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Date: June 2, 2005
Refer To: ER2005-0359

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SUBJECT: SUBMITTAL OF THE ADDENDUM TO THE COMPLETION REPORT FOR THE VOLUNTARY CORRECTIVE ACTION USING A SOIL VAPOR EXTRACTION SYSTEM AT AREA OF CONCERN 0-027

Dear Mr. Bearzi:

Enclosed are two hard copies with CDs containing electronic copies of the "Addendum to the Completion Report for the Voluntary Corrective Action using a Soil Vapor Extraction System at Area of Concern 0-027."

If you have any questions, please contact Terry Rust at (505) 665-8843 (trust@lanl.gov) or Bob Enz at (505) 667-7640 (renz@doeal.gov).

Sincerely,

David McInroy, Deputy Program Director
Environmental Remediation & Surveillance
Los Alamos National Laboratory

Sincerely,

David Gregory, Federal Project Director
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Los Alamos Site Office

7729

Enclosures: 1) Two hard copies – Addendum to the Completion Report for the Voluntary Corrective Action using a Soil Vapor Extraction System at Area of Concern 0-027 (ER2005-0021)
2) Two electronic copies – one in each binder (CDs)

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Document Title: **ADDENDUM TO THE COMPLETION REPORT FOR THE VOLUNTARY CORRECTION ACTION USING A SOIL VAPOR EXTRACTION SYSTEM AT AREA OF CONCERN 0-027**

I certify under penalty of law that these documents and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

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LA-UR-05-0583
June 2005
ER2005-0021

Addendum to the Completion Report for the Voluntary Corrective Action Using a Soil Vapor Extraction System at Area of Concern 0-027

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Prepared by
Environmental Stewardship–Remediation Services

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LA-UR-05-0583
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Addendum to the Completion Report for the Voluntary Corrective Action Using a Soil Vapor Extraction System at Area of Concern 0-027

June 2005

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EXECUTIVE SUMMARY

This report addendum documents the soil vapor extraction (SVE) system activities conducted by the Los Alamos National Laboratory Environmental Stewardship–Remediation Services project at Area of Concern (AOC) 0-027 in Technical Area 0. This voluntary corrective action (VCA) activity was guided by the 2002 VCA/interim action (IA) plan approved by the New Mexico Environment Department (NMED) in February 2003.

This document is an addendum to the completion report for the VCA at Solid Waste Management Units (SWMUs) 0-030(a), 0-030(b)-00, and 0-033(a) and AOCs 0-029(a,b,c) and 0-010(a,b) and for the IA at SWMU 21-021-99. It was not included in the 2003 VCA completion report to NMED because the SVE system was in operation and results were not available at the time the report was submitted.

The VCA consisted of installing and operating an SVE system for a 20-month period (November 2002–July 2004) to remove subsurface organic vapors and thereby reduce the potential risk to human health from residual subsurface contamination at the site. Concentrations of organic vapors were monitored regularly during operation of the SVE system, and confirmation samples were collected after operation was halted. The VCA removed over 7200 kg (15,877 lb) of total petroleum hydrocarbons from the subsurface at the site, reducing the human health risk at the site by an order of magnitude for carcinogenic chemicals, and by nearly half an order of magnitude for noncarcinogenic chemicals.

The VCA at AOC 0-027 is complete and the results of confirmation sampling indicate no potential unacceptable risk to human health or the environment.

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Acronyms

AOC	area of concern
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
BV	background value
COPC	chemical of potential concern
DOE	US Department of Energy
DRO	diesel range organics
ENV-RS	Environmental Stewardship–Remediation Services
EPA	US Environmental Protection Agency
ER	environmental restoration
GRO	gasoline range organics
HI	hazard index
HQ	hazard quotient
IA	interim action
IRIS	Integrated Risk Information System
K_{ow}	octanol water partition coefficient
LANL	Los Alamos National Laboratory
mm Hg	millimeters mercury
NMED	New Mexico Environment Department
NOAEL	no observed adverse effect level
PID	photoionization detector
PRS	potential release site
Qbt 3	Bandelier Tuff, Tshirege Member, Unit 3

RCRA	Resource Conservation and Recovery Act
RfD	reference dose
scfm	standard cubic feet per minute
SF	slope factor
SSL	soil screening level
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area
TAL	target analyte list
TPH	total petroleum hydrocarbons
VCA	voluntary corrective action
VOC	volatile organic compound

1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the US Department of Energy (DOE) and managed by the University of California. The Laboratory is located in north-central New Mexico approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe (see Figure 1.0-1). The site covers 40 mi^2 of the Pajarito Plateau, which consists of a series of finger-like mesas that are separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft. The eastern portion of the plateau stands 300 to 1000 ft above the Rio Grande.

The environmental restoration (ER) work conducted by the Laboratory's Environmental Stewardship–Remediation Services (ENV-RS) project (formerly known as the ER Project) is part of a national DOE effort to clean up facilities that were involved in weapons production. The goal of the ER activities is to ensure that DOE's past operations do not pose a potential unacceptable risk to human health or the environment in and around Los Alamos County. To achieve that goal, ENV-RS is investigating sites that were potentially contaminated by past Laboratory operations.

This document is an addendum to the voluntary corrective action (VCA) completion report for Solid Waste Management Units (SWMUs) 0-030(a), 0-030(b)-00, and 0-033(a) and Areas of Concern (AOCs) 0-029(a,b,c) and 0-010(a,b) and for the interim action (IA) at SWMU 21-021-99 (LANL 2003, 87625). Information for AOC 0-027 was not included in the VCA completion report because the soil vapor extraction (SVE) system was in operation and results were not available at the time the report was submitted to the New Mexico Environment Department (NMED).

Depending upon the type of contaminant(s) and the history of a site, either NMED or DOE has administrative authority over work performed by the ENV-RS project. NMED, under the auspices of the State of New Mexico, has authority over sites with hazardous waste or hazardous constituents, including the hazardous portion of mixed waste. Hazardous constituents are regulated under the Resource Conservation and Recovery Act (RCRA). DOE has authority over sites with radioactive contamination.

The area of concern addressed in this addendum, AOC 0-027, is not listed in Table A of the Module VIII of the Laboratory's RCRA Hazardous Waste Facility permit (EPA 1990, 01585; EPA 1994, 44146). DOE has administrative authority over the work performed by ENV-RS at this site.

This VCA completion report addendum describes the corrective action activities and sampling results at AOC 0-027, as prescribed in the VCA/IA plan, "Plan for the Voluntary Corrective Action at Potential Release Sites (PRSs) 0-030(b)-00, 0-027, 0-030(a), 0-029(a,b,c), 0-010(a,b), and 0-033(a), and the Interim Action at PRS 21-021" (LANL 2002, 73579). The plan was approved by NMED in February 2003 (NMED 2003, 76030). As reported in the VCA plan, the original screening evaluation used data collected in 1996 and concluded that the cancer risk from benzene was 5×10^{-6}. The purpose of the SVE system was to reduce that risk (LANL 2002, 73579). The corrective action involved the installation and operation of an SVE system using eight shallow boreholes for extraction and monitoring.

Subsurface samples were collected from multiple boreholes before and after the operation of the SVE system to determine the effectiveness of the corrective action in extracting volatile and semivolatile organic chemicals from the subsurface.

2.0 AOC 0-027

AOC 0-027 is located in Los Alamos at the intersection of Trinity Drive and DP Road, the current site of the Knights of Columbus Hall, which is owned by the Archdiocese of Santa Fe (see Figure 1.0-1). The site was used by the Laboratory as a fuel-tank farm from approximately 1946 to mid-1948. The site was converted in 1948 to a drum storage area where metal 55-gal. drums of lubricants were stored for distribution to various Laboratory sites and craft shops. The drum storage area was used until the early 1960s, when it was decommissioned.

The VCA/IA plan, as modified by comments from NMED (NMED 2003, 76030) called for the following actions at AOC 0-027:

- drill eight boreholes in 2002 for vapor-extraction and monitoring wells;
- collect core samples from the eight boreholes at three depths each to characterize the potential contamination prior to installing the SVE system;
- conduct an SVE using the eight boreholes configured as three vapor-extraction wells and five vapor-monitoring wells;
- run the SVE continuously for an unspecified period of time—when system air-sampling indicates a steady minimal removal rate, convert the system to a pulsed-mode operation and evaluate the ongoing effectiveness of the system; and
- drill eight new boreholes near the eight previous boreholes and collect confirmatory core samples from the same depths as the pre-SVE samples when the SVE operation is discontinued.

2.1 Site Description and Operational History

AOC 0-027 was a fuel-tank farm. At least eight above-ground oil storage tanks and three fill stations were located in the DP Road storage area beginning in 1946. The fuel-tank farm was relocated in 1948 to the area that is now SWMU 21-029. The oil tanks were decommissioned and also moved to SWMU 21-029, the DP Tank Farm (LANL 1990, 07511).

After the oil tanks were removed, the site was converted to a drum storage area where metal 55-gal. drums of lubricants were stored for distribution to various Laboratory sites and craft shops. The storage capacity of the site was approximately 600 to 700 drums and consisted of six cells, each approximately 38 ft wide with varying lengths (LANL 1990, 07511). The cells were separated by 2-ft-high earthen dikes around the northern perimeter and a concrete berm at the southern perimeter. The floor of each cell was sloped to the north and covered by 2 in. of gravel. The drum storage area was used until the early 1960s.

The current Knights of Columbus Hall building had been built on the property by 1965 (Figure 2.1-1). As seen in an aerial photo (Figure 2.1-2), the parking lot had been paved with concrete by 1974. Since that time, the configuration of the property has changed little.

2.2 Previous Activities

2.2.1 Previous Investigations

As reported in the VCA plan (LANL 2002, 73579), a geodetic survey was conducted in early 1996 using site plans and archival maps as guides. This geodetic survey was performed to determine the former locations of the drum storage cells and the above-ground fuel-storage tanks. The survey results were used to select soil vapor sampling locations and borehole locations. The selected locations included

seven north-south trending earthen berms and eight former above-ground fuel-storage tanks. Current structures were also surveyed, including the Knights of Columbus Hall building, associated outbuildings, and a cement-block wall along the south and west property lines.

In June 1996, a soil vapor survey was conducted in the vicinity of the former fuel-tank farm and drum storage area to determine whether vapor-phase contamination existed in the subsurface soils and tuff (LANL 2002, 73579). Survey results were used as screening samples to determine whether additional sampling should be conducted. Sampling was accomplished using probes that consisted of 5-ft lengths of 1-in. outside diameter stainless steel pipe fitted with a 1-in. stainless steel, retractable, disposable tip. Every attempt was made to drive the stainless steel sampling probes to a target depth of approximately 6 ft below ground surface (bgs) before collecting the soil vapor sample. At four locations, the target depth was not reached as a result of refusal. At two locations, the probes were driven to a depth of 10 ft before sampling. Soil vapor samples were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX). Sufficient evidence of BTEX contamination was found in these screening samples to warrant the collection of additional samples for analysis at a fixed laboratory.

In September and October of 1996, subsurface core samples were collected from 20 borehole locations (Figure 2.2-1) that were selected based on the locations of the former fuel-storage cells and areas of contaminated soil identified by the soil vapor survey (LANL 2002, 73579). Borehole depths ranged from 20 ft bgs to 60 ft bgs. Samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), target analyte list (TAL) metals, and pesticides/polychlorinated biphenyls. The 1996 sample data are included in Appendix A. Elevated levels of BTEX contaminants were found in the samples.

During December 1997, indoor air samples were collected in the Knights of Columbus Hall at various locations to determine if VOCs were present. Eight air samples were collected and analyzed for VOCs. These data are summarized in the VCA plan (LANL 2002, 73579). Toluene and 1,3-xylene were found at less than 2.3 parts per billion.

2.2.2 Preliminary Site Conceptual Model

The preliminary site conceptual model for AOC 0-027 is presented in Figure 2.2-2. Possible leaks of petroleum products from storage tanks, drums, or lines may have resulted in potential SVOC, VOC, and TPH contamination. Most of the site is now covered with a concrete parking lot, and there is minimal potential for surface exposure to contaminants in the paved area. For subsurface exposure to humans to be complete, the site would need to be excavated and contaminated subsurface material would need to be removed and redistributed on the surface, so that it could be available for contact. In the unpaved portions of the parking lot, a low risk to human health from exposure to potential volatile contaminants exists. The only potential ecological receptors that are known to be present on the site are ants that have burrowed into cracks in the parking lot. Ecological receptors will not be evaluated in the screening assessment.

2.3 Remedial Activities

Contamination was found in the subsurface at AOC 0-027 during field activities in 1996 (Appendix A includes the 1996 borehole data). In 2002, ENV-RS implemented an SVE system to reduce the potential human health risk at the site because the human health screening assessment based on the 1996 borehole data showed that the potential risk to the public was 5×10^{-6} from benzene (LANL 2002, 73579). Details of the SVE system and its operation are included in Section 2.3.2.

2.3.1 Investigative Activities during VCA

In March and April 2002, eight shallow boreholes were drilled in the parking area of the Knights of Columbus property (Figure 2.3-1). The boreholes ranged in depth from 30 ft to 47.5 ft, and were drilled using a truck-mounted drill rig with a split-spoon hollow-stem auger. Samples were collected from multiple depths in each borehole to determine the nature and extent of contamination before implementing the VCA. After the sampling activities, these eight boreholes were configured and used as monitoring and extraction wells for the SVE system.

In 2004, after the SVE operation was completed, eight new shallow boreholes were drilled, each within 8 ft to the northeast of one of the boreholes drilled in 2002, as confirmatory sampling locations for the SVE process (Figure 2.3-2). The 2004 boreholes were drilled to the same depths as the 2002 boreholes.

