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WASTE ASSESSMENT CHEMICAL CHARACTERIZATION OF THE WELDON SPRING SITE RAFFINATE PITS

For The :
Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

Prepared By MK-Ferguson Company And Jacobs Engineering Group

AUGUST 1989 **REV. 0**

U.S. Department Of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

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Prepared By

MK-FERGUSON COMPANY
Project Management Contractor
7295 Highway 94 South
St. Charles, Missouri 63303

For

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CHEMSLUD/TXTJOANN

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ABSTRACT

As part of the remedial investigation efforts conducted at the Weldon Spring Site Remedial Action Project (WSSRAP), it was recognized that an assessment of the nature and extent of the types of waste in the Weldon Spring Raffinate Pits (WSRP) was necessary to evaluate treatment and disposal alternatives. A sampling plan was developed, therefore, which detailed sample locations, sample parameters, and sampling techniques. The sampling effort consisted of collecting 145 samples from 42 locations. The sampling locations were evenly distributed across each of the four raffinate pits in terms of both area and depth.

The samples were analyzed for nitroaromatics, metals, inorganic anions, volatiles, semi-volatiles, PCBs/pesticides, oil and grease, total organic halogens, total organic carbon, cyanides and phenols. The data were then evaluated specific to each pit.

At a later date the surface waters of each pit were sampled and similarly analyzed for metals.

Samples were also analyzed for radiological contaminants. Information regarding radiological characterization is available in a companion report titled "Waste Assessment Radiological Characterization of the Weldon Spring Site Raffinate Pits, 1989."

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1 INTRODUCTION

This report presents an assessment of chemical contamination of the sludge material in the Weldon Spring Raffinate Pits (WSRP). Sample collection methods, sampling equipment decontamination techniques, analytical procedures and analytical results are also presented in this report, as well as interpretations of the results of sample analyses. The objective of this waste assessment was to supply data needed for sludge/sediment treatability studies which in turn will be necessary for the development and evaluation of remediation alternatives, design of the selected alternative, and verification of remedial effectiveness.

As part of the Remedial Investigation (RI) conducted at the Weldon Spring Site Remedial Action Project (WSSRAP), it was recognized that an assessment of the nature and extent of the types of waste in the Raffinate Pits (RP) was necessary to evaluate treatment and disposal alternatives. As part of the RI, a Waste Assessment Raffinate Pit Sampling Plan was developed (DOE, 1988). The purpose of this sampling plan was to provide a summary of existing data and to define the rationale for collection of the complement of data necessary to fully characterize the wastes contained in the RPs. This plan was submitted to the Environmental Protection Agency (EPA) and the Department of Natural Resources (DNR) for comments. Comments were incorporated in the sampling plan, and a responsiveness summary prepared.

This report presents results of the chemical assessment obtained by carrying out the sampling plan. The radiological assessment also obtained by carrying out the sampling plan is contained in a companion report "Waste Assessment Radiological Characterization of Raffinate Pits Weldon Spring Site" (DOE, 1989). The reports were separated because of their different objectives. From a radiologic standpoint, further testing was necessary to define the radioactive source term present in the raffinate sludge. Further chemical characterization was necessary to identify substances that may have been disposed of at the pits during operations of the chemical plant and subsequent clean-up activities.

1.1 BACKGROUND

1.1.1 Site History

The Weldon Spring Site Remedial Action Project is being conducted as a Major System Acquisition under the Surplus Facilities Management Program (SFMP) of the U. S. Department of Energy (DOE). The major goals of the SFMP are to eliminate potential hazards to the public and the environment that are associated with contamination at the SFMP sites and to make surplus real property available for other uses to the extent possible.

The Weldon Spring site is located near Weldon Spring, Missouri, about 48 km (30 mi) west of St. Louis (Figure 1-1). It is surrounded by large tracts of land owned by the federal government and the state of Missouri. The site consists of the raffinate pits, chemical plant, and quarry. The raffinate pits and chemical plant are on adjoining sites about 3.2 km (2 mi) southwest of the junction of Missouri (State) Route 94 and U.S.Route 40/61, with access from Route 94. The quarry is located in a comparatively remote area about 6.4 km (4 mi) south-southwest of the raffinate pits and chemical plant area; the quarry can also be accessed from Route 94. These areas are fenced and closed to the public.

From 1941 to 1944, the U.S. Department of the Army operated the Weldon Spring Ordnance Works, constructed on the land that

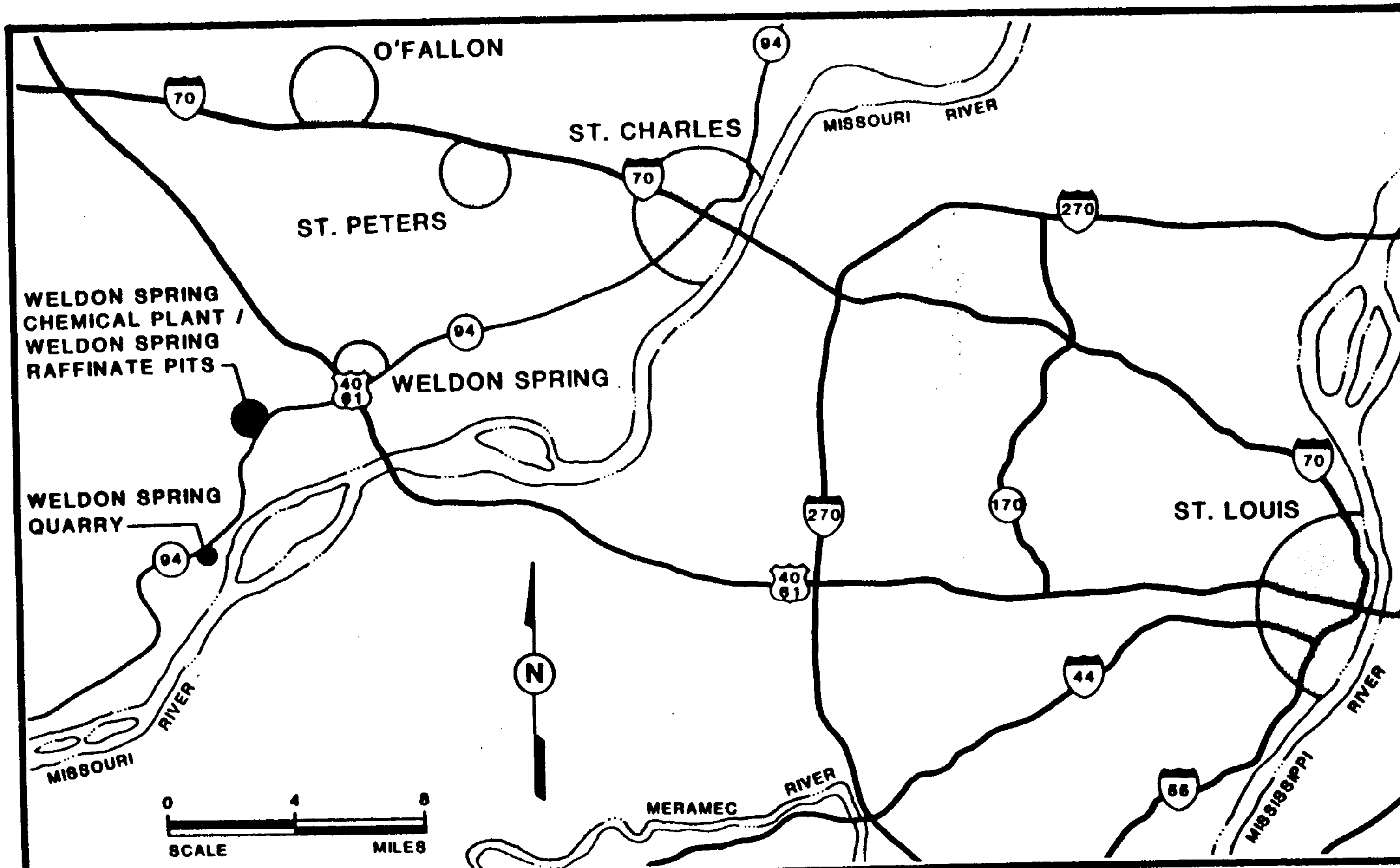

FIGURE 1-1

AREA AND VICINITY MAP, WELDON SPRING SITE, WELDON SPRING, MISSOURI is now the Weldon Spring site, for production of trinitrotoluene (TNT) and dinitrotoluene (DNT). The Army used the quarry for disposal of rubble contaminated with TNT. In the mid 1950s, 83 ha (205 acres) of the ordnance works property was transferred to the U.S. Atomic Energy Commission (AEC); this is now the raffinate pits and chemical plant area. An additional 6 ha (15 acres) was later transferred to the AEC for expansion of waste storage capacity. From 1957 to 1966, the AEC operated a uranium-processing facility at the Weldon Spring chemical plant.

Ore concentrates and some scrap metal were processed at the plant, and products that included uranium metal were then shipped to other sites. Thorium-containing materials were processed intermittently. Radioactive raffinates from the processing were placed in four on-site pits. These pits were constructed by excavating down into the existing clay formation and using the removed clay for construction of the dikes. Figure 1-2 is a layout of where the RPs are located in relation to the chemical plant. Other radioactive wastes were disposed of in the quarry.

After closure by the AEC, the chemical plant was reacquired by the Army in 1967. The Army partially decontaminated several buildings, dismantled some of the equipment, and began converting the facilities to produce herbicides. In 1969, prior to becoming operational, the herbicide project was canceled. In 1971, the Army returned the 21-ha (51-acre) portion of the site containing the raffinate pits to the AEC. As successor to the AEC, DOE assumed responsibility for the raffinate pits. In 1984, the Army repaired several of the buildings at the chemical plant; decontaminated some of the floors, walls, and ceilings; and isolated some contaminated equipment.

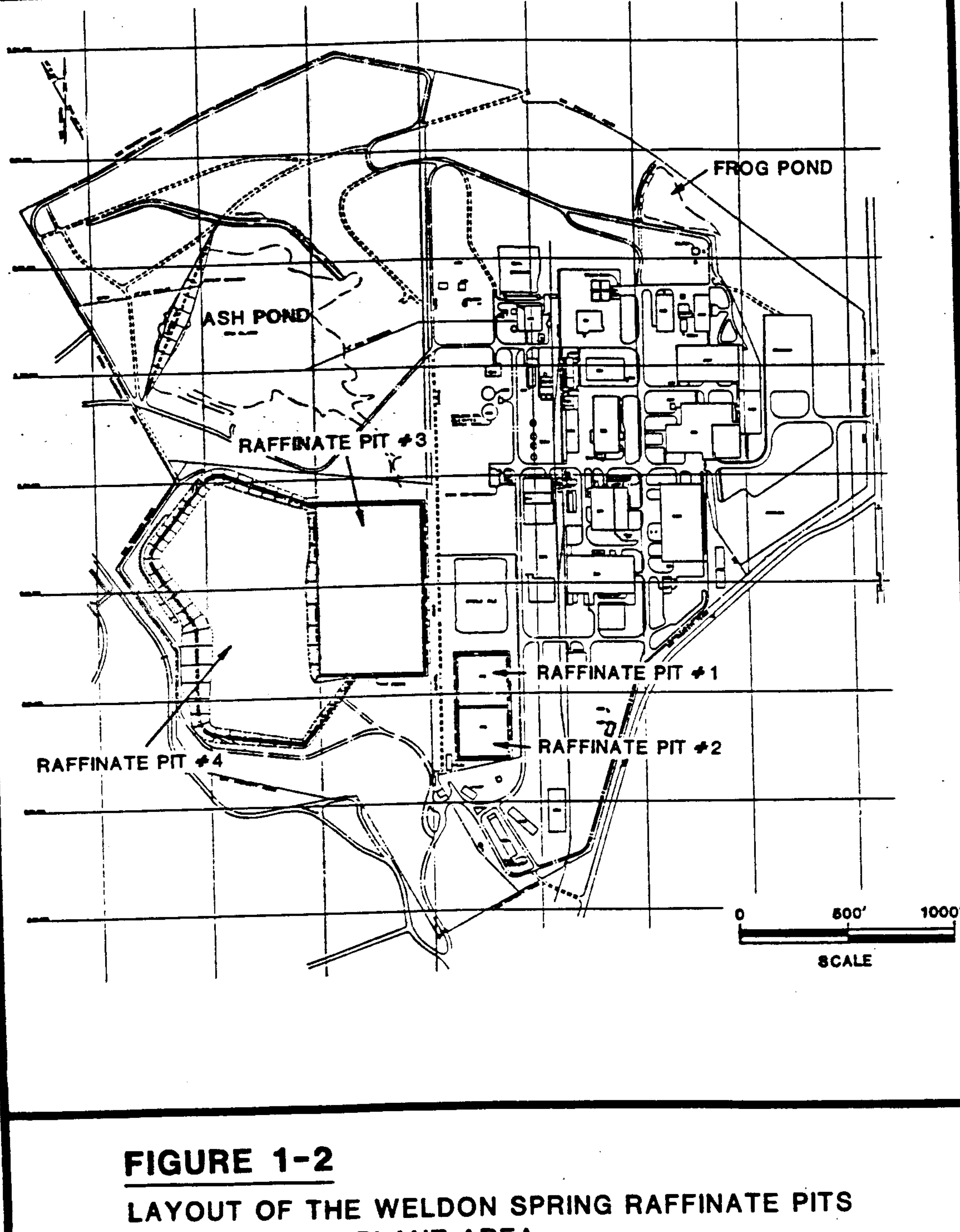

FIGURE 1-2

LAYOUT OF THE WELDON SPRING RAFFINATE PITS AND CHEMICAL PLANT AREA

In May 1985, DOE designated the control and decontamination of the Weldon Spring site as a Major Project (this project has since been designated as a Major Systems Acquisition). In October 1985, custody of the chemical plant was transferred to DOE. A project management contractor (PMC) for the Weldon Spring Site Remedial Action Project was selected in February 1986, and a DOE project office was established on the site in July 1986. The project management contractor assumed control of the Weldon Spring site on October 1, 1986.

On October 15, 1985, the EPA proposed to include the quarry on the National Priorities List (NPL). This listing occurred on July 22, 1987. On June 24, 1988, EPA proposed to expand this designation to include the raffinate pits and chemical plant area. This listing occurred on March 13, 1989.

1.1.2 Physical Description of Pits

Raffinate pits 1 and 2 were constructed in 1958, adjacent to each other, on nearly level terrain. Each pit covers an area of about 0.5 ha (1.2 acres) and has a depth of about 4 m (13 ft). The dikes of these two pits are approximately 1 m (3 ft) above the surrounding grade. Pit 1 contains approximately 17,900 cy of low-level radioactive residues from past uranium refining and metal production operations. Pit 2 contains approximately 19,000 cy of low-level radioactive residues. These waste volumes represent 100 percent of the capacity of each of the two pits. Table 1-1 presents the surface area, volume, and content of each of the four pits. These volumes were calculated during this study and were found to be near previous calculations. The volumes vary slightly due to the lack in previous studies of enough sample locations to fully characterize the pits.

TABLE 1-1 Surface Area and Volume of the Weldon Spring Raffinate Pits

Pit	Year Constructed	Surface Area (acres)	Total Pit Volume (cy)	Total Waste Volume (cy)	Percent Filled (cy)
1	1958	1.2	18,500	17,900	97
2	1958	1.2	18,500	19,000	103
3	1959	8.4	166,700	129,200	78
4	1964	15.0	444,400	30,200	7
TOTALS		**25.0**	**648,100**	**196,300**	

Reference: BNI, 1984.

Pit 3 was constructed in 1959 with a design volume of 166,700 cy, a surface area of approximately 3.4 ha (8.4 acres), and a depth of about 3.5 m (11 ft). The natural terrain slopes downward toward the west boundary so that the dikes around Pits 3 and 4, although approximately at the same elevation as those around Pits 1 and 2, are in fact much higher with respect to the original grade. A portion of the dike in the northeast corner of Pit 3 was constructed on existing terrain so that the dike is about 7 m (23 ft) above original grade in that area. Pit 3 is 78 percent filled and contains approximately 129,200 cy of radioactive residues from past uranium refining and metal production operations.

Pit 4 was constructed in 1964 with a design volume of 444,400 cy and is approximately 7 percent filled. The east dike of Pit 4 is common to the west dike of Pit 3. Pit 3 is designed to overflow into Pit 4 through a connecting pipe 2m (7 ft) below the top of the common dike. The west dike of Pit 4 extends to a maximum of about 11 m (35 ft) above the existing grade. Approximately 30,200 cy of radioactive materials are stored in Pit 4, and the sludge residue depth is at irregular levels across the pit.

The sludge material in the pits is covered with water for most of the year. The amount of water in the pits varies depending on the climatic conditions of a given year. During years with hot, dry summer months, the surface water in Pits 1 and 2 has sometimes evaporated, leaving the raffinate sludge with a dry and cracked surface. The level of water in Pits 3 and 4 also varies, but past observation indicates that some surface water is always present.

Maintenance, surveillance, and environmental monitoring have been continually conducted at the WSRP site since the former DOE contractor, Bechtel National, Inc., began operation in 1981. The site is fenced, posted, and patrolled by security guards. The grass is mowed, brush is cleared for access to each pit, and the fences are repaired as necessary.

In 1982, a portion of the dike around Pit 4 was repaired to stabilize a shallow, circular arc slide. The slide occurred because of the steep (38-47%) side slopes of sections of the existing dikes. The side slopes of Pit 4 were constructed at undesirably steep slopes in this section because the perimeter road encroached on the space needed for construction.

A detailed geologic report complete with geologic cross sections of Pits 3 and 4 is available for reference (BNI, 1984 - Geologic Report Weldon Spring Raffinate Pits Site).

1.1.3 Process Waste Description

There are three major waste types present in the raffinate pits. These are:

1. Neutralized raffinate liquors generated from uranium refining operations, including washed slag residues from uranium metal production operations and raffinate solids from the processing of thorium recycle materials
2. Contaminated water ponded on each raffinate pit
3. Contaminated rubble

Each of these waste types is addressed in greater detail in the following text.

1.1.3.1 Neutralized Raffinate Liquors

Neutralized raffinate liquors were generated as follows: the Weldon Spring Uranium Feed Materials Plant (WSUFMP) received yellow cake ore from various uranium mills across the U.S. The yellow cake feed material was ultimately dissolved in a process stream containing nitric acid solution. This solution contained the dissolved uranium along with all the other impurities found in the yellow cake ore. Once the uranium was stripped from the solution, the resulting waste was mixed with lime to produce what is referred to as neutralized raffinates. These neutralized raffinates were discharged directly to the raffinate pits.

In the final stage of the uranium production process, uranium tetrafluoride was reacted with magnesium producing uranium metal and magnesium fluoride. The magnesium fluoride slag was then redissolved with yellow cake feed material to recover unreacted uranium contained in the slag. The remaining magnesium fluoride, or washed slag, was deposited in the pits. Neutralized raffinates and washed slag were processed out of Building 103, the digestion and denitration building of the WSUFMP.

The residues contained in Pits 1, 2, and 3 consist of the neutralized raffinates and washed slag residues as described above. Pit 4 contains the same types of residues that are present in Pits 1, 2, and 3 plus raffinate solids from processing of thorium-232. It also contains recycle materials and significant quantities of drums and rubble placed during and after closure of the feed materials plant.

1.1.3.2 Contaminated Water

Approximately 54 million gallons of water is currently ponded on the raffinate pits. Section 2.4 of this report provides a detailed discussion of a previous analysis performed on these waters. Section 3.6 provides results from a more recent analysis performed on these waters.

1.1.3.3 Contaminated Rubble

The contaminated rubble consists of drums and steel scrap dumped during closure of the WSUFMP and when the Army began conversion of a portion of the plant for herbicide production. The main dumping area is in Pit 4. All of the rubble is presumed to be radiologically contaminated since it originated from the WSUFMP. There is no indication that any of this rubble includes containerized chemical wastes. Visual inspection of the rubble has revealed no drums remaining intact. A number of samples of the sludge material were taken sufficiently close to the rubble area to verify the presence or absence of chemical contamination.

1.1.4 Raffinate Pit Constituents

Radium-226 is present in the raffinate pits due to the decay of uranium to radium and trace amounts in the yellow cake. In addition, some feed materials processed in the early years of operation at the WSUFMP were high-grade uranium ore which would contribute both thorium-230 and radium-226 to the wastes in the raffinate pits. However, the majority of the radium was removed at the producing uranium mills and disposed of with the mill tailings (usually close to the source of the ore). Some thorium-230 was retained with the uranium when raw uranium ore was processed into yellow cake. Processes at the feed materials plant were designed to remove as much metals and silacious material impurities (including thorium-230) from the uranium as possible with the waste sent to the raffinate pits.

Numerous tanks, drums and other equipment were disposed of in Pit 4 during the 1967-1969 decontamination effort by the Army. A significant portion of the equipment from Buildings 101, 103, and 105 was dismantled and dumped in Pit 4. The equipment in these buildings would have been contaminated with uranium in a soluble form. Near the end of production at the feed materials plant, uranium was used to purge thorium wastes from all steps of the process. Wastes from this purge were disposed of in Pit 4.

1.2 PURPOSE

The purpose of the chemical characterization of the sludge/ sediment material within the pits is to define the degree of contamination and to help quantify the magnitude of the effort which will be required to ultimately dispose of the wastes. The variability of contaminant types within the sludges will determine the disposal alternatives to be evaluated. Knowledge of these contaminants is required to develop the rationale behind liner engineering and compatibility testing.

1.3 SCOPE

From previous studies, radiological and chemical characterization provided an indication of the types of radiochemicals and chemicals present in the raffinate pit sludges. The sampling program reported herein was designed to verify and fully supplement these studies. Samples taken to complete the sludge characterization were placed so as to provide uniform coverage of sludge area and depth in conjunction with previous sampling.

Analytical parameters were selected from the history of the processes performed during operation of the WSUFMP. However, because of the potential of indiscriminate dumping of other chemicals into the pits, a scan for hazardous substance list (HSL) compounds was conducted on composite samples acquired across each of the pits. This determined the actual concentration of suspected wastes, as well as verifying the presence or absence of other chemicals.

The sludges were analyzed for chemical products and by-products of process chemicals used on site, as well as their degradation products. These compounds include: metals, nitroaromatics and inorganic anions such as chloride, fluoride, nitrates, nitrites and sulfates. Also, a scan for chemical contamination from PCBs/pesticides, volatile and semi-volatile fractions was performed to determine their presence or absence. Analyses were performed for total organic carbon, total organic halogens and oil/grease to expand data for treatability studies. Analyses were performed for cyanides and phenols to determine their presence or absence.

2 PREVIOUS STUDIES

Three previous studies have been performed regarding various properties of the raffinate pit sludges and sediments. Bechtel National, Inc. (BNI) subcontracted with Eberline Instrument Corporation in 1983 to take samples of the waste in the raffinate pits and analyze them for stable metals and radiochemistry. BNI also subcontracted with Environmental Science and Engineering, Inc. (ESE) in 1983 to sample and analyze the raffinate pit wastes in an effort to select equipment best suited for dewatering the raffinate pit sludges. In 1986, BNI obtained samples of the raffinate pit sludges and subcontracted Thermo Analytical/ Eberline Laboratory to perform radiological analysis and analysis for EP toxicity, PCBs/pesticides, reactivity, ignitability, and pH.

One report has also been prepared for characterization of the raffinate pit surface waters. This report was prepared by the current Project Management Contractor (PMC) in 1987.

2.1 BECHTEL NATIONAL, INC. STUDY, 1983 (WITH EBERLINE)

In a screening-level survey, samples were collected and analyzed by Eberline Instrument Corporation in 1983. The data reported represent analytical results on a single, blended, mixed, composite sample prepared from multiple-location samples taken from each pit. Five samples were taken in Pits 3 and 4, one from each corner and one in the middle. Two samples were taken in Pits 1 and 2, one each from opposite corners. The samples were taken with a Shelby tube operated from a polystyrene barge. The stable metals (Table 2-1) were analyzed using the method of atomic absorption analysis. In addition, the inorganic anions of nitrate, fluoride, chloride, sulfate and hydroxide were reported.

TABLE 2-1 **Analysis of Stable Metals from Previous Studies Weldon Spring Raffinate Pits Sludge (mg/kg-dry)**

Analysis	Pit 1 Composite	Pit 2 Composite	Pit 3 Composite	Pit 4 Composite
Aluminum	4.3	4.1	6.2	4.0
Arsenic	130	170	54	1.0
Boron	60	350	50	30
Barium	23	20	10	22
Beryllium	0.016	0.025	0.015	0.007
Cadmium	9.1	7.3	5.1	2.8
Calcium	980	990	990	980
Cobalt	9.4	14	11	2.1
Chromium	90	60	60	70
Copper	5.5	4.9	5.5	4.4
Iron	210	200	130	210
Lead	110	140	220	1.5
Lithium	4.4	9.2	23.7	10.1
Magnesium	1,800	1,700	1,700	860
Manganese	7.8	7.8	9.4	8.8
Mercury	1.8	0.75	17	2.3
Molybdenum	4,700	2,800	2,500	370
Nickel	30	27	27	22
Phosphate	0.7	0.6	0.8	0.5
Potassium	650	620	220	310
Selenium	0.89	0.5	1.4	0.5
(Total)Silicon	10,000	16,400	13,000	13,800
Silver	2.0	0.39	1.4	0.1
Strontium	84	220	50	40
Titanium	1,000	860	1,150	670
Vanadium	5,000	800	800	300
Zirconium	17,000	14,400	19,000	11,500
Sodium	10,000	5,000	5,000	4,000
Zinc	10	20	10	10
Nitrate	50,000	18,000	22,000	220
Fluoride	23,000	2,500	107,000	64,300
Chloride	670	230	300	50
Sulfate	400	200	370	270
Hydroxide (% $CaCO_3$)	7	10	10	11
pH (pH units)	8.1	8.7	9.4	8.5

Ref. BNI, 1983

Table 2-1 shows unreasonably high zirconium levels in the pits due to no knowledge existing of zirconium being used at the WSS. Table 2-1 also shows the presence of high concentrations of silicon, sodium, nitrates, and fluoride, as well as elevated levels of arsenic, calcium, magnesium, and molybdenum in all four pits.

2.2 BECHTEL NATIONAL, INC. STUDY, 1983 (WITH ENVIRONMENTAL SCIENCE & ENGINEERING)

In 1983 Bechtel National, Inc. (BNI) contracted with Environmental Science and Engineering, Inc. (ESE) to sample and test the physical properties of the raffinate pit sludges. Testing was actually performed by Monteagle, Inc., Environmental and Energy Consultants, and Reitz & Jens, Inc.

The initial project intent was to use test results to select the type and size of mechanical dewatering equipment best suited for dewatering the raffinate pit sludges. Early test results indicated that the sludges had a considerably higher solids content than expected. These percent solids levels are greater than most mechanical dewatering devices can achieve. For this reason all further tests related to mechanical dewatering were stopped and replaced with a series of tests useful in developing other treatment options.

Sludges in each of the raffinate pits were sampled by driving a core sampling device into the sludge bed at preselected locations. The sampling was conducted from a polystyrene barge. The sampler was driven with a safety slide hammer and extractor. The sampler itself was constructed of 3-inch PVC tubing with a retaining apparatus and check valve to hold the sample during extraction.

