3-1-2006

Justification for Class III Permit Modification March 2006 SWMU234 Operable Unit 1309 Storm Drain System Outfall

Sandia National Laboratories/NM

This work supported by the
United States Department of Energy
under contract DE-AC04-94I85000.

Sandia National Laboratories

SWMU 234
Storm Drain System Outfall

EGIS — Environmental Geographic Information System

Environmental Restoration Project

Site History

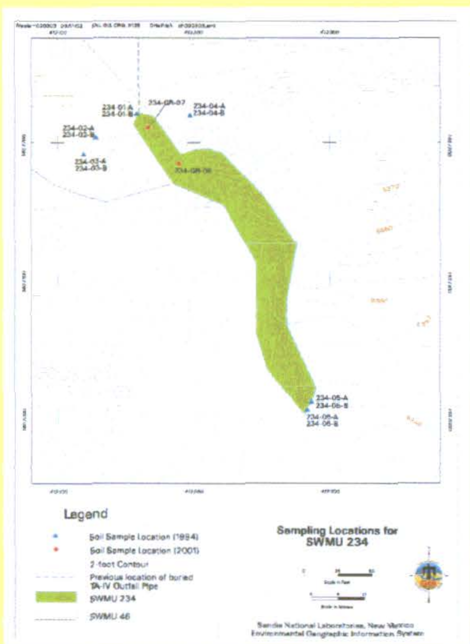
- SWMU 234 (Storm Drain System Outfall) covers approximately 0.15 acres of unpaved ground along the steep northern rim of Tijeras Arroyo. The outfall consists of a 270-ft long earthen ditch. No piping or outfall components are currently present at the site. Before removal in the early 1990s, the SWMU 234 outfall consisted of a steel pipe that discharged onto the ground surface. When the outfall pipe was removed, the storm water was re-directed through a buried pipe to the nearby SWMU 233 outfall.
- From the early 1980s until the early 1990s, the site occasionally received storm water from a paved area located inside the TA-IV perimeter fence. No chemical releases occurred at the site.

Depth to Groundwater

- The regional aquifer is approximately 470 ft bgs, and a perched aquifer (not a source of drinking water) is approximately 300 ft bgs.

Constituents of Concern

- VOCs
- SVOCs
- RCRA metals
- Chromium VI



Site boundary extends from the highest tree in top center of the photograph to the sewer manhole in foreground. The manhole and adjacent electrical vault are not part of the site. November 2000.

Summary of Data Used for NFA Justification

- In June 1994, the ground surface at SWMU 234 was surveyed for UXO/HE and radioactive materials; no anomalies were detected.
- In September 1994, twelve shallow-soil samples were collected at six locations that were all considered to be within the SWMU boundary at the time; later investigation (see below) revealed that six samples from three locations were outside the SWMU boundaries. The maximum sampling depth of the six original locations was three ft bgs. All the soil samples were analyzed for TAL metals, chromium VI and TPH. No TPH was detected in the soil samples. Three metals (arsenic, barium, and cadmium) had concentrations that exceeded the background values. Selected samples were also analyzed for VOCs, SVOCs, tritium, and gamma-emitting radionuclides. One VOC, acetone, was detected in one of the soil samples. Four SVOCs were detected. Th-232 and U-238, and tritium were detected above background values. Tritium also had activities above its background value.
- In September 2000, historical aerial photographs and TA-IV engineering drawings were used to determine the previous location for the outfall pipe. The boundary for SWMU 234 was revised after this evaluation.
- In June 2001, three soil samples plus one duplicate were collected with a backhoe from two locations along the centerline of the ditch. The soil samples were collected at depths ranging from 0 to 5 ft bgs. All the soil samples were analyzed for VOCs, SVOCs, TPH, RCRA metals, chromium VI, gamma-emitting radionuclides, gross alpha/beta, and tritium. No VOCs were detected in the samples. Seventeen SVOCs were detected. The maximum TPH concentration was 5.23 mg/kg. Chromium VI was detected above background in one sample at a concentration of 2.08 mg/kg. One sample had a silver concentration of 1 mg/kg that was near the background value. No radionuclides were detected above the background values; however, the MDA for U-235 exceeded the background value in several samples.

Recommended Future Land Use

- Industrial land use was established for this site.

Results of Risk Analysis

- Risk assessment results for the residential scenario are calculated per NMED risk assessment guidance in 2003 as presented in the "Supplemental Risk Document Supporting Class 3 Permit Modification Process."
- Because COCs were present in concentrations or activities greater than background-screening levels or because constituents were present that did not have background-screening levels, it was necessary to perform a risk assessment for the site. The risk assessment analysis evaluated the potential for adverse health effects for the residential land-use scenario.
- The maximum concentration value for lead was 13 mg/kg. The EPA intentionally does not provide any human health toxicological data on lead; therefore, no risk parameter values could be calculated. The NMED guidance for lead screening concentrations for construction and industrial land-use scenarios are 750 and 1,500 mg/kg, respectively. The EPA screening guidance value for a residential land-use scenario is 400 mg/kg. Because the maximum concentration value for lead at this site is less than the screening values, lead was eliminated from further consideration in the human health risk assessment. (See Footnote "b" in risk table below.)
- The total human health HI was 0.46 for the residential land-use scenario, which is less than the NMED guideline of 1. The total estimated excess cancer risk was 3E-5 for the residential land-use scenario, which is above the NMED guideline of 1E-5. Using the UCLs of the mean concentrations for the main contributors to risk [arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(g,h,i)perylene], the total estimated excess cancer risk was reduced to 2E-5. The incremental cancer risk is 8.4E-6 for the residential land-use scenario. The total and incremental HI, and the incremental excess cancer risks, using UCLs are below NMED guidelines.
- The human health incremental TEDE for a residential land-use scenario was 23 mrem/yr, which is below the EPA numerical guideline of 75 mrem/yr, and the human health incremental TEDE for an industrial land-use scenario was 13 mrem/yr, which is below the EPA numerical guideline of 15 mrem/yr. Therefore, SWMU 234 is eligible for unrestricted radiological release.
- Using the SNL ecological risk assessment methodology, the ecological risk for SWMU 234 is predicted to be low.
- In conclusion, human health risk under a residential land-use scenario and ecological risk are acceptable per NMED guidance. Thus, SWMU 234 is proposed for CAC without institutional controls.

Human Health Risk Assessment Values for SWMU 234
Nonradiological COCs

COC	Maximum/ UCL Concentration (mg/kg)	Residential Land-Use Scenario[a] (Maximum Concentrations)		Residential Land-Use Scenario[a] (UCL Concentrations)	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Inorganic					
Arsenic	7/**4.60**	0.32	2E-5	0.21	1E-5
Barium	240	0.05	–	0.05	–
Cadmium	2.9	0.07	2E-9	0.07	2E-9
Chromium[b], total	17.7	0.00	–	0.00	–
Chromium VI	2.08	0.01	1E-8	0.01	1E-8
Organic					
Acenaphthene	0.00625 J	0.00	–	0.00	–
Acetone	0.015	0.00	–	0.00	–
Anthracene	0.0212 J	0.00	–	0.00	–
Benzo(a)anthracene	0.258/**0.242**	0.00	4E-7	0.00	4E-7
Benzo(a)pyrene	0.435/**0.234**	0.00	7E-6	0.00	4E-6
Benzo(b)fluoranthene	0.506/**0.375**	0.00	8E-7	0.00	6E-7
Benzo(ghi)perylene	0.309/**0.267**	0.00	5E-6	0.00	4E-6
Benzo(k)fluoranthene	0.471	0.00	8E-8	0.00	8E-8
Carbazole	0.0182 J	0.00	6E-10	0.00	6E-10
Chrysene	0.435	0.00	7E-9	0.00	7E-9
Di-n-butyl phthalate	0.0207 J	0.00	–	0.00	–
Di-n-octyl phthalate	0.0102 J	0.00	–	0.00	–
bis(2-Ethylhexyl) phthalate	0.28 JB	0.00	6E-9	0.00	6E-9
Fluoranthene	0.450	0.00	–	0.00	–
Fluorene	0.00666 J	0.00	–	0.00	–
Indeno(1,2,3-c,d) pyrene	0.345 J	0.00	6E-7	0.00	6E-7
Phenanthrene	0.139	0.00	–	0.00	–
Pyrene	0.603	0.00	–	0.00	–
	Total	0.46	3E-5	0.35	2E-5
	NMED Guidance	*<1*	*<1E-5*	*<1*	*<1E-5*

Note: UCLs are calculated only for risk drivers. UCL concentrations are in **bold**.
[a]EPA 1989.
[b]For conservatism, the lower value of the two background values for surface and subsurface soils was used for comparison with the sample results in the risk assessment. Thus, although the maximum concentration of chromium and lead occurred in a surface sample, these results were compared to the subsurface background value.

For More Information Contact

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Sandia National Laboratories

Justification for Class III Permit Modification

March 2006

SWMU 234
Operable Unit 1309
Storm Drain System Outfall

NFA Submitted August 1995
NOD Response Submitted October 1996
NOD Response Submitted January 2000
NOD Response Submitted January 2003
Supplemental Risk Submitted June 2005

Environmental
Restoration
Project

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

NFA

Department of Energy
Albuquerque Operations Office
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AUG 28 1995

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. David Neleigh, Chief
New Mexico and Federal Facilities Section
RCRA Permits Branch
U. S. Environmental Protection Agency, Region VI
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Dear Mr. Neleigh:

Enclosed are copies of the second set of No Further Action (NFA) proposals for 23 solid waste management units (SWMUs) from the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) Final Permit for Sandia National Laboratories/New Mexico (SNL/NM), ID No. NM5890110518.

Copies of these proposals are also being submitted for comment to the New Mexico Environment Department (NMED), Hazardous and Radioactive Materials Bureau. The Class 3 permit modification process will be initiated after regulatory comments are addressed.

If you have any questions, please contact John Gould at (505) 845-6089 or Mark Jackson at (505) 845-6288.

Sincerely,

George K. Laskar

for Michael J. Zamorski
Acting Area Manager

Enclosures

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PROPOSAL FOR NO FURTHER ACTION

Site 234, Storm Drain System Outfall Site
Operable Unit 1309

SANDIA NATIONAL LABORATORIES/NEW MEXICO

1. Introduction

1.1 ER Site Identification Number and Name

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Environmental Restoration (ER) Site 234, Storm Drain System Outfall Site, Operable Unit (OU) 1309. ER Site 234 is listed in the Hazardous and Solid Waste Amendment (HSWA) Module IV (EPA August 1993) of the SNL/NM Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management Facility Permit (NM5890110518) (EPA August 1992).

1.2 SNL/NM Risk-Based NFA Process

This proposal for a determination of an NFA decision has been prepared using the criteria presented in Section 4.5.3 of the SNL/NM Program Implementation Plan (PIP) (SNL/NM February 1994). Specifically, this proposal will "contain information demonstrating that this SWMU has never contained constituents of concern that may pose a threat to human health or the environment" [as proposed in the Code of Federal Regulations (CFR), Section 40 Part 264.51(a) (2)] (EPA July 1990). The HSWA Module IV contains the same requirements for an NFA demonstration:

> Based on the results of the RFI [RCRA Facility Investigation] and other relevant information, the Permittee may submit an application to the Administrative Authority for a Class III permit modification under 40 CFR 270.42(c) to terminate the RFI/CMS [corrective measures study] process for a specific unit. This permit modification application must contain information demonstrating that there are no releases of hazardous waste including hazardous constituents from a particular SWMU at the facility that pose threats to human health and/or the environment, as well as additional information required in 40 CFR 270.42(c) (EPA August 1993).

For a risk-based proposal, an SWMU is eligible for an NFA determination if the NFA criterion established by the SNL/NM permit is met. This criterion, found in Section M.1 of the permit, is as follows: "[T]here are no releases of hazardous waste including hazardous constituents...that pose threats to human health and/or the environment..." This risk-base proposal contains information needed to make the NFA determination.

This proposal is using the technical approach which is the foundation for the SNL/NM corrective action process. The details of the SNL/NM technical approach are provided in Appendix C of the PIP. The first step in the technical approach is the data qualitative review step (the same step used to determine whether the SWMU is eligible for administrative NFA). Should significant uncertainties remain, the assessment of the SWMU continues within the SNL/NM technical approach.

At this site, sufficient data were not available to compare to established action levels or develop site-specific action levels. Background soil samples were collected and analyzed to develop upper tolerance limits (UTLs) for metals. Site-specific data were collected to compare to existing soil action levels (proposed Subpart S action levels) and UTLs. If site-specific concentrations exceeded the proposed Subpart S action levels or UTLs, then a risk assessment was performed. The site-specific concentrations were compared to the derived risk assessment action levels. Concentrations less than these action levels, either proposed Subpart S action levels, UTLs, or derived risk-based values, triggered this NFA proposal for Site 234.

1.3 Local Setting

SNL/NM occupies 2,829 acres of land owned by the Department of Energy (DOE), with an additional 14,920 acres of land provided by land-use permits with Kirtland Air Force Base (KAFB), the United States Forest Service, the State of New Mexico, and the Isleta Indian Reservation. SNL/NM has been involved in nuclear weapons research, component development, assembly, testing, and other nuclear activities since 1945.

ER Site 234 (Figure 1) is located on land owned by DOE. The outfall is located along the northern embankment of Tijeras Arroyo southeast of Building 981I (Inflatable Building) and a lagoon impoundment in Technical Area (TA) IV.

Surficial deposits in the SNL/KAFB area lie within four geomorphic provinces which in turn contain nine geomorphic subprovinces. Site 234 lies within the Tijeras Arroyo subprovince. The Tijeras Arroyo subprovince is characterized by broad, west-sloping alluvial surfaces and the 50-meter-deep Tijeras Arroyo. The Tijeras Arroyo subprovince contains deposits derived from many sources, including granitic and sedimentary rocks of the Sandia Mountains, sedimentary and metamorphic rocks of the Manzanita Mountains, and sediments of the Upper Santa Fe Group.

2. History of the SWMU

2.1 Sources of Supporting Information

In support of the request for a risk-based with confirmatory sampling NFA decision for ER Site 234, a background study was conducted to collect available and relevant site information. Interviews were conducted with SNL/NM staff and contractors familiar with site operational history.

The following information sources were available for the use in the evaluation of ER Site 234:

- Confirmatory sampling program conducted in September 1994
- Risk analysis for two radionuclides
- One surface radiation survey
- One unexploded ordnance/high explosives (UXO/HE) survey
- Interviews and personnel correspondence
- Historical aerial photographs spanning 40 years
- Personal breathing zone air sampling

2.2 Previous Audits, Inspections, and Findings

In November 1993, the Sandia ER staff recognized Site 234 as an SWMU. ER Site 234 was not listed as a potential release site based on the Comprehensive Environmental Assessment and Response Program (CEARP) interviews in 1985 (DOE September 1987). In addition, Site 234 was not included in the Environmental Protection Agency (EPA) RCRA Facility Assessment (RFA) in 1987 (EPA April 1987) and Site 234 was not included in the Hazard Ranking System (DOE September 1987).

2.3 Historical Operations

The outfall discharged industrial effluent and storm water from TA-IV (Figure 1). Currently, the outfall discharges only storm water. The specific constituents in the industrial effluent are not known. The possible discharge contaminants include chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, and other petroleum products. Mineral oil is also considered a potential soil contaminant because of a recent release (June 1994) of mineral oil at a similar outfall, Site 232.

3. Evaluation of Relevant Evidence

3.1 Unit Characteristics

The Storm Drain System Outfall is confined to the downstream natural drainage. All releases would be contained in this restricted area.

3.2 Operating Practices

Based on interviews and personnel correspondence, the outfall discharged industrial effluent and storm water from approximately 1978 to 1991. Examination of aerial photographs confirms this time frame but provides no additional information.

3.3 Presence or Absence of Visual Evidence

The approximately 250-foot long outfall and the cement culvert are the only physical evidence of the outfall system. No discoloration of soils was observed during site reconnaissance and soil sampling activities.

3.4 Results of Previous Sampling/Surveys

In 1994, the site was visually surveyed for surface indications of unexploded ordnance and UXO/HE. No UXO/HE were found (SNL/NM 1994a). Also in 1994, a surface radiation survey was conducted on the entire site using an Eberline ESP-2 portable scaler, with an Eberline SPA-8 (2 inch X 2 inch sodium iodide) detector. A 30-second integrated count was performed at each proposed sample location, while scanning the detector over an area approximately 2 feet in radius around the sample location. The alarm was set at 1.3 times the background count rate. No alarms occurred during the survey. No surface anomalies were detected (SNL/NM 1994b).

3.5 Assessment of Gaps in Information

No environmental sampling data existed for Site 234. If contamination was present, potential constituents of concern (metals, radioactive constituents, and organic constituents), would be expected at shallow depths. Metals and radioactive constituents generally adsorb on soil and precipitate rather than remaining soluble. If organic constituents were introduced in the drainage, they should be detectable in surface or shallow subsurface soils.

3.6 Confirmatory Sampling

A surface (0-6 inches deep) and shallow subsurface (6-36 inches deep) soil sampling program was developed and implemented in September 1994. The Confirmatory Sampling and Analysis Plan (SAP) can be found in Appendix A. Those soil sample results exceeding an action level are summarized in Table 1. A complete list of "hits" or detections and quality assurance (QA) results can be found in Appendix B.

For health and safety purposes, a photo-ionization detector, OVM, was used throughout the field program. The OVM measured no anomalous vapor concentrations.

Surface and shallow subsurface soil samples were collected at the most likely locations of contamination. The inlets to this site are uncontrolled. Two samples were collected at each of four inlets and four samples were collected at the furthest extent of visible erosion and scour (Figure 1). Every sample was analyzed for metals[1], chromium^{+6}, and total petroleum hydrocarbons (TPH). The six subsurface samples also were analyzed for volatile organic compounds (VOCs). Six samples were analyzed for semivolatile organic compounds (SVOCs). As a general check for radioactive constituents, two samples were analyzed for tritium, one sample was analyzed for isotopic uranium and plutonium, and four samples were screened with in-house gamma spectroscopy.

3.6.1 Background Samples for Metals and Radioactive Constituent

UTLs for background metals were calculated from analyses of 24 samples collected in the vicinity of the 11 sites discussed in the SAP (Appendix A). UTLs or background 95th percentiles for background radionuclides were calculated from samples collected throughout KAFB (IT 1994). A discussion of background calculations and supporting data and analyses are included in Appendices C and D.

[1] Although the targe analyte list (TAL) metal analytes include calcium, magnesium, potassium, and sodium, these nontoxic, major cations are not included in the evaluation. They do not pose a significant environmental or human health risk regardless of concentration.

3.6.2 Organic Compounds

No analyses yielded positive detections of organic compounds. All detections were qualified with a "J" (see Table 1), meaning detected below the reportable limit and most detections also were qualified with a "B," meaning detected in the associated blank. None of these qualified detections indicate significant contamination. No TPH was detected.

3.6.3 Metals

Personal breathing zone air sampling was performed to monitor airborne particulate contamination for metals at Site 234. No airborne metal contamination was detected. The maximum local background value for beryllium was 0.53 milligrams per kilogram (mg/kg). Beryllium was not detected above 0.53 mg/kg at Site 234. Mercury, selenium, silver, and chromium^{+6} were not detected in any site samples. No other metal samples had concentrations above the local background UTLs. Based on the soil sample data, metals pose an insignificant human health and environmental risk at Site 234.

3.6.4 Radionuclides

Thallium was not detected at Site 234. Plutonium-239/240, plutonium-238, and uranium-235/236 were not detected above the minimum detectable activity (MDA). Uranium-238 and uranium-234 were detected in Sample 234-01-A at 0.44 and 0.50 picocuries per gram (pCi/g), respectively; both were below the base-wide background 95th percentile of 1.1 and 1.0 pCi/g and below the maximum local background values of 0.84 and 0.97 pCi/g, respectively. Radium-226 was detected in Sample 234-01-A at 2.27 pCi/g compared to a base-wide background UTL of 1.94 pCi/g. Additional off-site radiological analyses for radium-226 indicated lower activities than 2.27 pCi/g. Tritium was detected in Samples 234-01-A and 234-05-A at 0.23 and 0.038 pCi/g, respectively.

3.6.5 Quality Assurance Results

As discussed in the Confirmatory Sampling and Analysis Plan (Appendix A), quality assurance samples, including field duplicates, trip blanks and rinsates, were collected as part of the 11-site sampling program. Analyses indicate that the field soil duplicates were comparable to the original soil sample results. The trip blanks and rinsates indicated no significant sampling contamination. QA results can be found in Appendix B. Level I and Level II data verification was conducted on all data, as described in the PIP (SNL/NM 1994).

3.7 Risk Analysis

To further evaluate the site data for radionuclides with activities above background UTLs (or 95th percentiles) or those without background UTLs, risk was analyzed for the combination of tritium and radium-226, assuming the maximum detected activities.

The risk calculations were designed to produce conservatively large estimates of radioactive dose to counter uncertainties in the soil data. This approach facilitates the following decision regarding future activities at Site 234:

- If the conservative estimates based on the soil data result in an unacceptable dose (greater than 10 mrem/year), further investigation and/or remediation will be needed; or

- If the dose estimates are acceptable, the potential for health hazards at the site is extremely low, and further actions will not be needed.

Radionuclide doses were computed using methods and equations promulgated in proposed RCRA Subpart S documentation (EPA 1990). Accordingly, all calculations were based on the assumption that receptor doses from radionuclides result from ingestion of contaminated soil.

Calculation of radionuclide doses required values of dose conversion factors, which are used to convert radionuclide intakes (in units of pCi/year) into effective dose equivalents (in units of mrem/year). Published values of dose conversion factors (Gilbert et al., 1989) exist for tritium and radium-226.

To assure that the computed doses were conservatively large, only the maximum observed activity of each constituent at a site was employed. To consider combined effects, a radiological dose was calculated as the sum of the individual doses.

Following proposed Subpart S methodology, the equation and parameter values used to calculate the summed radioactive dose were:

$$\text{DOSE} = \sum_{i} [\text{DSR}(i) \times \text{S}(i)] \tag{1}$$

where:

DOSE	=	total effective dose equivalent (mrem/yr);
DSR(I)	=	dose-to-soil concentration ratio for the i^{th} radionuclide (mrem/yr)/(pCi/g), = I X DCF(I);
S(I)	=	soil concentration of the i^{th} radionuclide (pCi/g);
I	=	soil ingestion rate = 0.2 g/day = 73 g/yr; and
DCF(I)	=	dose conversion factor for the i^{th} radionuclide (mrem/pCi).

The PIP stipulates that, for the purpose of computing media action levels, the total radioactive dose at a site should not be greater than 10 mrem/year (SNL/NM 1994), which corresponds to a cancer risk of less that 10^{-6} excess deaths.

The input and results of the risk calculations are presented in Table 2. The summed radioactive dose is less than 10 mrem/year. Therefore, the site is considered to be risk-free in terms of radionuclide contamination.

3.8 Rationale for Pursuing a Risk-based NFA Decision

Surface soil and shallow subsurface soil samples were collected at the uncontrolled inlets of the outfall and at the furthest extent of visible erosion/scour where the discharged effluent would have most likely settled. These areas are the most likely areas for contamination. SNL/NM is proposing a risk-based NFA because representative soil samples from ER Site 234 have concentrations less than action levels; either proposed Subpart S action levels, background UTLs, background 95th percentiles, or derived risk-based values.

In addition

- A site visit in 1993 by ER personnel confirmed the presence of a confined natural drainage with no discoloration in the soils.

- In June 1994, a UXO/HE visual survey was conducted by KAFB Explosives Ordnance Division (EOD) and found no UXO/HE ordnance debris at Site 234 (SNL/NM 1994a).

- In September, 1994, Personal Breathing zone air sampling was performed to monitor airborne particulate contamination for metals at Site 234. No airborne contamination was detected.

- In September, 1994, as part of the surface soil sampling effort at Site 234, a surface radiation survey was conducted (SNL/NM 1994b). No surface anomalies were detected at Site 234.

4. Conclusion

Based upon the evidence cited above, ER Site 234 has no releases of hazardous waste or hazardous constituents that pose a threat to human health and/or the environment. Therefore, ER Site 234 is recommended for an NFA determination.

5. References

5.1 ER Site References

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5.2 Reference Documents

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U.S. Environmental Protection Agency (EPA), August 1992. "Hazardous Waste Management Facility Permit No. NM5890110518, EPA Region VI," issued to Sandia National Laboratories, Albuquerque, New Mexico.

5.3 Aerial Photographs

Ebert & Associates, Inc., November 1994. "Photo-Interpretation and Digital Mapping of ER Sites 7,16,45,228 from Sequential Historical Aerial Photographs."

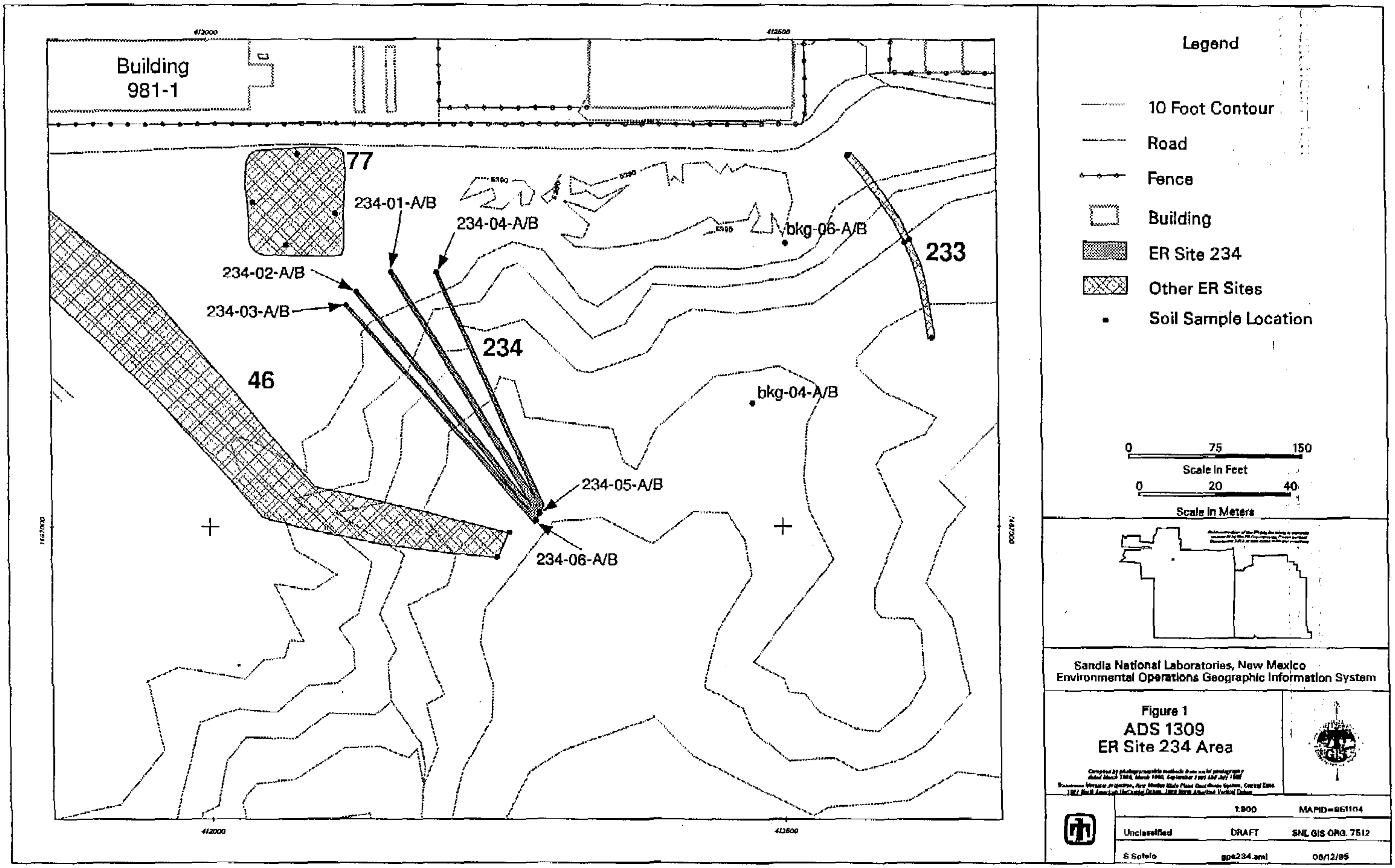

Figure 1. Storm Drain System Outfall Site 234.

Table 1. Site 234 - Results of Shallow Soil Sampling and Analysis

Sample Identifier	Analytical Method	Constituent	Concentration (mg/kg)	Qualifier(s)	Background (mg/kg)	Action Level (mg/kg)
234-01-B	VOCs (8240)	2-butanone	0.002	JB		
234-02-B	VOCs (8240)	2-butanone	0.003	JB		
234-03-B	VOCs (8240)	2-butanone	0.005	JB		
234-04-B	VOCs (8240)	2-butanone	0.004	JB		
234-05-B	VOCs (8240)	2-butanone	0.003	JB		
234-06-B	VOCs (8240)	2-butanone	0.004	JB		
234-05-A	SVOCs (8270)	Benzo(b) fluoranthene	0.043	J		
234-05-A	SVOCs (8270)	Benzo(a) pyrene	0.048	J		
234-03-A	SVOCs (8270)	Bis (2-ethylhexyl) phthalate	0.28	JB		
234-05-A	SVOCs (8270)	Chrysene	0.062	J		
234-05-A	SVOCs (8270)	Pyrene	0.034	J		
234-01-A	Tritium (600 906.0)	Tritium	0.23 (pCi/g)			12.6 pCi/g
234-05-A	Tritium (600 906.0)	Tritium	0.038 (pCi/g)			12.6 pCi/g
234-01-A	Gamma Spec (In-house)	Radium-226	2.27 pCi/g		1.94 pCi/g	125 pCi/g

Notes

A "J" qualifier means detected at a concentration below the laboratory reporting limit.

A "B" qualifier means detected in the associated blank sample.

For radium-226, background is the 95 percent upper tolerance level for the base-wide data.

The action levels for tritium and radium-226 are calculated risk-based levels.

Table 2. Risk Calculations for Site 234

Constituent	Activity (pCi/g)	DCF(I) (mrem/pCi)	Individual Dose (mrem/year)	Source of DCF
Radium-226	2.27E+00	1.10E-03	1.82E-01	Gilbert et al., 1989
Tritium	2.30E-01	6.30E-08	1.06E-06	Gilbert et al., 1989
Summed Dose			1.82E-01	

APPENDIX A

Confirmatory Sampling and Analysis Plan

APPENDIX B

Analytical Results

APPENDIX C

Background Calculations for Metals and Radionuclides

APPENDIX D

Probability Plots, Local Background UTL Calculations, and Base-wide Background UTLs for Radionuclides

SAMPLING AND ANALYSIS PLAN FOR ELEVEN SITES IN TIJERAS ARROYO OPERABLE UNIT SANDIA NATIONAL LABORATORIES/ NEW MEXICO

Sampling and Analysis Plan for Eleven Sites in Tijeras Arroyo Operable Unit

Introduction

The purpose of the sampling and analysis described in this plan is to determine the appropriate way to proceed toward closure of 11 (of the 17) sites in the Tijeras Arroyo Operable Unit. Based on the surface and shallow subsurface soil samples and analyses for the constituents of concern (COCs), one of three approaches will be pursued for each site:

1. A petition for "No Further Action" (NFA) will be produced for regulatory consideration;
2. A voluntary corrective measure (VCM) will be designed and implemented, hopefully followed by an NFA petition; or
3. The site assessment and eventual closure will follow the standard RFI/CMS path

Most of the sites covered by this Sampling and Analysis Plan (SAP) are outfalls from the storm water and sanitary sewer systems emanating from Sandia Technical Areas (TAs) I, II, and IV. The general sampling program for the outfalls will be to collect four samples at the head of the outfall, two samples of surface soil (0 to 6 inches deep) and two samples of shallow subsurface soil (18 to 36 inches deep) and four samples (two surface soil and two shallow subsurface soil) at the furthest extent of channel erosion and scour. The analytes for most of the samples are volatile organic compounds, semi-volatile organic compounds (BNAs), metals, chromium$^{+6,}$ for samples where chromium is found in a metals analysis, total petroleum hydrocarbon (TPH), explosives, Total Kjeldahl Nitrogen (TKN), nitrate/nitrite, and Gamma Spectroscopy for radionuclides, isotopic uranium, isotopic plutonium, tritium, and chlorodiphenyls (PCBs).

Sampling Procedures and Volumes

Surface soil samples will be collected with a stainless steel scoopula or trowel and placed in a stainless steel bowl. After at least 1000 ml[1] of soil has been collected, the soil will be thoroughly mixed in the bowl and transferred to two or three 500-ml sample bottles with a stainless steel scoopula. Sample bottles will be labeled accordingly and the appropriate sample information (sample depth, collection date and time, etc.) will be documented on the chain-of custody (COC) after each sample is collected. Samples will then be packaged and cooled to 4 degrees Celsius.

Shallow subsurface soil samples (18-36 inches) will be collected with a 2-inch (minimum) hand auger. A soil sample is collected by turning the auger clockwise and advancing it into the ground until the bucket at the end of the auger (last 6-8 inches) is full of soil or refusal occurs. Several runs with the auger is anticipated in order to obtain the appropriate volume. A hand shovel may also be used to bypass large rocks in order to continue with the auger. The auger is then extruded counter-clockwise from the ground and the soil is removed from the auger and placed in a stainless steel bowl. After 1,125[2] ml of soil has been collected, the soil will be mixed in the bowl and transferred to two or three 500-ml sample bottles and one 125-ml sample bottle with a stainless steel scoopula. Sample bottles will be labeled accordingly and the appropriate sample information will be documented on the COC after each sample is collected. Samples will then be packaged and cooled to 4 degrees Celsius.

Waste Generation and Equipment Decontamination

Decontamination of sampling equipment will be done between each sample. Decontamination will include thoroughly washing the inside and outside of the sampling equipment with a spray of ALCONOX™ or LIQUINOX™ and water; rinsing with distilled,

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[1]The sample volume varies between 1,000 and 1,500 ml depending on the analyses for the sample.

[2]The sample volume varies between 1,125 and 1,625 ml depending on the analyses for the sample.

deionized water; and drying before reusing. No soil waste will be generated. The soil removed from the hand-auger holes, while collecting samples at a depth of 18 to 36 inches, will be return to the hole. The sampling tools, which are scoopulas/trowels, hand-augers, and shovels, will be decontaminated with water and ALCONOX™ after each use. The decon leachate will be stored in capped 1-gallon containers. One or two containers will be used for each site and two to four containers will be used for the background samples. The containers will be labeled as "IDW" and the site number identified on each container. All the containers will be stored at Site 232, a central location. The leachate waste will be disposed according to the analytical results of the soil samples collected at the site.

Site Descriptions

The sites that will be sampled are

- Site 46, Old Acid Waste Line Outfall;
- Site 50, Old Centrifuge Site;
- Site 77, Oil Surface Impoundment;
- Site 227, Bldg. 904 outfall;
- Site 229, Storm Drain System Outfall;
- Site 230, Storm Drain System Outfall;
- Site 231, Storm Drain System Outfall;
- Site 232, Storm Drain System Outfall;
- Site 233, Storm Drain System Outfall;
- Site 234, Storm Drain System Outfall; and
- Site 235, Storm Drain System Outfall.

The site locations are shown in Figure 1. A description of the site history, conditions, previous investigations, and sampling plans are described in the following sections.

Site 46: Acid Waste Line Outfall

The Old Acid Waste Line carried wastes from several buildings in TA I. The waste line begins as a north-south trending, 750-feet long open trench in a grassy field northwest of Building 981-1 in TA IV. No pipe opening is visible at the "head" of the trench. As the trench crosses the field, it turns to the southeast and continues to a non-engineered spillway at the edge of Tijeras Arroyo. The spillway lies on a bank (40 to 50 feet of relief) composed of compacted alluvial sediment. Historical aerial photographs show vegetation, presumably supported by the discharge, growing southeast of the spillway to the active arroyo channel (about 200 feet distance from the spillway). The site is not restricted and is easily accessible.

During use, discharged effluent averaged an estimated 130,000 gallons per day. Use of the line has been discontinued. The line received wastes from plating, etching, and photo processing operations, and cooling tower "blow down". Acids and metals are target contaminants. Chromic acid and ferric chloride are mentioned specifically in the site history, and ferric chloride was found in the soils during a limited sampling event. Various radionuclides, possibly including tritium, uranium, and plutonium were used in TA I.

Building 863 was a source of discharge to the Acid Line. The information sheet for ER Site 98 (Building 863, TCA Photochemical Release: Silver Catch Boxes) indicates the presence of trichloromethane, silver, and photo-processing chemicals with an ammonia-like odor. The waste solution from the silver recovery unit reportedly was discharged to the Old Acid Waste Line, which is the only specific information about chemical discharges.

The site has been visually surveyed for surface indications of unexploded ordnance and high explosives (UXO/HE). No UXO/HE were found. Also, a surface radiation survey was conducted on the entire site. No surface radiation anomalies were detected.

The sampling program includes four samples collected at the "head" of the site outfall (by the fire extinguisher training area west of TA IV) and four samples collected by the spillway into the Tijeras Arroyo drainage (Figure 1). Every sample will be analyzed for tritium, metals, chromium^{+6} (if chromium is detected), TKN, and nitrate/nitrite. Half the samples will also be analyzed for semi-volatiles and cyanide. Additionally, all the subsurface samples will be analyzed for volatiles. The analytes are listed in Table 1. A "4" on the table indicates that ALL the samples will be analyzed
for that specific analyte whereas a "2" on the table indicates half the samples will have additional analyses for the analyte listed.

Site 50: Old Centrifuge
Site 50, Old Centrifuge, was an outdoor, rocket propelled centrifuge that was used in the early 1950s to test units under G forces. The facility is located east of the TA II fence in a slight depression on top the escarpment northwest of Tijeras Arroyo. The concrete centrifuge pad has a diameter of 80 to 90 feet. The site has a 7-foot high wooden retaining wall on the north, east, and south sides. The west side is open. The centrifuge arm assembly, which has a 20-foot radius, is sitting outside the wall to the north and appears to be intact. Control wiring to the center axis of the centrifuge was suspended from a cable between two telephone poles on the north and south side of the pad. The control wiring went to a bunker located to the southwest over the escarpment. The bunker had a electrical transformer containing PCB. The electrical transformer has been removed. The pad was not stained and no spills or leaks were reported.

The centrifuge was rocket driven by two T40 6-KS-3000 or two Deacon 3.5DS-5700 solid rocket motors. The combustion byproducts produced by these rocket motors were carbon dioxide, carbon monoxide, water, hydrochloric acid, aluminum oxide, and possibly barium oxide. No other HE is known or suspected at the site. The rocket orientation would expel combustion byproducts towards the retaining wall and the opening to the west. The rocket propellant would be consumed in the rocket motor case. Under normal operating conditions, no unburned propellant would be released.

In 1987, a reconnaissance investigation at five potential contaminated sites, including the Old Centrifuge Site, was conducted by the ER Project. Samples were analyzed for uranium, TNT, HSL inorganics, TCLP constituents, and EP Toxicity constituents. Metals, including barium, were detected at concentrations well below regulatory action levels. Total uranium concentrations were typical of area background levels. TNT, pesticides, PCBs, herbicides, and semi-volatiles TCLP compounds were not detected.

Prior to sampling, the surface will be surveyed for radiation. If contamination exists, it is expected to be around the edge of the centrifuge pad at the surface, probably along the open west side. The constituents of concern are metals (specifically lead, beryllium, and barium), depleted uranium, and high explosives. Four surface samples and four subsurface samples will be collected. The sampling locations will be biased toward the west side of the site because that is the open side (Figure 1). All surface samples will be analyzed for all the COCs. One-half of the subsurface samples will be analyzed for uranium and high explosives. All four subsurface samples will be analyzed for metals.

Site 77: Oil Surface Impoundment
The Oil Surface Impoundment Site is outside the TA IV fence, southeast of Building 981-1. The surface impoundment, which was constructed in the 1970's, is used to catch waste water from accelerators. At the time of the RCRA facilities environmental survey, the impoundment was unlined. Since then the impoundment was drained. Soil samples were analyzed for PCBs and

solvents. Based on the analytical results, the impoundment was determined to be clean. Subsequently, the impoundment was lined with geotextile and is now regulated under Sandia's Surface Water Discharge Program.

This site will not require UXO/HE or radiation surface surveys. Minimal confirmation sampling and analysis is proposed to verify that the site is clean. Three surface and three shallow subsurface samples are proposed. The samples will be collected along the perimeter of the existing lined pond (Figure 1). All the samples will be analyzed for PCBs. The subsurface soil samples also will be analyzed for volatile organic compounds (Table 1).

Site 227: Bunker 904 Outfall
Site 227 is an inactive outfall from the septic system for Building 904 (ER Site 48) in TA II. The site starts where the discharge exits the septic tank piping system, approximately 100 feet northeast of the southernmost point of TA II. The extent of the area influenced by the discharge may include the bank of Tijeras Arroyo below the outfall and some area between the outfall and the main channel of Tijeras Arroyo. The site is along the eastern edge of ER Site 45.

Building 904, built in 1948, was used for weapons assembly, HE testing, photo processing, and various other testing. Sanitary wastes were discharged to a septic tank, and other wastes were discharged to the outfall.

Mineral oil is also being considered a potential soil contaminant at all outfalls along the Tijeras Arroyo due to a recent release (June 1994) of mineral oil at Outfall 232 and vague historical records.

Possible soil contaminants are explosives, radioactive materials from weapons processing, including tritium, uranium, and plutonium, solvents (acetone, methylene chloride, methyl ethyl ketone, carbon tetrachloride, toluene, xylene, hexane, alcohols), and inorganics (ammonium hydroxide, barium, cadmium, silver, chromium, titanium, cyanide).

Access to this site is along the TA II perimeter road. This site is within the TA II testing exclusion zone. The best days to sample are generally Friday, Saturday, and Sunday, when testing ceases. Bruce Berry (telephone 845-8018) must be contacted to gain permission and access to this site. Prior to sampling

1. tumbleweeds will be cleared from locations to be sampled and placed adjacent to the drainage;
2. these locations will be visually scanned for UXO/HE; and
3. these locations will be screened for surface radiation anomalies.

The proposed sampling program is to collect four surface soil samples and four shallow subsurface samples. Two surface and two subsurface samples will be collected at the outfall. The other two surface and two subsurface samples will be collected at the furthest visible channel erosion and scour (Figure 1). The analytes are listed in Table 1.

Sites 229 - 235: Storm Drain Systems Outfalls
These sites consist of the discharge areas at seven outfalls along the northern embankment of Tijeras Arroyo. The outfalls discharged industrial effluent and storm water from TAs I, II, and IV. Presently they only discharge storm water. The outfalls receive runoff from Site 96 (Storm Drain System) and other engineered drain systems within the three TAs. The sites are along approximately ¾ miles of the embankment.

The specific constituents in the industrial effluent at these sites are not known. The possible discharged contaminants include chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, and other petroleum products. To cover this array of possible contaminants, soil samples will be analyzed for volatiles (subsurface samples only), semi-volatiles, metals and chromium^{+6}, if chromium is found in the metals analysis.

Mineral oil is also being considered a potential soil contaminant at all outfalls along the Tijeras Arroyo due to a recent release (June '94) of mineral oil at Outfall 232 and vague historical records. Therefore, soil samples will also be analyzed for TPH.

At Sites 229 through 234, prior to sampling

1. tumbleweeds will be cleared from locations to be sampled and placed adjacent to the drainage;
2. these locations will be visually scanned for UXO/HE; and
3. these locations will be screened for surface radiation anomalies.

Site 229 is due east of the footings of the old guard tower and the south "corner" of the TA II fence. It discharges near the top of the embankment through the center of ER Site 45. Access to this site is along the TA II perimeter road. This site is within the TA II testing exclusion zone. The best days to sample are generally Friday, Saturday, and Sunday, when testing ceases. Bruce Berry (telephone 845-8018) must be contacted to gain permission and access to this site. Because this site discharges from TA II, various radionuclides, possibly including tritium, uranium, and plutonium are of concern. Four surface soil and four subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 230 is west of Building 970 in TA IV. A drain pipe discharges into a bowl-shaped concrete structure adjacent to Building 970A. Flow from this structure is directed to a drain and flume located approximately 120 feet further west. The flume carries the flow to a discharge point slightly above the base of the arroyo embankment. Doug Bloomquist (845-7455) must be contacted to ensure that no laser testing is being performed in the area. Four surface soil and four subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 231 is west of Building 970 in TA IV. A drain pipe discharges to a concrete flume near the top of the embankment. The flume carries the flow to a discharge point near the base of the slope. Doug Bloomquist (845-7455) must be contacted to ensure that no laser testing is being performed in the area..Four surface soil and four subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 232 consists of two outfalls. One outfall is south of Building 970A, east of the lined lagoon. A drain pipe discharges to a concrete flume near the top of the embankment. The flume carries the flow to at discharge point near the bottom of hillside. On June 1, 1994, about 150 to 350 gallons of mineral oil was spilled into this outfall through the storm water drain by building 986. The day after the spill the site was screened for radiation and UXO/HE. No surface radiation anomalies or UXO/HE were found. Also, four surface soil and four subsurface soil samples were collected. The samples were sent to Quintera Laboratory in Denver for analysis for organics, metals, chromium^{+6}, and gamma spec. Other than TPH from the mineral, no contaminants were detected. A Voluntary Corrective Measure was conducted in July and August to remove soil contaminated with mineral oil above 100 mg/kg of TPH.

The second outfall in Site 232 also is south of Building 970A, west of lined lagoon, and approximately 120 feet east of the other Site 232 outfall. Discharge occurs from a concrete structure opening near base of embankment. Access to the site is along the road outside the south side of TA IV. Four surface soil and four subsurface soil samples will be collected at this drainage Figure 1). The analytes are listed in Table 1.

Site 233 is south-southwest of Building 986. Near the top of an escarpment, a small metal drain pipe discharges to an open drain which directs flow within another pipe before discharging near the base of the hillslope. Access to the site is along the road outside the south side of TA IV. Four surface soil and four subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 234 is southeast of Building 981I (Inflatable Building) and a lagoon impoundment (Site 77).

The site discharges into a steep-sided, deeply incised channel cut into the hillside. The drainage channel splits directly uphill of a tree. Access to the site is along the road outside the south side of TA IV. Both channels will be sampled. Six surface soil and six subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 235 is immediately downstream of a large concrete spillway on the northeast side of Pennsylvania and south of the Skeet Range, at the point where the road comes off the north bank of the arroyo and descends into the channel. The flow moves in a confined channel after dropping down the spillway. The site has been cleared for visible surface UXO/HE and screened for surface radiation with no anomalies detected. This channel is considerably larger than the other outfall sites. Six surface soil and six subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Background
Background soil concentrations for organic contaminants should be negligible. Background concentrations for total metals and radionuclides must be determined for comparison to concentrations found at the sites. Twelve locations have been identified to collect samples for background determination (Figure 1). At each of these sites, one sample will be collected at a depth of 0-6 inches and a second sample collected at 18-36 inches (Table 1).. In addition, the background study report prepared by International Technology Corporation (May 1994) will also be used to evaluate the data.

Quality Assurance
As shown in Table 1, quality assurance samples will include the following:

- Field "duplicates" on more than 10 percent of the samples. These samples will be collected adjacent to the original surface soil sample and in the same hole as the original subsurface soil sample;
- Field soil blanks for more than 10 percent of the VOC analyses. These sample will be obtained from Sample Management Office (SMO) and will contain no VOCs; and
- One rinsate blank. All rinsate will be composited in one container. A sample of the rinsate will be analyzed for all constituents. The disposal method for the rinsate will be determined by the analytical results on this sample.

... List of Analytes - Tijeras Arroyo - Outfall Sampling and Analysis Plan

Site	Site Name	Potential Contaminants	Surface Soils															Subsurface Soils															
			Number of Samples	BNAs (8270)	TAL Metals (6010/7000)	Cr^{+6}* (aqueous leaching)	Cyanide (acid digestion)	TPH (8015)	Explosives Res (8330)	TKN (acid digestion)	NO_3/NO_2 (353.2)	Gamma Spec (In-House) 600 901.1	Gamma Spec (Off-site) 600 901.1	PCBs (8080)	Tritium (600 906.0)	Isotopic Plutonium (600 7-79-081)	Isotopic Uranium (HASL-300 4.5)	Number of Samples	VOCs (8240)	BNAs (8270)	TAL Metals (6010/7000)	Cr^{+6}* (aqueous leaching)	Cyanide (acid digestion)	TPH (8015)	Explosives Res (8330)	TKN (acid digestion)	NO_3/NO_2 (353.2)	Gamma Spec (In-House) 600 901.1	Gamma Spec (Off-site) 600 901.1	PCBs (8080)	Tritium (600 906.0)	Isotopic Plutonium (600 7-79-081)	Isotopic Uranium (HASL-300 4.5)
46	Old Acid Waste Line Outfall (Tijeras Arroyo)	Ferric chloride, chromic acid and other acids, ammonia, photo processing chemicals and other unknown chemicals	4	2	4	4	2			4	4	4	2		4	2	2	4	4	2	4	4	2			4	4	4			4	2	2
50	Old Centrifuge Site (TA-2)	Rocket propellant and residues	4		4				4			2			2	1	2	4			4				2						1		1
77	Oil Surface Impoundment	Solvents and PCBs	4											4				4	4											4			
227	Bldg. 904 outfall (TA-2)	High explosives, radioactive materials, nitrate, toluene, methanol, other solvents, carbon tetrachloride, ammonium hydroxide, barium, cadmium, silver, chromium, titanium, cyanide	4	2	4	4	2	2	2	4	4	4	2		4	2	2	4	4	2	4	4	2	4	2	4	4	4			4	2	2
229	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				4	2		4	2	2	4	4	2	4	4		4				4			4	2	2
230	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
231	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
232	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
233	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
234	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	6	3	6	6		6				2			2	1	1	6	6	3	6	6		6				2					
235	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
Na	Background		12		12							12			3	3	3	12			12							12			3	3	3
QA	Duplicates	Na		2	5	4	1	4	1	1	1		1	1			2		5	2	5	4	1	4	1	1	1			1			1
QA	Field Soil Blank	Na																	5														
QA	Rinsate	Na		1	1	1	1	1	1	1	1	1	1	1	1	1	1		1		1												
	Totals		58	22	60	43	6	37	8	10	10	39	8	6	30	17	20	58	53	21	60	42	5	38	5	9	9	36		5	16	9	11
	Totals - Surface Plus Subsurface		116	43	120	85	11	75	13	19	19	75	8	11	46	26	31		53														

* Analyze for Cr^{+6} only if Cr is detected in metals analysis

Appendix B
Analytical Results

Site 234 Soil Results

Sample Identifier	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium
234-01-A	9300	16	1.6	210	0.5	2	42000	7.4	4.7	9.1	11000	10	4600	230	ND	8	1800
234-01-B	7800	13	1.6	190	0.4	2	46000	7.3	4.7	10	11000	9.4	4300	220	ND	8	1600
234-02-A	4700	8	5.3	140	0.3	2	50000	6.9	4.1	9.3	12000	8.7	2400	140	ND	6	1100
234-02-B	4500	8	1	160	ND	3	31000	7	5.7	9.6	12000	7.1	2200	130	ND	5	1100
234-03-A	6700	12	1.8	180	0.4	3	30000	11	4.1	13	9500	12	3500	210	ND	8	2300
234-03-B	6400	11	4.8	210	0.3	2	65000	11	3.5	9.8	9000	8.2	3200	180	ND	8	1800
234-04-A	5800	11	6.3	240	0.3	2	61000	5	3.9	8.5	8800	8.2	3500	130	ND	6	1400
234-04-B	6400	11	5.4	220	0.3	2	48000	5	4.1	7.2	10000	6.2	4100	150	ND	5	1400
234-05-A	7600	13	1.6	180	0.4	2	32000	7.6	4.8	9.5	12000	10	4400	260	ND	8	3200
234-05-B	6100	11	0.9	180	0.3	3	27000	6.7	4.5	9.8	13000	9.1	3500	210	ND	8	2200
234-06-A	11000	17	7	220	0.5	3	34000	9.9	4.9	11	13000	13	4800	260	ND	10	2600
234-06-B	3600	7	1	150	0.2	2	31000	5.4	3.6	9.6	8800	6.5	2300	150	ND	6	870

Sample Identifier	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Cr^{+6}	Radium-226	Radium-226	Radium-228	Tritium	Plutonium 239/240	Plutonium 238	Uranium-238	Uranium-235/236	Uranium-234
234-01-A	ND	ND	450	ND	23	64	ND	2.3			0.23	<0.004	<0.008	0.4	<0.013	1
234-01-B	ND	ND	480	ND	24	64	ND	NS								
234-02-A	ND	ND	320	ND	24	64	ND									
234-02-B	ND	ND	430	ND	24	77	ND									
234-03-A	ND	ND	300	ND	18	67	ND									
234-03-B	ND	ND	290	ND	21	57	ND									
234-04-A	ND	ND	320	ND	24	55	ND									
234-04-B	ND	ND	340	ND	30	57	ND									
234-05-A	ND	ND	300	ND	22	70	ND	NS	0.7	0.8	0.038					
234-05-B	ND	ND	320	ND	25	64	ND	NS								
234-06-A	ND	ND	360	ND	28	73	ND									
234-06-B	ND	ND	250	ND	18	47	ND									

Concentrations in mg/kg
Activities in pCi/g
Sample Identifier XX-XX-A - surface soil samples
Sample Identifier XX-XX-B - subsurface soil samples

Quality Assurance Results for Organic Constituents

Sample Identifier	Sample Type	2-Butanone	2-Hexanone	4-Methyl-2-pentanone	Acetone	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Chrysene	Di-n-octyl phthalate	Fluoranthene	Methylene Chloride	Phenanthrene	Pyrene	Styrene	total-Xylenes	TPH
227-01-A	original										0.066 J		0.055 J	0.040 J			
227-01-A	duplicate										0.038 J		0.051 J				
227-01-B	original	0.007 J		0.001 J													
227-01-B	duplicate	0.006 J			0.006 J												
227-04-B	original	0.004 J															
227-04-B	duplicate	0.005 J															
229-01-A	original					0.071 J	0.050 J	0.16 J	0.11 J		0.23 J		0.17 J	0.19 J			ND
229-01-A	duplicate					0.006 J	0.092 J	0.16 J	0.12 J		0.20 J		0.18 J	0.28 J			81
229-02-B	original	0.006 J															
229-02-B	duplicate	0.006 J															
229-03-B	original	0.006 J															
229-03-B	duplicate	0.006 J															
230-04-B	original	0.003 JB								0.16 J							
230-04-B	duplicate																
235-02-B	original	0.006 JB															
235-02-B	duplicate	0.004 JB															
Site 227	trip blank	0.010 B	0.003 J	0.002 J	0.019												
Site 229	trip blank	0.009 JB			0.015												
Site 230	trip blank	0.004 JB										0.003 J					
Site 232	trip blank	0.007 JB															
Site 234	trip blank	0.007 JB			0.015										0.001 J		
Site 235	rinsate	0.005 JB			0.010											0.001 J	ND

Quality Assurance Results for Inorganic and Radiological Constituents

Sample Identifier	Sample Type	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc
227-02-A	original	5800	9.3	5.9	180	ND	2.1	6.6	4.1	7.8	13000	7.5	160	ND	5.4	27	51
227-02-A	duplicate	6500	11	1.4	150	0.25	2.5	6.4	4.1	13	14000	9.1	170	ND	5.9	28	51
227-03-B	original	5100	8.8	0.92	140	ND	2.1	5.9	4.5	11	13000	7.5	200	ND	5.4	25	48
227-03-B	duplicate	6400	9.9	5.6	140	0.25	2.9	7.4	4.6	10	16000	8.9	230	ND	5.9	33	50
229-04-A	original	8100	13	5.7	150	0.32	2.3	8.0	4.2	7.9	13000	12	210	ND	6.3	24	55
229-04-A	duplicate	7700	12	1.5	140	0.30	2.2	8.0	4.2	7.7	12000	11	190	ND	6.2	24	52
230-04-B	original	1500	3.3	1.6	130	ND	0.61	2.3	ND	18	3500	4.2	110	ND	3.0	9.1	82
230-04-B	duplicate	2400	4.9	1.7	140	ND	0.68	3.1	2.5	15	4500	4.1	120	ND	3.4	9.7	71
235-01-A	original	3600	6.2	5.1	150	ND	2.7	6.0	8.4	6.6	20000	7.6	210	ND	4.5	36	66
235-01-A	duplicate	3000	5.3	1.3	160	ND	1.6	4.2	5.7	6.5	12000	9.4	180	ND	4.4	22	66
50-01-B	original	3100	6.5	2.1	110	0.25	1.3	4.1	3.9	6.2	7600	6.6	130	ND	4.5	17	18
50-01-B	duplicate	3900	7.5	2.0	110	0.26	1.3	4.3	4.0	5.7	8800	5.9	150	ND	4.2	18	21
50-02-A	original	5800	12	4.2	220	0.38	1.6	5.2	4.3	12	6700	25	210	ND	7.1	11	69
50-02-A	duplicate	7000	14	6.4	280	0.55	2.2	8.3	6.1	17	9000	35	290	0.04	9.4	18	61
Bkg-05-A	original	6400	13	5.7	210	0.53	1.8	6.1	6.6	14	10000	16	330	ND	8.9	22	37
Bkg-05-A	duplicate	5900	12	7.6	190	0.50	1.7	6.0	6.3	14	10000	16	320	ND	8.7	24	36
Site 235	rinsate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Sample Identifier	Sample Type	TKN	NO_3/NO_2	Potassium 40	Lead 212	Lead 214	Plutonium 239/240	Uranium 238	Uranium 235/236	Uranium 234
227-02-A	original	400	2.7							
227-02-A	duplicate	320	9.3							
227-03-A	original						0.004	0.4	0.15	0.61
227-03-A	duplicate							0.67	0.023	0.67
227-03-B	original							0.72	0.11	0.72
227-03-B	original	220	ND							
227-03-B	duplicate			27.8	0.71	0.7				
227-03-B	duplicate	190	1.4							
229-01-A	original						0.007	0.45	0.17	0.67
229-01-A	duplicate							0.73	0.034	0.6
229-03-B	original							0.45	0.058	0.45
229-03-B	duplicate							0.99	0.06	1

Notes on Quality Assurance Data

Explosive residues were not detected in Site 50 duplicate sample

Hexavalent chromium was not detected in five duplicates and one decon rinsate

Cyanide was not detected in two duplicates and one decon rinsate

PCBs were not detected in one Site 77 duplicate sample

Tritium and Plutonium-238 were not detected in four duplicate samples

Selenium, silver, and thallium were not detected in any quality assurance samples

Appendix C
Background Calculations for Metals and Radionuclides

Appendix C. Background Calculations for Metals and Radionuclides

To evaluate metals data, 24 background samples were collected for metals analyses.[4] Distribution analyses was performed first by constructing histograms. The histograms indicated a parametric distribution. Outliers were screened in a two-step process as described in the base wide background report (IT 1994). The first step is to perform an "a priori" screening for very high values relative to the rest of the data set. This is qualitatively performed by visually examining a column of sorted values. Maximum values that are a factor of 3 or 4 times higher than their nearest neighbor are removed from the data set during this step. None of the anomalous values were deleted by the "a priori" process.

The second step, from EPA, 1989, determines whether an observation that appears extreme fits the data distribution. A statistical parameter, T_n is calculated:

$$T_n = (X_n - X_a)/S$$

where:

X_n = questionable observation;

X_a = sample arithmetic mean; and

S = sample standard deviation

T_n is compared to a table of one-sided critical values for the appropriate significance level (upper 5 percent) and sample size from a table provided in EPA 1989. Extreme concentrations for barium, calcium, chromium, copper and nickel were identified as outliers and were excluded from the data set. These anomalous values may have resulted from laboratory or sampling error.

Probability plots were then replotted to determine whether the data fit normal or lognormal populations. These plots are shown in Appendix D. The UTL[5] was calculated for data sets that fit a normal or lognormal distribution. Data sets are provided in Appendix D. As recommended by EPA, a tolerance coefficient value of 95 percent was used (EPA 1989). Most metals background data fit lognormal distributions. Iron and zinc data fit normal distributions. UTLs were not calculated for mercury, selenium, and silver because mercury and selenium were not detected and silver was detected only once in the 24 background samples. The beryllium background data did not fit a normal or lognormal distribution. The maximum value in a data set is commonly taken as the UTL in a non-parametric setting (Guttman, 1970). The maximum background beryllium concentration was 0.53 mg/kg.

Base-wide background UTLs for radionuclides were established by International Technology (IT) Corporation to compare and evaluate radionuclide data (IT, 1994). A table is provided in Appendix

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[2]These data are referred to as local background data. The data collected throughout Kirtland Air Force Base (KAFB), with most of the data collected within SNL/NM technical areas, are called base-wide background data (IT 1994).

[3]UTL = x + K•S, where:
UTL = Upper tolerance limit;
x = Sample arithmetic mean (for normal distribution), sample geometric mean (for lognormal distribution);
S = Sample standard deviation; and
K = One-sided normal tolerance factor (95 percent for these evaluations).

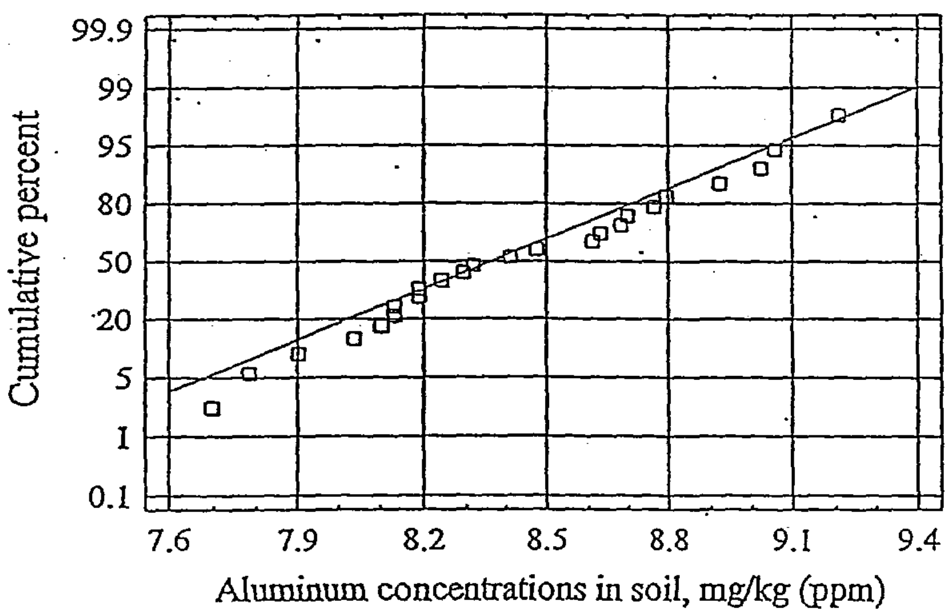
D with radionuclide background data and the corresponding UTLs. The maximum activity from the six local background samples for isotopic plutonium and isotopic uranium was used as an additional method to evaluate the data. Also, in-house gamma spectroscopy was performed on all 24 background samples and indicated low levels of radioactivity but no significant contamination.

Appendix D
Probability Plots, Local Background UTL Calculations, and Base-Wide Background UTLs for Radionuclides

```
m·    · Statistics for log(Aluminum)

  = 24
  age = 8.42942
 dian = 8.36529
 de =
 ometric mean = 8.41976
 riance = 0.170246
 ndard deviation = 0.412609
 ndard error = 0.0842235
 imum = 7.69621
 imum = 9.21034
 nge = 1.51413
 er quartile = 8.13153
 er quartile = 8.73178
 erquartile range = 0.600253
 wness = 0.132255
 d. skewness = 0.26451
 tosis = -0.792361
 d. kurtosis = -0.792361
 ff. of variation = 4.89487
  = 202.306
```

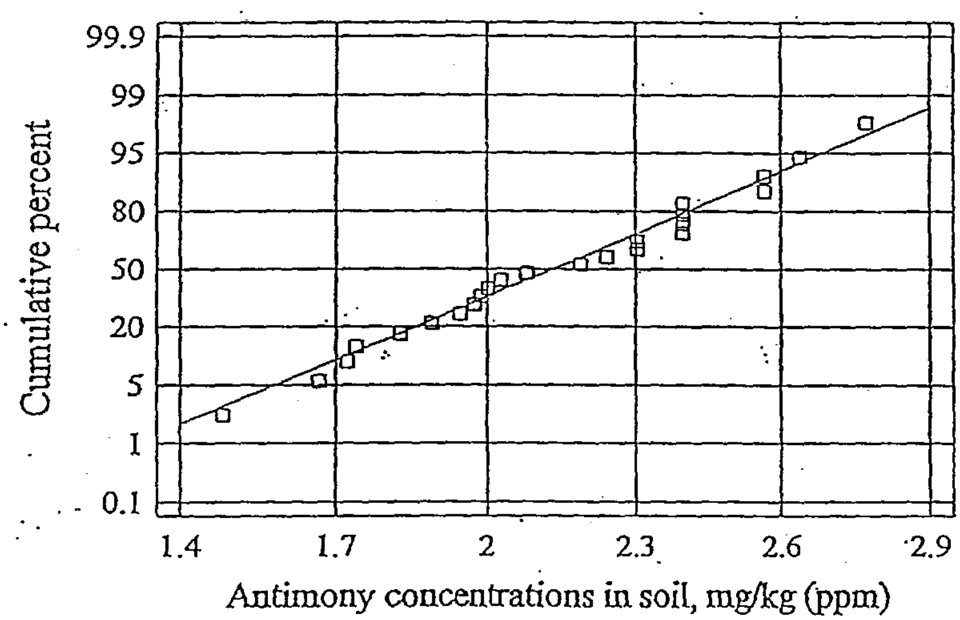
Lognormal Probability Plot for Aluminum



mmary Statistics for log(Antimony)

unt = 24
erage = 2.14609
dian = 2.13275
de = 2.3979
ometric mean = 2.12004
riance = 0.113831
andard deviation = 0.337309
andard error = 0.0688692
nimum = 1.4816
ximum = 2.77259
nge = 1.29098
wer quartile = 1.91649
per quartile = 2.3979
erquartile range = 0.481405
wness = -0.040772
d. skewness = -0.0815441
tosis = -0.744171
d. kurtosis = -0.744171
ff. of variation = 15.7211
= 51.5062

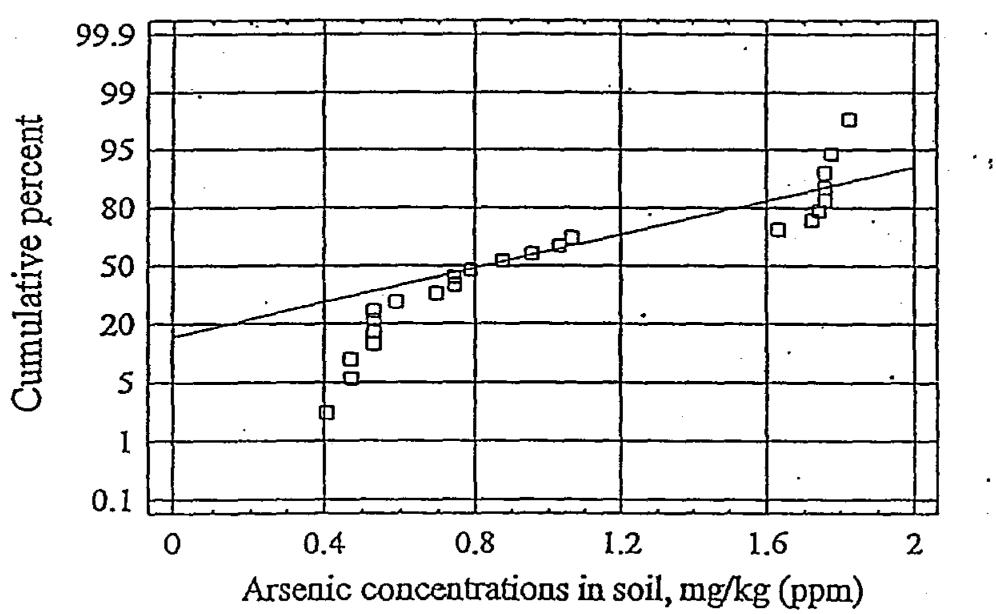
Lognormal Probability Plot for Antimony



Summary Statistics for Log(Arsenic)

```
Co     = 24
\   ,e = 1.038
Ie   n = 0.031963
Iode =
;eometric mean = 0.908119
'ariance = 0.291153
:tandard deviation = 0.539586
tandard error = 0.110143
:inimum = 0.405465
aximum = 1.82455
ange = 1.41908
ower quartile = 0.530628
pper quartile = 1.73162
nterquartile range = 1.20099
<ewness = 0.463036
:nd. skewness = 0.926071
ırtosis = -1.58507
:nd. kurtosis = -1.58507
›eff. of variation = 51.983
ım = 24.9121
```

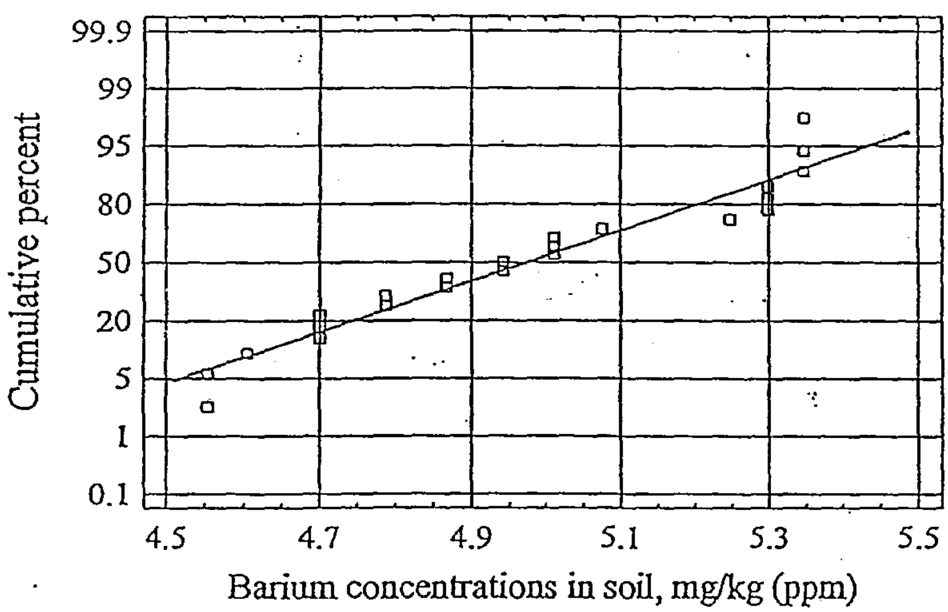
Lognormal Probability Plot for Arsenic



nmary Statistics for log(Barium)

```
unt = 23
erage = 4.96948
dian = 4.94164
de = 5.34711
ometric mean = 4.96236
riance = 0.0740602
andard deviation = 0.27214
ndard error = 0.0567451
nimum = 4.55388
ximum = 5.34711
nge = 0.793231
er quartile = 4.70048
er quartile = 5.29832
erquartile range = 0.597837
wness = 0.0653415
d. skewness = 0.127931
tosis = -1.30542
d. kurtosis = -1.27794
ef. of variation = 5.47622
 = 114.298
```

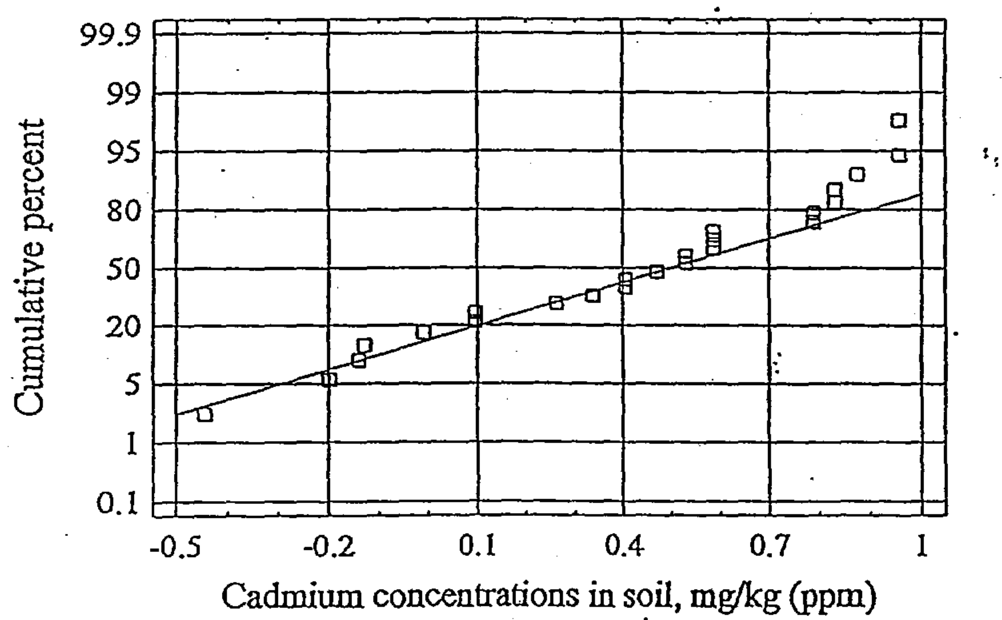
Lognormal Probability Plot for Barium



ummary Statistics for log(Cadmium)

= 24
.ge = 0.416764
dian = 0.500316
ode =
eometric mean =
riance = 0.159937
andard deviation = 0.399922
andard error = 0.0816337
nimum = -0.446287
ximum = 0.955511
nge = 1.4018
wer quartile = 0.0953102
per quartile = 0.788457
terquartile range = 0.693147
ewness = -0.506707
nd. skewness = -1.01341
rtosis = -0.674504
nd. kurtosis = -0.674504
eff. of variation = 95.9587
n = 10.0023

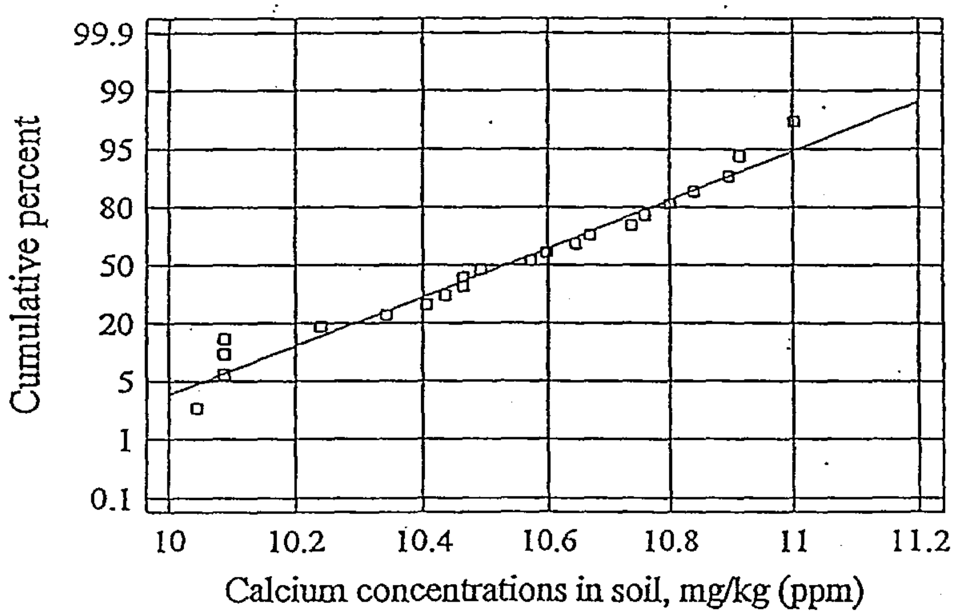
Lognormal Probability Plot for Cadmium



```
mary Statistics for log(Calcium)

nt = 23
rage = 10.5579
ian = 10.5713
e = 10.0058
metric mean = 10.5532
iance = 0.10513
ndard deviation = 0.324237
ndard error = 0.0676081
imum = 10.0432
imum = 11.2645
ge = 1.22121
er quartile = 10.3417
er quartile = 10.7996
erquartile range = 0.457833
mess = 0.109797
l. skewness = 0.214971
osis = -0.415646
l. kurtosis = -0.406895
f. of variation = 3.07103
= 242.832
```

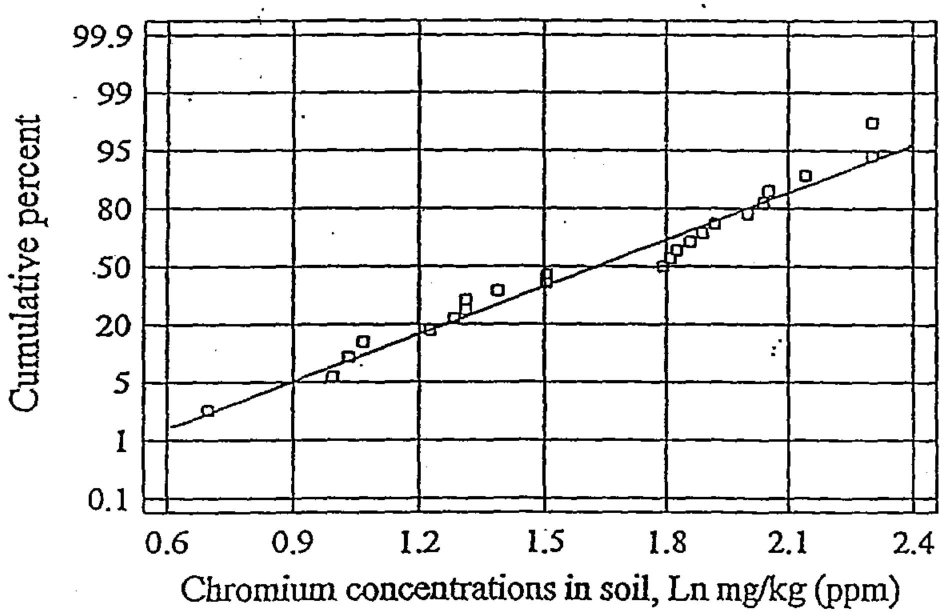
Lognormal Probability Plot for Calcium



Summary Statistics for log(Chromium)

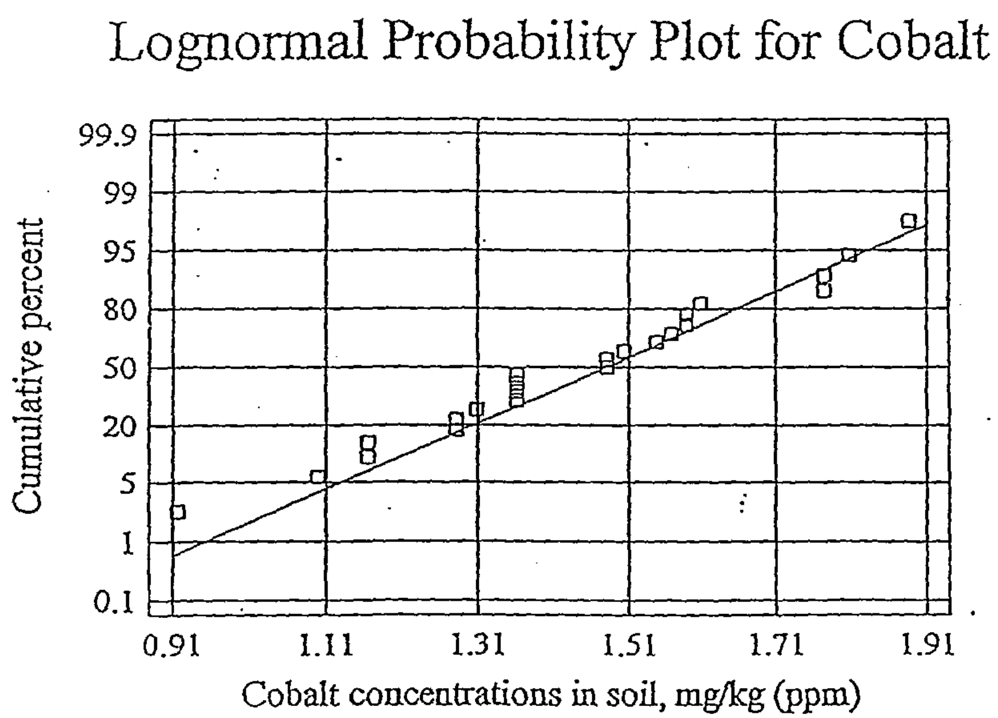
= 23
age = 1.61841
Median = 1.79176
Mode =
Geometric mean = 1.55042
Variance = 0.204195
Standard deviation = 0.451879
Standard error = 0.0942233
Minimum = 0.693147
Maximum = 2.30259
Range = 1.60944
ower quartile = 1.28093
Upper quartile = 2.00148
nterquartile range = 0.720546
kewness = -0.274151
tnd. skewness = -0.536757
urtosis = -0.905395
tnd. kurtosis = -0.886332
oeff. of variation = 27.9211
um = 37.2235

Lognormal Probability Plot for Chromium



ummary Statistics for log(Cobalt)

ount = 24
verage = 1.29969
edian = 1.42129
ode =
eometric mean =
ariance = 0.574775
tandard deviation = 0.758139
tandard error = 0.154754
inimum = -2.07944
aximum = 1.88707
ange = 3.96651
ower quartile = 1.28093
pper quartile = 1.58924
nterquartile range = 0.308301
ewness = -4.13299
nd. skewness = -8.26598
rtosis = 18.9091
nd. kurtosis = 18.9091
eff. of variation = 58.3324
m = 31.1925



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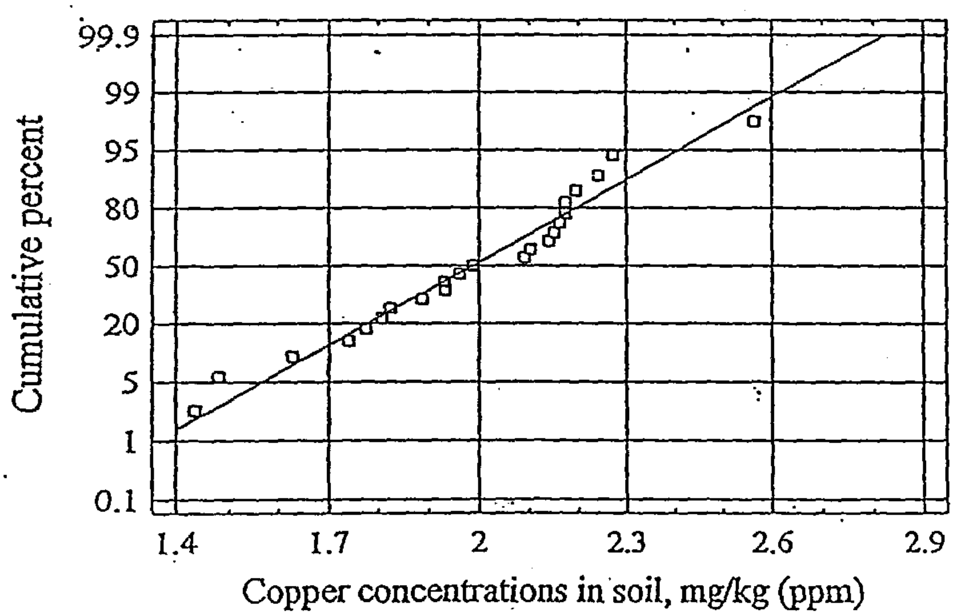
ımmary Statistics for log(Copper)

