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REPORTS

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ON-SITE GROUND, SURFACE WATER AND SLUDGE LABORATORY ANALYTICAL DATA AND MODIFIED GROUND WATER REMEDIATION PLAN FOR MAVERIK TANK FARM KIRTLAND, NEW MEXICO FOR MAVERIK COUNTRY STORES, INC.

DAMES & MOORE

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EXECUTIVE SUMMARY

This report presents the results of additional on-site surface and subsurface investigations conducted in January 1990 to better define current site conditions in the southwest corner of the Maverik Tank Farm in Kirtland, New Mexico, and presents modifications to the ground water remediation plan. This investigation was conducted principally to evaluate the extent of natural biodegradation in the shallow contaminated zone on-site. Extensive on-site ground water quality analytical data had not been obtained since October 1988, and since off-site ground water quality data obtained from 1987 through 1989 had indicated continuous improvement of the ground water quality, additional on-site sampling at this time was appropriate. In addition, the sludge and underlying soils in the eastern sludge pit were characterized.

The results of this monitoring effort indicate the following:

- The ground water quality in the deep aquifer on-site at MW-11 meets New Mexico drinking water quality standards for the parameters tested. The ground water quality in the deeper aquifer has remained stable.

- The shallow ground water, although still significantly contaminated, appears to have improved slightly. The low sulfate and dissolved oxygen concentrations detected at monitor well MW-12, well N-OW and the north-south interceptor trench indicate that biodegradation is occurring in the subsurface of the southwest area of the tank farm.

- The lateral extent of subsurface contamination appears to depend in part on the lithology and permeability of the subsurface material. The petroleum hydrocarbon contaminants tend to be adsorbed by the lower permeable silt and clay stringers encountered in the shallow aquifer.

- The results of the laboratory analytical tests on the sludge and associated underlying contaminated soils at the eastern sludge pit verify that neither the sludge nor soils are hazardous.

In addition, the modified ground water remediation plan which has been developed will be more effective than an interceptor trench in maintaining hydraulic control in the contaminated area in the southwestern part of the tank farm (the remediation zone). The remediation zone will be physically and chemically isolated via a shallow (approximately 20-feet deep) slurry wall. A shallow ground water pumping system in conjunction with enhanced biodegradation through the surface application of the pumped ground water (via sprinkling), and air sparging of the ground water (via wells) will aid in biodegradation as well as in volatilization of the volatile organic contaminants within the isolated remediation zone.

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LABORATORY ANALYTICAL DATA AND
MODIFIED GROUND WATER REMEDIATION PLAN
FOR MAVERIK TANK FARM
KIRTLAND, NEW MEXICO
FOR MAVERIK COUNTRY STORES, INC.

INTRODUCTION

This report summarizes the results of on-site ground and surface water and sludge and soil investigations conducted in the southwest corner of the tank farm in January 1990. The modified subsurface remediation plan is also included. A general site vicinity map and location map which show the area where remediation work and on-site sampling were conducted are included on Plates 1 and 2, respectively. A chart showing the key components of the remediation plan is presented on Plate 3.

Ground water quality analytical data obtained since 1987 from the previous baseline sampling Rounds 1, 2 and 3 for monitor wells MW-11 and MW-12 are also included in this report for comparative purposes. Ground water and surface water quality and field borehole data for wells E-OW and N-OW, the north-south interceptor trench, and boreholes 1 and 2, respectively are also included.

PURPOSE AND SCOPE

This work was conducted for the purpose of defining current site conditions in the southwest corner of the Maverik Tank Farm in order to refine the ground water remediation plan, and to characterize the sludge and underlying soils in the eastern sludge pit.

The scope of work conducted for this study included completion of the following tasks:

- Water quality sampling and laboratory analysis of waters from MW-11, MW-12, E-OW, N-OW and the north-south interceptor trench.
- Subsurface soil profiling in two hand augered boreholes located along the western and eastern boundaries of the southwestern corner of the tank farm
- Sampling and laboratory analysis of eastern sludge pit sludge and underlying soils for purposes of characterization.
- Revision of the ground water remediation plan based on the data presented herein and based on the biodegration feasibility study results (Dames & Moore, February 1990).
- The completion of this written report for review and consideration by the State of New Mexico Oil Conservation District.

ON-SITE WATER QUALITY DATA

The results of the water quality investigations conducted in January 1990 at Maverik's tank farm in Kirtland, New Mexico were valuable in defining current on-site conditions. The apparent biodegradation that has occurred in the shallow aquifer since November 1987, the lateral variation of the on-site subsurface contamination and the surface water quality in the north-south interceptor trench have been defined for the purpose of refining a ground water remediation plan as presented herein.

MONITOR WELLS AND BOREHOLES

Ground water quality data were obtained at monitor wells MW-11 and MW-12 and wells E-OW and N-OW, (the two wells that had been used as observation wells for the aquifer pumping test conducted in July 1989). The field and laboratory tests that were conducted on the water samples are listed in Table 1. The recent and historic field tests and laboratory analytical test results for sulfate are presented in Table 2, and the recent and historic laboratory results for detected organic constituents are listed in Table 3.

The results of the field and laboratory tests conducted at the four well sites and two boreholes indicate the following:

- The water quality in MW-11 (which is completed in the deeper gravel aquifer) does not indicate the presence of petroleum hydrocarbon contamination. Elevated concentrations of 1-2 dichloroethane (1-2 DCA) and benzene which were detected in February 1988 have not been detected in any of the other three sample rounds. The water quality in MW-11 meets drinking water quality standards for the State of New Mexico for all of the parameters tested. Only the sulfate concentration, at 598 milligrams per liter (mg/l), is elevated (as is typical for ground waters in this region), but is still below New Mexico's drinking water quality standard of 600 mg/l.

- The water quality in MW-12 (which is completed in the upper contaminated shallow silty sand aquifer) indicates that there is still significant petroleum hydrocarbon contamination in the shallow ground water at this site, but that the water quality appears to have improved as indicated by the decreased concentrations in the organic constituents detected. Specifically, in comparison to the Round 2, February 1988 sampling results (after the drop pipe was installed), concentrations for benzene have decreased from 24,000 ug/l to 2,400 ug/l, toluene from 20,000 ug/l to 1,100 ug/l, total xylenes from 10,000 ug/l to 640 ug/l and ethylbenzene from 1,500 ug/l to 120 ug/l. The concentrations for 1-2 DCA however, have fluctuated considerably over the 4 sampling rounds since 1987. This may be partially due to the fact that 1-2 DCA concentrations will vary, depending on the rate and direction of ground water flow from the contaminant source area. Because 1-2 DCA has a very low organic carbon partition coefficient and is highly soluble in water, it is typically found in the dissolved phase and is not adsorbed by the surrounding soils and sediments. The concentration of 1-2 DCA could therefore fluctuate with corresponding changes in ground water flow rates and directions. The recent concentration of 1-2 DCA measured 800 ug/l as compared to 450 ug/l in Round 1, 2,400 ug/l in Round 2 and <200 ug/l in Round 3.

  Of significance are the low concentrations of sulfate and dissolved oxygen detected in MW-12. As discussed in detail in the referenced Dames & Moore report (June 1988), the consistently low sulfate concentrations of 16, 9 and 30 mg/l indicate that reduction-oxidation (redox) processes from bacterial microorganisms (such as sulfate reduction that occurs in the latter phase of the redox hierarchy) that oxidize organic matter and reduce inorganic compounds in the ground water are occurring in the shallow ground water in the vicinity of MW-12. The main source of energy for the bacteria is the oxidation of organic matter. The equation that defines such sulfate reduction is:

$$CH_2O + 1/2\ SO_4^{2-} = 1/2\ HS^- + HCO_3^- + 1/2\ H^+.$$

- Comparison of the water quality in wells E-OW and N-OW indicates that the quality of the ground water at these two sites is significantly different, although both wells are completed in the upper shallow aquifer and are located only 12.2 feet from each other (Plate 2). The major differences in the water quality in wells E-OW and N-OW are the BTEX and 1-2 DCA concentrations. These constituent concentrations measured 20 versus 19,000 ug/l, <0.5 versus 8,400 ug/l, 7.2 versus 1,300 ug/l, 4.1 versus 5,900 ug/l and 6.5 versus 1,000 ug/l, for wells E-OW and N-OW, respectively. In addition, the sulfate concentration varied significantly, from only 68 ppm in well N-OW as compared to 455 ppm in well E-OW.

  The signficant variation in the water quality at these two sites may be due to the fact that well E-OW is located beyond the southeast boundary of the on-site contaminant plume and that lower permeable silt and clay stringers are encountered in well N-OW (as reflected by the low yields and recovery from well N-OW during water sample collection and well purging). Petroleum hydrocarbon contaminants would tend to be retained in these clay-silt zones and in the adjacent ground water. The low sulfate concentration in well N-OW as compared to well E-OW also indicates that biodegradation similar to that found at MW-12 may be occurring in the vicinity of well N-OW.

- Two boreholes (BH-1 and BH-2) were hand augered to depths of 8.5 and 8 feet, respectively. They were located along the eastern and western perimeters of the southwest corner of the tank farm (Plate 2). Although no ground water samples were taken, both boreholes intercepted the shallow water table. A photoionization (HNu) meter was used to take measurements of volatile organic constituents released from the soil samples above and at the water table (Appendix A, Table A-2). Petroleum hydrocarbon contamination was observed in both boreholes, with HNu readings ranging from 0 to 50 ppm within 1 and 2 feet of the ground surface, to 200 ppm at a depth of 5 feet. Ground water was encountered at depths of 6 feet and 5 feet in BH-1 and BH-2, respectively. Hydrocarbon odor was detected from all samples below 2 feet, and petroleum hydrocarbon sheens were observed on soil samples near the water table in both boreholes. Approximately 1/8 inch to 1/4 inch of free product was observed in the boreholes 18 hours after augering.

NORTH-SOUTH INTERCEPTOR TRENCH

The water quality sample obtained from the north-south interceptor trench (which reflects primarily shallow aquifer ground water inflow from a depth of 7 feet, from the north-northeast), is of similar quality but slightly worse than that found in MW-12. The water quality in the trench is probably representative of a composite ground water quality sample for the upper shallow aquifer in the contaminated area. The concentrations for BTEX measured 3,500 ug/l, 3,200 ug/l, 220 ug/l and 1,800 ug/l, respectively. The concentration of 1-2 DCA was below the detection limit of 250 ug/l. In addition, the sulfate concentration was low, 73 mg/l, similar to that measured in well N-OW. This low sulfate concentration is indicative that biodegradation processes are occurring.

LABORATORY ANALYTICAL TEST RESULTS: ON-SITE SLUDGE

Composite sludge and underlying soil samples were taken from two borehole locations on the western and eastern corners of the eastern sludge pit. Details of the sampling techniques and borehole logs are presented in Appendix A and Table A-1, respectively.

The sludge, which extends to a depth of 0.5 to 0.75 feet on the ground surface, is elevated in total petroleum hydrocarbons (13,300 mg/kg) and oil and grease (129,000 mg/kg). The sludge is not corrossive (pH = 7.2) or ignitable (>160°F). Only two metals, barium and lead, were detected in the leachate obtained from the EP toxicity test for total leachable metals. However, the concentrations were very low, at 0.10 mg/l and 0.18 mg/l, respectively, well below the minimum concentrations that define a material as hazardous (100 mg/l for barium and 5 mg/l for lead). Since the sludge is not a listed waste (e.g., not API separator sludge) and is not hazardous by characteristic, it can be disposed of as a non-hazardous solid waste.

Soil samples were also collected from below the sludge. Samples were collected and composited from depths of 0.5 feet to 5 feet, to the top of the water table. The soils consisted of brown and gray silty-clayey sand with some sludge mixed in. The laboratory analytical tests indicated that the contaminated soils underlying the sludge are also not hazardous by characteristic. Oil and grease measured 20,300 mg/kg, total petroleum hydrocarbon concentrations measured 2,560 mg/kg and barium, the only metal detected in the soil leachate, measured 1.6 mg/l. The soils are not corrosive (pH = 7.7) and the ignitability is greater than 160°F. The contaminated soils can therefore also be treated as a non-hazardous solid waste.

MODIFIED GROUND WATER REMEDIATION PLAN

In order to ensure better hydraulic control and physical isolation of the contaminated southwestern area of the tank farm (designated the remediation zone) a shallow (20-foot deep) slurry wall and dewatering wells will be utilized rather than an east-west interceptor trench. Water and nutrient application and air sparging will also be used to aid in soil and ground water remediation via bioremediation and volatilization.

This modified plan includes the following key changes from the plan outlined in Dames & Moore's November 1989 Status Report.

- Installation of a soil-bentonite slurry wall to prevent off-site migration of contaminants from the remediation zone, the upper shallow (12-foot deep) contaminated zone.
- Installation of several dewatering wells in the remediation zone to maintain a net hydraulic gradient into the site, to remove contaminated water that will be treated by the indigenous microbes in the soils, and to provide a source of water to enhance biodegradation of the soil contamination.
- Enhancement of biodegradation by the sprinkling of water in the remediation zone, by the batch application of nutrients, and by the sparging of air into the subsurface. Air sparging should also aid in volatilization of the volatile organic contaminants.

