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PHASE II SUBSURFACE SOIL AND SOLID WASTE CONTAMINANT EVALUATION
MAVERIK REFINERY AND TANK FARM
KIRTLAND, NEW MEXICO
FOR MAVERIK COUNTRY STORES, INC.

Dames & Moore

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EXECUTIVE SUMMARY

This report presents the results of the Phase II Subsurface Soil and Solid Waste Contaminant Evaluation at the Maverik Refinery and Tank Farm, Kirtland, New Mexico. This study follows the 1987-1988 Phase I Hydrogeologic Study, and was conducted to define the extent of and potential for soil contamination to act as a continued source of ground water contamination.

The Phase II investigation consisted of the following work elements: aquifer drilling and sampling of solid waste samples and core samples from 43 boreholes; field testing for organic vapor contamination in 101 drill core samples and surface solid waste samples; laboratory analysis of 37 selected soil samples for organics and metals and percent oil, water and solids; analysis of the data obtained during this investigation and review of all of the data obtained from previous investigations.

With the exception of 1,2-Dichloroethane (1,2-DCA), all of the typical refinery related volatile organics benzene, toluene, xylene and ethylbenzene which were found in the shallow ground water on-site, and off-site in the West Side Irrigation Ditch, were found at very high levels in the upper shallow (7 to 12 feet deep) subsurface soil and at the surface and solid waste sludge area on-site. Volatiles were detected at a maximum depth of 15 to 20 feet and detected but at much lower levels off-site, southwest of the tank farm.

Five refinery semivolatiles (bis(2 ethylhexyl)phthalate, 1-methylnaphthalene, naphthalene, phenanthrene and/or chrysene) were detected at 3 of the 4 on-site boreholes that were tested for specific refinery semivolatiles.

Six on-site subsurface soil and three surface and solid waste sludge samples tested for "Total Chromatographable Organics" (TCO), verified the presence of hydrocarbons (diesel fuel, gasoline and other light and heavy end refinery products) and semivolatiles within the upper 20 feet of the subsurface, in the northwest, west central southern and eastern parts of the tank farm.

The principal potential contaminant source areas at the tank farm include the solid waste sludges in the northwest corner; the eastern sludge pit; the subsurface soils in the southwest corner contaminated from the leaded gasoline spill; the west central part of the tank farm near the No. 5 Fuel Oil tank, the Crude Oil Tank and the No-Lead gas tanks and the sludge disposal area south of the Crude Oil tank.

The Phase II subsurface soil and solid waste contamination study results verify the results of the Phase I Hydrogeologic Study, that significant concentrations of tank farm related contaminants are confined to the upper zone of the shallow water table aquifer on-site with much lower levels of contaminants detected in the soils off-site.

Although there are significantly high levels of organic compounds in the shallow subsurface soils and ground water and solid wastes on-site, contaminant releases from the tank farm via ground water transport have not been significant. The West Side Irrigation Ditch is believed to have served as a major contaminant control mechanism to off-site contamination.

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INTRODUCTION

This report presents the results of the Phase II subsurface soil and solid waste evaluation at the Maverik Refinery and Tank Farm in Kirtland, New Mexico. Subsurface soil and solid waste conditions were evaluated on-site and off-site about 150 feet west and downgradient from the southwestern edge of the tank farm boundary and about 350 feet west of the northwestern corner of the tank farm. The general site location map and detailed plot plan showing the boreholes and pertinent monitor wells are included on Plates 1 and 2, respectively.

PURPOSE AND SCOPE

The purpose of this study was, as specified by the New Mexico Environmental Improvement Division (NMEID) in a letter dated December 18, 1987 to Maverik, to perform a subsurface soils and solid waste contaminant evaluation to "define the areal and vertical extent of soil contamination at the refinery and the potential for such soil contamination to act as a continued source of ground water contamination."

The scope of the Phase II work conducted by Dames & Moore and as outlined in the March 25, 1988 work plan to the EID, was verbally approved by the New Mexico EID on April 4, 1988, with the only modification being that metals analyses be conducted at two known solid waste disposal sites. The project scope accomplishes the objectives of:

1. Defining the vertical and lateral extent of subsurface soil and solid waste contamination.
2. Identifying and quantifying the contaminants present.

3. Identifying contaminant sources known or suspected.

4. Determining the potential for such soil and solid waste contamination to serve as a continued contaminant source to the ground water.

Specifically the following tasks were performed during the Phase II work:

TASK I - FIELD INVESTIGATIONS

- A detailed ground survey for surficial refinery solid waste product.
- Augering 43 shallow boreholes (24 on-site and 19 off-site) to depths of 0.8 feet to 22 feet.
- Testing 101 augered samples in the field with an organic vapor analyzer (OVA).
- Sampling 37 subsurface soil and solid waste materials for laboratory analysis.

TASK II - LABORATORY INVESTIGATIONS

- Rocky Mountain Analytical Laboratory (RMAL) analyzed the soil and solid waste samples for halogenated and aromatic volatile organics, total organic lead and 12 metals, total chromatographable organics (TCO) and initial and final boiling points, refinery hazardous volatile constituents, refinery hazardous semi-volatile constituents and percent oil, water and solids (Table 1). Their comprehensive report with analytical results is included in Appendix C.
- As per the NMEID's request that metals analyses be completed for at least two solid waste sludge samples, an EP toxicity test for metals was run on the sludge near the crude oil tank at borehole 3 (BH-3) and total metals were analyzed for the solids from the sludge pit to the east (BH-26). In addition, 8 to 12 refinery related metals were analyzed at four other sample sites for total metals concentrations.
- Laboratory analysis of refinery-related semi-volatile organics for 4 samples were analyzed by EPA Method 8270. For evaluating petroleum hydrocarbons and semi-volatiles, 10 samples were analyzed for TCO levels.
- Total organic lead was analyzed at 4 sample sites located near the 2.4 million gallon leaded gasoline storage tank.

TASK III - DATA EVALUATION

- OVA readings from drill cuttings were evaluated in the field to define the contaminated subsurface soil zones to be sampled for further testing in the laboratory and to determine if additional drilling was required to define the extent of contamination.

- Lithologic profiles and depths to the saturated zones were recorded during drilling. The data were used to construct detailed cross-sections on-site and off-site to the west.

- The Phase II lithologic, field OVA and laboratory analytical data as well as the Phase I hydrogeologic data were evaluated to define the source areas and vertical and lateral extent of subsurface soil and subsequent ground water contamination, both on-site and off-site.

- The significance of the subsurface soil and solid waste contamination was evaluated based on the toxicity of the contaminants detected, their potential for transport via ground water and surface water pathways and their potential impact on private water well users.

- This summary Phase II Report was prepared.

BACKGROUND

A detailed description of the facility is presented in our Phase I report (February 1988). The study site, owned by Maverik Country Stores, Inc., consisted of a small crude topping refinery and tank farm near Kirtland, New Mexico. Operations were conducted from 1963 until April 1982 at which time the facility was shut down.

As a result of the NMEID sampling and subsequent detection of ground and surface water contamination from the study site in December 1985, Maverik contracted to Dames & Moore to complete ground water, surface water and soil contamination studies. The Phase I hydrogeologic evaluation begain in March 1987. It was completed in February 1988 and included two formal Phase I written reports by Dames & Moore (February 1988 and June 1988). The results of the hydrogeologic study are summarized in the Dames & Moore Phase I Addendum Report. In summary, although high levels of organic contaminants were found on-site in the shallow ground waters in the southwest part of the tank farm, only trace levels of volatile organics were present off-site. Only one organic parameter (1,2-DCA), was detected at levels slightly above NMEID drinking water standards off-site in the private wells.

As a result of the Phase I Round 1 water quality data and discussions with the New Mexico EID, additional modifications to the original scope of work and completion schedules were agreed to in early January 1988 by Maverik and the EID. These included, as agreed to in the January 8, 1988 letter to the EID and as summarized in Table 5, a Phase II scope of work to include contaminant source and remedial action investigations and this Phase II completion report; and future reduced selective water quality sampling (Round 3) with a subsequent Round 3 water quality data report.

The Phase II scope of work originally included auger drilling of only 14 boreholes with 28 samples for laboratory analyses. In order to accurately define the vertical and lateral extent of contamination, 15 additional boreholes were drilled, 37 samples taken for laboratory analyses and 101 samples field tested with the OVA meter. The additional boreholes were required to define the contaminant boundaries, both vertically and laterally, from the original borehole site, as contamination was detected.

HYDROGEOLOGY

LOCAL

Detailed descriptions of the local as well as regional hydrogeology at the study site are included in the Phase I Dames & Moore report (February 1988). A summary of the key hydrogeologic characteristics pertinent to subsurface soil and solid waste contaminant impacts to the ground water are presented herein.

The study site, located approximately 0.4 mile north-northeast from the existing banks of the San Juan River is within the existing floodplain and is part of the regional ground water discharge system to the San Juan River. The underlying formation and aquifer is primarily Quaternary Valley fill alluvium (QAL) and Quaternary terrace gravel of silt, sand and gravel on river terrace surfaces. Bedrock at the site is dry and consists of the lower shale member of the Cretaceous Kirtland Shale Formation. The aquifer is a shallow, thin (less than 35 feet thick), alluvial-gravel aquifer that overlies the shale.

Flows in the alluvial gravel aquifer are from the north-northeast to the south-southwest discharging toward the San Juan River. The hydraulic gradient is approximately 0.01 ft/ft at a velocity of about 3 ft/day along the top of the underlying unsaturated Kirtland Shale Formation. Flows in the shallow siltier saturated zones near the irrigation ditches are significantly impacted by the irrigation ditch waters as well as by the topographic gradient toward the San Juan River which, as would be expected, is the same as the hydraulic gradient of the water table, about 0.01 ft/ft. There is no significant vertical hydraulic gradient in the shallow alluvial aquifer from the upper silty-clayey sand zone to the deeper sand and gravel zone.

Private water wells in the area are typically completed at depths between 15 and 40 feet and receive their waters from the permeable gravels and sands in the lower part of the water table aquifer.

The water table depth near the study site ranges from about 0.3 to 8 feet when the nearby irrigation ditches are flowing and recharging the ground waters, and from about 0.6 to 14 feet when there are no irrigation flows. On-site in the southern part of the tank farm and off-site to the southwest, the upper 20 feet of the water table aquifer is generally silty-clayey sand. In the southwestern part of the tank it is this lower permeable upper zone that has been impacted by the tank farm.

Coarser-grained sands and gravels are found at shallow depths in the northern part of the refinery. The cross-sections A-A' and B-B' in Appendix A illustrate this gradation. Contamination in the northern part of the refinery is within this upper gravel zone and grades into the silty-clayey sands to the south.

As discussed in detail in the Dames & Moore Phase I Addendum Report, the West Side Irrigation Ditch has directly impacted the amount of contaminated ground water which flowed off-site to the southwest. Maverik's construction of the interceptor trench (Plate 2) in March 1988, and subsequent capture of significant amounts of the on-site tank farm contaminants should further reduce subsurface contaminant migration off-site.

On the basis of this Phase II study (which shows significantly high levels of organic contaminants in the soils on-site and to a lesser extent off-site), and the low levels of organic contaminants previously detected in the ground waters off-site, it appears that the West Side Irrigation Ditch has served as an effective contaminant control mechanism. The ditch has intercepted significant amounts of organic contaminants in the ground water that otherwise would have migrated further south and southwest resulting in much higher levels of organic compounds than those detected in the downgradient monitor wells and private wells.

SUBSURFACE SOIL AND SOLID WASTE CONTAMINATION

BACKGROUND SOIL CHEMISTRY

Borehole 11, upgradient and in the northeast corner of the tank farm near background monitor well 1 (MW-1), was drilled and a sample from 10-12 feet analyzed for volatile organics. None were detected. The percentage oil, water and solids in this sample at 10 to 12 feet was 1.9 percent, 75.6 percent and 22.5 percent. The isopach map which shows the sample sites with non-detectable or very low concentrations of volatile organics as well as those with detectable levels is presented on Plate 3.

In addition, background (near 0) OVA levels were measured at BH-12, BH-14, BH-16, BH-19, BH-31, BH-35, BH-37, BH-38, BH-39 and BH-42 off-site to the west and at BH-7, BH-18, BH-25, and BH-28 on-site in the southern part of the tank farm. The boreholes off-site to the southwest where background OVA levels were measured were outside of the narrow plume which extends off-site from the southwest corner of the tank farm. The on-site boreholes that did not intercept contaminated soils were east and generally outside of the berms that surround the tanks.

No volatile organics were detected with the OVA meter at the following depths in the following boreholes: BH-2 (15-17 feet), BH-3 (15-17 feet), BH-4 (15-17 feet), BH-5 (10-12 feet; 15-17 feet), BH-6 (15-17 feet), BH-7 (5-7 feet; 10-12 feet; 15-17 feet), BH-12 (10-12 feet) and BH-14 (6-7 feet). With the exception of BH-12 and BH-14 located west of the tank farm, the other boreholes are located in the southwest part of the tank farm within the bermed areas surrounding the tanks.

Volatile contaminants were encountered in all of these on-site boreholes in the upper zone to a depth of about 12 feet. The fact that the deeper zones did not supports the ground water quality data and other soil chemistry data that show that it is primarily the upper subsurface zone that is significantly contaminated.

OVA readings from cores at BH-2 (15-17 feet) and BH-3 (15-17 feet) measured between 50 and 400 ppm and 300 to 700 ppm, respectively, but no volatile organics were detected in the laboratory above the given detection limits in these deeper zones (see Table 2). As with the aforementioned boreholes, volatile organics were detected in the shallow core samples above these zones, however. Borehole 2 is located southwest of an unleaded fuel tank and BH-3 is located in a sludge pit just south of the crude oil tank.

METALS

Metals analyses were conducted on samples from six boreholes on-site, two of which were from known sludge pits (Table 3). Total metals analyses were conducted on five of the samples and one EP toxicity test was conducted on a sludge sample from BH-3. The 8 to 12 metals analyzed for total concentrations are metals of concern at refineries ("Skinner List") and include the eight RCRA metals required for EP toxicity testing.

The metals concentrations measured in the EP toxicity test leachate at BH-3 were below detection levels for all metals except barium; the concentration of this metal was 2.7 mg/l compared with the regulatory threshold limit of 100 mg/l. The field OVA readings (>1,000 ppm) and gray to black sand encountered in the sample from BH-3 at 11 feet verify that this zone is contaminated.

Subsurface soil samples from the southwestern part of the tank farm at BH-1 (10 to 11.5 feet) and BH-2 (7 feet) exhibited low total metals concentrations.

The samples from BH-21 (1.25 feet) and BH-22 (3.5 feet) in the northwest part of the tank farm were from surface sludge samples. Metals concentrations were low, with barium, lead and vanadium detected at BH-21 near the No. 5 Fuel Oil Tank. Only barium, also at a low level, was detected at BH-22. BH-22 is located near the No. 1 Diesel Fuel tanks and north of BH-21.

The sludge sample from BH-26 to the east contained somewhat higher metals concentrations of arsenic, chromium, barium and lead.

As shown on Table 3 (Footnote 2), the concentrations of the metals from all of these samples are low and fall within the range for common soils.

Total organic lead (TOL) was detected at greater than 1 mg/kg (detection limit) only at BH-4 and at BH-5. The levels were 4 mg/kg and 2 mg/kg, respectively, at less than 7 feet deep. These boreholes are near the gasoline blending and leaded gasoline tanks. TOL was not detected (less than 1 mg/kg) at BH-1 and BH-7 also near the leaded gasoline tank but in the southwest (downgradient) corner of the tank farm.

ORGANIC COMPOUNDS

ON-SITE

Volatile Organics

Of the 14 boreholes (a total of 31 subsurface soil samples and 3 solid waste surface sludge samples) analyzed for volatile organics on-site, very high levels of volatile organic compounds were present in 16 of the samples and detectable levels of volatile organics in 6 samples on-site. Volatiles were analyzed for only one sample (BH-13) off-site.

The volatiles detected were benzene, o & p and m xylenes, toluene and ethylbenzene. The concentrations of these compounds are best summarized in Table 2 and the vertical and lateral extent shown on Plates A-15 through A-19 (cross-sections) and Plates B-1 through B-5 (isoconcentration maps), respectively.

The concentrations of the compounds were reported by RMAL in ug/kg which is in parts per billion. Consequently, although the numbers are high, the units magnify the actual concentrations. For example, if the concentrations had been reported in mg/kg (parts per million), all of the levels would have been decreased by three orders of magnitude.

The volatile organic compound 1,2-DCA has been detected in the ground waters on-site at very high levels (2,400 ug/l at MW-12) and off-site about 1,000 feet to the southwest at trace levels (7.7 ug/l to 16 ug/l). This compound is the only organic parameter found in the ground water off-site at this distance from the tank farm. It was not, however, detected in any soil or solid waste sludge samples.

Based on the 1,2-DCA levels in the on-site and off-site ground waters and the fact that 1,2-DCA is highly mobile, significant amounts of this compound have gone into solution and moved off-site via ground water flow and transport. The water solubility of 1,2-DCA is 8,520 mg/l as compared to the solubilities of the other volatile compounds detected which ranged from 0.3 mg/l to 1,750 mg/l (Table 4).

As shown on Plates B-1 through B-5, three distinct contaminant areas are depicted by isoconcentration contours. The northern contours depict surficial concentrations of the volatiles in the sludges and surface soils. The central contour shows the contamination between the No. 5 Fuel Oil Tank and the Crude Oil Tank at 10 to 12 feet in the zone sampled with the highest (>1,000 ppm) OVA readings. The highest concentrations of volatile contaminants on-site are found in the upper 5 to 7 feet in the southwest corner of the tank farm between the Crude Oil and Gasoline Tanks to the north and the 2.4 million gallon Leaded Gasoline Tank to the south (BH-1 through BH-6). Tnis is the area of the leaded gasoline spill and a solid waste sludge disposal area (BH-3).

The isoconcentration contours for the volatile organic compounds for this southwestern area are drawn for the upper 5 to 7 feet, the zone of maximum contamination in this part of the tank farm. Concentrations in the 10 to 12 foot zone were not contoured in this area since the contamination was significantly less, and at 15 to 17 feet, very low or not detectable. The lateral extent of the high contaminant levels in this area is well defined based on the low levels of the volatile compounds at BH-8 and BH-9 to the east, at BH-7 to the south and at BH-13 and BH-15 to the west. The northern boundary is not well defined due to contaminant impacts from the Crude Oil Tank to the north.

To summarize the data presented in Table 2, the values of the isoconcentration contours reflect the general range of the contaminant level for each compound in the upper 5 to 7 feet in the southwestern corner of the tank farm. The isoconcentration contours ranged as follows: 20,000 ug/kg to 200,000 ug/kg for m-xylene (Plate B-1), 1,000 ug/kg to 100,000 ug/kg for o & p xylene (Plate B-2), 3,000 ug/kg to 40,000 ug/kg for ethylbenzene (Plate B-3), 1,000 ug/kg to 200,000 ug/kg for toluene (Plate B-4) and 200 to 20,000 ug/kg for benzene.

Based on the Phase I work and water quality data for shallow MW-12 located in this southwestern area, benzene, toluene, total zylene and ethylbenzene were also found at very high levels in the ground water (24,000 ug/l, 20,000 ug/l, 10,000 ug/l, and 1,500 ug/l, respectively).

Concentrations of m-xylene, o & p xylene and ethylbenzene, were very high in the 10 to 12 foot zone in BH-10 and BH-23 in the central part of the tank farm between the No. 5 Fuel Oil Tank and the Crude Oil Tank. Toluene was at a very high level at BH-23 (19,000 ug/kg) and although benzene was present at BH-23 at 670 ug/kg and at 410 ug/kg at BH-10, it was at much lower levels than in the samples from the southwest or northwest of the tank farm. The isoconcentration contours for the central area range as follows: 70,000 ug/kg for m-xylene, 10,000 ug/kg to 30,000 ug/kg for o & p xylene, 10,000 ug/kg for ethylbenzene, 1,000 ug/kg to 19,000 ug/kg for toluene, and 500 ug/kg for benzene.

Concentrations of the volatile contaminants in the surficial soils and sludge (BH-21 and BH-22) in the northwest part of the tank farm are lower than in the southwest and central parts of the tank farm with the exception, as mentioned, of benzene. The isoconcentration contours range as follows: 10,000 ug/kg for m-xylene, 5,000 ug/kg for o & p xylene, 1,000 ug/kg for ethylbenzene, 10,000 ug/kg for toluene, 1,000 ug/kg to 2,000 ug/kg for benzene.

Total Chromatographable Organics

TCO analyses are used to detect concentrations of hydrocarbons including aliphatics and semivolatiles. Concentrations were detected at 9 of 10 of the sample sites (Table 2). As shown on Plate B-6, Appendix B, the highest TCO levels (54,000,000 ug/kg to 130,000,000 ug/kg) were detected in the northwest corner of the tank farm and to the east in the sludge pit (BH-26). Fuel and stove oil, gas and diesel fuel are the likely contaminants at BH-22, BH-21 and BH-20. These boreholes are located near the No. 5 Fuel Oil and Stove Oil Tanks. Heavy end products (oils) and some lighter end products (i.e., diesel) are present in the sludge pit (BH-26).

High TCO levels were detected at BH-23 (2,900,000 ug/kg from gasoline and oil) and (at a lower level of 250,000 ug/kg) at BH-24 to the south (from gasoline and diesel). These boreholes are located near the No. 5 Fuel Oil tank and Crude Oil tank, respectively.

High TCO levels (2,800,000 ug/kg) detected at BH-4 near the leaded gasoline and gasoline blending tanks were primarily from gasoline (from the leaded gasoline spill) and possibly diesel fuel.

No hydrocarbons were detected at BH-7 which is located just southwest of the leaded gasoline tank and lower TCO levels were detected at BH-8 (2,100 ug/kg) from gasoline. Lower TCO levels were also detected at BH-10 (40,000 ug/kg, from fuel oil and gasoline). BH-10 is located near the No. 5 Fuel Oil Tank.

With the exception of the samples from BH-20, BH-22 and BH-26, the subsurface soil and solid waste samples consisted of at least 70 percent solids, less than 6 percent oil and 10 to 25 percent water. In contrast, the soil and sludge samples from BH-20, BH-22 and BH-26 contained 10.3 percent, 93.7 percent and 51.3 percent oil, 78.8 percent, 4.3 percent and 39.7 percent solids, and 10.9 percent, 2 percent and 9 percent water, respectively. The high percentages of oil from BH-20, BH-22 and BH-26 reflect the fact that these samples consist of solid waste (sludge) material from the tank farm.

Samples with only slightly elevated percentages of oil (i.e., from 2.6 to 5.6 percent) were present at BH-4, BH-6 and BH-7 in the southwest corner of the tank farm near the gasoline blending and leaded gasoline tanks and at BH-21 to the north, near the No. 5 Fuel Oil Tank. The higher percentage of oil in these samples was likely due to the proximity of these sample sites to the tanks and past tank spills and leakage.

Detailed discussion of the TCO results including boiling points, RMAL's "type" chromatograms for gasoline, diesel fuel, oil, kerosene and a C10-C36 sample, and the chromatograms are included in Appendix D. The chromatograms indicate very high levels of primarily oil, gasoline and some diesel in the northwest corner of the tank farm; high levels of primarily diesel fuel and gasoline in the southwest corner; high levels of fuel oil and gasoline or diesel fuel in the west-central area; and primarily oil in the eastern sludge pit (BH-26), as discussed in Appendix D.

Semivolatiles

In addition to the 10 values for TCO, (which indicate the maximum possible concentration of semivolatiles present) specific refinery semivolatiles were analyzed for 4 samples on-site (BH-1, BH-2, BH-21 and BH-22). The semivolatiles detected were bis(2-ethylhexyl)phthalate, 1-methylnaphthalene, naphthalene, phenanthrene and chrysene. Chrysene was detected only at BH-22 at 28,000 ug/kg.

These compounds, except for chrysene, were detected at the highest levels in BH-2 to the south near the no-lead tank, at 7 feet at concentrations of 4,400 ug/kg, 6,500 ug/kg, 5,800 ug/kg, 1,200 ug/kg and <990 (detection level), for the aforementioned compounds as listed, respectively. Semivolatiles were not detected in BH-1 at 10 to 11.5 feet however. BH-1 is located southwest of BH-2 about 70 feet, and just south of a Gasoline Blending Tank.

The two surface solid waste samples from the northwest corner of the tank farm (BH-21 and BH-22) contained semivolatiles, although the sample from BH-22 contained only phenanthrene and chrysene at 30,000 ug/kg and 28,000 ug/kg, respectively. The sample from BH-21 contained high levels of bis(2-ethylhexyl)phthalate (1,200 ug/kg) and phenanthrene (1,400 ug/kg).

Characteristics of these semivolatile compounds are presented in Table 4. As indicated on Table 4, these compounds have a density close to water, relatively low vapor pressures, are not very soluble in water and tend to be adsorbed by soil and sediment and organic material in the soil. Consequently, the concentrations of semivolatile organics in the ground water are expected to be quite low.

The organic compound bis(2-ethylhexyl phthalate) is a phthalate ester which is a liquid used to make plastics more flexible and it is also used in electrical capacitors as a hydraulic and dielectric fluid. It is not a common semivolatile organic used in oil refinery processes although it frequently is detected at refinery sites.

The polycyclic aromatic hydrocarbons (PAH) are however typical refinery-related organic compounds and except for 1-methylnaphthalene, are priortiy pollutants.

Since these semivolatile organic compounds were detected in the subsurface soils and sludges, analyses for them in the ground water will be conducted at selected sites as part of the Round III water quality sampling program (Table 5). As mentioned previously, the characteristics of these compounds do not lend themselves to dissolution into the ground water and hence if detected at all, should be at low levels.

As previously discussed, TCO analysis gives an indication of the maximum concentration of semivolatiles. The TCO results show the highest levels of semivolatiles in the northwest corner, in the central area by the No. 5 Fuel

Oil and Crude Oil Tanks, to the south near the Gasoline Tanks and to the east in the sludge pit (BH-26).

ORGANIC COMPOUNDS

OFF-SITE

Volatile Organics

Three shallow borehole samples off-site and within 50 feet of the western edge of the southwest corner of the tank farm were tested for volatile organics. The off-site sample sites include BH-12 (10 to 12 feet), BH-13 (6 to 7 feet) and BH-14 (6 to 7 feet). These sites were selected due to their proximity to the tanks, the on-site surface sludge locations and ground water and surface water contamination observed east of these boreholes on-site. No volatile organics were detected at BH-12 and BH-14.

Volatile organic parameter concentrations at BH-13 at 6 to 7 feet, were 1,400 ug/kg m-xylene, 580 ug/kg o & p xylene, <100 ug/kg 1,2 DCA (i.e., not detected), 67 ug/kg ethylbenzene, 800 ug/kg toluene and 250 ug/kg benzene. In comparison to the contaminant levels on-site to the east (BH-1, BH-5 and BH-6), the levels in BH-13 are significantly lower. In addition, the extent of vertical contamination of volatile organics in BH-13 dropped significantly at 15 feet, from >1,000 ppm to 10 ppm. The OVA readings at BH-12 and BH-14, to depths of 17 feet, were all <1 ppm, verifying that there is no subsurface soil contamination of volatile organics at these two sites and very limited shallow off-site subsurface soil contamination in this area.

No laboratory analyses were conducted on samples from off-site BH-15, BH-32, BH-33, BH-34 and BH-36 (where OVA readings >1,000 ppm were detected). OVA readings >1,000 ppm were recorded to depths of 10.5 feet in BH-15 and to only 3 feet in BH-32 and to 6 feet in BH-33, BH-34 and BH-36. BH-15 is located about 60 feet west of BH-13 and BH-32, BH-33, BH-34 and BH-36 closely parallel (within about 10 feet) the Westside Irrigation Ditch. Although there were no laboratory tests for specific volatiles conducted on these five borehole samples, if there were detectable volatile organic contaminants, the levels would be expected to be at lower concentrations than detected at BH-13, since BH-13 is closer to the contaminant source area.

"Worst-case" off-site and on-site subsurface soil contamination from volatile organics based on the field OVA readings, laboratory analyses and field inspection, is presented on Plate 3. This map shows the areal and vertical extent of subsurface soils potentially impacted by historic tank farm operations. This map shows that the off-site subsurface soil contamination is limited to a small (about 100-foot wide, 10-feet deep and 100-foot long) zone that extends off-site to the southwest. This area corresponds with the ground water plume of 1,2-dichloroethane (DCA), as presented in Appendix B (Plate B-6) of the previous Dames & Moore report (June 1988). Boreholes (BH-15, BH-32, BH-34 and BH-36) that had elevated field OVA readings at shallow depths were key to defining this off-site plume.

The four boreholes drilled about 350 feet from the northwest corner of the tank farm and just south of the refinery (BH-40 through BH-43) intercepted gray to black silty sand and coarse sand and gravel (Plate A-14). Field OVA readings were fairly low (4 ppm to 300 ppm). No laboratory analyses for organics or metals were conducted on these samples.

CONCLUSIONS

The conclusions from this Phase II subsurface soil and solid waste contaminant evaluation are based on the work presented in the Dames & Moore reports (February 1988 and June 1988) and the data and evaluation presented herein of both on-site and off-site surface and subsurface conditions at the Maverik Refinery and Tank Farm near Kirtland, New Mexico. This work has reconfirmed the conclusions presented in the Phase I Hydrogeologic Evaluation - Addendum Report (June 1988) and has confirmed the following major findings:

1. The most significant concentrations of typical refinery-related volatile organics benzene, toluene, ethylbenzene, xylene and other hydrocarbons have been found primarily in the upper 7 to 12 feet of the silty-clayey sand zone at the refinery tank farm in the southwest corner where a leaded gasoline spill occurred, where the Crude Oil Tank sludge was placed and near the Gasoline and Gasoline Blending Tanks. High levels of these volatile organics have also been detected in the northwest corner of the refinery tank farm but in the shallow sands and gravels which grade into silty-clayey sands to the south. No 1,2-DCA was detected in the soils or sludge due to its high solubility and transport by ground and surface waters.

2. High concentrations of the semivolatile organics (including bis(2-ethylhexyl)phthalate, 1-methyl-naphthalene, naphthalene, phenanthrene and chrysene) have been detected on-site primarily in the northwest corner, in the central part, in the eastern sludge pit and in the upper 7 feet in the southwest corner of the tank farm.

3. Elevated concentrations of hydrocarbons, primarily oil, gasoline and diesel fuel, have been detected throughout the western part of the tank farm, in the solid wastes (sludges) found on-site in the northwest corner and in the eastern sludge pit, within the tank farm boundaries. High levels of hydrocarbons, primarily gasoline and diesel fuel were found in shallow subsurface soils in the central part of the tank farm and some were detected in the far southwest corner.

4. The concentrations of the eight RCRA metals tested using the EP toxicity test indicated that these metals concentrations in the subsurface soils are very low and not at levels considered toxic. The total metals concentrations in the subsurface soils in the southwest part of the tank farm as well as in the surface solid waste (sludge) samples in the east and northwest corner are low and typical of metals concentrations in soils.

5. Off-site contamination of the subsurface soils appears to be limited to two areas: a small 100-foot long, 10-foot deep and 100-foot wide zone immediately west of the southwest corner of the tank farm in the silty clayey sand, and a small 80-foot diameter area just south of the refinery and about 300 feet west of the northwest corner of the tank farm. The concentrations of the volatile organics in the subsurface soils off-site to the southwest are either below detection levels and/or are much lower than on-site, with xylene, ethylbenzene, toluene and benzene being the only volatile organics detected. Low field OVA readings in the northwest (4-300 ppm) were recorded in the 80-foot diameter zone off-site.

6. The subsurface soil laboratory data analysis for 37 samples and the field OVA data for 101 samples verified that the major contamination to the underlying soils from the tank farm operations is within the upper 7 to 12 feet and is not detected beyond a depth of about 15 to 20 feet. In the southwest part of the tank farm and downgradient to the south and west and off-site, the contaminated zone is principally a silty-clayey (low permeable) fine sand zone that overlies the coarser sand and gravel zone from which the downgradient private wells receive their water.

7. The contaminant source areas defined from the Phase II study include: the solid waste sludges in the northwest corner of the tank farm; the eastern sludge pit; the subsurface soils in the southwest corner contaminated from the leaded gasoline spill; the west-central part of the tank farm near the No. 5 Fuel Oil Tank; the Crude Oil Tank and the No-Lead Gas Tanks; the sludge disposal area south of the Crude Oil Tank.

8. The significantly high concentrations of the volatile and semivolatile organic compounds at the tank farm in both the sludges and subsurface soils, and the low concentrations of these same constituents in the ground water off-site can be accounted for by the Westside Irrigation Ditch effects. When dry, this ditch has served as an effective collection sump for contaminated ground waters that move off-site to the southwest. This ditch has prevented widespread movement of contaminated ground water off-site. When flowing, the ditch has served as a ground water boundary and recharge (dilution) mechanism to ground water movement off-site. The interceptor trench built in March 1988 has been even more effective than the ditch, (due to its location and depth), in collecting contaminants before they can migrate off-site.

9. As presented in our Phase I reports, only low concentrations of organic contaminants at trace levels or slightly above NMEID drinking water standards, have been detected off-site in the ground water. This along with the fact that the downgradient wells are not used for drinking water purposes confirm that the releases from the tank farm have not posed and do not pose an immediate threat to human health and the environment. Identification of the contaminants in the ground water, in the solid waste sludges and in the subsurface soils, and delineation of the contaminant source areas will be included in developing the remediation proposal.

REFERENCES

Arizona Department of Health Services, March 13, 1987. Draft Policy for Establishing Drinking Water Action Levels and Soil Cleanup Levels.

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.

EPA, April 1983. Hazardous Waste Land Treatment, SW-874, p. 273.