All core samples were collected from the split-spoon hollow-stem auger at the planned depth intervals (9–10 ft, 19–20 ft, and 29–30 ft) or at an interval based on VOC screening of the core. Photoionization detector (PID) readings of the core were taken immediately upon separating the halves of the split-spoon core barrel and were recorded in the field logbook, in the borehole log, and in the corresponding sample collection logs. PID readings in the workers' breathing zones were taken for health and safety purposes. Table 2.3-1 summarizes the samples collected in 2002 and 2004. Samples were analyzed for SVOCs, TPH-diesel range organics (DRO), TPH-gasoline range organics (GRO), and VOCs. The 2002 samples were also analyzed for TAL metals.

2.3.2 Remediation Activities

The SVE system consisted of a venting system to remove volatile organic contamination from the subsurface soil and tuff at the site. The venting system consisted of three extraction wells (Locations 00-02-19574, 00-02-19578, and 00-02-19579 in Figure 2.3-1) and one extraction blower. The blower was skid-mounted with all gauges, filters, and flow meters necessary for the soil-venting operation. Five vapor-monitoring wells (Locations 00-02-19573, 00-02-19575, 00-02-19576, 00-02-19577, and 00-02-19580 in Figure 2.3-1) were installed to help optimize the system operation and evaluate the system effectiveness.

The three extraction wells were constructed of 4-in. polyvinyl chloride riser pipe. Extraction wells 00-02-19574 and 00-02-19579 were installed to 37.5 ft bgs, with a screened interval of 17.5 to 37.5 ft bgs. Extraction well 00-02-19578 was installed to 47.5 ft bgs, with a screened interval of 27.5 to 47.5 ft bgs. The individual wells were connected to the blower using high-density polyethylene piping installed below grade. The three wells were connected to a manifold on the blower skid and were valved so that the flow from each well could be varied individually. Each well line was equipped with a vacuum gauge and flow meter.

The blower created a vacuum in the extraction wells that caused soil vapors to move into the well casings where they were recovered by the extraction blower and then treated by passing through two vapor-phase, granular-activated carbon filter units in series. The treated air then was discharged to the atmosphere. The units were replaced periodically when monitoring of the discharged air indicated that the limit of their capacity for retaining VOCs had been reached.

SVE System Operation and Monitoring

Following initial startup in November 2002, the SVE system operated 24 hours a day, 7 days a week. Throughout the 20-month period of operation, there were brief periods during which the system did not operate as a result of maintenance or repair activities.

Air monitoring using a PID was conducted approximately twice a week throughout the corrective action. Tedlar bag screening samples were collected and analyzed at an off-site laboratory for TPH-GRO by US Environmental Protection Agency (EPA) Method TO-14. These screening samples were collected every two to five days at the beginning of the corrective action. After approximately two months of operation, the frequency of Tedlar bag sampling was reduced to once every two weeks. After an additional eight months of operation, the frequency was reduced to monthly. The screening sample results (Table 2.3-2) allowed the contaminant mass removal rate of the system to be tracked during operation and allowed a running calculation of the total mass removed.

The hydrocarbon mass recovery rate over time is shown graphically in Figure 2.3-3 and presented in Table 2.3-2. The hydrocarbon recovery rate was calculated by multiplying the TPH-GRO concentration from individual SVE-discharged air samples by the SVE airflow rate at that time. Figure 2.3-3 shows the TPH-GRO recovery rate decreasing over time. Initial recovery rates were over 100 lb/day, with a peak of over 200 lb/day. During the last two months of operation, the TPH-GRO recovery rate had decreased to less than 1 lb/day. This trend indicated that the SVE system was no longer removing substantial contaminant mass. As subsurface air was extracted, the volatile constituents of the contamination were removed, leading to additional volatile components of the contaminant mass entering the gaseous phase to maintain the equilibrium. After approximately 14 months of operation, the system had largely removed the highly volatile components of the contamination in the areas affected by the system air flow. Upon reaching the point of an asymptotic removal rate, system operation can sometimes be further enhanced by switching to a pulsed operation; the system is turned off to allow subsurface vapor concentrations to rebound and is then reactivated and operated for a short period of time. At AOC 0-027 the system was turned off in January 2004; turned on March 30, 2004, and operated for 3 days; turned off for 3 days; and finally turned on and operated for approximately 3 months. The contaminant mass removal rate did not substantially increase in response to the pulsed operation. Because the contaminant removal rate had reached an overall asymptotic level, the SVE system operation was terminated on July 13, 2004.

Figure 2.3-3 also illustrates the cumulative pounds of hydrocarbons removed over the operational period from November 2002 to July 2004. The screening data, operational data (airflow and hours of operation), and cumulative mass removed are presented in Table 2.3-2. The cumulative pounds of hydrocarbons removed have been estimated based on the operating schedule as noted in the field notes, allowing for periods of known system downtime. It is estimated that 15,877 lb of TPH-GRO were removed by the SVE system at AOC 0-027 over the 20-month period of operation. Based on the weight ratio of benzene to TPH-GRO in the 2002 borehole samples, it is estimated that 95 lb of benzene were removed from the subsurface. Benzene was analyzed in the Tedlar screening samples beginning in June 2003. It was not analyzed before June 2003 because the SVE system was removing a large amount of benzene.

2.3.3 Confirmatory Sampling Data Review

Twenty-seven samples plus one field duplicate were collected in 2002 from eight boreholes at AOC 0-027. Twenty-seven samples plus one field duplicate sample were collected in 2004 from eight additional boreholes placed near the locations of the 2002 boreholes. Table 2.3-1 summarizes the samples collected in 2002 and 2004. Analysis request numbers for each sample are listed in the table.

The data used in this review and in the screening assessment for AOC 0-027 include the 2002 inorganic chemical and the 2004 organic chemical data. The 2002 organic data were not used in the screening assessment because the SVE system reduced and redistributed the organic chemicals; therefore, the 2002 organic chemical data do not represent current site conditions. The samples collected in 2004 were not analyzed for inorganic chemicals because the SVE operation is unlikely to have affected the distribution of inorganic chemicals. All data used quantitatively to identify chemicals of potential concern (COPCs) at AOC 0-027 were subjected to, and have met, ENV-RS quality assurance/quality control requirements.

The data review process for identifying COPCs began with a comparison of site data with naturally occurring background concentrations for inorganic chemicals and an evaluation of detection status for organic chemicals.

Background evaluations compared site inorganic chemical data to an established background data set for the Los Alamos area (LANL 1998, 59730). Organic chemical data were evaluated for detection status only. For background comparisons, the first step was to compare the site data with a background value (BV), which is a statistical upper confidence limit value for the background data set. If a site-specific datum exceeds its BV, additional evaluation of the datum may be performed by comparing the range of values in the site data set to the range of values for that chemical in the background data set. Sample concentrations that fall within the range of the concentrations in the background data set are not different from background.

2.3.3.1 Inorganic Chemical Comparison with BVs

Twenty-seven tuff samples were analyzed for TAL metals at AOC 0-027 in 2002. Sample concentrations were compared with the BV for Bandelier Tuff, Tshirege Member, Unit 3 (Qbt 3) (LANL 1998, 59730). Table 2.3-3 presents the frequency of detected inorganic chemicals above BV in tuff.

Ten inorganic chemicals (aluminum, barium, calcium, cobalt, copper, lead, magnesium, nickel, selenium, and thallium) were detected above the Qbt 3 BV in at least one sample. Table 2.3-4 presents all samples with inorganic chemicals detected above their respective BVs. Calcium, cobalt, copper, nickel, and selenium were each detected above the BV in only one sample. Of the inorganic chemicals with sample values greater than the BV, aluminum and magnesium are within the range of the background data set and are not retained as COPCs.

The maximum values for cobalt, copper, nickel, selenium, and thallium are less than 1 mg/kg above the BV. These analytes are not different from BVs and are not retained as COPCs.

Calcium does not have a published toxicity value, but is among those elements identified in Section 5.9.4 of the “Risk Assessment Guidance for Superfund” (EPA 1989, 08021) as essential macronutrients. The maximum value of calcium in the samples is 8030 mg/kg, which is less than twice the BV of 7340 mg/kg. Therefore, following the “Risk Assessment Guidance for Superfund,” calcium is not expected to result in adverse heath effects and is not discussed further.

Barium and lead are retained as COPCs.

2.3.3.2 Evaluation of Organic Chemicals

Twenty-five tuff samples and two fill samples were analyzed for SVOCs, VOCs, TPH-DRO, and TPH-GRO in 2004. Table 2.3-5 presents the frequency of detected organic chemicals in fill and tuff.

Twenty-two organic chemicals were detected in the fill and tuff samples. All samples with detected organic chemicals are presented in Table 2.3-6. Three of these organic chemicals (acetone, TPH-DRO, and TPH-GRO) were detected in over half the samples collected. All 22 detected organic chemicals presented in Table 2.3-4 are retained as COPCs.

Twenty-seven tuff samples were analyzed for SVOCs, VOCs, TPH-DRO, and TPH-GRO in 2002. Table 2.3-7 presents the frequency of detected organic chemicals in tuff samples in 2002. Twenty-three organic chemicals were detected in the tuff. This table is provided for informational purposes only because the 2002 organic data do not represent current site conditions. Notably, the maximum concentration of benzene decreased from 87 mg/kg in 2002 to 2.76 mg/kg in 2004.

2.3.4 Revised Site Conceptual Model

The preliminary conceptual model for AOC 0-027 is described in Section 2.2.2, and the revised site conceptual model remains unchanged. The preliminary conceptual model identified potential leaks from the former fuel-tank farm and from the drums and lines at the former drum storage area as the release mechanisms.

The purpose of the SVE system was to reduce the total concentration of the volatile fraction of the contaminant mass by removing vapor-phase chemicals present in the pore gas. The removal of benzene and other volatile chemical mass from the subsurface soils was expected to reduce risk.

2.3.4.1 Nature and Extent of Contamination

The nature and extent of contamination at AOC 0-027 have been defined by the environmental samples collected in 1996, 2002, and 2004. The extent was determined by the spatial distribution of the boreholes.

The COPCs identified by the data review for fill and tuff include barium; lead; acetone; benzene; benzoic acid; 2-butanone; n-butylbenzene; sec-butylbenzene; di-n-butylphthalate; ethylbenzene; n-isopropylbenzene; 4-isopropyltoluene; methylene chloride; 2-methylnaphthalene; naphthalene; phenol; 1-propylbenzene; toluene; TPH-DRO; TPH-GRO; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,2-xylene; and total xylenes (xylene[1,3-] + xylene[1,4-]).

TPH, both DRO and GRO, are present in the subsurface at AOC 0-027. TPH does not have an associated toxicity value. Rather, it is the constituent chemicals (VOCs or SVOCs) typically occurring in petroleum mixtures that result in associated risk.

In 1996, 20 boreholes were drilled and sampled (Figure 2.2-1). The data were used to bias the 2002 SVE extraction and monitoring wells but are not being used in the nature-and-extent discussion because they do not represent current site conditions. All the data are included in Appendix A, but the 1996 data and the 2002 organic data are for informational purposes only. The inorganic chemical data from the samples around the perimeter of the site show that inorganic chemicals were either not detected or detected at levels below background.

The 2002 inorganic COPCs (barium and lead) were detected above their respective BV ranges but at low levels in the tuff (Figure 2.3-4). The maximum value for barium was 212 mg/kg, and the maximum value

for lead was 123 mg/kg. The majority of the detected inorganic chemicals were found in the central locations (00-02-19576, 00-02-19578, and 00-02-19580), where the organic chemicals were also detected. The five highest concentrations of lead were detected at Location 00-02-19578. The highest concentration of barium was detected at Location 00-02-19580. Figure 2.3-4 shows that the perimeter locations have either inorganic chemicals below BV or inorganic chemicals at very low levels.

Detected organic chemicals are shown in Figure 2.3-5. The highest levels of TPH-DRO, TPH-GRO, benzene, the xylenes, ethylbenzene, and the trimethylbenzenes were detected in Locations 00-22861 and 00-22857, which are located in the center of the site. These contaminants decrease in concentration away from these center points. The COPCs also decreased in concentration with depth from each maximum value. Therefore, vertical and lateral extent has been defined.

2.3.4.2 Environmental Fate and Transport

The evaluation of environmental fate addresses the chemical processes that affect the persistence of a chemical in the environment. The evaluation of transport addresses the physical processes affecting mobility along the migration pathway. Infiltration into soils and tuff depends on the rate of precipitation or snowmelt, antecedent soil moisture status, depth of soil, and soil hydraulic properties. Infiltration into the tuff also depends on the unsaturated flow properties of the tuff. Joints and fractures in the tuff may provide additional pathways for moisture to enter the subsurface regime. In the case of AOC 0-027, most of the surface of the site is paved with concrete, so infiltration is not likely to contribute significantly to contaminant transport.

Properties such as vapor pressure and solubility in water are important in evaluating organic chemical mobility. The following information, summarized from Ney (1995, 58210), is presented to illustrate some aspects of the fate and transport tendencies of organic chemicals.

Water solubility. Water solubility is perhaps the most important chemical characteristic used to assess mobility of organic chemicals. The higher the water solubility of a chemical, the more likely it is to be mobile and the less likely it is to accumulate, bioaccumulate, volatilize, or persist in the environment. A highly soluble chemical (>1000 mg/L) is prone to biodegradation and metabolism that may detoxify the parent chemical. Acetone; benzene; benzoic acid; 2-butanone; 4-methyl-2-pentanone; methylene chloride; phenol; 1,1,2-trichloroethane; and 1,3,5-trimethylbenzene have water solubilities greater than 1000 mg/L. Toluene's water solubility is 558 mg/L, which means that it is also mobile, although less so than acetone.

