for many species as it is asphalt and the surrounding areas also are largely asphalt and high trafficked areas.	
Data Availability: Phase I and Phase II soil boring data is available for both surface and subsurface soil. No groundwater sampling has occurred.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase II, Cannon Air Force Base, New Mexico, Pre-Draft, Volume 1A, April 1995.

SWMU = Solid Waste Management Unit

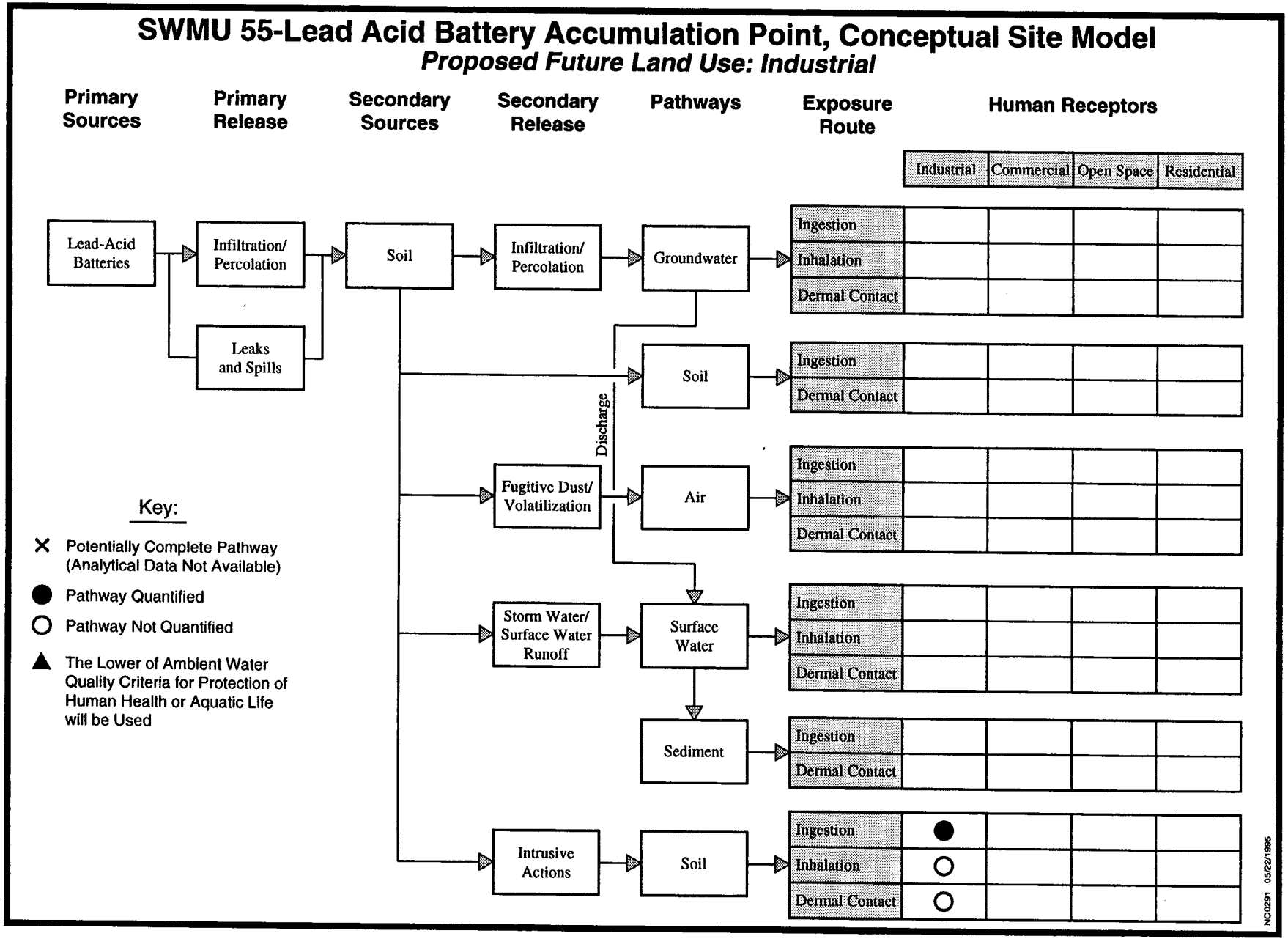

Figure 1-24. SWMU 55-Lead Acid Battery Accumulation Conceptual Site Model, Cannon AFB

Table 1-27

Cannon Air Force Base
SWMU 57 - Oil/Water Separator 379

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 379 is located within the motor pool compound adjacent to the southwest side of Building 379. The capacity of the O/WS is approximately 500 gallons. The dimensions of the unit are 5 ft by 6.5 ft and it extends to a depth of approximately 6 ft below the surface of the pavement. The site is covered by asphalt.	
Types of Waste: O/WS 375 receives wash water from heavy vehicle maintenance operations in Building 379. Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents and metals.	
Groundwater: Depth to groundwater is greater than 200 ft and sampling has indicated that there are no constituents in the soil at levels of concern.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: No contaminants were found to be above screening levels. No visual evidence of leaks or spills was observed.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Drainage from the site flows southwestward from Building 379 and eventually empties into a storm sewer. SWMU related contaminants are not expected to be carried in this drainage as the O/WS is below the surface.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual O/WS is below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1A, February 1994.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

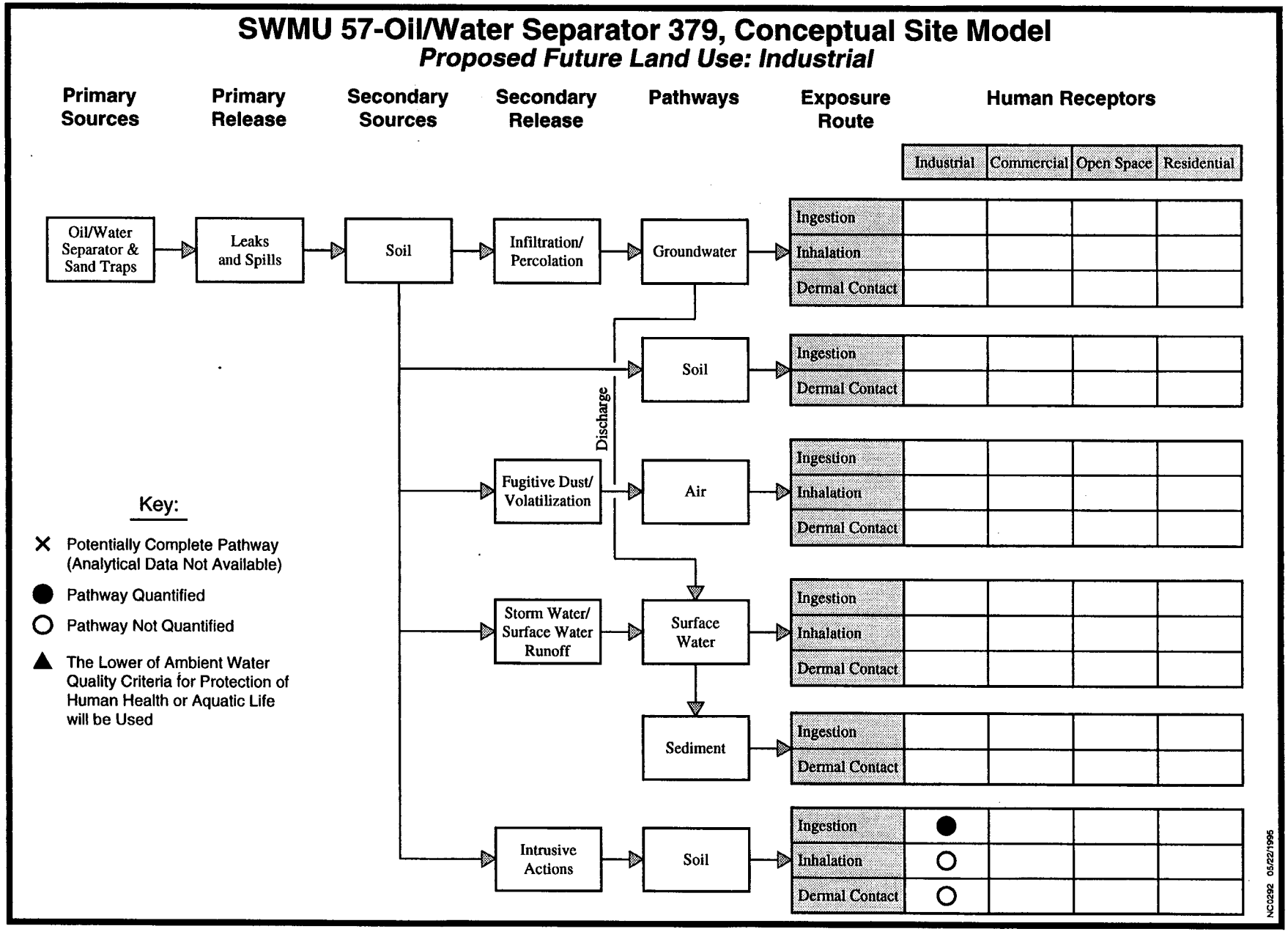

Figure 1-25. SWMU 57-Oil/Water Separator 379 Conceptual Site Model, Cannon AFB

Table 1-28

Cannon Air Force Base
SWMUs 61, 62, and 63 - Facility 5077

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: Facility 5077 is a washrack that includes two 380-gallon sand traps (SWMUs 61 and 62) and an O/WS (SWMU 63) southeast of the concrete pad. Although designated to be an O/WS, SWMU 63 has been found to be a concrete box with no baffles. It appears to be a sand trap also. This facility is rarely used and may be completely out of service.	
Types of Waste: These units received wash water from motor vehicles washed down in the washrack. Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents and metals.	
Groundwater: Sampling has indicated that depth to groundwater is approximately 200 ft.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Organic constituents were not detected at levels above the screening levels of the Base Line Risk Assessment (Woodward-Clyde 1994) at SWMUs 62 and 63. Inorganic constituents were not detected at levels outside the background ranges for any of the SWMUs.	Organics were detected at levels above the screening levels, but a Baseline Risk Assessment (Woodward-Clyde, 1994) has indicated that these contaminants do not pose a risk to human health or the environment. Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Drainage from the washrack flows into the sand traps and O/WS. The area around the O/WS is flat with no discernible gradient.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial/Open space. An area classified as recreational open space exists west of the SWMU a short distance away.	
Ecological Factors: Approximately 70% of the area in the immediate vicinity of the facility is asphalt. An ecological assessment evaluated risk to birds that use the grassy area around SWMU 63. The assessment concluded that no unacceptable risk to wildlife is expected.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1B, February 1994.

Woodward-Clyde. Baseline Risk Assessment for Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume II, February 1994.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

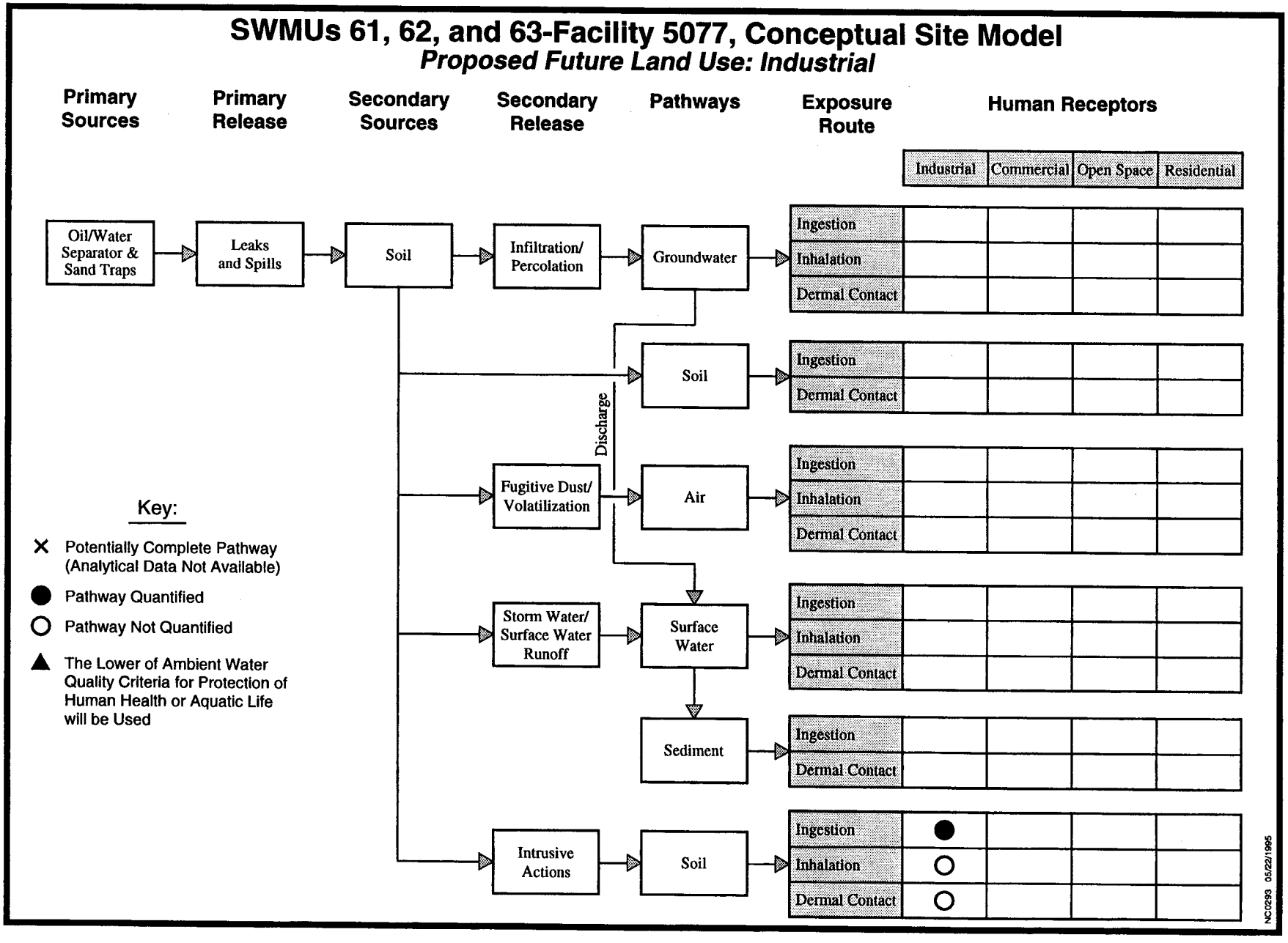

Figure 1-26. SWMU's 61, 62, and 63-Facility 5077 Conceptual Site Model, Cannon AFB

Table 1-29

Cannon Air Force Base
SWMU 70 - Oil/Water Separator 326 and Leach Field

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: The O/WS is located in the northwest corner of the POL maintenance facility. The dimensions of the O/WS are approximately 1.5 ft by 2 ft and it extends about 6 ft below the surface. It is connected to an oil storage tank approximately 7 ft below the surface and a leach well 7 ft north of the O/WS. An area of stressed vegetation was identified northwest of the SWMU. Overflow of the O/WS draining to this area may be the cause. The unit has been inactive since 1993.	
Types of Waste: O/WS 326 received wash water from JP-4 fuel truck maintenance operations in Building 326. Potential contaminants include JP-4, petroleum and synthetic lubricating oils, fuels, greases, solvents and metals.	
Groundwater: No groundwater samples have been taken and the vertical extent of soil contamination is unknown. Migration of contaminated groundwater off-site is possible if soil contamination has leached to groundwater.	Ingestion of groundwater is a potential exposure pathway due to the possibility of migration of contaminated water.
Soil: Soil sampling indicated the presence of contamination at this SWMU. The extent of contamination has not been adequately defined and additional field work along with a corrective measures study was recommended for this SWMU.	Because the unit is no longer in service, the source of contamination has been removed. There is concern regarding the leaching of soil contamination to groundwater.
Surface Water: Drainage from this site appears to flow to the north though the gradient is slight. There are no surface water bodies on this SWMU but it is possible that overflow from the separator may have drained offsite as runoff.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	

