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LANL REP 92

Department of Energy
Field Office, Albuquerque
Los Alamos Area Office
Los Alamos, New Mexico 87544

FEB 12 1993

Mr. Benito Garcia, Chief
Hazardous and Radioactive Materials Bureau
New Mexico Environment Department
525 Camino de los Marquez
Santa Fe, New Mexico 87502

Dear Mr. Garcia:

Enclosed are two copies of the Interim Status Closure Plan for the Technical Area 53 Surface Impoundments 166 Northeast and Northwest. In a November 23, 1992, letter to you from my office, the Los Alamos National Laboratory and the Department of Energy committed to this delivery by February 12, 1993.

Subsequent activity on our part will be delayed until you review and approve or provide comments on the plan. As the schedule provided in Section 5 of the document indicates, we have allowed up to six months for review, approval, or comment resolution, and reprint of the document.

Should you have any questions, please contact Steve Slaten at 505-665-5050.

Sincerely,

Joseph C. Vozella

Joseph C. Vozella, Acting Chief
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February 1993
Revision 0.0

INTERIM STATUS CLOSURE PLAN

SURFACE IMPOUNDMENTS TA-53-166 NORTHEAST AND TA-53-166 NORTHWEST

TECHNICAL AREA 53

Los Alamos National Laboratory
Environmental Restoration Group EM-13
Los Alamos, New Mexico 87544

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LIST OF ACRONYMS AND ABBREVIATIONS

AA	Atomic absorption spectroscopy
ASL	Above sea level
CFR	Code of Federal Regulations
Coliwasa	Composite Liquid Waste Sampler
DOE	US Department of Energy
EM-8	Los Alamos National Laboratory Environmental Protection Group
EM-9	Los Alamos National Laboratory Environmental Chemistry Group
EM-13	Los Alamos National Laboratory Environmental Restoration Group
EPA	Environmental Protection Agency
GC	Gas chromatography
GC/MS	Gas chromatography/mass spectroscopy
HWMR-6	New Mexico Hazardous Waste Regulations-6
HS-1	Los Alamos National Laboratory Health Physics Operations Group
HSP	Health and Safety Plan
ICP	Inductively coupled plasma emission spectroscopy
IWP	Installation Work Plan for Environmental Restoration
Laboratory	Los Alamos National Laboratory
LAMPF	Los Alamos Meson Physics Facility
MCL	Maximum contaminant level
NE	Northeast
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NW	Northwest
PCB	Polychlorinated biphenyl
PQL	Practical quantitation limit
QA	Quality assurance
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RPD	Relative percent difference
S	South
SAL	Screening action levels
TA	Technical Area

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compound
VOA	Volatile Organics Analysis

1.0 INTRODUCTION

This closure plan is submitted to the New Mexico Environment Department (NMED) to meet the requirements of the New Mexico Hazardous Waste Regulations-6 (HWMR-6) and the Resource Conservation and Recovery Act (RCRA). This closure plan only addresses closure of two surface impoundments at Technical Area (TA)-53. These impoundments were identified as mixed waste storage units in the RCRA Part A Permit Application for mixed waste submitted to the NMED on January 25, 1991, and in the RCRA Part B Permit Application for Surface Impoundments at Technical Area 53 submitted to the NMED in July 1991. Mixed waste contains both a hazardous waste, as defined by and regulated under RCRA, and radioactive waste. The mixed waste in the sludge deposited at the bottoms of the impoundments may include metals, organic compounds, and low-level radionuclides.

Los Alamos National Laboratory (Laboratory) is a multidisciplinary laboratory whose mission is to apply science and technology to solve national problems. Basic scientific research complements and strengthens the Laboratory's fundamental technical capabilities in such areas as weapons development, energy supply, and conservation programs. The laboratory is owned by the US Department of Energy (DOE), and is jointly operated by DOE and the University of California (LANL, 1992a).

This closure plan provides a description of the surface impoundments and the actions that will be implemented during closure. Closure of the impoundments will involve removal or decontamination of RCRA-regulated hazardous constituents present above health-risk-based cleanup levels. Removal or decontamination of radioactive constituents will not be addressed by this closure plan. Chapter 2.0 provides descriptive information on TA-53 and on the design and operation of the surface impoundments. Chapter 3.0 summarizes existing information concerning the chemical and physical characteristics of the water and sludge in the surface impoundment and also provides a plan for further sampling and analysis to be conducted as part of closure. Chapter 4.0 discusses the status of the groundwater monitoring waiver for the site. Chapter 5.0 provides a detailed description of closure activities. Chapter 6.0 describes the report that will be prepared to document closure.

Compliance with specific regulatory requirements for closure are addressed in Chapter 5.0. The HWMR-6 have incorporated the 1990 Code of Federal Regulations (CFR), Title 40, Parts

260 to 270. All regulatory citations in this closure plan will, therefore, be referenced to the 1990 40 CFR. Table 1-1 lists the regulations applicable for closure of these surface impoundments and identifies which sections of Chapter 5.0 address compliance with these regulations.

TABLE 1-1. APPLICABLE CLOSURE REGULATIONS AND ASSOCIATED CLOSURE PLAN SECTIONS

HWMR-6 Regulation	Closure Plan Section
265.111	5.1.1.1
265.112(b)	5.1.1.2
265.112(b)(1)	5.2.1
265.112(b)(2)	5.2.2, 5.2.3
265.112(b)(3)	5.2.4, 5.2.5
265.112(b)(4)	5.2.6, 5.3.1, 5.3.3, 5.3.4
265.112(b)(5)	5.2.7
265.112(b)(6)	5.2.8
265.112(b)(7)	5.2.8
265.112(c)	5.1.1.3
265.112(d)	5.1.1.4
265.112(e)	5.1.1.5
265.113(a)	5.1.2.1
265.113(b)	5.1.2.1
265.113(c)	5.1.2.2
265.114	5.1.3, 5.2.6, 5.3.1
265.115	5.1.4
265.116	5.1.5
265.117 - 265.120	5.4
265.142	5.1.6
265.143	5.1.7
265.144 - 265.145	5.4
265.147	5.1.8
265.228(a)	5.2.5, 5.2.6, 5.3.1, 5.3.2
265.228(b)	5.4

2.0 FACILITY DESCRIPTION

This chapter contains a general description of Los Alamos National Laboratory (Laboratory), Technical Area (TA)-53, and the surface impoundments undergoing closure.

2.1 General Description

The Laboratory is in Los Alamos County in north-central New Mexico, approximately 60 miles (mi) north-northeast of Albuquerque and 25 mi northwest of Santa Fe (Figure 2-1). The Laboratory, which occupies an area of 43 mi^2, and the associated residential areas of Los Alamos and White Rock are situated on the Pajarito Plateau. The plateau consists of a series of fingerlike mesas separated by deep east-west-trending canyons; intermittent streams lie at the bottoms of all of the canyons. The mesa tops range in elevation from approximately 7,800 ft at the flank of the Jemez Mountains (west of Los Alamos) to about 6,200 ft at their eastern extent, where they terminate above the Rio Grande Valley. (LANL, 1992a)

The Laboratory is divided into 51 TAs; 34 of these TAs are developed (Figure 2-2). The waste management units addressed in this closure plan are two surface impoundments at TA-53. (LANL, 1992a)

The main activity at TA-53 centers around the Los Alamos Meson Physics Facility (LAMPF) and its associated experimental areas. The LAMPF is a half-mi-long proton accelerator that produces secondary nuclear particles for various experimental programs, including basic research in nuclear physics, production of isotopes, and other work in radiochemistry, solid state physics research, and accelerator technology. In addition to the LAMPF and its associated experimental areas, TA-53 includes shops, warehouses, trailers for instruments and data logging, an office, and facilities for accelerator technology research. (DOE, 1987)

2.1.1 TA-53 Surface Impoundments

This section provides a description of the TA-53 surface impoundments. This description addresses design and construction, operation and maintenance, overtopping controls, erosion controls, and sources and types of wastes.

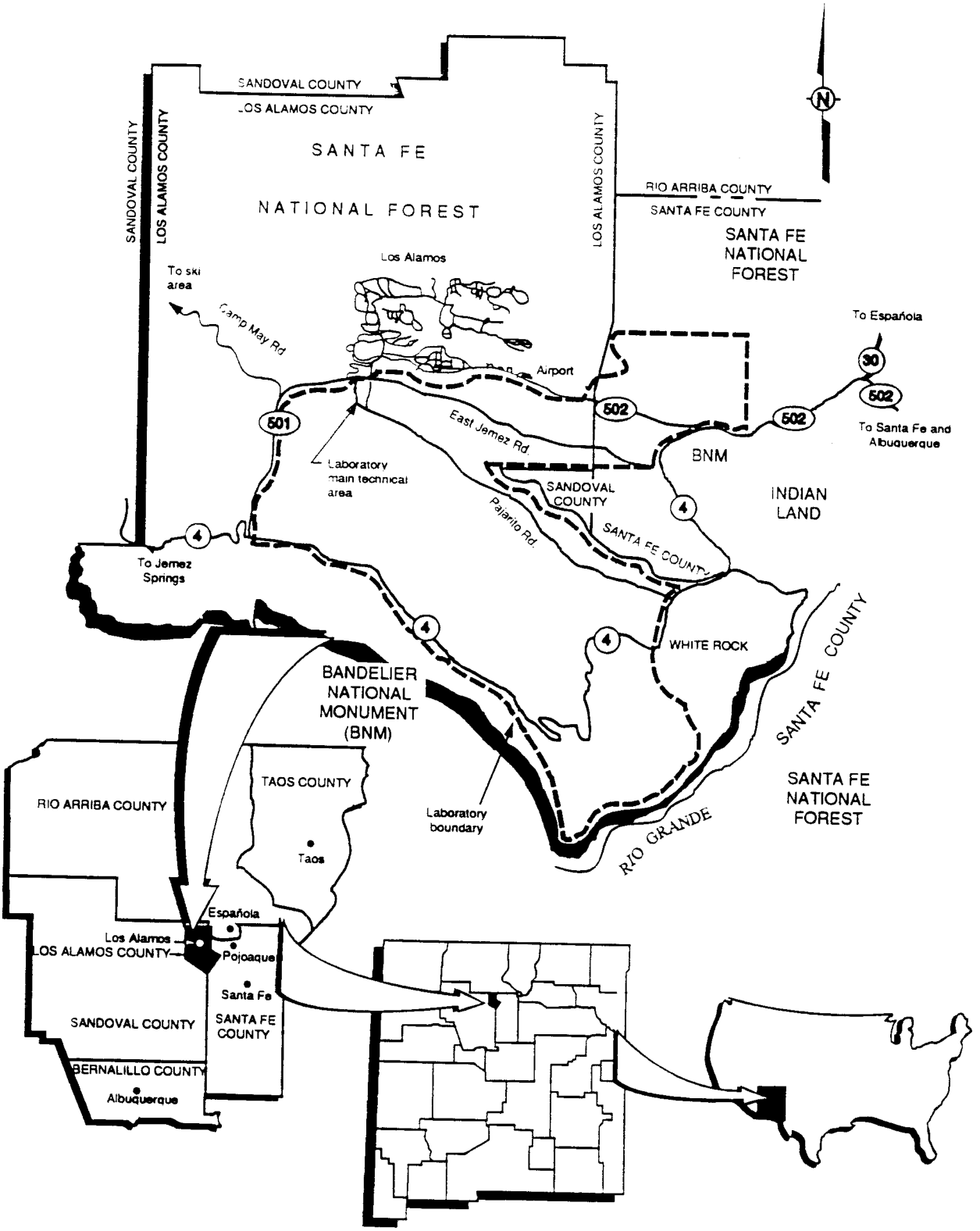

FIGURE 2-1. REGIONAL MAP OF LOS ALAMOS NATIONAL LABORATORY

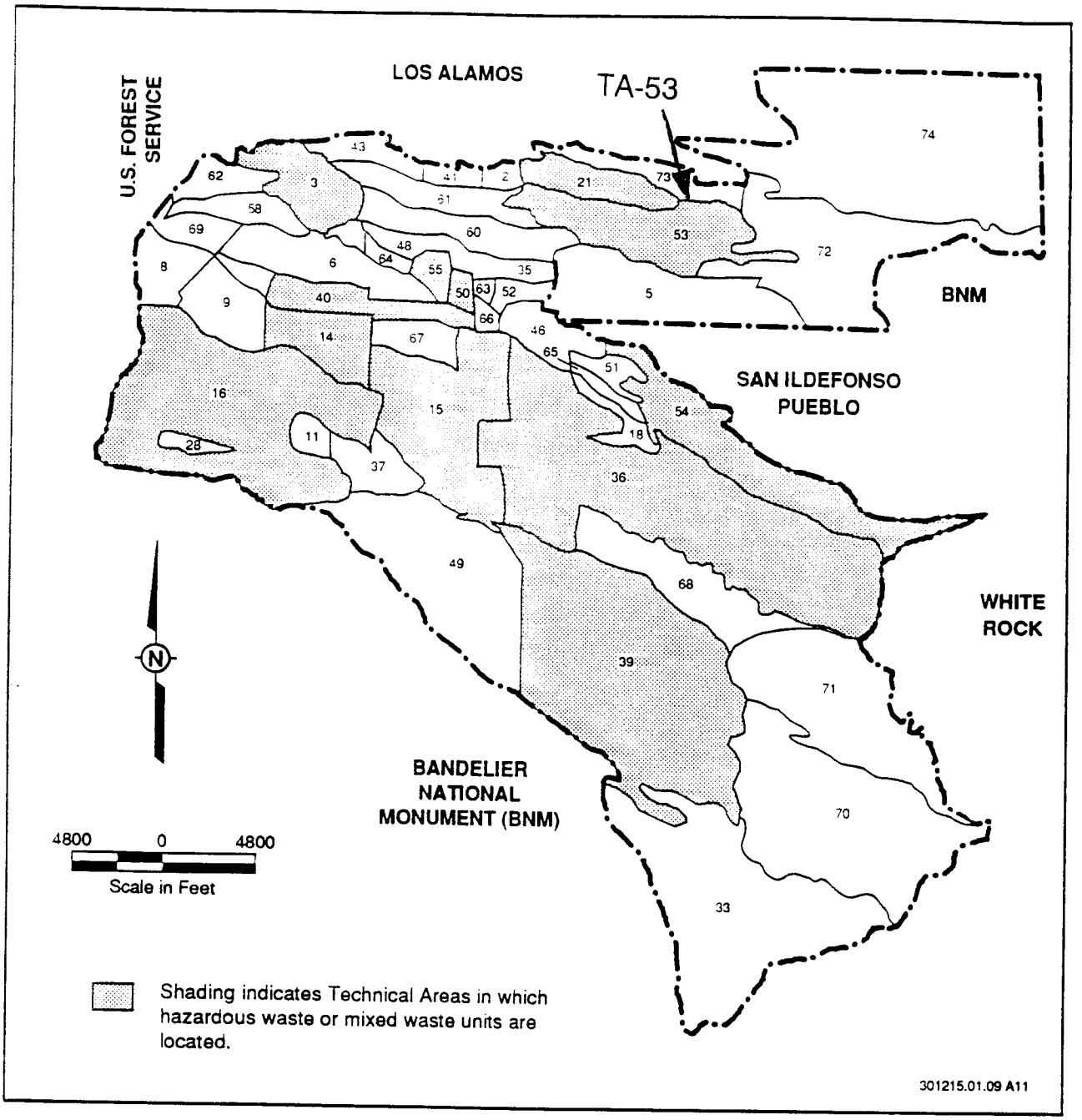

FIGURE 2-2. LOS ALAMOS NATIONAL LABORATORY TECHNICAL AREAS

2.1.1.1 Design and Construction

The two surface impoundments addressed in this closure plan are collectively identified with Laboratory Structure No. TA-53-166; in this document, the two impoundments will be distinguished as TA-53-166 northeast (NE) and TA-53-166 northwest (NW). The two surface impoundments, constructed in 1969, are 210 ft long by 210 ft wide, and are 6 ft deep. The impoundments have liquid storage capacities of 1,600,000 gal. each. In 1985, an additional surface impoundment was constructed adjacent to and on the south side of the two surface impoundments (LANL, 1992a). Appendix A contains "as-built" drawings for these two impoundments.

The surface impoundment dikes were constructed of materials obtained on site by excavating and pulverizing the welded volcanic tuff bedrock (Bandelier Tuff). The Bandelier Tuff in this area is an ashfall and ashflow tuff that was welded to varying degrees. The pulverized tuff is essentially a cohesionless soil (Boyd, 1966) that was placed in layers and compacted to 90% of the maximum density as defined by the Modified Proctor (ASTM D1557). (LANL, 1992a)

The impoundments were built with side slopes of 2:1 (horizontal:vertical). The base elevation of both impoundments is 6,916 ft above sea level (ASL), with maximum water elevations of 6,920 ft ASL. The elevation at the top of the berms ranges from a minimum of 6,922 ft ASL on the south, east, and west sides, to 6,927 ft ASL on the north side. There is a 32-ft-wide berm separating the two impoundments. (LANL, 1992a)

The liners in the two impoundments consist of a 4-in. layer of bentonite clay on the base of the impoundment and a gunite liner on the sidewalls. The clay liners were compacted to 95% of the maximum density as defined by the Modified Proctor (ASTM D1557). Typically, bentonite clay liners compacted to 95% of the Modified Proctor should yield a permeability of less than the standard 1×10^{-7} cm/sec. The 4-in.-thick bentonite clay liners in the impoundments are expected to have a saturated hydraulic conductivity of approximately 10^{-10} cm/sec (Fernandez et al., 1987). The gunite liners consist of approximately 4 to 6 in. of cement slurry without aggregate (shotcrete) that was sprayed onto the sides of the impoundments. (LANL, 1992a)

2.1.1.2 Operation and Maintenance

The NE and NW impoundments were originally planned as retention impoundments. The impoundments received sanitary as well as radioactive and industrial wastewaters. After their construction, however, the impoundments were frequently at capacity, which required discharges to be made. Growth in the contributing population meant that a third impoundment needed to be constructed to allow the system to continue as retention and evaporation impoundments. In 1985, a third impoundment was constructed to the south of the NE and NW impoundments. In 1989, this third impoundment, TA-53-166 South (S), was diverted into service as a total retention radioactive liquid waste storage impoundment (LANL, 1992a). The NE and NW impoundments then received sanitary wastewater only. The two impoundments received sanitary wastewater until February 2, 1993. The impoundments were taken out of service when TA-53 was connected to the TA-46 sanitary sewer system.

The two-impoundment system is rated at 120,000 gal. per day on a flow-through treatment basis. Although the piping is arranged to operate the impoundments in any configuration, normal operation is for flow to proceed through the system from the NW impoundment to the NE impoundment. The system was operated in a batch mode, with discharges occurring two or three times a year to Los Alamos Canyon through a National Pollutant Discharge Elimination System (NPDES) outfall, NPDES Serial No. 09S. (Historical information indicates that before the south impoundment was constructed, discharges from the north impoundments due to overfilling occurred on a fairly frequent basis.) When the decision was made to discharge to the outfall, effluent was sampled according to Environmental Protection Agency (EPA) Form 2C (NPDES) instructions. Parameters included biological oxygen demand, chemical oxygen demand, total organic carbon, and total suspended solids, as well as pollutants specified in the NPDES permit. Chlorine was sometimes added to the impoundments to reduce the total suspended solids and biological oxygen demand below the NPDES limits before discharge. (LANL, 1992a). Beginning in January 1992, the impoundments were operated on a continuous discharge basis. Discharge continued until January 31, 1993.

The NE and NW impoundments are each equipped with two Aqua Aerobics surface turbine aerators for aeration and enhanced evaporation to minimize the volume of water discharged to the outfall. In winter, ice forms on these impoundments, and the aerators are turned off.

The aerators have also been turned off during a discharge to the outfall to prevent unnecessary disturbance of sludge and other bottom sediments. (LANL, 1992a)

On occasion, water from the NE and NW impoundments was diverted to the adjacent south impoundment to maintain appropriate liquid levels and keep the liner weighted down. Later, these diversions were stopped and clean water was added to the south impoundment.

Before 1989, liquid radioactive wastewater was discharged to the two north impoundments. Special provisions have, therefore, been adopted for working in the area of the impoundments. These include treating all equipment associated with the impoundments as radioactive, and working in close coordination with the Health Physics Operations Group, HS-1, when disposing of this equipment or working in the area of the impoundments. (LANL, 1992a)

2.1.1.3 Overtopping Controls

The maximum water level in the impoundments was set to allow for at least 2 ft of freeboard. The 100-year, 24-hour storm event for the region is approximately 3 in. Therefore, in the event of a 100-year, 24-hour storm, multiplied by 1.3 to account for run-off from the dikes, the freeboard would be at 20.1 in., or 1.675 ft. The freeboard is visually inspected daily. (LANL, 1992a)

A pipe in the NE impoundment would allow discharge out the NPDES-permitted outfall in the event the impoundment reached high levels; however, it is still necessary to perform inspections for freeboard since there is a potential for overtopping if influent or precipitation exceeds the flow capacity of the NPDES discharge. (LANL, 1992a)

The impoundment berms serve as manmade barriers for flood control and drainage, as shown in Appendix A. In addition, natural drainage around the surface impoundments transports surface run-off away from the impoundments. (LANL 1992a)

2.1.1.4 Erosion Controls

The mechanism for causing erosion of the dike slope is direct rainfall on the dikes. The site is in a semiarid region. The average annual rainfall is less than 18 in., most of which comes during the months of April through October. The slopes were seeded to encourage vegetation growth; therefore, erosion of the dike material is not expected to be significant. (LANL, 1992a)

2.1.1.5 Sources and Types of Waste

The wastes in the impoundments at the time they were removed from service were wastewaters and the sludge contained in the bottom of the impoundments. The TA-53-166 NE and NW impoundments received sanitary waste and small amounts of industrial wastes since their construction in 1969; they also received radioactive waste until 1989. As a result of past disposal practices, mixed waste may have been introduced into the impoundments. Chapter 3.0 presents the results of past sampling and analysis of water and sludge. Several hazardous constituents have been detected. Administrative controls have been implemented at TA-53 to prevent mixed waste from entering the influent to the impoundments.

The TA-53 surface impoundments served all buildings at TA-53. Liquid waste generated on site was transferred to the impoundments via sanitary waste sewer lines, shown in Figure 2-3. Sanitary wastes from one holding tank (TA-53-1016) were trucked to the impoundments. Janitor sinks in the main buildings and some chemical sinks drained into the surface impoundments. (DOE, 1987)

Historically, sanitary sewage from other technical areas was trucked to TA-53 and disposed of in the NE and NW impoundments. This practice was discontinued in early July 1991. (LANL, 1992a)

The sludge has never been removed from the surface impoundments. Based on previous sampling efforts, the thickness of the sludge ranges from 3 to 18 in. (DOE, 1989)

It is unknown whether mixed wastes were disposed of in the surface impoundments. If they were, it is unknown what types of mixed wastes were disposed. Past sampling efforts

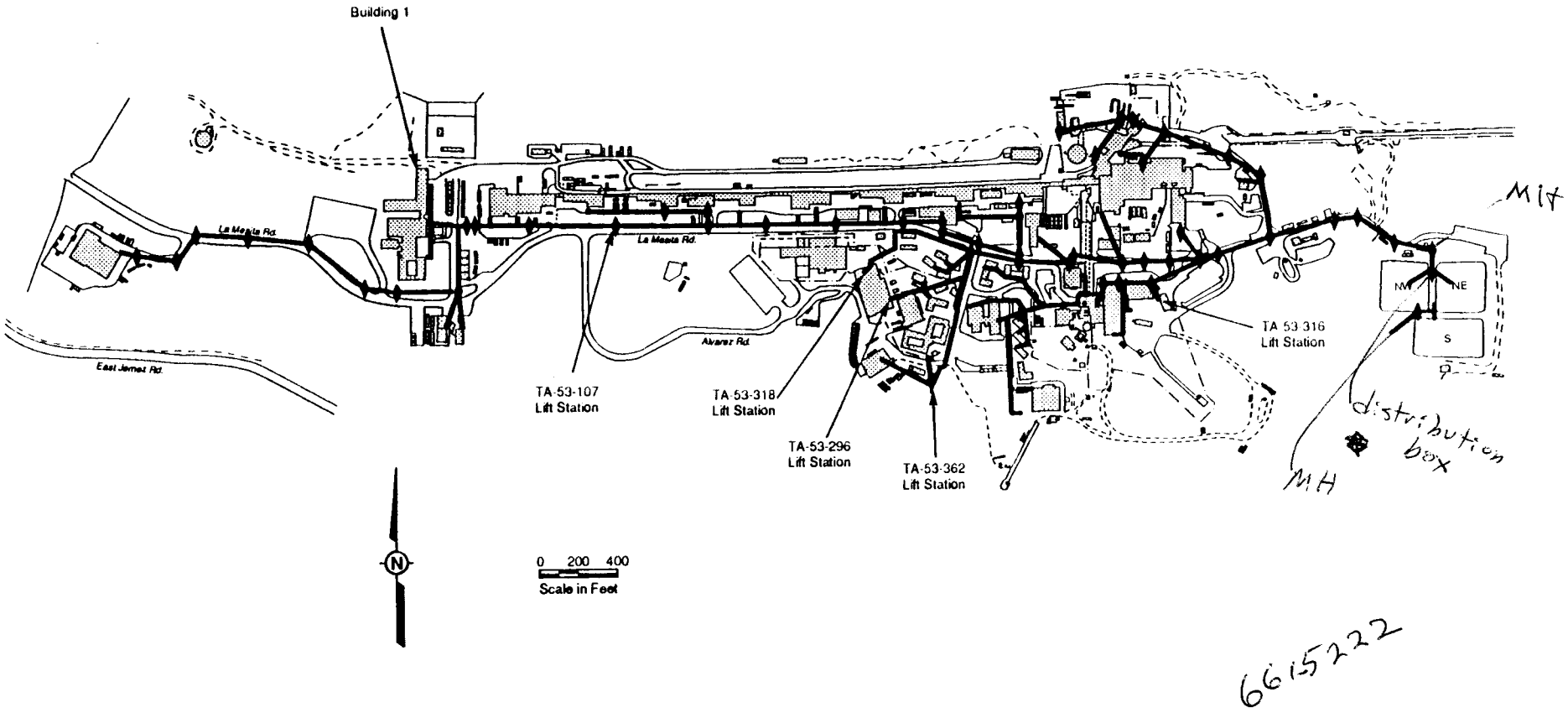

FIGURE 2-3. LOCATIONS OF SANITARY SEWER LINES IN TA-53

indicate the presence of very low levels of some hazardous constituents (See Section 3.1). It is impossible to determine whether these hazardous constituents were derived from listed wastes, characteristic wastes, or non-RCRA wastes. Listed wastes can only be determined by knowing how the wastes were generated and knowing detailed information regarding the chemical composition of the material before it became a waste.

2.1.2 Topographic Maps

A topographic map of the area near TA-53 surface impoundments is provided in Appendix B. Contour lines on this figure are at intervals of ten feet. This is sufficient to detail natural drainage in the vicinity of the surface impoundments.

2.1.3 Wells

The municipal and industrial water supply for the Laboratory and the surrounding community is from fifteen deep wells in three well fields and one gallery (industrial use). These water-supply wells are described in Section 2.1.3 of the Part B permit application for the impoundments (LANL, 1992a). The nearest well is approximately one mile from the impoundments.

2.1.4 Wind Rose

Surface winds are light at Los Alamos, averaging 7 mph. Wind speeds are strongest from March through May, and weakest in December and January. The strongest winds are generally southwesterly to northwesterly and occur in the afternoon or evening. Annual wind roses for four areas at the Laboratory are presented in Section 2.1.4 of the Part B permit application for the impoundments (LANL, 1992a).

2.1.5 Land Use

The communities closest to the Laboratory are Los Alamos, just north of the Laboratory; and White Rock, east-southeast of the Laboratory (Figure 2-1). The total population of Los Alamos County is approximately 19,000. Most of Los Alamos County, and adjoining portions of neighboring Sandoval, Rio Arriba, and Santa Fe Counties, is undeveloped. The only

significant developments in Los Alamos county are the Laboratory facilities and the associated residential communities. Land use for the area surrounding TA-53 and the Laboratory is described in Section 2.1.5 of the Part B permit application for the impoundments (LANL, 1992a).

2.2 Location Information

A detailed description of information related to the location of the surface impoundments is provided in Section 2.2 of the Part B permit application for the impoundments (LANL, 1992a). This information includes descriptions of:

- The impoundment location with respect to floodplains (Section 2.2.2 of the Part B application);
- The soils present at TA-53 and the Laboratory (Section 2.2.3 of the Part B application);
- The regional geology of the Laboratory and the site-specific geology of TA-53 (Section 2.2.4 of the Part B application); and
- Groundwater conditions for the Laboratory and TA-53 (Section 2.2.5 of the Part B application).

This information is summarized in the following paragraphs; more detailed descriptions are available in the above-referenced sections of the Part B permit application (LANL, 1992a). Groundwater information is also provided in Chapter 4.0 of this closure plan.

The TA-53 surface impoundments are not within the 100-year floodplain boundary (LANL, 1992a). These impoundments are at the top of an east-west-trending mesa bounded on the north and south by deep east-west-trending canyons. The base elevation of the impoundments is 6,916 ft ASL. The bottom elevation of the canyon south of the impoundments is 6,680 ft ASL.

The soils in TA-53 are classified as mesic rock outcrop. This land type is found on moderately sloping to steep mesa tops and edges and consists of about 65% tuff rock outcrop; 5% very shallow, undeveloped soils on tuff bedrock; 5% Hackroy soils; and 25% narrow escarpments. The Hackroy soils range from a sandy loam in the top 8 cm of depth, to a clay loam in depths of from 8 to 30 cm. Permeability rates range from 5 to 15 cm per hour in the top layers, to 0.5 to 0.15 cm per hour or less in the lower layers. The shrink-swell potential is low. The available water-holding capacity is 0.11 to 0.21 cm per cm, and the soil pH varies from 6.6 to 7.8. (LANL, 1992a)

The Laboratory is on the east-central edge of the Jemez Mountains. The Jemez Mountains are formed by a complex pile of volcanic rocks along the northwest margin of the Rio Grande rift in north-central New Mexico. The immense volume of Pliocene and Quaternary extrusive rocks that represents the Jemez volcanic field covers an area of over 30 mi east-to-west and 50 mi north-to-south, and is over 4,000 ft in thickness near the center. (LANL, 1992a)

TA-53 is on the western part of the Pajarito Plateau, which forms an apron of volcanic and sedimentary rocks around the eastern flanks of the Jemez Mountains. The plateau is aligned approximately north-south and is about 20-25 mi in length and 5 to 10 mi wide. It is bounded on the east by White Rock Canyon (which contains the Rio Grande), on the north and northeast by the Puye escarpment, and on the west by Sierra de los Valles. The Pajarito Plateau slopes gently eastward from an elevation of about 7,500 ft near the mountains towards the Rio Grande, where it terminates at an elevation of about 5,400 feet in steep slopes and cliffs formed by down cutting of the river. The plateau has been dissected into a number of narrow mesas by southeastward-trending intermittent streams.

The oldest unit exposed around the margins of the Pajarito Plateau and penetrated by drill holes on the plateau is the Miocene Santa Fe Group. The Santa Fe in this area consists of friable to moderately well-cemented siltstone and sandstones. Overlying the Santa Fe Group are the volcanic rocks of the Tschicoma Foundation, which consist of latite, quartz-latite flows, and pyroclastic rocks. Interfingering with the Tschicoma and overlying the Santa Fe Group are the conglomerate and fanglomerate rocks of the Puye Formation. Overlying and interfingering with the conglomerate of the Puye Formation are the basaltic rocks of Chino Mesa. The Pajarito Plateau is capped for the most part by the Bandelier Tuff, which ranges in

thickness from about 1,050 ft along the western edge of the plateau to about 260 ft just west of White Rock.