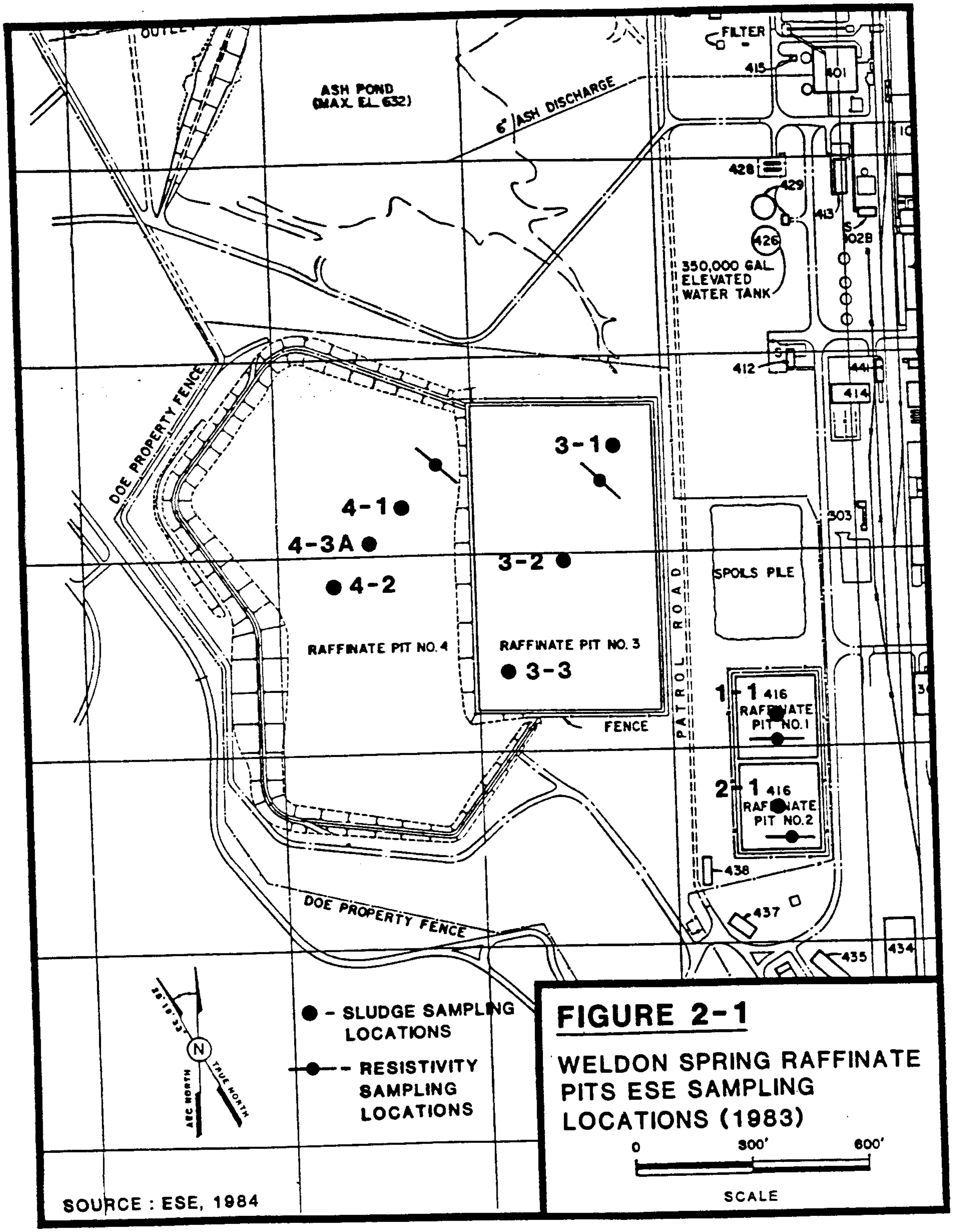

FIGURE 2-1

WELDON SPRING RAFFINATE PITS ESE SAMPLING LOCATIONS (1983)

TABLE 2-2 Weldon Spring Raffinate Pit Sampling Data

Sample Location	Time Sampled	Water Level Elevation	Depth to Top of Sludge (feet)	Depth to Bottom of Sludge (feet)	Depth of Sludge (feet)
3-3	1127 5/3/83	659.67	4.5	11.5	7.0
3-2	1140 5/3/83	659.67	4.0	13.0	9.0
3-1	1245 5/3/83	659.67	2.5	19.0	16.5
4-1	0846 5/5/83	647.68	6.0	9.0	3.0
4-2	1026 5/5/83	647.68	11.0	13.0	2.0
4-3a*	1328 5/5/83	647.68	9.5	12.0	2.5
2-1	1710 5/6/83	662.05	4.0	14.0	10.0
1-1	0908 5/6/83	662.01	4.0	15.5	11.5

* Station 4-3 was adjusted due to lack of sludge at original location; 4-3a was located between 4-1 and 4-2.

Source: Monteagle, Inc., 1983; and ESE, 1983.

Sludge samples were obtained from eight locations (three each from Pits 3 and 4, one each from Pits 1 and 2). Sample locations are shown in Figure 2-1. A summary of the sampling data is provided in Table 2-2. Samples were obtained from the top, middle and bottom of each core, providing 24 individual sludge samples. Sludge composites were made by homogenizing individual samples from each location within each pit. Preliminary tests were conducted on individual sludge samples; most testing was conducted on the composite samples (Reference ESE, 1983).

Table 2-3 lists percent total solids of each discrete sample. Percent total solids is defined as the weight of the solids in a sample divided by the total weight of the sample times one hundred. The total solids determination is useful in estimating the homogeneity or heterogeneity of the sludge. It can be interpreted from the solids data in Table 2-3 that the physical density of the sludge appears to be heterogeneous with no discernible trends or patterns. Interpretation of the data, however, is difficult due to the vibratory sampling technique.

Table 2-4 is a summary of physical properties of the composite sludge samples. The specific gravity of solids is the ratio of the dry density of the solid fraction (weight of solids divided by volume of sample) of a sample to the density of water (62.4 lbs/cf). This parameter can also be an indicator of homogeneity or heterogeneity. Although the specific gravity varies from pit to pit because the samples from each pit were composited for this particular test, the degree of heterogeneity within each pit is indeterminate.

Table 2-5 presents additional test results for the composite samples. The use and interpretation of moisture content, total solids, density, and specific gravity have been discussed. An additional parameter, viscosity, is a measure of

TABLE 2-3 Total Solids - Discrete Samples

Sample I.D.	% Total Solids (by weight)	Sample I.D.	% Total Solids (by weight)
Pit No. 1:		Pit No. 4:	
P-1 Top	37.8	P-4 1-Top	33.6
P-1 Middle	30.2	P-4 1-Middle	37.1
P-1 Bottom	30.4	P-4 1-Bottom	27.7
Pit No. 2:			
P-2 Top	25.6	P-4 2-Top	27.2
P-2 Middle	24.5	P-4 2-Middle	20.0
P-2 Bottom	32.6	P-4 2-Bottom	18.2
Pit No. 3:			
P-3 1-Top	50.0	P-4 3-Top	38.5
P-3 1-Middle	24.5	P-4 3-Middle	42.3
P-3 1-Bottom	28.3	P-4 3-Bottom	67.9
P-3 2-Top	22.6		
P-3 2-Middle	27.0		
P-3 2-Bottom	25.6		
P-3 3-Top	24.3		
P-3 3-Middle	22.5		
P-3 3-Bottom	25.1		

Ref.: WSRP Sludge Core Samples - BNI 1983 - ESE

TABLE 2-4 WSRP Physical Properties of Composite Samples

Property	Pit 1	Pit 2	Pit 3	Pit 4
Moisture Content	262	240	266	295
Specific Gravity of Solids	2.94	2.73	2.68	2.75
Response to Vibration*	none	none	none	none
% Finer than #200 Screen	90.8	99.93	89.2	94

* Vibration testing performed with equipment conforming to ASTM D-2049.

Ref. Reitz & Jens, Inc. (BNI, 1983, ESE)

TABLE 2-5 Composite Sample Testing Results of Raffinate Sludge

Pit No.	Moisture Content % of Wet Sample by Weight	Moisture* Content by Percentage	Total Solids % by Weight	Density (lbs/cf)	Specific Gravity of Sludge
1	72.4	123	27.6	200	1.189
2	70.6	142	29.4	235	1.217
3	72.7	191	27.3	320	1.204
4	74.7	254	25.3	380	1.182

Pit No.	Viscosity, cps **	Driving Weight, in grams to obtain 600 r.p.m
1	262%	74.35
2	240%	76.10
3	266%	75.29
4	295%	73.92

* Weight of water divided by weight of solids

** Centipoise

Ref. BNI 1983-ESE

fluidity. Information on sludge viscosity is used in the selection and sizing of mechanical equipment which might be used for mixing or pumping the sludge.

2.3 BECHTEL NATIONAL, INC., STUDY, 1986 (WITH THERMOANALYTIC/ EBERLINE LABORATORY)

BNI conducted an initial Resource Conservation and Recovery Act (RCRA) characteristic sampling program for the raffinate pits in 1986. The 28 sampling locations are shown on Figure 2-2. These locations were chosen using a random number generator method.

Eighteen samples were analyzed by Eberline Analytical Laboratories (EAL) for EP toxicity, reactivity, ignitability, PCBs/pesticides and pH. PCBs/pesticides analyses were useful in confirming their absence in the sludge. Tables 2-6 and 2-7 present the results of these analyses. All analytical results reported were below regulatory limits and EAL concluded that the material did not exhibit any of the four characteristics of RCRA hazardous waste (Reference BNI, 1986).

2.4 WSSRAP PROJECT MANAGEMENT CONTRACTOR STUDY, 1987

Surface water samples were collected from the four raffinate pits as a part of the Phase I Water Quality Assessment conducted in April 1987 by the PMC. Representative samples for each pit were collected from the shore and composited from at least four locations per pit. These samples were collected using a stainless steel bailer which was slowly lowered to a point just above the sediment. These samples were analyzed for the groundwater parameters listed in Table 2-8.

The analyses in Table 2-8 (Analytical Parameters) were selected based on known or suspected contaminants

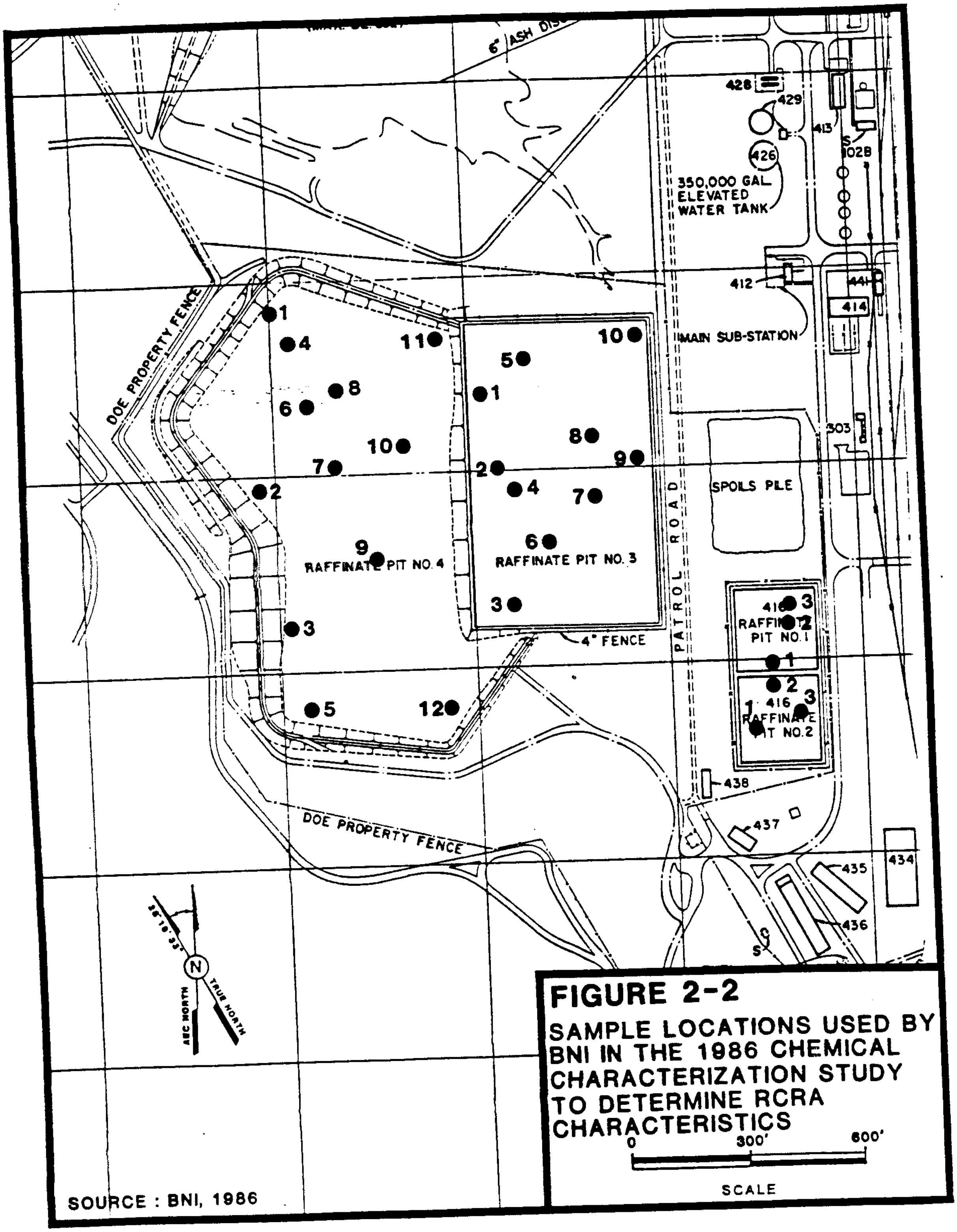

FIGURE 2-2

SAMPLE LOCATIONS USED BY BNI IN THE 1986 CHEMICAL CHARACTERIZATION STUDY TO DETERMINE RCRA CHARACTERISTICS

TABLE 2-6 EP TOXICITY RESULTS ORGANIC COMPOUNDS - PCBs

		PCB-1016 mg/L	PCB-1221 mg/L	PCB-1232 mg/L	PCB-1242 mg/L	PCB-1248 mg/L	PCB-1254 mg/L	PCB-1260 mg/L
Raffinate Pit 1	Location 1	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011
	Location 3	<0.0125	<0.0125	<0.0125	<0.0125	<0.0125	<0.0125	<0.0125
Raffinate Pit 2	Location 1	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 3	<0.0125	<0.0125	<0.0125	<0.0125	<0.0125	<0.0125	<0.0125
Raffinate Pit 3	Location 2	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 3	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 5	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 6	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 7	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 10	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
Raffinate Pit 4	Location 1	<0.0128	<0.0128	<0.0128	<0.0128	<0.0128	<0.0128	<0.0128
	Location 2	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 5	<0.0122	<0.0122	<0.0122	<0.0122	<0.0122	<0.0122	<0.0122
	Location 6	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 11	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111	<0.0111
	Location 12	<0.0101	<0.0101	<0.0101	<0.0101	<0.0101	<0.0101	<0.1010

< - denotes below detection limit
All concentrations noted were below detection limits.

TABLE 2-7 EP TOXICITY RESULTS ORGANIC COMPOUNDS - PESTICIDES

		ENDRIN mg/L	LINDANE mg/L	METHOXYCHLOR mg/L	TOXAPHENE mg/L	2,4-D mg/L	2,4,5-TPSILVEX mg/L
Raffinate Pit 1	Location 1	<0.000007	<0.000003	<0.00056	<0.00027	<0.001	<0.0001
	Location 3	<0.000008	<0.000037	<0.00063	<0.00030	<0.001	<0.0001
Raffinate Pit 2	Location 1	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 3	<0.000007	<0.000037	<0.00063	<0.00030	<0.001	<0.0001
Raffinate Pit 3	Location 2	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 3	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 5	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 6	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 7	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 10	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
Raffinate Pit 4	Location 1	<0.000008	<0.000038	<0.00064	<0.00031	<0.001	<0.0001
	Location 2	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 5	<0.000007	<0.000034	<0.00061	<0.00029	<0.001	<0.0001
	Location 6	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 9	<0.000007	<0.000035	<0.00059	<0.00028	<0.001	<0.0001
	Location 10	<0.000008	<0.000040	<0.00067	<0.00032	<0.001	<0.0001
	Location 11	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001
	Location 12	<0.000007	<0.000033	<0.00056	<0.00027	<0.001	<0.0001

< - Denotes below detection limit.

All concentrations noted were below detection limits.

TABLE 2-8 Analytical Parameters (Dissolved Fraction)
Phase I Water Quality Assessment

Uranium - Natural	Fluoride
Radium 226	Hardness
Radium 228	Total Dissolved Solids
Thorium 230	Total Organic Carbon
Thorium 232	CLP Metals; Lithium
Gross Alpha	CLP Organics
Gross Beta	U.S. ATHAMA Nitroaromatics
Nitrate	PCBs
Sulfate	Pesticides
Chloride	

Source: WSSRAP, 1987

(nitroaromatics, radionuclides, etc.) and to provide documentation of presence/absence regarding species not expected to be present in the water (organics, Hazardous Substance List (HSL) compounds, PCBs, pesticides, etc.).

Surface water samples from each pit were analyzed for nitroaromatics. A trace level (0.28 ppb) of 2,4 DNT was originally reported. After further review of chromatographs by the lab, it was determined this was a false positive. No other nitroaromatics were detected in any of the raffinate pit waters, as expected.

Raffinate pit water samples were also tested for four inorganic anions (nitrate, sulfate, chloride, and fluoride) and three water quality indicator parameters (Total Organic Carbon (TOC), Total Dissolved Solids (TDS) and hardness. Samples were tested for cyanides and, as expected, resulted in very low levels since cyanides were not known to be used in process operations. The results of these analyses are shown in Table 2-9. A comparison of recent data to historical data (Reference: DOE, DEIS - 1987) for the four inorganic anions is presented in Table 2-10.

Due to the nature of the uranium purification process used at the WSUFMP, high levels of nitrates and sulfates were present in the raffinate slurry as it entered the pits. Due to stratification of the sludges and lack of mixing, significant quantities of the inorganic anions would be expected in past pit water samples and in the raffinate sludge (Table 2-10). The table shows a significant reduction of nitrates in relation to time as compared to the other anions which increase or insignificantly decrease. The reduction of nitrates over time is believed to be a result of biological consumption. Algae exist in all of the pits.

TABLE 2-9 Inorganic Anion and Water Quality Data for Ponded Water in the Raffinate Pits
Phase I Water Quality Assessment

Concentration mg/L Location No.	Nitrate (as N)	Sulfate	Chloride	Fluoride	Hardness	TDS	TOC	Cyanide	Phenol
SW-3001 Raffinate Pit #1	422	231	1.50	1.90	872	3160	12	0.032	<0.005
SW-3002 Raffinate Pit #2	10.1	493	2.34	1.57	422	818	8	0.025	<0.005
SW-3003 Raffinate Pit #3	947	704	3.37	4.84	2107	6390	6	0.027	<0.005
SW-3004 Raffinate Pit #4	46.6	136	5.69	4.69	252	694	8	0.032	<0.005

Source: WSSRAP, 1987

< - Denotes below detection limit.

TABLE 2-10 Concentrations of Inorganic Anions in Ponded Raffinate Pit Water

Compound	Concentration (mg/L) 1987	1984[a]	1983[a]	1979[a]	1967[a]	Sludge - 1983 (mg/kg dry)
Pit 1						
Nitrate (as N)	442	652	697	-	5625	11250
Sulfate	231	400	100	-	2300	400
Fluoride	1.9	2.5	1.1	-	--	23000
Chloride	1.5	17	15	-	210	670
Pit 2						
Nitrate (as N)	10	204	-	-	8550	4050
Sulfate	493	990	460	-	3300	200
Fluoride	2.3	2.7	1	-	--	2500
Chloride	1.6	5.7	6	-	50	230
Pit 3						
Nitrate (as N)	947	1890	1485	2925	8325	4950
Sulfate	704	640	268	620	2200	370
Fluoride	4.8	8.9	2.7	6	--	107000
Chloride	3.4	25	20	37	90	300
Pit 4						
Nitrate (as N)	47	92	99	126	4725	495
Sulfate	136	150	70	140	2200	270
Fluoride	4.7	7.8	5.8	13	--	64300
Chloride	5.7	7.7	7	10	90	50

[a] Source - DOE, DEIS - 1987.

metals in high pH aqueous solutions, most of the metals are expected to exist as solids in the sludge.

In the digestion stage of the operations process, the magnesium fluoride slag from the final stage of the process was redissolved with yellow cake feed material to recover unreacted uranium. The magnesium fluoride would be separated in the aqueous phase of the solvent extraction circuit; thus substantial quantities of magnesium, as magnesium fluoride, should have been deposited in the pits. This probably explains the elevated magnesium levels. Lime was used to neutralize the aqueous phase of the extraction which probably explains the elevated calcium levels. Potash was used in the pilot scale buildings and various other facets of the operation, which probably explains the elevated potassium levels.

The sodium is believed to come from sodium carbonate which was used in the solvent treatment process at the WSUFMP. The sodium carbonate precipitated monobutyl phosphate (MBP) and dibutyl phosphate (DBP) from the stripped solvent into sodium salts, MBP and DBP inhibited stripping of uranium from the solvent.

Remaining metals (Table 2-11) probably originated as impurities in the yellow cake concentrate feed material which were removed during the metallurgical purification process.

Surface water samples from all four raffinate pits were also analyzed for volatile and semi-volatile organics, pesticides, and PCBs. No detectable levels of these compounds were observed in the water ponded on the raffinate pits.

Both Ra-226 and Ra-228 isotopes were present in raffinate pit ponded waters at varying activity levels. The highest level of radium-226 was detected in Pit 1 (61 pCi/L). Pit 4 contained the lowest radium-226 activity at 3.4 pCi/L. Radium-228 was observed in Pits 2, 3, and 4 at activities of 6, 32, and 13 pCi/L, respectively.

Thorium-230 was detected only in Pits 2 and 3 at levels of 13 and 16 pCi/L, respectively. Less than 5 pCi/L of thorium-230 was observed in Pit 4. Thorium-230 and thorium-232 activities could not be determined in Pit 1 due to interference. Based on thorium levels in the sludge in Pits 1 and 2, water in Pit 1 is expected to contain approximately 13 pCi/L thorium-230.

2.5 SUMMARY OF PREVIOUS STUDIES

Chemical characterization from previous studies provided an indication of the types of chemicals present in the raffinate pit sludges. However, further characterization was believed necessary to identify substances that might have been dumped during operation of the chemical plant and subsequent clean-up activities. In addition, previous information did not allow an interpretation of the degree of heterogeneity of the chemical makeup of the sludges.

Previous studies on the physical properties of the sludge indicated that the materials were very fine grained (nearly 95% passing the No. 200 sieve). The water content ranged from 70 to 75 percent with stratification of solids apparent. The material was described as having the consistency of pudding. The preliminary data indicated that wet bulk densities ranged from 73.9 lb/cf to 76.1 lb/cf. Depth estimates of the sludge ranged from an average of approximately two feet in Pit 4 to approximately 12 feet in Pit 3. The sludge was reported to be underlain by a stiff saturated clay. Physical characterization is adequate to conclude that the sludges exist in a highly heterogeneous physical state and that the solids content is sufficiently high to preclude the effective use of mechanical dewatering techniques. Further testing was considered necessary, however, in connection with treatability studies. The treatability studies will explore other stabilization technologies in an effort to achieve the regulatory goals of volume and toxicity reduction.

Past analyses for PCBs/pesticides confirmed no presence of these chemicals in the pits. This was expected due to no record of these chemicals being placed in the pits.

Surface water sample analyses detected very low levels of cyanides as expected due to no evidence of these compounds being employed at the site.

Low fluoride levels from the surface water study conducted in 1987 do not agree with the 1983 study from Bechtel. The 1983 study also showed unreasonably high zirconium levels in the pit waters which required additional confirmation. Previous studies have been useful indicators for characterization, but have not been complete or thorough enough to date. Previous studies also lack adequate characterization in regard to variation with depth.

3 SAMPLING

3.1 SAMPLING RATIONALE

In order to fully verify and supplement data from previous studies, a sampling plan, as described in the previous chapter, was developed. A set of specifications was also developed and a contract was awarded to Geotechnology Engineering and Environmental Services. Performance in the field occurred from July 1988 through October 1988 and January 1989. Sampling was accomplished in a single phase for Pits 1, 2, and 4 and in two phases for Pit 3. A second phase for Pit 3 was performed because a different sampling method was needed to sample some areas of the pit due to low water levels.

The number of samples needed was determined as follows. Since the data will be applied primarily toward evaluation of disposal alternatives, a 90 percent confidence limit about the mean with a relative error of the mean of 20 percent was chosen as adequate for devising the sampling strategy.

The approach utilizes the formula

$$n = (cv)^2 (t)^2 (p)^2$$

where
- n = the number of samples
- cv = the coefficient of variation in percent
- t = the student's value for 90% confidence and 30 degrees of freedom
- p = the acceptable error in percent

In the absence of usable data to determine actual variations in concentrations across the pits, some assumptions were made for the values of cv and p. Assumptions which were made for the raffinate sludge sampling were that the coefficient of variation was equal to 65% and the acceptable error was chosen at 20%. The t-value for 90% confidence level and 30 degrees of freedom was obtained from the student's t table as 1.66. Calculating the minimum necessary number of samples (n) from these numbers:

$$n = (65)^2(1.66)^2/(20)^2$$

$$n = 29.10$$

Rounding up, n = 30

Since each of the pits contains, in effect, a different statistical population, a coverage of 30 samples per pit was desired to achieve the desired confidence. Consideration was given to combining the sampling efforts for Pits 1 and 2, since the pits were immediately adjacent to one another and the wastes were deposited in both pits over a relatively short span of time. However, review of the previously collected data showed some variations in the concentrations of radiologic characters between the two pits. Therefore, these pits were treated as separate statistical populations, with 30 samples taken in each of the four pits. Figure 3-1 exhibits the sample location layout.

Field activities began with sampling of Pit 3 which consisted of obtaining samples from nine locations. The number of samples needed from each pit determined the number of locations sampled due to varying depths in each pit. Locations were selected for even distribution of each pit.