[illegible] = 23
[illegible]ge = 1.90556
[illegible]ian = 1.90787
le =
ometric mean = 1.96762
iance = 0.0713494
ndard deviation = 0.267113
ndard error = 0.0556969
imum = 1.43508
imum = 2.56495
ge = 1.12986
er quartile = 1.80829
er quartile = 2.17475
erquartile range = 0.366463
mess = -0.263077
i. skewness = -0.515077
tosis = 0.18883
i. kurtosis = 0.184854
f. of variation = 13.4528
= 45.6679

Lognormal Probability Plot for Copper

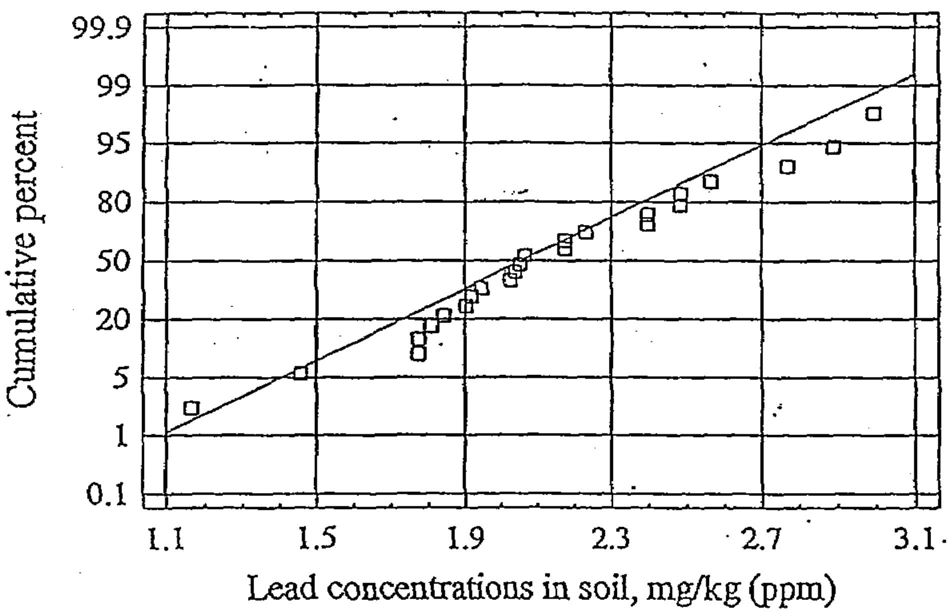


4

```
mary Statistics for log(Lead)

nt = 24
rage = 2.13936
ian = 2.06049
e =
metric mean = 2.09509
iance = 0.187882
ndard deviation = 0.433454
ndard error = 0.0884784
imum = 1.16315
imum = 2.99573
ge = 1.83258
er quartile = 1.87133
er quartile = 2.4414
erquartile range = 0.570072
wness = 0.0350174
l. skewness = 0.0700348
tosis = 0.200156
l. kurtosis = 0.200156
f. of variation = 20.261
= 51.3446
```

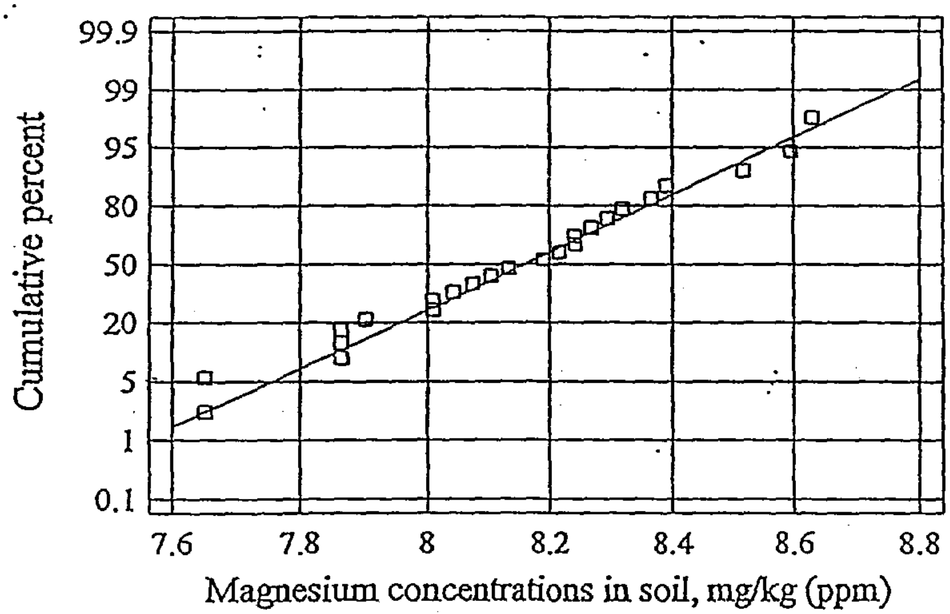
Lognormal Probability Plot for Lead



Summ-ry Statistics for log(Magnesium)

: = 24
\ ge = 8.14232
ledian = 8.16011
lode =
eometric mean = 8.13815
ariance = 0.0706013
tandard deviation = 0.265709
tandard error = 0.0542376
inimum = 7.64969
aximum = 8.63052
ange = 0.980829
ower quartile = 7.95369
pper quartile = 8.3064
nterquartile range = 0.352709
kewness = -0.0600481
nd. skewness = -0.120096
rtosis = -0.414246
nd. kurtosis = -0.414246
eff. of variation = 3.26331
m = 195.416

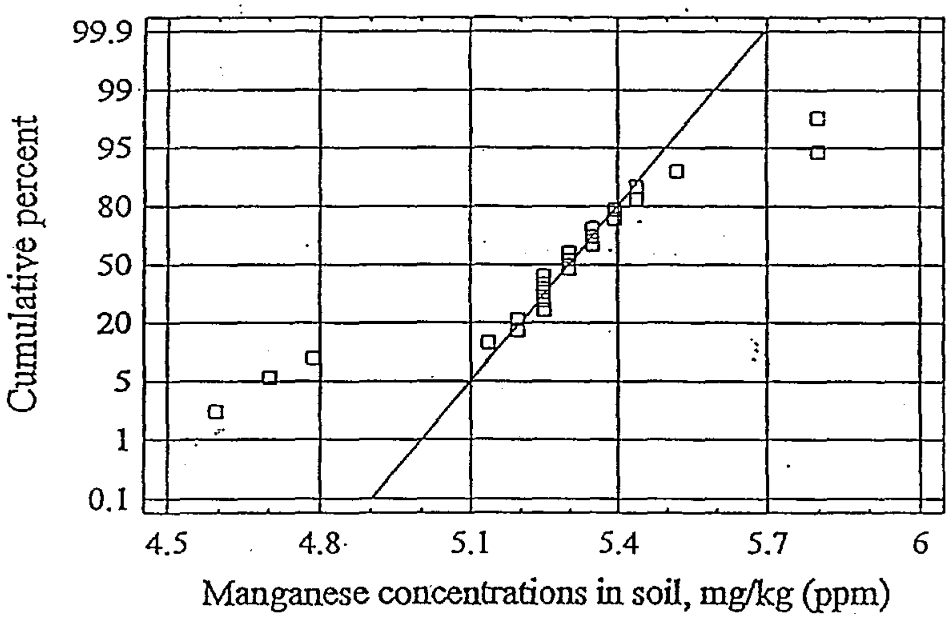
Lognormal Probability Plot for Magnesium



ummary Statistics for log(Manganese)

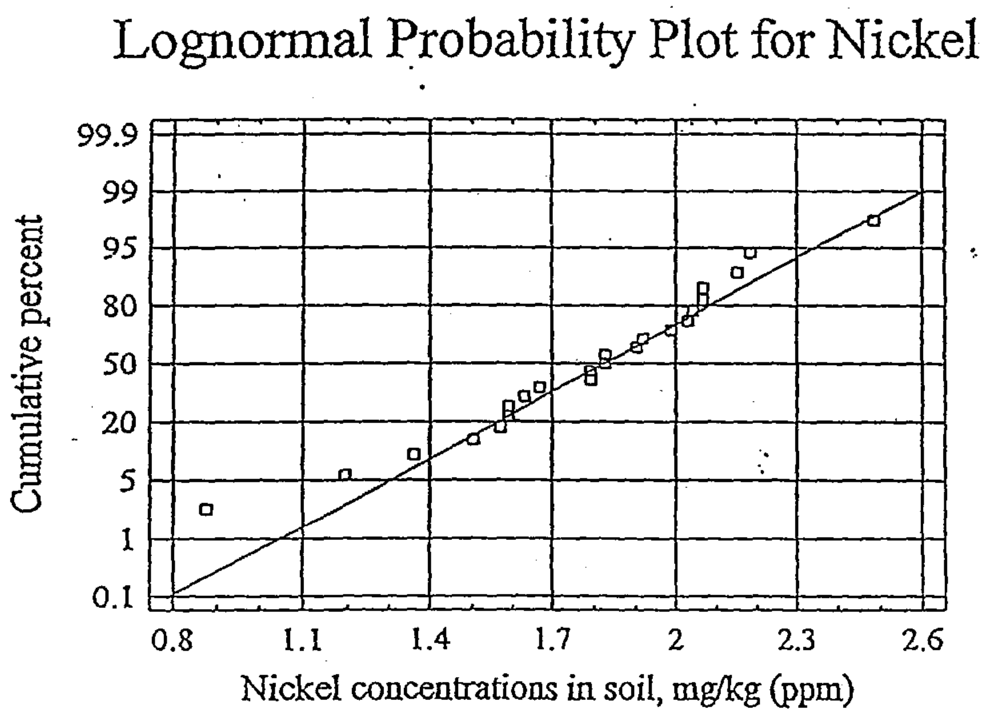
ount = 24
verage = 5.2733
edian = 5.29832
ode =
eometric mean = 5.2661
ariance = 0.0771874
tandard deviation = 0.277826
tandard error = 0.056711
inimum = 4.59512
aximum = 5.79909
inge = 1.20397
ower quartile = 5.21999
pper quartile = 5.39363
terquartile range = 0.173637
ewness = -0.660387
nd. skewness = -1.32077
rtosis = 1.62566
nd. kurtosis = 1.62566
eff. of variation = 5.26854
m = 126.559

Lognormal Probability Plot for Manganese



ummary Statistics for log(Nickel)

= 23
age = 1.78451
edian = 1.82455
ode =
eometric mean = 1.74596
ariance = 0.1246
tandard deviation = 0.352987
tandard error = 0.0736029
inimum = 0.875469
aximum = 2.48491
inge = 1.60944
wer quartile = 1.58924
per quartile = 2.04122
terquartile range = 0.451985
ewness = -0.609856
nd. skewness = -1.19403
rtosis = 0.992502
nd. kurtosis = 0.971605
eff. of variation = 19.7806
n = 41.0438

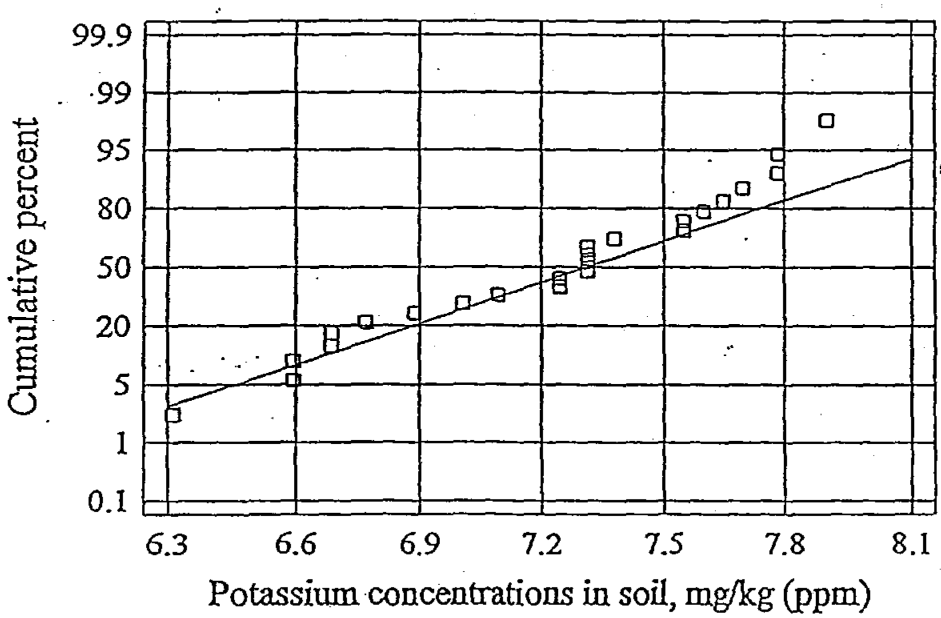


40

nary Statistics for log(Potassium)

```
it = 24
rage = 7.21862
ian = 7.31322
: = 7.31322
netric mean = 7.20542
ance = 0.195599
dard deviation = 0.442265
dard error = 0.0902771
mum = 6.30992
mum = 7.90101
e = 1.59109
r quartile = 6.82802
r quartile = 7.57526
rquartile range = 0.747233
ness = -0.373735
. skewness = -0.74747
osis = -0.83864
. kurtosis = -0.83864
f. of variation = 6.12673
= 173.247
```

Lognormal Probability Plot for Potassium

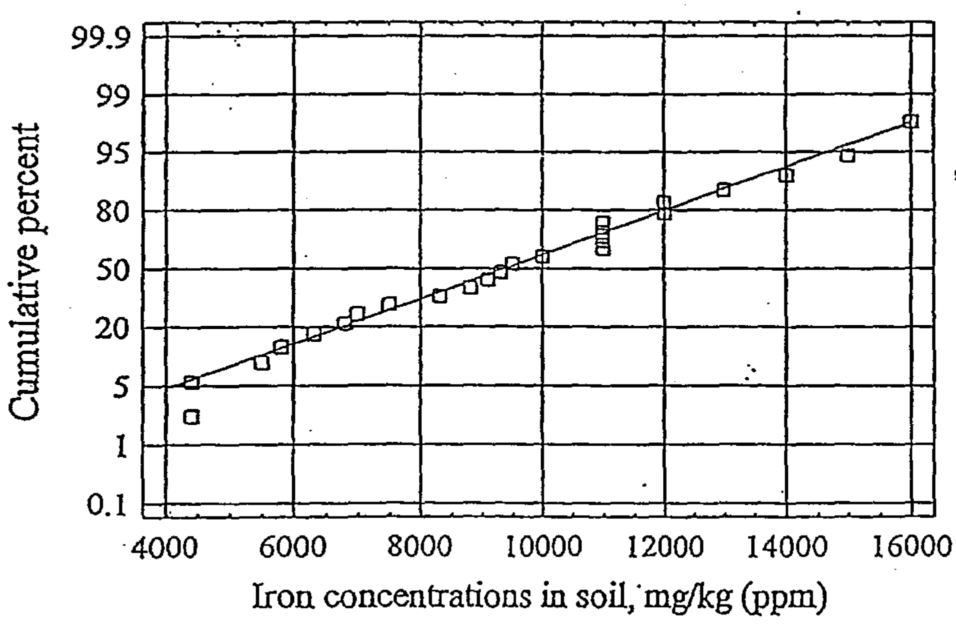


41

ummary Statistics for Iron

```
    = 24
 .age = 9529.17
edian = 9400.0
ode = 11000.0
eometric mean = 8977.5
ariance = 1.0363E7
tandard deviation = 3219.17
tandard error = 657.109
inimum = 4400.0
aximum = 16000.0
inge = 11600.0
ower quartile = 6900.0
pper quartile = 11500.0
iterquartile range = 4600.0
ewness = 0.20025
nd. skewness = 0.400499
rtosis = -0.620589
nd. kurtosis = -0.620589
eff. of variation = 33.7822
m = 228700.0
```

Normal Probability Plot for Iron

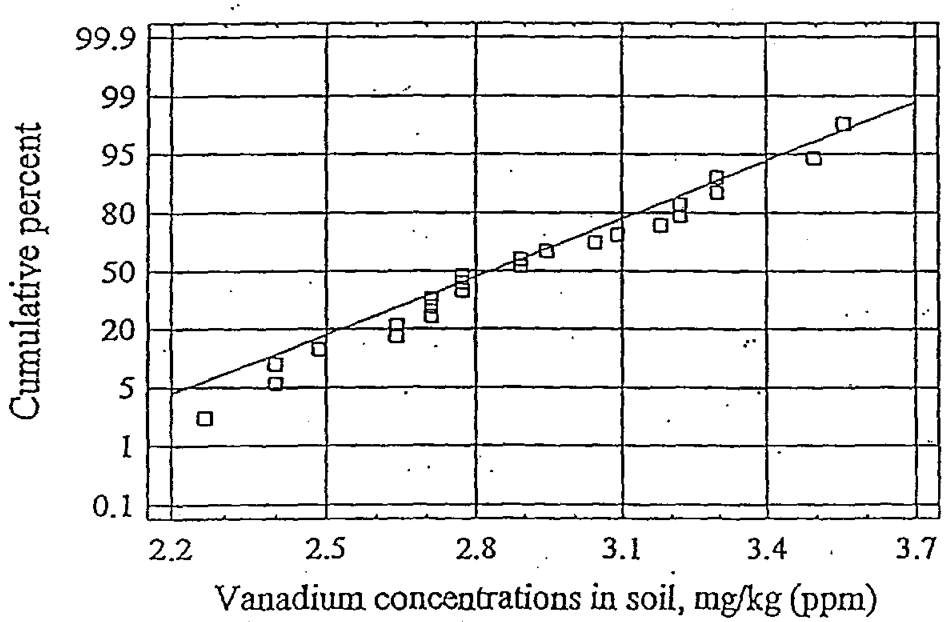


42

mmary Statistics for log(Vanadium)

unt = 24
erage = 2.89094
dian = 2.83140
de =
ometric mean = 2.87064
riance = 0.122444
andard deviation = 0.34992
andard error = 0.0714271
nimum = 2.26176
ximum = 3.55535
nge = 1.29358
wer quartile = 2.67355
per quartile = 3.19846
terquartile range = 0.524911
ewness = 0.158415
d. skewness = 0.316831
tosis = -0.688491
d. kurtosis = -0.688491
ff. of variation = 12.104
= 69.3826