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

TABLE 1

LABORATORY SOIL AND SOLID WASTE PARAMETERS

HALOGENATED VOLATILE ORGANICS
EPA METHOD 8010

Bromoform
Carbon Tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Dibromochloromethane
Bromodichloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-dichloropropene
Bromoethane
Chloromethane
Methylene chloride
1,1,2,2-Tetrachloroethane
Tetrachloroethene
trans-1,2-Dichloroethene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl chloride
1,1,2-Trichloro-
1,2,2-trifluoroethane
1,2-Dibromoethane (EDB)

AROMATIC VOLATILE ORGANICS
EPA METHOD 8020

Benzene
Chlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Ethylbenzene
Toluene
m-Xylene
o & p-Xylene(s)

TOTAL CHROMATOGRAPHABLE ORGANICS
GC/FID METHOD

Total Chromatographable Organics
Initial Boiling Point
Final Boiling Point

REFINERY HAZARDOUS CONSTITUENT VOLATILES
EPA METHOD 8240

Benzene
Carbon disulfide
Chlorobenzene
Chloroform
1,2-Dibromoethane
1,2-Dichloroethane
1,4-Dioxane
Methyl ethyl ketone
Styrene
Ethylbenzene
Toluene
m-Xylene
o & p-Xylene(s)

REFINERY HAZARDOUS CONSTITUENT SEMIVOLATILES
EPA METHOD 8270

Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
bis(2-Ethylhexyl)phthalate
Butylbenzyl phthalate
Chrysene
Dibenz(a,h)anthracene
Di-n-butyl phthalate
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Diethyl phthalate
7,12-Dimethylbenzanthracene
Dimethyl phthalate
Di-n-octyl phthalate
Fluoranthene
Indene
1-Methylnaphthalene
Naphthalene
Phenanthrene
Pyrene
Pyridine
Quinoline
Benzenethiol
o-Cresol
p & m-Cresol
2,4-Dimethylphenol
2,4-Dinitrophenol
4-Nitrophenol
Phenol

TABLE 1 (Continued)

EP TOXICITY TEST, METALS EPA 1310 EXTRACTION METHOD	EPA ICP,GF METHODS	INORGANIC PARAMETERS FREON EXTRACTION GRAVIMETRIC
Arsenic	7060	Oil
Barium	6010	Water
Cadmium	7131	Solids
Chromium	6010	
Lead	7421	
Mercury	7471	
Selenium	7740	
Silver	7761	

METALS PARAMETERS TOTAL METALS SW-846 METHOD	EPA METHOD
Antimony	6010
Arsenic	7060
Barium	6010
Beryllium	6010
Cadmium	6010
Chromium	6010
Cobalt	6010
Lead	6010
Mercury	7470
Nickel	6010
Selenium	7740
Vanadium	6010
Total Organic Lead	ENSECO Special

Note: For detail of methodology see ENSECO'S (RMAL) attached report (Appendix C).

TABLE 2

LABORATORY RESULTS FOR DETECTED ORGANIC CONSTITUENTS IN SUB-SURFACE SOILS
AND SOLID WASTE FOR MAVERIK COUNTRY STORES, REFINERY TANK FARM, KIRTLAND, NEW MEXICO

April 1988

Sample Site Designation And Depth Sampled (in feet)	1-2 DCA (ug/kg)	Volatiles m-xylene (ug/kg)	Volatiles o&p-xylene(s) (ug/kg)	Ethylbenzene (ug/kg)	Toluene (ug/kg)	Benzene(1) (ug/kg)	TOL Total Organic Lead (mg/kg)	TCO Total Chromatographable Organics (ug/kg)	Semivolatiles bis (2-Ethylhexyl) phthalate (ug/kg)	Semivolatiles 1-Methyl-naphthalene (ug/kg)	Semivolatiles Naphthalene (ug/kg)	Semivolatiles Phenanthrene (ug/kg)	Semivolatiles Chrysene (ug/kg)	OVA (ppm)	Oil %	Solids %
Boreholes																
On-Site																
BH-1 (5-6.5)	<1,000(1)	130,000	98,000	22,000	84,000	3,900	-(2)	-	-	-	-	-	-	>1,000	0.4	86.4
BH-1 (10-11.5)	<200	6,300	3,500	710	4,600	1,800	<1	-	<330	<330	<330	<330	<330	1,000 - 600	0.2	83.1
BH-1 (15.5-17)	<100	79	140	<50	<50	380	-	-	-	-	-	-	-	70 - 1	1.1	83.8
BH-2 (5-7)	<2,000	210,000	120,000	39,000	170,000	21,000	-	-	-	-	-	-	-	>1,000	1.0	85.1
BH-2 (7)	<5,000	99,000	69,000	15,000	65,000	<5,000	-	-	4400	6,500	5,800	1,200	<990	>1,000	1.0	85.1
BH-2 (10-12)	<670	39,000	21,000	7,000	27,000	2,500	-	-	-	-	-	-	-	800	0.8	80.8
BH-2 (15-17)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	400 - 50	0.9	84.2
BH-3 (5-7)	<1,000	17,000	90,000	26,000	13,000	5,200	-	-	-	-	-	-	-	>1,000	1.5	84.5
BH-3 (11)	-	-	-	-	-	-	-	-	-	-	-	-	-	>1,000	-	-
BH-3 (10-12)	<100	170	730	240	83	140	-	-	-	-	-	-	-	>1,000	0.1	81.5
BH-3 (15-17)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	700 - 300	1.6	82
BH-4 (5-7)	<2,000	170,000	120,000	29,000	160,000	24,000	4	2,800,000	-	-	-	-	-	>1,000	1.3	75
BH-4 (10-12)	<100	276	<50	<50	68	<50	-	-	-	-	-	-	-	15 - 1	5.2	79.4
BH-4 (15-17)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	1	1.0	76.9
BH-5 (5-7)	<1,000	37,000	25,000	6,000	25,000	2,000	2.0	-	-	-	-	-	-	>1,000	0.8	78.1
BH-5 (10-12)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	50 - 40	0.4	81.3
BH-5 (15-17)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	1	1.3	77.7
BH-6 (5-7)	<2,000	170,000	150,000	37,000	140,000	19,000	-	-	-	-	-	-	-	>1,000	0.4	78.9
BH-6 (10-12)	<100	390	340	53	190	<50	-	-	-	-	-	-	-	>1,000 - 10	5.6	71.7
BH-6 (15-17)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	1	0.8	80.7
BH-7 (5-7)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	10	2.3	83.8
BH-7 (10-12)	<100	<50	<50	<50	<50	<50	<1	<1,700	-	-	-	-	-	1	2.7	75.7
BH-7 (15-17)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	1	1.5	80.7
BH-8 (10-12)	<100	360	360	57	400	71	-	2,100	-	-	-	-	-	90 - 40	1.3	81.9
BH-9 (5-7)	<100	630	660	180	240	57	-	-	-	-	-	-	-	>1,000	0.8	78.2
BH-10 (12)	<100	63,000	13,000	10,000	870	410	-	-	-	-	-	-	-	>1,000	0.7	83.5
BH-10 (17)	-	-	-	-	-	-	-	40,000	-	-	-	-	-	>1,000	-	-
BH-11 (10-12)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	1	1.9	75.6
BH-20 (5-7)(sludge)	<100	130	150	76	120	75	-	54,000,000	-	-	-	-	-	>1,000	10.3	78.8
BH-21 (0-1.25)(surface)	<100	3,400	1,700	<100	<100	110	-	60,000,000	1,200	<990	<990	1,400	<990	>1,000	2.6	91.4
BH-22 (0-0.5)(sludge)	<200	10,000	6,100	1,800	11,000	2,000	-	130,000,000	<10,000	<10,000	<10,000	30,000	28,000	300 - 200	93.7	4.3
BH-23 (10-12)	<1,000	72,000	35,000	12,000	19,000	670	-	2,900,000	-	-	-	-	-	>1,000	0.1	88.5
BH-24 (5-11.5)	<200	17,000	10,000	2,400	2,100	<100	-	250,000	-	-	-	-	-	>1,000	0.2	89.2
BH-26 (0-1)(sludge)	-	-	-	-	-	-	-	130,000,000	-	-	-	-	-	1,000 - 200	51.3	39.7
Off-Site																
BH-12 (10-12)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	1	0.3	79.4
BH-13 (6-7)	<100	1,400	580	67	800	250	-	-	-	-	-	-	-	>1,000	1.4	81.8
BH-14 (6-7)	<100	<50	<50	<50	<50	<50	-	-	-	-	-	-	-	1	1.0	78.2

Footnotes:

(1) < Indicates below the detection (reporting) limit.

(2) - Indicates Not Analyzed

TABLE 3

LABORATORY RESULTS FOR DETECTED METALS IN SUB-SURFACE SOILS AND SOLID WASTE FOR MAVERIK COUNTRY STORES, REFINERY TANK FARM KIRTLAND, NEW MEXICO

On-Site Sample Designation And Depth Sampled (in feet)	Total Metals Concentrations (mg/kg)[1,2]												
	Sb	As	Ba	Be	Cd	Cr	Co	Pb	Hg	Ni	Se	Vn	Ag
BH-1 (10-11.5)	<5[3]	1.8	140	0.3	<0.5	3	3	9	<0.05	5	<0.2	11	-[3]
BH-2 (7)	<5	1.0	110	0.2	<0.5	3	2	13	<0.05	<4	<0.4	10	-
BH-21 (0-1.25) (surface)	<5	1.2	110	0.2	<0.5	2	2	8	<0.05	<4	<0.2	12	-
BH-22 (0-0.5) (sludge)	<5	<0.3	9.4	<0.1	<0.5	<1	<1	<5	<0.05	<4	<0.2	<1	-
BH-26 (0-1) (sludge)	-	9	63	-	<0.5	12	-	98	<0.05	-	<0.2	-	<0.5

	Leached Metals Concentrations (mg/l)							
	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
BH-3 (11) (EP Tox Test)	<0.1	2.7	<0.005	<0.01	<0.05	<0.001	<0.02	<0.005

Footnote:

(1) The parameters abbreviated are as follows:

Sb Antimony
As Arsenic
Ba Barium
Cd Cadmium
Cr Chromium
Co Cobalt
Pb Lead
Hg Mercury
Ni Nickel
Se Selenium
Ag Silver
Vn Vanadium

(2) Based on EPA (1983), Hazardous Waste Land Treatment, SW-874 (revised), common ranges for metals concentrations in soils are as follows: As 1-50 mg/kg; Ba 100-3,000 mg/kg; Be 0.1-40 mg/kg; Cd 0.01-0.7 mg/kg; Cr 1-1,000 mg/kg; Co 1-40 mg/kg; Hg 0.01-0.3 mg/kg; Ag 0.01-5 mg/kg.

(3) < Indicates below detection limit.

(4) - Indicates Not Analyzed

TABLE 4

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
Tetraethyl lead	323	1.65	0.3-0.8	0.1	4,900	-
Semivolatile Organic Parameters						
Phthlate Esters						
Bis(2-ethylhexyl phthalate	391	0.99	0.28	$3x10^{-7}$	-	75,850
Polycyclic Aromatic Hydrocarbons (PAH)						
1-Methyl naphthalene	142	1.02	12	-	-	-
Naphthalene	128	1.02	32	0.05	1,300	2,340
Phenanthrene	178	1.06	1	0.00068	14,000	28,840
Chrysene	228	1.27	0.001	$6x10^{-9}$	200,000	410,000

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

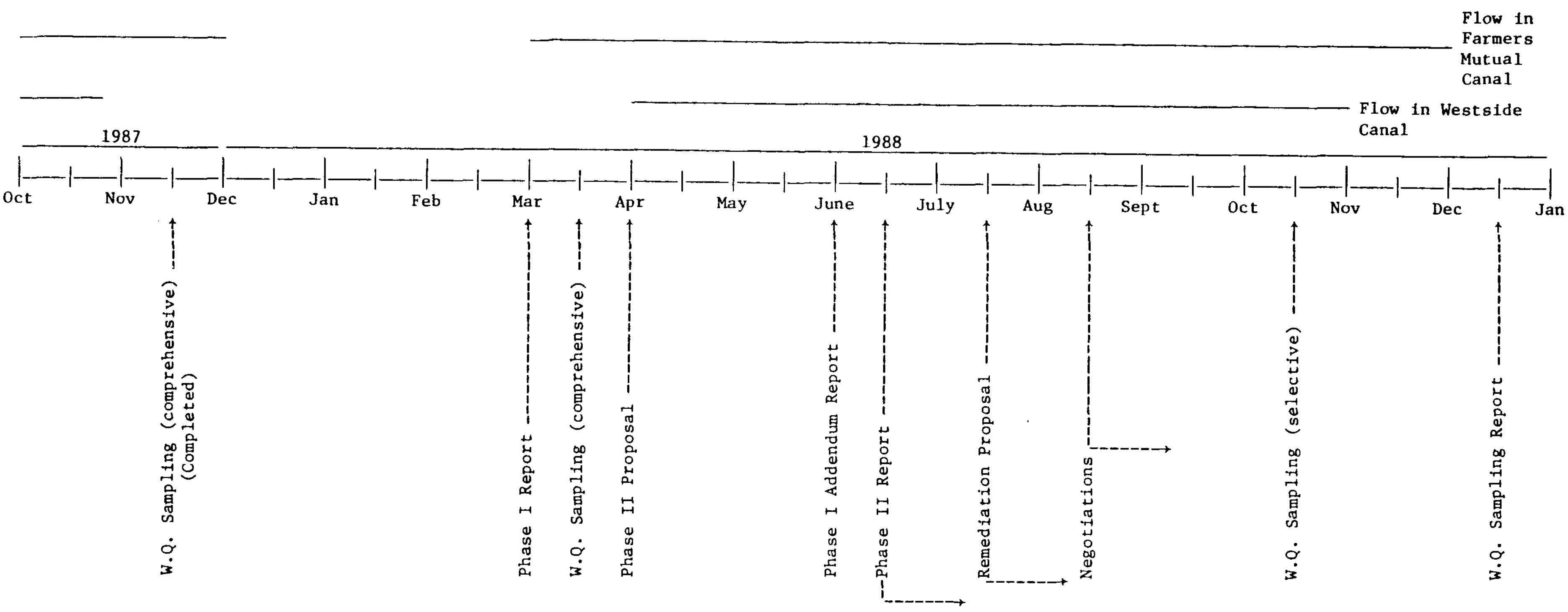
(2) Octanol-water partition coefficient, a measure of the tendency of a chemical at equilibrium to distribute between an organic phase (octanol) and water.

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.

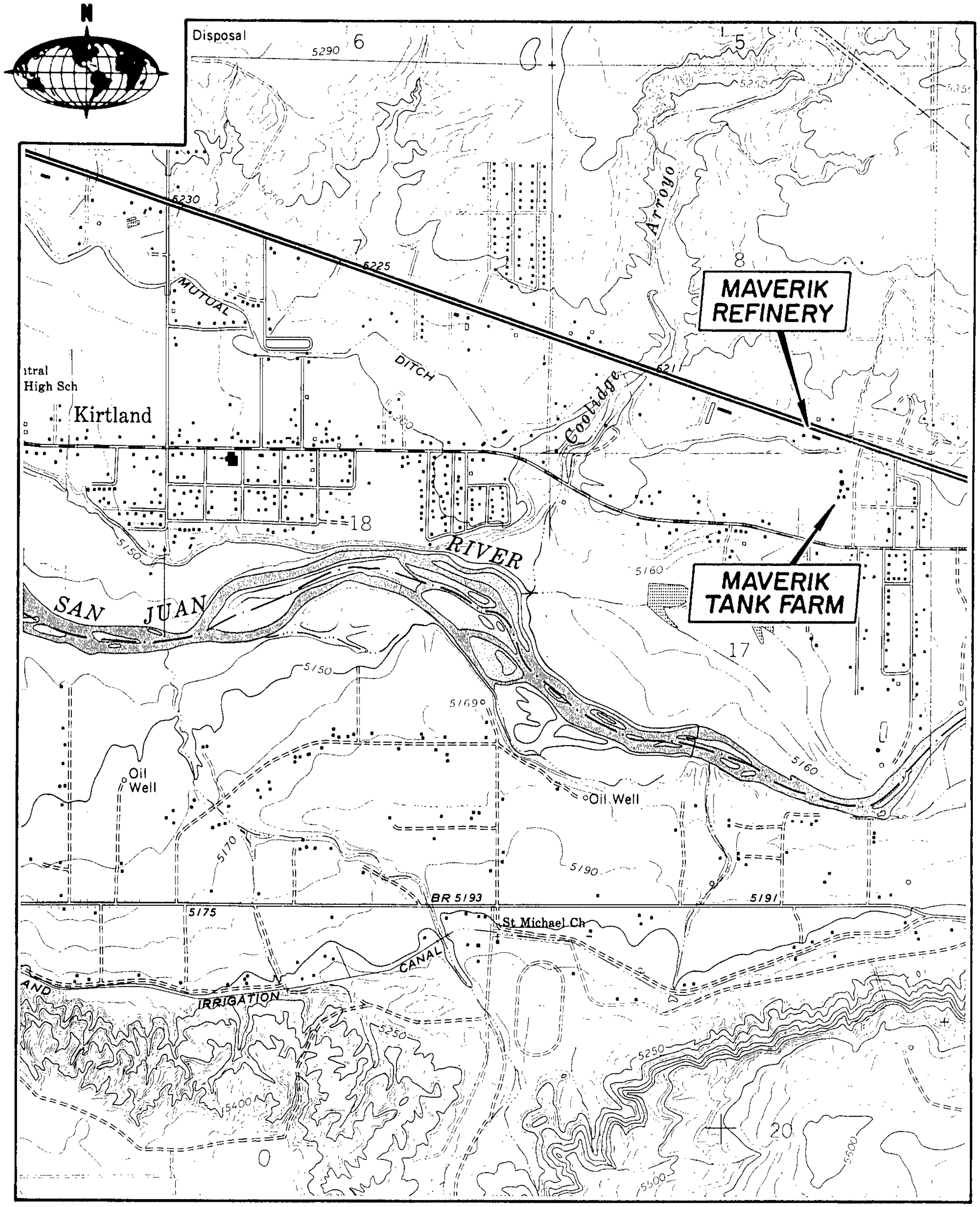
TABLE 5

PROJECT MILESTONE CHART (Revised 6/88) (1)

MAVERIK KIRTLAND, N.M. REFINERY INVESTIGATIONS



Footnote: (1) Due to the increased number of boreholes drilled (from 14 to 43) and laboratory samples (from 28 to 37) for the Phase II work, additional time was required for the laboratory sample analyses and subsequent data evaluation. This also advanced the "Remediation Proposal" completion date to mid-August with "Negotiations" to begin in mid-September. Water quality sampling in the fall and the subsequent data report will be completed at the original proposed times.



SCALE IN FEET
1000 0 1000 2000

VICINITY MAP

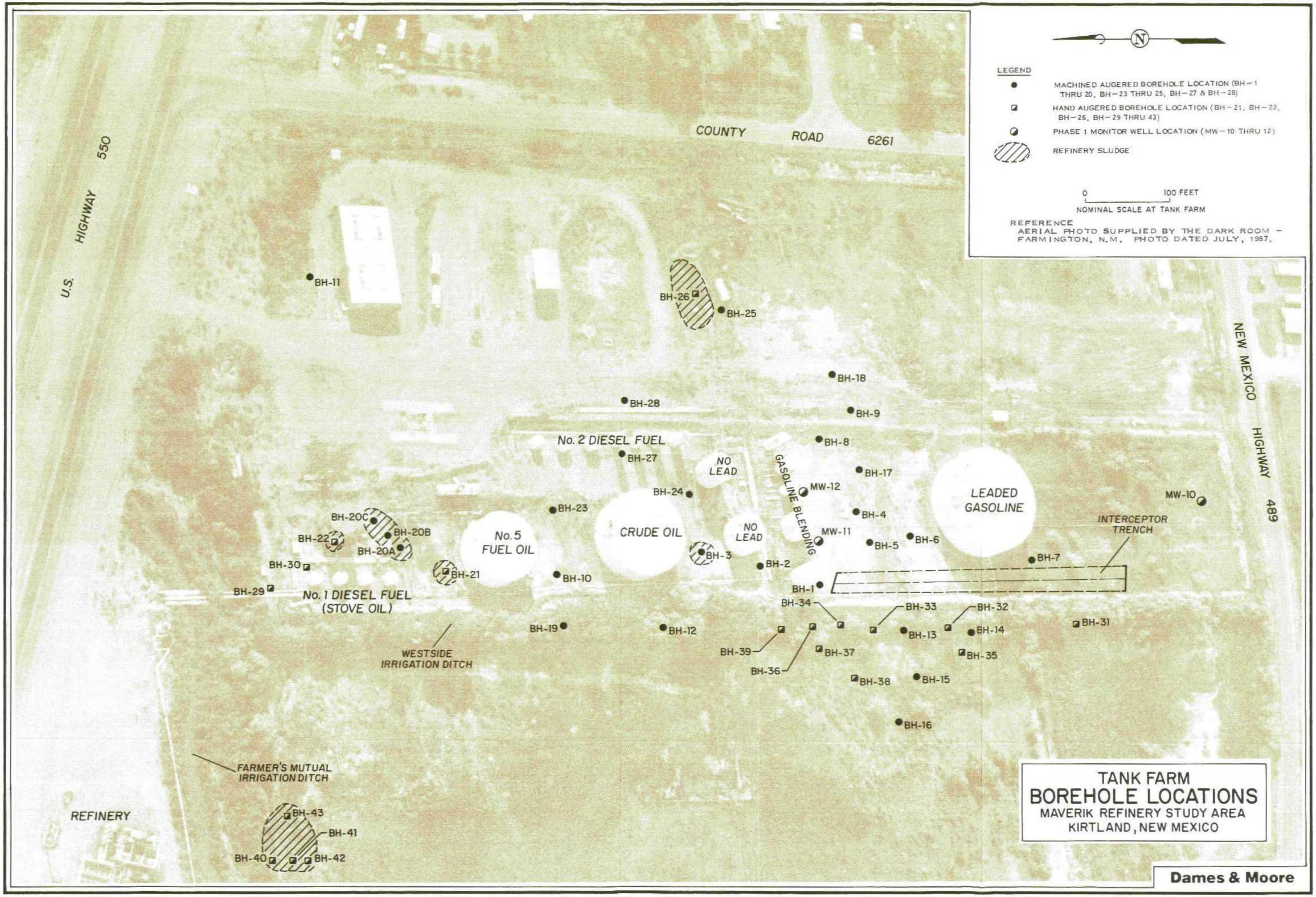
REFERENCE
U.S.G.S. QUADRANGLE ENTITLED
"KIRTLAND, NEW MEXICO" – 1966,
PHOTOREVISED 1979.

Dames & Moore

PLATE I

FILE ___ BY ___ DATE 1/27/87 CHECKED BY ___ DATE ___

FILE 14819-005 MAVERIK BY DATE 5/12/88 CHECKED BY DATE



TANK FARM
BOREHOLE LOCATIONS
MAVERIK REFINERY STUDY AREA
KIRTLAND, NEW MEXICO

Dames & Moore

PLATE 2

FILE #4819-005 MAVERIK BY ____ DATE 6/1/88 CHECKED BY ____ DATE ____

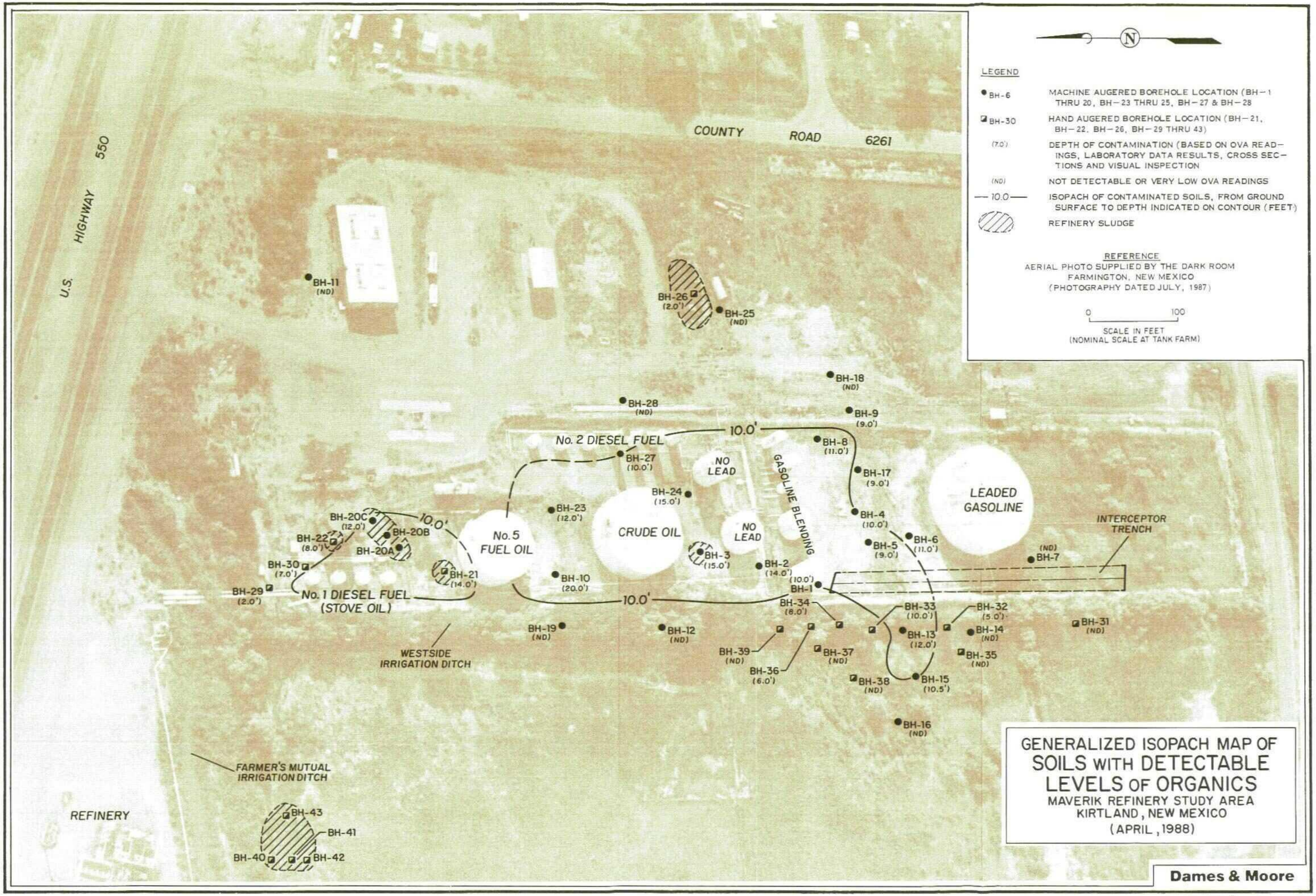


PLATE 3

APPENDIX A

BOREHOLE LOGS AND CROSS SECTIONS

APPENDIX A

BOREHOLE LOGS AND CROSS SECTIONS

BOREHOLE COMPLETIONS

The Phase II surface and subsurface soil evaluation included machine hollow-stem auger drilling 25 (6.25-inch diameter) boreholes to depths from 7 feet to 22 feet (averaging 17 feet), and hand augering 18 shallow boreholes to depths of 0.8 feet to 10 feet.

Detailed geologic logs are included which show borehole depths, subsurface lithology, approximate depth to the saturated zone and field measurements of organic vapor concentrations at specific soil intervals. The logs are presented on Plates A-1 through A-14. Table A-1 summarizes the borehole depths and vertical profile of the volatile organics in the soils based on the organic vapor analyzer (OVA) readings. With the exception of the shallow boreholes that were hand augered and could not be drilled deeper due to auger refusal, the boreholes were drilled to depths where there was no soil contamination where the OVA readings were at or approaching background ($\leq$ 1 ppm). This was done in order to define the vertical extent of contamination.

On-site and off-site geologic cross-sections were prepared. Locations of the cross-sections are shown on Plate A-15 and the cross-section themselves are presented on Plates A-16 through A-19. The geologic logs are based on the Unified Soil Classification System as presented on Plate A-20. These cross-sections, which include the OVA readings, show that elevated OVA levels were detected generally in the upper 17 to 20 feet in coarse gravels and sands in the northwest and downgradient to the southwest both on and off-site in the clayey silty sandy zone. Downgradient and off-site, the upper 17 to 20 foot zone lies above the highly permeable deeper gravel deposits (which were encountered at depth during the Phase I monitor well drilling). Geologic logs from the Phase I monitor wells MW-11, MW-12 and MW-10 were included on two of the Phase II borehole cross-sections (AA' and EE') to show the vertical separation of this deeper gravel zone from the upper low permeable contaminated zone.

Ground elevations at the borehole sites were not available but were estimated for the cross-sections based on the measured ground elevations for the Phase I monitor wells and the U.S.G.S. topographic quadrangle map of Kirtland, New Mexico. The contaminated soil zones were based on both the laboratory analytical data as well as the field OVA readings.

Because the Phase II borehole depths were shallow, the deeper lithologic correlations were inferred based on the Phase I monitor well logs. These correlations are indicated by dashed lines and question marks.

DRILLING AND SAMPLING METHODS

MACHINE AUGERED BOREHOLES

The machine augered boreholes were drilled with a CME Model 55 rotary hollow-stem auger owned by Mountain States Drilling Company from West Valley City, Utah. The auger flights were 3.75-inch inside diameter and 5-feet long. Composite samples were collected from 24-inch long split-spoon samplers.

To prevent potential cross-contamination between samples and drill holes, the split-spoon samplers were washed with high pressure high temperature (190°F) water between samples as were the auger flights after drilling each borehole. The generator and high pressure-temperature washer were on-site for easy accessibility during all of the Phase II drilling.

A Century Model 128 GC OVA meter was used on-site to continuously monitor the drill cuttings and the core samples from the split-spoon samples. OVA measurements were recorded after placing the samples in a plastic bag, to eliminate external interference. OVA readings were used to define the contaminated zones of which select samples were then collected for further comprehensive laboratory testing. A Dames & Moore hydrogeologist was in the field at all times for the drilling, OVA monitoring, sampling and borehole plugging.

The contaminated soil samples for laboratory analyses were taken as composite samples from the contaminated soils in the split-spoon sampler. They were then placed in the appropriate containers supplied by RMAL.

Boreholes were plugged to ground surface with a graded (to 0.75 inch) montmorillonite clay, "Holeplug," a product of NL Baroid, Houston, Texas. Borehole plugging was in compliance with the New Mexico State Engineer Office, Water Rights Division.

HAND AUGERED BOREHOLES

Hand augered boreholes were drilled with a 3-inch diameter stainless steel "Arts Machine Shop" (AMS) auger from Boise, Idaho by Dames & Moore's field hydrogeologist. Hand augered boreholes were required at 18 sites due to inaccessibility and drilling refusal with the machine auger drill rig. The hand augered drill cuttings were also field OVA-tested and collected in plastic bags as they came up during drilling.

Three soil samples were taken from three hand-augered boreholes for laboratory testing. They were all shallow samples (< 1.25 feet deep) but were located at critical locations to the north and east, on-site where surface soil contamination was visible.

Boreholes that were hand augered were shallow and backfilled with the original cuttings.

BOREHOLE LOCATIONS AND NUMBERS

A total of 14 boreholes were originally proposed and located based on the Phase I soil-gas survey data, ground and surface water quality data and visual observation of surface contaminants. This original plan was presented in the "Phase II Work Plan" by Dames & Moore (March 25, 1988). An additional 29 boreholes were added to this program for a total of 43 boreholes. Of these 43 boreholes, 19 were located off-site to the west, south and north of the tank farm. Twenty-four boreholes were located on-site.

Additional subsurface contamination discovered in the northern part of the tank farm and to the west, off-site, during the Phase II work, required that additional boreholes be drilled to define the lateral and vertical extent of the contamination. Where feasible, drilling and sampling were conducted until OVA readings reached or approached background.