After sampling was completed for Pit 3, the operation moved to Pit 4 where 18 locations were sampled. Due to a lack of sludge in Pit 4 (shallower depth than estimated), the number of samples was scaled down from 30 to 20. Subsequently the number of samples for Pit 3 was increased from 30 to 59 since it contained over half the total volume of sludge material. After

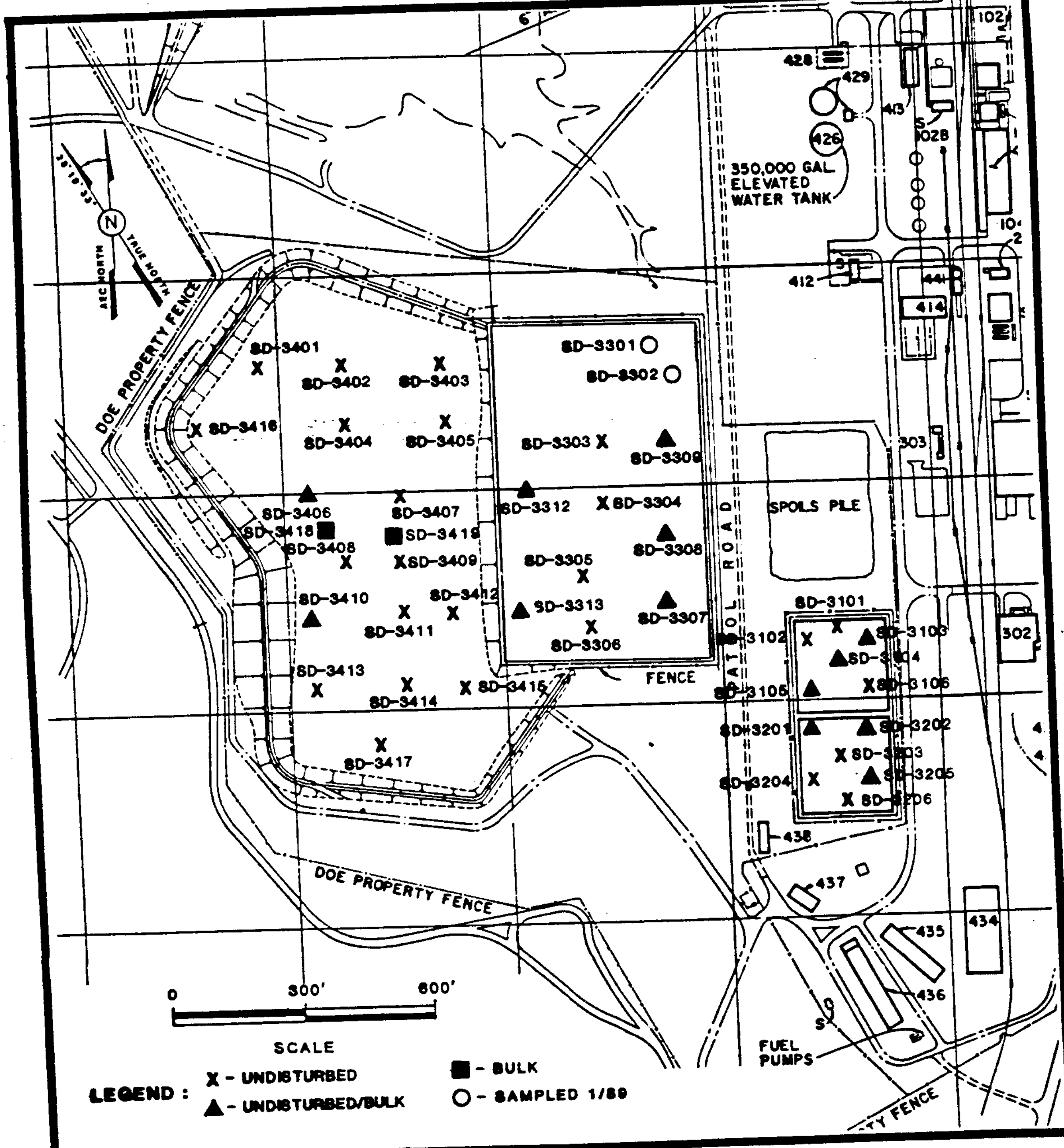

FIGURE 3-1

SAMPLING LOCATIONS FOR THE WSS RAFFINATE PITS CHARACTERIZATION sampling of Pit 4, the operation moved to Pits 1 and 2 respectively where six locations were sampled in each pit.

In January 1989, the second phase sampling of Pit 3 was accomplished. Seven samples were collected from two locations.

In March 1989, the surface water contained in each pit was sampled. The method of sampling from this operation is contained in Section 3.6. Results are contained in Section 4.8.

3.2 SAMPLE COLLECTION

3.2.1 Sample Location Access

The samples were collected using a barge-mounted drilling rig. The barge rig was maneuvered to specific sample locations through the use of cables and two electric winches mounted on the barge. Water had to be pumped from Pit 4 to Pits 1 and 2 to the minimum level needed to float the barge. Due to the summer drought, the water level above the sludge in these two pits dropped to six inches. The depth of ponded water was increased to two feet to float the barge. The sampling crew transferred from barge to shore through the use of a 14-foot john boat powered by a gasoline motor. Sample locations were located by line-of-sight cross-reference between survey grid stakes on each bank of the pits.

In the second phase sampling of Pit 3, a wooden platform was constructed. The platform was pulled into position by a truck driven on the berm. Samples were taken from two sample locations in approximately six inches of water.

3.2.2 Method of Collection

Samples were collected from the barge-mounted drilling rig as mentioned above with the exception of the Phase II sampling of Pit 3. The barge consisted of four steel sections with dimensions of 15 feet by 7.5 feet by 4 feet. The sections were connected together leaving a hole in the center from which to obtain samples. Phase II sampling of Pit 3 was accomplished from the wooden platform mentioned previously. A cathead and a tripod of aluminum poles was used instead of a drilling rig to reduce weight on the wooden platform. Undisturbed samples were collected with a piston sampler, consisting of an outer tube and a coaxial piston that created a suction pressure within the tube. The tube was two feet in length and three inches in diameter and made from steel. The samples were obtained by lowering a tube two feet followed by lowering 10-inch PVC casing around the tube to assure integrity of the hole. Bulk samples, used for physical tests, were obtained by cleaning out a 10-inch PVC casing with a bailer. Samples at intervals of two feet were taken continuously through the sludge from surface to clay.

Undisturbed samples were extruded from the tubes to a stainless steel tray where pictures were taken. The sludge was then placed in appropriate containers with the use of funnels, spatulas, spoons and probes. Parafilm was wrapped around the containers to prevent outside contamination of the containers.

3.2.3 Quantity/Containers/Preservation

Analysis of sludge materials required that samples be properly packaged to maintain sample integrity. Table 3-1 details the chemical container types, volumes used and the parameters tested as specified for different locations on aliquots from each container. Finally, the table also lists the method by which the samples were preserved.

Table 3-1 Sample Containers Chemical Analysis

Parameters	Containers	Preservatives
Volatile Organics	2-40ml vials	Refrigeration
Organics--Semi-Volatile, Pesticides, PCBs, Nitroaromatics, Total Organic Carbon, Total Organic Halogens Cyanides, Phenols	2-250ml wide-mouth amber glass jars	Refrigeration
Inorganics--Metals, Radiologic, Ionic Species	2-250ml wide-mouth amber glass jars	Refrigeration
Oil/Grease	1-1000 ml wide-mouth amber glass jar	Refrigeration

3.2.4 Decontamination of Sampling Equipment

Equipment that could possibly influence the chemical or radiologic character (either concentration or substance) of the samples through direct or indirect contact was decontaminated before and between uses. Each discrete undisturbed sample was collected with a sampler that had been decontaminated with pressure steam followed by a triple rinse with distilled water. Other sampling equipment that could potentially come in contact with the sample material was decontaminated with pressure steam between sampling locations. The barge and drilling rig were decontaminated with pressure steam following sampling in each pit. The barge and drilling rig were also rinsed as needed with water from a tank placed on the barge. All equipment (funnels, trays, etc.) used in transporting the sludge from the piston tube to the sampling containers was washed with Alconox soap and water followed by a rinse of water. The wooden platform was not removed from the pit area.

The effectiveness of the decontamination was verified by the following methods: 1) visual inspection of the sampling components; 2) radiologic scan through the use of an alpha probe or GM probe (as appropriate); and 3) periodic collection of rinsate samples from the sampling tools.

3.2.5 Sample Container Labeling

All samples were assigned a specific number and all samples were labeled. A description of the numbering system and field report abbreviations is located in Appendix A of this report. Information included on the labels was the site name and address, sample number, sampling personnel and date. Following completion of each label with the specific sample data, the labels were taped with clear plastic to protect the information and ensure that it remained legible.

3.3 SAMPLE ANALYSIS

All sample analyses were performed according to industry standard testing protocols. Sample analysis was performed by metaTRACE, Inc. Specific testing methods are listed in Table 3-2 according to the parameters of interest in this study.

The four pits were treated as separate statistical populations, due to suspected heterogeneity of sludge material. A complete column of sample was collected at each location to assess the degree of stratification of the waste materials.

Of greatest concern with respect to high degrees of variation are the semi-volatile organic compounds and their impacts on liner compatibility. To date, no data had been collected on the semi-volatile fraction from the raffinate pit sludges. A breakdown of the numbers of samples and analyses which were performed is given in Tables 3-3 through 3-8. A detailed list of analyses and detection limits can be found in Appendix B.

Other parameters investigated included CLP metals (plus lithium, molybdenum and zirconium), volatile organics, nitroaromatics, PCBs/pesticides, and inorganic anions (including chloride, fluoride, nitrate and sulfate). Previous studies investigated, to a very limited extent, the sludge's content of metals (minus lithium, molybdenum and zirconium), and PCBs/ pesticides, as well as the presence of nitroaromatics and inorganic anions in the supernatant waters. These studies revealed occasional areas across the pits where concentrations of metals (As, Ba, Cd, Pb, Hg, Ag) slightly exceeded detection limits (as determined through EP toxicity tests). Molybdenum was added because it might have been present as an impurity in the yellow cake. Zirconium was added to accurately define its presence, due to unreasonably high levels detected in the 1983

TABLE 3-2 Sample Analysis Criteria

Parameter	Standard Method of Analysis
Radiologic:	
Uranium and Thorium	EPA 520/5-84-006, Procedure 00-07
Radium	EPA 600/4-80-032
Chemical:	
Volatile Organics	CLP SOW #WA-87-J002
Semi-Volatile Organics	CLP SOW #WA-87-J002
PCBs	CLP SOW #WA-87-J002
Pesticides	CLP SOW #WA-87-J002
Metals (plus Li, Mo and Zi)	CLP SOW #WA-87-K026
Nitroaromatics	EPA Method 609 and USATHAMA Methodology
Inorganic Anions	EPA Method 300.0
Cyanides	CLP SW846-9010
Phenols	EPA Method 420.2
Physical:	
Sludge Moisture Content	ASTM D2216
Sludge and Solid Specific Gravity	SMEWW Method 213E and ASTM D854
Sludge Capillary Moisture	ASTM D3152
Sludge Particle Size Analysis	ASTM D422
Sludge Viscosity and Gel Strength	See Note 1
Sludge Surface Charge	Zeta Meter
Atterberg Limits	ASTM 4318
Sludge Centrifuge Moisture Yield	ASTM D425
Sludge Consolidation	ASTM D2435
Sludge Phase Separation	See Note 2

Note 1: Viscosity and Gel Strength

Viscosity was measured according to ASTM D4016. To measure gel strength, the viscometer is turned off and the grout or sludge allowed to stand for ten (10) minutes. The viscometer is then turned on at a low rate of shear ($5\ s^{-1}$ for a Fann viscometer) and the gel strength is read directly as the maximum deflection on the scale.

Note 2: Phase Separation

Phase separation, a measurement of drainable water, is determined by a settling test in a 250-ml graduate cylinder. A sludge sample (200 ml) is poured into the graduate and allowed to stand. Phase separation is calculated as the volume of clear, drainable surface water divided by the total initial volume X 100.

TABLE 3-3 Pit 1 Sampling Parameters

DEPTH LOCATION	0 - 2 ft.	2 - 4 ft.	4 - 6 ft.	6 - 8 ft.	8 - 10 ft.	10-12 ft.
1 - 1	V N S I P M	V N S I P M R	V N S I P M R	V N S I P M R	V N S I P M R	R
1 - 2	V N S I P M	V N S I P M R	V N S I P M	V N S I M	V N S I P M R	R
1 - 3	V N S M	V N S I P M	V N S I M R	V N S I M	V N S I M	
1 - 4	V N S I M	V N S I M	V N S I M	V N S I M	V N S I M	
1 - 5	S I M	S	S I M	S I M	S I M	
1 - 6	S I O M T X	S I O M T X	S I O M T X	S I O M T X	S O T X	

V = VOLATILES
S = SEMI-VOLATILES
P = PCBs/PESTICIDES
M = METALS
N = NITROAROMATICS
I = INORGANIC ANIONS
R = RADIOLOGICAL
O = OIL/GREASE
T = TOTAL ORGANIC CARBON
X = TOTAL ORGANIC HALOGENS

TABLE 3-4 Pit 2 Sampling Parameters

DEPTH LOCATION	0 - 2 ft.	2 - 4 ft.	4 - 6 ft.	6 - 8 ft.	8 - 10 ft.	10 - 12 ft.
2 - 1	V N S I P M	V N S I P M R	V N S I P M R	V N S I P M	V N S I P M	
2 - 2	V N S I P M	V N S I P M R	V N S I P M	V N S I M R	V N S I P M	
2 - 3	V N S I P M	V N S I P M	V N S I M	V N S I M	V N S I M R	
2 - 4	V N S I M	V N S I M	V N S I M	V	V	V
2- 5	S I O M T X	S I O M T X	S I M T X	S I O M T X	S I O M T X	
2- 6	S I M	S I M	S I M	S I M	S I M	S I M

V = VOLATILES
S = SEMI-VOLATILES
P = PCBs/PESTICIDES
M = METALS
N = NITROAROMATICS
I = INORGANIC ANIONS
R = RADIOLOGICAL
O = OIL/GREASE
T = TOTAL ORGANIC CARBON
X = TOTAL ORGANIC HALOGENS

TABLE 3-5 Pit 3 Sampling Parameters Phase I

Depth Location	0 - 2 ft.	2 - 4 ft.	4 - 6 ft.	6 - 8 ft.	8 - 10 ft.	10 - 12 ft.	UPPER COMP.	MIDDLE COMP.	LOWER COMP.
3-3	V R	R	R	V R	R	R	N S I P M	N S I P M	N S I P M
3-4	V R	R	R	V R	I M R	V	N S I P M		N S I P M
3-5	R	V R		R	V R		N S I P M		N S I P M
3-6	R	V R	R	R			N S I P M		N S I P M
3-7	S N X P O R T	O V T R X	I O M T R X	O V T R X					
3-8	V P I R M	V N P S R	V I R M	S P N R	R				
3-9	V R	S I R M	V R	S I R M	V R	R			
3-12	V I M	S I M	S P I N M	S	V				
3-13	S I M	V I M	S I M						

V = VOLATILES
S = SEMI-VOLATILES
P = PCBs/PESTICIDES
M = METALS
N = NITROAROMATICS
I = INORGANIC ANIONS
R = RADIOLOGICAL

O = OIL/GREASE
T = TOTAL ORGANIC CARBON
X = TOTAL ORGANIC HALOGENS

Table 3-6 Pit 3 Sampling Parameters Phase II

Depth Location	0-4 ft.	4-8 ft.	8-12 ft.	12-16 ft.
3 - 1	V C H S P I M R	P I M R	V C H S P I M R	V C H S P I M R N
3 - 2	P I M R	V C H S P I M R	V P I M R N	

V - Volatiles
S - Semi-Volatiles
P - PCBs/Pesticides
M - Metals
N - Nitroaromatics
I - Inorganic Anions
R - Radiological
O - Oil/Grease
T - Total Organic Carbon
X - Total Organic Halogens
C - Cyanides
H - Phenols

TABLE 3-7 Pit 4 Sludge Sampling Parameters

DEPTH LOCATION	0 - 2 ft.	2 - 4 ft.
4 - 3	R S M I V P N	
4 - 4	R S M I V P N	
4 - 5	R S M I V P N	
4 - 6	R S M I V P N O T X	*R S M I V P N
4 - 7	R S M I V P N T X	
4 - 8	*R S M I V P N	
4 - 9	R S M I V P N	
4 - 10	*R S M I V P N	R V
4 - 11	R S M I V P N	
4 - 12	R S M I V P N	
4 - 13	R S M I V P N	
4 - 14	R S M I V P N	
4 - 15	R S M I V P N	
4 - 16	R S M I V P N	
4 - 17	R S M I V P N	
4 - 18	**R	
4 - 19	**R	

V = VOLATILES
S = SEMI-VOLATILES
P = PCBs/PESTICIDES
M = METALS
N = NITROAROMATICS

I = INORGANIC ANIONS
R = RADIOLOGICAL
O = OIL/GREASE
T = TOTAL ORGANIC CARBON
X = TOTAL ORGANIC HALOGENS

* Two radiological samples collected and analyzed, one undisturbed and one bulk.
** Radiological samples were aliquots from bulk samples.

TABLE 3-8 Sampling Summary Indicating Total Analyses on Sampling From Each of the Raffinate Pits

Type of Analysis	Pit 1	Pit 2	Pit 3	Pit 4	Total
# Locations	6	6	11	19	42
# Samples	33	32	59	21	145
Particle Size	7	2	7	4	15
Moisture Content	9	6	21	10	43
Specific Gravity	9	6	21	10	43
Phase Separation	9	6	21	10	43
Viscosity	9	6	21	10	43
Atterberg Limits	9	6	21	10	43
5-gal. composite	23	15	49	10	92
Volatiles	20	21	23	17	81
Semi-Volatiles	30	29	23	16	98
PCBs/Pesticides	10	11	21	16	58
Metals	28	29	28	16	101
Nitroaromatics	20	18	15	16	69
Inorganic Anions	27	29	28	16	100
Radiological	9	5	41	22	77
De-con Rinsates *	2	2	1	1	6
Field Blanks *	2	1	1	1	5
Field Duplicates *	2	2	3	1	8
Total Organic Carbon	5	5	4	2	16
Total Organic Halogens	5	5	4	2	16
Oil/Grease	5	4	4	1	14
Phenols	0	0	4	0	4
Cyanides	0	0	4	0	4

* For this table these parameters refer only to chemical analyses.

BNI study. Lithium has been detected in two monitoring wells near the pits, so lithium was added to the metals analysis list.

The number of analyses for PCBs/pesticides was scaled back from thirty samples per pit to a total of 58 samples since some analyses previously performed on the sludges for these compounds indicated no presence above detection limits. Also, the number of analyses for nitroaromatics was slightly decreased from thirty samples per pit to a total of 69, because historical information and preliminary sampling of the supernatant waters showed no evidence of these compounds in pits. Cyanide analysis was performed only in Phase II sampling of Pit 3 due to no known evidence that they were ever used on the site. Sludge samples were also analyzed for oil and grease, total organic halogens, and total organic carbon to expand treatability studies. Samples were analyzed in the Phase II sampling of Pit 3 for phenols. Phenols are a degradation product of TNT.

3.4 QUALITY ASSURANCE MEASURES

All aspects of the site characterization, field investigations and data collection conformed to the required practices of the WSSRAP Remedial Investigation Quality Assurance Project Plan (RIQAPP) (DOE, 1989). The RIQAPP presents the policies, organizations, objectives, functional activities and specific quality assurance (QA) and quality control (QC) activities designed to achieve the data quality goals of WSSRAP. Detailed below are the specific practices which were employed as quality assurance measures during characterization of the wastes in the raffinate pits.

The general QA objectives for analytical data were that data of known and acceptable quality be provided. To provide a check of the quality of the laboratory analytical data, a number of blank, duplicate, and spiked samples were submitted to the analytical laboratory as per standard protocol for the CLP. Blank samples were analyzed to check for container contamination and the adequacy of field decontamination procedures. Duplicate samples provided a check for sampling and analytical error. Spiked samples were analyzed for recovery determination. The frequency of submittal is detailed in the following sections. A copy of the quality reports received from the lab may be found in Appendix D. These reports present data from duplicate, blank and spike analysis.

3.4.1 Field Blanks

One sample per each twenty samples collected was prepared as a field blank by filling a sample container with distilled, deionized water, exposed to the sampling environment to detect accidental or incidental contamination.

3.4.2 Decontamination (Rinsate) Blank

One rinsate blank sample was prepared per every twenty sludge samples collected. Following decontamination, rinsate samples were prepared by rinsing the sampling apparatus with distilled water and collecting the rinsate to check for residual contamination on the sampling tools.

3.4.3 Blind Field Duplicates

One sample per every twenty samples collected for chemical/ radiological analysis was split and both samples analyzed by the same laboratory to determine data reproducibility. These samples were labelled with different sample numbers to disguise their relationship.

3.5 DATA DOCUMENTATION

3.5.1 Sample Transfer/Chain-Of-Custody Records

All raffinate pit samples leaving the Weldon Spring Site were in Department of Transportation regulated and approved containers. All sludge samples were handled and shipped according to Environmental, Safety & Health (ES&H) Standard Operating Procedure (SOP) 2.03.10.

3.5.2 Field Reports

The field technical representative responsible for monitoring field activities, as outlined in Standard Operation Procedure numbers ENP-12 and ENP-18 (see Appendix A), filled out a field activity report and made appropriate entries into the field daily diary. Entries include date, time, sample number, location sketch, physical description, analyses requested, recovery and any problems encountered in obtaining the sample. Logs of stratification breaks, color, texture, etc. were also recorded for the undisturbed samples.

3.5.3 Photographs

Following extrusion from the sampling tool, all sludge samples were photographed. A legible sample identification card was placed in each frame to identify the sample in the picture.

3.6 PIT SURFACE WATER SAMPLING

To fully characterize the water contained in the raffinate pits, a recent sampling series was performed. Sampling of surface water was performed from a 14-foot john boat with the use of a peristaltic pump. Water was collected from four locations in each pit to make one composite sample. Two samples from each pit were composited. One sample was filtered by the lab before analysis and one was not. An extra sample was collected near the bottom of Pit 4 due to its greater depth. All samples were analyzed for CLP metals plus lithium and molybdenum, while radiological analysis was performed on the unfiltered samples. Section 4.8 contains the results of these analyses.

4 RESULTS

A listing of analytical results is presented in Appendix C of this report. Each group of analytical parameters is discussed in detail in the following sections. All interpretations made in this report are based on analytical results, field observations and past waste management practices. Table 4-1 lists the main constituents with an estimated total weight contained in the pits.

4.1 NITROAROMATICS

Sludge samples were analyzed for nitroaromatics using High Performance Liquid Chromatography (HPLC) according to United States Army Toxic and Hazardous Materials Agency (USATHAMA) methodology. A list of the nitroaromatic species and their detection limits may be found in Appendix B. No detectable levels of nitroaromatics were present in any samples collected.

4.2 INORGANIC ANIONS

Sludge samples were analyzed for nitrite, nitrate, sulfate, fluoride and chloride. Table 4-2 lists the lowest and highest values, average values and standard deviation for each pit and each anion. Elevated nitrate and sulfate levels were detected in all the pits with Pit 4 having substantially lower concentrations. Nitrite levels were elevated in all pits, with the exception of Pit 4. Chloride levels were slightly elevated in Pits 1, 2, and 3. Fluoride levels were only slightly elevated, with the higher levels in Pit 4.

Elevated nitrite and nitrate levels are associated with neutralized nitric acid which entered the pits during operation of the WSUFMP. These results were expected based on previous studies and knowledge of the process of the WSUFMP.

Table 4-1 Total Weight of Main Constituents Contained in Raffinate Pits

RAFFINATE PIT		Al	As	Ba	Cd	Pb	Mg	Mo	Na	V	Zr	NITRATE	SULFATE
PIT 1	AVE. CONC. (ug/g)	2601	400	61	7	108	6109	1001	5170	4003	122	28753	4885
	WEIGHT (lbs)	26000	4000	600	65	1000	61000	10000	51000	40000	1200	290000	48480
PIT 2	AVE. CONC. (ug/g)	4883	562	48	8	178	12746	1027	2901	2925	138	40382	6079
	WEIGHT (lbs)	56000	6500	550	90	2000	146000	12000	33000	34000	1600	460000	69777
PIT 3	AVE. CONC. (ug/g)	5317	550	94	3	155	8354	506	6637	2808	228	24554	3456
	WEIGHT (lbs)	380000	40000	6700	230	11000	600000	36000	480000	200000	16000	1750000	250000
PIT 4	AVE. CONC. (ug/g)	8953	107	1127	1	33	5008	61	390	358	60	148	373
	WEIGHT (lbs)	136000	1600	17000	16	500	76000	930	6000	5500	900	2200	5700
TOTAL PIT	lbs.	600000	51000	25000	400	14500	880000	60000	550000	280000	20000	2500000	370000
	WEIGHT TONS	300	26	13	0	7	440	30	280	140	10	1250	186

TABLE 4-2 RAFFINATE PIT ANIONS SUMMARY TABLE

	NITRITE ug/g	NITRATE ug/g	SULFATE ug/g	CHLORIDE ug/g	FLUORIDE ug/g
RAFFINATE PIT 1					
Lowest Value	114	7870	610	31.3	ND
Highest Value	1640	63207	7465	296	22.5
Average	477.11	28753.29	4884.61	175.20	5.79
Standard Deviation	348.35	12314.14	1607.03	76.82	8.34
RAFFINATE PIT 2					
Lowest Value	ND	2450	18	ND	ND
Highest Value	688	76695	7683	87	19.9
Average	185.86	40382.38	6079.45	39.71	2.37
Standard Deviation	230.06	26516.58	1338.37	27.56	5.46
RAFFINATE PIT 3					
Lowest Value	ND	ND	ND	ND	ND
Highest Value	715	39500	7820	124	51
Average	326.10	24554.36	3456.28	50.49	22.59
Standard Deviation	190.37	10640.42	2529.43	25.70	13.81
RAFFINATE PIT 4					
Lowest Value	ND	ND	ND	ND	ND
Highest Value	29.4	695	1800	26.1	165
Average	6.00	148.24	373.17	7.33	40.98
Standard Deviation	9.00	229.72	487.78	6.97	33.58

ND - Not Detected

Elevated sulfate levels probably originated as wastes from yellow cake impurities removed by the solvent extraction process. These elevated levels were also expected based on previous studies and knowledge of the process of the WSUFMP.

Slightly elevated fluoride levels were found in the raffinate pits. The presence of fluoride in the pits is due to the reintroduction of magnesium fluoride into the digestion phase of the process to recover entrapped uranium. Higher levels of fluoride were found in previous studies. Since the most recent investigation has been the most thorough and complete when compared to previous studies, it is considered a more reliable source. Due to the high solubility of fluoride, it is believed that most of the fluoride left the site in effluent streams. A simple mass balance using the amount of uranium produced each year of operation can be used to estimate the amount of fluorides generated each year. The reaction was as follows:

$$UF_4 + 2Mg \rightarrow U + 2\ MgF_2$$

The WSUFMP processed about 16,000 tons of uranium materials each year. This would have generated approximately 51,000 tons of fluoride over the 10-year period of operation. This number represents the total quantity of fluorides which would have been deposited in the pits. Were all the fluorides to remain in the pits today, that number would represent 25% of the total quantity of material which is presently in the pits. This number is about four orders of magnitude above the levels detected in fluoride analysis as seen in averages listed in

Table 4-2. This tells us that almost all the fluoride left through effluent streams (decant overflow) in soluble form.

Pits 1, 2 and 3 also contained slightly elevated levels of chloride. This species is possibly lithium chloride which was used on the site as an electrolytic salt.

4.3 VOLATILES AND SEMI-VOLATILES

It was expected that no organic chemical contamination from volatile and semi-volatile fractions was present in the sludge; however, a scan was performed to confirm their presence or absence. A list of individual compounds and elements as well as detection limits is included in Appendix B.

Results of volatile analyses may be found in Appendix C. Low levels of six compounds were detected by lab analysis of sludge samples. Acetone and methylene chloride were found in quality control blank samples as well as sludge samples indicating that they are probably a result of lab contamination. Quality control results containing blank sample analyses can be found in Appendix D.

One measurement of 8 ppb of 1-2 Dichloropropane over a detection limit of 5 ppb was detected at one location in Pit 2; 1-2 Dichloropropane is used in insecticide sprays and also as a solvent. It is not known where this contaminant originated, but it is probable that insecticide spraying around the pits was the source.

Low levels of toluene were found in sample analyses from one sample location in Pit 2 and one sample location in Pit 3. Low levels of 2-Butanone were found in sample analyses from one sample location in Pit 1 and one sample location in Pit 3. It is not known where this solvent contamination orginated, but it is suspected that lab contamination from sample analysis was the source.

Low levels of benzene were found in sample analyses from Pits 1, 2, and 3. One level at the detection limit and one level slightly over the detection limit were found in sample analyses from two locations in Pit 3. Pit 1 sample analyses detected levels from 10 of 20 locations sampled with a range of 6 to 30 ppb. Pit 2 sample analyses detected levels from 16 of 21 locations sampled with a range of 7 to 88 ppb. Although the source of this contamination is unknown, lab contamination is suspected here also due to their common lab use.

Results of semi-volatile analyses above detection limits can also be found in Appendix C. Low levels of bis(2-ethylhexyl) phthalate were detected in lab sample analyses from 2 locations in Pit 1 and three locations in Pit 4. Low levels of di-n-butylphthalate were detected in lab sample analyses from four locations in Pit 1 and one location in Pit 3. Sample analysis detected no semi-volatile contamination above detection limits from Pit 2. The two phthalates detected in the pits were also detected in blank samples suggesting that they are a result of lab contamination.