The lower the water solubility of a chemical (especially <10 mg/L), the more likely it will be immobilized through adsorption. Such chemicals tend to be more accumulative or bioaccumulative, persistent in the environment, are slightly prone to biodegradation, and may be metabolized in plants and animals. Dibenzofuran, di-n-butylphthalate, and phenanthrene have low water solubilities.

Vapor pressure. Chemicals with vapor pressure greater than 0.01 millimeter mercury (mm Hg), such as acetone; benzene; 2-butanone; n-butylbenzene; sec-butylbenzene; ethylbenzene; isopropylbenzene; 4-methyl-2-pentanone; methylene chloride; 2-methylnaphthalene; 1-propylbenzene; toluene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,2-xylene; and xylene (total) are more likely to volatilize and diffuse through the soil pore gas, with potential release to the atmosphere. Chemicals with vapor pressures less than 0.000001 mm Hg are less likely to volatilize and therefore tend to remain immobile.

The BTEX COPCs have vapor pressures greater than 0.01 mm Hg, indicating that the SVE system should have been able to volatilize these COPCs and remove them from the subsurface.

Octanol water partition coefficient. The octanol water partition coefficient (K_{ow}) is an indicator of the bioaccumulation or bioconcentration potential of a chemical in the fatty tissue of living organisms. The unitless K_{ow} value is an indicator of water solubility, mobility, sorption, and bioaccumulation. The higher the K_{ow} (>1000), the greater the affinity of the chemical to bioaccumulate/bioconcentrate in the food chain, the greater its potential for sorption in soil, and the lower its mobility (Ney 1995, 58210). Organic COPCs with a K_{ow} of greater than 1000 include n-butylbenzene; sec-butylbenzene; dibenzofuran; di-n-butylphthalate; ethylbenzene; isopropylbenzene; 4-isopropyltoluene; 2-methylnaphthalene; naphthalene; phenanthrene; 1-propylbenzene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,2-xylene; and total xylenes.

A K_{ow} of less than 500 indicates high water solubility, mobility, little to no bioaccumulation, and degradability by microbes, plants, and animals. Organic COPCs with a K_{ow} of less than 500 are acetone, benzene, benzoic acid, 2-butanone, 4-methyl-2-pentanone, methylene chloride, phenol, toluene, and 1,1,2-trichloroethane. Table 2.3-8 shows the water solubilities, the vapor pressure, and K_{ow} for the organic COPCs.

2.4 Site Assessments

2.4.1 Human Health Screening Assessment

The human health screening assessment was performed according to guidance from NMED (NMED 2004, 85615) and EPA (2004, 87478). The assessment consisted of four parts: scoping, screening evaluation, uncertainty analysis, and interpretation.

(a) Scoping

Land use at AOC 0-027 currently results in a limited social exposure and is expected to remain the same for the reasonably foreseeable future. The potential for human exposure to residual concentrations of chemicals in the environment at the site is moderate to low because the contaminants are beneath a concrete parking lot. The site is open to the public, although it is used mainly by members of the Knights of Columbus. Occasionally members of the public walk across the property.

Although a residential scenario is unlikely under current and projected future site conditions, the potential present-day risks were evaluated using this scenario for informational purposes only. An industrial scenario is presented also, because it represents a more realistic exposure scenario than the residential scenario. The soil screening levels (SSLs) used in the screening evaluation reflect an industrial scenario that is based on an exposure of 8 hr/day and 225 day/yr. In reality, the Knights of Columbus Hall is typically used, at most, 6 hr/week, which is the equivalent of one-fifth of the industrial-scenario exposure.

Sample values to a depth of 12 ft were considered in this evaluation because material (tuff and fill) from that depth could be excavated and brought to the surface for exposure.

(b) Screening Evaluation

The maximum concentrations of each COPC in the 0–12-ft depth were used in the screening assessments. Because only eight samples were collected from this depth profile in 2004, a 95% upper confidence limit could not be calculated to represent the site concentrations. Because a remedial action has been conducted at the site, the data from previous sampling (i.e., 1996 and 2002) no longer represent the site characteristics for organic chemicals. The 2002 inorganic chemical data were used in the screening assessment along with the 2004 organic chemical data.

A total of 24 COPCs were identified at AOC 0-027 based on the data review. Using only the COPCs from the surface to a depth of 12 ft reduces the number of COPCs to 21 (benzoic acid, di-n-butylphthalate, and phenol were not detected in the upper 12 ft). The remaining 21 COPCs are evaluated further in this section by comparing the maximum value from the site data to the chemical-specific SSL for each chemical. The residential and industrial SSLs are from NMED (NMED 2004, 85615), but if NMED has not provided SSLs for some chemicals, EPA Region 6 values (EPA 2004, 87478) are used and adjusted as necessary. In addition, if NMED provided only the saturated value, then the SSL is calculated using Equation 1 (p. 10) for the residential scenario and Equation 7 (p. 15) for the industrial scenario from the NMED technical background document (NMED 2004, 85615) to obtain risk-based values.

The SSLs for noncarcinogens are based on a hazard index (HI) target of 1.0. The SSLs for carcinogens are based on a cancer risk target of 10^{-5}. The representative concentration (maximum) for each COPC was compared with the SSL for carcinogens, and with 0.1 SSL for noncarcinogens because more than one noncarcinogenic COPC has been identified.

TPH does not have an associated toxicity. Rather, it is the constituent chemicals (volatile or semivolatile COPCs) typically occurring in petroleum mixtures that result in associated risks. Therefore, TPH-DRO and TPH-GRO are not discussed further in the screening assessment.

Some chemicals (4-isopropyltoluene and 2-methylnaphthalene) do not have toxicity values published in EPA's Integrated Risk Information System (IRIS) database, Health Effects Assessment Summary Tables, or by EPA's National Center for Environmental Assessment. For those chemicals, surrogate chemical toxicity values have been used based on similarity in chemical structure (NMED 2003, 81172; EPA 1989, 08021). The SSLs for these surrogates were used to evaluate whether the COPCs (4-isopropyltoluene and 2-methylnaphthalene) should be retained. In both cases, the maximum value of the COPC is less than 0.1 SSL. Therefore, both 4-isopropyltoluene and 2-methylnaphthalene are retained.

The HI (the sum of the ratios of maximum concentrations divided by the SSL) for the noncarcinogenic COPCs is approximately 5.4 for the residential scenario (see Table 2.4-1), which is greater than the target HI of 1.0. The industrial HI for the noncarcinogenic COPCs is approximately 1.5. Appendix B presents the residential and industrial HIs based on the 2002 data to show the decrease in risk that resulted from the VCA (see Table B-1 in Appendix B). The residential HI decreased from approximately 9.6 in 2002 to 5.4 in 2004. The industrial HI decreased from approximately 2.6 in 2002 to 1.5 in 2004.

The representative concentrations of the carcinogenic COPCs benzene, ethylbenzene, and methylene chloride were less than their SSLs. The total potential excess cancer risk from exposure to carcinogenic COPCs at AOC 0-027 is approximately 1.2×10^{-6} for the residential scenario and 4.5×10^{-7} for the industrial scenario (see Table 2.4-2). Both values are less than the NMED target risk level for carcinogenic risk of 1 in 100,000 (1×10^{-5}) (NMED 2004, 85615). Comparing the risk from carcinogenic COPCs based on 2004 data to the risk based on 2002 data (Table B-2) shows a decrease of approximately an order of magnitude for both the industrial and the residential scenarios.

(c) Uncertainty Analysis

The analysis presented in this human health screening assessment is subject to varying degrees and kinds of uncertainty. The uncertainties associated with the data evaluation, exposure assessment, toxicity assessment, the additive approach, and the use of surrogates may affect the results.

Data-evaluation and COPC-identification process. Uncertainties associated with the data may include sampling errors, laboratory analysis errors, and data analysis errors. For this site, these uncertainties are

expected to have little effect on the results even though the detected concentrations of some organic COPCs were qualified J (estimated), because the values were less than estimated quantitation limits.

Using the maximum value within the upper 12 ft bgs as the representative concentration for each COPC overestimates the risk at the site because a large number of the samples are nondetects. This overestimation is especially true of the risk drivers at the site (1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, toluene, 1,2-xylene, and total xylene). For example, 1,2,4-trimethylbenzene had two detected values (2.43 and 95.4 mg/kg) and the remaining seven nondetects were less than 0.12 mg/kg.

Exposure assessment. Uncertainties and biases were identified in four areas of the exposure-assessment process.

- *Identification of receptors.* Land-use and activity patterns are represented by those activities assumed by the residential and industrial land-use scenarios; however, the receptor is not exposed in the same manner as used to derive the SSLs. Because the potentially exposed individual is not likely to be on-site for 8 hr/day for 225 day/yr as assumed by the industrial scenario, the screening assessment overestimates the exposure and subsequently overestimates the current potential hazard and risk. The maximum amount of time that a given person spends at the Knights of Columbus Hall building is estimated as 6 hr/week for 52 weeks (4 hr/month at meetings, 4 hr/month at board of directors meetings, and 4 hr/week at social/recreational functions). Thus, the exposure risk calculated by using the industrial scenario is almost 6 times greater than the true risk to site personnel. If the HI is conservatively reduced by one-fifth to more closely reflect the actual amount of time spent on the site, then the HI would be approximately 0.3, well under the NMED target. Even this estimate is extremely conservative, considering that the maximum contaminant concentrations are beneath the parking lot. The time of potential exposure in the parking lot (as opposed to inside the building) would be much less than the estimated 6 hr/week spent at the site.

- *Exposure pathway assumptions.* For each exposure pathway, assumptions are made concerning the parameters, the routes of exposure, the amount of contaminated media to which an individual can be exposed, and intake rates for different routes of exposure. In the absence of site-specific data, the assumptions used are consistent with EPA-approved parameters and default values (NMED 2004, 85615; EPA 2004, 87478). When several upper-bound values are combined to estimate exposure for any one pathway, the resulting risks can be in excess of the 99th percentile and therefore outside the range that may be reasonably expected.

Toxicity values. The primary uncertainty associated with the screening values is related to the derivation of toxicity values used in the calculation. EPA toxicity values (reference doses [RfDs] and slope factors [SFs]) were used to derive the screening values used in this risk-screening assessment (EPA 2001, 70109; EPA 1997, 58968). Uncertainties were identified in three areas with respect to the toxicity values: (1) extrapolation from animals to humans, (2) extrapolation from one route of exposure to another route of exposure, and (3) interindividual variability in the human population.

- *Extrapolation from animals to humans*. The SFs and RfDs are often determined based on extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist in chemical absorption, metabolism, excretion, and toxic response between animals and humans. The EPA takes into account differences in body weight, surface area, and pharmacokinetic relationships between animals and humans to minimize the potential to underestimate the dose-response relationship. However, the EPA and researchers usually incorporate more conservatism into these steps.

- *Extrapolation from one route of exposure to another route of exposure*. The SFs and RfDs often contain extrapolations from one route of exposure to another. The extrapolation from the oral route to the inhalation and/or the dermal route is used in the derivation of some screening values. Differences in chemical absorption and/or toxicity between the two exposure routes could result in an over- or underestimation of risk or hazard.

- *Interindividual variability in the human population*. For noncarcinogenic effects, the amount of human variability in physical characteristics is important in determining the risks that can be expected at low exposures and in determining the no observed adverse effect level (NOAEL). The NOAEL/uncertainty-factor approach incorporates a 10-fold factor to reflect the possible interindividual variability in the human population and is generally considered a conservative estimate.

Additive approach. For noncarcinogens, the effects of a mixture of chemicals are generally unknown and possible interactions could be synergistic or antagonistic, thereby overestimating or underestimating the risk. Additionally, the RfDs for different chemicals are not based on the same severity, effect, or target organ. Therefore, the potential for occurrence of noncarcinogenic effects can be overestimated for chemicals that act by different mechanisms and on different target organs but are addressed additively.

Use of surrogate chemicals. Some chemicals do not have EPA-approved or provisional toxicity values. In these cases a similar chemical with available toxicity value is used as a surrogate. At this site, isopropylbenzene was used as a surrogate for 4-isopropyltoluene based on its structural similarity (NMED 2003, 81172). The difference between the two chemicals is a carbon molecule for 2-isopropyltoluene, which makes 4-isopropyltoluene more reactive. Although this substitution may underestimate the risk from 4-isopropyltoluene, it is not a major contributor to risk at the site (residential hazard quotient [HQ] of 9.9E-03 and industrial HQ of 2.5E-03).

Also, at this site, naphthalene was used as a surrogate for 2-methylnaphthalene based on its structural similarity (NMED 2003, 81172). The difference between the two chemicals is a carbon molecule in the number three position for 2-methylnaphthalene, which makes 2-methylnaphthalene more reactive. Although this substitution may underestimate the risk from 2-methylnaphthalene, it is not a major contributor to risk at the site (residential HQ of 4.4E-02 and industrial HQ of 1.0E-02).

(d) Interpretation

Based on a residential scenario, the HI (5.4) for noncarcinogenic COPCs, calculated from 2002 inorganic chemical data and 2004 organic chemical data, is greater than NMED's target level of 1.0 but approximately half the initial HI (based on 2002 inorganic and organic chemical data) of 9.6. The carcinogenic risk (1.2×10^{-6}) was reduced by an order of magnitude to less than NMED's target level of 1×10^{-5}.

Based on an industrial scenario, the HI (1.5) for noncarcinogenic COPCs is approximately the same as NMED's target level of 1.0. The industrial scenario (potentially exposed individual on-site for 1800 hr/yr) represents at least a 5-fold overestimate of the realistic maximum exposure time for AOC 0-027 (approximately 312 hr/yr). The carcinogenic risk (4.5×10^{-7}) under the industrial scenario is less than NMED's target level of 1×10^{-5}.