The only aquifer of the Pajarito Plateau capable of providing municipal and industrial water supply is in rocks of the Santa Fe Group and Puye Formation. The Tschicoma Formation and the Bandelier Tuff, west of the Pajarito Plateau on the flank of the mountains, contain small, localized bodies of perched water. The Bandelier Tuff contains no perched water beneath the Pajarito Plateau.

3.0 WASTE CHARACTERIZATION

This chapter presents existing information concerning the chemical characteristics of the wastes in the Technical Area (TA)-53 surface impoundments and describes waste characterization activities planned as part of closure. Section 3.1 presents the results of previous sampling and analysis activities and evaluates whether water and sludge in the surface impoundments are mixed wastes. Sections 3.2 through 3.6 describe waste sampling and analysis activities that will be performed during closure.

3.1 Waste Characteristics

The sludge and water in the two TA-53 surface impoundments have been characterized during several sampling efforts. These sampling events are described below. The results have been compared to specific hazardous waste characteristics and criteria.

3.1.1 Results of Past Analysis

The DOE Headquarters Environmental Survey sampled sludge from the two impoundments during 1987 (DOE, 1989). This sampling was performed to determine if the sludge had been contaminated from possible disposal of Resource Conservation and Recovery Act (RCRA) wastes to the impoundments. Three samples, each composited from subsamples collected at three locations, were collected from each impoundment. The subsamples consisted of grab samples collected using a pole-mounted beaker. Volatiles analysis was performed on one of the three subsamples rather than on the composite, so that volatiles would not be lost during compositing. Each sample was analyzed for volatile and semivolatile organics, metals, and gamma-emitting radionuclides. The results of analysis for volatiles, semivolatiles, and metals above detection limits are presented in Tables 3-1 through 3-3, respectively.

The results indicate that two volatiles and six semivolatiles were detected, although most of these results are suspected of being false positives (DOE 1989). For comparison with potential levels of concern, Tables 3-1 and 3-2 also include the proposed RCRA Subpart S action levels, 1992 Installation Work Plan for Environmental Restoration (IWP) screening action levels (SALs) for soil (LANL 1992b), and Toxicity Characteristic Leaching Procedure

TABLE 3-1. VOLATILE ORGANIC COMPOUNDS DETECTED IN SLUDGE SAMPLES

	Acetone, mg/kg	2-Butanone, mg/kg	Disulfide, mg/kg	Chloroform, mg/kg	4-Isopropyl-toluene, mg/kg	Toluene, mg/kg	1,2,4-Trimethyl-benzene, mg/kg
Subpart S, Sys.	8000	4000	8000			20000	
Subpart S, Carc.				110			
1992 Soil SAL, Sys.	8000	2100	7.4	800		890	
1992 Soil SAL, Carc.				0.21			
TCLP		4000		120			
Sample Location - See Note (a)							
1988 Samples							
NW LAGOON - 01	0.66 B					3.6 J	
NW LAGOON - 02						0.2	
NW LAGOON - 03	0.97 B					0.87	
NE LAGOON - 04	4.9						
NE LAGOON - 05	0.25						
NE LAGOON - 06	9.0 B						
July 1991 Samples							
AB-53-NW-1S						0.068	
AB-53-NW-2S						0.042	
AB-53-NW-4SQ						0.025	
April 1992 Samples							
53-NW-A-S					0.025		
53-NW-B-S	0.03						
53-NW-E-S	0.087						
53-NW-G-S						0.1	
53-NW-H-S						0.0066	
53-NW-I-S	0.14		0.011				0.019
53-NW-L-S						0.092	
53-NW-N-S			0.021				
53-NW-M-S	0.23	0.034	0.006			0.035	
53-NW-N-S-QA	0.11		0.014				

TABLE 3-1. VOLATILE ORGANIC COMPOUNDS DETECTED IN SLUDGE SAMPLES (Continued)

	Acetone, mg/kg	2-Butanone, mg/kg	Disulfide, mg/kg	Chloroform, mg/kg	4-Isopropyl-toluene, mg/kg	Toluene, mg/kg	1,2,4-Trimethyl-benzene, mg/kg
Subpart S, Sys.	8000	4000	8000			20000	
Subpart S, Carc.				110			
1992 Soil SAL, Sys.	8000	2100	7.4	800		890	
1992 Soil SAL, Carc.				0.21			
TCLP		4000		120			
53-NW-O-S						0.061	
53-NW-O-S-QA			0.5			0.2	
53-NE-B1-S	0.031						
53-NE-C1-S	0.16		0.0094				
53-NE-D1-S	0.025						
53-NE-S-S	0.12						
53-NE-T-S				0.011			
53-NE-W-S				0.0054			
53-NE-X-S	0.066						
53-NE-Y-S				0.0069			
53-NE-Z-S	0.17			0.0086			

Notes:
(a) NW indicates northwest impoundment, NE indicates northeast impoundment, A through D1 indicate sample block locations shown in Figures 3-1 and 3-2, S indicates sludge sample, Q and QA indicate duplicate samples.

Data Flags:
B - Analyte was detected in analytical method blank.
J - Analyte was positively identified, but numerical value may not be representative of amount actually present.

TABLE 3-2. SEMIVOLATILE ORGANIC COMPOUNDS DETECTED IN SLUDGE SAMPLES

	Benzidine, mg/kg	Benzoic Acid, mg/kg	Benzyl Alcohol, mg/kg	Bis-2-ethylhexyl-phthalate, mg/kg	Di-n-butyl-phthalate, mg/kg	Fluoranthene, mg/kg	2-Methyl phenol, mg/kg	4-Methyl phenol, mg/kg	Pyrene, mg/kg
Subpart S, Sys					8000		4000	4000	
Subpart S, Carc.	3.0			50					
1992 Soil SAL, Sys.				1600	8000	3200	4000	4000	2400
1992 Soil SAL, Carc.				50					
TCLP									
Sample Location - See Note (a)									
1988 Samples									
NW LAGOON - 01									0.05 JB
NW LAGOON - 02			0.057 J				0.03 J	1.1	
NW LAGOON - 03						0.088 J			0.12 JB
NE LAGOON - 04		0.11 JB							
NE LAGOON - 05									
NE LAGOON - 06									
July 1991 Samples									
AB-53-NW-1S	3.9			1.2	1.4				
AB-53-NW-2S	1.9			1.1					
AB-53-NW-3S					1.4				
April 1992 Samples									
53-NW-A-S		4.4		6.3					
53-NW-B-S		4.2		4.3					
53-NW-C-S				1.8	1.3				
53-NW-D-S		5.2		2.7					
53-NW-E-S		4.6		5.5					
53-NW-F-S				2.1					
53-NW-H-S				2.1					
53-NW-I-S		3.8		22.7					
53-NW-J-S				13.3					
53-NW-K-S				2.9					

TABLE 3-2. SEMIVOLATILE ORGANIC COMPOUNDS DETECTED IN SLUDGE SAMPLES (Continued)

	Benzidine, mg/kg	Benzoic Acid, mg/kg	Benzyl Alcohol, mg/kg	Bis-2-ethylhexyl-phthalate, mg/kg	Di-n-butyl-phthalate, mg/kg	Fluoranthene, mg/kg	2-Methyl phenol, mg/kg	4-Methyl phenol, mg/kg	Pyrene, mg/kg
Subpart S, Sys					8000		4000	4000	
Subpart S, Carc.	3.0			50					
1992 Soil SAL, Sys.				1600	8000	3200	4000	4000	2400
1992 Soil SAL, Carc.				50					
TCLP									
53-NW-N-S		3.9		5.3					
53-NW-M-S				8.8					
53-NW-N-S-QA		2.7		6.6					
53-NW-O-S				1.3					
53-NW-O-S-QA				0.99					
53-NE-A1-S				1.1					
53-NE-B1-S				1.3	3.8				
53-NE-C1-S				2.6					
53-NE-D1-S					1.1				
53-NE-Q-S					4				
53-NE-Q-S-QA					1.5				
53-NE-R-S					0.98				
53-NE-S-S				2	1.9				
53-NE-T-S		2.5		3.4					
53-NE-U-S				2	5.3				
53-NE-V-S					2.6				

Notes:
(a) NW indicates northwest impoundment, NE indicates northeast impoundment, A through D1 indicate sample block locations shown in Figures 3-1 and 3-2, S indicates sludge sample, Q and QA indicate duplicate samples.
(b) Shaded values are above action levels.

Data Flags:
B - Analyte was detected in analytical method blank.
J - Analyte was positively identified, but numerical value may not be representative of amount actually present

TABLE 3-3. METALS DETECTED IN SLUDGE SAMPLES

	Ag, mg/kg	As, mg/kg	Ba, mg/kg	Be, mg/kg	Cd, mg/kg	Cr, mg/kg	Cu, mg/kg	Hg, mg/kg	Pb, mg/kg	Se, mg/kg	Zn, mg/kg
Subpart S, Sys	200		4000					20.0			
Subpart S, Carc.		80.0		0.2	40	400					
1992 SAL, Sys.	400	24.0	5600		80	400		24.0	500	400	
1992 SAL, Carc.		0.4									
TCLP	100	100	2000		20.0	100		4.0	100	20.0	
Sample Location - See Note (a)											
1988 Samples	Ag, mg/kg	As, mg/kg	Ba, mg/kg	Be, mg/kg	Cd, mg/kg	Cr, mg/kg	Cu, mg/kg	Hg, mg/kg	Pb, mg/kg	Se, mg/kg	Zn, mg/kg
NW LAGOON - 01			112 W				303	1.1			578
NW LAGOON - 02	4.9 W			0.59 W		12.8	119	0.5			166
NW LAGOON - 03	7.1 W			0.67 W		17.7	241	0.49			385
NE LAGOON - 04			41.2 W				78.2				118
NE LAGOON - 05			85 W	0.9 W		14	97.6				178
NE LAGOON - 06			102 W	0.9 W			122				244
July 1991 Samples	Ag, mg/L	As, mg/L	Ba, mg/L	Be, mg/L	Cd, mg/L	Cr, mg/L	Cu, mg/L	Hg, mg/L	Pb, mg/L	Se, mg/L	
53-NW-1S	0.018	0.02	0.5								
53-NW-2S		0.03	0.57								
53-NW-3S		0.03	0.56			0.01					
53-NW-4SQ		0.03	0.63							0.03	
53-NE-1S											
53-NE-2S	0.015										
53-NE-3S	0.011										
April 1992 Samples	Ag, mg/kg	As, mg/kg	Ba, mg/kg	Be, mg/kg	Cd, mg/kg	Cr, mg/kg	Cu, mg/kg	Hg, mg/kg	Pb, mg/kg	Se, mg/kg	Zn, mg/kg
53-NW-A-S	2.3	2.3	26.6			6.3		0.229	9.5		
53-NW-B-S	2.1	2.8	44.8			11.1		0.252	17.9		
53-NW-C-S		2.7	43.8			7.7		0.165	13.5		
53-NW-D-S		2.0	48.5			5.9		0.081	21.7		
53-NW-E-S	2.3	2.4	50.2			7.1		0.269	16.5		
53-NW-F-S		2.7	31.4			6.4		0.302	12.6		
53-NW-G-S		2.9	46.1			14.8		0.080	11.4		
53-NW-H-S		2.2	45.3			9.8		0.178	11.5		

TABLE 3-3. METALS DETECTED IN SLUDGE SAMPLES (Continued)

	Ag, mg/kg	As, mg/kg	Ba, mg/kg	Be, mg/kg	Cd, mg/kg	Cr, mg/kg	Cu, mg/kg	Hg, mg/kg	Pb, mg/kg	Se, mg/kg	Zn, mg/kg
Subpart S, Sys	200		4000					20.0			
Subpart S, Carc.		80.0		0.2	40	400					
1992 SAL, Sys.	400	24.0	5600		80	400		24.0	500	400	
1992 SAL, Carc.		0.4									
TCLP	100	100	2000		20.0	100		4.0	100	20.0	
53-NW-I-S	3.2	3.6	28.2		1.9	8.4		0.388	26.8		
53-NW-J-S	3.8	2.8	29.4		3.1	16.4		0.407	44.8		
53-NW-K-S		2.7	36.0		2.8	11.3		0.480	27.3	2.1	
53-NW-L-S		2.3	43.3			8.7		0.096	20.2	2.0	
53-NW-N-S	2.0	2.6	26.0			7.3		0.240	14.1		
53-NW-M-S	5.1	2.5	33.5			7.4		0.340	14.4		
53-NW-N-S-QA	1.5	3.0	33.2			7.6		0.159	13.3		
53-NW-O-S		2.3	28.5			6.9		0.108	13.5		
53-NW-O-S-QA		2.3	44.2			6.5		0.098	15.2	5.9	
53-NE-A1-S		2.2	28.9			7.0		0.057	6.1		
53-NE-B1-S		2.8	38.9			6.0		0.039	6.2	5.8	
53-NE-C1-S	2.5	2.4	15.3			3.6		0.101	5.3	2.6	
53-NE-D1-S		3.0	41.4			6.1		0.043	6.9	3.6	
53-NE-E1-S		2.8	34.9			5.6		0.046	5.1	4.5	
53-NE-Q-S		1.8	21.7			3.5		0.035	3.7	3.2	
53-NE-Q-S-QA		2.1	22.7			5.3		0.042	4.1	1.6	
53-NE-R-S		3.3	38.3			7.9		0.034	5.6	2.5	
53-NE-S-S		4.3	52.4			9.4		0.036	10.3	2.6	
53-NE-T-S	2.8	2.8	9.3			3.0		0.089	4.4	6.8	
53-NE-U-S		2.5	24.4			6.1		0.043	6.2	5.3	
53-NE-V-S		3.6	39.6			8.3		0.029	5.7		
53-NE-W-S		3.4	35.1			7.7		0.030	4.9		
53-NE-W-S-QA		4.8	33.8			11.3		0.050	6.8		

TABLE 3-3. METALS DETECTED IN SLUDGE SAMPLES (Continued)

	Ag, mg/kg	As, mg/kg	Ba, mg/kg	Be, mg/kg	Cd, mg/kg	Cr, mg/kg	Cu, mg/kg	Hg, mg/kg	Pb, mg/kg	Se, mg/kg	Zn, mg/kg
Subpart S, Sys	200		4000					20.0			
Subpart S, Carc.		80.0		0.2	40	400					
1992 SAL, Sys.	400	24.0	5600		80	400		24.0	500	400	
1992 SAL, Carc.		0.4									
TCLP	100	100	2000		20.0	100		4.0	100	20.0	
53-NE-X-S		3.9	36.0			7.7		0.019	5.4		
53-NE-Y-S		2.8	13.2			5.4		0.114	4.4		
53-NE-Z-S	2.6	2.5	22.6			6.4		0.429	4.4		

Data Flags:
W - Analyte was present above the instrument detection limit but below the contract-required detection limit.

Notes:
(a) NW indicates northwest impoundment, NE indicates northeast impoundment, A through E1 indicate sample block locations shown in Figures 3-1 and 3-2, S indicates sludge sample, Q and QA indicate duplicate samples.
(b) Shaded values are above action levels.

(TCLP) screening levels[1]. All organic results were below all screening levels. Several metals were also detected. With the exception of beryllium, all results were below proposed RCRA Subpart S action levels for soil, 1992 IWP SALs for soil, and TCLP screening levels. Four of the six beryllium results were above the proposed RCRA Subpart S action level for soil.

The proposed RCRA Subpart S and IWP screening action levels for soil are very conservative indicators of levels of contamination that could pose a health risk through ingestion. Under both the proposed RCRA Subpart S corrective action regulations and the Los Alamos National Laboratory (Laboratory) Environmental Restoration (ER) program, constituents at concentrations below action levels do not present a human health risk. Constituants at concentrations above action levels do not necessarily pose a risk, but may require a more thorough evaluation to characterize risks.

The sludge and water in the impoundments were sampled by the Laboratory Environmental Protection Group (EM-8) in July 1991. Samples of sludge and water were collected from three locations at each impoundment. Water samples were grab samples collected at the mid-depth of the water column. Sludge samples were grab samples collected using a pole-mounted stainless steel beaker. These samples were analyzed for volatile and semivolatile organics and TCLP metals. All water samples were also analyzed for gross alpha and beta radioactivity. In addition, one water sample from each impoundment was analyzed for tritium and gamma-emitting radionuclides, and one sludge sample from each impoundment was analyzed for gamma-emitting radionuclides. Results for volatiles, semivolatiles, and metals above detection limits in sludge samples are presented in Tables 3-1 through 3-3, respectively. Detection limits for volatiles, semivolatiles, and metals below detection are presented in Appendices C, D, and E, respectively.

The volatiles analysis showed only toluene to be present above detection limits. Three semivolatile compounds, benzidine, di-n-butylphthalate, and bis-2-ethylhexylphthalate, were detected in sludge samples. With the exception of one result, organics were all well below

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[1] The TCLP screening level is the minimum possible total concentration that could cause a solid waste to fail the TCLP and be designated as a hazardous waste. If a constituent is present below this level, the waste could not fail the TCLP because all of the constituent was extracted. The screening level (mg/kg) is numerically equal to 20 times the TCLP regulatory limit (mg/L).

proposed RCRA Subpart S action levels and 1992 IWP SALs. Benzidine was detected in one sample slightly above the proposed RCRA Subpart S action level. All metals above detection were below proposed RCRA Subpart S action levels, 1992 IWP SALs, and TCLP screening levels.

No volatile organics were detected in any of the water samples. The only semivolatile organic detected was benzoic acid, which was detected in one sample at 15 ug/L. Detection limits for volatile and semivolatile organics below detection are presented in Appendices C and D, respectively. Results of analysis of water samples for metals are presented in Table 3-4. Detection limits for metals in water are presented in Appendix E. All metals results were below proposed RCRA Subpart S action levels, 1992 IWP SALs, TCLP regulatory levels, Safe Drinking Water Act maximum contaminant levels (MCLs), and New Mexico water quality standards.

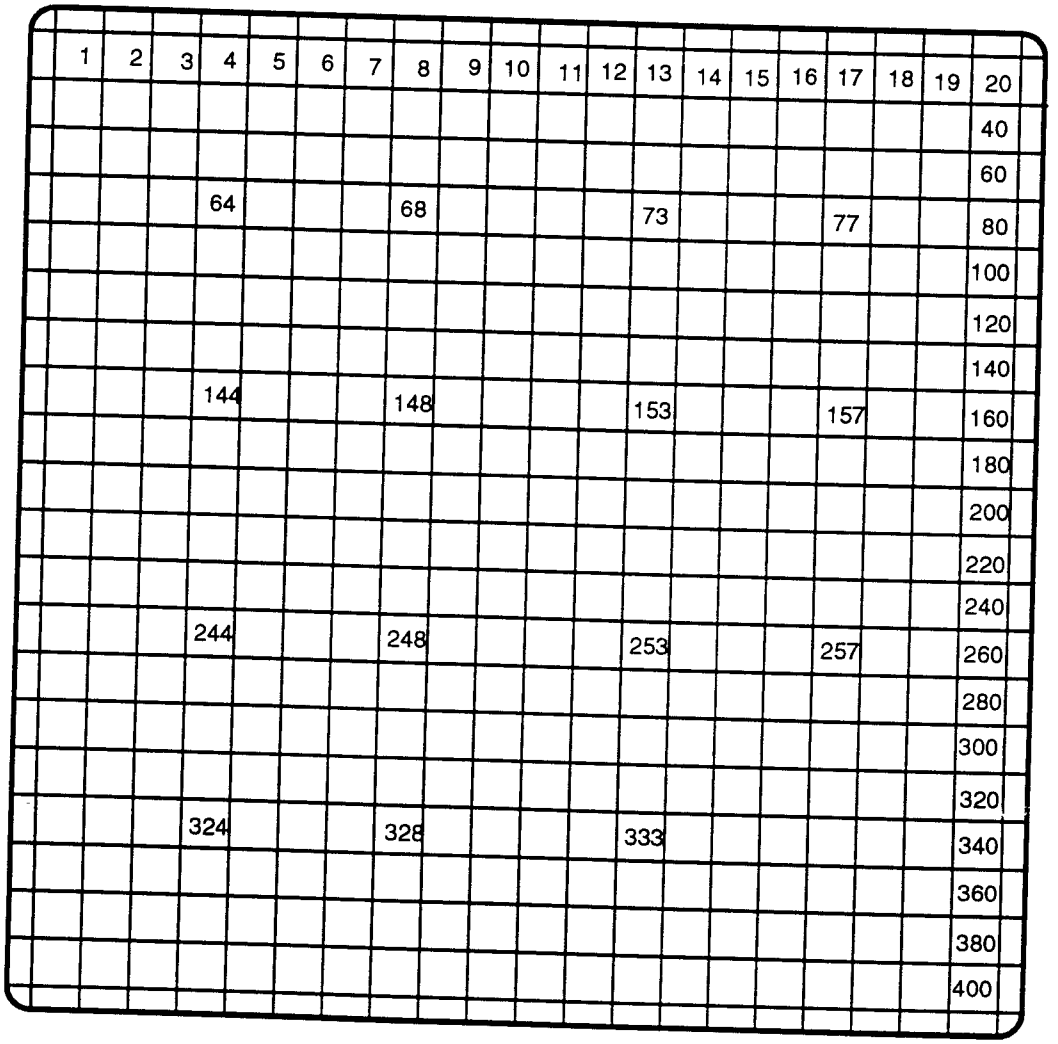
A third and more comprehensive round of sampling was performed by EM-8 in April 1992. Sludge samples were collected from fifteen locations in each impoundment. Sample locations were defined using a uniform grid, as shown in Figures 3-1 and 3-2 for the northwest (NW) and northeast (NE) impoundments, respectively. Grab samples of sludge were collected using a pole-mounted stainless steel beaker. All sludge samples were analyzed for volatile and semivolatile organics, TCLP metals, and polychlorinated biphenyls (PCBs). A sludge sample from each impoundment was also analyzed for organochlorine pesticides [Environmental Protection Agency (EPA) Method 8080], chlorinated herbicides (EPA Method 8150), pH, flashpoint, sulfide, and cyanide.

Results for volatiles, semivolatiles, metals, and PCBs above detection limits in sludge samples are presented in Tables 3-1, through 3-3, and Table 3-5, respectively. Detection limits for volatile and semivolatile organics and metals are presented in Appendices F, G, and H, respectively. Volatile and semivolatile organic results were similar to those from the July 1991 sampling, although more compounds were detected. The volatiles analysis showed acetone to be present above detection limits in eleven samples, 2-butanone in one sample, carbon disulfide in six samples, chloroform in four samples, 4-isopropyl toluene in one sample, toluene in six samples, and 1,2,4-trimethylbenzene in one sample. Semivolatiles analysis showed benzoic acid to be present above detection limits in eight samples, bis-2-ethylhexylphthalate in twenty-one samples, and di-n-butylphthalate in nine samples.

TABLE 3-4. METALS DETECTED IN WATER SAMPLES

	Ag, ug/L	As, ug/L	Ba, ug/L	Cd, ug/L	Cr, ug/L	Hg, ug/L	Pb, ug/L	Se, ug/L
Subpart S, Sys	50		1000.0			2		10
Subpart S, Carc.		50		10	50		50	
1992 SAL, Sys.	170	11	2400	35	170	11		170
1992 SAL, Carc.		0.02						
TCLP Reg. Level	5000	5000	100000	1000	5000	200	5000	1000
MCL	50	50	2000	5	100	2	50	50
NM Standard	50	100	1000	10	50	2	50	50
Sample Location - See Note (a)								
July 1991 Samples								
AB-53-NW-1W	23		60					
AB-53-NW-2W			70					
AB-53-NW-3W			70					
AB-53-NE-1W			80					
AB-53-NE-2W			80					
AB-53-NE-3W			80					
April 1992 Samples								
53-NW-O-W		6.8	27.9	4.5	5.8		2.4	4.5
53-NW-O-W-QA		6.3	33.4	4.4	5.7		3.1	3.4
53-NE-Y-W		4.6	28.3	2.8	2.9			1.3
53-NE-Y-W-QA		4.8	28.5	2.5	2.4			

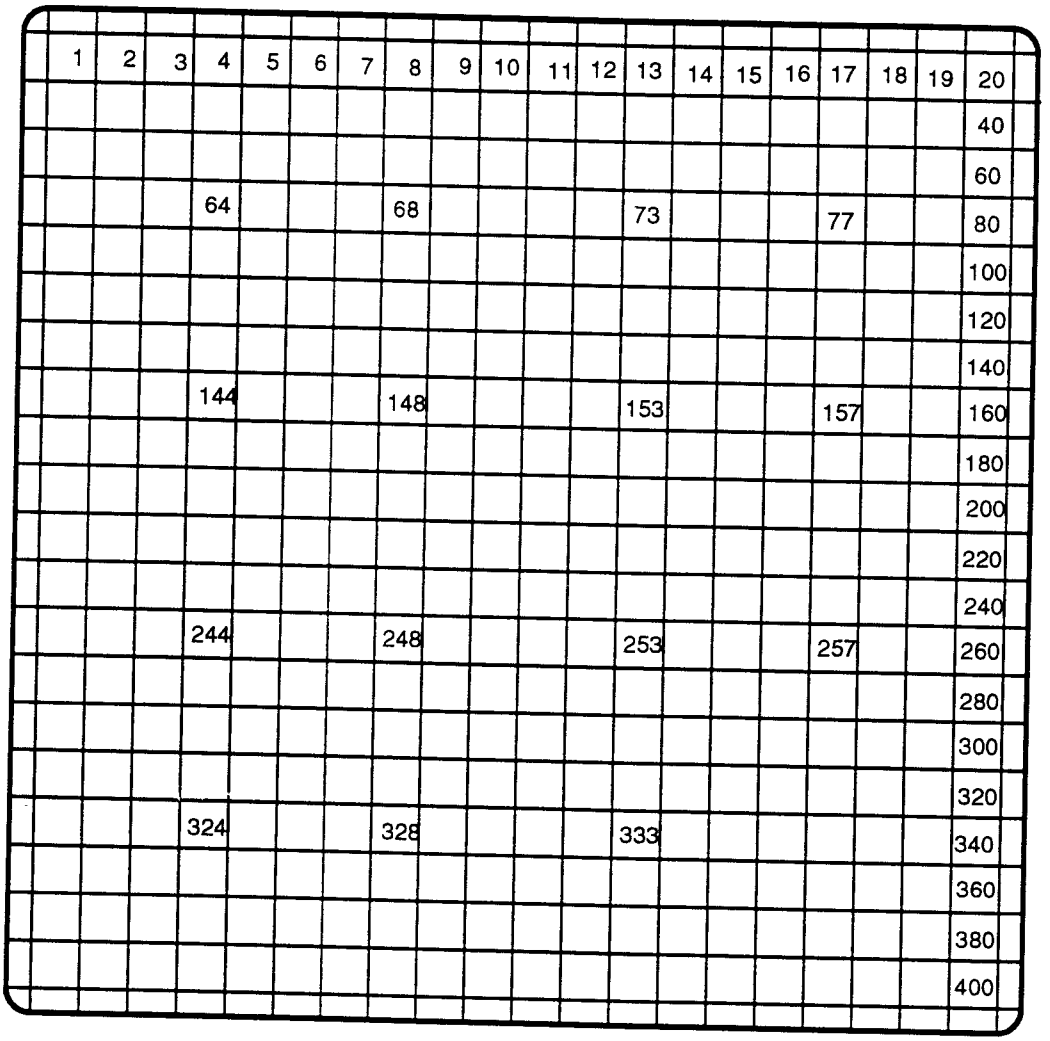
Notes:
(a) NW indicates northwest impoundment, NE indicates northeast impoundment, O AND Y indicate sample block locations shown in Figures 3-1 and 3-2, W indicates water sample, Q and QA indicate duplicate samples.



BLOCK	SAMPLE
64	A
68	B
73	C
77	D
144	E
148	F
153	G
157	H
244	I
248	J
253	K
257	L
324	M
328	N
333	O

N

FIGURE 3-1. LOCATIONS OF SLUDGE SAMPLES IN NORTHWEST IMPOUNDMENT, APRIL 1992



BLOCK	SAMPLE
64	Q
68	R
73	S
77	T
144	U
148	V
153	W
157	X
244	Y
248	Z
253	A1
257	B1
324	C1
328	D1
333	E1

N

FIGURE 3-2. LOCATIONS OF SLUDGE SAMPLES IN NORTHEAST IMPOUNDMENT, APRIL 1992

TABLE 3-5. PCBS DETECTED IN SLUDGE SAMPLES

	Mixed Aroclor, mg/kg	Aroclor 1242, mg/kg	Aroclor 1254, mg/kg
Subpart S, Sys			
Subpart S, Carc.	0.09		
40 CFR 761	10		
Sample Location - See Note (a)			
April 1992 Samples			
53-NE-C1-S	0.57	0.31	0.26
53-NE-Y-S	0.33	0.17	0.16
53-NE-Z-S	0.27	0.14	0.13

Notes:
(a) NE indicates northeast impoundment; C, Y, and Z indicate sample block locations shown in Figure 3-2, S indicates sludge sample.
(b) Shaded values are above action levels.

These organics were all well below proposed RCRA Subpart S action levels for soil, 1992 IWP SALs for soil, and TCLP screening levels. All metals above detection were below proposed RCRA Subpart S action levels for soils, 1992 IWP SALs for soils, and TCLP screening levels[2]. PCBs were detected in three sludge samples. The detection limit for PCB in sludge was 0.06 mg/kg. The total levels of PCB were above the proposed RCRA Subpart S action level based on carcinogenicity, but were below the EPA soil cleanup level of 10 mg/kg for unrestricted access areas [40 CFR 761.125(c)(4)(v)]. Several pesticides were present above detection limits. These results are presented in Table 3-6. No herbicides were present above detection limits. All pesticides were present below proposed RCRA Subpart S action levels and TCLP screening levels.

Water samples were also collected from one location in each impoundment. Samples were collected from the mid-depth of the water column using a discrete interval sampler. Water samples were analyzed for TCLP metals; volatile and semivolatile organics; PCBs; gross alpha, beta, and gamma radioactivity; and tritium.

Metal results above detection limits for water samples are presented in Table 3-4. Detection limits for water samples are presented in Appendix H. All results are below proposed RCRA Subpart S action levels, 1992 IWP SALs[3], TCLP regulatory levels, MCLs, and New Mexico water quality standards. The only volatile organic detected was acetone, which was detected at 48 ug/L in the sample from the NE impoundment. Acetone was not detected in a duplicate sample from this location. This concentration is below the proposed RCRA Subpart S action level (4000 ug/L) and the 1992 IWP SAL (3500 ug/L). No semivolatile organics or PCBs were detected in water samples. Detection limits for volatile and semivolatile organics are presented in Appendices F and G, respectively.

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[2] Arsenic concentrations were below the SAL based on systemic toxicity in all cases, but above the SAL based on carcinogenicity by approximately an order of magnitude. The carcinogenic SAL for arsenic is below the background concentration of arsenic in soils.

[3] Arsenic concentrations were below the SAL based on systemic toxicity in all cases, but above the SAL based on carcinogenicity by approximately two orders of magnitude.