Lognormal Probability Plot for Vanadium



4

```
ummary Statistics for Zinc

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  an = 52.0
ode = 52.0
eometric mean = 46.9434
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ximum = 69.0
nge = 48.0
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terquartile range = 17.0
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ıd. kurtosis = -0.0224531
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ı = 1176.0
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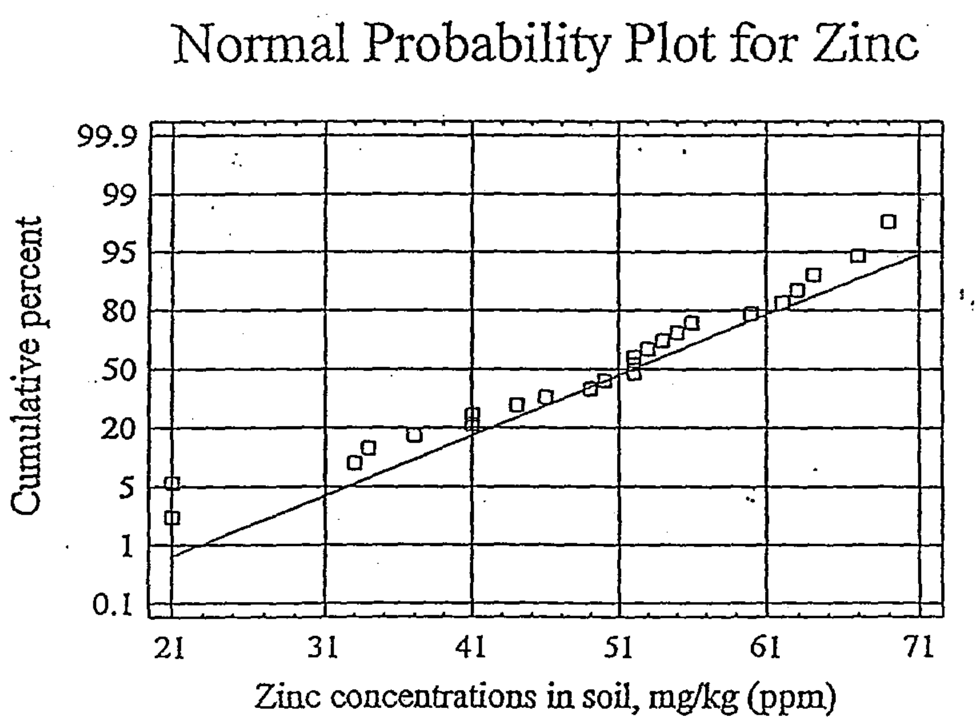

44

Local Background Soil Results

Sample Identifier	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury
Bkg-01-A	2700	6	2	110	ND	0.9	23000	3	3	6	5800	6	2100	190	ND
Bkg-01-B	4100	8	2	130	0.3	1.5	24000	5	4	7	8800	7	3100	230	ND
Bkg-02-A	2400	4	2	110	ND	0.8	35000	2	3	4	4400	3	2100	99	ND
Bkg-02-B	3400	7	2	130	ND	1	31000	3	3	6	6300	8	2700	210	ND
Bkg-03-A	4800	9	5	110	0.4	1.8	36000	6	5	9	11000	9	3700	210	ND
Bkg-03-B	6000	10	2	95	0.4	1.8	28000	7	5	9	11000	9	4400	250	ND
Bkg-04-A	4000	7	2	120	0.3	2.3	24000	9	4	13	9300	8	3000	190	ND
Bkg-04-B	3300	6	2	120	ND	1.4	24000	4	4	7	8300	6	2600	210	ND
Bkg-05-A	6400	13	6	210	0.5	1.8	78000	6	7	14	10000	16	5600	330	ND
Bkg-05-B	5500	10	6	140	0.5	1.7	33000	6	6	9	11000	11	3900	330	ND
Bkg-06-A	4500	9	6	150	0.3	1.5	46000	19	4	8	9100	8	3800	190	ND
Bkg-06-B	3800	8	2	150	0.3	1.1	51000	4	4	7	6800	7	3400	200	ND
Bkg-07-A	3100	6	2	95	0.3	1.1	34000	4	4	6	7000	12	2600	170	ND
Bkg-07-B	3600	7	3	100	0.3	1.3	39000	4	4	6	7500	7	3000	180	ND
Bkg-08-A	2200	5	6	160	ND	0.6	54000	3	ND	4	4400	4	2600	110	ND
Bkg-08-B	3600	7	3	190	ND	1.6	60000	5	4	7	9500	6	4100	180	ND
Bkg-09-A	5900	11	6	210	0.4	1.7	49000	6	5	7	11000	8	5400	230	ND
Bkg-09-B	3400	7	3	210	0.3	0.9	82000	3	3	5	5500	6	3800	120	ND
Bkg-10-A	7500	11	2	140	0.3	2.3	42000	8	5	8	13000	12	3200	190	ND
Bkg-10-B	6600	11	6	150	0.3	2.6	35000	7	4	10	14000	11	3300	200	ND
Bkg-11-A	8300	13	2	200	0.4	2.2	43000	8	5	9	12000	18	3600	190	ND
Bkg-11-B	10000	16	2	200	0.5	2.4	40000	10	6	9	16000	20	4000	220	ND
Bkg-12-A	5600	11	2	200	0.3	2.2	55000	7	5	9	12000	9	4300	200	ND
Bkg-12-B	8600	14	6	290	0.4	2.6	47000	10	6	9	15000	13	5000	220	ND

Concentrations in mg/kg
Activities in pCi/g
Sample Identifier XX-XX-A - surface soil samples
Sample Identifier XX-XX-B - subsurface soil samples

Local Background Soil Results

Sample Identifier	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Tritium	Plutonium 239/24	Plutonium 238	Uranium-238	Uranium-235/236	Uranium-234
Bkg-01-A	4	1500	ND	ND	ND	ND	11	50						
Bkg-01-B	6	2000	ND	ND	ND	ND	16	63						
Bkg-02-A	2	730	ND	ND	ND	ND	9.6	41						
Bkg-02-B	5	1600	ND	ND	ND	ND	11	53						
Bkg-03-A	7	1500	ND	ND	ND	ND	19	56						
Bkg-03-B	9	1200	ND	ND	480	ND	15	62						
Bkg-04-A	12	1900	ND	1	ND	ND	18	55	<0.010	<0.009	<0.011	0.8	0.28	1
Bkg-04-B	5	1400	ND	ND	ND	ND	16	52	<0.022	<0.008	<0.009	0.3	0.02	0.3
Bkg-05-A	9	2700	ND	ND	ND	ND	22	37						
Bkg-05-B	8	1400	ND	ND	ND	ND	18	34						
Bkg-06-A	13	1500	ND	ND	ND	ND	16	52						
Bkg-06-B	6	800	ND	ND	420	ND	14	54						
Bkg-07-A	5	870	ND	ND	ND	ND	15	21						
Bkg-07-B	5	800	ND	ND	380	ND	15	21						
Bkg-08-A	3	730	ND	ND	ND	ND	12	33						
Bkg-08-B	5	980	ND	ND	430	ND	21	67						
Bkg-09-A	8	1100	ND	ND	280	ND	24	41						
Bkg-09-B	5	550	ND	ND	640	ND	14	44						
Bkg-10-A	6	2400	ND	ND	ND	ND	27	52						
Bkg-10-B	7	2200	ND	ND	ND	ND	27	49						
Bkg-11-A	7	2100	ND	ND	280	ND	25	60	<0.023	<0.007	<0.017		0.03	0.5
Bkg-11-B	8	2400	ND	ND	290	ND	35	64	<0.024	<0.012	<0.018		0.03	0.6
Bkg-12-A	6	1500	ND	ND	ND	ND	25	46	<0.084	<0.030	<0.017		0.17	0.8
Bkg-12-B	8	1900	ND	ND	620	ND	33	69	<0.023	0.035	0.038	0.6	0.33	0.9

Concentrations in mg/kg
Activities in pCi/g
Sample Identifier XX-XX-A - surface soil samples
Sample Identifier XX-XX-B - subsurface soil samples

Normal Parameters for Tijeras Arroyo Local Metal Background Data

Statistical Parameter	Aluminum	Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Vanadium	Zinc
median	4300	8.5	2	140	2	6	4.2	7.3	9400	7.9	200	6.2	17	52
geometric mean	4579.9	8.6	3	144	2	5	3.7	7.3	8977.5	8.5	195	6	18	47
maximum	10000	16	6	210	3	10	6.6	13	16000	20	330	12	35	69
minimum	2200	4.4	2	95	1	2	0.1	4.2	4400	3.2	99	2.4	9.6	21
arithmetic average	4970.8	9	3	149	2	5.5	4.2	7.5	9529.2	9.3	202	6.3	19	49
standard deviation	2095.4	3	2	40.5	1	2.3	1.3	2	3219.2	4.2	53.6	2.1	6.9	13
normal tolerance	2.309	2.3	2	2.33	2	2.3	2.3	2.3	2.309	2.3	2.31	2.3	2.3	2.3
UTL	4927.4	16	7	244	3	11	7.3	12	16962	19	326	11	35	79

Lognormal Parameters for Tijeras Arroyo Local Metal Background Data

Statistical Parameter	Aluminum	Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Vanadium	Zinc
arithmetic average	8.4294	2.2	1	4.97	0	1.6	1.3	2	9.1025	2.1	5.27	1.8	2.9	3.8
standard deviation	0.4126	0.3	1	0.27	0	0.5	0.8	0.3	0.3631	0.4	0.28	0.4	0.3	0.3
normal tolerance	2.309	2.3	2	2.33	2	2.3	2.3	2.3	2.309	2.3	2.31	2.3	2.3	2.3
UTL	9.3821	2.9	2	5.6	1	2.7	3.1	2.6	9.941	3.1	5.91	2.6	3.7	4.6
e^{UTL}	11874	19	10	271	4	14	21	14	20764	23	370	14	40	98

Insufficient data for mercury, selenium, silver, and thallium to calculate statistics

All concentrations in mg/kg

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Summary of Background Concentrations for Radionuclides in Soil

Analyte	Original Number of Samples	Number of Detects	Number of Rejected Samples	Distribution Type	Range (pCi/g)	n[a]	Geometric Mean (pCi/g)	Median (pCi/g)	95th Upper Tolerance Limit (pCi/g)	95th Percentile (pCi/g)
Bismuth-212	324	17	307	Nonparametric	0.414–2.7	17	1.1055	1.0	–	2.7
Bismuth-214	340	321	19	Nonparametric	0.27–1.4	321	0.648	0.6	–	0.8
Cesium-137	802	561	26	–	–	–	–	–	–	–
(Surface)	–	–	–	Nonparametric	0.004–10.1	604	0.200	0.2495	–	0.92
(Subsurface)	–	–	–	Unknown[c]	<detection limit (<0.0686)	172	<detection limit (<0.0686)	<detection limit (<0.0686)	–	<detection limit (<0.0686)
Cobalt-60	321	11	74	Unknown	<detection limit (<0.0418)	247	<detection limit (<0.0418)	<detection limit (<0.0418)		<detection limit (<0.0418)
Lead-210[b]	338	40	292	Nonparametric	0.3–12.0	46	2.26838	2.835	–	6.8
Lead-212[b]	323	233	90	Lognormal	0.1–1.4	233	0.49689	0.5	1.0795	–
Lead-214[b]	249	241	9	Lognormal	0.29–1.13	240	0.549	0.56	0.90	–
Potassium-40	722	720	4	Normal	0.192–31.0	718	15.889	16.4	25.34	–
Radium-224	24	24	0	Nonparametric	0.43–0.97	24	0.6747	0.655	–	0.968
Radium-226	368	53	314	Lognormal	0.5–2.09	54	0.713	0.590	1.94	–
Radium-228	24	24	0	Nonparametric	0.45–1.05	24	0.695	0.630	–	1.05
Radon	0	0	0	Unknown	–	0	–	–	–	–
Strontium-90	54	45	9	Nonparametric	0.032–1.85	45	0.2528	0.2883	–	0.766
Thorium-232	136	136	0	Lognormal	0.23–1.20	136	0.7971	0.810	1.258	–
Thorium-234	365	52	330	Lognormal	0.324–3.0	35	0.7796	0.71	2.89	–
Tritium	0	0	0	Unknown	–	0	–	–		–
Uranium-234	4	4	0	Nonparametric	0.8–1.0	4	0.897	0.9	–	1.0
Uranium-235	95	21	75	Nonparametric	0.05–0.18	20	0.1198	0.1235	–	0.168
Uranium-238	223	206	17	Nonparametric	0.0033–2.065	206	0.506	0.763	–	1.1

[a]Sample size.
[b]These constituents are not listed as COC in Table 2-2 for this media.
[c]Constituents of concern are of unknown distribution type because data are either below the limit of detection, unusable, or nonexistent.

(IT, 1994)

NOD

Department of Energy
Field Office, Albuquerque
Kirtland Area Office
P.O. Box 5400
Albuquerque, New Mexico 87115

OCT 17 1996

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Benito Garcia, Bureau Chief
New Mexico Environment Department
Hazardous and Radioactive Materials Bureau
2044 Galisteo Street
P.O. Box 26110
Santa Fe, NM 87505-2100

Dear Mr. Garcia:

Enclosed are two copies of the Sandia National Laboratories, New Mexico/Department of Energy (SNL/NM/DOE) response to the New Mexico Environment Department (NMED) technical comments on the 23 No Further Action (NFA) proposals submitted to NMED in June of 1995.

If you have any questions, please contact John Gould at (505) 845-6089, or Mark Jackson at (505) 845-6288.

Sincerely,

Michael J. Zamorski
Acting Area Manager

Enclosure

cc w/enclosure:
T. Trujillo, AL, ERD
W. Cox, SNL, MS 1147
N. Weber, NMED-AIP
R. Kern, NMED-AIP
D. Neleigh, EPA, Region 6 (2 copies)

cc w/o enclosure:
B. Oms, KAO-AIP
E. Krauss, SNL, MS 0141
B. Hoditschek, NMED
S. Dinwiddie, NMED

OCT 21 1996

Sandia National Laboratories
Albuquerque, New Mexico
October 1996

Environmental Restoration Project
Responses to NMED Technical Comments
on No Further Action Proposals
Dated June 1995

INTRODUCTION

This document responds to comments received in a letter from the State of New Mexico Environment Department to the U.S. Department of Energy (Zamorski, July 29, 1996) documenting the review of 23 No Further Action (NFA) Proposals submitted in June 1995.

This response document is organized in numerical order by operable unit (OU) and subdivided in numerical order by site number, Each OU section provides NMED comments repeated in **bold** by comment number and by site number in the same order as provided in the call for response to comments. The DOE/SNL response is written in normal font style on a separate line under "Response". Responses to general technical comments begin on page 3 and responses to site-specific technical comments begin on page 4. Responses to general risk assessment comments begin on page 143 and responses to specific risk assessment comments begin on page 144. Additional supporting information for the site-specific comments is included as figures and tables within each comment response and as attachments to each section of this document.

TABLE OF CONTENTS

RESPONSES TO NMED TECHNICAL COMMENTS ON NO FURTHER ACTION PROPOSALS DATED JUNE 1995

GENERAL TECHNICAL COMMENTS

1. **Please provide a Table of Contents so that the individual sites and their order of discussion can be more readily tracked.**

   Response: A Table of Contents is provided with each No Further Action Proposal submission sent to the regulators.

2. **Information sources are listed for individual proposals within the section Sources of Supporting Information. Although the information sources might be useful for evaluation of the proposals, it is generally difficult to match the information source the referenced document. Information sources should be referenced.**

   Response: Citations in text to the references cited will be provided in future NFA proposals submissions and resubmissions.

3. **The background soil sampling results should be submitted for NMED review.**

   Response: A Site-Wide statistical study for determining the background concentrations of metals and radionuclides in soil and water at Sandia National Laboratories/New Mexico and Kirtland Air Force Base has been recently completed and submitted to NMED in March 1996 (IT, 1996). These new background values were used to replace values provided for specific NFA proposals in this response.

4. **Concerns exist over the sampling of the "septic system" solid waste management units (SWMUs). NMED believes the soil borings for drywells, seepage pits, or drain fields are inadequate. The proposal states that soil borings/samples were taken near the units (within 10 feet), but not underneath them. A sampling plan must be established to investigate underneath the seepage pits, drywells, or drain fields. Also, samples taken underneath the septic pipes/drain pipes need to be taken deeper than 3 feet.**

   Response: See Response to Site-Specific Technical Comment #1 below.

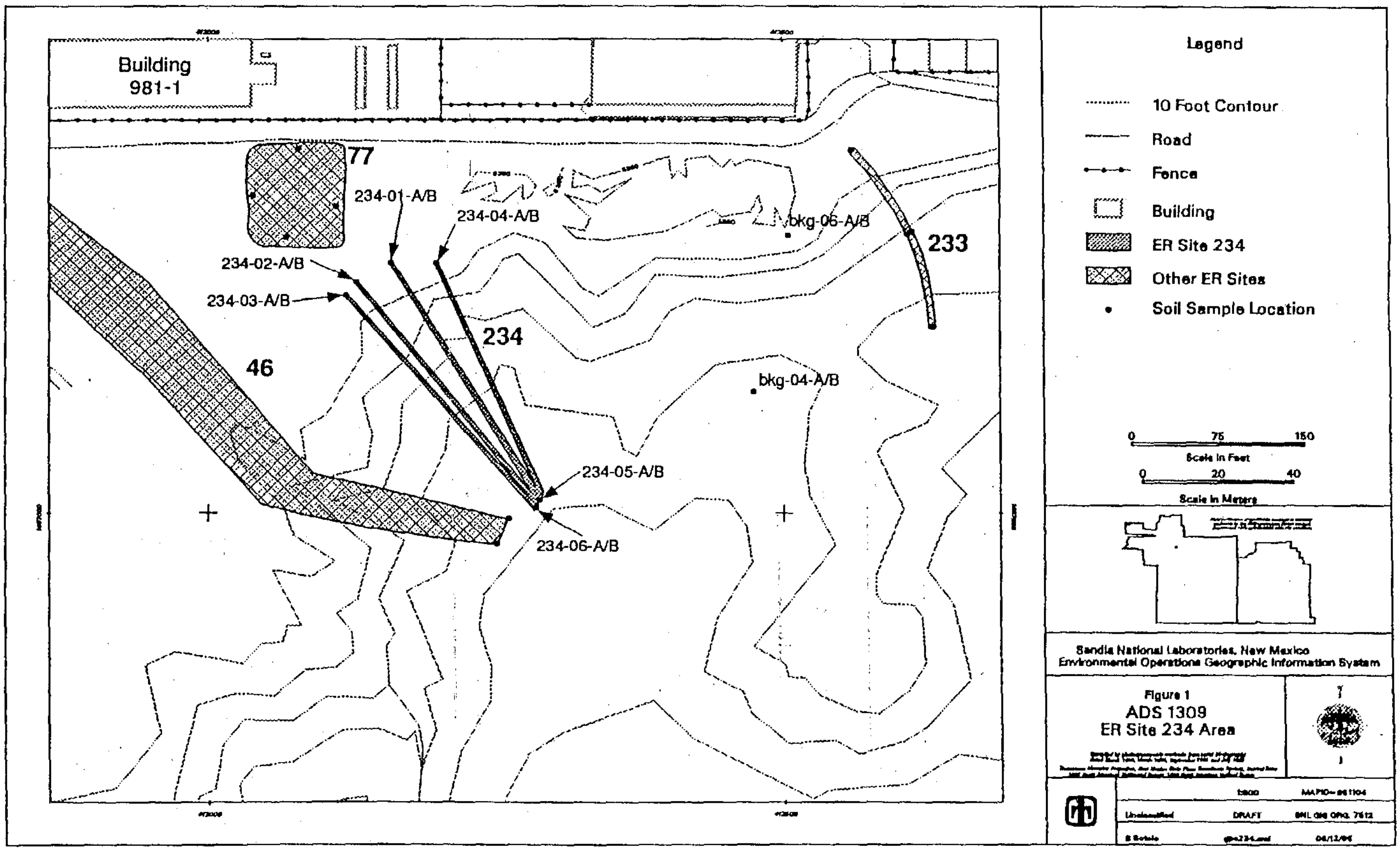
17. Site 234, OU 1309, Storm Drain Outfall Site

a. Comment a for Site 233 is pertinent to Site 234. [a] NMED understands that Site 233 received industrial effluent and storm water from Technical Area 4 from 1978 to 1991. Currently, the outfall discharges only storm water. The rate and volume of discharge are unknown. Potential contaminants of concern at Site 233 include metals, VOCs, and SVOCs. NMED is concerned that no specifics are provided as to the kinds and quantities of wastes managed via outfall discharges. Waste generation records and process knowledge might be used to better suggest what kinds and quantities of contaminants may have been released to the environment.

Response: SNL/NM has compiled additional historical and process data to reduce the misunderstanding that has previously surrounded ER Site 234 (Attachment C). Waste generation records were not relevant for ER Site 234 because the outfall received storm water for only several days per year. The purpose of the outfall system was to mitigate soil erosion on the steep slope south of TA-IV (Figure 1). No process or waste waters flowed into the outfall system; such fluids were directed to the sanitary sewer system or two evaporative lagoons. The COCs are solely based upon potential contaminants; no releases are known to have occurred in the area that drained to the ER Site 234 outfall. Discharges of storm water at SNL/NM are monitored by a Storm Water Program that follows Federal and State regulatory requirements (SNL/NM, 1995c).

In the June 1995 NFA Proposal, the potential COCs were considered to be chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, and mineral oil. This list of COCs was conservatively based upon chemicals used at TA-IV. However, no releases are known to have occurred in the area that drains to the ER Site 234 outfall. Likewise, no stained soil or stressed vegetation has been documented at the site. Additional historical, regulatory compliance, and process information for TA-IV has been gathered and is discussed in Attachment C.

As shown on SNL/NM Engineering Sheet UAD-H13 (Figure 2), Site 234 is a inactive, storm water system outfall that received water from the southwestern part of TA-IV near Buildings 981. Prior to the early 1990s, the Building 981 catch basins and roof drains were connected to this series of four, unpaved outfalls. The outfalls do not currently receive any type of water. Instead, storm water is now plumbed to the ER Site 233 outfall. Since the soil sampling was conducted in 1994, sloughed soil has covered the four discharge pipes (outfalls). The shallow ditches below the pipes still remain.


Building
981-1
77
234-01-A/B
234-04-A/B
234-02-A/B
234-03-A/B
234
46
bkg-06-A/B
233
bkg-04-A/B
234-05-A/B
234-06-A/B
Legend
10 Foot Contour
Road
Fence
Building
ER Site 234
Other ER Sites
Soil Sample Location
0 75 150
Scale in Feet
0 20 40
Scale in Meters
Sandia National Laboratories, New Mexico
Environmental Operations Geographic Information System
Figure 1
ADS 1309
ER Site 234 Area
DRAFT

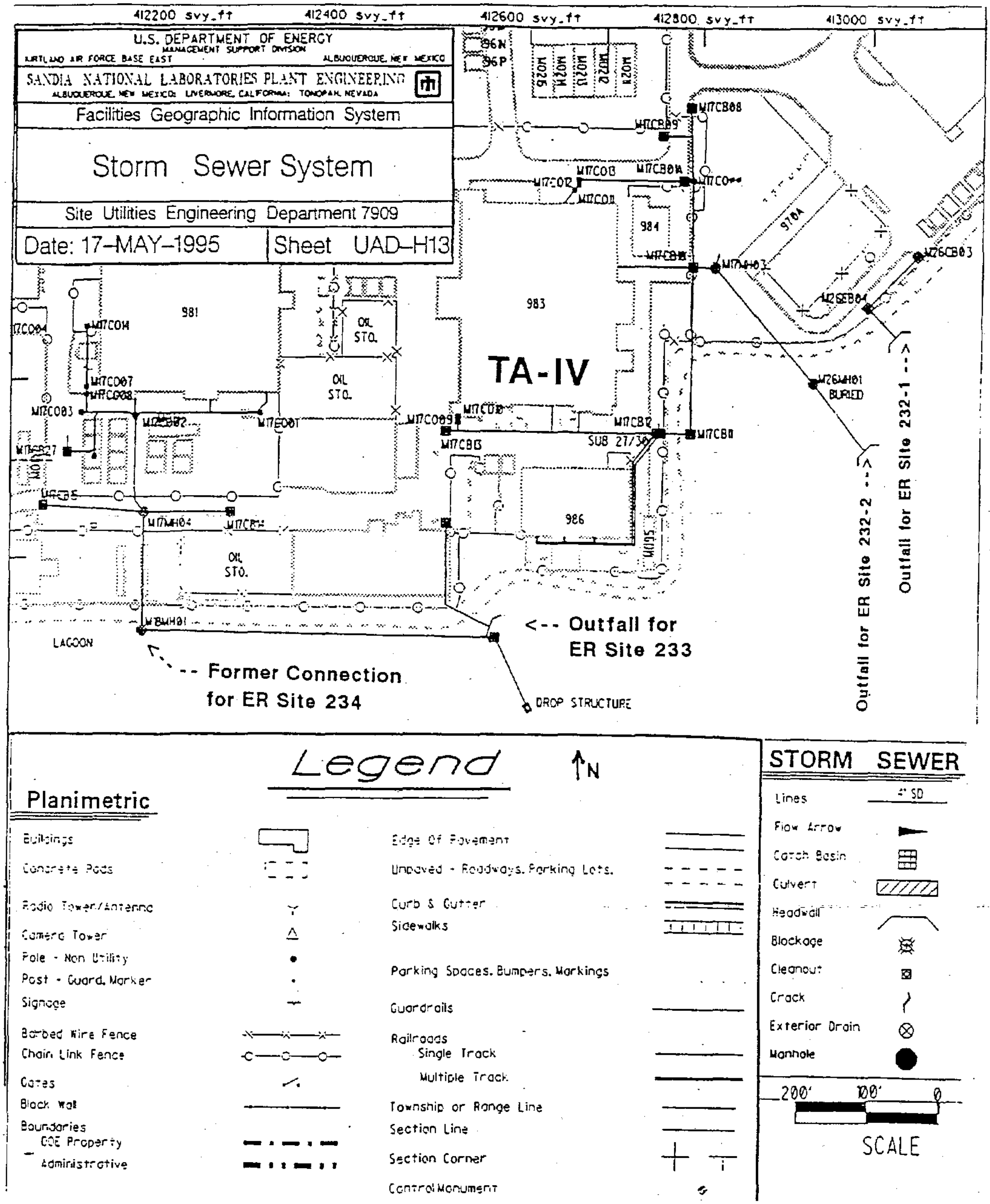


Figure 2. TA-IV storm-water system at ER Site 234. [Excerpt of SNL/NM Engineering Sheet UAD-H13; the ER site labels were added by the SNL/NM ER Project.]

b. Comments b, d, and e for Site 230 are pertinent to Site 234. [b] A maximum sampling depth of 6 to 36 inches may be inadequate to detect any contaminants of concern. Additionally, please explain why samples were potentially composited over as much as 30 inches? Why are actual sample depths not reported? [d] Method detection limits are not provided in Table 1 and Appendix B. [e] How was industrial effluent introduced into the drainage system that connected to the outfall? Are there pipes connected to the drainage system and/or outfall? Please provide construction plans (preferably "as built") of the entire drainage system.

Response: SNL/NM believes that the sampling interval was appropriate. Soil samples were collected from 0 to 36 inches at the ER Site 234 outfalls and associated drainage ditches where the potential for contamination was greatest. SNL/NM believes that some trace of contamination would be found in the surface or shallow subsurface soils if a significant deeper problem existed. The analytical methodology incorporated part-per-billion detection limits (Attachment A). Soil samples were composited for sampling simplicity due to the homogeneous nature of the soil. Each shallow sample was composited using soil from a depth interval of 0 - 6 inches. The samples shown in Table 4 with identification numbers that end in an "A" represent "shallow" soil (0 - 6 inches) samples. The mention of the subsurface-soil sampling interval being 6 - 36 inches is misleading. The subsurface-soil sampling interval was either 6 - 30 inches or 6 - 36 inches, depending of the analytes of interest. For convenience sake, the sampling interval for all subsurface-soil samples was standardized on the sample collection logs as 6 - 36 inches. The samples shown in Table 4 with identification numbers that end in an end in a "B" represent these "subsurface" samples. The sampling procedures are discussed in greater detail in Appendix A of the June 1995 *Proposal for NFA - Site 234*.

Method detection limits are listed in Attachment A of this response.

Additional historical and process information for TA-IV has been gathered and is discussed in Attachment C.

c. Comment b for Site 231 is pertinent to Site 234. [b] Soil/sediment samples should be collected from boreholes drilled along the alignment of the outfall and analyzed for constituents determined from process knowledge and waste disposal records.

Response: SNL/NM believes that the lack of significant shallow soil contamination at the upper and lower ends of the four ditches is sufficient to justify a NFA decision.

d. Section 3.6, Last Paragraph, in reference to SNL/NM's statement "Two samples were collected at each of the four inlets". Were the samples collected at "inlets" or at outfalls?

Response: Figure 3 shows that two soil samples were collected at each of the four outfalls pipes and also at the end of the drainage ditches.

e. NMED understands that no actual "inlets" or outfalls are visible at the site. NMED is concerned about whether SNL/NM sampled the four "inlets" at actual locations where waste waters may have been discharged.

Response: As shown on Figure 3, the soil samples were collected about two ft down slope of where surface water had been discharged from each outfall. During 1994 and 1995, the locations of the outfalls were still evident as holes in the steep slope south of TA-IV. Historical aerial photography was used to determine the site boundaries and to locate the 1994 soil-sampling points. Because the outfalls do not currently receive any type of water and continuing soil erosion occurs on the steep slope, the actual outfall pipes are now covered. However, the unlined ditches are still present.

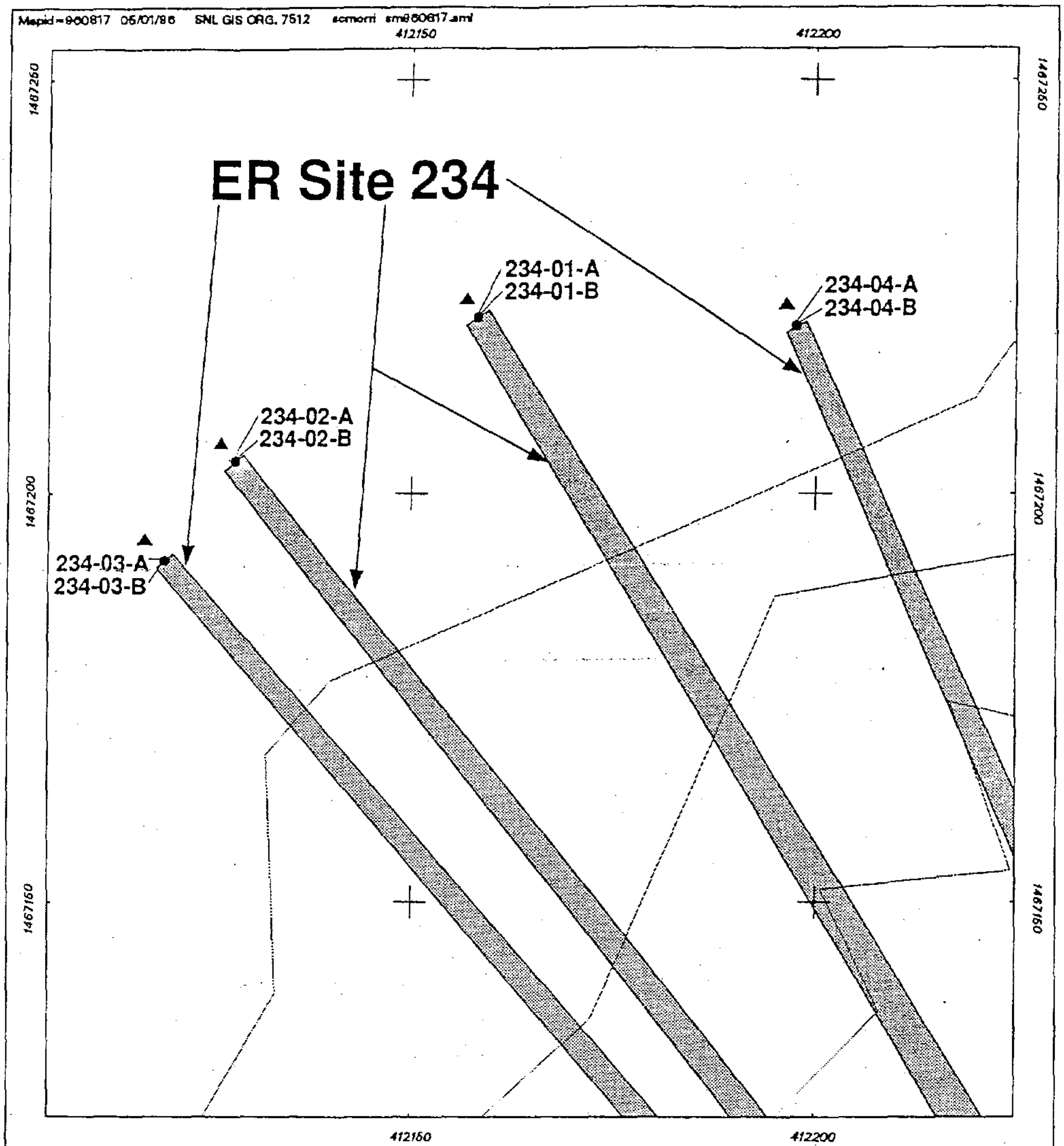
f. RECOMMENDATION: Based upon site concerns, including the lack of adequate sampling and inadequate information about the quantities of discharges and system construction, NMED considers that NFA is not currently appropriate for Site 234.

Response: SNL/NM believes that the lack of significant shallow soil contamination at the most likely release site is sufficient for a NFA decision. The soil-sampling results are discussed below in the SNL/NM Analytical Data Summary for ER Site 234 section.

SNL/NM Analytical Data Summary for ER Site 234

Introduction

Since the submission of the June 1995 *Proposal for NFA - Site 234,* three significant approaches have been employed by the SNL/NM ER Project for evaluating the potential impact of contaminants upon human health. First, a site-wide (the KAFB and SNL/NM area) statistical study has been recently completed for determining the background concentrations of metals and radionuclides in soil and water (IT, 1996). These new background values are listed in Attachment K and have been through a more rigorous statistical analysis and therefore replace



Legend

- Soil Sample Location
- Outfall (covered by soil)
- 10 Foot Contour
- ER Site 234

Figure 3
ADS 1309
ER Site 234 Outfall

Scale in Feet: 0, 10, 20
Scale in Meters: 0, 2.4, 4.8

Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System

the values that were used in the June 1995 NFA proposals. Second, the Tijeras Arroyo background values in Attachment K have been recalculated using U.S. EPA guidance (EPA, 1989; EPA, 1992a; EPA, 1992b). Third, a standardized risk-assessment approach has been implemented by SNL/NM with U.S. EPA Region VI acceptance. These three approaches and the screening of regulatory standards have been incorporated in the ER Site 234 risk assessment that is presented in Attachment K. Elevated metals and other non-radioactive constituents were evaluated using U.S. EPA guidance (EPA, 1989; EPA, 1991). Radionuclides that exceeded background were evaluated using DOE guidance and the RESRAD computer code for residual radioactive material (ORNL, 1994).

Background Concentrations

As part of the site-wide study, background concentrations were calculated for both the surface and subsurface soils of the North Super Group, which is defined as soils present in TA-I, TA-II, TA-IV, the northern rim of Tijeras Arroyo, and the northeastern portion of KAFB (IT, 1996). The depth of six inches was used for defining surface soil from subsurface soil. Two background concentrations are therefore listed for most of the metals and radionuclides in Tables 5 and 6. The background concentrations consist of either Upper Tolerance Limits (UTLs) or 95th Percentiles. An UTL was calculated for those COCs with normal or lognormal distributions; the 95th percentile was calculated for those COCs with nonparametric distributions.

Quality Assurance / Quality Control

The analytical results that were previously presented in the June 1995 *Proposal for NFA - Site 234* as Table 1 and Appendix B have been reorganized in this NOD response to incorporate the three new approaches. To prevent confusion, the reorganized analytical data are presented herein as Tables 4, 5, and 6. The tables present the maximum concentrations for each detected analyte as reported by the two, CLP-certified, offsite analytical laboratories (the Quanterra Environmental Services - St. Louis Laboratory and the ENCOTEC - Ann Arbor laboratory). The actual laboratory reports are available for review at the ER Project Records Center in Building 6584.

Attachment A lists the analytical methods and detection limits that were used in the Tijeras Arroyo OU sampling program. Quality Assurance (QA) samples, including field duplicates, trip blanks and rinsate samples, also were collected as part of the Tijeras Arroyo OU site-sampling program. The QA results demonstrated the effectiveness of the decontamination procedures (Appendix B - June 1995 *Proposal for NFA - Site 234*). Eleven QA-field duplicates were

Table 4. All reported concentrations of VOCs and SVOCs in ER Site 234 soil samples.

Sample Identifier[1]	Analyte	Type	Detection Limit (mg/kg, ppm)	Reported Concentration (mg/kg, ppm)	Qualifier
234-01-B	2-butanone	VOC[2]	0.010	0.002	B[3]J[4]
234-02-B	2-butanone	VOC	0.010	0.003	BJ
234-03-B	2-butanone	VOC	0.010	0.005	BJ
234-04-B	2-butanone	VOC	0.010	0.004	BJ
234-05-B	2-butanone	VOC	0.010	0.003	BJ
234-06-B	2-butanone	VOC	0.010	0.004	BJ
234-05-A	Benzo (b) fluoranthene	SVOC[5]	0.330	0.043	J
234-05-A	Benzo (a) pyrene	SVOC	0.330	0.048	J
234-03-A	Bis (2-ethylhexyl) phthalate	SVOC	0.330	0.28	BJ
234-05-A	Chrysene	SVOC	0.330	0.062	J
234-05-A	Pyrene	SVOC	0.330	0.034	J

[1]Sample identifier: First set of numbers denotes ER Site, second set of numbers denotes sample location, letter designator denotes sample depth (A denotes sample depth of 0 - 6 inches; B denotes sample depth of 6 - 30 or 6 - 36 inches).
[2]VOC = Volatile organic compound (EPA Method 8240).
[3]B = Qualifier denotes that the analyte was measured in the associated blank sample.
[4]J = Qualifier denotes that the analyte was reported at below the laboratory detection limit.
[5]SVOC = Semi-volatile organic compound (EPA Method 8270).

Table 5. Comparison of maximum concentrations in ER Site 234 soil versus Proposed Subpart S action levels and background UTLs and 95th Percentiles for North Super Group surface and subsurface soils.

Analyte	Maximum concentration in ER Site 234 soil (mg/kg, ppm)	Proposed Subpart S and Lead action levels (mg/kg, ppm) (EPA, 1990;EPA, 1994)	Surface soil UTL (mg/kg, ppm) (IT, 1996)	Surface soil 95th Percentile (mg/kg, ppm) (IT, 1996)	Subsurface soil UTL (mg/kg, ppm) (IT, 1996)	Subsurface soil 95th Percentile (mg/kg, ppm) (IT, 1996)
Metals						
Aluminum (Al)	11,000.0	n.s.[1]	n.c.[2]	n.c.	n.c.	n.c.
Antinomy (Sb)	17.0	30.0	n.a.[3]	3.9	n.a.	3.9
Arsenic (As)	6.3	80.0	n.a.	5.6	n.a.	4.4
Barium (Ba)	240.0	4,000.0	n.a.	200.0	n.a.	336.0
Beryllium (Be)	0.5	0.2	n.a.	0.8	n.a.	0.8
Cadmium (Cd)	3.0	40.0	n.a.	1.6	n.a.	0.9
Calcium (Ca)	65,000.0	n.s.	n.c.	n.c.	n.c.	n.c.
Chromium (Cr)-total	11.0	n.s.	n.a.	17.3	n.a.	12.8
Chromium-VI (Cr+6)	<0.1	400.0	n.c.	n.c.	n.c.	n.c.
Cobalt (Co)	5.7	n.s.	n.a.	7.1	n.a.	8.8
Copper (Cu)	13.0	n.s.	n.a.	25.5	n.a.	88.2
Iron (Fe)	13,000.0	n.s.	n.c.	n.c.	n.c.	n.c.
Lead (Pb)	13.0	400.0.	68.0	n.a.	n.a.	11.2
Magnesium (Mg)	4,800.0	n.s.	n.c.	n.c.	n.c.	n.c.
Manganese (Mn)	260.0	n.s.	n.c.	n.c.	n.c.	n.c.
Mercury (Hg)	<0.04	20.0	n.a.	0.31	n.a.	<0.1
Nickel (Ni)	10.0	2,000.0	n.a.	25.4	n.a.	25.4
Potassium (K)	3,200.0	n.s.	n.c.	n.c.	n.c.	n.c.
Selenium (Se)	<0.25	n.s.	n.a.	<1.0	n.a.	<1.0
Silver (Ag)	<0.5	200.0	n.a.	2.0	n.a.	<1.0
Sodium (Na)	480.0	n.s.	n.c.	n.c.	n.c.	n.c.
Thallium (Tl)	<0.5	n.s.	n.a.	<1.1	n.a.	<1.1
Vanadium (V)	30.0	n.s.	47.2	n.a.	n.a.	42.8
Zinc (Zn)	77.0	n.s.	n.a.	82.4	n.a.	82.4
Miscellaneous						
TPH	<40.0	n.s.	n.c.	n.c.	n.c.	n.c.

[1]n.s. = not specified.
[2]n.c. = not calculated. The analyte is not a COC for SNL or KAFB (IT, 1996).
[3]n.a. = not applicable. The UTL is provided for those COCs with normal or lognormal distributions; the 95th percentile is provided for those COCs with nonparametric distributions.

Table 6. Comparison of all reported maximum radionuclide activities in ER Site 234 soil versus background UTLs and 95th Percentiles for SNL North Area Group surface and subsurface soils.

Radionuclide	Maximum activity in ER Site 234 soil (pCi/g)	Surface soil UTL (pCi/g) (IT, 1996)	Surface soil 95th Percentile (pCi/g) (IT, 1996)	Subsurface soil UTL (pCi/g) (IT, 1996)	Subsurface soil 95th Percentile (pCi/g) (IT, 1996)
Plutonium-238	<0.008	n.c.[1]	n.c.	n.c.	n.c.
Plutonium-239/240	<0.004	n.c.	n.c.	n.c.	n.c.
Tritium	0.40	n.c.	n.c.	n.c.	n.c.
Uranium-234	0.59	1.6	n.a.	1.6	n.a.[2]
Uranium-235/236	0.013	n.a.	0.18	n.a.	0.18
Uranium-238	0.56	n.a.	1.3	n.a.	1.3

[1]n.c. = not calculated. The analyte is not a COC at SNL or KAFB (IT, 1996).

[2]n.a. = not applicable. The UTL is provided for those COCs with normal or lognormal distributions; the 95th percentile is provided for those COCs with nonparametric distributions.

collected for the soil samples (Attachment B). Relative percent difference (RPD) values were calculated for the metals, nitrate/nitrite, and radionuclides. The lack of detectable VOCs, SVOCs, and HE compounds did not allow RPDs to be calculated for those compounds. Of the 111 detectable metal and nitrate/nitrite concentrations, 85% of the RPDs were below the EPA-recommended target of 35%. Fifteen percent of the remaining RPDs were above the 35% target and probably are a function of the soil heterogeneity rather than a systematic error in sampling or analytical procedures. Of the nine detectable radionuclide activities, six were above the EPA-recommended target of 35%. However, the use of RPDs to evaluate the radionuclides values does not appear to be realistic because the activities were less than one pCi/g. Such low activities are well below background and are reported with relatively large 2-sigma errors. For example, U-235/236 was reported at 0.023 pCi/g with a 2-sigma error of 0.018 pCi/g. With a 95% confidence interval, the U-235/236 activity is in the range of 0.005 to 0.041 pCi/g and could therefore actually be below the minimum detectable activity (MDA) of 0.009 pCi/g. Soil heterogeneity could also account for the range of RPD values for the radionuclides. To conclude, the RPD values indicate that both the metal, nitrate/nitrite, and radionuclide analyses are of sufficient precision for preparing this NOD response.

Table 4 is the most detailed table and contains the maximum concentrations as well as all reported concentrations, including 'J' and 'B' values, for VOCs and SVOCs. Table 5 compares the maximum concentrations of metals, cyanide, and nitrate/nitrite (NO2+NO3) in ER Site 234 soil versus the Proposed Subpart S action levels (EPA, 1990) and the newly available background values (IT, 1996). Table 6 compares the maximum radionuclide activities in ER Site 234 soil versus the background UTLs and 95th Percentiles.

Sampling Locations

Twelve soil samples (234-01-A, 234-01-B, 234-02-A, 234-02-B, 234-03-A, 234-03-B, 234-04-A, 234-04-B, 234-05-A, 234-05-B, 234-06-A, and 234-06-B) were collected along the drainage ditches below the outfalls (Figure 3). No VOC or SVOC contamination was detected in the ER Site 234 soil samples (Table 4). Six organic compounds were reported with either 'J' and 'B' qualifiers as being below the laboratory reporting limit, or being detected in the associated blank sample, respectively. TPH was not detected in soil above the detection limit of 40 mg/kg (ppm).

Risk Assessment Conclusion

Using conservative assumptions and employing a Reasonable Maximum Exposure (RME) approach from RAGS (EPA, 1989), the risk assessment calculations show that for the industrial land-use scenario the Hazard Index (0.02) is significantly less than the U.S. EPA standard of 1. The estimated cancer risk (4×10^{-6}) is in the low-end of the suggested acceptable risk range (10^{-4} to 10^{-6}). The calculations show that for the residential land-use scenario the Hazard Index (0.09) is also significantly less than the U.S. EPA standard of 1. The estimated cancer risk (2×10^{-5}) is in the middle of the suggested acceptable risk range (10^{-4} to 10^{-6}). The dose and corresponding cancer risk from the radioactive components are much less than EPA guidance values; the estimated doses are 2×10^{-5} and 2×10^{-6} mrem/yr for the industrial and residential land-use scenarios, respectively. These values are much less than the Total Effective Dose Equivalent (TEDE) goal of 15 mrem/yr (40 CFR Part 196, 1994). The corresponding estimated cancer risk values are 1×10^{-9} and 4×10^{-11} for the industrial and residential land-use scenarios, respectively. These values are also much less than risk values calculated due to naturally occurring radiation. In conclusion, ER Site 234 does not have significant potential from either non-radioactive or radioactive contaminants to affect human health under either an industrial or a residential land-use scenario (Attachment K).

SNL/NM reiterates the request that the ER Site 234 be approved for NFA status.

18. Site 235, OU 1309, Storm Drain Outfall Site

a. **Comment a for Site 233 is pertinent to Site 235. [a] NMED understands that Site 233 received industrial effluent and storm water from Technical Area 4 from 1978 to 1991. Currently, the outfall discharges only storm water. The rate and volume of discharge are unknown. Potential contaminants of concern at Site 233 include metals, VOCs, and SVOCs. NMED is concerned that no specifics are provided as to the kinds and quantities of wastes managed via outfall discharges. Waste generation records and process knowledge might be used to better suggest what kinds and quantities of contaminants may have been released to the environment.**

Response: SNL/NM has compiled additional historical and process data to reduce the misunderstanding that has previously surrounded ER Site 235 (Attachment C). Waste generation records are not applicable for ER Site 235 because the outfall receives storm water. Industrial waste streams have not and do not enter the outfall. The purpose of the outfall system is to mitigate soil erosion along Pennsylvania Avenue. Sporadic storm water from the northeastern part of KAFB,

ATTACHMENT A

ANALYTICAL METHODS FOR SOIL SAMPLES

Attachment A -
Analytical Methods for Soil Samples

Table A-1. **Analytical Methods and Detection Limits for Cyanide, Nitrate/Nitrite, SVOCs, TKN, TPH, and VOCs in soil.**

Analyte	Method	Detection Limit, mg/kg (ppm)	Analytical Lab
Cyanide	U.S. EPA Method 9010	0.10	ENCOTEC
Nitrate/Nitrite	U.S. EPA Method 353.2	100.0	ENCOTEC
SVOCs	U.S. EPA Method 8270	0.30 - 2.6	ENCOTEC
TPH	U.S. EPA Method 418.1	40.0	ENCOTEC
VOCs	U.S. EPA Method 8240	0.005 - 0.010	ENCOTEC

ENCOTEC = Environmental Control Technology Corporation, Ann Arbor, Michigan
SVOCs = Semi-volatile organic compounds
TKN = Total Kjedahl Nitrogen
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds

Table A-2. **Analytical Methods and Detection Limits for Metals in soil.**

Metal	U.S. EPA Method	Detection Limit (mg/kg, ppm)	Analytical Lab
Aluminum(Al)	6010	10	ENCOTEC
Antinomy (Sb)	6010	3.0	ENCOTEC
Arsenic (As)	6010	0.50	ENCOTEC
Barium (Ba)	6010	10	ENCOTEC
Beryllium (Be)	6010	0.25	ENCOTEC
Cadmium (Cd)	6010	0.27	ENCOTEC
Calcium (Ca)	6010	250	ENCOTEC
Chromium (Cr)-total	6010	1.0	ENCOTEC
Chromium-VI (Cr+6)	7196	0.1	ENCOTEC
Cobalt (Co)	6010	2.5	ENCOTEC
Copper (Cu)	6010	1.2	ENCOTEC
Iron (Fe)	6010	5.0	ENCOTEC
Lead (Pb)	6010	2.0	ENCOTEC
Magnesium (Mg)	6010	256	ENCOTEC
Manganese (Mn)	6010	0.75	ENCOTEC
Mercury (Hg)	7471	0.04	ENCOTEC
Nickel (Ni)	6010	2.0	ENCOTEC
Potassium (K)	6010	250	ENCOTEC
Selenium (Se)	7741	0.25	ENCOTEC
Silver (Ag)	6010	0.5	ENCOTEC
Sodium (Na)	6010	250	ENCOTEC
Thallium (Tl)	6020	0.5	ENCOTEC
Vanadium (V)	6010	2.5	ENCOTEC
Zinc (Zn)	6010	1.0	ENCOTEC

Table A-3. Analytical Methods and Detection Limits for High Explosive Compounds in soil.

High Explosive Compound	U.S. EPA Method	Detection Limit (mg/kg, ppm)	Analytical Lab
1,3-Dinitrobenzene	8330	1.25	ENCOTEC
2,4-Dinitrotoluene	8330	1.25	ENCOTEC
2,6-Dinitrotoluene	8330	1.25	ENCOTEC
HMX	8330	1.25	ENCOTEC
Nitrobenzene	8330	1.25	ENCOTEC
o-nitrotoluene	8330	1.25	ENCOTEC
m-nitrotoluene	8330	1.25	ENCOTEC
p-nitrotoluene	8330	1.25	ENCOTEC
RDX	8330	1.25	ENCOTEC
Tetryl	8330	1.25	ENCOTEC
1,3,5-Trinitrobenzene	8330	1.25	ENCOTEC
2,4,6-Trinitrotoluene	8330	1.25	ENCOTEC

Table A-4. Analytical Methods for Radionuclides in soil.

Radionuclide	Method	Analytical Lab
Americium-241	HASL 300 - Gamma Spectroscopy	Quanterra
Cadmium-109	HASL 300 - Gamma Spectroscopy	Quanterra
Cerium-139	HASL 300 - Gamma Spectroscopy	Quanterra
Cesium-137	HASL 300 - Gamma Spectroscopy	Quanterra
Cobalt-57	HASL 300 - Gamma Spectroscopy	Quanterra
Cobalt-60	HASL 300 - Gamma Spectroscopy	Quanterra
Iodine-129	HASL 300 - Gamma Spectroscopy	Quanterra
Lead-212/214	HASL 300 - Gamma Spectroscopy	Quanterra
Mercury-203	HASL 300 - Gamma Spectroscopy	Quanterra
Plutonium-238	NAS-NS-3058 /SL13028/SL13033	Quanterra
Plutonium-239/240	NAS-NS-3058 /SL13028/SL13033	Quanterra
Potassium-40	HASL 300 - Gamma Spectroscopy	Quanterra
Strontium-85	HASL 300 - Gamma Spectroscopy	Quanterra
Thorium-232	HASL 300 - Gamma Spectroscopy	Quanterra
Thorium-234	HASL 300 - Gamma Spectroscopy	Quanterra
Tin-113	HASL 300 - Gamma Spectroscopy	Quanterra
Tritium	EERF-H.01	Quanterra
Uranium-234	NAS-NS-3050	Quanterra
Uranium-235/236	NAS-NS-3050	Quanterra
Uranium-238	NAS-NS-3050	Quanterra
Yttrium-88	HASL 300 - Gamma Spectroscopy	Quanterra

Quanterra = Quanterra Environmental Services - St. Louis Laboratory

ATTACHMENT B

RPD VALUES FOR SOIL SAMPLES

Attachment B -
RPD Values for Soil Samples

Table B-1. RPD values for soil sample 227-03-B.

Analyte	Sample 227-03-B, concentration (mg/kg) or activity (pCi/g)	Sample 227-03-B-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	6400	5100	23
Sb	9.9	8.8	12
As	5.6	0.92	144
Ba	140	140	0
Be	0.25	<0.25	N/A
Cd	2.9	2.1	32
Cr	7.4	5.9	23
Co	4.6	4.5	2
Cu	11	10	10
Fe	16000	13000	21
Pb	8.9	7.5	17
Mn	230	200	14
Hg	<0.04	<0.04	N/A
Ni	5.9	5.4	9
V	33	25	28
Zn	50	48	4
Nitrate/Nitrite	1.4	<100	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

RPD = Relative percent difference = $[\{D_1 - D_2\}/\{(D_1+D_2)/2\}] \times 100$
n.d.a. = no duplicate analysis
N/A = not applicable

Table B-2. RPD values for soil sample 229-04-A.

Analyte	Sample 229-04-A, concentration (mg/kg) or activity (pCi/g)	Sample 229-04-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	8100	7700	5
Sb	13	12	8
As	5.7	1.5	117
Ba	150	140	7
Be	0.32	0.30	6
Cd	2.3	2.2	4
Cr	8.0	8.0	0
Co	4.2	4.2	0
Cu	7.9	7.7	3
Fe	13000	12000	8
Pb	12	11	9
Mn	210	190	10
Hg	<0.04	<0.04	N/A
Ni	6.3	6.2	2
V	24	24	0
Zn	55	52	6
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-3. RPD values for soil sample 230-04-B.

Analyte	Sample 230-04-B, concentration (mg/kg) or activity (pCi/g)	Sample 230-04-B-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	2400	1500	46
Sb	4.9	3.3	39
As	1.7	1.6	6
Ba	140	130	7
Be	<0.25	<0.25	N/A
Cd	0.68	0.61	11
Cr	3.1	2.3	30
Co	2.5	ND	N/A
Cu	18	15	18
Fe	4500	3500	25
Pb	4.2	4.1	2
Mn	120	110	9
Hg	<0.04	<0.04	N/A
Ni	3.4	3.0	13
V	9.7	9.1	6
Zn	82	71	14
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-4. RPD values for soil sample 235-01-A.

Analyte	Sample 235-01-A, concentration (mg/kg) or activity (pCi/g)	Sample 235-01-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	3600	3000	18
Sb	6.2	5.3	16
As	5.1	1.3	119
Ba	160	150	6
Be	<0.25	<0.25	N/A
Cd	2.7	1.6	51
Cr	6.0	4.2	35
Co	8.4	5.7	38
Cu	6.6	6.5	2
Fe	20000	12000	50
Pb	9.4	7.6	21
Mn	210	180	15
Hg	<0.04	<0.04	N/A
Ni	4.5	4.4	2
V	36	22	48
Zn	66	66	0
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-5. RPD values for soil sample 50-01-B.

Analyte	Sample 50-01-B, concentration (mg/kg) or activity (pCi/g)	Sample 50-01-B-duplicate, concentration (mg/kg) or activity (pCi/g	RPD (%)
Al	3900	3100	23
Sb	7.5	6.5	14
As	2.1	2.0	5
Ba	110	110	0
Be	0.26	0.25	4
Cd	1.3	1.3	0
Cr	4.3	4.1	5
Co	4	3.9	3
Cu	6.2	5.7	8
Fe	8800	7600	15
Pb	6.6	5.9	11
Mn	150	130	14
Hg	<0.04	<0.04	N/A
Ni	4.5	4.2	7
V	18	17	6
Zn	21	18	15
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-6. RPD values for soil sample 50-02-A.

Analyte	Sample 50-02-A, concentration (mg/kg) or activity (pCi/g)	Sample 50-02-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	7000	5800	19
Sb	14	12	15
As	6.4	4.2	42
Ba	280	220	24
Be	0.55	0.38	37
Cd	2.2	1.6	32
Cr	8.3	5.2	46
Co	6.1	4.3	35
Cu	17	12	34
Fe	9000	6700	29
Pb	35	25	33
Mn	290	210	32
Hg	<0.04	0.04	N/A
Ni	9.4	7.1	28
V	18	11	48
Zn	69	61	12
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-7. RPD for soil sample BKG-05-A.

Analyte	Sample BKG-05-A, concentration (mg/kg) or activity (pCi/g)	Sample BKG-05-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	6400	5900	8
Sb	13	12	8
As	7.6	5.7	29
Ba	210	190	10
Be	0.53	0.50	6
Cd	1.8	1.7	6
Cr	6.1	6.0	2
Co	6.6	6.3	5
Cu	14	14	0
Fe	10000	10000	0
Pb	16	16	0
Mn	330	320	3
Hg	<0.04	<0.04	N/A
Ni	8.9	8.7	2
V	24	22	9
Zn	37	36	3
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-8. RPD values for soil sample 227-02-A.

Analyte	Sample 227-02-A, concentration (mg/kg) or activity (pCi/g)	Sample 227-02-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	6500	5800	11
Sb	11	9.3	17
As	5.9	1.4	123
Ba	180	150	18
Be	<0.25	<0.25	N/A
Cd	2.5	2.1	17
Cr	6.6	6.4	3
Co	4.1	4.1	0
Cu	13	7.8	50
Fe	14000	13000	7
Pb	9.1	7.5	19
Mn	170	160	6
Hg	<0.04	<0.04	N/A
Ni	5.9	5.4	9
V	28	27	4
Zn	51	51	0
Nitrate/Nitrite	9.3	2.7	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-9. RPD values for soil sample 229-03-B.

Analyte	Sample 229-03-B, concentration (mg/kg) or activity (pCi/g)	Sample 229-03-B-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	n.d.a.	n.d.a.	N/A
Sb	n.d.a.	n.d.a.	N/A
As	n.d.a.	n.d.a.	N/A
Ba	n.d.a.	n.d.a.	N/A
Be	n.d.a.	n.d.a.	N/A
Cd	n.d.a.	n.d.a.	N/A
Cr	n.d.a.	n.d.a.	N/A
Co	n.d.a.	n.d.a.	N/A
Cu	n.d.a.	n.d.a.	N/A
Fe	n.d.a.	n.d.a.	N/A
Pb	n.d.a.	n.d.a.	N/A
Mn	n.d.a.	n.d.a.	N/A
Hg	n.d.a.	n.d.a.	N/A
Ni	n.d.a.	n.d.a.	N/A
V	n.d.a.	n.d.a.	N/A
Zn	n.d.a.	n.d.a.	N/A
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	0.99	0.45	75
U-235/236	0.060	0.058	3
U-234	1.00	0.45	76
Tritium	n.d.a.	n.d.a.	N/A

Table B-10. **RPD values for soil sample 229-01-A.**

Analyte	Sample 229-01-A, concentration (mg/kg) or activity (pCi/g)	Sample 229-01-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	n.d.a.	n.d.a.	N/A
Sb	n.d.a.	n.d.a.	N/A
As	n.d.a.	n.d.a.	N/A
Ba	n.d.a.	n.d.a.	N/A
Be	n.d.a.	n.d.a.	N/A
Cd	n.d.a.	n.d.a.	N/A
Cr	n.d.a.	n.d.a.	N/A
Co	n.d.a.	n.d.a.	N/A
Cu	n.d.a.	n.d.a.	N/A
Fe	n.d.a.	n.d.a.	N/A
Pb	n.d.a.	n.d.a.	N/A
Mn	n.d.a.	n.d.a.	N/A
Hg	n.d.a.	n.d.a.	N/A
Ni	n.d.a.	n.d.a.	N/A
V	n.d.a.	n.d.a.	N/A
Zn	n.d.a.	n.d.a.	N/A
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	0.73	0.45	47
U-235/236	0.17	0.034	133
U-234	0.67	0.6	11
Tritium	n.d.a.	n.d.a.	N/A

Table B-11. RPD values for soil sample 227-03-A.

Analyte	Sample 227-03-A, concentration (mg/kg) or activity (pCi/g)	Sample 227-03-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	n.d.a.	n.d.a.	N/A
Sb	n.d.a.	n.d.a.	N/A
As	n.d.a.	n.d.a.	N/A
Ba	n.d.a.	n.d.a.	N/A
Be	n.d.a.	n.d.a.	N/A
Cd	n.d.a.	n.d.a.	N/A
Cr	n.d.a.	n.d.a.	N/A
Co	n.d.a.	n.d.a.	N/A
Cu	n.d.a.	n.d.a.	N/A
Fe	n.d.a.	n.d.a.	N/A
Pb	n.d.a.	n.d.a.	N/A
Mn	n.d.a.	n.d.a.	N/A
Hg	n.d.a.	n.d.a.	N/A
Ni	n.d.a.	n.d.a.	N/A
V	n.d.a.	n.d.a.	N/A
Zn	n.d.a.	n.d.a.	N/A
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	0.67	0.4	50
U-235/236	0.15	0.023	147
U-234	0.67	0.61	9
Tritium	<0.012	<0.014	N/A

ATTACHMENT C

RELEVANT ENVIRONMENTAL ASPECTS OF TA-IV

Attachment C -
Relevant Environmental Aspects of TA-IV

Since submittal of the Tijeras Arroyo Operable Unit NFA Proposals in June 1995, SNL has collected additional historical, regulatory compliance, and process information for Technical Area IV (TA-IV). In April 1996, the *Environmental Assessment for Operation, Upgrades, and Modifications in SNL/NM Technical Area IV* was submitted to various agencies (SNL/NM, 1996). SNL Organization 9300, the Applied Physics, Engineering, and Testing Center, operates TA-IV. With research operation beginning in 1980, TA-IV is the newest SNL technical area and has always operated using modern environmental, safety, and health procedures and considerations. Approximately 750 people work at the 83 acre facility. The principal mission for TA-IV is the research, development, and testing of pulsed power technology. Other activities include computer science, flight dynamics, satellite processing, and robotics. Major facilities include the SATURN x-ray facility, the High Energy Radiation Megavolt Electron Source-III (HERMES-III) gamma-ray facility, and the Particle Beam Fusion Accelerator-II (PBFA-II). Other smaller facilities include the Rocket Systems and Flight Dynamic Laboratory, the Payload and Satellite Processing Facility, the parallel Computing Science Laboratory, the Robotics Laboratory, and seven small accelerators.

Biological resources were evaluated before the construction of various TA-IV buildings was begun. An *Environmental Assessment for Operation, Upgrades, and Modifications in SNL/NM Technical Area IV* be was submitted to various agencies in 1996 (SNL/NM, 1996). This evaluation of biological resources at TA-IV is relevant for ten of the ER Sites (sites 46, 50, 77, 227, 229, 230, 231, 233, 234, and 235). These ten sites are located along the northern rim of Tijeras Arroyo in the vicinity of TA-I, TA-II, TA-IV, Pennsylvania Avenue, a Skeet Range, KAFB Landfill 8, and the Albuquerque International Airport. No undisturbed natural habitat remains in the vicinity of TA-IV. Vegetation is limited to scattered ruderal plants and a row of ornamental ash trees. Sufficient food, water, and cover are not available to support wildlife. No federally-listed endangered or threatened species (plants or animals) or state-listed endangered wildlife species (Group 1 or Group 2) are known to occur within the vicinity of TA-IV, based on two biological surveys performed by IT Corporation in 1995 for the SNL/NM Environmental Restoration Project (IT, 1995). No natural lakes or wetlands are present and all drainage flows are intermittent, occurring during periods of precipitation. The Environmental Assessment report concluded that additional building construction would have no impact on biological resources.

Air monitoring is routinely conducted at TA-IV when the various accelerators are operating. The HERMES-III, PBFA-II, and SABRE accelerators generate short-lived nitrogen-13 and oxygen-15 radioactive air emissions but are in amounts million of times smaller than Clear Air Act standards (SNL/NM, 1995c). The half-lives for nitrogen-13 and oxygen-15 are 10 minutes and 2 minutes, respectively. The SATURN accelerator has historically released tritium, but the dose was at such a low level that the source was exempted from the National Emission Standards for Hazardous Air Pollutants (NESHAP) permit requirement.

No ER sites are located within TA-IV. Likewise, no septic tanks have been used at TA-IV. However, 21 aboveground and underground storage tanks (USTs) have been used, primarily for storing dielectric oil. Only above storage tanks (ASTs) are still in use at TA-IV. These 20 tanks store dielectric oil, acid, caustic, and deionized water. No USTs are currently registered with the NMED. A fuel-oil UST (970-1) was removed in 1994; no soil contamination was present.

The Storm Water Program in the SNL/NM Compliance and Generator Interface Department is responsible for measuring and reporting storm-water quality associated with storm-water outfalls located across SNL/NM. The storm-water results are reported annually in the Site Environmental Report (SNL/NM, 1995c). In accordance with National Pollutant Discharge Elimination System (NPDES) requirements, SNL/NM submitted an *Application For Permit to Discharge Stormwater - Discharges Associated with Industrial Activity* to U.S. EPA Region VI in 1992 (SNL/NM, 1992). Due to workload constraints, the U.S. EPA has not acted on the permit. In 1996, SNL/NM will submit a multi-sector permit to the U.S. EPA for their approval with State of New Mexico review and concurrence.

The Storm Drain System Outfall known as ER Site 235 is located about 500 ft southwest of TA-IV on the northern rim of Tijeras Arroyo near the Pennsylvania Avenue bridge. The site consists of a flood-control channel that extends for about 1,500 ft below a concrete baffle chute (energy dissipator). A storm-water monitoring station is located at the upper end of the baffle chute and is designated as Outfall 5 in the NPDES application (SNL, 1992). Sporadic storm water from the northeastern part of Kirtland Air Force Base (KAFB), including SNL Technical Areas I and IV, flows through the baffle chute and the channel before reaching Tijeras Arroyo. The outfall drains approximately 475 acres of which 65% is an impervious surface (SNL, 1996). Figures in the NOD response for ER Site 235 show the watershed. The SNL/NM Storm Water Program collected water samples from Outfall 5 on July 23, 1992, August 6, 1992, and May 25, 1994. Composite and grab samples were analyzed for total metals, general inorganics, and various other parameters. Since the NPDES application has not been reviewed by the U.S. EPA, the water samples have been compared to the most stringent standards available (Federal drinking water standards). Except for manganese and coliform, the quality of the storm water was better than the Federal standards (Tables C-1 and C-2). Manganese was reported at 0.13 mg/L (ppm) which is slightly above the Secondary Maximum Contaminant Level (SMCL) of 0.05 mg/L (ppm). However, the metal analyses were total values, not the dissolved values which are typically compared to drinking water standards. The presence of coliform at 2,000 colonies per 100 mL of water most likely reflects transient wildlife. Water samples were not collected in 1993 or 1995 because of insufficient precipitation.

In the June 1995 NFA Proposal, the SNL/NM ER project considered the potential COCs in soil at ER Site 235 to be: chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, and mineral oil. Both radiation and unexploded ordnance (UXO) field surveys have been conducted at ER Site 235; no anomalies were detected.

No stained soil or stressed vegetation has been documented at the site. The SNL/NM ER project collected soil samples along the drainage ditch in the Fall of 1994; the results are discussed in the NOD Response.

Five other outfalls (ER Sites 230, 231, 232, 233, and 234) are located along the steep, Tijeras Arroyo northern rim at the eastern and southern edges of TA-IV. The purpose of the TA-IV outfalls is to reduce the amount of soil erosion caused by storm water. Discharge of storm water only occurs several days per year. During the period of April 7 to December 31, 1995, an automatic flow meter recorded storm-water flows on ten different days. Engineering drawings for the TA-IV storm-water and sanitary-sewer systems are presented in the NOD responses for ER Sites 230, 231, 233, and 234. No process or waste waters flow into the outfalls. Such fluids are directed to the sanitary sewer system or two evaporative lagoons.

The five TA-IV outfalls were added to the ER site list in 1993. However, only one of the sites has been involved in the spill or release of a Reportable Quantity (SNL, 1995b). The sole incident occurred in 1994 when mineral oil was spilled at ER Site 232. The contaminated soil was subsequently removed for off-site disposal. A NFA proposal for ER Site 232 will be submitted to NMED in late 1996.

In the June 1995 NFA Proposals, the SNL/NM ER project considered the potential COCs in soil at ER Sites 230, 231, 233, and 234 to be: chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, petroleum products, and mineral oil. Both radiation and unexploded ordnance (UXO) field surveys have been conducted at each site; no anomalies were detected. No stained soil or stressed vegetation has been documented at any of the sites. The SNL/NM ER project collected soil samples at each site in the Fall of 1994; the results are discussed in the respective NOD Responses.

Outfall 6 is a catch basin that is located about 50 ft upslope of ER Site 233. According to NPDES guidance, only one of the TA-IV outfalls requires monitoring because all the TA-IV outfalls receive storm water from similar sources (Fink, 1996). Due to infrequent precipitation and the lack of an automatic sampler, only two water samples (July 31 and September 15, 1992) have been collected at Outfall 6. Except for manganese and coliform, the quality of storm water was better than the Federal standards for drinking water (Table C-3). Manganese was reported at 0.24 mg/L (ppm) which is slightly above the Secondary Maximum Contaminant Level (SMCL) of 0.05 mg/L (ppm). However, the metal analyses were total values, not the dissolved values which are typically compared to drinking water standards. The presence of coliform at 4,000 colonies per 100 mL of water most likely reflects transient wildlife.

Two evaporative lagoons (impoundments) are located at TA-IV and both serve similar functions. The primary purpose of the two lagoons is to store surface-water runoff from precipitation that collects in the sumps of the outdoor transformer-oil tank farm spill-containment areas (SNL/NM, 1995b). Both lagoons are lined with synthetic geotextile membranes. Surface-water runoff is pumped to the lagoons by manually operated sump pumps. If visible oil is present in the sumps, a manually operated skimmer is used to transfer the skimmed oil to an oil storage tank. Lagoon #1 (ER Site 77) is located to the south of TA-IV and also receives non-routine water and transformer oil spills from floor trenches in Buildings 981 and 983. The capacity of Lagoon #1 is 137,000 gallons. Lagoon #2 is located in the eastern section of TA-IV and also receives non-routine water and transformer oil spills from floor trenches in Building 970. The capacity of Lagoon #2 is 127,000 gallons.

Operation of the two lagoons is the responsibility of SNL/NM Organization 9300 with oversight by the Water Quality Program in SNL/NM Organization 7500. The lagoons are regulated by NMED under 'Surface Water Discharge Plan 530' (DP-530). The Water Quality Program conducts semiannual inspections that include the measurement of the water levels and the collection of water samples. To date, water has not overflowed onto the ground surface. The water is analyzed for major ions, total dissolved solids (TDS), volatile organics, and extractable organics. Water quality results have not necessitated the pumping of the water for off-site disposal. NMED inspected the surface impoundments twice during 1995; no deficiencies were noted. The SNL/NM Water Quality Program submits a lagoon-monitoring report to NMED on a semiannual basis. The report includes water level measurements and analytical data.

<u>References</u>

Fink, C. (1996), Storm water protection officer, SNL/NM Compliance and Generator Interface Department, *personal communication* with J. R. Copland, Senior Hydrogeologist, Science Applications International Corporation, August 12, 1996.

IT Corporation (1995), *Sensitive Species Survey Results Environmental Restoration Project Sandia National Laboratories / New Mexico,* Albuquerque, New Mexico.

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Sandia National Laboratories / New Mexico (1995a), *Technical Area I (ADS 1302) RCRA Facility Investigation Work Plan,* February 1995, <u>Plate 5-11: ER Site 226, Acid Waste Line, Southern Section Showing Breaks Identified By Camera Survey And Proposed Sampling Locations</u>.

Sandia National Laboratories / New Mexico (1995b), *State of New Mexico Environmental Department Discharge DP-530 Lagoon Discharge Report,* Sandia National Laboratories, New Mexico.

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Table C-1. Comparison of Federal drinking water standards to maximum concentrations present in storm-water samples collected at NPDES Outfall 5 (ER Site 235) on July 23 and August 6, 1992 (SNL/NM, 1992).

Analyte	Maximum concentration of flow-weighted composite samples, mg/L (ppm)	Lowest MCL, MCLG, or SMCL, mg/L (ppm)	EPA method
Arsenic, total	0.0059	0.050	206.2
Barium, total	0.22	2.0	200.7
Cadmium, total	<0.0050	0.005	213.2
Chromium, total	<0.010	0.1	218.2
Copper, total	0.034	1.0	200.7
Lead, total	0.014	0.015	239.2
Manganese, total	0.13	0.05	200.7
Mercury, total	<0.00020	0.002	245.1
Nickel, total	<0.040	0.1	200.7
Selenium, total	<0.0050	0.05	270.2
Silver, total	<0.010	0.1	200.7
Zinc, total	0.18	5.0	200.7
BOD	11.0	n.s.	405.1
COD	87.9	n.s.	410.0
Cyanide	<0.010	n.s.	335.2
Fluoride	0.21	2.0	340.2
Gross Alpha	0±20 pCi/L	0 pCi/L	900.0/7110B
Gross Beta	10±20 pCi/L	0 mrem	900.0/7110B
HPLC Explosives	<0.032	0.0032	8330
Nitrate + Nitrite	0.76	10.0	353.2
Oil and Grease	<1.0	n.s.	413
Orthophosphate	0.18	n.s.	614
PCBs	<0.005	0.005	8080
Phenolics	0.016	n.s.	8040
Phosphorous as P	0.24	n.s.	365.3
Residual Chlorine	<0.20	n.s.	330
SVOCs	<0.085	0.085	8270
TDS	146.0	250.0	160.1
TKN	1.4	n.s.	351
Total Coliform	2,000 cl/100mL	0 cl/100mL	9230
TSS	221.0	n.s.	160.2
Volatile Organics	<0.005	n.s.	8240

Table C-2. Comparison of Federal drinking water standards to concentrations of total metals and general inorganics in storm-water samples collected at NPDES Outfall 5 (ER Site 235) on May 25, 1994.

Analyte	Composite sample concentration, mg/L (ppm)	Grab sample concentration, mg/L (ppm)	Lowest MCL, MCLG, or SMCL, mg/L (ppm)	EPA method
Antinomy, total	<0.060	<0.060	0.006	200.7
Arsenic, total	0.0033	<0.010	0.050	206.2
Beryllium, total	<0.0020	<0.0020	0.004	200.7
Cadmium, total	0.00076	0.0010	0.005	213.2
Chromium, total	0.0031	0.0044	0.1	218.2
Copper, total	0.0078	0.014	1.0	200.7
Lead, total	0.014	0.026	0.015	239.2
Mercury, total	<0.00020	<0.00020	0.002	245.1
Nickel, total	<0.040	<0.040	0.1	200.7
Selenium, total	<0.0050	<0.0050	0.05	270.2
Silver, total	<0.010	<0.010	0.1	200.7
Zinc, total	0.066	0.17	5.0	200.7
Alkalinity, total	57.2	46.2	n.s.	310.1
Ammonia as N	0.14	0.18	n.s.	350.1
Chloride	1.9	2.5	250.0	300.0
Fluoride	0.20	0.17	2.0	340.2
Nitrate + Nitrite	0.33	0.33	10.0	353.2
Phosphorous as P	0.25	0.36	n.s.	365.3
Sulfate	4.9	4.2	250.0	300.0
TDS	202.0	106.0	500.0	160.1
TSS	255.0	310.0	n.s.	160.2

All water analyses performed by the Quanterra Environmental Services, Inc. laboratory.
BOD = Biochemical Oxygen Demand
cl/mL = colonies per 100 milliliter of water
COD = Chemical Oxygen Demand
Drinking Water Standards: MCL = Maximum Contaminant Level; MCLG = Maximum Contaminant Level Goal; SMCL = Secondary Maximum Contaminant Level, (EPA, 1996). The lead value is an action level.
HPLC = High Performance Liquid Chromatography
mg/L = milligrams per liter = parts per million (ppm)
mrem = millirem
n.s. = not specified (U.S. EPA, 1996)
pCi/L = picocuries per liter
PCBs = Polychlorinated Biphenyls
TDS = Total Dissolved Solids
TKN = Total Kjedahl Nitrogen
TSS = Total Suspended Solids
VOCs = Volatile Organic Compounds. The reported concentrations of VOCs (2-hexanone at 0.011 mg/L (ppm), 2-butanone at 0.046 mg/L (ppm), and acetone at 0.0723 and 0.110 mg/L (ppm) are considered suspect because all three VOCs are common laboratory contaminants (Bleyler, 1988).

Table C-3. Comparison of Federal drinking water standards to maximum concentrations present in storm-water samples collected at NPDES Outfall 6 (catch basin above ER Site 233) on July 31 and September 15, 1992 (SNL/NM, 1992).

Analyte	Maximum concentration of flow-weighted composite samples, mg/L (ppm)	Lowest MCL, MCLG, or SMCL, mg/L (ppm)	EPA method
Arsenic, total	<0.0050	0.050	206.2
Barium, total	0.099	2.0	200.7
Cadmium, total	<0.0050	0.005	213.2
Chromium, total	<0.010	0.1	218.2
Copper, total	0.025	1.0	200.7
Lead, total	0.0067	0.015	239.2
Manganese, total	0.24	0.05	200.7
Mercury, total	<0.00080	0.002	245.1
Nickel, total	<0.040	0.1	200.7
Selenium, total	<0.010	0.05	270.2
Silver, total	<0.010	0.1	200.7
Zinc, total	0.20	5.0	200.7
BOD	62.8	n.s.	405.1
COD	422.0	n.s.	410.0
Cyanide	<0.010	n.s.	335.2
Fluoride	0.17	2.0	340.2
Gross Alpha	1±6 pCi/L	0 pCi/L	900.0/7110B
Gross Beta	10±3 pCi/L	0 mrem	900.0/7110B
HPLC Explosives	<0.0032	0.0032	8330
Nitrate + Nitrite	2.7	10.0	353.2
Oil and Grease	3.2	n.s.	413
Orthophosphate	<0.050	n.s.	614
PCBs	<0.005	0.005	8080
Phenolics	0.048	n.s.	8040
Phosphorous as P	0.060	n.s.	365.3
Residual Chlorine	1.9	n.s.	330
SVOCs	<0.085	0.085	8270
TDS	440.0	250.0	160.1
TKN	5.8	n.s.	351
Total Coliform	4,000 cl/100mL	0 cl/100mL	9230
TSS	56.0	n.s.	160.2
Volatile Organics	<0.005	n.s.	8240

ATTACHMENT K

ER SITE 234 RISK ASSESSMENT ANALYSIS

ATTACHMENT K - ER SITE 234: RISK ASSESSMENT ANALYSIS

I. Site Description and History

ER Site 234 is an inactive, storm water system that received water from the southwestern part of TA-IV near Building 981 from the mid-1980s to the early 1990s. The system consisted of four outfalls that drained to four, 250-ft long, unlined channels on the steep slope south of TA-IV. Prior the early 1990s, the Building 981 catch basins and roof drains were connected to the outfalls. The outfalls do not currently receive any type of water. Instead, storm water is now plumbed to the ER Site 233 outfall. Since the soil sampling was conducted in 1994 at ER Site 234, sloughed soil has covered the four outfalls. No process or waste waters flowed to the outfalls; such fluids were directed to the sanitary sewer system or two evaporative lagoons. Potential constituents of concern (COCs) in soil along the ditches include chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, and mineral oil. However, the COCs are solely based upon potential contaminants; no releases are known to have occurred in the area that drained to the outfall system. The list of COCs was conservatively based upon chemicals used at TA-IV. Both radiation and unexploded ordnance (UXO) field surveys have been conducted; no anomalies were detected. No stained soil or stressed vegetation has been documented at the site.

II. Risk Assessment Analysis

Risk assessment of a site includes a number of steps which culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at the site. The steps to be discussed in this section include:

Step 1.	Site data are described which provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways by which a representative population might be exposed to the COCs are identified.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The tiered approach includes screening steps, followed by potential intake calculations and a discussion or evaluation of the uncertainty in those calculations.
Step 4.	Data are described on the potential toxicity and cancer effects from exposure to the COCs and subsequent intake.
Step 5.	Potential toxicity effects (specified as a Hazard Index), cancer risks and radiation doses are calculated.

Step 6.	These values are compared with standards established by the USEPA and USDOE to determine if further evaluation, and potential site clean-up, is required.
Step 7.	Discussion of uncertainties in the previous steps.

II.1 Step 1. Site Data

Site history and site field characterization activities are used to identify potential COCs. The identification of COCs and the sampling to determine the concentration values of those COCs across the site are described in section SNL/NM Analytical Data Summary of the ER Site 234 NOD response. In order to provide conservatism in this risk assessment, the calculation uses only the maximum concentration value of each COC determined for the entire site. Chemicals that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium were not included in this risk assessment per USEPA 1989a. Both radioactive and nonradioactive COCs are evaluated. The nonradioactive chemicals are metals and organics.

II.2 Step 2. Pathway Identification

This site has been designated with a future land-use scenario of industrial (Attachment M). Because of the location and the characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion. The inhalation pathway for both chemicals and radionuclides is included because of the potential to inhale dust. Direct gamma exposure is also included in the radioactive contamination risk assessment. A groundwater pathway was not considered because no soil contamination was present in the sampling interval of 0 to 3 ft and the depth to groundwater is approximately 300 ft. Because of the lack of perennial surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered to not be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate.

PATHWAY IDENTIFICATION

Chemical Constituents	Radionuclide Constituents
Soil Ingestion	Soil Ingestion
Inhalation (Dust)	Inhalation (Dust and volatiles)
	Direct Gamma

II.3 Steps 3-5. Calculation of Hazard Indices and Cancer Risks

Steps 3 through 5 are discussed in this section. These steps include the discussion of the tiered approach in eliminating potential COCs from further consideration in the risk assessment process and the calculation of intakes from all identified exposure pathways, the discussion of the toxicity information, and the calculation of the hazard indices and cancer risks.

The risks from the COCs at ER Site 234 were evaluated using a tiered approach. First, the maximum concentrations of COCs for chemical constituents were compared to Tijeras Arroyo background screening levels using 95th UTLs or percentile values. If a maximum concentration of a particular COC exceeded the Tijeras Arroyo specific background screening level or if the COC was a radioactive constituent, then the COC was compared to the SNL/NM Site-Wide background screening level (IT, 1996). The Site-Wide UTL chosen for comparison was the minimum value when comparing surface and subsurface UTL values. This procedure was implemented to ensure use of the most conservative value during the comparison process and due to uncertainties associated with some sample depths. The maximum concentration of each COC was used in order to also provide a conservative estimate of the associated risk. Those COCs that were below the background screening level were not considered in further risk assessment analyses.

Second, the remaining maximum concentrations were compared with action levels calculated using methods and equations promulgated in the proposed RCRA Subpart S (40 CFR Part 264, 1990) and Risk Assessment Guidance for Superfund (RAGS) (USEPA, 1989a) documentation. Accordingly, all calculations were based on the assumption that receptor doses from both toxic and potentially carcinogenic compounds result most significantly from ingestion of contaminated soil. Because the samples were all taken from the surface or near-surface, this assumption is considered valid. If there are 10 or fewer COCs and each has a maximum concentration less than one-tenth of the action level, then the site would be judged to pose no significant health hazard to humans. If there are more than 10 COCs, the proposed Subpart S screening procedure was skipped.

Third, hazard indices and risk due to carcinogenic effects were calculated using Reasonable Maximum Exposure (RME) methods and equations promulgated in RAGS (USEPA, 1989a). The combined effects of all COCs in the soils that were above background concentration values were calculated. For toxic compounds, this was accomplished by summing the individual hazard quotients for each metal into a total Hazard Index. This Hazard Index is compared to the recommended standard of 1. For potentially carcinogenic compounds, the individual risks were summed. The total risk was compared to the recommended risk range of 10^{-4} to 10^{-6}. For the radioactive COCs, the cumulative dose was calculated and the corresponding excess cancer risk estimated.

II.3.1 Comparison to Background and Action Levels

Nonradioactive ER Site 234 COCs are listed in Table 1; radioactive COCs are listed in Table 2. Both tables show the along with the 95th percentile or UTL background levels (IT, 1996). A background level for chromium VI was not available. Background levels for plutonium and tritium are not applicable because these radionuclides do not occur naturally, or due to fallout, at levels greater than typical detection limits of common laboratory instrumentation. Background concentrations have been recalculated for the Tijeras Arroyo background locations that were used in the June 1995 NFA proposals. The recalculated Tijeras Arroyo values were prepared using a more rigorous statistical approach according to USEPA guidance (USEPA, 1989b, 1992a, and 1992b). The Tijeras Arroyo background locations were not differentiated on the basis of depth because of the homogenous nature of the soil and the limited sampling depth of 0 to 36 inches. As part of the IT (1996) site-wide study, background concentrations were calculated for both the surface (0-6 inch depth) and subsurface (>6 inch depth) soils of the North Super Group, which is defined as soils present in TA-I, TA-II, TA-IV, the northern rim of Tijeras Arroyo, and the northeastern portion of KAFB. The Site-Wide background levels have not yet been approved by the USEPA or the NMED but are the result of a comprehensive study of joint Sandia and U.S. Air Force data from the Kirtland Air Force Base (KAFB). The report was submitted for regulatory review in early 1996. The values shown in Table 1 and Table 2 supersede the background values described in an interim background study report (IT, 1994). Several compounds have maximum measured values greater than background screening levels. Those compounds are retained for further analysis. Because organic compounds do not have calculated background values, this screening step was skipped and all organics are carried into the risk assessment analyses.

Table 1. Nonradioactive Analytes at ER Site 234 and Comparison to the Background Screening Values.

Analyte	Maximum concentration (mg/kg)	Recalculated 95th % or UTL Level (mg/kg) for Tijeras Arroyo OU Background Locations	Is maximum COC concentration less than or equal to the applicable Tijeras Arroyo OU background screening level?	Site-Wide 95th % or UTL Level (mg/kg) for North Super Group Soils (IT, 1996)	Is maximum COC concentration equal to or less than background screening value?
Aluminum	11,000	11,874	Yes		
Antimony	17.0	18.6	Yes		
Arsenic	6.3	5.9	No	4.4	No
Barium	240.0	298	Yes		
Beryllium	0.5	0.58	Yes		
Cadmium	3.0	3.0	Yes		
Chromium-total	11.0	17.6	Yes		
Chromium (VI)	<0.1	NC	No	NC	No
Cobalt	5.7	7.3	Yes		
Copper	13.0	14.7	Yes		
Lead	13.0	23.1	Yes		
Manganese	260.0	330	Yes		
Mercury	<0.04	NC	No	<0.1	No
Nickel	10.0	14.8	Yes		
Selenium	<0.25	NC	No	<1.0	No
Silver	<0.5	NC	No	<1.0	No
Thallium	<0.5	NC	No	<1.1	No
Vanadium	30.0	40.4	Yes		
Zinc	77.0	79.2	Yes		

NC - not calculated

Table 2. Radioactive Analytes at ER Site 234 and Comparison to the Background Screening Values.

Analyte	Maximum concentration (pCi/g)	Site-Wide 95th % or UTL Level (pCi/g)	Is maximum COC concentration non-detect or less than background screening value?
Pu-238	ND	NC	Yes
Pu-239/240	ND	NC	Yes
Tritium	0.40	NC	No
U-234	0.59	1.6	Yes
U-235/236	0.013	0.18	Yes
U-238	0.56	1.3	Yes

ND - radionuclide not detected above minimum detectable activity

As part of the tiered approach to risk assessment, only those COCs that have values above the background screening level values are included in the next tier of risk assessment analyses. Also included in the next tier of analyses are COCs that do have background screening values. If less than ten COCs are above the background screening level, those COCs are screened using the proposed Subpart S action level procedure. If less than 10 COCs are above the background screening level, the proposed Subpart S screening procedure is skipped. Table 3 shows the inorganic COCs that were greater than the background screening value and organic COCs that do not have background screening values. The table shows the proposed Subpart S action level for the contaminants. The table compares the maximum concentration values to 1/10 of the proposed Subpart S action level. This methodology was guidance given to SNL/NM from the USEPA (USEPA, 1996a). This is the second screening process in the tiered risk assessment approach. Two nonradioactive compounds had concentration values greater than 1/10 of the proposed Subpart S action level. A proposed Subpart S action level was not calculated for three parameters. Because of these five compounds, the site fails the proposed Subpart S screening criteria and a Hazard Index value and cancer risk value must be calculated for all ten nonradioactive contaminants.

Radioactive contaminants do not have pre-determined action levels analogous to the proposed Subpart S and therefore this step in the screening process is not performed for radionuclides.

Table 3. Comparison of ER Site 234 COC Concentrations to Proposed Subpart S Action Levels.

COC name	Maximum concentration (mg/kg)	Proposed Subpart S Action Level (mg/kg)	Is individual contaminant less than 0.1 Action Level?
Arsenic	6.3	0.5	No
Chromium VI	<0.1	400	Yes
Mercury	<0.04	20	Yes
Selenium	<0.25	400	Yes
Silver	<0.5	400	Yes
Thallium	<0.5	NC	No
Benzo(b) fluoranthene	0.043 J	NC	No
Benzo(a) pyrene	0.048 J	0.1	No
Chrysene	0.062 J	NC	No
Pyrene	0.034 J	2,000	Yes

NC - not calculated

II.3.2 Identification of Toxicological Parameters

Tables 4 and 5 show the COCs that have been retained in the risk assessment and the values for the toxicological information available for those COCs.

Table 4. Toxicological Parameter Values for Nonradioactive COCs

COC name	RfD_o (mg/kg-d)	RfD_{inh} (mg/kg-d)	Confidence	SF_o (kg-d/mg)	SF_{inh} (kg-d/mg)	Cancer Class^
Arsenic	0.0003	--	M	1.5	15	A
Chromium (VI)	0.005	--	L	--	42	A
Mercury	0.0003	0.000086	--	--	--	D
Selenium	0.005	--	--	--	--	D
Silver	0.005	--	--	--	--	D
Thallium	--	--	--	--	--	D
Benzo(b) fluoranthene	--	--	--	0.73	0.61	B2
Benzo(a) pyrene	--	--	--	7.3	6.1	B2
Chrysene	--	--	--	0.0073	0.0061	B2
Pyrene	0.03	--	L	--	--	D

RfD_o - oral chronic reference dose in mg/kg-day
RfD_{inh} - inhalation chronic reference dose in mg/kg-day
SF_o - oral slope factor in $(mg/kg\text{-}day)^{-1}$
SF_{inh} - inhalation slope factor in $(mg/kg\text{-}day)^{-1}$
^ EPA weight-of-evidence classification system for carcinogenicity

A - human carcinogen
B1 - probable human carcinogen. Limited human data are available
B2 - probable human carcinogen. Indicates sufficient evidence in animals and inadequate or no evidence in humans.
C - possible human carcinogen
D - not classifiable as to human carcinogencity
E - evidence of noncarcinogenicity for humans

L - low
H - high
-- information not available

Table 5. Toxicological Parameter Values for Radioactive COCs

COC name	SF_e (m^2/pCi-yr)	SF_o (1/pCi)	SF_{inh} (1/pCi)	Cancer Class ^
Tritium	0	7.2E-14	9.6E-14	A

SF_e - external exposure slope factor (risk/yr per pCi/m^2)
SF_o - oral (ingestion) slope factor (risk/pCi)
SF_{inh} - inhalation slope factor (risk/pCi)
^ EPA weight-of-evidence classification system for carcinogenicity
A - human carcinogen
B1 - probable human carcinogen. Limited human data are available
B2 - probable human carcinogen. Indicates sufficient evidence in animals and inadequate or no evidence in humans.
C - possible human carcinogen
D - not classifiable as to human carcinogencity
E - evidence of noncarcinogenicity for humans

II.3.3 Exposure Assessment and Risk Characterization

Section II.3.3.1 describes the exposure assessment for this risk assessment. Section II.3.3.2 provides the risk characterization including the Hazard Index value and the excess cancer risk for both industrial and residential land-uses.

II.3.3.1 Exposure Assessment

Attachment M shows the equations and parameter values used in the calculation of intake values and the subsequent Hazard Index and Excess Cancer Risk values for the individual exposure pathways. The appendix shows the parameters for both industrial and residential land-use scenarios. The equations are based on RAGS (USEPA, 1989a). The parameters are based on information from RAGS (USEPA, 1989a) as well as other EPA guidance documents and reflect the RME approach advocated by RAGS.

Although the designated land-use scenario is industrial for this site, the risk values for a residential land-use scenario are also presented. These residential risk values are presented to show the potential to risk to human health even under the more restrictive land-use scenario.

II.3.3.2 Risk Characterization

Table 6 shows the that for the nonradioactive COCs, the Hazard Index value is 0.02 and the excess cancer risk is 4×10^{-6} for the assumed industrial land-use scenario. The numbers presented included exposure from soil ingestion and dust inhalation for the nonradioactive COCs.

Table 6. Risk Assessment Values for ER Site 234 Nonradioactive COCs.

COC Name	Maximum concentration (mg/kg)	Industrial Land-use Scenario		Residential Land-use Scenario	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	6.3	0.02	4E-6	0.08	2E-5