The corrective action resulted in significant reductions in risk to humans from both noncarcinogens and carcinogens.

2.4.2 Ecological Screening Assessment

Because the only observed ecological receptors at the site are ants, an ecological screening assessment was not conducted. No viable pathways for ecological receptors exist because most of the site is paved.

2.4.3 Other Applicable Assessments

2.4.3.1 Surface Water

AOC 0-027 has an erosion matrix potential score of 17.5, indicating low potential for erosion (see Appendix C). There is evidence of a man-made depression for runoff from the parking lot, which results in a surface water runoff subscore of 6.9. The sloped roof of the Knights of Columbus Hall building is a source for run-on, which gives a run-on subscore of 7.0. Over 75% of the site is paved. The site does have a gentle (<10%) slope to the northeast toward DP Canyon.

2.4.3.2 Groundwater

The regional aquifer beneath AOC 0-027 is at an elevation of approximately 5900 ft (as determined in Test Well 2 in Pueblo Canyon and in Otowi Well 4 in Los Alamos Canyon), chiefly within sediments of the Puye and Tesuque Formations (Purtymun 1995, 45344; Broxton et al. 1995, 50119). At AOC 0-027, the regional aquifer is approximately 1200 ft bgs. Runoff or infiltration from the AOC is not likely to reach the regional aquifer. No perched or alluvial groundwater has been identified beneath AOC 0-027.

2.4.4 Conclusions and Recommendations

Operation of the SVE system at AOC 0-027 over a 20-month period resulted in removing over 7200 kg (15,877 lb) of TPH from the subsurface. Of this, approximately 43 kg (95 lb) of benzene, the contaminant of greatest concern prior to the SVE, was removed.

As a result of the removal of organic vapors, the human health risk (based on an industrial scenario) at the site was reduced by an order of magnitude for carcinogenic COPCs, and by nearly half for noncarcinogenic COPCs, as shown in Tables 2.4-1 and 2.4-2. The carcinogenic risk (4.5×10^{-7}) is less than the NMED target of 1×10^{-5}. While the HI for noncarcinogens (1.5) is slightly greater than the NMED target of 1.0, the calculated HI is based on the maximum detected concentrations of noncarcinogenic COPCs rather than a 95% upper-confidence limit. For this reason, the HI is considered very conservative in this case.

In addition, although an industrial scenario was used to calculate risk for the site, the actual use of the site is much more limited. The Knights of Columbus Hall is used for activities for only a few hours at a time, typically once or twice a week, for approximately 6 hours total per week. Further, the majority of the residual contamination, and the highest concentrations, are located beneath the concrete parking lot rather than beneath the building itself, so that users of the building are not expected to be exposed to potential contamination for even 6 hr/week. Land use for the site is expected to continue without significant change for the foreseeable future. For these reasons, the industrial scenario is considered extremely conservative and is likely to greatly overestimate the actual risk at the site.

No complete pathways for ecological receptors occur at the site because all the contamination is in the subsurface and because the affected area of the site is paved with concrete.

Accordingly, AOC 0-027 is recommended for no further action. The AOC has been remediated in accordance with current and applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected land use.

3.0 WASTE MANAGEMENT

The waste generated during the VCA consisted of drill cuttings from the boreholes drilled in 2002 and fill material excavated from the trench used to install lines connecting the three extraction wells. This material consisted of tuff and fill with varying amounts of petroleum contamination. After characterization, the material was disposed of as New Mexico Special Waste at an approved facility. The total volume of waste was less than a single 20-yd^3 rolloff container.

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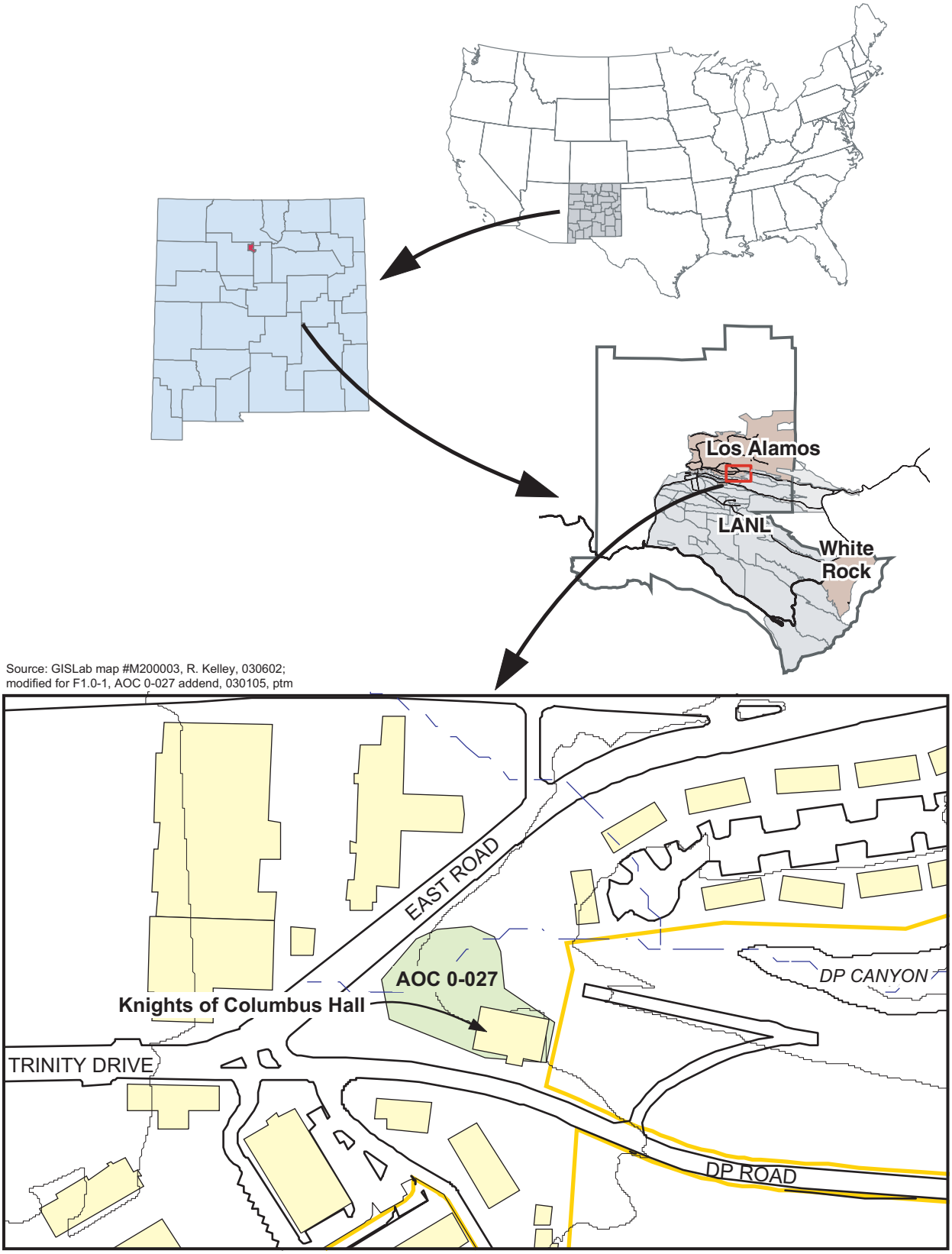