Table 1-29

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: No evaluation of ecological impacts has been conducted at this SWMU. The area is in a highly trafficked industrial use area so it is unlikely that the habitat is attractive to wildlife. Further investigation has been recommended regarding ecological risk.	
Data Availability: Soil data are available for this site. Additional sampling is required to establish extent of contamination in soil as well as to determine the presence or absence of contamination in groundwater.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1B, February 1994.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator
POL = Petroleum Oils and Lubricants

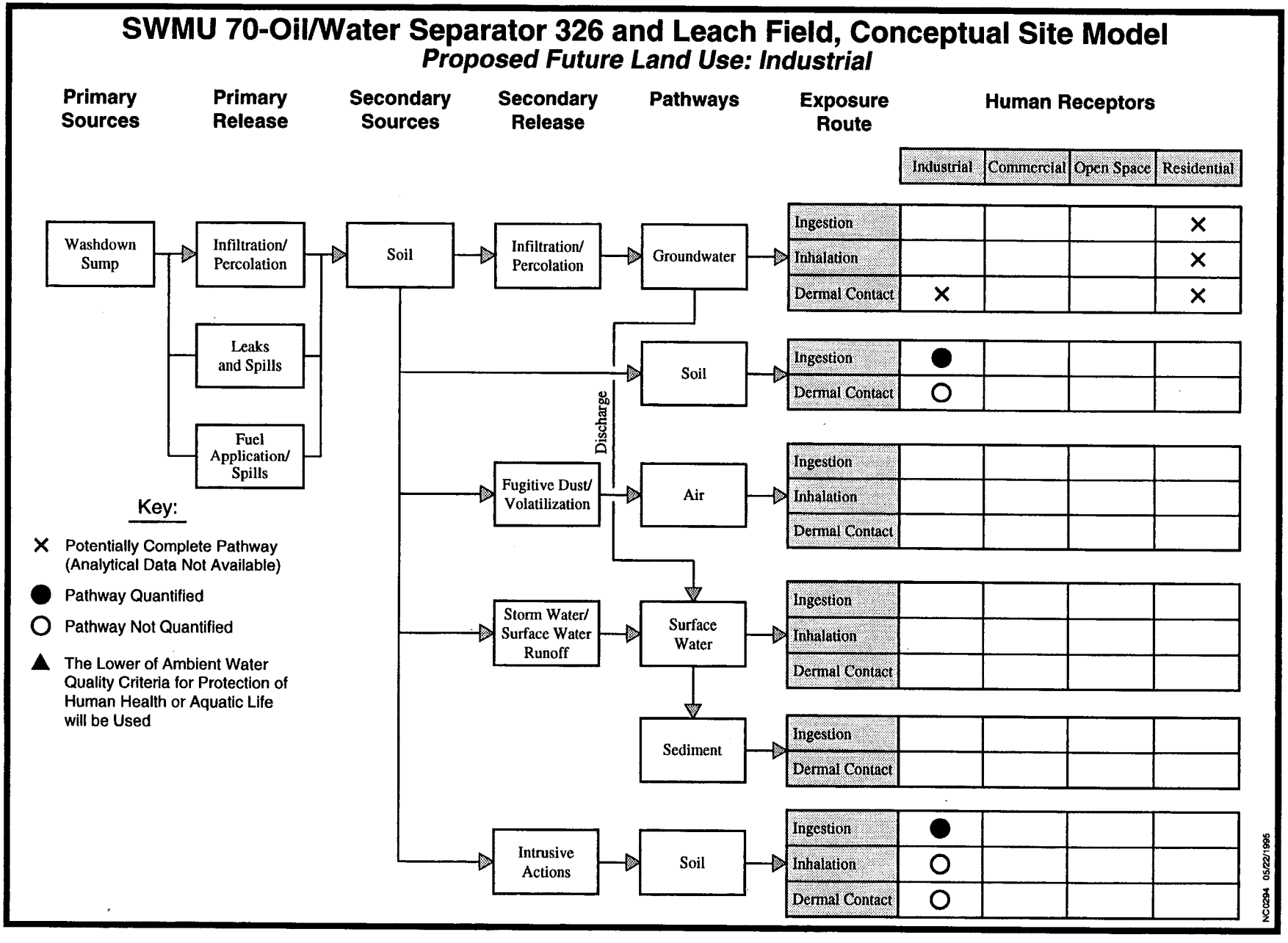

Figure 1-27. SWMU 70-Oil/Water Separator 326 Conceptual Site Model, Cannon AFB

Table 1-30

Cannon Air Force Base
SWMU 77 - Civil Engineering Container Storage Area, Facility No. 4038

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: The Container Storage Area is an open concrete pad approximately 150 ft by 250 ft. It is located east of Bldg 252 and south of the north boundary fence of the base. The area is secured by an 8 ft fence and a locked gate. The pad is the remaining foundation of the Portair Airfield Hangar from the 1930s. Grass surrounds the pad. The site is also known as Facility 4038.	
Types of Waste: Waste oil, solvents, aviation fuel, waste paint, PCBs and pesticides. Previous visual inspections have shown the presence of 55-gallon drums containing water, oil, solvents, and asphaltic material.	
Groundwater: Fate and transport modeling done in the Phase I RFI indicated that contaminants in soil at SWMU 77 would not be transported to groundwater at concentrations of concern. The Phase II chemicals of concern were detected almost entirely in the top 5 ft of soil and at low concentrations making it unlikely that groundwater would be impacted. No groundwater sampling has been done at this site.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: The soil under the SWMU is sandy clay/silt with occasional caliche. No visual contamination or odors were observed during sampling. Drilling and sampling activities for the Phase II investigation were designed to assess the lateral extent of soil contamination to the 20-ft depth.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with concrete.
Surface Water: There are no surface water bodies or drainage channels present on the site. Precipitation runs off the pad on all sides. Native surfaces in the area have no discernable slope.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Open space. This site is surrounded by a small grassy perimeter on all sides with a driveway leading into the south side. The base boundary fence is approximately 50 ft north of the storage area perimeter fence.	It is expected that the land use for the offsite area immediately adjacent to the base boundary would also be open space because of the presence of railroad tracks. This land is not expected to be used for recreational activities and would be categorized as restricted access due its close proximity to the runway and railroad tracks.

Table 1-30

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: An ecological assessment has been performed at this site. The results of this assessment showed no unacceptable risks due to chemical releases at this SWMU	
Data Availability: Phase I and Phase II soil boring data are available for both surface and subsurface soil. No groundwater sampling has occurred.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase II, Cannon Air Force Base, New Mexico, Pre-Draft, Volume 1A, April 1995.

SWMU = Solid Waste Management Unit
RFI = RCRA Facility Investigation

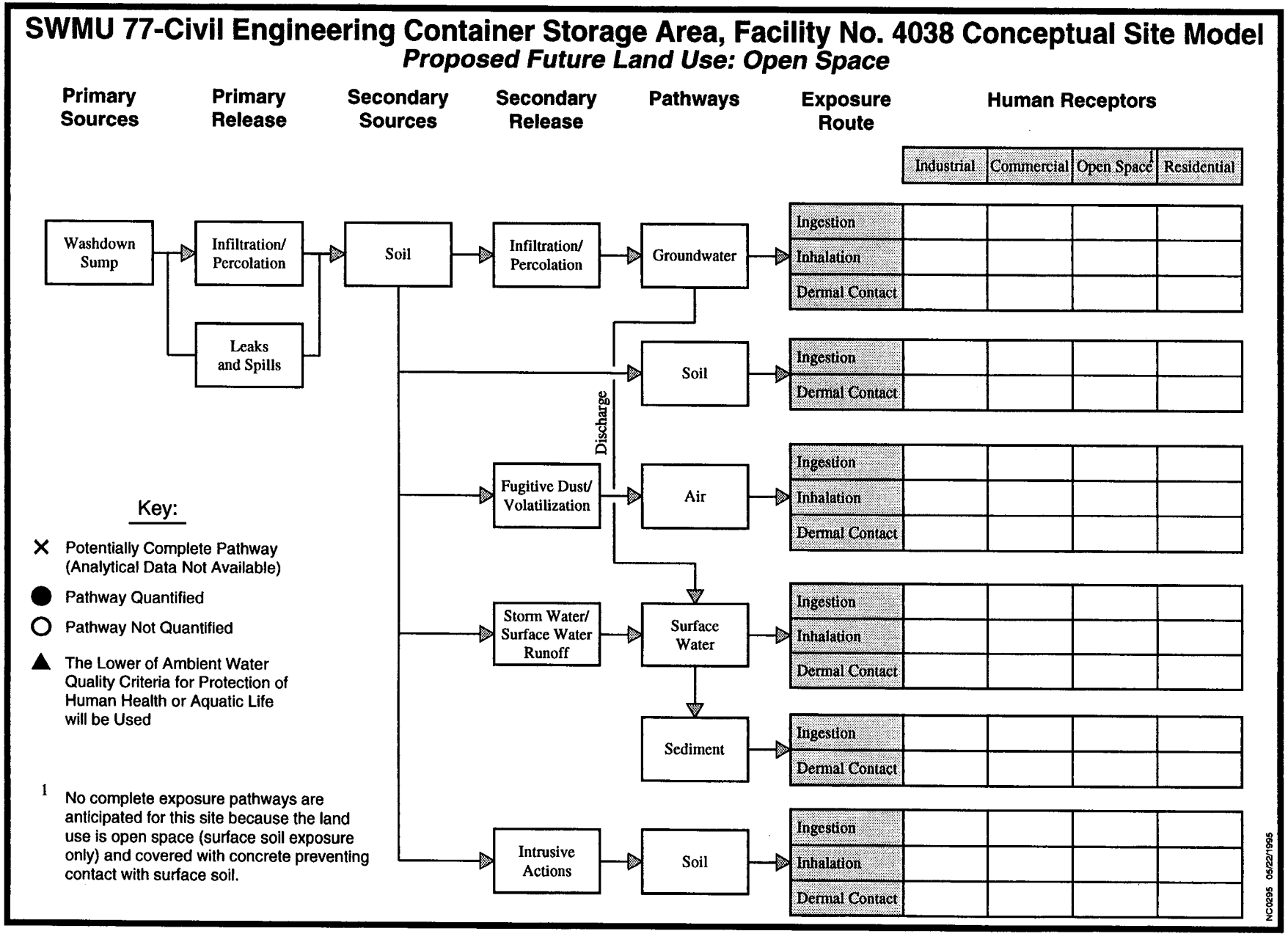

Figure 1-28. SWMU 77-Civil Engineering Container Storage Area Conceptual Site Model, Cannon AFB

Table 1-31

Cannon Air Force Base
SWMU 83 (ST-27) - Sump for Flight Apron Washdown

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: This SWMU was a sump located about 90 ft northwest of Building 120. The sump was constructed in a concrete slab and was removed in 1993. The site is partially covered with asphalt.	
Types of Waste: Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals. The separator also received rain and wash water.	
Groundwater: Groundwater was not sampled at this SWMU.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Below the asphalt pavement lies a silty clay fill material to about 4.2 ft. Toluene, 2-butanone, and phenol were detected, but did not exceed the screening criteria used in the RFI. Below the fill layer, a silty clay alluvium was found to depth of 18 ft. A light brown, hard silt was encountered below the silty clay. PAHs and TRPH were detected in the near surface soils; only benzo(a)pyrene was found to exceed the residential screening criteria used in the RFI.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered potential exposure pathways unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water is not present at this SWMU.	
Sediment: Sediment data are not applicable at this site.	
Surrounding Land Use: Industrial	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, in addition to the fact that the actual site lies below asphalt, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase II, Cannon Air Force Base, New Mexico. April 1993.

SWMU = Solid Waste Management Unit
PAHs = Polycyclic Aromatic Hydrocarbons
TRPH = Total Recoverable Petroleum Hydrocarbon

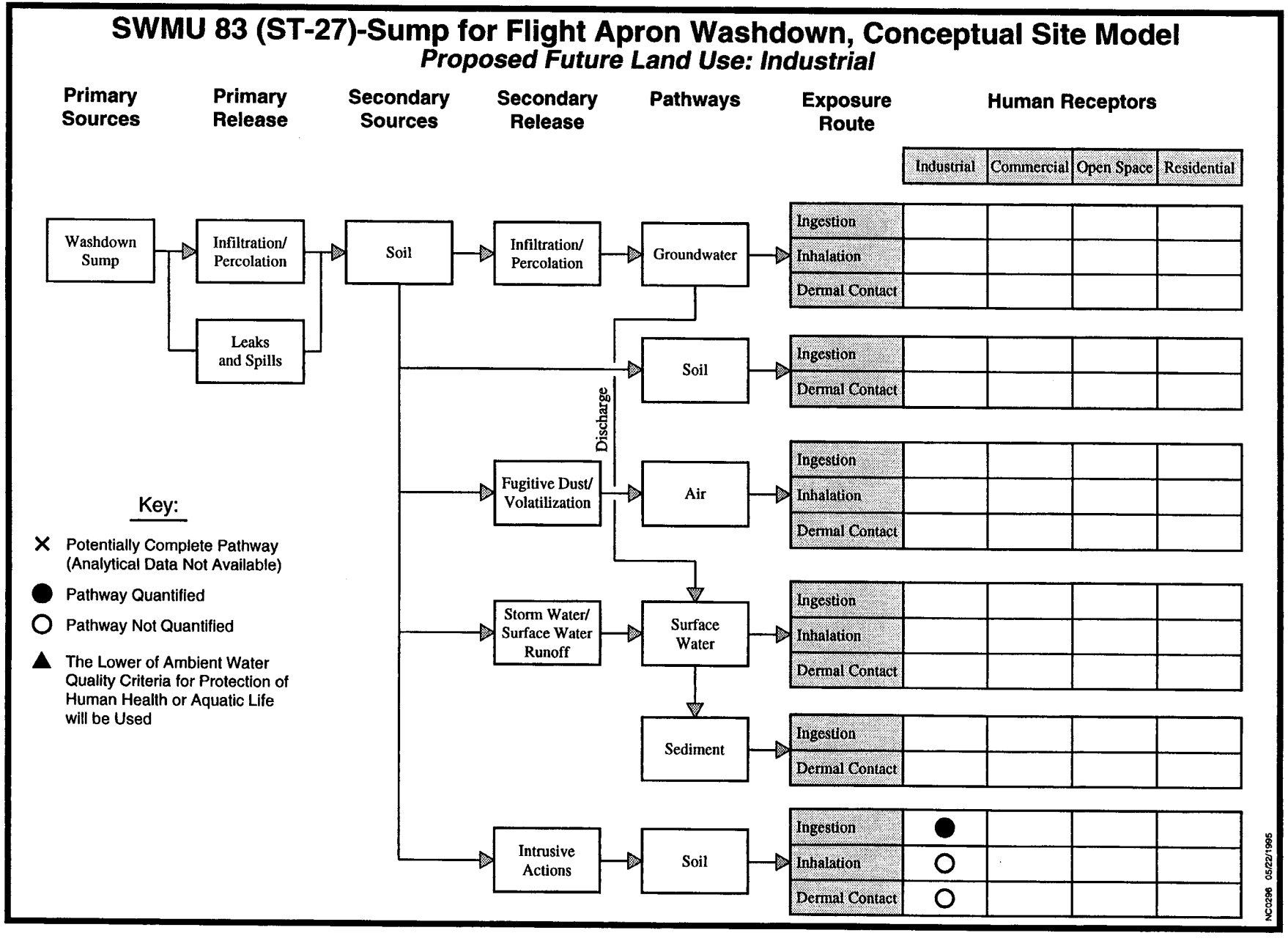

Figure 1-29. SWMU 83 (ST-27)-Sump for Flight Apron Washdown Conceptual Site Model, Cannon AFB

Table 1-32

Cannon Air Force Base
SWMUs 86-90 (SD-11) Engine Test Cell Area

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: The test cell (SWMU 86) was an enclosed tank and rested on a concrete slab near a taxiway in the southeastern area of the base. Aircraft engines were cleaned with steam and operated to perform various tests at this site. SWMU 86 initially discharged to an overflow pit (SWMU 87). An oil/water separator (SWMU 90) was added; this discharged to a leach field (SWMU 88). The effluent from SWMU 90 was likely discharged to an evaporation pond (SWMU 89); SWMU 89 was constructed in the area of the former leach field. The unit was active from 1965 to 1988.	
Types of Waste: Solvents and fuels from aircraft engine testing. The possible contaminants are the same for all units.	
Groundwater: Groundwater was not investigated at this site.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: The surface soil underlying the Engine Test Cell Area consist of sandy loam and loamy sand of the Amarillo soil group to only a few feet. The near surface soils (upper 30 ft) at this site consist of well sorted sands of the Ogallala formation and thin layers of caliche. Acetone, toluene, TPH, Sn, Ba, Cd, Cr, Co, Cu, Pb, Mn, Ni, and Zn were detected at elevated concentrations.	Inhalation of fugitive dusts is not considered a potential exposure pathway unless construction activities occur because the site is covered with asphalt.
Surface Water: Surface water may collect from time to time in the evaporation pond, but is not permanent.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: This site is disturbed and industrial and has little potential for impacts to ecological receptors.	
Data Availability: Soil data are available for this site.	