TABLE A-1

BOREHOLE DEPTHS AND VERTICAL PROFILE OF FIELD OVA Readings (4/88)

Borehole Designation(1)	Depth Drilled (ft)	Zones Tested(2) (ft)	Field OVA Readings(3) (ppm) Vertical Profile
On-Site			
BH-1	17	5 - 6.5	>1000
		10 - 11.5	1000 - 600
		15.5 - 16	70 - 50
		16 - 17	1
BH-2	17	5 - 7	>1000
		7	>1000
		10 - 12	800
		15 - 16	400 - 200
		16 - 17	200 - 50
BH-3	22	5 - 7	>1000
		10 - 12	>1000
		15 - 17	700 - 300
		20 - 21.5	400 - 200
		21.5 - 22	1
BH-4	17	5 - 6.5	>1000
		10 - 10.5	15 - 1
		10.5 - 12	1
		15 - 17	1
BH-5	17	5 - 7	>1000
		10.5	50 - 40
		11	1
		15 - 17	1
BH-6	17	5 - 7	>1000
		10 - 11.5	>1000
		11.5 - 12	15 - 10
		15 - 17	1
BH-7	17	5 - 7	10
		10 - 17	1
BH-8	17	5 - 7	200 - 150
		10 - 12	90 - 40
		15 - 17	1
BH-9	17	5 - 7	>1000
		10 - 17	1

TABLE A-1 (Continued)

Borehole Designation[1]	Depth Drilled (ft)	Zones Tested[2] (ft)	Field OVA Readings[3] (ppm) Vertical Profile
BH-10	21	5 - 7	>1000
		10 - 12	>1000
		15 - 17	>1000
		20 - 21	120 - 30
BH-11	17	5 - 7	1
		10 - 12	1
		15 - 17	1
BH-17	17	No lab sample, 5 - 7	>1000
		10 - 12	1
		15 - 17	1
BH-18	12	5 - 7	1
		10 - 12	1
BH-20 (sludge)	7	5 - 7	>1000
BH-21 (surface)	1.25	0 - 1.25	>1000
BH-22 (sludge)	3.5	0 - 3.5	300 - 200
BH-23	17	5 - 7	200 - 350
		10 - 12	>1000
		15 - 17	1
BH-24	17	5 - 7	>1000
		10 - 11.5	>1000
		11.5 - 12	200
		15 - 15.5	20 - 10
		15.5 - 17	1
BH-25	17	5 - 7	1
		10 - 12	1
		15 - 17	1
BH-26 (sludge)	2	0 - 2	1000 - 200
BH-27	17	5 - 7	450 - 300
		10 - 11	30 - 20
		11 - 12	1
		15 - 17	1

TABLE A-1 (Continued)

Borehole Designation[1]	Depth Drilled (ft)	Zones Tested[2] (ft)	Field OVA Readings[3] (ppm) Vertical Profile
BH-28	17	5 - 7	1
		10 - 12	1
		15 - 17	1
BH-29 (surface)	1.8	0.8 - 1.7	300 - 100
BH-30 (surface)	0.8	0.7	>1000
Off-Site			
BH-12	17	5 - 7	1
		10 - 12	1
		15 - 17	1
BH-13	17	5 - 7	>1000
		10 - 12	>1000
		15 - 17	10
BH-14	17	5 - 17	1
BH-15	12	5 - 7	>1000
		10 - 10.5	>1000
		11 - 12	1
BH-16	12	5 - 7	1
		10 - 12	1
BH-19	17	6 - 8	8 - 5
		10 - 12	1
		15 - 7	1
BH-31	6	0 - 1.5	1
		1.5 - 4.5	1
		4.5 - 6	1
BH-32	6	2.5 - 3	>1000
		3 - 6	1000 - 400
BH-33	6	0 - 3	1
		3 - 6	>1000

TABLE A-1 (Continued)

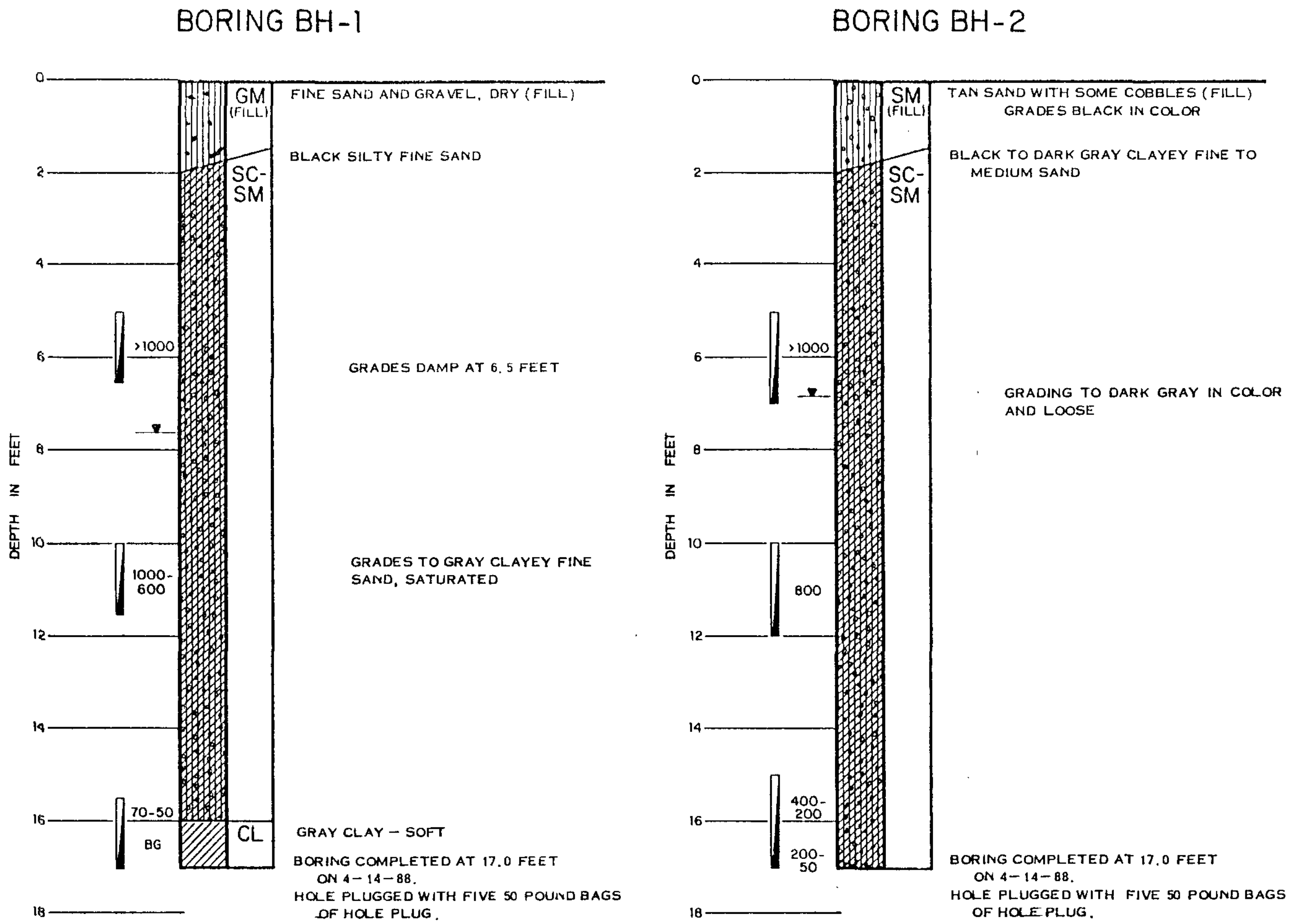
Borehole Designation(1)	Depth Drilled (ft)	Zones Tested(2) (ft)	Field OVA Readings(3)(ppm) Vertical Profile
BH-34	6	3 - 6	>1000
BH-35	6	3 - 6	1
BH-36	6	6	>1000
BH-37	6	3 - 6	1
BH-38	6	3 - 6	1
BH-39	6	4 - 6	1
BH-40 (surface)	2	2	20 - 10
BH-41	8	8	200 - 100
BH-42	10	10	6 - 4
BH-43	7	6 - 7	300 - 100

Footnotes:

(1) Boreholes BH-1 through BH-20, BH-23 through BH25, BH-27 and BH-28 were machine augered.
Boreholes BH-21, BH-22, BH-26 and BH-29-43 were hand augered.
Sites BH-26 and BH-22 were composite sludge pit waste samples.

(2) These zones were field tested for volatile organics using the OVA meter, and not necessarily those zones tested by the laboratory.

(3) An OVA reading of 1 reflects background "uncontaminated conditions."



KEY

A — ORGANIC VAPOR ANALYZER READINGS EXPRESSED IN PARTS PER MILLION (ppm)

DEPTH AT WHICH SPLIT SPOON SAMPLE WAS EXTRACTED

BG — BACKGROUND OVA READING

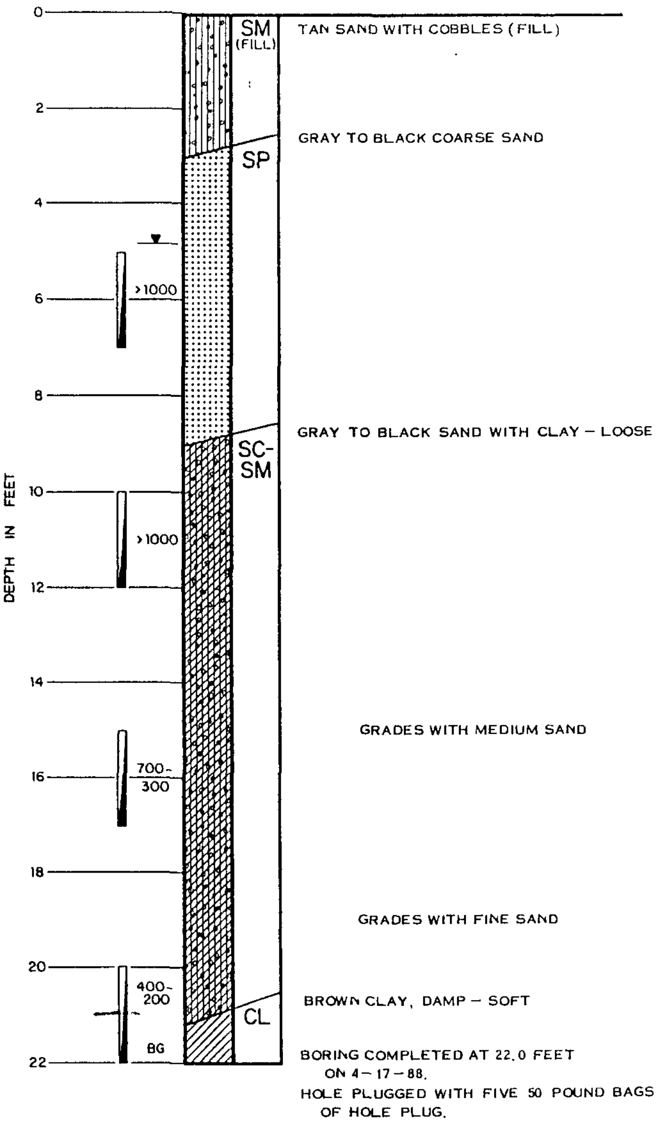
▼ — APPROXIMATE TOP OF SATURATION

LOG OF BORINGS

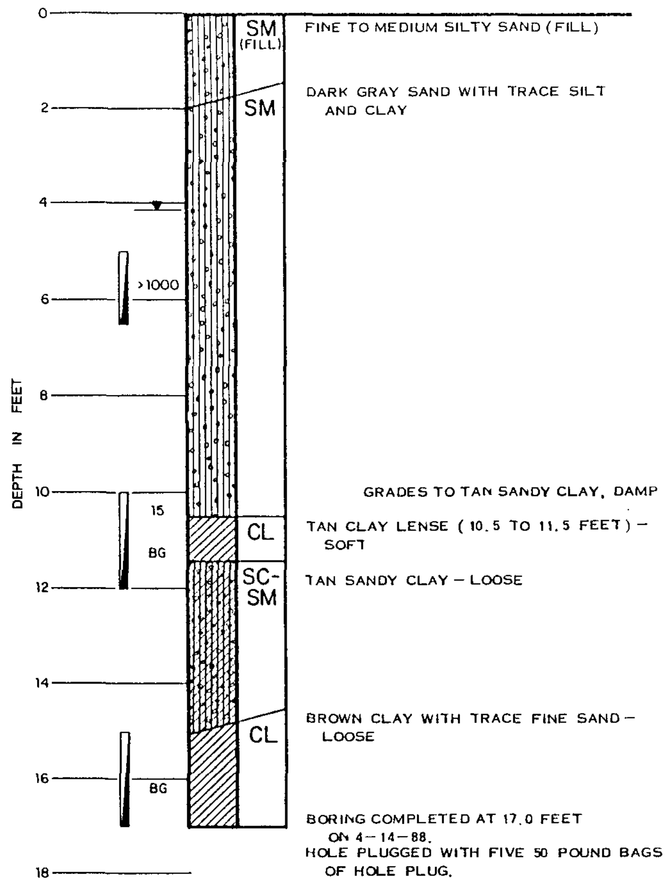
Dames & Moore

PLATE A-1

BORING BH-3



BORING BH-4



LOG OF BORINGS

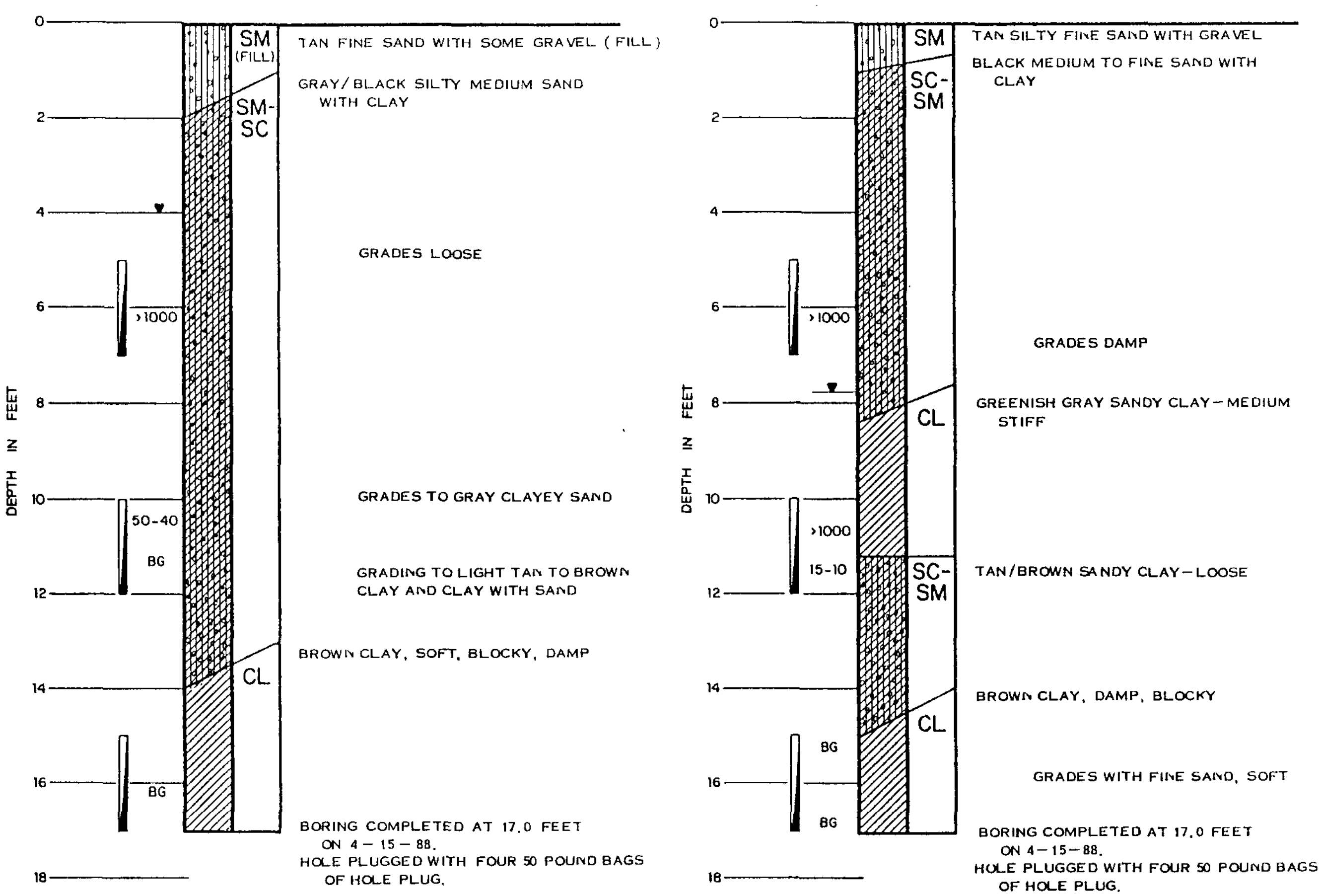
Dames & Moore

PLATE A-2

REVISIONS BY DATE BY DATE PLATE OF

FILE 14874-005-031 BY CHECKED BY DATE

BORING BH-5 BORING BH-6



KEY

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DEPTH AT WHICH SPLIT SPOON SAMPLE WAS EXTRACTED

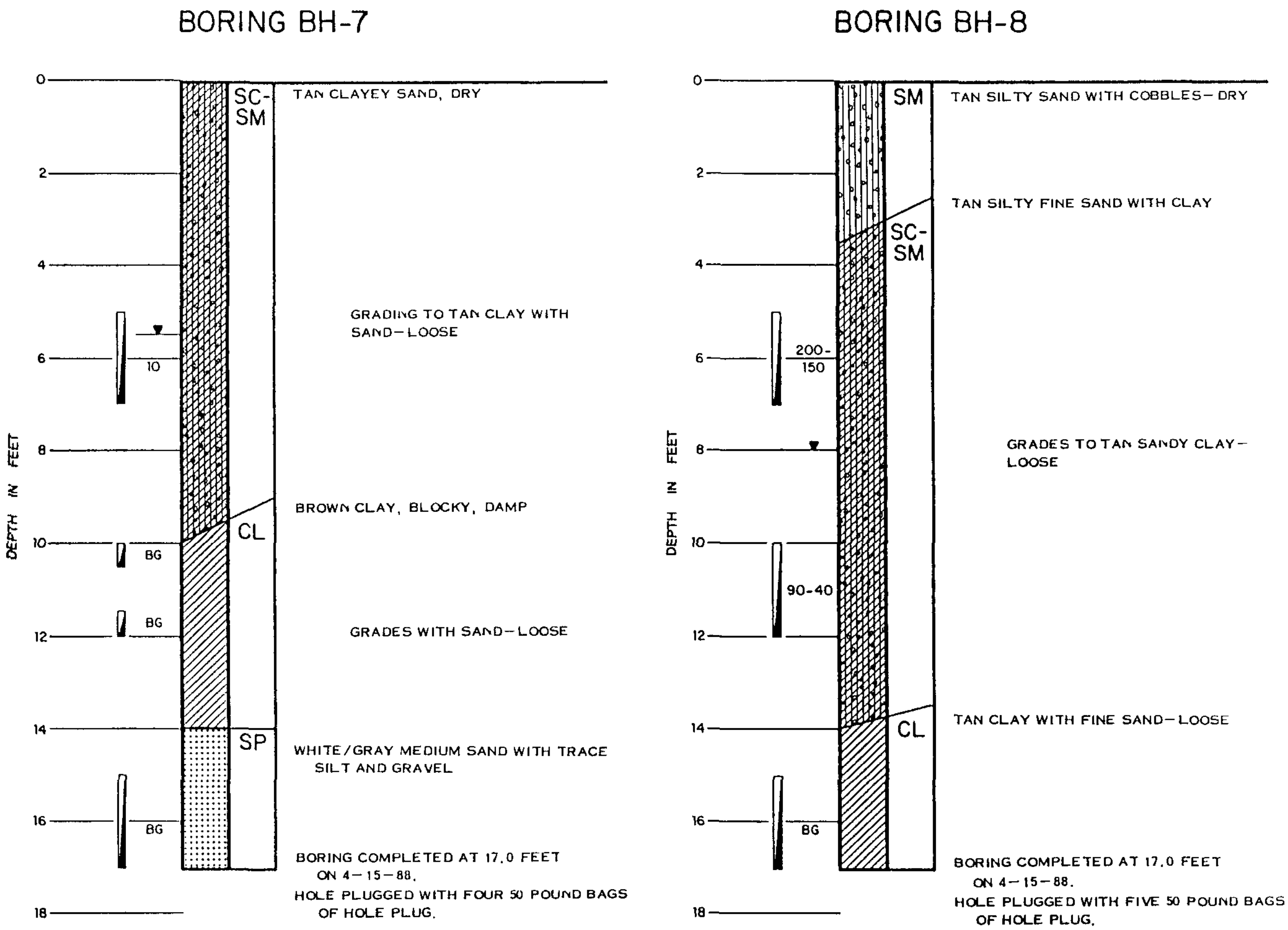
BG — BACKGROUND OVA READING

APPROXIMATE TOP OF SATURATION

LOG OF BORINGS

Dames & Moore

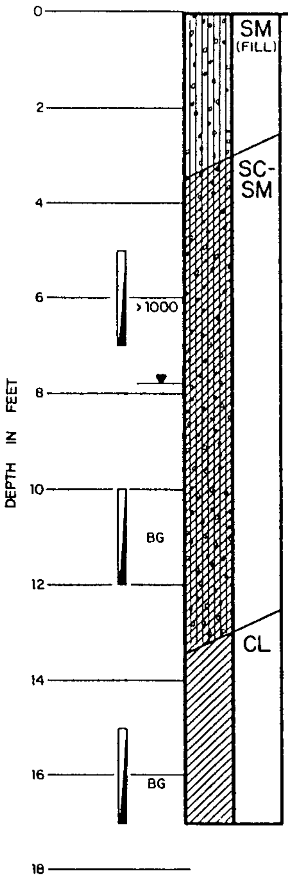
PLATE A-3



LOG OF BORINGS

Dames & Moore

BORING BH-9



TAN SILTY SAND AND GRAVEL (FILL)

DARK GRAY SILTY FINE SAND WITH CLAY

GRADES DAMP

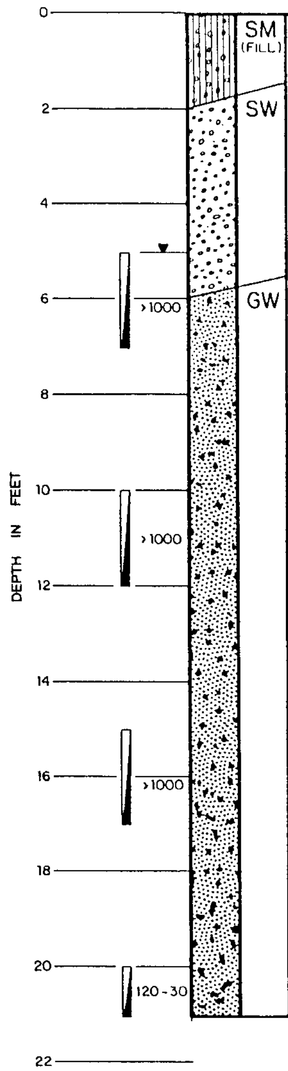
GRADES TO TAN CLAY WITH SAND–LOOSE

TAN CLAY–STIFF

GRADES BROWN IN COLOR WITH TRACE SAND–SOFT

BORING COMPLETED AT 17.0 FEET ON 4–16–88.
HOLE PLUGGED WITH FIVE 50 POUND BAGS OF HOLE PLUG.

BORING BH-10



BROWN SILTY FINE SAND WITH COBBLES (FILL)

GRAY/BLACK COARSE SAND WITH OCCASIONAL GRAVEL

BLACK GRAVEL AND BLACK/GRAY COARSE SAND

GRADING WITH NUMEROUS COBBLES

BORING COMPLETED AT 21.0 FEET ON 4–17–88.
HOLE PLUGGED WITH FIVE 50 POUND BAGS OF HOLE PLUG.

KEY

▢ A

A — ORGANIC VAPOR ANALYZER READINGS EXPRESSED IN PARTS PER MILLION (ppm)

▯ — DEPTH AT WHICH SPLIT SPOON SAMPLE WAS EXTRACTED

BG — BACKGROUND OVA READING

▼ — APPROXIMATE TOP OF SATURATION

LOG OF BORINGS

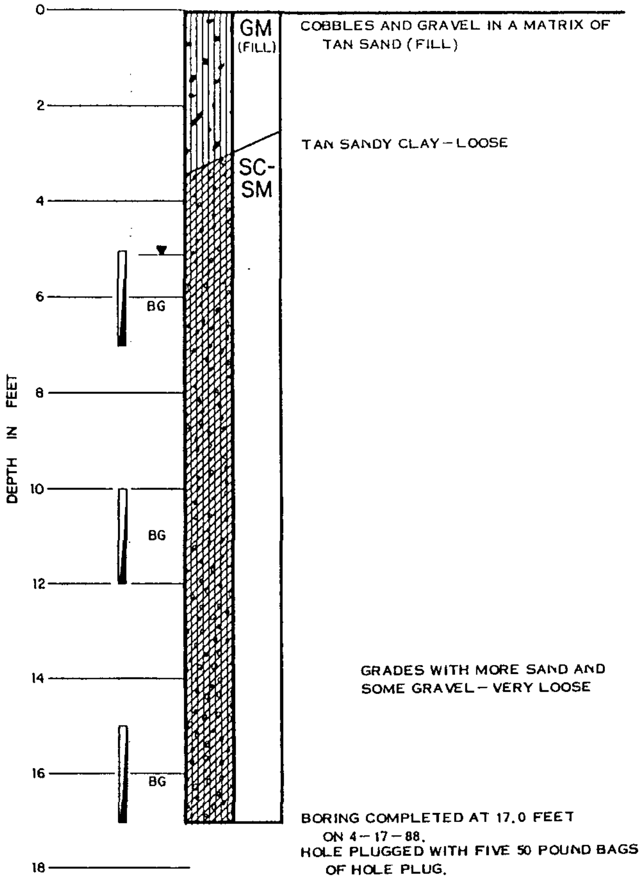
Dames & Moore

PLATE A-5

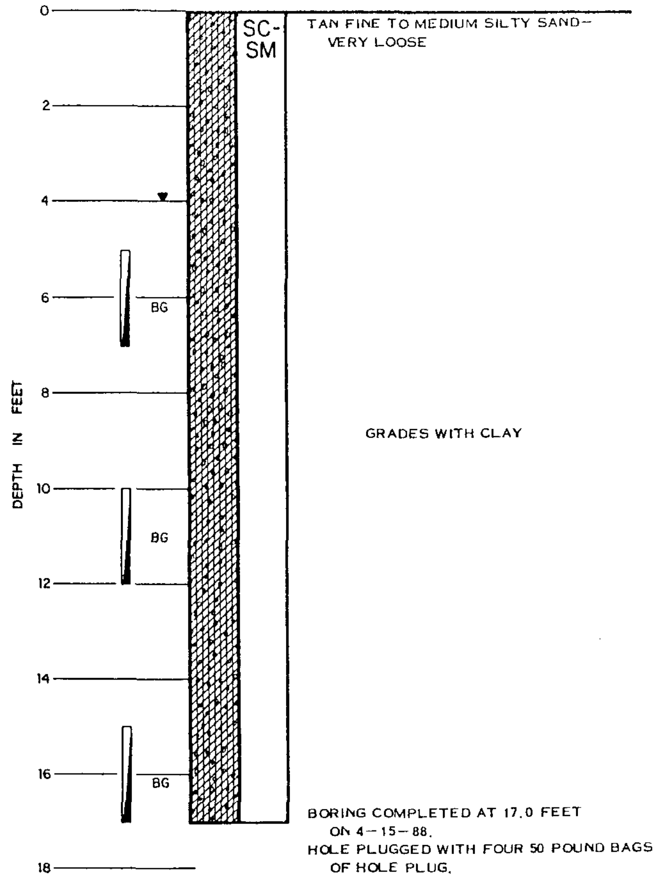
REVISIONS BY ___ DATE ___ BY ___ DATE ___ PLATE ___ OF ___

FILE 14819-005-031 BY ___ DATE ___ CHECKED BY ___ DATE ___

BORING BH-11



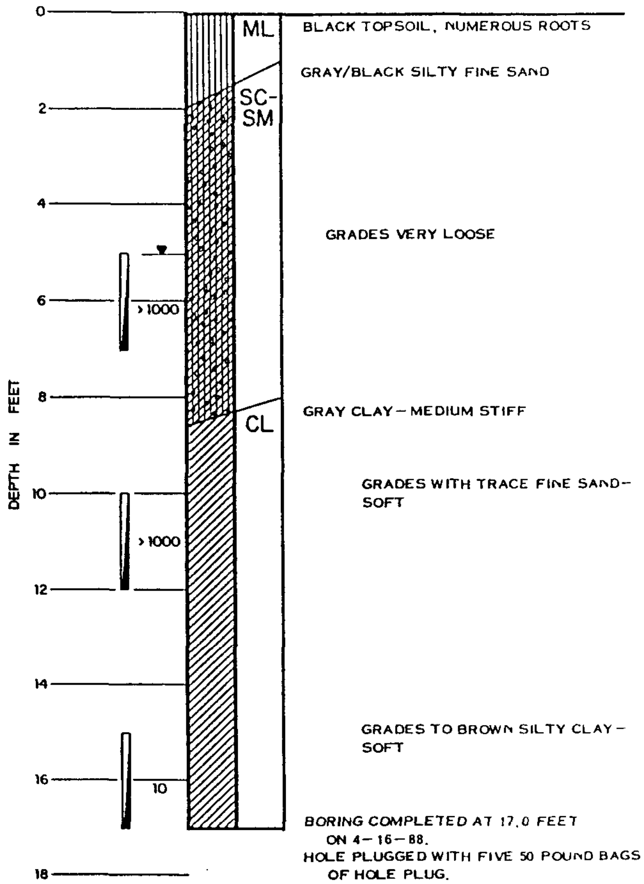
BORING BH-12



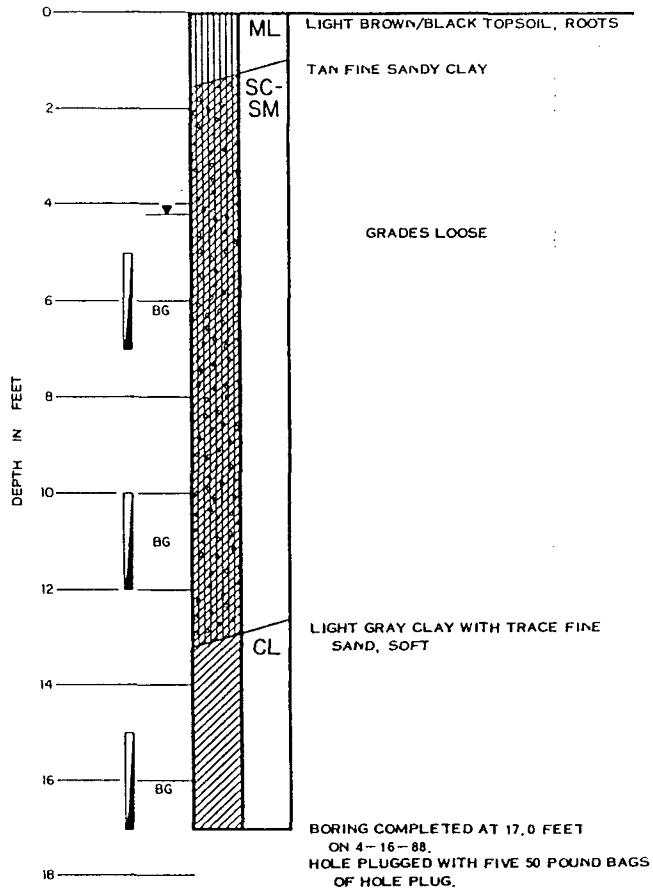
LOG OF BORINGS

Dames & Moore

BORING BH-13



BORING BH-14



KEY

Q A

A — ORGANIC VAPOR ANALYZER READINGS EXPRESSED IN PARTS PER MILLION (ppm)