Figure 1.0-1. Locations of New Mexico, the Laboratory, and AOC 0-027

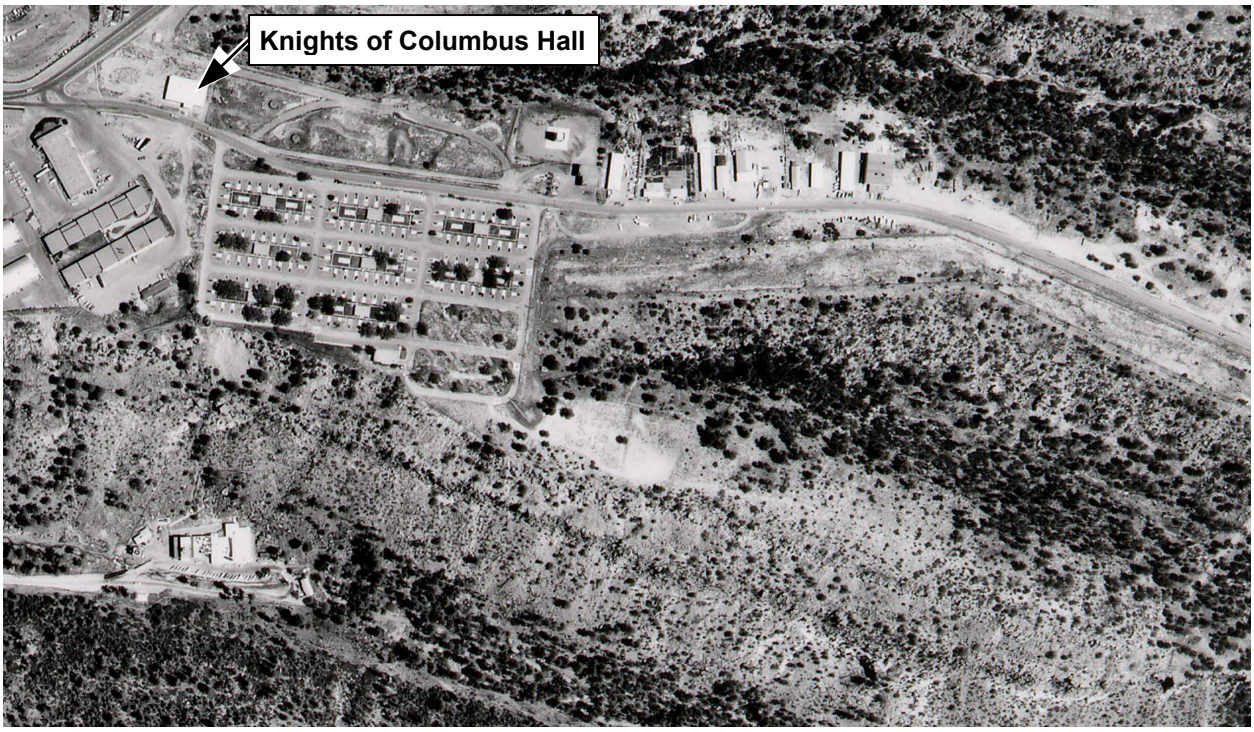

Figure 2.1-1. 1965 aerial photograph showing AOC 0-027

Figure 2.1-2. 1974 aerial photograph showing AOC 0-027

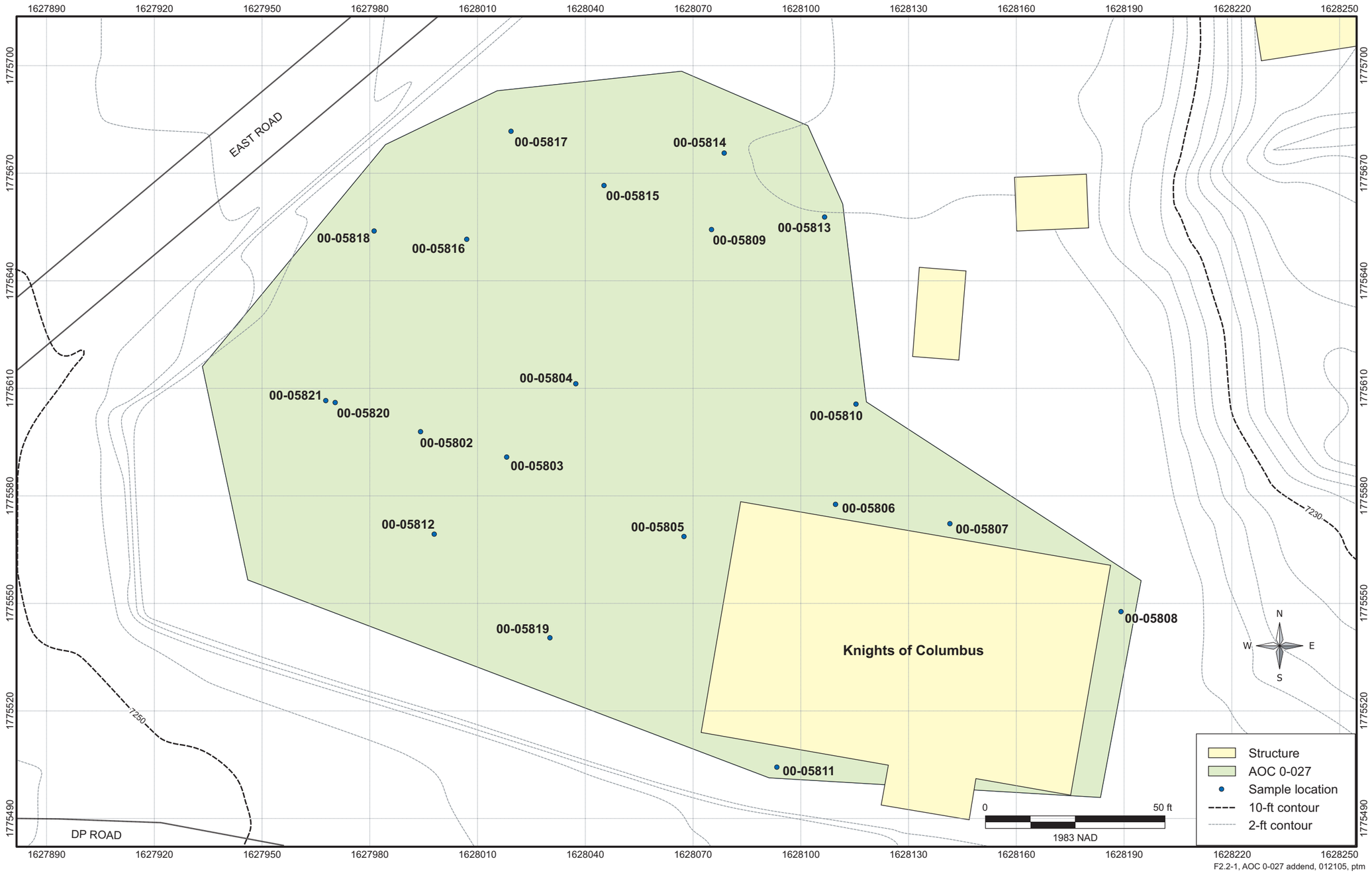

Figure 2.2-1. 1996 boreholes at AOC 0-027

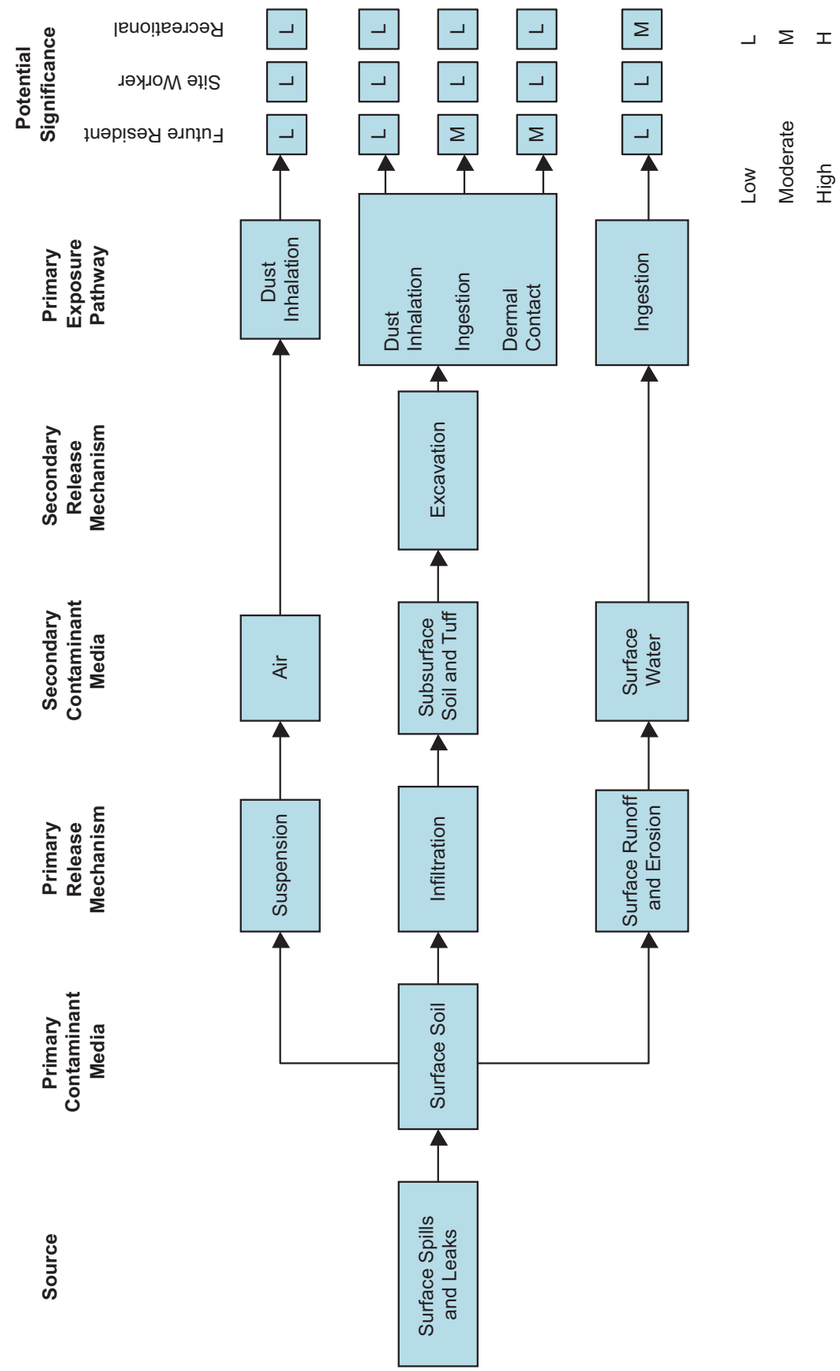

Figure 2.2-2. Preliminary conceptual model for AOC 0-027

Figure 2.3-1. 2002 boreholes at AOC 0-027

Figure 2.3-2. 2004 boreholes at AOC 0-027

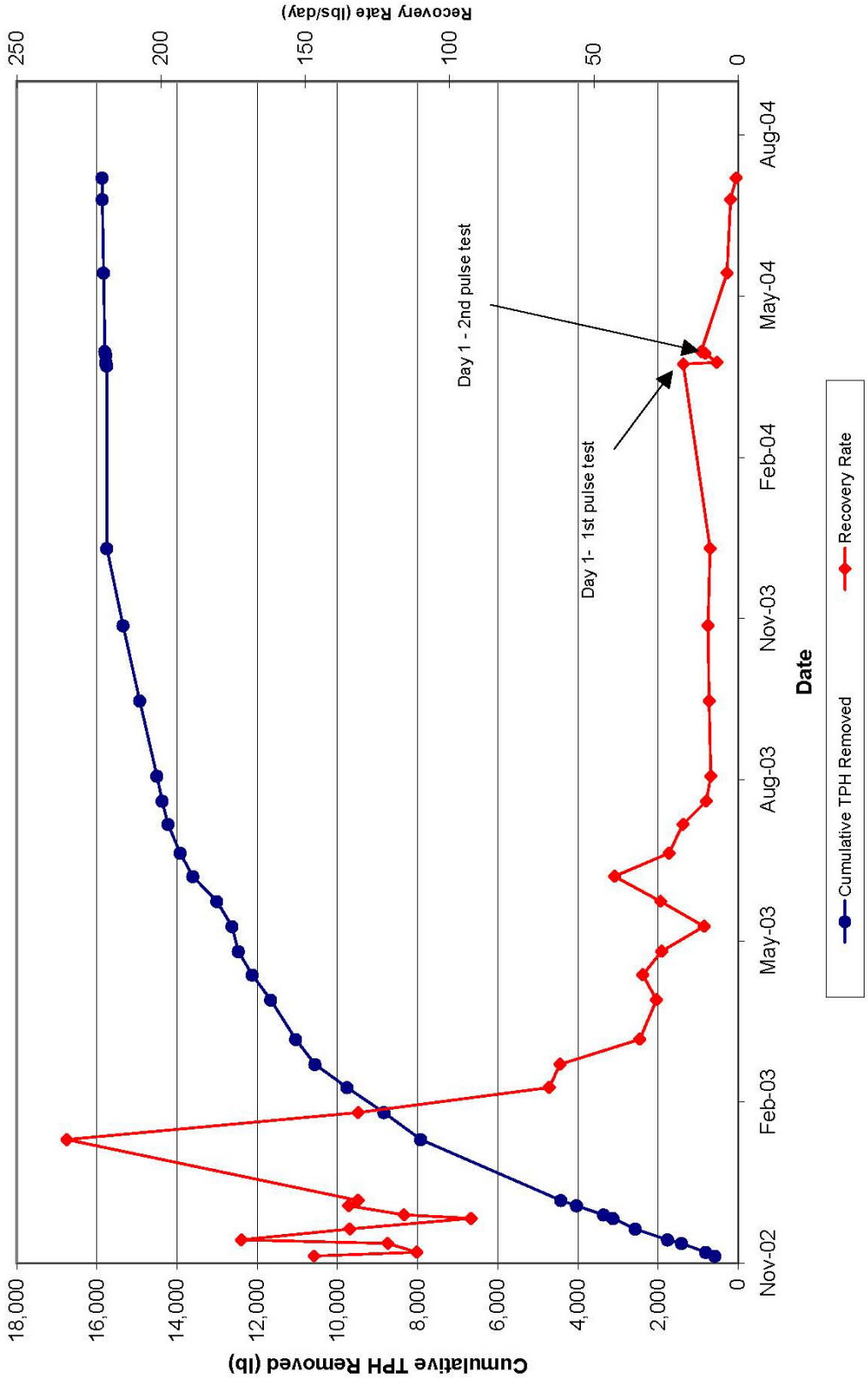

Figure 2.3-3. TPH removal rate and cumulative mass removed at AOC 0-027

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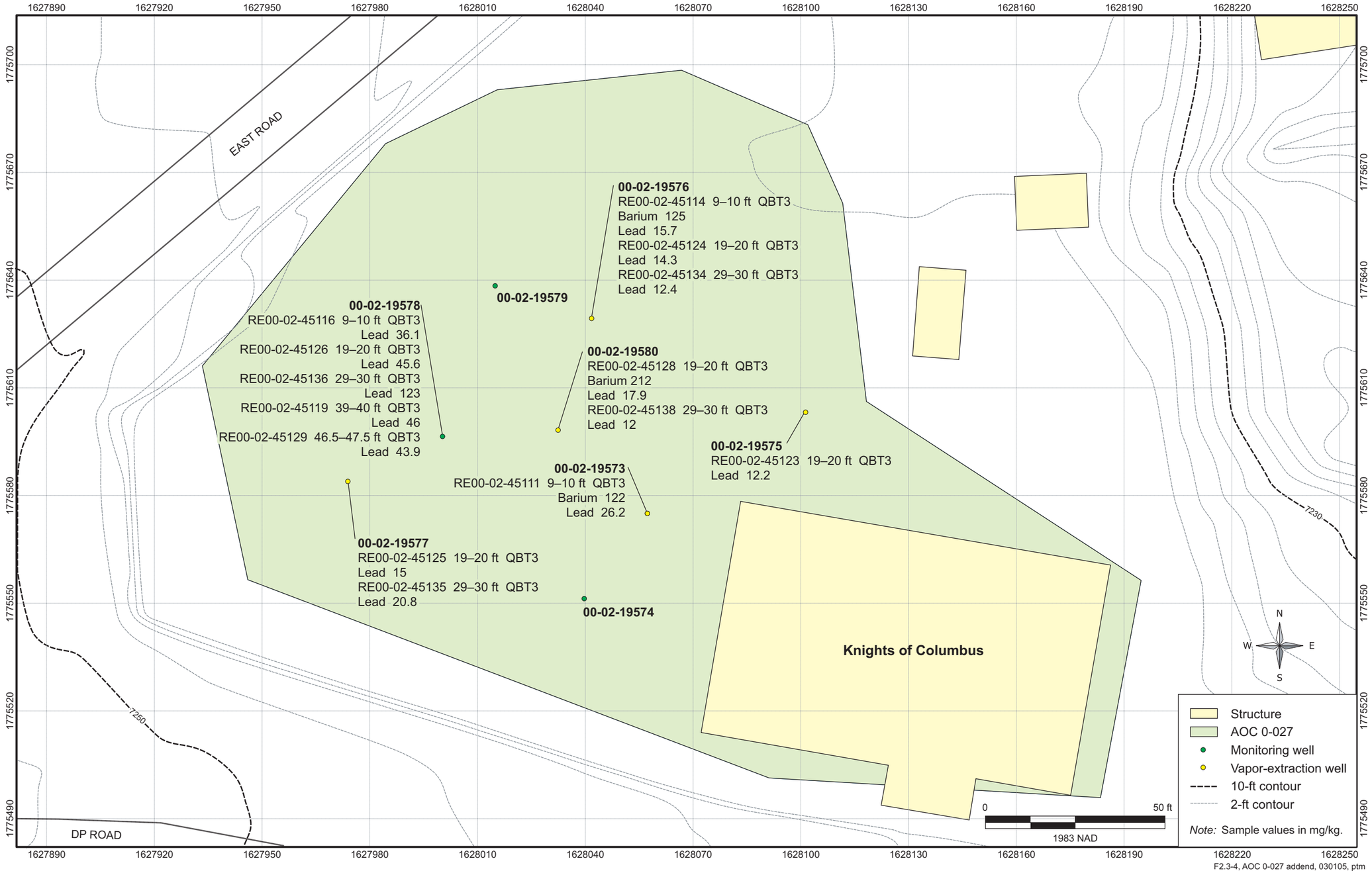