- Elimination of a subsurface free product recovery system and an air stripper.
- Backfilling of the existing north-south interceptor trench in order that the slurry wall can be extended to the western boundary.
- Remediation of the ground water via surface recharge and soil infiltration in the remediation zone only.
- Installation and monitoring of additional monitor well points inside as well as outside the remediation zone.

A slurry wall is an effective isolation technique to prevent future off-site migration of contamination and to minimize upgradient ground water from entering the remediation zone and becoming contaminated. Ground water withdrawals in conjunction with enhanced biodegradation will also serve to accelerate remediation of the site contained within the slurry wall.

The revised time schedule for this modified remediation plan is similar to the schedule for the previous plan and is included as Table B-1 in Appendix B. The remediation work is anticipated to begin immediately in April 1990, upon approval from the State Oil Conservation Division (OCD) with implementation by August 1990. Status reports will be issued to the OCD in 1990 and 1991. Active remediation is to be conducted through the summer of 1991. However, active remediation will not be terminated until such approval has been granted by the OCD.

CONCLUSIONS

The results of the January 1990 surface and subsurface investigations conducted at Maverik Country Stores Inc., Kirtland, New Mexico tank farm indicate that the following conditions currently exist on-site:

- The ground water quality in the deep aquifer is not contaminated from tank farm operations and meets New Mexico drinking water quality standards for the organic and inorganic constituents tested.

- The shallow ground water is contaminated with petroleum hydrocarbon products but appears to show some improvement in the water quality since monitoring began in November of 1987. Water quality data indicate that biodegradation processes are occurring and may be aiding in the reduction of benzene, toluene, ethylbenzene, xylene and 1-2 DCA, the petroleum hydrocarbon contaminants that have been detected.

- The lateral extent of subsurface contamination in the shallow aquifer varies and is dependent in part on the lithologic units encountered. Silt and clay stringers appear to restrict the lateral movement of the contaminants. The silt and clay stringers reduce the permeability in the shallow aquifer and thus the rate of ground water flow and contaminant migration.

- The laboratory analytical test results for the sludge and underlying soils at the eastern sludge pit verify that they are non-hazardous and can be disposed of as such.

- A modified ground water remediation plan has been developed that will be more effective than an interceptor trench in maintaining hydraulic control in a zone of low permeability and limited lateral and vertical contamination. The plan is based on physical and hydraulic isolation of the shallow contaminated area in the southwestern part of the tank farm (the remediation zone), via a slurry wall and a shallow ground water pumping system, in conjunction with enhanced biodegradation via the application (sprinkling) of ground water in the remediation zone, and air sparging of the ground water to aid in volatilization of the volatile organic contaminants within the isolated remediation zone.

REFERENCES

Dames & Moore, February 1988. Phase I Hydrogeologic Evaluation, Maverik Refinery and Tank Farm, Kirtland, New Mexico.

Dames & Moore, June 1988. Addendum to Phase I Hydrogeologic Evaluation, Maverik Refinery and Tank Farm, Kirtland, New Mexico.

Dames & Moore, June 1988. Phase II Subsurface Soil and Solid Waste Contaminant Evaluation For Maverik Refinery and Tank Farm, Kirtland, New Mexico.

Dames & Moore, September 14, 1988. Ground Water Remediation Plan for Maverik Country Stores, Inc., Kirtland, New Mexico Refinery Tank Farm.

Dames & Moore, January 1989. Water Quality Data Summary Report For Completion of The Hydrogeologic Evaluation, Maverik Refinery and Tank Farm, Kirtland, New Mexico For Maverik Country Stores, Inc.

Dames & Moore, July 1989. Status Report, Remediation Work, Aquifer Pump Test and Round 1 Long-Term Ground Water Quality Monitoring Data Results For Maverik Refinery and Tank Farm, Kirtland, New Mexico, For Maverik Country Stores, Inc.

Dames & Moore, February 1990. Status Report, Remediation Work and Round 3 Long-Term Ground Water Quality Monitoring Data Results For Maverik Refinery and Tank Farm, Kirtland, New Mexico, For Maverik Country Stores, Inc.

Dames & Moore, August 8, 1989. Amended Ground Water Remediation Plan.

EPA, October 1986. Superfund Public Health Evaluation Manual, EPA 540/1-86/060.

TABLE 1

FIELD AND LABORATORY WATER QUALITY PARAMETERS

Inorganics

Laboratory: Sulfate (Ion Chromatography)

Field Parameters

pH (Beckman No. 21 Digital pH Meter)

Specific Conductance (Amber Science, Inc. 605 Electric Conductivity Meter)

Dissolved Oxygen (YSI 5700 Series Oxygen Meter)

Halogenated Volatile Organics

EPA Method 601

1,2-Dichloroethane

Aromatic Volatile Organics

EPA Method 602

- Benzene
- Toluene
- Ethylbenzene
- Total xylenes

Note: For detail of methodology see ENSECO's (RMAL) attached report (Appendix A)

TABLE 2

1987-1990 FIELD TEST AND LABORATORY ANALYTICAL TEST RESULTS
FOR SULFATE (1)

Sample Site Designation	pH (field)	Conductivity (field)	Temperature (°C, field)	Dissolved Oxygen (field, ppm)	Sulfate (ppm)	Water Level (from ground surface, feet)
NM MCL(2)	6 - 9	NA	-	-	600	-
EPA MCL(3)	6.5 - 8.5	NA	-	-	250	-
MW-11	7.85; 7.80; 6.94; 7.29	1,050; 2,050; 2,600; 1,200	14.5; 15.3; 19.4; 12.8	- - - 1.7	592; 615*; - 598	3.71; 5.4; 4.62; 5.8
MW-12	6.74; 7.25; 6.93; 6.97	1,510; 2,010; 2,100; 1,600	17.0; 12.2; 23.0; 13.0	- - - 0.5	16; 9; - 30	3.47; 4.96; 4.57; 4.8
E-OW	- - - 7.35	- - - 1,200	- - - 9.5	- - - 1.8	- - - 455	- - - 4.2
N-OW	- - - 7.45	- - - 1,800	- - - 6.8	- - - 2.4	- - - 68	- - - 4.3
N-S Trench	- - - 7.49	- - - 1,000	- - - 2.0	- - - -	- - - 73	- - - -

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(1) Data from Round 1 (November 10-27, 1987), Round 2 (February 22-24, 1988), Round 3 (October 12-13, 1988) and Recent (January 16-17, 1990) are presented in columns 1, 2, 3 and 4, respectively.

(2) NM MCL defines the State of New Mexico maximum contaminant level for a constitiuent based on drinking water quality standards.

(3) EPA MCL or proposed MCLG (May 22, 1989) defines the Environmental Protection Agency maximum contaminant level for a constituent, based on drinking water quality standards.

* Exceeds New Mexico MCL For Drinking Water
\- Indicates not analyzed
NA Indicates not applicable

TABLE 3

1987 - 1990 LABORATORY RESULTS FOR DETECTED ORGANIC CONSTITUENTS(1)

Sample Site Designation (1) NM MCL (2) EPA MCL (3)	1-2 DCA (ug/l) 10 5	Total Xylenes (ug/l) 620 10,000	Ethylbenzene (ug/l 750 700	Benzene (ug/l) 10 5	Toluene (ug/l) 750 2,000
MW-11	1.0; 4.6; <1.0; <1.0	<0.5; <0.5; <0.5; <1.0	<0.5(4)	0.81; 3.8; <0.5; <0.5	<0.5
MW-12	450*; (5,6) 2,400*; <200; 800*	3,000*; 10,000*; 470; 640*	1,300*; 1,500*; 180; 120	19,000*; 24,000*; 6,200*; 2,400*	2,000*; 20,000*; 1,000*; 1,100*
E-OW	- - - 6.5	- - - 4.1	- - - 7.2	- - - 20*	- - - <0.5
N-OW	- - - <1,000	- - - 5,900*	- - - 1,300*	- - - 19,000*	- - - 8,400*
N-S Trench	- - - <250	- - - 1,800*	- - - 220	- - - 3,500*	- - - 3,200*

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(1) Data from Round 1 (November 10-27, 1987), Round 2 (February 22-24, 1988), Round 3 (October 12-13, 1988) and Recent (January 16-17, 1990) are presented in columns 1, 2, 3 and 4, respectively.

(2) NM MCL defines the State of New Mexico maximum contaminant level for a constitiuent based on drinking water quality standards.

(3) EPA MCL or proposed MCLG (May 22, 1989) defines the Environmental Protection Agency maximum contaminant level for a constituent, based on drinking water quality standards.

(4) The values indicated as less than (<) are detection limits only, and not actual concentrations. Only one value indicates that all values were the same.

(5) Sample site MW-12 in Round 1 only was contaminated with product and not representative of the water itself.

(6) Volatile organics for MW-12 were analyzed using GC/MS methods in Rounds 1 and 2. All other samples were analyzed using GC methods.

*	Exceeds New Mexico MCL For Drinking Water
-	Indicates not analyzed
NA	Indicates not applicable

TABLE 4

LABORTORY ANALYTICAL TEST RESULTS OF DETECTED CONSTITUENTS AND RCRA EP TOXICITY TEST RESULTS OF THE SLUDGE FROM THE EASTERN SLUDGE PIT (1)

Sample Site(2) Designation	Barium(3) (mg/l)	Lead(3) (mg/l)	Ignitability (°F)	Oil and Grease (mg/kg)	pH (ph Units)	Total Petroleum Hydrocarbons (mg/kg)
SL1	0.10	0.18	>160	129,000	7.2	13,300
S01	1.6	<0.05	>160	20,300	7.7	2,560

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(1) Sampled January 18, 1990; Composite samples taken from 1 to 5 feet in depth.

(2) Designated as MESP-SL1 and MESP-S01 in the laboratory reports. SL1 sample composited sludge from 0.0 to 0.5 and 0.75 feet in depth. S01 sample composited underlying soils from 0.5 to 5 feet in depth.

(3) EP Toxicity Leachate

<0.05 indicates below detection limit

TABLE 5

CHARACTERISTICS OF ORGANIC COMPOUNDS DETECTED

	Molecular Weight	Density (gm/cm^3)	Water Solubility (mg/l)	Vapor Pressure (mm Hg)	K_{oc} (1) (ml/g)	K_{ow} (2)
Volatile Organic Parameters						
Benzene	78	0.88	1,750	95	83	132
Ethylbenzene	106	0.87	152	7	1,100	1,412
Toluene	92	0.87	535	28	300	537
Xylene, m	106	0.86	130	10	871	1,820
Xylene, p	106	0.86	192	10	676	1,412
Xylene, o	106	0.88	175	10	426	891
1,2-Dichloroethane	99	1.26	8,520	64	14	30

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(1) Organic carbon partition coefficient, a measure of the tendency for organics to be adsorbed by soil and sediment.

(2) Octanol-water partition coefficient, a measure of the tendency of a chemical at equilibrium to distribute between an organic phase (octanol) and water.

Source: Superfund Public Health Evaluation Manual, EPA 540/1-86/060, October 1986; Land Treatment of Appendix VIII Constituents in Petroleum Industry Wastes, American Petroleum Institute Publication 4379, May 1984.