4.4 METALS

Raffinate pit sludge samples were analyzed for CLP metals plus lithium, molybdenum and zirconium. The results of these analyses by pit are presented in Appendix C of this report. Table 4-3 is a metals summary table presenting the lowest and highest values, average values and standard deviations for each pit. Raffinate pit sample analyses showed varying amounts of metals. Pit 1 analyses showed values above detection limits for all metals analyzed except lithium. Pit 2 analyses showed values above detection limits for all metals analyzed except

TABLE 4-3 RAFFINATE PIT METALS SUMMARY

RAFFINATE PIT		Al 20 ug/g	Sb 6 ug/g	As 1 ug/g	Ba 20 ug/g	Be 0.5 ug/g	Cd 0.5 ug/g	Ca 500 ug/g	Cr 1 ug/g	Co 5 ug/g	Cu 2.5 ug/g	Fe 10 ug/g	Pb 0.5 ug/g	Li 5 ug/g	Mg 500 ug/g	Mn 1.5 ug/g	Hg 0.1 ug/g	Mo 4.0 ug/g	Ni 4 ug/g	K 500 ug/g	Se 0.5 ug/g	Ag 1 ug/g	Na 500 ug/g	Tl 1 ug/g	V 5 ug/g	Zn 2 ug/g	Zr 20 ug/g
PIT 1																											
	LOW	1278	ND	64	ND	0.4	ND	29060	ND	ND	ND	26	ND	ND	607	50	ND	456	ND	ND	ND	ND	1007	ND	33	40	ND
	HIGH	5073	53	647	149	19	12	68020	39	14	238	12610	253	ND	16680	8469	0.15	1520	1429	1472	25	4.2	8023	7.8	7805	6693	231
	MEAN	2601	32	400	61	10	6	41002	19	5.6	135	7125	108	ND	6109	747	0.014	1001	68	354	1.6	0.6	5170	0.57	4003	631	122
	STD DEV	882	13	184	37	5	2.4	9970	8	3.4	48	2590	77	ND	4504	1537	0.041	291	262	435	1.1	1.1	1879	1.74	1889	1408	76
PIT 2																											
	LOW	2831	ND	259	21	4.4	4	24290	16	7	104	8875	23	ND	5540	531	ND	451	14	ND	ND	ND	26	ND	12	50	54
	HIGH	7247	36	983	73	13.3	14	49750	170	21	283	17200	373	17.5	20610	7583	0.32	4825	66	ND	ND	2.7	5638	ND	5187	248	277
	MEAN	4883	17	562	48	8.6	8.2	35280	36	13.2	215	13600	178	2.6	12746	1856	0.05	1027	30	ND	ND	0.2	2901	ND	2925	135	138
	STD DEV	1014	8	217	14	2.1	2.8	5698	30	4.3	46	2224	96	4.3	3487	1314	0.08	781	9	ND	ND	0.6	1794	ND	1099	47	58
PIT 3																											
	LOW	473	11	ND	18	2.6	2.0	21110	ND	ND	3	900	ND	ND	422	152	ND	4	17	ND	ND	ND	466	ND	755	20	ND
	HIGH	13970	87	6271	333	25	8.3	86100	18.7	14	511	22890	644	122	17110	1880	15	1241	8794	1075	81	1.7	23810	23	8660	213	1121
	MEAN	5317	31	550	94	8.2	3.3	40959	5.6	4.8	232	8936	155	29	8354	754	3.2	506	411	267	21	0.6	6637	6	2808	88	228
	STD DEV	2885	18	1124	66	5.7	1.8	18465	8.4	4.1	147	5262	131	32	3866	509	3.9	273	1619	283	23	1.2	4405	5.6	1887	55	285
PIT 4																											
	LOW	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	HIGH	27670	12	771	7740	13	8.6	40100	23	8	1548	21750	158	73	13230	421	15	293	134	1345	33	ND	1030	58	1900	1075	290
	MEAN	8953	2.4	107	1127	1.8	1.1	10681	8	3.5	152	9465	33	18	5008	158	1.1	61	32	590	6	ND	390	5	381	104	60
	STD DEV	6984	4.3	209	2119	3.1	2.3	10569	9	3.2	367	6652	39	17	4640	128	3.6	73	39	509	11	ND	297	14	514	252	98

potassium and selenium. Pit 3 analyses contained levels above detection limits for all metals analyzed. Pit 4 analyses contained values above detection limits for all metals analyzed except silver. Pit 4 in general contained lower amounts of metals than the other pits.

High levels of calcium were found in sample analyses for all four pits. Lime (calcium carbonate) was used to neutralize the acidic process waste before the wastes were slurried to the raffinate pits. This lime use at the feed materials plant contributed to the elevated levels of calcium present in the four pits.

Levels of magnesium were detected in sample analyses for all four pits. From the final process stage, magnesium fluoride slag was redissolved with yellow cake feed material to recover unreacted uranium. This is believed to be the source of magnesium in the pits. As with the fluoride analysis, magnesium levels were lower than expected and it is believed that most of the magnesium was discharged from the pits in the decant water stream. A simple mass balance can be used to estimate the amount of magnesium sent to the pits each year. The reaction is as follows:

$$UF_4 + 2\ Mg \rightarrow U + 2\ MgF_2$$

As mentioned in Section 4.2, the WSUFMP processed about 16,000 tons of uranium materials each year. This would have generated approximately 33,000 tons of magnesium over the 10-year period of operation. This number represents the total quantity of magnesium which would have been deposited in the pits. Were all the magnesium to remain in the pits today, that number would represent about 16% of the total quantity of material which is presently in the pits. This number is about two orders of magnitude above the levels detected in magnesium analysis as seen in averages listed in Table 4-3. The majority of magnesium appears to have been discharged with the effluent streams (decant overflow) with the fluorides, although to a less extent, due to the lower solubility of magnesium.

Lithium was detected in lab analyses from Pits 2, 3, and 4. It is probable that lithium levels detected in monitoring wells near the pits is a result of contamination from the pits. The lithium is believed to be a result of lithium chloride used as an electrolytic salt at the WSUFMP.

Levels of barium were found in sludge analyses for all four pits. Barium fluoride which was believed to be used as a radium coprecipitate or electrolytic salt at the WSUFMP is believed to be the source of this contamination.

High levels of sodium were detected in sludge analyses for all four pits. The sodium is believed to come from sodium carbonate which was used in the solvent treatment process at the WSUFMP.

Potash was used in the pilot scale buildings and various other facets of the operation and this probably explains the elevated potassium levels. The other metals are probably a result of impurities in the original ore processed at the WSUFMP.

4.5 PCBs/PESTICIDES

Sludge samples were analyzed for PCBs/pesticides. A list containing individual parameters and detection limits may be found in Appendix B. Ten of the fifty-eight samples analyzed could not be validated and were not used. It is believed, however, that the remaining sample results contain enough information to characterize the sludge for PCBs/pesticides. Results of detected PCBs/pesticides may be found in Appendix C.

Seven samples from Pit 1 and five samples from Pit 2 were analyzed and deemed valid. Two samples from Pit 1 and one sample from Pit 2 had low levels of the pesticide 4,4 DDE detected in analyses. One sample from Pit 1 had a level of 26 ppb beta-BHC, another pesticide, detected in sample analyses. There were no PCBs detected in sample analyses from Pit 2. Two samples from Pit 1 had levels slightly above detection limits of the PCB Aroclor 1248 and one had similar levels of the PCB Aroclor 1254 detected in sample analyses.

Twenty-one samples from Pit 3 and fifteen samples from Pit 4 were analyzed and deemed valid. No samples from Pits 3 and 4 had detectable levels of pesticides found in analyses. Aroclor 1248 was detected in one sample and Aroclor 1254 was found in three in sample analyses from Pit 3. Levels of Aroclor 1248 ranging from 424 to 1,637 ppb were found in three samples and Aroclor 1254 in six samples ranging from 170 to 1,300 ppb were detected in sample analyses from Pit 4. These were the highest levels of PCBs detected in the pits.

The source of the detected pesticides is unknown, but insecticides used in the area are suspected. The source of the low levels of PCBs is believed to be PCB-contaminated oil used in transformers on the site.

4.6 MISCELLANEOUS

Raffinate pit sludge samples were analyzed for oil and grease, total organic halogens and total organic carbon. Results of these analyses are contained in Appendix C.

As expected, no levels above detection limits resulted from total organic halogen analyses. No evidence exists linking the site with halogens.

All samples analyzed had detectable levels of oil and grease and these levels ranged from 0.12 to 0.94 percent. These levels were expected and are believed to be a result of tributyl phosphate (TBP) contamination from the solvent extraction process used at the WSUFMP. During sampling the sludge had an oily texture with color ranging from white to dark red to dark yellow. This supports the TBP conclusion, since it is a yellow viscous fluid used as a solvent.

Total organic carbon (TOC) concentrations ranged from 605 to 2646 ug/g. The TBP contamination is also believed to be the main contribution to the TOC levels detected in the pits. The algae and decaying organic matter in the pits could also contribute to this. The TOC values are in general one order of magnitude less than the oil and grease values. This is probably due to sodium carbonate which was used in the solvent extraction process of the WSUFMP or calcium carbonate used to neutralize the acidic process waste before it entered the raffinate pits. Carbonates are known to cause interference in TOC analysis.

4.7 CYANIDES AND PHENOLS

Four samples were collected from Pit 3 and analyzed for cyanides and total phenols. No cyanides were detected as was expected since there is no known record of cyanides being used at the site.

Phenols were detected in three of the four sample analyses with a range of 50 ppb to 160 ppb. These levels are near the detection limit of 50 ppb. Phenols are a common set of compounds. Due to the extremely low levels detected in our samples, phenols contamination of the sludge is deemed insignificant.

4.8 PIT SURFACE WATER RESULTS

Table 4-4 contains the results of pit water analyses. A comparison of the total water samples to the filtered water samples suggests that the pit water contains some small amounts of suspended metals. Sixteen of the 25 metals analyzed were detected in at least one of the pits. Most of the metals are expected to exist as solids in the sludge. A detailed description of where these metals originated may be found in Section 4.4. The pit water samples had levels of molybdenum detected at near or above the sludge sample analyses. The molybdenum is believed to have originated as an impurity in the original ore processed at the WSUFMP. The analysis of the filtered sample for Pit 1 revealed levels below detection limits for calcium, lithium, magnesium and potassium. These levels are believed to be false negatives and attributed to lab error.

TABLE 4-4 Raffinate Pit Water Data - Metals

	WSSRAP ID Detection Limit	Al 200 ug/L	Sb 60 ug/L	As 10 ug/L	Ba 200 ug/L	Be 5 ug/L	Cd 5 ug/L	Ca 5000 ug/L	Cr 10 ug/L	Co 50 ug/L	Cu 25 ug/L	Fe 100 ug/L	Pb 5 ug/L	Li 50 ug/L	Mg 5000 ug/L	Mn 15 ug/L	Hg 0.2 ug/L	Mo 4.0 ug/L	Ni 40 ug/L	K 5000 ug/L	Se 5 ug/L	Ag 10 ug/L	Na 5000 ug/L	Tl 10 ug/L	V 50 ug/L	Zn 20 ug/L
TOTAL																										
PIT 1	SW-3001-031789	ND	ND	12.7	ND	ND	ND	104400	ND	ND	ND	ND	ND	257.4	26020	ND	ND	2305	ND	34050	14.7	ND	71980	ND	1360	ND
PIT 2	SW-3002-031789	ND	ND	111	ND	ND	ND	26640	ND	ND	ND	ND	ND	185.9	37130	26	0.29	2743	ND	17450	ND	ND	134700	ND	747.9	ND
PIT 3	SW-3003-031789	ND	65.1	ND	ND	ND	ND	83720	ND	ND	ND	ND	ND	4462	63820	ND	ND	3947	ND	102300	220	ND	222400	ND	ND	26.8
PIT 4	SW-3004-031789	496.2	ND	4.49	ND	ND	ND	10240	ND	ND	ND	456.9	ND	492.9	33720	15.9	ND	693.4	ND	16600	7.46	ND	164100	ND	ND	59.6
PIT 4, BOTTOM	SW-3004-031789-B	510.2	ND	ND	ND	ND	ND	10020	ND	ND	ND	421.2	ND	496.7	34310	17.5	ND	705.1	ND	16600	7.88	ND	70360	ND	ND	ND
FILTERED																										
PIT 1	SW-3001-031789-DISS	ND	ND	12.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	470.8	ND	ND	18	ND	70360	ND	266.7	ND
PIT 2	SW-3002-031789-DISS	ND	ND	119	ND	ND	ND	27960	ND	ND	ND	171.4	ND	181.5	38420	ND	ND	2851	ND	15590	ND	ND	139900	ND	775.4	ND
PIT 3	SW-3003-031789-DISS	ND	81.3	ND	ND	ND	ND	46100	ND	ND	ND	153.4	ND	4334	34850	ND	ND	4052	ND	107300	199	ND	116100	ND	ND	ND
PIT 4	SW-3004-031789-DISS	ND	ND	ND	ND	ND	ND	10530	ND	ND	ND	132	ND	465.3	33420	ND	ND	716.8	49.1	22320	10.2	ND	161000	ND	ND	41.5
PIT 4, BOTTOM	SW-3004-031789-B-DISS	218.7	ND	ND	ND	ND	ND	19500	ND	ND	ND	139.4	ND	542.8	39880	ND	ND	769.5	ND	14450	10.4	ND	185200	ND	ND	31.8

ND - Not Detected

5 CONCLUSIONS

This investigation was designed to provide a summary of data necessary to fully characterize the wastes contained in the Weldon Spring Raffinate Pits.

Several preliminary conclusions can be made from the data presented in this report. These conclusions are:

1. Sample analyses indicate no nitroaromatic contamination in the raffinate pits.

2. There appears to be contamination in the pits from all inorganic anions and metals analyzed for.

3. In general, Pit 4 had lower detectable levels of anions and metals as shown by sample analysis. Pit 4 also has the lowest volume of sludge.

4. The sludge appears to be homogenous with respect to metals and anion contamination even though the range may be wide for individual chemicals. Pit 4 appears to be the only pit with great inhomogeneity.

5. There appears to be no contamination from semi-volatile compounds as indicated by sample analyses.

6. There appears to be no contamination from cyanides shown by sample analyses.

APPENDIX A

WSSRAP RAFFINATE PIT SAMPLE NUMBERING SYSTEM AND WSSRAP RAFFINATE PIT SAMPLE FIELD REPORT ABBREVIATIONS

WSSRAP RAFFINATE PIT SAMPLE NUMBERING SYSTEM

SAMPLE NUMBERING SYSTEM: SD-3101-0002-V-A-MS

1	2	3	4	5	6
SD	3101	0002	V	A	MS

1. Indicates the sample type, ie. SD refers to Sediment (See SOP No. 4.01.01 page 2).

2. Indicates the location number, pit number and sample location number, ie. 3 refers to the raffinate pits, 1 refers to Pit 1 and 01 refers to sample location 1 (see SOP No. 4.01.01 page 2).

3. Indicates the upper and lower limits of the sample interval, ie. sample interval is between 0 and 2 ft. (see SOP No. 4.01.01 page 4).

4. Indicates the category of analysis:

   V=Volatile
   O=Organic
   I=Inorganic
   B=Bulk
   P=Physical
   R=Radiological

5. Indicates the container number:

   A=First of two containers per sample
   B=Second of two containers per sample
   C=One container per sample

6. Indicates QA/QC samples:
   MS=Matrix Spike
   MD=Matrix Duplicate

CHEMSLUD/TXTJOANN

FD=Field Duplicate
FC=Field De-Con Rinsate
EA=EPA Samples

Notes:

1. Note the following composite samples:

SD-3100-0010-P	Composite of Pit 1
SD-3200-0010-P	Composite of Pit 2
SD-3300-0010-P	Composite of Pit 3
SD-3400-0010-P	Composite of Pit 4
SD-3000-0014-P	Composite of All Pits

2. Note U.C.=Upper Composite
   M.C.=Middle Composite
   L.C.=Lower Composite

3. Note the abbreviations used in the sample numbering system may not correspond to those used in the field report (See WSSRAP Raffinate Pit Sample Field Report Abbreviations).

WSSRAP RAFFINATE PIT SAMPLE FIELD REPORT ABBREVIATIONS

FIELD REPORT ABBREVIATIONS:

Sample Type:

- U=Undisturbed
- D=De-con Rinsate
- B=Field Blank
- Bu=Bulk
- Ph=Physical

Analysis:

- Z=Particle Size ASTM D422
- W=Moisture Content ASTM D2216
- G=Specific Gravity SMEWW Method 213E & ASTM D854
- H=Phase Separation Settling Test
- C=Viscosity ASTM D4016
- A=Atterberg Limits ASTM 4318
- So=Solidification
- V=Volatile Organics CLP SOW #WA-87-J002
- S=Semi-Volatiles CLP SOW #WA-87-J002
- P=PCBs/Pesticides CLP SOW #WA-87-J002
- M=Metals CLP SOW #WA-87-K026
- N=Nitroaromatics EPA Method 609 & USATHAMA Methodology
- I=Inorganic Anions EPA Method 300.0
- R=Radiological EPA 520/5-84-006, Procedure 00-07 and EPA 600/4-80-032
- O=Oil/Grease
- T=TOC
- X=TOX
- Y=Centr.Mois.Yield ASTM D425
- E=Capillary Moisture ASTM D3152

F=Surface Charge Zeta Meter
J=Consolidation ASTM D2435

Ship To: MT=Meta TRACE
CH=Chen & Associates
ORNL=Oak Ridge National Laboratory
SITE=Weldon Springs Site Radiation Control

* Note that the abbreviations used in the field report may not correspond to those used in the sample numbering system (See WSSRAP Raffinate Pit Sample Numbering System).

EXAMPLE

WSSRAP RAFFINATE PIT SLUDGE BOREHOLE LOG

SITE ID: SD3202

GRID ID: V, 22+30

SAMPLING METHOD: PISTON SAMPLER WITH 24IN. SHELBY TUBE

DATE: 9-21-88

STARTING TIME: 0852

ENDING TIME: 1023

FIELD REP.: M. WILLIAMS

SAMPLE INTERVAL (FT)	SAMPLE RECOVERY (IN)	VISUAL CLASSIFICATION (STRAT. BREAKS, COLOR, TEXTURE, ETC.)
0-2	24	top 8" sandy - breaks apart easily; few light bands 8-12"; bottom foot barely distinguishable bands - light orangish red to light reddish brown; medium stiffness - not too dry, a little moist
2-4	24	top 6" soft and moist; disturbed bedding planes - tannish brown; from 6" to the bottom uniform, very pale 1 inch bands; 10" to 24" color adds a little red one light colored band at 13". soft molding clay texture
4-6	24	light brown w/a little red throughout; soft, moist and sticky; barely distinguishable bands; one light coral colored band at 7"; a greenish brown band at 13"
6-8	24 photo of tray backwards	top 6" soft, disturbed planes; tans and light brown turning to reddish brown at 16"; light tan to white band at 8"; grey band at bottom; pinkish band at 20"; sticky, somewhat stiff
8-10 10-12	24 23 1 inch clay	47" sample; stiff and dense, a little sticky; slightly striated; 9-10' banded shades of red - a deep red band at 17"; a granular band at 6"; very thin tan and brown bands at 34"; brown band at 40

COMMENTS: 2 ft water Bulk sample done 9-23-88

EXAMPLE

WSSRAP RAFFINATE PIT SLUDGE SAMPLING FIELD REPORT

DATE: 9-21-88 FIELD REP.: M. WILLIAMS

LOCATION: PIT 2 SD3202 GRID #: V,22+30

SAMPLE NUMBER	SAMPLE TYPE	SIZE (ml) IDEAL	SIZE (ml) ACTUAL	DEPTH (ft)	ANALYSIS	SHIP TO	COMMENTS
STARTING TIME: 0852						ENDING TIME: 0904	
SD-3202-0002-R-C	U	500	500	0-2'	Rad.	SITE	
SD-3202-0002-V-A	U	40	40	"	V	MT	
SD-3202-0002-V-B	U	40	40	"	V	MT	
SD-3202-0002-O-A	U	250	250	"	S,P,N	MT	
SD-3202-0002-O-B	U	250	250	"	S,P,N	MT	
SD-3202-0002-I-A	U	250	250	"	I,M	MT	
SD-3202-0002-I-B	U	250	250	"	I,M	MT	
SD-3202-0002-V-A-FB	B	40	40	"	V	MT	
SD-3202-0002-V-B-FB	B	40	40	0-2'	V	MT	
STARTING TIME: 0909						ENDING TIME: 0920	
SD-3202-0204-I-C	U	500	500	2-4'	R	MT	
SD-3202-0204-V-A	U	40	40	"	V	MT	
SD-3202-0204-V-B	U	40	40	"	V	MT	
SD-3202-0204-O-A	U	250	250	"	S,P,N	MT	
SD-3202-0204-O-B	U	250	250	"	S,P,N	MT	
SD-3202-0204-I-A	U	250	250	"	I,M	MT	
SD-3202-0204-I-B	U	250	250	2-4'	I,M	MT	
STARTING TIME: 0923						ENDING TIME: 093	
SD-3202-0406-R-C	U	500	500	4-6'	Rad.	SITE	
SD-3202-0406-V-A	U	40	40	"	V	MT	
SD-3202-0406-V-B	U	40	40	"	V	MT	
SD-3202-0406-O-A	U	250	250	"	S,N	MT	
SD-3202-0406-O-B	U	250	250	"	S,N	MT	
SD-3202-0406-I-A	U	250	250	"	I,M	MT	
SD-3202-0406-I-B	U	250	250	4-6'	I,M	MT	
STARTING TIME: 0943						ENDING TIME: 095	
SD-3202-0608-I-C	U	500	500	6-8'	R	MT	
SD-3202-0608-V-A	U	40	40	"	V	MT	
SD-3202-0608-V-B	U	40	40	"	V	MT	
SD-3202-0608-O-A	U	250	250	"	S,N	MT	
SD-3202-0608-O-B	U	250	250	"	S,N	MT	
SD-3202-0608-I-A	U	250	250	"	I,M	MT	
SD-3202-0608-I-B	U	250	250	6-8'	I,M	MT	
STARTING TIME: 1001						ENDING TIME: 1023	
SD-3202-0810-R-C	U	500	500	8-11.9'	Rad.	SITE	
SD-3202-0810-V-A	U	40	40	"	V	MT	
SD-3202-0810-V-B	U	40	40	"	V	MT	
SD-3202-0810-V-A-MS	U	40	40	"	V	MT	
SD-3202-0810-V-B-MS	U	40	40	"	V	MT	
SD-3202-0810-V-A-MD	U	40	40	"	V	MT	
SD-3202-0810-V-B-MD	U	40	40	"	V	MT	
SD-3202-0810-O-A	U	250	250	"	S,P,N	MT	
SD-3202-0810-O-B	U	250	250	"	S,P,N	MT	
SD-3202-0810-O-A-MS	U	250	250	8-11.9'	S,P,N		

EXAMPLE

WSSRAP RAFFINATE PIT SLUDGE SAMPLING FIELD REPORT

	SD-3202-0810-O-B-MS	U	250	250	8-11.9'	S,P,N	MT	
	SD-3202-0810-O-A-MD	U	250	"	"	S,P,N	MT	
	SD-3202-0810-O-B-MD	U	250	"	"	S,P,N	MT	
	SD-3202-0810-I-A	U	250	"	"	I,M	MT	
	SD-3202-0810-I-B	U	250	"	"	I,M	MT	
	SD-3202-0810-I-A-MS	U	250	"	"	I,M	MT	
	SD-3202-0810-I-B-MS	U	250	"	"	I,M	MT	
	SD-3202-0810-I-A-MD	U	250	"	"	I,M	MT	
	SD-3202-0810-I-B-MD	U	250	250	8-11.9'	I,M	MT	
140	SD-3202-0002-B-C		5gal	1.6gal	0-2'	So	ORNL	
148	SD-3202-0204-B-C		5gal	1.6gal	2-4'	So	ORNL	
152	SD-3202-0406-B-C		5gal	1.6gal	4-6'	So	ORNL	
156	SD-3202-0608-B-C		5gal	1.6gal	6-8'	So	ORNL	
144	SD-3202-0810-B-C		5gal	1.6gal	8-10'	So	ORNL	
201	SD-3202-1012-B-C		5gal	1.6gal	10-12'	So	ORNL	

APPENDIX B

INDIVIDUAL PARAMETERS AND DETECTION LIMITS FOR VOLATILES, SEMI-VOLATILES, PCBs/PESTICIDES, METALS, NITROAROMATICS, INORGANIC ANIONS, OIL AND GREASE, TOTAL ORGANIC HALOGENS, TOTAL ORGANIC CARBON, CYANIDES AND PHENOLS ANALYSES.

(REF: US EPA CONTRACT LABORATORY PROGRAM STATEMENT OF WORK, 1984)

Hazardous Substance List (HSL) and
Contract Required Detection Limits (CRDL)**

VOLATILES	CAS NUMBER	LOW WATER[a] ug/L	DETECTION LIMITS* LOW SOIL/SEDIMENT[b] ug/kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-35-3	5	5
10. trans-1,2-Dichloroethene	156-60-5	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. trans-1,3-Dichloropropene	10061-02-6	5	5
21. Trichloroethene	79-01-6	5	5
22. Dibromochloromethane	124-48-1	5	5
23. 1,1,2-Trichloroethane	79-00-5	5	5
24. Benzene	71-43-2	5	5
25. cis-1,3-Dichloropropene	10061-01-5	5	5
26. 2-Chlorethyl Vinyl Ether	110-75-8	10	10
27. Bromoform	75-25-2	5	5
28. 2-Hexanone	591-78-6	10	10
29. 4-Methyl-2-Pentanone	108-10-1	10	10
30. Tetrachloroethene	127-18-4	5	5

Hazardous Substance List (HSL) and
Contract Required Detection Limits (CRDL)**

VOLATILES	CAS NUMBER	LOW WATER[a] ug/L	DETECTION LIMITS* LOW SOIL/SEDIMENT[b] ug/kg
31. Toluene	108-88-3	5	5
32. Chlorobenzene	108-90-7	5	5
33. Ethyl Benzene	100-41-4	5	5
34. Styrene	100-42-5	5	5
35. Total Zylenes		5	5

a Medium Water Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Water CRDL.

b Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Soil/Sediment CRDL.