Figure 2.3-4. Inorganic chemicals detected above BVs at AOC 0-027 in 2002

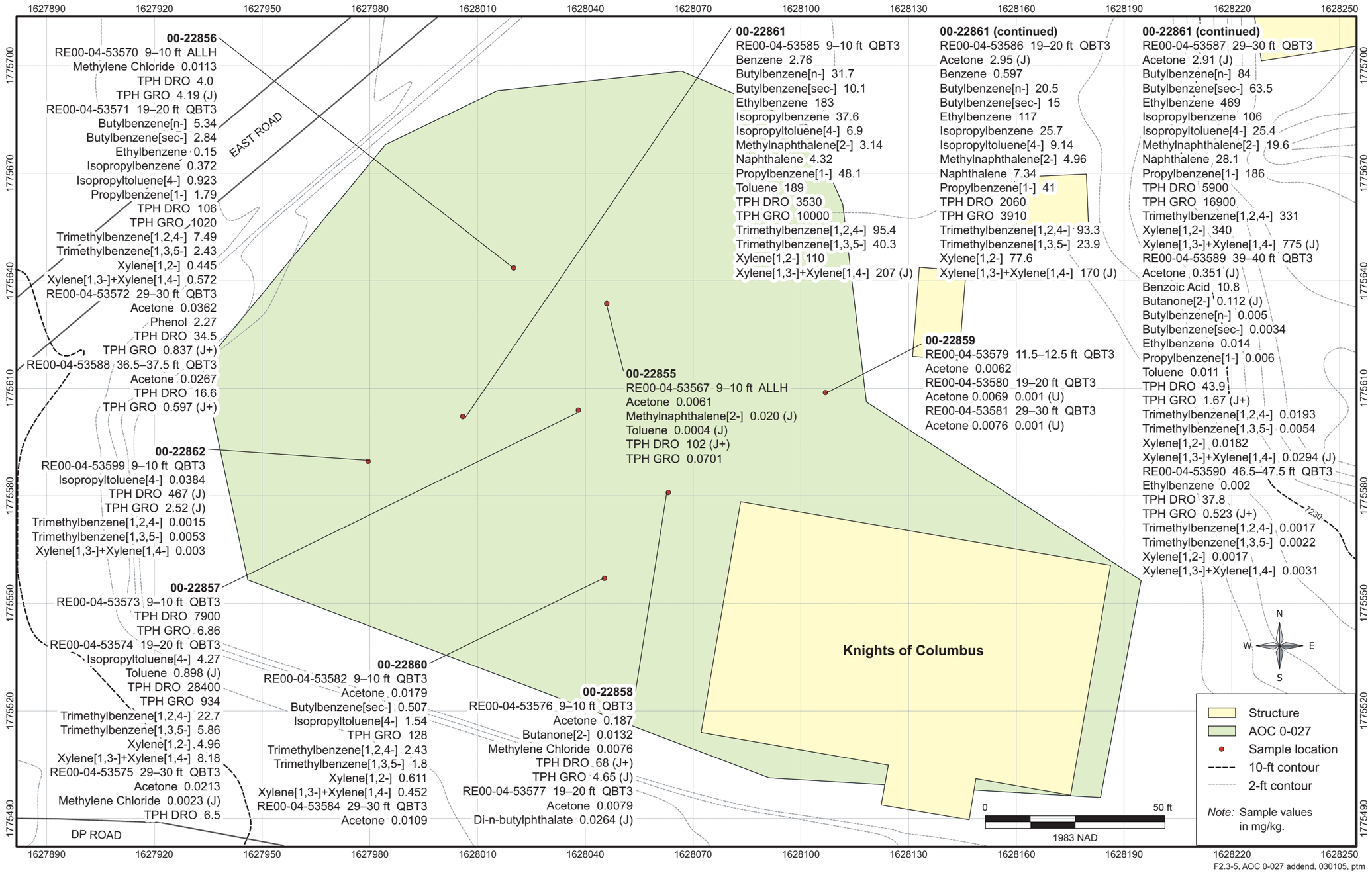

Figure 2.3-5. Organic chemicals detected at AOC 0-027 in 2004

Table 2.3-1
Summary of Soil and Tuff Samples Collected at AOC 0-027 in 2002 and 2004

Location ID	Sample ID	Depth (ft)	Media	Metals	SVOCs	TPH-DRO	TPH-GRO	VOCs
2002								
00-02-19573	RE00-02-45111	9–10	Qbt 3	680S[a]	679S	679S	679S	679S
00-02-19573	RE00-02-45121	19–20	Qbt 3	680S	679S	679S	679S	679S
00-02-19573	RE00-02-45131	29–30	Qbt 3	680S	679S	679S	679S	679S
00-02-19574	RE00-02-45112	9–10	Qbt 3	682S	681S	681S	681S	681S
00-02-19574	RE00-02-45122	19–20	Qbt 3	682S	681S	681S	681S	681S
00-02-19574	RE00-02-45132	29–30	Qbt 3	682S	681S	681S	681S	681S
00-02-19575	RE00-02-45113	9–10	Qbt 3	684S	683S	683S	683S	683S
00-02-19575	RE00-02-45123	19–20	Qbt 3	684S	683S	683S	683S	683S
00-02-19575	RE00-02-45133	29–30	Qbt 3	684S	683S	683S	683S	683S
00-02-19576	RE00-02-45114	9–10	Qbt 3	686S	685S	685S	685S	685S
00-02-19576	RE00-02-45124	19–20	Qbt 3	686S	685S	685S	685S	685S
00-02-19576	RE00-02-45134	29–30	Qbt 3	686S	685S	685S	685S	685S
00-02-19577	RE00-02-45115	9–10	Qbt 3	694S	693S	693S	693S	693S
00-02-19577	RE00-02-45125	19–20	Qbt 3	694S	693S	693S	693S	693S
00-02-19577	RE00-02-45135	29–30	Qbt 3	694S	693S	693S	693S	693S
00-02-19578	RE00-02-45116	9–10	Qbt 3	698S	697S	697S	697S	697S
00-02-19578	RE00-02-45141	9–10	Qbt 3	698S	697S	697S	697S	697S
00-02-19578	RE00-02-45126	19–20	Qbt 3	698S	697S	697S	697S	697S
00-02-19578	RE00-02-45136	29–30	Qbt 3	698S	697S	697S	697S	697S
00-02-19578	RE00-02-45119	39–40	Qbt 3	698S	697S	697S	697S	697S
00-02-19578	RE00-02-45129	46.5–47.5	Qbt 3	700S	699S	699S	699S	699S
00-02-19579	RE00-02-45117	9–10	Qbt 3	702S	701S	701S	701S	701S
00-02-19579	RE00-02-45127	19–20	Qbt 3	702S	701S	701S	701S	701S
00-02-19579	RE00-02-45137	29–30	Qbt 3	702S	701S	701S	701S	701S
00-02-19579	RE00-02-45139	36.5–37.5	Qbt 3	702S	701S	701S	701S	701S
00-02-19580	RE00-02-45118	9–10	Qbt 3	704S	703S	703S	703S	703S
00-02-19580	RE00-02-45128	19–20	Qbt 3	704S	703S	703S	703S	703S
00-02-19580	RE00-02-45138	29–30	Qbt 3	704S	703S	703S	703S	703S
2004								
00-22855	RE00-04-53567	9–10	Fill	—[b]	2205S	2205S	2205S	2205S
00-22855	RE00-04-53568	19–20	Qbt 3	—	2205S	2205S	2205S	2205S
00-22855	RE00-04-53569	29–30	Qbt 3	—	2205S	2205S	2205S	2205S
00-22856	RE00-04-53570	9–10	Fill	—	2206S	2206S	2206S	2206S
00-22856	RE00-04-53571	19–20	Qbt 3	—	2206S	2206S	2206S	2206S
00-22856	RE00-04-53572	29–30	Qbt 3	—	2206S	2206S	2206S	2206S
00-22856	RE00-04-53588	36.5–37.5	Qbt 3	—	2206S	2206S	2206S	2206S

Table 2.3-1 (continued)

Location ID	Sample ID	Depth (ft)	Media	Metals	SVOCs	TPH-DRO	TPH-GRO	VOCs
00-22857	RE00-04-53573	9–10	Qbt 3	—	2207S	2207S	2207S	2207S
00-22857	RE00-04-53574	19–20	Qbt 3	—	2207S	2207S	2207S	2207S
00-22857	RE00-04-53575	29–30	Qbt 3	—	2207S	2207S	2207S	2207S
00-22858	RE00-04-53576	9–10	Qbt 3	—	2207S	2207S	2207S	2207S
00-22858	RE00-04-53577	19–20	Qbt 3	—	2235S	2235S	2235S	2235S
00-22858	RE00-04-53578	29–30	Qbt 3	—	2235S	2235S	2235S	2235S
00-22859	RE00-04-53579	11.5–12.5	Qbt 3	—	2234S	2234S	2234S	2234S
00-22859	RE00-04-53580	19–20	Qbt 3	—	2234S	2234S	2234S	2234S
00-22859	RE00-04-53581	29–30	Qbt 3	—	2234S	2234S	2234S	2234S
00-22860	RE00-04-53582	9–10	Qbt 3	—	2236S	2236S	2236S	2236S
00-22860	RE00-04-53583	19–20	Qbt 3	—	2236S	2236S	2236S	2236S
00-22860	RE00-04-53594	19–20	Qbt 3	—	2236S	2236S	2236S	2236S
00-22860	RE00-04-53584	29–30	Qbt 3	—	2236S	2236S	2236S	2236S
00-22861	RE00-04-53585	9–10	Qbt 3	—	2237S	2237S	2237S	2237S
00-22861	RE00-04-53586	19–20	Qbt 3	—	2237S	2237S	2237S	2237S
00-22861	RE00-04-53587	29–30	Qbt 3	—	2237S	2237S	2237S	2237S
00-22861	RE00-04-53589	39–40	Qbt 3	—	2237S	2237S	2237S	2237S
00-22861	RE00-04-53590	46.5–47.5	Qbt 3	—	2237S	2237S	2237S	2237S
00-22862	RE00-04-53599	9–10	Qbt 3	—	2238S	2238S	2238S	2238S
00-22862	RE00-04-53600	19–20	Qbt 3	—	2238S	2238S	2238S	2238S
00-22862	RE00-04-53601	29–30	Qbt 3	—	2238S	2238S	2238S	2238S

[a] Request number indicates that this analysis was requested.

[b] — = Analysis was not requested.

Table 2.3-2
TPH-GRO Removal Data from Tedlar Bag Screening Samples at AOC 0-027

Date	TPH (mg/m³)	Airflow Rate (scfm[a])	Cumulative Hours of Operation	TPH Removed In Period (lb)	Recovery Rate (lb/day)	Cumulative TPH Removal (lb)	Estimated. Cumulative Benzene Removal (lb)
15-Nov-02	0	127	0	0	0	0	0
19-Nov-02	12,944	127	96	588	147	588	4
21-Nov-02	6683	127	144	223	111	811	6
26-Nov-02	14,703	127	264	607	121	1419	10
28-Nov-02	15,617	127	312	344	172	1763	12
04-Dec-02	8090	127	456	808	135	2571	18
10-Dec-02	8231	127	600	556	93	3127	22
12-Dec-02	12,170	127	648	232	116	3359	24
17-Dec-02	11,607	127	768	675	135	4034	28
23-Jan-03	27,013	127	1200	3,491	233	7921	55
07-Feb-03	9321	50	1752	1,976	132	8843	62
21-Feb-03	9638	97	2088	919	66	9762	68
06-Mar-03	5909	85	2400	803	62	10,565	74
20-Mar-03	3138	85	2736	479	34	11,044	77
11-Apr-03	4924	74	3264	624	28	11,668	82
25-Apr-03	5100	74	3600	463	33	12,131	85
08-May-03	3553	60	3912	346	27	12,477	87
22-May-03	795	60	4224	155	12	12,632	88
05-Jun-03	9110	60	4560	378	27	13,010	91
19-Jun-03	5698	60	4896	600	43	13,610	95
02-Jul-03	3356	57	5208	313	24	13,923	95
18-Jul-03	4151	57	5592	307	19	14,230	95
31-Jul-03	352	56	5904	145	11	14,375	95
14-Aug-03	3553	54	6240	134	10	14,509	95
25-Sep-03	464	56	7248	426	10	14,934	95
06-Nov-03	3693	60	8190	414	11	15,348	95
19-Dec-03	1794	64	9178	404	10	15,752	95
30-Mar-04	4115	72	9178	[b]	[b]	15,752	95
31-Mar-04	1773	72	9202	19	19	15,771	95
01-Apr-04	524	72	9226	7	7	15,779	95
05-Apr-04	2381	74	9226	[b]	[b]	15,779	95
06-Apr-04	1263	67	9250	11	11	15,790	95
07-Apr-04	3025	67	9274	13	13	15,803	95
21-May-04	616	79	10,330	31	4	15,834	95
01-Jul-04	106	87	11,314	35	3	15,870	95
13-Jul-04	106[c]	85	11,528	7	1	15,877	95

[a] scfm = Standard cubic feet per minute.
[b] Beginning of pulsed test.
[c] TPH value assumed to be equal to the previous data.

Table 2.3-3
Frequency of Inorganic Chemicals Detected above BVs in Tuff Samples at AOC 0-027

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range* (mg/kg)	BV (mg/kg)	Frequency of Detects Above BV	Frequency of Nondetects Above BV
Aluminum	Qbt 3	27	27	346 to 8030	7340	2/27	0/27
Antimony	Qbt 3	27	18	0.11 to 0.24	0.5	0/27	0/27
Arsenic	Qbt 3	27	26	0.22 to 1.9	2.79	0/27	0/27
Barium	Qbt 3	27	27	3 to 212	46	3/27	0/27
Beryllium	Qbt 3	27	27	0.11 to 1.1	1.21	0/27	0/27
Cadmium	Qbt 3	27	24	0.0064 to [0.3]	1.63	0/27	0/27
Calcium	Qbt 3	27	27	101 to 3600	2200	1/27	0/27
Chromium	Qbt 3	27	17	[0.53] to 5.5	7.14	0/27	0/27
Cobalt	Qbt 3	27	27	0.21 to 3.7	3.14	1/27	0/27
Copper	Qbt 3	27	27	0.71 to 6.4	4.66	1/27	0/27
Iron	Qbt 3	27	27	1970 to 9870	14500	0/27	0/27
Lead	Qbt 3	27	26	3.7 to 123	11.2	14/27	0/27
Magnesium	Qbt 3	27	27	88 to 1820	1690	2/27	0/27
Manganese	Qbt 3	27	27	89.7 to 428	482	0/27	0/27
Mercury	Qbt 3	27	2	0.025 to [0.04]	0.1	0/27	0/27
Nickel	Qbt 3	27	27	0.41 to 7.3	6.58	1/27	0/27
Potassium	Qbt 3	27	18	216 to 1020	3500	0/27	0/27
Selenium	Qbt 3	27	27	0.13 to 0.31	0.3	1/27	0/27
Silver	Qbt 3	27	4	[0.029 to 0.24]	1	0/27	0/27
Sodium	Qbt 3	27	27	84.2 to 396	2770	0/27	0/27
Thallium	Qbt 3	27	26	0.036 to 2.1	1.1	2/27	0/27
Vanadium	Qbt 3	27	27	0.58 to 16.1	17	0/27	0/27
Zinc	Qbt 3	27	27	23.3 to 45	63.5	0/27	0/27

*Brackets indicate nondetected concentration.