Source: Remedial Investigation Report for 18 Solid Waste Management Units, Woodward-Clyde and Consultants, 1992.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator TPH = Total Petroleum Hydrocarbons

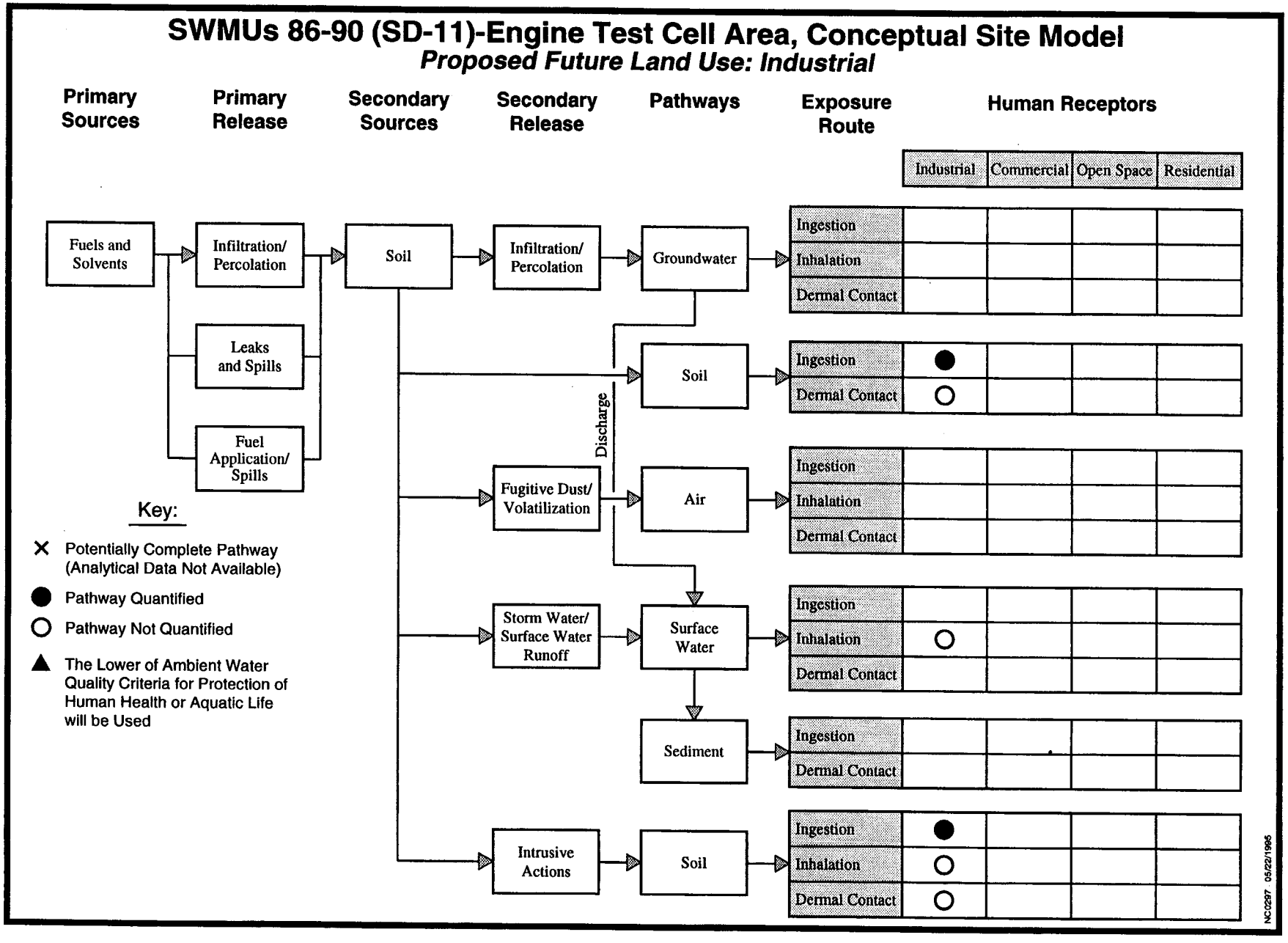

Figure 1-30. SWMU's 86-90 (SD-11)-Test Cell Area Conceptual Site Model, Cannon AFB

Table 1-33

Cannon Air Force Base
SWMU 92 - Oil/Water Separator 5120

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 5120 and the associated leach well are located in a grassy area east of Power Check Pad No. 5120. The dimensions of the O/WS are approximately 4 ft by 6 ft. The depth is believed to be less than 10 ft below ground surface. The O/WS and the leach well remain in place though the unit has been inactive since 1988.	
Types of Waste: O/WS 5120 received wash water from aircraft maintenance operations in Building 5120. Potential contaminants include JP-4 fuel, petroleum and synthetic lubricating oils, fuels, greases, solvents and metals.	
Groundwater: Fate and transport modeling for SWMU 92 indicated that contamination from soil would not migrate to groundwater in sufficient quantities to pose risk.	Based on these modeled concentrations, the groundwater pathway has been determined to be insignificant.
Soil: A Baseline Risk Assessment (Woodward-Clyde, 1994) for this SWMU indicated that no significant risks are expected from contamination related to this SWMU. The SWMU was not carried forward to Phase II.	
Surface Water: There are no surface water bodies on or associated with this SWMU. There is no discernable gradient and evidence of grading and reseeding are visible on the surface.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial. This SWMU is located in an industrial area in close proximity to the flight line	
Ecological Factors: An ecological assessment at this site indicated that no unacceptable ecological risks due to chemical releases are expected at this site.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1A, February 1994.

Woodward-Clyde. Baseline Risk Assessment for Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume II, February 1994.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

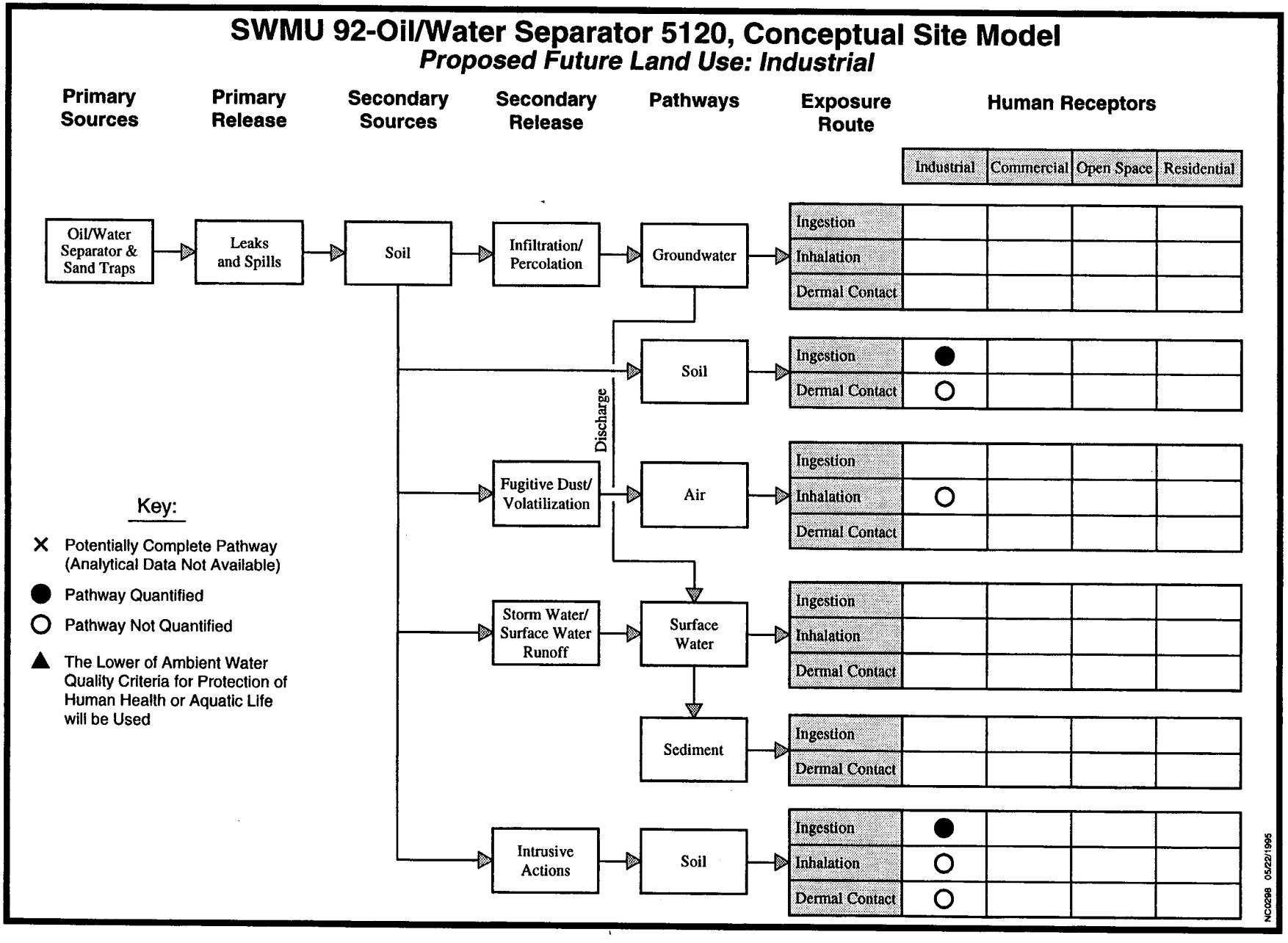

Figure 1-31. SWMU 92-Oil/Water Separator 5120 Conceptual Site Model, Cannon AFB

Table 1-34
Cannon Air Force Base
SWMU 93-Oil/Water Separator No.5121

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: O/WS 5121 was formerly located under the hush house portion of Building 5123, a jet engine testing facility. The O/WS and the leach well it discharged to were both removed in 1988 in conjunction with the demolition of the building. A new building was constructed and covers the site.	
Types of Waste: JP-4, petroleum and synthetic lubricating oils, greases, solvents and metals.	
Groundwater: Fate and transport modeling for the Phase 1 investigation showed migration of contaminants to groundwater (200-300 ft below ground surface) to be an insignificant pathway. In addition, only low levels of contamination were found in the subsurface soils.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Silty clay fill material predominates from the surface to approximately 4 ft below the site with traces of caliche and fine sand. Silty sand was found below the fill material. No visual signs of contamination were encountered.	Building 5123 now covers this site greatly reducing the possibility of exposure to contaminated soil. Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered a significant exposure pathway unless construction activity occurs.
Surface Water: Storm water runoff is considered to be an insignificant pathway due to the fact that the O/WS is primarily below ground and surface spills would be minimal.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: An ecological risk assessment conducted in conjunction with the Phase I investigation showed a low potential for risk to predatory birds. It is unlikely that this risk is significant because of the relatively small size of the SWMU in comparison to the hunting range of the birds.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase II, Cannon Air Force Base, New Mexico, Pre-Draft, Volume 1A, April 1995.

SWMU = Solid Waste Management Unit O/WS = Oil/Water Separator

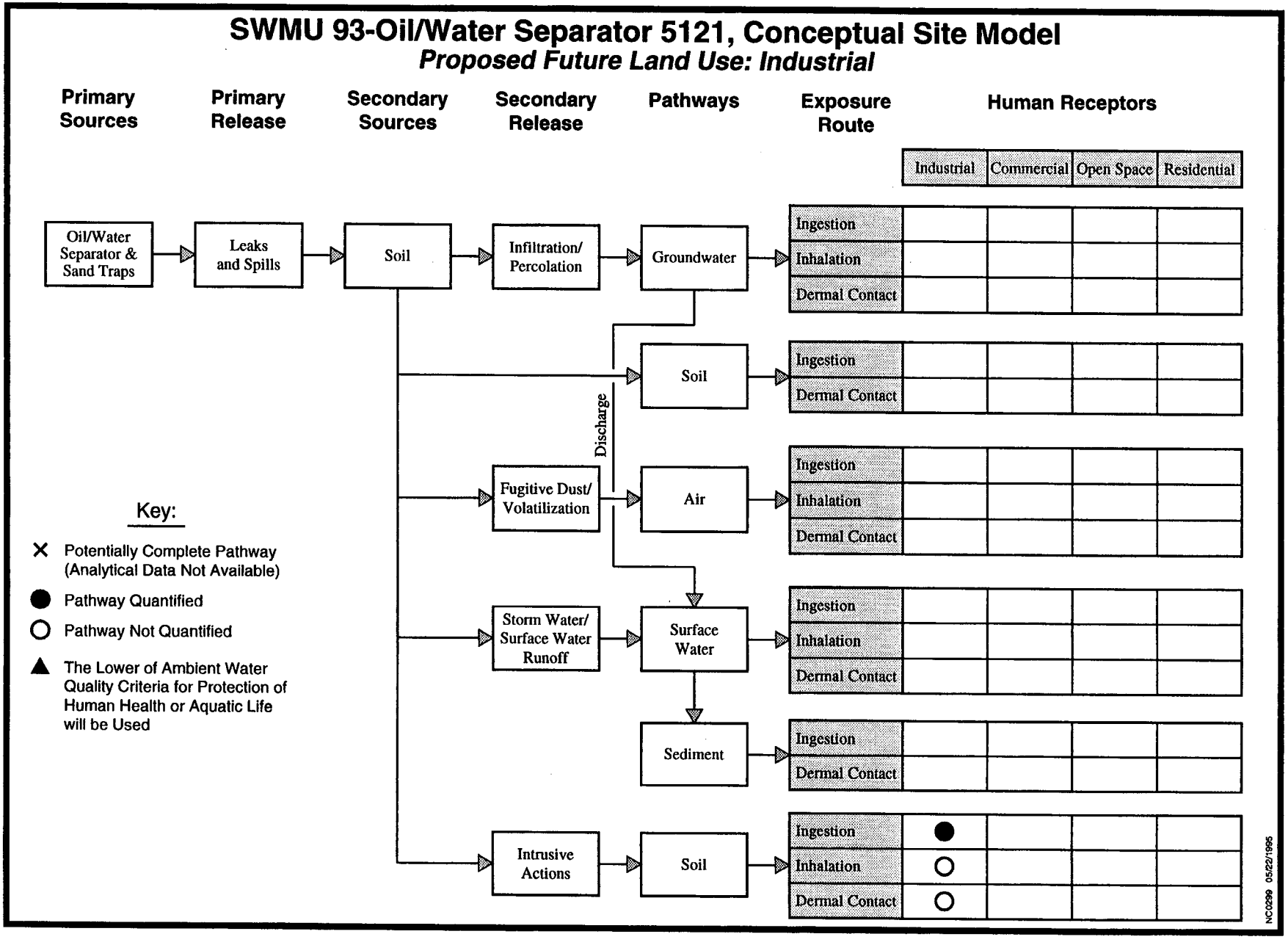

Figure 1-32. SWMU 93-Oil/Water Separator 5121 Conceptual Site Model, Cannon AFB

Table 1-35

Cannon Air Force Base
SWMU 94-Oil/Water Separator 5144

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: Facility 5144 is a two-bay vehicle washrack used for personal vehicle washing operations. The SWMU consists of two sand traps within the confines of the washrack and an additional sand trap located in a grassy area northwest of the washrack. This sand trap was mistakenly identified as an O/WS, but continues to be referred to as O/WS 5144. The units are believed to be less than 10 ft below ground surface. Facility 5144 has been dismantled and has not been used since 1988. The wash bays and sand traps remain intact. Their present contents are unknown.	
Types of Waste: The sand traps received wash water from personal vehicle washing operations. Potential contaminants include lubricating oils, fuels, greases, solvents and metals.	
Groundwater: Fate and transport modeling for SWMU 94 indicated that contamination from soil would not migrate to groundwater in sufficient quantities to pose risk.	Based on modeled concentrations, the groundwater pathway has been determined to be insignificant.
Soil: Soil sampling indicated the presence of contaminants at levels above screening criteria. A Baseline Risk Assessment (Woodward-Clyde, 1994) for this SWMU indicated that no significant risks are expected from contamination related to this SWMU.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered a potential exposure pathway unless construction activities occur because the site is paved and covered with grass.
Surface Water: There are no surface water bodies on or associated with this SWMU. The uncovered washrack drains into the sand trap. Runoff from the grassy area containing the additional sand trap grades to the east toward a northwest trending surface ditch.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial. This SWMU is located in an industrial area in close proximity to the flight line.	