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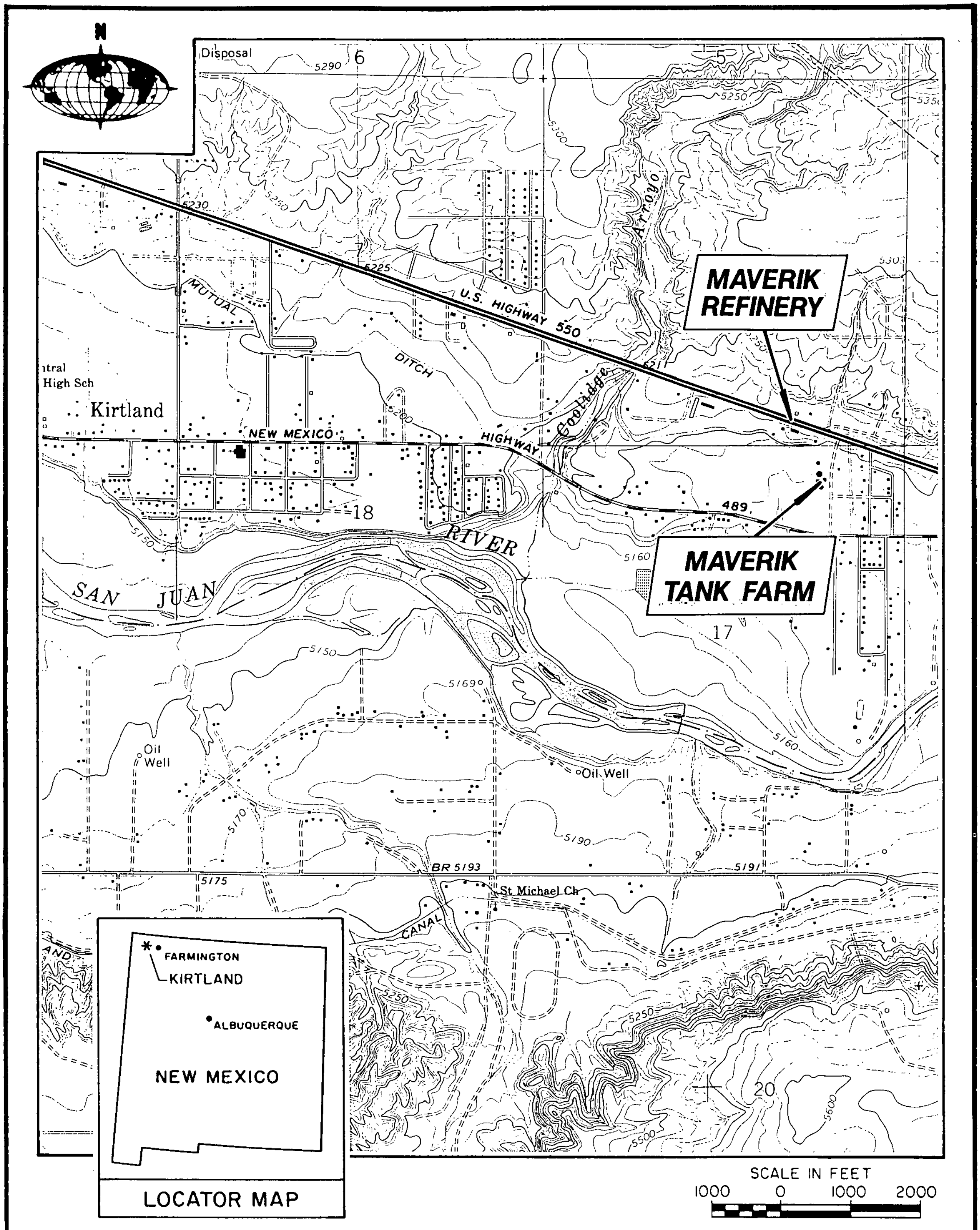

VICINITY MAP

REFERENCE
U.S.G.S. QUADRANGLE ENTITLED
"KIRTLAND, NEW MEXICO" – 1966,
PHOTOREVISED 1979.

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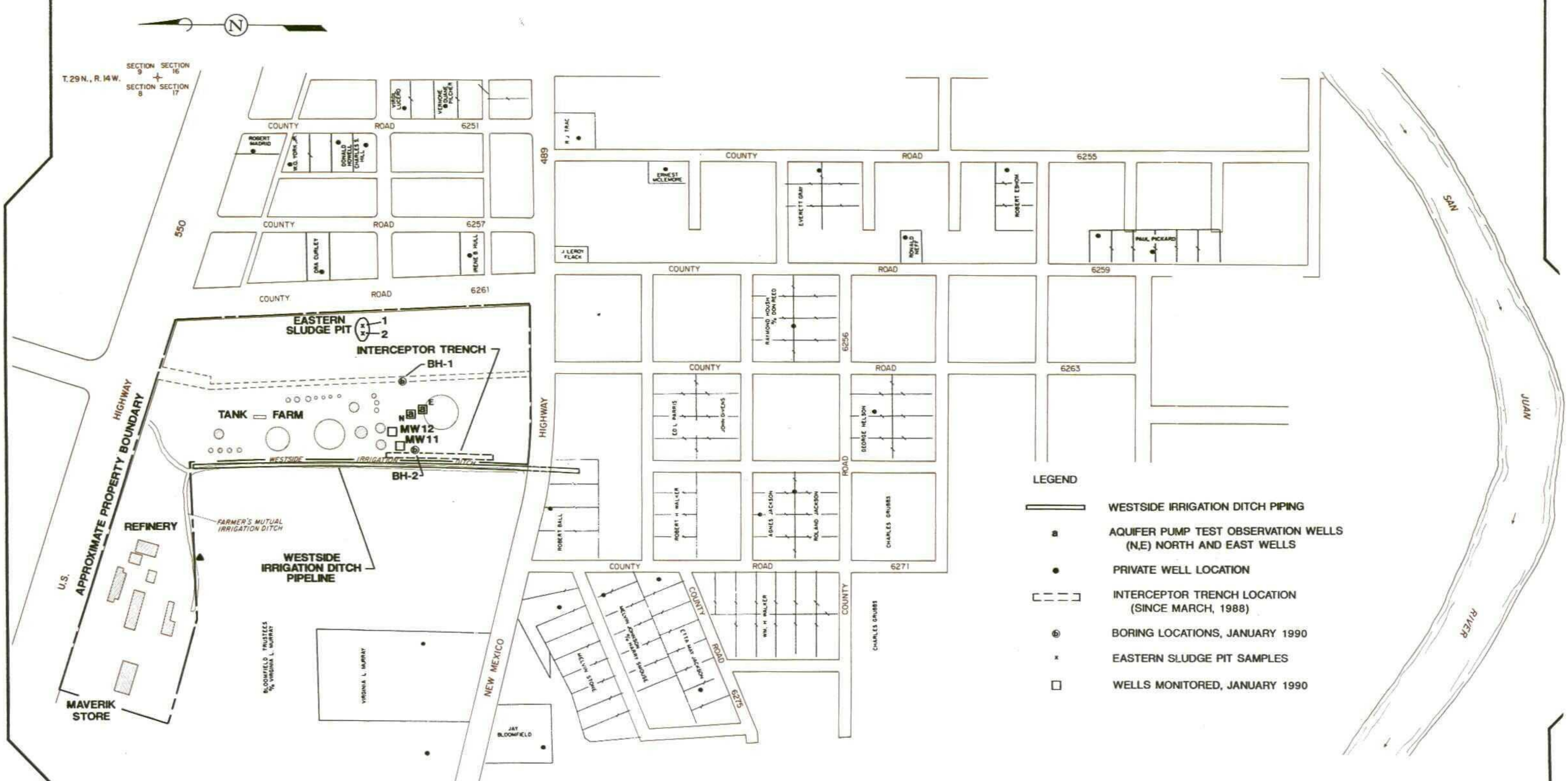
PLATE 1

BY ____ DATE ____
PLATE ____ OF ____

BY ____ DATE 10-21-82
CHECKED BY ____ DATE ____



ON-SITE SAMPLE LOCATION MAP

MAVERIK REFINERY AND TANK FARM
KIRTLAND, NEW MEXICO
(JANUARY 1990)

REFERENCE
ADAPTED FROM PRINTS ENTITLED "PROPERTY IDENTIFICATION MAP OF SAN JUAN COUNTY, NEW MEXICO" CODE NUMBER 2-083-171, SHEET NUMBERS D-3-17-1 AND D-3-17-4 (SECTION 17, TOWNSHIP 29 NORTH, RANGE 14 WEST) - PREPARED BY SAN JUAN COUNTY - UNDATED.

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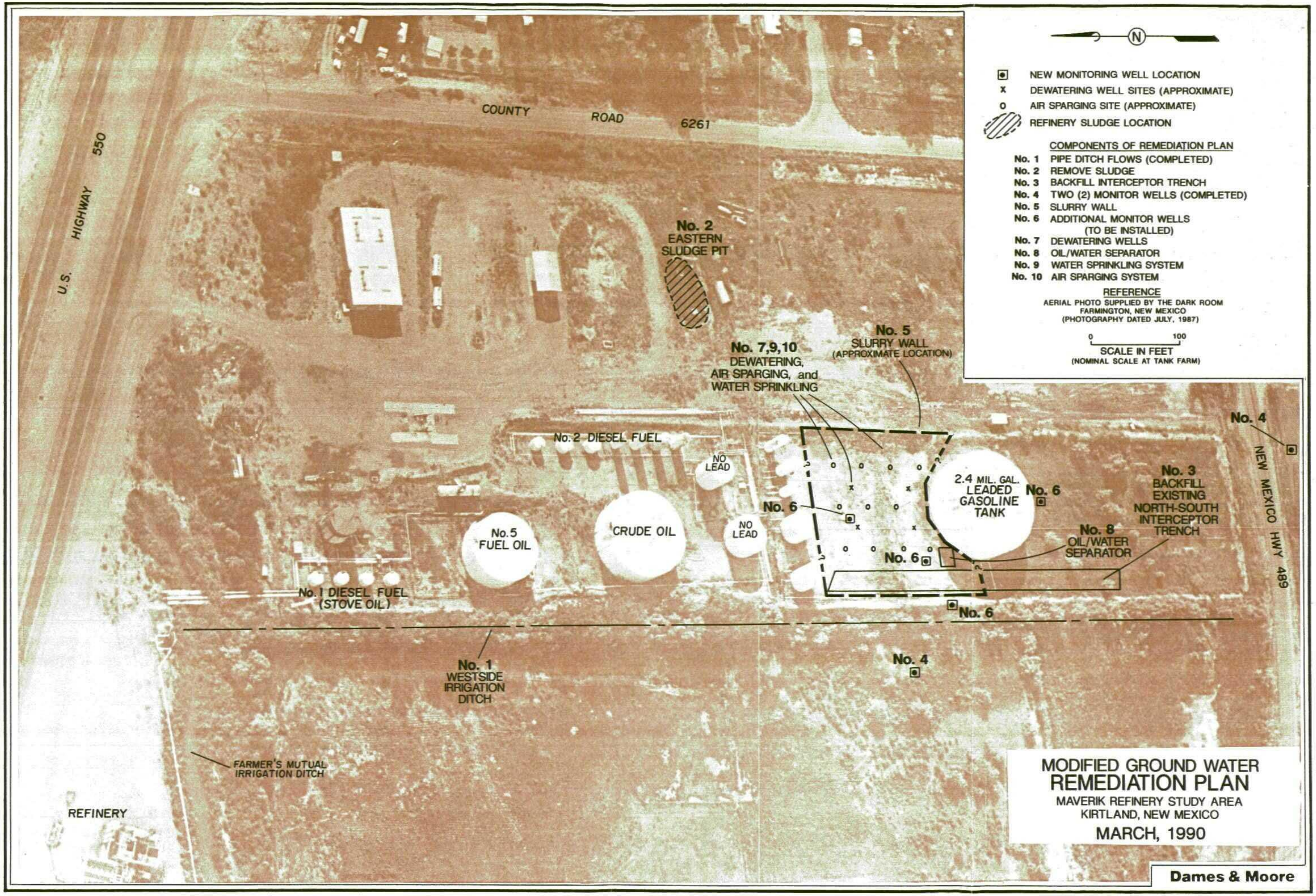


▣	NEW MONITORING WELL LOCATION
x	DEWATERING WELL SITES (APPROXIMATE)
o	AIR SPARGING SITE (APPROXIMATE)
▨	REFINERY SLUDGE LOCATION

COMPONENTS OF REMEDIATION PLAN

No. 1	PIPE DITCH FLOWS (COMPLETED)
No. 2	REMOVE SLUDGE
No. 3	BACKFILL INTERCEPTOR TRENCH
No. 4	TWO (2) MONITOR WELLS (COMPLETED)
No. 5	SLURRY WALL
No. 6	ADDITIONAL MONITOR WELLS (TO BE INSTALLED)
No. 7	DEWATERING WELLS
No. 8	OIL/WATER SEPARATOR
No. 9	WATER SPRINKLING SYSTEM
No. 10	AIR SPARGING SYSTEM

REFERENCE

AERIAL PHOTO SUPPLIED BY THE DARK ROOM
FARMINGTON, NEW MEXICO
(PHOTOGRAPHY DATED JULY, 1987)

MODIFIED GROUND WATER
REMEDIATION PLAN

MAVERIK REFINERY STUDY AREA
KIRTLAND, NEW MEXICO

MARCH, 1990

Dames & Moore

PLATE 3

FILE 14819-005 BY DATE CHECKED BY DATE

46612 (11-82)

APPENDIX A

LABORATORY AND FIELD ANALYTICAL RESULTS OF ON-SITE SLUDGE, GROUND AND SURFACE WATER QUALITY SAMPLES OBTAINED IN JANUARY 1990

APPENDIX A

LABORATORY AND FIELD ANALYTICAL RESULTS OF ON-SITE SLUDGE, GROUND AND SURFACE WATER QUALITY SAMPLES OBTAINED IN JANUARY 1990

WATER QUALITY SAMPLING

On-site monitor wells MW-11 and MW-12, the two pump test observation wells E-OW and N-OW and the north-south interceptor trench were sampled on-site to aid in the refinement of the remediation plan. The wells and trench were purged with a teflon bailer and a peristaltic pump, as in all previous sampling rounds. Ground water samples were then collected, preserved and analyzed in accordance with EPA guidance. All samples were analyzed by Rocky Mountain Analytical Laboratory (RMAL) a division of ENSECO, Incorporated, a well known multi-state certified and EPA Contract Laboratory Program laboratory in Arvada, Colorado. RMAL has conducted the laboratory analysis on all of the prior samples taken at the project site. Samples from the wells were collected by lowering a teflon bailer (equipped with an end ball valve) to the bottom of the wells. A peristaltic pump with teflon tubing was also utilized in sampling the wells and trench. Samples from the wells were collected after 3 to 5 casing volumes of water had been removed, and a grab sample was taken from the base of the trench.