DEPTH AT WHICH SPLIT SPOON SAMPLE WAS EXTRACTED

BG — BACKGROUND OVA READING

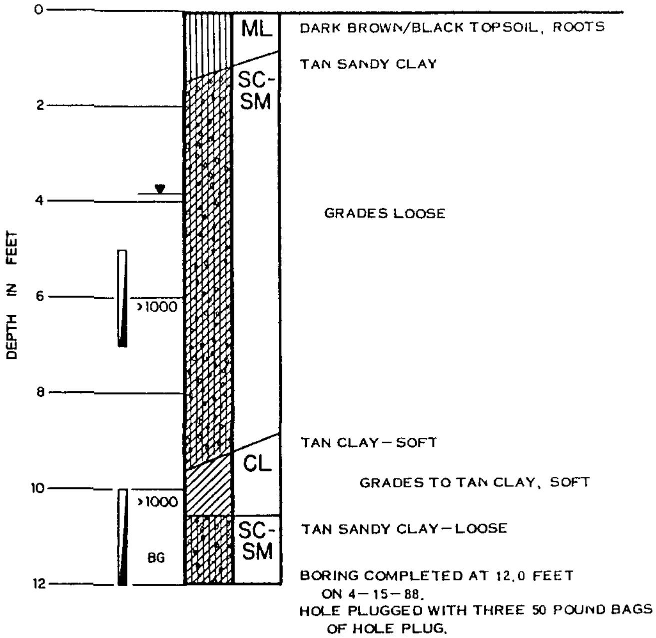
APPROXIMATE TOP OF SATURATION

LOG OF BORINGS

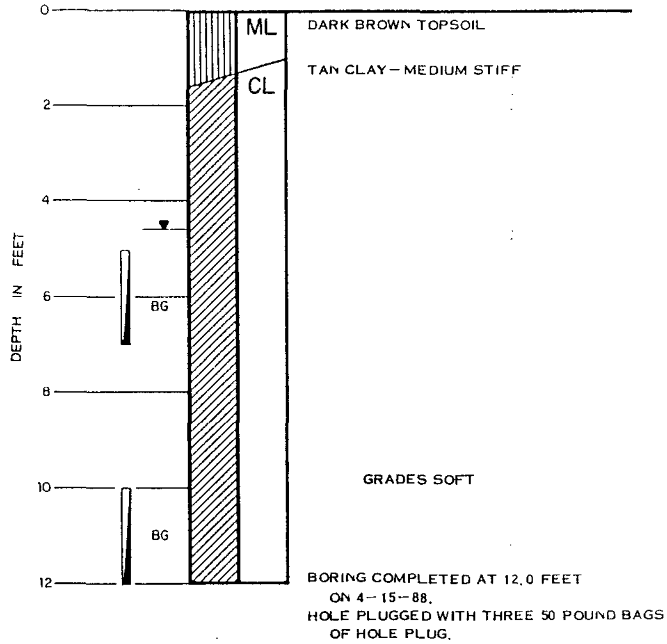
Dames & Moore

PLATE A-7

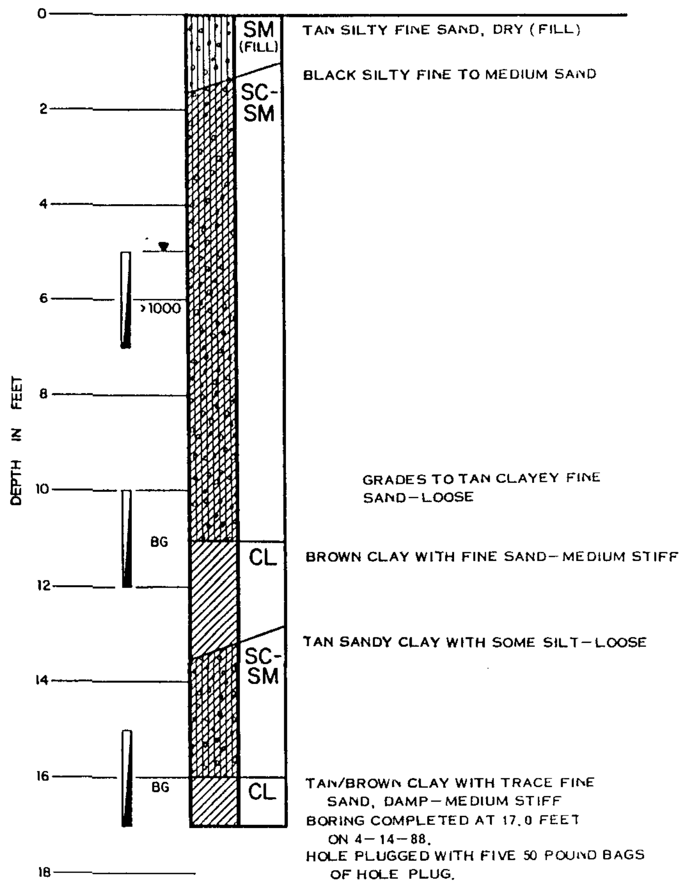
BORING BH-15



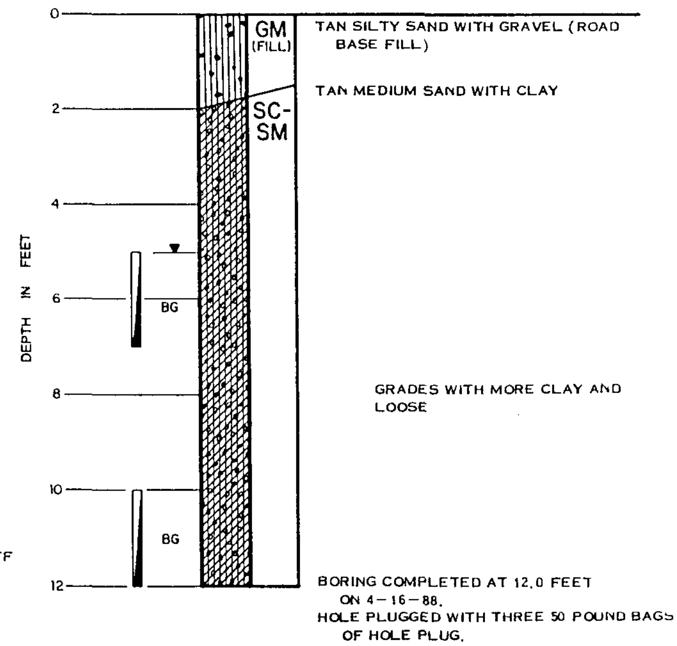
BORING BH-16



BORING BH-17

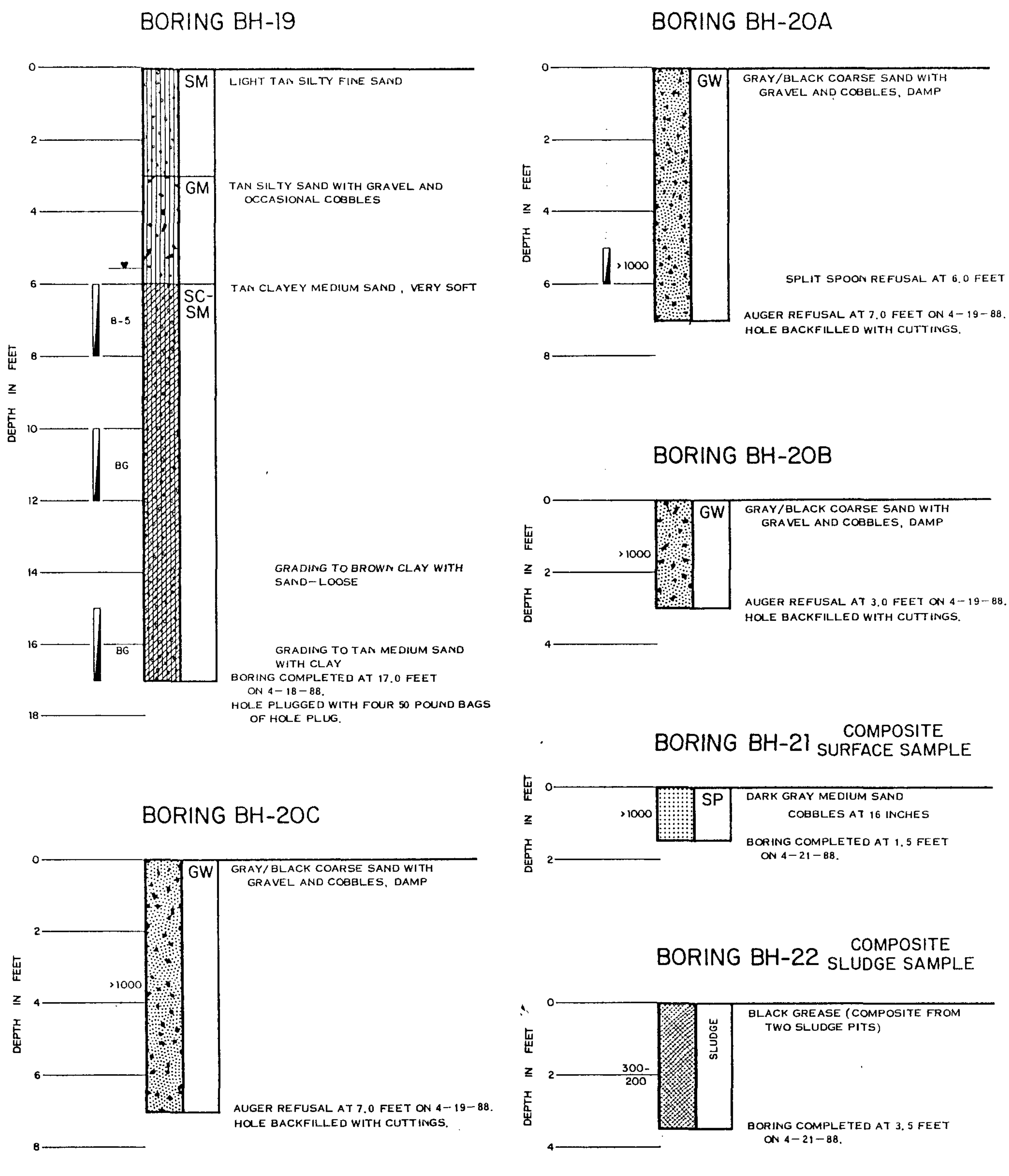


BORING BH-18



LOG OF BORINGS

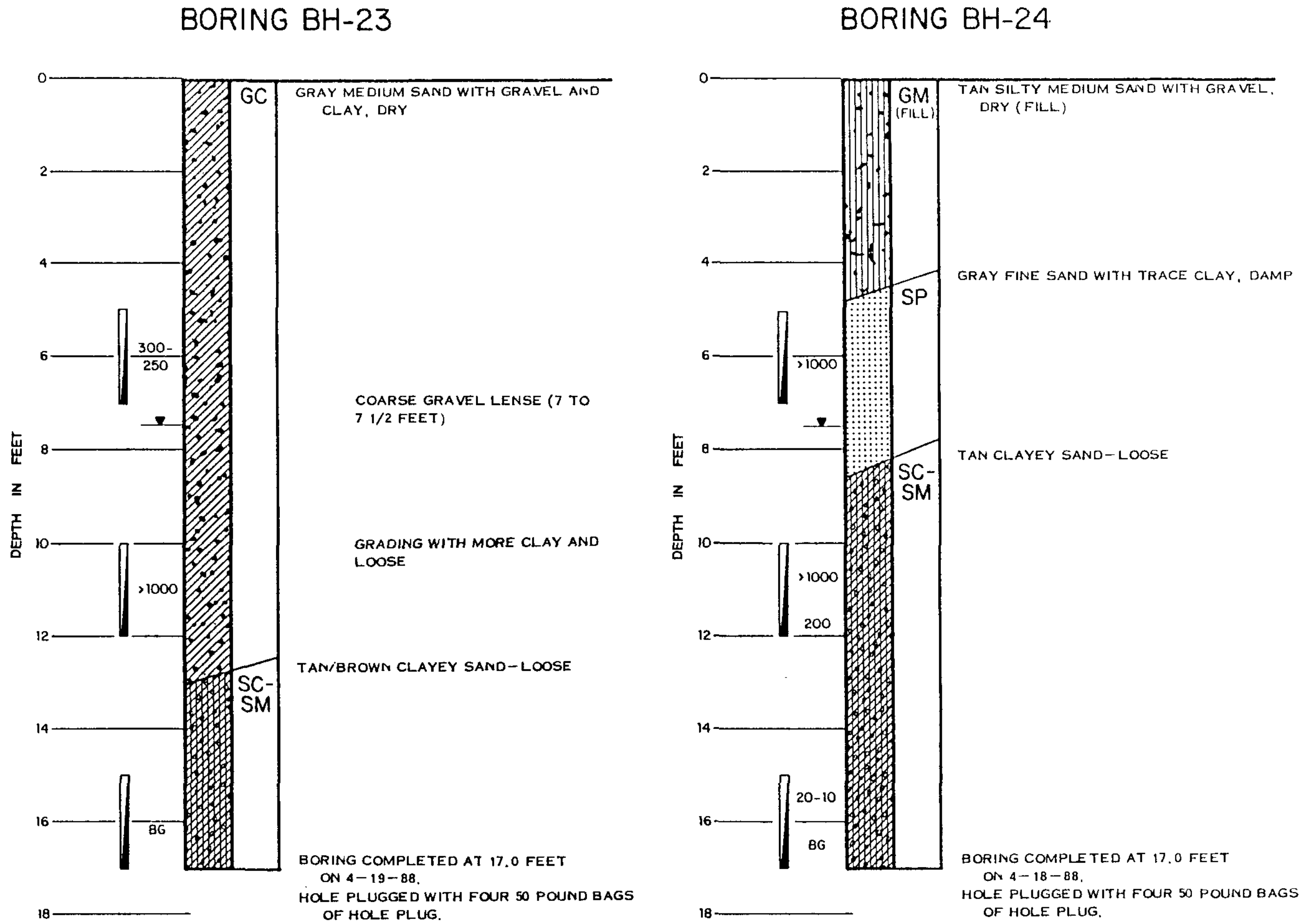
Dames & Moore



LOG OF BORINGS

Dames & Moore

PLATE A-9



KEY

A

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DEPTH AT WHICH SPLIT SPOON SAMPLE WAS EXTRACTED

BG — BACKGROUND OVA READING

APPROXIMATE TOP OF SATURATION

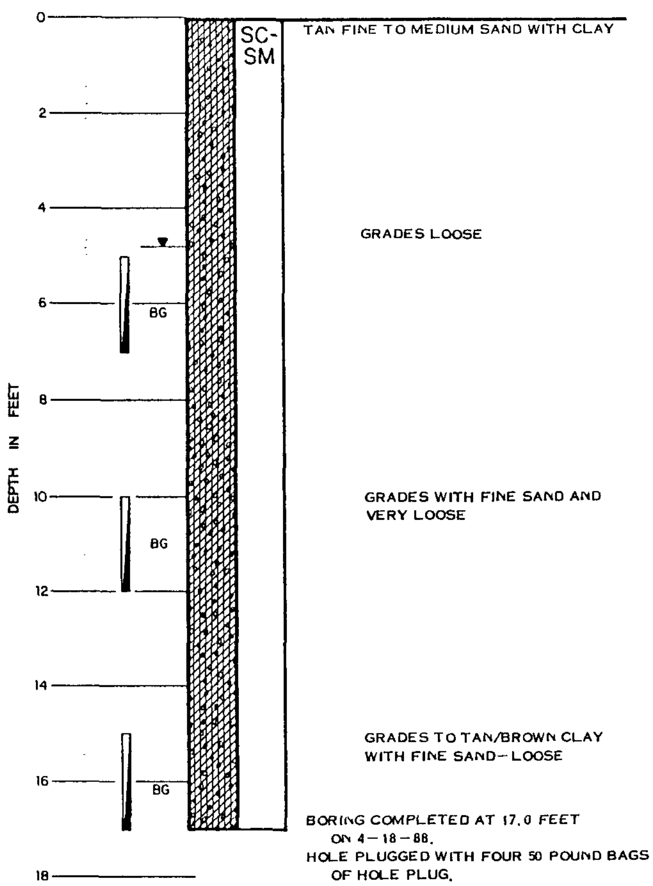
LOG OF BORINGS

Dames & Moore

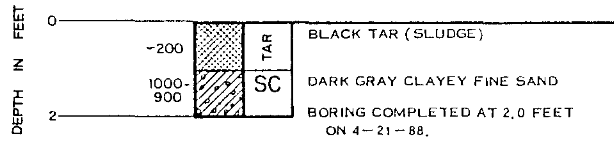
PLATE A-10

FILE 14819-005-031 BY CHECKED BY DATE DATE REVISIONS BY DATE BY DATE PLATE OF

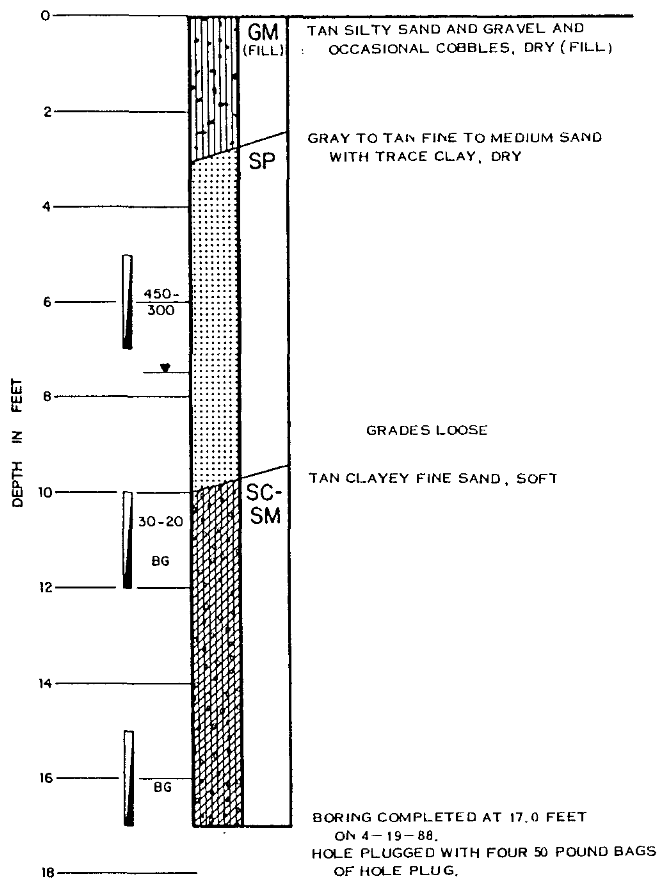
BORING BH-25



BORING BH-26 SLUDGE SAMPLE



BORING BH-27

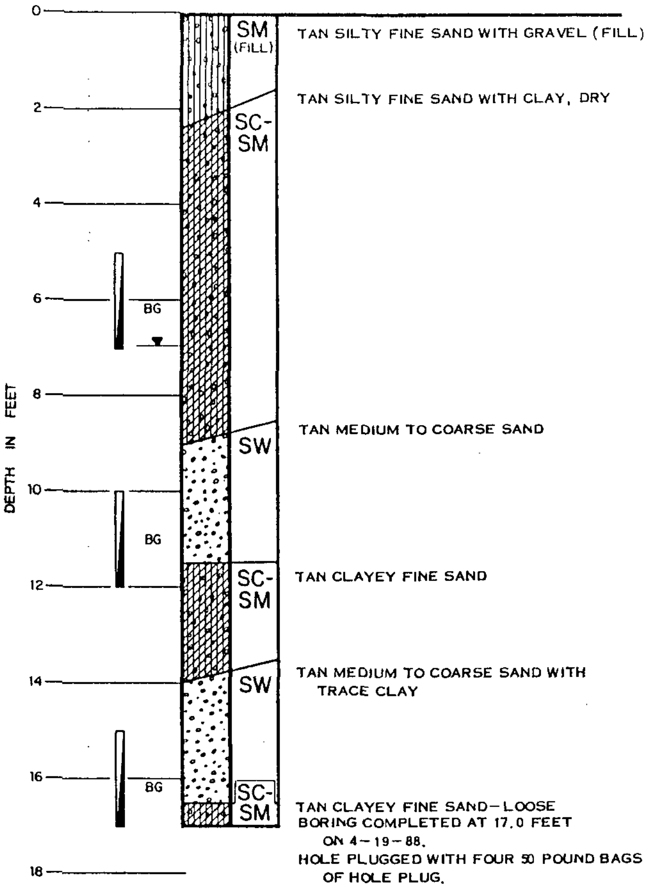


LOG OF BORINGS

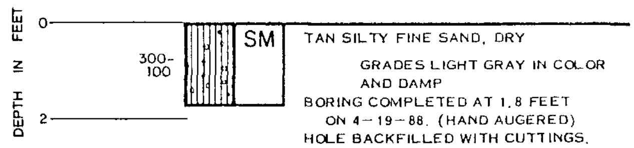
Dames & Moore

PLATE A-11

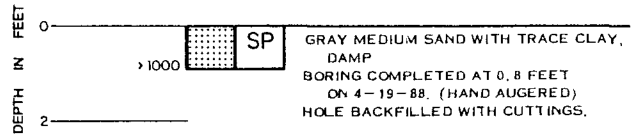
BORING BH-28



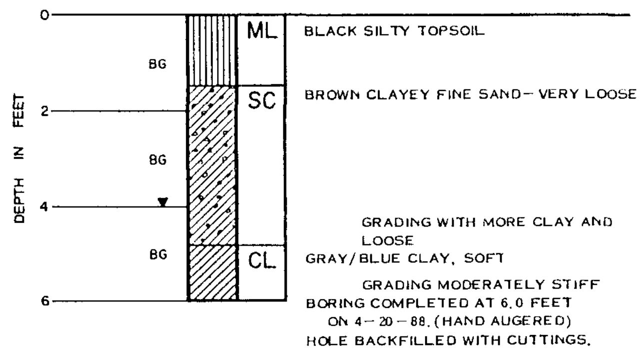
BORING BH-29



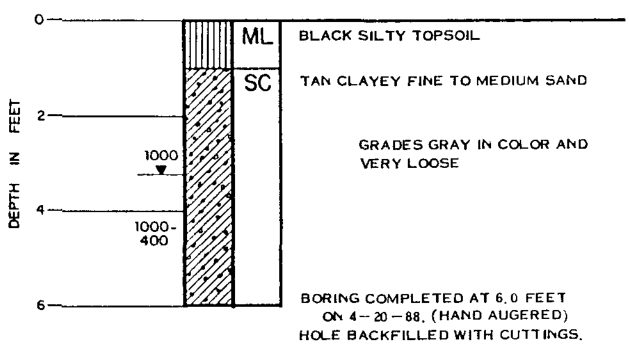
BORING BH-30



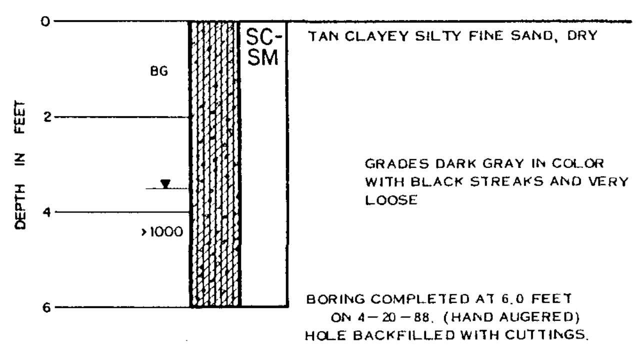
BORING BH-31



BORING BH-32



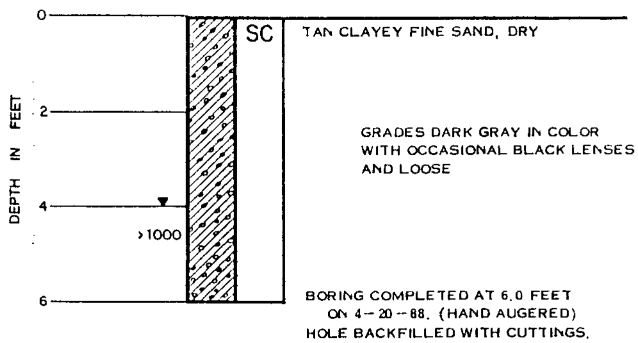
BORING BH-33



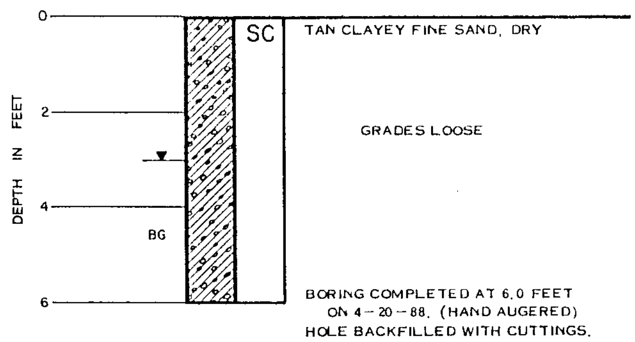
LOG OF BORINGS

Dames & Moore

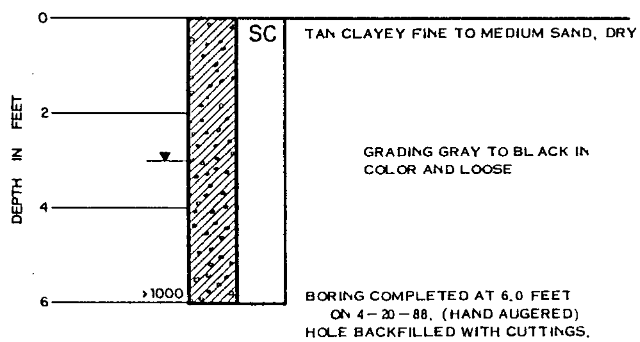
BORING BH-34



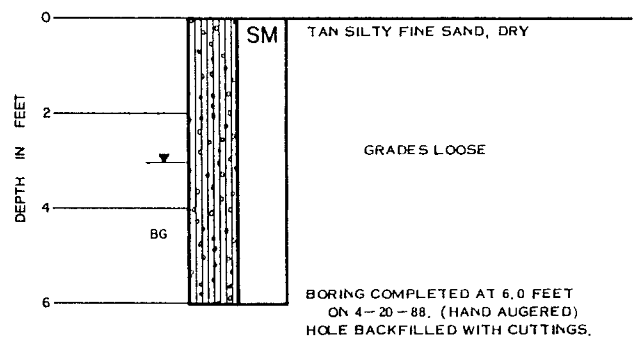
BORING BH-35



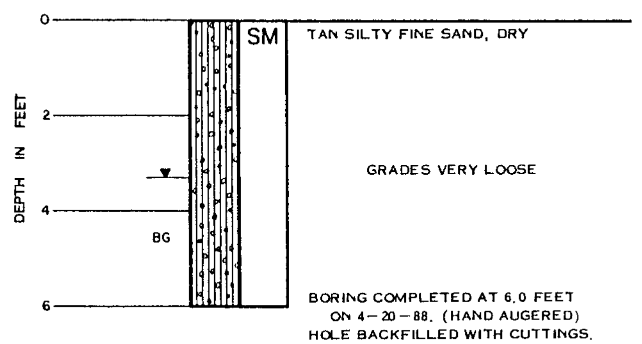
BORING BH-36



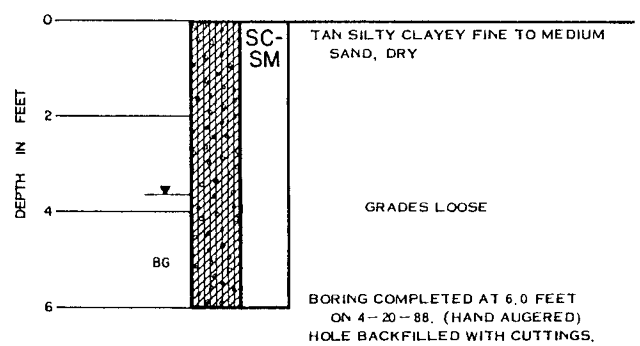
BORING BH-37



BORING BH-38



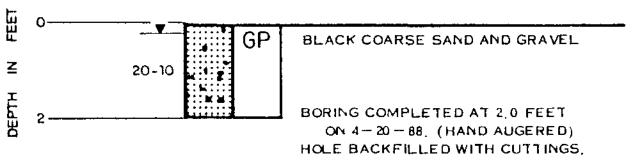
BORING BH-39



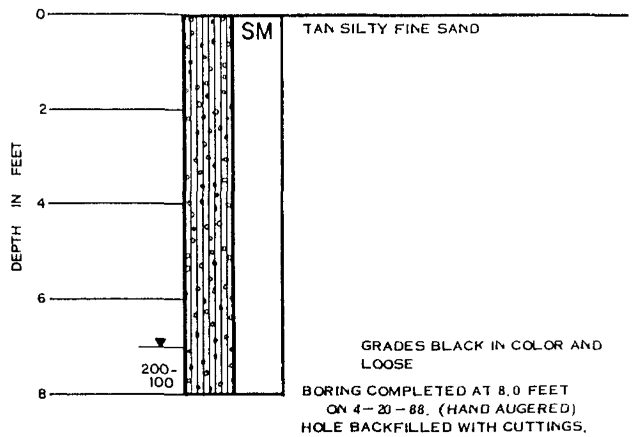
LOG OF BORINGS

Dames & Moore

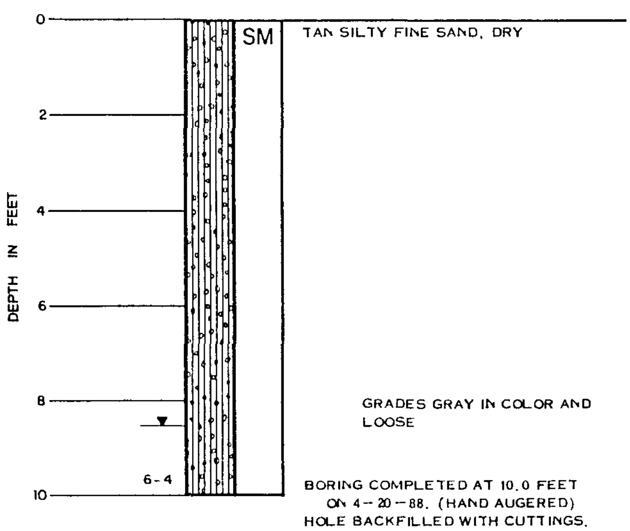
BORING BH-40



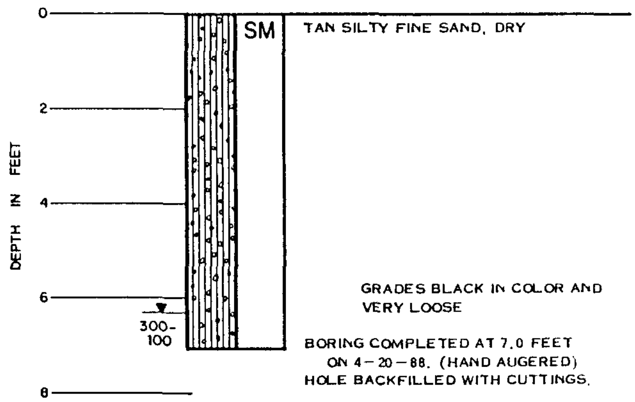
BORING BH-41



BORING BH-42



BORING BH-43



KEY

▯ A

A — ORGANIC VAPOR ANALYZER READINGS EXPRESSED IN PARTS PER MILLION (ppm)

▯ — DEPTH AT WHICH SPLIT SPOON SAMPLE WAS EXTRACTED

BG — BACKGROUND OVA READING

▼ — APPROXIMATE TOP OF SATURATION

LOG OF BORINGS

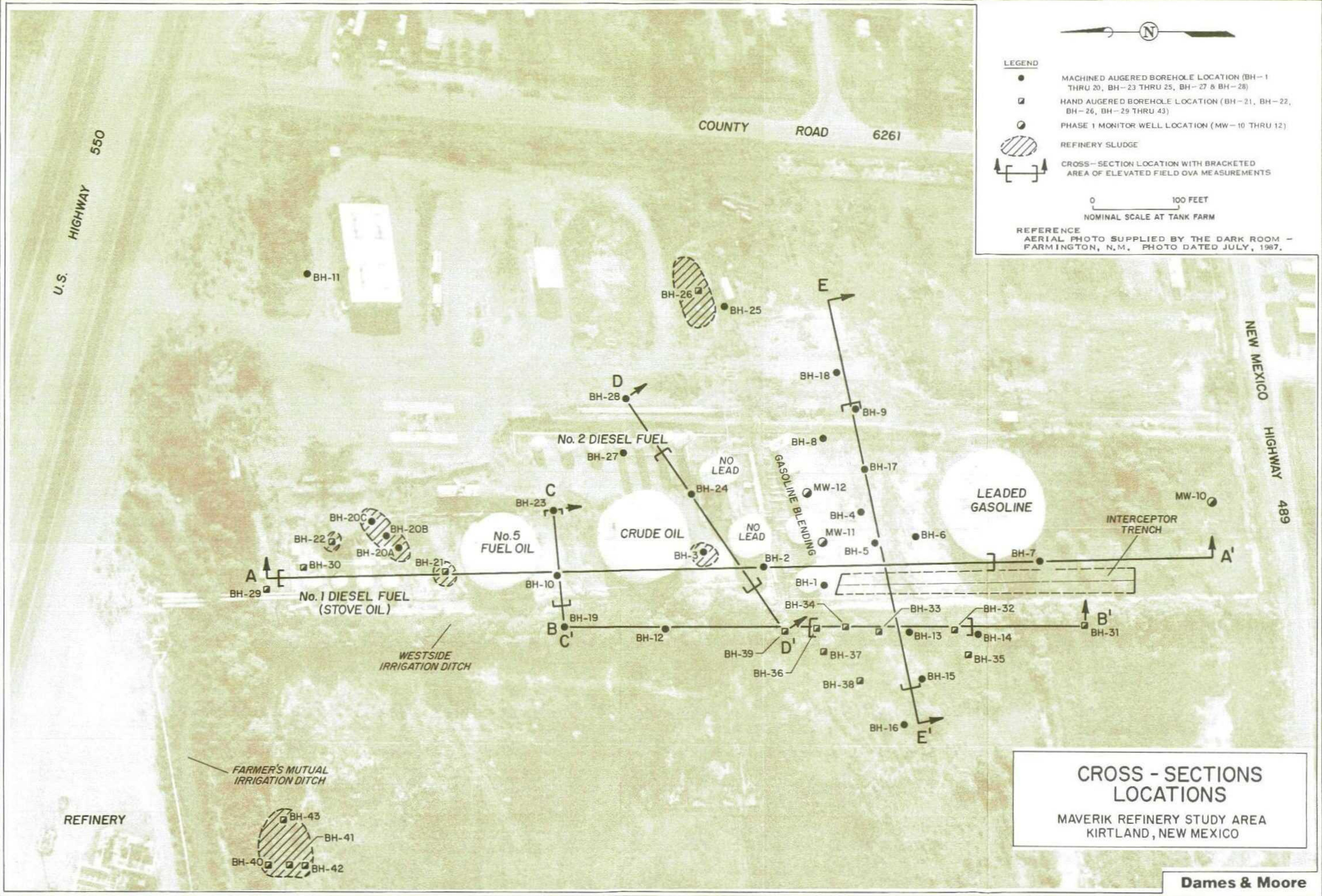
Dames & Moore

PLATE A-14

FILE 14819-005-031 BY DATE CHECKED BY DATE

REVISIONS BY DATE BY DATE PLATE OF

FILE 19819-005- BY DATE 5/23/88 CHECKED BY DATE

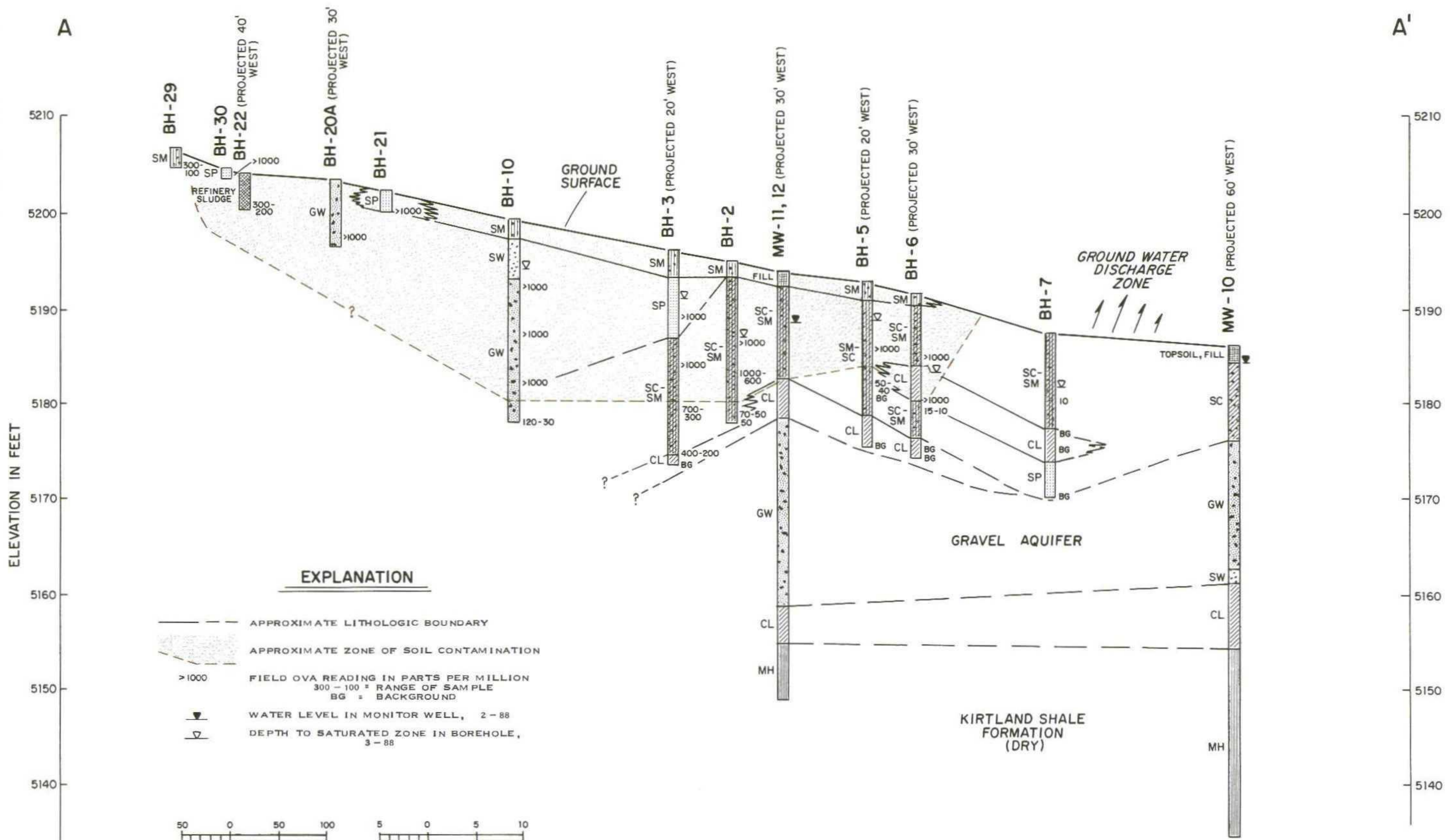


CROSS - SECTIONS LOCATIONS

MAVERIK REFINERY STUDY AREA
KIRTLAND, NEW MEXICO

Dames & Moore

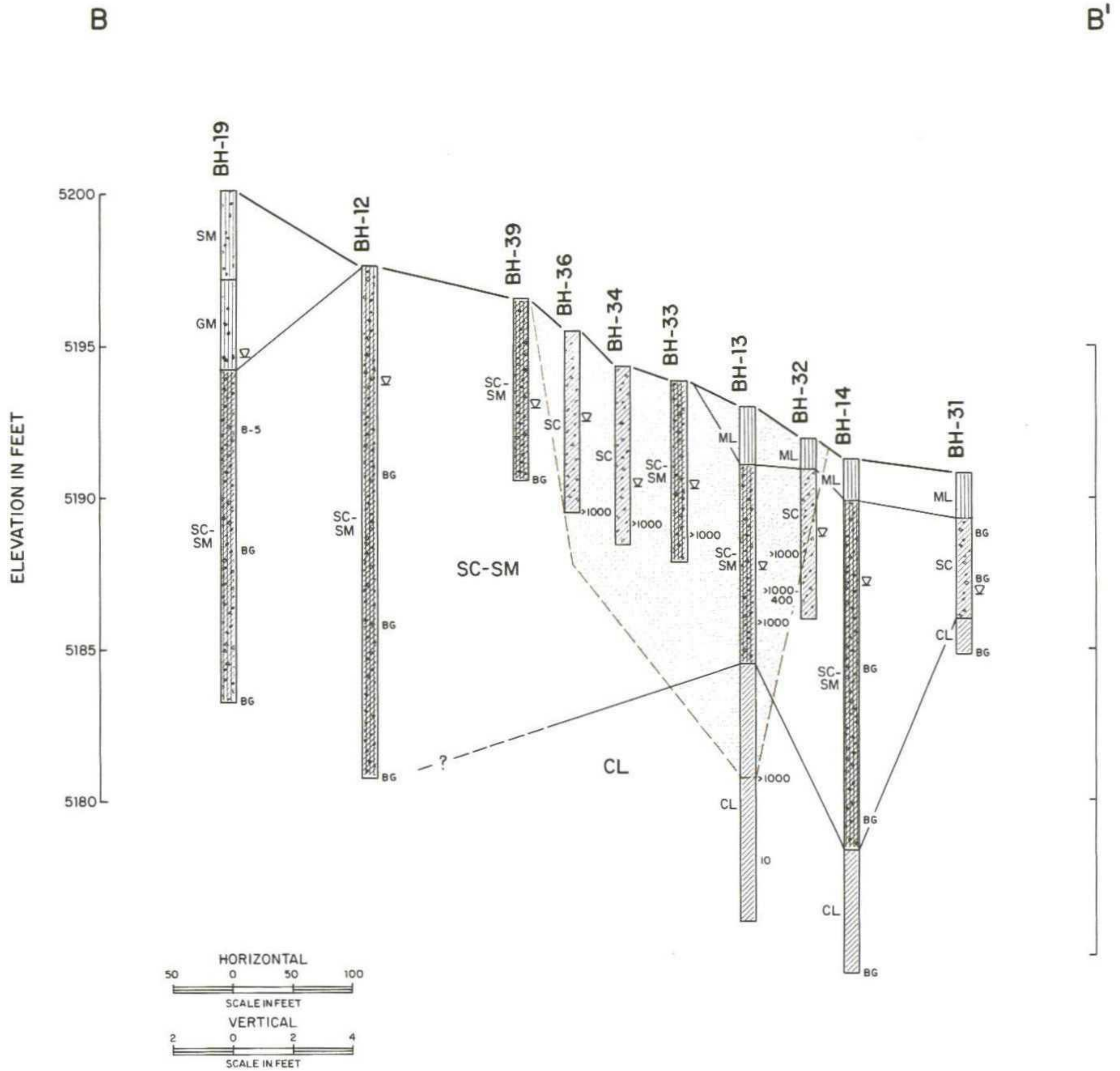
PLATE A-15



ON - SITE NORTH - SOUTH GEOLOGIC CROSS - SECTION A - A'