TABLE 3-6. RESULTS OF PESTICIDE AND HERBICIDE ANALYSIS OF SLUDGE SAMPLES

Chemical	Subpart S Action Level, Sys., ug/kg	Subpart S Action Level Carc., ug/kg	TCLP, ug/kg	Sample PF-NE-IT-1S, ug/kg	Sample PF-NW-IT-1S, ug/kg
April 1992 Samples					
Aldrin		40		< 2.3	< 12
alpha-BHC				< 1.7	< 9.4
beta-BHC				< 3.4	< 19
delta-BHC				< 5.1	< 28
Chlordane		500	600	< 8.0	< 44
p-p'-DDD		3000		11	< 34
p-p'-DDE		2000		57	17
p-p'-DDT		2000		16	< 37
Dieldrin		40		9.7	< 6.2
Endosulfan I	4000			< 8.0	< 44
Endosulfan II	4000			154	53
Endosulfan sulfate				< 38	< 200
Endrin	20000		400	< 3.4	< 19
Endrin aldehyde				< 13	< 72
Heptachlor		200	160	6.6	< 9.4
Heptachlor epoxide		80	160	< 47	< 260
Lindane		500	8000	< 2.3	< 12
Methoxychlor			200000	< 100	< 550
Toxaphene		600	10000	< 140	< 750
2,4-D	800000		200000	< 41	< 45
2,4,5-T				< 6.9	< 7.5
2,4,5-TP	800000		20000	< 5.9	< 6.4

3.1.2 Comparison of Results to Hazardous Waste Characteristics and Hazardous Waste Lists

The sampling results described above were evaluated, along with process knowledge of the wastes, to determine whether the water and sludge in the impoundments are mixed wastes as defined in the New Mexico Hazardous Waste Management Regulations-6 (HWMR-6), Part 261. The water and sludge were evaluated with respect to the hazardous waste characteristics given in HWMR-6, Sections 261.20 through 261.24 and the hazardous waste lists given in HWMR-6, Sections 261.30 through 261.33. The results of this evaluation are presented below.

3.1.2.1 Ignitability (HWMR-6, Section 261.21)

Water samples were not specifically tested to determine whether they met the characteristics for ignitable wastes (i.e., flash point less than 60°C). Because the liquid in the impoundments consists of water with trace amounts of organics, it is concluded that these wastes can be characterized as nonignitable without the need for testing.

Sludge samples were tested for flashpoint using a modified laboratory procedure. The procedure did not directly measure the flashpoint, but showed that vapors from the samples extinguished flame at temperatures ranging from 37.5°C to 43.5°C. It is noted that the definition of ignitable waste under HWMR-6, Section 261.21 does not specify flashpoint limits for nonliquid wastes. In addition, the sludge samples did not appear to meet any of the criteria for nonliquid ignitable wastes given in HWMR-6, Section 261.21(a)(2). For these reasons, it is concluded that the impoundment sludge is not an ignitable mixed waste.

3.1.2.2 Corrosivity (HWMR-6, Section 261.22)

Water and sludge samples collected from the surface impoundments were analyzed for pH to determine whether pH exceeded the limits for defining corrosive wastes. The pH values measured were not within the ranges for defining corrosive wastes (i.e., less than 2.0 or greater than 12.5). Based on these past results, it is concluded that the water and sludge in the impoundments are not corrosive mixed wastes.

3.1.2.3 Reactivity (HWMR-6, Section 261.23)

Evaluation of the water and sludge in the impoundments with respect to reactive waste properties given in HWMR-6, Sections 261.23(a)(1) through (a)(4) and 261.23(a)(6) through (a)(8) can be made on the basis of process knowledge. That is, the wastes are not unstable, explosive, or water reactive. To aid in evaluating wastes with respect to HWMR-6, Section 261.23(a)(5) (i.e., are they capable of generating toxic sulfide or cyanide fumes?), sludge samples were analyzed for sulfide and cyanide. Because cyanide was below detection limits (0.78 to 0.87 mg/kg), it is concluded that the wastes would not be reactive on the basis of generating hydrogen cyanide. Samples of sludge from the NW and NE impoundments contained sulfide at concentrations of 112 and 38.2 mg/kg, respectively. It is not known whether these concentrations of sulfide could cause generation of toxic gases in a quantity sufficient to present a danger to human health or the environment. Because these results are inconclusive, additional testing will be performed during closure to determine if the sludge is reactive on the basis of sulfide content.

3.1.2.4 Toxicity (HWMR-6, Section 261.24)

Water and sludge samples were not extracted using the TCLP procedure, but samples were analyzed for total concentrations of the toxic constituents contained in HWMR-6, Section 261.24. To determine whether water or sludge exhibits the toxicity characteristic, results of water and sludge analyses were compared with the TCLP regulatory levels contained in HWMR-6, Section 261.24. Maximum concentrations in water were compared directly with the regulatory levels. Maximum concentrations in sludge were compared with 20 times the regulatory level to account for the dilution that occurs during the TCLP extraction procedure. These comparisons are presented in Table 3-7 and show that all analytical results are below respective regulatory levels. On the basis of these results, it is concluded that the water and sludge are not toxic mixed wastes.

3.1.2.5 Listed Waste from Nonspecific Sources (HWMR-6, Section 261.31)

It is not certain whether the impoundments have ever received discharges of wastes listed under HWMR-6, Section 261.31. The possibility for such disposal exists because facilities that generate such wastes have or had discharge drains to the impoundments. Past analysis of

TABLE 3-7. MAXIMUM CONCENTRATIONS AND TCLP REGULATORY LEVELS

Constituent	Regulatory Level for Water, ug/L	Maximum Concentration in Water, ug/L	Minimum Regulatory Level for Sludge, mg/kg	Maximum Concentration in Sludge, mg/kg
Arsenic	5000	6.8	100	4.8
Barium	100000	80	2000	112
Benzene	500	<5.0	10	<0.023
Cadmium	1000	4.5	20	3.1
Carbon Tetrachloride	500	<5.0	10	<0.023
Chlordane	30	See Note (1)	0.6	<0.044
Chlorobenzene	100000	<5.0	2000	<0.023
Chloroform	6000	<5.0	120	0.011
Chromium	5000	5.8	100	17.7
o-Cresol	200000	<24	4000	<2.0
m-Cresol	200000	See Note (2)	4000	See Note (2)
p-Cresol	200000	<24	4000	<2.0
Cresol	200000	See Note (2)	4000	See Note (2)
2,4-D	10000	See Note (1)	200	<0.045
1,4-Dichlorobenzene	7500	<24	150	<2.0
1,2-Dichloroethane	500	<5.0	10	<0.023
1,1-Dichloroethylene	700	<5.0	14	<0.023
2,4-Dinitrotoluene	130	<24	2.6	<2.0
Endrin	20	See Note (1)	0.4	<0.019
epoxide	8	See Note (1)	0.16	<0.27
Hexachlorobenzene	130	<24	2.6	<2.0
Hexachlorobutadiene	500	<24	10	<2.0
Hexachloroethane	3000	<24	60	<2.0
Lead	5000	3.1	100	44.8
Lindane	400	See Note (1)	8	<0.012
Mercury	200	<0.2	4	1.1
Methoxychlor	10000	See Note (1)	200	<0.55
Methyl ethyl ketone	200000	<20	4000	0.034
Nitrobenzene	2000	<24	40	<2.0
Pentachlorophenol	100000	<24	2000	<2.0
Pyridine	5000	See Note (2)	100	See Note (2)
Selenium	1000	4.5	20	6.8
Silver	5000	23	100	7.1
Tetrachloroethylene	700	<5.0	14	<0.023
Toxaphene	500	See Note (1)	10	<0.75
Trichloroethylene	500	<5.0	10	<0.023
2,4,5-Trichlorophenol	400000	<24	8000	<2.0
2,4,6-Trichlorophenol	2000	<24	40	<2.0
2,4,5-TP	1000	See Note (1)	20	<0.0064
Vinyl chloride	200	<10	4	<0.046

Notes:
(1) - Water samples were not analyzed for organochlorine pesticides or herbicides.
(2) - Analysis performed did not include this compound as an analyte.

the water and sludge has detected chemicals that are constituents of listed waste streams. These chemicals and their associated waste codes include acetone (F003), 2-butanone (F005), carbon disulfide (F005), and toluene (F005). There are, however, no documented discharges of listed wastes to the impoundments.

The definition of F003 and F005 spent solvent wastes requires that the solvent contain, before use, at least 10% of one or more of the listed solvents. Without knowledge of the source of the constituents identified above, it is impossible to determine whether this condition was met.

If listed mixed wastes had been discharged to the impoundments, the water and sludge in the impoundments could be listed wastes because of the "mixture rule" [HWMR-6, Section 261.3(a)(2)(iii)]. However, mixtures of listed waste and solid waste are not hazardous if the waste was listed because of a characteristic and the mixture no longer exhibits that characteristic [HWMR-6, Section 261.3(a)(2)(iii)]. This definition would apply to spent acetone (F003), which is listed because it is ignitable. As explained in Section 3.1.2.1, the water and sludge are not ignitable; therefore, the water and sludge would not be listed wastes even if F003 acetone wastes had been discharged to the impoundments.

Under HWMR-6, Section 261.3(a)(2)(iv)(B), wastewaters containing 2-butanone, carbon disulfide, and toluene would not be listed as hazardous wastes if the wastewater discharge was regulated under the Clean Water Act and the maximum total weekly usage divided by the average weekly wastewater flow did not exceed 25 mg/L. If listed wastes containing 2-butanone, carbon disulfide, or toluene had been discharged to the impoundments, this exemption would likely have applied to these wastes.

It is concluded that the water and sludge in the impoundments are not listed waste under HWMR-6, Section 261.31. This conclusion is based on the following:

- There is no documented evidence of disposal of listed spent solvent wastes to the impoundments.

- The water and sludge in the impoundments do not display the hazardous waste characteristic for which F003 acetone wastes were listed (i.e., ignitability).

- Wastewater discharged to the impoundments that contained 2-butanone, carbon disulfide, and toluene may not have been mixed waste as defined under HWMR-6, Section 261.3(a)(2)(iv)(B).

3.1.2.6 Listed Waste from Specific Sources (HWMR-6, Section 261.32)

Activities conducted at TA-53 have not generated any of the wastes listed under HWMR-6, Section 261.32. None of the Laboratory facilities that generate mixed waste listed under HWMR-6, Section 261.32 have sent wastes to TA-53 for discharge to the impoundments. As a result, wastes listed under HWMR-6, Section 261.32 have not been discharged to the impoundments, and water and sludge are not mixed wastes under HWMR-6, Section 261.32.

3.1.2.7 Discarded Chemical Products (HWMR-6, Section 261.33)

It is not known whether the impoundments have received discharges of any wastes that are defined as listed wastes under HWMR-6, Section 261.33. Chemical products listed under HWMR-6, Section 261.33 are used at TA-53, including in facilities that discharge to the impoundments. There is, however, no documentation of discharges of discarded chemical products, off-specification species, container residues, or spill residues to the impoundments.

Past analysis of waste and sludge has included constituents that are listed under HWMR-6, Section 261.33. Constituents for which analysis has been performed, their associated waste codes, and their maximum concentrations or detection limits are summarized in Appendix I. Constituents that were present above detection limits are identified in Table 3-8. Given the absence of documentation concerning the sources of these constituents, it is not possible to determine whether the water or sludge would be listed wastes on the basis of the "mixture rule" [HWMR-6, Section 261.3(a)(2)(iii)]. Because the concentrations of TCLP constituents in the impoundment water and sludge are below RCRA characteristic levels and the water and sludge are not otherwise hazardous, they will not be considered listed mixed wastes under HWMR-6, Section 261.33.

TABLE 3-8. LISTED WASTE CONSTITUENTS DETECTED IN SLUDGE AND WATER

Constituent	Hazardous Waste Code Under HWMR-6, Section 261.31	Hazardous Waste Code Under HWMR-6, Section 261.33	Maximum Concentration in Sludge, mg/kg	Maximum Concentration in Water, ug/L
Acetone	F003	U002	4.9	48
m-Benzidene		P015	~~0.9~~ 3.9	
Beryllium		U021	~~3.9~~ 0.9	
2-Butanone	F005	U159	0.034	
Carbon Disulfide	F005	P022	0.5	
Chloroform		U044	0.011	
DDD		U060	0.011	
DDT		U061	0.016	
Di-n-butylphthalate		U069	5.3	
Dieldrin		P037	0.0097	
Endosulfan		P050	0.154	
Fluoranthene		U120	0.088	
Heptachlor		P059	0.0066	
Mercury		U151	1.1	
2-Methylphenol		U052	0.03	
4-Methylphenol		U052	1.1	
Toluene	F005	U220	3.6	

3.2 Sampling and Analysis Strategy

This section describes the strategy for the sampling and analysis activities to be implemented before and during closure. These activities will include sampling the water and sludge in the impoundments, the bentonite liner material, the soil/tuff beneath impoundment liners, and any wastes generated as part of closure.

Sampling and analysis are designed to support implementation of the closure strategy described in Chapter 5.0. Based on the results of previous sampling of water and sludge, it is expected that the requirements for clean closure under RCRA can be met without the need to remove sludge from the impoundments. Water and sludge will be sampled to confirm the results of previous sampling, to assure that contamination levels have not increased since the last sampling, and to confirm that the water and sludge are not mixed wastes.

The results of the chemical characterization of the sludge will be used to determine whether the closure performance standard specified in Section 5.1.1 will be met. The results of radiological characterization of the sludge will be used to support decisions under the Environmental Restoration Program for final disposition of the impoundments after RCRA closure is complete.

Soil sampling will be performed to determine whether there have been any releases from the impoundments that have resulted in contamination with hazardous constituents above health-based cleanup levels. Soil samples will be collected in and below the impoundment liners to determine if releases have occurred by infiltration through or around the liners.

Waste sampling and analysis will be performed to determine the regulatory status of wastes and to identify appropriate methods of disposal.

Sludge and water samples will be collected after the closure plan has been approved and sufficient water has evaporated from the impoundments to facilitate sampling. Sludge sampling will be performed as early in the closure process as possible so that data will be available to guide subsequent decisions concerning management of the sludge and impoundments. For example, sludge characterization data are needed before a decision can be made as to whether the sludge must be maintained wet or can be allowed to dry. Early

characterization data are also needed so that the closure plan can be amended if the data do not confirm previous levels of contamination. Liner and soil/tuff samples will be collected after the water has been allowed to evaporate from the impoundments.

Sludge samples within the impoundments will be collected using the same grid system as the April 1992 sampling. This grid system was recommended by the NMED in its response to the proposed sampling plan. Each surface impoundment will be subdivided into a grid of (approximately) 10-ft by 10-ft blocks, totalling 400 blocks. The blocks in each surface impoundment will be uniquely numbered and 16 blocks will be selected, each one equidistant from impoundment walls and from each other. An additional sample location will be established within 3 ft of the impoundment influent. Figures 3-3 and 3-4 are example schematics.

At the first block sampled in each impoundment, a water sample and duplicate will be collected. Grab samples of water will be collected instead of discrete interval samples because of the shallow depth of water. The water will be allowed to evaporate to a depth of approximately 1 ft before sampling. The water samples will be analyzed for metals, volatile and semivolatile organic compounds, PCBs and organochlorine pesticides, chlorinated herbicides, gross alpha and beta radioactivity, and tritium.

Sludge samples will be collected within each of the selected blocks, as near to the center of the block as can be achieved. The approximate depth of the sludge will be recorded at each sampling location. If the amount of sludge at a selected block is insufficient for the collection of an adequate sample volume, the absence of sufficient volume will be recorded in the field log book, and sampling will proceed to the next location. Sludge samples will be analyzed for metals, volatile and semivolatile organics, PCBs and organochlorine pesticides, chlorinated herbicides, reactive sulfide, gross alpha and beta radioactivity, tritium, and gamma-emitting radionuclides. Sludge samples will consist of grab samples collected at the bottom of the sludge profile, immediately above the bentonite liner. The bottom of the sludge profile will be sampled because it is expected to have the highest concentrations of potential contaminants of concern. The bottom of the profile would be the most likely location to detect dense immiscible organics (light immiscible organics are expected to have volatilized or been discharged). The sludge at the bottom of the profile would also be most representative of

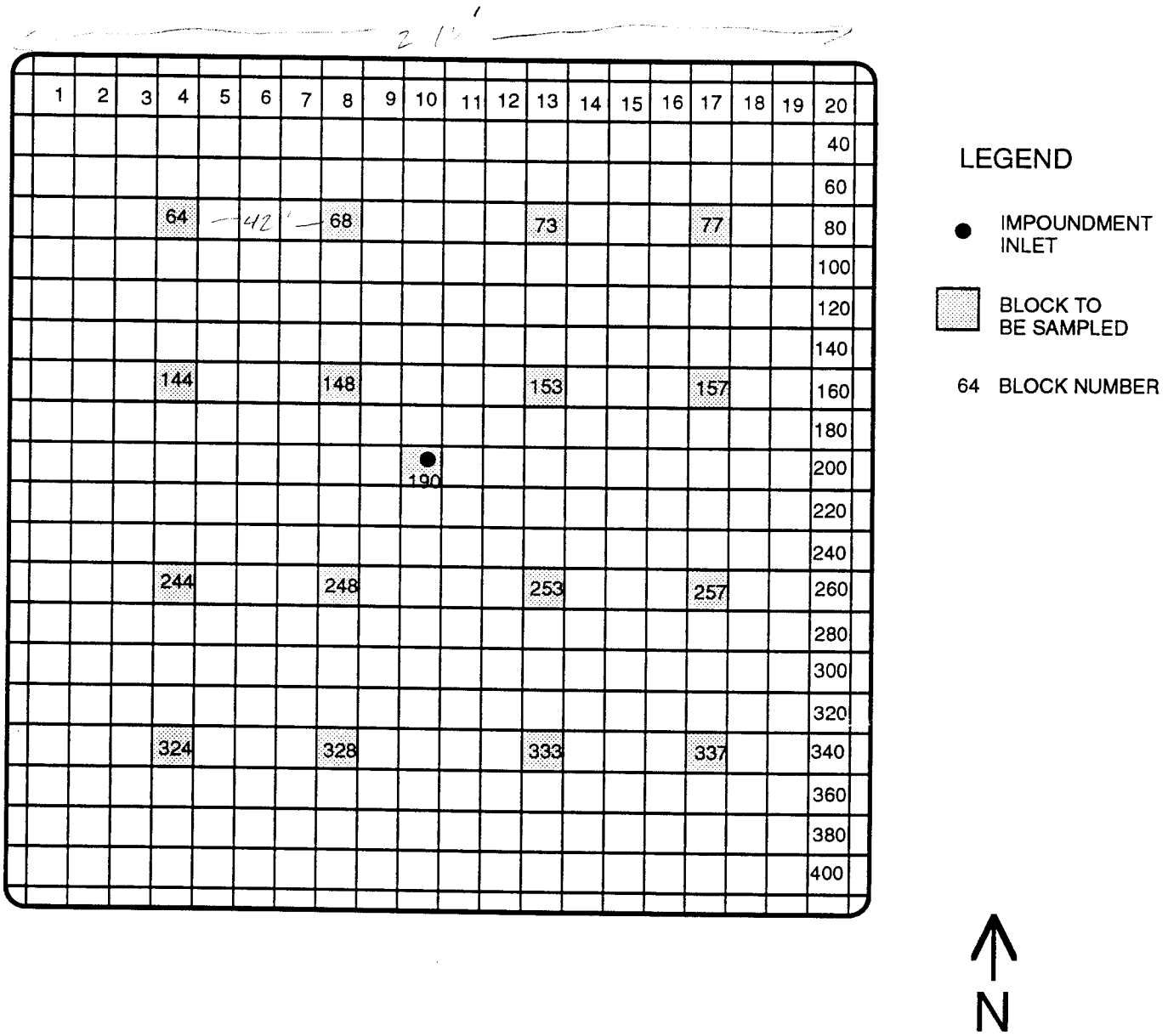

FIGURE 3-3. LOCATIONS OF SLUDGE, LINER, AND SOIL/TUFF SAMPLES INSIDE NORTHWEST IMPOUNDMENT

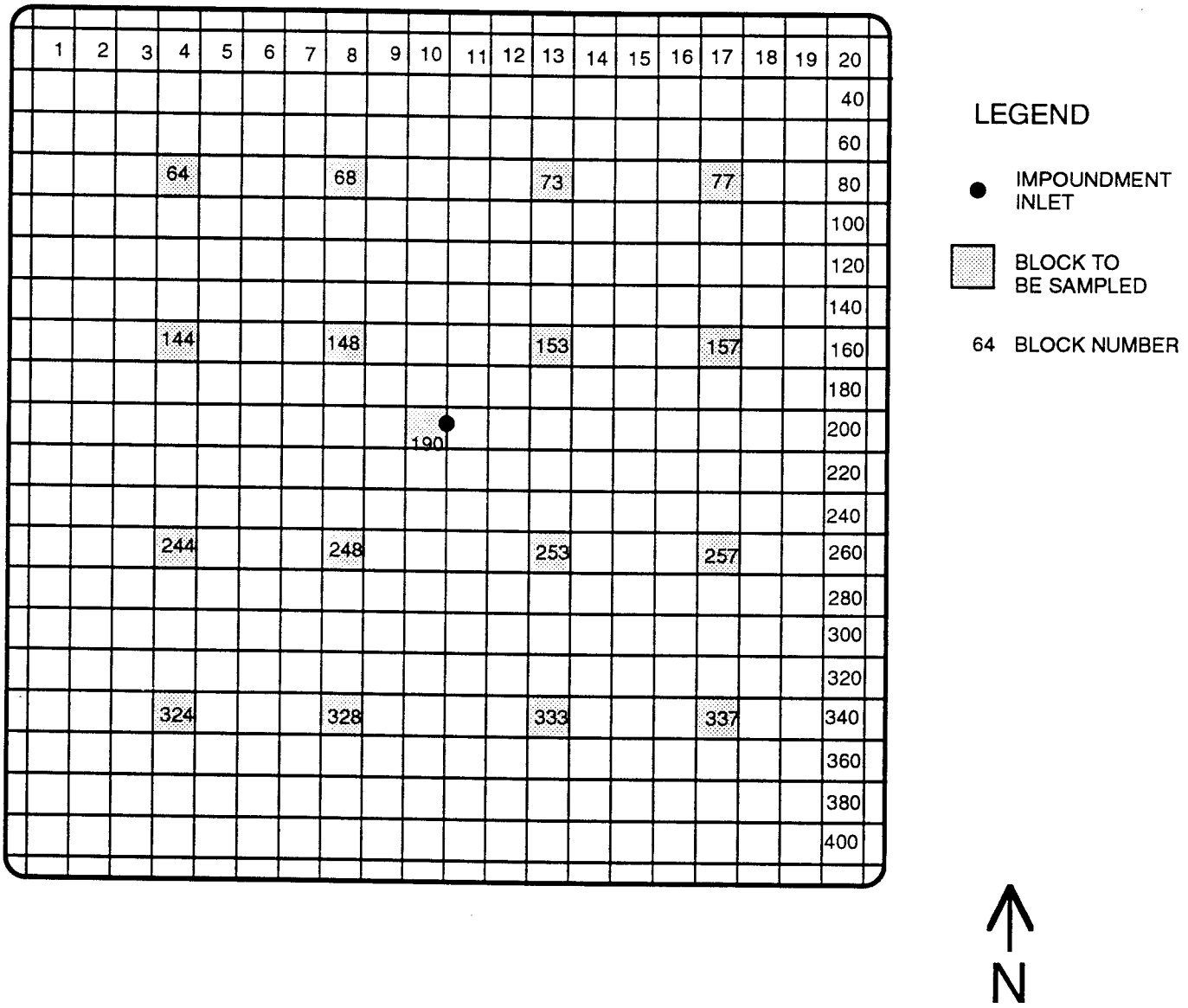

FIGURE 3-4. LOCATIONS OF SLUDGE, LINER, AND SOIL/TUFF SAMPLES INSIDE NORTHEAST IMPOUNDMENT

wastes discharged early in the operating history of the impoundments when administrative controls governing discharge of mixed wastes were not as strict as they are presently.

The bentonite impoundment liners and the soil or tuff beneath the liners will be collected at the same location as the sludge samples. Samples will be collected from the bentonite liner material and from the depth interval 0 to 6 in. below the liner. These samples will be representative of the top of the liner and soil profiles where the highest concentration of contaminants are expected to occur. All bentonite liner, soil, and tuff samples will undergo the same analyses as sludge samples, except for reactive sulfide. Only sludge is expected to have high concentrations of sulfide because of anaerobic biological activity.

Soil samples will also be collected beneath the gunite liners. Eight samples will be collected from beneath the sidewall liner in each impoundment. Samples will be located where there is any visual evidence of leakage, such as cracking. If there is no evidence of leakage, the samples will be collected at the corners of the impoundment and the middle of the sidewalls. The corners will be sampled because they are expected to be the most likely location for cracking and leakage. The midpoints will be sampled because they are equidistant from the corners. These samples will be collected as close to the bentonite/gunite interface as possible in order to detect leakage under the gunite. The depth interval 0 to 6 in. below the liners will be sampled. This interval is representative of the top of the soil profile where the highest concentrations of contaminants are expected to occur.

The analyses to be performed on sludge, bentonite, and soil/tuff samples will provide the necessary data to determine whether it is necessary to remove any sludge, bentonite, or soil/tuff to meet closure requirements. These analyses will also provide data needed to determine whether TCLP regulatory levels could be exceeded. If it is determined that removal is necessary and TCLP regulatory levels could be exceeded, samples of the materials to be removed will be collected and analyzed using the TCLP procedure.

Field quality assurance samples will be prepared in accordance with the following schedule: one trip blank will accompany each shipping cooler of water samples (containing volatiles samples) to the analytical laboratory; duplicate, field blank, and rinsate blank samples for water, sludge, and soil samples will be collected at a frequency of one duplicate and one blank for every 20 samples. Field quality control samples are discussed in Section 3.4.

3.3 Sampling Procedures

This section describes the procedures to be used for collection of water, sludge, soil and waste samples.

3.3.1 Field Logistics

The sampling sites will be examined before the start of field sampling to ensure that all required items are available. Coordination with the responsible group personnel at TA-53 is required for the use of storage and staging areas. Access to the surface impoundment site requires keys to the security fence gates and assistance from the Health Physics Operations Group (HS-1). Access to TA-53 may be restricted at any time during Meson Physics Facility operations. All personnel entering TA-53 must sign for a radiation-monitoring film badge to be worn while within TA-53. Site workers must also have received all required radiation worker protection training and appropriate Occupational Safety and Health Administration and RCRA training.

Exact locations for electrical power, clean zones, and drinking water must be identified before sampling. The waters of the surface impoundments are exclusion zones, and protective clothing must be worn if contact with surface impoundment waters or sludges is possible. Protective clothing requirements will be determined by the health and safety officer assigned to the project and will be described in a Health and Safety Plan (HSP) to be prepared before sampling. Exclusion zones and access, staging, and decontamination areas will be designated near each surface impoundment. The areas will be selected for ease of ingress and egress to watercraft used for sampling, monitoring, water sample collection, and for initial sample processing.

A decontamination area will be designated for tools, equipment, and personnel. (Decontamination procedures are discussed in detail in Section 3.3.10 of this plan.) All decontamination materials must be stored in drums with proper labels and identifying information. Efforts will be made to keep the volume of decontamination materials at a minimum. Persons involved in doing the actual decontamination will generally be dressed in protective clothing one level below that which the exclusion zone workers are required to wear. All personnel and equipment will be monitored for radioactive contamination before

leaving an exclusion zone, the central decontamination area, and the surface impoundment field site.

Field measurements for radioactivity and organic vapors shall be made and documented before, during, and after sampling activities at each surface impoundment each day that sampling is in progress. Measurements will be made using the instruments specified in the HSP. Instruments will be calibrated at the frequency specified in the HSP. Qualified radiation protection and health and safety personnel are responsible for this monitoring. Results of monitoring will be used to evaluate possible hazards at the site, evaluate current conditions, and specify personal protective equipment. All personnel will visually monitor for extreme weather conditions, lightning, or other physical or environmental hazards that may develop. Personnel will notify the project manager when unanticipated physical or environmental hazards develop.

3.3.2 Surface Impoundment Ingress/Egress

Ingress and egress to watercraft and the surface impoundments shall occur in exclusion zones established for that and supporting purposes. Ingress and egress via the slope of the surface impoundment dike will be aided by installing a rope or chain and lumber-rung ladder constructed for that purpose. This ladder will be firmly anchored to the top of the dike surface by driving 18-in. steel stakes into the dike, one per ladder support. An equivalent device may be used for ingress and egress if it provides adequate footing and protection for personnel. Anchors and rigging shall be inspected before each descent or ascent of the ladder. Sampling personnel shall load equipment and supplies sufficient to collect samples from one designated location into the watercraft using the ladder within the exclusion zone.

3.3.3 Sampling Point Location

Water, sludge, and soil samples will be collected at the locations described in Section 3.2. Water and sludge samples will be collected by a sampling crew in a boat. A crew on the impoundment dikes will assist in directing the boat to the sample locations. The tops of the dikes will be marked with flags to indicate the north-south and east-west coordinate locations of the sample points. One person will stand on one of the north-south aligned dikes with a rope attached to the front of the sampling boat. Another person will stand across the

impoundment on the other north-south aligned dike with a rope attached to the rear of the boat. The personnel on the dikes will maneuver the boat into position with the ropes using direction signals from the staff in the boat. The personnel in the boat will use the flags to determine when the boat is correctly positioned at the sampling location.

Liner and soil/tuff samples will be collected after the water has been removed from the impoundments. Samples inside the impoundments will be located in a similar manner as that described for water and sludge samples. That is, the sample crew will use the flags on the dikes to align themselves at the sample locations. A stake will be driven into the bottom of the impoundment to identify the sample location.

3.3.4 Water Sampling Procedures

Grab water samples will be collected using a stainless steel beaker. Samples will be collected using the following procedure:

1) Check the stainless steel beaker to assure that it has been decontaminated and is clean.

2) Obtain a grab sample by slowly immersing the beaker and raising it out of the water. Take care not to disturb the sludge layer. Carefully pour the water from the beaker into the sample containers. Take care to minimize disturbance of the samples for volatile organics analysis.

3) Assure that all sample containers are tightly capped. Rinse and dry the sample containers, attach labels and seals, record the sample information in the field log book, and complete the sample analysis request and chain-of-custody record.

4) Repeat Steps 2 and 3 until all sample containers for this sample location have been filled.

5) Decontaminate the used sampler before sampling at the next location. Store rags and any other waste in plastic bags for subsequent disposal.

3.3.5 Sludge Sampling Procedures

Based on the results of previous sampling, the consistency of the sludge is too liquid to allow adequate recovery with a core sampler. Samples will be collected using a pole-mounted beaker. This apparatus was approved by the NMED for use during the April 1992 sampling. Grab samples will be collected from the bottom of the sludge profile where the highest concentrations are expected. The sampling procedure is described below:

1) Check the stainless steel sample beaker to assure that it has been decontaminated and is clean.

2) Collect a grab sample of sludge from the bottom of the sludge profile using the pole-mounted beaker and transfer the sludge from the beaker to a decontaminated stainless steel bucket. Immediately collect the sample for volatiles organics analysis. Collect additional beakers of sludge and transfer to the bucket until enough sludge has been obtained to fill all sample containers.

3) Homogenize the sludge in the bucket using a stainless steel spoon. Transfer the homogenized sludge to appropriate sample containers.

4) Assure that all sample containers are tightly capped. Rinse and dry the sample containers, attach labels and seals, record the sample information in the field log book, and complete the sample analysis request and chain-of-custody record.

5) Decontaminate the sampler, spoon, and pan before sampling at the next location. Store used rags, gloves, and other wastes in plastic bags for subsequent disposal.

3.3.6 Soil/Tuff Sampling Procedures

Soil and tuff samples to be collected include samples of the bentonite impoundment liners and the soil and tuff beneath the bentonite and gunite liners. Samples of the bentonite liner and underlying soils will be collected using an 8-in. core sampler. Samples will be collected using the following procedure:

1) Assemble the decontaminated core sampler, including the disposable plastic liners. Attach the drive hammer.