Chromium (VI)	<0.1	0.00	3E-10	0.00	4E-10
Mercury	<0.04	0.00	--	0.00	--
Selenium	<0.25	0.00	--	0.00	--
Silver	<0.5	0.00	--	0.00	--
Thallium	<0.5	--	--	--	--
Benzo(b) fluoranthene	0.043 J	0.00	1E-8	0.00	5E-8
Benzo(a) pyrene	0.048J	0.00	2E-7	0.00	6E-7
Chrysene	0.062 J	0.00	2E-10	0.00	7E-10
Pyrene	0.034 J	0.00	--	0.00	--
TOTAL		**0.02**	**4E-6**	**0.08**	**2E-5**

NC - not calculated
NA - not applicable
-- information not available

For the residential land-use scenario, the Hazard Index value increases to 0.08 and the excess cancer risk is 2×10^{-5}. The numbers presented included exposure from soil ingestion and dust inhalation. Although USEPA (1991) generally recommends that inhalation not be included in a residential land-use scenario, this pathway is included because of the potential for soil in Albuquerque, NM to be eroded and, subsequently, for dust to be present even in predominantly residential areas. Because of the nature of the local soil, other exposure pathways are not considered (see Attachment M).

For the radioactive COCs, contribution from the direct gamma exposure pathway is included. Table 7 shows the total effective dose equivalent (TEDE) for both an industrial (5×10^{-5} mrem/yr) and residential (8×10^{-5} mrem/yr) land-use. In accordance with proposed EPA guidance, the standard being utilized is an excess TEDE of 15 mrem/yr (40 CFR Part 196, 1994), corresponding to an excess cancer risk of approximately 3×10^{-4}; the calculated dose values for ER Site 234 for both industrial and residential land-uses are well below that standard. The average radiation exposure due to natural sources (radon, internal radiation, cosmic radiation, and terrestrial radiation) in the U.S. is approximately 295 mrem/yr total effective dose (NCRP, 1987), with approximately 198 mrem/yr due to radon, 40 mrem/yr due to internal radiation (mainly K-40), 29 mrem/yr due to cosmic radiation and 28 mrem/yr due to terrestrial caused radiation. The value of 295 mrem/yr corresponds to an estimated cancer risk of 6×10^{-3}.

For a perspective on the estimated risk associated with background levels of radionuclides and to emphasize the conservativeness associated with RAGS RME risk and dose calculations, the excess cancer risk from background concentrations of radionuclides for relevant exposure pathways has also been estimated using RAGS methodologies. For an industrial or residential land-use scenario, using the 95th percentile or UTL values of radionuclides present in the background soil, the excess cancer risk from soil ingestion is calculated as 4×10^{-4}. The excess cancer risk for the inhalation pathway (i.e., inhalation of radon gas) is calculated as 0.1.

Table 7 shows not only the dose but also the estimated excess cancer risk as 1×10^{-9} for an industrial land-use and a value of 2×10^{-9} for a residential land-use. The excess cancer risk from the nonradioactive COCs and the radioactive COCs is not additive, as noted in RAGS (USEPA, 1989a).

Table 7. Risk Assessment Values for ER Site 234 Radioactive COCs.

COC Name	Max. Conc. (pCi/g)	Total Effective Dose Equivalent for Industrial Land-use (mrem/yr)	Total Effective Dose Equivalent for Residential Land-use (mrem/yr)	Excess Cancer Risk for Industrial Land-use	Excess Cancer Risk for Residential Land-use
Tritium	0.40	5E-5	8E-5	1E-9	2E-9
TOTAL		**5E-5**	**8E-5**	**1E-9**	**2E-9**

II.4 Step 6. Comparison of Risk Values to Numerical Standards.

The risk assessment analyses considered the evaluation of the potential for adverse health effects for both an industrial land-use scenario, which is the designated land-use scenario for this site, and also a residential land-use scenario.

For the industrial land-use scenario, the Hazard Index calculated is 0.02; this is much less than the numerical standard of 1 suggested in RAGS (1989a). The excess cancer risk is estimated at 4×10^{-6}. In RAGS, the USEPA suggests that a range of values (10^{-6} to 10^{-4}) be used as the numerical standard; the value calculated for this site is in the low-end of the suggested acceptable risk range. Therefore, for an industrial land-use scenario, the Hazard Index risk assessment values are significantly less than the established numerical standard and the excess cancer risk is in the low-end of the suggested acceptable risk range.

For the radioactive components of the industrial land-use scenario, the calculated dose is 5×10^{-5} mrem/yr, which is significantly less than the numerical standard of 15 mrem/yr suggested in the draft EPA guidance. The excess cancer risk estimate is 1×10^{-9}, which is significantly less than the excess cancer risk from naturally occurring radioactive sources.

For the residential land-use scenario, the calculated Hazard Index is 0.08, which is again significantly less than the numerical guidance. The excess cancer risk is estimated at 2×10^{-5}; this value is in the middle of the suggested acceptable risk range. The dose from the radioactive components is 8×10^{-5} mrem/yr, which is significantly less than the numerical guidance. The associated cancer risk is 2×10^{-9}, slightly higher than for the industrial land-use scenario but still significantly below background calculated risk values.

II.5 Uncertainty Discussion

The conclusion from the risk assessment analysis is that the potential effects on human health are small compared to established numerical standards when considering an industrial land-use scenario. Although the maximum arsenic concentration (6.3 mg/kg) exceeds the calculated UTL, it is within the range of arsenic concentration values measured in the Site-Wide background study and may be part of background. Therefore, this risk assessment is conservative as arsenic is a significant contributor to both the Hazard Index and the excess cancer risk. The uncertainty in this conclusion is considered to be small. Because of the location and history of the site, there is low uncertainty in the land-use scenario and the potentially affected populations that were considered in making the risk assessment analysis. An RME approach was used to calculate the risk assessment values, which means that the parameter values used in the calculations were conservative and that the calculated intakes are likely overestimates. Maximum measured values of the concentrations of the COCs were used to provide conservative results. Because the COCs are found in the surface soils and because of the location and physical characteristics of the site, there is little uncertainty in the exposure pathways relevant to the analysis. Table 4 shows the confidence in the toxicological parameter values. There is a mixture of estimated values and values from the Health Effects Assessment Summary Tables (HEAST) (EPA, 1996b) and Integrated Risk Information System (IRIS) (EPA, 1988, 1994a) data bases. The constituents without toxicological parameters have low concentrations and are judged to be insignificant contributors to the overall risk. Because of the conservative nature of the RME approach, the uncertainties in the toxicological values are not expected to be of high enough concern to change the conclusion from the risk assessment analysis. The overall uncertainty in all of the steps in the risk assessment process is considered to be not significant with respect to the conclusion reached.

III. Summary

The Storm Water System, ER Site 234, had relatively minor contamination consisting of some inorganic and organic nonradioactive and radioactive compounds. Although the maximum arsenic concentration (6.3 mg/kg) exceeds the calculated UTL, it is within the range of arsenic concentration values measured in the Site-Wide background study and may be part of background. In addition, based on historical records, arsenic is not considered to be a potential COC. Therefore, this risk assessment is conservative as arsenic is a significant contributor to both the Hazard Index and the excess cancer risk. Because of the location of the site on Kirtland AFB, the designated land-use scenario and the nature of the contamination, the potential exposure pathways identified for this site included soil ingestion and dust inhalation for chemical constituents and soil ingestion, dust inhalation, and direct gamma exposure for radionuclides. Using conservative assumptions and employing a RME approach to the risk assessment, the calculations show that for the industrial land-use scenario the Hazard Index (0.02) is significantly less than the USEPA standard of 1. The estimated cancer risk (4×10^{-6}) is in the low-end of the suggested acceptable risk range. The calculations show that for the residential land-use scenario the Hazard Index (0.08) is also significantly less than the USEPA standard of 1. The estimated cancer risk (2×10^{-5}) is in the middle of the suggested acceptable risk range. The dose and corresponding cancer risk from the radioactive components are much less than EPA guidance values; the estimated doses are 5×10^{-5} and 8×10^{-5} mrem/yr for the industrial and residential land-use scenarios, respectively. These values are much less than the numerical guidance of 15 mrem/yr in draft EPA guidance. The corresponding estimated cancer risk values are 1×10^{-9} and 2×10^{-9} for the industrial and residential land-use scenarios, respectively. These values are also much less than risk values calculated due to naturally occurring radiation.

The uncertainties associated with the calculations are considered small relative to the conservativeness of the risk assessment analysis. We therefore conclude that this site does not have significant potential to affect human health under either an industrial or a residential land-use scenario.

The ecological risk for this site has not been estimated at this time. Site-Wide ecological risk analyses are being conducted and the relevant analyses for this site will be presented when available.

IV. References

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USEPA, 1996b, Health Effects Assessment Summary Tables (HEAST)- Published quarterly by the Office of Research and Development and Office of Solid Waste and Emergency Response. NTIS#PB 91-921100.

17. Site 234, OU 1309, Storm Drain System Outfall Site

See above comment. [The analysis of radioactive risk should include an estimation of carcinogenic risk due to radioactive constituents.]

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 234, OU 1309, Storm Drain System Outfall Site in NMED Site-Specific Technical Comments discusses the risk.

18. Site 235, OU 1309, Storm Drain System Outfall Site

See above comment. [The analysis of radioactive risk should include an estimation of carcinogenic risk due to radioactive constituents.]

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 235, OU 1309, Storm Drain System Outfall Site in NMED Site-Specific Technical Comments discusses the risk.

ATTACHMENT M

SNL ER PROJECT EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

Sandia National Laboratories Environmental Restoration Program

EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

BACKGROUND

Sandia National Laboratories (SNL) proposes that a default set of exposure routes and associated default parameter values be developed for each future land-use designation being considered for SNL/NM Environmental Restoration project site. This default set of exposure scenarios and parameter values would be invoked for risk assessments unless site-specific information suggested other parameter values. Because many SNL/NM ER sites have similar types of contamination and physical settings, SNL believes that the risk assessment analyses at these sites will be similar. A default set of exposure scenarios and parameter values will facilitate the risk assessments and subsequent review.

The default exposure routes and parameter values suggested are those that SNL views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the USEPA Region VI and NMED, SNL proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all Environmental Restoration (ER) sites exist within the boundaries of the Kirtland AFB. Approximately 157 potential waste and release sites have been identified where hazardous, radiological, or mixed materials may have been released to the environment. Evaluation and characterization activities have occurred at all of these sites to varying degrees. Among other documents, the SNL/ER draft Environmental Assessment (DOE, 1996) presents a summary of the hydrogeology of the sites, the biological resources present and proposed land use scenarios for the SNL/NM ER sites. At this time, all SNL/NM ER sites have been tentatively designated for either industrial or recreational future land use.

Based on this and other related information, the SNL/NM ER project has screened the potential exposure routes and identified default parameter values to be used for calculating potential intake and subsequent hazard index and risk values. EPA (EPA, 1989a) provides a summary of exposure routes that could potentially be of significance at a specific waste site. These potential exposure routes consist of:

- Ingestion of contaminated drinking water;
- Ingestion of contaminated soil;
- Ingestion of contaminated fish and shell fish;
- Ingestion of contaminated fruits and vegetables;
- Ingestion of contaminated meat, eggs, and dairy products;
- Ingestion of contaminated surface water while swimming;
- Dermal contact with chemicals in water;
- Dermal contact with chemicals in soil;

- Inhalation of airborne compounds (vapor phase or particulate), and;
- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

Based on the location of the sites and the characteristics of the surface of the sites, we have evaluated these potential exposure routes to determine which should be considered in risk assessment analyses (the last exposure route is pertinent to radionuclides only). At SNL/NM ER sites, there does not presently occur any consumption of fish, shell fish, fruits, vegetables, meat, eggs, or dairy products that originate on-site. Additionally, no potential for swimming in surface water is present due to the high-desert environmental conditions. As documented in the computer code RESRAD manual (ANL, 1993), risks resulting from immersion in contaminated air or water are not significant compared to risks from other radiation exposure routes; these are therefore not included. SNL/NM ER has therefore excluded the following four potential exposure routes from further risk assessment evaluations at any SNL/NM ER site:

- Ingestion of contaminated fish and shell fish;
- Ingestion of contaminated fruits and vegetables;
- Ingestion of contaminated meat, eggs, and dairy products; and
- Ingestion of contaminated surface water while swimming.

That part of the exposure pathway for radionuclides related to immersion in contaminated air or water is also eliminated.

For future risk assessments, the exposure routes that will be considered are:

- Ingestion of contaminated drinking water;
- Ingestion of contaminated soil;
- Inhalation of airborne compounds (vapor phase or particulate).
- Dermal contact with chemicals in water;
- Dermal contact with chemicals in soils; and
- External exposure to penetrating radiation from ground surfaces with photon-emitting radionuclides.

EQUATIONS AND DEFAULT PARAMETER VALUES FOR IDENTIFIED EXPOSURE ROUTES

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation may also be significant for radionuclides. All six of the above routes will, however, be considered. The general equations for calculating potential intakes via these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund: Volume 1 (EPA, 1989a and 1991). Also shown are the default values SNL/NM ER suggests for use in Reasonable Maximum Exposure (RME) risk assessment calculations for an industrial scenario, based on EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants.

Chemicals

Ingestion of Chemicals in Drinking Water:

Scenario: A person ingests tap water and beverages made from tap water. All tap water consumed is assumed to come from an on-site drinking well. In accordance with EPA guidance, the default parameter values used reflect a residential exposure.

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

CW = chemical concentration in water (mg/L)
IR = ingestion rate (L water/d);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d)

Parameter	Units	Point Value	Justification
CW	mg/L	site-specific	
IR	L/d	2	Exposure Factors Handbook (EPA, 1989b); reasonable worst-case value
EF	d/yr	350	Exposure Factors Handbook (EPA, 1989b) and RAGS, Vol 1, Part B (EPA, 1991), reasonable worst-case value
ED	yr	30	Exposure Factors Handbook (EPA, 1989b) and RAGS, Vol 1, Part B (EPA, 1991), reasonable worst-case value
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	 10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

Ingestion of Chemicals in Soil:

Scenario: A worker engages in a combination of indoor and outdoor activities for 8 hours per day with inadvertent ingestion of soil from a layer of soil on the inside surfaces of the fingers and thumb from outdoor activities or inadvertent ingestion of soil from handling of food or cigarettes. An EPA suggested average value of 100 mg/d is used for the ingestion rate.

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times (10^{-6}\ kg/mg) \times EF \times FI \times ED}{BW \times AT}$$

CS = chemical concentration in soil (mg/kg);
IR = ingestion rate (mg soil/d);
FI = fraction ingested (default to 1);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d).

Parameter	Units	Point Value	Justification
CS	mg/kg	site-specific	
IR	mg/d	100	Exposure Factors Handbook (EPA, 1989b), RAGS (EPA, 1989a); conservative estimate
EF	d/yr	250	Reasonable worst-case value for worker; RAGS (EPA, 1989a)
FI	--	1	Worst-case value
ED	yr	30	Reasonable worst-case value for worker
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	 10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

Inhalation of Airborne (vapor phase or particulate) Chemicals:

Scenario: A worker is engaged in activities (indoors or outdoors) and inhales contaminant vapors present in the air or is exposed to contaminant particulates present in the air.

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

CA = chemical concentration in air (mg/m^3);
IR = inhalation rate (m^3/h);
ET = exposure time (h/d);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d).

Parameter	Units	Point Value	Justification
CA	mg/m^3	site-specific	
IR	m^3/h	2.5	Exposure Factors Handbook (EPA, 1989b); reasonable worst-case value
EF	d/yr	250	Reasonable worst-case value for worker
ET	h/d	8	Reasonable worst-case value
ED	yr	30	Reasonable worst-case value for worker
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	 10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

The chemical concentration in air can be either measured or calculated based on the concentration of contaminants in the soil. If field measurements are not available, vapor-phase concentrations can be determined using a volatilization factor (VF) to define the relationship between the concentration of contaminant in soil and the volatilized contaminants in air. Likewise, chemical concentrations based on particulates can be determined using a particulate emission factor (PEF) to define the relationship between the contaminant concentration in soil with the concentration of respirable particles in air due to fugitive dust emissions. The volatilization factor was established as part of the Hwang and Falco (1986) model developed by EPA's Exposure Assessment group. The particulate emission factor is derived by Cowherd (1985), applicable to a typical hazardous waste site where the surface contamination provides a relatively continuous and constant potential for emission over an extended period of time. The equations for calculating VFs and PEFs can be found in EPA (EPA, 1991). Alternative methods for calculating these factors are also available. These alternative methods can be discussed with EPA/NMED staff for use in risk assessments if they can be shown to be technically consistent or superior to current published guidance.

<u>Dermal Contact with Chemicals in Water:</u>
Scenario: A worker is in contact with contaminants in water, primarily through hygienic activities as hand washing or showering.

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times SA \times 10^4\ cm^2/m^2 \times PC \times ET \times EF \times ED \times 1\ L/10^3\ cm^3}{BW \times AT}$$

CW = chemical concentration in water (mg/L);
SA = skin surface area for contact (m^2);
PC = chemical specific dermal permeability constant (cm/h);
ET = exposure time (h/d);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d)

Parameter	Units	Point Value	Justification
CW	mg/L	site-specific	
SA	m^2	2	Exposure Factors Handbook (EPA, 1989b); {represents total body exposure); reasonable worst-case value
PC	cm/h	chemical specific	see e.g., Dermal Exposure Assessment (EPA, 1992)
EF	d/yr	250	Reasonable worst-case value for worker
ET	h/d	0.25	Dermal Exposure Assessment (EPA, 1992); reasonable worst case value
ED	yr	30	Reasonable worst-case value for worker
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	 10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

Dermal Contact with Soil:
Scenario: A worker is in contact with contaminants in soil for an exposure duration determined through discussions with EPA/NMED staff. A worker gets exposure to the head, hands, forearms and lower legs.

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times (10^{-6}\ kg/mg) \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

CS = chemical concentration in soil (mg/kg);
SA = skin surface area for contact (m^2);
AF = soil to skin adherence factor (mg/cm^2);
ABS = absorption factor (unitless);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d).

Parameter	Units	Point Value	Justification
CS	mg/kg	site-specific	
SA	m^2	0.53	Dermal Exposure Assessment (EPA, 1992); {accounts for adult exposure to head, hands, forearms, and lower legs); reasonable worst-case value
AF	mg/cm^2	1.0	Dermal Exposure Assessment (EPA, 1992); reasonable worst-case value
ABS	--		
EF	d/yr	250	Reasonable worst-case value for worker
ET	h/d	TBD	To be determined based on discussions with NMED staff.
ED	yr	30	Reasonable worst-case value for worker
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	 10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

EPA (EPA, 1992) recognizes that dermal contact exposure remains the least well understood of the major exposure routes. Chemical-specific data are often not available and dose-response relationships specific to dermal contact are not available. EPA (EPA, 1992) provides guidance on assessment of dermal exposure, including determination of permeability coefficients and other related parameters.

In addition to the equations presented above for absorbed dose via steady-state dermal exposure, EPA (EPA, 1992) presents methods for calculation of absorbed doses for unsteady-state exposure; these methods generally produce lower estimates of absorbed dose. The document also presents a screening process for determining if site-specific calculations of dermal exposure are necessary, assuming that dermal exposure is deemed a potentially valid route of contaminant exposure. In general, SNL/NM ER will use the latest guidance available from EPA on dermal exposure. This is an area where discussions with EPA/NMED staff on appropriate assumptions and parameter values is essential. Discussions with EPA/NMED staff are also necessary to determine when this exposure route should be invoked.

Radionuclides

Radionuclide Carcinogenic Effects from Water: Residential

Scenario: A worker drinks radioactively-contaminated water and inhales vapor from the water.

Total risk = (C_{rw} x SF_o x IR_w x EF x ED) + (C_{rw} x SF_i x IR_{air} x K x EF x ED)

C_{rw} = radionuclide concentration in water (pCi/L)
SF_i = inhalation slope factor (risk/pCi)
SF_o = oral (ingestion) slope factor (risk/pCi)
EF = exposure frequency (d/y)
ED = exposure duration (y)
IR_{air} = indoor inhalation rate (m^3/d)
IR_w = water ingestion rate (L/d)
K = volatilization factor (unitless)

Parameter	Units	Point Value	Justification
C_{rw}	pCi/L	site-specific	
SF_i	risk/pCi	radionuclide-specific	
SF_o	risk/pCi	radionuclide-specific	
EF	d/y	350	RAGS (EPA, 1989a)
ED	y	30	Reasonable worst-case estimate.
IR_{air}	m^3/d	15	RAGS (EPA, 1989a)
IR_w	L/d	2	Reasonable worst-case estimate.
K	unitless	0.5	RAGS (EPA, 1989a)

Radionuclide Carcinogenic Effects from Soil: Industrial

Scenario: A worker inadvertently ingests soil, inhales vapor and particulates from soil and is externally exposed to penetrating radiation ground surfaces contaminated with photon-emitting radionuclides.

$$\text{Total risk} = C_{rs} \times ED \times [(SF_o \times 10^{-3} g/mg \times EF \times IR_{soil}) + (SF_i \times 10^3 g/kg \times EF \times IR_{air} / VF) + (SF_i \times 10^3 g/kg \times EF \times IR_{air} / PEF) + (SF_e \times 10^3 g/kg \times D \times SD \times (1-S_e) \times T_e)]$$

C_{rs} = radionuclide concentration (pCi/g)
SF_i = inhalation slope factor (risk/pCi)
SF_o = oral (ingestion) slope factor (risk/pCi)
SF_e = external exposure slope factor (risk/y per pCi/m^2)
EF = exposure frequency (d/y)
ED = exposure duration (y)
IR_{air} = inhalation rate (m^3/d)

IR_{soil} = soil ingestion rate (mg/d)
VF = soil-to-air volatilization factor (m^3/kg)
PEF = particulate emission factor (m^3/kg)
D = depth of radionuclides in soil (m)
SD = soil density (kg/m^3)
S_e = gamma shielding factor (unitless)
T_e = gamma exposure factor (unitless)

Parameter	Units	Point Value	Justification
C_r	pCi/g	site-specific	
SF_i	risk/pCi	radionuclide-specific	
SF_o	risk/pCi	radionuclide-specific	
SF_e	risk/y per pCi/m^2	radionuclide-specific	
EF	d/y	250	RAGS (EPA, 1989a)
ED	y	30	Reasonable worst-case estimate.
IR_{air}	m^3/d	20	RAGS (EPA, 1989a)
IR_{soil}	mg/d	100	Reasonable worst-case estimate.
VF	m^3/kg	nuclide-specific	
PEF	m^3/kg	1.32×10^9	Region VI guidance.
D	m	0.1	RAGS (EPA, 1989a)
SD	kg/m^3	1430	RAGS (EPA, 1989a)
S_e	unitless	0.2	RAGS (EPA, 1989a)
T_e	unitless	1	RAGS (EPA, 1989a)

Summary for an Industrial Land-Use Scenario

SNL proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial future land-use scenario. The parameter values are based on EPA guidance and supplemented by information from other government sources. The values are generally consistent with those proposed by Los Alamos National Laboratory, with a few minor variations. If these exposure routes and parameters are acceptable, SNL will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

Summary for an Residential Land-Use Scenario

Sandia may choose to evaluate some sites using a residential land-use scenario in order to provide an indication of the effects of data uncertainty on risk value calculations or in order to potentially mitigate the need for institutional controls or restrictions on Sandia ER sites. For a risk assessment evaluating a residential land-use scenario, Sandia will use parameter values as documented in the Risk Assessment Guidance for Superfund (RAGS, 1989a). That EPA guidance document provides detailed discussion on the appropriate values to use for all of the potential exposure pathways.

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ATTACHMENT N

REFERENCES FOR TIJERAS ARROYO OU NOD RESPONSES

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GENERAL RISK ASSESSMENT COMMENTS

1. **Conclusions throughout the report are based largely on comparisons with previously established upper tolerance limits (UTLs). These UTLs have not been approved by NMED or limits (UTLs). These UTLs have not been approved by NMED or EPA and are therefore considered draft. The presented values have been compared with protective screening values for human health. Both residential and industrial scenario screening values have been considered since Sandia does not have a final future land use plan at this time.**

   Response: DOE/SNL understands that UTLs are considered draft until approved by NMED and EPA. As of April 1996, DOE/SNL has a final future land use plan and risk assessments will use future land use scenarios based upon that plan.

2. **The sites with reported radionuclides above background levels were evaluated based on a DOE established acceptable dose. EPA Region 6 policy requires that the evaluation of risk to radionuclides include an estimation of potential carcinogenic risk. A revision to the risk evaluation is requested.**

   Response: DOE/SNL will provide potential carcinogenic risk and dose due to radionuclide contamination in future NFA proposal submissions and resubmissions.

3. **For all sites, the following issues must be addressed: 1) potential ecological risk posed at the site, 2) the site as a potential source for ecological risk in transport of constituents through the septic system into Tijeras Arroyo, and 3) detection limits relative to human health-based screening levels.**

   Response: DOE/SNL is currently working on ecological risk assessments for all ER Sites which will be submitted as a supplemental document to NMED upon completion. DOE/SNL considers detection limits in preparing human health-based risk assessments.

6. <u>**Site 7, OU 1309, Gas Cylinder Disposal Site**</u>

This portion of the document does not contain risk assessment information for review.

Response: The need for a risk assessment is not applicable to ER Site 7 because no soil samples have been collected there. The collection of soil samples is not warranted. The section Site 7, OU 1309, Gas Cylinder Disposal Site in NMED Site-Specific Technical Comments discusses the findings that support the SNL/NM request for ER Site 7 to be granted NFA status.

7. <u>**Site 23, OU 1309, Disposal Trenches**</u>

This portion of the document does not contain risk assessment information for review.

Response: The need for a risk assessment is not applicable to ER Site 23 because no soil samples have been collected there. The collection of soil samples is not warranted. The section Site 23, OU 1309, Disposal Trenches in NMED Site-Specific Technical Comments discusses the findings that support the SNL/NM request for ER Site 23 to be granted NFA status.

8. <u>**Site 40, OU 1309, Oil Spill Site**</u>

Any value based on TPH does not allow for the evaluation of potential risk.

Response: The issue of a risk evaluation is not applicable because NMED has already granted NFA Status to ER Site 40 (Oil Spill Site) based upon NMED Underground Storage Tank regulations.

9. <u>**Site 46, OU 1309, Old Acid Waste Line Outfall Site**</u>

See general comment on risk analysis of radionuclides. [The sites with reported radionuclides above background levels were evaluated based on a DOE established acceptable dose. EPA Region 6 policy requires that the evaluation of risk to radionuclides include an estimation of potential carcinogenic risk. A revision to the risk evaluation is requested.]

Response: SNL/NM has recently completed, with EPA Region VI concurrence, a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 46, OU 1309, Old Acid Waste Line Site in NMED Site-Specific Technical Comments discusses the risk assessment.

10. **Site 50, OU 1309, Old Centrifuge Site**

The radioactive portion of the risk assessment was compared to a radioactive dose. It is EPA Region 6 policy to require the calculation of not only the radioactive dose present at a site, but also to require an evaluation of radioactive risk. SNL/NM should revise the risk evaluation accordingly.

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 50, OU 1309, Old Centrifuge Site in NMED Site-Specific Technical Comments discusses the risk assessment.

11. **Site 77, OU 1309, Oil Surface Impoundment Site**

The data provided appear to support an NFA proposal from a human health standpoint. However, the proposal should provide information on the potential for ecological impact.

Response: The issue of ecological impact is not applicable to ER Site 77 at this time. ER Site 77 is an active, evaporative lagoon (impoundment) that is used by TA-IV for storing tank-farm surface water. The lagoon is regulated under NMED 'Surface Water Discharge Plan 530' (DP-530). Since the lagoon is already regulated, monitored, and inspected according to NMED regulations, ER Site 77 should be granted NFA status. SNL/NM Organization 9300 manages the lagoon with oversight by the Water Quality Program in SNL/NM Organization 7500. The section Site 77, OU 1309, Oil Surface Impoundment Site in NMED Site-Specific Technical Comments presents more details.

12. **Site 227, OU 1309, Bunker 904 Outfall Site**

The radioactive risk analysis was based on comparative doses. The evaluation of the risk due to the radioactive dose should be part of the risk analysis. Please revise accordingly. The NFA proposal should address the potential for ecological risk.

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 227, OU 1309, Bunker 904 Outfall Site in NMED Site-Specific Technical Comments discusses the risk assessment. The issue of ecological risk is discussed in Item 3 of the NMED General Risk Assessment Comments section.

13. Site 229, OU 1309, Storm Drain System Outfall Site

The radioactive risk should be calculated also based on the potential carcinogenic risk presented by the radioactive dose.

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 229, OU 1309, Storm Drain System Outfall Site in NMED Site-Specific Technical Comments discusses the risk assessment.

14. Site 230, OU 1309, Storm Drain System Outfall Site

The analysis of radioactive risk should include an estimation of carcinogenic risk due to radioactive constituents.

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 230, OU 1309, Storm Drain System Outfall Site in NMED Site-Specific Technical Comments discusses the risk assessment.

15. Site 231, OU 1309, Storm Drain System Outfall Site

See comment to site 230 above. [The analysis of radioactive risk should include an estimation of carcinogenic risk due to radioactive constituents.]

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 231, OU 1309, Storm Drain System Outfall Site in NMED Site-Specific Technical Comments discusses the risk assessment.

16. Site 233, OU 1309, Storm Drain System Outfall Site

See comment above. [The analysis of radioactive risk should include an estimation of carcinogenic risk due to radioactive constituents.]

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 233, OU 1309, Storm Drain System Outfall Site in NMED Site-Specific Technical Comments discusses the risk assessment.

17. Site 234, OU 1309, Storm Drain System Outfall Site

See above comment. [The analysis of radioactive risk should include an estimation of carcinogenic risk due to radioactive constituents.]

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 234, OU 1309, Storm Drain System Outfall Site in NMED Site-Specific Technical Comments discusses the risk.

18. Site 235, OU 1309, Storm Drain System Outfall Site

See above comment. [The analysis of radioactive risk should include an estimation of carcinogenic risk due to radioactive constituents.]

Response: SNL/NM has recently completed a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 235, OU 1309, Storm Drain System Outfall Site in NMED Site-Specific Technical Comments discusses the risk.

NOD

U.S. Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P.O. Box 5400
Albuquerque, NM 87185-5400

JAN 26 2000

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous and Radioactive Materials Bureau
New Mexico Environment Department
2044 Galisteo Street
P.O. Box 26110
Santa Fe, NM 87502-2100

Dear Mr. Bearzi:

Enclosed is one of two NMED copies of the Department of Energy and Sandia National Laboratories/New Mexico response to the NMED Notice of Deficiency (NOD), dated October 13, 1999, for Environmental Restoration sites 7, 46, 48, 50, 136, 159, 166, 227, 229, 230, 231, 233, 234, and 235. These sites were all included in the 2nd batch of No Further Action (NFA) proposals.

If you have any questions, please contact John Gould at (505) 845-6089.

Sincerely,

George K. Laskar

Michael J. Zamorski
Area Manager

Enclosure

Sandia National Laboratories
Albuquerque, New Mexico
December 1999

Environmental Restoration Project
Responses to NMED Notice of Deficiency
No Further Action Proposals (2nd Round)
Dated June 1995

INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is submitting this Notice of Deficiency (NOD) response for sites managed by the Tijeras Arroyo Operable Unit (OU) 1309 and the Technical Area (TA) II OU 1303. This response addresses Enclosures A and B comments in the October 13, 1999 NOD (NMED, 1999).

This is the second NOD response for Environmental Restoration (ER) Sites 50 and 235. Most of the following information addresses omissions in the ER Sites 50 and 235 No Further Action (NFA) Proposals (SNL/NM, 1995) and the first ER Sites 50 and 235 NOD responses (SNL/NM, 1996). This response addresses the need for reorganizing the confirmatory sampling analytical data and conducting human health and ecological risk assessments. For ER Site 50, this response also contains additional analytical data obtained during the Voluntary Corrective Measure activities recently conducted at nearby ER Site 228A (the Centrifuge Dump Site) in 1999 (SNL/NM, 1999). For ER Site 235, this response addresses the need for reorganizing the confirmatory sampling analytical data and conducting human and ecological risk assessments.

TABLE OF CONTENTS

**RESPONSES TO NMED NOTICE OF DEFICIENCY COMMENTS
ON NO FURTHER ACTION PROPOSALS
ER SITES 7, 46, 48, 135, 136, 159, 165, 166, 167, 227, 229, 230, 231, 232, 233, AND 234
JUNE 1995 (2ND ROUND)**

ENCLOSURE B

The following discussion documents the negotiations between SNL/NM ER staff and NMED HRMB staff as requested in NMED (1999). These negotiations were finalized in a November 17, 1999 meeting.

OU 1303

ER Sites 48, 135, 136, 159, 165, 166, and 167 (TA-2 Septic Systems)

Additional site characterization work proposed includes:

1. **Finish compiling and provide the information requested in Stu Dindwiddie's letter to Michael Zamorski (DOE) and Joan Woodard (SNLNM) (dated December 11, 1998).**

   Response: The information requested in the referenced letter is listed below and is followed by the SNL/NM response.

   a. **Please submit maps showing the locations of boreholes with respect to seepage pits and other septic-system components for the above ER sites (48, 135, 136, 159, 165, 166, and 167).**

   Response: The existing site maps have been revised to reflect the best-known information on all the TA-II septic and drain system sites. The changes are based on SNL/NM Facilities Engineering drawings and Global Positioning System (GPS) mapping of visible system components. To improve the accuracy of the site maps, an excavator and GPS surveying will be used to locate system components below grade, confirm drainfield dimensions, and pinpoint effluent release locations. Planning for this work is in progress. Accurate site maps will be available in May 2000. Any further sampling at TA-II ER septic and drain system sites will be discussed with NMED HRMB staff when the maps are finalized. Note that this comment also addresses ER Sites 135 and 165, which were not incorporated in the 2nd Round of the NFA proposals. After discussions with NMED HRMB, the HE rinse-water drain from Site 48 will be investigated at the same time as co-located ER Sites 227 and 229, which are managed by Tijeras Arroyo OU 1309.

   b. **Please submit all analytical results of soil samples obtained from these boreholes. Data tables must include a listing of all constituents analyzed for, analytical methods, detection limits, and concentrations.**

Response: The requested soil analytical results for the boreholes at TA-II ER septic and drain system sites will be submitted with the revised site maps.

2. **Summarize in written form, as applicable, all geologic, hydrologic, and ground-water quality data for all boreholes and ground-water monitor wells in the vicinity of TA-2.**

Response: SNL/NM will summarize in written form, as applicable, all geologic, hydrologic, and groundwater quality data for all boreholes and groundwater monitor wells in the vicinity of the TA-II ER sites. This information will be presented in the Sandia North Groundwater Investigation Annual Report for FY01 or FY02.

Site-Specific Comments

OU 1309

ER Site 7, Gas Cylinder Disposal Pit

Additional site characterization work proposed includes:

1. **Collect subsurface soil samples from within the waste layer and immediately below the bottom of the landfill.**

2 **Subsurface samples will be collected from at least four (4) borings or trenches. At least one sample per boring/trench will be collected within 5 ft beneath the landfill. At least two samples per boring/trench will be collected at locations within the waste layer (more samples will be collected if the waste layer exceeds 15 ft thick).**

3. **The soil samples will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

Response: Unfortunately the name for ER Site 7 is misleading and refers to ER Site 6A, a gas cylinder disposal pit that was remediated in 1995. ER Site 7 contains construction and demolition debris from the Veteran's Administration (VA) Hospital. Prior to disposal of the construction and demolition debris, SNL/NM used the location as a sand and gravel quarry from 1980 to 1986.

DOE, SNL/NM, and KAFB's Environmental Management agreed on November 15, 1999 that responsibility for this site should be transferred to the KAFB Installation Restoration Program (IRP). The IRP intends to accept ownership for this site. DOE and KAFB are currently working on the transfer process. Therefore, SNL/NM will not be performing the additional proposed site characterization. After the IRP assumes responsibility for this site, SNL/NM will submit an administrative NFA proposal for ER Site 7.

ER Sites 46, 232, 233, 234, 227, 229, 230, and 231 (OU 1309 Outfalls)

The outfalls at ER Sites 46 and 227 are of the most concern to the HRMB; the others, which are storm drain outfalls, are clustered near ER sites 46 and 227. More specifically, ER Sites 229, 230, and 231 are grouped near ER Site 227; whereas, ER Sites 232, 233, and 234 are located near ER Site 46. Additional site characterization work proposed includes:

1. **Locate each outfall accurately.**

Response: SNL/NM will locate each outfall accurately for ER Sites 46, 227, 229, 230, 231, 232, 233, and 234. The recent discussions have revealed that the type of water released to each site needs to be clarified. ER Site 46 received rinse waters from TA-I buildings. ER Sites 227 and 229 received rinse waters from TA-II buildings. ER Sites 230, 231, 232, and 233 currently receive storm water from TA-IV. ER Site 234 previously received storm water from TA-IV, but is now inactive. Except for ER Site 232, all of these OU 1309 sites were documented in the 2nd Round of the NFA proposals.

The NFA proposal for ER Site 232 was submitted in the 8th Round in July 1997; additional work for ER Site 232 is addressed in SNL/NM (1999).

2. **Collect and analyze soil samples at the points of surface discharge and along the drainage channels. Analytical results of previous sampling will be used, to the extent possible, to meet this requirement.**

Response: SNL/NM will collect and analyze soil samples at the points of surface discharge and along the drainage channels that are unlined. More details are presented in item #4 below. Analytical results of previous sampling will be used, to the extent possible, to meet the NMED requirement. The soil samples will be collected according to the following Fiscal Year (FY) schedule: ER Site 46 (FY01), ER Site 227 (FY01), ER Site 229 (FY01), ER Site 230 (FY02), ER Site 231 (FY02), ER Site 232 (FY01), ER Site 233 (FY02), and ER Site 234 (FY02).

3. **Collect deep soil samples and vapor samples at ER Sites 46 and 227. Two 150-ft deep boreholes should be drilled at ER Site 46; one similar borehole should be drilled at ER Site 227. The soil-vapor monitor wells will be permanent installations. Soil samples will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, high explosives, hexavalent chromium, iron, and chloride.**

Response: SNL/NM will install two permanent 150-foot deep soil-vapor monitor wells at ER Site 46 and one similar monitor well at ER Site 227. At ER Site 46, the first well will be located at the end of the acid waste line, while the second well will be located at the southern end of the site. [The end (former outfall) of the acid waste line is estimated to be about 50 ft south-southwest of monitor well TJA-3.] The ER Site 227 well will be located at the eastern end of the site near the slope break. Soil samples will be analyzed for radiological constituents (gamma spectroscopy and gross alpha/beta), RCRA metals, volatile organic compounds, semi-volatile organic compounds, high explosives, hexavalent chromium, iron, and chloride. According to the FY00 baseline, performance of this fieldwork is scheduled for FY01.

4. **Collect shallow subsurface soil samples at each storm drain outfall (two boreholes at each location at maximum depths of 5 ft). The soil samples will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

Response: SNL/NM will collect shallow subsurface samples at two locations each at the storm-drain outfalls (ER Sites 230, 231, 232, 233, and 234). The samples will be collected at a depth of five ft, bgs from hand-augered boreholes. Except for ER Site 234, the boreholes for the TA-IV storm-drain outfalls will be located 5 ft and 30 ft downslope from the lowermost concrete structures at ER Sites 230, 231, 232, and 233. Not to be forgotten, ER Site 232 is unique because two storm drains are located there. At the remaining TA-IV storm-drain outfall (ER Site 234), the boreholes will be located at a similar lateral spacing with the northernmost borehole being located at the lowermost tip of the site. The soil samples from each site will be analyzed for radiological constituents (gamma spectroscopy and gross alpha/beta), RCRA metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.

5. **Collect a surface soil sample upstream of the drop inlet at ER Site 230. The soil sample will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

   Response: SNL/NM also will collect a surface (0 – 0.5 ft, bgs) soil sample for ER Site 230. The sample will be collected upstream of the drop inlet and next to the chain-link fence. The soil sample will be analyzed for radiological constituents (gamma spectroscopy and gross alpha/beta), RCRA metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.

6. **A new ground-water monitor well will be installed at the bottom of the slope at ER Site 46. The well will be completed in the regional aquifer, if perched water is not encountered.**

   Response: SNL/NM will install a groundwater monitor well at the bottom of the slope at ER Site 46. The well will be completed in the regional aquifer, if perched water is not encountered.

7. **Summarize in written form, as applicable, all geologic, hydrologic, and ground-water quality data for all boreholes and ground-water monitor wells in the vicinity of ER Sites 46 and 227. The information requested above for the TA-2 septic systems will meet this requirement for ER Site 227, which is located adjacent to TA-2.**

   Response: SNL/NM will summarize in written form, as applicable, all geologic, hydrologic, and groundwater quality data for all boreholes and groundwater monitor wells in the vicinity of ER Sites 46 and 227. This information will be presented in the Sandia North Groundwater Investigation Annual Report for FY01 or FY02.

8. **Revise and resubmit the data tables in the NFA proposals for each site, meeting the standards achieved in the 12th Round NFA proposals.**

   Response: After all the requested soil samples have been collected and the analytical results received, SNL/NM will revise and resubmit the soil-sample data tables for ER Sites 46, 227, 229, 230, 231, 232, 233, and 234 in a format meeting the standards set in the 12th Round NFA proposals. Risk assessments (human-health and ecological) will be prepared. The data tables and risk assessments will be incorporated into the 'statement of basis' format.

Reference (ER Site 7)

Sandia National Laboratories/New Mexico. Letter to Kirtland Area Office (KAO). "Transmittal of Responses to NMED for Request for Supplemental Information (RSI)," September 8, 1999.

NOD

Department of Energy
National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

JAN 31 2003

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. John E. Kieling, Manager
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Rd., Building E
Santa Fe, NM 87505

Dear Mr. Kieling:

Enclosed is one of two NMED copies of the Department of Energy (DOE) and Sandia National Laboratories/New Mexico Responses to the NMED Notices of Deficiency (NOD) for Solid Waste Management Units 230, 231, 232, 233, and 234 No Further Action Proposals, Dated June 1995 (2nd Round) and August 1997 (8th Round). Per our verbal agreement, the second NMED copy is being sent directly to the Sandia Staff Manager.

If you have any questions, please contact John Gould at (505) 845-6089.

Sincerely,

Karen L. Boardman

Karen L. Boardman
Manager

Enclosure

cc w/enclosure:
L. King, USEPA, Region 6 (2 copies via Certified Mail)
W. Moats, NMED-HWB (via Certified Mail)
M. Gardipe, ERD/AL
J. Parker, NMED-OB
R. Kennett, NMED-OB

cc: Paul
Records Center

cc w/o enclosure:
J. Estrada, OKSO-AIP
F. Nimick, SNL, MS 1087
J. Bearzi, NMED-HWB
D. Stockham, SNL, MS 1087
M. Davis, SNL, MS 1087
E. Krauss, SNL, MS 0141
S. Collins, SNL, MS 1087
J. Copland, SNL, MS1087
SSO Legal File

FEB 4 2003

Sandia National Laboratories
Albuquerque, New Mexico
December 2002

Environmental Restoration Project
Tijeras Arroyo Operable Unit 1309
Responses to NMED Notices of Deficiency for
Solid Waste Management Units 230, 231, 232, 233, and 234
No Further Action Proposals
Dated June 1995 (2nd Round) and
August 1997 (8th Round)

INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is submitting this Notice of Deficiency (NOD) Response for the Technical Area (TA)-IV storm-water outfalls (Solid Waste Management Units [SWMUs] 230, 231, 232, 233, and 234). These five sites are managed as part of the Tijeras Arroyo Operable Unit (TJAOU) 1309. The proposals for no further action (NFA) for SWMUs 230, 231, 233, and 234 were previously submitted in 1995 (SNL/NM June 1995). The NFA proposal for SWMU 232 was submitted in 1997 (SNL/NM August 1997). This response addresses both the most recent NOD (NMED October 1999) for the five sites (SWMUs 230, 231, 232, 233, and 234) and the previous Request for Supplemental Information (RSI) (Dinwiddie January 1999) that contained specific comments (1 through 5) regarding SWMU 232.

The NOD (NMED October 1999) included comments relating to a number of SWMUs at SNL/NM. Five comments (1, 2, 4, 5, 8) in Enclosure B of this NOD (NMED October 1999) addressed SWMUs 230, 231, 232, 233, and 234. This document presents the SNL/NM response to these comments. Incorporated into the response are the confirmatory sampling requirements that were identified by SNL/NM Environmental Restoration (ER) TJAOU staff and the New Mexico Environment Department (NMED) Hazardous and Radioactive Materials Bureau (HRMB) (now known as the Hazardous Waste Bureau) in a meeting held on November 17, 1999. The outcome of the meeting was NMED's request for additional confirmatory soil sampling at SWMUs 230 through 234. A Field Implementation Plan (FIP) was subsequently developed for these five SWMUs (SNL/NM May 2001) that describes the confirmatory sampling and analysis requirements and provides historical information for the outfalls. The FIP, provided as Attachment A, was used to guide the confirmatory sampling that was conducted in June 2001.

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LIST OF TABLES (Continued)

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LIST OF TABLES (Continued)

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LIST OF ATTACHMENTS

TIJERAS ARROYO OPERABLE UNIT 1309
RESPONSES TO NMED NOTICES OF DEFICIENCY
FOR NFA PROPOSALS

RESPONSES TO ENCLOSURE B, OCTOBER 1999 NOTICE OF DEFICIENCY—PROPOSED ADDITIONAL SITE CHARACTERIZATION WORK, NFA PROPOSALS, JUNE 1995 (2nd Round)

The NMED comments (NMED October 1999) relevant to the TA-IV storm-water outfalls (SWMUs 230, 231, 232, 233, and 234) are presented below in bold text. The SNL/NM response follows each comment.

ER Sites 46, 232, 233, 234, 227, 229, 230, and 231 (OU 1309 Outfalls)

The outfalls at ER Sites 46 and 227 are of the most concern to the HRMB; the others, which are storm drain outfalls, are clustered near ER sites 46 and 227. More specifically, ER Sites 229, 230, and 231 are grouped near ER Site 227; whereas, ER Sites 232, 233, and 234 are located near ER Site 46. Additional site characterization work proposed includes:

1. **Locate each outfall accurately.**

   Response: Figure 1 accurately depicts the locations of each TA-IV storm-water outfall (SWMUs 230, 231, 232-1, 232-2, 233, and 234). The outfalls are located along the southern boundary of TA-IV and the steep northern rim of Tijeras Arroyo. Figure 2 is an SNL/NM Facilities Engineering drawing depicting the various utilities that are located at the southern part of TA-IV. Storm water drains to the sites via buried pipes that are connected to either concrete ditches or concrete drop structures. The SWMUs consist of earthen ditches that start at the discharge point of each concrete feature. SWMUs 230, 231, 232-1, 232-2, and 233 currently receive storm water from TA-IV. SWMU 234 previously received storm water from TA-IV, but is now inactive.

   As shown on Figure 2, SNL/NM Facilities Engineering has assigned a structure number ('struc. no.') to each outfall. For example, structure number 58 corresponds to SWMU 230. Structure numbers 59 and 60A correspond to SWMUs 231 and 232-1, respectively. Structure number 60 corresponds to SWMU 232-2. A structure number is not assigned to SWMU 234 because the concrete features were removed in the early 1990s when piping from the Building 981 area was diverted to SWMU 233 (structure number 62).

2. **Collect and analyze soil samples at the points of surface discharge and along the drainage channels. Analytical results of previous sampling will be used, to the extent possible, to meet this requirement.**

   Response: In June 2001, SNL/NM collected the soil samples, requested by NMED at the November 17, 1999, meeting, at the points of surface discharge and along the earthen channels. At all of the SWMUs (230 through 234), soil samples were collected at lateral distances of 5 and 30 feet downslope of the storm-water discharge point; the sampling depths for these lateral locations began at 0 and 5 feet below ground surface (bgs). Additional surface (0 to 1 foot bgs) soil samples were collected at SWMUs 230, 232-2, and 233. Figures 3 through 8 depict the sampling locations at SWMUs 230 through 234.

Table 1 lists the number of samples that have been collected at each site. Table 2 lists the soil samples for each SWMU. Sampling was conducted in 1994, 1995, and 2001. The soil samples were analyzed by both on-site and off-site laboratories (Tables 3 through 109). Sampling and analysis details are presented in the Risk Screening Assessment Reports for each site (Attachments B through G).

4. **Collect shallow subsurface soil samples at each storm drain outfall (two boreholes at each location at maximum depths of 5 ft). The soil samples will be analyzed for radionuclides, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

Response: In 2001, SNL/NM collected shallow subsurface samples at two locations at each of the storm-drain outfalls (SWMUs 230, 231, 232, 233, and 234). A third soil sample was collected at SWMUs 230, 232-2, and 233 (Table 2). The samples were collected in accordance with guidance received at the November 17, 1999, meeting between SNL/NM ER TJAOU staff and the NMED HRMB. The surface soil (0 to 0.5 foot bgs) and 1-foot-bgs soil samples were collected with a hand trowel. Because of the uneven terrain and large cobbles that serve as erosion control below the storm-water outfalls, a backhoe was used to collect the 5-foot-bgs soil samples. NMED verbally approved use of the backhoe before the sampling was conducted (Copland April 2001).

The soil samples from each site were analyzed for radionuclides (gamma spectroscopy, tritium, and gross alpha/beta), Resource Conservation and Recovery Act (RCRA) metals, chromium-VI, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and total petroleum hydrocarbons (TPH) using U.S. Environmental Protection Agency (EPA) methods (EPA November 1986). The need for analyzing the soil samples for high explosive (HE) compounds was discounted after informing NMED that the TA-IV storm-water outfalls have never received any type of TA-II water (storm, septic, or waste) (SNL/NM May 2001), as previously assumed by NMED. HE compounds are not a contaminant of concern (COC) for any of the TA-IV storm-water outfalls (SWMUs 230, 231, 232, 233, and 234).

5. **Collect a surface soil sample upstream of the drop inlet at ER Site 230. The soil sample will be analyzed for radionuclides, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

Response: A surface soil (0 to 0.5 feet bgs) sample (230-GR-05-0.5) was collected upstream of the drop inlet next to the chain-link fence and analyzed for radionuclides (gamma spectroscopy, tritium, and gross alpha/beta), RCRA metals, chromium-VI, VOCs, SVOCs, and TPH using EPA methods (EPA November 1986). The need for analyzing the soil samples for HE compounds was discounted after informing NMED that the TA-IV storm-water outfalls have never received any type of TA-II water (storm, waste, or septic) (SNL/NM May 2001), as previously assumed by NMED. HE compounds are not a COC for any of the TA-IV storm-water outfalls (SWMUs 230, 231, 232, 233, and 234).

8. **Revise and resubmit the data tables in the NFA proposals for each site, meeting the standards achieved in the 12th Round NFA proposals.**

Response: Analytical data tables from the NFA proposals (SNL/NM June 1995; SNL/NM August 1997) have been revised using the 12th Round format. In addition to the soil samples that were collected in 1994 and 1995 for the NFA proposals, samples also were collected in 2001. Table 2 lists the soil samples for each SWMU. Table 1 lists the corresponding analytical data tables (Tables 3 through 109). The soil samples were analyzed using EPA methods (EPA November 1986) for VOCs, SVOCs, TPH, metals (RCRA metals and chromium-VI), and radionuclides (gamma spectroscopy, tritium, and gross alpha/beta). All detectable concentrations are presented in the tables. In those cases in which no detectable concentrations were reported for a particular analytical suite, a table listing the detection limits is presented. Analytical laboratories are noted on each data table.

Risk assessments (human health and ecological) have been prepared for each SWMU (230 through 234) using all the available sampling results. The risk assessment results, as well as the sampling techniques and analytical methods, are presented in the Risk Screening Assessment Reports for each site (Attachments B through G). The Data Validation Reports for each site are included in Attachments H through M.

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Copland, J.R., April 2001. *Personal communication* between J. R. Copland (Sandia National Laboratories/New Mexico Department 6133) and W. Moats (New Mexico Environment Department–Hazardous Waste Bureau) in Sandia National Laboratories/New Mexico—Environmental Restoration Project Logbook ER-050, page 126. April 27, 2001.

Dinwiddie, R.S., September 1997. New Mexico Environment Department letter to M.J. Zamorski (Kirtland Area Office/U.S. Department of Energy), regarding Request for Supplemental Information: Background Concentrations Report, SNL/KAFB. September 24, 1997.

Dinwiddie, R.S., January 1999. New Mexico Environment Department letter to M.J. Zamorski (Kirtland Area Office/U.S. Department of Energy), regarding Request for Supplemental Information: SNL/NM Proposals for No Further Action, Environmental Restoration Project, August 1997, Round 8 NFAs." January 18, 1999.

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Sandia National Laboratories/New Mexico (SNL/NM), August 1997. *Proposal for Risk-Based No Further Action Environmental Restoration Site 232 Storm Drain System Outfall Operable Unit 1309,* Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), May 2001, "Field Implementation Plan – Tijeras Arroyo Outfalls," Sandia National Laboratories/New Mexico, Albuquerque, New Mexico.

SNL/NM, see Sandia National Laboratories/New Mexico.

Tharp, T.L. (Sandia National Laboratories/New Mexico), February 1999. Memorandum to F.B. Nimick (Sandia National Laboratories/New Mexico), regarding Tritium Background Data Statistical Analysis for Site-Wide Surface Soils. February 25, 1999.

U.S. Environmental Protection Agency (EPA), November 1986. "Test Methods for Evaluating Solid Waste," 3rd ed., Update 111, SW-846, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

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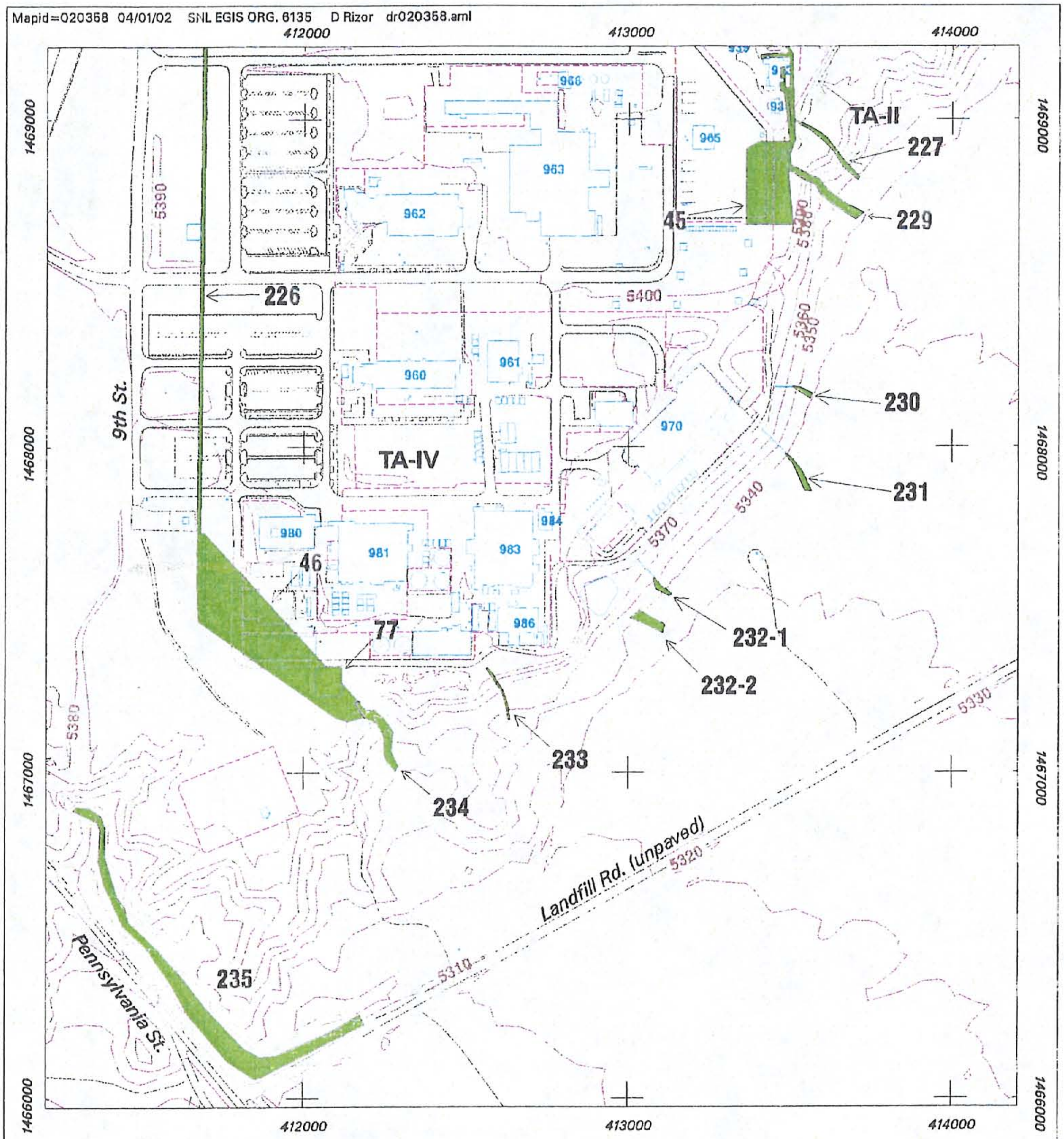

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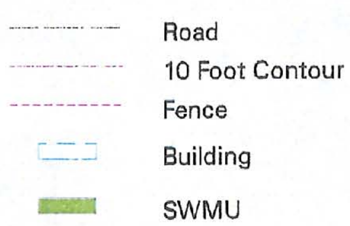
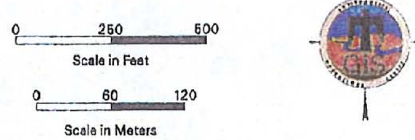


Figure 1
TA-IV Storm-Water Outfalls (SWMUs 230, 231 232, 233 and 234)



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

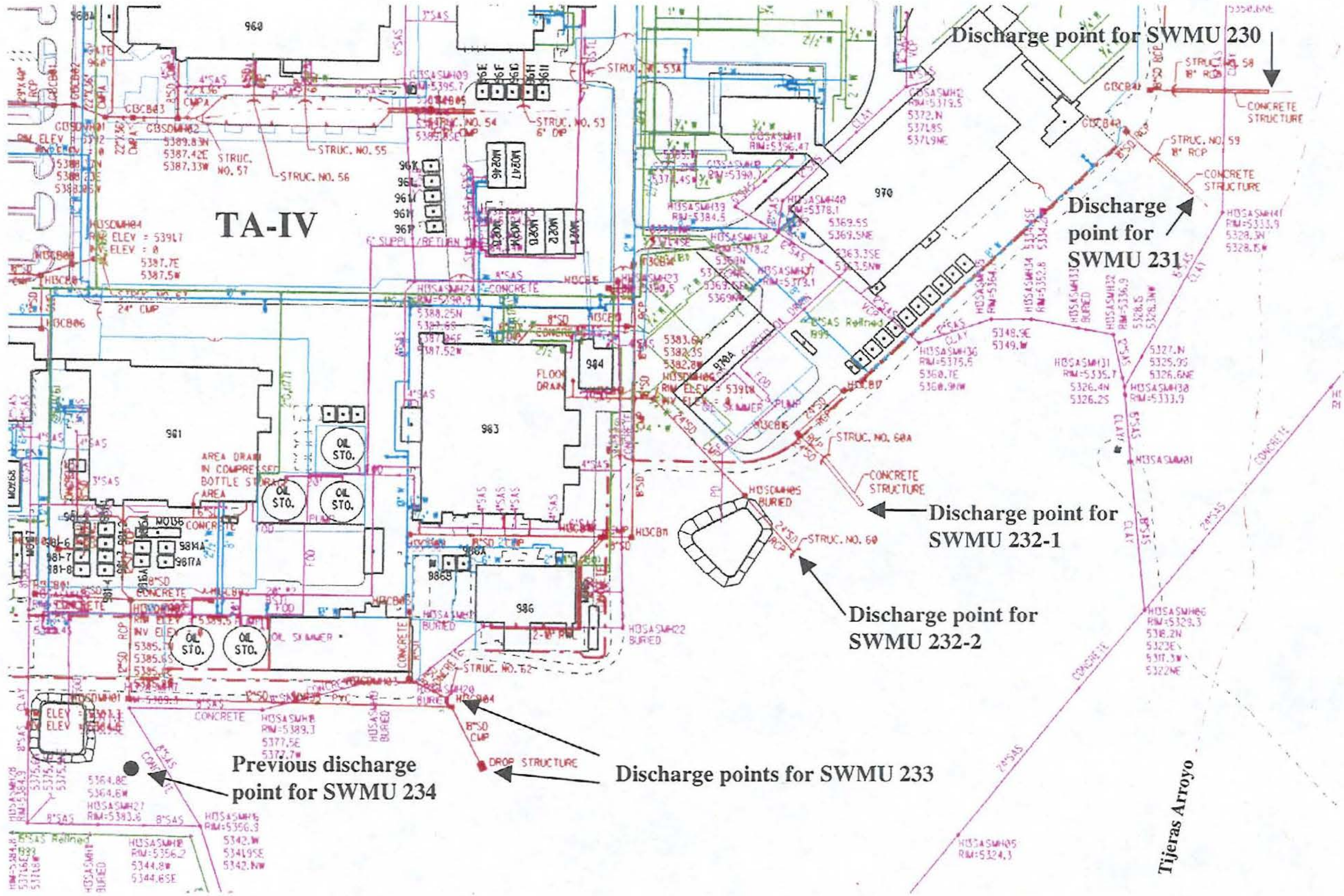


Figure 2. SNL/NM Facilities Engineering drawing for various utilities located on the south side of TA-IV. (Orange items are storm-drain features. Magenta lines are sanitary-sewer lines. Blue lines are potable-water lines. Green lines are natural gas lines and cathodic protection systems. Black lines are buildings and roads. Bold text with arrows added by the ER Project.)

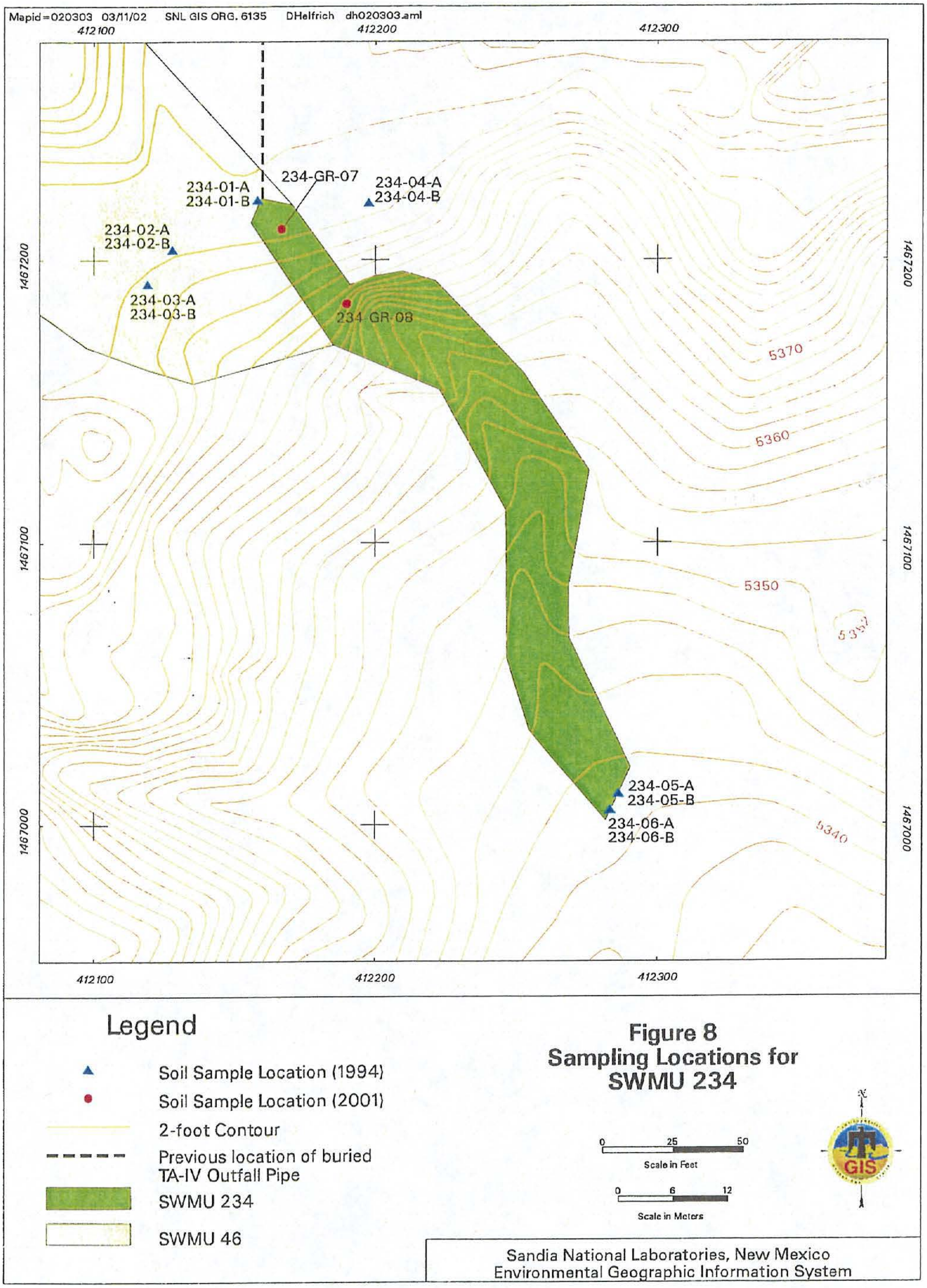


Figure 8
Sampling Locations for SWMU 234

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Tables

Table 1
Number of Confirmatory Soil-Sampling Locations and Corresponding Analytical Data Tables for the TA-IV Storm-Water Outfalls for SWMUs 230, 231, 232-1, 232-2, 233, and 234

SWMU	Locations Sampled in 1994	Locations Sampled in 1995	Locations Sampled in 2001	Total Sampling Locations	Corresponding Analytical Data Tables
230	8	--	3	11	3–21
231	8	--	2	10	22–40
232-1	8	5	3	16	41–60
232-2	41	--	2	43	61–74
233	8	--	3	11	75–92
234	6[a]	--	2	8	93–109

[a]Another six locations (see Table 2) are not included in this tally for SWMU 234 because the corresponding six samples were not collected where storm water had drained.
SWMU = Solid Waste Management Unit.
TA = Technical Area.
-- = Information not available.

Table 2
Soil Samples Collected at SWMUs 230, 231, 232-1, 232-2, 233, and 234

SWMU	Sample ID	Beginning Depth (ft bgs)
230	1994 sampling	
	230-01-A	0.0
	230-01-B	0.5
	230-02-A	0.0
	230-02-B	0.5
	230-03-A	0.0
	230-03-B	0.5
	230-04-A	0.0
	230-04-B	0.5
	2001 sampling	
	230-GR-05-0.0-S	0.0
	230-GR-06-0.0-S	0.0
	230-GR-06-0.0-DU	0.0
	230-GR-06-5.0-S	5.0
	230-GR-07-5.0-S	5.0
231	1994 sampling	
	231-01-A	0.0
	231-01-B	0.5
	231-02-A	0.0
	231-02-B	0.5
	231-03-A	0.0
	231-03-B	0.5
	231-04-A	0.0
	231-04-B	0.5
	2001 sampling	
	231-GR-05-0.0-S	0.0
	231-GR-05-0.0-DU	0.0
	231-GR-05-5.0-S	5.0
	231-GR-06-5.0-S	5.0
232-1	1994 sampling	
	232-1-01-A	0.0
	232-1-01-B	0.5
	232-1-02-A	0.0
	232-1-02-B	0.5
	232-1-03-A	0.0
	232-1-03-B	0.5
	232-1-04-A	0.0
	232-1-04-B	0.5
	1995 sampling	
	232-1-BH1-5-S-1	5.0
	232-1-BH1-10-S-1	10.0
	232-1-BH1-10-SD-1	10.0
	232-1-BH1-10-SO-1	10.0
	232-1-BH2-5-S-1	5.0
	232-1-BH2-10-S-1	10.0
	232-1-BH3-5-S-1	5.0
	232-1-BH3-10-S-1	10.0
	232-1-BH4-6-S-1	6.0
	232-1-BH4-10-S-1	10.0
	232-1-BH5-5-S-1	5.0
	232-1-BH5-10-S-1	10.0
	2001 sampling	
	232-1-GR-05-0.0-S	0.0
	232-1-GR-05-0.0-DU	0.0
	232-1-GR-06-5.0-S	5.0
	232-1-GR-07-5.0-S	5.0

Refer to footnotes at end of table.

Table 2 (Continued)
Soil Samples Collected at SWMUs 230, 231, 232-1, 232-2, 233, and 234

SWMU	Sample ID	Beginning Depth (ft bgs)
232-2	1994 sampling	
	015861	1[a]
	015862	1[a]
	015863	5[a]
	015864	5[a]
	015865	5[a]
	015866	5[a]
	015867	5[a]
	015868	5[a]
	015869	5[a]
	015870	5[a]
	015871	5[a]
	015872	1[a]
	015873	9
	015874	9
	015875	9
	015876	9
	015877	9
	015878	9
	015879	9
	015880	5[a]
	015881	5[a]
	015882	5[a]
	015883	5[a]
	015884	5[a]
	015885	10
	015886	6.5
	015887	9
	015888	6.5
	015889	6
	015890	1
	015891	10
	015892	7
	015893	4
	015894	10.5
	015895	9.5
	015896	3.5
	017817	1
	017818	8
	NMED-232-east	10
	NMED-232-west	6
	NMED-undisturbed	9
	2001 sampling	
	232-2-GR-01-0.0-S	0.0
	232-2-GR-01-0.0-DU	0.0
	232-2-GR-01-5.0-S	5.0
	232-2-GR-01-10.0-S	10.0
	232-2-GR-02-5.0-S	5.0
	232-2-GR-02-7.0-DU	7.0

Refer to footnotes at end of table.

Table 2 (Concluded)
Soil Samples Collected at SWMUs 230, 231, 232-1, 232-2, 233, and 234

SWMU	Sample ID	Beginning Depth (ft bgs)
233	1994 sampling	
	233-01-A	0.0
	233-01-B	0.5
	233-02-A	0.0
	233-02-B	0.5
	233-03-A	0.0
	233-03-B	0.5
	233-04-A	0.0
	233-04-B	0.5
	2001 sampling	
	233-GR-05-0.0-S	0.0
	233-GR-05-0.0-DU	0.0
	233-GR-05-5.0-S	5.0
	233-GR-06-0.0-S	0.0
	233-GR-06-5.0-S	5.0
	233-GR-07-5.0-S	5.0
234	1994 sampling	
	234-01-A	0.0
	234-01-B	0.5
	234-02-A	0.0[b]
	234-02-B	0.5[b]
	234-03-A	0.0[b]
	234-03-B	0.5[b]
	234-04-A	0.0[b]
	234-04-B	0.5[b]
	234-05-A	0.0
	234-05-B	0.5
	234-06-A	0.0
	234-06-B	0.5
	2001 sampling	
	234-GR-07-0.0-S	0.0
	234-GR-07-0.0-DU	0.0
	234-GR-07-5.0-S	5.0
	234-GR-08-5.0-S	5.0

[a]Approximate sample depth (sample collected during SWMU 232-2 excavation work).
[b]Analytical results for this SWMU 234 sample are not listed in the following analytical data tables because the sample was not collected where storm water had drained.
BH = Borehole.
DU = Duplicate.
ft bgs = Foot/feet below ground surface.
GR = Grab sample.
ID = Identification.
NMED = New Mexico Environment Department.
S = Soil sample.
SD = Soil sample duplicate.
SO = South sample.
SWMU = Solid Waste Management Unit.

Table 93
Summary of SWMU 234 Confirmatory Soil Sampling
VOC Analytical Detection Limits
September 1994
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit (mg/kg)
1,1,1-Trichloroethane	0.005
1,1,2,2-Tetrachloroethane	0.005
1,1,2-Trichloroethane	0.005
1,1-Dichloroethane	0.005
1,1-Dichloroethene	0.005
1,2-Dichloroethane	0.005
1,2-Dichloroethene	0.005
1,2-Dichloropropane	0.005
2-Butanone	0.01
2-Chloroethyl vinyl ether	0.01
2-Hexanone	0.01
4-methyl-2-Pentanone	0.01
Acetone	0.01
Benzene	0.005
Bromodichloromethane	0.005
Bromoform	0.005
Bromomethane	0.01
Carbon disulfide	0.005
Carbon tetrachloride	0.005
Chlorobenzene	0.005
Chloroethane	0.01
Chloroform	0.005
Chloromethane	0.01
Dibromochloromethane	0.005
Ethyl benzene	0.005
Methylene chloride	0.005
Styrene	0.005
Tetrachloroethene	0.005
Toluene	0.005
Trichloroethene	0.005
Vinyl acetate	0.01
Vinyl chloride	0.01
Xylene	0.005
cis-1,3-Dichloropropene	0.005
trans-1,3-Dichloropropene	0.005

[a]Environmental Control Technology Corporation Laboratory (ENCOTEC).
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

Table 94
Summary of SWMU 234 Confirmatory Soil Sampling
SVOC Analytical Results—Detections Only
September 1994
(Off-Site Laboratory)[a]

Sample Attributes			SVOCs (EPA Method 8270[b]) (mg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Benzo(a)pyrene	Benzo(b)fluoranthene	Chrysene	Pyrene
804	SITE 234-01-A	0–0.5	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)
804	SITE 234-01-B	0.5–3	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)
804	SITE 234-03-A	0–0.5	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)
804	SITE 234-03-B	0.5–3	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)
804	SITE 234-05-A	0–0.5	**0.048 J**	**0.043 J**	**0.062 J**	**0.034 J**
804	SITE 234-05-B	0.5–3	ND (0.33)	ND (0.33)	ND (0.33)	ND (0.33)

Note: Values in **bold** represent detected analytes.
[a]Environmental Control Technology Corporation Laboratory (ENCOTEC).
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J = Estimated value. See Data Validation Report (Attachment M).
mg/kg = Milligram(s) per kilogram.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.

Table 95
Summary of SWMU 234 Confirmatory Soil Sampling
SVOC Analytical Detection Limits
September 1994
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit (mg/kg)
1,2,4-Trichlorobenzene	0.33
1,2-Dichlorobenzene	0.33
1,3-Dichlorobenzene	0.33
1,4-Dichlorobenzene	0.33
2,2'-Dichlorodiisopropyl ether	0.33
2,4,5-Trichlorophenol	0.33
2,4,6-Trichlorophenol	0.33
2,4-Dichlorphenol	0.33
2,4-Dimethylphenol	0.33
2,4-Dinitrophenol	1.67
2,4-Dinitrotoluene	0.33
2,6-Dinitrotoluene	0.33
2-Chloronaphthalene	0.33
2-Chlorophenol	0.33
2-Methylnaphthalene	0.33
2-Nitroaniline	1.67
2-Nitrophenol	0.33
3,3'-Dichlorobenzidine	0.67
3-Nitroaniline	1.67
4-Bromophenyl phenyl ether	0.33
4-Chloro-3-methylphenol	0.33
4-Chlorobenzenamine	0.33
4-Chlorophenyl phenyl ether	0.33
4-Methylphenol	0.33
4-Nitroaniline	1.67
4-Nitrophenol	1.67
Acenaphthene	0.33
Acenaphthylene	0.33
Anthracene	0.33
Benzidine	2.66
Benzo(a)anthracene	0.33
Benzo(a)pyrene	0.33
Benzo(b)fluoranthene	0.33
Benzo(ghi)perylene	0.33
Benzo(k)fluoranthene	0.33
Benzoic acid	1.67
Benzyl alcohol	0.33
Butylbenzyl phthalate	0.33
Chrysene	0.33
Di-n-butyl phthalate	0.33
Di-n-octyl phthalate	0.33
Dibenz(a,h)anthracene	0.33
Dibenzofuran	0.33
Diethylphthalate	0.33
Dimethylphthalate	0.33

Refer to footnotes at end of table.

Table 95 (Concluded)
Summary of SWMU 234 Confirmatory Soil Sampling
SVOC Analytical Detection Limits
September 1994
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit (mg/kg)
Dinitro-o-cresol	1.67
Fluoranthene	0.33
Fluorene	0.33
Hexachlorobenzene	0.33
Hexachlorobutadiene	0.33
Hexachlorocyclopentadiene	0.33
Hexachloroethane	0.33
Indeno(1,2,3-c,d)pyrene	0.33
Isophorone	0.33
Naphthalene	0.33
Nitro-benzene	0.33
Pentachlorophenol	1.67
Phenanthrene	0.33
Phenol	0.33
Pyrene	0.33
bis(2-Chloroethoxy)methane	0.33
bis(2-Chloroethyl)ether	0.33
bis(2-Ethylhexyl)phthalate	0.33
n-Nitrosodiphenylamine	0.33
n-Nitrosodipropylamine	0.33
o-Cresol	0.33

[a]Environmental Control Technology Corporation Laboratory (ENCOTEC).
mg/kg = Milligram(s) per kilogram.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.

Table 96
Summary of SWMU 234 Confirmatory Soil Sampling
Petroleum Analytical Detection Limits
September 1994
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit (mg/kg)
Total petroleum hydrocarbon	40

[a]Environmental Control Technology Corporation Laboratory (ENCOTEC).
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.

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Table 97
Summary of SWMU 234 Confirmatory Soil Sampling
Metals Analytical Results
September 1994
(Off-Site Laboratory)[a]

Sample Attributes			Metals (EPA Methods 6010/6020/7196/7471/7741[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium
804	SITE 234-01-A	0–0.5	1.6	210	0.49	**2**	7.4
804	SITE 234-01-B	0.5–3	1.6	190	0.38	**1.9**	7.3
804	SITE 234-02-A	0–0.5	5.3	140	0.25	**2.4**	6.9
804	SITE 234-02-B	0.5–3	0.95	160	ND (0.25)	**2.7**	7
804	SITE 234-03-A	0–0.5	1.8	180	0.36	**2.9**	11
804	SITE 234-03-B	0.5–3	**4.8**	**210**	0.32	**2.2**	11
804	SITE 234-04-A	0–0.5	6.3	240	0.31	**1.6**	5
804	SITE 234-04-B	0.5–3	**5.4**	**220**	0.32	**1.8**	5
804	SITE 234-05-A	0–0.5	1.6	180	0.36	**2.3**	7.6
804	SITE 234-05-B	0.5–3	0.9	180	0.32	**2.5**	6.7
804	SITE 234-06-A	0–0.5	7	220	0.48	**2.8**	9.9
804	SITE 234-06-B	0.5–3	1	150	0.22	**2.1**	5.4
Background concentration (surface soil 0–0.5 ft)[d]			NC	281	0.8	<1	21.8
Background concentration (subsurface soil >0.5 ft)[d]			4.4	200	0.8	0.9	16.2

Refer to footnotes at end of table.

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Table 97 (Concluded)
Summary of SWMU 234 Confirmatory Soil Sampling
Metals Analytical Results
September 1994
(Off-Site Laboratory)[a]

Sample Attributes			Metals (EPA Methods 6010/6020/7196/7471/7741[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chromium (VI)	Lead	Mercury	Selenium	Silver
804	SITE 234-01-A	0–0.5	ND (0.1)	10	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-01-B	0.5–3	ND (0.1)	9.4	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-02-A	0–0.5	ND (0.1)	8.7	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-02-B	0.5–3	ND (0.1)	7.1	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-03-A	0–0.5	ND (0.1)	12	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-03-B	0.5–3	ND (0.1)	8.2	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-04-A	0–0.5	ND (0.1)	8.2	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-04-B	0.5–3	ND (0.1)	6.2	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-05-A	0–0.5	ND (0.1)	10	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-05-B	0.5–3	ND (0.1)	9.1	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-06-A	0–0.5	ND (0.1)	13	ND (0.04)	ND (0.25)	ND (0.5)
804	SITE 234-06-B	0.5–3	ND (0.1)	6.5	ND (0.04)	ND (0.25)	ND (0.5)
Background concentration (surface soil 0–0.5 ft)[d]			NC	39	<0.25	<1	<1
Background concentration (subsurface soil >0.5 ft)[d]			NC	11.2	<0.1	<1	<1

Note: Values in **bold** indicate concentrations greater than background.
[a]Environmental Control Technology Corporation Laboratory (ENCOTEC).
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Dinwiddie September 1997.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
mg/kg = Milligram(s) per kilogram.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the method detection limit, shown in parentheses.
SWMU = Solid Waste Management Unit.

Table 98
Summary of SWMU 234 Confirmatory Soil Sampling
Metals Analytical Detection Limits
September 1994
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit (mg/kg)
Arsenic	0.5–4.9
Barium	10
Beryllium	0.18–0.25
Cadmium	0.25
Chromium	1
Chromium (VI)	0.1
Lead	2
Mercury	0.04
Selenium	0.25
Silver	0.5

[a]Environmental Control Technology Corporation Laboratory (ENCOTEC).