Dames & Moore

FILE 14819-005 BY ____ DATE ____ CHECKED BY ____ DATE ____

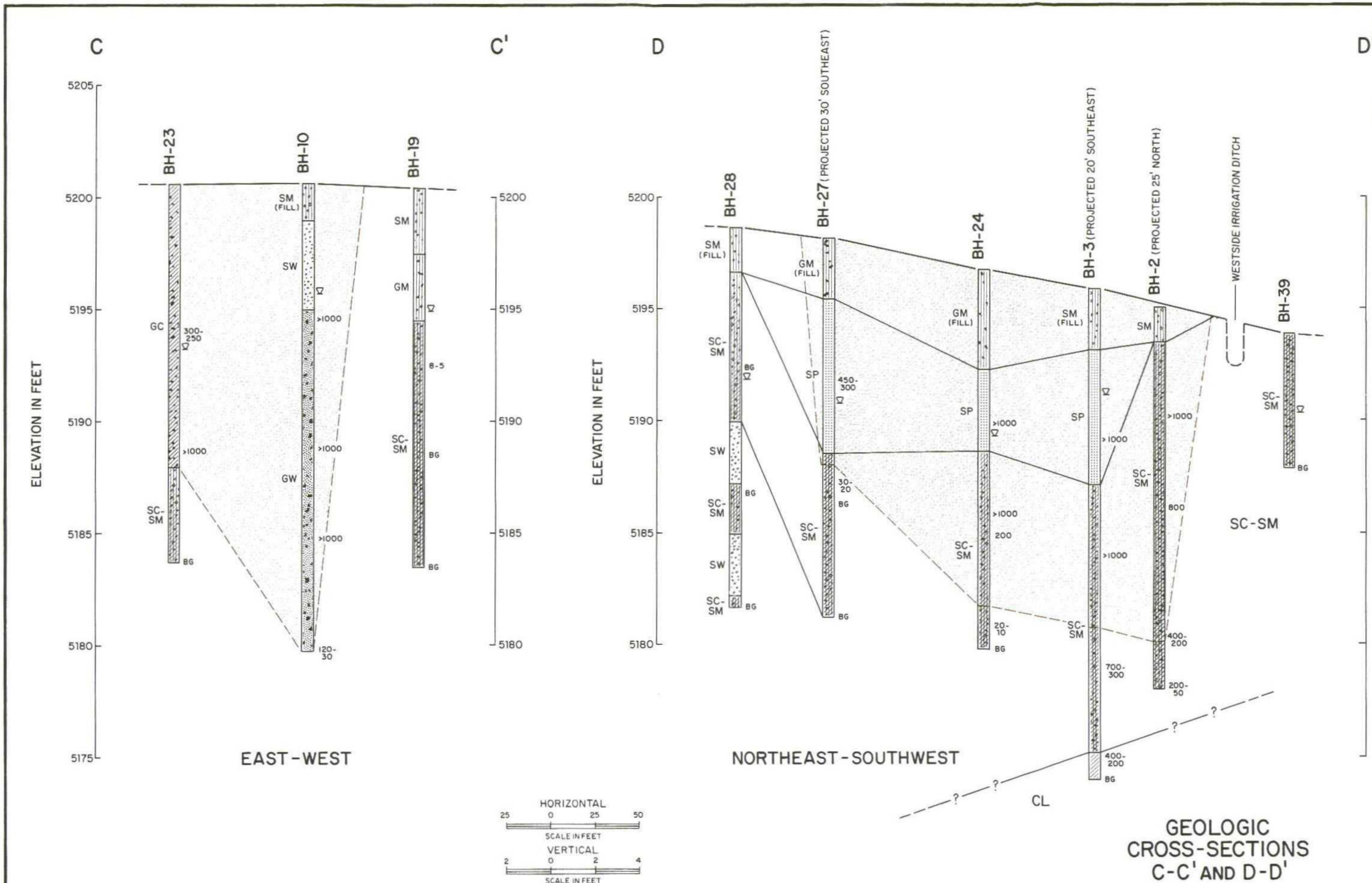


OFF-SITE NORTH-SOUTH
GEOLOGIC
CROSS-SECTION B-B'

Dames & Moore

PLATE A-17

FILE ___ BY ___ DATE ___ CHECKED BY ___ DATE ___



GEOLOGIC CROSS-SECTIONS C-C' AND D-D'

Dames & Moore

PLATE A-18

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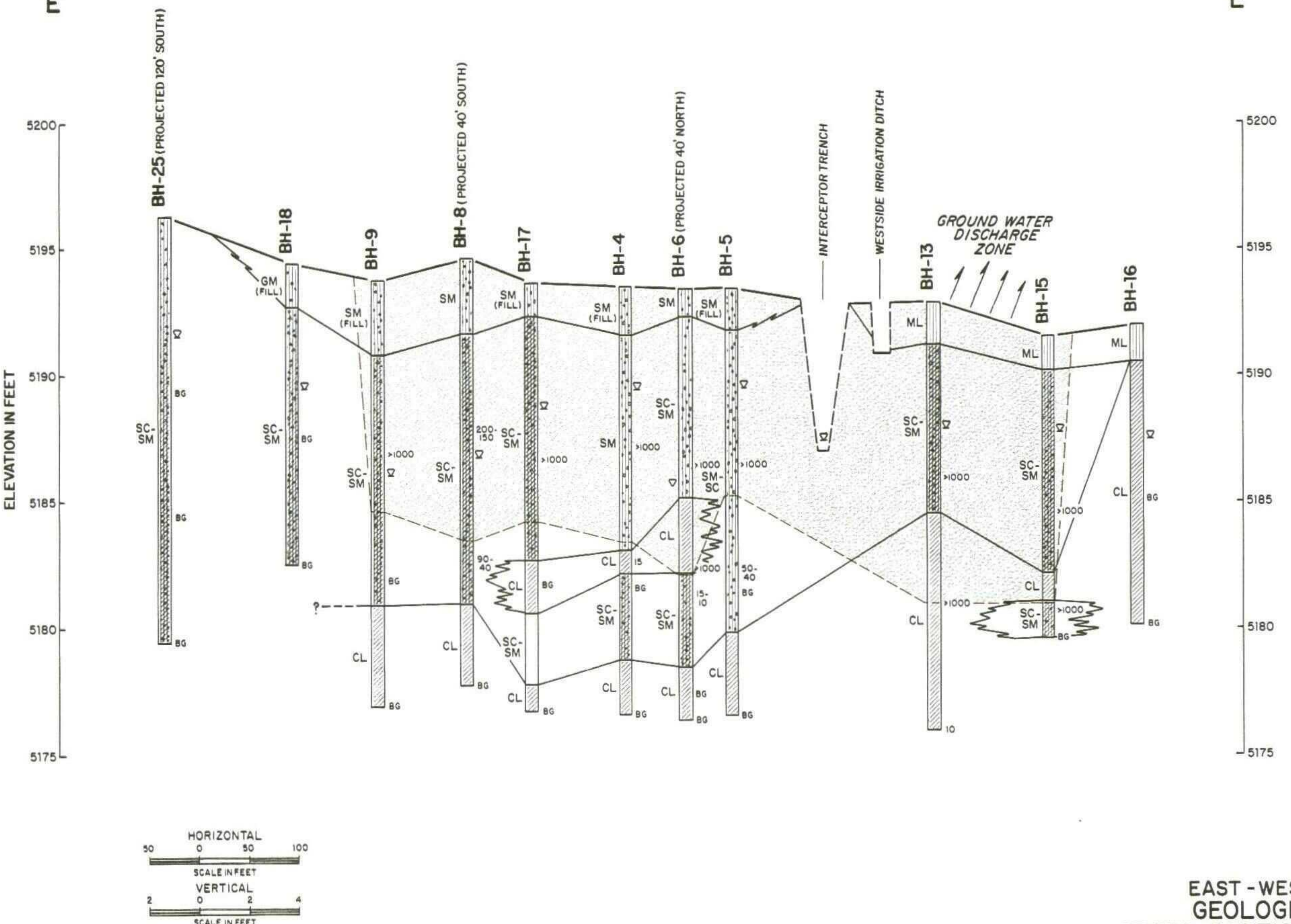


EAST - WEST
GEOLOGIC
CROSS-SECTION E - E'

Dames & Moore

PLATE A-19

FILE 14819-005- BY ___ DATE 5-23-88 CHECKED BY ___ DATE ___

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION <u>RETAINED</u> ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS <u>LARGER</u> THAN NO. 200 SIEVE SIZE				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION <u>PASSING</u> NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT <u>LESS</u> THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS <u>SMALLER</u> THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT <u>GREATER</u> THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

SOIL CLASSIFICATION CHART

UNIFIED SOIL CLASSIFICATION SYSTEM

Dames & Moore

APPENDIX B

SUBSURFACE SOIL CONTAMINANT ISOCON MAPS

APPENDIX B

SUBSURFACE SOIL CONTAMINANT ISOCON MAPS

Included herein are five isocon maps (Plates B-1 through B-5) based on the highest levels for the volatile organic compounds found, in the subsurface soils in three distinct areas at 5 to 7 feet in the southwest, 10 to 12 feet in the north-central part of the tank farm and near ground surface in the northwest corner of the tank farm. Included also is an isocon map of TCO for these same zones (Plate B-6).

These maps summarize the lateral and vertical extent of the significant subsurface soil contamination from Maverik's tank farm in Kirtland, New Mexico. The isocon maps include the concentrations of the major organic volatile contaminants present benzene, ethylbenzene, m-xylene, o & p xylene(s) and toluene and TCO concentrations.

The laboratory data used to prepare the isocon maps are summarized in Tables 2 and 3 and Appendix C.

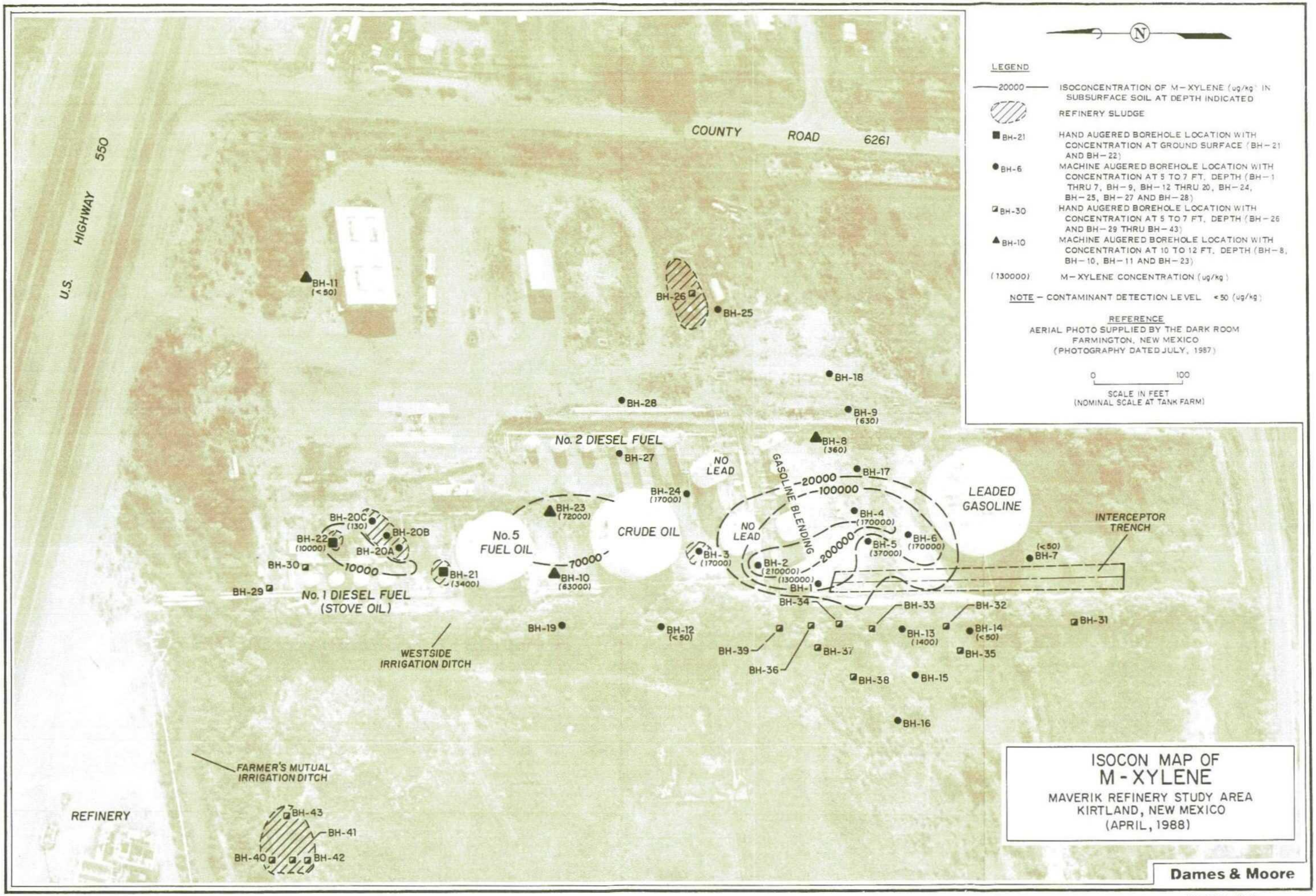


PLATE B-1

FILE 84819-005 MAVERIK BY ______ CHECKED BY ______ DATE ______ DATE ______

FILE 14/819-005 MAVERIK BY ____ DATE 4/1/88 CHECKED BY ____ DATE ____

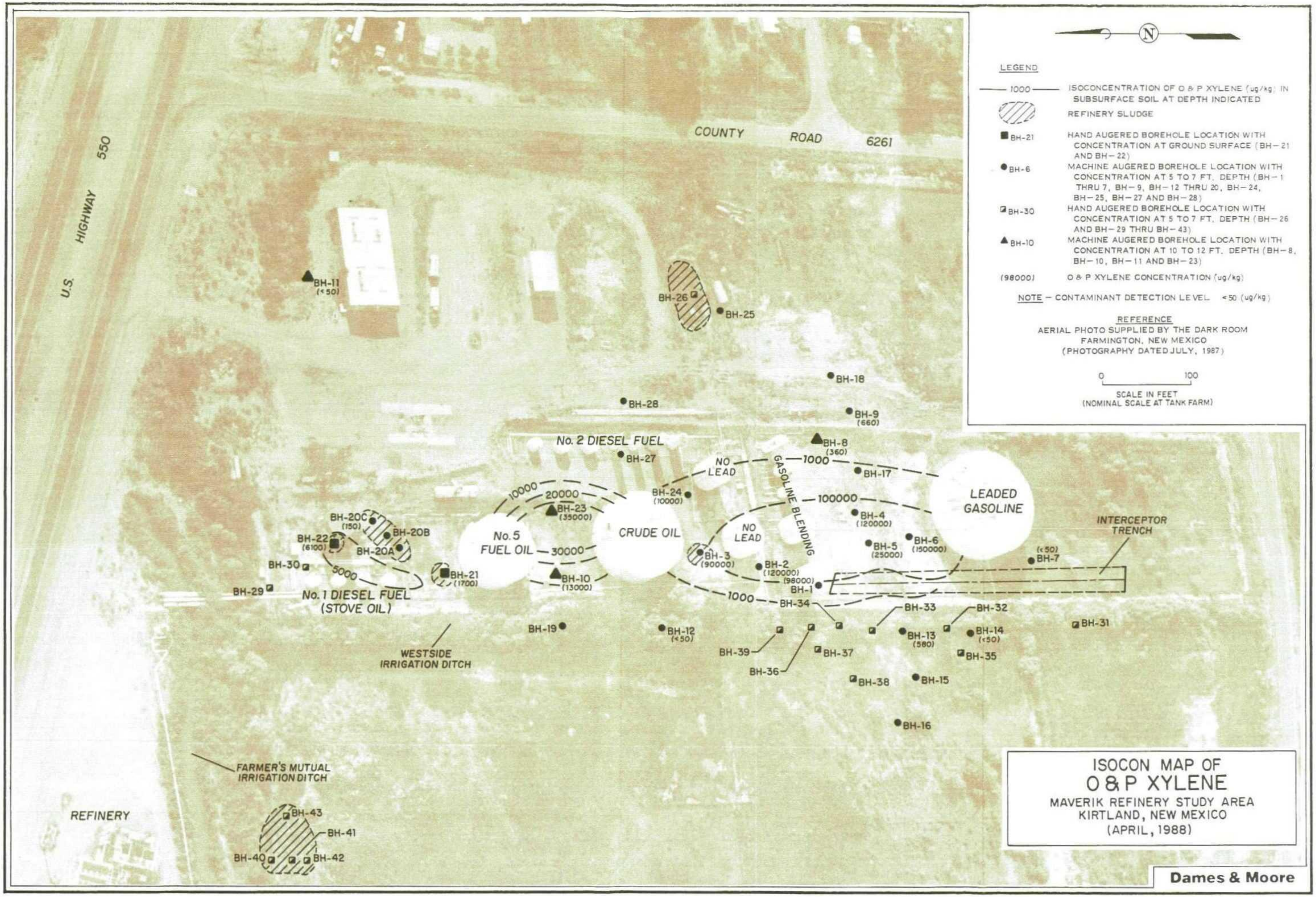
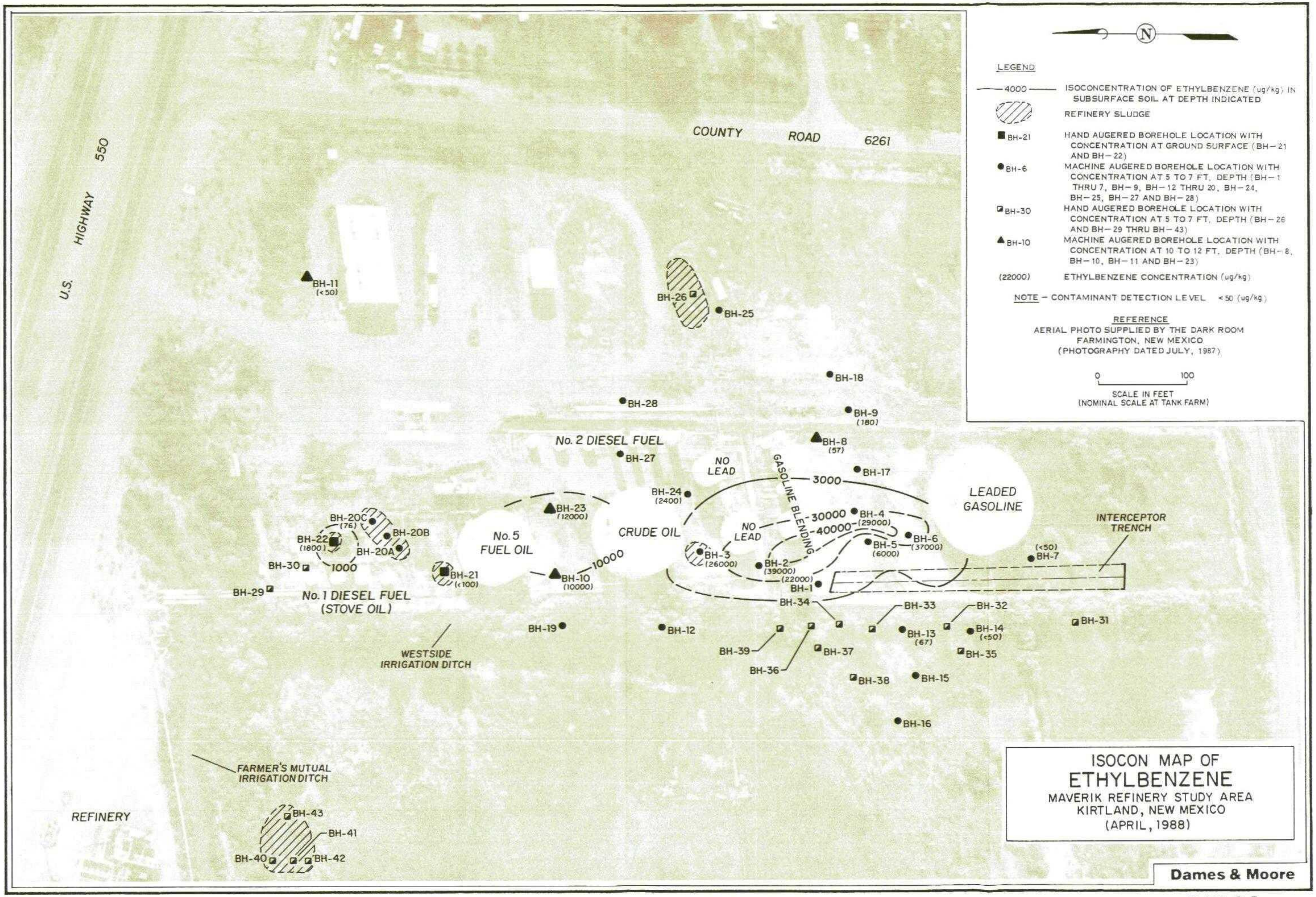


PLATE B-2

FILE 14819-005 MAVERIK BY ____ DATE 5-12-88 CHECKED BY ____ DATE ____



ISOCON MAP OF
ETHYLBENZENE
MAVERIK REFINERY STUDY AREA
KIRTLAND, NEW MEXICO
(APRIL, 1988)

Dames & Moore

PLATE B-3

FILE 14819-005 BY MAVERIK DATE 6-15-88 CHECKED BY DATE

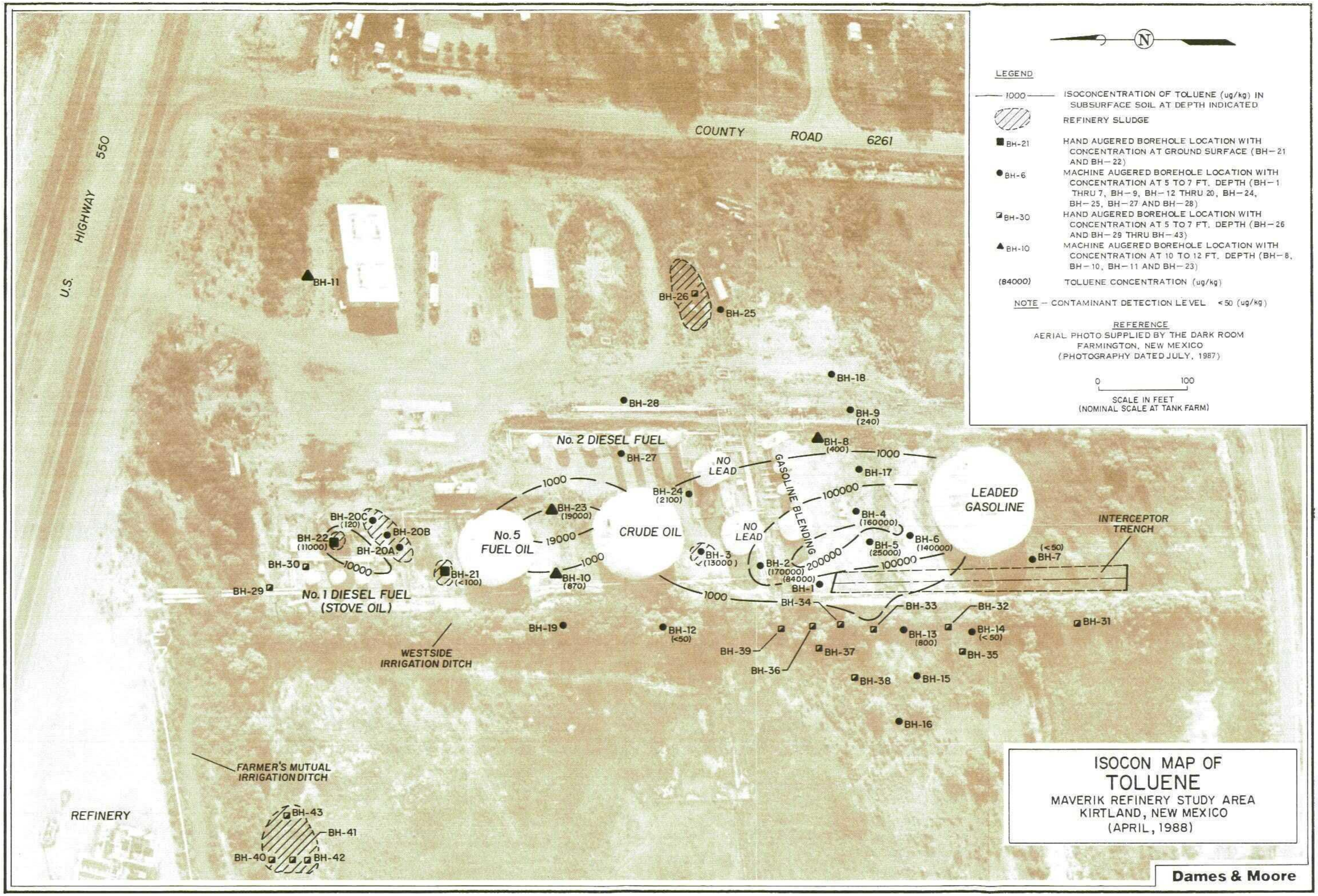
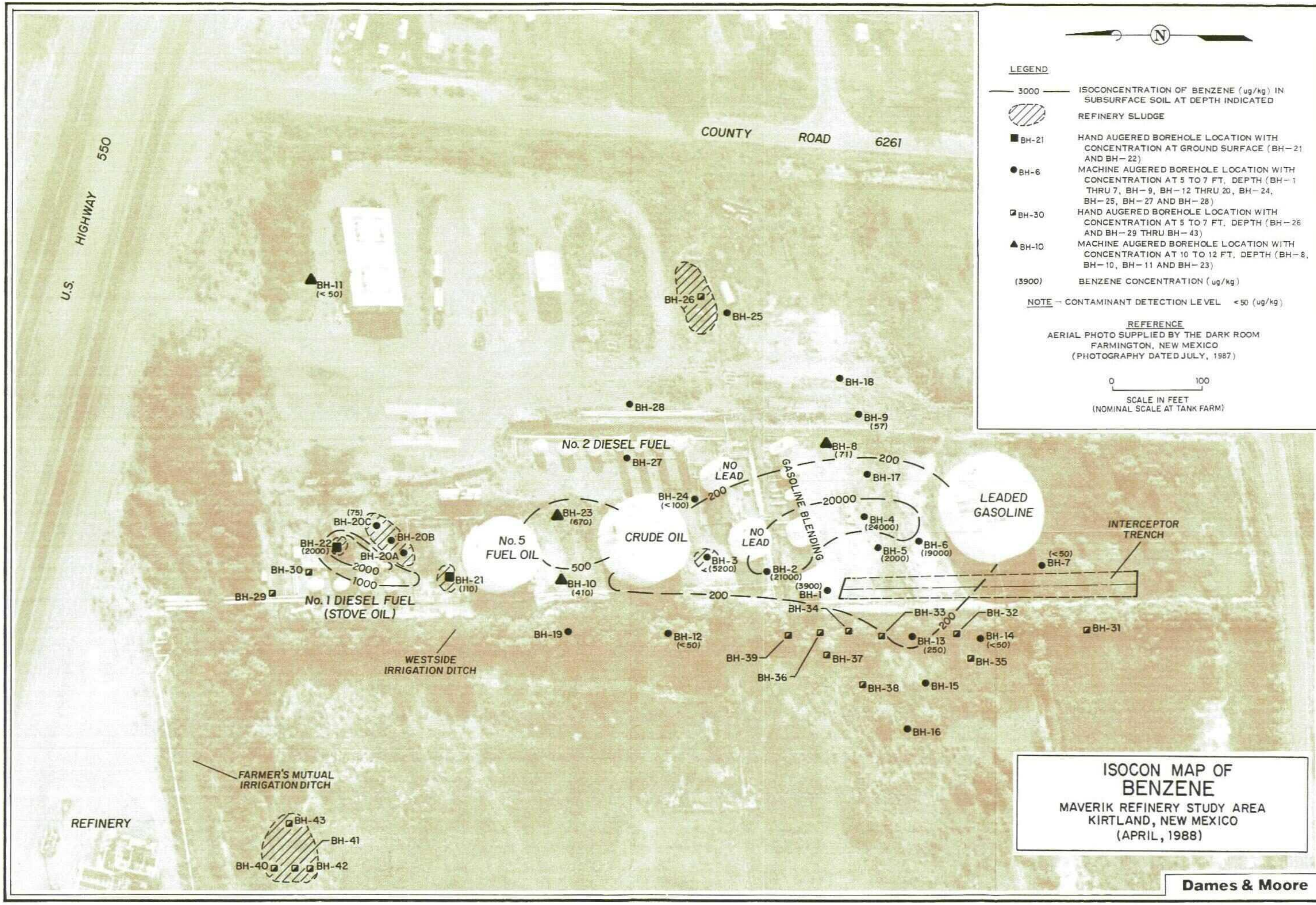


PLATE B-4



FILE 4819-005 BY MAVERIK DATE 6-15-88 CHECKED BY DATE

PLATE B-5

FILE 14819-005 MAVERIK BY ______ DATE 5-12-88 CHECKED BY ______ DATE ______

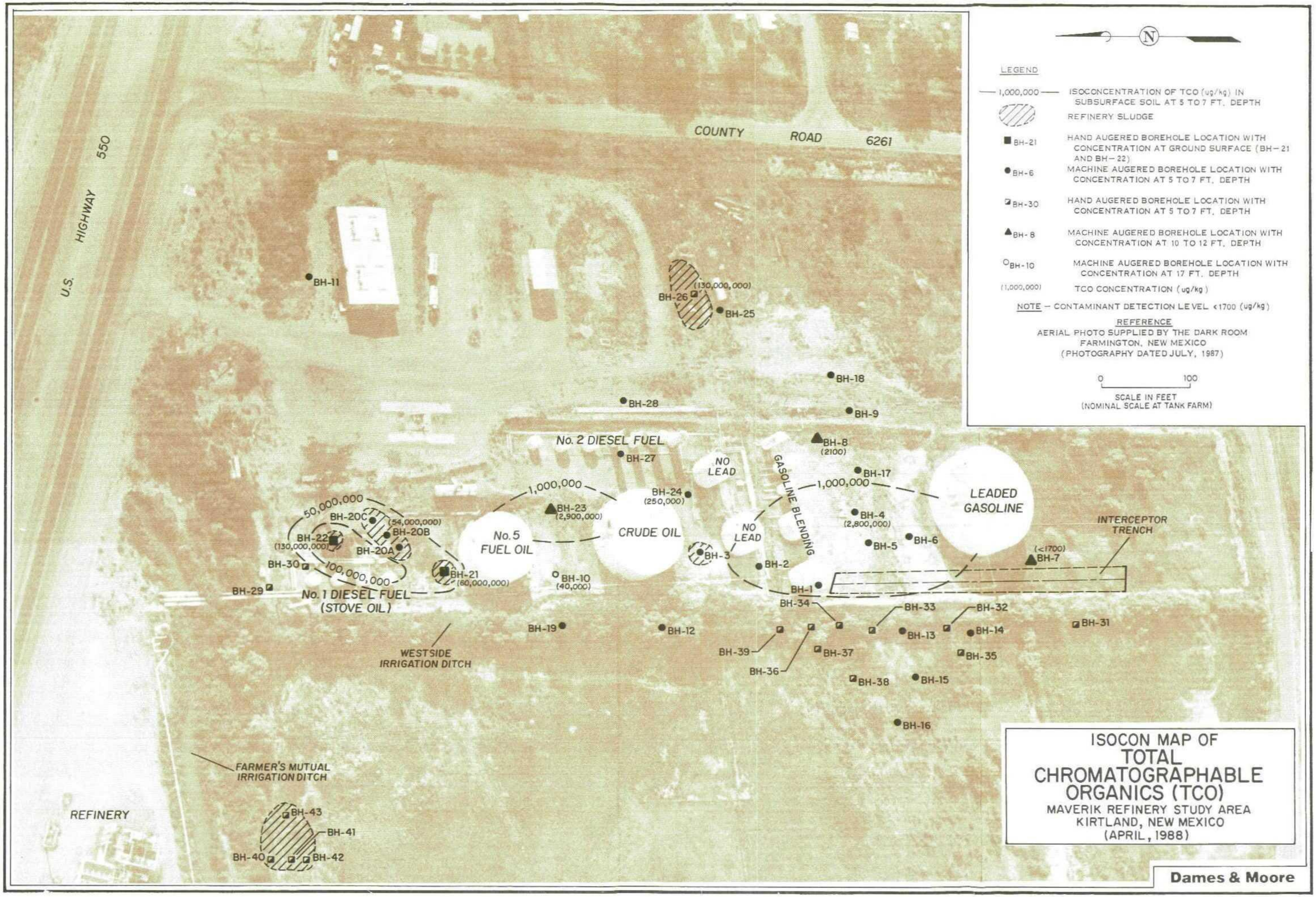


PLATE B-6

APPENDIX C

LABORATORY SOILS AND SOLID WASTE ANALYTICAL DATA

APPENDIX C

LABORATORY SOILS AND SOLID WASTE ANALYTICAL DATA

SOILS AND SOLID WASTE SAMPLING

The zones for the soils and solid waste samples from inside of the cores from the split-spoon sampler, the hand-augered drill cuttings and the near-surface samples that were composite samples, were representative of contaminated zones and were detected by field OVA readings and visual inspection of the soils. Nitrile gloves were worn during sample collection. Sample bottles were shipped directly to the site by RMAL. Samples were iced after collection and shipped to RMAL the following day, via overnight courier. Appropriate holding times were observed and chain-of-custody documentation was maintained and included herein.