2) Remove sludge from the sampling site until the top of the bentonite liner is exposed.

3) Drive the sampler downward through the liner and into the underlying soil. Drive the sampler to a depth of 8 in. or until refusal.

4) Withdraw the sampler from the soil, seal the end, and transfer the sampler to the sample preparation area outside of the impoundments.

5) Disassemble the sampler and remove the liner tubes. Record a description of the liner and underlying material in the field log book.

6) Split the liner tubes lengthwise using a clean knife. Separate the impoundment liner material from the underlying soil and discard the soil. Immediately collect samples for volatiles analysis by slicing vertical segments from the impoundment liner core using a clean stainless steel knife. Transfer the samples to appropriate containers using clean stainless steel spoons.

7) Collect the remaining samples of the impoundment liner material by obtaining vertical slices of the liner using a stainless steel spoon. Transfer samples to appropriate sample containers.

8) If additional liner material is needed to fill sample containers, install new liner tubes into the sampler and repeat steps 2 through 7 at an immediately adjacent location.

9) Assure that all sample containers are tightly capped. Rinse and dry the sample containers, attach labels and seals, record the sample information in the field log book, and complete the sample analysis request and chain-of-custody record.

10) Decontaminate the sampler, spoons, knives, and pan before sampling at the next location. Store used rags, gloves, and other wastes in plastic bags for subsequent disposal.

After the liner sample has been collected, samples of the underlying soil or tuff will be collected at the same location. If the bentonite liner material is underlain by soil or pulverized tuff, samples of the underlying material will be collected using an 8-in. core sampler. Samples will be collected using the following procedure:

1) Assemble the decontaminated core sampler, including the disposable plastic liners. Attach the drive hammer.

2) Remove all sludge and bentonite liner from the sampling site until the top of the soil is exposed.

3) Drive the sampler downward to a depth of 8 in. or until refusal.

4) Withdraw the sampler from the soil, seal the end, and transfer the sampler to the sample preparation area outside of the impoundments.

5) Disassemble the sampler and remove the liner tubes. Record a description of the soil in the field log book.

6) Split the liner tubes lengthwise using a clean knife. Keep the first 6 in. of soil core and discard the remainder. Immediately collect samples for volatiles analysis by slicing vertical segments from the soil core using a clean stainless steel knife. Transfer the samples to appropriate containers using clean stainless steel spoons.

7) Collect the remaining samples of soil by obtaining vertical slices using a stainless steel spoon. Transfer samples to appropriate sample containers.

8) If additional soil is needed to fill sample containers, install new liner tubes into the sampler and repeat steps 2 through 7 at an immediately adjacent location.

9) Assure that all sample containers are tightly capped. Rinse and dry the sample containers, attach labels and seals, record the sample information in the field log book, and complete the sample analysis request and chain-of-custody record.

10) Decontaminate the sampler, spoons, knives, and pan before sampling at the next location. Store used rags, gloves, and other wastes in plastic bags for subsequent disposal.

11) Seal the sample hole using bentonite pellets or cement-bentonite grout.

If the bentonite liner is underlain by tuff, samples of the tuff will be collected using either a hand-operated electric auger or a jack hammer with a stainless steel bit. Sampling with the auger will be attempted first. If this technique requires an excessive amount of time to collect an adequate amount of sample, the remaining samples will be collected using a jack hammer. Samples will be collected with the auger using the following procedure:

1) Remove the decontaminated auger from its protective packaging and attach the drive head.

2) Remove all sludge and the bentonite liner material until the top of the tuff is exposed.

3) Place a clean sheet of polyethylene over the tuff and cut a hole for the auger using a clean knife.

4) Drill into the tuff 6 in. using the auger. Allow cuttings to collect on the polyethylene sheet.

5) Collect samples by transferring cuttings from the polyethylene sheet to sample containers using a clean stainless steel spoon. Collect the sample for volatile organics analysis first.

6) If additional tuff is needed to fill sample containers, repeat steps 2 through 5 at an immediately adjacent location.

7) Assure that all sample containers are tightly capped. Rinse and dry the sample containers, attach labels and seals to them, record the sample information in the field log book, and complete the sample analysis request and chain-of-custody record.

8) Decontaminate the sampler, spoons, knives, and pan before sampling at the next location. Store used rags, gloves, and other wastes in plastic bags for subsequent disposal.

9) Seal the sample hole using bentonite pellets or cement-bentonite grout.

If the jack hammer must be used, samples will be collected using the following procedure:

1) Check the stainless steel hammer bit to assure that it has been decontaminated and is clean.

2) Remove all sludge and the bentonite liner material until the top of the tuff is exposed.

3) Place a clean sheet of polyethylene over the tuff and cut a hole approximately 1 ft square using a clean knife.

4) Use the jack hammer to pulverize the 1-ft-square area of tuff to a depth of 6 in. Collect the sample for volatile organics analysis as soon as adequate tuff has been pulverized. Transfer the pulverized tuff to sample containers using a clean stainless steel spoon.

5) Collect the remaining samples by transferring pulverized tuff to sample containers using a clean stainless steel spoon.

6) Assure that all sample containers are tightly capped. Rinse and dry the sample containers, attach labels and seals to them, record the sample information in the field log book, and complete the sample analysis request and chain-of-custody record.

7) Decontaminate the hammer bit, spoons, knives, and pan before sampling at the next location. Store used rags, gloves, and other wastes in plastic bags for subsequent disposal.

8) Seal the sample hole using bentonite pellets or cement-bentonite grout.

Samples of the material underlying the gunite liners will be collected using an 8-in. core sampler in a similar manner as samples under the bentonite liner. Samples will be collected using the following procedure:

1) Assemble the decontaminated core sampler, including the disposable plastic liners. Attach the drive hammer.

2) Remove the gunite liner material from the sample location using a jack hammer or sledge hammer. Remove any gunite fragments from the location before sampling.

3) Drive the sampler downward to a depth of 8 in.

4) Withdraw the sampler from the soil, seal the end, and transfer the sampler to the sample preparation area outside of the impoundments.

5) Disassemble the sampler and remove the liner tubes. Record a description of the material in the field log book.

6) Split the liner tubes lengthwise using a clean knife. Keep the first 6 in. of core and discard the remainder. Immediately collect samples for volatiles analysis by slicing vertical segments from the core using a clean stainless steel knife. Transfer the samples to appropriate containers using clean stainless steel spoons.

7) Collect the remaining samples by obtaining vertical slices using a stainless steel spoon. Transfer samples to appropriate sample containers.

8) If additional material is needed to fill sample containers, install new liner tubes into the sampler and repeat steps 2 through 7 at an immediately adjacent location.

9) Assure that all sample containers are tightly capped. Rinse and dry the sample containers, attach labels and seals, record the sample information in the field log book, and complete the sample analysis request and chain-of-custody record.

10) Decontaminate the sampler, spoons, knives, and pan before sampling at the next location. Store used rags, gloves, and other wastes in plastic bags for subsequent disposal.

11) Seal the sample hole using bentonite pellets or cement-bentonite grout.

3.3.7 Waste Sampling Procedures

Wastes generated during decontamination may include disposable equipment and supplies, decontamination solutions, and residuals from decontamination. Disposable equipment and supplies will not be sampled, but will be designated for management based on knowledge of the source of contamination. Decontamination wastes will be sampled and analyzed to determine proper means of disposal. Sampling methods will result in representative samples as described in HWMR-6, Section 261.20(c).

Liquid decontamination wastes will be contained in drums and sampled using disposable composite liquid waste samplers (Coliwasa) or similar equipment. Liquid samples will be collected using the following procedure:

1) Remove the decontaminated sampler from its protective packaging.

2) Open the sampler by pushing the interior rod down to unseat the bottom stopper.

3) Slowly lower the sampler into the liquid at a rate that permits the level of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sampler tube is lower than that outside the sampler, the sampling rate is too fast and will result in a nonrepresentative sample.

4) When the sampler stopper hits the bottom of the liquid container, raise the interior rod to seat the bottom stopper and close the sampler.

5) Slowly withdraw the sampler from the container with one hand and wipe the sampler tube with a disposable cloth with the other hand.

6) Carefully discharge the sample into appropriate containers, beginning with the sample for volatiles analysis. Discharge the sample by slowly unseating the bottom stopper.

7) Repeat steps 2 through 6 until all sample containers have been filled.

8) Assure that all sample containers are tightly capped. Rinse and dry the sample containers, attach labels and seals to them, record the sample information in the field log book, and complete the sample analysis request and chain-of-custody record.

9) Decontaminate the used sampler before collecting the next sample. Store rags and any other waste in plastic bags for subsequent disposal.

Solid and semisolid decontamination wastes (e.g., sludges from decontamination areas) will be stored in drums. Samples will be collected using a thief sampler or sampling trier, depending on the consistency of the waste. Samples will be collected using the following procedure:

1) Remove the decontaminated sampler from its protective packaging.

2) Push the sampler downward through the waste until the sampler hits the bottom of the container. If a thief sampler is being used, rotate the inner tube to close the sampler. If a trier is being used, rotate the sampler to free it from the waste.

3) Slowly withdraw the sampler from the container with one hand and wipe the outside of the sampler tube with a disposable cloth using the other hand.

4) Open the sampler and immediately collect a sample for volatiles analysis. Collect a composite sample for volatiles analysis by removing waste from the entire sample profile using a clean stainless steel spoon. After the volatiles sample has been collected, transfer the remainder of the sample to a clean stainless steel pan and homogenize it using a stainless steel spoon. Transfer the homogenized sample to appropriate sample containers.

5) Repeat steps 2 through 4 until all sample containers have been filled.

6) Tightly cap the sample containers. Rinse and dry the sample containers, attach labels and seals to them, record sampling information in the field log book, and complete the sample analysis request sheet and chain-of-custody record.

7) Decontaminate the sampler, spoon, and pan before collecting the next sample. Store rags, gloves, and any other waste in plastic bags for subsequent disposal.

3.3.8 Sample Preservation and Handling

The samples will require cooling with ice or other chemical preservation at the time of collection or during laboratory preparation before analysis. All samples require field preservation as soon after collection as is practical. Sample containers that are prepared with the appropriate preservative at the analytical laboratory may be used to simplify field preservation. Sample preservation will conform to the requirements of EPA SW-846, Volume II, Part III (EPA, 1986a). Sample containers will be precleaned (typically by the original supplier) using EPA quality assurance protocols appropriate for the intended use of the sample container. Sample container requirements, preservation, and holding times are listed in Table 3-9.

Following sample collection, sample container lids shall be fixed tightly to the containers, and the outside of the container shall be carefully rinsed with deionized water and dried. The purpose of the rinse is to minimize the spread of radioactive materials on sample container surfaces. After rinsing and drying, labels will be attached to the containers and the containers sealed with custody tape. The custody tape will be initialed and dated by a member of the field team. The sample containers will then be placed in polyethylene Ziploc® bags as secondary confinement in the event of leakage or breakage. The outside surfaces of the secondary sample containers will be monitored for radioactivity prior to packaging for transportation to the analytical laboratory.

Samples will be packaged in shipping coolers, cooled to approximately 4° C, with adequate cushioning and absorbent materials to reduce the likelihood of breakage and to contain fluids should breakage occur. Sample custody, analytical request documentation, and any

TABLE 3-9. SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

	Water and Aqueous Wastes			Sludge, Soil, and Nonaqueous Wastes		
Analysis	Container	Preservative	Holding Time	Container	Preservative	Holding Time
Metals	500-mL poly	HNO3 to pH < 2	180 days (Hg - 26 days)	125-mL poly	Cool to 4 degrees C	180 days (Hg - 26 days)
Volatile Organics	2 x 40-mL amber glass vial with septum top	Cool to 4 degrees C	14 days	2 x 40-mL amber glass vial with septum top	Cool to 4 degrees C	14 days
Semivolatile Organics	1-L amber glass	Cool to 4 degrees C	7 days extraction plus 40 days for analysis	500-mL wide mouth glass	Cool to 4 degrees C	7 days extraction plus 40 days for analysis
PCBs and Organochlorine Pesticides	1-L amber glass	Cool to 4 degrees C	7 days extraction plus 40 days for analysis	500-mL wide mouth glass	Cool to 4 degrees C	7 days extraction plus 40 days for analysis
Chlorinated Herbicides	1-L amber glass	Cool to 4 degrees C	7 days extraction plus 40 days for analysis	500-mL wide mouth glass	Cool to 4 degrees C	7 days extraction plus 40 days for analysis
Reactive Sulfide				4-oz amber glass	Cool to 4 degrees C	7 days
Gross Alpha and Beta Radioactivity	1-L poly	HNO3 to pH < 2	None	8-oz wide mouth glass	None	None
Gamma Spectroscopy	1-L poly	HNO3 to pH < 2	None	8-oz wide mouth glass	None	None
Tritium	100-mL glass	None	None			

additional laboratory-required documentation will be placed in Ziploc® bags and taped inside the cooler lid. Any sample with suspect hazardous constituents or with radioactive contamination greater than or equal to 2 nCi per gram must be accompanied by a completed Hazardous Materials Transfer Form (Figure 3-5). If the sample is to be shipped off site for analysis, placards bearing the word RADIOACTIVE shall be placed inside the cooler, on top of the packing materials, so as to be obvious to anyone when opening the cooler. All coolers not shipped off site will have such placards on the outside. Sample coolers will be sealed with packing tape, and radioactivity measurements will be taken at the cooler. Results of this radiation screening will be clearly indicated on the outside of the cooler. The project manager is responsible for packaging and placarding in accordance with Department of Transportation regulations (when samples travel via ground transportation) or with International Air Transport Association regulations (when they are transported by commercial cargo aircraft). Appropriate waybills will be affixed to the shipping coolers for off-site shipment, and the samples will be transported to the analytical laboratory as quickly as is practical.

Samples will be analyzed by the Laboratory Environmental Chemistry Group (EM-9) unless they cannot perform the required analyses or do not have sufficient laboratory capacity at the time that the analyses are required. The only required analyses that cannot be performed by EM-9 are organochlorine pesticides, chlorinated herbicides, and reactive sulfide. Samples for these analyses will be sent off site for analysis.

3.3.9 Field Sample Documentation

Field sampling activities will be documented through the use of a closure sampling field log book, sample labels, a chain-of-custody record, and a request for analysis form. These documents and their uses are described below. All field records generated during sampling activities will be transmitted to the Environmental Restoration Records-Processing Facility (RPF).

3.3.9.1 Field Log Book

A closure sampling field log book will be kept and will contain all information pertinent to field sampling. The log book will have bound and consecutively numbered pages in 8-1/2 by

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

HAZARDOUS MATERIALS TRANSFER FORM

HM No. 37551	SM No.	Date

Complete entire form. Please type or print. UPON DELIVERY, FORWARD THIS FORM TO THE HAZPACT OFFICE, MS: G728

FROM	Name				
	Telephone	Group	TA	Build.	Room

TO	Name				
	Telephone	Group	TA	Build.	Room

Check all that apply. Refer to 49 CFR 173.50 for hazard class definitions.

- ☐ 1.1 Explosives
- ☐ 1.2 Explosives
- ☐ 1.3 Explosives
- ☐ 1.4 Explosives
- ☐ 1.5 Very Insensitive Explosives:Blasting Agents
- ☐ 1.6 Extremely Insensitive Detonating Substances
- ☐ 2.1 Flammable Gas
- ☐ 2.2 Non-Flammable Compressed Gas
- ☐ 2.3 Poisonous Gas
- ☐ 3 Flammable and Combustible Liquid
- ☐ 4.1 Flammable Solid
- ☐ 4.2 Spontaneously Combustible Material
- ☐ 4.3 Dangerous When Wet
- ☐ 5.1 Oxidizer
- ☐ 5.2 Organic Peroxide
- ☐ 6.1 Poisonous Materials
- ☐ 6.2 Infectious Substance (Etiologic Agent)
- ☐ 7 Radioactive Material
- ☐ 8 Corrosive Material
- ☐ 9 Miscellaneous Hazardous Material
- ☐ Other Regulated Material

Form of Material
- ☐ Solid
- ☐ Liquid
- ☐ Compressed Gas
- ☐ Uncompressed Gas
- ☐ Cyrogenic Material
- ☐ Metal
- ☐ Powder

Chemical Name

Quantity per Container

Is this material a limited quantity? ☐ Yes ☐ No *If you do not know the definition of a limited quantity for the hazard class of your material, contact HAZPACT at 7-4127.* If your answer is yes complete and prepare your transfer per the instructions in 49 CFR for limited quantities. If your answer is no, and you do not have a Standard Operating Procedure approved by the HAZPACT Office for this category of material, then contact a HAZPACT Operations Representative at 7-4127 Radioactive shipments must include the identification of radionuclide, packaging identification, activity, transport index, and type of label applied.

No. of Pkgs.	Packaging Used	Proper Shipping Name	Hazard Class & Division	UN/NA Number	Packaging Group	Qty. or Residue	Gross Weight

TRANSPORTATION: THIS MATERIAL IS TO BE TRANSPORTED ONLY IN GOVERNMENT VEHICLES!

I certify that the above information is correct and that this transfer contains no hazardous materials other than those listed. This is to certify that the above-named materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. Signature:

Delivered By (Nuclear Material Handler) Signature	Received By (Receiving Custodian) Signature	Date

Placard(s) Required ☐ Yes ☐ No Label(s) Required ☐ Yes ☐ No

ADDITIONAL RADIOACTIVE MATERIAL INFORMATION REQUIRED

Transport Index:	Chemical Form:	Physical Form:

Radionuclide(s) _____
Curies _____
Grams _____
Type Of Label Required: _____

Radiation Levels
Contact _____ mR/hr
_____ mrem/hr
Total _____
At 1 Meter _____ mR/hr
_____ mrem/hr
Total _____

Exterior surfaces are free from removable contamination.	Tamper ID.	Nuclear Material ☐ Yes ☐ No
Health Physics Representative	Pro-Force Signature	Date

Form 1488 (4/91) ST 5052

FIGURE 3-5. HAZARDOUS MATERIALS TRANSFER FORM

11-in. format. The information entered into the log book should be sufficient to reconstruct the sampling situation without relying on the sample collector's memory. Minimum entries include:

1) purpose of sample;

2) location of sample;

3) name, organization, and business address of persons collecting samples and making log entries;

4) number and volume of sample and preservatives used (if any);

5) description of each sampling location, the sampling methodology, the equipment used, etc;

6) date and time of sample collection;

7) sample destination and transporter's name;

8) sketch of the sampling site;

9) log of photographs taken, if any;

10) field observations (ambient temperature, sky conditions, recent precipitation, etc.);

11) field measurements, if any (pH, flammability, conductivity, explosivity, etc.);

12) collector's sample identification number(s); and

13) signature of person responsible for the log entry.

3.3.9.2 Sample Label

An example sample label is shown in Figure 3-6. Each sample collected shall have a unique sample identification number assigned to it and recorded on an attached sample label. The sampling number scheme will be determined prior to the start of field work. Sample numbers will contain unique identifiers of sample location, date, etc. Sample numbers will be recorded on the sample labels with waterproof, indelible ink (except for volatile organics analysis [VOA] samples, which will be labeled using ballpoint or other nonsolvent-containing ink), or preprinted labels with sample numbers will be used. Labels will be of a waterproof material, rather than plain paper. The sample label must be completed to include the project name, sample number, collection date and time, collector's name, sample location, sample media description, preservative, and analysis requested. For samples analyzed on site, preprinted sample labels containing only the sample numbers and initials of the sample collector may be used.

3.3.9.3 Chain-of-Custody Record

The chain-of-custody record (Figure 3-7) documents a sample's history from collection through analysis and disposal. Upon collection in the field, every sample shall be recorded on the chain-of-custody record using the unique sample identification number. The person(s) collecting the sample must be identified on the form. A sample is considered to be in a person's custody when it is in his or her physical possession, in view after being in his or her physical possession, locked so that no one can tamper with it after it has been in his or her physical possession, or in a secured area restricted to authorized personnel. When custody of the sample(s) is passed from the sample collector to other personnel, the persons relinquishing and receiving custody must sign, date, and time-stamp the form so that the custody record remains unbroken. When samples are consigned to a commercial shipper, the person having custody at that time signs as relinquisher; the shipper's waybill then becomes part of the custody record, and the receiving laboratory signs for receipt upon opening the sample cooler. Chain-of-custody records must remain part of the permanent documentation for field sampling activities.

F

H R

Project Name _____

Project No _____

Sample No _____

Collection Date/ Time _____

Collector s Name _____

Sample Location _____

Sample Type/Depth/Description _____

Analyze For _____ Preservative _____

Bottle _____ of _____ _____ Filtered _____ Nonfiltered

23-8-85

FIGURE 3-6. EXAMPLE SAMPLE LABEL

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Health and Environmental Che. Group
Mail Stop K-484
Los Alamos, NM 87545

CHAIN OF CUSTODY RECORD

PROJ NO.	PROJECT NAME
SAMPLERS (Signature)	

STA NO	DATE	TIME	COMP	GRAB	STATION LOCATION	NO OF CONTAINERS							LABEL NO.	REMARKS

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	

Distribution: Original Accompanies Shipment. Copy to Field Files

FIGURE 3-7. CHAIN-OF-CUSTODY RECORD

3.3.9.4 Request for Analysis Form

The request for analysis form (Figure 3-8) corresponds with the chain-of-custody record in that both record information concerning the same group of samples. The request for analysis form provides information for the analytical laboratory on sample size, type, volume, and preservative; project identification and contact information; analytical tests to perform; project-specific quality control required; possible sample hazards, if known; and the requested disposition of the sample following analysis. The request for analysis form becomes part of the permanent project documentation.

3.3.10 Decontamination

Sampling equipment will be cleaned with a nonphosphate detergent before each sample is collected and at the end of sampling. All decontamination procedures shall take place within an exclusion zone or centralized decontamination area designated for that purpose. Methanol or acetone rinses will not be used so that samples taken for volatile organic analyses will not be compromised. Following the detergent wash, sampling equipment will be rinsed three times with deionized water. Samples of the final deionized water rinse will be collected as rinsate blank samples. Following decontamination, sampling equipment will be monitored for radioactivity. Additional decontamination procedures to prevent the spread of radioactive contamination may be mandated by the project manager.

3.3.11 Waste Disposal

Waste generated during field sampling activities is expected to consist of used personal protective equipment (gloves, booties, clothing, etc.), paper and packaging-type waste, excess sample fluids and materials, and decontamination solutions. Excess sample fluids and materials may be returned to the surface impoundments from which they were collected. Decontamination solutions and materials may be returned to the impoundments if contaminants are below cleanup levels. Other waste must be bagged in polyethylene-lined drums and contained on site. All waste generated within an exclusion zone or designated decontamination area must remain segregated from other wastes and the contents must be marked on the outside of the container. All waste will be screened for radioactivity prior to leaving the sampling site for storage or disposal.

REQUEST FOR ANALYSIS

R/A Control No.
C/C Control No. _____

PROJECT NAME _____
PROJECT NUMBER _____
PROFIT CENTER NUMBER _____
PROJECT MANAGER _____
BILL TO _____

PURCHASE ORDER NO. _____

DATE SAMPLES SHIPPED _____
LAB DESTINATION _____
LABORATORY CONTACT _____
SEND LAB REPORT TO _____

DATE REPORT REQUIRED _____
PROJECT CONTACT _____
PROJECT CONTACT PHONE NO. _____

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions

TURNAROUND TIME REQUIRED: (Rush must be approved by the Laboratory Project Manager)

Normal _____ Rush _____ (Subject to rush surcharge)

QC LEVEL: (Levels II and III subject to surcharge, project-specific requirements must be submitted to lab before beginning work)

I _____ II _____ III _____ Project Specific _____

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances.)

Non-hazard _____ Flammable Skin Irritant _____ Highly Toxic _____ Other _____ (Please Specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, archive and disposal.)

Return to Client _____ Disposal by Lab _____ Archive _____ (Indicate number of months.)

FOR LAB USE ONLY

Received by Date/Time

FIGURE 3-8. REQUEST FOR ANALYSIS FORM

3.4 Analytical Requirements

Test methods for chemical analysis will be performed according to procedures documented in EPA SW-846 (EPA, 1986b; EPA, 1986c; and EPA, 1986d) or in the proposed update to EPA SW-846 (EPA, 1991c).

Minimum calibration, operation, and quality control requirements (bias, precision, blank, and matrix effects) for laboratory analyses shall be performed as listed in the individual analytical methods of EPA SW-846 (EPA, 1986b; EPA, 1986c; EPA, 1986d; and EPA 1991c).

Analytical methods, practical quantitation limits (PQLs), proposed RCRA Subpart S action levels, and 1992 IWP SALs for metals are summarized in Table 3-10. Similar information for volatile organics; semivolatile organics; and organochlorine pesticides, PCBs, and chlorinated herbicides is presented in Tables 3-11 through 3-13, respectively. The PQLs are presented for comparison with action levels and may not be the detection limit actually achieved. Actual detection limits are laboratory-determined based on instrumentation and sample matrix.

3.4.1 Analytical Methods

Water, sludge, bentonite liner, soil, tuff, and waste samples will be analyzed for metals, volatile organics, semivolatile organics, organochlorine pesticides and PCBs, chlorinated herbicides, and radionuclides. Sludge samples will also be analyzed for reactive sulfide. Analytical methods to be used are identified and described in the following paragraphs. Analyses to be performed are summarized in Table 3-14.

Metals analysis may be performed using a combination of inductively coupled plasma (ICP) and atomic absorption spectroscopy (AA) methods. Prior to analysis, samples will be prepared by acid digestion. EPA Method 3005 will be used for digestion of water samples, and Method 3050 for digestion of sludge and soil samples. The analytical methods to be used will be determined by the laboratory based on instrument availability and required detection limits. It is currently expected that ICP-mass spectrometry (EPA Method 6020) will be used for analysis of most metals. This method was approved by the NMED for analysis of metals in the samples collected from the surface impoundments in April 1992. It is expected that a furnace AA method will be used for analysis of selenium (EPA Method 7740) and cold

TABLE 3-10. ANALYTES, METHODS, QUANTITATION LIMITS, AND ACTION LEVELS FOR METALS

Element	Method Numbers, Water	Practical Quantitation Limit, ug/L	Subpart S Action Level, ug/L	1992 IWP SAL, Systemic, ug/L	1992 IWP SAL, Carcinogenic, ug/L	Method Numbers, Sludge and Soil	Practical Quantitation Limit, mg/kg	Subpart S Action Level, mg/kg	1992 IWP SAL, Systemic, mg/kg	1992 IWP SAL, Carcinogenic, mg/kg
Aluminum	3005/6020	1.0				3050/6020	0.1			
Antimony	3005/6020	0.2	10	14		3050/6020	0.02	30	32	
Arsenic	3005/6020	4.0	50	11	0.02	3050/6020	0.4	80	24	0.4
Barium	3005/6020	0.2	2000	2400		3050/6020	0.02	4000	5600	
Beryllium	3005/6020	1.0	0.008	170	0.0081	3050/6020	0.1	0.2	400	0.16
Cadmium	3005/6020	0.7	5	35		3050/6020	0.07	40	80	
Chromium	3005/6020	0.2	100	170		3050/6020	0.02	400	400	
Cobalt	3005/6020	0.1				3050/6020	0.01			
Copper	3005/6020	0.3		1300		3050/6020	0.03		3000	
Lead	3005/6020	0.2	50			3050/6020	0.02			
Manganese	3005/6020	0.4		3500		3050/6020	0.04		8000	
Mercury	3005/7470	0.2	2	11		3050/7471	0.02	20	24	
Nickel	3005/6020	0.3	700	700		3050/6020	0.03	2000	1600	
Selenium	3005/7740	2.0	50	170		3050/7740	0.2		400	
Silver	3005/6020	0.4	50	170		3050/6020	0.04	200	400	
Thallium	3005/6020	0.5		2.8		3050/6020	0.05		6.4	
Zinc	3005/6020	0.8		10000		3050/6020	0.08		24000	

Note:
Shaded values are action levels less than practical quantitation limits.

TABLE 3-11. ANALYTES, METHODS, QUANTITATION LIMITS, AND ACTION LEVELS FOR VOLATILE ORGANICS

Compound	Method Numbers, Water	Practical Quantitation Limit, ug/L	Subpart S Action Level, ug/L	1992 IWP SAL, Systemic, ug/L	1992 IWP SAL, Carcinogenic, ug/L	Method Numbers, Sludge and Soil	Practical Quantitation Limit, mg/kg	Subpart S Action Level, mg/kg	1992 IWP SAL, Systemic, mg/kg	1992 IWP SAL, Carcinogenic, mg/kg
Acetone	8260	100	4000	3500		8260	0.1	8000	8000	
Benzene	8260	5	5		1.2	8260	0.005			0.67
Bromobenzene	8260	10				8260	0.01			
Bromochloromethane	8260	10				8260	0.01			
Bromodichloromethane	8260	5	0.03	700	0.27	8260	0.005	0.5	1600	5.4
Bromoform	8260	5	700	700	4.4	8260	0.005	2000	1600	89
Bromomethane	8260	10	50	49		8260	0.01	100	0.43	
2-Butanone	8260	100	2000	1700		8260	0.1	4000	2100	
n-Butylbenzene	8260	10				8260	0.01			
sec-Butylbenzene	8260	10				8260	0.01			
tert-Butylbenzene	8260	10				8260	0.01			
Carbon disulfide	8260	100	4000	3500		8260	0.1	8000	7.4	
Carbon tetrachloride	8260	5	5	25	0.27	8260	0.005	5	56	0.21
Chlorobenzene	8260	5	100	700		8260	0.005	2000	67	
Chloroethane	8260	10				8260	0.01		3300	
Chloroform	8260	5	6	350	5.7	8260	0.005	100	800	0.21
Chloromethane	8260	10			27	8260	0.01			6.4
o-Chlorotoluene	8260	10				8260	0.01			
p-Chlorotoluene	8260	10				8260	0.01			
1,2-Dibromo-3-chloropropane	8260	5				8260	0.005			
1,2-Dibromoethane	8260	5				8260	0.005			
Dibromomethane	8260	5				8260	0.005			
Dibromochloromethane	8260	5		700	4.2	8260	0.005		1600	8.3
o-Dichlorobenzene	8260	10	600			8260	0.01			
m-Dichlorobenzene	8260	10				8260	0.01			
p-Dichlorobenzene	8260	10	75			8260	0.01			
Dichlorodifluoromethane	8260	5	7000			8260	0.005	20000		
1,1-Dichloroethane	8260	5		3500		8260	0.005		410	
1,2-Dichloroethane	8260	5	5		0.38	8260	0.005	8		0.2
1,1-Dichloroethene	8260	5	7	310	0.58	8260	0.005	10	720	0.59
trans-1,2-Dichloroethylene	8260	5	100	350		8260	0.005		800	
cis-1,2-Dichloroethylene	8260	10	70	350		8260	0.01		800	
1,2-Dichloropropane	8260	5	5		0.51	8260	0.005		6.5	10
1,3-Dichloropropane	8260	10				8260	0.01			

TABLE 3-11. ANALYTES, METHODS, QUANTITATION LIMITS, AND ACTION LEVELS FOR VOLATILE ORGANICS (Continued)

Compound	Method Numbers, Water	Practical Quantitation Limit, ug/L	Subpart S Action Level, ug/L	1992 IWP SAL, Systemic, ug/L	1992 IWP SAL, Carcinogenic, ug/L	Method Numbers, Sludge and Soil	Practical Quantitation Limit, mg/kg	Subpart S Action Level, mg/kg	1992 IWP SAL, Systemic, mg/kg	1992 IWP SAL, Carcinogenic, mg/kg
2,2-Dichloropropane	8260	10				8260	0.01			
1,1-Dichloropropane	8260	10				8260	0.01			
cis-1,3-Dichloropropene	8260	5	10	11	0.19	8260	0.005	20	14	0.17
trans-1,3-Dichloropropene	8260	5	10	11	0.19	8260	0.005	20	14	0.17
Ethylbenzene	8260	5	700	3500		8260	0.005	8000	3100	
Ethylene dibromide	8260	10	0.0004			8260	0.01	0.008		
2-Hexanone	8260	50	2000			8260	0.05	4000		
Isopropylbenzene	8260	10				8260	0.01			
4-Isopropyltoluene	8260	10				8260	0.01			
Methyl iodide	8260	5				8260	0.005			
4-Methyl-2-pentanone	8260	50		1700		8260	0.05		510	
Methylene chloride	8260	5	5	2100	4.7	8260	0.005	90	1400	5.6
Propylbenzene	8260	10				8260				
Styrene	8260	5	100	7000		8260	0.005	20000	16000	
1,1,1,2-Tetrachloroethane	8260	5	10			8260	0.005	300		
1,1,2,2-Tetrachloroethane	8260	5	2		1.8	8260	0.005	40		3.9
Tetrachloroethylene	8260	5	5	350	0.67	8260	0.005	10	800	5.9
Toluene	8260	5	1000	7000		8260	0.005	20000	890	
1,1,2-Trichloro-1,2,2-trifluoroethane	8260	10				8260				
1,1,1-Trichloroethane	8260	5	200	3100		8260	0.005	7000	1000	
1,1,2-Trichloroethane	8260	5	6	140	6.1	8260	0.005	100	320	6.3
Trichloroethene	8260	5	5		3.2	8260	0.005	60		3.2
Trichlorofluoromethane	8260	10	10000			8260	0.01	20000		
1,2,3-Trichloropropane	8260	5	200			8260	0.005	500		
1,2,4-Trimethylbenzene	8260	10				8260	0.01			
1,3,5-Trimethylbenzene	8260	10				8260	0.01			
Vinyl acetate	8260	50				8260	0.05			
Vinyl chloride	8260	10	2		0.018	8260	0.01			0.013
Xylenes	8260	5	10000	70000		8260	0.005	200000	160000	

Note:
Shaded values are action levels less than practical quantitation limits.