The drop pipe that had been installed in monitor well MW-12 prior to Round 2 sampling was also used during this sampling round. The drop pipe was installed (as described in our February 1988 report) after a free oil phase had been detected in MW-12 during Round 1 sampling. Such a phase was present only in monitor well MW-12 during the long-term Round 1 sampling.

Sample bottles, with appropriate preservatives as detailed in RMAL's report, were shipped directly to the site by the laboratory. All samples were iced immediately after collection and shipped to RMAL on the day of collection via overnight courier. Chain-of-custody documentation was maintained.

SLUDGE SAMPLING

Sludge and the underlying contaminated soil samples were taken at two sites from the eastern sludge pit. The sludge and soil samples were composites of the sludge and soil from both sample sites. The soil samples were taken from composite samples from 0.5 to 5 feet in depth. Logs of the materials encountered at the two sample sites are shown in Table A-1.

Sludge and soil samples were obtained from the central part of the pit, on the western and eastern ends. Samples were obtained using a hand auger, composited in a stainless steel mixing bowl and placed in the soil sample jars obtained from RMAL. In addition, samples of both the sludge and soil were sent to Conservation Services, Inc. (CSI), in Denver, Colorado for their own waste characterization as required by EPA. CSI is an EPA approved waste disposal facility that will likely be transporting and receiving the sludge and underlying contaminated soil from the eastern sludge pit.

LABORATORY AND FIELD ANALYSIS

SOIL AND SLUDGE SAMPLES

EP toxicity leachate tests for the eight RCRA metals and EPA hazardous waste characterization (including cyanide reactivity, ignitability, pH for corrosivity evaluation and sulfide reactivity), oil and grease and total petroleum hydrocarbons (TPH) were conducted on the soil and sludge samples. Results are summarized in Table 3 in the text. The laboratory report from RMAL is included herein. Except for the concentration of sodium in the spiked QA/QC sample, all other parameters were within RMAL's quality assurance/quality control (QA/QC) limits for accuracy and precision.

In addition, two boreholes (BH-1 and BH-2, Plate 2) were hand augered to depths of 8.5 feet and 8 feet, respectively. The boreholes were augered along the western and eastern perimeters of the contaminated zone in the southwest corner of the tank farm to better define current conditions at these sites. Detailed field lithologic logs and HNu readings are presented in Table A-2.

WATER SAMPLES

RMAL conducted the laboratory analysis on the water quality samples for this and for all previous rounds. Analytical findings for the major inorganic and organic parameters for this round and previous sampling rounds for wells MW-11 and MW-12 are included in Table A-3. The data are presented in columns for comparative purposes. The detailed analytical report from RMAL is also included in this appendix.

The water quality analyses include a selected list of analytes based on those detected in previous sample rounds. RMAL conducted analyses for 1 halogenated volatile organic (1-2 DCA), 4 aromatic volatile organics (BTEX) and 1 inorganic parameter (sulfate). The specific parameters are listed in Table 1 along with the analytical methods used. GC methods 601 and 602 were used to detect volatile organics. RMAL mistakenly indicated that methods 8010 and 8020 were used. These refer to the comparable EPA analytical methodology for solids, not liquids.

Field analytical tests were conducted for the ground and surface water samples for pH, conductivity, temperature and dissolved oxygen concentration. These tests were performed by Dames & Moore at the time the water quality samples were collected. A Beckman No. 21 digital pH meter, an Amber Science, Inc. No. 605 electric conductivity meter, a glass thermometer and a YSI 5700 Series Oxygen Probe were used. The above meters were calibrated based on standards of pH 4.0 and 10.0 buffer solutions, potassium chloride solutions of 718 umhos/cm and 6,680 umhos/cm, and as per the YSI probe calibration protocol, via the saturated water technique, respectively.

GC methods 601 and 602 were used to analyze for the volatile organic compounds. Details of the test are included in RMAL's report, "Section III, Analytical Results." Laboratory QA/QC limits were within RMAL's control limits for accuracy and precision.

TABLE A-1

DETAILS ON SLUDGE AND SOIL SAMPLES ENCOUNTERED IN THE EASTERN SLUDGE PIT

Sample Site Designation/Location	Depth (feet)	Material/Lithologic Description
Borehole #1 (27.5 feet from the western berm, 17 feet from the southern berm)	0 - 0.5	Sludge(1)
	0.5 - 1	Brown sand(2)
	1 - 2	2-inch diameter gravel with interbedded gray sand(2)
	2 - 5	Gray sand, moist(2)
	5	Water table
Borehole #2 (17.5 feet from the eastern berm, 15 feet from the southern berm)	0 - 0.75	Sludge(1)
	0.75 - 1.5	Gray sand with sludge(2)
	1.5 - 5	Gray sand(2)
	5	Water table

---

(1) Composited for sludge sample SL1
(2) Composited for soil sample SO1

TABLE A-2

BOREHOLE LOGS

Borehole Designation(1)	Depth Below Ground Surface (in feet)	Lithologic Description	HNu Readings (ppm)	Comments (2)
BH-1	0 - 0.75	light brown sand	0	-
	0.75 - 1	light brown sand with gravel	0	-
	1 - 1.5	brown moist sand	0	-
	1.5 - 2	light gray to black sand	30	hydrocarbon odor
	2 - 2.5	light gray sand	150	hydrocarbon odor
	2.5 - 5	silty, clayey light gray sand	150	hydrocarbon odor
	5 - 5.5	silty, clayey light gray sand	200	strong hydrocarbon od
	6 - 7	silty sand	150	water at 6 feet sheen on samples strong hydrocarbon od
	7 - 8.5	silty sand	150	sheen on samples strong hydrocarbon od
BH-2	0 - 0.5	consolidated sand	0	-
	1	brown sand	50	-
	1 - 2.25	light gray sand with gravel	100	hydrocarbon odor
	2.25 - 3.5	black sand	200	hydrocarbon odor
	3.5 - 5	light gray silty sand	200	hydrocarbon odor
	5 - 8	light gray silty sand	100	water at 5 feet sheen on samples hydrocarbon odor

---

(1) See Plate 2

\- Indicates no comments

(2) NOTE: Due to borehole caving at and below the water table, samples taken below the water table are approximate.

TABLE A-3

MAVERIK-KIRTLAND WATER QUALITY

SAMPLE IDENTIFICATION	N-S TRENCH
DATE SAMPLED	1-17-90
INORGANIC PARAMETERS (mg/L except as noted)	
Calcium (Ca)	*
Magnesium (Mg)	*
Sodium (Na)	*
Potassium (K)	*
Iron (Fe)	*
Manganese (Mn)	*
Ammonia (as N)	*
Chloride (Cl)	*
Sulfate (SO4)	73.
Fluoride (F)	*
Nitrate and Nitrite (as N)	*
Total Alkalinity	*
Bicarbonate Alkalinity	*
Carbonate Alkalinity	*
Bicarbonate (HCO3)	*
Carbonate (CO3)	*
FIELD AND LABORATORY MEASUREMENTS	
Temperature (Degrees C)	2.0
Field pH	7.49
Lab pH (units)	*
Field Conductivity (umhos/cm	1000.0
Lab Conductivity (umhos/cm)	*
Total Dissolved Solids(mg/l)	*
VOLATILE ORGANICS DETECTED (ug/L)	
Benzene	3500.00
Ethylbenzene	220.00
Toluene	3200.00
m-Xylene	*
o,p-Xylene	*
Total Xylene	1800.00
1,2 Dichloroethane	< 250.00
TOTAL ORGANIC LEAD (mg/L)	
Total Organic Lead	*

<: Parameter value is less than given detection limits
*: Parameter was not analyzed.

TABLE A-3 (Continued-2)

MAVERIK-KIRTLAND WATER QUALITY

SAMPLE IDENTIFICATION	N-OW
DATE SAMPLED	1-17-90
INORGANIC PARAMETERS (mg/L except as noted)	
Calcium (Ca)	*
Magnesium (Mg)	*
Sodium (Na)	*
Potassium (K)	*
Iron (Fe)	*
Manganese (Mn)	*
Ammonia (as N)	*
Chloride (Cl)	*
Sulfate (SO4)	68.
Fluoride (F)	*
Nitrate and Nitrite (as N)	*
Total Alkalinity	*
Bicarbonate Alkalinity	*
Carbonate Alkalinity	*
Bicarbonate (HCO3)	*
Carbonate (CO3)	*
FIELD AND LABORATORY MEASUREMENTS	
Temperature (Degrees C)	6.8
Field pH	7.45
Lab pH (units)	*
Field Conductivity (umhos/cm	1800.0
Lab Conductivity (umhos/cm)	*
Total Dissolved Solids(mg/l)	*
VOLATILE ORGANICS DETECTED (ug/L)	
Benzene	19000.00
Ethylbenzene	1300.00
Toluene	8400.00
m-Xylene	*
o,p-Xylene	*
Total Xylene	5900.00
1,2 Dichloroethane	< 1000.00
TOTAL ORGANIC LEAD (mg/L)	
Total Organic Lead	*

<: Parameter value is less than given detection limits

*: Parameter was not analyzed.

TABLE A-3 (Continued-3)

MAVERIK-KIRTLAND WATER QUALITY

SAMPLE IDENTIFICATION	E-OW
DATE SAMPLED	1-17-90
INORGANIC PARAMETERS (mg/L except as noted)	
Calcium (Ca)	*
Magnesium (Mg)	*
Sodium (Na)	*
Potassium (K)	*
Iron (Fe)	*
Manganese (Mn)	*
Ammonia (as N)	*
Chloride (Cl)	*
Sulfate (SO4)	455.
Fluoride (F)	*
Nitrate and Nitrite (as N)	*
Total Alkalinity	*
Bicarbonate Alkalinity	*
Carbonate Alkalinity	*
Bicarbonate (HCO3)	*
Carbonate (CO3)	*
FIELD AND LABORATORY MEASUREMENTS	
Temperature (Degrees C)	9.5
Field pH	7.35
Lab pH (units)	*
Field Conductivity (umhos/cm	1200.0
Lab Conductivity (umhos/cm)	*
Total Dissolved Solids(mg/l)	*
VOLATILE ORGANICS DETECTED (ug/L)	
Benzene	20.00
Ethylbenzene	7.20
Toluene	< .50
m-Xylene	*
o,p-Xylene	*
Total Xylene	4.10
1,2 Dichloroethane	6.50
TOTAL ORGANIC LEAD (mg/L)	
Total Organic Lead	*

<: Parameter value is less than given detection limits
*: Parameter was not analyzed.

TABLE A-3 (Continued-4)

MAVERIK-KIRTLAND WATER QUALITY

SAMPLE IDENTIFICATION	MW-11	MW-11	MW-11	MW-11
DATE SAMPLED	11-11-87	2-23-88	10-12-88	1-16-90
INORGANIC PARAMETERS (mg/L except as noted)				
Calcium (Ca)	138.0	186.0	*	*
Magnesium (Mg)	21.0	28.0	*	*
Sodium (Na)	234.0	263.0	*	*
Potassium (K)	< 5.0	< 5.0	*	*
Iron (Fe)	< .05	< .05	*	*
Manganese (Mn)	*	1.000	*	*
Ammonia (as N)	< .1	< .1	*	*
Chloride (Cl)	45.0	184.0	*	*
Sulfate (SO4)	592.	615.	*	598.
Fluoride (F)	.5	.5	*	*
Nitrate and Nitrite (as N)	< .1	< .1	*	*
Total Alkalinity	267.0	242.0	*	*
Bicarbonate Alkalinity	267.0	242.0	*	*
Carbonate Alkalinity	< 5.0	*	*	*
Bicarbonate (HCO3)	325.5	295.1	*	*
Carbonate (CO3)	< 3.0	*	*	*
FIELD AND LABORATORY MEASUREMENTS				
Temperature (Degrees C)	14.5	*	19.4	12.8
Field pH	7.85	7.80	6.94	7.29
Lab pH (units)	7.80	7.62	*	*
Field Conductivity (umhos/cm	1050.0	2050.0	2600.0	1200.0
Lab Conductivity (umhos/cm)	1720.0	2120.0	*	*
Total Dissolved Solids(mg/l)	1250.0	1470.0	*	*
VOLATILE ORGANICS DETECTED (ug/L)				
Benzene	.81	25.00	< .50	< .50
Ethylbenzene	< .50	< .50	< .50	< .50
Toluene	< .50	< .50	< .50	< .50
m-Xylene	< .50	< .50	*	*
o,p-Xylene	< .50	< .50	*	*
Total Xylene	*	*	< .50	< 1.00
1,2 Dichloroethane	1.00	4.60	< 1.00	< 1.00
SEMIVOLATILE ORGANICS DETECTED (ug/L)				
Naphthalene	*	*	< 10.00	*
m & p-Cresol(s)	*	*	< 10.00	*
TOTAL ORGANIC LEAD (mg/L)				
Total Organic Lead	.007	< .004	*	*

<: Parameter value is less than given detection limits
*: Parameter was not analyzed.