LABORATORY ANALYSIS

RMAL conducted the analysis on the soil and solid waste samples collected for Phase II (Table C-1). The concentrations of the major organic and metals parameters detected in the soils and solid wastes are included in Table C-2. The comprehensive report from RMAL for all of the analyses is also included in this Appendix.

SOIL AND SOLID WASTE ANALYSES

The soil and solid waste analyses included the same organic parameters analyzed for the Phase I water quality analyses but included additional refinery related hazardous constituents. The detailed list of the laboratory parameters and EPA analytical methods used are presented in Table 1. The analytical tests conducted for each sample from each borehole are listed in Table C-1. RMAL conducted analyses for 26 halogenated volatile organics, 9 aromatic volatile organics and percent oil, water and solids at the 26 borehole sites that were sampled, with a total of 37 samples taken at various depths. In addition, at 14 representative highly contaminated sites, all or some of the following constituents were also analyzed: total chromatographable organics, 13 refinery hazardous volatile organics, 32 refinery hazardous semivolatile organics, the 8 RCRA metals for EP toxicity testing, 8 to 12 total refinery metals and total organic lead.

The concentrations of the contaminants as directly reported by RMAL reflect the in-situ concentration of the solid, liquid and oil. The soil and sludge samples consisted of at least 70 percent solids, less than 6 percent oil and 10 to 25 percent water. Therefore, the laboratory results as reported could be compared directly. Only the sludge samples from BH-20, BH-22 and BH-26 had high percentages of oil and low percentages of solids and therefore should be evaluated separately from the other results.

Where specific test methods have been approved and recommended, RMAL performs the analytical tests according to approved EPA methods and other regulatory agencies. Metals analyses are conducted by acid digestion followed by ICP analyses and graphite furnace AA. The EP-toxicity tests for metals included sample extraction with acetic acid followed by ICP analyses and graphite furnace AA.

Volatile organics were analyzed by purge and trap GC/MS or purge and trap GC with a selective detector. Semivolatile organics were analyzed by solvent extraction followed by capillary column GC/MS. Oil and grease were analyzed by gravimetric freon extraction.

ROCKY MOUNTAIN ANALYTICAL LABORATORY QA/QC PROGRAM

All analyses were conducted within approved holding times. Details of RMAL's QA/QC program and results are included in their report, Section V.

Accuracy and precision of Laboratory Control Samples and Surrogate Control Samples were within acceptance limits for those constituents present in the samples.

TABLE C-1

BOREHOLE SAMPLE ZONES AND ANALYTICAL LABORATORY TESTS CONDUCTED

Borehole Designation	RMAL Laboratory ID	Zones Sampled	Analytical Tests[1]
On-Site			
BH-1	67123-001	5 - 6.5	VOA, VOX, OWS
	67123-002	10 - 11.5	VOA, VOX, OWS, Skinner List
	67123-003	15.5 - 17	VOA, VOX, OWS
BH-2	67161-007	5 - 7	VOA, VOX, OWS
	67161-008	7	Skinner List
	67161-009	10 - 12	VOA, VOX, OWS
	67161-010	15 - 17	VOA, VOX, OWS
BH-3	67161-011	5 - 7	VOA, VOX, OWS
	67161-012	11	EPTOX, RCRA Metals
	67161-013	10 - 12	VOA, VOX, OWS
	67161-014	15 - 17	VOA, VOX, OWS
BH-4	67123-004	5 - 7	VOA, VOX, OWS, TOL, TCO
	67123-005	10 - 12	VOA, VOX, OWS
	67123-006	15 - 17	VOA, VOX, OWS
BH-5	67123-007	5 - 7	VOA, VOX, OWS, TOL
	67123-008	10 - 12	VOA, VOX, OWS
	67123-009	15 - 17	VOA, VOX, OWS
BH-6	67123-010	5 - 7	VOA, VOX, OWS
	67123-011	10 - 12	VOA, VOX, OWS
	67123-012	15 - 17	VOA, VOX, OWS
BH-7	67161-001	5 - 7	VOA, VOX, OWS
	67161-002	10 - 12	VOA, VOX, OWS, TOL, TCO
	67161-003	15 - 17	VOA, VOX, OWS
BH-8	67123-014	10 - 12	VOA, VOX, OWS, TCO
BH-9	67123-018	5 - 7	VOA, VOX, OWS
BH-10	67161-004	12	VOA, VOX
	67161-005	15	OWS
	67161-006	17	TCO
BH-11	67123-015	10 - 12	VOA, VOX, OWS
BH-20 (sludge)	67196-001	5 - 7	VOA, VOX, OWS, TCO
BH-21 *(surface)*	67196-002	0 - 1.25	Skinner List, VOA, VOX OWS, TCO
BH-22 (sludge)	67196-003	0 - 0.5	Skinner List, VOA, VOX OWS, TCO
BH-23	67196-004	10 - 12	VOA, VOX, OWS, TCO
BH-24	67196-005	5 - 11.5	VOA, VOX, OWS, TCO
BH-26 (sludge)	67196-006	0 - 1	RCRA Metals, OWS, TCO
Off-Site			
BH-12	67123-013	10 - 12	VOA, VOX, OWS
BH-13	67123-017	6 - 7	VOA, VOX, OWS
BH-14	67123-016	6 - 7	VOA, VOX, OWS

Footnotes:

(1) *Abbreviations For analytical Tests Conducted*
VOA = Aromatic Volatile Organics
VOX = Halogenated Volatile Organics
OWS = Percent Oil/Water/Soils
Skinner List = Refinery Hazardous Volatile, Semi-volatile, Total Metals
TCO = Total Chromatographable Organics
EPTOX = EP Toxicity Tests, Metals Only
RCRA Metals = 8 Metals, Total

TABLE C-2
MAVERIK-KIRTLAND SOIL CHEMISTRY

SAMPLE IDENTIFICATION	BH-1 5-6.5'
DATE SAMPLED	4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	3900.
Ethylbenzene	22000.
Toluene	84000.
m-Xylene	130000.
o,p-Xylene	98000.
1,2 Dichloroethane	< 1000.
COMPOSITION (PERCENT)	
OIL	.4
WATER	13.2
SOLIDS	86.4

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-1 10-11.5
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		1800.
Ethylbenzene		710.
Toluene		4600.
m-Xylene		6300.
o,p-Xylene		3500.
1,2 Dichloroethane	<	200.
TOTAL ORGANIC LEAD (mg/Kg)		
Total Organic Lead	<	1.0
METALS PARAMETERS (TOTAL, mg/Kg)		
Antimony	<	5.0
Arsenic		1.8
Barium		140.0
Beryllium		.30
Cadmium	<	.5
Chromium		3.0
Cobalt		3.0
Lead		9.0
Mercury	<	.05
Nickel		5.00
Selenium	<	.2
Vanadium		11.0
COMPOSITION (PERCENT)		
OIL		.2
WATER		16.7
SOLIDS		83.1

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-1 15.5-17
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		380.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene		79.
o,p-Xylene		140.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.1
WATER		15.1
SOLIDS		83.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-2 5-7'
DATE SAMPLED	4-18-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	21000.
Ethylbenzene	39000.
Toluene	170000.
m-Xylene	210000.
o,p-Xylene	120000.
1,2 Dichloroethane	< 2000.
COMPOSITION (PERCENT)	
OIL	1.0
WATER	13.9
SOLIDS	85.1

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-2 7'
DATE SAMPLED		4-18-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	5000.
Ethylbenzene		15000.
Toluene		65000.
m-Xylene		99000.
o,p-Xylene		69000.
1,2 Dichloroethane	<	5000.
SEMIVOLATILE ORGANICS DETECTED (ug/Kg)		
bis(2-Ethylhexyl)phthalate		4400.
1-Methylnaphthalene		6500.
Naphthalene		5800.
Phenanthrene		1200.
Chrysene	<	990.
METALS PARAMETERS (TOTAL, mg/Kg)		
Antimony	<	5.0
Arsenic		1.0
Barium		110.0
Beryllium		.20
Cadmium	<	.5
Chromium		3.0
Cobalt		2.0
Lead		13.0
Mercury	<	.05
Nickel	<	4.0
Selenium	<	.4
Vanadium		10.0
COMPOSITION (PERCENT)		
OIL		1.0
WATER		13.9
SOILDS		85.1

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-2 10-12'
DATE SAMPLED	4-18-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	2500.
Ethylbenzene	7000.
Toluene	27000.
m-Xylene	39000.
o,p-Xylene	21000.
1,2 Dichloroethane	< 670.
COMPOSITION (PERCENT)	
OIL	.8
WATER	18.4
SOLIDS	80.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-2 15-17'
DATE SAMPLED		4-18-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.9
WATER		14.9
SOLIDS		84.2

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-3 5-7'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		5200.
Ethylbenzene		26000.
Toluene		13000.
m-Xylene		17000.
o,p-Xylene		90000.
1,2 Dichloroethane	<	1000.
COMPOSITION (PERCENT)		
OIL		1.5
WATER		14.0
SOLIDS		84.5

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-3 10-12'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		140.
Ethylbenzene		240.
Toluene		83.
m-Xylene		170.
o,p-Xylene		730.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.1
WATER		18.4
SOLIDS		81.5

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-3 11'
DATE SAMPLED		4-17-88
EPI TOXICITY METALS, (mg/Kg)		
Arsenic	<	.1
Barium		2.7
Cadmium	<	.005
Chromium	<	.01
Lead	<	.05
Mercury	<	1.0
Selenium	<	.02
Silver	<	.005

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-3 15-17'
DATE SAMPLED	4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	< 50.
Ethylbenzene	< 50.
Toluene	< 50.
m-Xylene	< 50.
o,p-Xylene	< 50.
1,2 Dichloroethane	< 100.
COMPOSITION (PERCENT)	
OIL	1.6
WATER	16.4
SOLIDS	82.0

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-4 5-7'
DATE SAMPLED	4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	24000.
Ethylbenzene	29000.
Toluene	160000.
m-Xylene	170000.
o,p-Xylene	120000.
1,2 Dichloroethane	< 2000.
TOTAL ORGANIC LEAD (mg/Kg)	
Total Organic Lead	4.0
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)	
TCO	2800.
BOILING POINT (CENTIGRADE)	
INITIAL	100.
FINIAL	340.
COMPOSITION (PERCENT)	
OIL	1.3
WATER	23.7
SOILDS	75.0

<: Less than given detection limits.

TABLE C-2 (Cont.-13)
MAVERIK-KIRTLAND SOIL CHEMISTRY

SAMPLE IDENTIFICATION		BH-4 10-12'
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene		57.
m-Xylene		230.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		5.2
WATER		15.4
SOLIDS		79.4

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-4 15-17'
DATE SAMPLED	4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	< 50.
Ethylbenzene	< 50.
Toluene	< 50.
m-Xylene	< 50.
o,p-Xylene	< 50.
1,2 Dichloroethane	< 100.
COMPOSITION (PERCENT)	
OIL	1.0
WATER	22.1
SOLIDS	76.9

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-5 5-7'
DATE SAMPLED	4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	2000.
Ethylbenzene	6000.
Toluene	25000.
m-Xylene	37000.
o,p-Xylene	25000.
1,2 Dichloroethane	< 1000.
TOTAL ORGANIC LEAD (mg/Kg)	
Total Organic Lead	2.0
COMPOSITION (PERCENT)	
OIL	.8
WATER	21.1
SOILDS	78.1

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-5 10-12'
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.4
WATER		18.3
SOLIDS		81.3

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-5 15-17'
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.3
WATER		21.0
SOLIDS		77.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-6 5-7'
DATE SAMPLED	4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	19000.
Ethylbenzene	37000.
Toluene	140000.
m-Xylene	170000.
o,p-Xylene	150000.
1,2 Dichloroethane	< 2000.
COMPOSITION (PERCENT)	
OIL	.4
WATER	20.7
SOLIDS	78.9

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-6 10-12'
DATE SAMPLED		4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene		53.
Toluene		190.
m-Xylene		390.
o,p-Xylene		340.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		5.6
WATER		22.7
SOLIDS		71.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-6 15-17'
DATE SAMPLED		4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.8
WATER		18.5
SOLIDS		80.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-7 5-7'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		2.3
WATER		13.9
SOLIDS		83.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-7 10-12'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
TOTAL ORGANIC LEAD (mg/Kg)		
Total Organic Lead	<	1.0
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TOC	<	1.7
BOILING POINT (CENTIGRADE)		
Not applicable		
COMPOSITION (PERCENT)		
OIL		2.7
WATER		21.6
SOILDS		75.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-7 15-17'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.5
WATER		17.8
SOLIDS		80.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-8 10-12'
DATE SAMPLED		4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		71.
Ethylbenzene		57.
Toluene		400.
m-Xylene		360.
o,p-Xylene		390.
1,2 Dichloroethane	<	100.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		2.1
BOILING POINT (CENTIGRADE)		
INITIAL		100.
FINIAL		170.
COMPOSITION (PERCENT)		
OIL		1.3
WATER		16.8
SOILDS		81.9

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-9 5-7'
DATE SAMPLED	4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	57.
Ethylbenzene	180.
Toluene	240.
m-Xylene	630.
o,p-Xylene	660.
1,2 Dichloroethane	< 100.
COMPOSITION (PERCENT)	
OIL	.8
WATER	21.0
SOLIDS	78.2

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-10 12'
DATE SAMPLED	4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	410.
Ethylbenzene	10000.
Toluene	870.
m-Xylene	63000.
o,p-Xylene	13000.
1,2 Dichloroethane	< 100.
COMPOSITION (PERCENT)	
OIL	.7
WATER	15.8
SOLIDS	83.5

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-10 17'
DATE SAMPLED	4-21-88
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)	
TCO	40.
BOILING POINT (CENTIGRADE)	
INITIAL	100.
FINIAL	330.

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-11 10-12'
DATE SAMPLED		4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.9
WATER		22.5
SOLIDS		75.6

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-12 10-12'
DATE SAMPLED		4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.3
WATER		20.3
SOLIDS		79.4

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-13 6-7'
DATE SAMPLED		4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		250.
Ethylbenzene		67.
Toluene		800.
m-Xylene		1400.
o,p-Xylene		580.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.4
WATER		16.8
SOLIDS		81.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-14 6-7'
DATE SAMPLED		4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.0
WATER		20.8
SOLIDS		78.2

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-20 5-7'
DATE SAMPLED	4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	75.
Ethylbenzene	76.
Toluene	120.
m-Xylene	130.
o,p-Xylene	150.
1,2 Dichloroethane	< 100.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)	
TCO	54000.0
BOILING POINT (CENTIGRADE)	
INITIAL	250.
FINIAL	450.
COMPOSITION (PERCENT)	
OIL	10.3
WATER	10.9
SOILDS	78.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-21 0-1.25
DATE SAMPLED		4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		110.
Ethylbenzene	<	100.
Toluene	<	100.
m-Xylene		3400.
o,p-Xylene		1700.
1,2 Dichloroethane	<	100.
SEMIVOLATILE ORGANICS DETECTED (ug/Kg)		
bis (2-Ethylhexyl)phthalate		1200.
1-Methylnaphthalene	<	990.
Naphthalene	<	990.
Phenanthrene		1400.
Chrysene	<	990.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		60000.
BOILING POINT (CENTIGRADE)		
INITIAL		290.
FINIAL		500.
METALS PARAMETERS (TOTAL, mg/Kg)		
Antimony	<	5.0
Arsenic		1.20
Barium		110.0
Beryllium		.20
Cadmium	<	.5
Chromium		2.00
Cobalt		2.00
Lead		8.00
Mercury	<	.05
Nickel	<	4.00
Selenium	<	.2
Vanadium		12.00
COMPOSITION (PERCENT)		
OIL		2.6
WATER		6.0
SOLIDS		91.4

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-22 0-0.5'
DATE SAMPLED		4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		2000.
Ethylbenzene		1800.
Toluene		11000.
m-Xylene		10000.
o,p-Xylene		6100.
1,2 Dichloroethane	<	200.
SEMIVOLATILE ORGANICS DETECTED (mg/Kg)		
bis (2-Ethylhexyl)phthalate	<	10000.
1-Methylnaphthalene	<	10000.
Naphthalene	<	10000.
Phenanthrene		30000.
Chrysene		28000.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		130000.
BOILING POINT (CENTIGRADE)		
INITIAL		100.
FINIAL		500.
METALS PARAMETERS (TOTAL, mg/Kg)		
Antimony	<	5.0
Arsenic	<	.30
Barium		9.4
Beryllium	<	.10
Cadmium	<	.5
Chromium	<	1.00
Cobalt	<	1.00
Lead	<	5.00
Mercury	<	.05
Nickel	<	4.00
Selenium	<	.2
Vanadium	<	1.00
COMPOSITION (PERCENT)		
OIL		93.7
WATER		2.0
SOLIDS		4.3

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-23 10-12'
DATE SAMPLED	4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	670.
Ethylbenzene	12000.
Toluene	19000.
m-Xylene	72000.
o,p-Xylene	35000.
1,2 Dichloroethane	< 1000.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)	
TCO	2900.0
BOILING POINT (CENTIGRADE)	
INITIAL	100.
FINIAL	470.
COMPOSITION (PERCENT)	
OIL	.1
WATER	11.4
SOILDS	88.5

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-24 5-11.5
DATE SAMPLED	4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	< 100.
Ethylbenzene	2400.
Toluene	2100.
m-Xylene	17000.
o,p-Xylene	10000.
1,2 Dichloroethane	< 200.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)	
TCO	250.0
BOILING POINT (CENTIGRADE)	
INITIAL	100.
FINIAL	400.
COMPOSITION (PERCENT)	
OIL	.2
WATER	10.6
SOILDS	89.2

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-26 0-1'
DATE SAMPLED		4-21-88
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		130000.
BOILING POINT (CENTIGRADE)		
INITIAL		170.
FINIAL		500.
METALS PARAMETERS (TOTAL, mg/Kg)		
Arsenic		9.0
Barium		63.0
Cadmium	<	.5
Chromium		12.0
Lead		98.0
Mercury	<	.05
Selenium	<	.2
Silver	<	.5
COMPOSITION (PERCENT)		
OIL		51.3
WATER		9.0
SOILDS		39.7

<: Less than given detection limits.

TABLE C-1

BOREHOLE SAMPLE ZONES AND ANALYTICAL LABORATORY TESTS CONDUCTED

Borehole Designation	RMAL Laboratory ID	Zones Sampled	Analytical Tests[1]
On-Site			
BH-1	67123-001	5 - 6.5	VOA, VOX, OWS
	67123-002	10 - 11.5	VOA, VOX, OWS, Skinner List
	67123-003	15.5 - 17	VOA, VOX, OWS
BH-2	67161-007	5 - 7	VOA, VOX, OWS
	67161-008	7	Skinner List
	67161-009	10 - 12	VOA, VOX, OWS
	67161-010	15 - 17	VOA, VOX, OWS
BH-3	67161-011	5 - 7	VOA, VOX, OWS
	67161-012	11	EPTOX, RCRA Metals
	67161-013	10 - 12	VOA, VOX, OWS
	67161-014	15 - 17	VOA, VOX, OWS
BH-4	67123-004	5 - 7	VOA, VOX, OWS, TOL, TCO
	67123-005	10 - 12	VOA, VOX, OWS
	67123-006	15 - 17	VOA, VOX, OWS
BH-5	67123-007	5 - 7	VOA, VOX, OWS, TOL
	67123-008	10 - 12	VOA, VOX, OWS
	67123-009	15 - 17	VOA, VOX, OWS
BH-6	67123-010	5 - 7	VOA, VOX, OWS
	67123-011	10 - 12	VOA, VOX, OWS
	67123-012	15 - 17	VOA, VOX, OWS
BH-7	67161-001	5 - 7	VOA, VOX, OWS
	67161-002	10 - 12	VOA, VOX, OWS, TOL, TCO
	67161-003	15 - 17	VOA, VOX, OWS
BH-8	67123-014	10 - 12	VOA, VOX, OWS, TCO
BH-9	67123-018	5 - 7	VOA, VOX, OWS
BH-10	67161-004	12	VOA, VOX
	67161-005	15	OWS
	67161-006	17	TCO
BH-11	67123-015	10 - 12	VOA, VOX, OWS
BH-20 (sludge)	67196-001	5 - 7	VOA, VOX, OWS, TCO
BH-21 (surface)	67196-002	0 - 1.25	Skinner List, VOA, VOX OWS, TCO
BH-22 (sludge)	67196-003	0 - 0.5	Skinner List, VOA, VOX OWS, TCO
BH-23	67196-004	10 - 12	VOA, VOX, OWS, TCO
BH-24	67196-005	5 - 11.5	VOA, VOX, OWS, TCO
BH-26 (sludge)	67196-006	0 - 1	RCRA Metals, OWS, TCO
Off-Site			
BH-12	67123-013	10 - 12	VOA, VOX, OWS
BH-13	67123-017	6 - 7	VOA, VOX, OWS
BH-14	67123-016	6 - 7	VOA, VOX, OWS

Footnotes:

(1) Abbreviations For analytical Tests Conducted
VOA = Aromatic Volatile Organics
VOX = Halogenated Volatile Organics
OWS = Percent Oil/Water/Soils
Skinner List = Refinery Hazardous Volatile, Semi-volatile, Total Metals
TCO = Total Chromatographable Organics
EPTOX = EP Toxicity Tests, Metals Only
RCRA Metals = 8 Metals, Total

TABLE C-2
MAVERIK-KIRTLAND SOIL CHEMISTRY

SAMPLE IDENTIFICATION	BH-1 5-6.5'
DATE SAMPLED	4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	3900.
Ethylbenzene	22000.
Toluene	84000.
m-Xylene	130000.
o,p-Xylene	98000.
1,2 Dichloroethane	< 1000.
COMPOSITION (PERCENT)	
OIL	.4
WATER	13.2
SOLIDS	86.4

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-1 10-11.5
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		1800.
Ethylbenzene		710.
Toluene		4600.
m-Xylene		6300.
o,p-Xylene		3500.
1,2 Dichloroethane	<	200.
TOTAL ORGANIC LEAD (mg/Kg)		
Total Organic Lead	<	1.0
METALS PARAMETERS (TOTAL, mg/Kg)		
Antimony	<	5.0
Arsenic		1.8
Barium		140.0
Beryllium		.30
Cadmium	<	.5
Chromium		3.0
Cobalt		3.0
Lead		9.0
Mercury	<	.05
Nickel		5.00
Selenium	<	.2
Vanadium		11.0
COMPOSITION (PERCENT)		
OIL		.2
WATER		16.7
SOLIDS		83.1

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-1 15.5-17
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		380.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene		79.
o,p-Xylene		140.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.1
WATER		15.1
SOLIDS		83.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-2 5-7'
DATE SAMPLED	4-18-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	21000.
Ethylbenzene	39000.
Toluene	170000.
m-Xylene	210000.
o,p-Xylene	120000.
1,2 Dichloroethane	< 2000.
COMPOSITION (PERCENT)	
OIL	1.0
WATER	13.9
SOLIDS	85.1

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-2 7'
DATE SAMPLED		4-18-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	5000.
Ethylbenzene		15000.
Toluene		65000.
m-Xylene		99000.
o,p-Xylene		69000.
1,2 Dichloroethane	<	5000.
SEMIVOLATILE ORGANICS DETECTED (ug/Kg)		
bis(2-Ethylhexyl)phthalate		4400.
1-Methylnaphthalene		6500.
Naphthalene		5800.
Phenanthrene		1200.
Chrysene	<	990.
METALS PARAMETERS (TOTAL, mg/Kg)		
Antimony	<	5.0
Arsenic		1.0
Barium		110.0
Beryllium		.20
Cadmium	<	.5
Chromium		3.0
Cobalt		2.0
Lead		13.0
Mercury	<	.05
Nickel	<	4.0
Selenium	<	.4
Vanadium		10.0
COMPOSITION (PERCENT)		
OIL		1.0
WATER		13.9
SOILDS		85.1

<: Less than given detection limits.

MAVERIK-KIRTLAND SOIL CHEMISTRY

SAMPLE IDENTIFICATION		BH-2 10-12'
DATE SAMPLED		4-18-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		2500.
Ethylbenzene		7000.
Toluene		27000.
m-Xylene		39000.
o,p-Xylene		21000.
1,2 Dichloroethane	<	670.
COMPOSITION (PERCENT)		
OIL		.8
WATER		18.4
SOLIDS		80.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-2 15-17'
DATE SAMPLED		4-18-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.9
WATER		14.9
SOLIDS		84.2

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-3 5-7'
DATE SAMPLED	4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	5200.
Ethylbenzene	26000.
Toluene	13000.
m-Xylene	17000.
o,p-Xylene	90000.
1,2 Dichloroethane	< 1000.
COMPOSITION (PERCENT)	
OIL	1.5
WATER	14.0
SOLIDS	84.5

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-3 10-12′
DATE SAMPLED	4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	140.
Ethylbenzene	240.
Toluene	83.
m-Xylene	170.
o,p-Xylene	730.
1,2 Dichloroethane	< 100.
COMPOSITION (PERCENT)	
OIL	.1
WATER	18.4
SOLIDS	81.5

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-3 11'
DATE SAMPLED		4-17-88
EPI TOXICITY METALS, (mg/Kg)		
Arsenic	<	.1
Barium		2.7
Cadmium	<	.005
Chromium	<	.01
Lead	<	.05
Mercury	<	1.0
Selenium	<	.02
Silver	<	.005

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-3 15-17'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.6
WATER		16.4
SOLIDS		82.0

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-4 5-7'
DATE SAMPLED	4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	24000.
Ethylbenzene	29000.
Toluene	160000.
m-Xylene	170000.
o,p-Xylene	120000.
1,2 Dichloroethane	< 2000.
TOTAL ORGANIC LEAD (mg/Kg)	
Total Organic Lead	4.0
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)	
TCO	2800.
BOILING POINT (CENTIGRADE)	
INITIAL	100.
FINIAL	340.
COMPOSITION (PERCENT)	
OIL	1.3
WATER	23.7
SOILDS	75.0

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-4 10-12'
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene		57.
m-Xylene		230.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		5.2
WATER		15.4
SOLIDS		79.4

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-4 15-17'
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.0
WATER		22.1
SOLIDS		76.9

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-5 5-7'
DATE SAMPLED	4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	2000.
Ethylbenzene	6000.
Toluene	25000.
m-Xylene	37000.
o,p-Xylene	25000.
1,2 Dichloroethane	< 1000.
TOTAL ORGANIC LEAD (mg/Kg)	
Total Organic Lead	2.0
COMPOSITION (PERCENT)	
OIL	.8
WATER	21.1
SOILDS	78.1

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-5 10-12'
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.4
WATER		18.3
SOLIDS		81.3

<: Less than given detection limits.

TABLE C-2 (Cont.-17)
MAVERIK-KIRTLAND SOIL CHEMISTRY

SAMPLE IDENTIFICATION		BH-5 15-17'
DATE SAMPLED		4-14-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.3
WATER		21.0
SOLIDS		77.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-6 5-7'
DATE SAMPLED	4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	19000.
Ethylbenzene	37000.
Toluene	140000.
m-Xylene	170000.
o,p-Xylene	150000.
1,2 Dichloroethane	< 2000.
COMPOSITION (PERCENT)	
OIL	.4
WATER	20.7
SOLIDS	78.9

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-6 10-12'
DATE SAMPLED		4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene		53.
Toluene		190.
m-Xylene		390.
o,p-Xylene		340.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		5.6
WATER		22.7
SOLIDS		71.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-6 15-17'
DATE SAMPLED		4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.8
WATER		18.5
SOLIDS		80.7

<: Less than given detection limits.

TABLE C-2 (Cont.-21)
MAVERIK-KIRTLAND SOIL CHEMISTRY

SAMPLE IDENTIFICATION		BH-7 5-7'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		2.3
WATER		13.9
SOLIDS		83.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-7 10-12'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
TOTAL ORGANIC LEAD (mg/Kg)		
Total Organic Lead	<	1.0
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TOC	<	1.7
BOILING POINT (CENTIGRADE)		
Not applicable		
COMPOSITION (PERCENT)		
OIL		2.7
WATER		21.6
SOILDS		75.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-7 15-17'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.5
WATER		17.8
SOLIDS		80.7

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-8 10-12'
DATE SAMPLED		4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		71.
Ethylbenzene		57.
Toluene		400.
m-Xylene		360.
o,p-Xylene		390.
1,2 Dichloroethane	<	100.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		2.1
BOILING POINT (CENTIGRADE)		
INITIAL		100.
FINIAL		170.
COMPOSITION (PERCENT)		
OIL		1.3
WATER		16.8
SOILDS		81.9

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-9 5-7'
DATE SAMPLED		4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		57.
Ethylbenzene		180.
Toluene		240.
m-Xylene		630.
o,p-Xylene		660.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.8
WATER		21.0
SOLIDS		78.2

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-10 12'
DATE SAMPLED		4-17-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		410.
Ethylbenzene		10000.
Toluene		870.
m-Xylene		63000.
o,p-Xylene		13000.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.7
WATER		15.8
SOLIDS		83.5

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-10 17'
DATE SAMPLED	4-21-88
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)	
TCO	40.
BOILING POINT (CENTIGRADE)	
INITIAL	100.
FINIAL	330.

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-11 10-12'
DATE SAMPLED		4-16-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.9
WATER		22.5
SOLIDS		75.6

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-12 10-12'
DATE SAMPLED		4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		.3
WATER		20.3
SOLIDS		79.4

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-13 6-7'
DATE SAMPLED		4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		250.
Ethylbenzene		67.
Toluene		800.
m-Xylene		1400.
o,p-Xylene		580.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.4
WATER		16.8
SOLIDS		81.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-14 6-7'
DATE SAMPLED		4-15-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	50.
Ethylbenzene	<	50.
Toluene	<	50.
m-Xylene	<	50.
o,p-Xylene	<	50.
1,2 Dichloroethane	<	100.
COMPOSITION (PERCENT)		
OIL		1.0
WATER		20.8
SOLIDS		78.2

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-20 5-7'
DATE SAMPLED		4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		75.
Ethylbenzene		76.
Toluene		120.
m-Xylene		130.
o,p-Xylene		150.
1,2 Dichloroethane	<	100.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		54000.0
BOILING POINT (CENTIGRADE)		
INITIAL		250.
FINIAL		450.
COMPOSITION (PERCENT)		
OIL		10.3
WATER		10.9
SOILDS		78.8

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-21 0-1.25
DATE SAMPLED		4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		110.
Ethylbenzene	<	100.
Toluene	<	100.
m-Xylene		3400.
o,p-Xylene		1700.
1,2 Dichloroethane	<	100.
SEMIVOLATILE ORGANICS DETECTED (ug/Kg)		
bis (2-Ethylhexyl)phthalate		1200.
1-Methylnaphthalene	<	990.
Naphthalene	<	990.
Phenanthrene		1400.
Chrysene	<	990.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		60000.
BOILING POINT (CENTIGRADE)		
INITIAL		290.
FINIAL		500.
METALS PARAMETERS (TOTAL, mg/Kg)		
Antimony	<	5.0
Arsenic		1.20
Barium		110.0
Beryllium		.20
Cadmium	<	.5
Chromium		2.00
Cobalt		2.00
Lead		8.00
Mercury	<	.05
Nickel	<	4.00
Selenium	<	.2
Vanadium		12.00
COMPOSITION (PERCENT)		
OIL		2.6
WATER		6.0
SOLIDS		91.4

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-22 0-0.5'
DATE SAMPLED		4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene		2000.
Ethylbenzene		1800.
Toluene		11000.
m-Xylene		10000.
o,p-Xylene		6100.
1,2 Dichloroethane	<	200.
SEMIVOLATILE ORGANICS DETECTED (mg/Kg)		
bis (2-Ethylhexyl)phthalate	<	10000.
1-Methylnaphthalene	<	10000.
Naphthalene	<	10000.
Phenanthrene		30000.
Chrysene		28000.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		130000.
BOILING POINT (CENTIGRADE)		
INITIAL		100.
FINIAL		500.
METALS PARAMETERS (TOTAL, mg/Kg)		
Antimony	<	5.0
Arsenic	<	.30
Barium		9.4
Beryllium	<	.10
Cadmium	<	.5
Chromium	<	1.00
Cobalt	<	1.00
Lead	<	5.00
Mercury	<	.05
Nickel	<	4.00
Selenium	<	.2
Vanadium	<	1.00
COMPOSITION (PERCENT)		
OIL		93.7
WATER		2.0
SOLIDS		4.3

<: Less than given detection limits.