TABLE 3-12. ANALYTES, METHODS, QUANTITATION LIMITS, AND ACTION LEVELS FOR SEMIVOLATILE ORGANICS

Compound	Method Numbers, Water	Practical Quantitation Limit, ug/L	Subpart S Action Level, ug/L	1992 IWP SAL, Systemic, ug/L	1992 IWP SAL, Carcinogenic, ug/L	Method Numbers, Sludge and Soil	Practical Quantitation Limit, mg/kg	Subpart S Action Level, mg/kg	1992 IWP SAL, Systemic, mg/kg	1992 IWP SAL, Carcinogenic, mg/kg
Acenaphthene	3520/8270	10		2100		3540/8270	0.66		4800	
Acenaphthylene	3520/8270	10				3540/8270	0.66			
Aniline	3520/8270	10	6			3540/8270	0.66	100		
Anthracene	3520/8270	10		10000		3540/8270	0.66		24000	
Azobenzene	3520/8270	10				3540/8270	0.66			
m-Benzidene	3520/8270	10	0.0002			3540/8270	0.66	0.003		
Benzo(a)anthracene	3520/8270	10				3540/8270	0.66			
Benzo(a)pyrene	3520/8270	10			0.0048	3540/8270	0.66			0.1
Benzo(b)fluoranthene	3520/8270	10				3540/8270	0.66			
Benzo(g,h,i)perylene	3520/8270	10				3540/8270	0.66			
Benzo(k)fluoranthene	3520/8270	10				3540/8270	0.66			
Benzoic acid	3520/8270	50				3540/8270	3.3			
Benzyl alcohol	3520/8270	20				3540/8270	1.3			
bis(2-Chloroethoxy)methane	3520/8270	10				3540/8270	0.66			
bis(2-Chloroethyl ether)	3520/8270	10	0.03		0.032	3540/8270	0.66	0.6		0.13
bis(2-Chloroisopropyl)ether	3520/8270	10		1400	0.5	3540/8270	0.66		3200	100
bis(2-Ethylhexyl)phthalate	3520/8270	10	3	700	2.5	3540/8270	0.66	50	1600	50
4-Bromophenyl-phenylether	3520/8270	10				3540/8270	0.66			
Butylbenzylphthalate	3520/8270	10	7000	7000		3540/8270	0.66	20000	16000	
Carbazole	3520/8270	10			1.8	3540/8270	0.66			35
4-Chloro-3-methylphenol	3520/8270	20		70000		3540/8270	1.3		160000	
4-Chloroaniline	3520/8270	20		140		3540/8270	1.3		320	
2-Chloronaphthalene	3520/8270	10		2800		3540/8270	0.66		6400	
o-Chlorophenol	3520/8270	10	200	170		3540/8270	0.66	400	400	
4-Chlorophenyl-phenylether	3520/8270	10				3540/8270	0.66			
Chrysene	3520/8270	10				3540/8270	0.66			
Di-n-butylphthalate	3520/8270	10	4000	3500		3540/8270	0.66	8000	8000	
Di-n-octylphthalate	3520/8270	10		700		3540/8270	0.66		1600	
Dibenz(a,h)anthracene	3520/8270	10				3540/8270	0.66			
Dibenzofuran	3520/8270	10				3540/8270	0.66			
1,2-Dichlorobenzene	3520/8270	10		3100		3540/8270	0.66		1600	
1,3-Dichlorobenzene	3520/8270	10				3540/8270	0.66			
1,4-Dichlorobenzene	3520/8270	10			15	3540/8270	0.66		5800	290
3,3'-Dichlorobenzidine	3520/8270	20	0.08		0.078	3540/8270	1.3	2		1.6

TABLE 3-12. ANALYTES, METHODS, QUANTITATION LIMITS, AND ACTION LEVELS FOR SEMIVOLATILE ORGANICS (Continued)

Compound	Method Numbers, Water	Practical Quantitation Limit, ug/L	Subpart S Action Level, ug/L	1992 IWP SAL, Systemic, ug/L	1992 IWP SAL, Carcinogenic, ug/L	Method Numbers, Sludge and Soil	Practical Quantitation Limit, mg/kg	Subpart S Action Level, mg/kg	1992 IWP SAL, Systemic, mg/kg	1992 IWP SAL, Carcinogenic, mg/kg
2,4-Dichlorophenol	3520/8270	10	100	100		3540/8270	0.66	200	240	
Diethylphthalate	3520/8270	10	30000	28000		3540/8270	0.66	60000	64000	
Dimethylphthalate	3520/8270	10		35000		3540/8270	0.66		80000	
2,4-Dimethylphenol	3520/8270	10		700		3540/8270	0.66		1600	
4,6-Dinitro-2-methylphenol	3520/8270	50				3540/8270	3.3			
2,4-Dinitrophenol	3520/8270	50	70	70		3540/8270	3.3	200	160	
2,4-Dinitrotoluene	3520/8270	50		0.051		3540/8270	3.3		1	
2,6-Dinitrotoluene	3520/8270	10	0.05	0.051		3540/8270	0.66	1	1	
Fluoranthene	3520/8270	10		1400		3540/8270	0.66		3200	
Fluorene	3520/8270	10		1400		3540/8270	0.66		3200	
Hexachlorobenzene	3520/8270	10		28	0.022	3540/8270	0.66		64	0.44
Hexachlorobutadiene	3520/8270	10	4	70	4.5	3540/8270	0.66	90	160	90
Hexachlorocyclopentadiene	3520/8270	10	200	240		3540/8270	0.66	600	560	
Hexachloroethane	3520/8270	10	30	35	25	3540/8270	0.66	80	80	500
Indeno(1,2,3-cd)pyrene	3520/8270	10				3540/8270	0.66			
Isophorone	3520/8270	10	90	7000	370	3540/8270	0.66	2000	16000	7400
2-Methylnaphthalene	3520/8270	10				3540/8270	0.66			
2-Methylphenol	3520/8270	10	2000	1700		3540/8270	0.66	4000	4000	
3-Methylphenol	3520/8270	10	2000			3540/8270	0.66	4000		
4-Methylphenol	3520/8270	10	2000	1700		3540/8270	0.66	4000	4000	
Naphthalene	3520/8270	10		1400		3540/8270	0.66		3200	
2-Nitroaniline	3520/8270	50		2.1		3540/8270	3.3		4.8	
3-Nitroaniline	3520/8270	50				3540/8270	3.3			
4-Nitroaniline	3520/8270	50				3540/8270	3.3			
Nitrobenzene	3520/8270	10		18		3540/8270	0.66		5.3	
2-Nitrophenol	3520/8270	10				3540/8270	0.66			
4-Nitrophenol	3520/8270	50				3540/8270	3.3			
N-Nitroso-di-N-propylamine	3520/8270	10	0.005		0.005	3540/8270	0.66	0.1		0.1
N-Nitrosodimethylamine	3520/8270	20	0.0007			3540/8270	1.3	0.01		
N-Nitrosodiphenylamine	3520/8270	10	7		7.1	3540/8270	0.66	100		140
Pentachlorophenol	3520/8270	50	1000	1000	0.29	3540/8270	3.3	2000	2400	5.8
Phenanthrene	3520/8270	10				3540/8270	0.66			
Phenol	3520/8270	10	20000	21000		3540/8270	0.66	50000	48000	
Pyrene	3520/8270	10		1000		3540/8270	0.66		2400	

TABLE 3-12. ANALYTES, METHODS, QUANTITATION LIMITS, AND ACTION LEVELS FOR SEMIVOLATILE ORGANICS (Continued)

Compound	Method Numbers, Water	Practical Quantitation Limit, ug/L	Subpart S Action Level, ug/L	1992 IWP SAL, Systemic, ug/L	1992 IWP SAL, Carcinogenic, ug/L	Method Numbers, Sludge and Soil	Practical Quantitation Limit, mg/kg	Subpart S Action Level, mg/kg	1992 IWP SAL, Systemic, mg/kg	1992 IWP SAL, Carcinogenic, mg/kg
1,2,4-Trichlorobenzene	3520/8270	10	700	350		3540/8270	0.66	2000	160	
2,4,5-Trichlorophenol	3520/8270	10	4000	3500		3540/8270	0.66	8000	8000	
2,4,6-Trichlorophenol	3520/8270	10	2		3.2	3540/8270	0.66	40		64

Note:
Shaded values are action levels less than practical quantitation limits.

TABLE 3-13. ANALYTES, METHODS, QUANTITATION LIMITS, AND ACTION LEVELS FOR PESTICIDES, PCBS, AND HERBICIDES

Compound	Method Numbers, Water	Practical Quantitation Limit, ug/L	Subpart S Action Level, ug/L	Method Numbers, Sludge and Soil	Practical Quantitation Limit, mg/kg	Subpart S Action Level, mg/kg
Aldrin	3510/8080	0.04	0.002	3550/8080	0.00268	0.04
alpha-BHC	3510/8080	0.03	0.006	3550/8080	0.00201	0.1
beta-BHC	3510/8080	0.06	0.2	3550/8080	0.00402	4
delta-BHC	3510/8080	0.09		3550/8080	0.00603	
Chlordane	3510/8080	9.38	0.03	3550/8080		0.5
p-p'-DDD	3510/8080	0.11	0.1	3550/8080	0.00737	3
p-p'-DDE	3510/8080	0.04	0.1	3550/8080	0.00268	2
p-p'-DDT	3510/8080	0.12	0.1	3550/8080	0.00804	2
Dieldrin	3510/8080	0.02	0.2	3550/8080	0.00134	0.04
Endosulfan I	3510/8080	0.14	2	3550/8080	0.00938	3
Endosulfan II	3510/8080	0.04	2	3550/8080	0.00268	3
Endosulfan sulfate	3510/8080	0.66		3550/8080	0.04420	20
Endrin	3510/8080	0.06	0.2	3550/8080	0.00402	
Endrin aldehyde	3510/8080	0.23		3550/8080	0.01540	
Heptachlor	3510/8080	0.03	0.8	3550/8080	0.00201	0.2
Heptachlor epoxide	3510/8080	0.83	0.4	3550/8080	0.05560	0.08
Lindane	3510/8080	0.04	4	3550/8080	0.00268	0.5
Methoxychlor	3510/8080	1.76	100	3550/8080	0.11700	
Toxaphene	3510/8080	2.4	5	3550/8080	0.16100	0.6
PCB	3510/8080	0.64	0.005	8080 (b)	0.04360	0.09
2,4-D	8150	1.2	400	8150	0.80000	800
2,4-TP (Silvex)	8150	0.17	10	8150	0.11000	800

Notes:
(a) Shaded values are action levels less than practical quantitation limits.
(b) Sludge and soil samples will be extracted by sonication in hexane using a Laboratory procedure.

TABLE 3-14. SUMMARY OF ANALYSES BY MATRIX

	Media			
Analysis	Water	Sludge	Soil/Tuff	Wastes
Metals	X	X	X	X
Volatile Organics	X	X	X	X
Semivolatle Organics	X	X	X	X
Organochlorine Pesticides and PCBs	X	X	X	X
Chlorinated Herbicides	X	X	X	X
Reactive Sulfide		X		
Gross Alpha Radioactivity [see Note (a)]	X	X	X	X
Gross Beta Radioactivity [see Note (a)]	X	X	X	X
Gamma Spectroscopy [see Note (a)]		X	X	
Tritium [see Note (a)]	X	X	X	X

Notes:
(a) Radiological analyses are not being performed to support demonstration that the HWMR closure performance standard has been met. These data are being collected to support decisions regarding radiological contamination at this site that will be made as part of Environmental Restoration Program activities.

vapor AA (EPA Methods 7470 and 7471) will be used for mercury analysis. Alternately, ICP emission spectroscopy (EPA Method 6010) and other furnace AA methods (EPA 7000 series) may be used as long as the detection limits are at or below all action levels except the carcinogenic SALs for arsenic and beryllium in water and the proposed RCRA Subpart S action level for beryllium in water. These action levels are below the PQLs of current analytical methods.

Analysis of volatile organic compounds will be performed using purge and trap-gas chromatography/mass spectroscopy (GC/MS). Sample analysis by GC/MS will be performed using EPA Method 8260. Mass spectra library searches for Tentatively Identified Compounds (TICs) will be performed. Analytes, methods, required detection limits, proposed RCRA Subpart S action levels, and 1992 IWP SALs are summarized in Table 3-11.

Analysis of semivolatile organic compounds will be performed using GC/MS. Water samples will be prepared for analysis using continuous liquid-liquid extraction (EPA Method 3520). Sludge and soil samples will be prepared for analysis using sonication (EPA Method 3550) for nonradioactive samples or soxhlet extraction (EPA Method 3540) for radioactive samples. Sample extracts will then be analyzed for semivolatile organics by GC/MS using EPA Method 8270. Mass spectra library searches for TICs will be performed. Analytes, methods, PQLs, proposed RCRA Subpart S action levels, and 1992 IWP SALs are summarized in Table 3-12.

Analysis of organochlorine pesticides and PCBs will be performed using gas chromatography (GC). Water samples will be prepared for analysis using separatory funnel liquid-liquid extraction (EPA Method 3510). Sludge and soil samples will be prepared for analysis using sonication in hexane. Sample extracts will then be analyzed for organochlorine pesticides and PCBs by GC using EPA Method 8080. Analytes, methods, PQLs, proposed RCRA Subpart S action levels, and 1992 IWP SALs are summarized in Table 3-13.

Analysis of chlorinated herbicides will be performed by GC using EPA Method 8150. Analytes, methods, PQLs, and proposed RCRA Subpart S action levels are summarized in Table 3-13.

Sludge samples will be analyzed for total releasable sulfide using the test method presented in Section 7.3.4.2 of EPA SW-846 (EPA, 1986d). The sludge samples will be acidified to pH

2.0, and any gas that is generated will be trapped in an alkaline scrubber. The scrubber solution will then be analyzed for sulfide using EPA Method 9030. The test procedure will have a required detection limit of 100 mg sulfide per kg waste. The current EPA action level for sulfide for reactive wastes is 500 mg/kg (EPA, 1986d).

Radiological analysis will be performed using Laboratory procedures. Analysis for gross alpha and gross beta radioactivity will be performed using gas flow proportional counting. Approximate detection limits for gross alpha are 5 pCi/L for water and 10 pCi/g for soil and sludge. Approximate detection limits for gross beta are 6 pCi/L for water and 12 pCi/g for soil and sludge. Gamma-emitting radionuclides will be analyzed for using gamma spectroscopy. Detection limits vary with radionuclides and range from 15 to 300 pCi/L for water and 0.1 to 2.0 pCi/g for soil and sludge. Tritium will be analyzed for by distillation and liquid scintillation. The approximate detection limit is 400 pCi/L.

3.4.2 Laboratory Documentation

Documentation of sample acceptance at the analytical laboratory must be provided to the operable unit project leader (OUPL) following sample screening and log-in. This documentation may consist of signed copies of the chain-of-custody record or a letter detailing the field sample numbers accepted. Corresponding laboratory sample identification numbers should be provided to the OUPL. The laboratory is required to have procedures for minimizing cross contamination of samples and securing sample custody within the laboratory.

All laboratory analyst notebooks, log sheets, instrument printouts, charts, calculations, etc., relevant to analyses of these samples shall be identified and remain retrievable in the RPF. This information may be requested by the OUPL or quality assurance (QA) officer for independent review and validation.

The analytical laboratory shall be required to submit summary reports of analytical results to the OUPL. At a minimum, the data reports shall contain the information shown in the Data Format Checklist presented in Figure 3-9.

INCLUDE ON LAB DATA SHEETS:

Location of Sample:

Type of Sample (Matrix):

Laboratory Sample Identification Number:

Client Sample Identification Number:

Date Sample Collected:

Date Sample Received by Laboratory:

Date Sample Extracted (if appropriate):

Date Sample Analyzed:

Name and Telephone Number of Analyst:

Name, Signature, and Telephone Number of Laboratory Manager:

Weight and Volume of Sample Received:

Analytical Result With Units:

Detection Limit:

List of Tentatively Identified Compounds at or Above Method Detection Limit (if appropriate):

QA/QC That Pertains to Sample:

INCLUDE IN A NARRATIVE SUMMARY:

QA/QC Summary Listing All Technical Problems Encountered and Listing All Samples Affected:

Summary of Results by Sample for all Parameters Identified in the Closure Plan:

Report Presence of Tentatively Identified Compounds:

FIGURE 3-9. DATA FORMAT CHECKLIST

3.5 Quality Assurance/Quality Control

The OUPL is responsible for implementation of QA policies and quality control (QC) procedures. A QA officer, independent of this sampling and analysis task, will assume a QA function and report to the OUPL. The independent QA officer is responsible for conducting QA reviews to include second-level approvals of nonconformances and variances, primary approval of corrective actions, and audits of field and laboratory activities and documentation. Results of all QA reviews will be reported to the OUPL. QA review may be requested by the OUPL or higher-level management, or be initiated by the individual responsible for the QA function.

3.5.1 Field QC

Field QC activities will include collection of QC samples in addition to the field documentation requirements discussed in Section 3.3.9. QC samples to be collected include duplicate samples, trip blanks, field blanks, rinsate blanks, and laboratory QC samples. Table 3-15 summarizes field QC samples discussed in this closure plan.

Duplicate samples of water, sludge, and soil will be collected at a frequency of one duplicate sample per twenty environmental samples for each sample matrix. The field duplicate samples will be collected at the same locations as the corresponding environmental samples and will undergo the same analyses. The results of analysis of duplicate samples will be used to indicate the variability of the sampled matrix. Results will be used to calculate relative percent difference (RPD) using the following formula:

$$RPD = 100 \times (C_1 - C_2) / C_{ave}$$

where, C_1 is the concentration in the environmental sample, C_2 is the concentration in the duplicate sample, and C_{ave} is the mean of the concentrations in the environmental and duplicate samples. The RPD will be used as an indication of variability and will not be used to indicate the need for corrective actions.

Trip blanks are used to assess VOA sample integrity and contamination, which can occur during handling and transportation because of the permeable nature of the septa cap. A trip

TABLE 3-15. SUMMARY OF FIELD QUALITY CONTROL SAMPLES

QC Sample Type	Sample Matrix	Applicable Analysis	Frequency	Purpose	Acceptance Criteria	Corrective Action
Trip Blank	Water	Volatile Organics	One per shipping cooler containing samples	Monitor sample contamination in field and lab	See note (a)	Advisory -- no action required
Field Blank	Water, Soil, Bentonite, Tuff, Sludge	Volatile Organics, Semivolatile Organics, Pesticides/PCBs, Herbicides, Metals, Radionuclides	One per 20 samples -- at least one daily per analysis	Monitor field sample contamination	See notes (a) and (b)	Advisory -- no action required
Field Duplicate	Water, Soil, Bentonite, Tuff, Sludge, Waste	Volatile Organics, Semivolatile Organics, Pesticides/PCBs, Herbicides, Metals, Radionuclides	One per 20 soil/tuff, sludge, waste samples; one per 10 water samples. At least one per impoundment	Monitor sample variability	See note (c)	Advisory -- no action required
Equipment Rinsate Blank	Water, Soil, Bentonite, Tuff, Sludge, Waste	Volatile Organics, Semivolatile Organics, Pesticides/PCBs, Herbicides, Metals, Radionuclides	One per 20 soil/tuff, sludge, waste samples; one per 10 water samples.	Monitor decontamination effectiveness and sample cross contamination	See notes (a) and (b)	Advisory -- no action required

Notes:

(a) For volatiles and semivolatiles analysis, if blank shows detectable levels of any common laboratory contaminant, sample must exhibit that contaminant at a level equal to or greater than 10 times the quantitation limit to be considered detectable. For all other contaminants, sample must exhibit that contaminant at a level equal to or greater than 5 times the quantitation limit to be considered detectable.
(b) For pesticides and herbicides, if blank shows detectable level of any contaminant, sample must exhibit that contaminant at a level equal to or greater than 5 times the quantitation limit to be considered detectable.
(c) For water samples, the goal for relative percent difference is 25%. For sludge and soil samples, the goal for relative percent difference is 50%. These goals are based on the expected variability of the matrices to be sampled. Failure to meet these goals will not require corrective action, but may require evaluation cause of variability.

blank sample will accompany each shipment of water samples for volatiles analysis. Trip blanks will be prepared by the analytical laboratory from organic-free, deionized water. Two 40-mL-volume VOA sample vials will be prepared per trip blank sample. Trip blanks will be taken to the sampling site and packed one pair per shipping cooler containing VOA water samples. Trip blanks will be assigned unique sample identification numbers for tracking purposes, but will not be identified as blanks to the analytical laboratory.

Field blanks are used to assess sample contamination resulting from poor field techniques or poor ambient conditions at the site. Field blanks will be prepared from organic-free, deionized water prepared in bulk from an analytical laboratory. One container of field blank water should be taken to the field each day that water, soil, or sludge samples are collected.

Field blank samples will be prepared by pouring organic-free, deionized water from a container prepared in the laboratory to a sample container at the sample site. Field blank samples will be preserved in the same manner as water samples. Field blank samples will be collected at a frequency of one per every twenty soil, bentonite, tuff, and sludge samples and one per every ten water samples. Field blanks will be assigned a unique sample identification number for tracking purposes, but will not be identified as blanks to the analytical laboratory.

Equipment rinsate blanks are used to assess sample contamination from improperly cleaned sample equipment. Rinsate blanks will be collected after decontamination of sampling equipment. The decontaminated equipment will be rinsed with organic-free, deionized water and the rinsate collected in containers for the water samples. If disposable sampling equipment is used, rinsate blanks will be collected by rinsing an unused sampler. Rinsate blank samples will be collected at a frequency of one per every twenty soil, bentonite, tuff, and sludge samples, and one per every ten water samples. Rinsate blanks will be assigned a unique sample identification number for tracking purposes, but will not be identified as blanks to the analytical laboratory.

Laboratory QC samples are collected to provide sufficient sample volume for preparation of QC samples in the laboratory (e.g., matrix spikes and laboratory replicates). Laboratory QC samples will consist of double the required volume of sample for soil, bentonite, tuff, and sludge and triple the required volume of sample for water. Laboratory QC samples will be

collected at a frequency of one per twenty samples for each matrix. A minimum of one sample will be collected for each of the matrices being sampled.

Instrument calibration and maintenance are field activities subject to QC procedures. Field equipment requiring calibration will be limited to radioactivity-detection devices and organic vapor monitoring and other monitoring equipment specified in the HSP. This equipment will be calibrated and maintained using the manufacturer's instructions and appropriate Standard Operating Procedures.

Field personnel will monitor for organic vapors in the surface impoundment area and may prescribe additional personal protective devices based on these measurements. Monitoring shall be conducted for nonspecific organic vapors using either a photoionization detector or a flame ionization detector. Prior to field activities, the organic vapor analyzer will be calibrated by a trained technician using a calibration gas to check instrument response and ensure proper operation. Each day before monitoring at the site, the organic vapor analyzer shall be zeroed, set in an area free from organic vapors, response-checked using a commercially available calibration gas, and then taken to the surface impoundment site for monitoring.

Field documentation is an integral part of QA/QC. Field documentation requirements and procedures are discussed in detail in Section 3.3.9 of this sample plan.

3.5.2 Laboratory QC

The analytical laboratory(ies) will operate under a QA program plan that meets the requirements given in the Generic Quality Assurance Project Plan for RCRA Facility Investigations for the Los Alamos National Laboratory Environmental Restoration Program (LANL, 1991) and the NMED Components of an Adequate Laboratory Quality Assurance/Quality Control Plan. The Laboratory Quality Assurance Project Plan will specify the laboratory procedures to be used for establishing the quality of all analytical data.

3.6 Variances, Nonconformances, and Corrective Actions

Variances are deviations from approved work plans or procedures. Variance requests for field sampling and analysis procedures will be submitted to the project manager and

approved before being implemented. Telephoned or verbal approval from the project manager is sufficient to proceed with the variance. All variances from field sampling and analysis procedures will be documented in the field log book. Variances from analytical laboratory procedures will be requested, approved, and documented as described in the Laboratory Quality Assurance Project Plan.

Nonconformances are uncontrolled deviations from approved procedures of project requirements. Nonconformances may be detected and identified by project personnel or QA personnel. Every nonconformance for field procedures that affects quality will be documented and reported to the project manager and QA coordinator. Documentation will include identification of the person detecting the nonconformance, a description of the nonconformance, methods for correcting the nonconformance or a description of the variance granted, and a schedule for completing corrective action, if any. Nonconformances for analytical laboratory procedures will be documented and reported as described in the Laboratory Quality Assurance Project Plan.

Corrective actions for field procedures will be implemented as described on the nonconformance report. Documentation of corrective action implementation will be submitted to the project manager and QA coordinator. All corrective actions must be approved by the project manager and QA coordinator. Corrective actions for analytical laboratory procedures will be reported and approved as described in the Laboratory Quality Assurance Project Plan.

4.0 GROUNDWATER AND VADOSE ZONE MONITORING PROGRAM

This chapter describes groundwater monitoring activities implemented at the Technical Area (TA)-53 surface impoundments. Groundwater monitoring activities include those needed to satisfy the requirements of the New Mexico Hazardous Waste Regulations-6 (HWMR-6), Part 265, Subpart F, as well as other characterization activities.

4.1 Ground-Water Monitoring Waiver

Los Alamos National Laboratory (Laboratory) has determined that the groundwater monitoring requirements under HWMR-6, Part 265, Subpart F are waived for this site, as allowed under HWMR-6, Section 265.90(c). The Laboratory implemented a program to demonstrate that there is a low potential for migration of mixed wastes or hazardous constituents from the impoundments. This program was designed to meet the requirements for a waiver under HWMR-6, Section 265.90(c).

4.2 Vadose Zone Monitoring Program

Based on the absence of groundwater in quantities sufficient to sample in groundwater monitoring wells, the Laboratory has implemented a vadose zone monitoring program at the TA-53 surface impoundments. Vadose zone monitoring has been performed to better characterize the unsaturated zone hydrology at the site. The vadose zone monitoring program consists of an initial characterization program and ongoing monitoring. The following sections describe the monitoring program and summarize the results. The results of the monitoring program indicate that there have been no releases of RCRA-regulated hazardous constituents from the impoundments to the vadose zone.