Table 1-35

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: An ecological assessment at this site indicated that no unacceptable ecological risks due to chemical releases are expected at this site.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume 1A, February 1994.

Woodward-Clyde. Baseline Risk Assessment for Appendix III SWMUs-Phase I, Cannon Air Force Base, New Mexico, Volume II, February 1994.

SWMU = Solid Waste Management Unit
O/WS = Oil/Water Separator

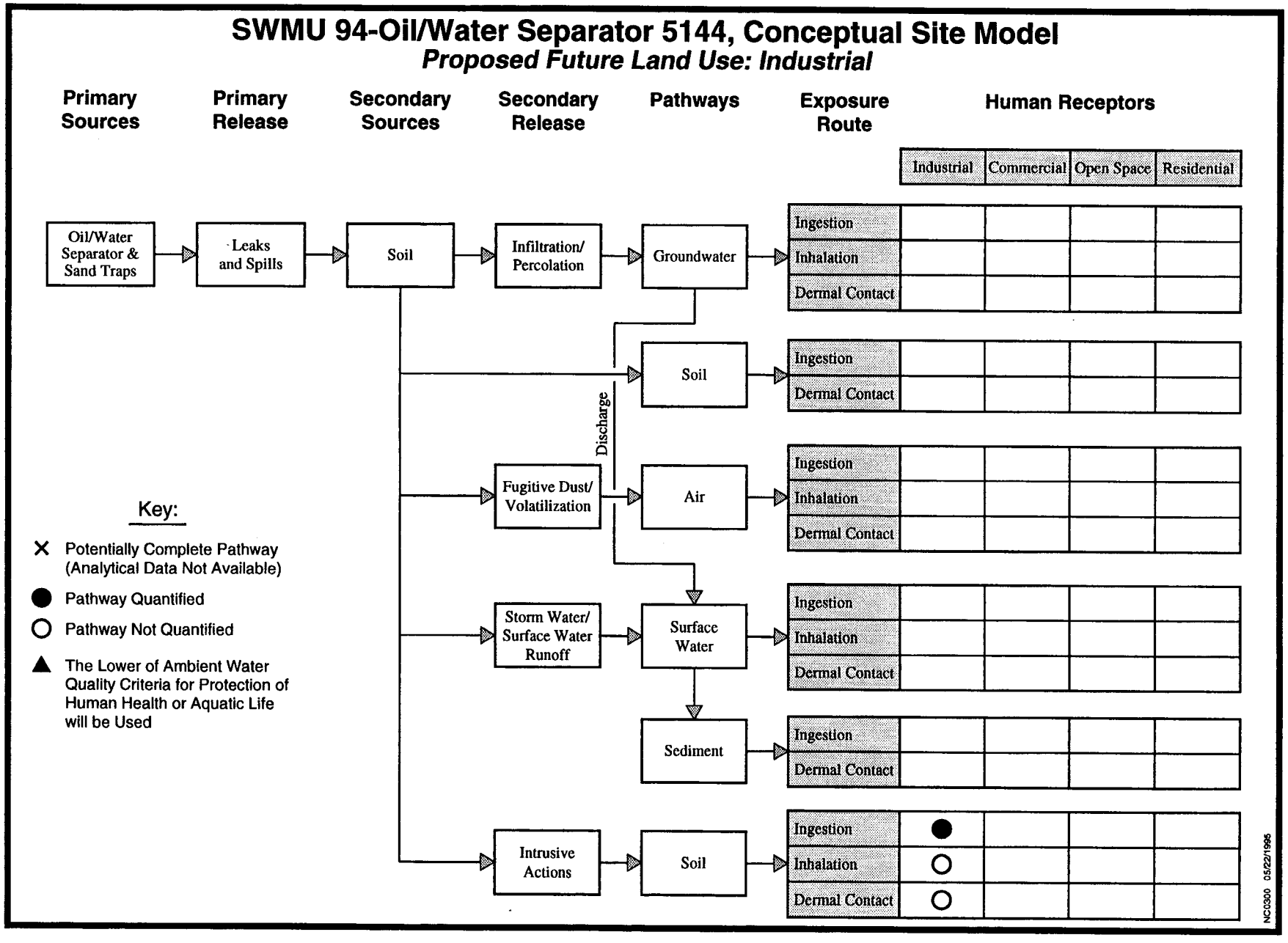

Figure 1-33. SWMU 94-Oil/Water Separator 5144 Conceptual Site Model, Cannon AFB

Table 1-36

Cannon Air Force Base
SWMU 95 (SD-20) - NE Stormwater Drainage Area

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial and Open Space (Restricted access)	
Site: This area is a natural depression which receives water from several O/WS, runoff water from runways and storm water drains in the east-central portion of the base. The ditch is approximately 40 ft wide and extends under a road to a field. The northeast end of the ditch is marked by a concrete culvert and is surrounded by heavy vegetation.	
Types of Waste: Oil and grease, fuels, solvents, and aircraft cleaning compounds have been identified in the O/WS effluent.	
Groundwater: The Ogallala Aquifer is approximately 265 ft below ground surface. Groundwater was not investigated at this site.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: Two distinct sand units (Ogallala fluvial deposits) are present beneath this site. The upper unit consists of very fine grained pale brown sands. The lower unit is composed of fine grained light to medium orange sands. Long chain organics common to JP-4 were found at low concentrations.	
Surface Water: Stormwater and surface runoff from the central part of the flight services area collects in the ditch at this site.	
Sediment: The sediment layer at this site is approximately 5 ft thick, but is not described. Ba, Cd, Cu, Fe, Pb, Hg, Ni, and Zn were detected above background levels.	
Surrounding Land Use: Open space	
Ecological Factors: This area becomes flooded for a portion of the year and may serve as habitat for migratory birds.	
Data Availability: Soil data are available for this site.	

Source: Remedial Investigation Report for 18 Solid Waste Management Units, Woodward-Clyde and Consultants, 1992.

O/WS = Oil/Water Separator

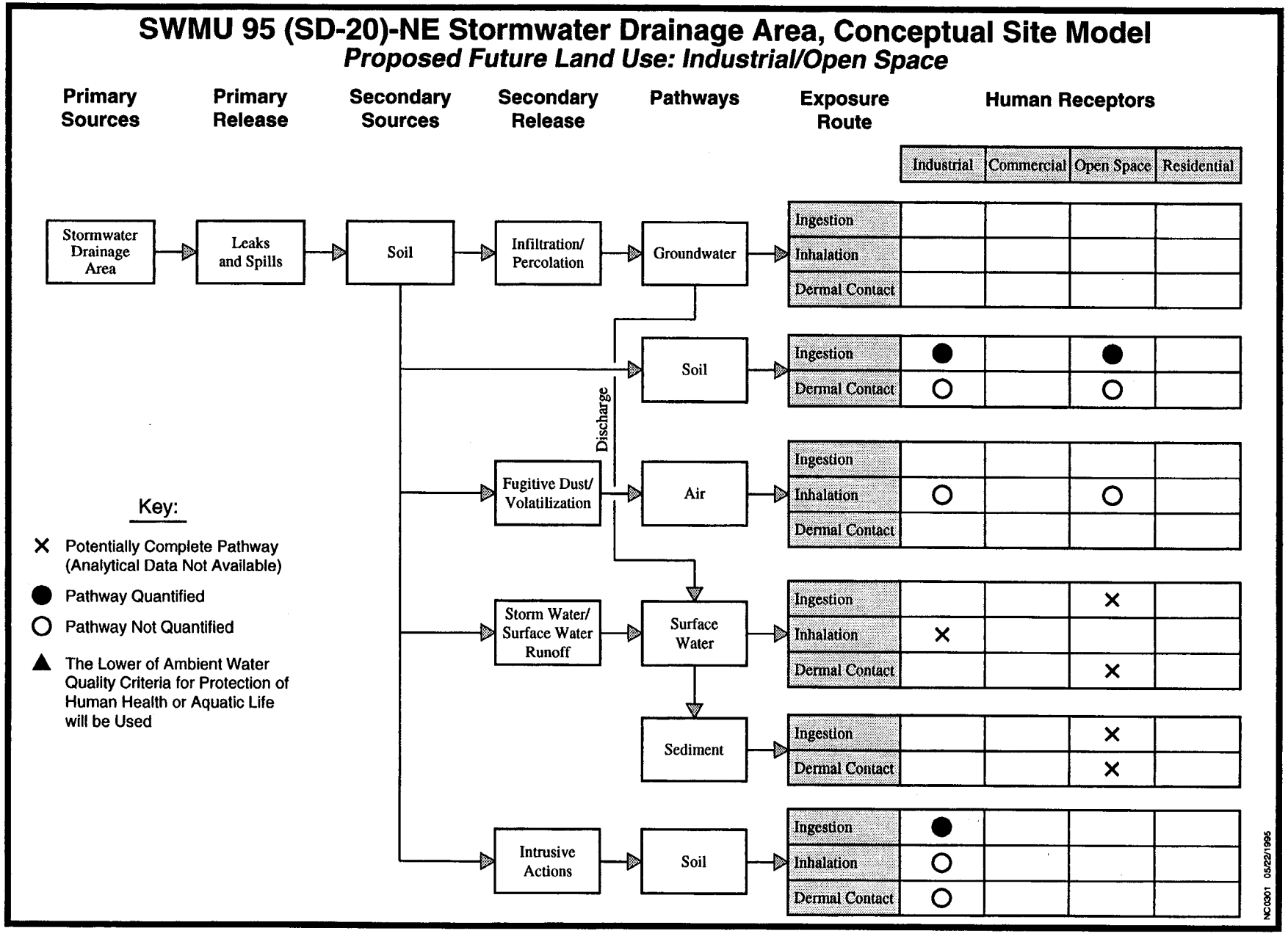

Figure 1-34. SWMU 95 (SD-20)-NE Stormwater Drainage Area Conceptual Site Model, Cannon AFB

Table 1-37
Cannon Air Force Base
SWMU 197 (LF-25) - Concrete Rubble Pile

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: SWMU 197 is a landfill occupying approximately 29 acres within the Base boundary in the east-central portion of the base. It is unknown when disposal was stopped at this area. Surface rubble covers the SWMU.	
Types of Waste: Temporary building and runways were demolished and disposed of following World War II. Rubble includes concrete, wood, metal, asbestos tile and pipe, and asphalt mixed with soil. Potential contaminants include VOCs, SVOCs, pesticides, herbicides, TPH, and metals.	
Groundwater: Depth to groundwater at Cannon AFB is approximately 250 ft or greater. Groundwater samples were taken from a monitoring well downgradient from the landfill. Carbon disulfide was detected at levels that exceeded the residential screening criteria used in the RFI.	No groundwater sampling was conducted for this investigation. However, monitoring wells have been installed in the area around this SWMU. Sampling results from these wells will be evaluated if such data becomes available.
Soil: No information is available on the lithology of the site. Trenches have been excavated in the landfill but the geological profile is not available.	
Surface Water: Surface water from the site enters the base storm water drainage system and flows to the Storm Water Collection Point (SWMU 85). SWMU 85 is an ephemeral lake basin located in the southwest corner of the base.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial and open space.	The eastern Base boundary is approximately 600 ft to the east of the lake. Dairy cattle were seen grazing during the site visit immediately adjacent to the Base boundary fence and agricultural crops are irrigated with the water from the Playa Lake.
Ecological Factors: The landfill is wooded and relatively undisturbed. It is likely a habitat for many different types of wildlife.	
Data Availability: Groundwater and soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase II, Cannon Air Force Base, New Mexico. Pre-Draft, Volume 1, April 1995.