mg/kg = Milligram(s) per kilogram.
SWMU= Solid Waste Management Unit.

Table 99
Summary of SWMU 234 Confirmatory Soil Sampling
Gamma Spectroscopy Analytical Results
September 1994
(Off-Site Laboratory)[a]

Sample Attributes			Activity (pCi/g)							
			Cesium-137		Thorium-232		Uranium-235		Uranium-238	
Record Number[b]	ER Sample ID	Sample Depth (ft)	Result	Error[c]	Result	Error[c]	Result	Error[c]	Result	Error[c]
0785	234-05-A	0–0.5	NR	--	6.46	0.609	NR	--	NR	--
784	SITE 234-01-A	0–0.5	ND (0.0184)	--	1.06	0.174	ND (0.0399)	--	1.64	0.529
784	SITE 234-01-B	0.5–3	ND (NR)	--	0.916	0.143	ND (0.0384)	--	1.79	0.529
784	SITE 234-05-A	0–0.5	0.101	0.0339	0.749	0.133	ND (0.0359)	--	ND (0.493)	--
784	SITE 234-05-B	0.5–3	0.0357	0.0202	0.966	0.154	ND (0.0377)	--	ND (0.507)	--
Background concentration (surface soil 0–0.5 ft)[d]			0.908	NA	NC	NA	NC	NA	NC	NA
Background concentration (subsurface soil >0.5 ft)[d]			NC	NA	NC	NA	NC	NA	NC	NA

Note: Values in **bold** indicate concentrations greater than background.
[a]Enseco/Quanterra Laboratory.
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations about the mean detected activity.
[d]Dinwiddie September 1997.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NR = Not reported or analyzed for sample interval.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.
-- = Information not available.

Table 100
Summary of SWMU 234 Confirmatory Soil Sampling
VOC Analytical Detection Limits
June 2001
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit for Soil Samples (µg/kg)	Method Detection Limit for Aqueous Samples (µg/L)
1,1,1-Trichloroethane	0.29	0.18
1,1,2,2-Tetrachloroethane	0.3	0.15
1,1,2-Trichloroethane	0.36	0.11
1,1-Dichloroethane	0.41	0.07
1,1-Dichloroethene	0.262	0.28
1,2-Dichloroethane	0.27	0.14
1,2-Dichloropropane	0.32	0.16
2-Butanone	0.76	0.81
2-Hexanone	0.94	0.79
4-methyl-2-Pentanone	1.34	0.7
Acetone	1	0.82
Benzene	0.39	0.14
Bromodichloromethane	0.35	0.15
Bromoform	0.36	0.1
Bromomethane	0.31	0.24
Carbon disulfide	0.62	0.9
Carbon tetrachloride	0.26	0.16
Chlorobenzene	0.4	0.2
Chloroethane	0.28	0.32
Chloroform	0.47	0.17
Chloromethane	0.35	0.21
Dibromochloromethane	0.41	0.16
Ethyl benzene	0.35	0.15
Methylene chloride	0.44	0.63
Styrene	0.32	0.15
Tetrachloroethene	0.4	0.21
Toluene	0.5	0.22
Trichloroethene	0.72	0.16
Vinyl acetate	0.77	0.44
Vinyl chloride	0.3	0.26
Xylene	1.05	0.44
cis-1,2-Dichloroethene	0.41	0.18
cis-1,3-Dichloropropene	0.28	0.18
trans-1,2-Dichloroethene	0.37	0.31
trans-1,3-Dichloropropene	0.24	0.17

[a]General Engineering Laboratories, Inc. (GEL).
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

Table 101
Summary of SWMU 234 Confirmatory Soil Sampling
SVOC Analytical Results—Detections Only
June 2001
(Off-Site Laboratory)[a]

Sample Attributes			SVOCs (EPA Method 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Acenaphthene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene
604316	TJAOU-234-GR-07-0.0-S	0.0	**6.26 J**	**15.2 J (33.3)**	**171**	**275**
604316	TJAOU-234-GR-07-0.0-DU	0.0	ND (4 J)	**21.2 J (33.3)**	**258**	**435**
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (4 J)	ND (4.66)	ND (5.99)	**13.1 J (33.3)**
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (4 J)	**7.96 J (33.3)**	**17.1 J (33.3)**	ND (2)
Quality Assurance/Quality Control Sample (µg/L)						
604569	TJAOU-234-GR-EB1	NA	ND (0.07 J)	ND (0.13)	ND (0.1)	ND (0.13)

Sample Attributes			SVOCs (EPA Method 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Carbazole
604316	TJAOU-234-GR-07-0.0-S	0.0	**396**	**309**	**272**	**13.4 J (333)**
604316	TJAOU-234-GR-07-0.0-DU	0.0	**506**	ND (5 J)	**471**	**18.2 J (333)**
604316	TJAOU-234-GR-07-5.0-S	5.0	**14.7 J (33.3)**	ND (5)	**7.04 J (33.3)**	ND (5)
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (2.33)	ND (5)	ND (5)	ND (5)
Quality Assurance/Quality Control Sample (µg/L)						
604569	TJAOU-234-GR-EB1	NA	ND (0.13)	ND (0.08)	ND (0.23)	ND (1.26)

Refer to footnotes at end of table.

Table 101 (Concluded)
Summary of SWMU 234 Confirmatory Soil Sampling SVOC Analytical Results—Detections Only June 2001 (Off-Site Laboratory)[a]

Sample Attributes			SVOCs (EPA Method 8270[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chrysene	Di-n-butyl phthalate	Di-n-octyl phthalate	Fluoranthene	Fluorene
604316	TJAOU-234-GR-07-0.0-S	0.0	**294**	ND (20.6)	**10.2 J (333)**	**305**	**6.66 J (33.3)**
604316	TJAOU-234-GR-07-0.0-DU	0.0	**435**	ND (20.6)	ND (8.99)	**450**	ND (3)
604316	TJAOU-234-GR-07-5.0-S	5.0	**12.5 J (33.3)**	ND (20.6)	ND (8.99)	**11.1 J (33.3)**	ND (3)
604316	TJAOU-234-GR-08-5.0-S	5.0	**17.7 J (33.3)**	**20.7 J (333)**	ND (8.99)	**33.3**	**3.02 J (33.3)**
Quality Assurance/Quality Control Sample (µg/L)							
604569	TJAOU-234-GR-EB1	NA	ND (0.12)	ND (1.82)	ND (2.12)	ND (0.12)	ND (0.12)

Sample Attributes			SVOCs (EPA Method 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	bis(2-Ethylhexyl)phthalate
604316	TJAOU-234-GR-07-0.0-S	0.0	**248 J**	**110**	**436**	**141 J**
604316	TJAOU-234-GR-07-0.0-DU	0.0	**345 J**	**139**	**603**	**80.3**
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (6.66)	**4.24 J (33.3)**	**13.9 J (33.3)**	**16.1 J**
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (6.66)	**42.2**	**54.9**	**140 J**
Quality Assurance/Quality Control Sample (µg/L)						
604569	TJAOU-234-GR-EB1	NA	ND (0.1)	ND (0.12)	ND (0.14)	ND (0.04)

Note: Values in **bold** represent detected analytes.
[a]General Engineering Laboratories, Inc. (GEL).
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.

DU = Duplicate sample.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J = Estimated value. See Data Validation Report (Attachment M).
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses. See Data Validation Report (Attachment M).
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
ND (#J) = Not detected, uncertainty in the detection limit, shown in parentheses. See Data Validation Report (Attachment M).
OU = Operable Unit.
S = Soil sample.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TB = Trip blank.
TJA = Tijeras Arroyo.

Table 102
Summary of SWMU 234 Confirmatory Soil Sampling
SVOC Analytical Detection Limits
June 2001
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit for Soil Samples (µg/kg)	Method Detection Limit for Aqueous Samples (µg/L)
1,2,4-Trichlorobenzene	4.66	1.52
1,2-Dichlorobenzene	4.33	1.63
1,3-Dichlorobenzene	3.33	1.51
1,4-Dichlorobenzene	5.99	1.83
2,4,5-Trichlorophenol	42.3	1.18
2,4,6-Trichlorophenol	24.6	1.12
2,4-Dichlorophenol	7.99	1.28
2,4-Dimethylphenol	71.9	1.29
2,4-Dinitrophenol	15	1.36
2,4-Dinitrotoluene	5	0.97
2,6-Dinitrotoluene	3	1.09
2-Chloronaphthalene	3.66	0.13
2-Chlorophenol	5	1.24
2-Methylnaphthalene	4	0.15
2-Nitroaniline	80.9	2.09
2-Nitrophenol	46.3	1.33
3,3'-Dichlorobenzidine	143	1.1
3-Nitroaniline	86.6	1.31
4-Bromophenyl phenyl ether	4.66	1.14
4-Chloro-3-methylphenol	36.6	1.39
4-Chlorobenzenamine	58.9	2.5
4-Chlorophenyl phenyl ether	3.33	1.18
4-Methylphenol	5.66	1.07
4-Nitroaniline	83.9	1.55
4-Nitrophenol	21	0.18
Acenaphthene	4	0.07
Acenaphthylene	3.66	0.1
Anthracene	4.66	0.13
Benzo(a)anthracene	5.99	0.1
Benzo(a)pyrene	2	0.13
Benzo(b)fluoranthene	2.33	0.13
Benzo(ghi)perylene	5	0.08
Benzo(k)fluoranthene	5	0.23
Butylbenzyl phthalate	12.7	1.82
Carbazole	5	1.26
Chrysene	6.33	0.12
Di-n-butyl phthalate	20.6	1.82
Di-n-octyl phthalate	8.99	2.12
Dibenz(a,h)anthracene	2.66	0.1
Dibenzofuran	2.66	0.99
Diethylphthalate	19.6	1.23
Dimethylphthalate	11.7	1.11
Dinitro-o-cresol	16	0.97
Diphenyl amine	15.7	1.02

Refer to footnotes at end of table.

Table 102 (Concluded)
Summary of SWMU 234 Confirmatory Soil Sampling
SVOC Analytical Detection Limits
June 2001
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit for Soil Samples (µg/kg)	Method Detection Limit for Aqueous Samples (µg/L)
Fluoranthene	3.33	0.12
Fluorene	3	0.12
Hexachlorobenzene	4.66	0.76
Hexachlorobutadiene	6.66	1.76
Hexachlorocyclopentadiene	33	1.1
Hexachloroethane	4.33	1.7
Indeno(1,2,3-c,d)pyrene	6.66	0.1
Isophorone	2.33	1.12
Naphthalene	3.33	0.12
Nitro-benzene	36.6	1.42
Pentachlorophenol	60.9	1.58
Phenanthrene	4	0.12
Phenol	3.66	0.84
Pyrene	8.66	0.14
bis(2-Chloroethoxy)methane	5.99	1.39
bis(2-Chloroethyl)ether	6.66	1.4
bis(2-Ethylhexyl)phthalate	6.99	0.04
bis-Chloroisopropyl ether	37.1	1.32
n-Nitrosodipropylamine	33	1.32
o-Cresol	47.6	1.26

[a]General Engineering Laboratories, Inc. (GEL).
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.

Table 103
Summary of SWMU 234 Confirmatory Soil Sampling
Total Petroleum Hydrocarbon Compounds Analytical Results—Detections Only
June 2001
(Off-Site Laboratory)[a]

Sample Attributes			TPH (EPA Method 8015[b]) (µg/kg)
Record Number[c]	ER Sample ID	Sample Depth (ft)	Diesel Range Organics
604316	TJAOU-234-GR-07-0.0-S	0.0	**1820**
604316	TJAOU-234-GR-07-0.0-DU	0.0	**5230**
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (450)
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (450)
Quality Assurance/Quality Control Sample (µg/L)			
604569	TJAOU-234-GR-EB1	NA	ND (20)[d]

Note: Values in **bold** represent detected analytes.
[a]General Engineering Laboratories, Inc. (GEL).
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Not detected at the laboratory reporting limit, shown in parentheses.
DU = Duplicate sample.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
OU = Operable Unit.
S = Soil sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
TPH = Total petroleum hydrocarbons.

Table 104
Summary of SWMU 234 Confirmatory Soil Sampling
Petroleum Analytical Detection Limits
June 2001
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit for Soil Samples (µg/kg)	Method Detection Limit for Aqueous Samples (µg/L)
Diesel range organics	450	3.37
Gasoline range organics	9.61	26.7

[a]General Engineering Laboratories, Inc. (GEL).
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
SWMU = Solid Waste Management Unit.

Table 105
Summary of SWMU 234 Confirmatory Soil Sampling
Metals Analytical Results
June 2001
(Off-Site Laboratory)[a]

Sample Attributes			Metals (EPA Methods 3005/3050/7196/7470/7471[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium
604316	TJAOU-234-GR-07-0.0-S	0.0	3.99	146	0.479 J (0.495)	0.536	12.5
604316	TJAOU-234-GR-07-0.0-DU	0.0	4.41	155	0.496	0.665	17.7
604316	TJAOU-234-GR-07-5.0-S	5.0	3.19	115	0.339 J (0.49)	0.437 J (0.49)	10.7
604316	TJAOU-234-GR-08-5.0-S	5.0	2.34	63.1	0.4 J (0.455)	0.151 J (0.455)	7.5
Background concentration[d] (surface/subsurface)[e]			NC/4.4	281/200	0.8/0.8	<1/0.9	21.8/16.2
Quality Assurance/Quality Control Sample (mg/L)							
604569	TJAOU-234-GR-EB1	NA	ND (0.00457)	0.00084 J (0.005)	ND (0.0002)	ND (0.00025 J)	ND (0.00078)

Sample Attributes			Metals (EPA Methods 3005/3050/7196/7470/7471[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chromium (VI)	Lead	Mercury	Selenium	Silver
604316	TJAOU-234-GR-07-0.0-S	0.0	**2.08**	10.1	0.0603	ND (0.135)	0.139 J (0.495)
604316	TJAOU-234-GR-07-0.0-DU	0.0	ND (0.07)	12.2	0.0162	ND (0.135)	0.26 J (0.49)
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (0.07)	5.37	0.0102	ND (0.135)	1
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (0.07)	5.2	ND (0.00455)	ND (0.135)	ND (0.0578)
Background concentration[d] (surface/subsurface)[e]			NC/NC	39/11.2	<0.25/<0.1	<1/<1	<1/<1
Quality Assurance/Quality Control Sample (mg/L)							
604569	TJAOU-234-GR-EB1	NA	0.007 J (0.01)	ND (0.00344)	ND (0.00007 J)	ND (0.00309 J)	0.00112 J (0.005)

Note: Values in **bold** indicate concentrations greater than background.
[a]General Engineering Laboratories, Inc. (GEL).
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Dinwiddie September 1997.
[e]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

DU = Duplicate sample.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses. See Data Validation Report (Attachment M).
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the method detection limit, shown in parentheses.
ND (#J) = Nondetect, uncertainty in the detection limit, shown in parentheses. See Data Validation Report (Attachment M).
OU = Operable Unit.
S = Soil sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.

Table 106
Summary of SWMU 234 Confirmatory Soil Sampling
Metals Analytical Detection Limits
June 2001
(Off-Site Laboratory)[a]

Analyte	Method Detection Limit for Soil Samples (mg/kg)	Method Detection Limit for Aqueous Samples (mg/L)
Arsenic	0.137	0.00457
Barium	0.0148	0.00021
Beryllium	0.00767	0.0002
Cadmium	0.013	0.00025
Chromium	0.218	0.00078
Chromium (VI)	0.07	0.005
Lead	0.17	0.00344
Mercury	0.00455	0.00007
Selenium	0.135	0.00309
Silver	0.0578	0.0002

[a]General Engineering Laboratories, Inc. (GEL).
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
SWMU = Solid Waste Management Unit.

Table 107
Summary of SWMU 234 Confirmatory Soil Sampling
Gamma Spectroscopy Analytical Results
June 2001
(On-Site and Off-Site Laboratories)

Sample Attributes			Activity (pCi/g)							
		Sample Depth (ft)	Cesium-137		Thorium-232		Uranium-235		Uranium-238	
Record Number[a]	ER Sample ID		Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
Samples Analyzed at RPSD Laboratory										
604315	TJAOU-234-GR-07-0.0-S	0.0	0.032	0.0186	1.16	0.549	ND (0.244)	--	ND (0.73)	--
604315	TJAOU-234-GR-07-0.0-DU	0.0	0.0546	0.0353	0.935	0.467	ND (0.278)	--	ND (0.81)	--
604315	TJAOU-234-GR-07-5.0-S	5.0	ND (0.0327)	--	0.762	0.364	ND (0.184)	--	ND (0.496)	--
604315	TJAOU-234-GR-08-5.0-S	5.0	ND (0.0305)	--	0.71	0.338	ND (0.147)	--	ND (0.474)	--
Samples Analyzed at GEL										
604316	TJAOU-234-GR-07-0.0-S	0.0	0.0631	0.0427	0.907	0.115	ND (0.199)	--	ND (1.09)	--
604316	TJAOU-234-GR-07-0.0-DU	0.0	0.0508	0.0304	0.962	0.123	ND (0.198)	--	ND (1.07)	--
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (0.0324)	--	1.09	0.133	ND (0.175)	--	ND (1.08)	--
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (0.0267)	--	0.67	0.0878	0.154	0.132	ND (0.89)	--
Background concentration[c] (surface/subsurface)[d]			0.908/NC	NA	NC/NC	--	NC/NC	--	NC/NC	--
Quality Assurance/Quality Control Samples (pCi/g)										
604568	TJAOU-234-GR-EB1	NA	ND (0.0274)	--	ND (0.163)	--	ND (0.133)	--	ND (0.308)	--
604569	TJAOU-234-GR-EB1	NA	ND (4.8)	--	ND (7.98)	--	ND (29.9)	--	ND (169)	--

[a]Analysis request/chain-of-custody record.
[b]Two standard deviations about the mean detected activity.
[c]Dinwiddie September 1997.
[d]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

DU = Duplicate sample.
EB = Equipment blank.
ER = Environmental Restoration.
ft = Foot (feet).
GEL = General Engineering Laboratories, Inc.
GR = Grab sample.
ID = Identification.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
OU = Operable Unit.
pCi/g = Picocurie(s) per gram.
RPSD = Radiation Protection Sample Diagnostics.
S = Soil sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
-- = Information not available.

Table 108
Summary of SWMU 234 Confirmatory Soil Sampling
Tritium Analytical Results
June 2001
(Off-Site Laboratory)[a]

Sample Attributes			Tritium Activity (pCi/g)	
Record Number[b]	ER Sample ID	Sample Depth (ft)	Result	Error[c]
604316	TJAOU-234-GR-07-0.0-S	0.0	ND (0.004)	--
604316	TJAOU-234-GR-07-0.0-DU	0.0	ND (0.006)	--
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (0.004)	--
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (0.004)	--
Background concentration[d]			0.021	NA
Quality Assurance/Quality Control Sample (pCi/g)				
604569	TJAOU-234-GR-EB1	NA	ND (0.004)	--

[a]General Engineering Laboratories, Inc. (GEL).
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations about the mean detected activity.
[d]The tritium background value of 0.021 pCi/g was calculated from the Tharp (February 1999) tritium background value of 420 pCi/L. The pCi/L value was converted to the pCi/g value using the assumption of 5 percent soil moisture and a soil density of 1 g/cubic centimeter.

DU = Duplicate sample.
EB = Equipment blank.
ER = Environmental Restoration.
ft = Foot (feet).
g = Gram(s).
GR = Grab sample.
ID = Identification.
L = Liter.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
OU = Operable Unit.
pCi = Picocurie(s).
S = Soil sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
-- = Information not available.

Table 109
Summary of SWMU 234 Confirmatory Soil Sampling
Gross Alpha and Beta Analysis
June 2001
(Off-Site Laboratory)[a]

Sample Attributes			Activity (pCi/g)			
			Gross Alpha		Gross Beta	
Record Number[b]	ER Sample ID	Sample Depth (ft)	Result	Error[c]	Result	Error[c]
604316	TJAOU-234-GR-07-0.0-S	0.0	**15.3**	6.55	**18.5**	3.25
604316	TJAOU-234-GR-07-0.0-DU	0.0	**11.6**	5.77	**16.1**	3.1
604316	TJAOU-234-GR-07-5.0-S	5.0	**18.4**	7.39	**25.1**	3.55
604316	TJAOU-234-GR-08-5.0-S	5.0	**14.3**	6.38	**21.7**	3.4
Quality Assurance/Quality Control Samples (pCi/L)						
604569	TJAOU-234-GR-EB1	NA	ND (78.7)	--	ND (0.325)	--

Note: Values in **bold** represent detected analytes. Background concentrations not available.
[a]General Engineering Laboratories, Inc. (GEL).
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations about the mean detected activity.
DU = Duplicate sample.
EB = Equipment blank.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable
ND ( ) = Not detected above the method detection limit, shown in parentheses.
OU = Operable Unit.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
S = Soil sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
-- = Information not available.

ATTACHMENT A
Field Implementation Plan—Tijeras Arroyo Outfalls

FIELD IMPLEMENTATION PLAN - TIJERAS ARROYO OUTFALLS - 2001, A SAMPLING ODYSSEY

Plan Authorization and Implementation

Prepared by _John R. Copland_ Date _31 May 2001_
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Reviewed by _Sue Collins_ Date _31 May 2001_
Sue Collins, 6133
Task Leader, Tijeras Arroyo Operable Unit

Approved by _Dwight J. Stockham_ Date _5/31/01_
Dwight Stockham, 6133
Department Manager, ER Technical Areas & Miscellaneous Sites

1.0 INTRODUCTION

This Field Implementation Plan (FIP) describes the confirmatory-soil sampling that will be conducted in the summer of 2001 at six of the Tijeras Arroyo Operable Unit (TJAOU) outfalls (Environmental Restoration [ER] Sites 230, 231, 232-1, 232-2, 233, and 234). These sites are managed by Sandia National Laboratories/New Mexico (SNL/NM) and are located on Kirtland Air Force Base (KAFB) along the northern rim of Tijeras Arroyo (Figure 1).

1.1 Project Information

Task Description Collect soil samples at TJAOU outfalls
Department 6133 ERMO Case No. 7225.02.02.10 ERFO Case No. 7225.02.03.01
Work Plan Title not applicable Field Team Leader John Copland
Scheduled Start of Sampling June 11, 2001 Estimated Completion July 1, 2001

1.2 Site Information

Technical Area OU 1309, Tijeras Arroyo Site(s) 230, 231, 232-1, 232-2 233, 234

1.3 Description of Sites

ER Sites 230, 231, 232-1, 232-2, 233, and 234 were designed to handle storm water from TA-IV (Table 1). One of the TA-IV outfalls, ER Site 234, is inactive. The outfalls are discussed in more detail in Section 2.

Table 1. Details for outfalls located near TA-IV.

ER Site	Type of water disposed of	Period of Use	Area (Acres)
230	Storm water from TA-IV	Early 1980s to present	0.02
231	Storm water from TA-IV	Early 1980s to present	0.04
232-1	Storm water from TA-IV	Early 1980s to present	0.01
232-2	Storm water from TA-IV	Early 1980s to present	0.02
233	Storm water from TA-IV	Early 1980s to present	0.03
234	Storm water from TA-IV	About 1979 to early 1990s	0.15

1.4 Physical Setting

The sites are located along the steep northern rim of Tijeras Arroyo and on the nearly flat floodplain between the Pennsylvania Avenue bridge and Powerline Road. However, none of the sites are located within the 100-year Tijeras Arroyo floodplain. The sites are not fenced; however, the sites are infrequently visited by non-ER Project personnel. Tijeras Arroyo is the most significant surface-water drainage feature on KAFB. The watershed for Tijeras Arroyo includes Tijeras Canyon and various storm-water channels in southeast Albuquerque. The arroyo eventually drains into the Rio Grande, approximately eight miles west of the Pennsylvania Avenue bridge.

The annual precipitation for the area, as measured at the Albuquerque International Sunport, is 8.1 inches (NOAA, 1990). No springs or perennial surface water bodies are located within four miles of the site. The vicinity of each site is unpaved. During most storm events, precipitation quickly infiltrates the soil. However, virtually all of the moisture undergoes evapotranspiration. Estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall (SNL/NM, 1998). Except for a few puddles, water does not pond at the sites even after heavy rainfall.

Groundwater monitoring for the area is conducted as part of the Tijeras Arroyo Groundwater (TAG) Investigation. Two water-bearing zones, the shallow water-bearing zone and the regional aquifer, underlie the area. The shallow water-bearing zone is not used for water supply. Ten shallow monitor wells are located in the vicinity of the site. The depth to the shallow water-bearing zone ranges across the area from about 280 to 330 ft below ground surface (bgs). Six regional-aquifer monitor wells are located in the vicinity. The depth to the regional aquifer ranges from approximately 450 to 500 ft bgs. Both the City of Albuquerque and KAFB utilize the regional aquifer for water supply. The nearest water-supply well is KAFB-4, which is located approximately 0.9 miles west of ER Site 234. KAFB-1 is the nearest downgradient water-supply well and is located approximately 1.4 miles northwest of ER Site 234.

For purposes of defining the background levels of metals and radionuclides, soil at the site has been included as part of the North Supergroup. More formally, the soil has been identified as the Bluepoint-Kokan Association (SNL/NM, 1998). The Bluepoint-Kokan Association consists of the Bluepoint loamy fine sand, which is developed on slopes of 5 to 15 percent, and the Kokan gravelly sand on slopes of 15 to 40 percent. These soils are slightly calcareous and mildly to moderately alkaline. Runoff potential ranges from slow to very rapid with water permeability being moderate to very rapid. The hazard of water erosion is slight to severe. The Bluepoint-Kokan Association is underlain by the upper unit of the Santa Fe Group. The upper Santa Fe Group consists of coarse- to fine-grained fluvial deposits from the ancestral Rio Grande that intertongue with coarse-grained alluvial fan/piedmont veneer facies, which extend westward from the Sandia and Manzanita Mountains. The upper Santa Fe unit is approximately 1,200 ft thick in the vicinity of the site (SNL/NM, 1998).

The land-use setting for the surrounding area is industrial. The area was originally desert grassland habitat, but has been highly disturbed by SNL/NM (IT Corporation, 1995). The site is principally vegetated by ruderal species such as Russian thistle (tumbleweed). Grasslands are the dominant plant community and include species such as blue and black grama and western cheatgrass. The indigenous wildlife includes reptiles, birds, and small mammals. However, wildlife use is limited by the degree of disturbance and proximity to operational facilities. The area was surveyed for sensitive species in 1994; no threatened or endangered species, or any other species of concern, have been identified in the area. No riparian or wetland habitats are present within four miles of the outfalls.

2.0 RESULTS OF PREVIOUS INVESTIGATIONS

Soil sampling, with varying degrees of practicality, has been conducted at each of the sites. All of the previous sampling results have been documented in various No Further Action (NFA) Proposals, Notice Of Deficiency (NOD) Responses, and a Request for Supplemental Information (RSI) Response (Table 2).

Table 2. List of documents for ER Sites 230, 231, 232-1, 232-2, 233, 234, and 235.

ER Site	SNL/NM Documents Sent to NMED	Records Center Barcode (Shears) #
230	NFA Proposal – Batch 2 – June 1995 NOD Response – October 1996 NOD Response – December 1999	50556 53440 198016
231	NFA Proposal – Batch 2– June 1995 NOD Response – October 1996 NOD Response – December 1999	50556 53440 198016
232-1	NFA Proposal – Batch 8 – August 1997 RSI Response – September 1999 NOD Response – December 1999	12262 165846 198016
232-2	NFA Proposal – Batch 8 – August 1997 RSI Response – September 1999 NOD Response – December 1999	12262 165846 198016
233	NFA Proposal – Batch 2 – June 1995 NOD Response – October 1996 NOD Response – December 1999	50556 53440 198016
234	NFA Proposal – Batch 2 – June 1995 NOD Response – October 1996 NOD Response – December 1999	50556 53440 198016
235	NFA Proposal – Batch 2 – June 1995 NOD Response – October 1996 NOD Response – December 1999	50556 53440 198016

Relevant details from the documents are summarized below for each of the outfalls. Recent findings and new clarifications also are discussed below.

2.1 Site History for the Storm-Water Outfalls

A redundancy in environmental compliance applies to the outfalls. Besides being listed as ER sites, the outfalls are also addressed by the National Pollutant Discharge Elimination System (NPDES) process in the SNL/NM Storm Water Program. Except for a mineral-oil spill at ER Site 232-2 in June of 1994, no other spills or releases of hazardous or radioactive materials have occurred at the outfalls. The mineral-oil spill was remediated in 1994. No stained soil or discolored outfall components have been seen since November 1995 when John Copland and Sue Collins began working on the sites. None of the sites have been on the radioactive materials management area (RMMA) list. However, ER Site 232-2 was informally tracked as a RMMA from June 1994 until November 1999.

The outfalls were constructed in various stages as buildings and parking lots were built at TA-IV. The sites are located on the steep northern rim of the arroyo where slopes range from about 20 to 40 degrees. The five ER sites along the south and southeast sides of TA-IV have a total of six outfalls. ER Site 232 is unique with two outfalls. Three of the six outfalls were constructed with concrete ditches that serve to minimize soil erosion on those rare days when precipitation falls at TA-IV. The concrete ditches at ER Sites 230, 231, and 232-1 range in length from about 55 to

70 ft. The depth and width of the concrete ditches are typically about two and four ft, respectively.

The TA-IV outfalls are shown on Photographs 1 to 18. Photograph 2 is an example of how the sites are marked with ER signs that are quite visible from the unpaved perimeter road on the south side of TA-IV. More ER signs are located on the Tijeras Arroyo floodplain. It is important to note that most of the ER signs do not accurately mark the site boundaries. All of these sites are, or have been, storm-water discharge points for TA-IV. The storm water comes from the TA-IV parking lots and roof drains. With research operations beginning in 1980, TA-IV is the newest SNL/NM technical area and has operated using modern environmental, safety, and health procedures. As such, TA-IV has had a minimal impact on the environment.

The first significant environmental work at began at the storm-water outfalls in 1994. Early that year, a visual inspection for UXO/HE material was conducted by KAFB Explosive Ordnance Disposal (EOD). No UXO/HE was observed. Also during 1994, Rust Geotech, Inc. conducted a gamma-radiation survey of the sites; no radioactive anomalies were found.

The uppermost boundary of each site is set at the point where storm water occasionally discharges on to the bare ground surface. At half of the outfalls, this boundary is at the lower end of the concrete ditch. At the other half of the outfalls, the uppermost boundary is set at the end of the outfall pipe. The lowermost boundary of each site was set in 1994, presumably at the farthest extent of soil erosion. As a result, each site is elongate. The sites vary in length from 70 to 280 ft, while the widths range from 5 to 35 ft.

Over the years, the long trench-like concrete components have had various names: flumes, concrete-drainage ditches, culverts, and channels. For simplicity, the term 'concrete ditches' has been used in this FIP and the attached figures. The term 'headwall' refers to the concrete component in which the outfall pipe is located.

In 1994, the *Sampling and Analysis Plan for Eleven Sites in Tijeras Arroyo Operable Unit SNL/NM* outlined the initial sampling for ER Sites 230 through 235 (SNL/NM, 1994). This sampling and analysis plan (SAP) will be known in this FIP as the *11-Sites SAP,* which in my opinion was poorly designed and executed. Except for ER Site 232-2, all of the outfall sites were sampled using the *11-Sites SAP* in September 1994. The soil samples were collected with a hand auger or trowel. Samples were collected from either 0-6 inches or 6-36 inches below ground surface (bgs). The shallow (0-6 inches) samples have an 'A' in the sample identifier. For example, the last (sixth) soil sample from ER Site 234 was identified as 234-06-A and was collected from a depth of 0 to 6 inches bgs. The 6-36 inches sample was identified as 234-06-B. The A and B samples were sometimes collected within just a few lateral inches of each other. Therefore, some older figures simplify the locations by combining the A and B samples into for example 234-06-A/B.

Figures 2 through 7 depict the 1994 soil-sampling locations. In September 2000, two locations per site were GPS'd as a verification check. The sample locations were found to be accurate in the EGIS database. However, some of the outfall components were found to be inaccurate on some of the old NOD figures. Figures 2 through 7 now accurately depict the outfall components.

In 1994, the TJAOU also collected background soil samples using the *11-Sites SAP*. Unique background values were subsequently calculated and used in the June 1995 NFA proposals for ER Sites 230, 231, 233, 234, and 235. However, these background values have been superseded by the NMED's approved background values that are used in the 1996 and 1999 NOD Responses.

Soil samples for the *11-Sites SAP* were analyzed for VOCs, SVOCs, total petroleum hydrocarbons (TPH), TAL metals, HE compounds, tritium, gamma-emitting radionuclides, and nitrate/nitrite. The samples were analyzed by Quanterra/Enseco and SNL/NM's Radiological Sample Diagnostic (Amir's) laboratory.

No significant contamination was identified at ER Sites 230, 231, 233, and 234. However, various problems such as the lack of sufficient quality assurance/quality control (QA/QC) samples nearly negated the usefulness of the analytical data. The failure to collect soil samples from the center line of the drainage ditches also has proven troublesome for NMED; they have not looked favorably at sample locations that are at the corners of the site boundaries instead of in-line with the concrete ditches and outfall pipes.

In their last NOD (October 13, 1999) concerning ER Sites 230 through 235, NMED requested that the analytical data for the 1994 sampling be formatted in the style of the 12th Batch NFA Proposals. This format was subsequently used in the ER Site 235 NOD Response, which NMED used as the basis for granting the site NFA status on March 27, 2000. Reformatting the remainder of the 1994 analytical data will be tedious because the data are not in ERDMS. However, hard copies for each site are on file in the Records Center. Besides reviewing the files for ER Sites 230 through 234, the ER Site 235 files and the October 1996 NOD Response will need to be reviewed in order to find all of the QA/QC samples. Except for the soil samples that were collected for the mineral-oil release, the samples at ER Sites 230 through 235 were collected during a one-week period in 1994. Unfortunately, some of the 1994 QA/QC samples such as the equipment blanks were collected on only one day. In the October 1996 NOD Response, some of the QA/QC results were inferred to be representative for the entire week during which ER Sites 230 through 235 had been sampled.

Unique features for each of the storm-water outfalls are discussed below in more detail.

2.1.1 Site History for ER Site 230

ER Site 230 consists of a 65-ft long earthen ditch (Photograph 1). The adjacent outfall components consist of a galvanized storm-water grate, buried 18-inch diameter concrete pipe, and a 55-ft long concrete ditch (Photographs 2 and 3). In 1994, four soil samples (230-01-A/B through 230-04-A/B) were collected down slope of the concrete ditch.

2.1.2 Site History for ER Site 231

ER Site 231 consists of a 140-ft long earthen ditch. The adjacent outfall components consist of a headwall with an 18-inch diameter concrete pipe that drains into 105-ft long concrete ditch

(Photographs 4 and 5). In 1994, four soil samples (231-01-A/B through 231-04-A/B) were collected down slope of the concrete ditch.

2.1.3 Site History for ER Site 232-1

ER Site 232-1 consists of a 70-ft long earthen ditch, the upper part of which is shown in Photograph 6. The adjacent outfall components consist of a headwall with a 24-inch diameter concrete pipe that drains into a 70-ft long concrete ditch and then the earthen ditch (Photograph 7). Two soil sampling investigations were conducted at ER Site 232-1. The first investigation in 1994 collected eight soil samples (232-01-A/B, 232-02-A/B, 232-03-A/B, and 232-04-A/B) to a maximum depth of 3 ft bgs. The soil samples contained total petroleum hydrocarbons (TPH) concentrations that ranged from non-detect [<50 mg/kg (ppm)] to a maximum of 860 ppm. A second investigation was subsequently implemented in 1995 to define the extent of TPH in soil. Samples were collected at depths of 5, 6, and/or 10 ft from five GeoProbe boreholes (BH-1, BH-2, BH-3, BH-4, and BH-5) which were placed at the same four sample locations as the first investigation and one additional location farther down slope (Figure 4). The 13 soil samples from the second investigation contained TPH concentrations that ranged from 6 to 32 ppm. The first and second investigations indicate that soil containing TPH concentrations above 100 ppm was limited to the immediate vicinity of the southern end of the concrete ditch at a depth of 3 ft or less. No SVOCs or VOCs such as benzene, toluene, ethylbenzene, or xylenes (BTEX) were detected in the soil samples.

In the RSI of September 1999, NMED requested the excavation of soil at ER Site 232-1 that contained greater than 100 ppm TPH. This overly conservative request was based upon surface-water concerns. A review of the 1994 sample results suggest that the volume of soil to be removed was just a couple of cubic yards. Unfortunately, depth measurements hung on the concrete ditch were not taken during the 1994 sampling. The issue of whether or not much soil erosion has occurred there has been a concern for ER Site 232-1. However, an aerial photograph shows that the ground surface was not graded to intercept the end of the concrete ditch (Photograph 8). Construction in the early 1980s left a significant drop-off of about five ft. Therefore, only a minor amount of soil erosion has occurred at ER Site 232-1. No oily stains have been observed on the concrete ditch or the nearby soil.

As mentioned above, NMED's RSI of September 1999 requested more soil sampling and the excavation of soil that contained TPH in excess of 100 ppm. However, recent guidance from NMED suggests that the excavation requirement is a moot issue. The July 18, 2000 letter from the NMED Hazardous Waste Bureau and the accompanying Position Paper (*Use of TPH Test Results for Site Characterization*) both endorse the August 13, 1993 guidelines from the New Mexico Oil Conservation Division (OCD). The OCD *Guidelines for Remediation of Leaks, Spills, and Releases* sets forth a ranking criteria for oil spills. ER Site 232-1 scores a ranking criteria of zero (0) because the depth to water is greater than 100 ft and no perennial surface-water bodies, water-supply wells, or other water sources are located nearby. Accordingly, the TPH action level for the site should be 5,000 ppm above background. Hopefully, NMED will issue a final decision supporting the use of the OCD guidelines.

2.1.4 Site History for ER Site 232-2

Prior to September 1996, some old records have confused the numbering for ER Sites 232-1 and 232-2. The numbering was standardized in the October 1996 NOD Response. The northern outfall discharges at ER Site 232-1, whereas the southern outfall discharges at ER Site 232-2. Uniquely, the *11-Sites SAP* was not used for Site 232-2 because of the mineral oil spill.

ER Site 232-2 consists of a 90-ft long earthen ditch (Photograph 9). The adjacent outfall components consist of a headwall with a 24-inch diameter concrete pipe that drains on to a five-ft long concrete slab and then the earthen ditch. No concrete ditch was installed at the site (Photograph 10). In June 1994, SNL/NM implemented a Voluntary Corrective Measure (VCM) to remediate the mineral oil spill at ER Site 232-2. Approximately 150 to 300 gallons of mineral oil had discharged from the outfall in June 1994. The mineral oil was HERMES oil, a petroleum-based oil that did not contain polychlorinated biphenyls (PCBs). The resulting oil stain on the ground surface down slope of the outfall was about 50-ft long with a width that varied from about 3 to 5 ft. The VCM involved excavation of oil-contaminated soil and confirmatory-soil sampling.

The VCM was conducted in July through November of 1994 to remove soil contaminated with mineral oil above the overly conservative cleanup goal of 100 ppm TPH. The contaminated soil was removed with a backhoe. The meager amount of field notes were summarized in the ER Site 232 NFA Proposal. The resulting trench began at the concrete slab and proceeded southeastward for about 75 ft. The average depth of the trench was about 5 ft. Near the concrete slab, the trench was excavated to a depth of about 9 ft. The southern end of the trench varied in depth from about 4 to 10 ft. The final width of the trench varied from about 15 to 30 ft. The total amount of excavated soil was approximately 429 cubic yards.

The sampling nomenclature for outfall 232-2 was an awkward set of 'blind' numbers (015861 through 015896, 017817, and 017818). A total of 101 samples and splits were collected and analyzed. Unfortunately, most of the sampling locations were apparently not documented. The 12 documented sampling locations are shown on Figure 5. Despite numerous tries, I have not been able to find a field log book for the VCM activities. Figure 5 depicts all the soil-sampling locations that I could find in the meager ER Site 232 notes.

Five VCM methods were used to verify that the cleanup goal was reached: visual observation of oil-stained soil; the use of a Hanby immunoassay kit; real-time monitoring with a FID; analyses of soil samples by ERCL; and analyses of soil samples by two off-site laboratories (Analytical Technologies, Inc. [ATI], and Enseco-Quanterra). As an additional verification check, SNL/NM and NMED collected 12 confirmatory soil samples along the trench in August, September, October 1994 (Figure 5). The SNL/NM samples (015887 through 015896) were analyzed for TPH and TAL metals by the Enseco-Quanterra laboratory. The maximum TPH concentration was 31.6 ppm. The three NMED split-soil samples were analyzed by their laboratory in Santa Fe; no VOCs or SVOCs were detected.

Based on the analyses of the verification samples, all of the mineral-oil contamination greater than the 100 ppm cleanup goal was successfully excavated. In addition, no significant concentrations of metals, VOCs, or SVOCs were present in soil. At the conclusion of the VCM field activities, the drainage below the outfall was backfilled with clean soil and the original grade was re-established. The excavated soil was disposed of off-site after being characterized as a non-regulated substance, i.e., not a Resource Conservation and Recovery Act (RCRA) hazardous waste or a radioactive waste. The soil was shipped to the United States Pollution Control Inc. - Grassy Mountain facility at Clive, Utah.

2.1.5 Site History for ER Site 233

ER Site 233 is a 175-ft long site that is unique with its two discharge points. The first discharge point is located next to the unpaved TA-IV perimeter road between the headwall/outfall pipe and the storm-water grate (Photograph 11). Storm water flows across bare ground at the first discharge point and then into the storm-water grate that is connected to an additional 75-ft long segment of buried piping. This piping terminates at a drop structure from which the storm water discharges for a second time on to the ground surface; this time into a earthen ditch (Photographs 12 and 13). In 1994, four soil samples (233-01-A/B through 233-04-A/B) were collected at ER Site 233 (Figure 11).

2.1.6 Site History for ER Site 234

ER Site 234 consists of a 270-ft long earthen ditch (Photograph 14). No outfall components are currently present at the site (Photograph 15). Before being removed in the early 1990s, the ER Site 234 outfall consisted of a steel pipe and possibly a headwall. No concrete ditch was used. In the early 1990s, the southernmost 90 ft of the outfall pipe was removed and storm water was re-directed through a buried pipe to the ER Site 233 outfall.

In September 2000, research of historical aerial photographs and engineering drawings revealed that the boundary for ER Site 234 was incorrect. The northern end of the site is now set where storm water had discharged from the outfall pipe. The southern end of the site remains where it was set in 1994 at the southern limit of soil erosion. A unrelated sewer manhole and a small electrical vault are located near the southern end of the site.

The soil-sample results also were recently re-evaluated. Of the six sampling locations (234-01-A/B through 234-06-A/B) that were used in 1994, only three locations (234-01-A/B, 234-05-A/B, and 234-06-A/B) are within the revised site boundary and potentially useful for site characterization. However, the sampling depth for sample 234-01-A/B was probably too shallow at a mere three ft bgs to have penetrated through the layer of backfill soil that remained after the removal of the outfall pipe. As such, sample 234-01-A/B may not have contained native soil from beneath or downstream of the outfall pipe. Samples 234-05-A/B and 234-06-A/B maybe useful for characterizing the southern end of the site. However, these two sample may contain some residual contaminants from the waste water that discharged from the outfall ditches. The other three sample locations (234-02-A/B, 234-03-A/B, and 234-04-A/B) were collected at useless locations where outfall pipes had been erroneously suspected in 1994.

One peculiar aspect of ER Site 234 is that TA-IV storm water was directed to the confluence area for the three ER Site 46 outfall ditches (OD-1, OD-2, and OD-3), where acid-waste water had discharged from 1948 to 1973. A review of historical aerial photography was used in August 2000 to re-evaluate the boundary for ER Site 46 (Photograph 16). Photograph 17 shows the surviving 60 ft segments for outfall ditches OD-1 and OD-2 at adjacent ER Site 46. In August 2000, steel-rebar markers with orange-square caps were placed at each end of the surviving segments. Because of TA-IV construction and installation/removal of the outfall pipe for ER Site 234, no field evidence for outfall ditch OD-3 remains. In August 2000, a steel-rebar marker was placed at the northern end of ER Site 234 outfall pipe where the was previously located; this location was GPS'd and verified to be where soil sample 234-01-A/B was collected in 1994 (Photograph 18).

2.2 Constituents of Concern

In the June 1995 No Further Action (NFA) Proposals, the COCs for ER Sites 230, 231, 233, and 234 were considered to be chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, and mineral oil. This list of COCs was conservatively based upon chemicals used at TA-IV. The analytes of VOCs, SVOCs, RCRA metals, and chromium-VI are indicative of the COCs. However no chemical releases are known to have occurred in the area that drains to these sites.

The August 1997 NFA Proposal for ER Site 232 was not consistent with the other four storm-water outfalls. For consistency sake, the above-listed COCs will hereafter be applied to ER Sites 232-1 and 232-2.

3.0 EVALUATION OF PREVIOUS INVESTIGATIONS

Analytical results from the 1994 soil sampling at ER Sites 230, 231, 232-1, 232-2, 233, and 234 did not identify any significant contamination. The oil spill of non-hazardous mineral oil at ER Site 232-2 has been remediated. No releases of chemical or radioactive materials have occurred at any of the storm-water outfalls.

4.0 PLANNED ACTIVITIES

The following sections describe the activities planned for the outfalls.

4.1 Overview

Soil samples will be collected at six ER sites. The samples will be collected by personnel from the Environmental Restoration Field Office (ERFO). Hand tools and a backhoe will be used to collect the samples.

The sampling at ER Sites 230, 231, 232-1, 232-2, 233, and 234 will follow-up on the 1994 shallow-soil sampling. Unfortunately, the 1994 samples were not collected from the centerline of the storm-water ditches. More sampling details are discussed in Section 4.3.2.

4.2 Permitting, Approval, and Notification Requirements

The ER Field Work Checklist has been completed for this FIP. In accordance with the National Environmental Policy Act (NEPA), a review of the potential impacts of this project has already been undertaken, and clearance to proceed has been granted (Bleakly, 2001). Even though part of the sites are located adjacent to the Tijeras Arroyo floodplain, a U.S. Army Corps of Engineers permit is not required for collecting the samples with the backhoe. This exception is inferred from the correspondence (Fink, 1998; Manger, 1998) that supported the heavy-equipment work at nearby ER Site 228A.

4.3 Planned Sampling Activities

The planned sample locations for ER Sites 230-234 are listed in Table 3 and are shown on Figures 2 through 7. Sampling design is based upon several documents (Table 2) and various meetings. The most important meeting occurred on 17 November 1999 with SNL/NM representatives (Sue Collins, John Copland, and Bob Galloway) talking with NMED staff (Will Moats and Roger Kennett). Findings of the meeting were subsequently incorporated into the last formal document (the NOD Response of December 1999). This FIP also expands upon Mr. Moat's expectations, some of which may not be totally evident in our various NOD Responses or the Request for Supplemental Information (RSI) Response. In typical fashion, NMED has not formally responded to the 2001 sampling as proposed in the December 1999 NOD Response because Sue Collins verbally committed during the November meeting to fulfill all of Mr. Moat's expectations.

Depending upon NMED's site-specific requests, either two or three locations will be sampled per site (Table 3). The first location at each site will be located approximately five ft directly down slope of where storm water has discharged on to the bare ground surface. The second location will be located 30 ft farther down the center line of the drainage ditch from the first sampling location. NMED requested that these '5 ft from outfall' and '35 ft from outfall' locations be sampled at depths of 5 and/or 10 ft, bgs (Table 3). For both ER Sites 230 and 233, NMED also requested locations next to the storm-water grates.

To ensure that no sampling issues are unresolved at the waste-water outfalls, the TJAOU has decided to collect additional surface-soil (0-1 ft bgs) samples at each of the '5' locations. Because of a recent revision to the boundary for ER Site 234, The TJAOU has determined that the sampling for that site needs to be slightly modified from the December 1999 NOD Response. As shown on Figure 7, the two 2001 sample locations for ER Site 234 reflect the September 2000 revision of the site boundary.

A total of 29 soil samples will be collected at the outfalls. To prevent confusion, the 2001 sample numbers will start where the 1994 sample numbers stopped. The 2001 sample locations will have slightly different sampling nomenclature than the 1994 samples because the ER Project standardized the sampling nomenclature in April 1995. For example, the next soil sample for ER Site 234 with be at the seventh location and will be identified as TJAOU-234-GR-07-S-5.

Table 3. Proposed 2001 Soil Samples for ER Sites 230, 231, 232-1, 232-2, 233, and 234.

ER Site	Sample Number	Depth (ft, bgs)	Sample location/comment
230	TJAOU-230-GR-05	0-1	Storm water grate near TA-IV fence
	TJAOU-230-GR-06	0-1	5 ft from lower end of concrete ditch
	TJAOU-230-GR-06-DU	dupe	--
	TJAOU-230-GR-06	5-6	5 ft from lower end of concrete ditch
	TJAOU-230-GR-07	5-6	35 ft from lower end of concrete ditch
231	TJAOU-231-GR-05	0-1	5 ft from lower end of concrete ditch
	TJAOU-231-GR-05-DU	dupe	--
	TJAOU-231-GR-05	5-6	5 ft from lower end of concrete ditch
	TJAOU-231-GR-06	5-6	35 ft from lower end of concrete ditch
232-1	TJAOU-232-1-GR-05	0-1	Underneath the lower end of concrete ditch
	TJAOU-232-1-GR-05-DU	dupe	--
	TJAOU-232-1-GR-06	5-6	5 ft from lower end of concrete ditch
	TJAOU-232-1-GR-07	5-6	35 ft from lower end of concrete ditch
232-2	TJAOU-232-2-GR-1	0-1	5 ft from outfall-pipe concrete slab
	TJAOU-232-2-GR-1-DU	dupe	--
	TJAOU-232-2-GR-1	5-6	5 ft from outfall-pipe concrete slab
	TJAOU-232-2-GR-1	10-11	5 ft from outfall-pipe concrete slab
	TJAOU-232-2-GR-2	5-6	35 ft from outfall-pipe concrete slab
	TJAOU-232-2-GR-2	10-11	35 ft from outfall-pipe concrete slab
233	TJAOU-233-GR-05	0-1	by storm-water grate at upper end of site
	TJAOU-233-GR-05-DU	dupe	--
	TJAOU-233-GR-05	5-6	by storm-water grate at upper end of site
	TJAOU-233-GR-06	0-1	5 ft from drop structure
	TJAOU-233-GR-06	5-6	5 ft from drop structure
	TJAOU-233-GR-07	5-6	35 ft from drop structure
234	TJAOU-234-GR-07	0-1	Upper end of site at rebar marker
	TJAOU-234-GR-07-DU	dupe	--
	TJAOU-234-GR-07	5-6	Upper end of site at rebar marker
	TJAOU-234-GR-08	5-6	35 ft from upper rebar marker
Total = 29	--	--	--

4.3.3 Conducting Buried-Utility Surveys

SNL/NM Facilities Engineering staff will perform line-spotting services and will locate the buried utilities at each of the seven sites. Dig/Penetration permits have been obtained from both SNL/NM and KAFB. Figure 8 shows a utilities coverage from the Facilities Engineering CAD system.

4.3.4 Implementing Waste-Management Procedures

No regulated waste will be generated.

4.3.5 Collecting Confirmatory-Soil Samples

The sampling procedures are listed in Table 4. Soil samples will be collected using either grab, hand-auger, and/or backhoe techniques. The use of a backhoe to collect soil samples at the outfalls was endorsed by Mr. Moats during a 27 April 2001 meeting with John Copland (logbook ER-050). Soil will be quickly transferred from the backhoe bucket to the sample containers.

Samples will be immediately labeled and placed in a cooler and stored at 4°C. Because none of sites are RMMAs, a RCT will not need to frisk and swipe the sample containers. Samples will be delivered to the Sample Management Office (SMO) for processing and shipment to the appropriate analytical laboratory. A completed Analysis Request and Chain-of-Custody form (ARCOC) will accompany each shipment.

Table 4. Applicable Operating Procedures for Sampling Activities.

Procedure #	Procedure Title
FOP 94-01	Safety Meetings, Inspections, and Pre-Entry Briefings
FOP 94-25	Documentation of Field Activities
FOP 94-26	General Equipment Decontamination
FOP 94-34	Field Sample Management and Custody
FOP 94-54	Surface Sediment/Soil Sampling
FOP 94-68	Field Change Control
FOP 94-69	Personnel Decontamination (Level D, C, and B Protection)

4.3.6 Decontamination of Sampling Equipment

No significant contamination is present at the six sites. To ensure that sample integrity is maintained, the sampling equipment will be decontaminated after each sample is collected (FOP 94-26). The decontamination will typically utilize dry-decontamination techniques such as scraping with a wire brush and wiping with paper towels. If used, decontamination water will be discharged directly to the ground surface without being sampled, provided that there is reason to believe that the sampling equipment has not brought up contamination not already existing on the ground surface. Discharges of decontamination water to the ground surface will be less than 50 gallons per week and less than 5 gallons per hour. Water will not be discharged in areas prone to erosion. Water will not be discharged in an area that will be sampled later. Decontamination water may be placed in open-top drums or left on a temporary pad for evaporation.

4.3.8 Final Grading

The backhoe work will have a small impact. After the sampling is completed at a particular site, the site will be returned to the pre-sampling topography. None of the alignments for the storm-water channels will be altered. Because the disturbed areas will each be less that 0.75 acres, no Topsoil Disturbance Permit is needed.

4.3.9 Final Report

Upon completion of the soil-sampling work and evaluation of the analytical data, NOD/RSI Responses will be prepared and subsequently submitted to NMED for regulatory review. After validation, the analytical results will be summarized using the format style of the 12th Batch or later NFA Proposals. Human-health/ecological risk assessments will be prepared for each site.

5.0 TEAM ORGANIZATION

Management:

Department 6133 Manager	Dwight Stockham	Organization	6133
OU 1309 Task Leader	Sue Collins	Organization	6133
OU 1309 Assistant Task Leader	John Copland	Organization	6133

Sampling:

Field Team Leader	John Copland	Organization	6133
ERFO Coordinator	Tony Roybal	Organization	6135

Analytical:

Sample Management Office	Doug Salmi	Organization	6133
Analytical Laboratories:	General Engineering Laboratory and RPSD		

6.0 HEALTH AND SAFETY

- Health and Safety Plan: Level D, use HASP for ER Site 228B – Centrifuge Dump Site, January 2000, per Change Directive 1309-2001-3.

- Notifications and Communications with adjacent facilities: TA-IV HERMES III Linear Accelerator (operator Roy Guttierrez, 845-7226). Outdoor testing may require the sampling effort to be briefly delayed during the HERMES III shots which are vented to the northeast of Building 970.

7.0 SAMPLE COLLECTION

Sample Media: X Environmental n/a Waste Matrix Type Soil

8.0 ANALYTICAL REQUIREMENTS

The analytes for the soil sampling are based upon the COCs discussed above as well as additional COCs that NMED has traditionally expected for SNL/NM. The COCs for each site are listed below.

- ER Site 230: VOCs, SVOCs, TPH, TAL metals, chromium-VI, tritium, gamma-emitting radionuclides, gross alpha/beta
- ER Site 231: VOCs, SVOCs, TPH, TAL metals, chromium-VI, tritium, gamma-emitting radionuclides, gross alpha/beta
- ER Site 232-1: VOCs, SVOCs, TPH, TAL metals, chromium-VI, tritium, gamma-emitting radionuclides, gross alpha/beta
- ER Site 232-2: PCBs, VOCs, SVOCs, TPH, TAL metals, chromium-VI, tritium, gamma-emitting radionuclides, gross alpha/beta
- ER Site 233: VOCs, SVOCs, TPH, TAL metals, chromium-VI, tritium, gamma-emitting radionuclides, gross alpha/beta
- ER Site 234: VOCs, SVOCs, TPH, TAL metals, chromium-VI, tritium, gamma-emitting radionuclides, gross alpha/beta

The soil samples will be analyzed using the analytical methods listed in Table 5. The detection limit for each COC will be lower than the respective HRMB background value and risk-assessment level. A bottle order has already been submitted to SMO.

Table 5. Analytical Methods for Confirmatory Soil Samples.

Analyte	Analytical Method
TAL metals	EPA 6010/7471
Cr-VI	EPA 7196
VOCs	EPA 8260
SVOCs	EPA 8270
TPH	EPA Method 8015-modified
PCBs	EPA 8080
Gross alpha/beta	EPA Method 900.0
Tritium	HASL 300
Gamma-emitting radionuclides	HASL 300

9.0 QUALITY CONTROL

For each site, the QA/QC samples shall consist of one soil duplicate (DU) and one aqueous equipment blank (EB) for each of the analytes. This rate will slightly exceed the 5% frequency typically used in ER's verification sampling. Trip (aqueous) blanks will accompany the soil samples for VOC analyses.

As necessary, additional QA/QC results such as matrix spike/matrix spike duplicate (MS/MSD) will be requested. The ratios for collecting/preparing other QA/QC samples are specified in Table 6.

Table 6. Collection/preparation Ratios for QA/QC Samples.

Field		Laboratory	
X Duplicate samples	10% of soil samples	X LCS	5% or 1 per batch
X Equipment Blank	1 per day	X MS	5% or 1 per batch
X Trip Blank - VOCs	1 per shipment	X MSD	5% or 1 per batch
Other		X Method blank	1 per analytical batch
		X Surrogate spike	all GC/MS samples

10.0 DATA VALIDATION

Analytical reports will be reviewed with the most current data-validation procedure suitable for the risk-assessment process.

11.0 SAMPLE NOMENCLATURE

The "ER Sample ID" nomenclature in Table 7 will be used to identify the samples. A block of 'random SMO numbers' for "Sample No. – Fraction" will be obtained from the automated phone number 284-5514.

Table 7. ER Sample ID nomenclature.

Operable Unit		Site		Location Category		Location Number		Sample depth (ft)	-	Sampling Media
AAAAA				NNN		AAA		NNNN.N	-	AAA
3 to 5 digits				2 to 3 digits		3 digits		5 digits	-	1 to 3 digits
Example										
Tijeras Arroyo		230		Grab		05		2 to 2.5		soil
Nomenclature										
TJAOU	-	230	-	GR	-	05	-	2	-	S

12.0 MAPPING

After the sampling is complete, sample locations will be mapped using Global Positioning System equipment. This will ensure that the locations are accurately mapped and the location data are archived.

13.0 REFERENCES

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Sandia National Laboratories / New Mexico (1995), *Proposal for No Further Action - Site 233, Operable Unit 1309,* in 'Proposals for No Further Action - Environmental Restoration Project,' SNL/NM Environmental Restoration Project, Albuquerque, NM, June 1995.

Sandia National Laboratories / New Mexico (1995), *Proposal for No Further Action - Site 234, Operable Unit 1309,* in 'Proposals for No Further Action - Environmental Restoration Project,' SNL/NM Environmental Restoration Project, Albuquerque, NM, June 1995.

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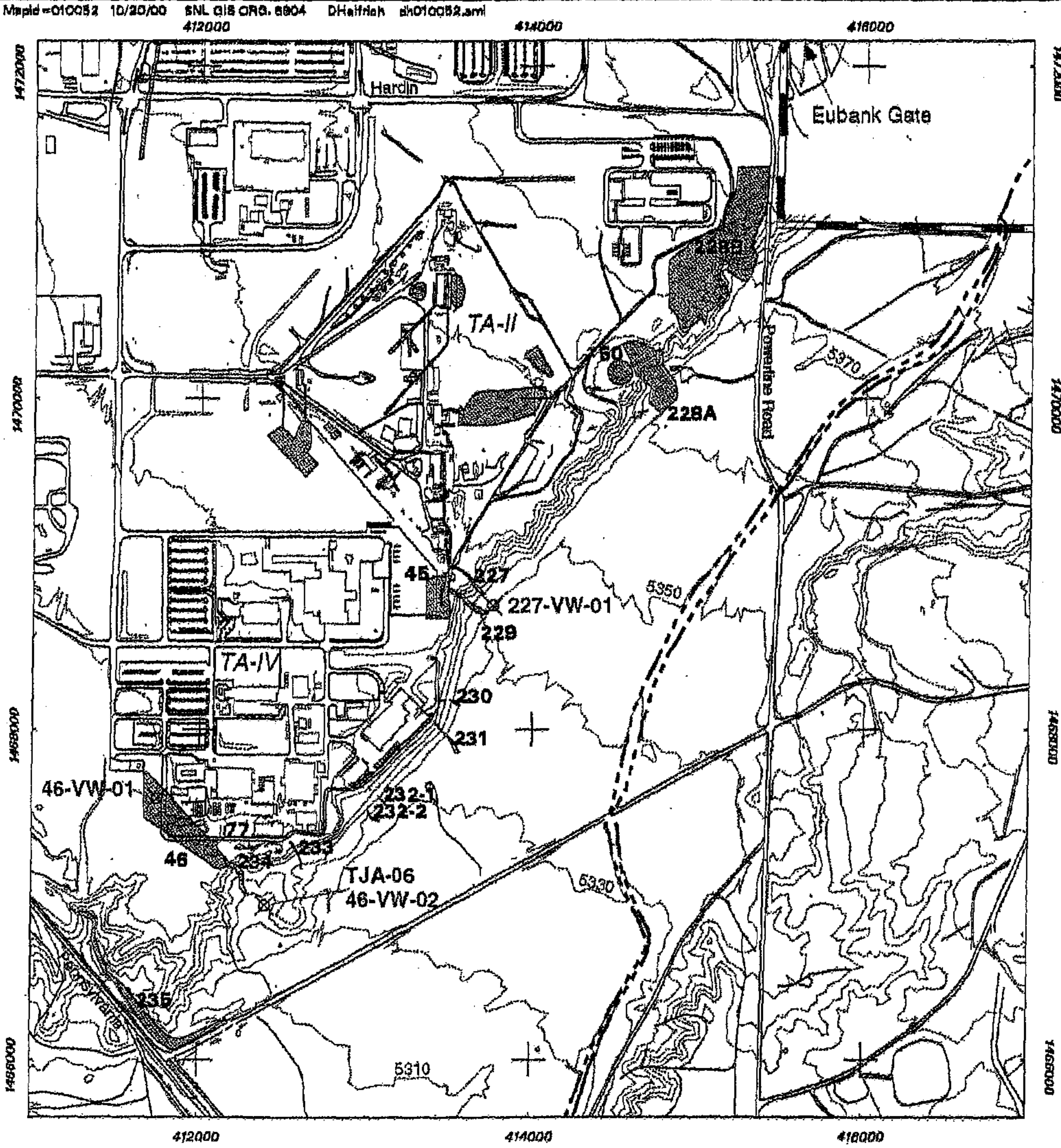
Sandia National Laboratories / New Mexico (2001) *Field logbook #ER-050*, page 126, April 27, 2001.

Mapid=010052 10/20/00 SNL GIS ORG. 6804 DHelfrich sh010052.aml



Legend

- Proposed Monitor Well
- Road
- 10 Foot Contour
- Tijeras Arroyo Channel
- KAFB Boundary
- Building
- ER Site

Figure 1
ER Sites 46 & 229
Proposed Locations for Groundwater & Soil Vapor Monitor Wells

0 500 1000
Scale in Feet

0 120 240
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

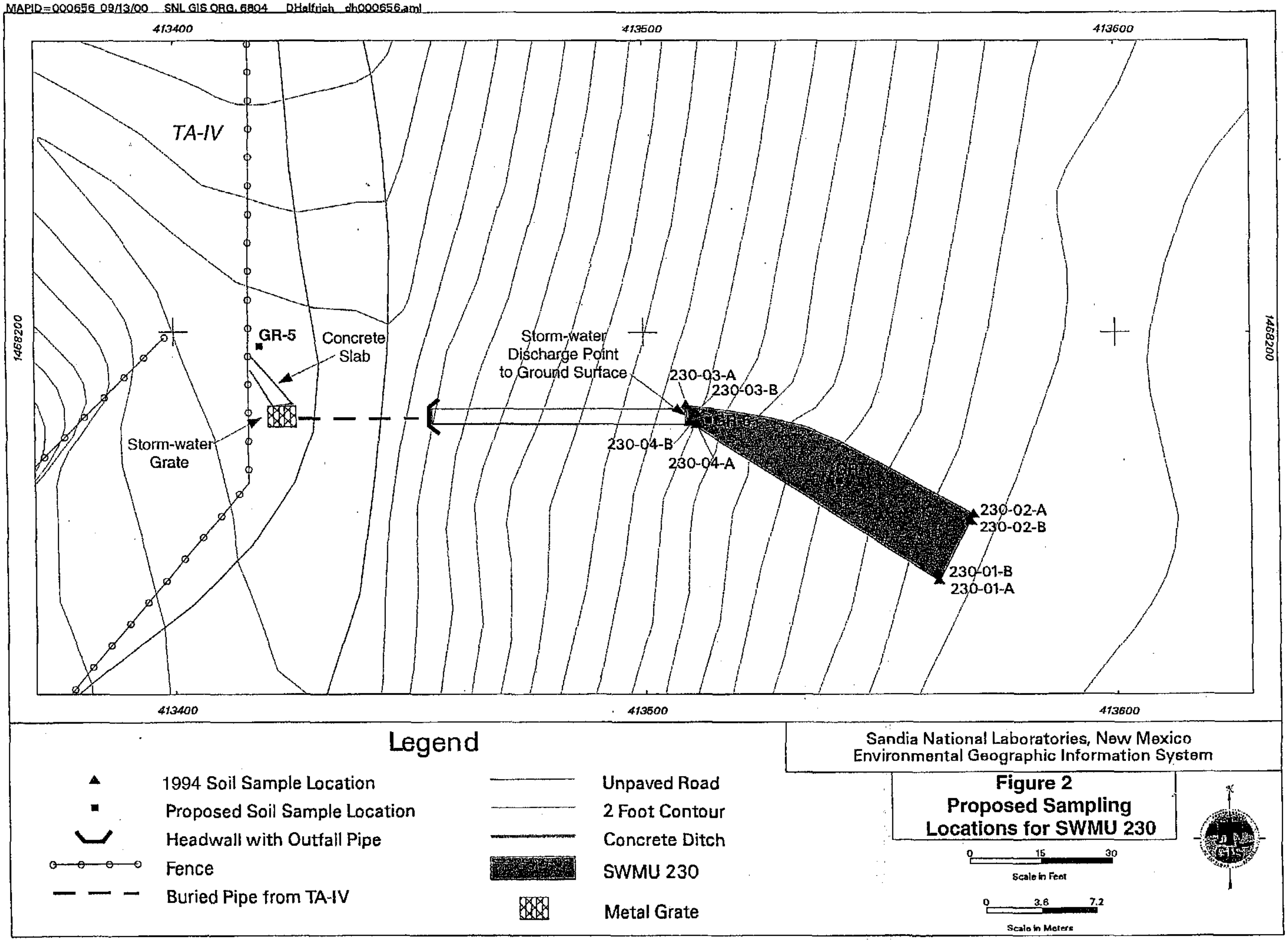
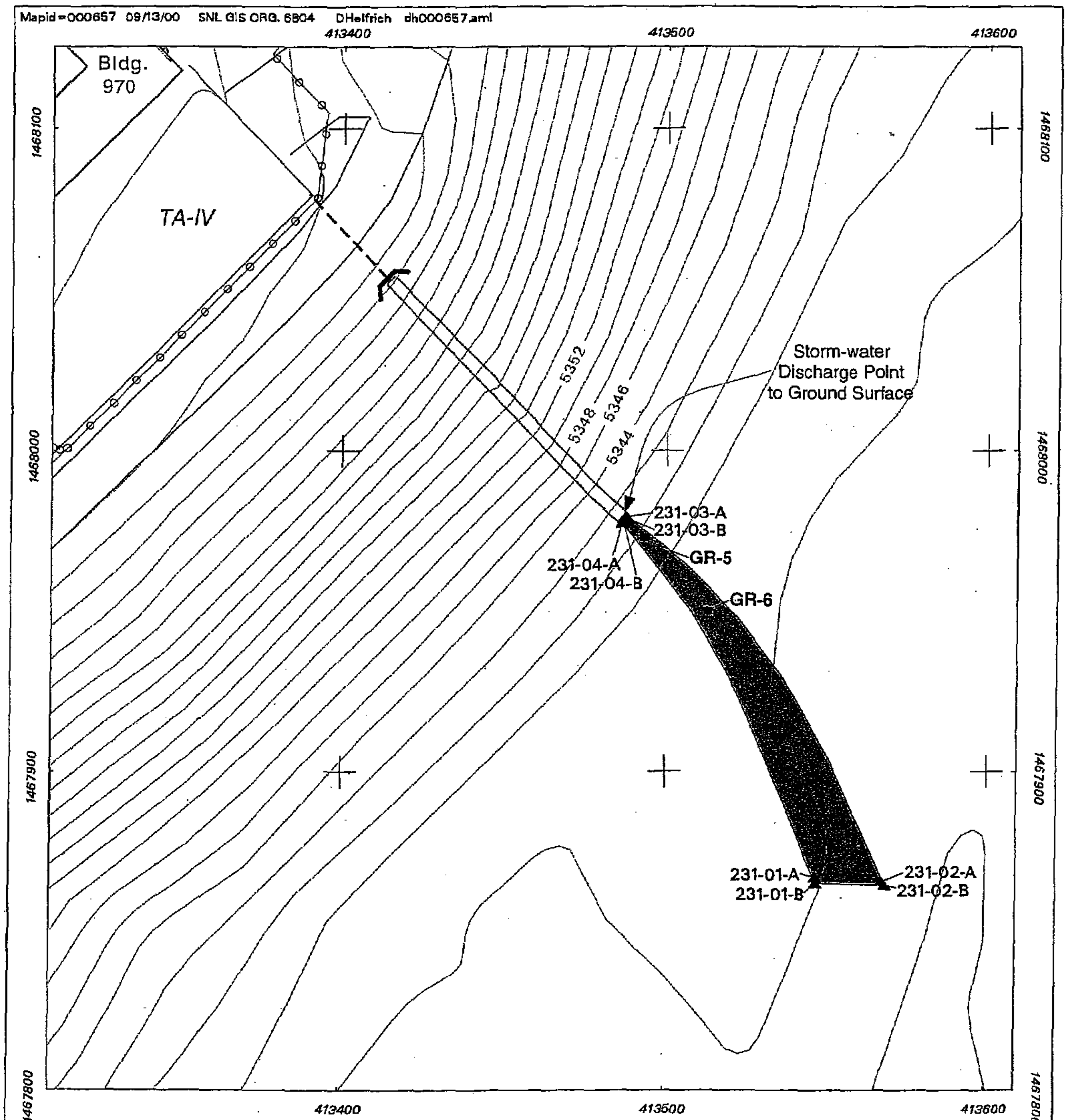


Figure 2
Proposed Sampling Locations for SWMU 230



Legend

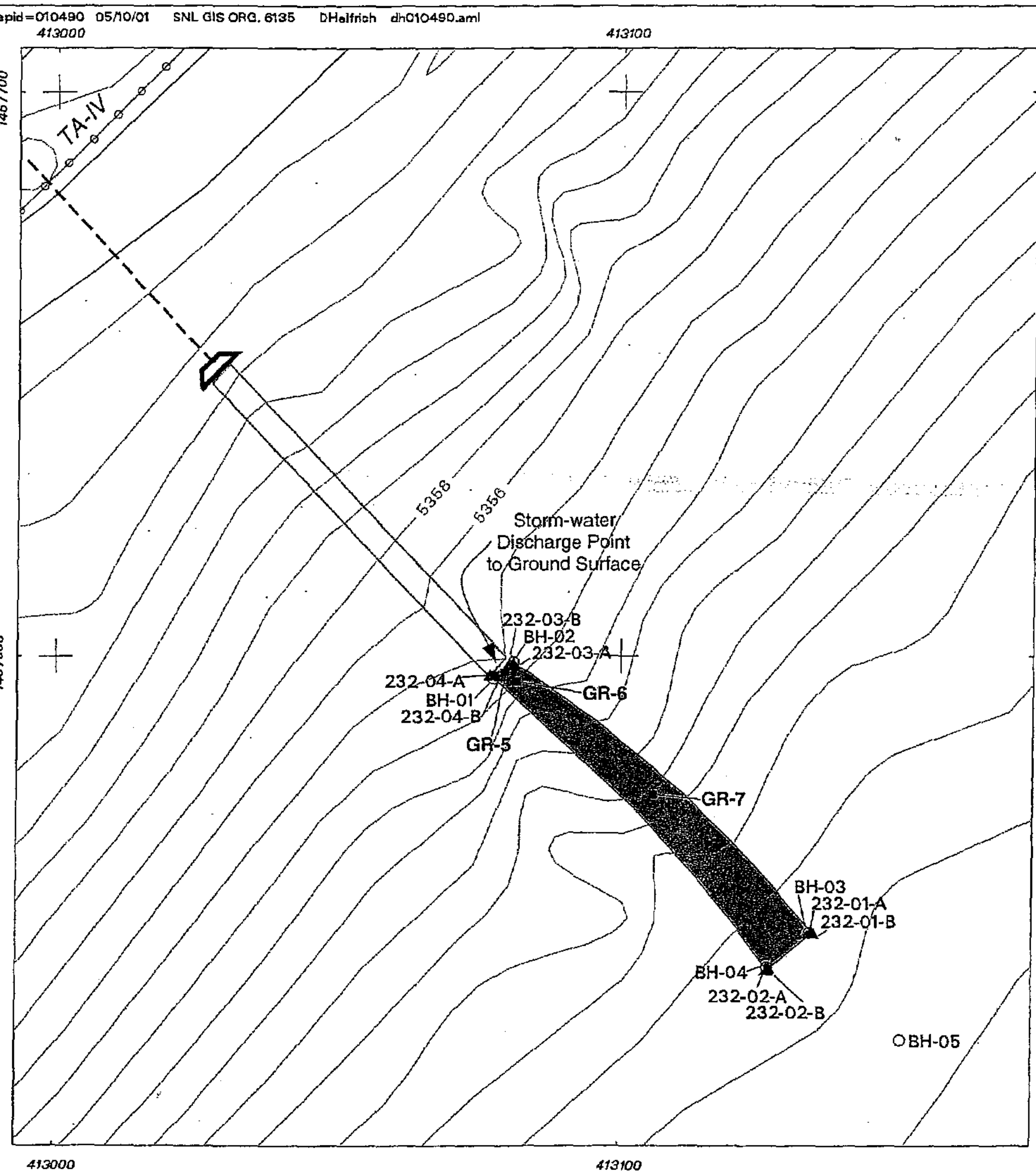
- ▲ 1994 Soil Sample Location
- ■ Proposed Soil Sample Location
- Headwall with Outfall Pipe
- Buried Pipe from TA-IV
- Fence
- Unpaved Road
- 2 Foot Contour
- Concrete Ditch
- SWMU 231

Figure 3
Proposed Sampling Locations for SWMU 231

0 25 50
Scale in Feet

0 6 12
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System



Legend

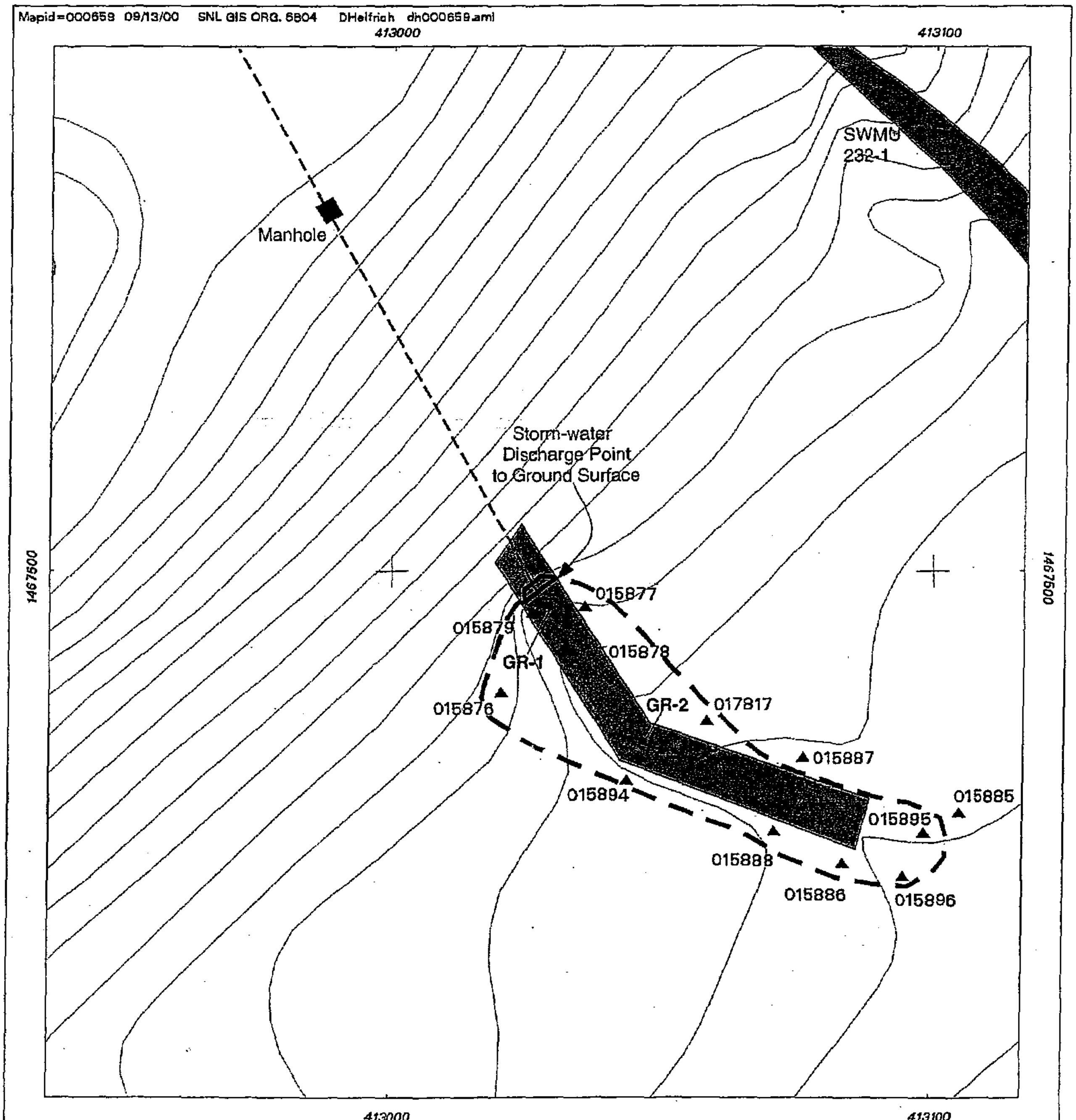
- 1995 Borehole
- 1994 Soil Sample Location
- Proposed Soil Sample Location
- Headwall with Outfall Pipe
- Fence
- Buried Pipe from TA-IV
- Unpaved Road
- 2 Foot Contour
- Concrete Ditch
- SWMU 232-1

Figure 4
Proposed Sampling Locations for Outfall 232-1 at SWMU 232

0 15 30 Scale in Feet

0 3.6 7.2 Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System



Legend

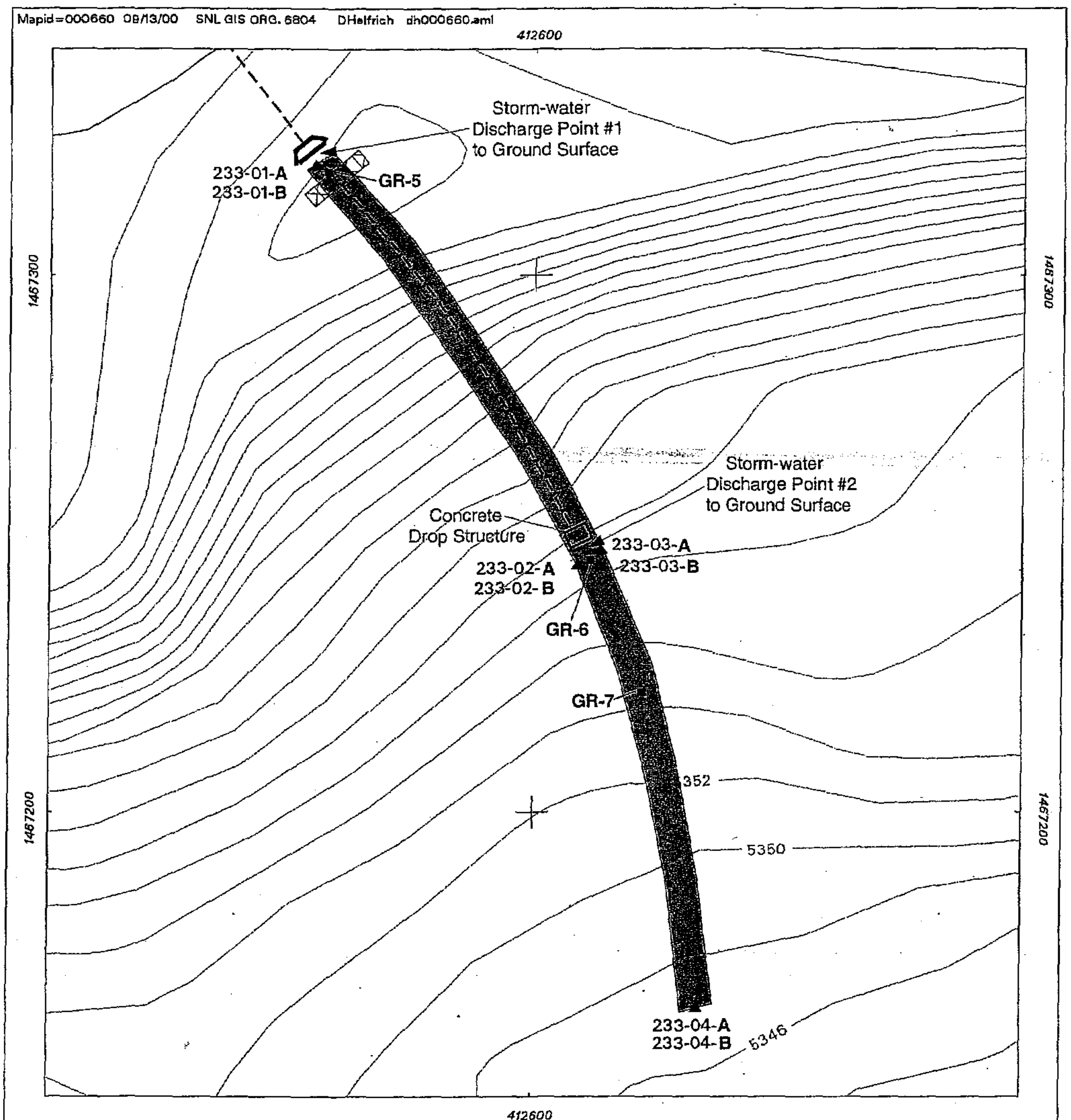
- ▲ 1994 Soil Sample Location
- ■ Proposed Soil Sample Location
- Headwall with Outfall Pipe
- Buried Pipe from TA-IV
- 2 Foot Contour
- Previous Excavation Extent
- SWMU 232-1 & 232-2

Figure 5
Proposed Sampling Locations for SWMU 232-2

0 15 30 Scale in Feet

0 3.6 7.2 Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System



Legend

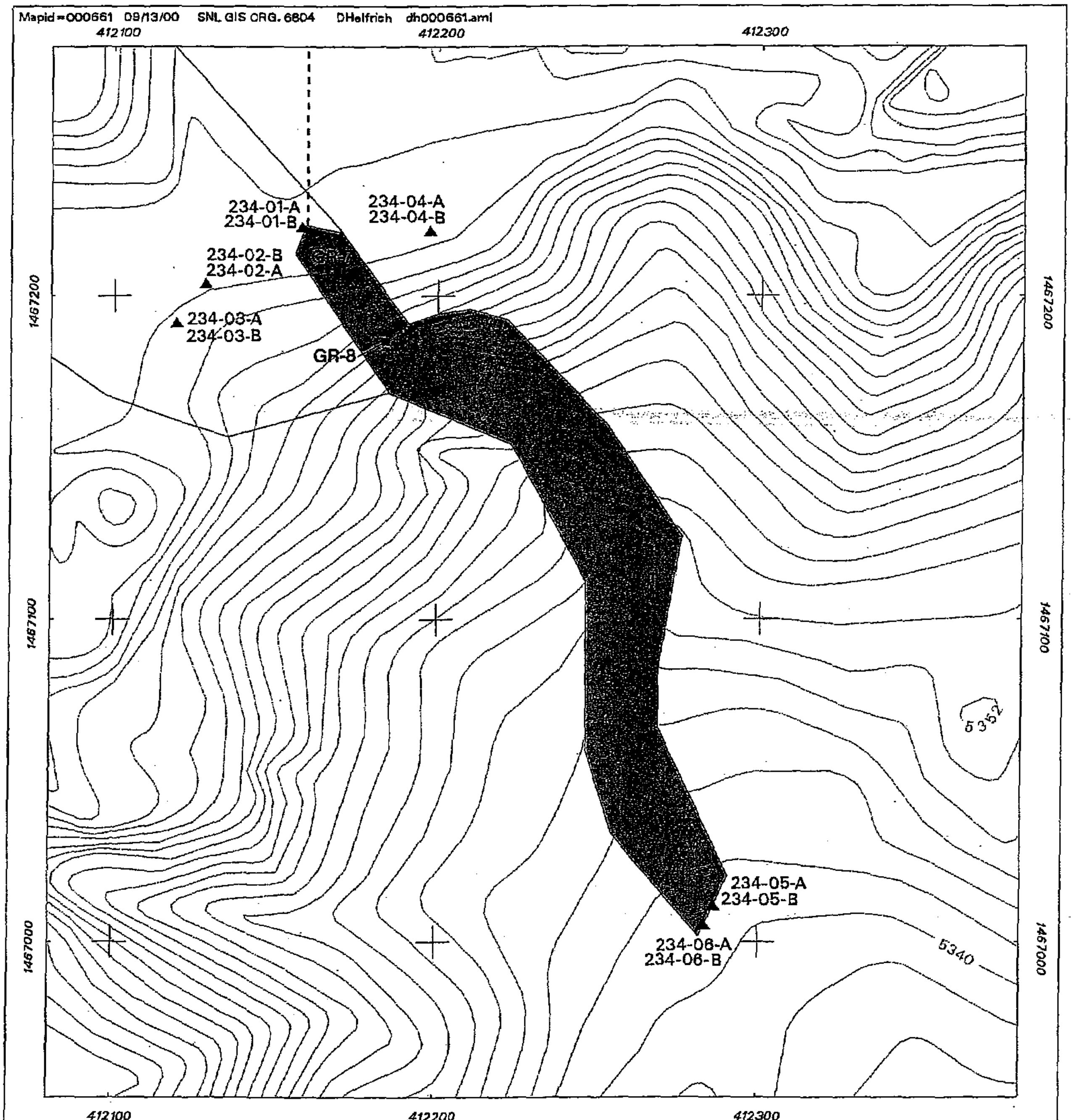
- 1994 Soil Sample Location
- Proposed Soil Sample Location
- Headwall with Outfall Pipe
- Storm Water Grate
- Buried Pipe from TA-IV
- 2 Foot Contour
- Unpaved Road
- SWMU 233

Figure 6
Proposed Sampling Locationf for SWMU 233

0 15 30
Scale in Feet

0 3.6 7.2
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

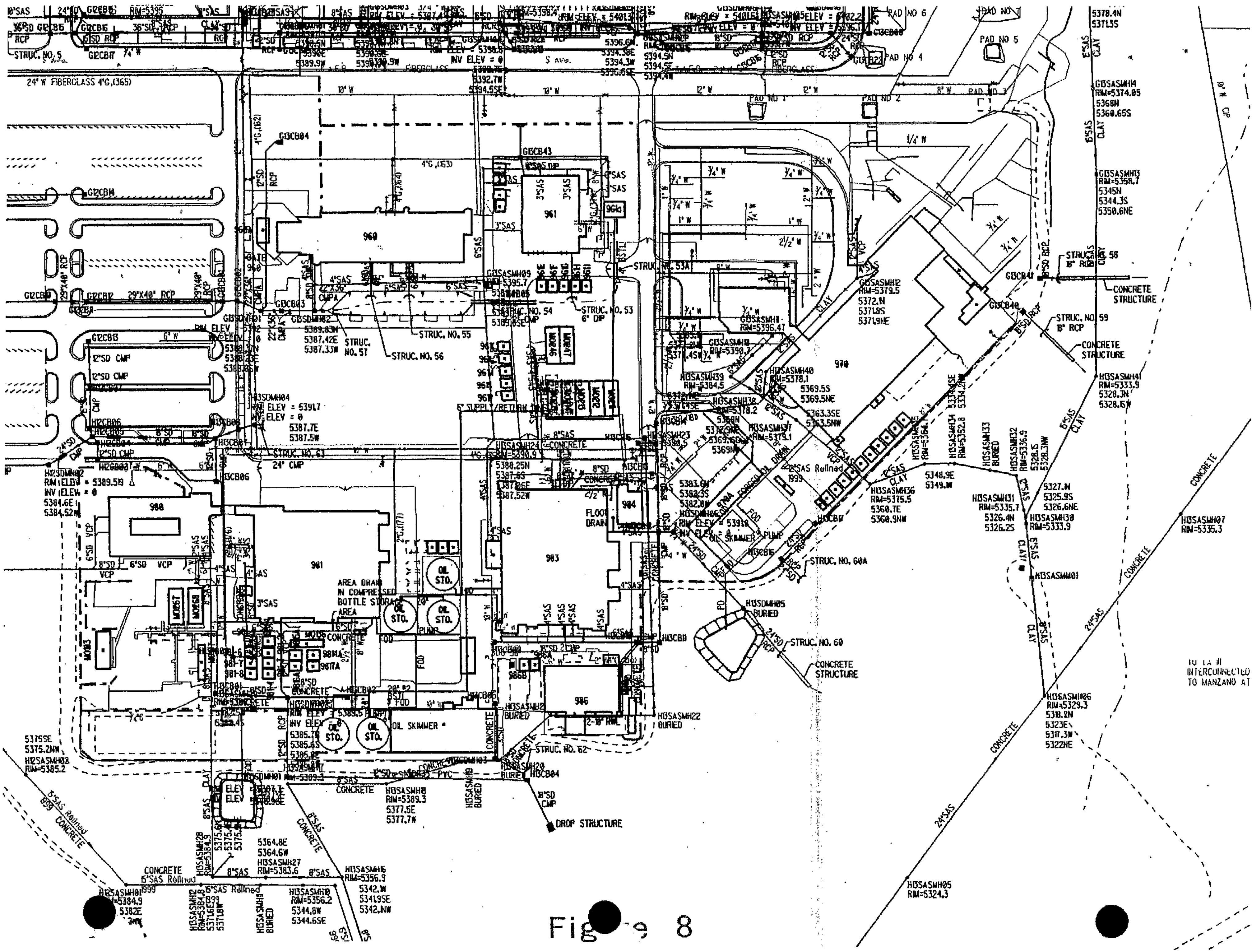


Legend

- ▲ 1994 Soil Sample Location
- ■ Proposed Soil Sample Location
- 2 Foot Contour
- Previous location of buried TA-IV Outfall Pipe
- SWMU 234
- SWMU 46

Figure 7 Proposed Sampling Locations for SWMU 234

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

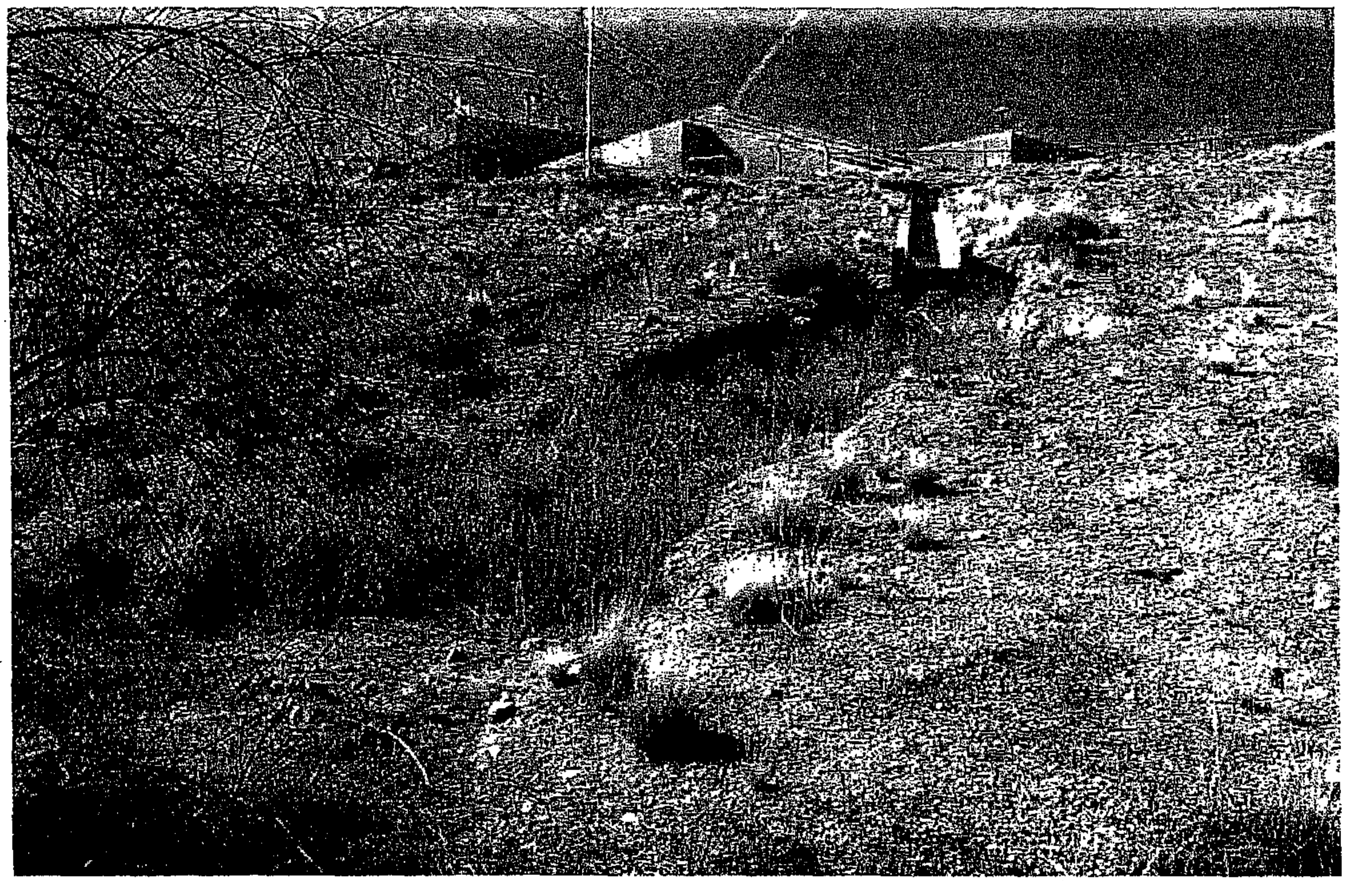


24" W FIBERGLASS 4"C,(365)
STRUC. NO. 5
PAD NO 1
PAD NO 2
PAD NO 3
PAD NO 4
PAD NO 5
PAD NO 6
PAD NO 7
960
961
970
980
983
984
986
STRUC. NO. 53
STRUC. NO. 53A
STRUC. NO. 54
STRUC. NO. 55
STRUC. NO. 56
STRUC. NO. 57
STRUC. NO. 58
STRUC. NO. 59
STRUC. NO. 60
STRUC. NO. 60A
STRUC. NO. 61
STRUC. NO. 62
CONCRETE STRUCTURE
DROP STRUCTURE
OIL SKIMMER
OIL STO.
AREA DRAIN IN COMPRESSED BOTTLE STORAGE AREA
FLOOR DRAIN
6" SUPPLY/RETURN
TO TA III INTERCONNECTED TO MANZANO AT

Fig e 8

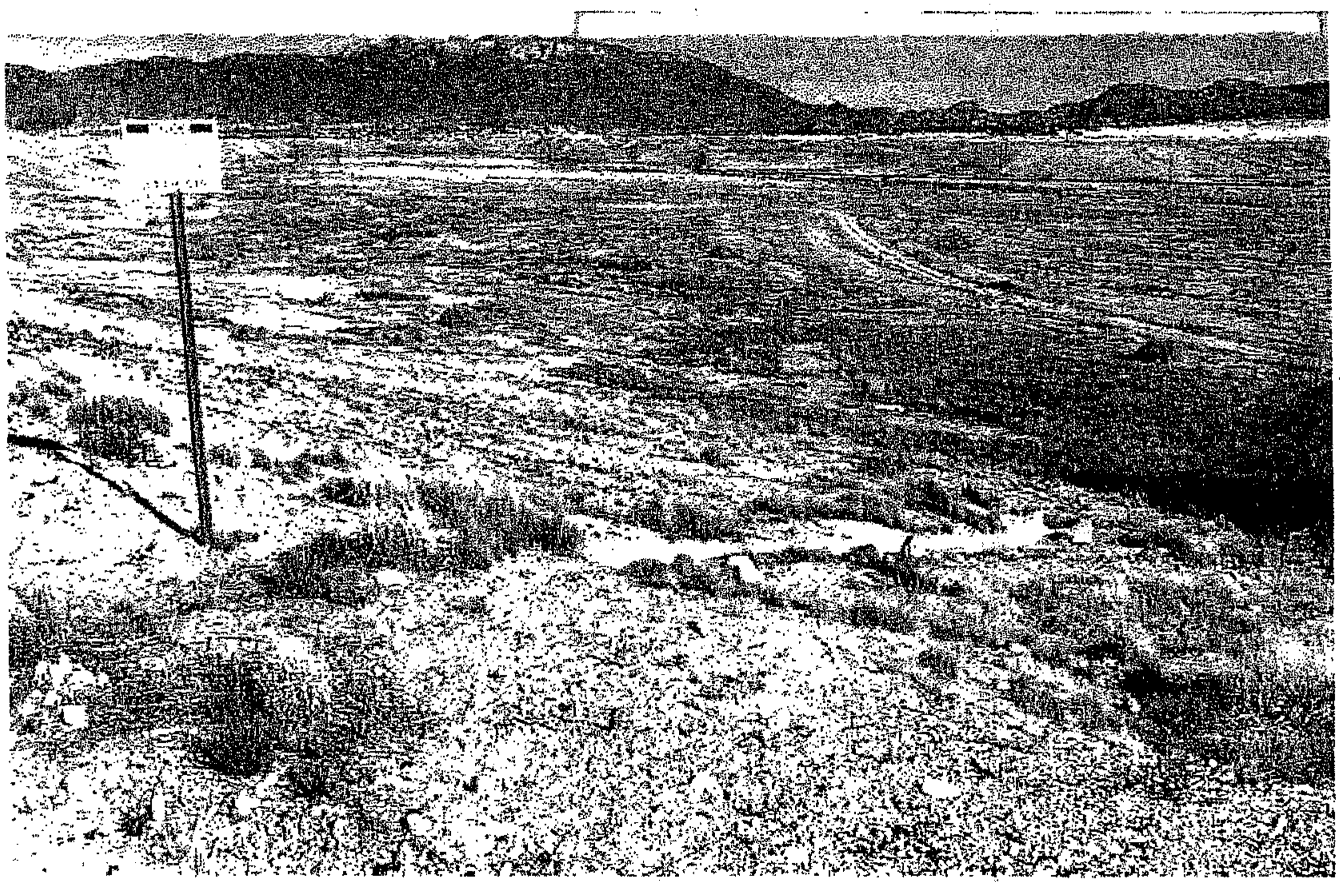
Photograph 1: ER Site 230

Site boundary encompasses the tumbleweed-filled earthen ditch. Lower end of the concrete ditch is the storm-water discharge point where the site begins. Tree at left marks the approximate lower end of the site. [field visit - 29 Nov 2000]



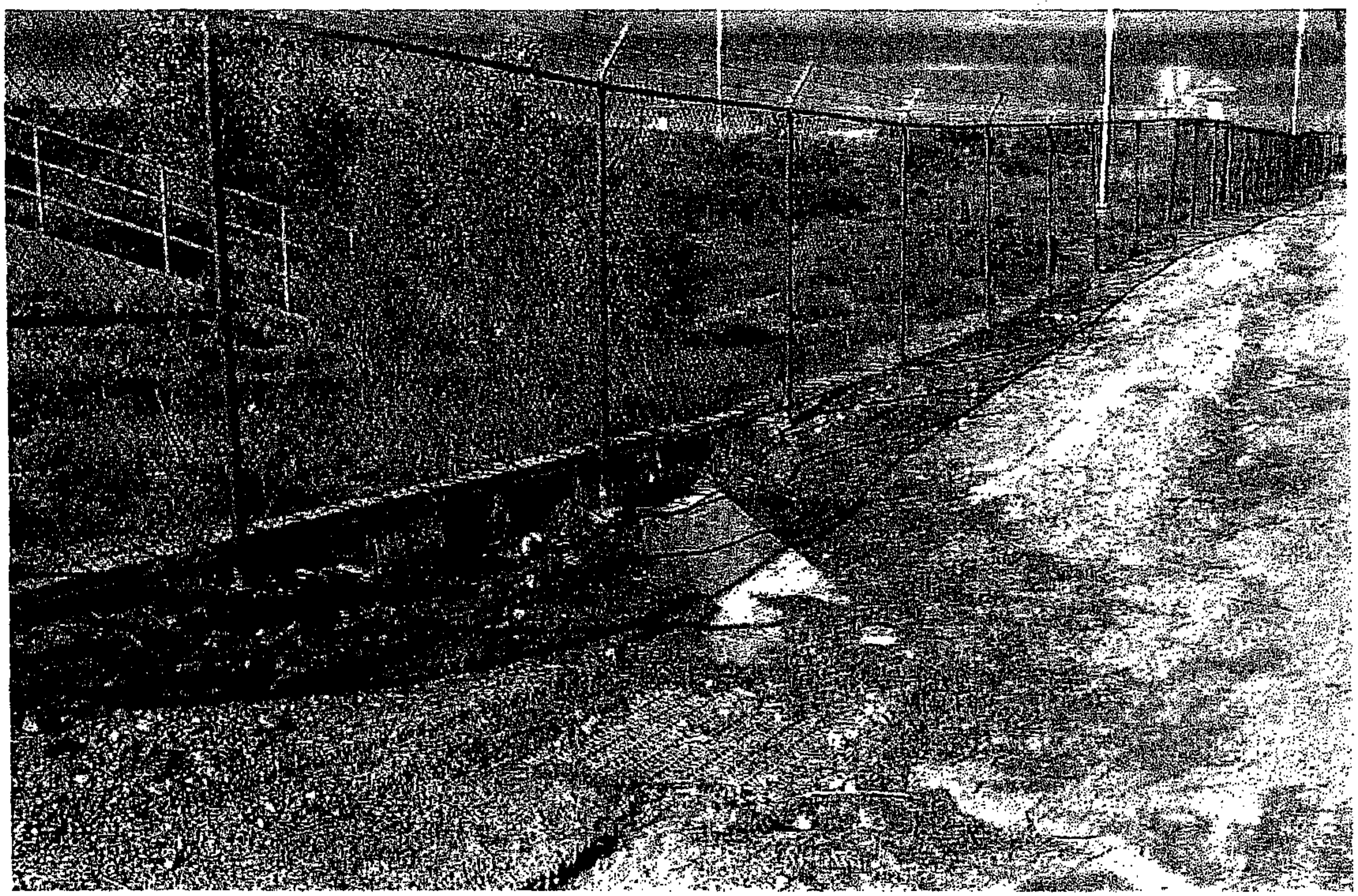
Photograph 2: ER Site 230

ER sign is located about 60 ft west of the site, which starts below the concrete ditch at extreme right of photograph. [field visit - 29 Nov 2000]



Photograph 3: ER Site 230

The storm-water grate next to the TA-IV fence is plumbed to the concrete ditch above ER Site 230. The grate is located approximately 80 ft west of the site.
[field visit - 29 Nov 2000]



Photograph 4: ER Site 231

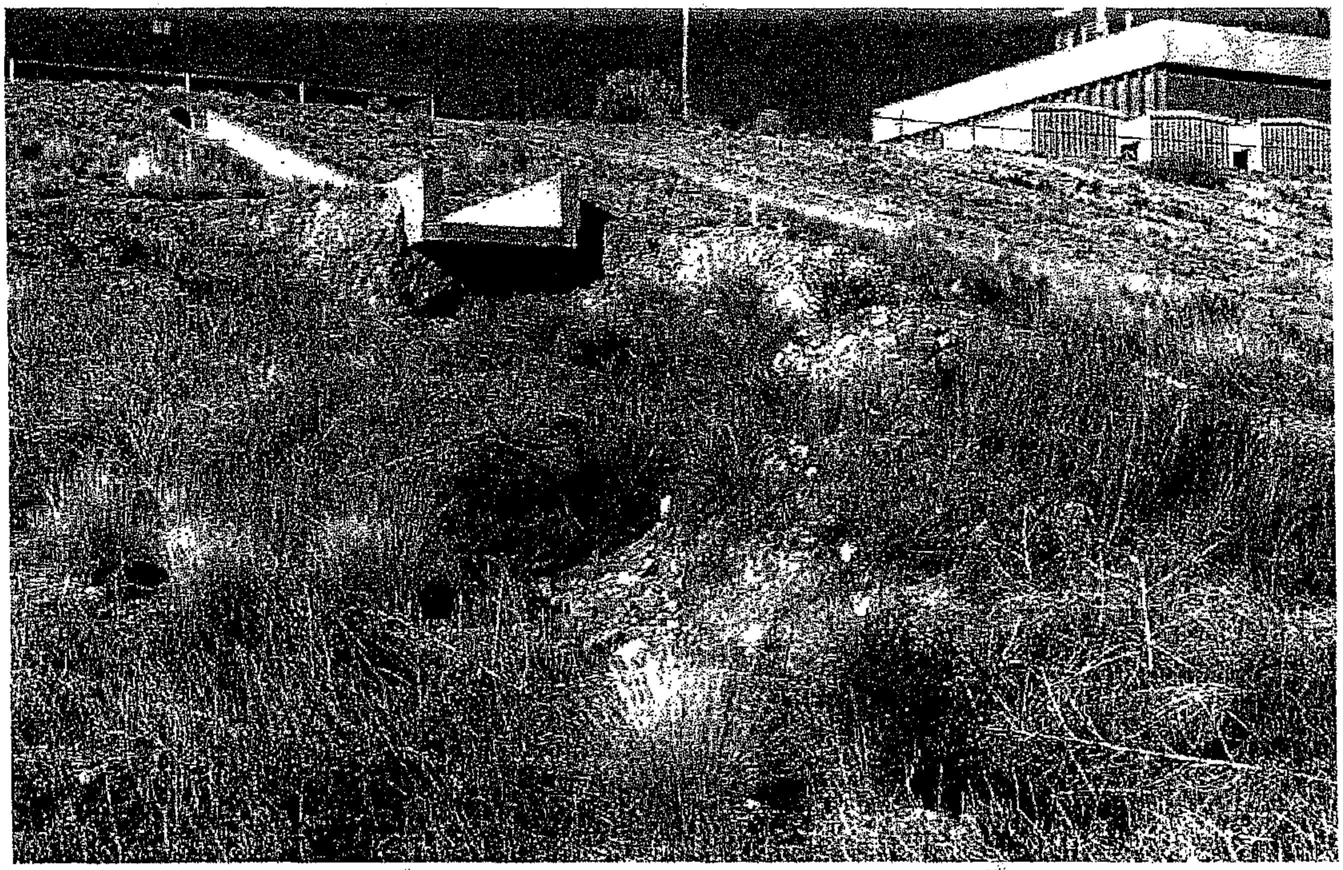
Site begins at the lower end of the concrete ditch where storm-water discharges onto the ground surface. [field visit - 29 Nov 2000]

Photograph 5: ER Site 231

ER sign is located about 120 ft northwest of the site, which begins at the lower end of the concrete ditch. [field visit - 29 Nov 2000]

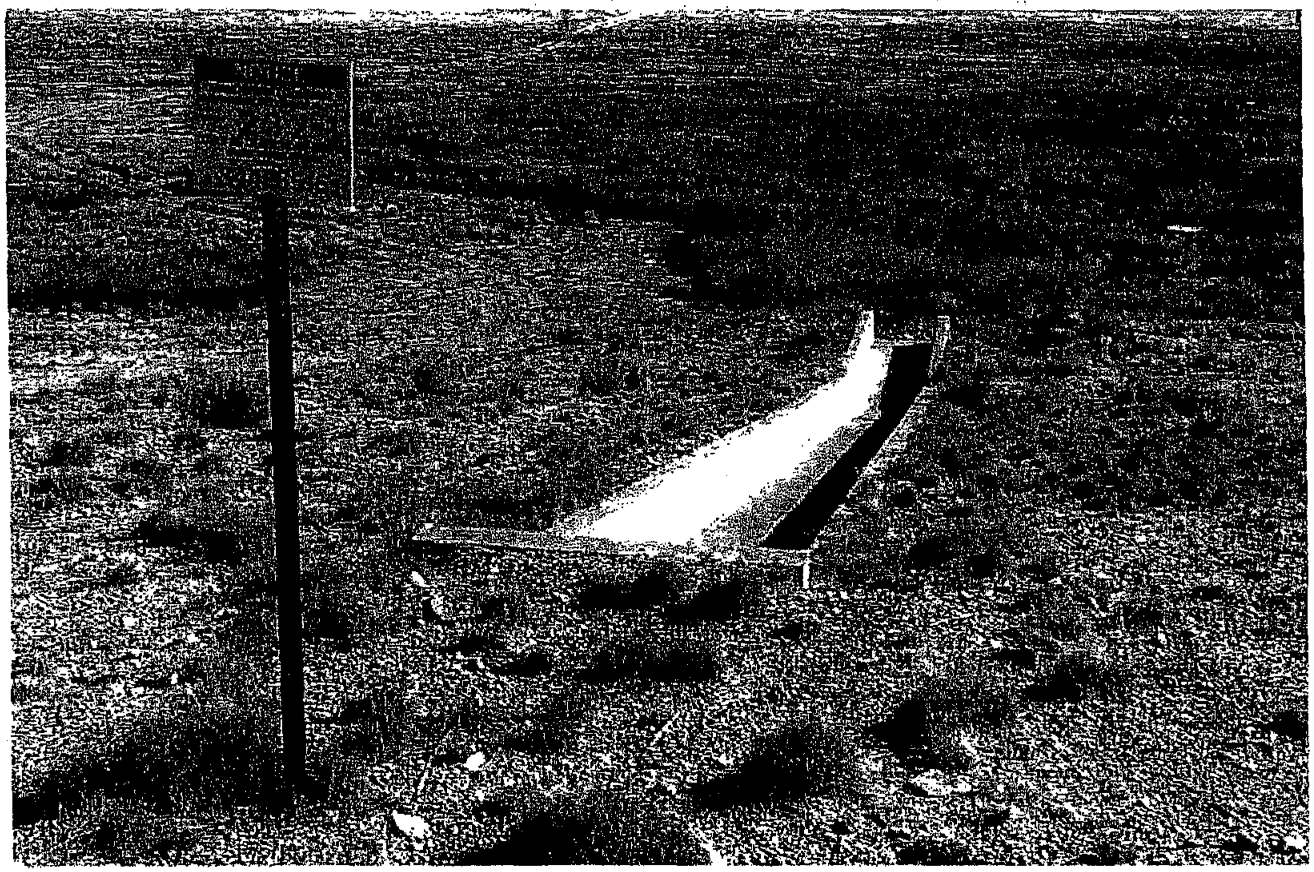
Photograph 6: ER Site 232-1

Site boundary encompasses the tumbleweed-filled earthen ditch. Lower end of concrete ditch is the storm-water discharge point where the site begins. [field visit - 29 Nov 2000]



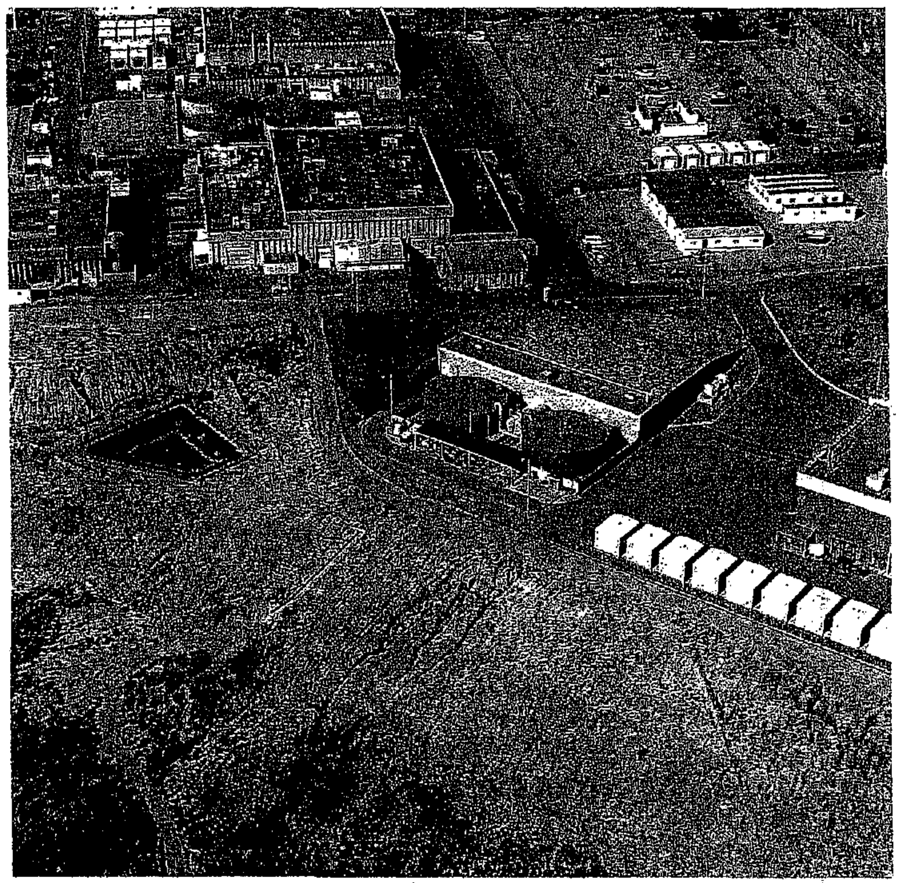
Photograph 7: ER Site 232-1

ER sign is located about 90 ft northwest of the site, which begins just below the concrete ditch. [field visit - 29 Nov 2000]



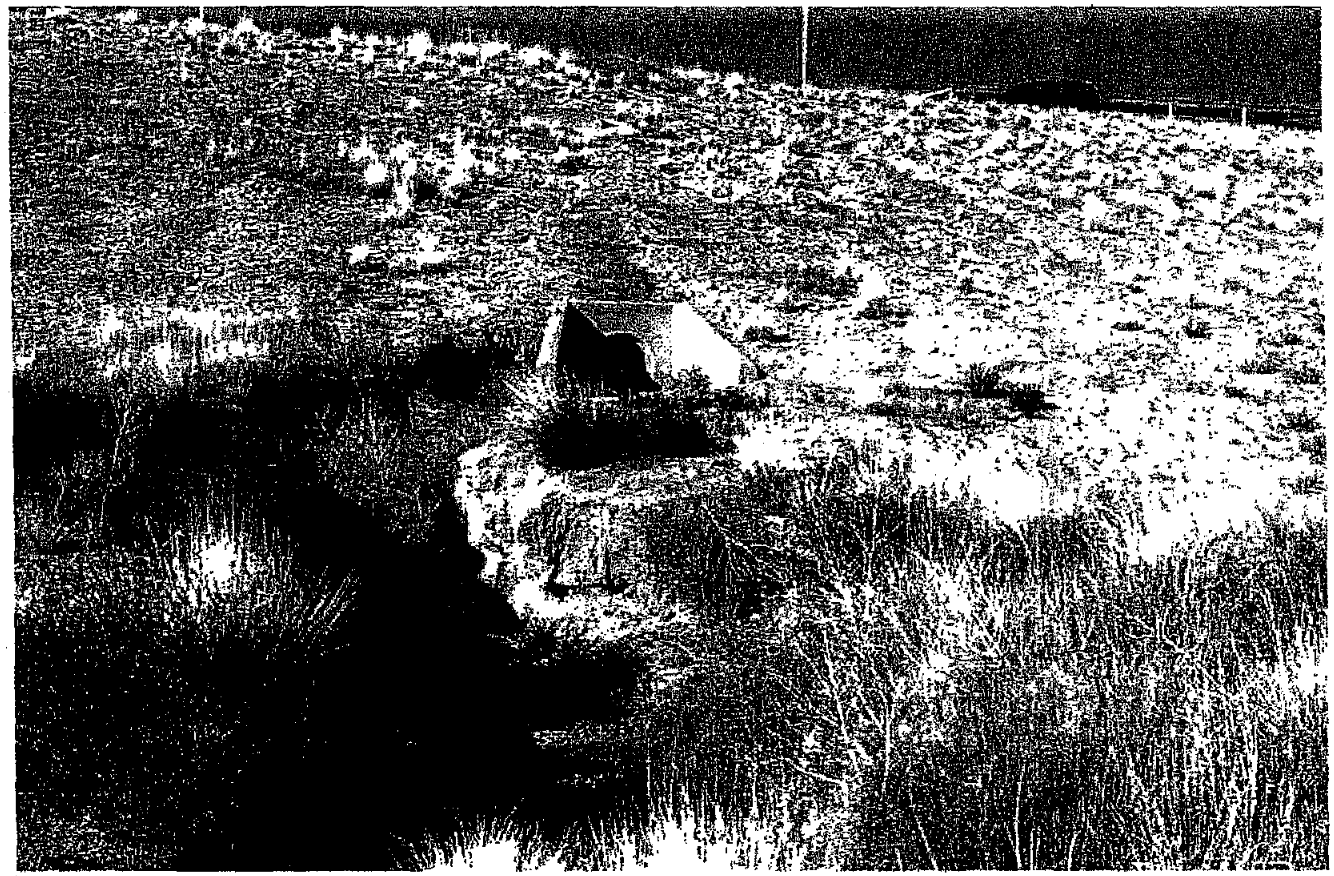
Photograph 8: ER Sites 232-1 and 232-2

Concrete ditch above ER Site 232-1 is clearly visible in left center of photograph.
The drop structure above ER Site 232-2 is located farther left.
[oblique aerial view to west, early 1990s]



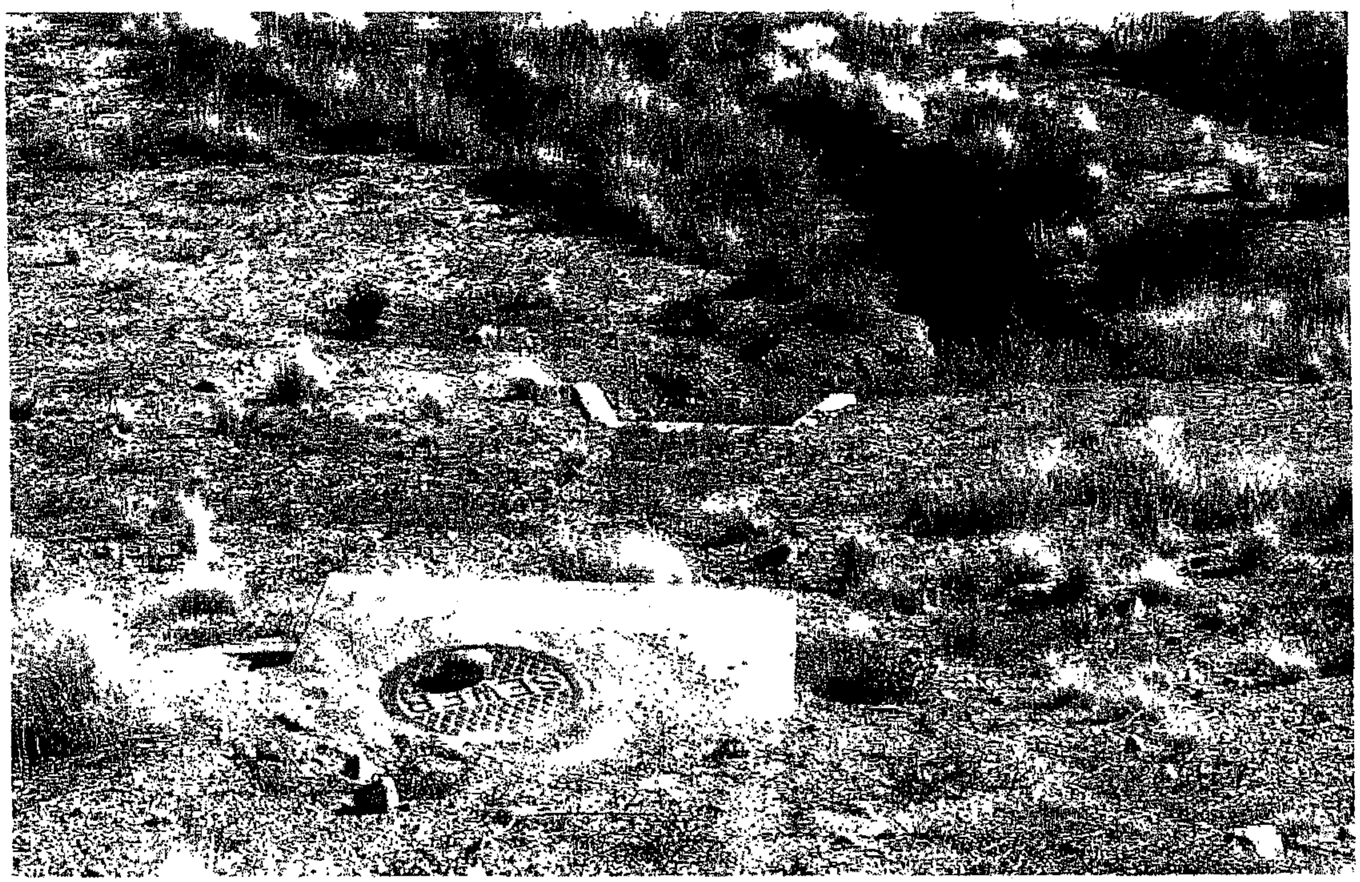
Photograph 9: ER Site 232-2

Site boundary encompasses the earthen ditch below the headwall and outfall pipe.
[field visit - 29 Nov 2000]



Photograph 10: ER Site 232-2

Site boundary encompasses the earthen ditch below the headwall. The storm-water access box has a misleading 'sewer' manhole. [field visit - 29 Nov 2000]

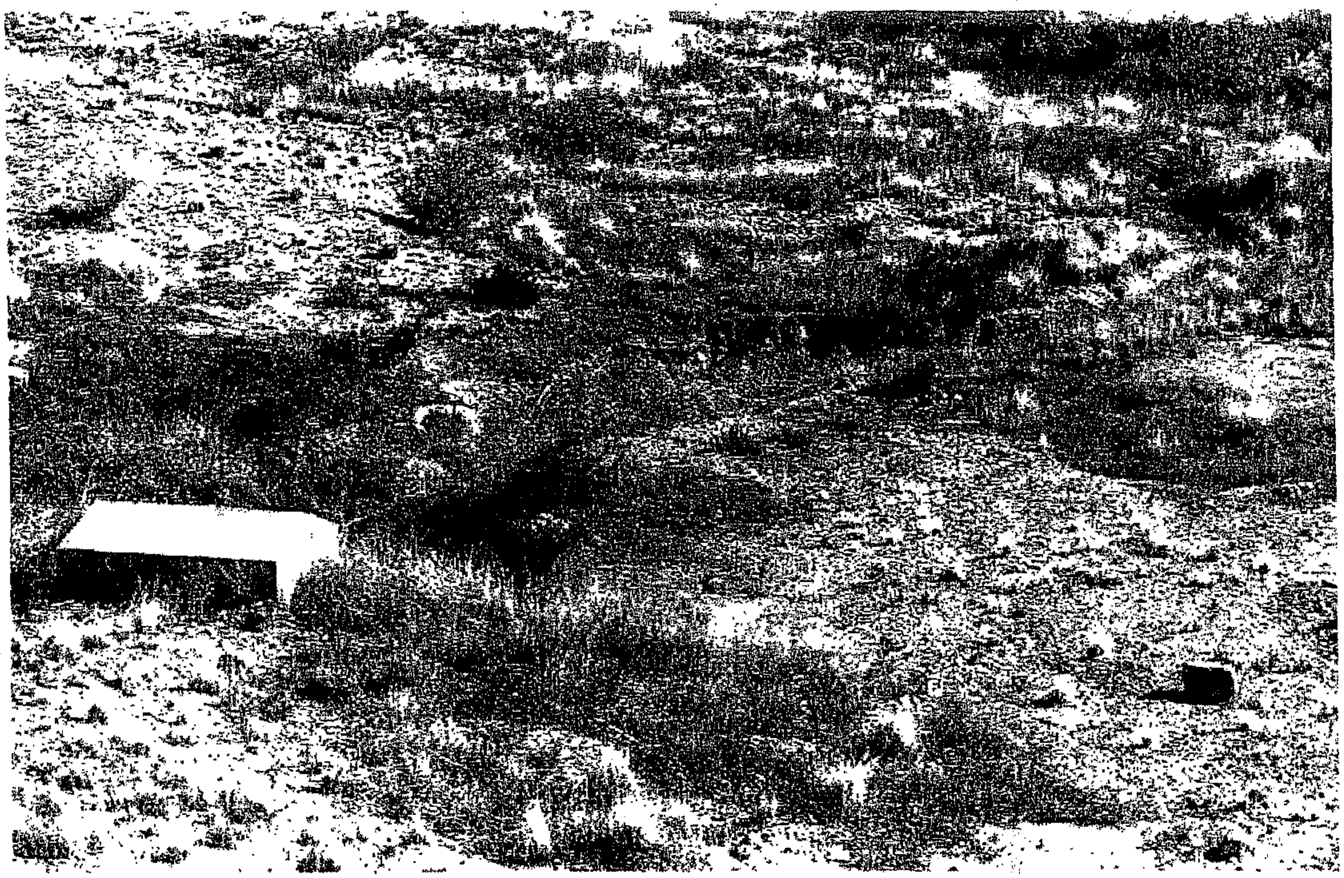


Photograph 11: ER Site 233

Site begins at the storm-water discharge point located between the headwall and the red storm-water grate in left center of photograph. Telephone pole with electrical box is at upper left corner of photograph. [field visit - 29 Nov 2000]

Photograph 12: ER Site 233

Drop structure on left side of photograph is the second storm-water discharge point at ER Site 233. [field visit - 29 Nov 2000]

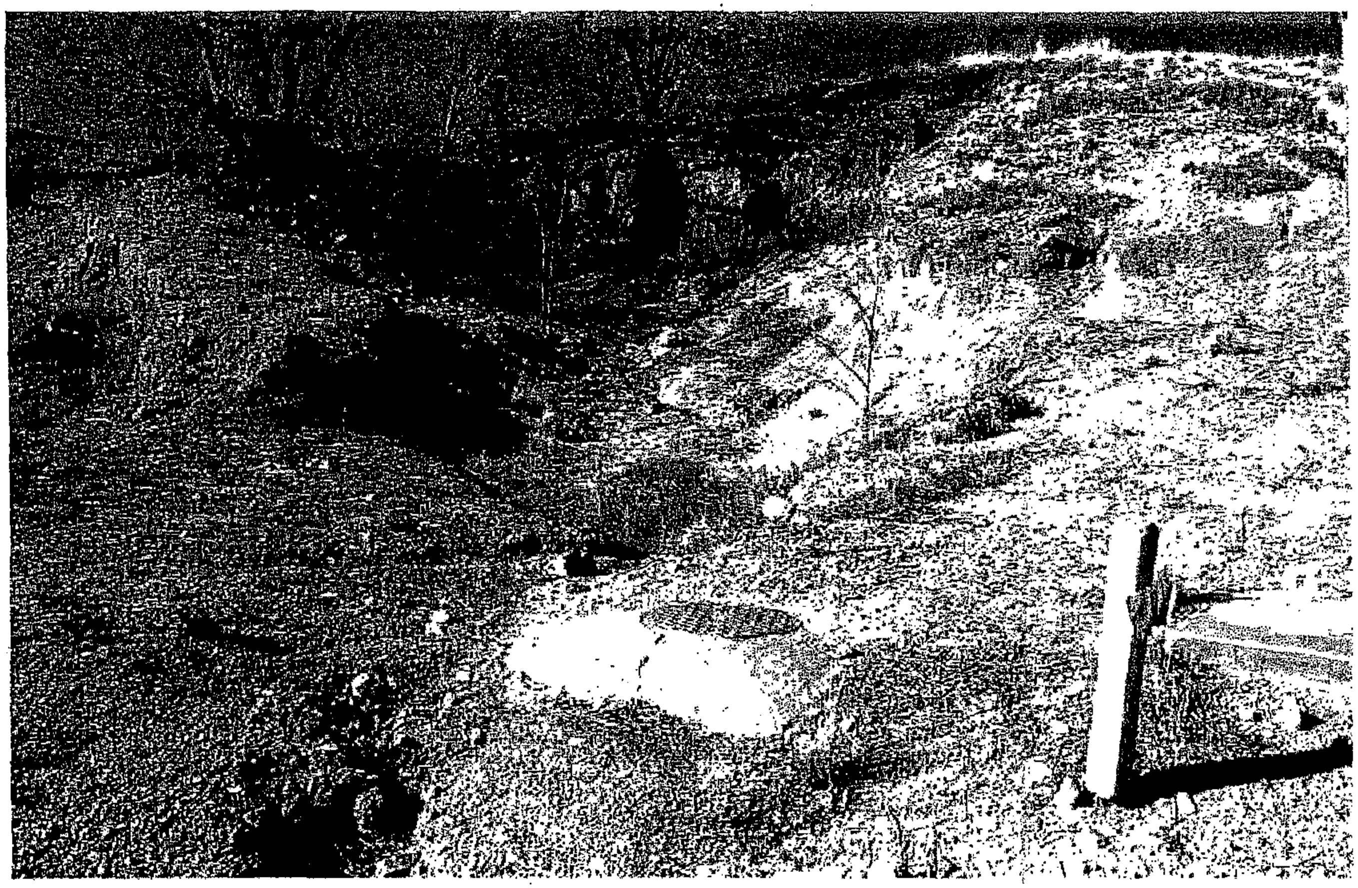


Photograph 13: ER Site 233

Site boundary extends from near the telephone pole on skyline, through the drop structure, and along the earthen ditch in foreground. [field visit - 29 Nov 2000]

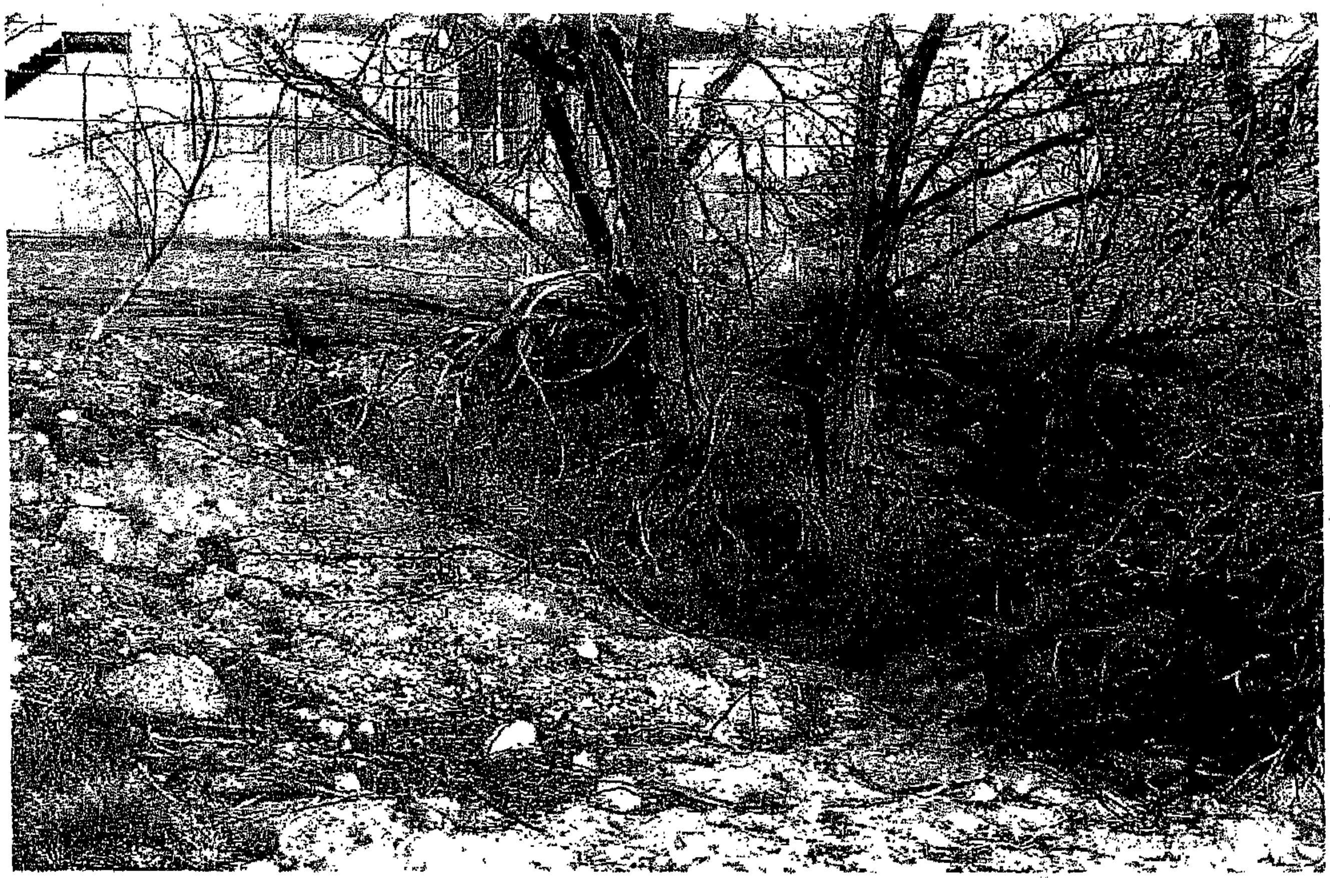
Photograph 14: ER Site 234

Site boundary encompasses the earthen ditch that extends from the previous storm-water discharge point (located near the highest tree in top center of photograph) to the sewer manhole in foreground. The manhole and adjacent electrical vault are not part of the site.
[field visit - 29 Nov 2000]



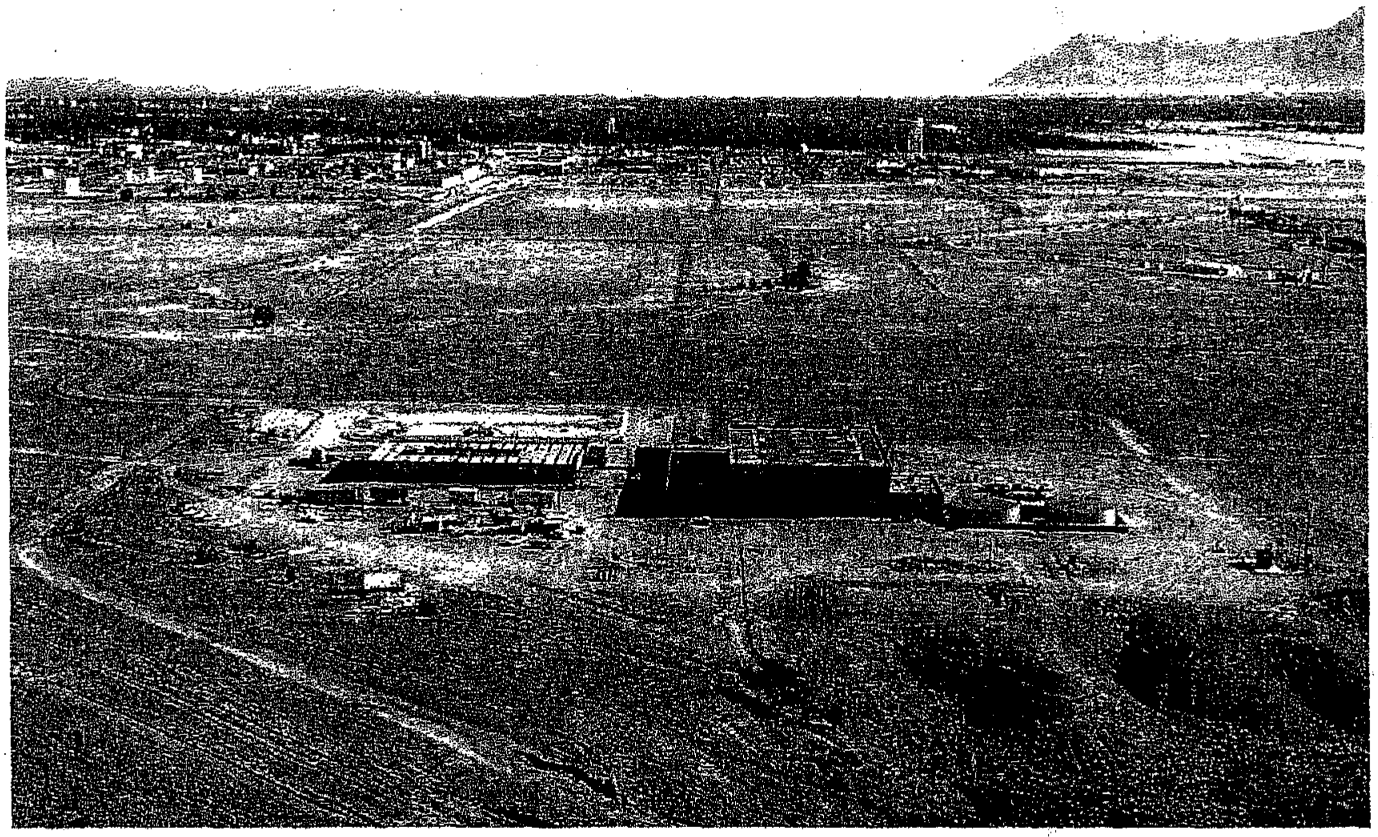
Photograph 15: ER Site 234

Trees and concrete rubble partially obscure the ditch where storm water from the ER Site 234 pipe previously discharged. TA-I waste water from outfall ditch OD-3 also discharged here prior to the construction of TA-IV. [field visit - 29 Nov 2000]



Photograph 16: ER Sites 46 and 234

Construction of TA-IV and a trench for the storm-sewer outfall pipe that drained to ER Site 234. A "new" surface-water ditch cuts across the lower-left corner of photograph. The nearby outfall ditch OD-1 is marked by trees.
[oblique aerial view to north, 1978]



Photograph 17: ER Site 46

Steel-rebar markers were placed in August 2000 to mark the surviving segments of acid-waste line outfall ditches OD-1 and OD-2. The upper part of ER Site 234 is located along the trees. [field visit - 29 Nov 2000]

Photograph 18: ER Site 234

The steel-rebar marker in left center of photograph was placed in August 2000 to mark where the storm-sewer outfall pipe was previously located. [field visit - 29 Nov 2000]

ATTACHMENT G
SWMU 234 Risk Screening Assessment Report

TABLE OF CONTENTS

LIST OF TABLES

SWMU 234: RISK SCREENING ASSESSMENT REPORT

I. Site Description and History

Solid Waste Management Unit (SWMU) 234 (the Storm Drain System Outfall) at Sandia National Laboratories/New Mexico (SNL/NM) is located about 145 feet south of Technical Area (TA)-IV on land that is owned by Kirtland Air Force Base (KAFB) and leased to the U.S. Department of Energy (DOE). SWMU 234 encompasses 0.15 acres of unpaved ground, consisting of a 270-foot-long earthen ditch that previously received storm water from a paved parking lot and storage yards located on the south side of Building 981. Storm water discharged at the site from the early 1980s through the early 1990s and was directed to the site via buried piping. The outfall was built in the early 1980s for the purpose of reducing the amount of soil erosion caused by storm water. The site is situated at the slope break between the steeply sloping, northern rim of Tijeras Arroyo and the nearly flat floodplain below. The vicinity of SWMU 234 is unpaved. Ground elevations at the site range from 5,385 to 5,341 feet, above mean sea level (SNL/NM April 1995).

SWMU 234 is one of five storm-water outfalls that have been connected to TA-IV; the other four are SWMUs 230, 231, 232, and 233. The TA-IV storm-water outfalls are managed under two separate regulatory programs (the Environmental Restoration [ER] Project for RCRA Corrective Action, and the Storm Water Program annual reporting for National Pollutant Discharge Elimination System [NPDES] compliance). The outfalls were added to the SWMU list in 1993, even though no chemical releases had been reported for the catchment areas. Similarly, no stained soil has been identified at SWMU 234 during inspections conducted between 1993 and 2002. In 1994, the ground surface was surveyed for unexploded ordnance/high explosives and radioactive materials; no anomalies were detected. In September 2000, a review of historical aerial photography revealed that TA-I waste water from SWMU 46 had discharged into the same area as SWMU 234. This discharge of waste water occurred from 1948 to 1973.

In the June 1995 No Further Action (NFA) Proposal for SWMU 234, the potential contaminants of concern (COCs) were considered to be chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, and mineral oil. This list of COCs was conservatively based upon chemicals used at TA-IV. The analytes of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), Resource Conservation and Recovery Act (RCRA) metals, and chromium-VI are indicative of the COCs.

The TA-IV outfalls discharge storm water about a dozen days per year in response to significant precipitation, typically resulting from summer thunderstorms. The outfalls do not discharge industrial waste water or septic waste. The SNL/NM Storm Water Program collects TA-IV storm-water samples from Station 6 and reports the water quality data in the annual SNL/NM Site Environmental Report. Except for a mineral-oil spill at SWMU 232-2 in 1994, no chemical releases have been reported at the TA-IV storm-water outfalls. None of the outfalls have been on the SNL/NM radioactive materials management area list.

The annual precipitation for the area, as measured at the Albuquerque International Sunport, is 8.1 inches. During most rainfall events, rainfall quickly infiltrates the soil near SWMU 234. However, virtually all of the moisture subsequently undergoes evapotranspiration. The estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall.

No springs or other perennial surface-water bodies are located within four miles of SWMU 234, which is located approximately 1,800 feet north of the active channel of Tijeras Arroyo, but is not within the 100-year floodplain. Surface water flows only about several times per year in that segment of the active channel nearest TA-IV. Tijeras Arroyo is the most significant surface-water drainage feature on KAFB. The arroyo originates in Tijeras Canyon, which is bounded by the Sandia Mountains to the north and the Manzano Mountains to the south. The arroyo trends southwest across KAFB, eventually merging with the Rio Grande, approximately 8.3 miles west of SWMU 234.

Groundwater monitoring for the area surrounding SWMU 234 is conducted as part of the Tijeras Arroyo Groundwater (TAG) Investigation. Two water-bearing zones, the shallow groundwater system and the regional aquifer, underlie SWMU 234. The shallow groundwater system is not used for water supply purposes. The depth to the shallow groundwater system is approximately 300 feet below ground surface (bgs). The depth to the regional aquifer is approximately 470 feet bgs. Both the City of Albuquerque and KAFB utilize the regional aquifer as a water supply source. The nearest downgradient water-supply well is KAFB-1, which is located approximately 1.4 miles northwest of the site.

Grasslands, including such species as blue/black gramma and western cheatgrass, are the dominant plant community surrounding SWMU 234. The site also is vegetated by ruderal species, such as Russian thistle (tumbleweed). Soil at the site has been identified as the Bluepoint-Kokan Association (USDA 1977). For purposes of defining the background levels of metals and radionuclides in soil, this soil has been included as part of the Tijeras Supergroup. The Bluepoint-Kokan Association consists of Bluepoint loamy fine sand, which is developed on slopes of 5 to 15 percent, with Kokan gravelly sand on slopes of 15 to 40 percent. These soils are slightly calcareous and mildly to moderately alkaline. The runoff potential ranges from slow to very rapid, and the hazard of water erosion is slight to severe. The surficial deposits are underlain by the upper unit of the Santa Fe Group (Connell et al. 1999), which consists of coarse- to fine-grained fluvial deposits from the ancestral Rio Grande that intertongue with the coarse-grained alluvial fan/piedmont facies extending westward from the Sandia and Manzano Mountains. The upper Santa Fe Group unit is approximately 3,500 feet thick in the vicinity of the site.

II. Data Quality Objectives

The Data Quality Objectives (DQOs) for SWMU 234 were presented in two documents: the 1994 *Sampling and Analysis Plan for Eleven Sites in Tijeras Arroyo Operable Unit* (SAP) (SNL/NM June 1994) and the 2001 *Tijeras Arroyo Outfalls Field Implementation Plan* (FIP) (SNL/NM May 2001). The two plans identified the site-specific confirmatory locations, sample depths, sampling procedures, and analytical requirements. The DQOs also outlined the Quality Control/Quality Assurance (QA/QC) requirements necessary for producing defensible analytical data suitable for risk assessment purposes. The confirmatory sampling was designed to determine whether soil contamination had resulted from the discharge of TA-IV storm water. Therefore, soil samples were collected along the earthen ditch at locations both beneath and downslope of the storm-water discharge point.

In September 1994, 12 soil samples were collected using either a hand trowel or a hand auger. However, only 6 of the 12 soil samples (234-01-A, 234-01-B, 234-05-A, 234-05-B, 234-06-A, and 234-06-B) were collected from the earthen ditch. Table 1 shows the analyses performed on these six samples, which are representative of the site. Review of historical aerial photographs revealed that the other six samples (234-02-A, 234-02-B, 234-03-A, 234-03-B, 234-04-A, and 234-04-B) were collected at locations where TA-IV storm water had not drained; these analytical results are not included in Table 1 and are not considered in this assessment.

Table 1
Number of Analyses for Samples Collected in 1994 at SWMU 234

Sample Type	VOCs	SVOCs	TPH	RCRA Metals[a]	Radionuclides[b]	Number of Analyses
Soil	3	3	6	6	7	31
VOC trip blank	1	–	–	–	–	1
Total	4	3	6	6	7	32

[a]Includes the eight RCRA metals and chromium-VI.
[b]Includes isotopic analyses (gamma emitters) and tritium.
Sample numbers: 234-01-A, 234-01-B, 234-05-A, 234-05-B, 234-06-A, 234-06-B.
Sampling date: September 1994.
Analysis Request/Chain of Custody forms: 00784, 00804.
RCRA = Resource Conservation and Recovery Act.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TPH = Total petroleum hydrocarbon.
VOC = Volatile organic compound.
– = Information not available.