4.2.1 Initial Vadose Zone Characterization

Four 50-ft boreholes were drilled adjacent to the impoundments to determine if a saturated zone is present and to determine if contamination has resulted from placement of liquid in the impoundments. The locations of these boreholes are identified as Boreholes 1 through 4 on Figure 4-1. An additional 50-ft borehole, identified as Borehole B on Figure 4-1, was drilled 450 ft west of the impoundments to confirm expected background moisture and tritium

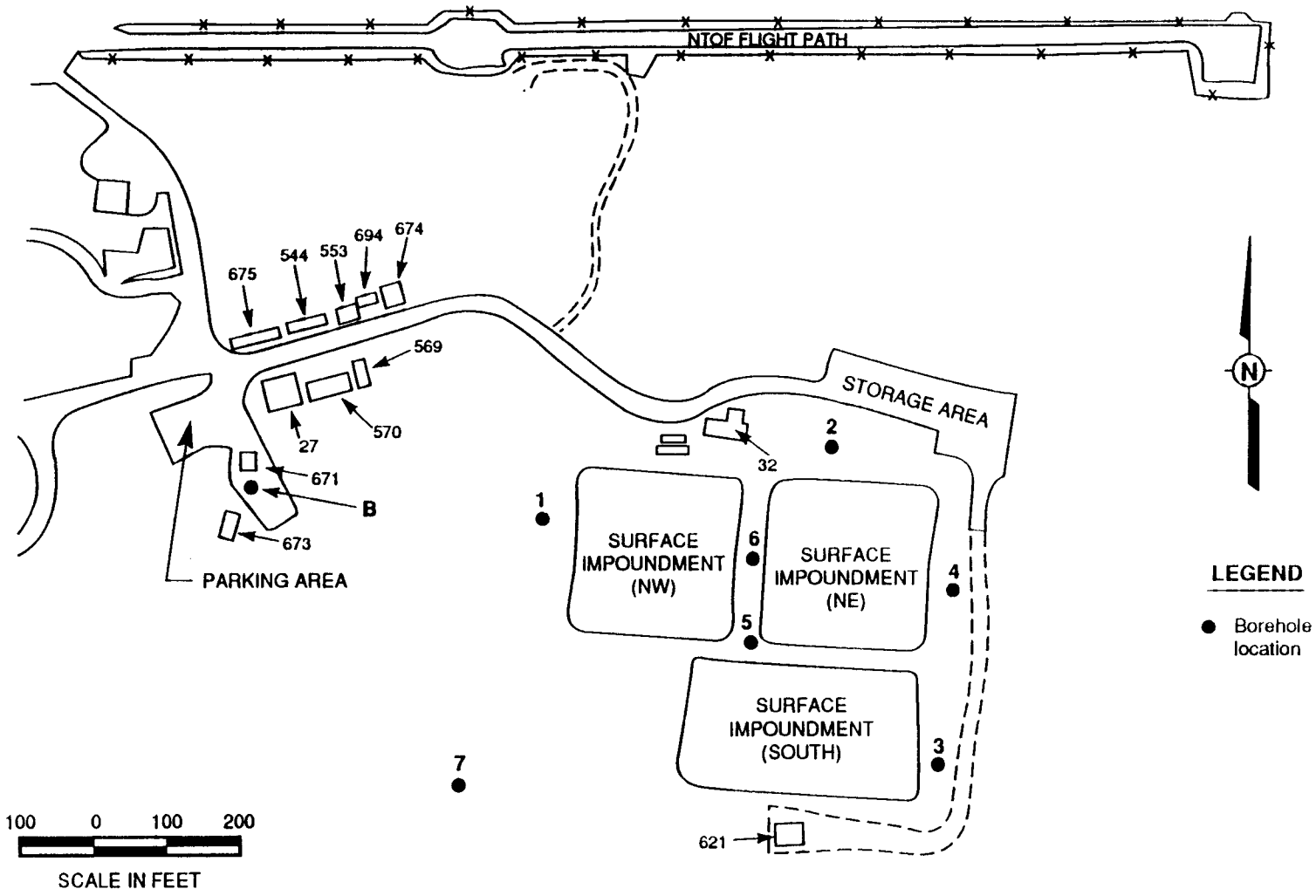

FIGURE 4-1. BOREHOLE LOCATIONS NEAR TA-53 SURFACE IMPOUNDMENTS

levels. Grab samples of cuttings were collected every 5 ft in all five 50-ft boreholes, were analyzed for tritium and gravimetric moisture, and were scanned for gamma radiation. No saturated zone was encountered. The boreholes were completed as neutron-moisture access wells. (LANL, 1992a)

A 100-ft borehole, identified as Borehole 5 on Figure 4-1, was drilled between the three impoundments to better identify the likelihood of a release. Grab samples of cuttings were collected every 5 ft for the first 50 ft, and every 10 ft thereafter. These samples were analyzed for tritium and gravimetric moisture, and were scanned for gamma radiation. This borehole was completed as a pore-gas monitoring system. (LANL, 1992a)

Two additional boreholes were drilled to collect subsurface core samples. Borehole 6 was placed between the northwest (NW) and northeast (NE) impoundments to evaluate the potential impact of these impoundments beyond the influence of a historic outfall near Borehole 5. Samples were collected at 5 ft intervals for the first 30 ft, and at 10 ft intervals thereafter, to a depth of 150 ft. These cores were analyzed for tritium and gravimetric moisture at each sampling depth; volatile organics at 5 ft through 30 ft, 50 ft, 80 ft, 100 ft, 110 ft, 140 ft, and 150 ft; semivolatile organics at 5 ft through 30 ft, 50 ft, 80 ft. 100 ft, and 150 ft; and total metals at 20 ft and 100 ft. Samples were also collected at depths of 40, 60, 100, 110, and 150 ft for hydraulic properties testing. Tests performed were initial moisture content, dry bulk density, porosity, saturated and unsaturated hydraulic conductivity, and moisture-retention characteristics. (LANL, 1992a)

Borehole 7 was drilled near the head of a small canyon directly adjacent to and southwest of the impoundments (see Figure 4-1) to identify impact from the impoundments at depths beyond Boreholes 1 through 6 and B. Samples were collected at 5 ft intervals for the first 35 ft, and at 10-ft intervals thereafter, to a depth of 80 ft. These samples were analyzed for tritium and gravimetric moisture. Three samples, collected at depths of 5 ft, 20 ft, and 80 ft, were analyzed for volatile and semivolatile organics. Samples were collected at depths of 70 and 80 ft for hydraulic properties testing. This borehole was completed as a neutron-moisture access well with a cup lysimeter. (LANL, 1992a)

Results of analysis of soil samples collected from the boreholes were previously submitted to the New Mexico Environment Department with the Part B permit application for the

impoundments (LANL, 1992a). These results showed no detectable organics and no metals above expected background. Results of gravimetric moisture and tritium analyses indicated that some migration of tritium into the subsurface has apparently occurred. The source of this tritium is not known. Possible sources include discharges to the ditch south of the NE and NW impoundments that occurred before construction of the S impoundment, evaporation from the impoundments, air/stack emissions, and/or infiltration from the impoundments (LANL, 1992c). These results, however, do not indicate release of RCRA-regulated hazardous constituents. Samples that contained elevated levels of tritium showed no detectable organic hazardous constituents and no levels of metals above expected background (LANL, 1992a).

4.2.2 Vadose Zone Monitoring

The vadose zone monitoring system consists of one borehole with five pore-gas sample ports and five boreholes completed as neutron-moisture access wells, one of which also has a cup lysimeter. The following paragraphs present a brief description of the monitoring program and summarize relevant results. More detailed descriptions are presented in the Part B permit application for the impoundments (LANL, 1992a) and the Exposure Assessment Information Report (LANL, 1992c).

The pore-gas monitoring system was installed in Borehole 5. Pore-gas sample ports were installed at depths of 20, 40, 60, 80, and 93.5 ft. The pore-gas monitoring program is described in the Part B permit application for the impoundments. The program calls for pore gas to be sampled quarterly for one year and, if no organic hazardous constituents are detected, semiannually thereafter until closure. If organic constituents were detected before closure, quarterly sampling would resume until no significant increase was detected. Semiannual sampling would resume at that time (LANL, 1992a).

Pore-gas monitoring was performed on August 29, 1991; December 16, 1991; March 27, 1992; June 23, 1992; and September 23, 1992. Pore-gas samples were analyzed for volatile organic compounds. No volatile organics have been detected in any of the samples at or above the detection limit of 8 ug per sample tube. These results do not indicate release of any RCRA-regulated volatile hazardous constituents from the impoundments. It is noted that low boiling point compounds that chromatographically elute before or coelute with the carbon

disulfide used to extract the sample tubes (e.g., vinyl chloride or chloromethane) would not be observed by the analytical procedure.

Borings 1. 2, 3, 4, 7, and B were completed as neutron-moisture access wells. The moisture content monitoring program is described in the Part B permit application for the impoundments. The program calls for neutron-moisture access wells to be monitored quarterly until two consecutive years have passed with no indication of significant increase in moisture; then monitoring would occur semiannually until closure. If moisture levels increase prior to closure, quarterly sampling would resume until no significant increase was detected. Semiannual sampling would resume at that time (LANL, 1992a).

Neutron moisture monitoring was performed on August 29, 1991; December 10 and 11, 1991; April 22 and 23, 1992; June 17, 1992; July 6, 1992; and September 16 and 18, 1992. The results from the neutron moisture monitoring do not shown any significant changes in moisture content.

5.0 CLOSURE AND POSTCLOSURE REQUIREMENTS

This chapter describes how requirements of the New Mexico Hazardous Waste Regulations-6 (HWMR-6) for closure of the TA-53-166 northeast (NE) and northwest (NW) impoundments will be met. Section 5.1 describes general closure requirements, and Section 5.2 describes requirements applicable to surface impoundments. Decontamination procedures are presented in Section 5.3, and Section 5.4 discusses postclosure requirements.

5.1 General Closure Requirements

This section describes how general closure requirements applicable to interim status facilities will be met.

5.1.1 Partial and/or Final Closure Activities [HWMR-6, Sections 265.111, 265.112, and 265.228(a)(1)]

This plan presents the activities required for final closure of the TA-53-166 NE and NW surface impoundments. Los Alamos National Laboratory (Laboratory) intends to close the TA-53 surface impoundments in accordance with the clean closure requirements of HWMR-6, Sections 265.111 and 265.228(a)(1). To meet these requirements, all mixed wastes will be removed. All waste residues, containment system components, subsoils, and structures and equipment contaminated above health-based levels will either be removed or decontaminated. Waste residues, containment system components, subsoils, and structures and equipment having hazardous constituents below health-based levels may be left in place or removed.

5.1.1.1 Closure Performance Standard (HWMR-6, Section 265.111)

The surface impoundments will be closed in a manner that:

- minimizes the need for further maintenance, and
- controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, postclosure escape of mixed waste, hazardous constituents,

leachate, contaminated run-off, or mixed waste decomposition products to ground or surface waters or to the atmosphere.

This standard will be met by the removal of all mixed wastes from the surface impoundments. In addition, all sludge, liners, soil, equipment, and structures contaminated with HWMR-6, Part 261 Appendix VIII constituents above health-risk-based cleanup levels will be removed or decontaminated.

All equipment will be decontaminated, using the procedures described in Section 5.3.1, or removed for final disposition. All residuals resulting from decontamination will be removed for final disposition as described in Section 5.3.2.

The closure performance standard does not address radioactive contaminants that may be present in the impoundments. Any actions necessary to protect human health and the environment from exposure to radionuclides at this site will not be addressed as part of this closure plan, but will be addressed through the Laboratory Environmental Restoration Program. Radioactive contamination at this site will be evaluated during the Resource Conservation and Recovery Act (RCRA) Facility Investigation for TA-53 (Operable Unit 1100).

5.1.1.2 Cleanup Levels

The approach for determining whether the closure performance standard has been met is illustrated in Figure 5-1. Under this approach, cleanup levels will only be identified for constituents for which there are established, defensible human health toxicity data. These constituents are limited to those having Installation Work Plan for Environmental Restoration (IWP) screening action levels (SALs) or proposed RCRA Subpart S action levels (EPA, 1990).

As shown in Figure 5-1, measured concentrations of constituents in sludge, soil, bentonite, and tuff will initially be compared to SALs. If all values are below the SAL, the closure performance standard will be met for that constituent. If values are above the SAL, three options exist: contaminated areas can be removed, contaminants can be closed in place, or a site-specific risk assessment can be performed to determine a cleanup level. The decision of which option to take will depend on the extent and levels of contamination. If levels are

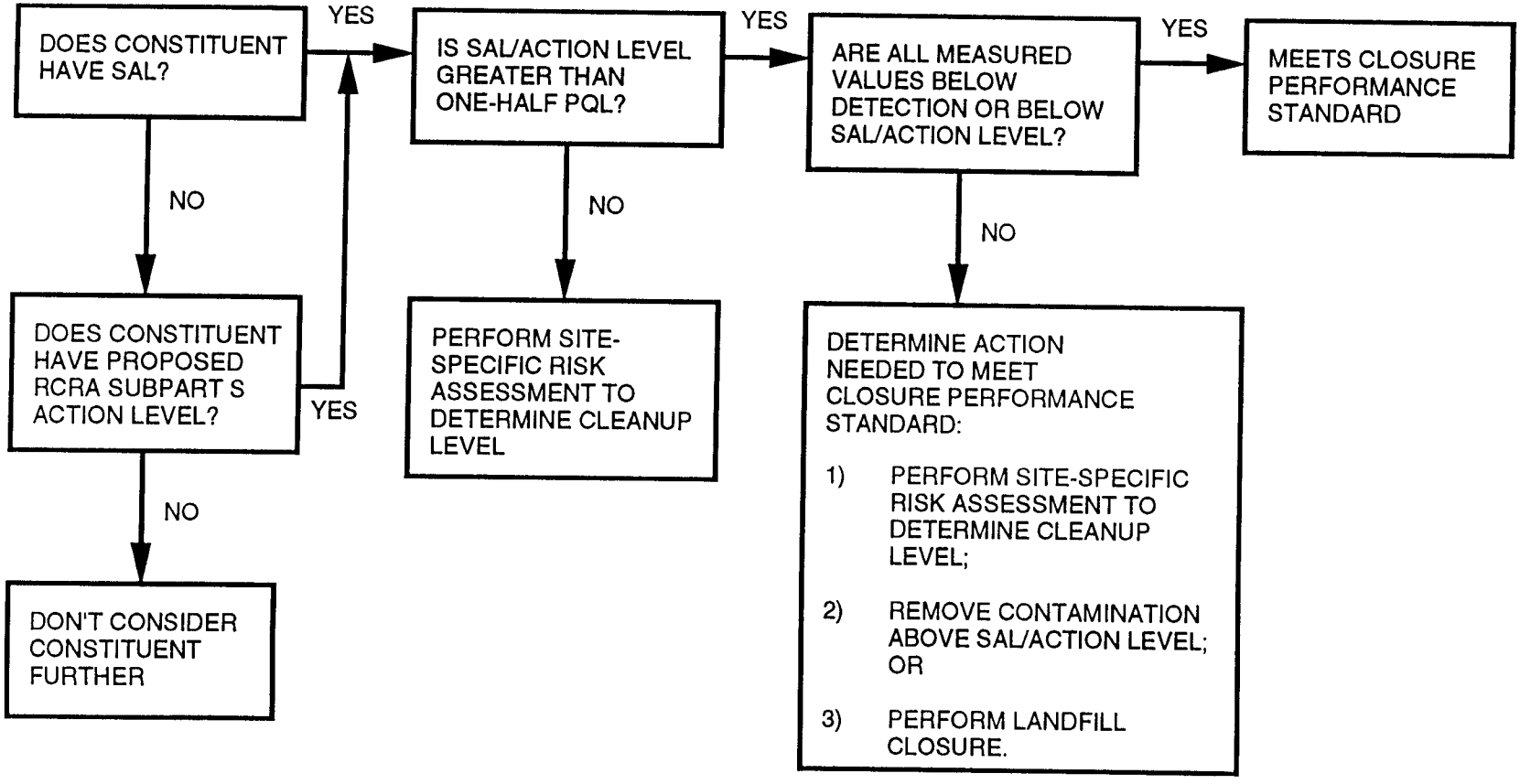

FIGURE 5-1. PROCESS FOR DETERMINING IF CLOSURE PERFORMANCE STANDARD IS MET

greatly above the SALs and contamination is localized, removal will probably be undertaken. If levels are greatly above the SALs and the extent of contamination is great, landfill closure will probably be undertaken. If levels are not greatly above the SALs, a risk assessment will probably be performed.

If it is necessary to close the impoundments as landfills with contamination left in place, the requirements of HWMR-6, Section 265.228(a) will be met. Before implementing landfill closure, an amended closure/postclosure Plan will be prepared and submitted to the NMED.

If a constituent does not have an SAL, the approach described above will be used with the proposed RCRA Subpart S action level. If a constituent does not have either an SAL or a Subpart S action level, it will not be considered further unless levels indicate a characteristic mixed waste.

Special consideration must be given to constituents whose SAL or RCRA Subpart S action level is less than the practical quantitation limit (PQL). PQLs for the contaminants being considered are included in Tables 3-10 through 3-13. If the SAL or RCRA Subpart S action level is greater than or equal to one-half the PQL and all constituent concentrations are below detection, the closure performance standard will be met. The rationale for this decision is Environmental Protection Agency (EPA) guidance that calls for one-half the detection limit to be used as the concentration for constituents below detection when performing risk assessments (EPA, 1989). If the SAL or RCRA Subpart S action level is less than one-half the PQL, site-specific health-risk-based cleanup levels will be established. These cleanup levels will be established in accordance with current EPA guidance for human health risk assessments (EPA, 1989; EPA, 1991a; EPA, 1991b; EPA, 1992).

5.1.1.3 Contents of Plan [HWMR-6, Section 265.112(b)]

This Plan identifies the steps necessary to perform final closure of the surface impoundments.

- Section 5.2.1 describes how the impoundments will be closed in accordance with the closure performance standard in Section 5.1.1.1 [HWMR-6, Section 265.112(b)(1)].

- Section 5.2.2 provides a general description of how final closure will be conducted [HWMR-6, Section 265.112(b)(2)].

- Section 5.2.3 identifies the maximum extent of operation that was unclosed during the active life of the impoundments [HWMR-6, Section 265.112(b)(2)].

- Section 5.2.4 estimates the maximum inventory of mixed waste in the impoundments during the active life of the impoundments [HWMR-6, Section 265.112(b)(3)].

- Section 5.2.5 provides a detailed description of the methods that will be used to characterize, remove, transport, treat, store, and dispose all mixed wastes. In addition, it identifies the off-site mixed waste management unit(s) to be used, if applicable, and the type(s) of unit(s) to be used. This section also references specific sampling and analysis procedures that will be used [HWMR-6, Section 265.112(b)(3)].

- Section 5.2.6 provides a detailed description of the steps needed to characterize, remove, or decontaminate all materials and equipment contaminated with hazardous constituents above the health-based cleanup levels. This section references methods for sampling and analysis, and criteria for determining the extent of decontamination necessary to satisfy the closure performance standard [HWMR-6, Section 265.112(b)(4)].

- Section 5.2.7 provides a detailed description of other activities necessary to ensure that the closure performance standard is met [HWMR-6, Section 265.112(b)(5)].

- Section 5.2.8 provides a schedule for final closure of each impoundment. This schedule includes the total time required to close each impoundment, and the time required to perform all of the activities described in Section 5.2 [HWMR-6, Section 265.112(b)(6)].

5.1.1.4 Amendment of Closure Plan [HWMR-6, Section 265.112(c)]

No changes in unit operating plans or unit design are expected that would require amendment to the closure plan.

The closure plan will be amended and submitted to the NMED whenever:

- there is a change in the expected year of closure, or
- an unexpected event is encountered during final closure activities that requires amendment to the closure plan. An unexpected event would include the discovery of mixed waste residuals that cannot be removed.

The closure plan must be amended and submitted to the NMED within 60 days after an unexpected event has occurred that affects the closure plan. If the unexpected event occurs during the final closure period, the closure plan must be amended and submitted within 30 days after the unexpected event. In addition, if an approved plan is being amended, a written request to authorize a change to the approved plan must accompany the amended plan.

The Laboratory Environmental Restoration Group (EM-13) will be responsible for maintaining and amending the closure plan.

5.1.1.5 Notification of Closure [HWMR-6, Section 265.112(d)]

Submission of the closure plan constitutes notification of the Laboratory's intent to close these impoundments. This notification is being made within 30 days of the last receipt of wastes at the impoundments, which was February 2, 1993. The date of the last receipt of mixed waste at the impoundments is not known as it is uncertain whether mixed wastes were ever discharged to the impoundments.

5.1.1.6 Closure Activities Performed Prior to Notification of Closure [HWMR-6, Section 265.112(e)]

The Laboratory did not begin removal of mixed wastes and decontamination or dismantling of equipment prior to notification of final closure.

5.1.2 Time Allowed for Closure [HWMR-6, Section 265.113]

5.1.2.1 Extension of Closure Timeframe [HWMR-6, Sections 265.113(a),(b)]

The closure regulations require the Laboratory to remove all mixed wastes within 90 days of closure plan approval and to complete final closure activities within 180 days after approval of the closure plan, unless a longer period has been approved.

An extension of these closure timeframes is requested. Sections 5.2.5 and 5.2.6 demonstrate that the waste removal may, of necessity, take longer than 90 days after approval of the closure plan, and final closure activities may, of necessity, take longer than 180 days after approval of the closure plan.

As described in Sections 5.2.5 and 5.2.6, removal of wastes and completion of closure activities will depend on removal of the water from the impoundments by evaporation. The time required for evaporation of water from the impoundments will depend on weather conditions and cannot be accurately predicted. Based on available data, evaporation of the water is expected to take from twelve to sixteen months from cessation of discharge of wastewater to the impoundments (February 2, 1993). As shown in Section 5.2.8, closure activities are not expected to be completed until mid-1994.

5.1.2.2 Timeframe for Demonstrations for Extensions [HWMR-6, Section 265.113(c)]

Section 5.1.2.1 includes an initial request for extension of the timeframe for removal of wastes and completion of closure activities.

If waste removal will take longer than the timeframe provided in Section 5.2.8, the Laboratory will submit a demonstration, referred to in HWMR-6, Section 265.113(a)(1), within at least 30 days before the expiration of the timeframe for waste removal provided in Section 5.2.8.

If completion of final closure activities will take longer than the timeframe provided in Section 5.2.8, the Laboratory will submit a demonstration referred to in HWMR-6, Section 265.113(b)(1) within at least 30 days before the expiration of the timeframe for completion of closure activities in Section 5.2.8.

5.1.3 Disposal or Decontamination of Equipment, Structures, and Soils [HWMR-6, Section 265.114]

During the final closure period, all equipment, structures, and soil contaminated above health-based levels must be properly disposed of or decontaminated.

Contaminated equipment will be decontaminated in accordance with the procedures described in Section 5.3.1.

Contaminated structures and soils will be identified, decontaminated, removed, and disposed of in accordance with the procedures described in Section 5.3.1.

All materials contaminated with hazardous constituents above health-based cleanup levels will be decontaminated or removed. Section 5.3.2 describes how wastes generated during closure will be managed.

Section 5.3.3 describes the criteria used to determine when decontamination and removal activities have met the closure performance standard.

Section 5.3.4 describes the specific sampling and analysis procedures to be used to verify that all materials remaining on site after closure meet the closure performance standard.

5.1.4 Certification of Closure [HWMR-6, Section 265.115]

Within 60 days of completion of the final closure activities described in this plan, a certification of closure will be submitted to the NMED. This certification will indicate that the TA-53-166

NE and NW surface impoundments have been closed in accordance with the specifications in the approved closure plan. The closure certification will be submitted by registered mail and will be signed by the DOE Los Alamos Area Office Manager and the Laboratory Associate Director for Support, or their authorized representatives, and by an independent, registered professional engineer. Exhibits 5-1 and 5-2 are examples of the closure certificates that will be submitted in the Final Closure Report described in Chapter 6.0. In addition, documentation supporting the independent registered professional engineer's certification will be furnished to the NMED at this time. This documentation will consist of the Final Closure Report described in Chapter 6.0.

5.1.5 Survey Plat [HWMR-6, Section 265.116]

This closure plan does not include closure of the surface impoundments as landfills. Thus, submission of a survey plat indicating the location of landfill units is not required. If, during closure, it is determined that it is necessary to close any areas as disposal units, the closure plan will be amended. The amended plan will include the survey plat requirements of HWMR-6, Section 265.116.

5.1.6 Closure Cost Estimate (HWMR-6, Section 265.142)

A closure cost estimate is not required because federal facilities are exempt from this requirement per HWMR-6, Section 265.140(c).

5.1.7 Financial Assurance for Closure (HWMR-6, Section 265.143)

Financial assurance mechanisms are not required because federal facilities are exempt from this requirement per HWMR-6, Section 265.140(c).

EXHIBIT 5-1. SAMPLE OWNER OR OPERATOR CLOSURE CERTIFICATION

The undersigned, the United States Department of Energy, Albuquerque Operations, and the University of California, which formerly owned or operated the Technical Area (TA)-53-166 Northwest and TA-53-166 Northeast surface impoundments (hereinafter "Facility) located at Los Alamos National Laboratory, in Los Alamos County, New Mexico, permanently ceased the active operation of the facility and have fully implemented all measures relating to the closure of the facility as set forth in the closure plan approved by the New Mexico Environment Department for said facility.

NOW, THEREFORE, we, the United States Department of Energy, Albuquerque Operations, and the University of California, hereby swear and affirm that the above-named facility has been closed in accordance with the facility's closure plan approved in writing by the Secretary, New Mexico Environment Department, on _____, 19_, that all measures relating to the closure of the facility required by the closure plan and the New Mexico Hazardous Waste Regulations have been fully implemented, and that to the best of our knowledge, no violations exist that may have arisen prior to closure.

For the United States Department of Energy, Albuquerque Operations (Owner/Operator):	For the University of California (Operator):
_____	_____
(Signature)	(Signature)
_____	_____
(Name)	(Name)
_____	_____
(Title)	(Title)

Taken, sworn and subscribed before me, this
_____ day of _____ A.D. 19_

_____

_____
(Notary)

EXHIBIT 5-2. SAMPLE INDEPENDENT REGISTERED PROFESSIONAL ENGINEER CLOSURE CERTIFICATION

I, _____(Name)_____, a Professional Engineer registered pursuant to the Professional Engineers registration laws of the State of New Mexico, hereby certify that I have reviewed the closure plan for the Technical Area (TA)-53-166 Northwest and TA-53-166 Northeast surface impoundments ("facility") at Los Alamos National Laboratory, that I am familiar with the New Mexico Hazardous Waste Regulations applied to closure of such facility, and that I personally have made visual inspection(s) of the aforementioned facility, and that the closure of the aforementioned facility has been performed in full and complete accordance with the facility's closure plan approved in writing by the Secretary, New Mexico Environment Division, on _____, 19_, and the New Mexico Hazardous Waste Regulations.

_____ _____

(Signature) (Date)

_____

(Professional Engineering License Number)

(Seal)

_____

(Business Address)

_____

(Telephone Number)

5.1.8 Liability Requirements (HWMR-6, Section 265.147)

Liability coverage is not required because federal facilities are exempt from this requirement per HWMR-6, Section 265.140(c).

5.2 Specific Closure Requirements for Surface Impoundments

5.2.1 Description of How Each Unit Will be Closed [HWMR-6, Section 265.112(b)(1)]

The water in the impoundments will be sampled and removed as described in Sections 3.3.4 and Section 5.2.5, respectively. The sludge and waste residues (i.e., bentonite liner, soils, and tuff) may be removed from the impoundments if sample analysis reveals that concentrations of HWMR-6, Part 261 Appendix VIII hazardous constituents are above the cleanup levels discussed in Section 5.1.1.2 or that the sludge or residues are characteristic mixed wastes. If removal is necessary, confirmatory sampling will be performed to demonstrate that all contaminated materials above the cleanup levels or mixed-waste characteristic levels have been removed. Sludge and waste residues will remain in the impoundment if analysis reveals that the closure performance standard has been met (Section 5.1.1.2) and the residues are not mixed wastes. All contaminated materials removed from the impoundments will be packaged, labeled, and transported to TA-54 in accordance with Laboratory waste management requirements. Wastes that are determined through sampling and analysis to be nonhazardous, low-level radioactive wastes will be taken to TA-54 Area G for disposal. Wastes that are determined to be mixed wastes will be taken to a storage facility at TA-54 that is operating under interim status.

5.2.2 Description of how Final Closure will be Conducted [HWMR-6, Section 265.112(b)(2)]

Clean closure of the impoundments will be performed through several activities. These activities include: 1) sampling of the water and sludge in the impoundments; 2) removal of water from the impoundments by evaporation; 3) sampling of the bentonite liner and soils/tuff; 4) removal and disposal of contaminated materials, if necessary based on the results of sampling and analysis; and 5) stabilization of the site. The sampling activities are discussed in detail in Section 3.3. Removal activities are discussed in Sections 5.2.5 and 5.2.7. Stabilization is discussed in Section 5.2.7.

If it is determined that removal of all contaminated materials is not feasible due to the nature and extent of contamination, the impoundments will be closed as landfills as required by HWMR-6, Section 265.228(a)(2) and an amended closure/postclosure plan will be prepared and submitted to the NMED.

5.2.3 Identification of Maximum Extent of Operation [HWMR-6, Section 265.112(b)(2)]

The TA-53-166 NE and NW impoundments were in operation at the same time. The maximum extent of operation, therefore, includes storage of wastes in both impoundments and any release of wastes beyond the impoundments by leakage. The extent, if any, of release by leakage through the liners will be assessed through soil sampling, as described in Section 3.2.

5.2.4 Estimate of the Maximum Inventory of Hazardous Waste [HWMR-6, Section 265.112(b)(3)]

In Section 3.1.2.5., it was concluded that the water and sludge currently in the impoundments are not clearly mixed wastes under HWMR-6, Part 261. Therefore, there is no current inventory of mixed wastes. Because of incomplete knowledge concerning past disposal of mixed wastes to the impoundments, it is not possible to determine the maximum, if any, historical inventory of mixed wastes. The maximum inventory of water and sludge in the impoundments will be used as a conservative estimate of the maximum inventory of mixed wastes that may ever have been in the impoundments. A conservative estimate of the maximum inventory of water is the volume of water present when the impoundments were full (i.e., water was discharging). The maximum inventory of sludge is the inventory on February 2, 1993, when inflow to the impoundments was stopped. This inventory is the maximum sludge inventory because no sludge has ever been removed from the impoundments. These inventories are estimated below.

The maximum depth of water in the impoundments is 4 ft, which is the difference between the maximum water elevation and the elevation of the bottom of the impoundments. The design capacity of each impoundment, based on this maximum water elevation, is 1,629,144 gal. This volume represents the maximum inventory of water in each impoundment.

The sludge in the north impoundments has never been removed. Based on previous sampling activities, the sludge is estimated to be 3- to 18-in. thick (DOE, 1989). For a sludge thickness of 3 in., each impoundment will contain approximately 8,700 ft^2 (0.20 acre-ft) of sludge. For a sludge thickness of 18 in., each impoundment will contain approximately 54,000 ft^2 (1.23 acre-ft) of sludge. Therefore, it is estimated that each impoundment contains approximately 8,700 to 54,000 ft^2 of sludge, taking into account the 2:1 slope of the impoundment walls.

5.2.5 Detailed Description of Removal of Waste Inventory [HWMR-6, Section 265.112(b)(4)]

Water in the impoundments will be removed by direct evaporation from the NE and NW impoundments. An evaporation timetable is shown in Table 5-1. This table shows losses that would occur following cessation of influent to the impoundments on February 2, 1993. Precipitation input is based on mean precipitation data for Los Alamos (LANL, 1992d). Evaporation is based on data for 1987 presented in the Exposure Information Assessment Report (LANL, 1992c).

The time required to evaporate the water down to the top of the sludge will depend on the depth of the sludge in the impoundments. It is estimated that the sludge depth is from 3 to 18 in. Based on an initial depth of 48 in. of water in the impoundments, it would require from 12 to 16 months to evaporate the water to the top of the sludge. If it is necessary to increase the evaporation rate, the impoundment aerators can be used.

The results from analysis of sludge will be used to determine whether the closure performance standard has been met, as described in Section 5.1.1.2. If results indicate that the standard has not been met, it may be necessary to remove sludge from the impoundments. The specific methods and procedures to be used for removal will depend on the extent of contamination. Any expected removal can be performed with wheel- or track-mounted excavation equipment. All sludge removed from the impoundments will be packaged, labeled, and transported to TA-54 in accordance with approved Laboratory waste management procedures. Wastes that are determined through sampling and analysis to be nonhazardous, low-level radioactive wastes will be taken to TA-54 Area G for disposal. Wastes that are determined to be mixed wastes will be taken to a storage facility at TA-54 that is operating under interim status.

TABLE 5-1. ESTIMATED EVAPORATION TIMETABLE FOR TA-53 IMPOUNDMENTS

Month	Precipitation (in.)[a]	Evaporation (in.)[b]	Net Loss (in.)
February 1993	0.80	2.82	2.02
March	1.22	5.80	6.60
April	1.01	6.16	11.75
May	1.17	5.84	16.42
June	1.36	4.31	19.37
July	3.26	7.92	24.03
August	3.52	6.04	26.55
September	2.12	3.06	27.49
October	1.30	2.12	28.31
November	1.02	1.65	28.94
December	1.08	1.57	29.43
January 1994	0.86	1.92	30.49
February	0.80	2.82	32.51
March	1.22	5.80	37.09
April	1.01	6.16	42.24
May	1.17	5.84	46.91

Notes:

(a) Based on mean precipitation data in Table G-60, 1990 Environmental Surveillance Report. (LANL, 1992d). Includes water equivalent of frozen precipitation.

(b) Based on evaporation data (1987) in Appendix V, Exposure Assessment Information, TA-53 Surface Impoundments, (LANL, 1992c).

5.2.6 Detailed Description of Removal of Waste Residues [HWMR-6, Section 265.112(b)(4)]

The bentonite impoundment liners, and the soil and tuff beneath the bentonite and gunite impoundment liners will be sampled as described in Section 3.3.6. The results of soil and tuff sample analysis will be used to determine whether the closure performance standard has been met, as described in Section 5.1.1.2. If results indicate that the standard has not been met, it may be necessary to remove contaminated soil and/or tuff. The specific methods and procedures to be used for removal will depend on the extent of contamination. Any expected removal can be performed with wheel- or track-mounted excavation equipment. If it is necessary to remove soil from the berms, the gunite liner will also be removed and sampled to determine how it can be disposed of. All contaminated soil, tuff, and liner material will be packaged, labeled, and transported to TA-54 in accordance with approved Laboratory waste management procedures. Soils, tuff, and liner material that are determined through sampling and analysis to be nonhazardous, low-level radioactive wastes will be taken to TA-54 Area G for disposal. Soils, tuff, and liner material that are determined to be mixed wastes will be taken to a storage facility at TA-54 that is operating under interim status.