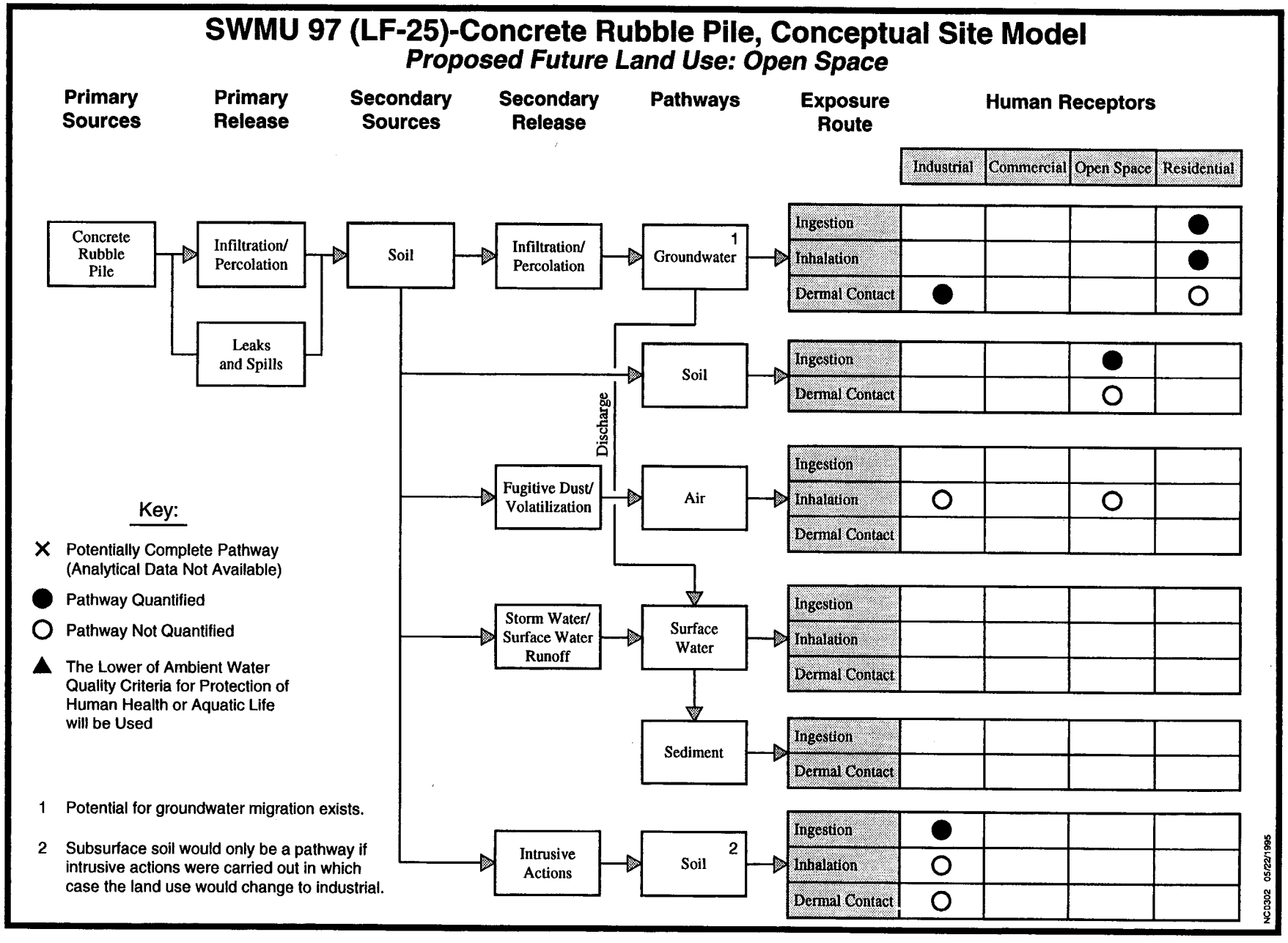

Figure 1-35. SWMU 97 (LF-25)-Concrete Rubble Pile Conceptual Site Model, Cannon AFB

Table 1-38

Cannon Air Force Base
SWMUs 101 and 102 (SD-21) - Wastewater Treatment System-Lagoons

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: This site consists of two unlined surface impoundments which have been in use since 1966. The lagoons operate in series and have a total surface area of 32 acres. They are constructed with unlined earth bottoms and have concrete lined banks.	
Types of Waste: Combined sanitary and industrial wastewater is treated in the lagoons.	
Groundwater: Saturated zones were detected at approximately 275 ft below ground surface. Groundwater flow direction is to the southeast. Samples taken from four wells at the SWMU showed groundwater had not been impacted by the SWMU.	
Soil: Soils below the sludge/sediment layer were not sampled.	
Surface Water: This is a surface water body, with an average depth of 3.5 ft. The maximum depth is 4.5 ft. The two dikes are separated by a 12.5 ft levee and discharge to the playa lake, SWMU 103. Cu, CN, Pb, Hg, Ag, Zn, and sulfides were detected.	
Sediment: Sludge samples were collected from approximately 3-4 ft. This sediment consists of greenish black silt and clay sized particles which have settled out of suspension from the wastewater. Low levels of PCBs, pesticides, and phthalates were detected.	
Surrounding Land Use: Industrial. This site is just south of the ordinance area.	
Ecological Factors: This site discharges to the playa (SWMU 103) lake. Both areas may provide habitat for dabbler ducks, which possibly feed on aquatic organisms. Potential risks exist for the ducks and other biota.	
Data Availability: Sediment, surface water, and groundwater data are available for these sites.	

Source: Remedial Investigation Report for 18 Solid Waste Management Units, Woodward-Clyde and Consultants, 1992.

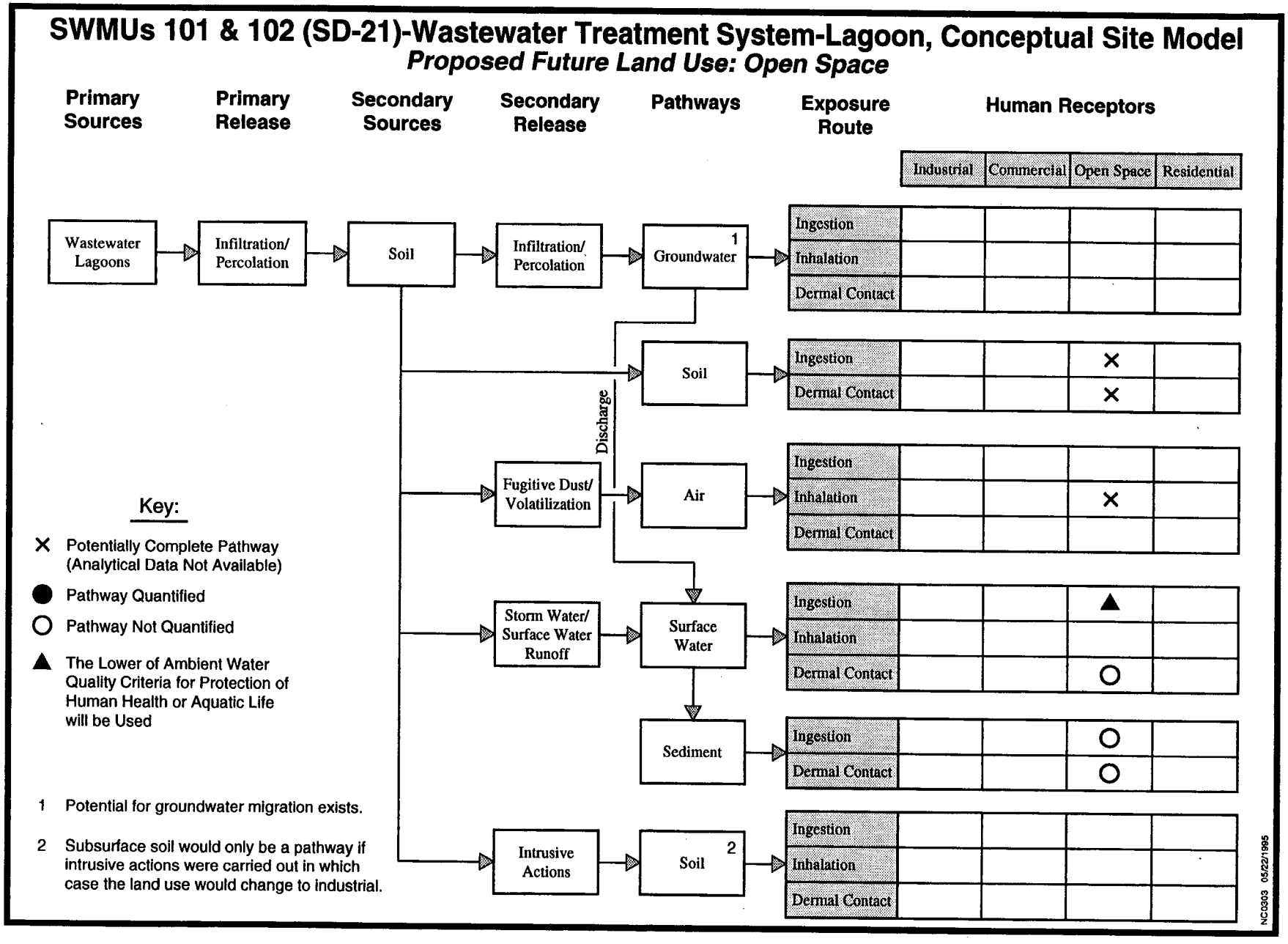

Figure 1-36. SWMU's 101 and 102 (SD-21)-Wastewater Treatment System Conceptual Site Model, Cannon AFB

Table 1-39

Cannon Air Force Base
SWMU 103 - Wastewater Playa Lake

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: The Playa Lake is a shallow surface water body occupying approximately 13 acres near the eastern boundary of the Base. The water level is maintained at about two-thirds capacity by influent from the wastewater treatment lagoons and discharge for irrigation purposes to a local farmer.	
Types of Waste: Industrial and sanitary wastewater effluent specifically VOCs, SVOCs, PCBs, pesticides, and metals.	
Groundwater: Groundwater was not addressed in the Phase I investigation. Phase II soil borings were designed to evaluate the potential for soil contaminants to leach to groundwater. These borings were not able to be completed to the planned depth of 60 ft. Based on 5-ft deep soil samples, the RFI states that impacts to groundwater are unlikely. However, monitoring wells have been installed in the area around this SWMU. Sampling results from these wells will be evaluated if such data becomes available.	It is unlikely that groundwater is a complete exposure pathway due to its depth and small chance of contamination from soils.
Soil: The subsurface soil under and around the lake consists mainly of fine-grained fill material and Ogallala Formation sediments. No visual contamination or odors were observed during sampling.	
Surface Water: Surface water samples were taken in the Phase I investigation at 3 locations within the lake. The surface water is pumped out off-site for irrigation purposes.	
Sediment: Sediment/sludge samples were collected in the Phase I and the Phase II investigations. It was noted that these samples had a putrid smell. Low levels of VOCs, SVOCs, Pesticides, and PCB 1254 were detected.	
Surrounding Land Use: Industrial/Open space. An aircraft maintenance operations area borders the northwest edge of the Playa Lake. The rest of the lake is surrounded by open space land use. The eastern Base boundary is approximately 600 ft to the east of the lake. Dairy cattle were seen grazing during the site visit immediately adjacent to the Base boundary fence and agricultural crops are irrigated with the water from the Playa Lake.	Consumption of dairy or meat products from potentially contaminated cows needs to be considered; consumption of potentially contaminated crops needs to be considered.

Table 1-39

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: An ecological assessment has been performed at this site. The results of this assessment showed potential risks to predatory birds. The report sites significant uncertainties regarding assumptions that may decrease risk. Thus, the actual level of risk is unknown.	
Data Availability: Phase I and Phase II soil boring data are available for both surface and subsurface soil. Sediment and surface water data are also available. No groundwater sampling was done as a part of this RFI. However, monitoring wells have been installed in the area. The availability of this data is not currently known, but will be evaluated if it becomes available.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase II, Cannon Air Force Base, New Mexico, Pre-Draft, Volume 1A, April 1995.

VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs = Poly Chlorinated Biphenyls

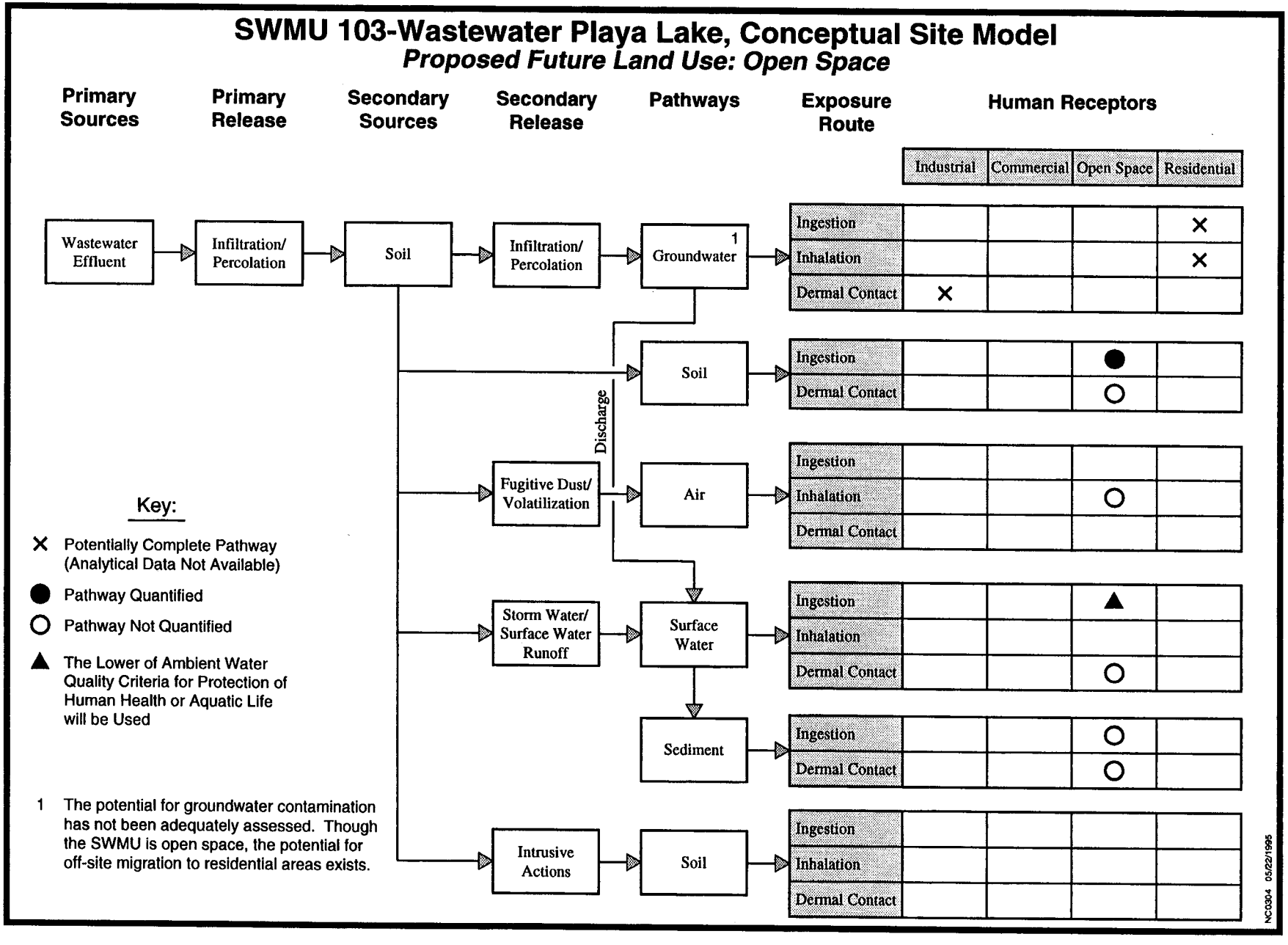

Figure 1-37. SWMU 103-Wastewater Playa Lake Conceptual Site Model, Cannon AFB

Table 1-40
Cannon Air Force Base
SWMU 104 (LF-04) - Landfill No. 4

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: Landfill No. 4 is an unlined 6.3-acre landfill located on the east side of CAFB immediately north of the Playa Lake. This landfill was operated from 1967 to 1968, then abandoned in 1968. It presently exists as a vegetated, mostly flat area with remnant depressions of the former trenches.	
Types of Waste: Domestic and industrial wastes including waste oil and solvents, paints, paint thinners, pesticide containers, and empty cans and drums. Accumulated wastes were placed in trenches and burned.	
Groundwater: Ogallala fluvial deposits, consisting of well to moderately sorted sand, underlies this SWMU. The first water bearing zone occurs from 325 to 340 ft below ground surface across the site. The hydraulic gradient beneath this SWMUs approximately 0.0025 ft/ft. Evaluation of the chemical quality of the groundwater indicates that the groundwater has not been impacted.	Groundwater is not considered a potential route of exposure due to its depth and small chance of contamination from soils.
Soil: Only TICs (tentatively identified compounds), potential laboratory contaminants and trace amounts of pesticides have been identified in the soil below the base of the landfill.	
Surface Water: Although surface water may collect in some areas of the landfill for short periods of time, surface water data is not available for this site. Results from surface water modeling indicated that contaminants associated with runoff from the site may potentially contaminate the playa lake located just south of the landfill.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Open space	
Ecological Factors: Results of the environmental evaluation indicate the level of exposure of wildlife known to inhabit the landfill and surrounding areas to contaminants present at the site is likely to be low. Therefore, potential adverse impacts of contamination from Landfill No. 4 on critical habitats and endangered species in the area is judged to be insignificant.	
Data Availability: Soil data are available for this site.	

Source: Remedial Investigation Report, Landfill No. 4, Radian Corporation, 1993.