SAMPLE IDENTIFICATION	BH-23 10-12'
DATE SAMPLED	4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)	
Benzene	670.
Ethylbenzene	12000.
Toluene	19000.
m-Xylene	72000.
o,p-Xylene	35000.
1,2 Dichloroethane	< 1000.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)	
TCO	2900.0
BOILING POINT (CENTIGRADE)	
INITIAL	100.
FINIAL	470.
COMPOSITION (PERCENT)	
OIL	.1
WATER	11.4
SOILDS	88.5

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-24 5-11.5
DATE SAMPLED		4-21-88
VOLATILE ORGANICS DETECTED (ug/Kg)		
Benzene	<	100.
Ethylbenzene		2400.
Toluene		2100.
m-Xylene		17000.
o,p-Xylene		10000.
1,2 Dichloroethane	<	200.
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		250.0
BOILING POINT (CENTIGRADE)		
INITIAL		100.
FINIAL		400.
COMPOSITION (PERCENT)		
OIL		.2
WATER		10.6
SOILDS		89.2

<: Less than given detection limits.

SAMPLE IDENTIFICATION		BH-26 0-1'
DATE SAMPLED		4-21-88
TOTAL CHROMATOGRAPHABLE ORGANICS (mg/Kg)		
TCO		130000.
BOILING POINT (CENTIGRADE)		
INITIAL		170.
FINIAL		500.
METALS PARAMETERS (TOTAL, mg/Kg)		
Arsenic		9.0
Barium		63.0
Cadmium	<	.5
Chromium		12.0
Lead		98.0
Mercury	<	.05
Selenium	<	.2
Silver	<	.5
COMPOSITION (PERCENT)		
OIL		51.3
WATER		9.0
SOILDS		39.7

<: Less than given detection limits.

Rocky Mountain
Analytical Laboratory

Enseco

ANALYTICAL RESULTS

FOR

DAMES AND MOORE

MAY 11, 1988

Reviewed by: Jeanne B Howbert

Jeanne B. Howbert

Michael P. Phillips, Ph.D.n

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I. OVERVIEW

On April 15 and 18, 1988, Enseco-Rocky Mountain Analytical Laboratory received 18 samples from Dames and Moore. A complete listing of tests requested, by sample, is given in Section III.

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:

I. Overview
II. Sample Description Information
III. Analytical Tests Assigned (not included)
IV. Analytical Results
V. Quality Control Report
VI. Description of Analytical Methodology

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

II. 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 five digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the five 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.

SAMPLE DESCRIPTION INFORMATION

for

DAMES AND MOORE

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
67123-001-00	BH-1 5-6 1\2'	Soil	04/14/88	04/15/88
67123-002-00	BH-1 10-11 1\2'	Soil	04/14/88	04/15/88
67123-003-00	BH-1 15 1\2-17'	Soil	04/14/88	04/15/88
67123-004-00	BH-4 5-7'	Soil	04/14/88	04/15/88
67123-005-00	BH-4 10-12'	Soil	04/14/88	04/15/88
67123-006-00	BH-4 15-17'	Soil	04/14/88	04/15/88
67123-007-00	BH-5 5-7'	Soil	04/14/88	04/15/88
67123-008-00	BH-5 10-12'	Soil	04/14/88	04/15/88
67123-009-00	BH-5 15-17'	Soil	04/14/88	04/15/88
67123-010-00	BH-6 5-7'	Soil	04/16/88	04/18/88
67123-011-00	BH-6 10-12'	Soil	04/16/88	04/18/88
67123-012-00	BH-6 15-17'	Soil	04/16/88	04/18/88
67123-013-00	BH-12 10-12'	Soil	04/15/88	04/18/88
67123-014-00	BH-8 10-12'	Soil	04/15/88	04/18/88
67123-015-00	BH-11 10-12'	Soil	04/16/88	04/18/88
67123-016-00	BH-14 6-7'	Soil	04/15/88	04/18/88
67123-017-00	BH-13 6-7'	Soil	04/15/88	04/18/88
67123-018-00	BH-9 5-7'	Soil	04/16/88	04/18/88

IV. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, with tests reported in the following order: GC/MS, Chromatography, Metals and Inorganics.

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. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is given in Section V.

The analytical data reported are subject to the following limitations of the analytical methodology:

<u>GC/MS</u>

Volatile Organics

a) The cis- and trans-isomers of dichloroethylene cannot be distinguished using EPA Method 624. All dichloroethylene present is reported as trans-dichloroethylene.

Semivolatile Organics

a) Benzo(b) and benzo(k) fluoranthene cannot be differentiated based on their mass spectra; retention times are almost identical. The isomer which is the closest in retention time to the sample is reported.

b) 1,2-diphenylhydrazine is measured as azobenzene.

c) N-Nitrosodiphenylamine decomposes in the gas chromatographic inlet to diphenylamine.

Chromatography

Methods 601 and 8010

a) Dichlorodifluoromethane (Freon 12) and vinyl chloride coelute under the specified analytical conditions. All data are reported as a combined value for the two compounds.

b) Dibromochloromethane, cis-1,3-dichloropropene and 1,1,2-trichloroethane are unresolved. The three compounds are reported as a single combined value.

c) Tetrachloroethene and 1,1,2,2-tetrachloroethane coelute and are reported as a combined result.

Method 602 and 8020

a) The ortho and para isomers of xylene coelute and are reported as a single concentration value.

TOTAL CHROMATOGRAPHABLE ORGANICS

Total Chromatographable Organics (TCO) were determined from a methylene chloride extraction and subsequent analysis by capillary column gas chromatography with a flame ionization detector (GC/FID). The TCO result was based on the entire area under the chromatogram as compared to the response to eicosane. The detection limit is based on the response of diesel.

The pattern of the FID chromatogram (fingerprint) was compared to fingerprints of various petroleum products. If, on the judgement of the analyst, the fingerprint of the sample matched the fingerprint of a petroleum product, the concentration of the product was also reported. If components of a particular product were present, but the complexity of the overall chromatogram was such that it could not be reliably determined if the product was or was not present, then, the result for that product contains the following statement: "Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved."

In addition to reporting a TCO value, the results contain boiling point information. This boiling point range represents the range of 80 to 90 percent of the compounds detected in the sample.

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-1 5-6 1\2'

Laboratory ID: 67123-001 Enseco ID: 67123-001

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	5000
Carbon tetrachloride	N.D.	ug/kg	500
Chlorobenzene	N.D.	ug/kg	2000
Chloroethane	N.D.	ug/kg	5000
Chloroform	N.D.	ug/kg	500
Dibromochloromethane	N.D.	ug/kg	1000
Bromodichloromethane	N.D.	ug/kg	1000
1,1-Dichloroethane	N.D.	ug/kg	500
1,2-Dichloroethane	N.D.	ug/kg	1000
1,1-Dichloroethene	N.D.	ug/kg	500
1,2-Dichloropropane	N.D.	ug/kg	1000
cis-1,3-Dichloropropene	N.D.	ug/kg	2000
trans-1,3-Dichloropropene	N.D.	ug/kg	500
Bromomethane	N.D.	ug/kg	5000
Chloromethane	N.D.	ug/kg	5000
Methylene chloride	N.D.	ug/kg	5000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	1000
Tetrachloroethene	N.D.	ug/kg	500
trans-1,2-Dichloroethene	N.D.	ug/kg	500
1,1,1-Trichloroethane	N.D.	ug/kg	500
1,1,2-Trichloroethane	N.D.	ug/kg	1000
Trichloroethene	N.D.	ug/kg	1000
Vinyl chloride	N.D.	ug/kg	1000
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	1000
1,2-Dibromoethane (EDB)	N.D.	ug/kg	2000

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

Enseco

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-1 5-6 1\2'

Laboratory ID: 67123-001 Enseco ID: 67123-001

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	3900	ug/kg	500
Chlorobenzene	N.D.	ug/kg	500
1,2-Dichlorobenzene	N.D.	ug/kg	500
1,3-Dichlorobenzene	N.D.	ug/kg	500
1,4-Dichlorobenzene	N.D.	ug/kg	500
Ethylbenzene	22000	ug/kg	500
Toluene	84000	ug/kg	500
m-Xylene	130000	ug/kg	500
o & p-Xylene(s)	98000	ug/kg	500

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

Sample: 67123-001

Enseco

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-1 5-6 1\2'

Laboratory ID: 67123-001 Enseco ID: 67123-001

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.4	%	0.1		04/21/88
Water	13.2	%	0.1		04/21/88
Solids	86.4	%	0.1		04/21/88

N.D. = Not detected

Approved by: Lindsay Breyer

Enseco

REFINERY HAZARDOUS CONSTITUENT VOLATILES

EPA METHOD 8240

Client Name: DAMES AND MOORE

Client ID: BH-1 10-11 1\2'

Laboratory ID: 67123-002 Enseco ID: 67123-002

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	1700	ug/kg	1000
Carbon disulfide	N.D.	ug/kg	1000
Chlorobenzene	N.D.	ug/kg	1000
Chloroform	N.D.	ug/kg	1000
1,2-Dibromoethane	N.D.	ug/kg	1000
1,2-Dichloroethane	N.D.	ug/kg	1000
1,4-Dioxane	N.D.	ug/kg	20000
Methyl ethyl ketone	N.D.	ug/kg	5000
Styrene	N.D.	ug/kg	1000
Ethylbenzene	N.D.	ug/kg	1000
Toluene	N.D.	ug/kg	1000
m-Xylene	1300	ug/kg	1000
o & p-Xylene(s)	1000	ug/kg	1000
Surrogate			
Toluene-D8	97	%	-
Bromofluorobenzene(BFB)	102	%	-
1,2-Dichloroethane-D4	104	%	-

N.D. = Not detected

Reported by: Stephen Siegal Approved by: Jeffrey Lowry

Sample: 67123-002

REFINERY HAZARDOUS CONSTITUENT SEMIVOLATILES

Client Name: DAMES AND MOORE

Client ID: BH-1 10-11 1\2'

Laboratory ID: 67123-002 Enseco ID: 67123-002

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Prepared: 04/19/88 Analyzed: 05/06/88

Parameter	Result	Units (as received)	Reporting Limit
Anthracene	N.D.	ug/kg	330
Benzo(a)anthracene	N.D.	ug/kg	330
Benzo(b)fluoranthene	N.D.	ug/kg	330
Benzo(k)fluoranthene	N.D.	ug/kg	330
Benzo(a)pyrene	N.D.	ug/kg	330
bis(2-Ethylhexyl)phthalate	N.D.	ug/kg	330
Butylbenzyl phthalate	N.D.	ug/kg	330
Chrysene	N.D.	ug/kg	330
Dibenz(a,h)anthracene	N.D.	ug/kg	330
Di-n-butyl phthalate	N.D.	ug/kg	330
1,2-Dichlorobenzene	N.D.	ug/kg	330
1,3-Dicholrobenzene	N.D.	ug/kg	330
1,4-Dichlorobenzene	N.D.	ug/kg	330
Diethyl phthalate	N.D.	ug/kg	330
7,12-Dimethylbenzanthracene	N.D.	ug/kg	330
Dimethyl phthalate	N.D.	ug/kg	330
Di-n-octyl phthalate	N.D.	ug/kg	330
Fluoranthene	N.D.	ug/kg	330
Indene	N.D.	ug/kg	330
1-Methylnaphthalene	N.D.	ug/kg	330
Naphthalene	N.D.	ug/kg	330
Phenanthrene	N.D.	ug/kg	330
Pyrene	N.D.	ug/kg	330
Pyridine	N.D.	ug/kg	-
Quinoline	N.D.	ug/kg	330
Benzenethiol	N.D.	ug/kg	-
o-Cresol	N.D.	ug/kg	330
p & m-Cresol	N.D.	ug/kg	330
2,4-Dimethylphenol	N.D.	ug/kg	330
2,4-Dinitrophenol	N.D.	ug/kg	1600
4-Nitrophenol	N.D.	ug/kg	1600

N.D. = Not detected

REFINERY HAZARDOUS CONSTITUENT SEMIVOLATILES (CONT.)

Client Name: DAMES AND MOORE

Client ID: BH-1 10-11 1\2'

Laboratory ID: 67123-002 Enseco ID: 67123-002

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Prepared: 04/19/88 Analyzed: 05/06/88

Parameter	Result	Units (as received)	Reporting Limit
Phenol	N.D.	ug/kg	330
Surrogate			
Nitrobenzene-D5	71	%	-
2-Fluorobiphenyl	76	%	-
Terphenyl-D14	87	%	-
Phenol-D5	40	%	-
2-Fluorophenol	50	%	-
2,4,6-Tribromophenol	60	%	-

N.D. = Not detected

Reported by: Timothy Miller Approved by: Jeffrey Lowry

Enseco

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-1 10-11 1\2'

Laboratory ID: 67123-002 Enseco ID: 67123-002

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	1000
Carbon tetrachloride	N.D.	ug/kg	100
Chlorobenzene	N.D.	ug/kg	400
Chloroethane	N.D.	ug/kg	1000
Chloroform	N.D.	ug/kg	100
Dibromochloromethane	N.D.	ug/kg	200
Bromodichloromethane	N.D.	ug/kg	200
1,1-Dichloroethane	N.D.	ug/kg	100
1,2-Dichloroethane	N.D.	ug/kg	200
1,1-Dichloroethene	N.D.	ug/kg	100
1,2-Dichloropropane	N.D.	ug/kg	200
cis-1,3-Dichloropropene	N.D.	ug/kg	400
trans-1,3-Dichloropropene	N.D.	ug/kg	100
Bromomethane	N.D.	ug/kg	1000
Chloromethane	N.D.	ug/kg	1000
Methylene chloride	N.D.	ug/kg	1000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	200
Tetrachloroethene	N.D.	ug/kg	100
trans-1,2-Dichloroethene	N.D.	ug/kg	100
1,1,1-Trichloroethane	N.D.	ug/kg	100
1,1,2-Trichloroethane	N.D.	ug/kg	200
Trichloroethene	N.D.	ug/kg	200
Vinyl chloride	N.D.	ug/kg	200
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	200
1,2-Dibromoethane (EDB)	N.D.	ug/kg	400

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-1 10-11 1\2'

Laboratory ID: 67123-002 Enseco ID: 67123-002

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	1800	ug/kg	100
Chlorobenzene	N.D.	ug/kg	100
1,2-Dichlorobenzene	N.D.	ug/kg	100
1,3-Dichlorobenzene	N.D.	ug/kg	100
1,4-Dichlorobenzene	N.D.	ug/kg	100
Ethylbenzene	710	ug/kg	100
Toluene	4600	ug/kg	100
m-Xylene	6300	ug/kg	100
o & p-Xylene(s)	3500	ug/kg	100

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

METALS PARAMETERS
TOTAL METALS

Client Name: DAMES AND MOORE

Client ID: BH-1 10-11 1\2'

Laboratory ID: 67123-002 Enseco ID: 67123-002

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/kg	5	6010	04/25/88
Arsenic	1.8	mg/kg	0.3	7060	04/29/88
Barium	140	mg/kg	0.5	6010	04/25/88
Beryllium	0.3	mg/kg	0.1	6010	04/25/88
Cadmium	N.D.	mg/kg	0.5	6010	04/25/88
Chromium	3	mg/kg	1	6010	04/25/88
Cobalt	3	mg/kg	1	6010	04/25/88
Lead	9	mg/kg	5	6010	04/25/88
Mercury	N.D.	ug/kg	50	7471	04/29/88
Nickel	5	mg/kg	4	6010	04/25/88
Selenium	N.D.	mg/kg	0.2	7740	04/29/88
Vanadium	11	mg/kg	1	6010	04/25/88

N.D. = Not detected

Approved by: Will Pratt

METALS PARAMETERS

Client Name: DAMES AND MOORE
Client ID: BH-1 10-11 1\2'
Laboratory ID: 67123-002 Enseco ID: 67123-002
Matrix: Soil Sampled: 04/14/88 Received: 04/15/88
Authorized: 04/15/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Total Organic Lead	N.D.	mg/kg	1	Enseco	05/03/88

N.D. = Not detected

Approved by: Will Pratt

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-1 10-11 1\2'

Laboratory ID: 67123-002 Enseco ID: 67123-002

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.2	%	0.1		04/21/88
Water	16.7	%	0.1		04/21/88
Solids	83.1	%	0.1		04/21/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-1 15 1\2-17'

Laboratory ID: 67123-003 Enseco ID: 67123-003

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

Sample: 67123-003

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-1 15 1\2-17'

Laboratory ID: 67123-003 Enseco ID: 67123-003

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	380	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	79	ug/kg	50
o & p-Xylene(s)	140	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

Enseco

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-1 15 1\2-17'

Laboratory ID: 67123-003   Enseco ID: 67123-003

Matrix: Soil   Sampled: 04/14/88   Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.1	%	0.1		04/21/88
Water	15.1	%	0.1		04/21/88
Solids	83.8	%	0.1		04/21/88

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 67123-003

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-4 5-7'

Laboratory ID: 67123-004 Enseco ID: 67123-004

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	10000
Carbon tetrachloride	N.D.	ug/kg	1000
Chlorobenzene	N.D.	ug/kg	4000
Chloroethane	N.D.	ug/kg	10000
Chloroform	N.D.	ug/kg	1000
Dibromochloromethane	N.D.	ug/kg	2000
Bromodichloromethane	N.D.	ug/kg	2000
1,1-Dichloroethane	N.D.	ug/kg	1000
1,2-Dichloroethane	N.D.	ug/kg	2000
1,1-Dichloroethene	N.D.	ug/kg	1000
1,2-Dichloropropane	N.D.	ug/kg	2000
cis-1,3-Dichloropropene	N.D.	ug/kg	4000
trans-1,3-Dichloropropene	N.D.	ug/kg	1000
Bromomethane	N.D.	ug/kg	10000
Chloromethane	N.D.	ug/kg	10000
Methylene chloride	N.D.	ug/kg	10000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	2000
Tetrachloroethene	N.D.	ug/kg	1000
trans-1,2-Dichloroethene	N.D.	ug/kg	1000
1,1,1-Trichloroethane	N.D.	ug/kg	1000
1,1,2-Trichloroethane	N.D.	ug/kg	2000
Trichloroethene	N.D.	ug/kg	2000
Vinyl chloride	N.D.	ug/kg	2000
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	2000
1,2-Dibromoethane (EDB)	N.D.	ug/kg	4000

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-4 5-7'

Laboratory ID: 67123-004 Enseco ID: 67123-004

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	24000	ug/kg	1000
Chlorobenzene	N.D.	ug/kg	1000
1,2-Dichlorobenzene	N.D.	ug/kg	1000
1,3-Dichlorobenzene	N.D.	ug/kg	1000
1,4-Dichlorobenzene	N.D.	ug/kg	1000
Ethylbenzene	29000	ug/kg	1000
Toluene	160000	ug/kg	1000
m-Xylene	170000	ug/kg	1000
o & p-Xylene(s)	120000	ug/kg	1000

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: DAMES AND MOORE
Client ID: BH-4 5-7'
Laboratory ID: 67123-004 Enseco ID: 67123-004
Matrix: Soil Sampled: 04/14/88 Received: 04/15/88
Authorized: 04/15/88 Analyzed: 04/28/88

	Value	Units	Detection Limit
Total Chromatographable Organics	2800000	ug/kg	1,700
Initial Boiling Point*	100°	°C	-
Final Boiling Point*	340°	°C	-
Gasoline	ND	ug/kg	17000
Stoddard Solvent	ND	ug/kg	17000
Jet Fuel	ND	ug/kg	17000
Kerosene	ND	ug/kg	17000
Diesel	ND	ug/kg	17000
Motor Oil	ND	ug/kg	330000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

METALS PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-4 5-7'

Laboratory ID: 67123-004 Enseco ID: 67123-004

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Total Organic Lead	4	mg/kg	1	Enseco	05/03/88

N.D. = Not detected

Approved by: Will Pratt

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-4 5-7'

Laboratory ID: 67123-004 Enseco ID: 67123-004

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.3	%	0.1		04/21/88
Water	23.7	%	0.1		04/21/88
Solids	75.0	%	0.1		04/21/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-4 10-12'

Laboratory ID: 67123-005 Enseco ID: 67123-005

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-4 10-12'

Laboratory ID: 67123-005 Enseco ID: 67123-005

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	57	ug/kg	50
m-Xylene	230	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-4 10-12'

Laboratory ID: 67123-005 Enseco ID: 67123-005

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	5.2	%	0.1		04/21/88
Water	15.4	%	0.1		04/21/88
Solids	79.4	%	0.1		04/21/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-4 15-17'

Laboratory ID: 67123-006 Enseco ID: 67123-006

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-4 15-17'

Laboratory ID: 67123-006   Enseco ID: 67123-006

Matrix: Soil   Sampled: 04/14/88   Received: 04/15/88

Authorized: 04/15/88   Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy   Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-4 15-17'

Laboratory ID: 67123-006 Enseco ID: 67123-006

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.0	%	0.1		04/21/88
Water	22.1	%	0.1		04/21/88
Solids	76.9	%	0.1		04/21/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-5 5-7'

Laboratory ID: 67123-007 Enseco ID: 67123-007

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	5000
Carbon tetrachloride	N.D.	ug/kg	500
Chlorobenzene	N.D.	ug/kg	2000
Chloroethane	N.D.	ug/kg	5000
Chloroform	N.D.	ug/kg	500
Dibromochloromethane	N.D.	ug/kg	1000
Bromodichloromethane	N.D.	ug/kg	1000
1,1-Dichloroethane	N.D.	ug/kg	500
1,2-Dichloroethane	N.D.	ug/kg	1000
1,1-Dichloroethene	N.D.	ug/kg	500
1,2-Dichloropropane	N.D.	ug/kg	1000
cis-1,3-Dichloropropene	N.D.	ug/kg	2000
trans-1,3-Dichloropropene	N.D.	ug/kg	500
Bromomethane	N.D.	ug/kg	5000
Chloromethane	N.D.	ug/kg	5000
Methylene chloride	N.D.	ug/kg	5000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	1000
Tetrachloroethene	N.D.	ug/kg	500
trans-1,2-Dichloroethene	N.D.	ug/kg	500
1,1,1-Trichloroethane	N.D.	ug/kg	500
1,1,2-Trichloroethane	N.D.	ug/kg	1000
Trichloroethene	N.D.	ug/kg	1000
Vinyl chloride	N.D.	ug/kg	1000
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	1000
1,2-Dibromoethane (EDB)	N.D.	ug/kg	2000

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-5 5-7'

Laboratory ID: 67123-007 Enseco ID: 67123-007

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	2000	ug/kg	500
Chlorobenzene	N.D.	ug/kg	500
1,2-Dichlorobenzene	N.D.	ug/kg	500
1,3-Dichlorobenzene	N.D.	ug/kg	500
1,4-Dichlorobenzene	N.D.	ug/kg	500
Ethylbenzene	6000	ug/kg	500
Toluene	25000	ug/kg	500
m-Xylene	37000	ug/kg	500
o & p-Xylene(s)	25000	ug/kg	500

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

METALS PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-5 5-7'

Laboratory ID: 67123-007 Enseco ID: 67123-007

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Total Organic Lead	2	mg/kg	1	Enseco	05/03/88

N.D. = Not detected

Approved by: Will Pratt

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-5 5-7'

Laboratory ID: 67123-007 Enseco ID: 67123-007

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.8	%	0.1		04/22/88
Water	21.1	%	0.1		04/22/88
Solids	78.1	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-5 10-12'

Laboratory ID: 67123-008 Enseco ID: 67123-008

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

Sample: 67123-008

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-5 10-12'

Laboratory ID: 67123-008 Enseco ID: 67123-008

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-5 10-12'

Laboratory ID: 67123-008 Enseco ID: 67123-008

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.4	%	0.1		04/22/88
Water	18.3	%	0.1		04/22/88
Solids	81.3	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-5 15-17'

Laboratory ID: 67123-009 Enseco ID: 67123-009

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-5 15-17'

Laboratory ID: 67123-009 Enseco ID: 67123-009

Matrix: Soil Sampled: 04/14/88 Received: 04/15/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE
Client ID: BH-5 15-17'
Laboratory ID: 67123-009 Enseco ID: 67123-009
Matrix: Soil Sampled: 04/14/88 Received: 04/15/88
Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.3	%	0.1		04/22/88
Water	21.0	%	0.1		04/22/88
Solids	77.7	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-6 5-7'

Laboratory ID: 67123-010 Enseco ID: 67123-010

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	10000
Carbon tetrachloride	N.D.	ug/kg	1000
Chlorobenzene	N.D.	ug/kg	4000
Chloroethane	N.D.	ug/kg	10000
Chloroform	N.D.	ug/kg	1000
Dibromochloromethane	N.D.	ug/kg	2000
Bromodichloromethane	N.D.	ug/kg	2000
1,1-Dichloroethane	N.D.	ug/kg	1000
1,2-Dichloroethane	N.D.	ug/kg	2000
1,1-Dichloroethene	N.D.	ug/kg	1000
1,2-Dichloropropane	N.D.	ug/kg	2000
cis-1,3-Dichloropropene	N.D.	ug/kg	4000
trans-1,3-Dichloropropene	N.D.	ug/kg	1000
Bromomethane	N.D.	ug/kg	10000
Chloromethane	N.D.	ug/kg	10000
Methylene chloride	N.D.	ug/kg	10000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	2000
Tetrachloroethene	N.D.	ug/kg	1000
trans-1,2-Dichloroethene	N.D.	ug/kg	1000
1,1,1-Trichloroethane	N.D.	ug/kg	1000
1,1,2-Trichloroethane	N.D.	ug/kg	2000
Trichloroethene	N.D.	ug/kg	2000
Vinyl chloride	N.D.	ug/kg	2000
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	2000
1,2-Dibromoethane (EDB)	N.D.	ug/kg	4000

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-6 5-7'

Laboratory ID: 67123-010 Enseco ID: 67123-010

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	19000	ug/kg	1000
Chlorobenzene	N.D.	ug/kg	1000
1,2-Dichlorobenzene	N.D.	ug/kg	1000
1,3-Dichlorobenzene	N.D.	ug/kg	1000
1,4-Dichlorobenzene	N.D.	ug/kg	1000
Ethylbenzene	37000	ug/kg	1000
Toluene	140000	ug/kg	1000
m-Xylene	170000	ug/kg	1000
o & p-Xylene(s)	150000	ug/kg	1000

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-6 5-7'

Laboratory ID: 67123-010 Enseco ID: 67123-010

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.4	%	0.1		04/22/88
Water	20.7	%	0.1		04/22/88
Solids	78.9	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-6 10-12'

Laboratory ID: 67123-011 Enseco ID: 67123-011

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-6 10-12'

Laboratory ID: 67123-011 Enseco ID: 67123-011

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	53	ug/kg	50
Toluene	190	ug/kg	50
m-Xylene	390	ug/kg	50
o & p-Xylene(s)	340	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-6 10-12'

Laboratory ID: 67123-011 Enseco ID: 67123-011

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	5.6	%	0.1		04/22/88
Water	22.7	%	0.1		04/22/88
Solids	71.7	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-6 15-17'

Laboratory ID: 67123-012   Enseco ID: 67123-012

Matrix: Soil   Sampled: 04/16/88   Received: 04/18/88

Authorized: 04/15/88   Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy   Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-6 15-17'

Laboratory ID: 67123-012 Enseco ID: 67123-012

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

Enseco

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-6 15-17'

Laboratory ID: 67123-012 Enseco ID: 67123-012

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.8	%	0.1		04/22/88
Water	18.5	%	0.1		04/22/88
Solids	80.7	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-12 10-12'

Laboratory ID: 67123-013 Enseco ID: 67123-013

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-12 10-12'

Laboratory ID: 67123-013 Enseco ID: 67123-013

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE
Client ID: BH-12 10-12'
Laboratory ID: 67123-013 Enseco ID: 67123-013
Matrix: Soil Sampled: 04/15/88 Received: 04/18/88
Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.3	%	0.1		04/22/88
Water	20.3	%	0.1		04/22/88
Solids	79.4	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-8 10-12'

Laboratory ID: 67123-014 Enseco ID: 67123-014

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-8 10-12'

Laboratory ID: 67123-014 Enseco ID: 67123-014

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	71	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	57	ug/kg	50
Toluene	400	ug/kg	50
m-Xylene	360	ug/kg	50
o & p-Xylene(s)	390	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: DAMES AND MOORE
Client ID: BH-8 10-12'
Laboratory ID: 67123-014 Enseco ID: 67123-014
Matrix: Soil Sampled: 04/15/88 Received: 04/18/88
Authorized: 04/15/88 Analyzed: 04/28/88

	Value	Units	Detection Limit
Total Chromatographable Organics	2100	ug/kg	1,700
Initial Boiling Point*	100°	°C	-
Final Boiling Point*	170°	°C	-
Gasoline	ND	ug/kg	17000
Stoddard Solvent	ND	ug/kg	17000
Jet Fuel	ND	ug/kg	17000
Kerosene	ND	ug/kg	17000
Diesel	ND	ug/kg	17000
Motor Oil	ND	ug/kg	330000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE
Client ID: BH-8 10-12'
Laboratory ID: 67123-014 Enseco ID: 67123-014
Matrix: Soil Sampled: 04/15/88 Received: 04/18/88
Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.3	%	0.1		04/22/88
Water	16.8	%	0.1		04/22/88
Solids	81.9	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-11 10-12'

Laboratory ID: 67123-015 Enseco ID: 67123-015

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/29/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

Sample: 67123-015

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-11 10-12'

Laboratory ID: 67123-015 Enseco ID: 67123-015

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/29/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-11 10-12'

Laboratory ID: 67123-015 Enseco ID: 67123-015

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.9	%	0.1		04/22/88
Water	22.5	%	0.1		04/22/88
Solids	75.6	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-14 6-7'

Laboratory ID: 67123-016 Enseco ID: 67123-016

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/27/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-14 6-7'

Laboratory ID: 67123-016 Enseco ID: 67123-016

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Stanley L. Dunlavy Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-14 6-7'

Laboratory ID: 67123-016 Enseco ID: 67123-016

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.0	%	0.1		04/22/88
Water	20.8	%	0.1		04/22/88
Solids	78.2	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-13 6-7'

Laboratory ID: 67123-017 Enseco ID: 67123-017

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/29/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-13 6-7'

Laboratory ID: 67123-017 Enseco ID: 67123-017

Matrix: Soil Sampled: 04/15/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/29/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	250	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	67	ug/kg	50
Toluene	800	ug/kg	50
m-Xylene	1400	ug/kg	50
o & p-Xylene(s)	580	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE
Client ID: BH-13 6-7'
Laboratory ID: 67123-017   Enseco ID: 67123-017
Matrix: Soil   Sampled: 04/15/88   Received: 04/18/88
Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.4	%	0.1		04/22/88
Water	16.8	%	0.1		04/22/88
Solids	81.8	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-9 5-7'

Laboratory ID: 67123-018 Enseco ID: 67123-018

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/29/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-9 5-7'

Laboratory ID: 67123-018 Enseco ID: 67123-018

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88 Analyzed: 04/29/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	57	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	180	ug/kg	50
Toluene	240	ug/kg	50
m-Xylene	630	ug/kg	50
o & p-Xylene(s)	660	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-9 5-7'

Laboratory ID: 67123-018 Enseco ID: 67123-018

Matrix: Soil Sampled: 04/16/88 Received: 04/18/88

Authorized: 04/15/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.8	%	0.1		04/22/88
Water	21.0	%	0.1		04/22/88
Solids	78.2	%	0.1		04/22/88

N.D. = Not detected

Approved by: Lindsay Breyer

V. QUALITY CONTROL REPORT

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 Laboratory Control Samples (LCS) at frequent, well-defined intervals. An LCS 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 LCS 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 LCS 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 Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

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

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

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

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, LCS 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. The test codes assigned are defined in Section VI., Analytical Methodology.

QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	SCS
67123-002-00	Standard Soil	BNA	BNA 097AA	BNA 097BA
67123-002-00	Standard Soil	VOA	VOA 029AK	VOA 029DK

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: BNA on Standard Soil								
QC Lot: BNA 097AA								
Concentration Units: (ug/kg)								
Pentachlorophenol	6670	6100	5980	91	90	17-109	2.0	47
Phenol	6670	4620	4480	69	67	26- 90	3.1	35
2-Chlorophenol	6670	5720	5410	86	81	25-102	5.6	50
4-Chloro-3-methylphenol	6670	6370	5950	96	89	26-103	6.8	33
4-Nitrophenol	6670	4740	4510	71	68	11-114	5.0	50
1,2,4-Trichlorobenzene	3330	2760	2640	83	79	38-107	4.4	23
Acenaphthene	3330	3020	2920	91	88	31-137	3.4	19
2,4-Dinitrotoluene	3330	3180	2910	95#	87	28- 89	8.9	47
Pyrene	3330	3650	3500	110	105	35-142	4.2	36
N-Nitrosodi-n-propylamine	3330	2790	2860	84	86	41-126	2.5	38
1,4-Dichlorobenzene	3330	2530	2420	76	73	28-104	4.4	27
Test: VOA on Standard Soil								
QC Lot: VOA 029AK								
Concentration Units: (ug/kg)								
1,1-Dichloroethene	5000	4020	4320	80	86	59-172	7.2	22
Trichloroethene	5000	5430	5690	109	114	62-137	4.7	24
Chlorobenzene	5000	5700	5920	114	118	60-133	3.8	21
Toluene	5000	5530	5800	111	116	59-139	4.8	21
Benzene	5000	5130	5380	103	108	66-142	4.8	21

= Recovery outside standard QC limits.