SEMI-VOLATILES	CAS NUMBER	LOW WATER[c] ug/L	DETECTION LIMITS* LOW SOIL/SEDIMENT[d] ug/kg
36. Phenol	108-95-2	10	330
37. bis(2-Chlorethyl) ether	111-44-4	10	330
38. 2-Chlorophenol	95-57-8	10	330
39. 1,3-Dichlorobenzene	541-73-1	10	330
40. 1,4-Dichlorobenzene	106-46-7	10	330
41. Benzyl Alcohol	100-51-6	10	330
42. 1,2-Dichlorobenzene	95-50-1	10	330
43. 2-Methylphenol	95-48-7	10	330
44. bis(2-Chloroisopropyl) ether	39638-32-9	10	330
45. 4-Methylphenol	106-44-5	10	330
46. N-Nitroso-Dipropylamine	621-64-7	10	330
47. Hexachloroethane	67-72-1	10	330
48. Nitrobenzene	98-95-3	10	330
49. Isophorone	78-59-1	10	330
50. 2-Nitrophenol	88-75-5	10	330
51. 2,4-Dimethylphenol	105-67-9	10	330
52. Benzoic Acid	65-85-0	50	1600
53. bis(2-Chloroethoxy) methane	111-91-1	10	330
54. 2,4-Dichlorophenol	120-83-2	10	330
55. 1,2,4-Trichlorobenzene	120-82-1	10	330
56. Naphthalene	91-20-3	10	330
57. 4-Chloroaniline	106-47-8	10	330
58. Hexachlorobutadiene	87-68-3	10	330
59. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
60. 2-Methylnaphthalene	91-57-6	10	330
61. Hexachlorocyclopentadiene	77-47-4	10	330
62. 2,4,6-Trichlorophenol	88-06-2	10	330
63. 2,4,5-Trichlorophenol	95-95-4	50	1600
64. 2-Chloronaphthalene	91-58-7	10	330
65. 2-Nitroaniline	88-74-4	50	1600
66. Dimethyl Phthalate	131-11-3	10	330
67. Acenaphthylene	208-96-8	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600

SEMI-VOLATILES	CAS NUMBER	LOW WATER[c] ug/L	DETECTION LIMITS* LOW SOIL/SEDIMENT[d] ug/kg
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. 2,6-Dinitrotoluene	606-20-2	10	330
75. Diethylphthalate	84-66-2	10	330
76. 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
77. Fluorene	86-73-7	10	330
78. 4-Nitroaniline	100-01-6	50	1600
79. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
80. N-nitrosodiphenylamine	86-30-6	10	330
81. 4-Bromophenyl Phenyl ether	101-55-3	10	330
82. Hexachlorobenzene	118-74-1	10	330
83. Pentachlorophenol	87-86-5	50	1600
84. Phenanthrene	85-01-8	10	330
85. Anthracene	120-12-7	10	330
86. Di-n-butylphthalate	84-74-2	10	330
87. Fluoranthene	206-44-0	10	330
88. Pyrene	129-00-0	10	330
89. Butyl Benzyl Phthalate	85-68-7	10	330
90. 3,3'-Dichlorobenzidine	91-94-1	20	660
91. Benzo(a)anthracene	56-55-3	10	330
92. bis(2-ethylhexyl)phthalate	117-81-7	10	330
93. Chrysene	218-01-9	10	330
94. Di-n-octyl Phthalate	117-84-0	10	330
95. Benzo(b)fluoranthene	205-99-2	10	330
96. Benzo(k)fluoranthene	207-08-9	10	330
97. Benzo(a)pyrene	50-32-8	10	330
98. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
99. Dibenz(a,h)anthracene	53-70-3	10	330
100. Benzo(g,h,i)perylene	191-24-2	10	330

[c] Medium Water Contract Required Detection Limits (CRDL) for Semi-volatile HSL Compounds are 100 times the individual Low Water CRDL.

[d] Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-volatile HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

PCBs/PESTICIDES	CAS NUMBER	LOW WATER[e] ug/L	DETECTION LIMITS* LOW SOIL/SEDIMENT[f] ug/kg
101. alpha-BHC	319-84-6	0.05	8.0
102. beta-BHC	319-85-7	0.05	8.0
103. delta-BHC	319-86-8	0.05	8.0
104. gamma-BHC (Lindane)	58-89-9	0.05	8.0
105. Heptachlor	76-44-8	0.05	8.0
106. Aldrin	309-00-2	0.05	8.0
107. Heptachlor Expoxide	1024-57-3	0.05	8.0
108. Endosulfan I	959-98-8	0.05	8.0
109. Dieldrin	60-57-1	0.10	16.0
110. 4,4'-DDE	72-55-9	0.10	16.0
111. Endrin	72-20-8	0.10	16.0
112. Endosulfan II	33213-65-9	0.10	16.0
113. 4,4'-DDD	72-54-8	0.10	16.0
114. Endosulfan Sulfate	1031-07-8	0.10	16.0
115. 4,4'-DDT	50-29-3	0.10	16.0
116. Endrin Ketone	53494-70-5	0.10	16.0
117. Methoxychlor	72-43-5	0.5	80.0
118. Chlordane	57-74-9	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. AROCLOR-1016	12674-11-2	0.5	80.0
121. AROCLOR-1221	11104-28-2	0.5	80.0
122. AROCLOR-1232	11141-16-5	0.5	80.0
123. AROCLOR-1242	53469-21-9	0.5	80.0
124. AROCLOR-1248	12672-29-6	0.5	80.0
125. AROCLOR-1254	11097-69-1	1.0	160.0
126. AROCLOR-1260	11096-82-5	1.0	160.0

e Medium Water Contract Required Detection Limits (CRDL) for Pesticide HSL Compounds are 100 times the individual Low Water CRDL.

f Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Pesticide HSL compounds are 15 times the individual Low Soil/Sediment CRDL.

* Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

** Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

ELEMENTS DETERMINED BY INDUCTIVELY COUPLED PLASMA EMISSION OR ATOMIC ABSORPTION SPECTROSCOPY

ELEMENT	CONTRACT REQUIRED DETECTION LEVEL[1,2] (µg/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20

OTHER METALS

METAL	DETECTION LIMIT µg/g
Lithium	5
Molybdenum	4
Zirconium	20

PARAMETERS & DETECTION LIMITS

NITROAROMATICS

2,4,6-Trinitrotoluene	1.2 µg/g
2,4-Dinitrotoluene	0.75 µg/g
2,6-Dinitrotoluene	1.41 µg/g
Nitrobenzene	1.44 µg/g
1,3,5-Trinitrobenzene	0.57 µg/g
1,3-Dinitrobenzene	0.9 µg/g

INORGANIC ANIONS

Nitrite	0.5 µg/g
Nitrate	0.5 µg/g
Sulfate	5.0 µg/g
Chloride	1.25 µg/g
Fluoride	1.25 µg/g

MISCELLANEOUS

Oil and grease	Percent
Total Organic Halogens	10 µg/g
Total Organic Carbon	10 µg/g
Cyanide	0.25 µg/g
Phenols	0.05 µg/g

APPENDIX C

RESULTS OF INORGANIC ANION, VOLATILES, SEMI-VOLATILES, METALS, PCBs/PESTICIDES, OIL AND GREASE, TOTAL ORGANIC HALOGENS, TOTAL ORGANIC CARBON, CYANIDES AND PHENOLS ANALYSES PERFORMED ON RAFFINATE PIT SLUDGE.

RAFFINATE SLUDGE ANIONS RESULTS
PIT 1

SAMPLE ID	DATE SAMPLED	NITRITE 0.5 UG/G	NITRATE 0.5 UG/G	SULFATE 0.5 UG/G	CHLORIDE 1.25 UG/G	FLUORIDE 1.25 UG/G
SD-3101-0002-I	09/12	241	8560	5840	138	ND
SD-3101-0204-I	09/12	187	8740	4710	136	ND
SD-3101-0406-I	09/12	342	22660	4740	191	8
SD-3101-0608-I	09/12	820	31390	5090	219	ND
SD-3101-0810-I	09/12	882	34500	5250	237	ND
SD-3102-0002-I	09/12	435	7870	5540	280	ND
SD-3102-0204-I	09/12	780	16120	610	140	ND
SD-3102-0406-I	09/12	1640	23030	5140	154	ND
SD-3102-0608-I	09/12	1250	28130	4470	150	ND
SD-3102-0810-I	09/12	570	31400	4590	160	18.9
SD-3103-0204-I	09/14	333	29830	3700	283	ND
SD-3103-0406-I	09/14	360	31470	4950	296	ND
SD-3103-0608-I	09/14	420	38550	5160	207	21
SD-3103-0810-I	09/14	535	37770	4980	289	ND
SD-3104-0002-I	09/13	150	10570	1250	125	ND
SD-3104-0204-I	09/13	114	30331	7230	194	9.1
SD-3104-0406-I	09/13	257	31430	5220	287	ND
SD-3104-0608-I	09/13	307	38000	5030	195	ND
SD-3104-0810-I	09/13	351	31460	5190	182	ND
SD-3105-0002-I	09/08	463	17588	7127	31.3	17.1
SD-3105-0406-I	09/08	628	51492	7465	38.4	21.1
SD-3105-0608-I	09/08	554	63207	6302	86.2	26.0
SD-3105-0810-I	09/08	114	38862	5485	37.1	19.8
SD-3106-0002-I	09/13	170	16760	1750	205	ND
SD-3106-0204-I	09/13	186	31430	2920	213	11.2
SD-3106-0406-I	09/13	172	31450	5430	195	13.5
SD-3106-0608-I	09/13	337	29830	4800	193	ND

ND - NOT DETECTED

RAFFINATE SLUDGE ANIONS RESULTS
PIT 2

SAMPLE ID	DATE SAMPLED	NITRITE 0.5 UG/G	NITRATE 0.5 UG/G	SULFATE 0.5 UG/G	CHLORIDE 1.25 UG/G	FLUORIDE 1.25 UG/G
SD-3201-0002-I	09/15	41.4	5315	7373	9.9	7.6
SD-3201-0204-I	09/15	ND	25948	5970	35.7	7.6
SD-3201-0406-I	09/15	ND	68623	5868	67.9	10.6
SD-3201-0608-I	09/15	27.6	53893	5555	68.1	19.9
SD-3201-0810-I	09/15	633	62753	6030	68.1	19.8
SD-3202-0002-I	09/22	18.9	2648	7303	6	ND
SD-3202-0204-I	09/22	142	19588	6650	17.5	ND
SD-3202-0406-I	09/22	505	45083	6220	70.3	ND
SD-3202-0608-I	09/22	505	72275	6028	87	ND
SD-3202-0810-I	09/22	585	69005	6198	70.7	ND
SD-3203-0002-I	09/21	26.8	5010	7683	6.4	3.2
SD-3203-0204-I	09/21	142	27163	6278	17	ND
SD-3203-0406-I	09/21	ND	48288	5520	56.3	ND
SD-3203-0608-I	09/21	ND	65743	5560	6.7	ND
SD-3203-0810-I	09/21	538	76638	6078	70.2	ND
SD-3204-0002-I	09/15	22.4	2450	7445	7.8	ND
SD-3204-0204-I	09/15	140	13190	4785	30.2	ND
SD-3204-0406-I	09/15	140	24585	6370	37	ND
SD-3205-0002-I	09/21	21	3320	7640	7.2	ND
SD-3205-0204-I	09/21	131	16880	18	ND	ND
SD-3205-0406-I	09/21	143	33978	6723	30.5	ND
SD-3205-0608-I	09/21	600	48375	6295	70.4	ND
SD-3205-0810-I	09/21	ND	66215	5955	71	ND
SD-3206-0002-I	09/20	42.4	5993	7170	9.8	ND
SD-3206-0204-I	09/20	142	29715	6348	21	ND
SD-3206-0406-I	09/20	129	50790	5850	30.1	ND
SD-3206-0608-I	09/20	ND	75860	5985	37.2	ND
SD-3206-0810-I	09/20	26.4	76695	5733	70.9	ND
SD-3206-1012-I	09/20	688	75070	5673	70.8	ND

ND - NOT DETECTED

RAFFINATE SLUDGE ANIONS RESULTS
PIT 3

SAMPLE ID	DATE SAMPLED	NITRITE 0.5 UG/G	NITRATE 0.5 UG/G	SULFATE 0.5 UG/G	CHLORIDE 1.25 UG/G	FLUORIDE 1.25 UG/G
SD-3301-0004-I	01/04	NA	5589	1381	16.6	5.4
SD-3301-0408-I	01/04	NA	8705	ND	14.1	4.2
SD-3301-0812-I	01/04	NA	7685	6.7	15.1	5
SD-3301-1216-I	01/04	NA	7691	936	13.1	3.7
SD-3302-0004-I	01/09	NA	19739	1151	51.6	8.2
SD-3302-0408-I	01/09	NA	33175	7.3	45.9	22.1
SD-3302-0812-I	01/09	NA	31998	13.9	94.8	24.0
SD-3303-U.C.I	07/28	320	8980	6120	29	22
SD-3303-M.C.I	07/28	715	22170	1730	48	ND
SD-3303-L.C.I	07/28	480	34450	1870	50	ND
SD-3304-U.C.I	07/25	385	32520	7820	74	36
SD-3304-L.C.I	07/25	372	33950	2740	79	34
SD-3305-U.C.I	07/26	392	28520	7550	46	28
SD-3305-L.C.I	07/26	563	24300	6070	91	51
SD-3306-U.C.I	07/27	165	28470	5910	39	36
SD-3306-L.C.I	07/27	336	31400	6220	75	39
SD-3304-0810-I	07/27	277	28380	2520	31	20
SD-3307-0406-I	08/03	376	38050	6130	62	35
SD-3308-0002-I	08/03	93	11100	5280	28	30
SD-3308-0406-I	08/03	442	35210	6410	57	29
SD-3309-0204-I	08/02	ND	24040	1750	47.6	17
SD-3309-0608-I	08/02	ND	39500	500	124	ND
SD-3312-0002-I	08/04	216	18220	3450	39	27
SD-3312-0204-I	08/04	481	31130	5100	47	32
SD-3312-0406-I	08/04	588	33750	5500	49	32
SD-3313-0002-I	08/04	52	9120	2340	31	31
SD-3313-0204-I	08/04	181	23340	2490	53	27
SD-3313-0406-I	08/04	414	36340	5780	63	34

ND - NOT DETECTED
NA - NOT ANALYZED

RAFFINATE SLUDGE ANIONS RESULTS
PIT 4

SAMPLE ID	DATE SAMPLED	NITRITE 0.5 UG/G	NITRATE 0.5 UG/G	SULFATE 0.5 UG/G	CHLORIDE 1.25 UG/G	FLUORIDE 1.25 UG/G
SD-3403-0002-I	08/26	ND	0.9	45.7	1.7	20.2
SD-3404-0002-I	08/26	ND	7.8	104	5.9	28.7
SD-3405-0002-I	08/17	1.4	6	88.2	2.3	34.4
SD-3406-0002-I	08/24	18.9	695	750	11.6	32.3
SD-3406-0204-I	08/24	29.4	564	1800	26.1	24.1
SD-3407-0002-I	08/18	20.6	231	1020	10.3	40.4
SD-3408-0002-I	08/25	ND	ND	78	3	23
SD-3409-0002-I	08/25	ND	ND	14.5	2.9	24
SD-3410-0002-I	08/26	7.8	51.4	5.6	6.1	47.5
SD-3411-0002-I	08/16	2.4	332	414	6	53.9
SD-3412-0002-I	08/26	ND	0.6	67.2	2.5	31.7
SD-3413-0002-I	08/16	1.25	1.4	367	4.5	165
SD-3414-0002-I	08/26	ND	1.2	2.57	2.9	22.3
SD-3415-0002-I	08/17	12.3	478	889	22.3	50.8
SD-3416-0002-I	08/18	2	2	87	6.5	25.7
SD-3417-0002-I	08/26	ND	0.6	238	2.7	31.6

ND - NOT DETECTED

RAFFINATE SLUDGE VOLATILES RESULTS
PIT 1

SAMPLE ID	DATE SAMPLED	ACETONE 10 UG/KG	BENZENE 5 UG/KG	TOLUENE 5 UG/KG	METHYLENE CHLORIDE 5 UG/KG	2-BUTANONE 10 UG/KG	1,2-DICHLOROPROPANE 5 UG/KG
SD-3101-0002-V	9/12	52	ND	ND	ND	ND	ND
SD-3101-0204-V	9/12	79	ND	ND	ND	ND	ND
SD-3101-0406-V	9/12	105	ND	ND	ND	ND	ND
SD-3101-0608-V	9/12	150	16	ND	ND	ND	ND
SD-3101-0810-V	9/12	ND	ND	ND	ND	ND	ND
SD-3102-0002-V	9/12	ND	ND	ND	ND	ND	ND
SD-3102-0204-V	9/12	160	ND	ND	ND	ND	ND
SD-3102-0406-V	9/12	110	ND	ND	5	ND	ND
SD-3102-0608-V	9/12	190	9	ND	6	ND	ND
SD-3102-0810-V	9/12	150	9	ND	ND	ND	ND
SD-3103-0002-V	9/14	84	ND	ND	9	ND	ND
SD-3103-0204-V	9/14	160	6	ND	5	ND	ND
SD-3103-0406-V	9/14	ND	30	ND	6	ND	ND
SD-3103-0608-V	9/14	150	11	ND	ND	140	ND
SD-3103-0810-V	9/14	94	ND	ND	ND	ND	ND
SD-3104-0002-V	9/13	ND	ND	ND	ND	ND	ND
SD-3104-0204-V	9/13	150	16	ND	ND	ND	ND
SD-3104-0406-V	9/13	ND	9	ND	ND	ND	ND
SD-3104-0608-V	9/13	200	7	ND	ND	ND	ND
SD-3104-0810-V	9/13	460	6	ND	61	ND	ND

.D - NOT DETECTED

CHEMSLUD/TXTJOANN

RAFFINATE SLUDGE VOLATILES RESULTS
PIT 2

SAMPLE ID	DATE SAMPLED	ACETONE 10 UG/KG	BENZENE 5 UG/KG	TOLUENE 5 UG/KG	METHYLENE CHLORIDE 5 UG/KG	2-BUTANONE 10 UG/KG	1,2-DICHLOROPROPANE 5 UG/KG
SD-3201-0002-V	9/15	ND	ND	ND	ND	ND	ND
SD-3201-0204-V	9/15	110	22	6	ND	ND	ND
SD-3201-0406-V	9/15	110	58	ND	ND	ND	ND
SD-3201-0608-V	9/15	77	26	ND	ND	ND	ND
SD-3201-0810-V	9/15	95	88	ND	ND	ND	ND
SD-3202-0002-V	9/22	74	ND	ND	ND	ND	ND
SD-3202-0204-V	9/22	27	9	ND	ND	ND	ND
SD-3202-0406-V	9/22	69	26	ND	ND	ND	ND
SD-3202-0608-V	9/22	19	38	ND	ND	ND	ND
SD-3202-0810-V	9/22	ND	32	ND	ND	ND	8
SD-3203-0002-V	9/21	151	ND	ND	ND	ND	ND
SD-3203-0204-V	9/21	73	ND	ND	52	ND	ND
SD-3203-0406-V	9/21	88	15	ND	ND	ND	ND
SD-3203-0608-V	9/21	224	49	ND	ND	ND	ND
SD-3203-0810-V	9/21	85	20	ND	ND	ND	ND
SD-3204-0002-V	9/15	ND	ND	ND	ND	ND	ND
SD-3204-0204-V	9/15	64	7	ND	ND	ND	ND
SD-3204-0406-V	9/15	190	9	ND	ND	ND	ND
SD-3204-0608-V	9/15	200	24	ND	ND	ND	ND
SD-3204-0810-V	9/15	52	14	ND	6	ND	ND
SD-3204-1012-V	9/15	150	75	ND	ND	ND	ND

ND - NOT DETECTED

RAFFINATE SLUDGE VOLATILES RESULTS
PITS 3 AND 4

SAMPLE ID	DATE SAMPLED	ACETONE 10 UG/KG	BENZENE 5 UG/KG	TOLUENE 5 UG/KG	METHYLENE CHLORIDE 5 UG/KG	2-BUTANONE 10 UG/KG	1,2-DICHLOROPROPANE 5 UG/KG
PIT 3							
SD-3301-0004-V	1/04	43	ND	ND	6.8	ND	ND
SD-3301-0812-V	1/04	68	ND	ND	7.3	ND	ND
SD-3301-0408-V	1/09	220	6.5	ND	6.6	ND	ND
SD-3302-0812-V	1/09	62	ND	ND	ND	ND	ND
SD-3303-0002-V	7/29	ND	ND	ND	ND	ND	ND
SD-3303-0608-V	7/29	140	ND	ND	ND	ND	ND
SD-3304-0002-V	7/27	ND	ND	ND	ND	ND	ND
SD-3304-0608-V	7/27	ND	ND	ND	ND	ND	ND
SD-3304-1012-V	7/27	ND	ND	ND	ND	ND	ND
SD-3305-0204-V	7/27	210	ND	ND	ND	ND	ND
SD-3305-0810-V	7/27	110	ND	ND	ND	ND	ND
SD-3306-0204-V	7/28	82	ND	ND	ND	ND	ND
SD-3307-0204-V	8/3	78	ND	38	ND	ND	ND
SD-3307-0608-V	8/3	41	ND	ND	ND	ND	ND
SD-3308-0002-V	8/3	24	ND	ND	ND	ND	ND
SD-3308-0204-V	8/3	ND	ND	ND	ND	ND	ND
SD-3308-0406-V	8/3	75	ND	ND	39	ND	ND
SD-3309-0002-V	8/2	88	ND	ND	ND	ND	ND
SD-3309-0406-V	8/2	98	5	ND	ND	ND	ND
D-3309-0810-V	8/2	49	ND	ND	ND	170	ND
SD-3312-0002-V	8/4	ND	ND	ND	ND	ND	ND
SD-3312-0810-V	8/4	30	ND	ND	ND	ND	ND
SD-3313-0204-V	8/4	69	ND	ND	21	ND	ND
PIT 4							
SD-3403-0002-V	8/26	15	ND	ND	9	ND	ND
SD-3404-0002-V	8/26	19	ND	ND	8	ND	ND
SD-3405-0002-V	8/17	ND	ND	ND	25	ND	ND
SD-3406-0002-V	8/24	60	ND	ND	60	ND	ND
SD-3406-0204-V	8/24	65	ND	ND	43	ND	ND
SD-3407-0002-V	8/18	ND	ND	ND	ND	ND	ND
SD-3408-0002-V	8/25	ND	ND	ND	30	ND	ND
SD-3409-0002-V	8/25	ND	ND	ND	9	ND	ND
SD-3410-0002-V	8/26	19	ND	ND	ND	ND	ND
SD-3410-0204-V	8/26	130	ND	ND	14	ND	ND
SD-3411-0002-V	8/16	ND	ND	ND	ND	ND	ND
SD-3412-0002-V	8/26	ND	ND	ND	ND	ND	ND
SD-3413-0002-V	8/15	ND	ND	ND	ND	ND	ND
SD-3414-0002-V	8/26	ND	ND	ND	ND	ND	ND
SD-3415-0002-V	8/17	ND	ND	ND	ND	ND	ND
SD-3416-0002-V	8/18	ND	ND	ND	ND	ND	ND
SD-3417-0002-V	8/26	ND	ND	ND	8	ND	ND

ND - NOT DETECTED

CHEMSLUD/TXTJOANN

RAFFINATE SEMI-VOLATILE RESULTS

		DATE SAMPLED	bis(2-ethylhexyl)phthalate 330 UG/KG	Di-n-butylphthalate 330 UG/KG
PIT 1	SD-3102-0608-0	09/12	970	ND
	SD-3104-0406-0	09/13	ND	560
	SD-3104-0810-0	09/13	330	ND
	SD-3106-0002-0	09/13	ND	520
	SD-3106-0406-0	09/13	ND	890
	SD-3106-0810-0	09/13	ND	1100
PIT 3	SD-3303-L-C-0	07/28	ND	500
PIT 4	SD-3403-0002-0	08/26	333	ND
	SD-3406-0002-0	08/24	1300	ND
	SD-3416-0002-0	08/18	1500	ND

ND - NOT DETECTED

Appendix C - Raffinate Pit Sludge Data - Metals - Pit 1

WSSRAP_ID	DATE_SAM	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	K	Se	Ag	Na	Tl	V	Zn	Zr
		20	6	1	20	0.5	0.5	500	1	5	2.5	10	0.5	5	500	1.5	0.1	4.0	4	500	0.5	1	500	1	5	2	20
		ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g
SD-3101-0002-I	09/12/88	1507	20.65	284.3	ND	5.012	6.586	45060	14.22	ND	89.16	3616	ND	ND	1539	102.5	ND	455.8	13.30	ND	ND	1.254	2583	ND	2099	489.9	83.7
SD-3101-0204-I	09/12/88	2266	26.45	334.9	32.29	7.160	5.961	48100	14.54	ND	123.0	6655	ND	ND	2458	227.4	ND	776.4	26.3	ND	ND	ND	2853	ND	2805	296.9	93.2
SD-3101-0406-I	09/12/88	1934	23.87	220.5	68.05	9.738	4.9	31280	15.82	6.759	121.7	8498	114.2	ND	3690	256.3	ND	882.2	18.9	ND	ND	ND	4341	ND	3856	181	144.5
SD-3101-0608-I	09/12/88	3036	41.94	500.6	135.3	17.18	8.3	31390	28.29	6.944	171.4	9147	160.1	ND	6177	699.6	ND	1175	20.6	706.5	ND	ND	5713	ND	6791	174	200
SD-3101-0810-I	09/12/88	2764	45.16	559.8	82.07	11.60	6.6	29060	20.62	5.497	167.5	7302	181.8	ND	12520	432.4	ND	1326	17.0	882.7	ND	1.241	6780	ND	4816	40.3	231
SD-3102-0002-I	09/12/88	1923	ND	94.6	32.3	3.4	ND	53990	ND	ND	ND	26.4	24.6	ND	2199	159	ND	1219	16.9	ND	ND	1.44	1007	ND	1372	480	ND
SD-3102-0204-I	09/12/88	1481	26.45	263.9	38.00	10.02	7.2	38990	26.05	14.11	91.84	5233	74.52	ND	2474	203.9	ND	565.3	21.1	ND	ND	ND	3389	ND	4367	539	121.6
SD-3102-0406-I	09/12/88	2464	37.42	315.4	140.9	12.67	5.169	47300	24.77	5.358	142.2	6822	102.4	ND	4426	390.7	0.14	1067	16.3	643.2	ND	2.822	4946	ND	5194	133.1	196.1
SD-3102-0608-I	09/12/88	2387	25.16	523.4	54.20	8.735	6.669	29650	17.18	5.115	168.3	6173	135.4	ND	8354	284.7	0.1	1011	ND	670.6	ND	ND	5942	4.230	3630	44.88	161.1
SD-3102-0810-I	09/12/88	3837	20.65	634.6	79.61	10.88	8.045	36850	21.42	13.16	161.2	12610	124.9	ND	11670	1860	ND	1135	ND	828	ND	ND	5319	ND	3365	128	193.5
SD-3103-0002-I	09/14/88	2345	31.05	343.2	33.01	9.420	9.255	49950	18.21	ND	108.9	7327	ND	ND	2519	207.6	ND	1439	17.61	ND	ND	ND	2830	ND	3405	823.1	112.2
SD-3103-0204-I	09/14/88	2196	35.41	208.9	42.28	12.43	4.055	40730	17.64	8.710	128.6	7301	93.05	ND	3277	264.3	ND	933.8	23.03	ND	ND	ND	4243	ND	4631	208.2	120.1
SD-3103-0406-I	09/14/88	1634	41.62	395	149.3	16.02	6.04	32090	20.11	ND	138.7	7978	125.7	ND	5781	235.3	ND	1520	1429	ND	25.4	4.22	6411	ND	5967	4167	ND
SD-3103-0608-I	09/14/88	2650	46.99	506.3	72.02	18.34	6.758	32840	24.44	5.794	159.4	7321	134.8	ND	7195	565.6	ND	1071	20.00	ND	ND	ND	8023	ND	6812	85.31	186.2
SD-3103-0810-I	09/14/88	3756	25.22	506	59.03	10.27	7.169	37990	20.94	10.42	179.2	10550	136.4	ND	12150	1452	ND	953.1	30.47	ND	ND	ND	7582	ND	3195	104.6	166.9
SD-3104-0002-I	09/13/88	1278	8.7	63.76	7.96	2.2	2.23	68020	5.05	ND	36.96	1368	ND	ND	1522	50.24	ND	463.9	12.24	ND	ND	ND	3954	ND	817.3	325.2	ND
SD-3104-0204-I	09/13/88	2055	35.41	641.3	49.41	8.619	7.228	49250	14.55	ND	238.2	4803	ND	ND	2061	98.28	ND	690.5	17.47	ND	ND	ND	3712	ND	3209	116.0	119
SD-3104-0406-I	09/13/88	1651	35.41	240.4	47.56	11.78	3.350	47690	10.48	ND	122.0	6318	68.29	ND	2762	210	ND	741.7	26.39	ND	ND	ND	6146	ND	4253	66.17	ND
SD-3104-0608-I	09/13/88	2531	52.39	451.5	70.65	17.64	6.317	33790	16.15	5.479	166.6	6827	110.6	ND	6372	528.3	ND	1130	15.38	ND	ND	ND	7963	ND	6334	72.62	ND
SD-3104-0810-I	09/13/88	4006	25.22	647.1	89.21	9.270	9.226	35760	18.31	5.730	139.1	8617	227.5	ND	13960	616.9	ND	1070	21.11	ND	ND	ND	7592	ND	3238	6693	157.5
SD-3105-0002-I	09/08/88	3300	52.92	645.7	117.7	18.65	9.853	34060	36.79	6.953	202.2	9353.0	171.7	ND	6509	537.5	0.15	1493	26.94	770.3	ND	3.166	2788	ND	7805	187.5	231.4
SD-3105-0406-I	09/08/88	2527	45.4	588	58.8	11.6	6.94	30220	18.3	5.12	162.8	7420	253	ND	12440	474	ND	1414	14.95	1117	ND	ND	6040	7.8	4708	45.73	179.1
SD-3105-0608-I	09/08/88	3688	31.62	588	50.0	8.4	7.9	36950	20.8	8.2	159.4	9907	253	ND	16680	826.9	ND	1039	25.9	1472	19.0	ND	6475	3.92	3008	73.28	203.0
SD-3105-0810-I	09/08/88	5073	16.49	524.3	39.59	6.862	6.340	34380	17.09	7.834	145.2	9217	202	ND	12270	815.0	ND	719.2		1164	ND	ND	6308	ND	2511	65.08	
SD-3106-0002-I	09/14/88	1975	21.34	85.61	ND	6.614	11.81	49850	12.80	2.866	93.49	5029	ND	ND	1565	214	ND	880.6	12.20	ND	ND	ND	3172	ND	2329	1585	66.6
SD-3106-0204-I	09/14/88	2227	25.71	164.4	34.13	8.769	2.909	63730	14.06	6.129	72.61	6096	76.70	ND	3607	284.4	ND	636.7	16.19	ND	ND	ND	6040	ND	33.29	128.0	108.4
SD-3106-0406-I	09/14/88	2903	32.50	274.8	37.79	11.78	5.876	44400	15.53	5.502	118.9	9495	75.94	ND	4274	449.5	ND	1166	19.60	ND	ND	ND	4688	ND	4270	309.3	132.8
SD-3106-0608-I	09/14/88	3421	48.99	596.0	78.03	19.09	7.963	34690	39.18	5.936	179.1	8499	164.0	ND	606.9	8469	ND	1048	26.56	524	ND	ND	7917	ND	7251	102.6	215.6