SWMU = Solid Waste Management Unit CAFB - Cannon Air Force Base

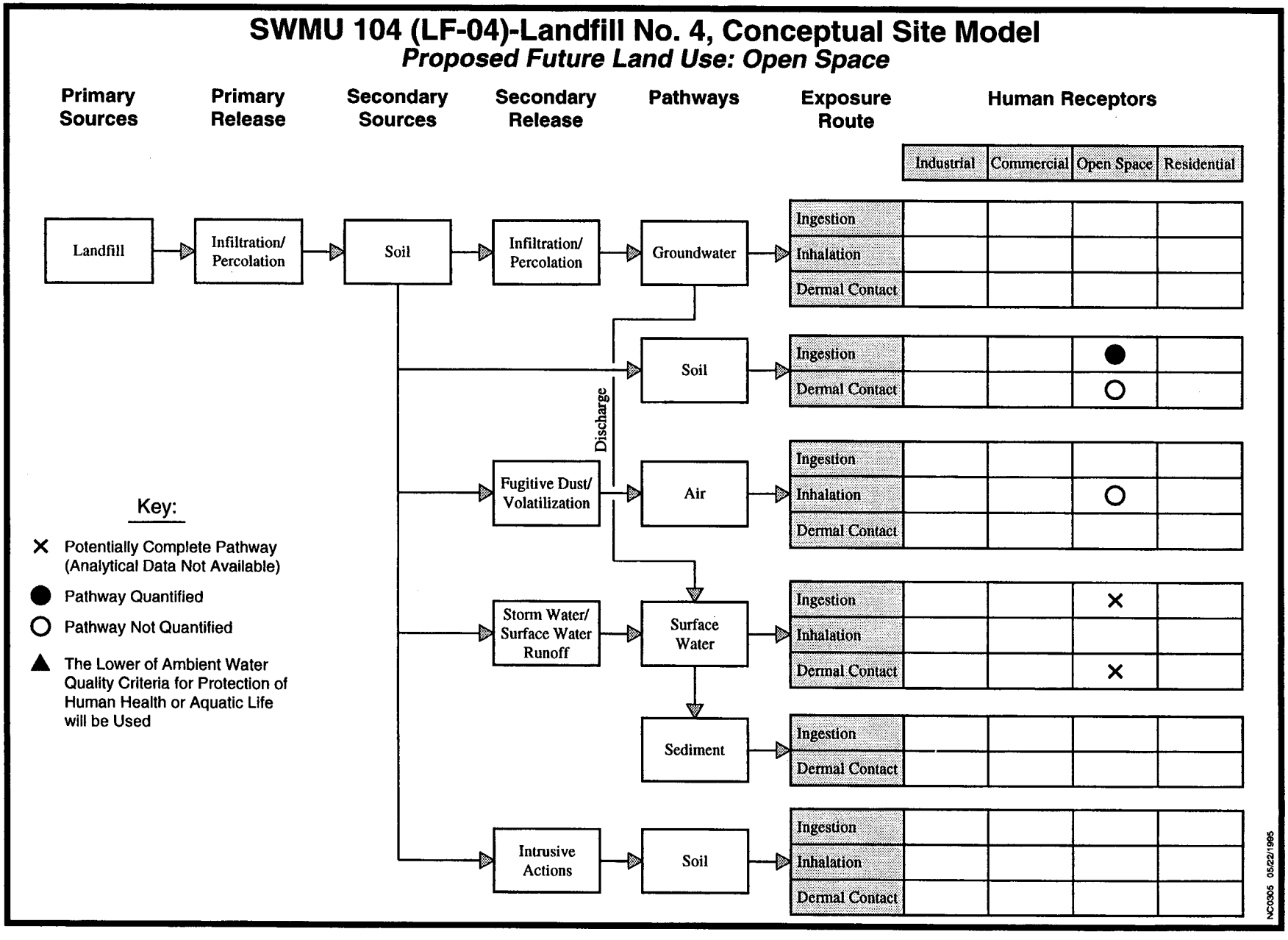

Figure 1-38. SWMU 104 (LF-04)-Landfill No. 4 Conceptual Site Model, Cannon AFB

Table 1-41

Cannon Air Force Base
SWMU 105 (LF-03) - Landfill No. 3

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: Landfill No. 3 is a 13.5-acre inactive landfill located on the east side of CAFB just south of the Ordinance Area and east of Perimeter Road. Landfill No. 3 received wastes between the years of 1959 and 1967. While active, this unlined, 13.5-acre cut-and-fill area received domestic and industrial solid wastes. After being abandoned in 1967, the site was not investigated until the U.S. Air Force (USAF) Installation Restoration Program (IRP), Phase I, was conducted at CAFB in 1982 and 1983.	
Types of Waste: Domestic solid wastes, waste oils, solvents, paints, paint thinners and strippers, pesticide containers and various empty cans and drums were burned in trenches and buried at Landfill No. 3. As trenches became filled, other trenches were excavated nearby and likewise filled.	
Groundwater: A previous risk assessment demonstrated that the risk to groundwater from this site is insignificant. Groundwater exists at approximately 273 ft below ground surface.	
Soil: This investigation addressed the 20- to 60-ft depth interval. The vertical extent of organics in the soil has not been delineated beyond this interval. A previous risk assessment demonstrated that the risks from deep soil contamination are insignificant.	
Surface Water: Although surface water may collect in some areas of the landfill for short periods of time, surface water data is not available for this site.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Open space	

Table 1-41

(Continued)

Site Specific Factors	Other Considerations
Ecological Factors: Landfill No. 3 is vegetated with a variety of grasses. The area is not maintained in any manner and the grass is tall. Grainfields lie east and south of the landfill separated by a narrow fence-line corridor. A playa lake is located 465 ft to the north on a down gradient (surface) slope from the landfill. The pocket gopher and the deer mouse are two common small mammals found at CAFB. Both animals inhabit areas covered with small shrubs and grasses similar to Landfill No. 3. Pheasant, quail, and migratory waterfowl feed on waste grains in the fields adjacent to the landfill. Waterfowl, mostly dabbler ducks, utilize the playa lake as a resting and feeding area during migration. The primary predators in the area are several species of raptors. Mated pairs of Mississippi Kite, recently removed from New Mexico's protected species list, have been seen on the base defending territory near the golf course. Occasionally a big game animal, such as the pronghorn antelope, has been seen in the vicinity.	
Data Availability: Soil data are available for this site.	

Source: Remedial Investigation Report, Landfill No. 3, Radian Corporation, 1993.

CAFB = Cannon Air Force Base

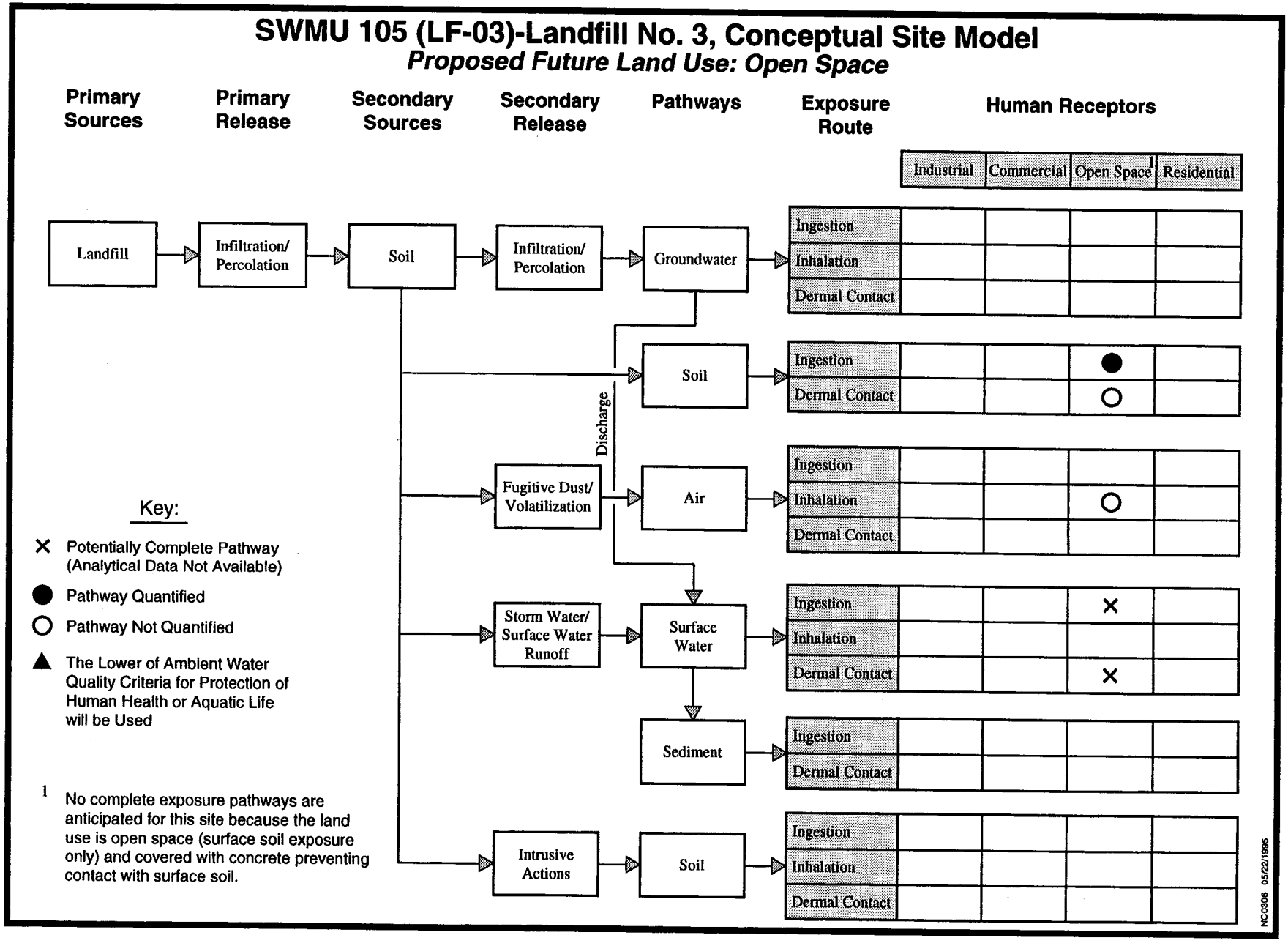

Figure 1-39. SWMU 105 (LF-03)-Landfill No. 3 Conceptual Site Model, Cannon AFB

Table 1-42

Cannon Air Force Base
SWMU 108 - EOD Activities Area

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: This SWMU is located on the southeast corner of the Base, directly west of the Fire Department Training Area. The area is circular with a circumference of about 200 ft, defined by a 1 ft high earthen berm. This area has been active since the early 1970s and is used for training base personnel in the safe use of ordinance.	
Types of Waste: Potential contaminants include organic compounds, high explosive compounds, and metals.	
Groundwater: Groundwater was not sampled at this SWMU. The soil contamination does not pose a risk to the groundwater.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: A reddish brown, low plastic, dry silty clay exists in the top 6 inches underlain by a reddish brown, loose silty clay with some caliche. Toluene, 2-butanone, Sn, Ba, Mn, Ni, Se, Vn, and Zn were detected. Barium was the only constituent detected above residential screening criteria.	
Surface Water: Surface water is not present at this SWMU.	
Sediment: Sediments are not applicable to this site.	
Surrounding Land Use: Open Space	
Ecological Factors: This site has no vegetation or notable surface feature that would serve as refuge for ecological receptors. The area is routinely regraded to remove surface vegetation and debris.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix II SWMUs-Phase II, Cannon Air Force Base, New Mexico. April 1993.

SWMU = Solid Waste Management Unit

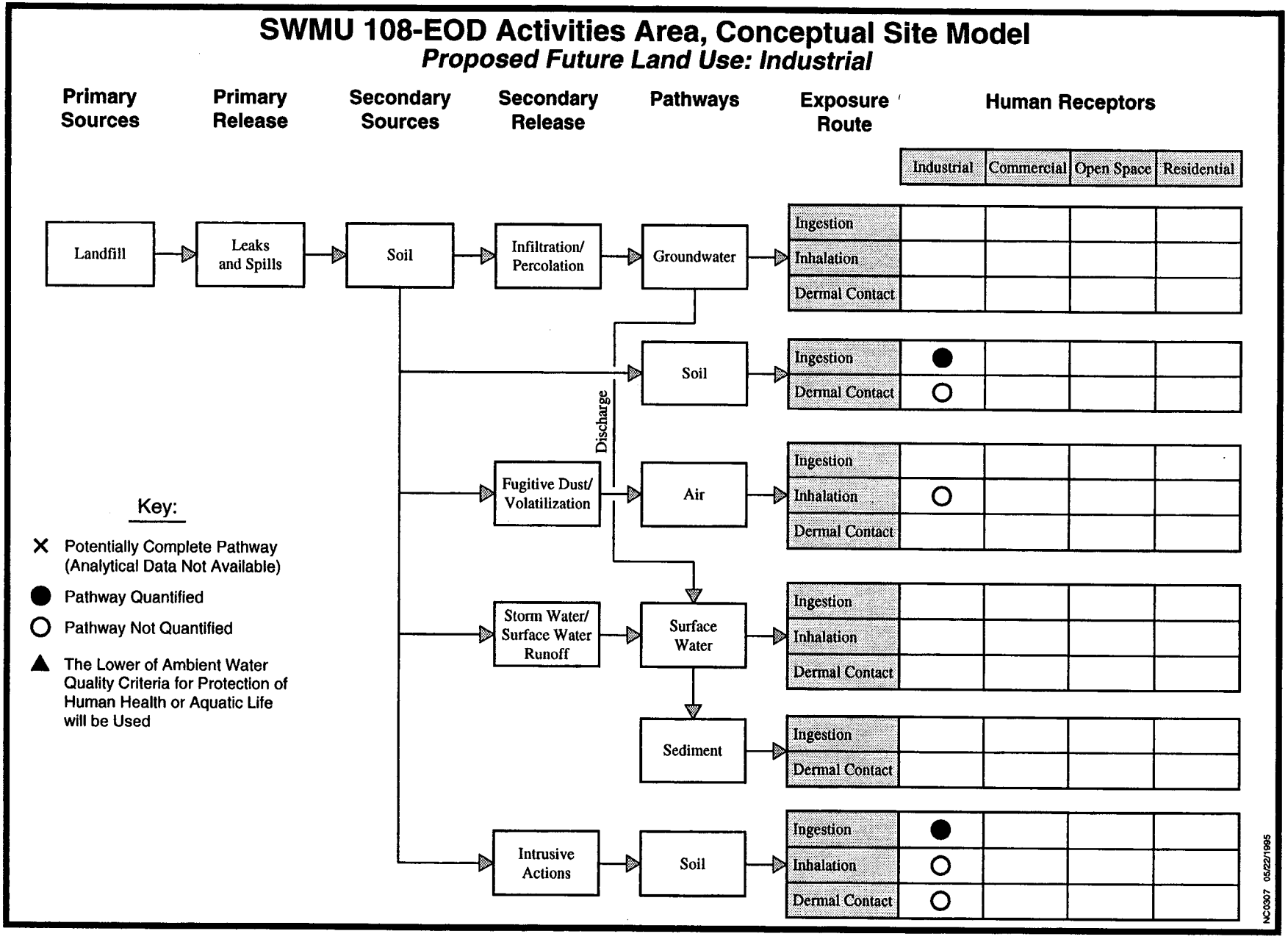

Figure 1-40. SWMU 108-EOD Activities Area Conceptual Site Model, Cannon AFB

Table 1-43

Cannon Air Force Base
SWMU 109 (FT-09) - Fire Department Training Area No. 4

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: This site was used as a fuel truck cleaning area between 1961 and 1974 and then converted to a fire training area. It consists of a mock aircraft, an automobile chassis, and an aboveground fuel storage tank.	
Types of Waste: Reclaimed JP-4 (contaminated with water and solvents) was used as fuel.	
Groundwater: The Ogallala Aquifer occurs at approximately 265 ft.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: 35 subsurface soil samples were collected from four soil borings. Silty, calcareous sand (with caliche present in the upper horizon)was found and was underlain by sand. Distinct caliche layers were present in the upper 40 ft. Xylenes and ethylbenzene occur from near the ground surface to 12 ft in the area surrounding the former mock aircraft. Four surface samples were collected for chemical analysis. Hydrocarbons are present in the surface soil.	
Surface Water: Surface water is not present at this site.	
Sediment: Sediments are not applicable to this site.	
Surrounding Land Use: Open space	
Ecological Factors: Because of the industrial nature of this area and the area surrounding the site, this SWMU is not considered to be a suitable ecological habitat.	
Data Availability: Soil data are available for this site.	