The sampling at SWMU 234 was conducted as part of a week-long sampling effort that involved most of the TA-IV storm-water outfalls. The maximum sampling depth at SWMU 234 was 3 feet bgs. The soil samples were analyzed for VOCs, SVOCs, total petroleum hydrocarbons (TPH), RCRA metals, chromium-VI, and radionuclides (gamma emitters and tritium). The samples were submitted to Environmental Control Technology Corporation (ENCOTEC), Quanterra, and the on-site SNL/NM Radiation Protection Sample Diagnostic (RPSD) Laboratory.

No VOCs, SVOCs, or TPH were detected in the 1994 soil samples. Two metals (arsenic and barium) were detected at levels slightly above background. No radionuclides were reported above background levels. A VOC trip blank was supplied by ENCOTEC. In accordance with the SAP, the other QA/QC samples (duplicates and equipment [aqueous rinsate] blanks) were collected at nearby SWMUs 230, 232, and 235. No significant QA/QC problems were identified in the QA/QC samples.

In June 2001, soil samples were collected at two locations along the earthen ditch (Table 2) at depths of 0 to 1 foot bgs and 5 to 6 feet bgs, downslope of the storm-water discharge point (the southern end of the concrete ditch). The 0- to 1-foot-bgs samples were collected with a hand trowel. Because of the uneven terrain and the large cobbles that serve as erosion control, a backhoe was used to collect the 5-foot-bgs soil samples from the earthen ditch. The New Mexico Environment Department (NMED) verbally approved use of the backhoe before the sampling was conducted. The soil samples were analyzed for VOCs, SVOCs, TPH, RCRA metals, chromium-VI, and radionuclides (gamma emitters, tritium, and gross alpha/beta). The soil samples were submitted to General Engineering Laboratories Inc. (GEL), and the RPSD Laboratory.

Table 2
Number of Analyses for Samples Collected in 2001 at SWMU 234

Sample Type	VOCs	SVOCs	TPH	RCRA Metals[a]	Radionuclides[b]	Number of Analyses
Soil	3	3	3	3	3	15
Duplicate	1	1	1	1	1	5
VOC Trip Blank	1	–	–	–	–	1
Equipment Blank	1	1	1	1	1	5
Total Samples	6	5	5	5	5	26

[a]Includes the eight RCRA metals and chromium-VI.
[b]Includes isotopic analyses (gamma emitters), gross alpha/beta, and tritium.
Sample numbers: TJAOU-234-GR-07, TJAOU-234-GR-07-DU, and TJAOU-234-GR-08.
Sampling date: June 14, 2001.
Analysis Request/Chain of Custody forms: 604315, 604316, 604568, 604569.
RCRA = Resource Conservation and Recovery Act.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TPH = Total petroleum hydrocarbon.
VOC = Volatile organic compound.
– = Information not available.

No VOCs were reported in the 2001 soil samples. Seventeen SVOCs were reported, with pyrene having the maximum value at only 603 parts per billion (ppb). The maximum TPH concentration was 1,820 ppb. Two metals (chromium and chromium-VI) were reported at concentrations slightly above background. No radionuclides were reported above background levels.

A total of 11 QA/QC analyses are applicable to the June 2001 sampling at SWMU 234. As shown in Table 2, the QA/QC analyses consisted of five soil duplicates, one aqueous VOC trip blank, and five equipment blanks. The duplicate soil samples were collected at a ratio of one duplicate per three environmental samples. The aqueous VOC trip blank was supplied by GEL. Equipment (aqueous rinsate) blanks were prepared for each suite of analytes. No significant problems were identified in the QA/QC samples.

Table 3 summarizes the analytical methods and the data quality requirements from both the SAP and FIP. Excluding the QA/QC samples, a total of 55 analyses were reported for the SWMU 234 confirmatory soil samples. This includes 51 analyses from the off-site laboratories (ENCOTEC, Quanterra, and GEL) and 4 samples from the on-site RPSD laboratory.

The analytical data were verified/validated by SNL/NM in accordance with the ER Project Quality Assurance Project Plan. The 1994 analytical data were reviewed using the Data Verification/Validation (DV) process (SNL/NM July 1994) involving DV1 and DV2 checklists

Table 3
Summary of Data Quality Requirements and Total Number of Analyses for Confirmatory Soil Samples Collected at SWMU 234

Analytical Method[a]	Data Quality Level	Analyses from Off-Site Laboratories[b]	Analyses from On-Site Laboratory[c]
VOCs EPA Method 8260A	Defensible	6	–
SVOCs EPA Method 8270	Defensible	6	–
TPH EPA Method 8015	Defensible	9	–
RCRA metals EPA Method 6010/7000	Defensible	9	–
Chromium-VI EPA Method 6010/7000	Defensible	9	–
Gamma Spectroscopy EPA Method 901.1	Defensible	4	4
Tritium EPA Method 901.1	Defensible	5	–
Gamma Alpha/Beta EPA Method 900	Defensible	3	–
Total number of analyses[d]	–	51	4

[a]From EPA (November 1986).
[b]The off-site laboratories are ENCOTEC, Quanterra, and GEL.
[c]The on-site laboratory is the Radiation Protection Sample Diagnostic Laboratory.
[d]The number of analyses does not include QA/QC samples.
EPA = U.S. Environmental Protection Agency.
GEL = General Engineering Laboratories Inc.
QA/QC = Quality assurance/quality control.
RCRA = Resource Conservation and Recovery Act.
SVOC = Semivolatile organic compound.
SWMU = solid waste management unit.
TPH = Total petroleum hydrocarbon.
VOC = Volatile organic compound.

(Attachment M). The 2001 analytical data were reviewed using DV3 procedures according to the "Data Validation Procedure for Chemical and Radiochemical Data" SNL/NM Environmental Restoration Project Analytical Operating Procedure (AOP) 00-03, Rev. 0 (SNL/NM January 2000). The DV3 reports are presented in Attachment M. The gamma-spectroscopy data from the RPSD Laboratory were reviewed according to "Laboratory Data Review Guidelines," Procedure No: RPSD-02-11, Issue No: 02 (SNL/NM July 1996). The RPSD gamma-spectroscopy results are presented in Attachment M. Review of the 1994 and 2001 analyses confirm that the analytical data from the four analytical laboratories are defensible and therefore acceptable for use in the NFA proposal. Therefore, the DQOs have been fulfilled.

III. Determination of Nature, Rate, and Extent of Contamination

III.1 Introduction

The determination of the nature, migration rate, and extent of contamination at SWMU 234 was based upon an initial conceptual model validated with confirmatory soil sampling. The initial conceptual model was developed from the review of engineering drawings, ER Project records, and NPDES documents. The DQOs contained in the SAP and FIP identified the sample locations, sample density, sample depth, and analytical requirements. The sample data were subsequently used to develop the final conceptual model for SWMU 234. The quality of the data used to specifically determine the nature, migration rate, and extent of contamination is described below.

III.2 Nature of Contamination

Both the nature of contamination and the potential for the degradation of COCs at SWMU 234 were evaluated using laboratory analyses of the confirmatory soil samples (Section IV). The requirements included analyses for VOCs, SVOCs, RCRA metals, chromium-VI, and radionuclides. The analyses characterized any potential contaminants resulting from the discharge of TA-IV storm water. The analytes and methods listed in Table 3 are appropriate for characterizing the COCs and potential degradation products at SWMU 234.

III.3 Rate of Contaminant Migration

SWMU 234 is an inactive site. No spills of chemical or radioactive materials have been reported for the catchment area that previously drained to SWMU 234. If any spills or releases had occurred, the rate of COC migration from surficial soil would be dependent predominantly upon precipitation and occasional storm-water flow as described in Section V. Data available from the TAG Investigation; numerous SNL/NM monitoring programs for air, water, and radionuclides; various biological surveys; and meteorological monitoring are adequate for characterizing the rate of COC migration at SWMU 234.

III.4 Extent of Contamination

Surface and subsurface confirmatory soil samples were collected from SWMU 234 in 1994 and 2001 to determine whether contaminants were present. The locations and depths of the 2001 samples were determined using verbal guidance from NMED. The two phases (1994 and 2001) of confirmatory soil sampling were collected from the ground surface to a maximum depth of 5 feet. Sampling at a more extensive variety of depths was not a concern at SWMU 234 because no chemical spills had occurred, and neither the concrete ditch nor the surrounding soil were stained or discolored. In summary, the design of the confirmatory sampling was appropriate and adequate to determine the nature, migration rate, and extent of residual COCs in surface and subsurface soils at SWMU 234.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities were used to identify potential COCs. The SWMU 234 NFA proposal describes the identification of COCs and the sampling that was conducted in order to determine the concentration levels of those COCs across the site. Generally, COCs evaluated in this risk assessment include all detected organic and all radiological and inorganic COCs for which samples were analyzed. When the detection limit of an organic compound was too high (i.e., could possibly cause an adverse effect to human health or the environment), the compound was retained. Nondetect organic constituents not included in this assessment were found to have detection limits low enough to ensure protection of human health and the environment. In order to provide conservatism in this risk assessment, the calculation used only the maximum concentration value of each COC found for the entire site. The SNL/NM maximum background concentration (Dinwiddie September 1997, Tharp 1999) was selected to provide the background screening listed in Tables 4 and 5. Human health nonradiological COCs also were compared to SNL/NM proposed Subpart S action levels, if applicable (Table 4) (IT July 1994).

Nonradiological inorganic constituents that are essential nutrients, such as iron, magnesium, calcium, potassium, and sodium, were not included in this risk assessment (EPA 1989). Both radiological and nonradiological COCs were evaluated. The nonradiological COCs included both organic and inorganic compounds.

Table 4 lists nonradiological COCs and Table 5 lists the radiological COCs for the human health and ecological risk assessments at SWMU 234. Each table shows the applicable SNL/NM background concentration screening values (Dinwiddie September 1997, Tharp 1999). Tables 4 and 5 are discussed in Sections VI.4, VII.2, and VII.3.

V. Fate and Transport

The primary release of COCs at SWMU 234 may have occurred to the surface soil as a result of discharge of storm-water runoff from TA-IV. Wind, water, and biota are natural mechanisms of COC transport from the primary release point. Because the site is a deeply incised channel with surrounding vegetation, wind is unlikely to be a significant mechanism for COC transport from the site.

Water at SWMU 234 was received primarily as storm-water discharge from TA-IV. Storm-water runoff was released at an outfall near the top of the northern embankment of Tijeras Arroyo. Below the outfall, this water flowed through an open, unlined channel toward Tijeras Arroyo. This channel split into multiple channels as it descended the embankment. Additional water received at this site includes precipitation (rain and occasionally snow). Based upon the average rainfall measured at the nearby Albuquerque International Sunport, the site receives approximately 8.1 inches of precipitation per year.

Because of the relatively steep slope of the open channel, surface water readily flows from the site, allowing little time to infiltrate. However, the coarse nature of the soil in the channel allows for rapid infiltration and percolation of surface water near the soil surface. Water that infiltrates into the soil will continue to percolate through the soil until field capacity is reached. COCs may be leached deeper into the subsurface soil with this percolation. Evapotranspiration rates in the area of the site are high (averaging approximately 95 to 99 percent of the water received as

Table 4
Nonradiological COCs for Human Health and Ecological Risk Assessment at SWMU 234 with Comparison to the Associated SNL/NM Background Screening Value, BCF, Log K_{ow}

COC Name	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K_{ow} (for organic COCs)	Bioaccumulator?[b] (BCF>40, log K_{ow}>4)
Arsenic	7	4.4	No	44[c]	NA	Yes
Barium	240	200	No	170[d]	NA	Yes
Beryllium	0.496	0.80	Yes	19[c]	NA	No
Cadmium	2.9	<1	No	64[c]	NA	Yes
Chromium, total	17.7	16.2	No	16[c]	NA	No
Chromium VI	2.08	NC	Unknown	16[c]	NA	No
Lead	13	11.2	No	49[c]	NA	Yes
Mercury	0.0603	<0.1	Unknown	5500[c]	NA	Yes
Selenium	0.13[g]	<1	Unknown	800[f]	NA	Yes
Silver	1	<1	No	0.5[c]	NA	No
Acenaphthene	0.00626 J	NA	NA	389[e]	3.92[e]	Yes
Anthracene	0.0212 J	NA	NA	917[c]	4.45[c]	Yes
Benzo(a)anthracene	0.258	NA	NA	10,000[e]	5.61[e]	Yes
Benzo(a)pyrene	0.435	NA	NA	3,000[c]	6.04[c]	Yes
Benzo(b)fluoranthene	0.506	NA	NA	–	6.124[e]	Yes
Benzo(ghi)perylene	0.309	NA	NA	58,884[e]	6.58[e]	Yes
Benzo(k)fluoranthene	0.471	NA	NA	93,325[e]	6.84[e]	Yes
Bis (2-ethylhexyl) phthalate	0.0803	NA	NA	851[h]	7.6[e]	Yes
Carbazole	0.0182 J	NA	NA	–	–	–
Chrysene	0.435	NA	NA	18,000[e]	5.91[e]	Yes
Di-n-butyl phthalate	0.0207 J	NA	NA	6,761[h]	4.61[e]	Yes
Di-n-octyl phthalate	0.0102 J	NA	NA	9,334[e]	5.22[e]	Yes
Fluoranthene	0.450	NA	NA	12,302[e]	4.90[e]	Yes

Refer to footnotes at end of table.

Table 4 (Concluded)
Nonradiological COCs for Human Health and Ecological Risk Assessment at SWMU 234 with Comparison to the Associated SNL/NM Background Screening Value, BCF, Log K_{ow}

COC Name	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K_{ow} (for organic COCs)	Bioaccumulator?[b] (BCF>40, log K_{ow}>4)
Fluorene	0.00666 J	NA	**NA**	2,239[e]	4.18[e]	**Yes**
Indeno(1,2,3-c,d)pyrene	0.345 J	NA	**NA**	59,407[e]	6.58[e]	**Yes**
Phenanthrene	0.139	NA	**NA**	23,800[c]	4.63[c]	**Yes**
Pyrene	0.603	NA	**NA**	36,300[c]	5.32[e]	**Yes**

Note: **Bold** indicates the COCs that exceed the background screening values and/or are bioaccumulators.
[a]From Dinwiddie (September 1997) Tijeras Supergroup Soils.
[b]NMED (March 1998).
[c]Yanicak (March 1997).
[d]Neumann (1976).
[e]Micromedex(1998)
[f]Callahan et al. (1979).
[g]Parameter was nondetect. Concentration is approximately 0.5 of the detection limit.
[h]Howard (1989)
[i]Howard (1990)

B = Constituent was found in associated blank.
BCF = Bioconcentration factor.
COC = Constituent(s) of concern.
J = Estimated value.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NC = Not calculated.
NMED = New Mexico Environment Department.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
– = Information not available.

Table 5
Radiological COCs for Human Health and Ecological Risk Assessment at SWMU 234 with Comparison to the Associated SNL/NM Background Screening Value and BCF

COC Name	Maximum Concentration (pCi/g)	SNL/NM Background Concentration (pCi/g)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Is COC a Bioaccumulator?[b] (BCF>40)
Th-232	**6.46**	1.54	**No**	3000[c]	No[d]
U-238	**1.79**	1.3	**No**	900[c]	**Yes**
U-235	0.278 (MDA)	0.18	**No**	900[c]	**Yes**
H-3	0.006 (MDA)	0.021[e]	Yes	0	No

Note: **Bold** indicates COCs that exceed background screening values and/or are bioaccumulators.
[a]From Dinwiddie (September 1997), North Supergroup Soils (background values not calculated for Tijeras).
[b]NMED (March 1998).
[c]Baker and Soldat (1992).
[d]Yanicak (March 1997).
[e]The tritium background value of 0.021 pCi/g was calculated from the Tharp (February 1999) tritium background value of 420 pCi/L. The pCi/L value was converted to the pCi/g value using the assumption of 5 percent soil moisture and a soil density of 1 g/cubic centimeter.

BCF = Bioconcentration factor.
COC = Constituent(s) of concern.
g = Gram(s).
L = Liter.
MDA = Minimum detectable activity.
NMED = New Mexico Environment Department.
pCi = Picocurie(s).
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

precipitation), and therefore most of the water that infiltrates into the soil is expected to be lost through this process. Because of the low annual precipitation, high evapotranspiration rates, and depth to groundwater at this site (in excess of 270 feet bgs), infiltration and percolation are not expected to be sufficient to leach COCs into groundwater.

COCs can enter the food chain via uptake by plant roots. These COCs may be transported to the aboveground tissues where they may be either consumed by herbivores or returned to the soil as litter. Aboveground litter is capable of transport by wind until consumed by decomposer organisms in soil. Constituents in plant tissues that are consumed by herbivores may be either absorbed into tissues or returned to the soil in feces (either at the site or transported from the site by the herbivore). The herbivore may be eaten by a carnivore or scavenger and the constituents in the tissues again will be either absorbed or excreted by the consumer. The potential for transport of the constituents within the food chain is dependent upon both the mobility of the species that comprise the food chain and the potential for the constituent to accumulate in tissues and be transferred across the links in the food chain. The natural vegetation at SWMU 234 is grassland; however, the habitat has been highly disturbed by construction activities associated with TA-IV. Because of the small size of the site, the arid environment, and the disturbed nature of the habitat, food-chain uptake is not considered to be a potentially significant transport mechanism at this site.

The COCs at SWMU 234 include both inorganic and organic constituents. The inorganic constituents include both radiological and nonradiological analytes. The inorganic COCs are elemental in form and generally are not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Other transformations of inorganic consitituents may include changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). The rate of these processes, however, will be limited by the aridity of the environment at this site. Organic COCs may be degraded through photolysis, hydrolysis, and biotransformation. Photolysis requires light, and therefore takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water and may occur in the soil solution. Biotransformation (i.e., transformation due to plants, animals, and microorganisms) may occur; however, biological activity may be limited by the arid environment at this site. Some organic COCs (e.g., acetone) may be lost through volatilization.

Table 6 summarizes the fate and transport processes that may occur at SWMU 234. Because the site is an open channel for storm-water runoff from TA-IV, the potential for COC transport via surface-water runoff is high. COCs that have leached into the subsurface soil will be protected from transport by surface-water flow. The potential for significant transport by wind is low and the potential for COCs to leach into groundwater is very low due to both the depth to groundwater and the arid environment. The site is open to use by wildlife, and some vegetation occurs at the site; therefore, uptake into the food chain is possible, but the small size of the site and the disturbed nature of the habitat make this an insignificant transport mechanism for COCs. The potential for significant loss of COCs by degradation and/or transformation is generally low; however, some organics may be lost near the soil surface through volatilization.

Table 6
Summary of Fate and Transport at SWMU 234

Transport and Fate Mechanism	Existence at Site	Significance
Wind	Yes	Low
Surface runoff	Yes	High
Migration to groundwater	No	None
Food chain uptake	Yes	Low
Transformation/degradation	Yes	Low

SWMU = Solid Waste Management Unit.

VI. Human Health Risk Screening Assessment

VI.1 Introduction

Human health risk screening assessment of this site includes a number of steps that culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at the site. The steps to be discussed include the following:

Step 1.	Site data are described that provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways are identified by which a representative population might be exposed to the COCs.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The first component of the tiered approach includes two screening procedures. One screening procedure compares the maximum concentration of the COC to an SNL/NM maximum background screening value. COCs that are not eliminated during the first screening procedure are subjected to a second screening procedure that compares the maximum concentration of the COC to the SNL/NM proposed Subpart S action level.
Step 4.	Toxicological parameters are identified and referenced for COCs that were not eliminated during the screening steps.
Step 5.	Potential toxicity effects (specified as a hazard index [HI]) and estimated excess cancer risks are calculated for nonradiological COCs and background. For radiological COCs, the incremental total effective dose equivalent (TEDE) and incremental estimated cancer risk are calculated by subtracting applicable background concentrations directly from maximum on-site contaminant values. This background subtraction applies only when a radiological COC occurs as contamination and exists as a natural background radionuclide.
Step 6.	These values are compared with guidelines established by the U.S. Environmental Protection Agency (EPA), NMED, and the DOE to determine whether further evaluation and potential site cleanup are required. Nonradiological COC risk values also are compared to background risk so that an incremental risk can be calculated.
Step 7.	Uncertainties regarding the contents of the previous steps are addressed.

VI.2 Step 1. Site Data

Section I of this risk assessment provides the site description and history for SWMU 234. Section II presents the argument that DQOs were satisfied. Section III describes the determination of the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

SWMU 234 has been designated with a future land use scenario of industrial (DOE et al. September 1995) (see Appendix 1 for default exposure pathways and parameters). Because of the location and characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for the nonradiological COCs and direct gamma exposure for the radiological COCs. The inhalation pathway for both nonradiological and radiological COCs is included because the potential exists to inhale dust and volatiles. Soil ingestion is included for the radiological COCs as well. No water pathways to the groundwater are considered. Depth to groundwater at SWMU 234 is approximately 270 feet bgs. Because of the lack of surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is not considered to be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate for the industrial land use scenario. However, plant uptake is considered for the residential land use scenario.

Pathway Identification

Nonradiological Constituents	Radiological Constituents
Soil ingestion	Soil ingestion
Inhalation (dust and volatiles)	Inhalation (dust and volatiles)
Plant uptake (residential only)	Plant uptake (residential only)
	Direct gamma

VI.4 Step 3. COC Screening Procedures

This section discusses Step 3, which includes the two screening procedures. The first screening procedure compared the maximum COC concentration to the background screening level. The second screening procedure compared maximum COC concentrations to SNL/NM proposed Subpart S action levels. This second procedure was applied only to COCs that were not eliminated during the first screening procedure.

VI.4.1 Background Screening Procedure

VI.4.1.1 Methodology

Maximum concentrations of nonradiological COCs were compared to the approved SNL/NM maximum screening levels for this area (Dinwiddie September 1997). The SNL/NM maximum background concentration was selected to provide the background screen in Table 4 and was used to calculate risk attributable to background in Table 10 (Section VI.6.2). Only the COCs that either were detected above their respective SNL/NM maximum background screening levels or did not have either a quantifiable or a calculated background screening level were considered in further risk assessment analyses.

For radiological COCs that exceeded the SNL/NM background screening levels, background values were subtracted from the individual maximum radionuclide concentrations. Those that did not exceed these background levels were not carried any further in the risk assessment.

This approach is consistent with DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1993). Radiological COCs that did not have a background value and were detected above the analytical minimum detectable activity were carried through the risk assessment at their maximum levels. The resultant radiological COCs remaining after this step are referred to as background-adjusted radiological COCs.

VI.4.1.2 Results

Tables 4 and 5 present the maximum COC concentrations at SWMU 234 that were compared to the SNL/NM maximum background values (Dinwiddie September 1997) for the human health risk assessment. For the nonradiological COCs, six constituents were measured at concentrations greater than their respective background values. Three nonradiological COCs had no quantifiable background concentration, so it is not known whether those COCs exceeded background values. Seventeen COCs were organic compounds that do not have corresponding calculated background concentrations.

The maximum concentration value for lead is 13 milligrams (mg) per kilogram (kg). The EPA intentionally does not provide any human health toxicological data on lead; therefore, no risk parameter values could be calculated. However, NMED guidance for lead screening concentrations for construction and industrial land use scenarios are 750 and 1500 mg/kg, respectively (Olson and Moats March 2000). The EPA screening guidance value for a residential land use scenario is 400 mg/kg (Laws July 1994). The maximum concentration value for lead at this site is less than all the screening values; therefore, lead is eliminated from further consideration in the human health risk assessment.

For the radiological COCs, only three constituents (Th-232, U-235, and U-238) exhibited a maximum activity concentration or minimum detectable activity slightly greater than their corresponding background values.

VI.4.2 Subpart S Screening Procedure

VI.4.2.1 Methodology

The maximum concentrations of nonradiological COCs not eliminated during the background screening process were compared with action levels (IT July 1994) calculated using methods and equations promulgated in the proposed RCRA Subpart S (EPA 1990) and Risk Assessment Guidance for Superfund (RAGS) (EPA 1989) documentation. Accordingly, all calculations were based upon the assumption that receptor doses from both toxic and potentially carcinogenic compounds result most significantly from ingestion of contaminated soil. Because all of the samples were taken from the surface and near-surface soils, this assumption is considered valid. If there were ten or fewer COCs, and each had a maximum concentration of less than 1/10 the action level, then the site was judged to pose no significant health hazard to humans. If there were more than ten COCs, then the Subpart S screening procedure was not performed.

VI.4.2.2 Results

Table 4 indicates that more than ten COCs failed the background screening procedure. Therefore, the Subpart S screening procedure was not performed. Thus, all constituents that exceeded the background screening values were carried forward in the risk assessment process, and an individual hazard quotient (HQ), cumulative HI, and excess cancer risk value were calculated for each COC.

Because radiological COCs have no predetermined action levels analogous to proposed Subpart S levels, this step in the screening process was not performed for radiological COCs.

VI.5 Step 4. Identification of Toxicological Parameters

Tables 7 (nonradiological) and 8 (radiological) list the COCs retained in the risk assessment and the values for the available toxicological information. The toxicological values used for nonradiological COCs in Table 7 were from the Integrated Risk Information System (IRIS) (EPA 1998a), the Health Effects Assessment Summary Tables (HEAST) (EPA 1997a), and the Region 9 (EPA 1996) and Region 3 (EPA 1997b) electronic databases. Dose conversion factors (DCFs) used in determining the excess TEDE values for radiological COCs for the individual pathways were the default values provided in the RESRAD computer code (Yu et al. 1993a) as developed in the following documents:

- DCFs for ingestion and inhalation are taken from "Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion" (EPA 1988).

- DCFs for surface contamination (contamination on the surface of the site) were taken from DOE/EH-0070, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public" (DOE 1988).

- DCFs for volume contamination (exposure to contamination deeper than the immediate surface of the site) were calculated using the methods discussed in "Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil" (Kocher 1983) and in ANL/EAIS-8, *Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil* (Yu et al. 1993b).

VI.6 Step 5. Exposure Assessment and Risk Characterization

Section VI.6.1 describes the exposure assessment for this risk assessment. Section VI.6.2 provides the risk characterization, including the HI and excess cancer risk for both the potential nonradiological COCs and associated background for industrial and residential land uses. The incremental TEDE and incremental estimated cancer risk are provided for the background-adjusted radiological COCs for both industrial and residential land uses.

Table 7
Toxicological Parameter Values for SWMU 234 Nonradiological COCs

COC Name	RfD_o (mg/kg-d)	Confidence[a]	RfD_{inh} (mg/kg-d)	Confidence[a]	SF_o (mg/kg-day)$^{-1}$	Sf_{inh} (mg/kg-day)$^{-1}$	Cancer Class[b]
Arsenic	3E-4[c]	M	–	–	1.5E+0[c]	1.5E+1[c]	A
Barium	7E-2[c]	M	1.4E-4[d]	–	–	–	–
Cadmium	5E-4[c]	H	5.7E-5[d]	–	–	6.3E+0[c]	B1
Chromium, total	1E+0[c]	L	5.7E-7[f]	–	–	–	–
Chromium VI	5E-3[c]	L	–	–	–	4.2E+1[c]	A
Mercury	3E-4[e]	–	8.6E-5[c]	M	–	–	D
Selenium	5E-3[c]	H	–	–	–	–	D
Silver	5E-3[c]	L	–	–	–	–	D
Acenaphthene	6E-2[c]	L	6E-2[d]	–	–	–	–
Anthracene	3E-1[c]	L	3E-1[d]	–	–	–	D
Benzo(a) anthracene	–	–	–	–	7.3E-1[d]	7.3E-1[d]	–
Benzo(a) pyrene	–	–	–	–	7.3E+0[c]	7.3E+0[d]	B2
Benzo(b) fluoranthene	–	–	–	–	7.3E-1[d]	7.3E-1[d]	B2
Benzo(ghi) perylene[g]	–	–	–	–	7.3E+0[d]	7.3E+0[d]	B2
Benzo(k) fluoranthene	–	–	–	–	7.3E-2[d]	7.3E-2[d]	B2
Bis (2-ethylhexyl) phthalate	2E-2[d]	–	2.2E-2[d]	–	1.4E-2[d]	1.4E-2[d]	–
Carbazole	–	–	–	–	2E-2[e]	2E-2[d]	B2
Chrysene	–	–	–	–	7.3E-3[d]	7.3E-3[d]	B2
Di-n-butyl phthalate	1E-1[c]	L	1E-1[d]	–	–	–	D
Di-n-octyl phthalate	2E-2[e]	–	2E-2[e]	–	–	–	–
Fluoranthene	4E-2[c]	L	4E-2[d]	–	–	–	D
Fluorene	4E-2[c]	L	4E-2[d]	–	–	–	D
Indeno(1,2,3-c,d)pyrene	–	–	–	–	7.3E-1[d]	7.3E-1[d]	B2
Phenanthrene[h]	3E-1[c]	L	3E-1[d]	–	–	–	D
Pyrene	3E-2[c]	L	3E-2[d]	–	–	–	D

[a]Confidence associated with IRIS (EPA 1998a) database values. Confidence: L = low, M = medium, H = high.
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 1998a), with the exception of carbazole, which was taken from HEAST (EPA 1997a):

A = Human carcinogen.
B1 = Probable human carcinogen. Limited human data available.
B2 = Probable human carcinogen. Sufficient evidence in animals and inadequate or no evidence in humans.
D = Not classifiable as to human carcinogenicity.

Table 7 (Concluded)
Toxicological Parameter Values for SWMU 234 Nonradiological COCs

[c]Toxicological parameter values from IRIS electronic database (EPA 1998a).
[d]Toxicological parameter values from EPA Region 9 electronic database (EPA 1996).
[e]Toxicological parameter values from HEAST database (EPA 1997a).
[f]Toxicological parameter values from EPA Region 3 electronic database (EPA 1997b).
[g]Benzo(ghi)perylene does not have toxicological parameter values. Dibenz(ah)anthracene used as a surrogate.
[h]Phenanthrene does not have toxicological parameter values. Anthracene used as a surrogate.
COC = Constituent(s) of concern.
EPA = U.S. Environmental Protection Agency.
HEAST = Health Effects Assessment Summary Tables.
IRIS = Integrated Risk Information System.
mg/kg-d = Milligram(s) per kilogram per day.
$(mg/kg\text{-}day)^{-1}$ = Per milligram per kilogram per day.
RfD_{inh} = Inhalation chronic reference dose.
RfD_o = Oral chronic reference dose.
SF_{inh} = Inhalation slope factor.
SF_o = Oral slope factor.
SWMU = Solid Waste Management Unit.
-- = Information not available.

Table 8
Radiological Toxicological Parameter Values for SWMU 234 COCs Obtained from RESRAD Risk Coefficients[a]

COC Name	SF_o (1/pCi)	SF_{inh} (1/pCi)	SF_{ev} (g/pCi-yr)	Cancer Class[b]
Th-232	3.30E-11	1.90E-08	2.00E-11	A
U-238	6.20E-11	1.20E-08	6.60E-08	A
U-235	4.70E-11	1.30E-08	1.7E-07	A

[a]From Yu et al. (1993a).
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989): A = Human carcinogen for high dose and high dose rate (i.e., greater than 50 rem per year). For low-level environmental exposures, the carcinogenic effect has not been observed and documented.
1/pCi = One per picocurie.
COC = Constituent(s) of concern.
EPA = U.S. Environmental Protection Agency.
g/pCi-yr = Gram(s) per picocurie per year.
SF_{ev} = External volume exposure slope factor.
SF_{inh} = Inhalation slope factor.
SF_o = Oral (ingestion) slope factor.
SWMU = Solid Waste Management Unit.

VI.6.1 Exposure Assessment

Appendix 1 provides the equations and parameter input values used in calculating intake values and subsequent HI and excess cancer risk values for the individual exposure pathways. The appendix shows parameters for both industrial and residential land use scenarios. The equations for nonradiological COCs are based upon the RAGS (EPA 1989). Parameters are based upon information from the RAGS (EPA 1989), as well as other EPA guidance documents, and reflect the reasonable maximum exposure (RME) approach advocated by the RAGS (EPA 1989). For radiological COCs, the coded equations provided in RESRAD computer code are used to estimate the incremental TEDE and cancer risk for individual exposure pathways. Further discussion of this process is provided in the *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD* (Yu et al. 1993a).

Although the designated land use scenario is industrial for this site, risk and TEDE values for a residential land use scenario also are presented only to provide perspective of potential risk to human health under the more restrictive land use scenario.

VI.6.2 Risk Characterization

Table 9 shows an HI of 0.03 and an estimated excess cancer risk of 6E-6 for the SWMU 234 nonradiological COCs under the designated industrial land use scenario. The numbers presented include exposure from soil ingestion and dust and volatile inhalation for nonradiological COCs. Table 10 shows an HI of 0.01 and an estimated excess cancer risk of 2E-6, assuming the maximum background concentrations of the SWMU 234 associated background constituents for the designated industrial land use scenario.

For the radiological COCs, contribution from the direct gamma exposure pathway is included. For the industrial land use scenario, an incremental TEDE of 13 millirem (mrem) per year (/yr) was calculated. In accordance with EPA guidance found in Office of Solid Waste and Emergency Response Directive No. 9200.4-18 (EPA 1997c), an incremental TEDE of 15 mrem/yr was used for the probable land use scenario (industrial in this case); the calculated dose value for SWMU 234 for the industrial land use scenario was well below this guideline. The estimated excess cancer risk was 1.9E-4.

For the residential land use scenario, the HI was 3 and the excess cancer risk was 1E-4 for nonradiological COCs (Table 9). The numbers in the table include exposure from soil ingestion, dust and volatile inhalation, and plant uptake. Although the EPA (EPA 1991) generally recommends that inhalation not be included in a residential land use scenario, this pathway was evaluated because of the potential for soil in Albuquerque, New Mexico, to be eroded and, subsequently, for dust to be present in predominantly residential areas. Because of the nature of the local soil, other exposure pathways were not considered (see Appendix 1). Table 10 shows that for the SWMU 234 associated background constituents, the HI is 0.3 and the calculated excess cancer risk is 5E-5.

For the radiological COCs, the incremental TEDE for the residential land use scenario was 23 mrem/yr. The guideline being used was an excess TEDE of 75 mrem/yr (SNL/NM February 1998) for a complete loss of institutional controls (residential land use in this case); the calculated dose value for SWMU 234 under the residential land use scenario was well

Table 9
Risk Assessment Values for SWMU 234 Nonradiological COCs

COC Name	Maximum Concentration (mg/kg)	Industrial Land Use Scenario[a]		Residential Land Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	7	0.02	4E-6	0.40	8E-5
Barium	240	0.00	–	0.04	–
Cadmium	2.9	0.01	1E-9	2.37	2E-9
Chromium, total	17.7	0.00	–	0.01	–
Chromium VI	2.08	0.00	5E-9	0.00	8E-9
Mercury	0.0603	0.00	–	0.10	–
Selenium	0.13[b]	0.00	–	0.05	–
Silver	1	0.00	–	0.04	–
Acenaphthene	0.00626 J	0.00	–	0.00	–
Anthracene	0.0212 J	0.00	–	0.00	–
Benzo(a)anthracene	0.258	0.00	7E-8	0.00	9E-7
Benzo(a)pyrene	0.435	0.00	1E-6	0.00	1E-5
Benzo(b)fluoranthene	0.506	0.00	1E-7	0.00	1E-6
Benzo(ghi)perylene	0.309	0.00	8E-7	0.00	1E-5
Benzo(k)fluoranthene	0.471	0.00	1E-8	0.00	1E-7
Bis(2-ethylhexyl)phthalate	0.0803	0.00	4E-10	0.00	3E-9
Carbazole	0.0182 J	0.00	1E-10	0.00	8E-6
Chrysene	0.435	0.00	1E-9	0.00	2E-8
Di-n-butyl phthalate	0.0207 J	0.00	–	0.00	–
Di-n-octyl phthalate	0.0102 J	0.00	–	0.00	–
Fluoranthene	0.450	0.00	–	0.00	–
Fluorene	0.00666 J	0.00	–	0.00	–
Indeno(1,2,3-c,d) pyrene	0.345 J	0.00	9E-8	0.00	6E-7
Phenanthrene	0.139	0.00	–	0.00	–
Pyrene	0.603	0.00	–	0.00	–
Total		**0.03**	**6E-6**	**3**	**1E-4**

[a]From EPA (1989).
[b]Parameter was nondetect. Concentration assumed to be approximately 0.5 of detection limit.
COC = Constituent(s) of concern.
EPA = U.S. Environmental Protection Agency.
J = Estimated value.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
– = Information not available.

Table 10
Risk Assessment Values for SWMU 234 Nonradiological Background Constituents

COC Name	Background Concentration[a] (mg/kg)	Industrial Land Use Scenario[b]		Residential Land Use Scenario[b]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	4.4	0.01	2E-6	0.25	5E-5
Barium	200	0.00	–	0.03	–
Cadmium	<1	–	–	–	–
Chromium, total	16.2	0.00	–	0.01	–
Chromium VI	NC	–	–	–	–
Mercury	<0.1	–	–	–	–
Selenium	<1	–	–	–	–
Silver	<1	–	–	–	–
Total		**0.01**	**2E-6**	**0.3**	**5E-5**

[a]From Dinwiddie (September 1997), Tijeras Supergroup Soils.
[b]From EPA (1989).
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
NC = Not calculated.
SWMU = Solid Waste Management Unit.
– = Information not available.

below this guideline. Consequently, SWMU 234 is eligible for unrestricted radiological release because the residential land use scenario resulted in an incremental TEDE of less than 75 mrem/yr to the on-site receptor. The estimated excess cancer risk was 3.0E-4. The excess cancer risk from the nonradiological COCs and the radiological COCs is not additive, as noted in the RAGS (EPA 1989).

VI.7 Step 6. Comparison of Risk Values to Numerical Guidelines

The human health risk assessment analysis evaluated the potential for adverse health effects for both the industrial land use scenario (the designated land use scenario for this site) and the residential land use scenario.

For the industrial land use scenario, the HI for nonradiological COCs was 0.03 (less than the numerical guideline of 1 suggested in the RAGS [EPA 1989]). Excess cancer risk was estimated at 6E-6. NMED Guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001); thus, the excess cancer risk for this site is below the suggested acceptable risk value. This assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the industrial and residential land use scenarios. Assuming the industrial land use scenario, the HI was 0.01 for nonradiological COCs and the calculated excess cancer risk was 2E-6. Incremental risk is determined by subtracting risk associated with background from potential COC risk. These numbers were not rounded before the difference was determined and, therefore, may appear to be inconsistent with numbers presented in tables and within the text. For conservatism, the background constituents that do not have quantified background concentrations are assumed to have an HQ of 0.00. Incremental HI was 0.02 and estimated incremental cancer risk was 4.08E-6 for the industrial land use scenario. Both the incremental HI and excess cancer risk to human health from nonradiological COCs were below proposed guidelines under the industrial land use scenario.

For the industrial land use scenario, incremental TEDE was 13 mrem/yr for radiological COCs, which is significantly less than EPA's numerical guideline of 15 mrem/yr. Incremental estimated excess cancer risk was 1.9E-4.

For the residential land use scenario, the calculated HI for nonradiological COCs was 3, which is above the numerical guidance. Excess cancer risk was estimated at 1E-4. NMED Guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001); thus, the excess cancer risk for this site is above the suggested acceptable risk value. The HI for associated background for the residential land use scenario was 0.3 and the estimated excess cancer risk was 5E-5. The incremental HI was 2.72 and the estimated incremental cancer risk was 6.06E-5 for the residential land use scenario. Both the incremental HI and excess cancer risk to human health from nonradiological COCs were above proposed guidelines considering a residential land use scenario.

The incremental TEDE under the residential land use scenario from the radiological constituents was 23 mrem/yr, which is significantly less than the numerical guideline of 75 mrem/yr suggested in the SNL/NM RESRAD Input Parameter Assumptions and Justification (SNL/NM February 1998). The estimated excess cancer risk was 3.0E-4.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at SWMU 234 was based upon an initial conceptual model that was validated with confirmatory soil sampling conducted across the site. The sampling was implemented in accordance with the SAP and FIP. The DQOs in the SAP and FIP are considered appropriate for use in the SWMU 234 risk screening assessments. The analytical data, based upon sample location, density, and depth of the six samples collected along the earthen ditch, are representative of the site. The analytical results satisfy the DQOs and were verified/validated in accordance with SNL/NM procedures. The QA/QC findings demonstrate that the analytical data were adequate in quality. Therefore, there is no uncertainty associated with the data quality used to perform the risk screening assessment at SWMU 234.

Because of the location, history of the site, and future designated land use (DOE et al. September 1995), there is low uncertainty in both the land use scenario and the potentially affected populations that were considered in performing the risk assessment analysis. Because the COCs are found in surface and near-surface soils, and because of the location and physical characteristics of the site, there is little uncertainty in the exposure pathways relevant to this analysis.

An RME approach was used to calculate the risk assessment values. This means that the parameter values in the calculations were conservative and calculated intakes were probably overestimates. Maximum COC concentrations measured were used to provide conservative results.

Table 7 shows the uncertainties (confidence level) in nonradiological toxicological parameter values. There is a mixture of estimated values and values from the IRIS (EPA 1998a), the HEAST (EPA 1997a), and the EPA Region 9 (EPA 1996) and Region 3 (EPA 1997b) electronic databases. Where values are not provided, information is not available from these sources. Because of the conservative nature of the RME approach, uncertainties in toxicological values are not expected to change the conclusion from the risk assessment analysis.

Both the human health HI and excess cancer risk for the nonradiological COCs were acceptable compared to established numerical guidance considering the industrial land use scenario.

For radiological COCs, the conclusion of the risk assessment was that potential effects on human health for both industrial and residential land use scenarios were within guidelines and represent only a small fraction of the estimated 360 mrem/yr received by the average U.S. population (NCRP 1987).

The overall uncertainty in all of the steps in the risk assessment process is not considered to be significant with respect to the conclusion reached.

VI.9 Summary

SWMU 234 sampling identified COCs consisting of some inorganic, organic and radiological compounds. Because of the location of the site, the designated industrial land use scenario, and the nature of contamination, potential exposure pathways evaluated for this site included soil ingestion as well as dust and volatile inhalation for chemical constituents, and soil ingestion, dust inhalation, and direct gamma exposure for radionuclides. Plant uptake was included as an exposure pathway for the residential land use scenario.

Using conservative assumptions and an RME approach to risk assessment, calculations for nonradiological COCs show that for the industrial land use scenario the HI (0.03) was significantly less than the accepted numerical guidance from EPA. Excess cancer risk (6E-6) was also below the acceptable risk value provided by NMED for an industrial land use scenario (Bearzi January 2001). The incremental HI was 0.02, and the incremental cancer risk was 4.08E-6 for the industrial land use scenario.

Incremental TEDE and corresponding estimated cancer risk from radiological COCs were much lower than EPA guidance values; the estimated TEDE was 13 mrem/yr for the industrial land use scenario, much lower than the numerical guidance of 15 mrem/yr in EPA guidance (EPA 1997c). The corresponding incremental estimated cancer risk value was 1.9E-4 for the industrial land use scenario. Furthermore, the incremental TEDE for the residential land use scenario that results from a complete loss of institutional control was only 23 mrem/yr with an associated risk of 3.0E-4. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore, SWMU 234 is eligible for unrestricted radiological release.

Uncertainties associated with the calculations are considered to be small relative to the conservatism of this risk assessment analysis. Therefore, it is concluded that this site poses no significant risk to human health under the industrial land use scenario.

VII. Ecological Risk Screening Assessment

VII.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPECs) in soils at SWMU 234. A component of the NMED Risk-Based Decision Tree (NMED March 1998) is to conduct an ecological screening assessment that corresponds with that presented in EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997d). The current methodology is tiered and contains an initial scoping assessment followed by a more detailed screening assessment. Initial components of NMED's decision tree (a discussion of DQOs, data assessment, and evaluations of bioaccumulation and fate and transport potential) are addressed in previous sections of this report. Following the completion of the scoping assessment, a determination is made as to whether a more detailed examination of potential ecological risk is necessary. If deemed necessary, the scoping assessment proceeds to a screening assessment, whereby a more quantitative estimate of ecological risk is conducted. Although this assessment incorporates conservatisms into the estimation of ecological risks, ecological relevance and professional judgment also are used as recommended by the EPA (EPA 1998b) to ensure that predicted exposures of selected ecological receptors reflect those reasonably expected to occur at the site.

VII.2 Scoping Assessment

The scoping assessment focuses primarily on the likelihood of biota at or adjacent to the site to be exposed to constituents associated with site activities. Included in this section are an evaluation of existing data and a comparison of maximum concentrations detected to background concentrations, examination of bioaccumulation potential, and fate and transport potential. A scoping risk management decision (Section VII.2.4) involves summarizing the scoping results and determining whether further examination of potential ecological impacts is necessary.

VII.2.1 Data Assessment

As indicated in Section IV (Tables 4 and 5), inorganic constituents in soil within the 0- to 5-foot-depth interval that exceeded or did not have quantified background screening concentrations were as follows:

- Arsenic
- Barium
- Cadmium
- Chromium (total)
- Chromium VI
- Lead
- Mercury
- Selenium
- Silver
- Th-232

- U-235
- U-238.

Organic analytes detected in soil that exceeded background were as follows:

- Acenaphthene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Carbazole
- Chrysene
- Di-n-butyl phthalate
- Di-n-octyl phthalate
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Phenanthrene
- Pyrene.

VII.2.2 Bioaccumulation

Among the COPECs listed in Section VII.2.1, the following were considered to have bioaccumulation potential in aquatic environments (Section IV, Tables 4 and 5):

- Arsenic
- Barium
- Cadmium
- Lead
- Mercury
- Selenium
- U-235
- U-238
- Acenaphthene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Chrysene

- Di-n-butyl phthalate
- Di-n-octyl phthalate
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Phenanthrene
- Pyrene.

It should be noted, however, that as directed by the NMED (NMED March 1998), bioaccumulation for inorganic constituents is assessed exclusively based upon maximum reported bioconcentration factors (BCF) for aquatic species. Because only aquatic BCFs are used to evaluate the bioaccumulation potential for metals, bioaccumulation in terrestrial species is likely to be overpredicted.

VII.2.3 Fate and Transport Potential

The potential for the COPECs to migrate from the source of contamination to other media or biota is discussed in Section V. As noted in Table 6 (Section V), wind is expected to be of low significance as a transport mechanism for COPECs at this site, and surface-water runoff is potentially of high significance. Migration to groundwater is not anticipated. Food chain uptake is expected to be of low significance. Degradation (decay) and transformation of the inorganic COPECs and radionuclides is expected to be of low significance, but some organic COPECs may be lost through volatilization.

VII.2.4 Scoping Risk-Management Decision

Based upon information gathered through the scoping assessment, it was concluded that complete ecological pathways may be associated with this SWMU and that COPECs also exist at the site. As a consequence, a screening assessment was deemed necessary to predict the potential level of ecological risk associated with the site.

VII.3 Screening Assessment

As concluded in Section VII.2.4, both complete ecological pathways and COPECs are associated with this SWMU. The screening assessment performed for the site involves a quantitative estimate of current ecological risks using exposure models in association with exposure parameters and toxicity information obtained from the literature. The estimation of potential ecological risks is conservative to ensure that ecological risks are not underpredicted.

Components within the screening assessment include the following:

- Problem Formulation—sets the stage for the evaluation of potential exposure and risk.

- Exposure Estimation—provides a quantitative estimate of potential exposure.

- Ecological Effects Evaluation—presents benchmarks used to gauge the toxicity of COPECs to specific receptors.

- Risk Characterization—characterizes the ecological risk associated with exposure of the receptors to environmental media at the site.

- Uncertainty Assessment—discusses uncertainties associated with the estimation of exposure and risk.

- Risk Interpretation—evaluates ecological risk in terms of HQs and ecological significance.

- Screening Assessment Scientific/Management Decision Point—presents the decision to risk managers based upon the results of the screening assessment.

VII.3.1 Problem Formulation

Problem formulation is the initial stage of the screening assessment that provides the introduction to the risk evaluation process. Components that are addressed in this section include a discussion of ecological pathways and the ecological setting, identification of COPECs, and selection of ecological receptors. The conceptual model, ecological food webs, and ecological endpoints (other components commonly addressed in a screening assessment) are presented in the "Predictive Ecological Risk Assessment Methodology for SNL/NM ER Program" (IT July 1998) and are not duplicated here.

VII.3.1.1 Ecological Pathways and Setting

SWMU 234 is approximately 0.15 acre in size. The site is located in an area dominated by grassland habitat. The site itself is a series of open drainage channels on the lower slope of the northern embankment of Tijeras Arroyo. This slope consists of fill material that covers the original soil surface. The vegetation consists primarily of ruderal and early successional grassland plants. Although the habitat grades into the riparian scrubland habitat of Tijeras Arroyo, this habitat is not well developed on the site due to the steepness of the slope of the embankment and ephemeral nature of the flows (primarily outflow from the TA-IV storm-water system). The site is open to use by wildlife and it does not contain perennial surface water. A sensitive species survey of the site was conducted in 1994 (IT February 1995). No threatened, endangered, or other sensitive species were found within this SWMU.

Complete ecological pathways may exist at this site through the exposure of plants and wildlife to COPECs in surface soil. It was assumed that direct uptake of COPECs from soil is the major route of exposure for plants and that exposure of plants to wind-blown soil is minor. Exposure modeling for the wildlife receptors was limited to the food and soil ingestion pathways, and external radiation. Because of the lack of surface water at this site, exposure to COPECs through the ingestion of surface water was considered insignificant. Inhalation and dermal contact also were considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Groundwater is not expected to be affected by COCs at this site.

VII.3.1.2 COPECs

Discharge of storm-water runoff from TA-IV is the potential source of the COPECs associated with the soils at SWMU 234. Inorganic and organic COPECs identified for SWMU 234 are listed in Section VII.2.1. The inorganic COPECs include both radiological and nonradiological analytes. The inorganic analytes were screened against background concentrations and those that exceeded or did not have quantified SNL/NM background screening levels (Dinwiddie September 1997) for the area were considered to be COPECs. Nonradiological inorganics that are essential nutrients, such as iron, magnesium, calcium, potassium, and sodium, were not included in this risk assessment as set forth by the EPA (EPA 1989). All organic analytes detected were considered to be COPECs for the site. In order to provide conservatism, this ecological risk assessment was based upon the maximum soil concentrations of the COPECs measured in the surface soil at this site. Tables 4 and 5 present maximum concentrations for the COPECs.

VII.3.1.3 Ecological Receptors

A nonspecific perennial plant was selected as the receptor to represent plant species at the site (IT July 1998). Vascular plants are the principal primary producers at the site and are key to the diversity and productivity of the wildlife community associated with it. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. The burrowing owl was selected to represent a top predator at this site. The burrowing owl is present at SNL/NM and is designated a species of management concern by the U.S. Fish and Wildlife Service in Region 2, which includes the state of New Mexico (USFWS September 1995).

VII.3.2 Exposure Estimation

For nonradiological COPECs, direct uptake from the soil was considered the only significant route of exposure for terrestrial plants. Exposure modeling for the wildlife receptors was limited to food and soil ingestion pathways. Inhalation and dermal contact were considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Drinking water also was considered an insignificant pathway because of the lack of surface water at this site. The deer mouse was modeled under three dietary regimes: as an herbivore (100 percent of its diet as plant material), as an omnivore (50 percent of its diet as plants and 50 percent as soil invertebrates), and as an insectivore (100 percent of its diet as soil invertebrates). The burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Because the exposure in the burrowing owl from a diet consisting of equal parts of herbivorous, omnivorous, and insectivorous mice would be equivalent to the exposure consisting of only omnivorous mice, the diet of the burrowing owl was modeled with intake of omnivorous mice only. Both species were modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 11 presents the species-specific factors used in modeling exposures in the wildlife receptors. Justification for use of the factors presented in this table is described in the ecological risk assessment methodology document (IT July 1998).

Table 11
Exposure Factors for Ecological Receptors at SWMU 234

Receptor Species	Class/Order	Trophic Level	Body Weight (kg)[a]	Food Intake Rate (kg/day)[b]	Dietary Composition[c]	Home Range (acres)
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Herbivore	2.39E-2[d]	3.72E-3	Plants: 100% (+ Soil at 2% of intake)	2.7E-1[e]
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Omnivore	2.39E-2[d]	3.72E-3	Plants: 50% Invertebrates: 50% (+ Soil at 2% of intake)	2.7E-1[e]
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Insectivore	2.39E-2[d]	3.72E-3	Invertebrates: 100% (+ Soil at 2% of intake)	2.7E-1[e]
Burrowing owl (*Speotyto cunicularia*)	Aves/ Strigiformes	Carnivore	1.55E-1[f]	1.73E-2	Rodents: 100% (+ Soil at 2% of intake)	3.5E+1[g]

[a]Body weights are in kg wet weight.
[b]Food intake rates are estimated from the allometric equations presented in Nagy (1987). Units are kg dry weight per day.
[c]Dietary compositions are generalized for modeling purposes. Default soil intake value of 2% of food intake.
[d]From Silva and Downing (1995).
[e]EPA (1993), based upon the average home range measured in semiarid shrubland in Idaho.
[f]From Dunning (1993).
[g]From Haug et al. (1993).
EPA = U.S. Environmental Protection Agency.
kg = Kilogram(s).
kg/day = Kilogram(s) per day.
SWMU = Solid Waste Management Unit.

Although home range also is included in this table, exposures for this risk assessment were modeled using an area use factor of 1, implying that all food items and soil ingested come from the site being investigated. The maximum COPEC concentrations measured in surface soil samples were used to conservatively estimate potential exposures and risks to plants and wildlife at this site.

For the radiological dose rate calculations, the deer mouse was modeled as an herbivore (100 percent of its diet as plants), and the burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Both were modeled with soil ingestion comprising 2 percent of the total dietary intake. Receptors are exposed to radiation both internally and externally from Th-232, U-235, and U-238. Internal and external dose rates to the deer mouse and the burrowing owl are approximated using modified dose-rate models from DOE (DOE 1995) as presented in the ecological risk assessment methodology document for the SNL/NM ER Project (IT July 1998). Radionuclide-dependent data for the dose-rate calculations were obtained from Baker and Soldat (1992). The external-dose-rate model examines the total-body dose-rate to a receptor residing in soil exposed to radionuclides. The soil surrounding the receptor is assumed to be an infinite medium uniformly contaminated with gamma-emitting radionuclides. The external-dose-rate model is the same for both the deer mouse and the burrowing owl. The internal total-body dose-rate model assumes that a fraction of the radionuclide concentration ingested by a receptor is absorbed by the body and concentrated at the center of a spherical body shape. This provides for a conservative estimate for absorbed dose. This concentrated radiation source at the center of the body of the receptor is assumed to be a "point" source. Radiation emitted from this point source is absorbed by the body tissues to contribute to the absorbed dose. Alpha and beta emitters are assumed to transfer 100 percent of their energy to the receptor as they pass through tissues. Gamma-emitting radionuclides transfer only a fraction of their energy to the tissues because gamma rays interact less with matter than do beta or alpha emitters. The external and internal dose-rate results are summed to calculate a total dose rate from exposure to Th-232, U-235, and U-238 in soil.

Table 12 provides the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 13 shows maximum concentrations in soil and derived concentrations in tissues of the various food chain elements that are used to model dietary exposures for each of the wildlife receptors.

VII.3.3 Ecological Effects Evaluation

Table 14 presents benchmark toxicity values for the plant and wildlife receptors. For plants, the benchmark soil concentrations are based upon the lowest-observed-adverse-effect level (LOAEL). For wildlife, the toxicity benchmarks are based upon the no-observed-adverse-effect level (NOAEL) for chronic oral exposure in a taxonomically similar test species. Sufficient toxicity information was not available to estimate the LOAELs or NOAELs for some COPECs.

The benchmark used for exposure of terrestrial receptors to radiation was 0.1 rad/day. This value has been recommended by the International Atomic Energy Agency (IAEA 1992) for the protection of terrestrial populations. Because plants and insects are less sensitive to radiation than vertebrates (Whicker and Schultz 1982), the dose of 0.1 rad/day also should protect other groups within the terrestrial habitat of SWMU 234.

Table 12
Transfer Factors Used in Exposure Models for Constituents of Potential Ecological Concern at SWMU 234

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Inorganic			
Arsenic	4.0E-2 [a]	1.0E+0 [b]	2.0E-3 [a]
Barium	1.5E-1 [a]	1.0E+0 [b]	2.0E-4 [c]
Cadmium	5.5E-1 [a]	6.0E-1 [d]	5.5E-4 [a]
Chromium (total)	4.0E-2 [c]	1.3E-1 [e]	3.0E-2 [c]
Chromium VI	4.0E-2 [c]	1.3E-1 [e]	3.0E-2 [c]
Lead	9.0E-2 [c]	4.0E-2 [d]	8.0E-4 [c]
Mercury	1.0E+0 [c]	1.0E+0 [b]	2.5E-1 [a]
Selenium	5.0E-1 [c]	1.0E+0 [b]	1.0E-1 [c]
Silver	1.0E+0 [c]	2.5E-1 [d]	5.0E-3 [c]
Organic [f]			
Acenaphthene	2.1E-1	2.1E+1	2.1E-4
Anthracene	1.0E-1	2.2E+1	7.3E-4
Benzo(a)anthracene	2.2E-2	2.5E+1	1.2E-2
Benzo(a)pyrene	1.1E-2	2.7E+1	3.8E-2
Benzo(b)fluoranthene	6.2E-3	2.8E+1	1.1E-1
Benzo(g,h,i)perylene	6.1E-3	2.8E+1	1.2E-1
Benzo(k)fluoranthene	4.3E-3	2.9E+1	2.1E-1
Bis(2-ethylhexyl)phthalate	1.6E-3	3.2E+1	1.3E+0
Carbazole	3.9E+1	1.3E+1	1.8E-8
Chrysene	1.5E-2	2.6E+1	2.3E-2
Di-n-butyl phthalate	8.4E-2	2.2E+1	1.1E-3
Di-n-octyl phthalate	3.7E-2	2.4E+1	4.5E-3
Fluoranthene	5.7E-2	2.3E+1	2.1E-3
Fluorene	1.5E-1	2.1E+1	3.8E-4
Indeno(1,2,3-cd)pyrene	6.1E-3	2.8E+1	1.2E-1
Phenanthrene	8.9E-2	2.2E+1	9.6E-4
Pyrene	3.3E-2	2.4E+1	5.8E-3

[a]From Baes et al. (1984).
[b]Default value.
[c]From NCRP (January 1989).
[d]From Stafford et al. (1991).
[e]From Ma (1982).
[f]Soil-to-plant and food-to-muscle transfer factors from equations developed in Travis and Arms (1988). Soil-to-invertebrate transfer factors from equations developed in Connell and Markwell (1990). All three equations are based upon the relationship of the transfer factor to the log K_{ow} value of compound.

K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
NCRP = National Council on Radiation Protection and Measurements.
SWMU = Solid Waste Management Unit.

Table 13
Media Concentrations[a] for Constituents of Potential Ecological Concern at SWMU 234

Constituent of Potential Ecological Concern	Soil (maximum)[a]	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Inorganic				
Arsenic	7.0E+0	2.8E-1	7.0E+0	2.4E-2
Barium	2.4E+2	3.6E+1	2.4E+2	8.9E-2
Cadmium	2.9E+0	1.6E+0	1.7E+0	3.0E-3
Chromium (total)	1.8E+1	7.1E-1	2.3E+0	1.7E-1
Chromium VI	2.1E+0	8.3E-2	2.7E-1	2.1E-2
Lead	1.3E+1	1.2E+0	5.2E-1	2.8E-3
Mercury	6.0E-2	6.0E-2	6.0E-2	4.8E-2
Selenium	1.3E-1 [d]	6.5E-2	1.3E-1	3.1E-2
Silver	1.0E+0	1.0E+0	2.5E-1	1.0E-2
Organic				
Acenaphthene	6.3E-3 [e]	1.3E-3	1.3E-1	4.2E-5
Anthracene	2.1E-2 [e]	2.2E-3	4.7E-1	5.3E-4
Benzo(a)anthracene	2.6E-1	5.7E-3	6.5E+0	1.2E-1
Benzo(a)pyrene	4.4E-1	5.0E-3	1.2E+1	6.8E-1
Benzo(b)fluoranthene	5.1E-1	3.1E-3	1.4E+1	2.5E+0
Benzo(g,h,i)perylene	3.1E-1	1.9E-3	8.7E+0	1.6E+0
Benzo(k)fluoranthene	4.7E-1	2.0E-3	1.4E+1	5.2E+0
Bis(2-ethylhexyl)phthalate	8.0E-2 [e]	1.3E-4	2.5E+0	1.8E+1
Carbazole	1.8E-2 [e]	7.1E-1	2.4E-1	2.7E-8
Chrysene	4.4E-1	6.5E-3	1.1E+1	4.2E-1
Di-n-butyl phthalate	2.1E-2 [e]	1.7E-3	4.6E-1	7.7E-4
Di-n-octyl phthalate	1.0E-2 [e]	3.8E-4	2.5E-1	1.7E-3
Fluoranthene	4.5E-1	2.6E-2	1.0E+1	3.5E-2
Fluorene	6.7E-3 [e]	9.9E-4	1.4E-1	8.6E-5
Indeno(1,2,3-cd)pyrene	3.5E-1 [e]	2.1E-3	9.7E+0	1.8E+0
Phenanthrene	1.4E-1	1.2E-2	3.1E+0	4.7E-3
Pyrene	6.0E-1	2.0E-2	1.5E+1	1.3E-1

[a]In milligrams per kilogram. All biotic media are based upon dry weight of the media. Soil concentration measurements are assumed to have been based upon dry weight. Values have been rounded to two significant digits after calculation.
[b]Product of the soil concentration and the corresponding transfer factor.
[c]Based upon the deer mouse with an omnivorous diet. Product of the average concentration ingested in food and soil times the food-to-muscle transfer factor times a wet weight-dry weight conversion factor of 3.125 (EPA 1993).
[d]Parameter is nondetect. Concentration equals one-half the method detection limit.
[e]Based upon an estimated concentration.
EPA = U.S. Environmental Protection Agency.
SWMU = Solid Waste Management Unit.

Table 14
Toxicity Benchmarks for Ecological Receptors at SWMU 234

Constituent of Potential Ecological Concern	Plant Benchmark[a,b]	Mammalian NOAELs			Avian NOAELs		
		Mammalian Test Species[c,d]	Test Species NOAEL[d,e]	Deer Mouse NOAEL[e,f]	Avian Test Species[d]	Test Species NOAEL[d,e]	Burrowing Owl NOAEL[e,g]
Inorganics							
Arsenic	10	mouse	0.126	0.133	mallard	5.14	5.14
Barium	500	rat [h]	5.1	10.5	chicken	20.8	20.8
Cadmium	3	rat [i]	1.0	1.89	mallard	1.45	1.45
Chromium (total)	1	rat	2737	5354	black duck	1.0	1.0
Chromium VI	1	rat	3.28	6.42	–	–	–
Lead	50	rat	8.0	15.7	American kestrel	3.85	3.85
Mercury (Organic)	0.3	rat	0.032	0.063	mallard	0.0064	0.006
Mercury (Inorganic)	0.3	mouse	13.2	13.97	Japanese Quail	0.45	0.45
Selenium	1	rat	0.2	0.391	screech owl	0.44	0.44
Silver	2	rat	17.8[j]	34.8	–	–	–
Organic							
Acenaphthene	18[k]	mouse	17.5[l]	18.5	–	–	–
Anthracene	18[k]	mouse	100[m]	105.8	–	–	–
Benzo(a)anthracene	18[k]	mouse	1.0[n]	1.058	–	–	–
Benzo(a)pyrene	18[k]	mouse	1.0	1.058	–	–	–
Benzo(b)fluoranthene	18[k]	mouse	1.0[n]	1.058	–	–	–
Benzo(g,h,i)perylene	18[k]	mouse	1.0[n]	1.058	–	–	–
Benzo(k)fluoranthene	18[k]	mouse	1.0[n]	1.058	–	–	–
Bis(2-ethylhexyl)phthalate	–	mouse	18.3	19.4	ringed dove	1.1	1.1
Carbazole	–	–	–	–	–	–	–
Chrysene	18[k]	mouse	1.0[k]	1.058	–	–	–
Di-n-butyl phthalate	200	mouse	550	582	ringed dove	0.11	0.11
Di-n-octyl phthalate	–	mouse	79.4[o]	84.04	–	–	–

Refer to footnotes at end of table.

Table 14 (Concluded)
Toxicity Benchmarks for Ecological Receptors at SWMU 234

Constituent of Potential Ecological Concern	Plant Benchmark[a,b]	Mammalian NOAELs			Avian NOAELs		
		Mammalian Test Species[c,d]	Test Species NOAEL[d,e]	Deer Mouse NOAEL[e,f]	Avian Test Species[d]	Test Species NOAEL[d,e]	Burrowing Owl NOAEL[e,g]
Fluoranthene	18[k]	mouse	12.5[p]	13.23	–	–	–
Fluorene	18[k]	mouse	12.5[p]	13.23	–	–	–
Indeno(1,2,3-cd)pyrene	18[k]	mouse	1.0[n]	1.058	–	–	–
Phenanthrene	18[k]	mouse	1.0[n]	1.058	–	–	–
Pyrene	18[k]	mouse	7.5[q]	7.94	–	–	–

[a]In milligrams per kilogram soil dry weight.
[b]From Efroymson et al. (1997).
[c]Body weights (in kilograms) for the NOAEL conversion are as follows: lab mouse, 0.030; lab rat, 0.350 (except where noted).
[d]From Sample et al. (1996), except where noted.
[e]In milligrams per kilogram body weight per day.
[f]Based upon NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.0239 kilogram and a mammalian scaling factor of 0.25.
[g]Based upon NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.
[h]Body weight: 0.435 kilogram.
[i]Body weight: 0.303 kilogram.
[j]Based upon a rat LOAEL of 89 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.2.
[k]From Sims and Overcash (1983).
[l]Based upon EPA (1998a).
[m]NOAEL based upon the highest dose (1,000 mg/kg/d, subchronic) (EPA 1989b) and an uncertainty factor of 0.1.
[n]No data available. Toxicity value based upon NOAEL for benzo(a)pyrene.
[o]Test species NOAEL based upon mouse NOAEL for bis(2-ethylhexyl)phthalate and ratio of LD_{50} values (6,513/1,500) from RTECS (1997).
[p]Based upon subchronic NOAEL of 125 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.1.
[q]Based upon subchronic NOAEL of 75 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.1.

EPA = U.S. Environmental Protection Agency.
LD_{50} = Acute lethal dose to 50 percent of the test population.
LOAEL = Lowest-observed-adverse-effect level.
mg/kg/d = Milligrams per kilogram per day.
NOAEL = No-observable adverse effect level.
RTECS = Registry of Toxic Effects of Chemical Substances.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data.

VII.3.4 Risk Characterization

Maximum concentrations in soil and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. Table 15 presents the results of these comparisons. HQs are used to quantify the comparison with benchmarks for both plant and wildlife exposure.

HQs for plants exceeded unity for total chromium and chromium VI. HQs for plants could not be determined for bis(2-ethylhexyl)phthalate, carbazole, and di-n-octyl phthalate due to a lack of toxicity information for these COPECs. HQs exceeded unity for arsenic, barium, benzo(b)fluoranthene, and benzo(k)fluoranthene for the omnivorous and insectivorous deer mice, and for benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, and indeno(1,2,3-cd)pyrene for the insectivorous deer mouse. HQs for carbazole could not be determined for the insectivorous deer mouse because of a lack of sufficient toxicity information. No HQs exceeded unity for the burrowing owl. HQs for chromium VI, silver, and all organics, except bis(2-ethylhexyl)phthalate and di-n-butyl phthalate, could not be determined for the burrowing owl because of a lack of sufficient toxicity information. As directed by NMED, HIs were calculated for each of the receptors (the HI is the sum of chemical-specific HQs for all pathways for a given receptor). All receptors had total HIs greater than unity, with a maximum HI of 24 for the insectivorous deer mouse.

Tables 16 and 17 summarize the internal and external dose-rate-model results for Th-232, U-235, and U-238 for the deer mouse and burrowing owl, respectively. The total radiation dose rate to the deer mouse was predicted to be 1.5E-3 rad/day and that for the burrowing owl was 1.5E-3 rad/day. The dose rates for the deer mouse and the burrowing owl are less than the benchmark of 0.1 rad/day.

VII.3.5 Uncertainty Assessment

Many uncertainties are associated with the characterization of ecological risks at SWMU 234. These uncertainties result from assumptions used in calculating risk that could overestimate or underestimate true risk presented at a site. For this risk assessment, assumptions are made that are more likely to overestimate exposures and risk rather than to underestimate them. These conservative assumptions are used in order to be more protective of the ecological resources potentially affected by the site. Conservatisms incorporated into this risk assessment include the use of maximum analyte concentrations measured in soil samples to evaluate risk, the use of wildlife toxicity benchmarks based upon NOAEL values, the incorporation of strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse, and the assumption that all food and soil ingested by the wildlife receptors come from the site. Each of these uncertainties, which are consistent among each of the SWMU-specific ecological risk assessments, is discussed in greater detail in the uncertainty section of the ecological risk assessment methodology document for the SNL/NM ER Project (IT July 1998).

Uncertainties associated with the estimation of risk to ecological receptors following exposure to Th-232, U-234, and U-238 are primarily related to those inherent in the radionuclide-specific data. Radionuclide-dependent data are measured values that have their associated errors. The dose-rate models used for these calculations are based upon conservative estimates of receptor shape, radiation absorption by body tissues, and intake parameters. The goal is to provide a realistic but conservative estimate of a receptor's internal and external exposure to radionuclides in soil.

Table 15
Hazard Quotients for Ecological Receptors at SWMU 234

Constituent of Potential Ecological Concern	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
Inorganic					
Arsenic	7.0E-1	4.9E-1	**4.4E+0**	**8.3E+0**	3.5E-3
Barium	4.8E-1	6.0E-1	**2.1E+0**	**3.6E+0**	2.6E-2
Cadmium	9.7E-1	1.4E-1	1.4E-1	1.5E-1	4.7E-3
Chromium (total)	**1.8E+1**	3.1E-5	5.4E-5	7.7E-5	5.9E-2