ND - Not Detected

Appendix C - Raffinate Pit Sludge Data - Metals - Pit 2

WSSRAP_ID	DATE_SAM	Al 20 ug/g	Sb 6 ug/g	As 1 ug/g	Ba 20 ug/g	Be 0.5 ug/g	Cd 0.5 ug/g	Ca 500 ug/g	Cr 1 ug/g	Co 5 ug/g	Cu 2.5 ug/g	Fe 10 ug/g	Pb 0.5 ug/g	Li 5 ug/g	Mg 500 ug/	Mn 1.5 ug/g	Hg 0.1 ug/g	Mo 4.0 ug/g	Ni 4 ug/g	K 500 ug/g	Se 0.5 ug/g	Ag 1 ug/g	Na 500 ug/g	Tl 1 ug/g	V 5 ug/g	Zn 2 ug/g	Zr 20 ug/g
SD-3201-0002-I	09/15/88	4079	16.01	363	65.18	8.12	4.5	24290	15.94	6.65	144.3	8975	197	ND	8768	717.9	ND	741.1	20.00	ND	ND	ND	883.9	ND	2708	49.66	167
SD-3201-0204-I	09/15/88	3600	14.55	311	34.03	9.22	4.70	31020	20.94	13.58	159.8	11860	129	ND	12010	1836	ND	493.5	25.08	ND	ND	ND	ND	ND	2055	171.7	147.3
SD-3201-0406-I	09/15/88	2831	7.76	291	29.93	4.66	4.82	35390	21.25	6.68	117.6	9084	95.2	ND	7075	531.1	ND	521.9	19.94	ND	ND	ND	5157	ND	1264	67.8	60.86
SD-3201-0608-I	09/15/88	5097	15.18	352	35.39	8.57	5.38	38660	27.85	13.89	178.2	13010	99.6	17.5	11890	1721	ND	549.7	31.28	ND	ND	ND	4055	ND	2108	201.6	115.9
SD-3201-0810-I	09/15/88	4780	17.9	894	73.19	8.74	12.27	41340	101.1	9.55	225.9	14540	72.2	9.83	7112	758.3	.13	1319	66.39	ND	ND	2.69	4698	ND	3630	126	69.42
SD-3202-0002-I	09/22/88	4822	33.78	504	64.11	11.69	8.09	25490	36.78	16.65	251.4	14490	221	ND	13120	2570	ND	1227	36.81	ND	ND	ND	543.4	ND	4233	161.0	201.8
SD-3202-0204-I	09/22/88	6654	19.75	640	62.59	9.01	7.68	29470	24.07	9.62	224.8	12700	285	ND	14260	1079	0.1	1184	26.35	ND	ND	ND	1594	ND	3998	64.91	144.2
SD-3202-0406-I	09/22/88	4843	14.55	489	50.33	12.55	6.67	32580	33.15	18.90	252.1	16920	254.4	ND	15530	3011	ND	676.4	34.87	ND	ND	ND	3062	ND	4075	174.4	165.9
SD-3202-0608-I	09/22/88	4758	18.19	287	46.38	10.51	6.37	39760	25.94	19.44	269.7	13870	96.5	ND	14240	2291	0.1	706.5	29.50	ND	ND	ND	4723	ND	3299	179.0	145.7
SD-3202-0810-I	09/22/88	3279	10.39	742.1	56.41	6.43	10.47	40400	169.5	8.78	202.6	13180	66.4	ND	9646	704.6	0.1	887.2	30.19	ND	ND	ND	5163	ND	2663	95.55	64.88
SD-3203-0002-I	09/21/88	5970	36.33	767	72.84	11.84	10.5	36940	27.7	12.8	244.8	13870	337	5.7	5540	1452	ND	1607	30.3	ND	ND	ND	666.7	ND	5139	109.6	242
SD-3203-0204-I	09/21/88	3618	9.5	617	45.4	8.0	9.97	32980	25.10	13.62	248.1	12720	246	ND	14360	1689	ND	755.4	28.13	ND	ND	ND	2075	ND	2948	115.9	126
SD-3203-0406-I	09/21/88	4457	10.5	372	31.11	8.7	6.5	37140	27.2	20.8	186.6	13710	148	5.5	14120	2511	ND	705.7	28.4	ND	ND	ND	3308	ND	1847	247.8	148.3
SD-3203-0608-I	09/21/88	5979	ND	259	22.3	4.4	4.24	38020	26.33	8.3	104.1	8875	73.3	10.93	8452	7583	ND	4825	22.3	ND	ND	ND	4293	ND	12.85	92.0	65.8
SD-3203-0810-I	09/21/88	4258	15.59	876	59.8	8.04	13.2	41390	43.9	10.1	260.1	16290	84.7	ND	10630	978.8	0.32	1013	35.7	ND	ND	1.4	4781	ND	3245	135	79.4
SD-3204-0002-I	09/15/88	5125	22.78	849	52.8	9.7	11.47	30980	27.21	19.64	247.9	17200	370	ND	15140	2825	.10	1297	43.98	ND	ND	ND	531.6	ND	3088	183.2	277.2
SD-3204-0204-I	09/15/88	5640	15.73	533	63.93	8.91	8.06	38900	27.02	15.19	283.4	16260	270	8.66	16620	2152	.10	870.1	33.53	ND	ND	ND	1909	ND	2898	148.1	152.2
SD-3204-0406-I	09/15/88	5513	16.81	602	52.8	10.03	9.26	35390	28.68	18.77	262.7	17050	257	6.781	15900	2634	ND	878.3	32.05	ND	ND	ND	1950	ND	3190	175	164.4
SD-3205-0002-I	09/22/88	5581	29.60	653.7	57.47	13.30	8.99	27930	36.82	16.04	245.1	15750	22.5	ND	17140	2237	ND	1285	36.69	ND	ND	ND	546.0	ND	5187	136.4	217.8
SD-3205-0204-I	09/22/88	5337	27.53	750.8	47.29	7.78	9.106	33530	54.22	8.23	205.0	14280	260	ND	14910	655.9	ND	1413	26.22	ND	ND	ND	1509	ND	3563	61.44	190.9
SD-3205-0406-I	09/22/88	4506	12.98	521.8	42.73	8.15	7.89	26930	21.74	14.47	238.7	12690	203	ND	15860	1875	ND	589.7	29.44	ND	ND	ND	2530	ND	2636	140.9	121.0
SD-3205-0608-I	09/22/88	7247	14.02	361.1	42.43	9.01	5.12	36680	21.69	14.25	200.7	11230	240.7	ND	12070	1712	0.1	506.0	25.69	ND	ND	ND	3449	ND	3111	129.3	138.9
SD-3205-0810-I	09/22/88	3666	14.54	843.9	49.22	6.43	10.98	40280	41.34	9.91	266.7	13320	102.5	ND	10910	766.8	ND	876.1	28.14	ND	ND	ND	5439	ND	2518	80.04	78.94
SD-3206-0002-I	09/21/88	5169	17.3	852	47.3	9.6	12.04	32290	30.51	12.93	226.3	16190	373	ND	20610	1414	ND	1271	29.92	ND	ND	ND	677	ND	4230	100.5	238
SD-3206-0204-I	09/21/88	4298	14.66	478	45.1	8.7	8.2	30410	24.5	14.4	232	13570	211	ND	16500	2058	ND	803	25.0	ND	ND	ND	2017	ND	2954	132.1	116.2
SD-3206-0406-I	09/21/88	5102	13.6	419	29.0	8.99	7.3	32870	26.1	20.7	228.6	14020	151.4	ND	15640	2779	ND	450.5	30.52	ND	ND	ND	3022	ND	2269	203.3	106.5
SD-3206-0608-I	09/21/88	6517	28.56	271	20.51	6.43	4.166	49750	16.4	8.75	139.3	11920	136	ND	11810	1426	0.12	835.0	14.29	ND	ND	ND	4298	ND	1684	173.9	117.1
SD-3206-0810-I	09/21/88	4935	ND	429	39.19	6.65	6.695	38620	35.54	11.72	184.1	12770	103	ND	10450	1295	ND	560.4	34.68	ND	ND	ND	5638	ND	1658	152.5	92.51
SD-3206-1012-I	09/21/88	3941	10.93	983	51.85	6.112	13.95	43690	29.74	8.538	214.7	14060	67.6	ND	9329	564.2	0.27	925.0	25.96	ND	ND	1.719	5591	ND	2625	116.9	54.04

ND - Not Detected

Appendix C - Raffinate Pit Sludge Data - Metals - Pit 3

WSSRAP_ID	DATE_SAM	Al 20 ug/g/	Sb 6 ug/g	As 1 ug/g	Ba 20 ug/g	Be 0.5 ug/g	Cd 0.5 ug/g	Ca 500 ug/g	Cr 1 ug/g	Co 5 ug/g	Cu 2.5 ug/g	Fe 10 ug/g	Pb 0.5 ug/g	Li 5 ug/g	Mg 500 ug/g	Mn 1.5 ug/g	Hg 0.1 ug/g	Mo 4.0 ug/g	Ni 4 ug/g	K 500 ug/g	Se 0.5 ug/g	Ag 1 ug/g	Na 500 ug/g	Tl 1 ug/g	V 5 ug/g	Zn 2 ug/g	Zr 20 ug/g
SD-3301-0004-1	01/04/89	2166	14	106	79	2.5	ND	23,100	14.8	ND	91	3238	64	14.7	8450	213	1.58	294	23	ND	13.6	ND	3543	1.83	776	26	ND
SD-3301-0408-1	01/04/89	3019	27	212	30	10	1.5	43,830	18.3	ND	116	4406	79	5.7	3686	290	0.39	420	17.85	ND	31.5	1.1	6246	3.6	3676	34	ND
SD-3301-0812-1	01/04/89	3497	18	250	20	10	2.5	46,790	16	10	120	7891	71	ND	5962	1307	0.26	855	23	ND	16	2.9	5506	4	2761	100	ND
SD-3301-1216-1	01/04/89	4068	37	554	32	14	5.3	39,540	25.4	7.2	335	9187	80	ND	6566	825	0.42	763	22	ND	23.1	5	5852	9.3	4837	79	ND
SD-3302-0004-1	01/09/89	4419	26	144	90	6.2	1.2	48,290	18.8	ND	161	6299	171	19.1	6788	422	1.31	292	33	ND	30	ND	4324	9.2	2079	67	251
SD-3302-0408-1	01/09/89	2820	19	148	24	8	2.2	51,380	10.9	ND	96.4	3056	ND	ND	3425	224	0.4	709	17	ND	7.6	2.6	5488	2.3	2686	36	1121
SD-3302-0812-1	01/09/89	3343	20	213	29	9.5	1.5	42,970	16.6	ND	124	5006	59	ND	4441	568	0.53	533	31	ND	8.1	1.6	4628	2.8	3121	44	1112
SD-3303-L.C.1	07/29/88	4125	21.9	223	23.9	7.24	3.47	36,484	ND	6.81	174	7222	50.2	5.91	6056	1087	2.04	553	21.7	ND	24.0	ND	5327	5.20	2966	114	202
SD-3303-M.C.1	07/29/88	3877	31.1	256	33.2	6.32	3.56	47,530	ND	ND	118	5630	186	6.93	ND	342	0.245	333	17.4	ND	38.2	ND	6095	8.21	3411	56.8	335
SD-3303-U.C.1	07/29/88	4297	37.6	194	79.7	5.21	2.20	24,260	ND	ND	178	900	122	17.4	8095	689	0.55	529	157	ND	33.3	ND	4278	11.2	2107	97.2	261
SD-3304-0810-1	07/27/88	13970	67.4	1063	94.5	25.4	8.28	84790	ND	13.6	455	15270	143	10.8	15200	1880	0.72	1241	53.5	1075	73.0	ND	13090	14.9	8660	209	406
SD-3304-L.C.1	07/27/88	11760	71.6	817	104	24.8	7.80	86100	ND	13.6	457	17210	194	10.4	15030	1834	1.86	1232	56.9	812	81.12	ND	13540	11.9	8590	207	481
SD-3304-U.C.1	07/26/88	8615	46.2	427	164	12.2	2.39	63720	ND	ND	359	17110	284	33.7	17110	1457	1.84	571	318	ND	62.0	ND	8985	9.1	3420	166	280
SD-3305-L.C.1	07/27/88	9928	87.3	647	134	15.8	2.70	71910	ND	8.30	421	22890	644	6.60	12630	1837	0.81	739	216	644	61.4	ND	12620	22.8	4227	213	81.1
SD-3305-U.C.1	07/27/88	8595	36.6	581	131	8.32	3.90	61050	ND	9.60	511	17570	402	57.0	14020	1150	9.49	615	171	ND	22.5	ND	7910	12.3	2684	154	240
SD-3306-L.C.1	07/28/88	4134	43.9	343	127	6.46	2.03	24700	ND	ND	224	9443	184	33.5	8707	885	1.2	382	8794	ND	32.1	ND	5400	5.46	1858	68.6	190
SD-3306-U.C.1	07/28/88	6071	24.7	511	146	5.88	4.39	43210	ND	5.11	3.68	12000	187	122	10430	393	6.43	648	89.8	ND	9.8	ND	ND	9.64	1923	66.8	160
SD-3307-0406-1	08/03/88	4952	22.3	367	64.8	4.45	2.94	39310	ND	10.1	475	9493	237	43.9	6780	730	3.27	424	34.7	ND	ND	ND	5355	ND	1449	80.9	273
SD-3308-0002-1	08/03/88	4420	16.4	305	333	4.0	4.53	24140	ND	ND	326	5655	96.5	59.1	9710	307	7.95	363	185	ND	ND	ND	2632	ND	1525	45.8	189
SD-3308-0406-1	08/03/88	5718	25.5	212	70.2	5.81	2.10	24500	ND	6.23	209	12990	202	43.9	7327	1013	0.67	347	72.8	ND	ND	ND	6112	ND	1586	122	281
SD-3309-0204-1	08/02/88	3992	31.42	377	63.64	6.764	3.585	21110	18.67	6.281	7.67	5723	100.9	9.159	5035	514.6	2.18	277.5	37.04	ND	ND	1.716	4279	ND	2553	69.63	385.6
SD-3309-0608-1	08/02/88	3302	19.37	201	ND	7.891	2.494	21110	17.44	ND	134.9	3845	25.8	5.392	3529	464.2	0.33	312.7	23.84	869.5	30.3	1.025	5936	3.43	2935	19.97	135.2
SD-3312-0002-1	08/05/88	5333	20.6	244	201	4.07	3.89	38770	ND	ND	301	6511	90.2	62.2	11650	299	12.14	3.96	94.6	ND	ND	ND	3175	ND	1685	52.9	
SD-3312-0204-1	08/05/88	3799	29.4		86.0	2.77	5.66	24100	ND	ND	223	5275		35.2	9425	531	7.59	354	153	ND	ND	ND	5926	ND	1193	46.7	
SD-3312-0406-1	08/05/88	473.0	32.3	366	127	5.95	3.84	23960	ND	5.37	251	5935	254	18.4	8633	492	0.35	347	663	ND	ND	ND	6317	12.3	2365	108	
SD-3313-0002-1	08/04/88	7200	11.0	140	84.2	2.56	2.65	24680	ND	ND	2.75	13450	66.0	69.1	7790	152	5.66	213	46.1	ND	ND	ND	23810	3.73	755	35.1	
SD-3313-0204-1	08/05/88	5510	17.4	6271	110	3.18	2.87	21690	ND	ND	399	5450	124	113	9617	309	15.42	461	75.6	ND	ND	ND	3828	ND	1295	57.7	
SD-3313-0406-1	08/04/88	5470	23.3	231	142	4.82	2.18	43830	ND	7.98	216	11550	229	20.6	7395	888	4.93	362	61.3	ND	ND	ND	5168	4.76	1488	91.2	

ND - Not Detected

Appendix C - Raffinate Pit Sludge Data - Metals - Pit 4

WSSRAP_ID	DATE_SAM	Al 20 ug/g	Sb 6 ug/g	As 1 ug/g	Ba 20 ug/g	Be 0.5 ug/g	Cd 0.5 ug/g	Ca 500 ug/g	Cr 1 ug/g	Co 5 ug/g	Cu 2.5 ug/g	Fe 10 ug/g	Pb 0.5 ug/g	Li 5 ug/g	Mg 500 ug/g	Mn 1.5 ug/g	Hg 0.1 ug/g	Mo 4.0 ug/g	Ni 4 ug/g	K 500 ug/g	Se 0.5 ug/g	Ag 1 ug/g	Na 500 ug/g	Tl 1 ug/g	V 5 ug/g	Zn 2 ug/g	Zr 20 ug/g
SD-3403-0002-I	08/26/88	9694	ND	12.8	488.8	0.7174	0.6370	14860	16.41	6.391	16.67	15250	15.8	16.84	2818	402.8	0.26	38.89	ND	649.1	ND	ND	678.5	ND	102.4	38.18	33
SD-3404-0002-I	08/26/88	8669	ND	5.63	124.9	1.280	ND	2712	15.49	6.79	1548	21750	15.7	5.023	1485	149.3	0.20	9.25	28.42	880	ND	ND	ND	2.60	26.05	33.76	ND
SD-3405-0002-I	08/17/88	27670	ND	9.80	4962	.760	ND	6210	22.9	6.14	39.0	18520	11.2	27.6	4100	257	ND	20.4	32.7	1296	2.66	ND	ND	1.71	100	67.4	ND
SD-3406-0002-I	08/24/88	5135	7.90	771	179	4.21	8.63	17720	ND	ND	75.0	8340	89.3	72.6	8360	69.7	ND	133	21.1	ND	15.9	ND	648	58.0	1900	39.8	218
SD-3406-0204-I	08/24/88	993	11.6	501	43.6	1.90	4.79	40100	ND	ND	184	4850	158	24.6	12300	168	15.02	293	134	ND	ND	ND	737	4.12	788	42.0	143
SD-3407-0002-I	08/18/88	6140	7.62	ND	706	2.83	2.10	19820	ND	ND	74.7	5796	56	7.82	12870	90.6	0.82	141.	28.3	ND	4.07	ND	500	4.99	1220	61.1	ND
SD-3408-0002-I	08/25/88	9651	ND	6.09	168.0	ND	ND	2331	14.03	6.656	8.877	11370	15.9	13.89	1305	421.0	0.10	27.42	11.70	717.0	1.03	ND	ND	ND	29.41	34.47	290
SD-3409-0002-I	08/25/88	ND	ND	6.58	ND	ND	ND	ND	ND	ND	ND	29.88	11.2	10.27	ND	ND	0.20	ND	30.60	ND	1.12	ND	ND	ND	ND	7.934	ND
SD-3410-0002-I	08/26/88	4001	ND	110	2560	2.050	ND	11810	11.72	ND	67.29	2922	40.3	6.647	9930	58.77	0.54	67.66	24.89	ND	3.50	ND	ND	2.46	501.7	74.94	ND
SD-3411-0002-I	08/16/88	12120	11.6	68.2	249	1.38	ND	24770	ND	ND	96.5	6400	15.1	11.2	ND	141	ND	100	24.2	1345	32.9	ND	1030	1.63	515	80.3	ND
SD-3412-0002-I	08/26/88	14540	ND	6.4	203.0	ND	ND	10630	15.32	7.961	15.66	13120	12.8	24.52	2480	248.0	0.18	28.78	11.24	1082	ND	ND	ND	ND	77.62	30.03	24
SD-3413-0002-I	08/16/88	16480	ND	20.72	7740	12.9	ND	ND	ND	ND	245	7200	26.6	28.8	13230	25.4	ND	22.2	129	889	32.9	ND	658	ND	418	1075	ND
SD-3414-0002-I	08/26/88	ND	ND	82.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.39	ND	ND	ND	1.39	ND	ND	ND	ND	ND	ND
SD-3415-0002-I	08/17/88	3021	ND	100	38.5	.480	ND	8750	ND	ND	29.9	2650	25.8	ND	6250	36.1	ND	56.4	12.7	ND	ND	ND	ND	5.78	311	14.1	ND
SD-3416-0002-I	08/18/88	12320	ND	ND	192	.590	ND	1790	13.0	7.84	11.5	15280	16.3	21.1	2325	256	ND	16.2	11.8	1081	ND	ND	ND	ND	28.0	39.8	ND
SD-3417-0002-I	08/26/88	12770	ND	5.5	384.7	ND	ND	8930	22.32	7.43	15.18	17970	13.5	18.83	2448	199.0	ND	29.55	15.53	1148	ND	ND	ND	ND	77.09	31.8	ND

ND - Not Detected

PCBs/PESTICIDES RESULTS
PITS 1 AND 2

Sample ID	Date Sampled	Beta-BHC (8 ug/kg)	4,4 DDE (80 ug/kg)	AROCLOR 1248 (80 ug/kg)	AROCLOR 1254 (160 ug/kg)
Pit 1					
SD-3101-0204-0	09/12/88	ND	20	ND	ND
SD-3101-0406-0	09/12/88	ND	ND	190	ND
SD-3101-0608-0	C9/12/88	ND	ND	ND	ND
SD-3101-0810-0	09/12/88	ND	ND	ND	220
SD-3102-0204-0	09/12/88	ND	ND	ND	ND
SD-3102-0406-0	09/12/88	ND	ND	150	ND
SD-3103-0204-0	09/14/88	26	39	ND	ND
Pit 2					
SD-3201-0204-0	09/15/88	ND	ND	ND	ND
SD-3201-0406-0	09/15/88	ND	ND	ND	ND
SD-3201-0608-0	09/15/88	ND	ND	ND	ND
SD-3201-0810-0	09/15/88	ND	95	ND	ND
SD-3202-0810-0	09/22/88	ND	ND	ND	ND

ND - NOT DETECTED

PCBs/PESTICIDES RESULTS
PIT 3

SAMPLE I.D.	DATE SAMPLED	AROCLOR 1248 (80 ug/kg)	AROCLOR 1254 (160 ug/kg)
SD-3301-0004-0	01/04/89	ND	ND
SD-3301-0408-0	01/04/89	ND	ND
SD-3301-0812-0	01/04/89	ND	ND
SD-3301-1216-0	01/04/89	ND	ND
SD-3302-0004-0	01/09/89	ND	ND
SD-3302-0408-0	01/09/89	ND	ND
SD-3302-0812-0	02/09/89	ND	ND
SD-3303-UCO	07/29/88	ND	530
SD-3303-MCO	07/29/88	ND	240
SD-3303-LCO	07/29/88	ND	ND
SD-3304-UCO	07/26/88	ND	ND
SD-3304-LCO	07/27/88	ND	ND
SD-3305-UCO	07/27/88	ND	ND
SD-3305-LCO	07/27/88	ND	ND
SD-3306-UCO	07/28/88	ND	ND
SD-3306-LCO	07/28/88	ND	220
SD-3307-0002-0	08/03/88	ND	ND
SD-3308-0002-0	08/03/88	ND	ND
SD-3308-0204-0	08/03/88	ND	ND
SD-3308-0608-0	08/03/88	150	ND
SD-3312-0406-0	08/05/88	ND	ND

ND - NOT DETECTED

PCBs/PESTICIDES RESULTS
PIT 4

SAMPLE I.D.	DATE SAMPLED	AROCLOR 1248 (80 ug/kg)	AROCLOR 1254 (160 ug/kg)
SD-3403-0002-0	08/26/88	ND	ND
SD-3404-0002-0	08/26/88	1637	1011
SD-3405-0002-0	08/17/88	ND	ND
SD-3406-0002-0	08/24/88	ND	ND
SD-3406-0204-0	08/24/88	ND	ND
SD-3408-0002-0	08/25/88	ND	ND
SD-3409-0002-0	08/25/88	ND	ND
SD-3410-0002-0	08/26/88	ND	ND
SD-3411-0002-0	08/16/88	ND	ND
SD-3412-0002-0	08/26/88	ND	ND
SD-3413-0002-0	08/16/88	ND	300
SD-3414-0002-0	08/26/88	424	354
SD-3415-0002-0	08/17/88	ND	170
SD-3416-0002-0	08/18/88	ND	400
SD-3417-0002-0	08/26/88	830	1300

ND - NOT DETECTED

RAFFINATE PIT SLUDGE DATA MISCELLANEOUS

SAMPLE ID	DATE SAMPLED	OIL & GREASE PERCENT	TOTAL ORGANIC HALOGENS LLD = 10 UG/G	TOTAL ORGANIC CARBON 10 UG/G
RAFFINATE PIT 1				
SD-3106-0002-0	09/14/88	0.284	ND	659
SD-3106-0204-0	09/14/88	0.716	ND	1349
SD-3106-0406-0	09/14/88	0.18	ND	2378
SD-3106-0608-0	09/14/88	0.238	ND	2085
SD-3106-0810-0	09/14/88	0.088	ND	632
RAFFINATE PIT 2				
SD-3205-0002-0	09/22/88	0.74	ND	1453
SD-3205-0204-0	09/22/88	0.94	ND	1233
SD-3205-0406-0	09/22/88	NA	ND	2646
SD-3205-0608-0	09/22/88	0.166	ND	1680
SD-3205-0810-0	09/22/88	0.12	ND	2484
RAFFINATE PIT 3				
SD-3307-0002-0	08/03/88	0.414	ND	915
SD-3307-0204-0	08/03/88	0.234	ND	785
SD-3307-0406-0	08/03/88	0.194	ND	701
SD-3307-0608-0	08/03/88	0.892	ND	955
RAFFINATE PIT 4				
SD-3406-0002-0	08/24/88	0.334	ND	960
SD-3407-0002-0	08/18/88	NA	ND	605