5.2.7 Detailed Description of other Necessary Activities [HWMR-6, Section 265.112(b)(5)]

Following completion of sampling activities, the site will be temporarily stabilized by covering the impoundments with a 30-mil polyethylene cover. This cover will extend over the tops of the impoundment dikes. This cover will be installed to:

- prevent airborne release of radioactive contaminants in the sludge;
- prevent precipitation from contacting the sludge;
- prevent contact with the sludge by humans and animals; and
- provide a temporary wastewater storage facility for use in conjunction with closure of the south impoundment.

If the results of the sludge, soil, bentonite, and tuff sampling indicate that materials must be removed from the impoundments to meet the closure performance standard, the cover can be temporarily removed to allow removal.

The requirements for final stabilization of the impoundments following completion and certification of closure under HWMR-6 will be determined through the Laboratory Environmental Restoration Program.

The weekly inspections required by HWMR-6, Section 265.226(a)(2) will be continued until closure is complete. Daily inspections for freeboard will not be performed because wastewaters are no longer being added to the impoundments and the existing freeboard is adequate to contain precipitation (see Table 5-1).

The specific activities identified in HWMR-6, Section 265.112(b)(5) (i.e., groundwater monitoring, leachate collection, and run-on and run-off control) are not necessary to complete closure. Groundwater monitoring is not required, as discussed in Chapter 4.0. No leachate will be generated during closure. Run-on and run-off will be controlled by the existing surface impoundment dikes.

5.2.8 Schedule for Closure of Each Unit [HWMR-6, Section 265.112(b)(6)]

The two impoundments will be closed simultaneously. The estimated schedule for closure activities is presented in Figure 5-2.

Water and sludge sampling and analysis will be performed concurrently with water evaporation. Water and sludge sampling will be performed after this closure plan has been approved by the NMED and sufficient water has evaporated to facilitate sampling. Sampling will not be performed until the water has evaporated to a depth of 1 ft above the maximum thickness of sludge. Allowing the water to evaporate to this depth will make it easier to perform the sludge sampling procedure described in Section 3.3.5. The water will not be allowed to evaporate below this depth, to avoid having the sludge layer be disturbed by the boat used for sampling. If this closure plan has not been approved by the time that the water evaporates to this depth, clean water will be added to the impoundments to maintain this depth until sampling can be performed. The remaining sampling will be performed after water

has been evaporated to the maximum allowable extent based on the results of the sludge sampling and analysis.

The results of the sludge sample analysis will be used to determine whether site-specific risk-based cleanup levels are needed. The results of the sludge analysis will also be used to evaluate the hazard associated with potential airborne releases. This evaluation will be used to determine whether the sludge can be allowed to dry completely or whether it must be maintained wet.

Liner and soil/tuff sampling will be performed after evaporation to the maximum allowable extent is complete. The need for removal and confirmatory sampling will be evaluated after receipt and review of analytical data and development of risk-based cleanup levels, if necessary. Following completion of soil/tuff sampling, the impoundments will be temporarily stabilized by installation of a polyethylene cover.

The total estimated cumulative time to complete closure, assuming no removal or confirmatory sampling is needed, ranges from 16.5 months to 20.5 months. This estimate is based on twelve to sixteen months for evaporation (including water and sludge sampling and analysis and cleanup level development), two weeks for soil, bentonite, and tuff sampling, three months for soil, bentonite, and tuff sample analysis, and one month for preparation of the Final Closure Report. If removal and confirmatory sampling are necessary, an additional six months is expected to be needed.

5.3 Decontamination Procedures [HWMR-6, Section 265.112(b)(4)]

Decontamination efforts during closure of the TA-53 surface impoundments will involve decontamination of sampling equipment; any equipment operated within the impoundments to remove sludge, soil, bentonite or tuff; and the gunite impoundment liners. Removal of contaminated sludge, soil, bentonite, and tuff was previously described in Sections 5.2.5 and 5.2.6, respectively.

ACTIVITY	MONTHS AFTER START OF CLOSURE																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Submit Closure Plan	X																		
Closure Plan Approved [See Note (a)]						X													
Water and Sludge Sampling							XX												
Water and Sludge Sample Analysis							XXX	XXXX	XXXX	XX									
Development of Risk-Based Cleanup Levels										XXX	XXXX	XX							
Evaporation of Water [See Note (b)]	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX					
Liner and Soil/Tuff Sampling															XX				
Liner and Soil/Tuff Sample Analysis															XXX	XXXX	XXXX	XX	
Install Impoundment Covers															XXX	XXXX	XX		
Preparation of Final Closure Report																		XXX	XX

Notes:
(a) Six month period for revision and approval of closure plan is assumed.
(b) Fourteen month period shown for evaporation is middle of estimated range of twelve to sixteen months.

FIGURE 5-2. ESTIMATED CLOSURE SCHEDULE

5.3.1 Procedures for Cleaning Equipment and Removing Contaminated Soils [HWMR-6, Section 265.112(b)(4)]

Sampling equipment, and any other small equipment that comes into contact with water, sludge, or other residuals will be decontaminated after use. Decontamination will take place at the area specifically established for that purpose. Decontamination of small equipment will be performed as follows:

1) Equipment will be given a radiological survey to determine whether it is radioactively contaminated. Radiological surveys will be performed using Laboratory procedures. Separate decontamination lines will be used for radioactively contaminated equipment and nonradioactively contaminated equipment, and decontamination wastes from these two lines will be segregated. The two lines will use identical decontamination procedures.

2) Equipment will be thoroughly scrubbed using a solution of Alconox® or other nonphosphate laboratory detergent. Detergent strength will be per the manufacturer's recommendations. All visible signs of contamination will be removed.

3) Equipment will be thoroughly rinsed with clean tap water so that no detergent is left on the equipment.

4) Equipment will be triple rinsed with organic-free deionized water.

5) If the equipment is not to be used immediately, it will be allowed to air dry and will be wrapped with aluminum foil, with the dull side of the foil toward the equipment.

6) All equipment will be radiologically surveyed to confirm radiological decontamination.

All decontamination wastes (i.e., wash and rinse waters) will be collected in polyethylene-lined drums. Polyethylene is compatible with the dilute detergent and any contaminants expected to be present in the decontamination wastes.

Large equipment operated within the impoundments will be decontaminated within a bermed, lined decontamination area established for this purpose. Before beginning decontamination, the condition of the liner will be evaluated to determine if it is in suitable condition. The decontamination area liner will be inspected for tears, holes, and integrity of seams, if any. If the liner is judged to be in unsatisfactory condition, a new liner will be installed.

Prior to decontamination, all equipment will be radiologically surveyed to determine if the equipment is radioactively contaminated. Liquid wastes from decontamination of radioactively contaminated equipment will be kept separate from those from nonradioactively contaminated equipment.

Large equipment will be decontaminated by steam cleaning using a nonphosphate detergent solution. This equipment will be steam cleaned until all visible contamination is removed, and then rinsed with clean tap water. A sample of the final water rinse will be collected to verify decontamination. Liquid decontamination wastes will be collected within the bermed area and pumped into polyethylene-lined drums. Residual liquid that cannot be pumped from the bermed area will be absorbed using absorbent pillows or pads. The absorbent will be placed in polyethylene-lined drums. Solids and sludges will be scooped from the bermed area into polyethylene-lined drums.

After all equipment decontamination is complete, all wastes will be pumped from the decontamination area liner into drums. The liner will then be decontaminated by steam cleaning followed by three rinses with clean water. The wash and rinse water will be pumped into drums at the completion of each wash/rinse. A sample of the final water rinse will be collected to verify decontamination. The decontamination area liner will be allowed to air dry and will then be removed for disposal. The liner will be cut into strips approximately 30-in. wide. Each strip will be rolled to fit into an open-top 55-gal. polyethylene-lined drum. Before placement in the drums, the liner material will be given a radiological survey to determine if it will be managed as solid waste or low-level waste. Each drum will be filled with liner material, sealed, labeled, and transported to TA-54 for disposal.

The gunite impoundment liners will be decontaminated by steam cleaning followed by water rinsing. The gunite liner will be decontaminated from the top of the liner down to the top of the sludge. The liner beneath the sludge will not be decontaminated unless it is determined

that the sludge must be removed from the impoundments. The reason for not decontaminating the liner under the sludge is that the liner is expected to be less contaminated than the sludge that it is in contact with. Gunite liner decontamination wastes will not be collected, but will be allowed to drain into the impoundment. Gunite liner decontamination will be performed before soil samples are collected from beneath the liner. If soil sampling shows that it is necessary to remove the soil from the berms, any decontaminated gunite liner removed in order to excavate soil will be sampled to determine how it can be disposed of.

5.3.2 Management of Generated Wastes [HWMR-6, Section 265.114]

Wastes that may be generated during closure of the TA-53 surface impoundments include personnel protective clothing, disposable sampling equipment, liquids and sludges from decontamination, the liner from the equipment decontamination area, and sludge, soil, tuff, and bentonite and gunite liner material contaminated above cleanup levels that is removed from the impoundments. Wastes will be sampled as described in Section 3.3.7.

In addition to determining wastes that exceed risk-based levels, the results of chemical analysis of samples of sludge, soil/tuff, liner material, and wastes will be used to determine whether TCLP regulatory levels for toxic mixed wastes under HWMR-6, Section 261.24 could be exceeded. Any materials that must be disposed of, and that could exceed TCLP regulatory levels, will be resampled and analyzed using the TCLP procedure. Additionally, results of reactive sulfide analysis of sludge samples will be used to determine whether the sludge is a reactive mixed waste under HWMR-6, Section 261.23. Based on existing waste characterization data (see Section 3.1), these wastes are expected to be designated as nonhazardous, low-level radioactive wastes. Liquid wastes and sludges that sampling shows to be below cleanup levels will be returned to the impoundments. All other wastes will be packaged, labeled, and transported to TA-54 for disposal. Wastes containing free liquids will be solidified to eliminate free liquids before disposal. These activities will be performed in accordance with approved Laboratory procedures for waste management.

If sampling and analysis indicate that wastes exhibit the toxicity characteristic under HWMR-6, Section 261.24 or the reactivity characteristic under HWMR-6, Section 261.23, they will be managed as mixed wastes. Mixed wastes will be drummed, labeled, manifested, and

transported to TA-54 for storage in accordance with Laboratory procedures. These procedures comply with the applicable requirements of HWMR-6, Parts 261 and 262. If a change under interim status for TA-54 is required in order to store these wastes, a revised Part A permit application will be submitted to the NMED with a request for approval, if necessary. If any of these mixed wastes exceed land disposal restriction treatment standards, storage of these wastes will be addressed in the Federal Facility Compliance Agreement for the Laboratory.

5.3.3 Criteria for Determining the Extent of Decontamination Necessary [HWMR-6, Section 265.112(b)(4)]

Criteria for decontamination will depend on the type of material being decontaminated. Criteria for equipment decontamination are qualitative criteria based on how and where the equipment is used. All nondisposable sampling equipment will be decontaminated following use, primarily to avoid cross-contamination of samples. All other equipment that comes into contact with the water or sludge in the impoundments, the impoundment liners, or soils/tuff beneath the liners will be decontaminated. Any other equipment used within the contamination control area established per the health and safety plan will also be decontaminated. All equipment will be decontaminated to remove contaminants known or suspected to be present. Based on existing data (see Section 3.1), the primary contamination of concern will be radioactive contamination associated with sludge. The equipment decontamination procedures described in Section 5.3.1 are designed to remove this contamination. The qualitative equipment decontamination criteria will also be applied to the gunite liners. As with equipment, contamination of the gunite liner is expected to be limited to surface contamination that can be removed using the decontamination procedure.

All sludge, soil, bentonite, and tuff contaminated above the health-based levels described in Section 5.1.1.2 will either be removed from the surface impoundments or left in place rather than decontaminated. These levels include proposed RCRA Subpart S action levels, IWP SALs, and health-based levels developed from a site-specific risk assessment. These level are quantitative criteria that indicate allowable levels of contamination.

5.3.4 Methods for Sampling and Testing to Demonstrate Success of Decontamination [HWMR-6, Section 265.112(b)(4)]

Decontaminated equipment will not be sampled to determine the effectiveness of chemical decontamination. Rather, effectiveness will be based on knowledge of the contaminants present, known effectiveness of the decontamination agents used, removal of all visual evidence of contamination, and collection of rinsate blank samples, as described in Section 3.5.1.

Effectiveness of radiological decontamination of equipment will also be based on knowledge of the contaminants present, known effectiveness of the decontamination agents used, removal of all visual evidence of contamination, and collection of rinsate blank samples. In addition, equipment will be radiologically surveyed following decontamination to verify that all radioactivity is below Laboratory radiological release limits.

5.4 General Postclosure Care Requirements [HWMR-6, Sections 265.117 - 265.120, 265.144, 265.145, and 265.228(b)]

As currently described in this closure plan, the TA-53 surface impoundments will not be closed as mixed-waste landfills. As a result, postclosure care requirements are not applicable per HWMR-6, Section 265.110(b). If, during closure, it is determined that all mixed-waste residues cannot practicably be removed, the closure plan will be amended and additional procedures developed for meeting the closure performance standard given in Section 5.1.1.1. These additional procedures may require postclosure care. If so, a postclosure plan will be prepared that addresses the applicable requirements of HWMR-6, Sections 265.117 through 265.120. The postclosure plan will be prepared and submitted to the NMED within 90 days of determination of the need for such a plan.

It is noted that if a postclosure plan is necessary, a postclosure cost estimate (HWMR-6, Section 265.144) and a financial assurance mechanism for postclosure care (HWMR-6, Section 265.145) will not be required because federal facilities are exempt from those requirements per HWMR-6, Section 265.140(c).

6.0 FINAL CLOSURE REPORT

Upon completion of closure activities, a Final Closure Report will be sent to the Secretary, New Mexico Environment Department. This report will document the final closure and contain, at a minimum, the following:

1) the certifications described in Section 5.1.4;

2) any variance from the activities described in the approved closure plan and the reason for the variance;

3) a tabular summary of all sampling results, showing:

   a. sample identification,

   b. sampling location,

   c. the datum reported,

   d. detection limit for each datum,

   e. a measure of analytical precision,

   f. identification of analytical procedure, and

   g. identification of analytical laboratory;

4) a QA/QC statement on the adequacy of the analyses and the decontamination demonstration;

5) the location of supporting documentation, including:

   a. field log books,

b. laboratory sample analysis reports,

c. QA/QC documentation, and

d. chain-of-custody records;

6) disposition and disposal location of all regulated and nonregulated residuals; and

7) a certification of the accuracy of the report.

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APPENDICES

APPENDIX A

AS-BUILT DRAWINGS OF NORTHEAST AND NORTHWEST IMPOUNDMENTS

APPENDIX B

TOPOGRAPHIC MAP OF AREA AROUND TA-53 SURFACE IMPOUNDMENTS

APPENDIX C

DETECTION LIMITS FOR VOLATILE ORGANICS FOR JULY 1991 SAMPLING

DETECTION LIMITS FOR VOLATILE ORGANICS, JULY 1991

	July 1991 Sludge Samples		July 1991 Water Samples	
Compound	Minimum Detection Limit, mg/kg	Maximum Detection Limit, mg/kg	Minimum Detection Limit, ug/L	Maximum Detection Limit, ug/L
Acetone	0.020	0.020	20	20
Acrolein	0.100	0.100	100	100
Acrylonitrile	0.100	0.100	100	100
Benzene	0.005	0.005	5	5
Bromobenzene	0.005	0.005	5	5
Bromochloromethane	0.005	0.005	5	5
Bromodichloromethane	0.005	0.005	5	5
Bromoform	0.005	0.005	5	5
Bromomethane	0.010	0.010	10	10
2-Butanone	0.020	0.020	20	20
n-Butylbenzene	0.005	0.005	5	5
sec-Butylbenzene	0.005	0.005	5	5
tert-Butylbenzene	0.005	0.005	5	5
Carbon disulfide	0.005	0.005	5	5
Carbon tetrachloride	0.005	0.005	5	5
Chlorobenzene	0.005	0.005	5	5
Chlorodibromomethane	0.005	0.005	5	5
Chloroethane	0.010	0.010	10	10
2-Chloroethylvinyl ether	0.050	0.050	50	50
Chloroform	0.005	0.005	5	5
Chloromethane	0.010	0.010	10	10
o-Chlorotoluene	0.005	0.005	5	5
p-Chlorotoluene	0.005	0.005	5	5
1,2-Dibromo-3-chloropropane	0.010	0.010	10	10
1,2-Dibromoethane	0.005	0.005	5	5
Dibromomethane	0.005	0.005	5	5
o-Dichlorobenzene	0.005	0.005	5	5
m-Dichlorobenzene	0.005	0.005	5	5
p-Dichlorobenzene	0.005	0.005	5	5
Dichlorodifluoromethane	0.010	0.010	10	10
1,1-Dichloroethane	0.005	0.005	5	5
1,2-Dichloroethane	0.005	0.005	5	5
1,1-Dichloroethene	0.005	0.005	5	5
trans-1,2-Dichloroethylene	0.005	0.005	5	5
cis-1,2-Dichloroethylene	0.005	0.005	5	5
1,2-Dichloropropane	0.005	0.005	5	5
1,3-Dichloropropane	0.005	0.005	5	5
2,2-Dichloropropane	0.005	0.005	5	5
1,1-Dichloropropane	0.005	0.005	5	5
cis-1,3-Dichloropropene	0.005	0.005	5	5
trans-1,3-Dichloropropene	0.005	0.005	5	5

DETECTION LIMITS FOR VOLATILE ORGANICS, JULY 1991 (Continued)

	July 1991 Sludge Samples		July 1991 Water Samples	
Compound	Minimum Detection Limit, mg/kg	Maximum Detection Limit, mg/kg	Minimum Detection Limit, ug/L	Maximum Detection Limit, ug/L
Ethylbenzene	0.005	0.005	5	5
Ethylene dibromide	0.005	0.005	5	5
2-Hexanone	0.020	0.020	20	20
Isopropylbenzene	0.005	0.005	5	5
4-Isopropyltoluene	0.005	0.005	5	5
Methyl iodide	0.005	0.005	5	5
4-Methyl-2-pentanone	0.020	0.020	20	20
Methylene chloride	0.005	0.005	5	5
Propylbenzene	0.005	0.005	5	5
Styrene	0.005	0.005	5	5
1,1,1,2-Tetrachloroethane	0.005	0.005	5	5
1,1,2,2-Tetrachloroethane	0.005	0.005	5	5
Tetrachloroethylene	0.005	0.005	5	5
Toluene	0.005	0.005	5	5
1,1,2-Trichloro-1,2,2-trifluoroethane	0.005	0.005	5	5
1,1,1-Trichloroethane	0.005	0.005	5	5
1,1,2-Trichloroethane	0.005	0.005	5	5
Trichloroethene	0.005	0.005	5	5
Trichlorofluoromethane	0.005	0.005	5	5
1,2,3-Trichloropropane	0.005	0.005	5	5
1,2,4-Trimethylbenzene	0.005	0.005	5	5
1,3,5-Trimethylbenzene	0.005	0.005	5	5
Vinyl acetate	0.010	0.010	10	10
Vinyl chloride	0.010	0.010	10	10
Xylenes	0.005	0.005	5	5

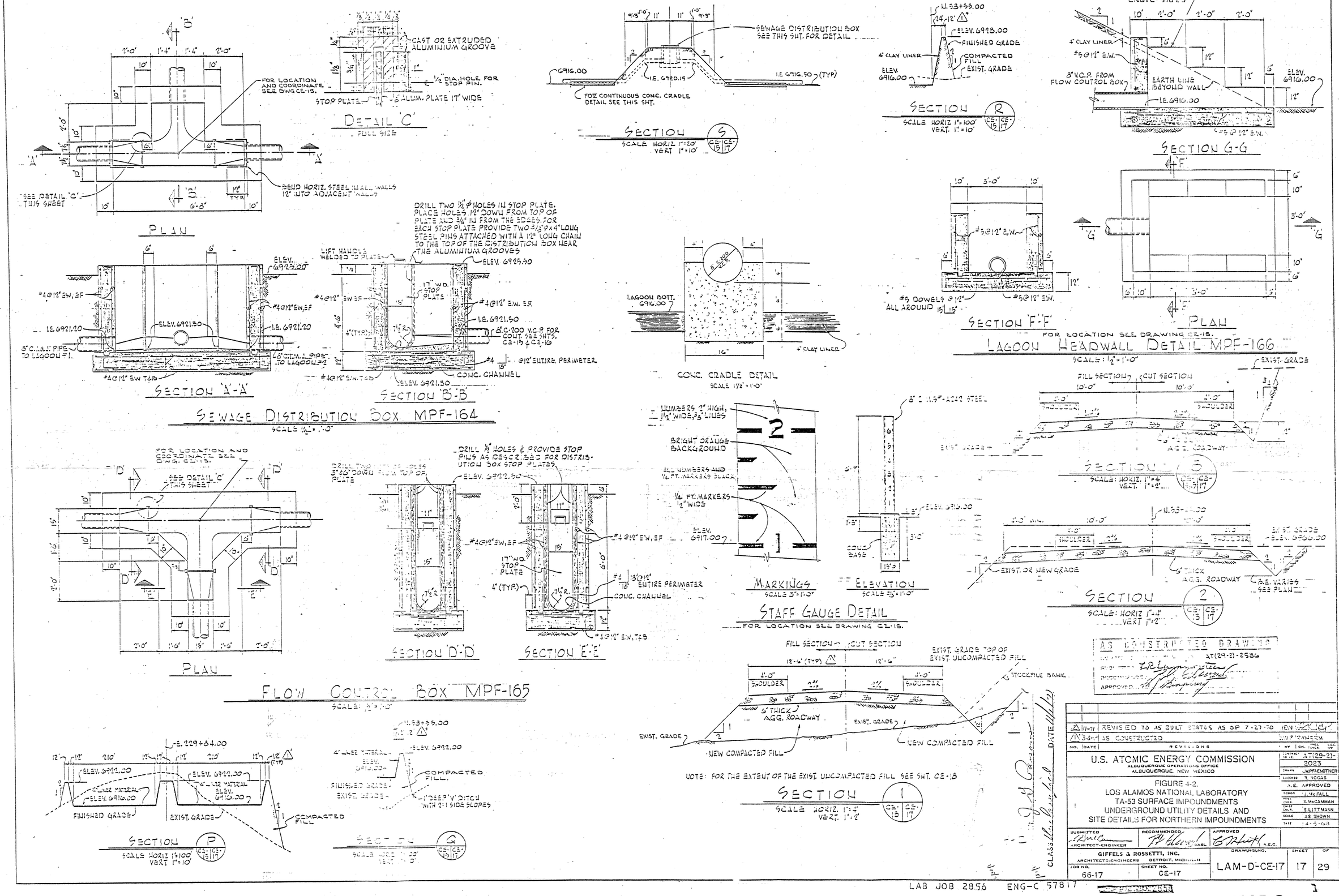
APPENDIX D

DETECTION LIMITS FOR SEMIVOLATILE ORGANICS FOR JULY 1991 SAMPLING

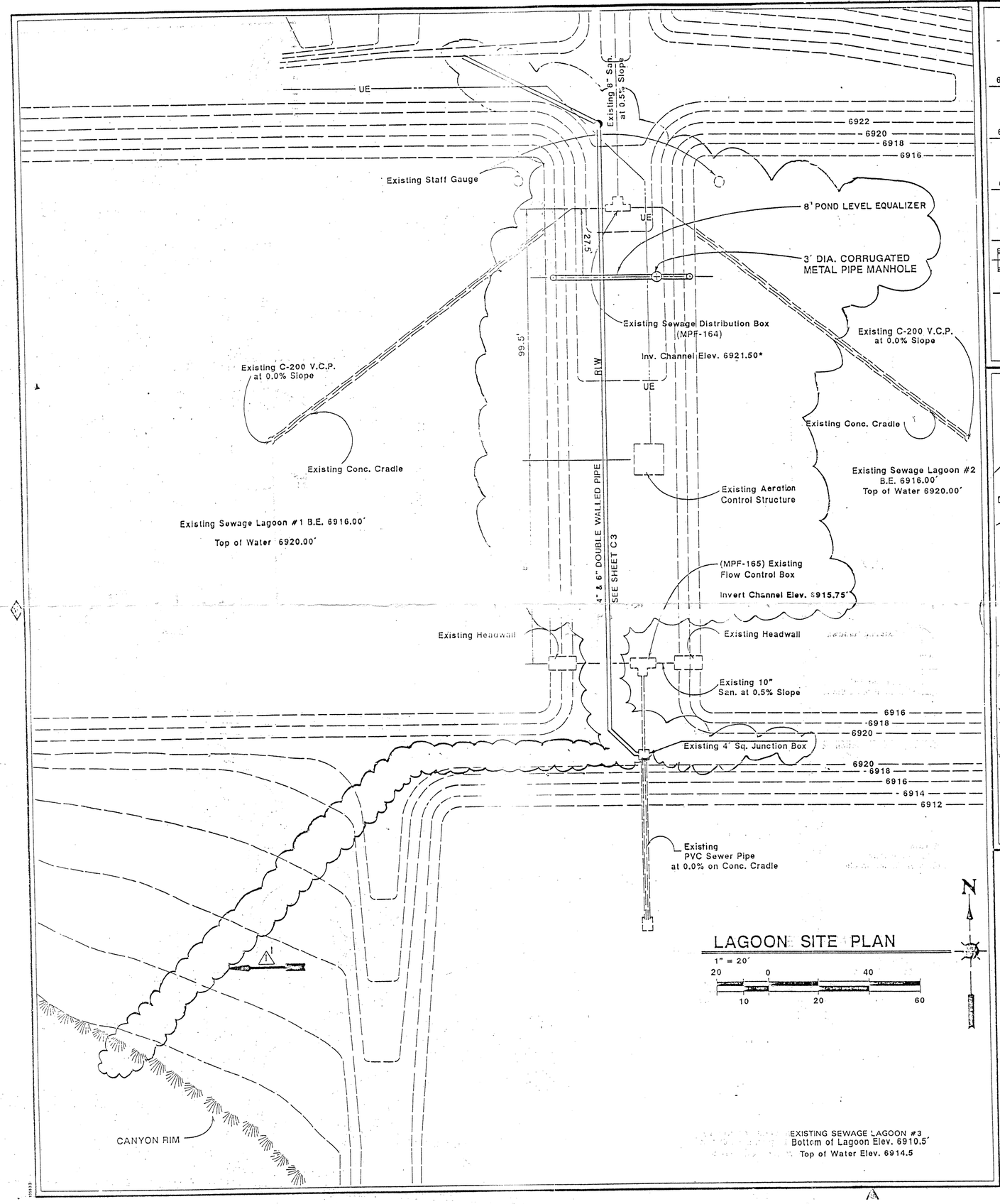
DETECTION LIMITS FOR SEMIVOLATILE ORGANICS, JULY 1991

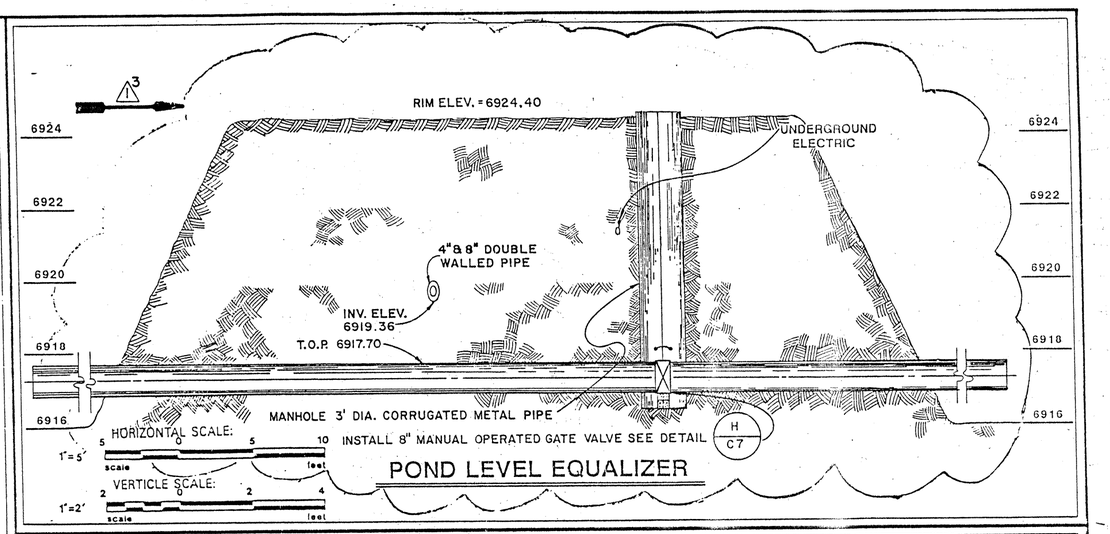
	July 1991 Sludge Samples		July 1991 Water Samples	
Compound	Detection Limit, mg/kg	Detection Limit, mg/kg	Detection Limit, ug/L	Detection Limit, ug/L
Acenaphthene	0.48	0.65	10	24
Acenaphthylene	0.48	0.65	10	24
Aniline	0.48	0.65	10	24
Anthracene	0.48	0.65	10	24
Azobenzene	0.48	0.65	10	24
m-Benzidene	0.48	0.65	10	24
Benzo(a)anthracene	0.48	0.65	10	24
Benzo(a)pyrene	0.48	0.65	10	24
Benzo(b)fluoranthene	0.48	0.65	10	24
Benzo(g,h,i)perylene	0.48	0.65	10	24
Benzo(k)fluoranthene	0.48	0.65	10	24
Benzoic acid	0.48	0.65	10	24
Benzyl alcohol	0.48	0.65	10	24
bis(2-Chloroethoxy)methane	0.48	0.65	10	24
bis(2-Chloroethyl ether)	0.48	0.65	10	24
bis(2-Chloroisopropyl)ether	0.48	0.65	10	24
bis(2-Ethylhexyl)phthalate	0.48	0.65	10	24
4-Bromophenyl-phenylether	0.48	0.65	10	24
Butylbenzylphthalate	0.48	0.65	10	24
4-Chloro-3-methylphenol	0.48	0.65	10	24
4-Chloroaniline	0.48	0.65	10	24
2-Chloronaphthalene	0.48	0.65	10	24
o-Chlorophenol	0.48	0.65	10	24
4-Chlorophenyl-phenylether	0.48	0.65	10	24
Chrysene	0.48	0.65	10	24
Di-n-butylphthalate	0.48	0.65	10	24
Di-n-octylphthalate	0.48	0.65	10	24
Dibenz(a,h)anthracene	0.48	0.65	10	24
Dibenzofuran	0.48	0.65	10	24
1,2-Dichlorobenzene	0.48	0.65	10	24
1,3-Dichlorobenzene	0.48	0.65	10	24
1,4-Dichlorobenzene	0.48	0.65	10	24
3,3'-Dichlorobenzidine	0.48	0.65	10	24
2,4-Dichlorophenol	0.48	0.65	10	24
Diethylphthalate	0.48	0.65	10	24
Dimethylphthalate	0.48	0.65	10	24
2,4-Dimethylphenol	0.48	0.65	10	24
2,4-Dinitrophenol	0.48	0.65	10	24
2,4-Dinitrotoluene	0.48	0.65	10	24
2,6-Dinitrotoluene	0.48	0.65	10	24
Fluoranthene	0.48	0.65	10	24
Fluorene	0.48	0.65	10	24
Hexachlorobenzene	0.48	0.65	10	24

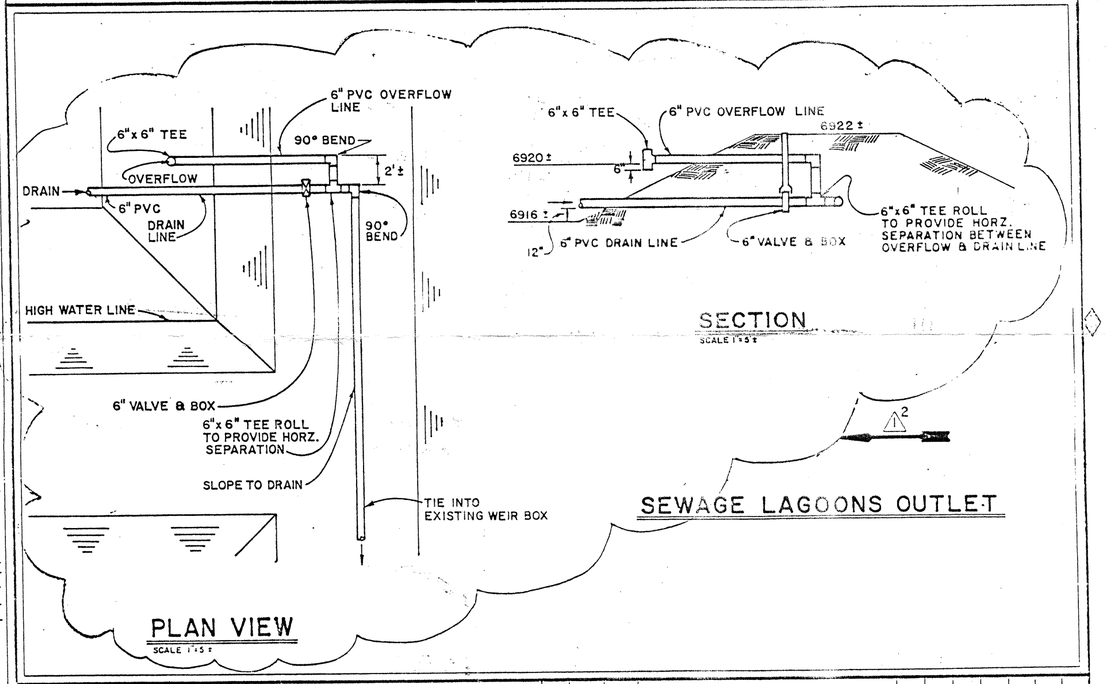
B. K. ELLIOTT CO. 301 750 2-66



4285-C







NOTE:
CONTRACTOR SHALL VERIFY LOCATIONS OF EXISTING UTILITIES IN TRENCHES AND REPORT ANY CONFLICTS TO ENG. 1 PRIOR TO CONSTRUCTION OF PROJECT.