Table 2.3-4
Inorganic Chemicals Detected above BVs in Tuff Samples at AOC 0-027

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Barium	Calcium	Cobalt	Copper	Lead	Magnesium	Nickel	Selenium	Thallium
Qbt 2,3,4 BV				**7340**	**46**	**2200**	**3.14**	**4.66**	**11.2**	**1690**	**6.58**	**0.3**	**1.1**
RE00-02-45111	00-02-19573	9–10	Qbt 3	8030	122 (J-)	—*	—	—	26.2 (J+)	1750	7.3	—	—
RE00-02-45123	00-02-19575	19–20	Qbt 3	—	—	—	—	—	12.2	—	—	—	—
RE00-02-45114	00-02-19576	9–10	Qbt 3	7750	125	3600	3.7	6.4	15.7	1820	—	—	1.3 (J)
RE00-02-45124	00-02-19576	19–20	Qbt 3	—	—	—	—	—	14.3	—	—	—	—
RE00-02-45134	00-02-19576	29–30	Qbt 3	—	—	—	—	—	12.4	—	—	—	—
RE00-02-45115	00-02-19577	9–10	Qbt 3	—	—	—	—	—	—	—	—	0.31	—
RE00-02-45125	00-02-19577	19–20	Qbt 3	—	—	—	—	—	15	—	—	—	—
RE00-02-45135	00-02-19577	29–30	Qbt 3	—	—	—	—	—	20.8	—	—	—	—
RE00-02-45116	00-02-19578	9–10	Qbt 3	—	—	—	—	—	36.1	—	—	—	2 (J)
RE00-02-45126	00-02-19578	19–20	Qbt 3	—	—	—	—	—	45.6	—	—	—	—
RE00-02-45136	00-02-19578	29–30	Qbt 3	—	—	—	—	—	123	—	—	—	—
RE00-02-45119	00-02-19578	39–40	Qbt 3	—	—	—	—	—	46	—	—	—	—
RE00-02-45129	00-02-19578	46.5–47.5	Qbt 3	—	—	—	—	—	43.9	—	—	—	—
RE00-02-45128	00-02-19580	19–20	Qbt 3	—	212	—	—	—	17.9	—	—	—	—
RE00-02-45138	00-02-19580	29–30	Qbt 3	—	—	—	—	—	12	—	—	—	—

* — = Chemical not detected above BV.

Table 2.3-5
Frequency of Detected Organic Chemicals in Fill and Tuff Samples at AOC 0-027 in 2004

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range* (mg/kg)	Frequency of Detects
Acetone	Fill	2	1	[0.006] to 0.0061	1/2
Acetone	Qbt 3	25	13	[0.0051] to [5.7]	13/25
Benzene	Qbt 3	25	2	[0.001] to 2.76	2/25
Benzoic Acid	Qbt 3	25	1	[0.133] to [30.6]	1/25
Butanone[2-]	Qbt 3	25	2	[0.0051] to [5.7]	2/25
Butylbenzene[n-]	Qbt 3	25	5	[0.001] to 84	5/25
Butylbenzene[sec-]	Qbt 3	25	6	[0.001] to 63.5	6/25
Di-n-butylphthalate	Qbt 3	25	1	0.0264 to [15.3]	1/25
Ethylbenzene	Qbt 3	25	8	[0.001] to 469	8/25
Isopropylbenzene	Qbt 3	25	5	[0.001] to 106	5/25
Isopropyltoluene[4-]	Qbt 3	25	6	[0.00074] to 25.4	6/25
Methylene Chloride	Fill	2	1	[0.0049] to 0.0113	1/2
Methylene Chloride	Qbt 3	25	2	[0.0022] to [5.7]	2/25
Methylnaphthalene[2-]	Fill	2	1	0.0202 to [0.0398]	1/2
Methylnaphthalene[2-]	Qbt 3	25	4	[0.0224] to 84.2	4/25
Naphthalene	Qbt 3	25	4	[0.0352] to 28.1	4/25
Phenol	Qbt 3	25	1	[0.352] to [15.3]	1/25
Propylbenzene[1-]	Qbt 3	25	5	[0.0008] to 186	5/25
Toluene	Fill	2	1	0.00038 to [0.0012]	1/2
Toluene	Qbt 3	25	4	0.00052 to 189	4/25
TPH-DRO	Fill	2	2	4 to 102	2/2
TPH-DRO	Qbt 3	25	13	[1.7] to 28400	13/25
TPH-GRO	Fill	2	2	0.0701 to 4.19	2/2
TPH-GRO	Qbt 3	25	13	[0.0537] to 16900	13/25
Trimethylbenzene[1,2,4-]	Qbt 3	25	8	[0.001] to 331	8/25
Trimethylbenzene[1,3,5-]	Qbt 3	25	7	[0.001] to [109]	7/25
Xylene[1,2-]	Qbt 3	25	7	[0.00062] to 340	7/25
Xylene[1,3-]+Xylene[1,4-]	Qbt 3	25	8	[0.002] to 775	8/25

*Brackets indicate detection limit.

Table 2.3-6
Detected Organic Chemicals in Fill and Tuff Samples at AOC 0-027 in 2004

Sample ID	Location ID	Depth (ft)	Media	Acetone	Benzene	Benzoic Acid	2-Butanone	n-Butylbenzene	sec-Butylbenzene	Di-n-butylphthalate	Ethylbenzene	Isopropylbenzene	4-Isopropyltoluene	Methylene Chloride
RE00-04-53567	00-22855	9–10	Soil	0.0061	—*	—	—	—	—	—	—	—	—	—
RE00-04-53570	00-22856	9–10	Soil	—	—	—	—	—	—	—	—	—	—	0.0113
RE00-04-53571	00-22856	19–20	Qbt 3	—	—	—	—	5.34	2.84	—	0.15	0.372	0.923	—
RE00-04-53572	00-22856	29–30	Qbt 3	0.0362	—	—	—	—	—	—	—	—	—	—
RE00-04-53588	00-22856	36.5–37.5	Qbt 3	0.0267	—	—	—	—	—	—	—	—	—	—
RE00-04-53573	00-22857	9–10	Qbt 3	—	—	—	—	—	—	—	—	—	—	—
RE00-04-53574	00-22857	19–20	Qbt 3	—	—	—	—	—	—	—	0.805 (J)	0.83 (J)	4.27	—
RE00-04-53575	00-22857	29–30	Qbt 3	0.0213	—	—	—	—	—	—	—	—	—	0.0023 (J)
RE00-04-53576	00-22858	9–10	Qbt 3	0.187	—	—	0.0132	—	—	—	—	—	—	0.0076
RE00-04-53577	00-22858	19–20	Qbt 3	0.0079	—	—	—	—	—	0.0264 (J)	—	—	—	—
RE00-04-53579	00-22859	11.5–12.5	Qbt 3	0.0062	—	—	—	—	—	—	—	—	—	—
RE00-04-53580	00-22859	19–20	Qbt 3	0.0069	—	—	—	—	—	—	—	—	—	—
RE00-04-53581	00-22859	29–30	Qbt 3	0.0076	—	—	—	—	—	—	—	—	—	—
RE00-04-53582	00-22860	9–10	Qbt 3	0.0179	—	—	—	—	0.507	—	0.0846	—	1.54	—
RE00-04-53594	00-22860	19–20	Qbt 3	—	—	—	—	—	—	—	—	—	—	—
RE00-04-53584	00-22860	29–30	Qbt 3	0.0109	—	—	—	—	—	—	—	—	—	—
RE00-04-53585	00-22861	9–10	Qbt 3	—	2.76	—	—	31.7	10.1	—	183	37.6	6.9	—
RE00-04-53586	00-22861	19–20	Qbt 3	2.95 (J)	0.597	—	—	20.5	15	—	117	25.7	9.14	—
RE00-04-53587	00-22861	29–30	Qbt 3	2.91 (J)	—	—	—	84	63.5	—	469	106	25.4	—
RE00-04-53589	00-22861	39–40	Qbt 3	0.351 (J)	—	10.8	0.112 (J)	0.005	0.0034	—	0.0141	—	—	—
RE00-04-53590	00-22861	46.5–47.5	Qbt 3	—	—	—	—	—	—	—	0.0019	—	—	—
RE00-04-53599	00-22862	9–10	Qbt 3	—	—	—	—	—	—	—	—	—	—	—

Table 2.3-6 (continued)

Sample ID	Location ID	Depth (ft)	Media	2-Methylnaphthalene	Naphthalene	Phenol	1-Propylbenzene	Toluene	TPH-DRO	TPH-GRO	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	1,2-Xylene	1,3-Xylene+1,4-Xylene
RE00-04-53567	00-22855	9–10	Soil	0.0202 (J)	—	—	—	0.00038 (J)	102 (J+)	0.0701	—	—	—	—
RE00-04-53570	00-22856	9–10	Soil	—	—	—	—	—	4	4.19 (J)	—	—	—	—
RE00-04-53571	00-22856	19–20	Qbt 3	—	—	—	1.79	—	106	1020	7.49	2.43	0.445	0.572
RE00-04-53572	00-22856	29–30	Qbt 3	—	—	2.27	—	—	34.5	0.837 (J+)	—	—	—	—
RE00-04-53588	00-22856	36.5–37.5	Qbt 3	—	—	—	—	—	16.6	0.597 (J+)	—	—	—	—
RE00-04-53573	00-22857	9–10	Qbt 3	—	—	—	—	—	7900	6.86	—	—	—	—
RE00-04-53574	00-22857	19–20	Qbt 3	84.2	19.7	—	—	0.898 (J)	28400	934	22.7	5.86	4.96	8.18
RE00-04-53575	00-22857	29–30	Qbt 3	—	—	—	—	—	6.5	—	—	—	—	—
RE00-04-53576	00-22858	9–10	Qbt 3	—	—	—	—	0.00052 (J)	68 (J+)	4.65 (J)	—	—	—	—
RE00-04-53577	00-22858	19–20	Qbt 3	—	—	—	—	—	—	—	—	—	—	—
RE00-04-53579	00-22859	11.5–12.5	Qbt 3	—	—	—	—	—	—	—	—	—	—	—
RE00-04-53580	00-22859	19–20	Qbt 3	—	—	—	—	—	—	—	—	—	—	—
RE00-04-53581	00-22859	29–30	Qbt 3	—	—	—	—	—	—	—	—	—	—	—
RE00-04-53582	00-22860	9–10	Qbt 3	—	—	—	—	—	—	128	2.43	1.8	0.611	0.452
RE00-04-53594	00-22860	19–20	Qbt 3	—	—	—	—	—	14600 (J)	—	—	—	—	—
RE00-04-53584	00-22860	29–30	Qbt 3	—	—	—	—	—	—	—	—	—	—	—
RE00-04-53585	00-22861	9–10	Qbt 3	3.14	4.32	—	48.1	189	3530	10000	95.4	40.3	110	207 (J)
RE00-04-53586	00-22861	19–20	Qbt 3	4.96	7.34	—	41	—	2060	3910	93.3	23.9	77.6	170 (J)
RE00-04-53587	00-22861	29–30	Qbt 3	19.6	28.1	—	186	—	5900	16900	331	—	340	775 (J)
RE00-04-53589	00-22861	39–40	Qbt 3	—	—	—	0.0063	0.0107	43.9	1.67 (J+)	0.0193	0.0054	0.0182	0.0294 (J)
RE00-04-53590	00-22861	46.5–47.5	Qbt 3	—	—	—	—	—	37.8	0.523 (J+)	0.0017	0.0022	—	0.0031
RE00-04-53599	00-22862	9–10	Qbt 3	—	—	—	—	—	467 (J)	2.52 (J)	—	—	—	—

* — = Chemical not detected.

Table 2.3-7
Frequency of Detected Organic Chemicals in Tuff Samples at AOC 0-027 in 2002

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range* (mg/kg)	Frequency of Detects
Acetone	Qbt 3	27	13	0.013 to [86]	13/27
Benzene	Qbt 3	27	7	0.0034 to 87	7/27
Benzoic Acid	Qbt 3	27	3	[1.7] to [18]	3/27
Butanone[2-]	Qbt 3	27	5	0.0054 to [120]	5/27
Butylbenzene[n-]	Qbt 3	27	8	[0.0048] to 100	8/27
Butylbenzene[sec-]	Qbt 3	27	8	0.0027 to 37	8/27
Dibenzofuran	Qbt 3	27	5	0.16 to 0.43	5/27
Ethylbenzene	Qbt 3	27	12	0.0038 to 690	12/27
Isopropylbenzene	Qbt 3	27	8	[0.0048] to 110	8/27
Isopropyltoluene[4-]	Qbt 3	27	11	[0.0057] to 31	11/27
Methyl-2-pentanone[4-]	Qbt 3	27	1	0.0038 to [120]	1/27
Methylene Chloride	Qbt 3	27	4	[0.0048] to 61	4/27
Methylnaphthalene[2-]	Qbt 3	27	9	0.16 to 150	9/27
Naphthalene	Qbt 3	27	5	[0.35] to 8.8	5/27
Phenanthrene	Qbt 3	27	4	0.13 to [0.39]	4/27
Propylbenzene[1-]	Qbt 3	27	9	[0.0048] to 190	9/27
Toluene	Qbt 3	27	8	0.0013 to 1100	8/27
TPH-DRO	Qbt 3	27	13	[27] to 8500	13/27
TPH-GRO	Qbt 3	27	16	[0.11] to 25000	16/27
Trichloroethane[1,1,2-]	Qbt 3	27	1	[0.0048] to [22]	1/27
Trimethylbenzene[1,2,4-]	Qbt 3	27	13	0.0016 to 210	13/27
Trimethylbenzene[1,3,5-]	Qbt 3	27	12	0.0038 to 100	12/27
Xylene (Total)	Qbt 3	27	13	0.0044 to 1300	13/27

*Brackets indicate detection limit.