Chromium VI	**2.1E+0**	3.0E-3	5.3E-3	7.6E-3	–
Lead	2.6E-1	1.4E-2	1.1E-2	7.8E-3	7.6E-3
Mercury (Organic)	2.0E-1	1.5E-1	1.5E-1	1.5E-1	8.6E-1
Mercury (Inorganic)	2.0E-1	6.9E-4	6.9E-4	6.9E-4	1.2E-2
Selenium	1.3E-1	2.7E-2	4.0E-2	5.3E-2	8.6E-3
Silver	5.0E-1	4.6E-3	2.9E-3	1.2E-3	–
Organic					
Acenaphthene	3.5E-4	1.2E-5	5.5E-4	1.1E-3	–
Anthracene	1.2E-3	3.9E-6	3.4E-4	6.9E-4	–
Benzo(a)anthracene	1.4E-2	1.6E-3	4.8E-1	9.5E-1	–
Benzo(a)pyrene	2.4E-2	2.0E-3	8.5E-1	**1.7E+0**	–
Benzo(b)fluoranthene	2.8E-2	1.9E-3	**1.0E+0**	**2.1E+0**	–
Benzo(g,h,i)perylene	1.7E-2	1.2E-3	6.4E-1	**1.3E+0**	–
Benzo(k)fluoranthene	2.6E-2	1.7E-3	**1.0E+0**	**2.0E+0**	–
Bis(2-ethylhexyl)phthalate	–	1.4E-5	1.0E-2	2.0E-2	5.2E-1
Carbazole	–	–	–	–	–
Chrysene	2.4E-2	2.2E-3	8.3E-1	**1.7E+0**	–
Di-n-butyl phthalate	1.0E-4	5.7E-7	6.2E-5	1.2E-4	1.2E-3
Di-n-octyl phthalate	–	1.1E-6	2.3E-4	4.5E-4	–
Fluoranthene	2.5E-2	4.1E-4	6.1E-2	1.2E-1	–
Fluorene	3.7E-4	1.3E-5	8.4E-4	1.7E-3	–
Indeno(1,2,3-cd)pyrene	1.9E-2	1.3E-3	7.1E-1	**1.4E+0**	–

Refer to footnotes at end of table.

Table 15 (Concluded)
Hazard Quotients for Ecological Receptors at SWMU 234

Constituent of Potential Ecological Concern	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
Phenanthrene	7.7E-3	2.2E-3	2.3E-1	4.6E-1	–
Pyrene	3.4E-2	6.2E-4	1.4E-1	2.9E-1	–
HI[b]	**2.4E+1**	**1.4E+0**	**1.3E+1**	**2.4E+1**	**1.5E+0**

[a]**Bold** values indicate the HQ or HI exceeds unity.
[b]The HI is the sum of individual HQs.
HI = Hazard index.
HQ = Hazard quotient.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data available for risk estimation purposes.

Table 16
Internal and External Dose Rates for Deer Mice Exposed to Radionuclides at SWMU 234

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Th-232	6.5E+0	2.6E-6	1.2E-3	1.2E-3
U-238	1.8E+0	1.8E-5	2.7E-4	2.9E-4
U-235	2.78E-1[a]	3.0E-6	4.5E-6	7.6E-6
Total		2.4E-5	1.5E-3	1.5E-3

[a]Parameter is nondetect. Concentration is the minimum detectable activity.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

Table 17
Internal and External Dose Rates for Burrowing Owls Exposed to Radionuclides at SWMU 234

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Th-232	6.5E+0	3.8E-6	1.2E-3	1.2E-3
U-238	1.8E+0	7.3E-6	2.7E-4	2.8E-4
U-235	2.78E-1[a]	3.1E-6	4.5E-6	7.6E-6
Total		1.4E-5	1.5E-3	1.5E-3

[a]Parameter is nondetect. Concentration is the minimum detectable activity.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. Conservatisms in the modeling of exposure and risk can result in the prediction of risk to ecological receptors when exposed at background concentrations. As shown in Table 18, HQs associated with exposures to background are greater than 1.0 for arsenic, barium and total chromium. For these COPECs at SWMU 234, background may account for approximately 63, 83, and 92 percent of the HQ values. It is, therefore, likely that the actual risks from arsenic, barium, and total chromium at SWMU 234 are overestimated by the HQs calculated in this screening assessment because of conservatisms incorporated into both the exposure assessment and toxicity benchmarks for these COPECs (e.g., the use of NOAELs for wildlife receptors).

Another conservatism is the assumption of an area use factor of 1 for the purpose of estimating exposure in this screening assessment. All food and soil ingested by the burrowing owl are assumed to come from the site. The HQs for this receptor shown in Table 15 are based upon an assumed area use factor of 1. However, the home range of the burrowing owl (35 acres [see Table 11]) is greater than the area of the site (approximately 0.15 acre); therefore, an area use factor (i.e., the ratio of the area of the site to the home range of receptor) of less than 1

Table 18
HQs for Ecological Receptors Exposed to Background Concentrations at SWMU 234

Constituent of Potential Ecological Concern	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
Inorganic					
Arsenic	4.4E-1	3.1E-1	**2.8E+0**	**5.2E+0**	2.2E-3
Barium	4.0E-1	5.0E-1	**1.8E+0**	**3.0E+0**	2.2E-2
Cadmium	1.7E-1	2.4E-2	2.5E-2	2.6E-2	8.1E-4
Chromium (total)	**1.6E+1**	2.8E-5	4.9E-5	7.1E-5	5.4E-2
Chromium VI	–	–	–	–	–
Lead	2.2E-1	1.2E-2	9.5E-3	6.7E-3	6.6E-3
Mercury (Organic)	1.7E-1	1.3E-1	1.3E-1	1.3E-1	7.1E-1
Mercury (Inorganic)	1.7E-1	5.7E-4	5.7E-4	5.7E-4	1.0E-2
Selenium	5.0E-1	1.0E-1	1.5E-1	2.0E-1	3.3E-2
Silver	2.5E-1	2.3E-3	1.4E-3	6.0E-4	–
HI[b]	**1.8E+1**	**1.1E+0**	**4.9E+0**	**8.6E+0**	8.4E-1

[a]**Bold** values indicate the HQ or HI exceeds unity.
[b]The HI is the sum of individual HQs.
HI = Hazard index.
HQ = Hazard quotient.
SWMU = Solid Waste Management Unit.
– = Insufficient background or toxicity data available for risk estimation purposes.

would be justified for this receptor to reflect the probable fraction of the ingested food and soil that come from the site as opposed to that from surrounding areas. Based upon the home range of the burrowing owl, an area use factor of 0.011 would be justified for this receptor at this site.

A significant source of uncertainty associated with the prediction of ecological risks at this site is the use of the maximum measured concentrations to evaluate exposure and risk. This results in a conservative exposure scenario that does not necessarily reflect actual site conditions. To assess the potential degree of overestimation caused by using the maximum measured soil concentrations in the exposure assessment, average soil concentrations were calculated for the COPECs with HQs greater than unity to determine whether these HQs can be accounted for by the magnitude of the extreme measurement. The mean concentrations of arsenic, barium, and total chromium (3.26, 172, and 8.66 mg/kg, respectively) were found to be less than the corresponding background screening values. Therefore, risks from exposures to these COPECs at SWMU 234 are likely to be within the background levels as shown in Table 18. The mean concentration of chromium VI (0.218 mg/kg, as based upon the use of full detection limits for nondetections) is less than the plant toxicity benchmark for this COPEC. Therefore, no risk from chromium VI is predicted for this site based upon the mean concentration. For the six COPECs that showed HQs greater than unity (benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, and indeno[1,2,3-cd]pyrene), mean values were calculated based upon the use of one-half the detection limit for nondetections. The mean values for benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo[g,h,i]perylene, chrysene, and indeno[1,2,3-cd]pyrene (0.16, 0.18, 0.17, 0.17, 0.17, and 0.16 mg/kg, respectively) all result in HQs of less than 1 for either the omnivorous or insectivorous deer mouse, as appropriate. Therefore, in all cases, the risk indicated by the HQs greater than unity and/or greater than the respective background HQs can be attributed to the use of the maximum concentration as the exposure concentration for ecological receptors.

Based upon this uncertainty analysis, ecological risks at SWMU 234 are expected to be low. HQs greater than unity were initially predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to exposure concentration and the contribution of background risk.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 234 were estimated through a screening assessment that incorporated site-specific information when available. Overall, risks to ecological receptors are expected to be low because predicted risks associated with exposure to COPECs are based upon calculations using maximum detected values. The mean concentrations of arsenic, barium, and total chromium were found to be within background range. The mean concentrations of chromium VI, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene and indeno(1,2,3-cd)pyrene did not result in HQs greater than unity. Based upon this final analysis, ecological risks associated with SWMU 234 are expected to be low.

VII.3.7 Screening Assessment Scientific/Management Decision Point

After potential ecological risks associated with the site have been assessed, a decision is made regarding whether the site should be recommended for NFA or whether additional data should be collected to assess actual ecological risk at the site more thoroughly. With respect to this site, ecological risks are predicted to be low. The scientific/management decision is to recommend this site for NFA.

VIII. References

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APPENDIX 1
EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

Introduction

Sandia National Laboratories/New Mexico (SNL/NM) proposes that a default set of exposure routes and associated default parameter values be developed for each future land use designation being considered for SNL/NM Environmental Restoration (ER) project sites. This default set of exposure scenarios and parameter values would be invoked for risk assessments unless site-specific information suggested other parameter values. Because many SNL/NM solid waste management units (SWMU) have similar types of contamination and physical settings, SNL/NM believes that the risk assessment analyses at these sites can be similar. A default set of exposure scenarios and parameter values will facilitate the risk assessments and subsequent review.

The default exposure routes and parameter values suggested are those that SNL/NM views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the U.S. Environmental Protection Agency (EPA) Region VI and New Mexico Environment Department (NMED), SNL/NM proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all SWMUs exist within the boundaries of the Kirtland Air Force Base (KAFB). Approximately 157 potential waste and release sites have been identified where hazardous, radiological, or mixed materials may have been released to the environment. Evaluation and characterization activities have occurred at all of these sites to varying degrees. Among other documents, the SNL/NM ER draft Environmental Assessment (DOE 1996) presents a summary of the hydrogeology of the sites, the biological resources present and proposed land use scenarios for the SNL/NM SWMUs. At this time, all SNL/NM SWMUs have been tentatively designated for either industrial or recreational future land use. The NMED has also requested that risk calculations be performed based upon a residential land use scenario. All three land use scenarios will be addressed in this document.

The SNL/NM ER project has screened the potential exposure routes and identified default parameter values to be used for calculating potential intake and subsequent Hazard index (HI), excess cancer risk and dose values. The EPA (EPA 1989a) provides a summary of exposure routes that could potentially be of significance at a specific waste site. These potential exposure routes consist of:

- Ingestion of contaminated drinking water
- Ingestion of contaminated soil
- Ingestion of contaminated fish and shellfish
- Ingestion of contaminated fruits and vegetables
- Ingestion of contaminated meat, eggs, and dairy products

- Ingestion of contaminated surface water while swimming
- Dermal contact with chemicals in water
- Dermal contact with chemicals in soil
- Inhalation of airborne compounds (vapor phase or particulate)
- External exposure to penetrating radiation (immersion in contaminated air, immersion in contaminated water, and exposure from ground surfaces with photon-emitting radionuclides).

Based upon the location of the SNL/NM SWMUs and the characteristics of the surface and subsurface at the sites, we have evaluated these potential exposure routes for different land use scenarios to determine which should be considered in risk assessment analyses (the last exposure route is pertinent to radionuclides only). At SNL/NM SWMUs, currently no consumption of fish, shellfish, fruits, vegetables, meat, eggs, or dairy occurs for products that originate on site. Additionally, no potential for swimming in surface water is present due to the high-desert environmental conditions. As documented in the RESRAD computer code manual (ANL 1993), risks resulting from immersion in contaminated air or water are not significant compared to risks from other radiation exposure routes.

For the industrial and recreational land use scenarios, SNL/NM ER has, therefore, excluded the following four potential exposure routes from further risk assessment evaluations at any SNL/NM SWMU:

- Ingestion of contaminated fish and shellfish
- Ingestion of contaminated fruits and vegetables
- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming.

That part of the exposure pathway for radionuclides related to immersion in contaminated air or water also is eliminated.

For the residential land use scenario, we will include ingestion of contaminated fruits and vegetables because of the potential for residential gardening.

Based upon this evaluation, for future risk assessments the exposure routes that will be considered are shown in Table 1. Dermal contact is included as a potential exposure pathway in all land use scenarios. However, the potential for dermal exposure to inorganic compounds is not considered significant and will not be included. In general, the dermal exposure pathway is generally not considered to be significant relative to water ingestion and soil ingestion pathways, but will be considered for organic components. Because of the lack of toxicological parameter values for this pathway, the inclusion of this exposure pathway into risk assessment calculations may not be possible and may be part of the uncertainty analysis for a site where dermal contact is potentially applicable.

Table 1
Exposure Pathways Considered for Various Land Use Scenarios

Industrial	Recreational	Residential
Ingestion of contaminated drinking water	Ingestion of contaminated drinking water	Ingestion of contaminated drinking water
Ingestion of contaminated soil	Ingestion of contaminated soil	Ingestion of contaminated soil
Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)
Dermal contact	Dermal contact	Dermal contact
External exposure to penetrating radiation from ground surfaces	External exposure to penetrating radiation from ground surfaces	Ingestion of fruits and vegetables
		External exposure to penetrating radiation from ground surfaces

Equations and Default Parameter Values for Identified Exposure Routes

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation also may be significant for radionuclides. All of the above routes will, however, be considered for their appropriate land use scenarios. The general equations for calculating potential intakes via these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund (RAGS): Volume 1 (EPA 1989a, 1991). These general equations also apply to calculating potential intakes for radionuclides. A more in-depth discussion of the equations used in performing radiological pathway analyses with the RESRAD code may be found in the RESRAD Manual (ANL 1993). Also shown are the default values SNL/NM ER suggests for use in RME risk assessment calculations for industrial, recreational, and residential scenarios, based upon EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants. RESRAD input parameters that are left as the default values provided with the code are not discussed. Further information relating to these parameters may be found in the RESRAD Manual (ANL 1993).

Generic Equation for Calculation of Risk Parameter Values

The equation used to calculate the risk parameter values (i.e., hazard quotients/hazard index [HI], excess cancer risk, or radiation total effective dose equivalent [dose]) is similar for all exposure pathways and is given by:

Risk (or Dose) = Intake x Toxicity Effect (either carcinogenic, noncarcinogenic, or radiological)

$$= C \times (CR \times EFD/BW/AT) \times \text{Toxicity Effect} \quad (1)$$

where

C = contaminant concentration (site specific)
CR = contact rate for the exposure pathway
EFD= exposure frequency and duration
BW = body weight of average exposure individual
AT = time over which exposure is averaged.

The total risk/dose (either cancer risk or HI) is the sum of the risks/doses for all of the site-specific exposure pathways and contaminants.

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the constituents of concern (COC) present at the site. This estimate is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk range of 1E-6 for Class A and B carcinogens and 1E-5 for Class C carcinogens. The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the HI) for the toxicity resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of this quantitative estimate with the EPA standard HI of unity (1). The evaluation of the health hazard due to radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site.

The specific equations used for the individual exposure pathways can be found in RAGS (EPA 1989a) and the RESRAD Manual (ANL 1993). Table 2 shows the default parameter values suggested for used by SNL/NM at SWMUs, based upon the selected land use scenario. References are given at the end of the table indicating the source for the chosen parameter values. The intention of SNL/NM is to use default values that are consistent with regulatory guidance and consistent with the RME approach. Therefore, the values chosen will, in general, provide a conservative estimate of the actual risk parameter. These parameter values are suggested for use for the various exposure pathways based upon the assumption that a particular site has no unusual characteristics that contradict the default assumptions. For sites for which the assumptions are not valid, the parameter values will be modified and documented.

<u>Summary</u>

SNL/NM proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial, recreational or residential future land use scenario. There are no current residential land use designations at SNL/NM ER sites, but this scenario has been requested to be considered by the NMED. For sites designated as industrial or recreational land use, SNL/NM will provide risk parameter values based upon a residential land use scenario to indicate the effects of data uncertainty on risk value calculations or in order to potentially mitigate the need for institutional controls or restrictions on SNL/NM ER sites. The parameter values are based upon EPA guidance and supplemented by information from other government sources. The values are generally consistent with those proposed by Los Alamos National Laboratory, with a few minor variations. If these exposure routes and parameters are acceptable, SNL/NM will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

Table 2
Default Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency	8 hr/day for 250 day	4 hr/wk for 52 wk/yr	350 day/yr
Exposure duration (yr)	25[a,b]	30[a,b]	30[a,b]
Body weight (kg)	70[a,b]	70 adult[a,b] 15 child	70 adult[a,b] 15 child
Averaging Time (days) for carcinogenic compounds (= 70 y x 365 day/yr) for noncarcinogenic compounds (= ED x 365 day/yr)	 25,550[a] 9,125	 25,550[a] 10,950	 25,550[a] 10,950
Soil Ingestion Pathway			
Ingestion rate	100 mg/day[c]	200 mg/day child 100 mg/day adult	200 mg/day child 100 mg/day adult
Inhalation Pathway			
Inhalation rate (m^3/yr)	5,000[a,b]	260[d]	7,000[a,b,d]
Volatilization factor (m^3/kg)	Chemical specific	chemical specific	chemical specific
Particulate emission factor (m^3/kg)	1.32E9[a]	1.32E9[a]	1.32E9[a]
Water Ingestion Pathway			
Ingestion rate (liter/day)	2[a,b]	2[a,b]	2[a,b]
Food Ingestion Pathway			
Ingestion rate (kg/yr)	NA	NA	138[b,d]
Fraction ingested	NA	NA	0.25[b,d]
Dermal Pathway			
Surface area in water (m^2)	2[b,e]	2[b,e]	2[b,e]
Surface area in soil (m^2)	0.53[b,e]	0.53[b,e]	0.53[b,e]
Permeability coefficient	Chemical specific	chemical specific	chemical specific

[a]Risk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).
[b]Exposure Factors Handbook (EPA 1989b).
[c]EPA Region VI guidance.
[d]For radionuclides, RESRAD (Argonne National Laboratory, 1993. *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD*, Version 5.0, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, IL. 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.
[e]Dermal Exposure Assessment (EPA 1992).
ED = Exposure duration.
EPA = U.S. Environmental Protection Agency.
hr = Hour.
kg = Kilogram(s).
m^2 = Square meter(s).
m^3 = Cubic meter(s).
mg = Milligram(s).
NA = Not available.
wk = Week.
yr = Year.

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ATTACHMENT M
Data Validation Reports for SWMU 234

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

Site 234

Project Name Tijeras Arroyo; Site 234 Page 1 of 4
Case Number 3632.300
Sample Numbers 017880/81/82/83

AR/COC No. 00804 Analytical laboratory ENCOTEC SDG No. 71-091
AR/COC No. ______ Analytical laboratory ______ SDG No. ______
AR/COC No. ______ Analytical laboratory ______ SDG No. ______
AR/COC No. ______ Analytical laboratory ______ SDG No. ______

In the tables below, mark any information that is missing or incorrect.

1.0 Sample Collection Log

Item	Complete?		Corrected?	
	Yes	No	Yes	No[a]
Date	✓			
Sheet number and total number of sheets below	✓			
General information	✓			
Sample description	✓			
Sample ID number(s) and fraction number(s)		✓		✓
Location	✓			
Time of sample collection	✓			
Sample type	✓			
Depth below surface	✓			
QC sample?[b]	✓			
Comments	✓			
Analyses requested	✓			
Project information	✓			
Project name	✓			
Case number/service order number	✓			
Contact information	✓			
Turnaround time	✓			
Regulatory program		✓		
Special QC requirements	✓			
Sample team member(s), their signature(s), and initials	✓			
Sample tracking information (the "Data Entered" and "By" spaces may be empty)	✓			

[a] Describe any uncorrected deficiencies in Section 5.0, "Completeness Assessment," below.
[b] Comments are only required for QC samples; for other samples, this item can be blank.

Reviewed by: [signature]
Date: 10-28-94

49743

SHEARS #

INFORMATION COPY

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

2.0 Analysis Request and Chain of Custody Record

Item	Complete?		Corrected?	
	Yes	No	Yes	No[a]
Page number and total number of pages	✓			
Project information	✓			
Sample shipping information	✓			
Contract and case number	✓			
SMO authorization signature	✓			
Location information	✓			
Sample number(s)/fraction number(s)		✓		
Sample ID information	✓			
Date/time sample(s) collected	✓			
Sample matrix	✓			
Container type(s)	✓			
Sample volume	✓			
Preservative (chemical and/or thermal)	✓			
Sample collection method	✓			
Sample type	✓			
Required analytical testing	✓			
Sample information	✓			
Special instruction/QC requirements	✓			
Custody records	✓			
Lab sample number	✓			
Condition upon receipt	✓			

[a] Describe any uncorrected deficiencies in Section 5.0 "Completeness Assessment" below.

3.0 Document Comparison

Item	Complete?		Corrected?	
	Yes	No	Yes	No[a]
Dates on Sample Collection Log and AR/COC agree.	✓			
Sample team members on the Sample Collection Log and the AR/COC agree.	✓			
Sample ID numbers on Sample Collection Log and AR/COC agree.	✓			
Date and time on Sample Collection Log and AR/COC agree.	✓			
Analyses requested on AR/COC agree with those shown on Sample Collection Log.	✓			
Project information on Sample Collection Log and AR/COC agree.	✓			
The sample location on the Sample Collection Log agrees with the AR/COC and project- specific plan requirements or authorized changes to the plan(s).	✓			
The number of investigative and QC samples collected was that specified in the project-specific plan(s) or authorized changes to the plan(s).	✓			
The analyses requested on the AR/COC were those specified in the project-specific plan(s) or authorized changes to the plan(s).	✓			

[a] Describe any uncorrected deficiencies in Section 5.0 "Completeness Assessment," below.

Reviewed by: [signature] Date: 10-28-94

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

4.0 Analytical Laboratory Report

Item	Complete?		Corrected?	
	Yes	No	Yes	No[a]
Data reviewed, signature	✓			
Date samples received	✓			
Method reference number(s)	✓	✓		
Quality control data	✓			
Matrix spike/matrix spike duplicate data	NA			
Narrative complete	✓			

[a] Describe any uncorrected deficiencies in Section 5.0 "Completeness Assessment" below.

5.0 Completeness Assessment For each section below, mark the appropriate box and describe any problems that remain unresolved.

5.1 Sample Collection Log — Yes / No

All boxes on the Sample Collection Log are complete: ☑ Yes ☐ No

Some boxes have been checked no; all problems are resolved. ☑ Yes ☐ No

If any boxes have been checked no, describe problem and resolution:

(1) Sample fractions were used to indicate different "xyz locations" for the sample instead of indicating different analysis request. The latter use of fractions is customary; should a project use fraction numbers otherwise is the call of the project leader. (2) No regulatory program mentioned

5.2 Analysis Request And Chain Of Custody Record AR/COC — Yes / No

All boxes on the AR/COC review are complete: ☐ Yes ☐ No

Some boxes have been checked no; all problems are resolved. ☐ Yes ☐ No

If any boxes have been checked no, describe problem and resolution:

See 5.1

Reviewed by: [signature]

Date: 10-28-94

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

5.3 Document Comparison	Yes	No
All boxes on the Document Comparison are complete:	☑	☐
Some boxes have been checked no; all problems are resolved.	☑	☐

If any boxes have been checked no, describe problem and resolution:
Without the SAP, these boxes marked "?" could not be answered

5.4 Analytical Laboratory Report	Yes	No
All boxes on the Lab Report review are complete:	☐	☐
Some boxes have been checked no; all problems are resolved.	☑	☐

If any boxes have been checked no, describe problem and resolution:
The COC requested TPH (8015); the lab ran TPH by 418.1

BASED ON THE REVIEW, DOCUMENTATION IS COMPLETE: ☐ Yes ☐ No

Reviewed by: [signature] Approved by:* ______
Date: 10-28-94 Date: ______

* Task/Project Leader must approve data package.

COMMENTS: ______

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Project Name Tijeras Arroyo Site 234
Case Number 3632.300
Sample Numbers 017880/81/82/83

AR/COC No. 00804 Analytical laboratory Encotec SDG No. 71-041
AR/COC No. ________ Analytical laboratory ________ SDG No. ________
AR/COC No. ________ Analytical laboratory ________ SDG No. ________
AR/COC No. ________ Analytical laboratory ________ SDG No. ________

1.0 EVALUATION

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
1) Sample volume, container, and preservation correct?		✓	Two samples, 017882-3 and 017881-1 were received broken and replaced with 017882-5 and 017881-2 respectively. See lab narrative
2) Holding times met for all samples?	✓		
3) Reporting units appropriate for the matrix and meet project-specific requirements?	✓		
4) Quantitation limit met for all samples?	✓		
5) Accuracy a) Laboratory control sample accuracy reported and met for all samples?	✓		
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique?	✓		

Reviewed by: Doug Salmon

Date: 10-28-94

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
c) Matrix spike recovery data reported and met for all samples for which it was requested?	N/A		–
6) Precision a) Laboratory control sample precision reported and met for all samples?	✓		
b) Matrix spike duplicate RPD data reported and met for all samples for which it was requested?	N/A		
7) Blank data a) Method or reagent blank data reported and met for all samples?	✓		2-Butanone was detected in the method blank and samples, obviously it is a trace, minor contaminant
b) Sampling blank (e.g., field, trip, and equipment) data reported and met?	✓		
8) Narrative included, correct, and complete?	✓		

2.0 COMMENTS: All items marked "No" above must be explained in this section. For each item, give SNL/NM ID No. and the analysis, if appropriate, of all samples affected by the finding.

Reviewed by: ____________________

Date: ____________________

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

2.0 COMMENTS CONTINUATION SHEET

Reviewed by: ____________________

Date: ____________________

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

3.0 SUMMARY: Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted. Use the qualifiers given at the end of the table if possible. Explain any other qualifiers in the comments column.

Sample/ Fraction No.	Analysis	Qualifiers	Comments
017880-5	VOC	JB	2-Butanone contaminate
81-4	"		at low levels also found in
82-4	"		the method blank
83-4	"		
84-6	"		
85-3	"		
88	"		
Method Blank	"		
017882-1	SVOC	JB	Bis (2-ethylhexyl) phthalate
Method Blank	"	"	"

Attach continuation sheet for additional samples

QUALIFIERS:

J = Estimated quantity (provide reason)
B = Contamination in blank (indicate which blank)
P = Laboratory precision does not meet criteria
R = Reporting units inappropriate
N = There is presumptive evidence of the presence of the material
UJ = The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
Q = Quantitation limit does not meet criteria
A = Laboratory accuracy does not meet criteria
U = Analyte is undetected (indicate which analyte and reason for qualification)
NJ = There is presumptive evidence of the presence of the material at an estimated quantity.

Reviewed by: [signature]

Date: 10-28-94

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

SAMPLE FINDINGS SUMMARY CONTINUATION SHEET

Sample/ Fraction No.	Analysis	Qualifiers	Comments

Reviewed by: [signature] Approved by:* ____________________

Date: 10-28-94 Date: ____________________

*Task/Project Leader must approve data package.

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Site 234

DOCUMENTATION COMPLETENESS CHECKLIST (DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

Project Name Site 46 Page 1 of 4
Case Number 3632.300
Sample Numbers 017876, 017877, 017878, 017879, 017886, 017889, 017880, 017884

AR/COC No. 00783 Analytical laboratory Quanterra - STL SDG No. 017876-2
AR/COC No. 00787 Analytical laboratory Quanterra - STL SDG No. 017876-2
AR/COC No. 00785 Analytical laboratory Quanterra - STL SDG No. 017876-2
AR/COC No. ______ Analytical laboratory ______ SDG No. ______

In the tables below, mark any information that is missing or incorrect.

1.0 Sample Collection Log

Item	Complete? Yes	Complete? No	Corrected? Yes	Corrected? No[a]
Date	✓			
Sheet number and total number of sheets below	✓			
General information	✓			
Sample description	✓			
Sample ID number(s) and fraction number(s)	✓			
Location	✓			
Time of sample collection	✓			
Sample type	✓			
Depth below surface	NA			
QC sample?[b] None	✓			
Comments	✓			
Analyses requested	✓			
Project information	✓			
Project name	✓			
Case number/service order number	✓			
Contact information	✓			
Turnaround time COC	NA			
Regulatory program	NA			
Special QC requirements	NA			
Sample team member(s), their signature(s), and initials	✓			
Sample tracking information (the "Data Entered" and "By" spaces may be empty)	✓			

[a] Describe any uncorrected deficiencies in Section 5.0, "Completeness Assessment," below.
[b] Comments are only required for QC samples; for other samples, this item can be blank.

Reviewed by: Howard Seeley

Date: 11/22/94

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SHEARS # 26549

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

2.0 Analysis Request and Chain of Custody Record

Item	Complete?		Corrected?	
	Yes	No	Yes	No[a]
Page number and total number of pages	✓			
Project information	✓			
Sample shipping information	✓			
Contract and case number	✓			
SMO authorization signature	✓			
Location information	✓			
Sample number(s)/fraction number(s)	✓			
Sample ID information	✓			
Date/time sample(s) collected	✓			
Sample matrix	✓			
Container type(s)	✓			
Sample volume	✓			
Preservative (chemical and/or thermal)	✓			
Sample collection method SCL	NA			
Sample type	✓			
Required analytical testing	✓			
Sample information	✓			
Special instruction/QC requirements	✓			
Custody records Case narrative	✓			
Lab sample number	✓			
Condition upon receipt	✓			

[a] Describe any uncorrected deficiencies in Section 5.0 "Completeness Assessment" below.

3.0 Document Comparison

Item	Complete?		Corrected?	
	Yes	No	Yes	No[a]
Dates on Sample Collection Log and AR/COC agree.	✓			
Sample team members on the Sample Collection Log and the AR/COC agree.	~~✓~~	✓		✓
Sample ID numbers on Sample Collection Log and AR/COC agree.	✓			
Date and time on Sample Collection Log and AR/COC agree.	✓			
Analyses requested on AR/COC agree with those shown on Sample Collection Log.	✓			
Project information on Sample Collection Log and AR/COC agree.	✓			
The sample location on the Sample Collection Log agrees with the AR/COC and project- specific plan requirements or authorized changes to the plan(s).	NA			
The number of investigative and QC samples collected was that specified in the project-specific plan(s) or authorized changes to the plan(s).	NA			
The analyses requested on the AR/COC were those specified in the project-specific plan(s) or authorized changes to the plan(s).	NA			

[a] Describe any uncorrected deficiencies in Section 5.0, "Completeness Assessment," below.

Reviewed by: Howard Seeley Date: 11/22/94

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

4.0 Analytical Laboratory Report

Item	Complete?		Corrected?	
	Yes	No	Yes	No[a]
Data reviewed, signature	✓			
Date samples received	✓			
Method reference number(s)	✓			
Quality control data	✓			
Matrix spike/matrix spike duplicate data	✓			
Narrative complete	✓			

[a] Describe any uncorrected deficiencies in Section 5.0 "Completeness Assessment" below.

5.0 Completeness Assessment For each section below, mark the appropriate box and describe any problems that remain unresolved.

5.1 Sample Collection Log

	Yes	No
All boxes on the Sample Collection Log are complete:	☑	☐
Some boxes have been checked no; all problems are resolved.	☐	☐

If any boxes have been checked no, describe problem and resolution:

5.2 Analysis Request And Chain Of Custody Record AR/COC

	Yes	No
All boxes on the AR/COC review are complete:	☑	☐
Some boxes have been checked no; all problems are resolved.	☐	☐

If any boxes have been checked no, describe problem and resolution:

Reviewed by: [signature]

Date: 11/22/94

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

5.3 Document Comparison

	Yes	No
All boxes on the Document Comparison are complete:	☑	☐
Some boxes have been checked no; all problems are resolved.	☐	☑

If any boxes have been checked no, describe problem and resolution:
SCL-01608 lists C. Montillier as sample team member. Not shown on COC 00785.

5.4 Analytical Laboratory Report

	Yes	No
All boxes on the Lab Report review are complete:	☑	☐
Some boxes have been checked no; all problems are resolved.	☐	☐

If any boxes have been checked no, describe problem and resolution:
* COC stated specific procedures numbers. Lab lists different procedure numbers. They are probably equivalent but potential problem if specific procedures are required.

BASED ON THE REVIEW, DOCUMENTATION IS COMPLETE: ☐ Yes ☑ No

Reviewed by: Howard Seeley Approved by:* ____________
Date: 11/--/94 Date: ____________

* Task/Project Leader must approve data package.

COMMENTS: ____________

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Project Name Site 46 Page 1 of 5
Case Number 3632.300
Sample Numbers 017876, 017877, 017878, 017879, 017886, 017889, 017880, 017884

AR/COC No. 00783 Analytical laboratory Quanterra - STL SDG No. 017876-2
AR/COC No. 00787 Analytical laboratory Quanterra - STL SDG No. 017876-2
AR/COC No. 00785 Analytical laboratory Quanterra - STL SDG No. 017876-2
AR/COC No. ______ Analytical laboratory ______ SDG No. ______

1.0 EVALUATION

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
1) Sample volume, container, and preservation correct?	✓		
2) Holding times met for all samples?	✓		
3) Reporting units appropriate for the matrix and meet project-specific requirements?	✓		Tritium - all samples
4) Quantitation limit met for all samples?		✓	Tritium - all samples Gamma - all samples
5) Accuracy a) Laboratory control sample accuracy reported and met for all samples?	✓		~~Awaiting lab response 12/1/94~~ HS Response rec'd 2/17/95 - ok HS
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique?	NA		

Reviewed by: H Seeley

Date: 12/1/94

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
c) Matrix spike recovery data reported and met for all samples for which it was requested?	✓		Awaiting lab response 12/1/94 Response incorporated 2/17/95
6) Precision a) Laboratory control sample precision reported and met for all samples?	NA		Awaiting lab response 12/1/94 Response incorporated 2/17/95.
b) Matrix spike duplicate RPD data reported and met for all samples for which it was requested?	NA		Awaiting lab response 12/1/94 Response incorporated 2/17/95.
7) Blank data a) Method or reagent blank data reported and met for all samples?	✓		
b) Sampling blank (e.g., field, trip, and equipment) data reported and met?	NA		
8) Narrative included, correct, and complete?	✓		

2.0 COMMENTS: All items marked "No" above must be explained in this section. For each item, give SNL/NM ID No. and the analysis, if appropriate, of all samples affected by the finding.

1) Tritium reported in units of pCi/g; usually reported in pCi/L for SNL.
2) Since tritium reported in pCi/g, no conclusion made for DA in pCi/L.
3) Gamma MDA > DA due to insufficient material after lab prep.
All samples affected.

Reviewed by: H. Seeley

Date: 12/1/94

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

2.0 COMMENTS CONTINUATION SHEET

Awaiting lab response to continue DV-2 check of LCS/MS recoveries.

Response rec'd and incorporated 2/17/95. OK - HS

Reviewed by: H. Sodlay

Date: 12/1/94

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

3.0 SUMMARY: Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted. Use the qualifiers given at the end of the table if possible. Explain any other qualifiers in the comments column.

Sample/ Fraction No.	Analysis	Qualifiers	Comments
017876-2	Gamma	Q	MDA > requested DA
017878-1	Gamma	Q	MDA > requested DA

Attach continuation sheet for additional samples

QUALIFIERS:

J = Estimated quantity (provide reason)
B = Contamination in blank (indicate which blank)
P = Laboratory precision does not meet criteria
R = Reporting units inappropriate
N = There is presumptive evidence of the presence of the material
UJ = The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Q = Quantitation limit does not meet criteria
A = Laboratory accuracy does not meet criteria
U = Analyte is undetected (indicate which analyte and reason for qualification)
NJ = There is presumptive evidence of the presence of the material at an estimated quantity.

Reviewed by: H. Seeley

Date: 12/1/94

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

SAMPLE FINDINGS SUMMARY CONTINUATION SHEET

Sample/ Fraction No.	Analysis	Qualifiers	Comments

Reviewed by: H. Sedley Approved by:* ____________

Date: 12/1/94 Date: ____________

*Task/Project Leader must approve data package.

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Site 234

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

Project Name Tijeras Arroyo

Page 1 of 4

Case Number 3632.360

Sample Numbers 017912-4, 017915-3, 017880-4, 017884-3, 017876-017879, 018081

AR/COC No. 0807 Analytical laboratory Quanterra-STL SDG No. 6298
AR/COC No. 0783 Analytical laboratory ↓ SDG No. 6235
AR/COC No. 0785 Analytical laboratory ↓ SDG No. 6235
AR/COC No. 0933 Analytical laboratory ↓ SDG No. 6351

In the tables below, mark any information that is missing or incorrect.

1.0 Sample Collection Log

NA

Item	Complete? Yes	Complete? No	Corrected? Yes	Corrected? No[a]
Date				
Sheet number and total number of sheets below				
General information				
Sample description				
Sample ID number(s) and fraction number(s)				
Location				
Time of sample collection				
Sample type				
Depth below surface				
QC sample?[b]				
Comments				
Analyses requested				
Project information				
Project name				
Case number/service order number				
Contact information				
Turnaround time				
Regulatory program				
Special QC requirements				
Sample team member(s), their signature(s), and initials				
Sample tracking information (the "Data Entered" and "By" spaces may be empty)				

hs 2/28/95

[a] Describe any uncorrected deficiencies in Section 5.0, "Completeness Assessment," below.
[b] Comments are only required for QC samples; for other samples, this item can be blank.

Reviewed by: Howard Seeley

Date: 2-28-95

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SHEARS # 54535

DOCUMENTATION COMPLETENESS CHECKLIST (DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

2.0 Analysis Request and Chain of Custody Record

NA

Item	Complete? Yes	Complete? No	Corrected? Yes	Corrected? No[a]
Page number and total number of pages				
Project information				
Sample shipping information				
Contract and case number				
SMO authorization signature				
Location information				
Sample number(s)/fraction number(s)				
Sample ID information				
Date/time sample(s) collected				
Sample matrix				
Container type(s)				
Sample volume				
Preservative (chemical and/or thermal)				
Sample collection method				
Sample type				
Required analytical testing				
Sample information				
Special instruction/QC requirements				
Custody records				
Lab sample number				
Condition upon receipt				

[a] Describe any uncorrected deficiencies in Section 5.0 "Completeness Assessment" below.

HS 2/28/95

3.0 Document Comparison

NA

Item	Complete? Yes	Complete? No	Corrected? Yes	Corrected? No[a]
Dates on Sample Collection Log and AR/COC agree.				
Sample team members on the Sample Collection Log and the AR/COC agree.				
Sample ID numbers on Sample Collection Log and AR/COC agree.				
Date and time on Sample Collection Log and AR/COC agree.				
Analyses requested on AR/COC agree with those shown on Sample Collection Log.				
Project information on Sample Collection Log and AR/COC agree.				
The sample location on the Sample Collection Log agrees with the AR/COC and project-specific plan requirements or authorized changes to the plan(s).				
The number of investigative and QC samples collected was that specified in the project-specific plan(s) or authorized changes to the plan(s).				
The analyses requested on the AR/COC were those specified in the project-specific plan(s) or authorized changes to the plan(s).				

NA HS 2/28/95

[a] Describe any uncorrected deficiencies in Section 5.0, "Completeness Assessment," below.

Reviewed by: H. Sedley   Date: 2-28-95

DOCUMENTATION COMPLETENESS CHECKLIST (DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

4.0 Analytical Laboratory Report

Item	Complete?		Corrected?	
	Yes	No	Yes	No[a]
Data reviewed, signature	✓			
Date samples received	✓			
Method reference number(s)	✓			
Quality control data	✓			
Matrix spike/matrix spike duplicate data	NA			
Narrative complete	✓			

[a] Describe any uncorrected deficiencies in Section 5.0 "Completeness Assessment" below.

5.0 Completeness Assessment For each section below, mark the appropriate box and describe any problems that remain unresolved.

5.1 Sample Collection Log — Yes / No

All boxes on the Sample Collection Log are complete: ☐ ☐
Some boxes have been checked no; all problems are resolved. ☐ ☐

If any boxes have been checked no, describe problem and resolution: NA

5.2 Analysis Request And Chain Of Custody Record AR/COC — Yes / No

All boxes on the AR/COC review are complete: ☐ ☐
Some boxes have been checked no; all problems are resolved. ☐ ☐

If any boxes have been checked no, describe problem and resolution: NA

Reviewed by: H. Seeley
Date: 2-28-95

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1—DV1)

5.3 Document Comparison	Yes	No
All boxes on the Document Comparison are complete:	☐	☐
Some boxes have been checked no; all problems are resolved.	☐	☐

If any boxes have been checked no, describe problem and resolution: NA

5.4 Analytical Laboratory Report	Yes	No
All boxes on the Lab Report review are complete:	☑	☐
Some boxes have been checked no; all problems are resolved.	☐	☐

If any boxes have been checked no, describe problem and resolution:

BASED ON THE REVIEW, DOCUMENTATION IS COMPLETE: ☑ Yes ☐ No

Reviewed by: H. Seeley Approved by:*
Date: 2-28-95 Date:

* Task/Project Leader must approve data package.

COMMENTS: Data pkg made up of additional analyses requested for several COCs. Refer to initial DV reports for SCL/COC verification.

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Project Name Tijeras Arroyo

Page 1 of 5

Case Number 7632.300

Sample Numbers 017912, 017915, 017880, 017884, 017876-017879, 018081

AR/COC No. 0807	Analytical laboratory Quanterra - STL	SDG No. 6298
AR/COC No. 0783	Analytical laboratory ↓	SDG No. 6235
AR/COC No. 0785	Analytical laboratory ↓	SDG No. 6235
AR/COC No. 0933	Analytical laboratory ↓	SDG No. 6351

1.0 EVALUATION

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
1) Sample volume, container, and preservation correct?	✓		
2) Holding times met for all samples?	✓		
3) Reporting units appropriate for the matrix and meet project-specific requirements?	✓		
4) Quantitation limit met for all samples?		✓	Ra-226 - see comments
5) Accuracy a) Laboratory control sample accuracy reported and met for all samples?	✓		
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique?	NA		

Reviewed by: Howard Seeley

Date: 2-28-95

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
c) Matrix spike recovery data reported and met for all samples for which it was requested?	NA		—
6) Precision a) Laboratory control sample precision reported and met for all samples?	NA		
b) Matrix spike duplicate RPD data reported and met for all samples for which it was requested?	NA		
7) Blank data a) Method or reagent blank data reported and met for all samples? SAP not provided.	✓		See comments
b) Sampling blank (e.g., field, trip, and equipment) data reported and met?	NA		
8) Narrative included, correct, and complete?	✓		

2.0 COMMENTS: All items marked "No" above must be explained in this section. For each item, give SNL/NM ID No. and the analysis, if appropriate, of all samples affected by the finding.

Reviewed by: H. Seeley

Date: 2-28-95

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

2.0 COMMENTS CONTINUATION SHEET

1) Quantitation limits: Per case narrative, some sample MDA's exceeded the requested MDA for Ra-226. Project-specific criteria not available to confirm. Impact left to decision of task leader.

2) Blanks: Project-specific criteria not available for verification. Blank result for Ra-226 was positive. All but one sample result ~~were~~ were w/in 3x the blank value. Task leader should consider potential impact of blank result on sample data.

Reviewed by: H. Seeley

Date: 2-28-95

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

3.0 SUMMARY: Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted. Use the qualifiers given at the end of the table if possible. Explain any other qualifiers in the comments column.

Sample/ Fraction No.	Analysis	Qualifiers	Comments
			HS 2/28/95

Attach continuation sheet for additional samples

QUALIFIERS:

J = Estimated quantity (provide reason)
B = Contamination in blank (indicate which blank)
P = Laboratory precision does not meet criteria
R = Reporting units inappropriate
N = There is presumptive evidence of the presence of the material
UJ = The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
Q = Quantitation limit does not meet criteria
A = Laboratory accuracy does not meet criteria
U = Analyte is undetected (indicate which analyte and reason for qualification)
NJ = There is presumptive evidence of the presence of the material at an estimated quantity.

Reviewed by: H. Seeley

Date: 2-28-95

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

SAMPLE FINDINGS SUMMARY CONTINUATION SHEET

Sample/ Fraction No.	Analysis	Qualifiers	Comments
			HS
			2/28/95

Reviewed by: H. Seeley   Approved by:* ____________

Date: 2-28-95   Date: ____________

*Task/Project Leader must approve data package.

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Encotec

Sandia National Laboratories

SNL/NM 017880 SNL/NM 017882 SNL/NM 017883

SNL/NM 017881

SWMU 234

ENVIRONMENTAL PROGRAMS SAMPLE COLLECTION LOG

SCL- 01609

AR/COC No.: AR/COC- 00804

SF 2001-SCL (12-93)

PAGE 1 OF 3

GENERAL INFORMATION	DATE: 9/21/94	WEATHER: Sunny / Clear / 80°F	SAMPLING INFORMATION	ON-SITE CONTACT: Jan Curtis	ORG. 7582 / PHONE 505-263-3390
	SAMPLING PROCEDURE REFERENCE: SAP			AREA: 1309	LOCATION: Site 234
	PURPOSE OF SAMPLING: Preliminary Assessment				
SAMPLE DESCRIPTION	MATRIX: ☐ GAS ☐ LIQUID ☐ SLUDGE ☐ SOLID ☐ WATER ☐ OIL ☒ SOIL ☐ HAZ WASTE ☐ OTHER				
	COLLECTED FROM: ☐ DRUM ☐ TANK ☐ SURFACE WATER ☒ SOIL ☐ WASTE WATER ☐ GROUND WATER ☐ OTHER				

ANALYSES

Sample Number - Fraction	Time	LOCATION	COMMENTS	Sample Type Grab/Comp.	QC Sample (Y/N)	~~TAL metals, Cr+6, Cyanide/TKN/Nitrate~~	~~BNA~~	VOC	TPH/BNA	TAL metals/Cr+6	TPH		
017880-1	1435	Site 234-01-A	Surface soil 0-6"						X				
017880-2	1437	Site 234-01-A	Surface soil 0-6"							X			
017880-5	1445	Site 234-01-B	Subsurface soil 6-36"					X					
017880-6	1444	Site 234-01-B	Subsurface soil 6-36"						X				
017880-7	1445	Site 234-01-B	Subsurface soil 6-36"							X			
017881-1	1500	Site 234-02-A	Surface soil 0-6" ← Broken jar								X		
017881-2	1459	Site 234-02-A	Surface soil 0-6" This Fraction Used For TPH							X			
017881-3	1505	Site 234-02-B	Subsurface soil 6-36"							X			

PROJECT	PROJECT NAME: Tijeras Arroyo	CASE NUMBER: 3632.300	PROJECT CONTACT: Jim Brinkman	ORG 7582	PHONE 505-848-0455
*ADDITIONAL INFORMATION: (Log Book Ref. #)					

SAMPLE TEAM MEMBERS	NAME	SIGNATURE	INIT	COMPANY/ORGANIZATION
	1. RANDALL ROBERTS	Randall Roberts	C	CDM/FEDERAL PROGRAMS
	2. Mary Albani	Mary Albani	MA	Roy F. Weston, Inc.
	3. Carlos Montillano	Carlos Montillano	CBM	CDM/Federal Programs

SAMPLE TRACKING	SAMPLE DISTRIBUTION: Encotec	TRANSPORTED BY: A 44565	SPECIAL HANDLING:
	DATE SHIPPED (MM-DD-YY): 9/22/94	DATA ENTERED (MM-DD-YY): 9-30-94	BY: [signature]

*NOTE: Any additional sampling information must be recorded in an SNL-Issued Log Book or SCL Continuation Form with a Reference No. entered in this space.

WHITE - To Sample Management Office PINK - Originator ☐ TO BE COMPLETED BY SMO

SNL/NM 017884 SNL/NM 017885

[redacted]

p37-78

Sandia National Laboratories

SF 2001-SCC (4-94)

(Encotec)

ENVIRONMENTAL PROGRAMS SAMPLE COLLECTION LOG

(Continuation)

SCL- 01609

AR/COC No.: AR/COC- 00804

Sample Number - Fraction	Time	LOCATION	COMMENTS	Sample Type Grab/Comp.	QC Sample (Y/N)	ANALYSES: TPH	VOC	TPH/BNA	TAL metals/Cr+6				
017881-5	1507	Site 234-02-B	Subsurface soil 6-36"			X							
017881-4	1506	Site 234-02-B	Subsurface soil 6-36"				X						
017882-1	1520	Site 234-03-A	Surface soil 0-6"					X					
017882-2	1522	Site 234-03-A	Surface soil 0-6"						X				
[redacted]													
017884-1	1615	Site 234-05-A	Surface soil 0-6"					X					
017884-2	1615	Site 234-05-A	Surface soil 0-6"						X				
(JC) ~~017884-3~~	~~1615~~	~~Site 234-05~~											
017884-5	1625	Site 234-05-B	Subsurface soil 6-36"						X				
017884-6	1625	Site 234-~~06~~ 05 -B	Subsurface soil 6-36"				X						
017884-7	1625	Site 234-05-B	Subsurface soil 6-36"					X					

WHITE - To Sample Management Office PINK - Originator

Sandia National Laboratories

SF 2001-SCC (4-94)

Encotec

ENVIRONMENTAL PROGRAMS SAMPLE COLLECTION LOG

(Continuation)

SCL- 01609

AR/COC No.: AR/COC- 00804

PAGE 3 OF 3

Sample Number - Fraction	Time	LOCATION	COMMENTS	Sample Type Grab/Comp.	QC Sample (Y/N)	VOC	TAL metals/Cr+6	TPH					
017885-3	1640	Site 234-06-B	Subsurface soil 6-36"			X							
017885-2	1630	Site 234-06-A	Surface soil 0-6"				X						
017885-1	1630	Site 234-06-A	Surface soil 0-6"					X					
017885-5	1634	Site 234-06-B	Subsurface soil 6-36"				X						
017885-4	1634	Site 234-06-B	Subsurface soil 6-36"					X					
017988	1730	Site 234	Soil trip blank			X							

WHITE - To Sample Management Office PINK - Originator

Sandia National Laboratories

SF 2001-COC (12-93)

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

AR/COC- 07804

PAGE 1 OF 2

Department No.: 7582
Project/Task Manager: Jim Brinkman
Project Name: Tijeras Arroyo
Sample Team Members: Mary Alboni, Randy Roberts
SCI or Logbook Ref. No.: 01609

Date Samples Shipped: 9/22/94
Carrier/Waybill No.: A44365
Lab Destination: Encotec
Lab Contact: Roger Roussell
SMO Contact/Phone: Pam Puissant
Send Report to SMO: Debbie Constant
SMO Reference No.:

Bill to: Sandia National Laboratories
Supplier Services Department
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154
Contract No.: 67-4736 A
Case No.: 3632.300
SMO Authorization: [signature]

Sample Number - Fraction	Date/Time Collected	Sample Matrix	Container Type	Sample Volume	Preservative	Required Analytical Testing	Lab Sample Number	Condition on Receipt
017880 - 1	9/21/94 1435	Soil	Glass	500 ml	ice 4°C	TPH (8015) / BNA (8270)	43135	ok
017880 - 2	9/21/94 1435	Soil				TAL metals (6010/7000), Cr^{+6} *	43136	
017880 - 5	1445		Stainless Steel	150 ml		VOC (8240)	43137	
017880 - 6	1449		Glass	500 ml		TPH (8015) / BNA (8270)	43138	
017880 - 7	1445			500 ml		TAL metals (6010/7000), Cr^{+6} *	43139	
017881 - 1	1500					TPH (8015)	43140	[illegible]
[redacted]								

Possible Hazard Identification
☒ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Radiological

*Reference attached radiological screening for specific contact readings.

Turnaround Time
☒ Normal ☐ Rush Required Report Date

Special Instructions/QC Requirements
* Analyze for Cr^{+6} only if Cr is detected in metals analysis.
Method for Cr^{+6} is aqueous leaching

Sample Disposal
☐ Return to Client ☒ Disposal by Lab Archive Until

	Org.	Date	Time		Org.	Date	Time
1. Relinquished by [signature]	7582	9/22/94	1000	4. Relinquished by			
1. Received by [signature]	SMO 7576	9/22/94	1000	4. Received by			
2. Relinquished by [signature]	SMO 7576	9/22/94	1400	5. Relinquished by			
2. Received by Jim Coleman	ENCOTEC	9/23/94	10:15	5. Received by			
3. Relinquished by				6. Relinquished by			
3. Received by				6. Received by			

WHITE - To Accompany Samples, Laboratory Copy   BLUE- To Accompany Samples, Return to SMO   YELLOW- SMO Suspense Copy   PINK- Field Copy

Sandia National Laboratories

SF 2001-COD (12-93)

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD
(continuation)

AR/COC- [illegible]

PAGE 2 OF 2

Project Name: Tijeras Arroyo   Project/Task Manager: Jim Brinkman   Case No.: 3632.300

Sample Number - Fraction	Sample Matrix	Date/Time Collected	Container Type	Sample Volume	Preservative	Required Analytical Testing	Lab Sample Number	Condition on Receipt
[redacted]								
017784-1		1615				TPH (8015), BNA (8270)	43155	
017784-2		1615				TAL Metals (6010/7000), Cr^{+6} *	43156	
017784-5		1625				" — "	43157	
017784-6		1625	Stainless Steel	150 ml		VOC (8240)	43158	
017784-7		1625	Glass	500 ml		TPH (8015), BNA (8270)	43159	
017785-3		1640	Stainless Steel	150 ml		VOC (8240)	43160	
017785-2		1630	Glass	500 ml		TAL Metals (6010/7000), Cr^{+6} *	43161	
017785-1		1630				TPH (8015)	43162	
017785-5		1634				TAL Metals (6010/7000), Cr^{+6} *	43163	
017785-4		1634				TPH (8015)	43164	
017988		[illegible]	[illegible]	[illegible]	4 °C	VOC ([illegible])	43165	

WHITE - To Accompany Samples, Laboratory Copy   BLUE - To Accompany Samples, Return to SMO   YELLOW - SMO Suspense Copy   PINK - Field Copy

Sandia National Laboratories (in-house)

SF 2001-SCL (12-93)

ENVIRONMENTAL PROGRAMS SAMPLE COLLECTION LOG

234

SCL- 01607

AR/COC No.: AR/COC- 00784

PAGE 1 OF 1

GENERAL INFORMATION

DATE: 9/21/94 — WEATHER: Sunny / Clear 80°F

SAMPLING PROCEDURE REFERENCE: SAP

SAMPLING INFORMATION: ON-SITE CONTACT: Jan Curtis — ORG. 7582 — PHONE 505-263-3390 — AREA 1309 — LOCATION Site 234

PURPOSE OF SAMPLING: Preliminary Assessment

SAMPLE DESCRIPTION

MATRIX: ☐ GAS ☐ LIQUID ☐ SLUDGE ☐ SOLID ☐ WATER ☐ OIL ☒ SOIL ☐ HAZ WASTE ☐ OTHER

COLLECTED FROM: ☐ DRUM ☐ TANK ☐ SURFACE WATER ☒ SOIL ☐ WASTE WATER ☐ GROUND WATER ☐ OTHER

Sample Number - Fraction	Time	LOCATION	COMMENTS	Sample Type Grab/Comp.	QC Sample (Y/N)	ANALYSES: Gamma Spec
017880-3	1435	Site 234-01-A	Surface soil 0-6"			X
017880-8	1444	Site 234-01-B	Subsurface soil 6-36"			X
017884-4	1615	Site 234-05-A	Surface soil 0-6"			X
017884-8	1625	Site 234-05-B	Subsurface soil 6-36"			X

PROJECT: PROJECT NAME Tijeras Arroyo — CASE NUMBER 3632.300 — PROJECT CONTACT Jim Brinkman — ORG. 7582 — PHONE 505-848-0455

*ADDITIONAL INFORMATION: (Log Book Ref. #)

SAMPLE TEAM MEMBERS

	NAME	SIGNATURE	INIT	COMPANY/ORGANIZATION
1.	Mary Albani	[signature]	MA	Roy F. Weston, Inc
2.	Randall Roberts	[signature]	RR	CDM/Federal Programs
3.	Charles Montalbano	[signature]	CM	CDM/Federal Programs

SAMPLE TRACKING: SAMPLE DISTRIBUTION SJL 7715 — TRANSPORTED BY: — SPECIAL HANDLING: — DATE SHIPPED (MM-DD-YY) 9/22/94 — DATA ENTERED (MM-DD-YY) 9-30-94 — BY: Dein Z oggie

*NOTE: Any additional sampling information must be recorded in an SNL-Issued Log Book or SCL Continuation Form with a Reference No. entered in this space.

WHITE - To Sample Management Office PINK - Originator ☐ TO BE COMPLETED BY SMO

Sandia National Laboratories

SF 2001-COC (12-93)

940494

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

AR/COC- 00784

PAGE 1 OF 1

Department No.: 7582	Date Samples Shipped: 9/22/94	Bill to:	Sandia National Laboratories
Project/Task Manager: Jim Brinkman	Carrier/Waybill No.: HC		Supplier Services Department
Project Name: Tijeras Arroyo	Lab Destination: SNL 7715 Lab		P.O. Box 5800 MS 0154
Sample Team Members: Mary Albani, Randy Roberts	Lab Contact: Amir		Albuquerque, NM 87185-0154
	SMO Contact/Phone: ~~Pam Puissant Ank~~	Contract No.:	
	Send Report to SMO: Mack McLaughlin	Case No.:	3632.300
SCL or Logbook Ref. No.: 01607	SMO Reference No.:	SMO Authorization:	[signature]

Sample Number - Fraction	Sample Matrix	Date/Time Collected	Container Type	Sample Volume	Preservative	Required Analytical Testing	Lab Sample Number	Condition on Receipt
017880-3	Soil	9/21/94 1435	Marinelli	500ml	Ice 4°C	Gamma Spec (600 901.1)		
017880-8	Soil	9/21/94 1444	↓	↓	↓	↓		
017884-4	Soil	9/21/94 1615	↓	↓	↓	↓		
017884-8	Soil	9/21/94 1625	↓	↓	↓	↓		

Possible Hazard Identification
☐ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Radiological

*Reference attached radiological screening for specific contact readings.

Turnaround Time
☒ Normal ☐ Rush Required Report Date

Special Instructions/QC Requirements

Sample Disposal
☒ Return to Client ~~☒~~ Disposal by Lab (JC) Archive Until

	Org.	Date	Time		Org.	Date	Time
1. Relinquished by [signature]	7582	9/22/94	0930	4. Relinquished by			
1. Received by [signature]	SMO-7576	9/22/94	0930	4. Received by			
2. Relinquished by [signature]	SMO-7576	9/22/94	9:57	5. Relinquished by			
2. Received by S. B. Ebara	7715	9/22/94	957	5. Received by			
3. Relinquished by [signature] for [signature]	7715	9/26/94	1400	6. Relinquished by			
3. Received by [signature]	SMO 7576	9/26/94	1400	6. Received by			

WHITE - To Accompany Samples, Laboratory Copy BLUE - To Accompany Samples, Return to SMO YELLOW - Suspense Copy PINK - Field Copy

Sandia National Laboratories

SF 2001-COC (12-93)

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

AR/COC- 00784

PAGE 1 OF 1

Department No.: 7582	Date Samples Shipped: 9/22/94	Bill to:	Sandia National Laboratories
Project/Task Manager: Jim Brinkman	Carrier/Waybill No.: [illegible]		Supplier Services Department
Project Name: Tijeras Arroyo	Lab Destination: SNL 7715 Lab		P.O. Box 5800 MS 0154
Sample Team Members: [illegible]	Lab Contact: [illegible]		Albuquerque, NM 87185-0154
[illegible]	SMO Contact/Phone: ~~Pam Persson~~ Mark [illegible]	Contract No.:	
	Send Report to SMO: Mark [illegible]	Case No.: 3632.300	
SCL or Logbook Ref. No.: C1607	SMO Reference No.:	SMO Authorization: [illegible]	

Sample Number	Fraction	Sample Matrix	Date/Time Collected	Container Type	Sample Volume	Preservative	Required Analytical Testing	Lab Sample Number	Condition on Receipt
017480-3		Soil	9/21/94 1435	Marinelli	500ml	ice	Gamma Spec (GOO 901.1)		
017480-8		Soil	9/21/94 1444	↓	↓	↓	↓		
017474-4		Soil	9/21/94 1615	↓	↓	↓	↓		
017484-8		Soil	9/21/94 1625	↓	↓	↓	↓		

Possible Hazard Identification
☐ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Radiological

*Reference attached radiological screening for specific contact readings.

Turnaround Time
☒ Normal ☐ Rush ____ Required Report Date ____

Special Instructions/QC Requirements

Sample Disposal
☒ Return to Client ☒ Disposal by Lab (JC) Archive Until ____

1. Relinquished by [signature]	Org. 7582	Date 9/22/94	Time 0930	4. Relinquished by	Org.	Date	Time
1. Received by [signature]	Org. [illegible]	Date [illegible]	Time	4. Received by	Org.	Date	Time
2. Relinquished by [signature]	Org. [illegible]	Date	Time 7:57	5. Relinquished by	Org.	Date	Time
2. Received by [signature]	Org. 7715	Date 9/22/94	Time 957	5. Received by	Org.	Date	Time
3. Relinquished by [signature]	Org. [illegible]	Date [illegible]	Time 910	6. Relinquished by	Org.	Date	Time
3. Received by [signature]	Org. [illegible]	Date [illegible]	Time [illegible]	6. Received by	Org.	Date	Time

WHITE - To Accompany Samples, Laboratory Copy BLUE - To Accompany Samples, Return to SMO YELLOW - SMO Suspense Copy PINK - Field Copy

Date: 9/22/94

Sandia National Laboratories
Radioactive Sample Diagnostics Program

SAMPLE ANALYSIS REQUEST

To be completed by Customer | *Shaded areas are for Lab use*

Customer: Jim Brinkman
Organization: 7582
Project Location: Tijeras Arroyo
Phone: 845-0867
Date Results Needed: 9/28/94
Suspect Isotopes:

Hazards/Special Instructions:
PLEASE CONTACT THE SMO FACILITY AT 845-0867 OR 844-0941 UPON COMPLETION OF DATA PACKAGE.

Batch Log Number: 940494
Logged By: SBE
Analysis Type: ☒ Gamma ☐ H-3 ☐ Alpha/Beta ☐ Other
Rad Scan Background: <0.1 mR/hr

Customer Sample ID	Sample Type	Date/Time Collected	Sample Volume	Requested Analysis	RSDP Sample ID	Rad Scan mR/hr	Analyst	Remarks/Flags
017876-1	Soil	9/21/94 1051	500ml	Gamma Spec	01	<0.1		821g
017876-8	↓	1100	↓	↓	02	<0.1		582g
017877-3		1122			03	<0.1		813g
017877-4		1130			04	<0.1		601g
017878-2		1320			05	<0.1		854g
017878-9		1326			06	<0.1	~~668g~~	668g
017879-1		1340			07	<0.1		1058g
017879-4	↓	1353	↓	↓	08	<0.1		756g
another page.								

Relinquished by [signature] Date 9/22/94 Received by S.B.Ebarra Date 9/22/94
Relinquished by [signature] SBE Date 9/26/94 Received by [signature] Date 9/26/94
Relinquished by____ Date____ Received by____ Date____

Date: 9/22/94

Sandia National Laboratories
Radioactive Sample Diagnostics Program

SAMPLE ANALYSIS REQUEST

To be completed by Customer

Shaded areas are for Lab use

Customer: Jim Brukman
Organization: 7582
Project Location: Tij Arroyo
Phone: 845-0867
Date Results Needed: 9/28/94.
Suspect Isotopes:

Hazards/Special Instructions:
PLEASE CONTACT THE SMO FACILITY AT 845-0867 OR 844-0941 UPON COMPLETION OF DATA PACKAGE.

Batch Log Number: 940494
Logged By: SBE
Analysis Type: ☒ Gamma ☐ H-3 ☐ Alpha/Beta ☐ other
Rad Scan Background: <10 L mR/hr

Customer Sample ID	Sample Type	Date/Time Collected	Sample Volume	Requested Analysis	RSDP Sample ID	Rad Scan mR/hr	Analysis	Remarks/Flags
017880-3	soil	9/21/94 1435	500ml	Gamma Spec	09	<0.1		697 g
017880-8	↓	1444	↓	↓	10	<0.1		709 g
017884-4	↓	1615	↓	↓	11	<0.1		720 g
017884-8	↓	↓ 1625	↓	↓	12	<0.1		735 g
LCS	—	1-Nov-90	—	γ	13			

Relinquished by [signature] Date 9/22/94 Received by S.B.Ebara Date 9/22/94
Relinquished by [signature] Date 9/26/94 Received by [signature] Date 9/26/94
Relinquished by ______ Date ______ Received by ______ Date ______

Page 1 of 2

Sample Findings Summary

Site: Site 46 Drilling **AR/COC:** 604316/604569 **Data Type:** Radiochemical

Sample ID	Method/CAS Number (Analysis/Analyte): 13967-70-9 (Cs-134)	14932-40-2 (Th-231)	13968-53-1 (Ru-103)
COC #604316			
056022-005 TJAOU-234-GR-07-0.0-DU		R	
056023-005 TJAOU-234-GR-07-5.0-DU	R	R	
056024-005 TJAOU-234-GR-08-5.0-DU		R	
COC #604569			
055885-007 TJAOU-234-GR-EB1			R

Validated By: Mr. Kenneth Salaz **Date:** 9/26/01

Sample Findings Summary

Site: Site 46 Drilling **AR/COC:** 604316/604569 **Data Type:** Organic

Sample ID	Method/CAS Number (Analysis/Analyte)														
	VOCs:	67-64-1 (acetone)	79-01-6 (trichloroethene)	SVOCs:	83-32-9 (acenaphthene)	99-09-2 (m-nitroaniline)	51-28-5 (2,4-dinitrophenol)	117-81-7 (bis(2-ethylhexyl)phthalate)	193-39-5 (indeno(1,2,3-cd)pyrene)	191-24-2 (benzo(g,h,i)perylene)		394878-87-0 (diesel range organics)			
COC #604316															
056021-002 TJAOU-234-GR-07-0.0-S		UJ	UJ												
056021-003 TJAOU-234-GR-07-0.0-S					J			J	J						
056022-002 TJAOU-234-GR-07-0.0-DU		UJ	UJ												
056022-003 TJAOU-234-GR-07-0.0-DU					UJ		UJ		J	UJ					
056023-002 TJAOU-234-GR-07-5.0-S		R	UJ												
056023-003 TJAOU-234-GR-07-5.0-S					UJ			J							
056024-002 TJAOU-234-GR-08-5.0-S		R	UJ												
056024-003 TJAOU-234-GR-08-5.0-S					UJ			J							
054687-001 TJAOU-234-GR-TB1		UJ	UJ												
COC #604569															
055885-002 TJAOU-234-GR-EB1		UJ	UJ												
055885-003 TJAOU-234-GR-EB1					UJ	UJ	UJ								
055885-009 TJAOU-234-GR-EB1												20U,B			

Validated By: [signature] Mr. Kenneth Salaz **Date:** 9/19/01

Sample Findings Summary

Site: Site 46 Drilling **AR/COC:** 604316/604569 **Data Type:** Inorganic

Sample ID	Method/CAS Number (Analysis/Analyte)														
	7429-90-5 (Al)	7440-43-9 (Cd)	7440-70-2 (Ca)	7440-48-4 (Co)	7440-50-8 (Cu)	7440-09-7 (K)	7440-22-4 (Ag)	7440-23-5 (Na)	7440-66-6 (Zn)	7782-49-2 (Se)	7440-36-0 (Sb)		7439-97-6 (Hg)		18540-29-9 (Cr+6)
COC #604316															
056021-003 TJAOU-234-GR-07-0.0-S							J,B2	J,B2							
056022-003 TJAOU-234-GR-07-0.0-DU							J,B2	J,B2							
056023-003 TJAOU-234-GR-07-5.0-S								J,B2							
056024-003 TJAOU-234-GR-08-5.0-S								J,B2							
COC #604569															
055885-004 TJAOU-234-GR-EB1	UJ,B3	UJ,B3	J,B3	UJ,B3	UJ,B3	J,B3			J,B3	UJ,B3	UJ,B3		UJ,B3		
055885-008 TJAOU-234-GR-EB1															J,HT

Validated By: Mr. Kenneth Salaz **Date:** 9/19/01

Analytical Quality Associates, Inc.
616 Maxine NE
Albuquerque, NM 87123
Phone: 505-299-5201
Fax: 505-299-6744
Email: minteer@aol.com

MEMORANDUM

DATE: September 19, 2001

TO: File

FROM: Kenneth Salaz

SUBJECT: Organic Data Review and Validation - SNL
Site 46 Drilling, ARCOC #604316/604569,
GEL SDG #44247/44248, Project/Task No. 7225.02.02.06

See the attached Data Validation Worksheets for supporting documentation on the data review and validation.

Summary

All samples were prepared and analyzed with approved procedures using methods EPA8260A/B VOCs, EPA8270C SVOCs, and EPA8015A/B Gasoline/Diesel Range Organics (GRO/DRO). Problems were identified with the data package that result in the qualification of data.

1. VOC Analysis: The initial calibration response factors (RFs) of trichloroethene for the equipment blank (EB), trip blank (TB) and the soil samples were less than (<) the required minimum but greater than (>) 0.01. Also, the continuing calibration verification (CCV) percent differences (%Ds) of acetone for the EB, TB, and soil samples 44247-001 and -002 were >40% but <60%. The associated sample results were ND and will be qualified "UJ." The CCV %D of acetone for soil samples -003 and -004 was >60%. The associated sample results were ND and will be qualified "R" (unusable).

   SVOC Analysis: The initial calibration RFs of acenaphthene for the EB and the soil samples were < the required minimum but >0.01. The associated result of sample 44247-001 was a detect and will be qualified "J." All other associated sample results were ND and will be qualified "UJ." The CCV %Ds of m-nitroaniline and 2,4-dinitrophenol for the EB, as well as those of benzo(g,h,i)perylene and 2,4-dinitrophenol for soil sample 44247-006, were >40% but <60%. The associated sample results were ND and will be qualified "UJ." The CCV %D of bis(2-ethylhexyl)phthalate for soil samples -005, -007, and -008, as well as that of indeno(1,2,3-cd)pyrene for all soil samples, were >20% but <40%. All associated bis(2-ethylhexyl)phthalate results and the indeno(1,2,3-cd)pyrene results of samples -005 and -006 were detects and will be qualified "J."

2. DRO Analysis: In the method blank for the EB, DRO were detected. The associated sample result was a detect, <5X the blank concentration, < the reporting limit (RL), and will be qualified "20U,B."

Data are acceptable except as noted above. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All Analyses: All samples were analyzed within the prescribed holding times and properly preserved.

Calibration

VOC Analysis: The initial and continuing calibrations met QC acceptance criteria except as noted above in the summary section and the following. The CCV %Ds of 2-butanone and vinyl acetate for all samples, as well as that of 2-hexanone for only the soil samples, were >20% but <40%. However, all associated sample results were ND. Thus, no sample data were qualified.

SVOC Analysis: The initial and continuing calibrations met QC acceptance criteria except as noted above in the summary section and the following. The initial calibration correlation coefficient (R^2 value) of 4-nitrophenol was <0.99 but >0.90. Also, the CCV %D of 4-nitroaniline for the EB, as well as those of 2,4,5-trichlorophenol, 2,6-dinitrotoluene, 4-nitrophenol, and dibenz(a,h)anthracene were >20% but <40%. However, all associated sample results were ND. Thus, no sample data were qualified.

GRO/DRO Analyses: The initial and continuing calibrations met all QC acceptance criteria.

Blanks

VOC Analysis: No target analytes were detected in the method blanks except for the following. In the method blank for soil samples 44247-003 and -004, acetone was detected. However, the associated sample results were ND. Thus, no sample data were qualified.

SVOC Analysis: No target analytes were detected in the method blanks except for the following. In the method blank for the EB, bis(2-ethylhexyl)phthalate was detected. However, the associated sample result was ND. Thus, no sample data were qualified.

GRO/DRO Analyses: No target analytes were detected in the method blanks except as noted above in the summary section.

Surrogates

All Analyses: All surrogate %Rs met QC acceptance criteria.

Internal Standards (ISs)

VOC/SVOC Analyses: The IS areas and retention times (RTs) met QC acceptance criteria.

GRO/DRO Analyses: No ISs were required for these methods.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses

VOC Analysis: The MS/MSD analyses for all samples were performed on samples from other SDGs. No sample data were qualified as a result. The case narratives stated that all QC acceptance criteria were met.

SVOC Analysis: The MS/MSD analyses for the EB met all QC acceptance criteria. The MS/MSD analyses for the soil samples were performed on a sample from another SDG. No sample data were qualified as a result. The case narrative stated that all QC acceptance criteria were met.

DRO Analysis: The MS/MSD analyses for the soil samples were performed on a sample from another SDG. The case narrative did not state whether or not QC acceptance criteria were met. No sample data were qualified as a result. The MS/MSD analyses for the EB met QC acceptance criteria except for the following. The MSD percent recovery (%R) was slightly < QC acceptance limits. However, the MS %R and MSD relative percent difference (RPD) met QC acceptance criteria. Thus, no sample data were qualified.

GRO Analysis: The MS/MSD analyses for the soil samples were performed on a sample from another SDG. The case narrative stated that all QC acceptance criteria were met. No MS/MSD analyses were performed for the EB because it is a QC sample. No sample data were qualified as a result.

Laboratory Control Sample (LCS/LCSD) Analyses

All Analyses: The LCS/LCSD analyses met all QC acceptance criteria.

Other QC

VOC Analysis: No target analytes were detected in the TB. No target analytes were detected in the EB except bromoform and dibromochloromethane. However, all associated sample results were ND. Thus, no sample data were qualified. A field duplicate was submitted. However, there are no "required" review criteria for field duplicate analyses comparability.

All Other Analyses: No target analytes were detected in the EBs. Field duplicates were submitted. However, there are no "required" review criteria for field duplicate analyses comparability. No field blanks (FBs) were submitted on the ARCOC.

No other specific issues were identified which affect data quality.

Please contact me if you have any questions or comments regarding the review of this package.

Analytical Quality Associates, Inc.
616 Maxine NE
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MEMORANDUM

DATE: September 28, 2001

TO: File

FROM: Kenneth Salaz

SUBJECT: Radiochemical Data Review and Validation - SNL Site 46 Drilling, ARCOC #604316/604569, GEL SDG #44247/44248, Case No. 7225.02.02.06

See the attached Data Validation Worksheets for supporting documentation on the data review and validation.

Summary

All samples were prepared and analyzed with approved procedures using methods EPA900.0 Gross Alpha/Beta, EPA906.0 Tritium, and EPA901.1/HASL300 Gamma Spec.

It should be noted that radiochemical sample results that are reported at values greater than the RL (decision level concentration or DLC) might be less than the calculated minimum detectable activity (MDA).

Problems were identified with the data package that result in the qualification of data.

1. Gamma Spec Analysis: The Th-231 results of samples 44247-014, -015, and -016 were rejected by the laboratory due to low abundance. Thus, these sample results will be qualified "R" (unusable).

2. Gamma Spec Analysis: The Ru-103 result of sample 44248-007 and the Cs-134 result of sample 44247-015 were negative, and the absolute values were > the associated MDA. Thus, these sample results will be qualified "R" (unusable).

Data are acceptable except as noted above. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

All Analyses: All samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All Analyses: The case narratives stated the instruments used were properly calibrated.

Blanks