NA - NOT ANALYZED
ND - NOT DETECTED

Raffinate Pit Sludge Data
Cyanides and Phenols

Sample ID	Date Sampled	Cyanides LLD = 0.25 ug/g	Phenols LLD = 0.05 ug/g
SD-3301-0004	01/04/89	ND	0.05
SD-3301-0812	01/04/89	ND	0.10
SD-3301-1216	01/04/89	ND	0.16
SD-3302-0408	01/09/89	ND	ND

ND - Not Detected

APPENDIX D

QA/QC DATA IN THE FORM OF QUALITY REPORTS FROM metaTRACE CONTAINING BLANK, DUPLICATE AND MATRIX SPIKE ANALYSES.

metaTRACE, Inc. 13715 Rider Trail North ▪ Earth City, MO 63045 ▪ (314) 298-8566

WELDON SPRING SITE REMEDIAL ACTION PROJECT

QUALITY CONTROL REPORT
RAFFINATE SLUDGE
7/26/88 - 7/29/88

metaTRACE, Inc. 13715 Rider Trail North • Earth City, MO 63045 • (314) 298-8566

Attachment #1 (Raffinate)

VOA - Blank Contamination

VBlk #	Request #	Compound	Concentration
237	122	Methylene Chloride	23 ug/l
238	128	Acetone	10 ug/kg
245	130, 133	Acetone	12 ug/kg
246	136	Methylene Chloride	7 ug/l
251A	141	Methylene Chloride	3J ug/l
263B	157, 159	Methylene Chloride	4J ug/kg
265A	157	Methylene Chloride Acetone	6 ug/kg 29 ug/kg
272A	169	Methylene Chloride	23 ug/kg
273B	169	Methylene Chloride	5 ug/kg

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Attachment #2 (Raffinate Sludge)

BNA - Blank Contamination

Blank #	Fraction	Req #	Compound	Conc.
331A	B/N	104	bis(2-Ethylhexyl)phthalate Di-n-octylphthalate	330 ug/kg 130J ug/kg
326	B/N	117, 118 119	bis(2-Ethylhexyl)phthalate	67J ug/kg
333	B/N	122, 128	Di-n-butylphthalate bis(2-Ethylhexyl)phthalate	33J ug/kg 730 ug/kg
338	B/N	133	bis(2-Ethylhexyl)phthalate	67J ug/kg
339	B/N	130	bis(2-Ethylhexyl)phthalate	15 ug/l
344	B/N	136	bis(2-Ethylhexyl)phthalate Di-n-octylphthalate	100J ug/kg 133J ug/kg
371	B/N	159	bis(2-Ethylhexyl)phthalate	100J ug/kg
374	B/N	154	bis(2-Ethylhexyl)phthalate	180J ug/kg
387	B/N	162	bis(2-Ethylhexyl)phthalate	100J ug/kg
388	B/N	162	bis(2-Ethylhexyl)phthalate Di-n-octylphthalate	90J ug/kg 50J ug/kg
395	B/N	169	bis(2-Ethylhexyl)phthalate	80J ug/kg
396	B/N	169	bis(2-Ethylhexyl)phthalate	50J ug/kg
408	B/N	174	bis(2-Ethylhexyl)phthalate	40J ug/kg
409	B/N	174	bis(2-Ethylhexyl)phthalate	40J ug/kg
419	B/N	174	bis(2-Ethylhexyl)phthalate	80J ug/kg

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Attachment #4 (Raffinate Sludge)

BNA - Samples Extracted out of Hold Time

Sample #	Date Received	Date Extracted
AA17758	09/09/88	09/20/88
AA17954	09/14/88	09/20/88
AA18185	09/16/88	09/27/88
AA18188	09/16/88	09/27/88
AA18191	09/16/88	09/27/88
AA18194	09/16/88	09/27/88
AA18197	09/16/88	09/27/88
AA188929	09/23/88	10/06/88
AA18938	09/23/88	10/06/88

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Attachment #5 (Raffinate Sludge)

Additional Comments

AA16744 - Not analyzed (NA). Marked not received on chain of custody.

AA16750 - Not entered on chain of custody

AA17768 - NA. Trip blank sent but no samples were sent for VOA analysis

AA17975 - Missed on chain of custody

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3A

WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

ıme: metaTRACE Contract: 100-03

ab Code: META Case No.: ______ SAS No.: ______ SDG No.: ______

atrix Spike - EPA Sample No.: ______

AA15847 MS

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	50	ND	45	90	61-145
Trichloroethene	50	ND	44	89	71-120
Benzene	50	ND	42	85	76-127
Toluene	50	ND	41	81	76-125
Chlorobenzene	50	ND	38	75	75-130

AA15848 MSD

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	50	42	85	6	14	61-145
Trichloroethene	50	44	88	1	14	71-120
Benzene	50	41	83	2	11	76-127
Toluene	50	41	82	1	13	76-125
Chlorobenzene	50	39	77	3	13	75-130

Column to be used to flag recovery and RPD values with an asterisk

Values outside of QC limits

?D: 0 out of 5 outside limits
ɔike Recovery: 0 out of 10 outside limits

ɔMMENTS: ______

3B

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

-b Name: metaTRACE Contract: 100-03

a ode: META Case No.: ______ SAS No.: ______ SDG No.: ______

atrix Spike - EPA Sample No.: __________ Level:(low/med) _____

AA15939 MS

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	50	ND	43	85	59-172
Trichloroethene	50	ND	51	102	62-137
Benzene	50	ND	50	101	66-142
Toluene	50	130	329	400*	59-139
Chlorobenzene	50	ND	43	85	60-133

AA15941 MSD

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	50	41	82	4	22	59-172
Trichloroethene	50	51	102	0	24	62-137
Benzene	50	51	101	0	21	66-142
Toluene	50	207	154*	99*	21	59-139
Chlorobenzene	50	43	85	0	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

Values outside of QC limits

D: 1 out of 5 outside limits
ike Recovery: 2 out of 10 outside limits

MMENTS: ______________________

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3B

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

-b Name: metaTRACE Contract: 100-03

ab Code: META Case No.: ______ SAS No.: ______ SDG No.: ______

atrix Spike - EPA Sample No.: ______ Level:(low/med) low

AA16860 MS

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	100	0	98	98	59-172
Trichloroethene	50	0	50	100	62-137
Benzene	50	0	45	90	66-142
Toluene	50	0	46	92	59-139
Chlorobenzene	50	0	49	98	60-133

AA16861 MSD

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	100	101	101	3	22	59-172
Trichloroethene	50	49	98	2	24	62-137
Benzene	50	45	90	0	21	66-142
Toluene	50	44	88	4	21	59-139
Chlorobenzene	50	48	98	0	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

Values outside of QC limits

D: 0 out of 5 outside limits
ike Recovery: 0 out of 10 outside limits

MMENTS: 1,1-Dichloroethene spiked at double concentration

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SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

·h Name: metaTRACE Contract: 100-03

ıb ‿ode: ________ Case No.: ______ SAS No.: ______ SDG No.: ______

ıtrix Spike - EPA Sample No.: __________ Level:(low/med) low

AA18006 MS

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	50	0	170	339*	59-172
Trichloroethene	50	0	55	111	62-137
Benzene	50	0	64	128	66-142
Toluene	50	0	48	95	59-139
Chlorobenzene	50	0	41	82	60-133

AA1807 MSD

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	50	170	340*	2	22	59-172
Trichloroethene	50	59	118	6	24	62-137
Benzene	50	68	136	6	21	66-142
Toluene	50	50	100	5	21	59-139
Chlorobenzene	50	43	86	4	21	60-133

:olumn to be used to flag recovery and RPD values with an asterisk

/alues outside of QC limits

): 0 out of 5 outside limits
.ke Recovery: 2 out of 10 outside limits

MENTS: ______________________________

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3B
SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

h Name: metaTRACE Contract: 100-03

ab ode: META Case No.: ______ SAS No.: ______ SDG No.: ______

atrix Spike - EPA Sample No.: ______ Level:(low/med) Low

AA18006 MS DC

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	100	0	489	97	59-172
Trichloroethene	50	0	244	98	62-137
Benzene	50	0	262	105	66-142
Toluene	50	0	228	91	59-139
Chlorobenzene	50	0	229	92	60-133

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	100	490	98	1	22	59-172
Trichloroethene	50	246	99	1	24	62-137
Benzene	50	268	108	3	21	66-142
Toluene	50	239	96	5	21	59-139
Chlorobenzene	50	237	95	3	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

Values outside of QC limits

D: 0 out of 5 outside limits
ike Recovery: 0 out of 10 outside limits

MMENTS: 1,1-Dichlorethene spiked at double concentration

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3B

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Name: metaTRACE Contract: 100-03

.b ode: META Case No.: ______ SAS No.: ______ SDG No.: ______

trix Spike - EPA Sample No.: ______ Level:(low/med) ______

AA18925 MS

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	100	0	111	111	59-172
Trichloroethene	50	0	42	84	62-137
Benzene	50	0	139	278*	66-142
Toluene	50	0	45	90	59-139
Chlorobenzene	50	0	41	81	60-133

AA18948 MSD

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene	100	96	96	14	22	59-172
Trichloroethene	50	50	100	16	24	62-137
Benzene	50	86	172*	47*	21	66-142
Toluene	50	47	94	4	21	59-139
Chlorobenzene	50	45	90	11	21	60-133

Column to be used to flag recovery and RPD values with an asterisk

Values outside of QC limits

D: 1 out of 5 outside limits
ike Recovery: 2 out of 10 outside limits

MENTS: ______

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3D

SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

ɔ ɯe: metaTRACE, Inc. Contract: 100-03

ɔ Code: meta Case No.: ______ SAS No.: ______ SDG No.: ______

:rix Spike - EPA Sample No.: AA18007MS Level:(low/med) low

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
?henol	6700	0	6800	102*	26- 90
?-Chlorophenol	6700	0	7900	118*	25-102
·,4-Dichlorobenzene	3300	0	4200	125*	28-104
?-Nitroso-di-n-prop.(1)	3300	0	5400	163*	41-126
·,2,4-Trichlorobenzene	3300	0	4000	121*	38-107
·-Chloro-3-methylphenol	6700	0	40	0 *	26-103
·cenaphthene	3300	0	5400	161*	31-137
-Nitrophenol	6700	0	1700	0.6*	11-114
,4-Dinitrotoluene	3300	0	200	6 *	28- 89
?entachlorophenol	6700	0	9000	135*	17-109
?yrene	3300	0	7000	210*	35-142

AA18010MSD

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
henol	6700	7800	117*	14	35	26- 90
-Chlorophenol	6700	11000	167*	34	50	25-102
,4-Dichlorobenzene	3300	4000	121*	3	27	28-104
-Nitroso-di-n-prop.(1)	3300	7500	225*	32	38	41-126
,2,4-Trichlorobenzene	3300	3800	113*	7	23	38-107
-Chloro-3-methylphenol	6700	330	0 *	0	33	26-103
cenaphthene	3300	4600	138*	15	19	31-137
-Nitrophenol	6700	70	2 *	200*	50	11-114
,4-Dinitrotoluene	3300	140	4 *	40	47	28- 89
entachlorophenol	6700	7400	112*	19	47	17-109
yrene	3300	6200	187*	12	36	35-142

N-Nitroso-di-n-propylamine

ɔlumn to be used to flag recovery and RPD values with an asterisk
.lues outside of QC limits

1 out of 11 outside limits
e ?ecovery: 22 out of 22 outside limits

E...S: ______

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SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: metaTRACE, Inc. Contract: 100-03

Lab Code: meta Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix Spike - EPA Sample No.: AA18589MS Level:(low/med) low

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
Phenol	6700	0	3600	53	26- 90
2-Chlorophenol	6700	0	3900	59	25-102
1,4-Dichlorobenzene	3300	0	1700	50	28-104
N-Nitroso-di-n-prop.(1)	3300	0	1800	53	41-126
1,2,4-Trichlorobenzene	3300	0	1800	54	38-107
4-Chloro-3-methylphenol	6700	0	3800	57	26-103
Acenaphthene	3300	0	1900	57	31-137
4-Nitrophenol	6700	0	3400	51	11-114
2,4-Dinitrotoluene	3300	0	2200	67	28- 89
Pentachlorophenol	6700	0	4300	64	17-109
Pyrene	3300	0	2000	61	35-142

AA18588MS

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol	6700	3200	48	10	35	26- 90
2-Chlorophenol	6700	3400	51	14	50	25-102
1,4-Dichlorobenzene	3300	1500	44	13	27	28-104
N-Nitroso-di-n-prop.(1)	3300	1500	46	14	38	41-126
1,2,4-Trichlorobenzene	3300	1500	46	16	23	38-107
4-Chloro-3-methylphenol	6700	3100	47	19	33	26-103
Acenaphthene	3300	1600	48	17	19	31-137
4-Nitrophenol	6700	2600	39	27	50	11-114
2,4-Dinitrotoluene	3300	1800	54	22	47	28- 89
Pentachlorophenol	6700	3400	51	22	47	17-109
Pyrene	3300	1800	55	10	36	35-142

(1) N-Nitroso-di-n-propylamine

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 11 outside limits
Spike Recovery: 0 out of 22 outside limits

COMMENTS: ______________________

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SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

ɔ Name: metaTRACE, Inc. Contract: 100-03

ɔ Code: meta Case No.: ______ SAS No.: ______ SDG No.: ______

:rix Spike - EPA Sample No.:*AA18926MS Level:(low/med) low

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
ᵓhenol	6700	0	0*	0*	26- 90
²-Chlorophenol	6700	0	0*	0*	25-102
.,4-Dichlorobenzene	3300	0	0*	0*	28-104
I-Nitroso-di-n-prop.(1)	3300	0	0*	0*	41-126
.,2,4-Trichlorobenzene	3300	0	0*	0*	38-107
-Chloro-3-methylphenol	6700	0	0*	0*	26-103
.cenaphthene	3300	0	0*	0*	31-137
-Nitrophenol	6700	0	0*	0*	11-114
,4-Dinitrotoluene	3300	0	0*	0*	28- 89
entachlorophenol	6700	0	0*	0*	17-109
yrene	3300	0	0*	0*	35-142

*AA18949MSD

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
ɹenol	6700	0	0*	0*	35	26- 90
-Chlorophenol	6700	0	0*	0*	50	25-102
.4-Dichlorobenzene	3300	0	0*	0*	27	28-104
-Nitroso-di-n-prop.(1)	3300	0	0*	0*	38	41-126
.2,4-Trichlorobenzene	3300	0	0*	0*	23	38-107
-Chloro-3-methylphenol	6700	0	0*	0*	33	26-103
:enaphthene	3300	0	0*	0*	19	31-137
-Nitrophenol	6700	0	0*	0*	50	11-114
4-Dinitrotoluene	3300	0	0*	0*	47	28- 89
:ntachlorophenol	6700	0	0*	0*	47	17-109
'rene	3300	0	0*	0*	36	35-142

N-Nitroso-di-n-propylamine

lumn to be used to flag recovery and RPD values with an asterisk
lues outside of QC limits

11 out of 11 outside limits
e Recovery: 22 out of 22 outside limits

: * AA18949MSD - no spike recovery and on AA18926MS - no spike recovery

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ES-19-03-M-03-0

WELDON SPRING SITE REMEDIAL ACTION PROJECT

RAFFINATE SLUDGE QUALITY CONTROL REPORT
ANIONS AND NITROAROMATICS

AUGUST - SEPTEMBER, 1988

CLIENT: MK Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: All samples analyzed for nitroaromatics (Raffinate Slud

GC/HPLC ANALYSIS CONFORMANCE SUMMARY

1) GC/HPLC CALIBRATION - INITIAL CALIBRATION CURVE OR CALIBRATION CHECK STANDARD RUN PER METHOD HPLC-USATHAMA ☒

2) BLANK CONTAMINATION - COMPOUNDS LISTED

a) GC N/A

b) HPLC No contaminates

3) SPIKED BLANK WITHIN CONTROL LIMITS ☒

4) SAMPLE HOLDING TIMES MET AA17816, AA17819 extracted past hold time due to screening. AA17822 extrated past hold time due to a mistake on the metaTRACE chain of custody. ☐

5) MINIMUM DETECTION LIMITS ON GC/HPLC METHODS AT OR BELOW METHOD SPECIFICATIONS ☒

6) ALL SAMPLES CONFORM TO EPA-CLP QA/QC CRITERIA UNLESS OTHERWISE DENOTED BELOW ☒

ADDITIONAL COMMENTS:

[signature]
PROJECT MANAGER

maxiTRACE, Inc. 13715 Rider Trail North • Earth City, MO 63045 •

CLIENT: MK Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: All samples analyzed for anions (Raffinate Sludge)

METALS/INORGANIC ANALYSIS CONFORMANCE SUMMARY

1) INITIAL CALIBRATION CURVE OR CALIBRATION CHECK STANDARD RUN PER METHOD EPA-CLP ☒

2) BLANK CONTAMINATION - COMPOUNDS LISTED

a) METALS N/A

b) INORGANIC NO contaminates

3) SPIKED BLANK (LABORATORY CONTROL SAMPLE) WITHIN CONTROL LIMITS ☒

4) SAMPLE HOLDING TIMES MET All holding times met. ☒

5) MINIMUM DETECTION LIMITS ON METALS/INORGANICS AT OR BELOW METHOD SPECIFICATIONS EPA-CLP ☒

6) ALL SAMPLES CONFORM TO EPA-CLP QA/QC CRITERIA UNLESS OTHERWISE DENOTED BELOW ☒

ADDITIONAL COMMENTS:

[signature]
PROJECT MANAGER

metaTRACE, Inc. 13715 Rider Trail North • Earth City, MO 63045 • (314) 298-8566

WSSRAP PROJECT NO: 100-03
NITROAROMATICS - RAFFINATE SLUDGE
MS/MSD RESULTS
PERCENT RECOVERY

SAMPLE #: AA18007
SITE ID: SD-3104-0810-0-MS

ANALYTE	MATRIX SPIKE	MATRIX SPIKE DUP
1,3,5-TNB	98	101
1,3-DNB	102	103
NITROBENZENE	106	107
2,4,6-TNT	106	112
2,6-DNT	113	119
2,4-DNT	101	119

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WSSRAP PROJECT NO: 100-03
NITROAROMATICS - RAFFINATE SLUDGE
MS/MSD RESULTS
PERCENT RECOVERY

SAMPLE #: AA18926
SITE ID: SD-3202-0810-0-MS

ANALYTE	MATRIX SPIKE	MATRIX SPIKE DUP
1,3,5-TNB	95	101
1,3-DNB	99	105
NITROBENZENE	109	113
2,4,6-TNT	97	101
2,6-DNT	96	95
2,4-DNT	96	103

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M-K F CU N CO.
RECEIVED
DEC 5 1988
WSSRAP CONTRACT 3589

WSSRAP PROJECT NO: 100-03
RAFFINATE SLUDGE
UNITS: UG/G

SAMPLE # AA18008
SITE ID: SD-3104-0810-I-MS

ANALYTE	SAMPLE CONC.	ADDED AMT.	SPIKE	% RECOVERED
NITRATE	7680	1000	7920	91
CHLORIDE	280	1000	1506	118
FLOURIDE	ND	1000	1100	110
SULFATE	5100	1000	6100	100
NITRITE	425	1000	1412	99

RAFFINATE SLUDGE DUPLICATE
UNITS: UG/G

SAMPLE # AA18005
SITE ID: SD-3104-0810-I

	NITRITE	NITRATE	FLOURIDE	CHLORIDE	SULFATE
RESULT #1	351	31460	ND	182	5190
RESULT #2	425	7680	ND	280	5100

WSSRAP PROJECT NO: 100-03
RAFFINATE SLUDGE
UNITS: UG/G

SAMPLE # AA18591
SITE ID: SD-3206-0002-I-MS

ANALYTE	SAMPLE CONC.	ADDED AMT.	SPIKE	% RECOVERED
NITRATE	7503	5000	11005	88
CHLORIDE	9.4	5000	4928	98
FLOURIDE	ND	5000	5955	119
SULFATE	7520	5000	11133	89
NITRITE	43.6	5000	5343	106

RAFFINATE SLUDGE DUPLICATE
UNITS: UG/G

SAMPLE # AA18587
SITE ID: SD-3206-0002-I

	NITRITE	NITRATE	FLOURIDE	CHLORIDE	SULFATE
RESULT #1	42.4	5993	ND	9.8	7170
RESULT #2	43.6	7503	ND	9.4	7520

WSSRAP PROJECT NO: 100-03
RAFFINATE SLUDGE
UNITS: UG/G

SAMPLE # AA18927
SITE ID: SD-3202-0810-I-MS

ANALYTE	SAMPLE CONC.	ADDED AMT.	SPIKE	% RECOVERED
NITRATE	73730	5000	84818	108
CHLORIDE	70.4	5000	5070	100
FLOURIDE	ND	5000	6073	121
SULFATE	5780	5000	9555	89
NITRITE	628	5000	5998	107

RAFFINATE SLUDGE DUPLICATE
UNITS: UG/G

SAMPLE # AA18930
SITE ID: SD-3202-0810-I

	NITRITE	NITRATE	FLOURIDE	CHLORIDE	SULFATE
RESULT #1	585	69005	ND	70.7	6198
RESULT #2	628	73730	ND	70.4	5780

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WSSRAP PROJECT NO: 100-03
RAFFINATE SPIKE
UNITS: UG/G

SAMPLE # 18950
SITE ID: SD-3202-0810-I-MD

ANALTYE	RESULT #1	RESULT #2
Aluminum	4758	3862
Antimony	18.19	13.50
Arsenic	415.1	912.8
Barium	46.38	64.35
Beryllium	10.51	8.043
Cadmium	6.367	5.118
Calcium	39760	44360
Chromium	25.94	21.69
Cobalt	19.44	14.25
Copper	269.7	200.7
Iron	13870	11230
Lead	149.7	90.70
Lithium	1.227	< 10
Magnesium	14240	11250
Manganese	2291.0	833.5
Mercury	0.10	0.17
Molybdenum	706.5	1038.0
Nickel	29.50	36.79
Potassium	< 326	< 326
Selenium	< 1.0	< 1.0
Silver	< 0.6	< 0.6
Sodium	4723	5851.0
Thallium	< 1.0	< 1.0
Vanadium	3299	3221
Zinc	179.0	104.7

metaTRACE, Inc.

WELDON SPRING SITE REMEDIAL ACTION PROJECT

QUALITY CONTROL REPORT - METALS

RAFFINATE SLUDGE

metaTRACE, Inc. 13715 Rider Trail North • Earth City, MO 63045 • (314) 298-8566

WSSRAP PROJECT NO: 100-03
RAFFINATE SPIKE
UNITS: UG/G

SAMPLE # 18008
SITE ID: SD-3104-0810-I-MS

ANALYTE	SAMPLE CONC.	SPIKE CONC	SAMPLE +SPIKE	% RECOVERED
Aluminum	4006	---	3289	---
Antimony	25.22	100	121.8	96.6
Arsenic	647.1	400	946.3	74.8
Barium	89.21	400	441.7	88.1
Beryllium	9.270	10	21.45	121.8
Cadmium	9.3	10	19.8	105
Calcium	35760	---	36330	---
Chromium	18.31	40	57.41	97.8
Cobalt	5.730	100	98.21	92.5
Copper	139.1	50	219.3	160.4
Iron	8617	---	8493	---
Lead	227.5	100	258.3	30.8
Lithium	< 10	---	< 10	---
Magnesium	13960	---	12150	---
Manganese	616.9	100	892.9	276
Mercury	< 0.1	0.5	0.50	100
Molybdenum	1070	---	1046	---
Nickel	21.11	100	110.4	89.3
Potassium	< 326	---	< 326	---
Selenium	< 1.0	2	3.56	175
Silver	< 0.6	10	6.375	63.8
Sodium	7592	---	7682	---
Thallium	< 1.0	8	3.56	47
Vanadium	3238	100	4064	826
Zinc	66.83	100	170.7	103.9

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WSSRAP PROJECT NO: 100-03
RAFFINATE SPIKE
UNITS: UG/G

SAMPLE # 18591
SITE ID: SD-3206-0002-I-MS

ANALYTE	SAMPLE CONC.	SPIKE CONC	SAMPLE +SPIKE	% RECOVERED
Aluminum	5169	---	4704	---
Antimony	17.28	100	64.41	47.1
Arsenic	851.9	400	1071	54.8
Barium	47.29	400	435.4	97.0
Beryllium	9.642	10	17.82	81.8
Cadmium	12.04	10	22.87	108.3
Calcium	32290	---	28790	---
Chromium	30.51	40	63.90	83.5
Cobalt	12.93	100	105.9	93.0
Copper	226.3	50	252.7	52.8
Iron	16190	---	14810	---
Lead	373.3	100	426.1	52.8
Lithium	0.6835	---	0.5188	---
Magnesium	20610	---	17690	---
Manganese	1414	100	1705	291
Mercury	< 0.1	0.5	0.52	104
Molybdenum	1271	---	1169	---
Nickel	29.92	100	119.2	89.3
Potassium	< 326	---	< 326	---
Selenium	< 1.0	2	< 1.0	0
Silver	< 0.6	10	6.271	62.7
Sodium	677.3	---	648.7	---
Thallium	< 1.0	10	< 1.0	0
Vanadium	4230	100	3539	0
Zinc	100.5	100	201.1	100.6

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WSSRAP PROJECT NO: 100-03
RAFFINATE SPIKE
UNITS: UG/G

SAMPLE # 18927
SITE ID: SD-3202-0810-I-MS

ANALYTE	SAMPLE CONC.	SPIKE CONC	SAMPLE +SPIKE	% RECOVERED
Aluminum	4758	---	3823	---
Antimony	18.19	100	60.80	42.6
Arsenic	415.1	400	1285	217.5
Barium	46.38	400	461.7	103.8
Beryllium	10.51	10	17.69	71.8
Cadmium	6.367	10	25.41	190.4
Calcium	39760	---	43660	---
Chromium	25.94	40	77.93	130.0
Cobalt	19.44	100	105.8	86.4
Copper	269.7	50	299.6	59.8
Iron	13870	---	17170	---
Lead	149.7	100	182.2	32.5
Lithium	1.227	---	0.2006	---
Magnesium	14240	---	11150	---
Manganese	2291	100	910.9	0
Mercury	0.10	0.5	0.59	98
Molybdenum	706.5	---	1012	---
Nickel	29.50	100	126.0	96.5
Potassium	< 326	---	< 326	---
Selenium	< 1.0	2	< 1.0	0
Silver	< 0.6	10	9.858	98.6
Sodium	4723	---	5675	---
Thallium	< 1.0	10	< 1.0	0
Vanadium	3299	100	3238	0
Zinc	179.0	100	188.7	9.7

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WSSRAP PROJECT NO: 100-03
RAFFINATE SPIKE
UNITS: UG/G

SAMPLE # 18011
SITE ID: SD-3104-08140-I-MSD

ANALTYE	RESULT #1	RESULT #2
Aluminum	4006	2922
Antimony	25.22	25.71
Arsenic	647.1	452.7
Barium	89.21	52.49
Beryllium	9.270	9.520
Cadmium	< 1.0	< 1.0
Calcium	35760	30860
Chromium	18.31	19.88
Cobalt	5.730	5.841
Copper	139.1	140.5
Iron	8617	7227
Lead	227.5	224.5
Lithium	< 10	< 10
Magnesium	13960	17480
Manganese	616.9	594.9
Mercury	< 0.1	< 0.1
Molybdenum	1070.0	720.3
Nickel	21.11	20.80
Potassium	< 326	< 326
Selenium	< 1.0	< 1.0
Silver	< 0.6	< 0.6
Sodium	7592	8011
Thallium	< 1.0	< 1.0
Vanadium	3238	3230
Zinc	66.83	55.01

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WSSRAP PROJECT NO: 100-03
RAFFINATE SPIKE
UNITS: UG/G

SAMPLE # 18590
SITE ID: SD-3206-0002-I-MD

ANALTYE	RESULT #1	RESULT #2
Aluminum	5169	4497
Antimony	17.28	14.66
Arsenic	851.9	658.8
Barium	47.29	42.95
Beryllium	9.642	7.475
Cadmium	12.04	9.106
Calcium	32290	27630
Chromium	30.51	23.54
Cobalt	12.93	12.18
Copper	226.3	206.6
Iron	16190	13970
Lead	373.3	312.7
Lithium	0.6835	< 10
Magnesium	20610	17020
Manganese	1414.0	1499.0
Mercury	< 0.1	< 0.1
Molybdenum	1271.0	1076.0
Nickel	29.92	29.04
Potassium	< 326	< 326
Selenium	< 1.0	< 1.0
Silver	< 0.6	< 0.6
Sodium	677.3	739.1
Thallium	< 1.0	< 1.0
Vanadium	4230	3155
Zinc	100.5	98.01

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CLIENT: MK Ferguson
PROJECT #'s: 700-03
SAMPLE #'s: AA24189, AA24190, AA24196, AA24198, AA24201, AA24202, AA24205
AA24618, AA24619, AA24621

GC/MS ANALYSIS CONFORMANCE SUMMARY

1) GC/MS TUNE SPECIFICATIONS ☒

   a) BFB PASSED ☒
   b) DFTPP PASSED

2) GC/MS TUNING FREQUENCY - PERFORMED PER METHOD EPA-CLP ☒

3) GC/MS CALIBRATION - INITIAL CALIBRATION CURVE OR CALIBRATION CHECK STANDARD RUN PER METHOD EPA-CLP ☒

4) GC/MS CALIBRATION REQUIREMENTS MET ☒

   a) CALIBRATION CHECK COMPOUNDS ☒
   b) SYSTEM PERFORMANCE CHECK COMPOUNDS

5) BLANK CONTAMINATION - COMPOUNDS LISTED
   VBlK J012B Methylene Chloride 5ug/Kg, Acetone 31ug/Kg

   a) VOA FRACTION VBlK J010 Methylene Chloride 5ug/Kg, Acetone 23ug/Kg
   b) B/N FRACTION bis(2-Ethylhexyl)phthalate = SBlK 599 - 310ug/Kg, SBlK 607 - 380ug/K
   c) A/E FRACTION No contaminates SBlK 598 - 490ug/

6) SURROGATE RECOVERIES MEET CRITERIA (IF NOT MET, REFER TO INDIVIDUAL SURROGATE RECOVERY FORMS FOR ACTUAL RECOVERIES) ☒

   a) VOA FRACTION All surrogates within limits
   b) B/N FRACTION All surrogates within limits
   c) A/E FRACTION All surrogates within limits

7) SPIKED BLANK WITHIN CONTROL LIMITS Not applicable ☐

8) SAMPLE HOLDING TIMES MET See Comments ☒

9) MINIMUM DETECTION LIMITS ON ALL FRACTIONS AT OR BELOW METHOD SPECIFICATIONS. (IF NOT CHECKED REFER TO INDIVIDUAL ANALYSIS REPORTS FOR THE ACTUAL MDL'S) ☒

10) ALL SAMPLES CONFORM TO EPA-CLP QA/QC CRITERIA UNLESS OTHERWISE DENOTED BELOW. ☒

ADDITIONAL COMMENTS: AA24201 (SO-3301-0812-0-FO) and AA24205 (SO-3301-1216-0) were extracted for BNA on 11/13/89. Due to no recovery of internal standards, they were reextracted at medium level on 11/23/89.