TABLE A-3 (Continued-5)

MAVERIK-KIRTLAND WATER QUALITY

SAMPLE IDENTIFICATION	MW-12	MW-12	MW-12	MW-12
DATE SAMPLED	11-27-87	2-23-88	10-12-88	1-17-90
INORGANIC PARAMETERS (mg/L except as noted)				
Calcium (Ca)	148.0	133.0	*	*
Magnesium (Mg)	42.0	39.0	*	*
Sodium (Na)	222.0	239.0	*	*
Potassium (K)	< 5.0	< 5.0	*	*
Iron (Fe)	.13	.09	*	*
Manganese (Mn)	*	3.600	*	*
Ammonia (as N)	< .1	< .1	*	*
Chloride (Cl)	321.0	360.0	*	*
Sulfate (SO4)	16.	9.	*	30.
Fluoride (F)	.3	.3	*	*
Nitrate and Nitrite (as N)	< .1	< .1	*	*
Total Alkalinity	508.0	541.0	*	*
Bicarbonate Alkalinity	*	541.0	*	*
Carbonate Alkalinity	*	*	*	*
Bicarbonate (HCO3)	*	659.6	*	*
Carbonate (CO3)	*	*	*	*
FIELD AND LABORATORY MEASUREMENTS				
Temperature (Degrees C)	17.0	*	23.0	13.0
Field pH	6.74	7.25	6.93	6.97
Lab pH (units)	6.99	7.05	*	*
Field Conductivity (umhos/cm	1510.0	2010.0	2100.0	1600.0
Lab Conductivity (umhos/cm)	1930.0	2070.0	*	*
Total Dissolved Solids(mg/l)	1200.0	1310.0	*	*
VOLATILE ORGANICS DETECTED (ug/L)				
Benzene	19000.00	24000.00	6200.00	2400.00
Ethylbenzene	1300.00	1500.00	180.00	120.00
Toluene	2000.00	20000.00	1000.00	1100.00
m-Xylene	*	*	*	*
o,p-Xylene	*	*	*	*
Total Xylene	3000.00	10000.00	470.00	640.00
1,2 Dichloroethane	450.00	2400.00	< 200.00	800.00
SEMIVOLATILE ORGANICS DETECTED (ug/L)				
Naphthalene	*	*	33.00	*
m & p-Cresol(s)	*	*	11.00	*
TOTAL ORGANIC LEAD (mg/L)				
Total Organic Lead	< .020	.060	*	*

<: Parameter value is less than given detection limits
*: Parameter was not analyzed.

Rocky Mountain
Analytical Laboratory

Enseco Incorporated

ANALYTICAL RESULTS

FOR

DAMES & MOORE

ENSECO-RMAL NO. 008144

JANUARY 26, 1990

Enseco

Reviewed by: Randall Thompson

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611

Facsimile: 303/431-7171

Introduction

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

- Sample Description Information
- Analytical Test Requests
- Analytical Results
- Quality Control Report

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Enseco - RMAL is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

SAMPLE DESCRIPTION INFORMATION
for
Dames and Moore

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
008144-0001-SA	MESP-SL1	SOIL	18 JAN 90	15:00	20 JAN 90
008144-0002-SA	MESP-Sol	SOIL	18 JAN 90	15:00	20 JAN 90

ANALYTICAL TEST REQUESTS
for
Dames and Moore

Lab ID: 008144	Group Code	Analysis Description	Custom Test?
0001 - 0002	A	pH	N
		Total Petroleum Hydrocarbons (TPH), IR	N
		EP Toxicity Metals, ICP (EP Leachate)	N
		Prep digestion for Metals from an EP Leachate	N
		EP Toxicity Extraction / Metals Aliquot	N
		Oil & Grease, Gravimetric	N
		Selenium, Furnace AA (EP Leachate)	N
		Mercury, Cold Vapor AA (EP Leachate)	N
		Prep-Mercury, Cold Vapor AA (EP Leachate)	N
		Ignitability, Closed Cup	N
		Cyanide, Reactive	N
		Sulfide, Reactive	N

Analytical Results

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Enseco reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Enseco-RMAL is no longer routinely blank-correcting analytical data. Uncorrected analytical results are reported, along with associated blank results, for all organic and metals analyses. Analytical results and blank results are reported for conventional inorganic parameters as specified in the method. This policy is described in detail in the Enseco Incorporated Quality Assurance Program Plan for Environmental Chemical Monitoring, Revision 3.3, April, 1989.

The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is provided subsequently.

Metals

EP Toxicity Leachate

Client Name: Dames and Moore
Client ID: MESP-SL1
Lab ID: 008144-0001-SA Enseco ID: 1064809
Matrix: SOIL Sampled: 18 JAN 90 Received: 20 JAN 90
Authorized: 20 JAN 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Arsenic	ND	mg/L	0.1	6010	24 JAN 90	25 JAN 90
Barium	0.10	mg/L	0.01	6010	24 JAN 90	25 JAN 90
Cadmium	ND	mg/L	0.005	6010	24 JAN 90	25 JAN 90
Chromium	ND	mg/L	0.01	6010	24 JAN 90	25 JAN 90
Lead	0.18	mg/L	0.05	6010	24 JAN 90	25 JAN 90
Silver	ND	mg/L	0.01	6010	24 JAN 90	25 JAN 90
Mercury	ND	mg/L	0.002	7470	24 JAN 90	25 JAN 90
Selenium	ND	mg/L	0.05	7740	24 JAN 90	25 JAN 90

ND = Not detected
NA = Not applicable

Reported By: Fred Velasquez Approved By: Kimberly Conroy

Metals

EP Toxicity Leachate

Client Name: Dames and Moore
Client ID: MESP-Sol
Lab ID: 008144-0002-SA
Matrix: SOIL
Authorized: 20 JAN 90
Enseco ID: 1064810
Sampled: 18 JAN 90
Prepared: See Below
Received: 20 JAN 90
Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Arsenic	ND	mg/L	0.1	6010	24 JAN 90	25 JAN 90
Barium	1.6	mg/L	0.01	6010	24 JAN 90	25 JAN 90
Cadmium	ND	mg/L	0.005	6010	24 JAN 90	25 JAN 90
Chromium	ND	mg/L	0.01	6010	24 JAN 90	25 JAN 90
Lead	ND	mg/L	0.05	6010	24 JAN 90	25 JAN 90
Silver	ND	mg/L	0.01	6010	24 JAN 90	25 JAN 90
Mercury	ND	mg/L	0.002	7470	24 JAN 90	25 JAN 90
Selenium	ND	mg/L	0.05	7740	24 JAN 90	25 JAN 90

ND = Not detected
NA = Not applicable

Reported By: Fred Velasquez

Approved By: Kimberly Conroy

General Inorganics

Client Name: Dames and Moore
Client ID: MESP-SL1
Lab ID: 008144-0001-SA
Enseco ID: 1064809
Matrix: SOIL
Sampled: 18 JAN 90
Received: 20 JAN 90
Authorized: 20 JAN 90
Prepared: See Below
Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Cyanide, Reactive	ND	mg/kg	0.1	EPA/OSW	NA	23 JAN 90
Ignitability	>160	deg. F	--	1010/1020	NA	23 JAN 90 o
Oil and Grease	129000	mg/kg	100	9070 Mod.	NA	24 JAN 90
pH	7.2	units	--	9045/ASTM	NA	23 JAN 90
Sulfide, Reactive	ND	mg/kg	0.5	EPA/OSW	NA	23 JAN 90
Total Petroleum Hydrocarbons	13300	mg/kg	50	9070	NA	23 JAN 90

Note o : This test is unreliable for any sample other than a non-aqueous liquid.

ND = Not detected
NA = Not applicable

Reported By: Ron Maiorana
Approved By: Kimberly Conroy

General Inorganics

Client Name: Dames and Moore
Client ID: MESP-Sol
Lab ID: 008144-0002-SA
Enseco ID: 1064810
Matrix: SOIL
Sampled: 18 JAN 90
Received: 20 JAN 90
Authorized: 20 JAN 90
Prepared: See Below
Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Cyanide, Reactive	ND	mg/kg	0.1	EPA/OSW	NA	23 JAN 90
Ignitability	>160	deg. F	--	1010/1020	NA	23 JAN 90
Oil and Grease	20300	mg/kg	100	9070 Mod.	NA	24 JAN 90
pH	7.7	units	--	9045/ASTM	NA	23 JAN 90
Sulfide, Reactive	ND	mg/kg	0.5	EPA/OSW	NA	23 JAN 90
Total Petroleum Hydrocarbons	2560	mg/kg	50	9070	NA	23 JAN 90

Note o : This test is unreliable for any sample other than a non-aqueous liquid.

ND = Not detected
NA = Not applicable

Reported By: Ron Maiorana

Approved By: Kimberly Conroy

Rocky Mountain Analytical Laboratory
4955 Yarrow Street, Arvada, CO 80002 (303) 421-6611

A DIVISION OF
ENSECO
INCORPORATED

01/20/90

Peter Olsen
Dames and Moore
Suite 200
250 East Broadway
Salt Lake City, UT 84111

Dear Dr. Olsen:

This is to acknowledge that we received your 2 samples at our laboratory. They have been assigned our lab project number 008144. Enclosed is a sample description form indicating our sample numbers and your corresponding identifications and a copy of the Chain of Custody. In addition to the sample descriptions, this form also provides you with sample disposition information.

As a service to you, Enseco Incorporated will dispose of and/or store samples as designated by you for a nominal fee; or, return the sample to you at no charge.

A Final Disposition Form will accompany the final report which will reflect the current disposition status of the samples. A change in sample disposition status can be made on this form and mailed back to Enseco within thirty (30) days. A sample disposition status of "PENDING" requires you to select a sample disposition option of either STORE, DISPOSE, or RETURN within thirty (30) days or the samples will be shipped back to your report mailing address.

If you have any questions regarding your project or need additional sample bottles please contact me.

Sincerely,

Randall Thompson
Program Administrator

Rocky Mountain Analytical Labor

01/20/90

SAMPLE DESCRIPTION INFORMATION

for

Dames and Moore

Sample No.	Sample Description	Sample Type	Date Sampled	Date Received	Sample Disposal
*008144-0001-SA	MESP-SL1	WASTE	01/18/90	01/20/90	PENDING
*008144-0002-SA	MESP-So1	WASTE	01/18/90	01/20/90	PENDING

* = Receipt of this new sample is acknowledged by this letter

Quality Control Results

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco - Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Enseco QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with either representative target compounds or surrogate compounds appropriate to the method being used. An SCS is prepared for each sample lot for which the DCS pair are not analyzed.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\%\ \text{Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\ \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2}\ |}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

QC LOT ASSIGNMENT REPORT
Metals Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
008144-0001-SA	AQUEOUS	ICP-AD	24 JAN 90-X	24 JAN 90-X
008144-0001-SA	AQUEOUS	SE-FAA-AD	24 JAN 90-X	24 JAN 90-X
008144-0001-SA	AQUEOUS	HG-CVAA-AT	24 JAN 90-A	24 JAN 90-A
008144-0002-SA	AQUEOUS	ICP-AD	24 JAN 90-X	24 JAN 90-X
008144-0002-SA	AQUEOUS	SE-FAA-AD	24 JAN 90-X	24 JAN 90-X
008144-0002-SA	AQUEOUS	HG-CVAA-AT	24 JAN 90-A	24 JAN 90-A

DUPLICATE CONTROL SAMPLE REPORT
Metals Analysis and Preparation

Category: ICP-AD
Matrix: AQUEOUS
QC Lot: 24 JAN 90-X
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Aluminum	2.0	1.81	1.78	1.80	90	75-125	1.7	20
Antimony	0.5	0.48	0.48	0.48	96	75-125	0.0	20
Arsenic	0.5	0.42	0.42	0.42	84	75-125	0.0	20
Barium	2.0	1.52	1.49	1.50	75	75-125	2.0	20
Beryllium	0.05	0.040	0.040	0.040	80	75-125	0.0	20
Cadmium	0.05	0.043	0.040	0.042	83	75-125	7.2	20
Calcium	100	84.7	83.0	83.8	84	75-125	2.0	20
Chromium	0.2	0.17	0.17	0.17	85	75-125	0.0	20
Cobalt	0.5	0.40	0.40	0.40	80	75-125	0.0	20
Copper	0.25	0.21	0.21	0.21	84	75-125	0.0	20
Iron	1.0	0.89	0.88	0.88	89	75-125	1.1	20
Lead	0.5	0.42	0.41	0.42	83	75-125	2.4	20
Magnesium	50	43.4	42.5	43.0	86	75-125	2.1	20
Manganese	0.5	0.42	0.41	0.42	83	75-125	2.4	20
Nickel	0.5	0.45	0.44	0.44	89	75-125	2.2	20
Potassium	100	82.2	80.6	81.4	81	75-125	2.0	20
Silver	0.05	0.040	0.038	0.039	78	75-125	5.1	20
Sodium	100	74.4	73.0	73.7	74	75-125	1.9	20
Vanadium	0.5	0.41	0.40	0.40	81	75-125	2.5	20
Zinc	0.5	0.45	0.44	0.44	89	75-125	2.2	20