All Analyses: No target analytes were detected in the method blanks at concentrations greater than (>) the associated MDAs.

Matrix Spike (MS) Analysis

All Analyses: The MS analyses were performed on samples from other SDGs. No sample data should be qualified as a result. The case narratives stated that all QC acceptance criteria were met.

Laboratory Control Sample (LCS) Analysis

All Analyses: The LCS analyses met all QC acceptance criteria.

Replicates

All Analyses: The replicate analyses were performed on samples from other SDGs. No sample data should be qualified as a result. The case narratives stated that all QC acceptance criteria were met.

Tracer/Carrier Recoveries

All Analyses: No tracers/carriers were required for these methods.

Negative Bias

Gamma Spec Analysis: Sample results met negative bias QC acceptance criteria except as noted above in the summary section.

All Other Analyses: All sample results met negative bias QC acceptance criteria.

Other QC

All Analyses: No target analytes were detected in the equipment blanks (EBs). No field duplicates or field blanks (FBs) were submitted on the ARCOC.

No other specific issues were identified which affect data quality.

Analytical Quality Associates, Inc.
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MEMORANDUM

DATE: September 19, 2001

TO: File

FROM: Kenneth Salaz

SUBJECT: Inorganic Data Review and Validation - SNL
Site 46 Drilling, ARCOC #604316/604569,
GEL SDG #44247/44248, Project/Task No. 7225.02.02.06

See the attached Data Validation Worksheets for supporting documentation on the data review and validation.

Summary

All samples were prepared and analyzed with approved procedures using methods EPA6010B ICP-AES, EPA7470/1A CVAA, and EPA7196A (Cr+6). Problems were identified with the data package that result in the qualification of data.

1. Cr+6 Analysis: The equipment blank (EB) for this analysis was received by the laboratory beyond 2X the method specified holding time. The associated sample result was a detect and will be qualified "J,HT."

2. ICP Analysis: In the initial calibration blank (ICB) and/or continuing calibration blank (CCB) for the EB, aluminum (Al), cadmium (Cd), calcium (Ca), cobalt (Co), copper (Cu), potassium (K), selenium (Se), antimony (Sb), and zinc (Zn) were detected at negative concentrations. The absolute values were greater than (>) the detection limit (DL) but less than (<) the reporting limit (RL). The Ca, K, and Zn results were detects, <5X the DL, and will be qualified "J,B3." All other associated results were non-detect (ND) and will be qualified "UJ,B3."

   CVAA Analysis: In the ICB and CCB for the EB, mercury (Hg) was detected at negative concentrations. The absolute values were > the DL but < the RL. The associated sample result was ND and will be qualified "UJ,B3."

3. ICP Analysis: In the EB, silver (Ag) and sodium (Na) were detected. All Na results, as well as the Ag results of samples 44247-005 and -006, were detects, <5X the blank concentrations, and will be qualified "J,B2."

4. CVAA Analysis: The replicate relative percent difference (RPD) of Hg for the soil samples was >35%. The associated results of samples 44247-005, -006, and -007 were detects and will be qualified "J." The associated result of sample -008 was ND and will be qualified "UJ."

Data are acceptable. QC measures appear to be adequate. The following sections discuss the data review and validation.

Holding Times/Preservation

Cr+6 Analysis: All samples were not analyzed within the prescribed holding times as noted above in the summary section. All samples were properly preserved.

ICP/CVAA Analyses: All samples were analyzed within the prescribed holding times and properly preserved.

Calibration

All Analyses: The initial and continuing calibrations met all QC acceptance criteria.

Blanks

ICP Analysis: No target analytes were detected in the blanks except as noted above in the summary section and the following. In the CCB for the EB, iron (Fe) and thallium (Tl) were detected, and Co was detected in the method blank. In the ICB and/or CCB for the soil samples, barium (Ba), Ca, Fe, arsenic (As), Sb, and Tl were detected, and Ba, Ca, magnesium (Mg), and manganese (Mn) were detected in the method blank. However, all associated sample results were either ND or >5X the blank concentrations. Thus, no sample data were qualified. In the ICB and CCB for the EB, Na was detected at negative concentrations. In the ICB and/or CCB for the soil samples, Al, Cd, Co, Cu, K, Na, and lead (Pb) were also detected at negative concentrations. The absolute values were > the DL but < the RL. However, all associated sample results were >5X the DL. Thus, no sample data were qualified.

CVAA Analysis: No target analytes were detected in the blanks except as noted above in the summary section.

Cr+6 Analysis: No target analytes were detected in the blanks except for the following. In the method blank for the soil samples, Cr+6 was detected. However, all associated sample results were either ND or >5X the blank concentrations. Thus, no sample data were qualified.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses

ICP/Cr+6 Analyses: The MS analyses for the EBs met all QC acceptance criteria. The MS analyses for the soil samples were performed on samples from other SDGs. The case narratives stated that all QC acceptance criteria were not met. No sample data were qualified as a result. No MSD analyses were performed. The replicate analyses were used as measures of laboratory precision.

CVAA Analysis: The MS analysis for the soil samples met all QC acceptance criteria. The MS analysis for the EB was performed on a sample from another SDG. The case narrative stated that all QC acceptance criteria were met. No sample data were qualified as a result. No MSD analyses were performed. The replicate analyses were used as measures of laboratory precision.

Laboratory Control Sample (LCS/LCSD) Analyses

All Analyses: The LCS/LCSD analyses met all QC acceptance criteria.

Replicate Analysis

ICP Analysis: The replicate analysis for the EB met all QC acceptance criteria. The replicate analysis for the soil samples was performed on a sample from another SDG. The case narrative stated that all QC acceptance criteria were not met. No sample data were qualified as a result.

CVAA Analysis: The replicate analysis for the soil samples did not meet QC acceptance criteria as noted above in the summary section. The replicate analysis for the EB was performed on a sample from another SDG. The case narrative stated that all QC acceptance criteria were met. No sample data were qualified as a result.

Cr+6 Analysis: The replicate analysis for the EB met all QC acceptance criteria. The replicate analysis for the soil samples was performed on a sample from another SDG. The case narrative stated that all QC acceptance criteria were met. No sample data were qualified as a result.

ICP Interference Check Sample (ICS)

ICP Analysis: The ICSs met all QC acceptance criteria.

CVAA/Cr+6 Analyses: No ICS was required for these methods.

ICP Serial Dilution

ICP Analysis: The serial dilution analysis for the EB met all QC acceptance criteria. The serial dilution analysis for the soil samples was performed on a sample from another SDG. The case narrative stated that all QC acceptance criteria were not met. No sample data were qualified as a result.

CVAA/Cr+6 Analyses: No serial dilution was required for these methods.

Other QC

ICP Analysis: A field duplicate was submitted. However, there are no "required" review criteria for field duplicate analyses comparability. No target analytes were detected in the EB except as noted above in the summary section and Ba, Ca, Mg, K, and Zn. However, all associated sample results were >5X the blank concentrations. Thus, no sample data were qualified. No field blank (FB) was submitted on the ARCOC.

CVAA Analysis: A field duplicate was submitted. However, there are no "required" review criteria for field duplicate analyses comparability. No target analytes were detected in the EB. No FB was submitted on the ARCOC.

Cr+6 Analysis: A field duplicate was submitted. However, there are no "required" review criteria for field duplicate analyses comparability. In the EB, Cr+6 was detected. However, all associated sample results were either ND or >5X the blank concentrations. Thus, no sample data were qualified. No FB was submitted on the ARCOC.

No other specific issues were identified which affect data quality.

Please contact me if you have any questions or comments regarding the review of this package.

Data Validation Summary

Site/Project: Site 46 Drilling Project/Task #: 7225.02.02.06 # of Samples: 26 Matrix: 16 soil / 10 aqueous

AR/COC #: 604316 / 604569 Laboratory Sample IDs: 44247-001 to -016

Laboratory: GEL 44248-001 to -010

SDG #: 44247/44248

QC Element	Analysis									
	Organics				Inorganics				RAD	Other
	VOC	SVOC	Pesticide/ PCB	HPLC (HE)	ICP/AES	GFAA/ AA	CVAA (Hg)	CN		
1. Holding Times/Preservation	✓	✓	NA	NA	✓	NA	✓	NA	✓	J, HT
2. Calibrations	R; UJ	J; UJ	↓	↓	✓	↓	✓	↓	✓	U, B
3. Method Blanks	✓	✓			✓		UJ, B3		✓	✓
4. MS/MSD	NA	NA			✓		✓		NA	✓
5. Laboratory Control Samples	✓	✓			✓		✓		✓	✓
6. Replicates					✓		J		NA	NA
7. Surrogates	✓	✓								↓
8. Internal Standards	✓	✓								
9. TCL Compound Identification	✓	✓								
10. ICP Interference Check Sample					✓					
11. ICP Serial Dilution					NA					
12. Carrier/Chemical Tracer Recoveries									NA	↓
13. Other QC	✓	✓	↓	↓	J, B2	↓	✓	↓	~~✓~~ R	✓

RKS 9/18/01

J = Estimated
U = Not Detected
UJ = Not Detected, Estimated
R = Unusable

Check (√) = Acceptable
Shaded Cells = Not Applicable (also "NA")
NP = Not Provided
Other: ______

Reviewed By: [signature] Date: 9/28/01

Holding Time and Preservation

Site/Project: Site 46 Drilling AR/COC #: 604316/604569 Laboratory Sample IDs: 44247-001 to -016

Laboratory: GEL SDG #: 44247/44248 44248-001 to -010

# of Samples: 26 Matrix: 16 soil/10 aqueous

Sample ID	Analytical Method	Holding Time Criteria	Days Holding Time was Exceeded	Preservation Criteria	Preservation Deficiency	Comments
44248-008	EPA 7196A(Cr6)	24 hrs	4	NA	NA	Received by lab beyond 2X holding time.

Reviewed By: [signature] Date: 9/17/01

Volatile Organics (SW 846 Method 8260)

Site/Project: Site 46 Drilling AR/COC #: 604316 # of Samples: 4 Matrix: Soil

Laboratory: GEL SDG #: 44247 Laboratory Sample IDs: 44247-001 to -004

Methods: EPA 8260A Batch #s: 85288

IS	CAS #	Name	TCL	Min. RF	Intercept	Calib. RF >.05	Calib. RSD/ R^2 <20% / 0.99	CCV(1) %D 20%	Method Blks	LCS	LCSD	LCS RPD	(2) MS	MSD	MS RPD	(3) Field Dup. RPD	Equip. Blanks (ug/L)	Trip Blanks	CCV %D	
1	74-87-3	Chloromethane	✓	0.10	NA	✓	✓	✓	✓							NA	✓	✓	✓	
1	74-83-9	Bromomethane		0.10	NA															
1	75-01-4	vinyl chloride		0.10	✓															
1	75-00-3	Chloroethane		0.01	NA															
1	75-09-2	methylene chloride (10xblk)		0.01	✓			↓	↓										↓	
1	67-64-1	acetone(10xblk)		0.01	✓			45.2	✓/10										62.6	
1	75-15-0	carbon disulfide		0.10	NA			✓	✓										✓	
1	75-35-4	1,1-dichloroethene		0.20						✓	✓	✓	NA	NA	NA					
1	75-34-3	1,1-dichloroethane		0.10																
1	67-66-3	Chloroform		0.20																
1	107-06-2	1,2-dichloroethane		0.10				↓											↓	
1	78-93-3	2-butanone(10xblk)		0.01				26.3											35.3	
2	71-55-6	1,1,1-trichloroethane		0.10				✓											✓	
2	56-23-5	carbon tetrachloride		0.10																
2	75-27-4	Bromodichloromethane		0.20																
2	78-87-5	1,2-dichloropropane		0.01																
2	10061-01-5	cis-1,3-dichloropropene		0.20		↓														
2	79-01-6	Trichloroethene		0.30		0.22				✓	✓	✓	NA	NA	NA		↓			
2	124-48-1	Dibromochloromethane		0.10		✓											0.452			
2	79-00-5	1,1,2-trichloroethane		0.10													✓			
2	71-43-2	Benzene		0.50						✓	✓	✓	NA	NA	NA					
2	10061-02-6	trans-1,3-dichloropropene		0.10													↓			
2	75-25-2	Bromoform		0.10													0.625			
3	108-10-1	4-methyl-2-pentanone		0.10													✓		↓	
3	591-78-6	2-hexanone		0.01															28.7	
3	127-18-4	Tetrachloroethene		0.20															✓	
3	79-34-5	1,1,2,2-tetrachloroethane		0.30																
3	108-88-3	toluene(10xblk)		0.40						✓	✓	✓	NA	NA	NA					
3	108-90-7	Chlorobenzene		0.50						✓	✓	✓	NA	NA	NA					
3	100-41-4	Ethylbenzene		0.10																
3	100-42-5	Styrene		0.30																
3	1330-20-7	xylenes(total)		0.30																
	540-59-0	1,2-dichloroethylene(total)		0.01				↓											↓	
	108-05-4	Vinyl Acetate	↓		↓	↓	↓	-30.4	↓							↓	↓	↓	-31.7	

Comments:

Notes: Shaded rows are RCRA compounds.

NA = Not Applicable

(1) CCV + 1st MB entries apply to samples -001 + -002 only.

(2) MS/MSD performed on a sample from another SDG. All QC criteria were met.

(3) Field dup. submitted. No QC criteria.

Reviewed By: [signature] Date: 9/17/01

Volatile Organics

Site/Project: Site 46 Drilling AR/COC #: 604316 Batch #s: 85288

Laboratory: GEL SDG #: 44247 # of Samples: 4 Matrix: Soil

Surrogate Recovery and Internal Standard Outliers (SW 846 Method 8260)

Sample	SMC 1	SMC 2	SMC 3	IS 1 area	IS 1 RT	IS 2 area	IS 2 RT	IS 3 area	IS 3 RT
All									
Passed									

SMC 1: Bromofluorobenzene
SMC 2: Dibromofluormethane
SMC 3: Toluene-d8

IS 1: Fluorobenzene
IS 2: Chlorobenzene-d5
IS 3: 1,4-Dichlorobenzene-d4

Comments:

Volatile Organics (SW 846 Method 8260)

Site/Project: ~~S-74, Gulf Rem, Wide Ex~~ Site 46 Drilling (9/17/01) AR/COC #: ~~604480~~ 604316/604569 # of Samples: 2 Matrix: aqueous

Laboratory: GEL SDG #: ~~44783~~ 44248 Laboratory Sample IDs: 44248-001 (TB) & -002 (EB)

Methods: EPA 8260B Batch #s: 84765

IS	CAS #	Name	TCL	Min. RF	Intercept	Calib. RF >.05	Calib. RSD/ R^2 <20% / 0.99	CCV %D 20%	Method Blks	LCS	LCSD	LCS RPD	MS (1)	MSD	MS RPD	Field Dup. RPD	Equip. Blanks	Trip Blanks		
1	74-87-3	Chloromethane	✓	0.10	NA	✓	✓	✓	✓							NA	NA	NA		
1	74-83-9	Bromomethane	✓	0.10	"	✓	✓													
1	75-01-4	vinyl chloride	✓	0.10	✓	✓	✓													
1	75-00-3	Chloroethane	✓	0.01	NA	✓	✓													
1	75-09-2	methylene chloride (10xblk)	✓	0.01	✓	✓	✓	↓												
1	67-64-1	acetone(10xblk)	✓	0.01	✓	✓	✓	45.2												
1	75-15-0	carbon disulfide	✓	0.10	NA	✓	✓	✓												
1	75-35-4	1,1-dichloroethene	✓	0.20		✓	✓			✓	✓	✓	NA	NA	NA					
1	75-34-3	1,1-dichloroethane	✓	0.10		✓	✓													
1	67-66-3	Chloroform	✓	0.20		✓	✓													
1	107-06-2	1,2-dichloroethane	✓	0.10		✓	✓	↓												
1	78-93-3	2-butanone(10xblk)	✓	0.01		✓	✓	26.3												
2	71-55-6	1,1,1-trichloroethane	✓	0.10		✓	✓	✓												
2	56-23-5	carbon tetrachloride	✓	0.10		✓	✓													
2	75-27-4	Bromodichloromethane	✓	0.20		✓	✓													
2	78-87-5	1,2-dichloropropane	✓	0.01		✓	✓													
2	10061-01-5	cis-1,3-dichloropropene	✓	0.20		✓	✓													
2	79-01-6	Trichloroethene	✓	0.30		0.12	✓			✓	✓	✓	NA	NA	NA					
2	124-48-1	Dibromochloromethane	✓	0.10		✓	✓													
2	79-00-5	1,1,2-trichloroethane	✓	0.10		✓	✓													
2	71-43-2	Benzene	✓	0.50		✓	✓			✓	✓	✓	NA	NA	NA					
2	10061-02-6	trans-1,3-dichloropropene	✓	0.10		✓	✓													
2	75-25-2	Bromoform	✓	0.10		✓	✓													
3	108-10-1	4-methyl-2-pentanone	✓	0.10		✓	✓													
3	591-78-6	2-hexanone	✓	0.01		✓	✓													
3	127-18-4	Tetrachloroethene	✓	0.20		✓	✓													
3	79-34-5	1,1,2,2-tetrachloroethane	✓	0.30		✓	✓													
3	108-88-3	toluene(10xblk)	✓	0.40		✓	✓			✓	✓	✓	NA	NA	NA					
3	108-90-7	Chlorobenzene	✓	0.50		✓	✓			✓	✓	✓	NA	NA	NA					
3	100-41-4	Ethylbenzene	✓	0.10		✓	✓													
3	100-42-5	Styrene	✓	0.30		✓	✓													
3	1330-20-7	xylenes(total)	✓	0.30		✓	✓													
	540-59-0	1,2-dichloroethylene(total)	✓	0.01		✓	✓	↓												
	108-05-4	Vinyl Acetate	✓		↓	✓	✓	-30.4	↓							↓	↓	↓		

Comments: Notes: Shaded rows are RCRA compounds. NA = Not Applicable

(1) MS/MSD performed on a sample from another SDG. Case narrative stated all QC were met.

Reviewed By: [signature] Date: 9/17/01

Volatile Organics

Site/Project: S-74, CWLF Rem, Wills Ex AR/COC #: 604316/604569 Batch #s: 84765

Laboratory: GEL SDG #: 44248 # of Samples: 2 Matrix: aqueous

Surrogate Recovery and Internal Standard Outliers (SW 846 Method 8260)

Sample	SMC 1	SMC 2	SMC 3	IS 1 area	IS 1 RT	IS 2 area	IS 2 RT	IS 3 area	IS 3 RT
All									
Passed									

SMC 1: Bromofluorobenzene
SMC 2: Dibromofluormethane
SMC 3: Toluene-d8

IS 1: Fluorobenzene
IS 2: Chlorobenzene-d5
IS 3: 1,4-Dichlorobenzene-d4

Comments:

Semivolatile Organics (SW 846 Method 8270)

Site/Project: Site 46 Drilling AR/COC #: ~~604569~~ 316 (wst 9/17/01) Laboratory Sample IDs: 44247-005 to -008

Laboratory: GEL SDG #: 44247

Methods: EPA 8270C

# of Samples: 4 Matrix: ~~Aqueous~~ Soil (KAS 9/17/01) Batch #s: 85613

IS	BNA	CAS #	NAME	TCL	Min. RF	Intercept	Calib. RF >.05	Calib. RSD/ R^2 <20% / 0.99	CCV %D 20%	Method Blanks	LCS	LCSD	LCS RPD	① MS	MSD	MS RPD	② Field Dup. RPD	Equip. Blanks	Field Blanks	③ CCV %D	
1	A	108-95-2	Phenol	✓	0.80	NA	✓	✓	✓	✓	✓	✓	✓	NA	NA	NA	NA	✓	NA	✓	
1	BN	111-44-4	bis(2-Chloroethyl)ether		0.70		✓	✓													
1	A	95-57-8	2-Chlorophenol		0.80		✓	✓			✓	✓	✓	NA	NA	NA					
1	BN	541-73-1	1,3-Dichlorobenzene		0.60		✓	✓													
1	BN	106-46-7	1,4-Dichlorobenzene		0.50		✓	✓			✓	✓	✓	NA	NA	NA					
1	BN	95-50-1	1,2-Dichlorobenzene		0.40		✓	✓													
1	A	95-48-7	o-cresol		0.70		✓	✓			✓	✓	✓	NA	NA	NA					
1	BN	108-60-1	bis(2-chloroisopropyl)ether		0.01		✓	✓													
1	A	106-44-5	m,p-cresols		0.60		✓	✓			✓	✓	✓	NA	NA	NA					
1	BN	621-64-7	N-Nitroso-di-n-propylamine		0.50		✓	✓			✓	✓	✓								
1	BN	67-72-1	Hexachloroethane		0.30		✓	✓			✓	✓	✓								
2	BN	98-95-3	Nitrobenzene		0.20		✓	✓			✓	✓	✓	↓	↓	↓					
2	BN	78-59-1	Isophorone		0.40		✓	✓													
2	A	88-75-5	2-Nitrophenol		0.10		✓	✓													
2	A	105-67-9	2,4-Dimethylphenol		0.20		✓	✓													
2	BN	111-91-1	bis(2-Chloroethoxy)methane		0.30		✓	✓													
2	A	120-83-2	2,4-Dichlorophenol		0.20		✓	✓													
2	BN	120-82-1	1,2,4-Trichlorobenzene		0.20		✓	✓			✓	✓	✓	NA	NA	NA					
2	BN	91-20-3	Naphthalene		0.70		✓	✓													
2	BN	106-47-8	4-Chloroaniline		0.01		✓	✓													
2	BN	87-68-3	Hexachlorobutadiene		0.01		✓	✓			✓	✓	✓	NA	NA	NA					
2	A	59-50-7	4-Chloro-3-methylphenol		0.20		✓	✓			✓	✓	✓	NA	NA	NA					
2	BN	91-57-6	2-Methylnaphthalene		0.40	↓	✓	✓													
3	BN	77-47-4	Hexachlorocyclopentadiene		0.01	✓	✓	✓													
3	A	88-06-2	2,4,6-Trichlorophenol		0.20	NA	✓	✓	✓		✓	✓	✓	NA	NA	NA				↓	
3	A	95-95-4	2,4,5-Trichlorophenol	↓	0.20	NA	✓	✓	↓	↓	✓	✓	✓	NA	NA	NA	↓	↓	↓	23.8	

Comments: ① MS/MSD performed on a sample from another SDG. Case narrative stated QC met.
② Field dup. submitted. No QC criteria.
③ CCV %D applies to sample -006 only.

Notes: Shaded rows are RCRA compounds.

NA = Not Applicable

Reviewed By: [signature] Date: 9/17/01

Semivolatile Organics

Site/Project: Site 46 Drilling AR/COC #: 604316 Batch #s: 85613

Laboratory: GEL SDG #: 44247 # of Samples: 4 Matrix: Soil

IS	BNA	CAS #	NAME	TCL	Min. RF	Intercept	Calib. RF >.05	Calib. RSD/ R^2 <20% / 0.99	CCV %D 20%	Method Blanks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup. RPD	Equip. Blanks	Field Blanks	CCV %D	
3	BN	91-58-7	2-Chloronaphthalene	✓	0.80	NA	✓	✓	✓	✓							NA	✓	NA	✓	
3	BN	88-74-4	2-Nitroaniline (o-)		0.01		✓	✓													
3	BN	131-11-3	Dimethylphthalate		0.01		✓	✓													
3	BN	208-96-8	Acenaphthylene		0.90		✓	✓												↓	
3	BN	606-20-2	2,6-Dinitrotoluene		0.20	↓	✓	✓												22.0	
3	BN	99-09-2	3-Nitroaniline (m-)		0.01	✓	✓	✓												✓	
3	BN	83-32-9	Acenaphthene		0.90	NA	0.80	✓			✓	✓	✓	NA	NA	NA				✓	
3	A	51-28-5	2,4-Dinitrophenol		0.01	✓	✓	✓	↓											43.7	
3	A	100-02-7	4-Nitrophenol		0.01	✓	✓	✓	-22.0		✓	✓	✓	NA	NA	NA				-21.0	
3	BN	132-64-9	Dibenzofuran		0.80	NA	✓	✓	✓											✓	
3	BN	121-14-2	2,4-Dinitrotoluene		0.20	✓	✓	✓			✓	✓	✓	NA	NA	NA					
3	BN	84-66-2	Diethylphthalate		0.01	NA	✓	✓													
3	BN	7005-72-3	4-Chlorophenyl-phenylether		0.40		✓	✓													
3	BN	86-73-7	Fluorene		0.90	↓	✓	✓													
3	BN	100-01-6	4-Nitroaniline (p-)		0.01	✓	✓	✓													
4	A	534-52-1	4,6-Dinitro-2-methylphenol		0.01	✓	✓	✓													
4	BN	86-30-6	Diphenylamine		0.01	NA	✓	✓													
4	BN	101-55-3	4-Bromophenyl-phenylether		0.10		✓	✓													
4	BN	118-74-1	Hexachlorobenzene		0.10	↓	✓	✓			✓	✓	✓	NA	NA	NA					
4	A	87-86-5	Pentachlorophenol		0.05	✓	✓	✓			✓	✓	✓	NA	NA	NA					
4	BN	85-01-8	Phenanthrene		0.70	NA	✓	✓													
4	BN	120-12-7	Anthracene		0.70		✓	✓													
4	BN	86-74-8	Carbazole		0.01		✓	✓													
4	BN	84-74-2	Di-n-butylphthalate		0.01		✓	✓													
4	BN	206-44-0	Fluoranthene		0.60		✓	✓													
5	BN	129-00-0	Pyrene		0.60		✓	✓			✓	✓	✓	NA	NA	NA					
5	BN	85-68-7	Butylbenzylphthalate		0.01		✓	✓													
5	BN	91-94-1	3,3'-Dichlorobenzidine		0.01		✓	✓													
5	BN	56-55-3	Benzo(a)anthracene	↓	0.80	↓	✓	✓	↓	↓							↓	↓	↓	↓	

Comments:

Semivolatile Organics

Site/Project: Site 46 Drilling AR/COC #: 604316 Batch #s: 85613

Laboratory: GEL SDG #: 44247 # of Samples: 4 Matrix: soil

IS	BNA	CAS #	NAME	TCL	Min. RF	Intercept	Calib. RF >.05	Calib. RSD/ R^2 <20% / 0.99	CCV %D 20%	Method Blanks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup. RPD	Equip. Blanks	Field Blanks	CCV %D	
5	BN	218-01-9	Chrysene	✓	0.70	NA	✓	✓	✓	✓							NA	✓	NA	✓	
5	BN	117-81-7	bis(2-Ethylhexyl)phthalate		0.01		✓	✓	27.1												
6	BN	117-84-0	Di-n-octylphthalate		0.01		✓	✓	✓												
6	BN	205-99-2	Benzo(b)fluoranthene		0.70		✓	✓													
6	BN	207-08-9	Benzo(k)fluoranthene		0.70		✓	✓													
6	BN	50-32-8	Benzo(a)pyrene		0.70		✓	✓	↓											↓	
6	BN	193-39-5	Indeno(1,2,3-cd)pyrene		0.50	↓	✓	✓	22.7											31.3	
6	BN	53-70-3	Dibenzo(a,h)anthracene		0.40	✓	✓	✓	✓											27.0	
6	BN	191-24-2	Benzo(g,h,i)perylene	↓	0.50	NA	✓	✓	34.2	↓							↓	↓	↓	44.7	

Surrogate Recovery Outliers

Sample	SMC 1	SMC 2	SMC 3	SMC 4	SMC 5	SMC 6	SMC 7	SMC 8
All Passed								

SMC 1: Nitrobenzene-d5 (BN) SMC 2: 2-Fluorobiphenyl (BN) SMC 3: Terphenyl-d14 (BN)
SMC 4: Phenol-d5 (A) SMC 5: 2-Fluorophenol (A) SMC 6: 2,4,6-Tribromophenol (A)
SMC 7: 2-2-Chlorophenol-d4 (A) SMC 8: 1,2-Dichlorobenzene-d4 (BN)

Comments:

Internal Standard Outliers

Sample	IS 1-area	IS 1-RT	IS 2-area	IS 2-RT	IS 3-area	IS 3-RT	IS 4-area	IS 4-RT	IS 5-area	IS 5-RT	IS 6-area	IS 6-RT
All Passed												

IS 1: 1,4-Dichlorobenzene-d4 (BN) IS 2: Naphthalene-d8 (BN) IS 3: Acenaphthene-d10 (BN)
IS 4: Phenathrene-d10 (BN) IS 5: Chrysene-d12 (BN) IS 6: Perylene-d12 (BN)

Semivolatile Organics (SW 846 Method 8270)

Site/Project: Site 46 Drilling AR/COC #: 604569 Laboratory Sample IDs: 44248 -003(EB)

Laboratory: GEL SDG #: 44248

Methods: EPA 8270C

# of Samples: 1 Matrix: aqueous Batch #s: 84884

IS	BNA	CAS #	NAME	TCL	Min. RF	Intercept	Calib. RF	Calib. RSD/ R^2	CCV %D	Method Blanks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup. RPD	Equip. Blanks	Field Blanks		
							>.05	<20% / 0.99	20%												
1	A	108-95-2	Phenol	✓	0.80	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	NA		
1	BN	111-44-4	bis(2-Chloroethyl)ether	✓	0.70		✓	✓													
1	A	95-57-8	2-Chlorophenol	✓	0.80		✓	✓			✓	✓	✓	✓	✓	✓					
1	BN	541-73-1	1,3-Dichlorobenzene	✓	0.60		✓	✓													
1	BN	106-46-7	1,4-Dichlorobenzene	✓	0.50		✓	✓			✓	✓	✓	✓	✓	✓					
1	BN	95-50-1	1,2-Dichlorobenzene	✓	0.40		✓	✓													
1	A	95-48-7	o-cresol	✓	0.70		✓	✓			✓	✓	✓	✓	✓	✓					
1	BN	108-60-1	bis(2-chloroisopropyl)ether	✓	0.01		✓	✓													
1	A	106-44-5	m,p-cresols	✓	0.60		✓	✓			✓	✓	✓	✓	✓	✓					
1	BN	621-64-7	N-Nitroso-di-n-propylamine	✓	0.50		✓	✓			✓	✓	✓								
1	BN	67-72-1	Hexachloroethane	✓	0.30		✓	✓			✓	✓	✓								
2	BN	98-95-3	Nitrobenzene	✓	0.20		✓	✓			✓	✓	✓	↓	↓	↓					
2	BN	78-59-1	Isophorone	✓	0.40		✓	✓													
2	A	88-75-5	2-Nitrophenol	✓	0.10		✓	✓													
2	A	105-67-9	2,4-Dimethylphenol	✓	0.20		✓	✓													
2	BN	111-91-1	bis(2-Chloroethoxy)methane	✓	0.30		✓	✓													
2	A	120-83-2	2,4-Dichlorophenol	✓	0.20		✓	✓													
2	BN	120-82-1	1,2,4-Trichlorobenzene	✓	0.20		✓	✓			✓	✓	✓	✓	✓	✓					
2	BN	91-20-3	Naphthalene	✓	0.70		✓	✓	↓												
2	BN	106-47-8	4-Chloroaniline	✓	0.01		✓	✓	29.4												
2	BN	87-68-3	Hexachlorobutadiene	✓	0.01		✓	✓	✓		✓	✓	✓	✓	✓	✓					
2	A	59-50-7	4-Chloro-3-methylphenol	✓	0.20	↓	✓	✓			✓	✓	✓	✓	✓	✓					
2	BN	91-57-6	2-Methylnaphthalene	✓	0.40	✓	✓	✓													
3	BN	77-47-4	Hexachlorocyclopentadiene	✓	0.01	✓	✓	✓													
3	A	88-06-2	2,4,6-Trichlorophenol	✓	0.20	NA	✓	✓			✓	✓	✓	✓	✓	✓					
3	A	95-95-4	2,4,5-Trichlorophenol	✓	0.20	"	✓	✓	↓	↓	✓	✓	✓	✓	✓	✓	↓	↓	↓		

Comments:

Notes: Shaded rows are RCRA compounds.

NA = Not Applicable

Reviewed By: [signature] Date: 9/17/01

Semivolatile Organics

Site/Project: Site 46 Drilling   AR/COC #: 604569   Batch #s: 84884

Laboratory: GEL   SDG #: 44248   # of Samples: 1   Matrix: aqueous

IS	BNA	CAS #	NAME	TCL	Min. RF	Intercept	Calib. RF	Calib. RSD/ R^2	CCV %D	Method Blanks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup. RPD	Equip. Blanks	Field Blanks		
							>.05	<20% / 0.99	20%												
3	BN	91-58-7	2-Chloronaphthalene	✓	0.80	NA	✓	✓	✓	✓							NA	NA	NA		
3	BN	88-74-4	2-Nitroaniline (o-)	✓	0.01		✓	✓													
3	BN	131-11-3	Dimethylphthalate	✓	0.01		✓	✓													
3	BN	208-96-8	Acenaphthylene	✓	0.90		✓	✓													
3	BN	606-20-2	2,6-Dinitrotoluene	✓	0.20	↓	✓	✓	↓												
3	BN	99-09-2	3-Nitroaniline (m-)	✓	0.01	✓	✓	✓	46.1												
3	BN	83-32-9	Acenaphthene	✓	0.90	NA	0.88	✓	✓		✓	✓	✓	✓	✓	✓					
3	A	51-28-5	2,4-Dinitrophenol	✓	0.01	✓	✓	✓	42.9												
3	A	100-02-7	4-Nitrophenol	✓	0.01	✓	✓	0.98	✓		✓	✓	✓	✓	✓	✓					
3	BN	132-64-9	Dibenzofuran	✓	0.80	NA	✓	✓													
3	BN	121-14-2	2,4-Dinitrotoluene	✓	0.20		✓	✓			✓	✓	✓	✓	✓	✓					
3	BN	84-66-2	Diethylphthalate	✓	0.01		✓	✓													
3	BN	7005-72-3	4-Chlorophenyl-phenylether	✓	0.40		✓	✓													
3	BN	86-73-7	Fluorene	✓	0.90		✓	✓													
3	BN	100-01-6	4-Nitroaniline (p-)	✓	0.01	↓	✓	✓													
4	A	534-52-1	4,6-Dinitro-2-methylphenol	✓	0.01	✓	✓	✓													
4	BN	86-30-6	Diphenylamine	✓	0.01	NA	✓	✓													
4	BN	101-55-3	4-Bromophenyl-phenylether	✓	0.10		✓	✓													
4	BN	118-74-1	Hexachlorobenzene	✓	0.10	↓	✓	✓			✓	✓	✓	✓	✓	✓					
4	A	87-86-5	Pentachlorophenol	✓	0.05	✓	✓	✓			✓	✓	✓	✓	✓	✓					
4	BN	85-01-8	Phenanthrene	✓	0.70	NA	✓	✓													
4	BN	120-12-7	Anthracene	✓	0.70		✓	✓													
4	BN	86-74-8	Carbazole	✓	0.01		✓	✓													
4	BN	84-74-2	Di-n-butylphthalate	✓	0.01		✓	✓													
4	BN	206-44-0	Fluoranthene	✓	0.60		✓	✓													
5	BN	129-00-0	Pyrene	✓	0.60		✓	✓			✓	✓	✓	✓	✓	✓					
5	BN	85-68-7	Butylbenzylphthalate	✓	0.01		✓	✓													
5	BN	91-94-1	3,3'-Dichlorobenzidine	✓	0.01		✓	✓													
5	BN	56-55-3	Benzo(a)anthracene	✓	0.80	↓	✓	✓	↓	↓							↓	↓	↓		

Comments:

Semivolatile Organics

Site/Project: Site 46 Drilling AR/COC #: 604569 Batch #s: 84884

Laboratory: GEL SDG #: 44248 # of Samples: 1 Matrix: aqueous

IS	BNA	CAS #	NAME	TCL	Min. RF	Intercept	Calib. RF >.05	Calib. RSD/ R^2 <20% / 0.99	CCV %D 20%	Method Blanks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup, RPD	Equip. Blanks	Field Blanks		
5	BN	218-01-9	Chrysene	✓	0.70	NA	✓	✓	✓	✓							NA	NA	NA		
5	BN	117-81-7	bis(2-Ethylhexyl)phthalate	✓	0.01	↓	✓	✓	↓	0.0108							↓	↓	↓		
6	BN	117-84-0	Di-n-octylphthalate	✓	0.01		✓	✓		✓											
6	BN	205-99-2	Benzo(b)fluoranthene	✓	0.70		✓	✓		↓											
6	BN	207-08-9	Benzo(k)fluoranthene	✓	0.70		✓	✓													
6	BN	50-32-8	Benzo(a)pyrene	✓	0.70	↓	✓	✓													
6	BN	193-39-5	Indeno(1,2,3-cd)pyrene	✓	0.50	✓	✓	✓													
6	BN	53-70-3	Dibenzo(a,h)anthracene	✓	0.40	✓	✓	✓													
6	BN	191-24-2	Benzo(g,h,i)perylene	✓	0.50	NA	✓	✓	↓	↓							↓	↓	↓		

Surrogate Recovery Outliers

Sample	SMC 1	SMC 2	SMC 3	SMC 4	SMC 5	SMC 6	SMC 7	SMC 8
All Passed								

SMC 1: Nitrobenzene-d5 (BN) SMC 2: 2-Fluorobiphenyl (BN) SMC 3: Terphenyl-d14 (BN)
SMC 4: Phenol-d5 (A) SMC 5: 2-Fluorophenol (A) SMC 6: 2,4,6-Tribromophenol (A)
SMC 7: 2-2-Chlorophenol-d4 (A) SMC 8: 1,2-Dichlorobenzene-d4 (BN)

Comments:

Internal Standard Outliers

Sample	IS 1-area	IS 1-RT	IS 2-area	IS 2-RT	IS 3-area	IS 3-RT	IS 4-area	IS 4-RT	IS 5-area	IS 5-RT	IS 6-area	IS 6-RT
All Passed												

IS 1: 1,4-Dichlorobenzene-d4 (BN) IS 2: Naphthalene-d8 (BN) IS 3: Acenaphthene-d10 (BN)
IS 4: Phenathrene-d10 (BN) IS 5: Chrysene-d12 (BN) IS 6: Perylene-d12 (BN)

Organics (supplemental)

Site/Project: Site 46 Drilling   AR/COC #: 604316   # of Samples: 8   Matrix: Soil

Laboratory: GEL   Laboratory Report #: 44247   Laboratory Sample IDs: 44247-001 to -008

Methods: EPA 8015A/B   Batch #s: 85616, 84112

IS	CAS #	Name	TCL	Min. RF	Intercept	Calib. RF >.05	Calib. RSD/ R^2 <20% / 0.99	CCV %D 20%	Method Blks	LCS	LCSD	LCS RPD	① MS	MSD	MS RPD	② Field Dup. RPD	Equip. Blanks	Trip Blanks		
	394878 -87-0	DRO	✓		✓	NA	✓	✓	✓	✓	✓	✓	NA	NA	NA	NA	✓	NA		
	GRO	GRO	✓		NA	NA	✓	✓	✓	✓	✓	✓	NA	NA	NA	NA	✓	NA		
	#	All Surrogate %Rs met QC criteria.																		

Notes: Shaded rows are RCRA compounds.

Comments: ① MS/MSD for DRO + GRO performed on samples from other SDGs. The DRO case narrative did not state whether or not QC criteria were met. The GRO case narrative stated all QC criteria were met.   NA = Not Applicable

② Field dups submitted. No QC criteria.

Reviewed By: [illegible]   Date: 9/18/01

Organics (supplemental)

Site/Project: Site 46 Drilling AR/COC #: 604569 # of Samples: 2 Matrix: aqueous

Laboratory: GEL Laboratory Report #: 44248 Laboratory Sample IDs: 44248-009(DRO) + -010(GRO)

Methods: EPA8015A/B(DRO), Batch #s: 84762, 84435

IS	CAS #	Name	TCL	Min. RF	Intercept	Calib. RF >.05	Calib. RSD/ R^2 <20% / 0.99	CCV %D 20%	Method Blks	LCS	LCSD	LCS RPD	① MS	MSD	MS RPD	Field Dup. RPD	Equip. Blanks	Trip Blanks		
	394878-87-0	DRO	✓		✓	NA	✓	✓	6.83	✓	✓	✓	✓	48	✓	NA	NA	NA		
	GRO	GRO	✓		NA	NA	✓	✓	✓	✓	✓	✓	NA	NA	NA	NA	NA	NA		
	*	All Surrogate %Rs met QC criteria.																		

Notes: Shaded rows are RCRA compounds.

NA = Not Applicable

Comments: ① No MS/MSD performed for GRO because sample was an EB.

Reviewed By: [illegible] Date: 9/18/01

Inorganic Metals

Site/Project: Site 46 Drilling AR/COC #: 604316 Laboratory Sample IDs: 44247-005 to -008

Laboratory: GEL Laboratory Report #: 44247

Methods: EPA6010B (ICP), EPA7471A (CVAA)

# of Samples: 4 Matrix: soil Batch #s: 84960, 90381

CAS #/ Analyte	QC Element																			
	TAL	ICV	CCV	ICB (µg/L)	③ CCB (µg/L)	Method Blanks	LCS	LCSD	LCSD RPD	① MS	MSD	MSD RPD	Rep. RPD	ICS AB	Serial Dilution	② Field Dup. RPD	(µg/L) Equip. Blanks	Field Blanks		
7429-90-5 Al	✓	✓	✓	-9.41	-24.1	✓	✓	✓	✓	NA	NA	NA	NA	✓	NA	NA	✓	NA		
7440-39-3 Ba				✓	0.19	0.0371											0.836			
7440-41-7 Be				✓	✓	✓											✓			
7440-43-9 Cd				-1.02	-1.26	✓											✓			
7440-70-2 Ca				✓	17.9	17.9											159			
7440-47-3 Cr					✓	✓											✓			
7440-48-4 Co				↓	-0.502															
7440-50-8 Cu				-0.841	-0.767															
7439-89-6 Fe				✓	8.78	↓											↓			
7439-95-4 Mg					8.91	1.49											17.7			
7439-96-5 Mn					✓	0.0691											✓			
7440-02-0 Ni				✓		✓											✓			
7440-09-7 K				-6.61													34			
7440-22-4 Ag				✓	↓												1.12			
7440-23-5 Na					-18.1												1,520			
7440-31-5 Sn					✓												✓			
7440-62-2 V																	✓			
7440-66-6 Zn	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		9.43			
7439-92-1 Pb	✓	✓	✓	-1.48	-1.35	✓	✓	✓	✓	NA	NA	NA	NA	✓	NA		✓			
7782-49-2 Se				✓	✓															
7440-38-2 As				✓	3.73															
7440-36-0 Sb				3.48	✓															
7440-28-0 Tl	↓	↓	↓	✓	✓/4.21	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓			
7439-97-6 Hg	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	10.8	NA	NA	↓	✓	↓		
Cyanide CN																				

Notes: Shaded rows are RCRA metals. Solids-to-aqueous conversion: mg / kg = µg / g : [(µg / g) x (sample mass {g} / sample vol. {ml}) x (1000 ml / 1 liter)] / Dilution Factor = µg / l NA = Not Applicable

Comments: ① MS + Rep for ICP performed on a sample from another SDG. The case narrative stated that all QC criteria were met + serial dil.

② Field dup. submitted. No QC criteria

③ 2nd Tl entry applies to samples -007 + -008 only.

Reviewed By: [signature] Date: 9/18/01

Inorganic Metals

Site/Project: Site 46 Drilling AR/COC #: 604569 Laboratory Sample IDs: 44248-004 (EB)

Laboratory: GEL SDG #: 44248

Methods: EPA6010B(ICP), EPA7470A(CVAA)

# of Samples: 1 Matrix: aqueous Batch #s: 90590, 86352

CAS #/ Analyte	QC Element																		
	TAL	ICV	CCV	ICB (µg/L)	CCB (µg/L)	Method Blanks	LCS	LCSD	LCSD RPD	① MS	MSD	MSD RPD	Rep. RPD	ICS AB	Serial Dilution	Field Dup. RPD	Equip. Blanks	Field Blanks	
7429-90-5 Al	✓	✓	✓	17.3	-30.0	✓	✓	✓	✓	✓	NA	NA	NA	✓	NA	NA	NA	NA	
7440-39-3 Ba	✓			✓	✓														
7440-41-7 Be	✓				✓														
7440-43-9 Cd	✓			↓	-0.333								✓						
7440-70-2 Ca	✓			-23.2	-23.8								✓						
7440-47-3 Cr	✓			✓	✓	✓							NA						
7440-48-4 Co	✓			-0.618	✓	0.000435													
7440-50-8 Cu	✓			-0.773	0.681	✓													
7439-89-6 Fe	✓			✓	12.8														
7439-95-4 Mg	✓				✓														
7439-96-5 Mn	✓																		
7440-02-0 Ni	✓			↓	↓														
7440-09-7 K	✓			-12.1	-17.6														
7440-22-4 Ag	✓			✓	✓								✓						
7440-23-5 Na	✓			-43.5	-67.1								✓						
7440-62-2 V	✓			✓	✓								NA						
7440-66-6 Zn	✓	↓	↓	-3.86	-3.61	↓	↓	↓	↓	↓	↓	↓	✓	↓	↓				
7439-92-1 Pb	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	NA	✓	NA				
7782-49-2 Se	✓			-3.13															
7440-38-2 As	✓			✓	↓														
7440-36-0 Sb	✓			7.08	-4.8														
7440-28-0 Tl	✓	↓	↓	✓	5.94	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				
7439-97-6 Hg	✓	✓	✓	-0.093	-0.103	✓	✓	✓	✓	NA	NA	NA	NA	NA	NA	↓	↓	↓	
Cyanide CN																			

Notes: Shaded rows are RCRA metals. Solids-to-aqueous conversion: mg / kg = µg / g : [(µg / g) x (sample mass {g} / sample vol. {ml}) x (1000 ml / 1 liter)] / Dilution Factor = µg / l NA = Not Applicable

Comments: ① MS + Rep. for Hg performed on a sample from another SDG. Case narrative stated all QC criteria were met.

Reviewed By: [signature] Date: [illegible]/18/01

General Chemistry

Site/Project: Site 46 Drilling AR/COC #: 604569 / 604316 Laboratory Sample IDs: 44248-008 (EB)

Laboratory: GEL Laboratory Report #: 44248 / 44247 44247-005 to -008

Methods: EPA 7196A

# of Samples: 5 Matrix: 1 aqueous, 4 soil Batch #s: 84264, 90790

CAS #	Analyte	QC Element																		
		TAL	ICV	CCV	ICB	CCB	Method Blanks	LCS	LCSD	LCSD RPD	① MS	MSD	MSD RPD	Rep. RPD	ICS AB	Serial Dilution	② Field Dup. RPD	Equip. Blanks (mg/L)	Field Blanks	
18540-29-9	(aqueous) Cr+6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	NA	NA	NA	NA	NA	NA	
↓	Cr+6 (soil)	✓	✓	✓	✓	✓	0.074	✓	✓	✓	NA	NA	NA	NA	↓	↓	↓	0.007 ~~0.009~~ ↓ KMS 9/18/01	↓	

Comments: ① MS + Rep. for soil samples performed on a sample from another SDG. The case narrative stated that the MSs did not meet QC criteria, but the replicate analysis did meet QC criteria. NA = Not Applicable

② Field dup. submitted. No QC criteria.

Reviewed By: [signature] Date: 9/18/01

Radiochemistry

Site/Project: Site 46 Drilling AR/COC #: 604316 Laboratory Sample IDs: 44247-009 to -016

Laboratory: GEL SDG #: 44247

Methods: HASL 300 (Gamma Spec), EPA 900.0 (Gross α/β), EPA 906.0 (H3)

# of Samples: 8 Matrix: soil Batch #s: 85749, 85544, 86493

Analyte	QC Element												
	Method Blanks	LCS	① MS	Rep RER	② Equip. Blanks	Field Dup. RER	Field Blanks	Sample ID	Isotope	IS/Trace	Sample ID	Isotope	IS/Trace
Criteria	U	20%	25%	<1.0	U	<1.0	U			50-105			50-105
H3	✓	✓	NA	NA	✓	NA	NA						
U-238								NA					
U-234													
U-235/-236													
Th-232													
Th-228													
Th-230													
Pu-239/-240													
Gross Alpha	✓	✓	NA	NA	✓	NA	NA						
Nonvolatile Beta	✓	✓	NA	NA	✓	NA	NA						
Ra-226													
Ra-228													
Ni-63													
Gamma Spec. Am-241	✓	✓	NA	NA	✓	NA	NA						
Gamma Spec. Cs-137	↓	✓	↓	↓	↓	↓	↓						
Gamma Spec. Co-60	↓	✓	↓	↓	↓	↓	↓						

Parameter	Method	Typical Tracer	Typical Carrier
Iso-U	Alpha spec.	U-232	NA
Iso-Pu	Alpha spec.	Pu-242	NA
Iso-Th	Alpha spec.	Th-229	NA
Am-241	Alpha spec.	Am-242	NA
Sr-90	Beta	Y ingrowth	NA
Ni-63	Beta	NA	Ni by ICP
Ra-226	Deamination	NA	NA
Ra-226	Alpha spec.	Ba-133 or Ra-225	NA
Ra-228	Gamma spec.	Ba-133	NA

Gamma spec. LCS contains: Am-241, Cs-137, and Co-60

Comments: NA = Not Applicable

① MS & Reps performed on samples from other SDGs. The case narrative stated all QC criteria were met.

② Field dup. submitted. No QC criteria.

Reviewed By: [signature] Date: 9/20/01

Radiochemistry

Site/Project: Site 46 Drilling　AR/COC #: 604569　Laboratory Sample IDs: 44248-005, -006, -007

Laboratory: GEL　SDG #: 44248

Methods: EPA900.0 (Gross α/β), EPA901.1 (Gamma Spec), EPA906.0 (H_3)

# of Samples: 3　Matrix: aqueous　Batch #s: 81883, 85112, 85721

Analyte	QC Element												
	Method Blanks	LCS	①MS	Rep RER	Equip. Blanks	Field Dup. RER	Field Blanks	Sample ID	Isotope	IS/Trace	Sample ID	Isotope	IS/Trace
Criteria	U	20%	25%	<1.0	U	<1.0	U			50-105			50-105
H3	✓	✓	NA	NA	NA	NA	NA	NA					
U-238													
U-234													
U-235/-236													
Th-232													
Th-228													
Th-230													
Pu-239/-240													
Gross Alpha	✓	✓	NA	NA	NA	NA	NA						
Nonvolatile Beta	✓	✓	NA	NA	NA	NA	NA						
Ra-226													
Ra-228													
Ni-63													
Gamma Spec. Am-241	✓	✓	NA	NA	NA	NA	NA						
Gamma Spec. Cs-137	↓	↓	↓	↓	↓	↓	↓						
Gamma Spec. Co-60	↓	↓	↓	↓	↓	↓	↓						

Parameter	Method	Typical Tracer	Typical Carrier
Iso-U	Alpha spec.	U-232	NA
Iso-Pu	Alpha spec.	Pu-242	NA
Iso-Th	Alpha spec.	Th-229	NA
Am-241	Alpha spec.	Am-242	NA
Sr-90	Beta	Y ingrowth	NA
Ni-63	Beta	NA	Ni by ICP
Ra-226	Deamination	NA	NA
Ra-226	Alpha spec.	Ba-133 or Ra-225	NA
Ra-228	Gamma spec.	Ba-133	NA

Gamma spec. LCS contains: Am-241, Cs-137, and Co-60

Comments:　NA = Not Applicable

① MS + Reps performed on samples from other SDGs. The case narrative stated all QC criteria were met.

Reviewed By: [illegible]　Date: 9/2[illegible]

Records Center Code: ER / 1309 / 234 DAT

SMO ANALYTICAL DATA ROUTING FORM

Project Name: Tijeras Arroyo Op Unit (Site 46 Drilling)

Task No./Service Order: 7225_02.02.06 / CF0 102

SNL Task Leader: COLLINS

Org/Mail Stop: 06133/1087

SMO Project Coordinator: SALMI

Sample Ship Date: 6/18/01

ARCOC	Lab	Lab ID	Preliminary Received	Final Received	EDD Req'd YES	EDD Req'd NO	EDD Rec'd YES	EDD Rec'd NO
604316	GEL	44247A		7/19/01	X		X	
604569	GEL	44247B		7/19/01	X		X	

	Date		
Correction Requested from Lab:	8-6-01	Correction Request #:	2826
Corrections Received:	8-13-01	Requester:	Palencia
Review Complete:	8-6-01	Signature:	W. Palencia
Priority Data Faxed:		Faxed To:	
Preliminary Notification:		Person Notified:	
Final Transmittal:	8-6-01	Transmitted To:	Collins
		Transmitted By:	Palencia
Filed in Records Center/ER:		Filed By:	

Comments: Electronic data on Q:/SMO/STAR/EDD by COC

To validation 8/14/01

Received (Records Center) By: ____________

Contract Verification Review (CVR)

Project Leader COLLINS

Project Name TIJERAS ARROYO OP UNIT (SITE 46 DRILLING)

Case No. 7225_02.02.06

AR/COC No. 604316 & 604569

Analytical Lab GEL

SDG No. 44247A & B

In the tables below, mark any information that is missing or incorrect and give an explanation.

1.0 Analysis Request and Chain of Custody Record and Log-In Information

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
1.1	All items on COC complete - data entry clerk initialed and dated	X				
1.2	Container type(s) correct for analyses requested	X				
1.3	Sample volume adequate for # and types of analyses requested	X				
1.4	Preservative correct for analyses requested	X				
1.5	Custody records continuous and complete	X				
1.6	Lab sample number(s) provided and SNL sample number(s) cross referenced and correct	X				
1.7	Date samples received	X				
1.8	Condition upon receipt information provided	X				

2.0 Analytical Laboratory Report

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
2.1	Data reviewed, signature	X				
2.2	Method reference number(s) complete and correct	X				
2.3	QC analysis and acceptance limits provided (MB, LCS, Replicate)	X				
2.4	Matrix spike/matrix spike duplicate data provided(if requested)	X				
2.5	Detection limits provided; PQL and MDL(or IDL), MDA and L_c	X				
2.6	QC batch numbers provided	X				
2.7	Dilution factors provided and all dilution levels reported	X				
2.8	Data reported in appropriate units and using correct significant figures	X				
2.9	Radiochemistry analysis uncertainty (2 sigma error) and tracer recovery (if applicable) reported	X				
2.10	Narrative provided	X				
2.11	TAT met	X				
2.12	Hold times met		X	SAMPLE #055885-008 RECEIVED PAST HOLDING TIME	X	
2.13	Contractual qualifiers provided	X				
2.14	All requested result and TIC (if requested) data provided	X				

Contract Verification Review (Continued)

3.0 Data Quality Evaluation

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
3.1 Are reporting units appropriate for the matrix and meet contract specified or project-specific requirements? Inorganics and metals reported as ppm (mg/liter or mg/Kg)? Tritium reported in picocuries per liter with percent moisture for soil samples? Units consistent between QC samples and sample data	X		
3.2 Quantitation limit met for all samples	X		
3.3 Accuracy a) Laboratory control samples accuracy reported and met for all samples	X		
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique	X		
c) Matrix spike recovery data reported and met		X	MERCURY FAILED RECOVERY LIMITS DRO FAILED RECOVERY LIMITS FOR MSD
3.4 Precision a) Replicate sample precision reported and met for all inorganic and radiochemistry samples		X	RPD FOR MERCURY OUTSIDE ACCEPTANCE LIMITS
b) Matrix spike duplicate RPD data reported and met for all organic samples	X		
3.5 Blank data a) Method or reagent blank data reported and met for all samples		X	ACETONE DETECTED IN VOC METHOD BLANK BIS(2-ETHYLHEXYL)PHTHALATE DETECTED IN SVOC METHOD BLANK DIESEL RANGE ORGANICS DETECTED IN TPH METHOD BLANK CALCIUM DETECTED IN METALS BLANK
b) Sampling blank (e.g., field, trip, and equipment) data reported and met		X	BROMOFORM & DBCM DETECTED IN VOC EQUIPMENT BLANK DIESEL RANGE ORGANICS DETECTED IN TPH EQUIPMENT BLANK CALCIUM, SODIUM & ZINC DETECTED IN METALS EQUIPMENT BLANK
3.6 Contractual qualifiers provided: "J"- estimated quantity; "B"-analyte found in method blank above the MDL for organic or above the PQL for inorganic; "U"-analyte undetected (results are below the MDL, IDL, or MDA (radiochemical)); "H"-analysis done beyond the holding time	X		
3.7 Narrative addresses planchet flaming for gross alpha/bet	X		
3.8 Narrative included, correct, and complete			
3[illegible] ond column confirmation data provided for methods 8330 (high ex[illegible]es) and			

Contract Verification Review (Continued)

4.0 Calibration and Validation Documentation

Item	Yes	No	Comments
4.1 GC/MS (8260, 8270, etc.)			
a) 12-hour tune check provided	X		
b) Initial calibration provided	X		
c) Continuing calibration provided	X		
d) Internal standard performance data provided	X		
e) Instrument run logs provided	X		
4.2 GC/HPLC (8330 and 8010 and 8082)			
a) Initial calibration provided	X		
b) Continuing calibration provided	X		
c) Instrument run logs provided	X		
4.3 Inorganics (metals)			
a) Initial calibration provided	X		
b) Continuing calibration provided	X		
c) ICP interference check sample data provided	X		
d) ICP serial dilution provided	X		
e) Instrument run logs provided	X		
4.4 Radiochemistry			
a) Instrument run logs provided	X		

Contract Verification Review (Concluded)

5.0 Problem Resolution

Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted.

Sample/Fraction No.	Analysis	Problems/Comments/Resolutions
LCS/LCD	8270	RPDs FOR LCS/LCDs INCORRECTLY REPORTED AS 0 (PG. 773 & 778)

Were deficiencies unresolved? ☑ Yes ☐ No

Based on the review, this data package is complete. ☐ Yes ☑ No

If no, provide: nonconformance report or correction request number 2826 and date correction request was submitted: 8-6-2001

Reviewed by: W. Palencia Date: 8-6-2001 Closed by: W. Palencia Date: 8-14-01

ANALYSIS REQUEST AND CHAIN OF CUSTODY

ernal Lab
tch No. N/A SAR/WR No.

AR/COC 604569

pt. No./Mail Stop:	6133/1087	Date Samples Shipped: 6-18-01	SMO Use	Contract No:	AJ2480A
ject/Task Manager:	Sue Collins	Carrier/Waybill No. 745032		Project/Task No.:	7225/02.02.06
oject Name:	~~Site 46~~ Tijeras Arroyo Op Unit	Lab Contact:	Edie Kent	SMO Authorization:	[signature]
cord Center Code:	ER/1309/234/DAT	Lab Destination:	General Engineering Labs		
gbook Ref. No.:	ER078 2	SMO Contact/Phone:	P. Pulssant/844-3185		
rvice Order No.	CF0102-01	Send Report to SMO:	Suzi Jensen		

☑ Waste Characterization
RCRA Date: ______
☐ Send:Preliminary/report to ______
☐ Validation Required
☐ Released by COC No.:
Bill To: Sandia National Labs (Accounts Payable)
PO Box 5800, MS-0154, Albuquerque, NM 87185-05

ocation: Tech Area Tijeras Arroyo — Reference LOV(available at SMO)

ample No.-Fraction	ER Sample ID or Sample Location Detail	Beginning Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preserva-tive	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
055885-002	TJAOU-234-GR-EB1	N/A	234	6.14.01/1430	DIW	G	3x40 ml	4C, HCL	G	EB	VOCs (8260)	
055885-003	TJAOU-234-GR-EB1	N/A	234	6.14.01/1430	DIW	AG	2x1L	4C	G	EB	SVOCs (8270	
055885-004	TJAOU-234-GR-EB1	N/A	234	6.14.01/1431	DIW	P	~~250~~ 500 ml	4C, HNO3	G	EB	TAL METALS (6010/7471)	
055885-005	TJAOU-234-GR-EB1	N/A	234	6.14.01/1431	DIW	AG	250 ml	4C	G	EB	Tritium	
055885-006	TJAOU-234-GR-EB1	N/A	234	6.14.01/1432	DIW	P	1 L	4C, HNO3	G	EB	Gross Alpha/Gross Beta (900)	
055885-007	TJAOU-234-GR-EB1	N/A	234	6.14.01/1432	DIW	P	1 L	4C, HNO3	G	EB	Gamma Spec (300.0)	
055885-008	TJAOU-234-GR-EB1	N/A	234	6.14.01/1432	DIW	P	250 ml	4C	G	EB	Cr-6 (7196)	
055885-009	TJAOU-234-GR-EB1	N/A	234	6.14.01/1433	DIW	AG	2x1L	4C	G	EB	TPH (8015 Diesel Range)	
055885-010	TJAOU-234-GR-EB1	N/A	234	6.14.01/1433	DIW	G	3x40 ml	4C, HCL	G	EB	TPH (8015 Gas Range)	

MMA ☐ Yes ☑ No Ref. No.
ample Disposal ☐ Return to Client ☑ Disposal by lab
rnaround Time ☐ 7 Day* ☐ 15 Day* ☑ 30 Day
turn Samples By: ☐ Negotiated TAT

Sample Tracking — SMO Use
Date Entered(mm/dd/yy) 06/25/01
Entered by: JAC
QC inits. [initials]

Special Instructions/QC Requirements:
EDD ☑ Yes ☐ No
Raw Data Package ☑ Yes ☐ No
*Send/e-mail report to:
*Please list as separate report.

Abnormal Conditions on Receipt

ample eam embers	Name	Signature	Init.	Company/Organization/Phone/Cellular
	Robin Ryan	[signature]	RR	GRAM/6133/845-8851
	Margaret Sanchez			RF Weston/6135/845-3267

		Org.	Date	Time		Org.	Date	Time
Relinquished by	[signature]	6133	6/14/01	1540	4.Relinquished by			
Received by	[signature]	6132	6/14/01	1540	4. Received by			
Relinquished by	[signature]	6132	6/18/01	1230	5.Relinquished by			
Received by					5. Received by			
Relinquished by					6.Relinquished by			
Received by					6. Received by			

& 15 Day Turnaround Time: ERCL requires prior notification.

SF 2001-COC (7/00)

CONTRACT LABORATORY
ANALYSIS REQUEST AND CHAIN OF CUSTODY

Internal Lab Batch No. N/A   SAR/WR No.

Page 1 of 2

AR/COC 604316

Dept. No./Mail Stop:	6133/1087	Date Samples Shipped:	6-18-01 SMO USE	Contract No:	AJ2480A
Project/Task Manager:	Sue Collins	Carrier/Waybill No.	745032	Project/Task No.:	7225/02.02.06
Project Name:	~~Site 46~~ Tijeras Arroyo Op Unit-Site	Lab Contact:	Edie Kent	SMO Authorization:	[signature]
Record Center Code:	ER/1309/234/DAT	Lab Destination:	General Engineering Labs		
Logbook Ref. No.:	ER078	SMO Contact/Phone:	P. Puissant/844-3185		
Service Order No.	CF0102-01	Send Report to SMO:	Suzi Jensen		

☑ Waste Characterization
RCRA Date:
☑ Send: Preliminary report to John Copland
☐ Validation Required
☐ Released by COC No.:
Bill To: Sandia National Labs (Accounts Payable)
PO Box 5800, MS-0154, Albuquerque, NM 87185-0

Location: Tech Area — Reference LOV(available at SMO)

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Beginning Depth (ft)	ER Site No.	Date/Time(hr) Collected	Sample Matrix	Container Type	Container Volume	Preservative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
056021-002	TJAOU-234-GR-07-0.0-S	0.0	234	6.14.01/1039	S	AG	125 ml	4C	G	SA	VOCs (8260)	
056021-003	TJAOU-234-GR-07-0.0-S	0.0	234	6.14.01/1039	S	AG	1L	4C	G	SA	SVOCs(8270), TAL Metals (6010/7471), Cr-6(7196), TPH(8015)	
056021-004	TJAOU-234-GR-07-0.0-S	0.0	234	6.14.01/1039	S	G	2x1L	4C	G	SA	Tritium	
056021-005	TJAOU-234-GR-07-0.0-S	0.0	234	6.14.01/1039	S	G	500 ml	4C	G	SA	Gamma Spec (HASL 300.0) Gross Alpha/Beta (900)	
056022-002	TJAOU-234-GR-07-0.0-DU	0.0	234	6.14.01/1040	S	AG	125 ml	4C	G	DU	VOCs (8260)	
056022-003	TJAOU-234-GR-07-0.0-DU	0.0	234	6.14.01/1040	S	AG	1L	4C	G	DU	SVOCs(8270), TAL Metals (6010/7471), Cr-6(7196), TPH(8015)	
056022-004	TJAOU-234-GR-07-0.0-DU	0.0	234	6.14.01/1040	S	AG	2x1L	4C	G	DU	Tritium	
056022-005	TJAOU-234-GR-07-0.0-DU	0.0	234	6.14.01/1040	S	G	500 ml	4C	G	DU	Gamma Spec (HASL 300.0) Gross Alpha/Beta (900)	

RMMA ☐ Yes ☑ No Ref. No.
Sample Disposal ☐ Return to Client ☑ Disposal by lab
Turnaround Time ☐ 7 Day* ☐ 15 Day* ☑ 30 Day
Return Samples By: ☐ Negotiated TAT

Sample Tracking — SMO Use
Date Entered(mm/dd/yy) 06/25/01
Entered by: JAC
QC inits.

Special Instructions/QC Requirements:
EDD ☑ Yes ☐ No
Raw Data Package ☑ Yes ☐ No
*Send/e-mail report to:
*Please list as separate report.

Abnormal Conditions on Receipt

Sample Team Members	Name	Signature	Init	Company/Organization/Phone/Cellular
	Robin Ryan	[signature]	RR	GRAM/6133/845-8821
	Margaret Sanchez			RF Weston/6135/845-3267

	Org.	Date	Time		Org.	Date	Time
1. Relinquished by [signature]	6133	6/14/01	1540	4. Relinquished by			
1. Received by [signature]	6132	6/14/01	1540	4. Received by			
2. Relinquished by [signature]	6132	6/18/01	1215	5. Relinquished by			
2. Received by				5. Received by			
3. Relinquished by				6. Relinquished by			
3. Received by				6. Received by			

*7 & 15 Day Turnaround Time: ERCL requires prior notification.

SF 2001-COC (7/00)

CONTRACT LABORATORY
Analysis Request And Chain Of Custody (Continuation)

AR/COC- 604316

Project Name: Site 46		Project/Task Manger: Sue Collins									Project/Task No.: 7225.02.02.06	
Location	Tech Area											
Building	Room	Reference LOV (available at SMO)										Lab use
Sample No-Fraction	ER Sample ID or Sample Location detail	Beginning Depth (ft)	ER Site No.	Date/Time (hr) Collected	Sample Matrix	Container Type	Container Volume	Preserv-ative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
056023-002	TJAOU-234-GR-07-5.0-S	5.0	234	6.14.01/ 1105	S	AG	125 ml	4C	G	SA	VOCs (8260)	
056023-003	TJAOU-234-GR-07-5.0-S	5.0	234	6.14.01/ 1105	S	AG	1L	4C	G	SA	SVOCs (8270), TAL Metals (6010/ 7471), Cr-VI (7196), TPH (8015)	
056023-004	TJAOU-234-GR-07-5.0-S	5.0	234	6.14.01/ 1105	S	G	2x1L	4C	G	SA	Tritium	
056023-005	TJAOU-234-GR-07-5.0-S	5.0	234	6.14.01/ 1105	S	G	500 ml	4C	G	SA	Gamma Spec (HASL 300.0) Gross Alpha/Beta (900)	
056024-002	TJAOU-234-GR-08-5.0-S	5.0	234	6.14.01/ 1445	S	AG	125 ml	4C	G	SA	VOCs (8260)	
056024-003	TJAOU-234-GR-08-5.0-S	5.0	234	6.14.01/ 1445	S	AG	1L	4C	G	SA	SVOCs (8270), TAL Metals (6010/ 7471), Cr-VI (7196), TPH (8015)	
056024-004	TJAOU-234-GR-08-5.0-S	5.0	234	6.14.01/ 1445	S	G	2x1L	4C	G	SA	Tritium	
056024-005	TJAOU-234-GR-08-5.0-S	5.0	234	6.14.01/ 1445	S	G	500 ml	4C	G	SA	Gamma Spec (HASL 300.0) Gross Alpha/Beta (900)	
054687-001	TJAOU-234-GR-TB1	N/A	234	6.14.01/ ~~1445~~ 1030	DIW	G	3x40ml	4C,HCL	G	TB	VOCs (8260)	

Abnormal Conditions on Receipt LAB USE

Recipient Initials ________

SUPPLEMENTAL
RISK

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

JUN 1 6 2005

CC: ES/SEC
MS

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. James Bearzi, Bureau Chief
New Mexico Environment Department
Hazardous Waste Bureau
Permits Management Program
2905 Rodeo Park Road, Building 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation, DOE is submitting a copy of the supplemental residential risk screening results for solid waste management units (SWMUs) 4, 5, 52, 233, and 234 identified as SWMUs under the Hazardous and Solid Waste Amendments Module of the Resource Conservation and Recovery Act (RCRA) Permit for Sandia National Laboratories, New Mexico (EPA ID No. NM5890110518).

SWMUs 4, 5 and 52 are part of the Liquid Waste Disposal System (LWDS) Operable Unit in Technical Area III/V. The original No Further Action (NFA) Proposals for SWMUs 4, 5, and 52 were submitted to the New Mexico Environment Department (NMED) as part of the RCRA Field Investigation (RFI) for the LWDS in September 1995. Additionally, a response was submitted to NMED in January 1998 and October 1998 to each of two separate Requests for Supplemental Information (RSIs) for SWMUs 4, 5 and 52. A third response to an RSI request was submitted to NMED in May 2001 for SWMU 52. In December 2002, supplemental RSI information was summarized and provided to NMED for SWMU 5.

SWMUs 233 and 234 are part of the Tijeras Arroyo Operable Unit. The original NFA proposals for SWMUs 233 and 234 were submitted to NMED in June 1995 as part of the Round 2 NFA submittals. Additionally, responses were submitted to NMED in October 1996, December 1999, and December 2000 for three separate RSIs.

The enclosed information updates the residential risk screening results for these five SWMUs to achieve consistency with the methodology currently used by the Sandia ER Project and is provided to the NMED to support a determination of Corrective Action Complete Without Controls for these five sites.

The Compliance Order on Consent (COOC) contains deliverable dates for Investigation Reports related to two of these sites: SWMU 4 by March 31, 2006; and SWMU 52 by September 30, 2004. For each of these sites, the previously submitted NFA proposals and RSI responses (referenced above) satisfy these deliverables as indicated by footnote 1 to Table XI-3 of the COOC. No further site-specific investigations have been undertaken at either of these SWMUs, eliminating the need for additional investigation reporting. The information included with this submittal is limited to updated residential risk screening results using current methodology.

If you have any questions, please contact John Gould at (505) 845-6089.

Sincerely,

Patty Wagner for
Manager

Enclosures

cc w/enclosures:
W. Moats, NMED-HWB (via Certified Mail)
L. King, EPA, Region 6 (via Certified Mail)
M. Gardipe, NNSA/SC/ERD
J. Volkerding, DOE-NMED-OB
D. Pepe, NMED-OB, Santa Fe

cc w/o enclosures:
J. Estrada, SSO, MS 0184
F. Nimick, SNL, MS 1089
R. E. Fate, SNL, MS 1089
M. J. Davis, SNL, MS 1089
M. Nagy, SNL, MS 1089
D. Stockham, SNL, MS 1087
B. Langkopf, SNL, MS 1087
S. Griffith, SNL, MS 1087
A. Blumberg, SNL, MS 0141

Sandia National Laboratories/New Mexico
Environmental Restoration Project

SUPPLEMENTAL RISK DOCUMENT FOR SWMUs 4, 5, 52, 233, and 234

June 2005

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

INTRODUCTION

The Environmental Restoration Project at Sandia National Laboratories/New Mexico (SNL/NM) is responsible for the investigation and remediation, as necessary, of solid waste management units (SWMUs) identified in the Hazardous and Solid Waste Amendments module of the Resource Conservation and Recovery Act (RCRA) permit. All activities under the RCRA permit, including the investigation and remediation of SWMUs, are regulated by the New Mexico Environment Department (NMED).

This supplemental risk document addresses five SWMUs (4, 5, 52, 233, and 234), which have been proposed for No Further Action (NFA) but are yet to be considered appropriate for NFA by the NMED. A brief site history and residential risk assessment analysis for SWMUs 5, 233 and 234, as well as comprehensive risk assessment reports for SWMUs 4 and 52 are included in this document. The reports for SWMUs 4 and 52 replace earlier risk assessments and provide human health risk assessments for both industrial and residential land-use scenarios as well as ecological risk assessments.

All of the risk assessments in this document were completed using a residential land-use scenario and risk guidance provided by the NMED in the "Technical Background Document for Development of Soil Screening Levels" (NMED December 2000). Appendix 1 in the reports for SWMUs 4 and 52 contains the SNL/NM default exposure pathways and input parameters. For SWMUs that exceeded NMED risk guidance levels, summary statistics (upper confidence limits [UCLs]) were calculated for the constituents that were primary contributors to the overall risk and are included as attachments in the individual reports. Standard U.S. Environmental Protection Agency guidance (EPA 1992) was used to calculate the UCLs.

In April 2003, the NMED requested that SNL/NM change its risk approach to include the dermal pathway for all land-use scenarios and to eliminate the food ingestion pathway for the residential land-use scenario.

In April 2004, the NMED issued the Compliance Order on Consent (Consent Order) (NMED April 2004) that resulted in another change related to the risk assessment process. The Consent Order replaced the "no further action" terminology by establishing two categories of sites for which corrective action is complete: Corrective Action Complete With Controls and Corrective Action Complete Without Controls.

The supplemental risk assessments in this document provide the basis for determining the appropriate category (Corrective Action Complete With Controls or Corrective Action Complete Without Controls) for each of the five SWMUs analyzed. Each of the SWMUs addressed in this document poses an insignificant risk to human health under the residential land-use scenario. Thus a Certificate of Completion is requested from the NMED, designating each of the SWMUs in this document as Corrective Action Complete Without Controls.

Additional information, including detailed descriptions of site location, history, characterization, confirmatory sampling events, and other related data, is contained in the NFA proposal, response to Request for Supplemental Information, or response to Notice of Deficiency documents for each SWMU. Supplemental information for each SWMU is identified in Table 1.

Table 1
Identification of Documents with Supplemental Information for Each SNL/NM SWMU Proposed for Corrective Action Complete Without Controls

OU Name	OU	SWMU	NFA Date Submitted/Batch No.	Response to NOD or RSI Submittal Date
Liquid Waste Disposal System	1307	4	September 1995/ LWDS RFI Report	January 1998 and October 1998
Liquid Waste Disposal System	1307	5	September 1995/ LWDS RFI Report	January 1998, October 1998, and December 2002
Liquid Waste Disposal System	1307	52	September 1995/ LWDS RFI Report	January 1998, October 1998, and May 2001
Tijeras Arroyo	1309	233	June 1995/2	October 1996, December 1999, and December 2002
Tijeras Arroyo	1309	234	June 1995/2	October 1996, December 1999, and December 2002

LWDS = Liquid Waste Disposal System.
NFA = No Further Action.
NOD = Notice of Deficiency.
OU = Operable Unit.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
RSI = Request for Supplemental Information.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

REFERENCES

EPA, see U.S. Environmental Protection Agency.

New Mexico Environment Department (NMED), December 2000. "Technical Background Document for Development of Soil Screening Levels," Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, New Mexico Environment Department, Santa Fe, New Mexico. December 18, 2000.

New Mexico Environment Department (NMED), April 2004. "Compliance Order on Consent Pursuant to New Mexico Hazardous Waste Act § 74-4-10," New Mexico Environment Department, Santa Fe, New Mexico. April 29, 2004.

NMED, see New Mexico Environment Department.

U.S. Environmental Protection Agency (EPA), 1992. "Dermal Exposure Assessment: Principles and Applications," EPA/600/8-91/011B, Office of Research and Development, Washington, D.C.

Sandia National Laboratories/New Mexico
Environmental Restoration Project

REVISED RESIDENTIAL RISK ASSESSMENT ANALYSES FOR SWMUs 5, 233, AND 234

June 2005

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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3.0 SWMU 234: STORM DRAIN SYSTEM OUTFALL

3.1 Site Location and Operational History

SWMU 234 at SNL/NM is located about 145 feet south of TA-IV on land that is owned by KAFB and leased to the DOE. SWMU 234 encompasses 0.15 acres of unpaved ground, consisting of a 270-foot-long earthen ditch that previously received storm water from a paved parking lot and storage yards located on the south side of Building 981. Storm water discharged at the site from the early 1980s through the early 1990s and was directed to the site via buried piping. The outfall was built in the early 1980s for the purpose of reducing the amount of soil erosion caused by storm water. The site is situated at the slope break between the steeply sloping, northern rim of Tijeras Arroyo and the nearly flat floodplain below. The vicinity of SWMU 234 is unpaved. Ground elevations at the site range from 5,385 to 5,341 feet amsl.

SWMU 234 is one of five storm-water outfalls that have been connected to TA-IV; the other four are SWMUs 230, 231, 232, and 233. The TA-IV storm-water outfalls are managed under two separate regulatory programs (the ER Project for RCRA Corrective Action, and the Storm Water Program annual reporting for NPDES compliance). The outfalls were added to the SWMU list in 1993, even though no chemical releases had been reported for the catchment areas. Similarly, no stained soil was identified at SWMU 234 during inspections conducted between 1993 and 2002. In 1994, the ground surface was surveyed for unexploded ordnance/high explosives and radioactive materials; no anomalies were detected. In September 2000, a review of historical aerial photography revealed that TA-I waste water from SWMU 46 had discharged into the same area as SWMU 234. This discharge of waste water occurred from 1948 to 1973.

In the June 1995 NFA Proposal for SWMU 233, the potential COCs were considered to be chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, and mineral oil. This list of COCs was conservatively based upon chemicals used at TA-IV. The analytes of VOCs, SVOCs, RCRA metals, and chromium-VI are indicative of the COCs.

The TA-IV outfalls discharge storm water about a dozen days per year in response to significant precipitation, typically resulting from summer thunderstorms. The outfalls do not discharge industrial waste water or septic waste. The SNL/NM Storm Water Program collects TA-IV storm-water samples from Station 6 and reports the water quality data in the annual SNL/NM Site Environmental Report. Except for a mineral-oil spill at SWMU 232-2 in 1994, no chemical releases have been reported at the TA-IV storm-water outfalls. None of the outfalls have been on the SNL/NM radioactive materials management area list.

Figure 3 shows the boundary of SWMU 234 and the sampling locations.

3.2 Results of Risk Analysis

The risk assessment calculation was performed using maximum COC concentrations and the methods specified in NMED's "Technical Background Document for Development of Soil Screening Levels" (NMED December 2000). As shown in Table 3, the total human health HI (0.46) is less than the NMED guidance value of 1 for the residential land-use scenario. The

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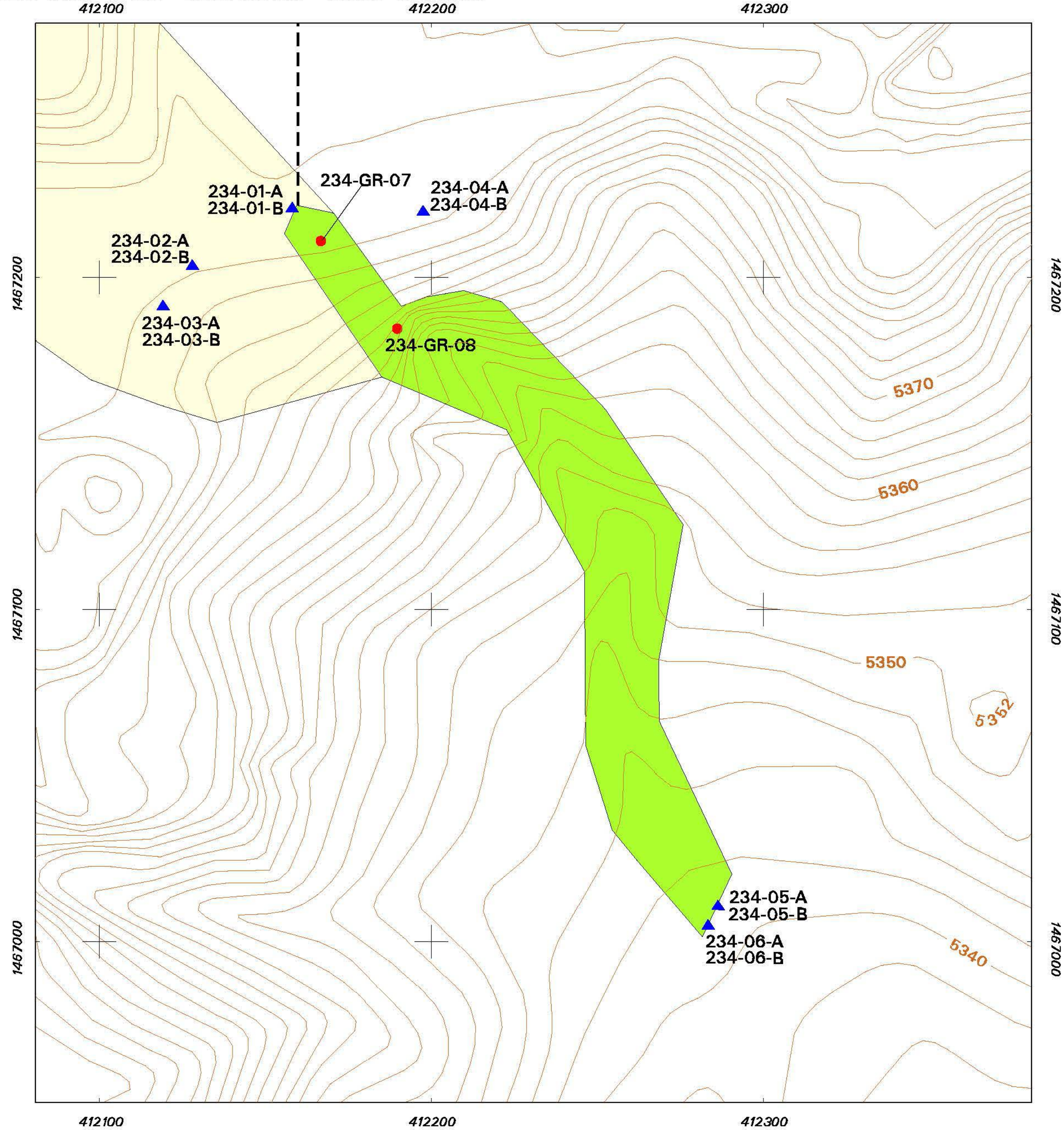
Mapid=020303 03/11/02 SNL GIS ORG. 6135 DHelfrich dh020303.aml



Legend

- ▲ Soil Sample Location (1994)
- ● Soil Sample Location (2001)
- 2-foot Contour
- Previous location of buried TA-IV Outfall Pipe
- SWMU 234
- SWMU 46

Figure 3

Sampling Locations for SWMU 234

0 25 50
Scale in Feet

0 6 12
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Table 3
Human Health Risk Assessment Values for SWMU 234 Nonradiological COCs

COC	Maximum/ UCL Concentration (mg/kg)	SNL/NM Background Concentration[a] (mg/kg)	Residential Land-Use Scenario[b] (Maximum Concentrations)		Residential Land-Use Scenario[b] (UCL Concentrations)	
			Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Inorganic						
Arsenic	7/**4.60**	4.4	0.32	2E-5	0.21	1E-5
Barium	240	200	0.05	–	0.05	–
Cadmium	2.9	<1	0.07	2E-9	0.07	2E-9
Chromium, total	17.7	16.2	0.00	–	0.00	–
Chromium VI	2.08	NC	0.01	1E-8	0.01	1E-8
Mercury	0.0603	<0.1	Below Background	Below Background	Below Background	Below Background
Selenium	0.13[c]	<1	Below Background	Below Background	Below Background	Below Background
Silver	1	<1	Below Background	Below Background	Below Background	Below Background
Organic						
Acenaphthene	0.00626 J	–	0.00	–	0.00	–
Acetone	0.015	–	0.00	–	0.00	–
Anthracene	0.0212 J	–	0.00	–	0.00	–
Benzo(a)anthracene	0.258/**0.242**	–	0.00	4E-7	0.00	4E-7
Benzo(a)pyrene	0.435/**0.234**	–	0.00	7E-6	0.00	4E-6
Benzo(b)fluoranthene	0.506/**0.375**	–	0.00	8E-7	0.00	6E-7
Benzo(ghi)perylene	0.309/**0.267**	–	0.00	5E-6	0.00	4E-6
Benzo(k)fluoranthene	0.471	–	0.00	8E-8	0.00	8E-8
Carbazole	0.0182 J	–	0.00	6E-10	0.00	6E-10
Chrysene	0.435	–	0.00	7E-9	0.00	7E-9
Di-n-butyl phthalate	0.0207 J	–	0.00	–	0.00	–
Di-n-octyl phthalate	0.0102 J	–	0.00	–	0.00	–
bis(2-Ethylhexyl) phthalate	0.28 JB	–	0.00	6E-9	0.00	6E-9
Fluoranthene	0.450	–	0.00	–	0.00	–
Fluorene	0.00666 J	–	0.00	–	0.00	–

Refer to footnotes at end of table.

Table 3 (Concluded)
Human Health Risk Assessment Values for SWMU 234 Nonradiological COCs

COC	Maximum/ UCL Concentration (mg/kg)	SNL/NM Background Concentration[a] (mg/kg)	Residential Land-Use Scenario[b] (Maximum Concentrations)		Residential Land-Use Scenario[b] (UCL Concentrations)	
			Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Indeno(1,2,3-c,d) pyrene	0.345 J	–	0.00	6E-7	0.00	6E-7
Phenanthrene	0.139	–	0.00	–	0.00	–
Pyrene	0.603	–	0.00	–	0.00	–
Total			0.46	3E-5	0.35	2E-5

Note: UCLs are calculated only for risk drivers. UCL concentrations are in **bold**.
[a]Dinwiddie September 1997, Tijeras Supergroup.
[b]EPA 1989.
[c]Maximum concentration is one-half the detection limit.
B = Analyte detected in method blank.
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
J = Estimated concentration.
mg/kg = Milligram(s) per kilogram.
NC = Not calculated.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
UCL = Upper confidence limit (in **bold**).
– = Information not available.

total estimated excess cancer risk is 3E-5 for the residential land-use scenario. NMED guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001), thus the excess cancer risk for this site is higher than the suggested acceptable risk value.

The estimated excess cancer risk is slightly higher than the NMED guidelines for the residential land-use scenario when maximum COC concentrations were used in the risk calculation. However, the site has been adequately characterized and average concentrations are more representative of actual site conditions. The UCL of the mean concentrations used for the main risk drivers at this site are as follows (Appendix 1):

- Arsenic (4.60 mg/kg)
- Benzo(a)anthracene (0.242 mg/kg)
- Benzo(a)pyrene (0.234 mg/kg)
- Benzo(b)fluoranthene (0.375 mg/kg)
- Benzo(ghi)perylene (0.267 mg/kg)

With the UCL of the mean concentrations, the total estimated excess cancer risk is reduced to 2E-5. In addition, Table 4 shows that for the SWMU 234 associated background constituents, an estimated excess cancer risk of 1E-5 for the residential land-use scenario. The estimated incremental cancer risk is 8.4E-6 for the residential land-use scenario. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs considering the residential land-use scenario. Thus, using realistic concentrations in the risk calculations that more accurately depict actual site conditions and incremental risk, the HI and estimated excess cancer risk are lower than NMED guidelines.

Table 4
Risk Assessment Values for SWMU 234
Nonradiological Background Constituents

COC	Background Concentration[a] (mg/kg)	Residential Land-Use Scenario[b]	
		Hazard Index	Cancer Risk
Arsenic	4.4	0.20	1E-5
Barium	200	0.04	–
Cadmium	<1	–	–
Chromium, total	16.2	0.00	–
Chromium VI	NC	–	–
Mercury	<0.1	–	–
Selenium	<1	–	–
Silver	<1	–	–
Total		**0.24**	**1E-5**

[a]Dinwiddie September 1997, Tijeras Supergroup Soils.
[b]EPA 1989.
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
NC = Not calculated.
SWMU = Solid Waste Management Unit.
– = Information not available.

In conclusion, human health risk for SWMU 234 is within the acceptable range according to NMED guidance for a residential land-use scenario.

4.0 REFERENCES

Bearzi, J.P. (New Mexico Environment Department), January 2001. Memorandum to RCRA-Regulated Facilities, "Risk-Based Screening Levels for RCRA Corrective Action Sites in New Mexico," Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico. January 23, 2001.

Dinwiddie, R.S. (New Mexico Environment Department), September 1997. Letter to M.J. Zamorski (U.S. Department of Energy), "Request for Supplemental Information: Background Concentrations Report, SNL/KAFB." September 24, 1997.

EPA, see U.S. Environmental Protection Agency.

New Mexico Environment Department (NMED), December 2000. "Technical Background Document for Development of Soil Screening Levels," Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, New Mexico Environment Department, Santa Fe, New Mexico. December 18, 2000.

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Sandia National Laboratories/New Mexico (SNL/NM), November 2001. "TA-V Groundwater Investigation, Fiscal Years 1999 and 2000," Sandia National Laboratories, Albuquerque, New Mexico.

SNL/NM, see Sandia National Laboratories/New Mexico.

U.S. Environmental Protection Agency (EPA), 1989. "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual," EPA/540-1089/002, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

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APPENDIX 1
CALCULATION OF THE UPPER CONFIDENCE LIMITS OF MEAN CONCENTRATIONS

For conservatism, Sandia National Laboratories/New Mexico uses the maximum concentration of the constituents of concern (COCs) for initial risk calculation. If the maximum concentrations produce risk above New Mexico Environment Department (NMED) guidelines, conservatism with this approach is evaluated and, if appropriate, a more realistic approach is applied. When the site has been adequately characterized, an estimate of the mean concentration of the COCs is more representative of actual site conditions. The NMED has proposed the use of the upper confidence limit (UCL) of the mean to represent average concentrations at a site (NMED December 2000). The UCL is calculated according to NMED guidance (Tharp June 2002) using the U.S. Environmental Protection Agency ProUCL program (EPA April 2002). Attached are the outputs from that program and the calculated UCLs used in the risk analysis.

<u>References</u>

EPA, see U.S. Environmental Protection Agency.

New Mexico Environment Department (NMED), December 2000. "Technical Background Document for Development of Soil Screening Levels," Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, New Mexico Environment Department, Santa Fe, New Mexico. December 18, 2000.

NMED, see New Mexico Environment Department.

Tharp, T. (Weston Solutions, Inc.), June 2002. *Personal communication* with K. Olsen (Hazardous Waste Bureau, New Mexico Environment Department). June 12, 2002.

U.S. Environmental Protection Agency (EPA), April 2002. *ProUCL User's Guide*, U.S. Environmental Protection Agency, Washington, D.C.

ATTACHMENT

SWMU 234

SWMU 234		
Summary Statistics for	arsenic	
Number of Samples	16	
Minimum	0.900	
Maximum	7.000	
Mean	3.261	
Median	2.765	
Standard Deviation	2.057	
Variance	4.231	
Coefficient of Variation	0.631	
Skewness	0.432	
Shapiro-Wilk Test Statisitic	0.912	
Shapiro-Wilk 5% Critical Value	0.887	
Data are Normal: Use Student's-t UCL		
99 % UCL (Assuming Normal Data)		
Student's-t	4.599	
99 % UCL (Adjusted for Skewness)		
Adjusted-CLT	4.567	
Modified-t	4.609	
99 % Non-parametric UCL		
CLT	4.457	
Jackknife	4.599	
Standard Bootstrap	4.420	
Bootstrap-t	4.832	
Chebyshev (Mean, Std)	8.378	

SWMU 234		
Summary Statistics for	benzo(a)anthracene	
Number of Samples	11	
Minimum	0.0005	
Maximum	0.258	
Mean	0.13087	
Median	0.16500	
Standard Deviation	0.08429	
Variance	0.00711	
Coefficient of Variation	0.64408	
Skewness	-0.69832	
Shapiro-Wilk Test Statisitic	0.66877	
Shapiro-Wilk 5% Critical Value	0.85000	
Data not Lognormal at 5% Significance Level		
Data not Normal: Try Non-parametric UCL		
95 % UCL (Assuming Normal Data)		
Student's-t	0.17694	
95 % UCL (Adjusted for Skewness)		
Adjusted-CLT	0.16696	
Modified-t	0.17604	
95 % Non-parametric UCL		
CLT	0.17268	
Jackknife	0.17694	
Standard Bootstrap	0.17118	
Bootstrap-t	0.16966	
Chebyshev (Mean, Std)	0.24165	

SWMU 234	
Summary Statistics for	benzo(a)pyrene
Number of Samples	10
Minimum	0.0010
Maximum	0.4350
Mean	0.1597
Median	0.1650
Standard Deviation	0.1284
Variance	0.0165
Coefficient of Variation	0.8041
Skewness	0.9085
Shapiro-Wilk Test Statisitic	0.7595
Shapiro-Wilk 5% Critical Value	0.8420
Data are Normal: Use Student's-t UCL	
95 % UCL (Assuming Normal Data)	
Student's-t	0.2341
95 % UCL (Adjusted for Skewness)	
Adjusted-CLT	0.2390
Modified-t	0.2361
95 % Non-parametric UCL	
CLT	0.2265
Jackknife	0.2341
Standard Bootstrap	0.2205
Bootstrap-t	0.2491
Chebyshev (Mean, Std)	0.3367

SWMU 234		
Summary Statistics for	benzo(b)fluoranthene	
Number of Samples	11	
Minimum	0.00065	
Maximum	0.506	
Mean	0.1624	
Median	0.1650	
Standard Deviation	0.1615	
Variance	0.0261	
Coefficient of Variation	0.9945	
Skewness	1.1590	
Shapiro-Wilk Test Statisitic	0.8008	
Shapiro-Wilk 5% Critical Value	0.8500	
Data not Lognormal at 5% Significance Level		
Data not Normal: Try Non-parametric UCL		
95 % UCL (Assuming Normal Data)		
Student's-t	0.2507	
95 % UCL (Adjusted for Skewness)		
Adjusted-CLT	0.2607	
Modified-t	0.2535	
95 % Non-parametric UCL		
CLT	0.2425	
Jackknife	0.2507	
Standard Bootstrap	0.2405	
Bootstrap-t	0.2964	
Chebyshev (Mean, Std)	0.3747	

SWMU 234	
Summary Statistics for	benzo(ghi)perylene
Number of Samples	10
Minimum	0.0025
Maximum	0.3090
Mean	0.1307
Median	0.1650
Standard Deviation	0.0990
Variance	0.0098
Coefficient of Variation	0.7575
Skewness	-0.0569
Shapiro-Wilk Test Statisitic	0.6549
Shapiro-Wilk 5% Critical Value	0.8420
Data not Lognormal at 5% Significance Level	
Data not Normal: Try Non-parametric UCL	
95 % UCL (Assuming Normal Data)	
Student's-t	0.1880
95 % UCL (Adjusted for Skewness)	
Adjusted-CLT	0.1815
Modified-t	0.1879
95 % Non-parametric UCL	
CLT	0.1821
Jackknife	0.1880
Standard Bootstrap	0.1804
Bootstrap-t	0.1848
Chebyshev (Mean, Std)	0.2671