Source: Remedial Investigation Report for 18 Solid Waste Management Units, Woodward-Clyde and Consultants, 1992.

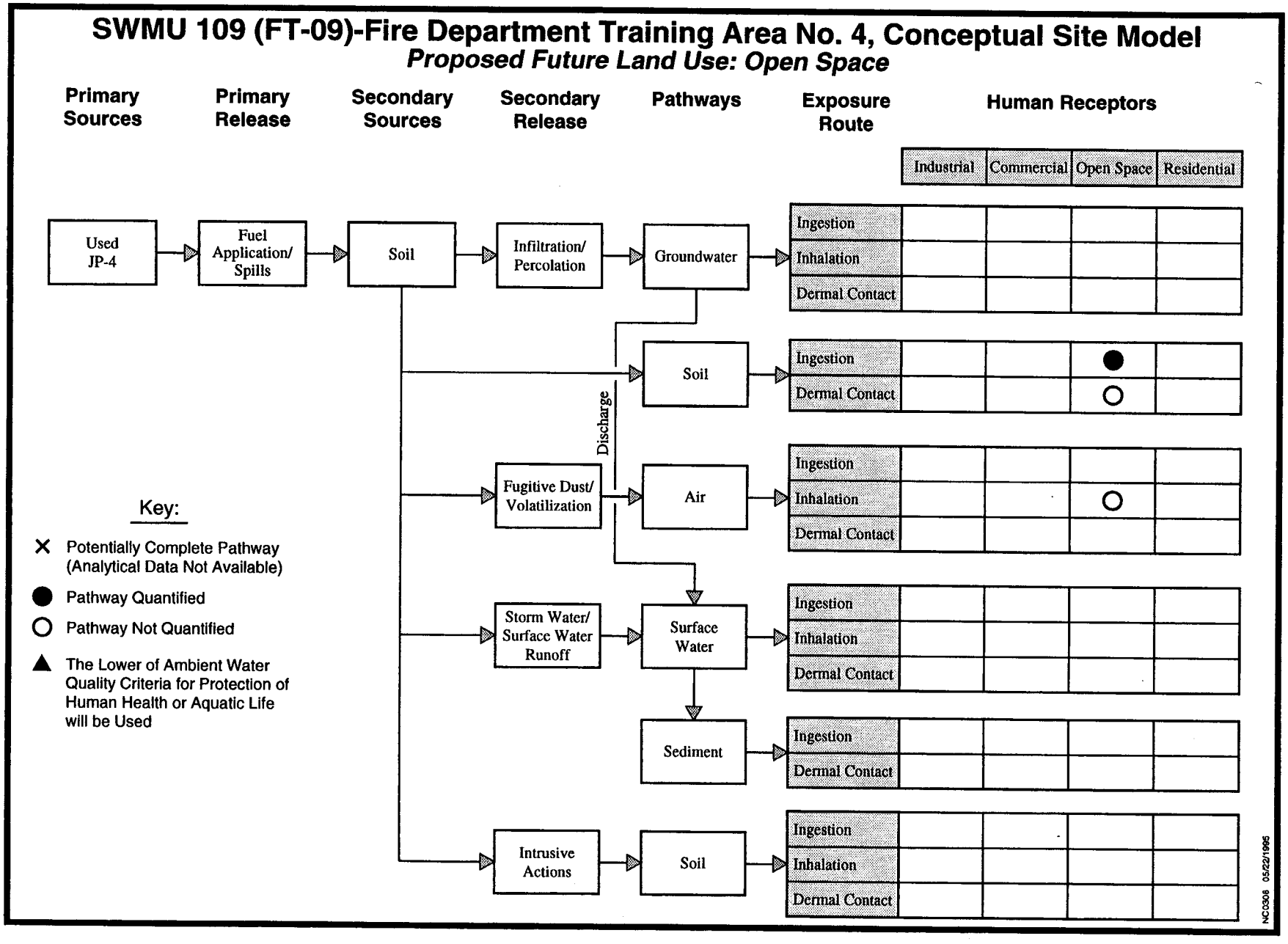

Figure 1-41. SWMU 109 (FT-09)-Fire Department Training Area No. 4 Conceptual Site Model, Cannon AFB

Table 1-44

Cannon Air Force Base
SWMU 113 (LF-05) - Landfill No. 5

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial/Open Space	
Site: This site is an active landfill in the southeastern corner of the base, occupying approximately 30 acres. The unit began operation in 1986 and Cell No. 3 (now closed) received hazardous wastes.	
Types of Waste: Domestic solid wastes, paint, paint removers and thinners, pesticide containers, and various empty cans and drums. Approximately 5-10 drums per month were disposed of at this site.	
Groundwater: Ogallala fluvial deposits, consisting of well to moderately sorted sand, underlie this SWMU. The first water bearing zone occurs from 325 to 340 ft below ground surface across the site. The hydraulic gradient beneath this SWMU s approximately 0.0025 ft/ft. Evaluation of the chemical quality of the groundwater indicates that the groundwater has not been impacted. Groundwater monitoring is ongoing at this site.	Groundwater is not considered an exposure pathway due to its depth and small chance of contamination from soils.
Soil: The soil horizons consist of four or five fairly distinct sand, gravel, or sand/caliche units to a depth of 365 ft. The area of contaminated soil, Cell No. 3, is closed with an impermeable cap and is not considered a risk.	Inhalation of fugitive dusts and ingestion or dermal contact with contaminated soil are not considered a potential exposure pathway unless construction activities or intrusive actions occur at Cell No. 3.
Surface Water: Although surface water may collect in some areas of the landfill for short periods of time, surface water data is not available.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial/Open space.	
Ecological Factors: This site is disturbed, but contains grasses, shrubs, and weeds, which may provide habitat for ecological receptors such as rodents, jackrabbits, and hawks.	
Data Availability: Groundwater and soil data are available for this site.	

Source: Remedial Investigation Report for 18 Solid Waste Management Units, Woodward-Clyde and Consultants, 1992.

SWMU = Solid Waste Management Unit

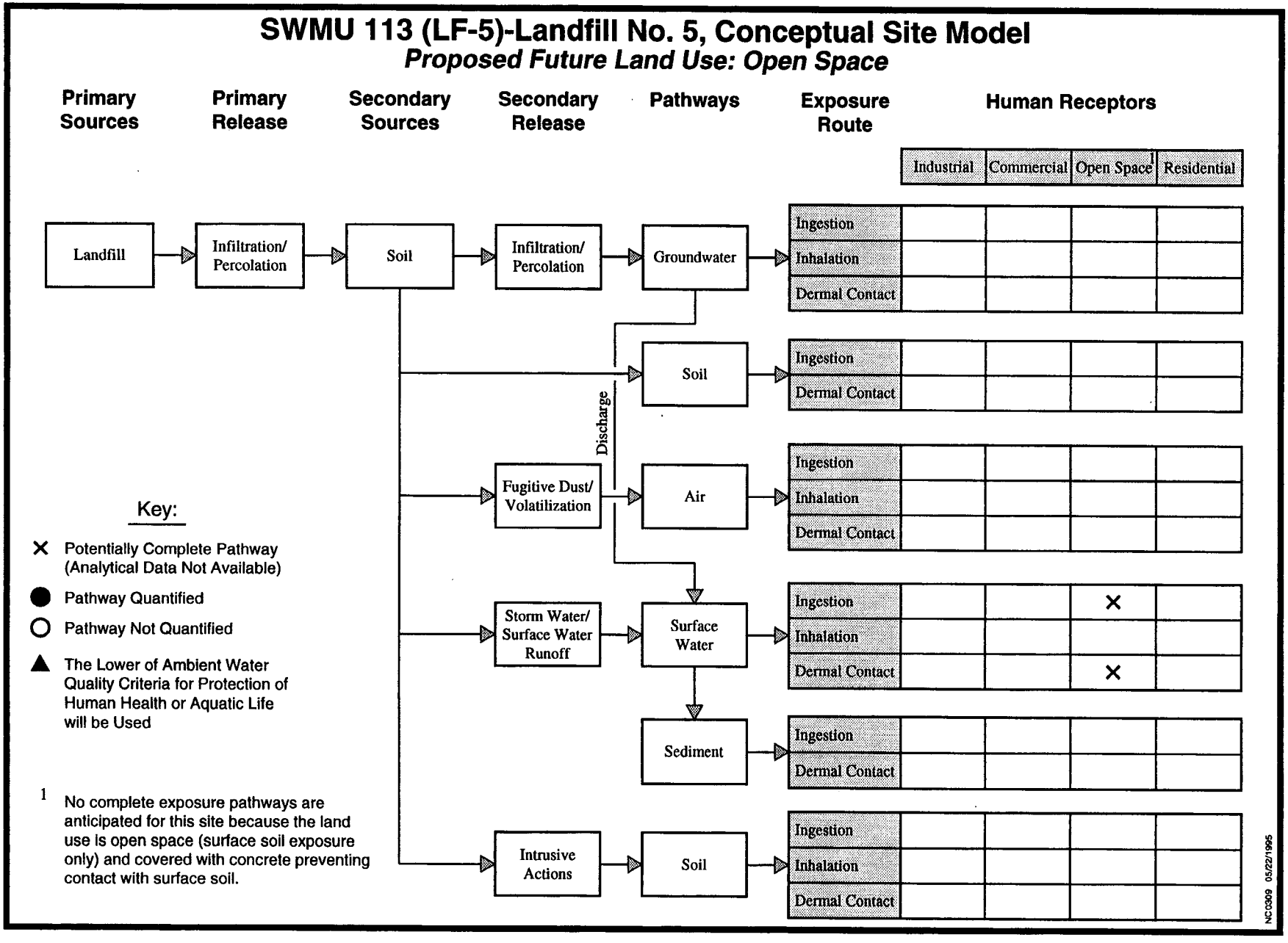

Figure 1-42. SWMU 113 (LF-5)-Landfill No. 5 Conceptual Site Model, Cannon AFB

Table 1-45

Cannon Air Force Base
SWMU 114 - Melrose Air Force Range Expended Ordnance Burial Site

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: Melrose Bombing Range consists of 30,000 acres approximately 25 miles west of Cannon AFB and was first activated in 1952. This site consists of 8-9 pits (approximately 50 yds long) that were used to deposit scrap metal from exploded ordnance. Waste drums were possibly disposed here.	
Types of Waste: Residue high explosives from exploded/unexploded ordnance. Waste oils and waste solvents.	
Groundwater: No groundwater sampling has been performed.	
Soil: No subsurface soil sampling has been performed	
Surface Water: Surface water may periodically collect in the pits, but does not travel off-site.	
Sediment: No sediment sampling has been performed.	
Surrounding Land Use: Open space (rangeland with grazing cattle)	
Ecological Factors: A golden eagle nesting site is locate nearby.	
Data Availability: No data is available at this time. Investigation is underway.	

Source: 2 March 1995 site visit; Radian Corporation under the direction of Mr. John Constantine, Cannon AFB RPM.

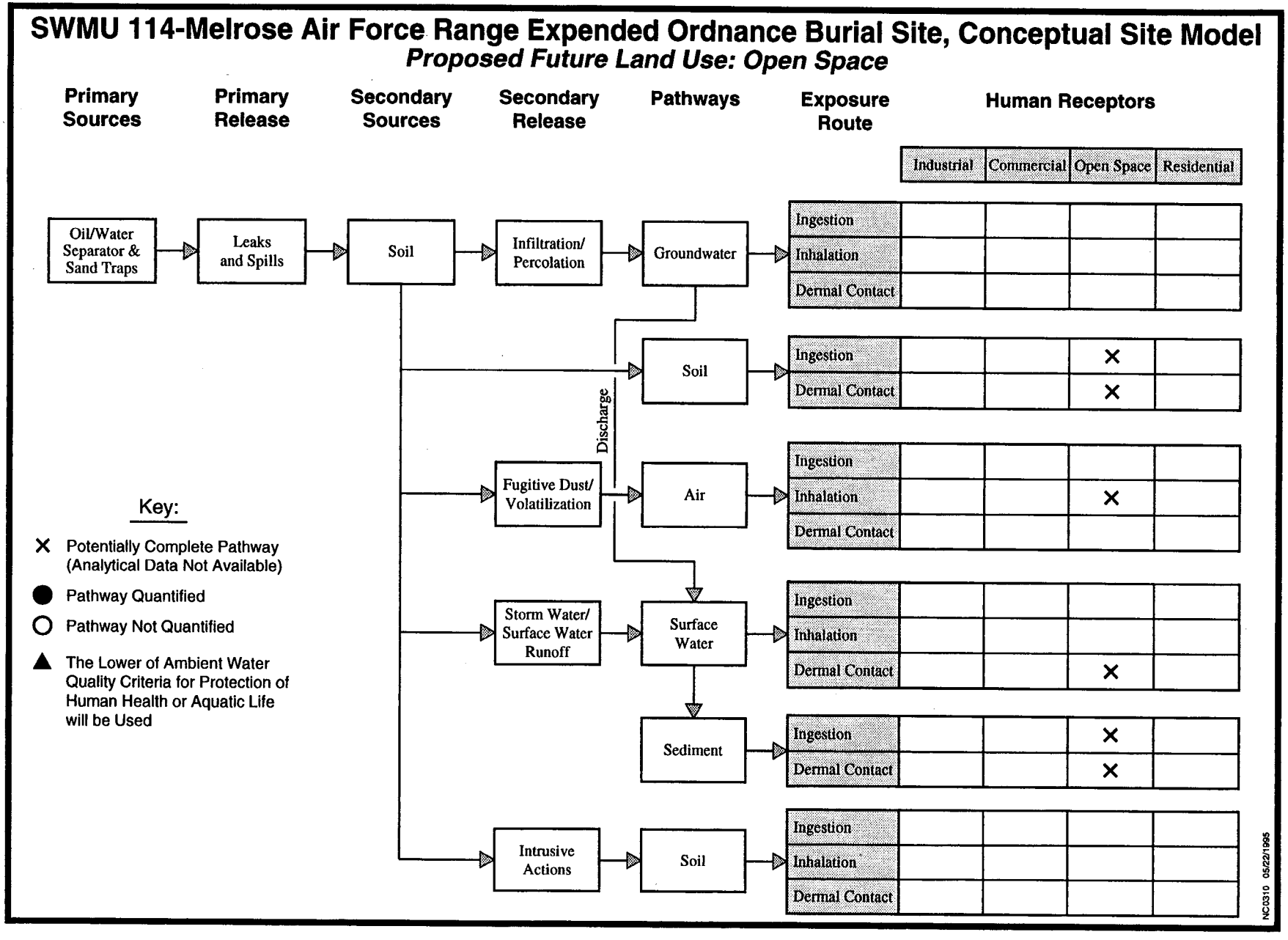

Figure 1-43. SWMU 114-Melrose Domestic Landfill Site Conceptual Site Model, Cannon AFB

Table 1-46

Cannon Air Force Base
SWMU 115 - Melrose Air Force Range Explosives Contaminated Burial Site

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: Melrose Bombing Range consists of 30,000 acres approximately 25 miles west of Cannon AFB and was first activated in 1952. This site is a semi-arroyo that is suspected of receiving unexploded ammunition.	
Types of Waste: Unexploded ammunition.	
Groundwater: No groundwater sampling has been performed.	
Soil: No subsurface soil sampling has been performed	
Surface Water: Surface water flows through this site and leads to a reservoir approximately 50 yds away. The water from the reservoir is not used for human consumption.	
Sediment: No sediment sampling has been performed.	
Surrounding Land Use: Open space (rangeland with grazing cattle)	
Ecological Factors: None identified.	
Data Availability: No data is available at this time. Investigation is underway.	