Category: SE-FAA-AD
Matrix: AQUEOUS
QC Lot: 24 JAN 90-X
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Selenium	0.01	0.011	0.012	0.012	115	75-125	8.7	20

Category: HG-CVAA-AT
Matrix: AQUEOUS
QC Lot: 24 JAN 90-A
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Mercury	0.0010	0.00107	0.00108	0.00108	108	75-125	0.9	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Metals Analysis and Preparation

Test: ICP-RCRA-E
Matrix: SOIL
QC Lot: 24 JAN 90-X QC Run: 24 JAN 90-X

Analyte	Result	Units	Reporting Limit
Arsenic	ND	mg/L	0.1
Barium	ND	mg/L	0.01
Cadmium	ND	mg/L	0.005
Chromium	ND	mg/L	0.01
Lead	ND	mg/L	0.05
Silver	ND	mg/L	0.01

Test: SE-FAA-EP-
Matrix: SOIL
QC Lot: 24 JAN 90-X QC Run: 24 JAN 90-X

Analyte	Result	Units	Reporting Limit
Selenium	ND	mg/L	0.05

Test: HG-CVAA-EP
Matrix: SOIL
QC Lot: 24 JAN 90-A QC Run: 24 JAN 90-A

Analyte	Result	Units	Reporting Limit
Mercury	ND	mg/L	0.002

QC LOT ASSIGNMENT REPORT
Wet Chemistry Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
008144-0001-SA	AQUEOUS	PH-A	23 JAN 90-A	-
008144-0001-SA	SOIL	TPH-IR-S	23 JAN 90-A	23 JAN 90-A
008144-0001-SA	SOIL	O&G-G-S	24 JAN 90-D	24 JAN 90-D
008144-0001-SA	SOIL	CNR-S	23 JAN 90-A	23 JAN 90-A
008144-0001-SA	SOIL	SR-S	23 JAN 90-A	23 JAN 90-A
008144-0002-SA	AQUEOUS	PH-A	23 JAN 90-A	-
008144-0002-SA	SOIL	TPH-IR-S	23 JAN 90-A	23 JAN 90-A
008144-0002-SA	SOIL	O&G-G-S	24 JAN 90-D	24 JAN 90-D
008144-0002-SA	SOIL	CNR-S	23 JAN 90-A	23 JAN 90-A
008144-0002-SA	SOIL	SR-S	23 JAN 90-A	23 JAN 90-A

DUPLICATE CONTROL SAMPLE REPORT
Wet Chemistry Analysis and Preparation

Analyte	Concentration				Accuracy Average(%)		Precision (RPD)	
	Spiked	Measured						
		DCS1	DCS2	AVG	DCS	Limits	DCS	Limit
Category: PH-A Matrix: AQUEOUS QC Lot: 23 JAN 90-A Concentration Units: units								
pH	9.1	9.12	9.12	9.12	100	98-102	0.0	5
Category: TPH-IR-S Matrix: SOIL QC Lot: 23 JAN 90-A Concentration Units: mg/kg								
Total Petroleum Hydrocarbons	1000	951	943	947	95	75-125	0.8	20
Category: O&G-G-S Matrix: SOIL QC Lot: 24 JAN 90-D Concentration Units: mg/kg								
Oil and Grease	2500	2540	2500	2520	101	75-125	1.6	20
Category: CNR-S Matrix: SOIL QC Lot: 23 JAN 90-A Concentration Units: mg/kg								
Cyanide, Reactive	100	10.4	13.8	12.1	12	0-100	28	200
Category: SR-S Matrix: SOIL QC Lot: 23 JAN 90-A Concentration Units: mg/kg								
Sulfide, Reactive	89	37.0	34.7	35.8	40	0-200	6.4	200

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation

Analyte	Result	Units	Reporting Limit
Test: TPH-IR-W Matrix: SOIL QC Lot: 23 JAN 90-A QC Run: 23 JAN 90-A			
Total Petroleum Hydrocarbons	ND	mg/kg	50
Test: O&G-G-W Matrix: SOIL QC Lot: 24 JAN 90-D QC Run: 24 JAN 90-D			
Oil and Grease	ND	mg/kg	100
Test: CNREAC-TEC Matrix: SOIL QC Lot: 23 JAN 90-A QC Run: 23 JAN 90-A			
Cyanide, Reactive	ND	mg/kg	0.1
Test: SREAC-SPEC Matrix: SOIL QC Lot: 23 JAN 90-A QC Run: 23 JAN 90-A			
Sulfide, Reactive	ND	mg/kg	0.5

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Facsimile: 303/431-7171

CHAIN OF CUSTODY

No.

Attn: Randy Thompson

Enseco Client: Dames & Moore

Project: Maverick Ref. - Kirtland, NM

…pling Co.: Dames & Moore

Samp… …ite: Maverick

Team Leader: Levi Todd

SAMPLE SAFE™ CONDITIONS

1. Packed by: ______ Seal # ______
2. Seal Intact Upon Receipt by Sampling Co.: [✓ Yes] No
3. Condition of Contents: OK
4. Sealed for Shipping by: Levi Todd
5. Initial Contents Temp.: 14 °C Seal # ______
6. Sampling Status: [✓ Done] Continuing Until ______
7. Seal Intact Upon Receipt by Laboratory: Yes No
8. Contents Temperature Upon Receipt by Lab: ______ °C
9. Condition of Contents: ______

844	Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
01	1/18/90	3:00pm	MESP - SL1	sludge	1	pH, TPH, EPTox Metals, reactivity, O&G, ignitability (if liq)	Top 4-6" sludge layer
02	1/18/90	3:00pm	MESP - S01	soil	1	″	Composite of two boreholes from 1-5'

CUSTODY TRANSFERS PRIOR TO SHIPPING

	Relinquished by: (signed)	Received by: (signed)	Date	Time
1				
2				
3				

SHIPPING DETAILS

Delivered to Shipper by: Levi Todd

Method of Shipment: Fed-X Airbill # 464125129 6

Received for Lab: RMA Signed: ______ Date/Time 01-20-90 0830

Enseco Project No. ______

White and Pink Copies to Lab Yellow to Sampler

SS-001

Rocky Mountain
Analytical Laboratory

Enseco Incorporated

ANALYTICAL RESULTS
FOR
DAMES & MOORE
ENSECO-RMAL NO. 008124

JANUARY 29, 1990

Enseco

Reviewed by: Randall Thompson

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611

Facsimile: 303/431-7171

Introduction

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

- Sample Description Information
- Analytical Test Requests
- Analytical Results
- Quality Control Report

Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interferences or analytes present at concentrations above the linear calibration curve, samples were diluted. For this project samples 008124-0003, 0004 and 0005 were diluted during the Methods 601 and 602 analyses due to concentrations of target compounds. The reporting limits have been adjusted relative to these dilutions.

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Enseco - RMAL is assigned a unique six digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the six digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Test Requests

The Analytical Test Requests lists the analyses that were performed on each sample. The Custom Test column indicates where tests have been modified to conform to the specific requirements of this project.

SAMPLE DESCRIPTION INFORMATION
for
Dames and Moore

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
008124-0001-SA	MW11	AQUEOUS	16 JAN 90	17:15	18 JAN 90
008124-0002-SA	EOW	AQUEOUS	17 JAN 90	10:00	18 JAN 90
008124-0003-SA	NOW	AQUEOUS	17 JAN 90	11:30	18 JAN 90
008124-0004-SA	MW12	AQUEOUS	17 JAN 90	14:15	18 JAN 90
008124-0005-SA	Trench	AQUEOUS	17 JAN 90	15:30	18 JAN 90

ANALYTICAL TEST REQUESTS
for
Dames and Moore

Lab ID: 008124	Group Code	Analysis Description	Custom Test?
0001 - 0005	A	Halogenated Volatile Organics	Y
		Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)	N
		Sulfate, Ion Chromatography	N

Analytical Results

The analytical results for this project are presented in the following data tables. Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Enseco reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content.

Enseco-RMAL is no longer routinely blank-correcting analytical data. Uncorrected analytical results are reported, along with associated blank results, for all organic and metals analyses. Analytical results and blank results are reported for conventional inorganic parameters as specified in the method. This policy is described in detail in the Enseco Incorporated Quality Assurance Program Plan for Environmental Chemical Monitoring, Revision 3.3, April, 1989.

The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is provided subsequently.

Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)

Method 8020

Client Name: Dames and Moore
Client ID: MW11
Lab ID: 008124-0001-SA
Enseco ID: 1064668
Matrix: AQUEOUS
Sampled: 16 JAN 90
Received: 18 JAN 90
Authorized: 18 JAN 90
Prepared: NA
Analyzed: 19 JAN 90

Parameter	Result	Units	Reporting Limit
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	1.0

ND = Not detected
NA = Not applicable

Reported By: William Sullivan
Approved By: Barbara Sullivan

Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)

Method 8020

Client Name:	Dames and Moore		
Client ID:	EOW		
Lab ID:	008124-0002-SA	Enseco ID: 1064669	
Matrix:	AQUEOUS	Sampled: 17 JAN 90	Received: 18 JAN 90
Authorized:	18 JAN 90	Prepared: NA	Analyzed: 19 JAN 90

Parameter	Result	Units	Reporting Limit
Benzene	20	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	7.2	ug/L	0.50
Xylenes (total)	4.1	ug/L	1.0

ND = Not detected
NA = Not applicable

Reported By: William Sullivan Approved By: Barbara Sullivan

Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)

Method 8020

Client Name: Dames and Moore
Client ID: NOW
Lab ID: 008124-0003-SA
Enseco ID: 1064670
Matrix: AQUEOUS
Sampled: 17 JAN 90
Received: 18 JAN 90
Authorized: 18 JAN 90
Prepared: NA
Analyzed: 23 JAN 90

Parameter	Result	Units	Reporting Limit
Benzene	19000	ug/L	500
Toluene	8400	ug/L	500
Ethylbenzene	1300	ug/L	500
Xylenes (total)	5900	ug/L	1000

ND = Not detected
NA = Not applicable

Reported By: Nathaniel Biah

Approved By: Barbara Sullivan

Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)

Method 8020

Client Name: Dames and Moore
Client ID: MW12
Lab ID: 008124-0004-SA
Enseco ID: 1064671
Matrix: AQUEOUS
Sampled: 17 JAN 90
Received: 18 JAN 90
Authorized: 18 JAN 90
Prepared: NA
Analyzed: 19 JAN 90

Parameter	Result	Units	Reporting Limit
Benzene	2400	ug/L	50
Toluene	1100	ug/L	50
Ethylbenzene	120	ug/L	50
Xylenes (total)	640	ug/L	100

ND = Not detected
NA = Not applicable

Reported By: William Sullivan

Approved By: Barbara Sullivan

Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX)

Method 8020

Client Name: Dames and Moore
Client ID: Trench
Lab ID: 008124-0005-SA   Enseco ID: 1064672
Matrix: AQUEOUS   Sampled: 17 JAN 90   Received: 18 JAN 90
Authorized: 18 JAN 90   Prepared: NA   Analyzed: 19 JAN 90

Parameter	Result	Units	Reporting Limit
Benzene	3500	ug/L	120
Toluene	3200	ug/L	120
Ethylbenzene	220	ug/L	120
Xylenes (total)	1800	ug/L	250

ND = Not detected
NA = Not applicable

Reported By: William Sullivan   Approved By: Barbara Sullivan

Halogenated Volatile Organics

Method 8010

Client Name: Dames and Moore
Client ID: MW11
Lab ID: 008124-0001-SA
Enseco ID: 1064668
Matrix: AQUEOUS
Sampled: 16 JAN 90
Received: 18 JAN 90
Authorized: 18 JAN 90
Prepared: NA
Analyzed: 26 JAN 90

Parameter	Result	Units	Reporting Limit
1,2-Dichloroethane	ND	ug/L	1.0

ND = Not detected
NA = Not applicable

Reported By: William Sullivan
Approved By: Barbara Sullivan

Halogenated Volatile Organics

Method 8010

Client Name: Dames and Moore
Client ID: EOW
Lab ID: 008124-0002-SA
Enseco ID: 1064669
Matrix: AQUEOUS
Sampled: 17 JAN 90
Received: 18 JAN 90
Authorized: 18 JAN 90
Prepared: NA
Analyzed: 26 JAN 90