[signature]
PROJECT MANAGER

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CLIENT: M K Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: AA24190, AA24194, AA24196, AA24201, AA24205, AA24612, AA24614, AA24616, AA24619, AA24622

GC/HPLC ANALYSIS CONFORMANCE SUMMARY

1) GC/HPLC CALIBRATION - INITIAL CALIBRATION CURVE OR CALIBRATION CHECK STANDARD RUN PER METHOD GC-EPA CLP, HPLC-USATHAMA ☒

2) BLANK CONTAMINATION - COMPOUNDS LISTED

a) GC No contaminates

b) HPLC No contaminates

3) SPIKED BLANK WITHIN CONTROL LIMITS ☒

4) SAMPLE HOLDING TIMES MET See comments ☒

5) MINIMUM DETECTION LIMITS ON GC/HPLC METHODS AT OR BELOW METHOD SPECIFICATIONS ☒

6) ALL SAMPLES CONFORM TO EPA-CLP QA/QC CRITERIA UNLESS OTHERWISE DENOTED BELOW ☒

ADDITIONAL COMMENTS:
AA24612 (SO-3302-0004-0)
AA24614 (SO-3302-0004-0-MS)
AA24616 (SO-3302-0004-0-MSD)
AA24622 (SO-3302-0812-0)
} Extracted 1/16/89. Had to reextract on 2/7/89 due to a contaminated blank

[signature]
PROJECT MANAGER

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CLIENT: M K Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: AA24192, AA24195, AA24199, AA24203, AA24206, AA24613, AA24620, AA2462[illegible]

RADIOCHEMICAL ANALYSIS CONFORMANCE SUMMARY

1) GAS PROPORTIONAL COUNTER

- a) BACKGROUND ACCEPTABLE ALPHA ☑
- b) BACKGROUND ACCEPTABLE BETA ☑
- c) PERFORMANCE CHECK ACCEPTABLE ALPHA ☑
- d) PERFORMANCE CHECK ACCEPTABLE BETA ☑

2) ALPHA SPECTROMETER

- a) BACKGROUND ACCEPTABLE ☑
- b) CALIBRATION (KeV/CHANNEL) VERIFICATION ☐

3) ALPHA SCINTILLATION COUNTER

- a) BACKGROUND ACCEPTABLE ☑
- b) PERFORMANCE CHECK ACCEPTABLE ☐

4) METHOD SPECIFIC PARAMETERS

- a) BLANK IN CONTROL [*]
- b) SPIKED BLANK IN CONTROL ☑
- c) RPD FOR DUPLICATES IN CONTROL ☑

ADDITIONAL COMMENTS:
* nat U OK — Th - both blanks positive for Th 230 - level insignificant compared to level of samples
225 OK
226 OK

[signature]
PROJECT MANAGER

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WSSRAP PROJECT NO: 100-03
RAFFINATE SLUDGE SPIKE
UNITS: UG/G

SAMPLE # AA24615
SITE ID: SD-3302-0004-I-MS

ANALYTE	SAMPLE CONC.	SPIKE CONC	SAMPLE +SPIKE	% RECOVERED
Aluminum	4419	---	3316	---
Antimony	22.5	100	121	93
Arsenic	177	8	116	+
Barium	90.3	400	439	85
Beryllium	6.2	10	13.9	75
Cadmium	1.63	10	12.3	107
Calcium	48300	---	41970	---
Chromium	18.8	40	53.3	86
Cobalt	4.8	100	91.2	87
Copper	161	50	304	300
Iron	6300	---	5928	---
Lead	171	100	188	17
Lithium	19.1	---	10.1	---
Magnesium	6788	---	5808	---
Manganese	422	100	382	+
Mercury	1.3	0.5	1.5	40
Molybdenum	292	---	205	---
Nickel	32.9	100	102	69
Potassium	800U	---	800U	---
Selenium	29.7	2	16.8	+
Silver	1.4U	10	10.1	101
Sodium	4324	---	3491	---
Thallium	9.2	10	13.5	43
Vanadium	2079	100	1804	+
Zinc	67.3	100	122	55

(+) - Spike less than 1/4 of sample value

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WSSRAP PROJECT NO: 100-03
RAFFINATE SLUDGE DUPLICATE
UNITS: UG/G

SAMPLE # AA24613
SITE ID: SD-3302-0004-I

ANALTYE	RESULT #1	RESULT #2
Aluminum	4419	3691
Antimony	25.5	26.8
Arsenic	177	169
Barium	90.3	75.6
Beryllium	6.2	5.5
Cadmium	1.63	1.18
Calcium	48300	41900
Chromium	18.8	27.1
Cobalt	4.8	4.1
Copper	161	133
Iron	6300	5605
Lead	171	117
Lithium	19.1	10.6
Magnesium	6788	6323
Manganese	422	360
Mercury	1.3	0.95
Molybdenum	292	243
Nickel	32.9	35.4
Potassium	800U	800U
Selenium	29.7	20.2
Silver	1.4U	1.4U
Sodium	4324	3780
Thallium	9.2	4.3
Vanadium	2079	1896
Zinc	67.3	43.4
Zirconium	251.2	254.0

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WSSRAP PROJECT NO: 100-03
Raffinate Sludge
UNITS: UG/G

SAMPLE # AA24615
SITE ID: SD-3302-0004-I-MS

ANALYTE	SAMPLE CONC.	ADDED AMT.	SPIKE	% RECOVERED
Nitrate	20523	2000	22407	99
Chloride	53.7	200	192	76
Flouride	11.0	10	15.5	74
Sulfate	545	200	707	95

Raffinate Sludge Duplicate
UNITS: UG/G

SAMPLE # AA24613
SITE ID: SD-3302-0004-I

	Nitrite	Flouride	Chloride	Sulfate
RESULT #1	19739	8.2	51.6	1151
RESULT #2	20523	11.0	53.7	545

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WSRAP PROJECT NO: 100-03
Pesticide/PCB - Raffinate Sludge
MS/MSD RESULTS
Percent Recovery

SAMPLE #: AA24614
SITE ID: SD-3302-0004-0-MS

Analyte	Matrix Spike	Matrix Spike Dup
Lindane	56	48
Heptachlor	52	63
Aldrin	96	81
Dieldrin	90	79
Endrin	96	87
4.4'DDT	130	116

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CLIENT: MK Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: AA15566-AA15571, AA15574-AA15594, AA15646-AA15651, AA1567X-A

GC/MS ANALYSIS CONFORMANCE SUMMARY

1) GC/MS TUNE SPECIFICATIONS
   - a) BFB PASSED ☒
   - b) DFTPP PASSED ☒

2) GC/MS TUNING FREQUENCY - PERFORMED PER METHOD EPA-CLP ☒

3) GC/MS CALIBRATION - INITIAL CALIBRATION CURVE OR CALIBRATION CHECK STANDARD RUN PER METHOD EPA-CLP ☒

4) GC/MS CALIBRATION REQUIREMENTS MET
   - a) CALIBRATION CHECK COMPOUNDS ☒
   - b) SYSTEM PERFORMANCE CHECK COMPOUNDS ☒

5) BLANK CONTAMINATION - COMPOUNDS LISTED
   - a) VOA FRACTION Methylene chloride, Acetone
   - b) B/N FRACTION Di-n-octylphthalate
   - c) A/E FRACTION No Contaminates

6) SURROGATE RECOVERIES MEET CRITERIA (IF NOT MET, REFER TO INDIVIDUAL SURROGATE RECOVERY FORMS FOR ACTUAL RECOVERIES) ☒
   - a) VOA FRACTION All surrogates within limits
   - b) B/N FRACTION All surrogates within limits
   - c) A/E FRACTION AA15646(1), AA15676(2)

7) SPIKED BLANK WITHIN CONTROL LIMITS N/A ☐

8) SAMPLE HOLDING TIMES MET All holding times were met ☒

9) MINIMUM DETECTION LIMITS ON ALL FRACTIONS AT OR BELOW METHOD SPECIFICATIONS. (IF NOT CHECKED REFER TO INDIVIDUAL ANALYSIS REPORTS FOR THE ACTUAL MDL'S) ☒

10) ALL SAMPLES CONFORM TO EPA-CLP QA/QC CRITERIA UNLESS OTHERWISE DENOTED BELOW. ☒

ADDITIONAL COMMENTS:

[signature]
PROJECT MANAGER

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CLIENT: MK Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: AA15571, AA15574-AA15580, AA15646, AA15647, AA15676-AA15680

GC/HPLC ANALYSIS CONFORMANCE SUMMARY

1) GC/HPLC CALIBRATION - INITIAL CALIBRATION CURVE OR CALIBRATION CHECK STANDARD RUN PER METHOD GC-EPA CLP/HPLC - USATHAMA ☒

2) BLANK CONTAMINATION - COMPOUNDS LISTED

   a) GC No contaminates

   b) HPLC No contaminates

3) SPIKED BLANK WITHIN CONTROL LIMITS ☒

4) SAMPLE HOLDING TIMES MET All holding times met ☒

5) MINIMUM DETECTION LIMITS ON GC/HPLC METHODS AT OR BELOW METHOD SPECIFICATIONS ☒

6) ALL SAMPLES CONFORM TO EPA-CLP QA/QC CRITERIA UNLESS OTHERWISE DENOTED BELOW ☒

ADDITIONAL COMMENTS:

[signature]
PROJECT MANAGER

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CLIENT: MK Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: AA15572, AA15573-AA15583, AA15648, AA15649, AA15677-AA15681

METALS/INORGANIC ANALYSIS CONFORMANCE SUMMARY

1) INITIAL CALIBRATION CURVE OR CALIBRATION CHECK STANDARD RUN PER METHOD EPA-CLP ☒

2) BLANK CONTAMINATION - COMPOUNDS LISTED

   a) METALS No contaminates

   b) INORGANIC No contaminates

3) SPIKED BLANK (LABORATORY CONTROL SAMPLE) WITHIN CONTROL LIMITS ☒

4) SAMPLE HOLDING TIMES MET All holding times met ☒

5) MINIMUM DETECTION LIMITS ON METALS/INORGANICS AT OR BELOW METHOD SPECIFICATIONS EPA-CLP ☒

6) ALL SAMPLES CONFORM TO EPA-CLP QA/QC CRITERIA UNLESS OTHERWISE DENOTED BELOW ☒

ADDITIONAL COMMENTS: ______

[signature]
PROJECT MANAGER

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CLIENT: MK Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: AA15565-AA15570, AA15588-AA15597, AA15657-AA15645, AA15670-AA1582

RADIOCHEMICAL ANALYSIS CONFORMANCE SUMMARY

1) GAS PROPORTIONAL COUNTER

- a) BACKGROUND ACCEPTABLE ALPHA ☒
- b) BACKGROUND ACCEPTABLE BETA ☒
- c) PERFORMANCE CHECK ACCEPTABLE ALPHA ☒
- d) PERFORMANCE CHECK ACCEPTABLE BETA ☒

2) ALPHA SPECTROMETER

- a) BACKGROUND ACCEPTABLE ☒
- b) CALIBRATION (KeV/CHANNEL) VERIFICATION ☒

3) ALPHA SCINTILLATION COUNTER

- a) BACKGROUND ACCEPTABLE ☒
- b) PERFORMANCE CHECK ACCEPTABLE ☒

4) METHOD SPECIFIC PARAMETERS

- a) BLANK IN CONTROL ☒
- b) SPIKED BLANK IN CONTROL ☒
- c) RPD FOR DUPLICATES IN CONTROL ☐

ADDITIONAL COMMENTS: Duplicates for Th232 out of control. This is caused by the influence of Th230 due to the high levels present

[signature]
PROJECT MANAGER

3D

metaTRACE Inc. — SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY — Earth City, MO 63045 — (314) 298-8566

Lab Name: metaTRACE Contract: 100-03

Lab Code: meta Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix Spike - EPA Sample No.: ____________ Level:(low/med) low

AA15576 MS

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
Phenol	6700	ND	3300	49	26- 90
-Chlorophenol	6700	ND	4000	59	25-102
,4-Dichlorobenzene	3300	ND	2000	59	28-104
N-Nitroso-di-n-prop.(1)	3300	ND	2200	66	41-126
,2,4-Trichlorobenzene	3300	ND	2200	67	38-107
-Chloro-3-methylphenol	6700	ND	3400	51	26-103
Acenaphthene	3300	ND	2300	70	31-137
4-Nitrophenol	6700	ND	49	1*	11-114
,4-Dinitrotoluene	3300	ND	770	23*	28- 89
entachlorophenol	6700	ND	2600	39	17-109
Pyrene	3300	ND	2400	71	35-142

AA15577 MSD

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
enol	6700	2700	40	20	35	26- 90
-Chlorophenol	6700	2900	44	29	50	25-102
4-Dichlorobenzene	3300	1800	53	11	27	28-104
Nitroso-di-n-prop.(1)	3300	1800	54	20	38	41-126
,2,4-Trichlorobenzene	3300	2100	63	6	23	38-107
-Chloro-3-methylphenol	6700	1700	26	66*	33	26-103
enaphthene	3300	2100	64	9	19	31-137
-Nitrophenol	6700	100	1*	0	50	11-114
,4-Dinitrotoluene	3300	530	16*	36	47	28- 89
ntachlorophenol	6700	2400	36	8	47	17-109
rene	3300	2000	61	15	36	35-142

N-Nitroso-di-n-propylamine

column to be used to flag recovery and RPD values with an asterisk
lues outside of QC limits

: 1 ~~4~~ HS 8-4-88 out of 11 outside limits
Recovery: 4 out of 22 outside limits

TS: ____

Reviewed 8-4-88 HS

metaTRACE Inc. (314) 298-8566

3F
SOIL PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: META-TRACE Contract: 100-03

Code: META Case No.: ______ SAS No.: ______ SDG No.: ______

Matrix Spike - EPA Sample No.: ⊛ SD 3305-LC-0 Level: (low/med) LOW

AA15576 MS

COMPOUND	SPIKE ADDED (ug/Kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
Lindane	26.7	4.5	18	51	46-127
Heptachlor	26.7	0	23	86	35-130
Aldrin	26.7	0	21	79	34-132
Dieldrin	66.7	0	46	69	31-134
Endrin	66.7	0	42	63	42-139
4,4' DDT	66.7	0	49	73	23-134

AA15577 MSD

COMPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Lindane	26.7	18	57	0	50	46-127
Heptachlor	26.7	19	71	19	31	35-130
Aldrin	26.7	21	79	0	43	34-132
Dieldrin	66.7	49	73	6	38	31-134
Endrin	66.7	44	66	5	45	42-139
4,4' DDT	66.7	36	54	30	50	23-134

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 6 outside limits
Spike Recovery: 0 out of 12 outside limits

Reviewed 8-4-88 WB

COMMENTS: ⊛ Calculations on M.S. + M.S.D. were made by subtracting out the AR 1254 interfering peaks that were found in SD3305-LC-0.

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WSRAP PROJECT NO: 100-03
Nitroaromatics - Raffinate Sludge
MS/MSD RESULTS
Percent Recovery

SAMPLE #: AA15575
SITE ID: SD-3305-L.C.O.

Analyte	Matrix Spike	Matrix Spike Dup.
1,3,5-TNB	103	103
1,3-DNB	103	103
Nitrobenzene	103	103
2,4,6-TNT	103	103
2,6-DNT	91	84
2,4-DNT	103	107

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WSSRAP PROJECT NO: 100-03
Raffinate Sludge SPIKE
UNITS: MG/KG

SAMPLE # AA15581
SITE ID: SD-3305-L.C.I.

ANALYTE	SAMPLE CONC.	SPIKE CONC	SAMPLE +SPIKE	% RECOVERED
Aluminum	9928	---	NR	----
Antimony	87.3	100	199	112
Arsenic	647	2	742	*
Barium	134	400	567	108
Beryllium	15.8	10	27.2	114
Cadmium	2.7	10	12.5	98
Calcium	71910	---	NR	----
Chromium	1.0U	not spiked	1.0U	----
Cobalt	8.3	100	103	94.7
Copper	421	50	500	*
Iron	22890	---	NR	----
Lead	644	100	744	*
Lithium	6.6	50	56.9	101
Magnesium	12630	---	NR	----
Manganese	1837	100	2173	*
Mercury	0.81	not spiked	0.80	----
Molybdenum	739	100	854	*
Nickel	216	100	318	102
Potassium	644	---	NR	----
Selenium	61.4	1.0	----	*
Silver	1.0U	1.0U	1.0U	----
Sodium	12620	---	NR	----
Thallium	22.8	10	29	62
Vanadium	4227	100	4739	*
Zinc	213	100	301	88

* Spike value less than 1/4 of the sample value making data unuseable.

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WSSRAP PROJECT NO: 100-03
Raffinate Sludge SPIKE
UNITS: MG/KG

SAMPLE # 15581
SITE ID: SD-3305-L.C.I.

ANALTYE	RESULT #1	RESULT #2
Aluminum	9928	10260
Antimony	87.3	83
Arsenic	647	580
Barium	134	126
Beryllium	15.8	14.7
Cadmium	2.7	3.1
Calcium	71910	66390
Chromium	1.0U	1.0U
Cobalt	8.3	8.1
Copper	421	366
Iron	22890	21890
Lead	644	480
Lithium	6.6	7.3
Magnesium	1837	1738
Manganese	1837	1738
Mercury	0.81	0.48
Molybdenum	739	685
Nickel	216	161
Potassium	644	508
Selenium	61.4	69.0
Silver	1.0U	1.0U
Sodium	12610	11970
Thallium	22.8	16.6
Vanadium	4227	4033
Zinc	213	181

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WSSRAP PROJECT NO: 100-03
Raffinate Sludge Spike
UNITS: UG/G

SAMPLE # AA15582
SITE ID: SD-3305-L.C.I. MS

Analyte	Sample Conc.	Added Amt.	Spike	% Recovered
Nitrate	36,105	10,000	45,700	99
Nitrite	552	100	580	89
Chloride	62	100	125	77
Flouride	36	100	90	66
Sulfate	7,240	10,000	16,600	96

Raffinate Sludge Duplicate
UNITS: UG/G

SAMPLE # AA15581
SITE ID: SD-3305-L.C.I.

	Nitrite	Nitrate	Flouride	Chloride	Sulfate
RESULT #1	563	24,300	51	91	6,070
RESULT #2	552	36,105	36	62	7,240

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WELDON SPRING SITE REMEDIAL ACTION PROJECT

QUALITY CONTROL REPORT - GC/MS

RAFFINATE SLUDGE

Volatiles +
Semi-Volatiles

metaTRACE, Inc. 13715 Rider Trail North • Earth City, MO 63045 • (314) 298-8566

CLIENT: M K Ferguson
PROJECT #'s: 100-03
SAMPLE #'s: All samples analyzed by GC/MS (Raffinate Sludge)

GC/MS ANALYSIS CONFORMANCE SUMMARY

1) GC/MS TUNE SPECIFICATIONS ☒
   a) BFB PASSED
   b) DFTPP PASSED ☒

2) GC/MS TUNING FREQUENCY - PERFORMED PER METHOD EPA-CLP ☒

3) GC/MS CALIBRATION - INITIAL CALIBRATION CURVE OR CALIBRATION CHECK STANDARD RUN PER METHOD EPA-CLP ☒

4) GC/MS CALIBRATION REQUIREMENTS MET
   a) CALIBRATION CHECK COMPOUNDS ☒
   b) SYSTEM PERFORMANCE CHECK COMPOUNDS ☒

5) BLANK CONTAMINATION - COMPOUNDS LISTED
   a) VOA FRACTION See attachment #1
   b) B/N FRACTION See attachment #2
   c) A/E FRACTION No contaminates

6) SURROGATE RECOVERIES MEET CRITERIA (IF NOT MET, REFER TO INDIVIDUAL SURROGATE RECOVERY FORMS FOR ACTUAL RECOVERIES) ☒
   a) VOA FRACTION All surrogates within limits
   b) B/N FRACTION AA16653(1), AA16655(1), AA18926MS(1), AA18949MSD(1)
   c) A/E FRACTION See attachment #3

7) SPIKED BLANK WITHIN CONTROL LIMITS Not applicable ☐

8) SAMPLE HOLDING TIMES MET All holding times met - VOA See attachment #4 - BNA ☒

9) MINIMUM DETECTION LIMITS ON ALL FRACTIONS AT OR BELOW METHOD SPECIFICATIONS. (IF NOT CHECKED REFER TO INDIVIDUAL ANALYSIS REPORTS FOR THE ACTUAL MDL'S) ☒

10) ALL SAMPLES CONFORM TO EPA-CLP QA/QC CRITERIA UNLESS OTHERWISE DENOTED BELOW. ☒

ADDITIONAL COMMENTS: See attachment #5

[signature]
PROJECT MANAGER

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Mr. Gale Wright, Chief (3 copies)
Remedial Section/Superfund Branch
U. S. Environmental Protection Agency
Region VII
725 Minnesota Avenue
Kansas City, KS 66101

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Mr. Dave Bedan (3 copies)
State of Missouri
Department of Natural Resources
Post Office Box 176
Jefferson City, MO 65102

Argonne National Laboratory

Mr. John Peterson
Energy and Environmental Systems Division
Argonne National Laboratory
9700 South Cass Avenue, Building 362
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Oak Ridge Operations

B.J. Davis
U.S. Department of Energy
Environmental Protection Agency
Oak Ridge Operations Office
Post Office Box 2001
Oak Ridge, TN 37830

A.P. Avel, CE-53 (letter w/o encl)
U.S. Department of Energy
Environmental Protection Agency
Oak Ridge Operations Office
Post Office Box 2001
Oak Ridge, TN 37830

G.W. Benedict, CE-50 (letter w/o encl)
U.S. Department of Energy
Acting Assistant Manager for Construction and Engineering
Oak Ridge Operations Office
Post Office Box 2001
Oak Ridge, TN 37830

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Department of the Army

Mr. Clark Gunion
Civil Engineer/Project Manager
Superfund Branch
U.S. Army Corps of Engineers
601 East 12th Street
Kansas City, MO 64106

Commander
U.S. Army Toxic and Hazardous Materials Agency
ATTN: CETH-IR-R (Dr. Robert York)
Aberdeen Proving Ground, MD 21010-5401

Mr. Karl J. Daubel
Environmental Coordinator,
Weldon Spring Training Area
U.S. Department of the Army
Highway 94 South, Rural Route 2
Box 226
St. Charles, MO 63303

U.S. Geological Survey

Mr. Dan Bauer
U.S. Department of Interior
Geological Survey, Mail Stop 200
1400 Independence Road
Rolla, MO 65401

State and Local

Mr. Stanley Remington
2524 Westminster Drive
St. Charles, MO 63301

Honorable Gerald Ohlms (letter w/o encl)
St. Charles County Courthouse
118 North Second Street
St. Charles, MO 63301

Mr. Daryl Roberts, Chief
Bureau of Environmental Epidemiology
State of Missouri Department of Health
Post Office Box 570
Jefferson City, MO 65102

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Mr. William Dieffenbach, Supervisor
Environmental Services
State of Missouri
Department of Conservation
Post Office Box 180
Jefferson City, MO 65102-0180

U.S. Department of Energy

Ms. Gale Turi
U.S. Department of Energy
Division of Facility and Site Decommissioning
NE-23, Room D-424, HQ-GTN
19902 Germantown Road
Germantown, MD 20545

Oak Ridge National Laboratory

Mr. Park Owen
Remedial Action Program Information Center
Oak Ridge National Laboratory
Martin-Marietta Energy Systems, Inc.
Post Office Box X
Oak Ridge, TN 37831

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Mr. J.D. Berger
Oak Ridge Associated Universities
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Mr. Dan Brown
Francis Howell High School
7001 Highway 94 South
St. Charles, MO 63303

Administrative Record

WSSRAP Public Document Room
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