Source: 2 March 1995 site visit; Radian Corporation under the direction of Mr. John Constantine, Cannon AFB RPM.

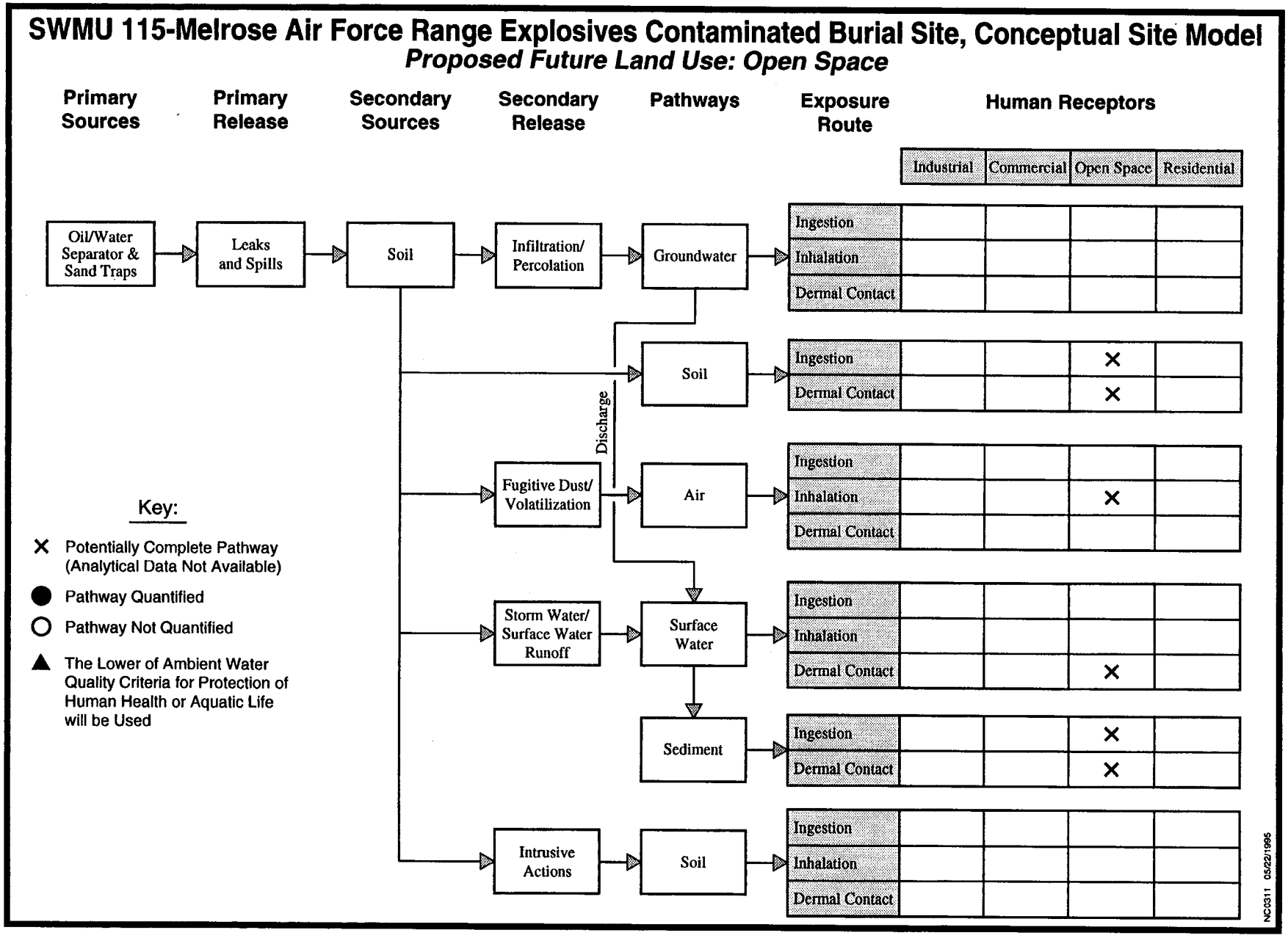

Figure 1-44. SWMU 115-Melrose Explosives Contaminated Burial Site Conceptual Site Model, Cannon AFB

Table 1-47

Cannon Air Force Base
SWMU 117 - Melrose Air Force Range Domestic Waste Pile

Site Specific Factors	Other Considerations
Proposed Future Land Use: Open Space	
Site: Melrose Bombing Range consists of 30,000 acres approximately 25 miles west of Cannon AFB and was first activated in 1952. This former landfill received domestic wastes and is visibly only by a slight change in vegetation where the cell are located.	
Groundwater: No groundwater sampling has been performed.	
Soil: No subsurface soil sampling has been performed	
Types of Waste: Domestic wastes from range support activities.	
Surface Water: No surface water sampling has been performed. There is no obvious migration potential for surface water.	
Sediment: No sediment sampling has been performed.	
Surrounding Land Use: Commercial or Industrial (compound area) and Open space (rangeland with grazing cattle).	
Ecological Factors: None identified.	
Data Availability: No data is available at this time. Investigation is underway.	

Source: 2 March 1995 site visit; Radian Corporation under the direction of Mr. John Constantine, Cannon AFB RPM.

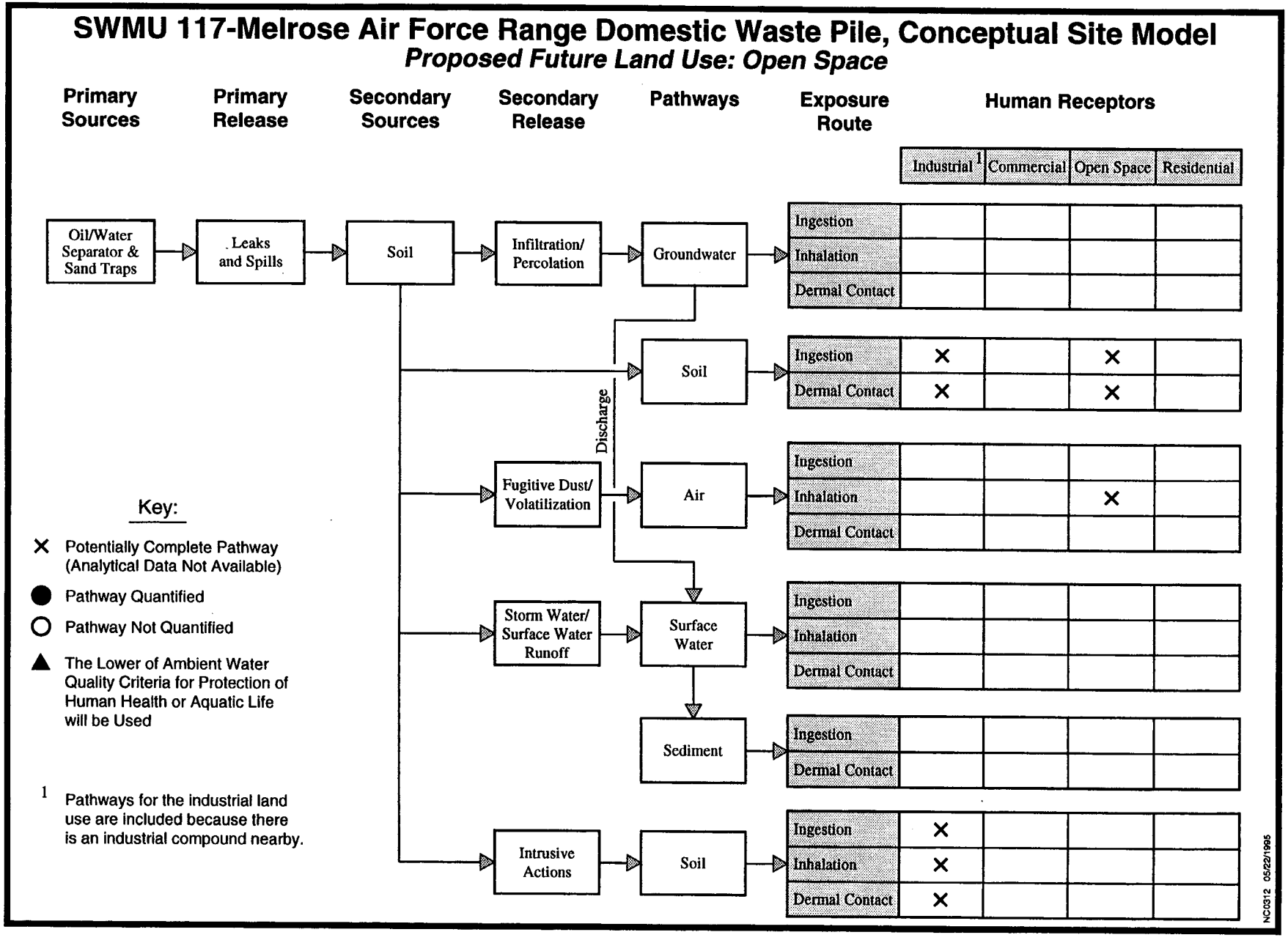

Figure 1-45. SWMU 117-Melrose Domestic Waste Pile Conceptual Site Model, Cannon AFB

Table 1-48
Cannon Air Force Base
SWMU 127 - Sand Trap and Leach Fields at the POL Washrack

Site Specific Factors	Other Considerations
Proposed Future Land Use: Industrial	
Site: SWMU 127 is a 135-gallon concrete sand trap and 2 leach fields that receive wash water from the POL refueling truck washrack at Facility 4095. The second leach field was installed in 1991 to replace the original leach field that reportedly ceased to function in the late 1980s. The original leach field remains intact but is bypassed and no longer used. An O/WS is also present at this site but was not investigated in the Appendix III RFI based on a lack of evidence of spillage or leakage during a visual inspection.	
Types of Waste: JP-4, grease, motor oil.	
Groundwater: Most of the chemicals of concern were detected only in the upper 5 ft of soil indicating that infiltration to the groundwater is unlikely. Fate and transport modeling indicated that transport to groundwater is not expected. Uncertainty exists concerning TRPH constituents that appear to have been released and migrated vertically to a depth of at least 50 ft. These constituents are not expected to impact groundwater, but there is concern about the possibility of future migration. Vertical distribution of TRPH has not been fully defined.	
Soil: Borings through the leach field area encountered silty clay from the surface to approximately 18 ft. Sandy silt, silt and sand were encountered at lower depths. No visual contamination or odors were noted during drilling or sampling events.	
Surface Water: Storm water runoff is considered to be an insignificant pathway due to the fact that the surface area is small and surface spills would be minimal. The leach fields are designed to contain any surface water runoff.	
Sediment: Sediment data are not applicable to this site.	
Surrounding Land Use: Industrial	
Ecological Factors: An ecological risk assessment has shown that no unacceptable risks due to chemical releases are expected at this SWMU.	
Data Availability: Soil data are available for this site.	

Source: Woodward-Clyde. RCRA Facility Investigation, Appendix III SWMUs-Phase II, Cannon Air Force Base, New Mexico, Pre-Draft, Volume 1A, April 1995.

O/WS = Oil/Water Separator TRPH = Total Recoverable Petroleum Hydrocarbons

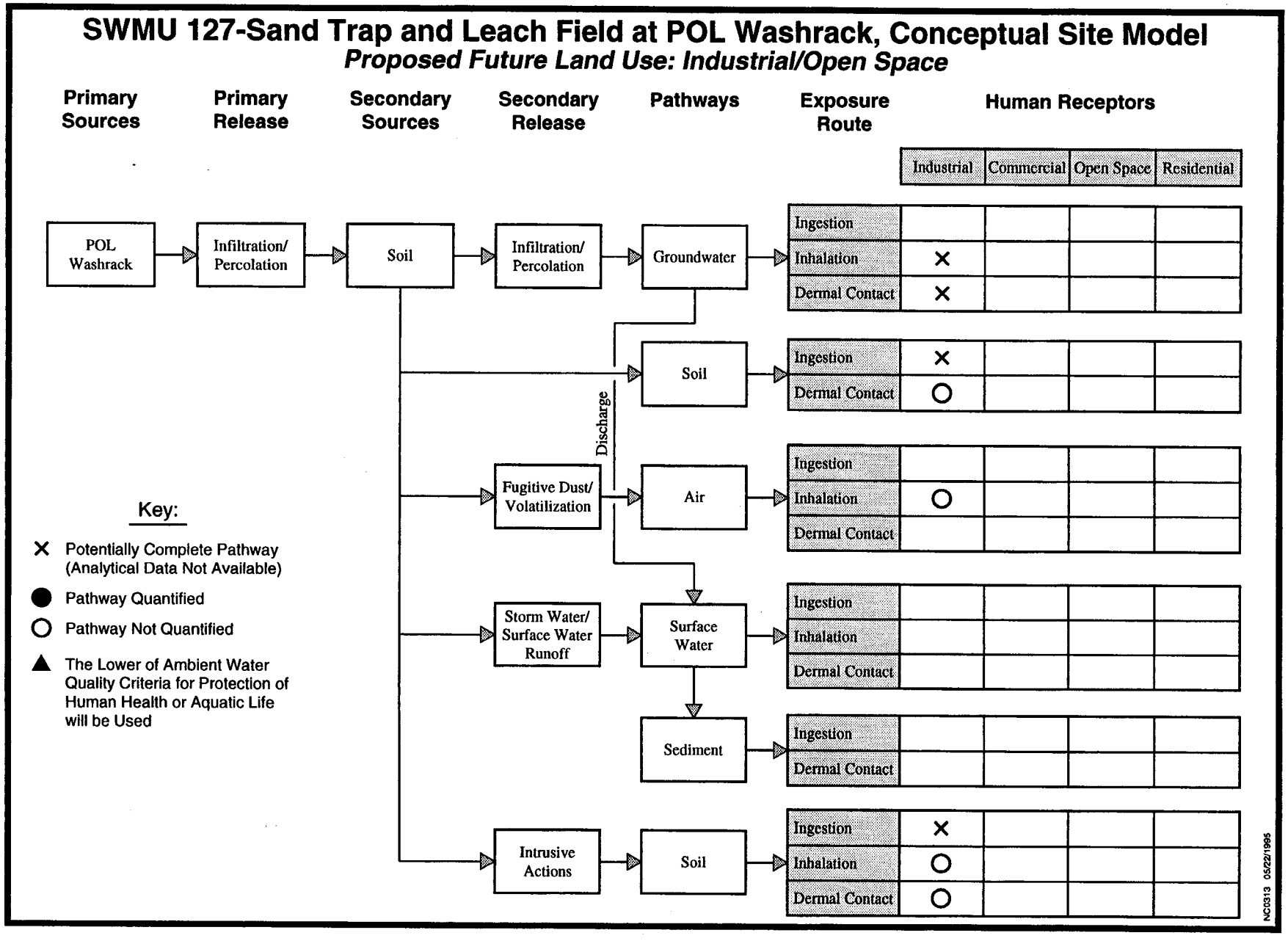

Figure 1-46. SWMU 127-Oil/Water Separator 4095 and Leach Field Conceptual Site Model, Cannon AFB

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