Parameter	Result	Units	Reporting Limit
1,2-Dichloroethane	6.5	ug/L	1.0

ND = Not detected
NA = Not applicable

Reported By: William Sullivan
Approved By: Barbara Sullivan

Halogenated Volatile Organics

Method 8010

Client Name: Dames and Moore
Client ID: NOW
Lab ID: 008124-0003-SA
Enseco ID: 1064670
Matrix: AQUEOUS
Sampled: 17 JAN 90
Received: 18 JAN 90
Authorized: 18 JAN 90
Prepared: NA
Analyzed: 26 JAN 90

Parameter	Result	Units	Reporting Limit
1,2-Dichloroethane	ND	ug/L	1000

ND = Not detected
NA = Not applicable

Reported By: William Sullivan
Approved By: Barbara Sullivan

Halogenated Volatile Organics

Method 8010

Client Name:	Dames and Moore				
Client ID:	MW12				
Lab ID:	008124-0004-SA	Enseco ID:	1064671		
Matrix:	AQUEOUS	Sampled:	17 JAN 90	Received:	18 JAN 90
Authorized:	18 JAN 90	Prepared:	NA	Analyzed:	26 JAN 90

Parameter	Result	Units	Reporting Limit
1,2-Dichloroethane	800	ug/L	100

ND = Not detected
NA = Not applicable

Reported By: William Sullivan

Approved By: Barbara Sullivan

Halogenated Volatile Organics

Method 8010

Client Name: Dames and Moore
Client ID: Trench
Lab ID: 008124-0005-SA
Enseco ID: 1064672
Matrix: AQUEOUS
Sampled: 17 JAN 90
Received: 18 JAN 90
Authorized: 18 JAN 90
Prepared: NA
Analyzed: 26 JAN 90

Parameter	Result	Units	Reporting Limit
1,2-Dichloroethane	ND	ug/L	250

ND = Not detected
NA = Not applicable

Reported By: William Sullivan

Approved By: Barbara Sullivan

General Inorganics

Client Name: Dames and Moore
Client ID: MW11
Lab ID: 008124-0001-SA
Matrix: AQUEOUS
Authorized: 18 JAN 90

Enseco ID: 1064668
Sampled: 16 JAN 90
Prepared: See Below

Received: 18 JAN 90
Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Sulfate	598	mg/L	5	300.0	NA	25 JAN 90

ND = Not detected
NA = Not applicable

Reported By: Steve Pope

Approved By: Kimberly Conroy

General Inorganics

Client Name: Dames and Moore
Client ID: EOW
Lab ID: 008124-0002-SA Enseco ID: 1064669
Matrix: AQUEOUS Sampled: 17 JAN 90 Received: 18 JAN 90
Authorized: 18 JAN 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Sulfate	455	mg/L	5	300.0	NA	25 JAN 90

ND = Not detected
NA = Not applicable

Reported By: Steve Pope Approved By: Kimberly Conroy

General Inorganics

Client Name:	Dames and Moore				
Client ID:	NOW				
Lab ID:	008124-0003-SA	Enseco ID:	1064670		
Matrix:	AQUEOUS	Sampled:	17 JAN 90	Received:	18 JAN 90
Authorized:	18 JAN 90	Prepared:	See Below	Analyzed:	See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Sulfate	68	mg/L	5	300.0	NA	25 JAN 90

ND = Not detected
NA = Not applicable

Reported By: Steve Pope

Approved By: Kimberly Conroy

General Inorganics

Client Name: Dames and Moore
Client ID: MW12
Lab ID: 008124-0004-SA
Matrix: AQUEOUS
Authorized: 18 JAN 90

Enseco ID: 1064671
Sampled: 17 JAN 90
Prepared: See Below

Received: 18 JAN 90
Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Sulfate	30	mg/L	5	300.0	NA	25 JAN 90

ND = Not detected
NA = Not applicable

Reported By: Steve Pope

Approved By: Kimberly Conroy

General Inorganics

Client Name: Dames and Moore
Client ID: Trench
Lab ID: 008124-0005-SA
Enseco ID: 1064672
Matrix: AQUEOUS
Sampled: 17 JAN 90
Received: 18 JAN 90
Authorized: 18 JAN 90
Prepared: See Below
Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Sulfate	73	mg/L	5	300.0	NA	25 JAN 90

ND = Not detected
NA = Not applicable

Reported By: Steve Pope

Approved By: Kimberly Conroy

Rocky Mountain Analytical Laboratory
4955 Yarrow Street, Arvada, CO 80002 (303) 421-6611

A DIVISION OF
ENSECO
INCORPORATED

01/18/90

Peter Olsen
Dames and Moore
Suite 200
250 East Broadway
Salt Lake City, UT 84111

Dear Dr. Olsen:

This is to acknowledge that we received your 5 samples at our laboratory. They have been assigned our lab project number 008124. Enclosed is a sample description form indicating our sample numbers and your corresponding identifications and a copy of the Chain of Custody. In addition to the sample descriptions, this form also provides you with sample disposition information.

As a service to you, Enseco Incorporated will dispose of and/or store samples as designated by you for a nominal fee; or, return the sample to you at no charge.

A Final Disposition Form will accompany the final report which will reflect the current disposition status of the samples. A change in sample disposition status can be made on this form and mailed back to Enseco within thirty (30) days. A sample disposition status of "PENDING" requires you to select a sample disposition option of either STORE, DISPOSE, or RETURN within thirty (30) days or the samples will be shipped back to your report mailing address.

If you have any questions regarding your project or need additional sample bottles please contact me.

Sincerely,

Randall Thompson
Program Administrator

Rocky Mountain Analytical Labor

01/18/90

SAMPLE DESCRIPTION INFORMATION

for

Dames and Moore

Sample No.	Sample Description	Sample Type	Date Sampled	Date Received	Sample Disposal
*008124-0001-SA	MW11	AQUEOUS	01/16/90	01/18/90	PENDING
*008124-0002-SA	EOW	AQUEOUS	01/17/90	01/18/90	PENDING
*008124-0003-SA	NOW	AQUEOUS	01/17/90	01/18/90	PENDING
*008124-0004-SA	MW12	AQUEOUS	01/17/90	01/18/90	PENDING
*008124-0005-SA	Trench	AQUEOUS	01/17/90	01/18/90	PENDING

* = Receipt of this new sample is acknowledged by this letter

Quality Control Results

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco - Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Enseco QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of Duplicate Control Samples (DCS) at frequent, well-defined intervals. Each DCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the DCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate DCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For each batch of samples analyzed, an additional control measure is taken in the form of a Single Control Sample (SCS). The SCS consists of a control matrix that is spiked with either representative target compounds or surrogate compounds appropriate to the method being used. An SCS is prepared for each sample lot for which the DCS pair are not analyzed.

Accuracy for DCS and SCS is measured by Percent Recovery.

$$\%\ \text{Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for DCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{|\ \text{Measured Concentration DCS1} - \text{Measured Concentration DCS2}\ |}{(\text{Measured Concentration DCS1} + \text{Measured Concentration DCS2})/2} \times 100$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, DCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report.

QC LOT ASSIGNMENT REPORT
Volatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
008124-0001-SA	AQUEOUS	601-A	26 JAN 90-H	26 JAN 90-H
008124-0001-SA	AQUEOUS	602-A	19 JAN 90-P	19 JAN 90-P
008124-0002-SA	AQUEOUS	601-A	26 JAN 90-H	26 JAN 90-H
008124-0002-SA	AQUEOUS	602-A	19 JAN 90-P	19 JAN 90-P
008124-0003-SA	AQUEOUS	601-A	26 JAN 90-H	26 JAN 90-H
008124-0003-SA	AQUEOUS	602-A	22 JAN 90-L	22 JAN 90-L
008124-0004-SA	AQUEOUS	601-A	26 JAN 90-H	26 JAN 90-H
008124-0004-SA	AQUEOUS	602-A	19 JAN 90-P	19 JAN 90-P
008124-0005-SA	AQUEOUS	601-A	26 JAN 90-H	26 JAN 90-H
008124-0005-SA	AQUEOUS	602-A	19 JAN 90-P	19 JAN 90-P

DUPLICATE CONTROL SAMPLE REPORT
Volatile Organics by GC

Category: 601-A
Matrix: AQUEOUS
QC Lot: 26 JAN 90-H
Concentration Units: ug/L

Analyte	Concentration Spiked	Concentration Measured DCS1	Concentration Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
1,1-Dichloroethane	5.0	4.35	4.27	4.31	86	80-130	1.9	20
Chloroform	5.0	5.45	5.56	5.50	110	80-120	2.0	20
Bromodichloromethane	10	10.3	10.2	10.2	103	80-120	1.0	20
Trichloroethene	5.0	5.34	5.33	5.34	107	70-120	0.2	20
Chlorobenzene	5.0	5.44	5.25	5.34	107	80-120	3.6	20

Category: 602-A
Matrix: AQUEOUS
QC Lot: 19 JAN 90-P
Concentration Units: ug/L

Analyte	Concentration Spiked	Concentration Measured DCS1	Concentration Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Benzene	5.0	3.82	3.88	3.85	77	75-115	1.6	20
Toluene	5.0	3.93	3.95	3.94	79	75-115	0.5	20
Chlorobenzene	5.0	4.16	4.17	4.16	83	75-115	0.2	20
Ethylbenzene	5.0	4.29	4.25	4.27	85	75-115	0.9	20
Xylenes (total)	5.0	4.05	4.02	4.04	81	75-115	0.7	20
1,3-Dichlorobenzene	5.0	4.25	4.23	4.24	85	75-115	0.5	20

Category: 602-A
Matrix: AQUEOUS
QC Lot: 22 JAN 90-L
Concentration Units: ug/L

Analyte	Concentration Spiked	Concentration Measured DCS1	Concentration Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Benzene	5.0	4.18	4.15	4.16	83	75-115	0.7	20
Toluene	5.0	4.51	4.46	4.48	90	75-115	1.1	20
Chlorobenzene	5.0	4.83	4.78	4.80	96	75-115	1.0	20
Ethylbenzene	5.0	4.85	4.84	4.84	97	75-115	0.2	20
Xylenes (total)	5.0	4.81	4.76	4.78	96	75-115	1.0	20
1,3-Dichlorobenzene	5.0	5.27	5.20	5.24	105	75-115	1.3	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

SINGLE CONTROL SAMPLE REPORT
Volatile Organics by GC

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	SCS	Limits
Category: 601-A Matrix: AQUEOUS QC Lot: 26 JAN 90-H QC Run: 26 JAN 90-H Concentration Units: ug/L				
Bromochloromethane	5.00	5.14	103	20-160
Category: 602-A Matrix: AQUEOUS QC Lot: 19 JAN 90-P QC Run: 19 JAN 90-P Concentration Units: ug/L				
a,a,a-Trifluorotoluene	5.00	5.09	102	20-160
Category: 602-A Matrix: AQUEOUS QC Lot: 22 JAN 90-L QC Run: 22 JAN 90-L Concentration Units: ug/L				
a,a,a-Trifluorotoluene	30.0	29.4	98	20-160

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Volatile Organics by GC

Analyte	Result	Units	Reporting Limit
Test: 601-A Matrix: AQUEOUS QC Lot: 26 JAN 90-H QC Run: 26 JAN 90-H			
1,2-Dichloroethane	ND	ug/L	1.0
Test: 602-BTEX-A Matrix: AQUEOUS QC Lot: 19 JAN 90-P QC Run: 19 JAN 90-P			
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	1.0
Test: 602-BTEX-A Matrix: AQUEOUS QC Lot: 22 JAN 90-L QC Run: 22 JAN 90-L			
Benzene	ND	ug/L	0.50
Toluene	ND	ug/L	0.50
Ethylbenzene	ND	ug/L	0.50
Xylenes (total)	ND	ug/L	1.0

QC LOT ASSIGNMENT REPORT
Wet Chemistry Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
008124-0001-SA	AQUEOUS	S04-IC-A	25 JAN 90-M	-
008124-0002-SA	AQUEOUS	S04-IC-A	25 JAN 90-M	-
008124-0003-SA	AQUEOUS	S04-IC-A	25 JAN 90-M	-
008124-0004-SA	AQUEOUS	S04-IC-A	25 JAN 90-M	-
008124-0005-SA	AQUEOUS	S04-IC-A	25 JAN 90-M	-

DUPLICATE CONTROL SAMPLE REPORT
Wet Chemistry Analysis and Preparation

Category: S04-IC-A
Matrix: AQUEOUS
QC Lot: 25 JAN 90-M
Concentration Units: mg/L

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Average(%) Limits	Precision (RPD) DCS	Precision (RPD) Limit
Sulfate	200	197	197	197	99	93-107	0.0	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Facsimile: 303/431-7171

CHAIN OF CUSTODY

No.