Table 2.3-8
Physiochemical Properties for Organic COPCs

Name	Water Solubility (mg/L)[a]	Vapor Pressure (mm Hg)[a] at 25°C	K_{ow}[a]
Acetone	6.04E+05	2.99E-01	6.00E-01
Benzene	1.78E+03	1.25E-01	1.37E+02
Benzoic Acid	2.40E+03[b]	7.0E-04[b]	74.1[b]
Butanone[2-]	1.36E+05[c]	90.6[c]	1.94[c]
n-Butylbenzene	11.8[b]	1.06[b]	2.40E+04[b]
sec-Butylbenzene	17.6[b]	1.75[b]	3.71E+04[b]
Dibenzofuran	3.1[b]	2.48E-03[b]	1.32E+04[b]
Di-n-butylphthalate	10.8	5.55E-08	5.25E+04
Ethylbenzene	173	1.26E-02	1.33E+03
Isopropylbenzene	50[b]	4.5[b]	4.57E+03[b]
Isopropyltoluene[4-]	56	6.00E-03	4.10E+03
Methyl-2-pentanone[4-]	2.0E+4	2.5E-02	15.5
Methylene Chloride	1.74E+04	4.87E-01	18
Methylnaphthalene[2-]	24.6[b]	5.5E-02[b]	7.24E+03[b]
Naphthalene	31.1	1.17E-04	2.36E+03
Phenanthrene	1.28	1.35E-03	3.55E+04
Phenol	9.08E+04	5.74E-04	30.0
Propylbenzene[1-]	23.4[b]	3.42[b]	4.90E+03[b]
Toluene	558	3.71E-02	465
Trichloroethane[1,1,2-]	4.4E+03	3.31E-02	125
Trimethylbenzene[1,2,4-]	57[b]	2.1[b]	6.03E+03[b]
Trimethylbenzene[1,3,5-]	7.5E+04[b]	2.1[b]	2.63E+03[b]
Xylene[1,2-]	186	1.06E-02	1.35E+03
Xylene (total)	186	1.06E-02	1.48E+03

[a] Denotes reference information from http://www.epa.gov/earth1r6/6pd/rcra_c/pd-o/appd1a.pdf.

[b] Denotes reference information from http://www.toxnet.nlm.nih.gov.

[c] Denotes reference information from http://www.atsdr.cdc.gov/toxprofiles/tp17-c4.pdf.

Table 2.4-1
Screening Evaluation for Noncarcinogenic COPCs at AOC 0-027

Noncarcinogenic	Maximum Value less than 12 ft (mg/kg)	Residential NMED SSL[a] (mg/kg)	Residential HQ	Industrial NMED SSL[b] (mg/kg)	Industrial HQ
Acetone	0.187	7.04E+04	2.66E-06	1.46E+05[c]	1.28E-06
Barium	125	5.45E+03	2.29E-02	7.83E+04	1.60E-03
Butanone[2-]	0.0132	573	2.30E-05	2110[c]	6.26E-06
n-Butylbenzene	31.7	580.9[d]	5.46E-02	2570[c]	1.23E-02
sec-Butylbenzene	10	456.9[d]	2.19E-02	1930[c]	5.18E-03
Isopropylbenzene	37.6	700	5.37E-02	2730	0.01
Isopropyltoluene[4-][e]	6.9	700	9.86E-03	2730	2.53E-03
Lead	36.1	400	9.03E-02	750	4.81E-02
Methylnaphthlene[2-][f]	3.14	71.9	4.37E-02	273	0.01
Naphthlene	4.32	71.9	6.01E-02	273[c]	0.02
Propylbenzene[1-]	48.1	580.9[d]	8.28E-02	2570[c]	1.87E-02
Toluene	189	795.4[d]	0.24	3040[c]	0.06
Trimethylbenzene[1,2,4-]	95.4	52.2	1.83	191.0	0.50
Trimethylbenzene[1,3,5-]	40.3	22.3	1.81	81.4[c]	0.50
Xylene[1,2-]	110	260.9[d]	0.42	967[c]	0.11
Xylenes	207	296.8[d]	0.70	1100[c]	0.19
		HI =	**5.43**	**HI =**	**1.49**

[a] Value from NMED, Residential (NMED 2004, 85615).
[b] Value from NMED, Industrial (NMED 2004, 85615).
[c] Value calculated using Equation 7 (NMED 2004, 85615).
[d] Value calculated using Equation 1 (NMED 2004, 85615).
[e] Isopropylbenzene used as a surrogate for isopropyltoluene.
[f] Naphthalene used as a surrogate for 2-methylnaphthalene.

Table 2.4-2
Screening Evaluation for Carcinogenic COPCs at AOC 0-027

Carcinogenic	Maximum Value (mg/kg)	Residential NMED SSL[a] (mg/kg)	Residential Cancer Risk	Industrial NMED SSL[b] (mg/kg)	Industrial Cancer Risk
Benzene	2.76	27	1.02E-06	73.6	3.75E-07
Ethylbenzene	183	1.06E+04	1.73E-07	2.54E+04	7.20E-08
Methylene chloride	0.0113	165	6.85E-10	440	2.57E-10
		Total ICR[c] =	**1.20E-06**	**Total ICR =**	**4.47E-07**

[a] Value from NMED, Residential (NMED 2004, 85615).
[b] Value from NMED, Industrial (NMED 2004, 85615).
[c] ICR=Incremental cancer risk.

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Appendix A

Analytical Suites and Results
(CD on inside back cover of this report)

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Appendix B

2002 Screening Evaluation

Table B-1
Screening Evaluation for Noncarcinogenic COPCs at AOC 0-027 Using 2002 Data

Analyte	2002 Maximum Value (mg/kg)	Residential NMED SSL[a] (mg/kg)	Residential HQ	Industrial NMED SSL[b] (mg/kg)	Industrial HQ
Acetone	0.16	7.04E+04	2.27E-06	1.46E+05[c]	1.10E-06
Barium	125	5.45E+03	0.02	7.83E+04	1.60E-03
Butanone[2-]	0.043	573	7.50E-05	2110[c]	2.04E-05
n-Butylbenzene	66	580.9[d]	0.11	2570[c]	2.57E-02
sec-Butylbenzene	37	456.9[d]	0.08	1930[c]	1.92E-02
Dibenzofuran	0.28	313	8.95E-04	3.17E+03	8.83E-05
Isopropylbenzene	72	700	0.10	2730	2.64E-02
Isopropyltoluene[4-]	25	700[e]	0.04	2730[e]	9.16E-03
Lead	36.1	400	0.09	750	4.81E-02
Methylnaphthalene[2-]	6.7	71.9[f]	0.09	273.0[f]	2.45E-02
Naphthalene	7.2	71.9	0.10	273[c]	2.64E-02
Phenanthrene	0.13	1.80E+03	7.22E-05	2.05E+04	6.34E-06
Propylbenzene[1-]	100	580.9[d]	0.17	2570[c]	3.89E-02
Toluene	72	795.4[d]	0.09	3040[c]	2.37E-02
Trimethylbenzene[1,2,4-]	210	52.2	4.02	191.0	1.10E+00
Trimethylbenzene[1,3,5-]	61	22.3	2.74	81.4[c]	7.49E-01
Xylene[1,2-]	NA[g]	n/a[h]	n/a	n/a	n/a
Xylene (total)	570	296.8[d]	1.92	1100[c]	5.18E-01
			9.58		**2.61**

[a] Value from NMED, Residential (NMED 2004, 85615).
[b] Value from NMED, Industrial (NMED 2004, 85615).
[c] Value calculated using Equation 7 (NMED 2004, 85615).
[d] Value calculated using Equation 1 (NMED 2004, 85615).
[e] Isopropylbenzene used as a surrogate for isopropyltoluene.
[f] Naphthalene used as a surrogate for 2-methylnaphthalene.
[g] NA = Not analyzed.
[h] n/a = Not applicable.

Table B-2
Screening Evaluation for Carcinogenic COPCs at AOC 0-027 Using 2002 Data

Analyte	Maximum Value (mg/kg)	Residential NMED SSL[a]	Residential Cancer Risk	Industrial NMED SSL[b]	Industrial Cancer Risk
Benzene	28	27	1.04E-05	73.6	3.80E-06
Ethylbenzene	380	1.06E+04	3.58E-07	2.54E+04	1.50E-07
Methylene Chloride	ND[c]	n/a[d]	n/a	n/a	n/a
	Total Excess Cancer Risk= 1.07E-05			**Total Excess Cancer Risk= 3.95E-06**	

[a] Value from NMED, Residential (NMED 2004, 85615).

[b] Value from NMED, Industrial (NMED 2004, 85615).

[c] ND = Not detected.

[d] n/a = Not applicable.

Appendix C

Surface Water Site Assessment for AOC 0-027

Surface Water Site Assessment

Site Information

Site ID:	PRS ID:	Nearest Struct:
86	00-027	

Setting

Topography

On Mesa Top: Yes **On Bench in Canyon:** No **On Canyon Floor, Not Channel:** No **In Channel in Canyon Floor:** No

Topography Explanation:

Old fuel tank storage area at Knights of Columbus building.

Ground/Canopy Cover

Sparse (<25%): No **Medium (25-75%):** No **Thick (>75%):** Yes

Ground/Canopy Cover Explanation:

Area cemented over for parking lot.

Slope at Area Impacted

Flat (<10%): Yes **Gradual (10-30%):** No **Steep (>30%):** No

Slope Explanation:

Gentle slope to the north east.

Run-off

Is There Visible Evidence of Run-off Discharging from Site:

Yes

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Surface Water Site Assessment

PRS ID: 00-027

Run-off (Continued)

Is Run-off Channelized:	Channel Type:
Yes	Man-Made

Channelization Explanation:
Depression for run-off from parking lot.

Where Does Evidence of Runoff Terminate:
Other

Terminus Explanation
0-030(a) gets run-off from 0-027 parking lot drainage.

Has Run-off Caused Visible Erosion:	Erosion Type:
No	

Erosion Explanation:

Run-on

Structural Run On. Are Structures Creating Run-on to the Site:
Yes

Structural Run-on Explanation:
Sloped roof of building creating run-on

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Run-on (Continued)

Natural Run-on. Is Natural Drainage Creating Run-on to the Site:
No

Natural Run-on Explanation:
None

Current Operations Run-on. Are Current Operations Creating Run-on to the Site:
No

Current Operations Run-on Explanation:
Current operations are not adversely impacting run-on to the site.

Assessment Finding

Based on the Above Criteria and the Assessment of this Site, Does Soil Erosion Potential Exist:
No

Sign Off

Site Not Found:	Revision of Earlier Assessment:	
No	Yes	
Name of Assessment Author:		**Assessment Date:**
Randy Johnson		11/30/2001

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Surface Water Site Assessment

PRS ID: 00-027

Additional Information

Trash and Debris Notes

Is there Visible Trash and Debris on the Site:	Is there Visible Trash and Debris In a Watercourse:
No	No

Trash and Debris Explanation:

General Notes

Assessment Comments:

The site was originally assessed on 8/5/97 (score 29.2). The site was revisited on 11/30/01, no changes to the site observations were made except that the straw bales observed on 08/25/01 are no longer present. The percent ground coverage was changed to 75-100% to reflect the concrete coverage for the parking lot.

Best Management Practice Notes

Are Permanent BMPs in Place:	Permanent BMPs in Place:
No	

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Surface Water Site Assessment

PRS ID: 00-027

Erosion Matrix

Erosion/Sediment Transport Potential Scoring Criteria	Max Score Poss	Score Modifers for Transport Potential			Resulting Score
		Low (max * 0.1)	Med (max * 0.5)	High (max * 1.0)	
Setting Group (Max Total 43)					
Topography - On Mesa Top:	1	For these four criteria, use the single highest score from the criteria that received a "Yes" answer.			1.0
Topography - On Bench in Canyon:	4				
Topography - On Canyon Floor, Not in Channel:	13				
Topography - In Channel in Canyon Floor:	17				
Ground/Canopy Cover (Percent):	13	>75%	25-75%	<25%	1.3
Slope at Area Impacted:	13	<10%	10-30%	>30%	1.3
Run-off Group (Max Total 46)					
Visible Evidence of Run-off:	5	"Yes" = 5. "No" = 0 here and for two scores below.			5.0
Where Run-off Terminates:	19	"Other"	"Bench"	"Drainage/Canyon"	1.9
Visible Erosion:		"No" = 0. If "Yes", score by Erosion Type.			
Erosion Type:	22	"Sheet"	"Rill"	"Gully"	
Run-on Group (Max Total 11)					
Structural Run-on:	7	"No" = 0. "Yes" = 7.			7.0
Natural Run-on:	7	"No" = 0. "Yes" = 7.			0.0
Current Operations Run-on:	4	"No" = 0. "Yes" = 4.			0.0
Maximum Possible Total Score:	**100**	*** Actual Total Score:**			**17.5**

Revision of Earlier Assessment: Yes

*** No permanent BMPs are in place. Score could be lower with them.**

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