NO.	DATE	CLASS REV.	REVISIONS	DWN	DES	CHKD	REQ GRP	REQ D.O.	ENG GRP	ENG D.O.
3	2/92		REVISED LAGOON SITE PLAN. REVISED POND LEVEL EQUALIZER ADDED PLAN VIEW AND SECTION. DELETED WEST SANITARY SEWER OUTFLOW TO AS-BUILT STATUS.	G.V.						

MERRICK — SOUTHWEST BRANCH, LOS ALAMOS, NEW MEXICO

FIGURE 4-7.
LOS ALAMOS NATIONAL LABORATORY
TA-53 SURFACE IMPOUNDMENTS
N.E. IMPOUNDMENT OUTFALL LINE
AND POND LEVEL EQUALIZER

DRAWN	PENNEY
DESIGN	SPANDE
CHECKED	ZIMMERMAN
RELEASED	M.ZARRABY
DATE	1-27-89

SUBMITTED: Masoud Zarraby — RECOMMENDED: E.M. Hook — APPROVED: J. Gordon Williams

Los Alamos — Los Alamos National Laboratory, Los Alamos, New Mexico 87545

SHEET C6 — 8 OF 18

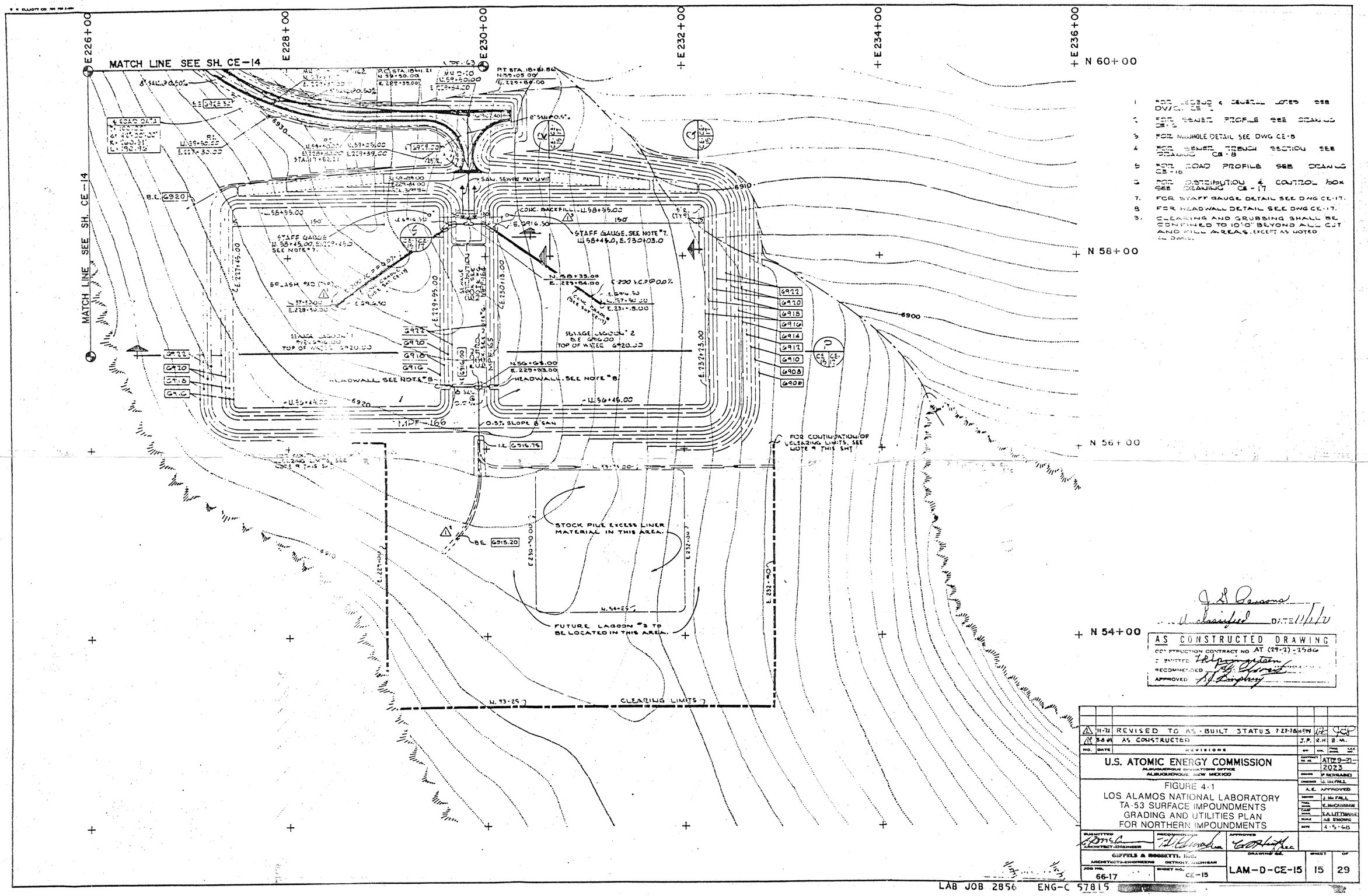
CLASSIFICATION U/L — REVIEWER E.M. Hook — DATE 1 Feb 89

REQUESTING DIVISION HSE-DO N/A — LAB JOB NO. 9546-53 — DRAWING NO. ENG-C45523 — REV. 1

REQUESTING GROUP HSE-8 N/A

MASOUD ZARRABY — NEW MEXICO — 7720 — REGISTERED PROFESSIONAL ENGINEER

4285-B



LAB JOB 2856 ENG-C 57815 [redacted]

4285-D

DETECTION LIMITS FOR SEMIVOLATILE ORGANICS, JULY 1991 (Continued)

	July 1991 Sludge Samples		July 1991 Water Samples	
Compound	Detection Limit, mg/kg	Detection Limit, mg/kg	Detection Limit, ug/L	Detection Limit, ug/L
Hexachlorobutadiene	0.48	0.65	10	24
Hexachlorocyclopentadiene	0.48	0.65	10	24
Hexachloroethane	0.48	0.65	10	24
Indeno(1,2,3-cd)pyrene	0.48	0.65	10	24
Isophorone	0.48	0.65	10	24
4,6-Dinitro-2-methylphenol	0.48	0.65	10	24
2-Methylnaphthalene	0.48	0.65	10	24
2-Methylphenol	0.48	0.65	10	24
4-Methylphenol	0.48	0.65	10	24
Naphthalene	0.48	0.65	10	24
2-Nitroaniline	0.48	0.65	10	24
3-Nitroaniline	0.48	0.65	10	24
4-Nitroaniline	0.48	0.65	10	24
Nitrobenzene	0.48	0.65	10	24
2-Nitrophenol	0.48	0.65	10	24
4-Nitrophenol	0.48	0.65	10	24
N-Nitroso-di-N-propylamine	0.48	0.65	10	24
N-Nitrosodimethylamine	0.48	0.65	10	24
N-Nitrosodiphenylamine	0.48	0.65	10	24
Pentachlorophenol	0.48	0.65	10	24
Phenanthrene	0.48	0.65	10	24
Phenol	0.48	0.65	10	24
Pyrene	0.48	0.65	10	24
1,2,4-Trichlorobenzene	0.48	0.65	10	24
2,4,5-Trichlorophenol	0.48	0.65	10	24
2,4,6-Trichlorophenol	0.48	0.65	10	24

APPENDIX E

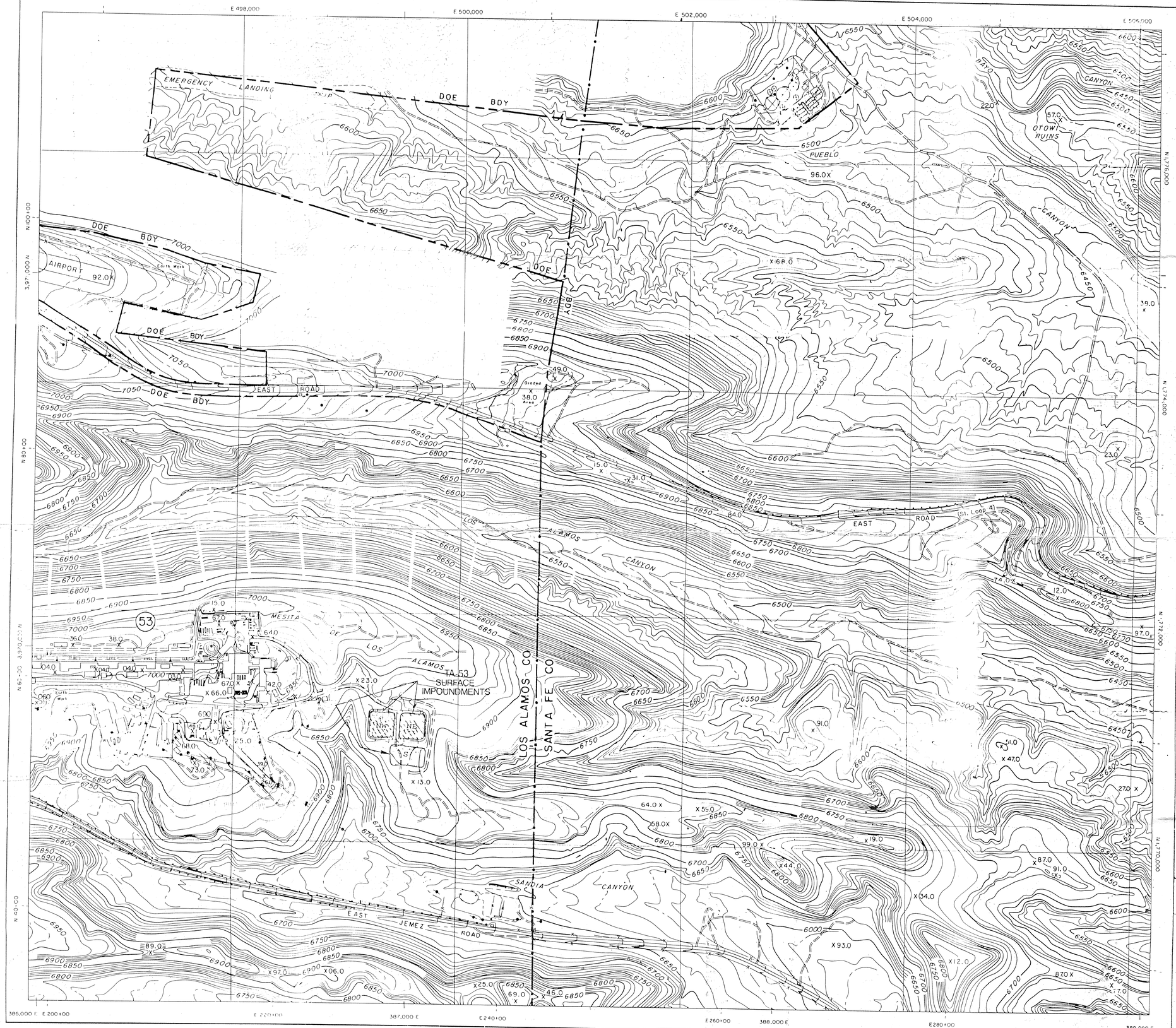
DETECTION LIMITS FOR METALS FOR JULY 1991 SAMPLING

DETECTION LIMITS FOR METALS, JULY 1991

	July 1991 Sludge Samples		July 1991 Water Samples	
Element	Detection Limit, ug/L	Detection Limit, ug/L	Detection Limit, ug/L	Detection Limit, ug/L
Arsenic	20	20	20	20
Cadmium	10	10	10	10
Chromium	10	10	10	10
Mercury	0.2	0.2	0.2	0.2
Lead	50	50	50	50
Selenium	20	20	20	20
Silver	10	10	10	10

APPENDIX F

DETECTION LIMITS FOR VOLATILE ORGANICS FOR APRIL 1992 SAMPLING



LEGEND

X 93.0	SPOT ELEVATION	N 1,768,000	NMSP GR
—6900—	INDEX CONTOUR	3,989,000 N	UTM GR
	INTERMEDIATE CONTOUR 10ft.	N 240+00	LASL GR
	SUPPLEMENTARY CONTOUR 5ft.		
	CONTOURS THROUGH HEAVY VEGETATION		
	COUNTY LINES – TRANSFERRED FROM USGS 1:24,000 QUADRANGLES		
	DOE BOUNDARY – X & Y COORDINATE DATA PROVIDED BY LASL		
	DOE BOUNDARY – SURVEY DESCRIPTIONS OR RECORD PLATS PROVIDED BY LASL.		
	DOE BOUNDARY – TRANSFERRED FROM USGS 1:24,000 QUADRANGLES BASED ON PROJECTED COUNTY LINES.		

35	TECHNICAL AREA NO.		TOWER
	BUILDING		PIPE LINE
	FENCE		CUT LINE OR POWER LINE CLEARANCE SCAR
	PAVED ROAD		WATER TOWER
	DIRT ROAD	tank	TANK
	JEEP TRAIL		POND
	CULVERT		RETAINING WALL
	GUARD RAIL		EARTH DIKES OR BERMS
	TUNNEL		EARTH WORK OR GRADED AREAS
	EARTHEN BUNKERS		GATE
	POWER POLE		

SHEET LAYOUT

MAPPING COMPLETED BY PHOTOGRAMMETRIC METHODS, UTILIZING 1:30,000, 1:12,000 & 1:13,200 PHOTOGRAPHY, OBTAINED IN NOV. 1976 & JUNE 1980 WITH ZEISS RMK A 15/23 CAMERAS OF 153.42 & 152.43mm C.F.L. RESPECTIVELY. MAPPING BASED ON CONTROL SURVEYS TIED TO THE NEW MEXICO STATE PLANE COORDINATE SYSTEM (CENTRAL ZONE). MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY SPECIFICATIONS.

400 200 0 400 800 1200 FEET

100 50 0 100 200 300 400 METERS

GRAPHIC SCALE 1 in = 400 ft

CONTOUR INTERVAL 10 ft

TECHNICAL AREAS

53 MPF–SITE

LOS ALAMOS SCIENTIFIC LABORATORY

FIGURE 2-3

CONTOUR MAP SHOWING THE LOCATIONS OF THE SURFACE IMPOUNDMENTS AT TA-53

4285-A

LAB JOB NO. 56

1" = 400' SCALE

PLAN / TOP

SHEET 14 OF 2

P_000002

DETECTION LIMITS FOR VOLATILE ORGANICS, APRIL 1992

	April 1992 Sludge Samples		April 1992 Water Samples	
Compound	Minimum Detection Limit, mg/kg	Maximum Detection Limit, mg/kg	Minimum Detection Limit, ug/L	Maximum Detection Limit, ug/L
Acetone	0.020	0.092	20	20
Benzene	0.005	0.023	5	5
Bromobenzene	0.005	0.023	5	5
Bromochloromethane	0.005	0.023	5	5
Bromodichloromethane	0.005	0.023	5	5
Bromoform	0.005	0.023	5	5
Bromomethane	0.010	0.046	10	10
2-Butanone	0.020	0.092	20	20
n-Butylbenzene	0.005	0.023	5	5
sec-Butylbenzene	0.005	0.023	5	5
tert-Butylbenzene	0.005	0.023	5	5
Carbon disulfide	0.005	0.023	5	5
Carbon tetrachloride	0.005	0.023	5	5
Chlorobenzene	0.005	0.023	5	5
Chlorodibromomethane	0.005	0.023	5	5
Chloroethane	0.010	0.046	10	10
Chloroform	0.005	0.023	5	5
Chloromethane	0.010	0.046	10	10
o-Chlorotoluene	0.005	0.023	5	5
p-Chlorotoluene	0.005	0.023	5	5
1,2-Dibromo-3-chloropropane	0.010	0.046	10	10
1,2-Dibromoethane	0.005	0.023	5	5
Dibromomethane	0.005	0.023	5	5
o-Dichlorobenzene	0.005	0.023	5	5
m-Dichlorobenzene	0.005	0.023	5	5
p-Dichlorobenzene	0.005	0.023	5	5
Dichlorodifluoromethane	0.010	0.046	10	10
1,1-Dichloroethane	0.005	0.023	5	5
1,2-Dichloroethane	0.005	0.023	5	5
1,1-Dichloroethene	0.005	0.023	5	5
trans-1,2-Dichloroethylene	0.005	0.023	5	5
cis-1,2-Dichloroethylene	0.005	0.023	5	5
1,2-Dichloropropane	0.005	0.023	5	5
1,3-Dichloropropane	0.005	0.023	5	5
2,2-Dichloropropane	0.005	0.023	5	5
1,1-Dichloropropane	0.005	0.023	5	5
cis-1,3-Dichloropropene	0.005	0.023	5	5
trans-1,3-Dichloropropene	0.005	0.023	5	5
Ethylbenzene	0.005	0.023	5	5
Ethylene dibromide	0.005	0.023	5	5
2-Hexanone	0.020	0.092	20	20

DETECTION LIMITS FOR VOLATILE ORGANICS, APRIL 1992 (Continued)

	April 1992 Sludge Samples		April 1992 Water Samples	
Compound	Minimum Detection Limit, mg/kg	Maximum Detection Limit, mg/kg	Minimum Detection Limit, ug/L	Maximum Detection Limit, ug/L
Isopropylbenzene	0.005	0.023	5	5
4-Isopropyltoluene	0.005	0.005	5	5
Methyl iodide	0.005	0.023	5	5
4-Methyl-2-pentanone	0.020	0.092	20	20
Methylene chloride	0.005	0.023	5	5
Propylbenzene	0.005	0.023	5	5
Styrene	0.005	0.023	5	5
1,1,1,2-Tetrachloroethane	0.005	0.023	5	5
1,1,2,2-Tetrachloroethane	0.005	0.023	5	5
Tetrachloroethylene	0.005	0.023	5	5
Toluene	0.005	0.023	5	5
1,1,2-Trichloro-1,2,2-trifluoroethane	0.005	0.023	5	5
1,1,1-Trichloroethane	0.005	0.023	5	5
1,1,2-Trichloroethane	0.005	0.023	5	5
Trichloroethene	0.005	0.023	5	5
Trichlorofluoromethane	0.005	0.023	5	5
1,2,3-Trichloropropane	0.005	0.023	5	5
1,2,4-Trimethylbenzene	0.005	0.023	5	5
1,3,5-Trimethylbenzene	0.005	0.023	5	5
Vinyl acetate	0.010	0.046	10	10
Vinyl chloride	0.010	0.046	10	10
Xylenes	0.005	0.023	5	5

APPENDIX G

DETECTION LIMITS FOR SEMIVOLATILE ORGANICS FOR APRIL 1992 SAMPLING

DETECTION LIMITS FOR SEMIVOLATILE ORGANICS, APRIL 1992

	April 1992 Sludge Samples		April 1992 Water Samples	
Compound	Detection Limit, mg/kg	Detection Limit, mg/kg	Detection Limit, ug/L	Detection Limit, ug/L
Acenaphthene	0.93	2.00	11	11
Acenaphthylene	0.93	2.00	11	11
Aniline	0.93	2.00	11	11
Anthracene	0.93	2.00	11	11
Azobenzene	0.93	2.00	11	11
m-Benzidene	0.93	2.00	11	11
Benzo(a)anthracene	0.93	2.00	11	11
Benzo(a)pyrene	0.93	2.00	11	11
Benzo(b)fluoranthene	0.93	2.00	11	11
Benzo(g,h,i)perylene	0.93	2.00	11	11
Benzo(k)fluoranthene	0.93	2.00	11	11
Benzoic acid	0.93	2.00	11	11
Benzyl alcohol	0.93	2.00	11	11
bis(2-Chloroethoxy)methane	0.93	2.00	11	11
bis(2-Chloroethyl ether)	0.93	2.00	11	11
bis(2-Chloroisopropyl)ether	0.93	2.00	11	11
bis(2-Ethylhexyl)phthalate	1.90	1.90	11	11
4-Bromophenyl-phenylether	0.93	2.00	11	11
Butylbenzylphthalate	0.93	2.00	11	11
4-Chloro-3-methylphenol	0.93	2.00	11	11
4-Chloroaniline	0.93	2.00	11	11
2-Chloronaphthalene	0.93	2.00	11	11
o-Chlorophenol	0.93	2.00	11	11
4-Chlorophenyl-phenylether	0.93	2.00	11	11
Chrysene	0.93	2.00	11	11
Di-n-butylphthalate	1.90	2.00	11	11
Di-n-octylphthalate	0.93	2.00	11	11
Dibenz(a,h)anthracene	0.93	2.00	11	11
Dibenzofuran	0.93	2.00	11	11
1,2-Dichlorobenzene	0.93	2.00	11	11
1,3-Dichlorobenzene	0.93	2.00	11	11
1,4-Dichlorobenzene	0.93	2.00	11	11
3,3'-Dichlorobenzidine	0.93	2.00	11	11
2,4-Dichlorophenol	0.93	2.00	11	11
Diethylphthalate	0.93	2.00	11	11
Dimethylphthalate	0.93	2.00	11	11
2,4-Dimethylphenol	0.93	2.00	11	11
2,4-Dinitrophenol	0.93	2.00	11	11
2,4-Dinitrotoluene	0.93	2.00	11	11
2,6-Dinitrotoluene	0.93	2.00	11	11
Fluoranthene	0.93	2.00	11	11
Fluorene	0.93	2.00	11	11
Hexachlorobenzene	0.93	2.00	11	11

DETECTION LIMITS FOR SEMIVOLATILE ORGANICS, APRIL 1992 (Contined)

	April 1992 Sludge Samples		April 1992 Water Samples	
Compound	Detection Limit, mg/kg	Detection Limit, mg/kg	Detection Limit, ug/L	Detection Limit, ug/L
Hexachlorobutadiene	0.93	2.00	11	11
Hexachlorocyclopentadiene	0.93	2.00	11	11
Hexachloroethane	0.93	2.00	11	11
Indeno(1,2,3-cd)pyrene	0.93	2.00	11	11
Isophorone	0.93	2.00	11	11
4,6-Dinitro-2-methylphenol	0.93	2.00	11	11
2-Methylnaphthalene	0.93	2.00	11	11
2-Methylphenol	0.93	2.00	11	11
4-Methylphenol	0.93	2.00	11	11
Naphthalene	0.93	2.00	11	11
2-Nitroaniline	0.93	2.00	11	11
3-Nitroaniline	0.93	2.00	11	11
4-Nitroaniline	0.93	2.00	11	11
Nitrobenzene	0.93	2.00	11	11
2-Nitrophenol	0.93	2.00	11	11
4-Nitrophenol	0.93	2.00	11	11
N-Nitroso-di-N-propylamine	0.93	2.00	11	11
N-Nitrosodimethylamine	0.93	2.00	11	11
N-Nitrosodiphenylamine	0.93	2.00	11	11
Pentachlorophenol	0.93	2.00	11	11
Phenanthrene	0.93	2.00	11	11
Phenol	0.93	2.00	11	11
Pyrene	0.93	2.00	11	11
1,2,4-Trichlorobenzene	0.93	2.00	11	11
2,4,5-Trichlorophenol	0.93	2.00	11	11
2,4,6-Trichlorophenol	0.93	2.00	11	11

APPENDIX H

DETECTION LIMITS FOR METALS FOR JULY 1991 SAMPLING

DETECTION LIMITS FOR METALS, APRIL 1992

	April 1992 Sludge Samples		April 1992 Water Samples	
Element	Minimum Detection Limit, mg/kg	Maximum Detection Limit, mg/kg	Minimum Detection Limit, ug/L	Maximum Detection Limit, ug/L
Cadmium	0.92	2.1		
Mercury			0.1	0.1
Lead			1.0	1.0
Selenium	1.2	1.9	1.0	1.0
Silver	0.92	2.1	1.0	1.0

APPENDIX I

MAXIMUM DETECTED CONCENTRATIONS AND DETECTION LIMITS FOR LISTED WASTE CONSTITUENTS

MAXIMUM CONCENTRATIONS OF LISTED HAZARDOUS WASTE CONSTITUENTS

Constituent	Hazardous Waste Code	Maximum Concentration in Sludge, mg/kg	Maximum Concentration in Water, ug/L
Acetone	U002	4.9	48
Acrolein	P003	<0.1	<100
Acrylonitrile	U009	<0.1	<100
Aldrin	P004	<0.012	See note (1)
Aniline	U012	<2.0	<24
Benzene	U019	<0.023	<5
m-Benzidene	U021	~~<2.0~~ 3.9	<24
Benzo(a)pyrene	U022	<2.0	<24
Beryllium	P015	0.90	See note (1)
Bromoform	U225	<0.023	<5
4-Bromophenyl-phenylether	U030	<2.0	<24
2-Butanone	U159	0.034	<20
Carbon disulfide	P022	0.50	<5
Carbon tetrachloride	U211	<0.023	<5
Chlordane	U036	<0.044	See note (1)
Chlorobenzene	U037	<0.023	<5
2-Chloroethylvinyl ether	U042	<0.05	<50
Chloroform	U044	0.011	<5
4-Chloro-3-methylphenol	U039	<2.0	<24
2-Chloronaphthalene	U047	<2.0	<24
o-Chlorophenol	U048	<2.0	<24
Chrysene	U050	<2.0	<24
p-p'-DDD	U060	0.011	See note (1)
p-p'-DDT	U061	0.016	See note (1)
2,4-D	U240	<0.045	See note (1)
Dibenz(a,h)anthracene	U063	<2.0	<24
Di-n-butylphthalate	U069	5.3	<24
Di-n-octylphthalate	U107	<2.0	<24
o-Dichlorobenzene	U070	<2.0	<24
m-Dichlorobenzene	U071	<2.0	<24
p-Dichlorobenzene	U072	<2.0	<24
3,3'-Dichlorobenzidine	U073	<2.0	<24
Dichlorodifluoromethane	U075	<0.046	<10
1,1-Dichloroethene	U078	<0.023	<5
trans-1,2-Dichloroethylene	U079	<0.023	<5
cis-1,2-Dichloroethylene	U079	<0.023	<5
2,4-Dichlorophenol	U081	<2.0	<24
cis-1,3-Dichloropropene	U084	<0.023	<5
trans-1,3-Dichloropropene	U084	<0.023	<5
Dieldrin	P037	0.0097	See note (1)
Dimethylphthalate	U102	<2.0	<24
2,4-Dimethylphenol	U101	<2.0	<24

MAXIMUM CONCENTRATIONS OF LISTED HAZARDOUS WASTE CONSTITUENTS (Continued)

Constituent	Hazardous Waste Code	Maximum Concentration in Sludge, mg/kg	Maximum Concentration in Water, ug/L
4,6-Dinitro-2-methylphenol	P047	<2.0	<24
2,4-Dinitrophenol	P048	<2.0	<24
2,4-Dinitrotoluene	U105	<2.0	<24
2,6-Dinitrotoluene	U106	<2.0	<24
Endosulfan I	P050	<0.044	See note (1)
Endosulfan II	P050	0.154	See note (1)
Endrin	P051	<0.019	See note (1)
Endrin aldehyde	P051	<0.072	See note (1)
Ethylene dibromide	U067	<2.0	<5
Fluoranthene	U120	0.088	<24
Heptachlor	P059	0.0066	See note (1)
Hexachlorobenzene	U127	<2.0	<24
Hexachlorobutadiene	U128	<2.0	<24
Hexachlorocyclopentadiene	U130	<2.0	<24
Hexachloroethane	U131	<2.0	<24
Indeno(1,2,3-cd)pyrene	U137	<2.0	<24
Lindane	U129	<0.012	See note (1)
Mercury	U151	1.10	<0.2
Methyl iodide	U138	<0.023	<5
4-Methyl-2-pentanone	U161	<0.092	<20
Methylene chloride	U080	<0.023	<5
2-Methylphenol	U052	0.030	<24
4-Methylphenol	U052	1.10	<24
Methoxychlor	U247	<0.55	See note (1)
Naphthalene	U165	<2.0	<24
Nitrobenzene	U169	<2.0	<24
4-Nitrophenol	U170	<2.0	<24
N-Nitrosodimethylamine	P082	<2.0	<24
Pentachlorophenol	F027	<2.0	<24
Phenol	U188	<2.0	<24
2,4,5-T	F027	<0.0075	See note (1)
2,4,5-TP	F027	<0.0064	See note (1)
1,1,1,2-Tetrachloroethane	U208	<0.023	<5
1,1,2,2-Tetrachloroethane	U209	<0.023	<5
Tetrachloroethylene	U210	<0.023	<5
Toluene	U220	3.6	<5
Toxaphene	P123	<0.75	See note (1)
1,1,2-Trichloroethane	U227	<0.023	<5
Trichloroethene	U228	<0.023	<5
Trichlorofluoromethane	U121	<0.023	<5
2,4,5-Trichlorophenol	F027	<2.0	<24
2,4,6-Trichlorophenol	F027	<2.0	<24

MAXIMUM CONCENTRATIONS OF LISTED HAZARDOUS WASTE CONSTITUENTS (Continued)

Constituent	Hazardous Waste Code	Maximum Concentration in Sludge, mg/kg	Maximum Concentration in Water, ug/L
Vinyl chloride	U043	<0.046	<10
Xylenes	U239	<0.023	<5

Notes:
(1) - Water samples were not analyzed for this constituent.