Attn: Randy Thompson

Enseco Client: Dames & Moore

Project: Maverick Ref. - Kirtland, New Mexico

Sampling Co.: Dames & Moore

Sampling Site: Maverick

Team Leader: Levi Todd

SAMPLE SAFE™ CONDITIONS

1. Packed by: ______ Seal # ______
2. Seal Intact Upon Receipt by Sampling Co.: Yes No
3. Condition of Contents: Intact
4. Sealed for Shipping by: Levi Todd
5. Initial Contents Temp.: ± 4 °C Seal # ______
6. Sampling Status: Done [✓ Continuing Until] ? 1/18 or 19/90
7. Seal Intact Upon Receipt by Laboratory: Yes No
8. Contents Temperature Upon Receipt by Lab: ______ °C
9. Condition of Contents: ______

	Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
01	1/16/90	5:15pm	MW11 - S1	Water	1	SO_4^{-2}	Not Filtered
	~~1/16/90~~	~~5:15pm~~	~~MW11 - V1 V1 MW11 - V3~~ ~~MW11 - V2 V2~~	~~Water~~	~~3~~	~~BTEX, 1,2 DCA~~	Entered Wrong Description
01 ~~02~~	1/16/90	5:20pm	MW11 - 1V, MW11 - 2V, MW11 - 3V	Water	3	BTEX; 1,2 DCA	
02	1/17/90	10:00AM	EOW - S1	Wtr	1	SO_4^{-2}	
02 ~~04~~	1/17/90	10:00am	EOW - V1, EOW - V2, EOW - V3	Wtr	3	BTEX; 1,2 DCA	
03	1/17/90	11:30am	NOW - S1	Wtr	1	SO_4^{-2}	
03 ~~06~~	1/17/90	11:30am	N-OW - V1, N-OW - V2, N-OW - V3	Wtr	3	BTEY; 1,2 DCA	
04 ~~07~~	1/17/90	2:15pm	MW12 - S1	Wtr	1	SO_4^{-2}	
04 ~~08~~	1/17/90	2:15pm	MW12 - V1, MW12 - V2, MW12 - V3	Wtr	3	BTEX; 1,2 DCA	
05 ~~09~~	1/17/90	3:30pm	Trench	Wtr	1	SO_4^{-2}	
05 ~~10~~	1/17/90	3:30pm	Trench - V1, Trench - V2, Trench - V2	Wtr	3	BTEX; 1,2 DCA	

CUSTODY TRANSFERS PRIOR TO SHIPPING

	Relinquished by: (signed)	Received by: (signed)	Date	Time
1				
2				
3				

SHIPPING DETAILS

Delivered to Shipper by: Levi Todd

Method of Shipment: Fed - X Airbill # 464 1255861

Received for Lab: RMAL Signed: ______ Date/Time 01-18-90 0900

Enseco Project No

APPENDIX B

DETAILS: MODIFICATIONS TO THE GROUND WATER REMEDIATION PLAN

APPENDIX B
DETAILS: MODIFICATIONS TO THE GROUND WATER REMEDIATION PLAN

This remediation plan addresses the shallow soil and ground water contamination in the remediation zone, the southwestern area of the tank farm. This plan differs from the previous plan in that an east-west interceptor trench will not be constructed. A slurry wall and dewatering wells will provide better isolation and hydraulic control than an east-west interceptor trench, and the application of the pumped water via sprinkling in conjunction with air sparging will enhance bioremediation of the ground water and soils within the remediation zone. This modified plan (see Plate 3) includes the following key changes from the plan outlined in Dames & Moore's November 1989 report:

- Installation of a soil-bentonite slurry wall (permeability $\leq 1X10^{-7}$ cm/sec) to prevent off-site migration of contaminants from the remediation zone, the upper shallow (12-foot deep) contaminated zone. The exact location and depth of the slurry wall will be determined subsequent to additional borehole drilling and sampling.
- Installation of several (2 to 4) dewatering wells in the remediation zone to maintain a net hydraulic gradient into the site, to remove contaminated water that will be treated by the indigenous microbes in the soils, and to provide a source of water to enhance biodegradation of the soil contamination.
- Enhancement of biodegradation by the application (e.g., sprinkling) of water in the remediation zone, by the batch application of nutrients, and by the sparging of air into the subsurface. Air sparging should also aid in volatilization of the volatile organic contaminants.
- Elimination of a subsurface free product recovery system and an air stripper.
- Backfilling of the existing north-south interceptor trench in order that the slurry wall can be extended to the western boundary.
- Remediation of the ground water via surface recharge and soil infiltration in the remediation zone only.
- Installation and monitoring of additional monitor well points inside as well as outside the remediation zone.

A slurry wall is an efficient isolation technique to prevent future off-site migration of contamination and to minimize upgradient ground water from entering the remediation zone and becoming contaminated. Ground water withdrawals in conjunction with enhanced biodegradation will also serve to accelerate remediation of the site contained within the slurry wall.

The 10 components of the Modified Plan (which include some of the same components of the previous plan) include the following:

1.* The Westside Irrigation Ditch waters which flow along the entire western edge of the tank farm property boundary were contained in 10-inch diameter plastic pipe to prevent contamination of the irrigation waters (completed in March 1989).

2. The refinery sludge in the eastern part of the tank farm was characterized, and shown to be non-hazardous. The sludge will be excavated and disposed of off-site and backfilled with clean fill.

3. The existing north-south interceptor trench will be backfilled and compacted with the material previously excavated from the trench.

4.* Two additional off-site monitor wells were constructed to monitor the effectiveness of remediation off-site, downgradient to the southwest of the tank farm. Water levels have been and will continue to be measured and samples analyzed for volatile organics (aromatic and halogenated), total dissolved solids, sulfate, and chloride from these two monitor wells and existing monitor well MW-9, MW-10, and MW-13 three times in year 1 (1989), two times in year 2 (1990), one time in year 3 (1991), with monitoring only as needed thereafter.

5. A soil-bentonite slurry wall, about 20-feet deep keyed into the underlying clay, will be constructed around the perimeter of the southwestern area (the remediation zone) as shown on Plate 3 of the text. Prior to construction, some preparatory site work will be required. This work will consist of drilling and sampling of 15 to 30 boreholes located along the future slurry wall site to define the depth to, and thickness of, the underlying clay and the southern and northern boundaries of subsurface soil contamination (the exact location and depth of the slurry wall will be determined based on this additional data); backfilling the north-south trench as mentioned above; relocation of portions of the existing berms; and grouting of wells MW-12, MW-11, N-OW, E-OW, and TW.

---

* Indicates already completed as per the original Phase I Plan (September 14, 1989)

6. Upon completion of the slurry wall, two monitor wells will be installed downgradient of the slurry wall to be used to monitor for possible off-site contaminant migration and two monitor wells will be installed within the site to be used to monitor on-site concentrations of contaminants. Water levels will be measured and samples analyzed for the same constituents as listed in component #4 above as well as for any indicator parameters associated with the nutrients that will be applied (e.g., nitrate, phosphate).

7. Approximately four dewatering wells will be installed within the remediation zone contained by the slurry wall. These wells will be intermittently pumped to maintain a net hydraulic gradient into the site ensuring additional control of contamination.

8. A free product/water separator will be installed to separate any free product from the recovered water. The free product will be discharged to a holding tank whereupon it will then be sold to a local refiner.

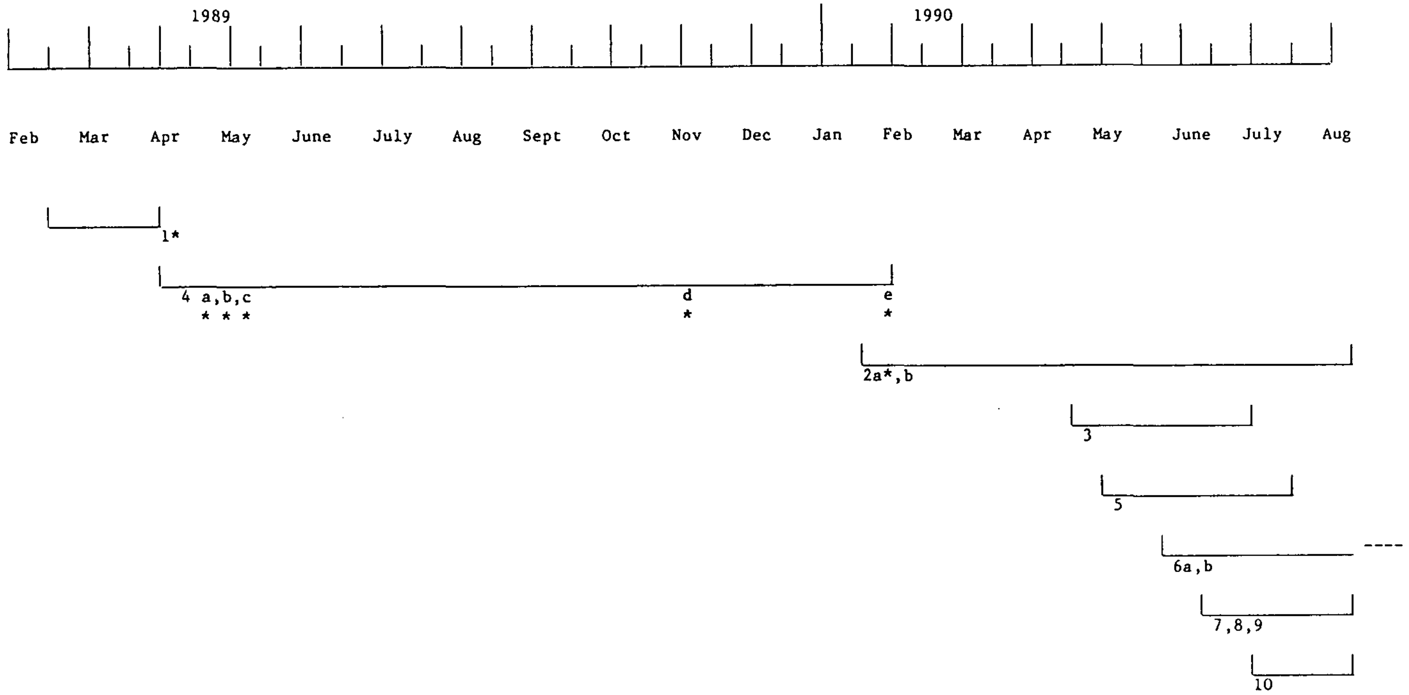
9. The water will subsequently be applied to the surface via a sprinkling system to enhance in-situ bioremediation of contamination within the vadose zone. Nutrients, such as nitrates and phosphates, will be intermittently applied to the site. These nutrients will be applied in dissolved form at concentrations sufficient to enhance biodegradation. Initial concentrations to be applied are estimated to be between 60-120 mg/l nitrogen and 35-70 mg/l phosphorus. These concentrations are based on the results of ENSR's biodegration feasibility study (see Dames & Moore, February 1990). Subsequent application concentrations and rates will be dependent on the data monitoring results.

10. Air sparging wells and a blower will be installed to introduce additional oxygen into the subsurface to further enhance biodegredation and volatilization of the volatile organic contaminants. Air sparging may be performed on an intermittent or continuous basis. Measurement of the dissolved oxygen in the ground water and the percentage of oxygen in the vadose zone will be the basis for determining the frequency of operation.

The time table for implementation of the modified remediation plan is shown on Table B-1. Implementation of the modified plan is anticipated to begin immediately in April 1990, upon approval from the State Oil Conservation Division (OCD). Installation of the slurry wall and bioremediation enhancement system is anticipated to be completed by August 1990. Status reports will be issued to the OCD in 1990 and 1991. Active remediation is to be conducted through the summer of 1991. However, active remediation will not be terminated until such approval has been granted by the OCD.

TABLE B-1

REVISED TIME SCHEDULE, MODIFIED GROUND WATER REMEDIATION PLAN
FOR MAVERIK COUNTRY STORES, INC. (MARCH 1990)
KIRTLAND, NEW MEXICO, REFINERY TANK FARM



No.	Components
*1	Pipe Westside Ditch Flows
*2a	Sludge Evaluation
2b	Sludge Disposal (includes tank residuals)
3	Backfill North-South Interceptor Trench
*4a	Install Two New Monitor Wells
*4b	Water Quality Monitoring Data Report, Round 1
*4c	Conduct Pump Test
*4d	Water Quality Monitoring Data Report, Round 2
*4e	Water Quality Monitoring Data Report, Round 3
*4f	Refine Plan
5	Install Slurry Wall
6a	Install Four Additional Monitor Wells
6b	Water Quality Monitoring Data Report, Year 1
7	Install Dewatering Wells
8	Install Oil/Water Separator
9	Install Water Sprinkling System
10	Install Air Sparging System

(1) Components as defined in the Modified (March 1990) Ground Water Remediation Plan for Maverik Country Stores, Inc., Kirtland, New Mexico Refinery Tank Farm. Times for completion reflect, where required, data collection, laboratory analysis, final design specifications, contract and equipment procurement, construction, and start-up.

* Indicates work completed

---- Indicates additional monitoring