SURROGATE CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: BNA on Standard Soil QC Lot: BNA 097BA Concentration Units: (ug/kg)				
Phenol-D5	3330	2050	62	24-113
2-Fluorophenol	3330	2860	86	25-121
2,4,6-Tribromophenol	3330	2860	86	19-122
Nitrobenzene-D5	1670	1520	91	23-120
2-Fluorobiphenyl	1670	1620	97	30-115
Terphenyl-D14	1670	1720	103	18-137
Test: VOA on Standard Soil QC Lot: VOA 029DK Concentration Units: (ug/kg)				
Toluene-D8	5000	4910	98	81-117
Bromofluorobenzene (BFB)	5000	4990	100	74-121
1,2-Dichloroethane-D4	5000	5240	105	70-121

QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	QC Lot Number SCS
67123-001-00	Standard Soil	601	601 115AW	601 115AW
67123-001-00	Standard Soil	602	602 124AW	602 124AW
67123-002-00	Standard Soil	601	601 115AW	601 115AW
67123-002-00	Standard Soil	602	602 124AW	602 124AW
67123-003-00	Standard Soil	601	601 113AW	601 113AW
67123-003-00	Standard Soil	602	602 122AW	602 122AW
67123-004-00	Standard Soil	601	601 115AW	601 115AW
67123-004-00	Standard Soil	602	602 124AW	602 124AW
67123-005-00	Standard Soil	601	601 113AW	601 113AW
67123-005-00	Standard Soil	602	602 122AW	602 122AW
67123-006-00	Standard Soil	601	601 113AW	601 113AW
67123-006-00	Standard Soil	602	602 122AW	602 122AW
67123-007-00	Standard Soil	601	601 115AW	601 115AW
67123-007-00	Standard Soil	602	602 124AW	602 124AW
67123-008-00	Standard Soil	601	601 113AW	601 113AW
67123-008-00	Standard Soil	602	602 122AW	602 122AW
67123-009-00	Standard Soil	601	601 113AW	601 113AW
67123-009-00	Standard Soil	602	602 122AW	602 122AW
67123-010-00	Standard Soil	601	601 115AW	601 115AW
67123-010-00	Standard Soil	602	602 124AW	602 124AW
67123-011-00	Standard Soil	601	601 113AW	601 113AW
67123-011-00	Standard Soil	602	602 122AW	602 122AW
67123-012-00	Standard Soil	601	601 113AW	601 113AW
67123-012-00	Standard Soil	602	602 122AW	602 122AW
67123-013-00	Standard Soil	601	601 113AW	601 113AW
67123-013-00	Standard Soil	602	602 122AW	602 122AW
67123-014-00	Standard Soil	601	601 115AW	601 115AW
67123-014-00	Standard Soil	602	602 124AW	602 124AW
67123-015-00	Standard Soil	601	601 114AW	601 114AW
67123-015-00	Standard Soil	602	602 123AW	602 123AW
67123-016-00	Standard Soil	601	601 115AW	601 115AW
67123-016-00	Standard Soil	602	602 124AW	602 124AW
67123-017-00	Standard Soil	601	601 114AW	601 114AW
67123-017-00	Standard Soil	602	602 123AW	602 123AW
67123-018-00	Standard Soil	601	601 114AW	601 114AW
67123-018-00	Standard Soil	602	602 123AW	602 123AW

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Test: 601 on Standard Soil
QC Lot: 601 113AW
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Chloromethane	2000	1510	1480	76	74	59-140	2.0	25
Bromomethane	2000	2620	2560	131	128	58-141	2.3	25
Vinyl chloride	2000	1780	1750	89	88	68-132	1.7	25
Chloroethane	2000	2210	2210	111	111	77-123	0.0	20
Methylene chloride	2000	2570	2470	129#	124#	77-123	4.0	20
Trichlorofluoromethane	2000	2190	2100	110	105	66-134	4.2	25
1,1-Dichloroethene	2000	2060	2010	103	101	63-137	2.5	20
1,1-Dichloroethane	2000	2040	1990	102	100	84-116	2.5	20
trans-1,2-Dichloroethene	2000	2130	2010	107	101	64-136	5.8	20
Chloroform	2000	2100	2100	105	105	75-125	0.0	20
1,1,2-Trichloro-1,2,2-trifluor	2000	1910	1810	96	91	67-134	5.4	20
1,2-Dichloroethane	2000	2210	2030	111	102	72-129	8.5	20
1,1,1-Trichloroethane	2000	1870	1760	94	88	71-129	6.1	20
Carbon tetrachloride	2000	2080	1920	104	96	68-131	8.0	20
Bromodichloromethane	2000	1950	1870	98	94	76-124	4.2	20
1,2-Dichloropropane	2000	1950	1860	98	93	74-126	4.7	20
trans-1,3-Dichloropropene	2000	1980	1870	99	94	64-136	5.7	20
Trichloroethene	2000	2380	2080	119	104	77-123	13.5	20
1,1,2-Trichloroethane	6000	8430	7560	141#	126	69-132	10.9	20
Dibromochloromethane	6000	8430	7560	141#	126	69-132	10.9	20
cis-1,3-Dichloropropene	6000	8430	7560	141#	126	69-132	10.9	20
1,2-Dibromoethane (EDB)	2000	1790	1710	90	86	74-127	4.6	20
Bromoform	2000	1970	1960	99	98	74-127	0.5	20
1,1,2,2-Tetrachloroethane	4000	3720	3620	93	91	60-140	2.7	20
Tetrachloroethene	4000	3720	3620	93	91	60-140	2.7	20
Chlorobenzene	2000	1950	1930	98	97	72-128	1.0	20
1,3-Dichlorobenzene	2000	1950	1890	98	95	50-150	3.1	20
1,2-Dichlorobenzene	2000	1820	1770	91	89	70-130	2.8	20
1,4-Dichlorobenzene	2000	1780	1740	89	87	70-130	2.3	20

Test: 601 on Standard Soil
QC Lot: 601 114AW
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Chloromethane	2000	1340	1230	67	62	59-140	8.6	25
Bromomethane	2000	2550	2500	128	125	58-141	2.0	25
Vinyl chloride	2000	1740	1740	87	87	68-132	0.0	25
Chloroethane	2000	1830	1800	92	90	77-123	1.7	20
Methylene chloride	2000	2450	2500	123	125#	77-123	2.0	20

= Recovery outside standard QC limits.

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Test: 601 on Standard Soil
QC Lot: 601 114AW
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Trichlorofluoromethane	2000	2100	2330	105	117	66-134	10.4	25
1,1-Dichloroethene	2000	1950	2060	98	103	63-137	5.5	20
1,1-Dichloroethane	2000	1970	2040	99	102	84-116	3.5	20
trans-1,2-Dichloroethene	2000	2030	2040	102	102	64-136	0.5	20
Chloroform	2000	2070	2070	104	104	75-125	0.0	20
1,1,2-Trichloro-1,2,2-trifluor	2000	1750	1780	88	89	67-134	1.7	20
1,2-Dichloroethane	2000	1840	1900	92	95	72-129	3.2	20
1,1,1-Trichloroethane	2000	1770	1790	89	90	71-129	1.1	20
Carbon tetrachloride	2000	1910	1960	96	98	68-131	2.6	20
Bromodichloromethane	2000	1830	1930	92	97	76-124	5.3	20
1,2-Dichloropropane	2000	1820	1890	91	95	74-126	3.8	20
trans-1,3-Dichloropropene	2000	1830	1980	92	99	64-136	7.9	20
Trichloroethene	2000	2060	2310	103	116	77-123	11.4	20
1,1,2-Trichloroethane	6000	7370	8210	123	137#	69-132	10.8	20
Dibromochloromethane	6000	7370	8210	123	137#	69-132	10.8	20
cis-1,3-Dichloropropene	6000	7370	8210	123	137#	69-132	10.8	20
1,2-Dibromoethane (EDB)	2000	1700	1800	85	90	74-127	5.7	20
Bromoform	2000	1820	1870	91	94	74-127	2.7	20
1,1,2,2-Tetrachloroethane	4000	3780	3730	95	93	60-140	1.3	20
Tetrachloroethene	4000	3780	3730	95	93	60-140	1.3	20
Chlorobenzene	2000	1980	1970	99	99	72-128	0.5	20
1,3-Dichlorobenzene	2000	2070	1950	104	98	50-150	6.0	20
1,2-Dichlorobenzene	2000	2080	2010	104	101	70-130	3.4	20
1,4-Dichlorobenzene	2000	1800	1800	90	90	70-130	0.0	20

Test: 601 on Standard Soil
QC Lot: 601 115AW
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Chloromethane	2000	1170	1130	59	57#	59-140	3.5	25
Bromomethane	2000	2130	2190	107	110	58-141	2.8	25
Vinyl chloride	2000	1430	1500	72	75	68-132	4.8	25
Chloroethane	2000	1660	1670	83	84	77-123	0.6	20
Methylene chloride	2000	2370	2450	119	123	77-123	3.3	20
Trichlorofluoromethane	2000	1930	1940	97	97	66-134	0.5	25
1,1-Dichloroethene	2000	1640	1600	82	80	63-137	2.5	20
1,1-Dichloroethane	2000	1920	1920	96	96	84-116	0.0	20
trans-1,2-Dichloroethene	2000	1790	1780	90	89	64-136	0.6	20
Chloroform	2000	2030	2050	102	103	75-125	1.0	20

= Recovery outside standard QC limits.

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: 601 on Standard Soil QC Lot: 601 115AW Concentration Units: (ug/kg)								
1,1,2-Trichloro-1,2,2-trifluor	2000	1650	1720	83	86	67-134	4.2	20
1,2-Dichloroethane	2000	1660	1770	83	89	72-129	6.4	20
1,1,1-Trichloroethane	2000	1730	1760	87	88	71-129	1.7	20
Carbon tetrachloride	2000	1870	1940	94	97	68-131	3.7	20
Bromodichloromethane	2000	1850	1940	93	97	76-124	4.7	20
1,2-Dichloropropane	2000	1810	1850	91	93	74-126	2.2	20
trans-1,3-Dichloropropene	2000	1880	1880	94	94	64-136	0.0	20
Trichloroethene	2000	1980	2100	99	105	77-123	5.9	20
1,1,2-Trichloroethane	6000	7360	8100	123	135#	69-132	9.6	20
Dibromochloromethane	6000	7360	8100	123	135#	69-132	9.6	20
cis-1,3-Dichloropropene	6000	7360	8100	123	135#	69-132	9.6	20
1,2-Dibromoethane (EDB)	2000	1740	1830	87	92	74-127	5.0	20
Bromoform	2000	1890	1980	95	99	74-127	4.7	20
1,1,2,2-Tetrachloroethane	4000	3470	3690	87	92	60-140	6.1	20
Tetrachloroethene	4000	3470	3690	87	92	60-140	6.1	20
Chlorobenzene	2000	1790	1880	90	94	72-128	4.9	20
1,3-Dichlorobenzene	2000	1880	1890	94	95	50-150	0.5	20
1,2-Dichlorobenzene	2000	1890	1910	95	96	70-130	1.1	20
1,4-Dichlorobenzene	2000	1710	1740	86	87	70-130	1.7	20
Test: 602 on Standard Soil QC Lot: 602 122AW Concentration Units: (ug/kg)								
Benzene	2000	2030	2010	102	101	77-123	1.0	20
Toluene	2000	2030	2000	102	100	77-123	1.5	20
Chlorobenzene	2000	2170	2150	109	108	81-119	0.9	20
Ethylbenzene	2000	2110	2070	106	104	63-137	1.9	20
m-Xylene	2000	2000	1960	100	98	77-123	2.0	20
o & p-Xylene(s)	4000	4260	4170	107	104	77-123	2.1	20
1,3-Dichlorobenzene	2000	2110	2090	106	105	77-123	1.0	20
1,2-Dichlorobenzene	2000	2000	1990	100	100	63-137	0.5	20
1,4-Dichlorobenzene	2000	2110	2130	106	107	70-130	0.9	20

= Recovery outside standard QC limits.

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Test: 602 on Standard Soil
QC Lot: 602 123AW
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Benzene	2000	1990	2020	100	101	77-123	1.5	20
Toluene	2000	2010	2050	101	103	77-123	2.0	20
Chlorobenzene	2000	2150	2190	108	110	81-119	1.8	20
Ethylbenzene	2000	2080	2120	104	106	63-137	1.9	20
m-Xylene	2000	1990	2010	100	101	77-123	1.0	20
o & p-Xylene(s)	4000	4230	4290	106	107	77-123	1.4	20
1,3-Dichlorobenzene	2000	2130	2140	107	107	77-123	0.5	20
1,2-Dichlorobenzene	2000	1990	2020	100	101	63-137	1.5	20
1,4-Dichlorobenzene	2000	2180	2190	109	110	70-130	0.5	20

Test: 602 on Standard Soil
QC Lot: 602 124AW
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Benzene	2000	1890	1920	95	96	77-123	1.6	20
Toluene	2000	1900	1930	95	97	77-123	1.6	20
Chlorobenzene	2000	2080	2100	104	105	81-119	1.0	20
Ethylbenzene	2000	2010	2030	101	102	63-137	1.0	20
m-Xylene	2000	1950	1910	98	96	77-123	2.1	20
o & p-Xylene(s)	4000	4040	4090	101	102	77-123	1.2	20
1,3-Dichlorobenzene	2000	2070	2060	104	103	77-123	0.5	20
1,2-Dichlorobenzene	2000	1950	1970	98	99	63-137	1.0	20
1,4-Dichlorobenzene	2000	2090	2110	105	106	70-130	1.0	20

SURROGATE CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: 601 on Standard Soil QC Lot: 601 113AW Concentration Units: (ug/kg)				
Bromochloromethane	3000	3010	100	20-160
Test: 601 on Standard Soil QC Lot: 601 114AW Concentration Units: (ug/kg)				
Bromochloromethane	3000	2880	96	20-160
Test: 601 on Standard Soil QC Lot: 601 115AW Concentration Units: (ug/kg)				
Bromochloromethane	3000	2980	99	20-160
Test: 602 on Standard Soil QC Lot: 602 122AW Concentration Units: (ug/kg)				
a,a,a-Trifluorotoluene	3000	3530	118	20-160
Test: 602 on Standard Soil QC Lot: 602 123AW Concentration Units: (ug/kg)				
a,a,a-Trifluorotoluene	3000	3270	109	20-160
Test: 602 on Standard Soil QC Lot: 602 124AW Concentration Units: (ug/kg)				
a,a,a-Trifluorotoluene	3000	3430	114	20-160

QC LOT ASSIGNMENT REPORT

INORGANICS - METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
67123-002-00	Standard Soil	FAST	FAST205AA
67123-002-00	Standard Soil	FSET	FSET205AA
67123-002-00	Standard Soil	HGT	HGT 196AA
67123-002-00	Standard Soil	ICPT	ICPT234AA

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: FAST on Standard Soil QC Lot: FAST205AA Concentration Units: (mg/kg)								
Arsenic	4	4.3	4.2	108	105	75-125	2.4	20
Test: FSET on Standard Soil QC Lot: FSET205AA Concentration Units: (mg/kg)								
Selenium	2	2.0	2.1	100	105	75-125	4.9	20
Test: HGT on Standard Soil QC Lot: HGT 196AA Concentration Units: (ug/kg)								
Mercury	500	516	532	103	106	75-125	3.1	20
Test: ICPT on Standard Soil QC Lot: ICPT234AA Concentration Units: (mg/kg)								
Antimony	0.5	0.44	0.46	88	92	75-125	4.4	20
Arsenic	2.0	1.74	1.74	87	87	75-125	0.0	20
Barium	2.0	1.94	1.97	97	99	75-125	1.5	20
Beryllium	0.05	0.046	0.046	92	92	75-125	0.0	20
Cadmium	0.05	0.050	0.050	100	100	75-125	0.0	20
Chromium	0.2	0.19	0.19	95	95	75-125	0.0	20
Cobalt	0.5	0.48	0.48	96	96	75-125	0.0	20
Copper	0.25	0.26	0.26	104	104	75-125	0.0	20
Lead	0.5	0.48	0.48	96	96	75-125	0.0	20
Manganese	0.5	0.52	0.52	104	104	75-125	0.0	20
Nickel	0.5	0.52	0.52	104	104	75-125	0.0	20
Silver	0.05	0.045	0.043	90	86	75-125	4.5	20
Tin	0.5	0.52	0.55	104	110	75-125	5.6	20
Vanadium	0.5	0.47	0.47	94	94	75-125	0.0	20
Zinc	0.5	0.49	0.49	98	98	75-125	0.0	20

Rocky Mountain Analytical Laboratory

4955 Yarrow Street, Arvada, CO 80002 (303) 421-6611

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CHAIN OF CUSTODY

RMAL Client: Daniel Moore - Caribou 4-Corners, Maverik
Sampling Co.: Daniel Moore
Project Name/No.: Maverik County Stores Kirtland N.M.

RMAL Project No.: 6-7103
Sampling Personnel: L. Bardwell
Sampling Site: Boyd

Date	Time	Sample ID/Description	Type	No. Containers	Parameters	Remarks
	1100-1130	BH-1	Soils	8	8010 8020 organic Lead Shipping o/o [illegible]	[illegible]
	1300	BH-4	Soils	8	TCH 8010 8020 organic Lead o/o [illegible]	[illegible]
	1500	BH-5	Soils	7	8010 8020 organic Lead o/o [illegible]	[illegible]
					BH-1 5-6.12 -01	
					BH-1 10-11.12 02	BH5-15-17
					BH-1 14-17 03	
					BH4- 5-7 [illegible]	
					BH4- 10-12 [illegible]	
					BH4- 15-17 [illegible]	
					BH5 5-7 07 [illegible]	

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time
Larry Bardwell	4/11 1630	~~Fed-X~~ Fed-X would not sign	4/14 1635				
Method of Shipment: Fed-X		Shipped by: (Signature) Fed-X		Delivered by: (Signature)		Received for Laboratory by: (Signature) [signature]	Date / Time 4/15/88 851

White Copy to Lab Pink Copy to Client Yellow Copy to Sampler

SS - 001

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

A DIVISION OF
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CHAIN OF CUSTODY

RMAL Client Dames & Moore

Sampling Co.

Project Name/No. Caribou-4 Corners, Maverik Country Stores

RMAL Project No. ~~67115~~ 67132

Sampling Personnel L. Bardwell

Sampling Site Soils

Date	Time	Sample ID/Description	Type	No. Containers	Parameters	Remarks
4/16	1500	BH-6	Soils	6	% oil + 8010-8020 - 5-7' % oil + " " - 10-12' % oil + " " 15-17'	10 11 12
4/15	1100	BH-12	"	2	% oil + 8010-8020 10-12'	13
4/15	900	BH-8	"	3	% oil + 8010 + 8020 - 10-12' TCH - 10-12'	14
4/16	100	BH-11	"	2	% oil 8010-8020 10-12'	15
4/15	1500	BH-14	"	2	% oil + 8010-8020 6-7'	16
4/15	1300	BH-13	"	2	% oil 8010-8020 6-7'	17
4/16	1200	BH-9	"	2	[illegible] 8010-8020 5-7'	18

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time
Larry Bardwell	4/16/88 1630		4/16 1630				
Method of Shipment: Fed-X		Shipped by: (Signature) [illegible]		Delivered by: (Signature)		Received for Laboratory by: (Signature) [illegible]	4/18/88

White Copy to Lab Pink Copy to Client Yellow Copy to Sampler

C & W

SS - 001

VI. ANALYTICAL METHODOLOGY

Enseco - Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods, 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco - Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses by ICP supported by graphite furnace AA
- Volatile Organics: purge and trap GC/MS or purge and trap GC with a selective detector.
- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS, and
- Pesticides/Herbicides: solvent extraction, followed by gas chromatography.

Exact method references are given in the following tables.

ANALYTICAL METHODOLOGY - ORGANIC TESTS

Test	Description	Methodology	Reference
VOA	Volatile Organics	Purge & Trap, GC/MS	624(1)/8240(2)
BNA	Semivolatile Organics	Extraction, GC/MS	625(1)/8270(2)
DXN	Dioxin	Extraction, GC/MS	613(1)/8280(2)
601	Halogenated Volatile Organics	Purge & Trap GC/Hall	601(1)/8010(2)
THM	Trihalomethanes	Purge & Trap GC/Hall	601(1)/8010(2)
602	Aromatic Volatile Organics	Purge & Trap GC/PID	602(1)/8020(2)
OCP	Organochlorine Pesticides	Extraction, GC/ECD	608(1)/8080(2)
OPP	Organophosphate Pesticides	Extraction, GC/FPD	614(1)/8140(2)
619	Triazine Pesticides	Extraction, GC/NPD	619(1)
LC CARB	Carbamate and Urea Pesticides	Extraction, HPLC	632(1)
PCB	PCB's	Extraction, GC/ECD	608(1)/8080(2)
HRB	Phenoxyacid Herbicides	Extraction, GC/ECD	615(1)/8150(2)
603	Acrolein & Acrylonitrile	Purge & Trap GC/FID	603(1)/8030(2)
604	Phenols	Extraction, GC/FID	604(1)/8040(2)
605	Benzidines	Extraction, HPLC	605(1)/8050(2)
606	Phthalate Esters	Extraction, GC/FID	606(1)/8060(2)
607	Nitrosamines	Extraction, GC/NPD	607(1)
609	Nitroaromatics & Cyclic Ketones	Extraction, GC/NPD	609(1)/8090(2)
PNA	Polynuclear Aromatic Hydrocarbons	Extraction, HPLC	610(1)/8310(2)
611	Haloethers	Extraction, GC/ECD	611(1)
612	Chlorinated Hydrocarbons	Extraction, GC/ECD	612(1)/8120(2)
GD FID	Hydrocarbon Scan	Extraction, GC/FID	D3328-78(3)
GC BPD	Boiling Point Determination	Extraction, GC/FID	D2887-84(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 2nd Edition, 1984.
(3) "Annual Book of ASTM Standards", Volume 11.01, 1985.
(4) "Annual Book of ASTM Standards", Volume 05.02, 1984.

ANALYTICAL METHODOLOGY - INORGANIC TESTS

Test	Description	Methodology	Reference
ICP	Trace Metals	ICP Emission Spectroscopy	200.7(1)/6010(2)
FSB	Antimony	Furnace Atomic Absorption	204.2(1)/7041(2)
FAS	Arsenic	Furnace Atomic Absorption	206.2(1)/7060(2)
FCD	Cadmium	Furnace Atomic Absorption	213.2(1)/7131(2)
FPB	Lead	Furnace Atomic Absorption	239.2(1)/7421(2)
FSE	Selenium	Furnace Atomic Absorption	270.2(1)/7740(2)
FAG	Silver	Furnace Atomic Absorption	272.2(1)/7761(2)
FTL	Thallium	Furnace Atomic Absorption	279.2(1)/7841(2)
CVHG	Mercury	Cold Vapor Atomic	245.1(1)/7471(2)
CR + 6	Chromium (VI)	Colorimetric	312B(3)
IC CL	Chloride	Ion Chromatography	300.0(1)
BURCL	Chloride	Manual Titrimetric	325.3(1)
METF	Fluoride	Electrode	340.2(1)
IC SO4	Sulfate	IC	300.0(1)
SPESO4	Sulfate	Manual Turbidimetric	375.4(1)
METALK	Alkalinity, Total	Titrimetric	310.1(1)
METACK	Alkalinity, Forms	Titrimetric	403(3)
TECNOXT	Nitrate+Nitrite as N	Cd Reduction Colorimetric	353.2(1)
METPH	pH	Meter	150.1(1)/9045(2)
CELSP	Specific Conductance @ 25°C	Bridge	120.1(1)
BALTDS	Total Dissolved Solids	Gravimetric, 180°C	160.1(1)
BALTSS	Total Suspended Solids	Gravimetric, 105°C	160.2(1)
BALTS	Total Solids	Gravimetric, 105°C	160.3(1)
BALTVS	Total Volatile Solids	Gravimetric, 550°C	160.4(1)
TECO P	Ortho-Phosphate as P	Two Reagent Colorimetric	365.3(1)
TECT P	Total Phosphorus as P	Digestion-Colorimetric	365.3(1)
ICP	Total Phosphorus as P	Digestion-ICP/AES	200.7(1)
ICP	Silica as SiO_2	ICP/AES	200.7(1)
SPESIO2	Silica as SiO_2	Colorimetric	370.1(1)
METBOD	Biochemical Oxygen Demand	Dilution Bottle-D.O. probe	405.1(1)
METCOD	Chemical Oxygen Demand	Micro Colorimetric	410.4(1)
TOCTOC	Total Organic Carbon	UV Oxidation-IR	415.2(1)
METNH3	Ammonia as N	Electrode	350.3(1)
TECNH3	Ammonia as N	Automated Colorimetric	350.1(1)
METTKN	Total Kjeldahl Nitrogen as N	Digestion-Electrode	351.4(1)
TECTKN	Total Kjeldahl Nitrogen as N	Digestion-Colorimetric	351.2(1)
TOXTOX	Total Organic Halogen	Combustion-Titrimetric	9020(2)
TONO1	Total Organic Nitrogen	Calculation (TKN-NH_3)	-
BAL O&G	Oil and Grease	Freon Extraction-Gravimetric	413.1(1)
IR AO&G	Oil and Grease	Freon Extraction-IR	413.2(1)
TECCN F	Cyanide Amendable to Chlorination	Chlorination-Distillation-Colorimetric	335.1(1)
TECCN W	Weak & Dissolved Cyanide	Distillation-Colorimetric	412H(3)
TECCN T	Total Cyanide	Distillation-Colorimetric	335.2(1)/9010(2)
STEPHEN	Phenolics	Distillation-Colorimetric	420.1(1)
COLIF F	Fecal Coliform	Membrane Filter	909C(3)
COLIF T	Total Coliform	Membrane Filter	909A(3)

ANALYTICAL METHODOLOGY - INORGANIC TESTS (CONT.)

Test	Description	Methodology	Reference
IC BR	Bromide	Ion Chromatography	300.0(1)
POTCL2R	Residual Chlorine	Amperometric	330.2(1)
NESCOLR	Color	Pt-Co Colorimetric	110.2(1)
ICPHAR	Hardness as $CaCo_3$	Calculation	200.7(1)/314A(3)
TECNO2	Nitrite as N	Colorimetric	354.1(1)
SPES	Sulfide	Colorimetric	376.2(1)/9030(2)
BURSO3	Sulfite	Titrimetric	377.1(1)
SPEMBAS	MBAS (Surfactants)	Colorimetric	425.1(1)
SPETURB	Turbidity	Turbidimeter	180.1(1)
Gross Alpha		Proportional Counter	703(3)
Gross Beta		Proportional Counter	703(3)
Radium 226		Separation - Counter	705(3)
Radium 228		Separation - Counter	707(3)
Uranium		Fluorimetric	D2907.75(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 2nd Edition, 1984.
(3) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, 1980.
(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

Enseco-RMAL Product Summary
Total Chromatographable Hydrocarbons by GC/FID
Price List Item # 278

Summary: After a solvent extraction, the sample is analyzed by capillary column gas chromatography with flame ionization detection (GC/FID). The GC conditions are adjusted to measure compounds with boiling points between 70°C and 500°C. Results are reported as "total chromatographable hydrocarbons." The nominal detection limit is 50-100 ug/L for waters and 1-5 mg/kg for solids. The "fingerprint" resulting from the analysis is compared to fingerprints from standard petroleum products (gasoline, jet fuel, kerosene, etc.). If, based on the analyst's interpretation, a match to a petroleum product can be assigned, then the product identification is also reported.

Discussion: A flame ionization detector is a "universal" detector that responds to virtually any organic compound. The use of this detector system to measure petroleum products can be found in ASTM Method D-2887. The technique has also been used as a method for identifying "water borne oil," (ASTM D3328-78). The EPA has extended the technique to measuring diesel in drill cuttings (Federal Register, August 26, 1985). The EPA has also described an approach for determining "total chromatographable organics." (IERL-RTP Procedures Manual, EPA-600/7-78-201, 1978).

The method developed at Enseco-RMAL is based on this previous work, but has been designed for broader applications. The sample extraction technique and the GC analysis conditions are designed to address not only common petroleum products but also the range of semivolatile organics determined by GC/MS in EPA Method 625. Thus, besides providing an estimate of the type and concentration of petroleum products in a sample, the technique also serves as a "screen" for the presence of semivolatile compounds normally analyzed by GC/MS.

Due to weathering, soil attenuation, water solubilities and other related effects, product identifications cannot always be achieved by this technique. Furthermore, since the technique is constrained to compounds with boiling points greater than 70°C, it does not address the full range of gasoline components. In terms of the screening aspects of this method, the results do provide an indication as to the maximum concentration of any semivolatile compound that could be present in a sample.

Sample Requirements: Water - 1000 mL, Soil - 100 g

Rocky Mountain
Analytical Laboratory

ANALYTICAL RESULTS

FOR

DAMES & MOORE

MAY 20, 1988

Enseco

Reviewed by: Jeannie B. Howbert

Jeannie B. Howbert

Michael P. Phillips

Michael P. Phillips, Ph.D.

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I. OVERVIEW

On April 19, 1988, Enseco-Rocky Mountain Analytical Laboratory received 14 samples from Dames & Moore. A complete listing of tests requested, by sample, is given in Section III.

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:

I. Overview
   A. Standard
   B. Regulatory - Refinery
II. Sample Description Information
III. Analytical Tests Assigned (not included)
IV. Analytical Results
V. Quality Control Report
VI. Description of Analytical Methodology

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

The detection limits for the volatile and semivolatile analyses for sample 67161-08 are elevated due to the presence of non-target compounds.

B. Regulatory Overview - Refinery

In 1984, the EPA distributed several versions of a subset of Appendix VIII constituents to be used principally for delisting petroleum refinery wastes (K048-K052). This list, commonly referred to as the "Skinner" list has been adapted for use in land treatment demonstrations, site closures and other related activities associated with petroleum refining RCRA programs. In early

1985, a modified version of the Skinner list appeared in "Petitions to Delist Hazardous Waste, A Guidance Manual" (EPA/530-SW-85-003). This revised list, as shown in Table I, consists of 12 metals and 43 organic compounds and currently forms the basis for analytical work on samples collected at petroleum refineries.

The organic compounds have been classified as volatile and semivolatile (base/neutral/acid) compounds. Three of the "compounds" listed (xylenes, dichlorobenzenes and cresols) are measured and reported in terms of their specific isomers. Analytical standards are not available for two of the compounds, dibenz(a,h)acridine and methyl chrysene. Therefore, these compounds cannot be measured and analytical results are not presented for these compounds. Two of the remaining compounds, benzenethiol and pyridine cannot be recovered consistently from environmental samples and consequently, method detection limits for these compounds cannot be established. This statement is made based on the results of a methods evaluation study sponsored by API.

Table 2 summarizes the analytical methods used to determine Appendix VIII refinery constituents. For the organic compounds, methods are listed for both the complete list and a subset of this list analyzed by alternate methods.

Between October, 1983 and July, 1985, the EPA released three methods manuals and a "Guidance Manual" which were compendiums of modified SW-846 methods specifically adapted for the analysis of Appendix VIII constituents in petroleum refining wastes. The most useful document was an October, 1984 draft methods manual which was released but never formally distributed by EPA. These documents did not contain many of the important details that are critical to the successful analysis of environmental samples relevant to petroleum refineries.

Thus, although the methods used by Enseco-RMAL in the analysis of petroleum refinery wastes are based on these various EPA documents, the actual details of each method have been modified in order to generate acceptable data. These modifications have been based on information given in numerous documents, some of which are cited in Table 3. In addition to the documents listed in the bibliography, Enseco-RMAL an ongoing dialogue with EPA/OSW to ensure that the latest EPA guidance is incorporated into the analytical approach.

The analytical data tables which follow present results for the Appendix VIII refinery hazardous constituents which are measurable.

TABLE 1. APPENDIX VIII HAZARDOUS CONSTITUENT SUBSET FOR PETROLEUM REFINERY STUDIES*

Metals

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Lead
Mercury
Nickel
Selenium
Vanadium

Volatile Organics

Benzene
Carbon disulfide
Chlorobenzene
Chloroform
1,2-Dibromoethane
1,2-Dichloroethane
1,4-Dioxane
Methyl ethyl ketone
Styrene
Ethyl benzene
Toluene
Xylenes[1]

Base/Neutral Organics

Anthracene
Benz(a)anthracene
Benzo(b)fluoranthene

Base/Neutral Organics (Cont.)

Benzo(k)fluoranthene
Benzo(a)pyrene
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Chrysene
Dibenz(a,h)acridine[2]
Dibenz(a,h)anthracene
Di-n-butyl phthalate
Dichlorobenzenes[1]
Diethyl phthalate
7,12-Dimethylbenz(a)anthracene
Dimethyl phthalate
Di-n-octyl phthalate
Fluoranthene
Indene
Methyl chrysene[2]
1-Methylnaphthalene
Naphthalene
Phenanthrene
Pyrene
Pyridine[3]
Quinoline

Acid Organics

Benzenethiol[3]
Cresols[1]
2,4-Dimethylphenol
2,4-Dinitrophenol
4-Nitrophenol
Phenol

*"Petitions to Delist Hazardous Wastes, A Guidance Manual," EPA/530-SW-85-003, April, 1985.
1) Reported as ortho-, meta-, and para-isomers.
2) No analytical standard available.
3) Not consistently recoverable using standard analytical methods.

TABLE 2. SUMMARY OF ANALYTICAL METHODS FOR REFINERY CONSTITUENTS

Metals	Method
Antimony	7041
Arsenic	7060
Lead	7421
Mercury	7470
Selenium	7740
ICP Scan (Ba, Be, Cd, Cr, Co, Ni, V)	6010

	GC/MS Method	Screening Method
Volatile Organics	8240	8020[a]
Semivolatile Organics	8270	8310[b]

a) Volatile Aromatics
b) Polynuclear Aromatic Hydrocarbons

TABLE 3. BIBLIOGRAPHY

A. Documents Pertaining to Appendix VIII Constituents

(1) January, 1984 letter from Myles Morse pertaining to delisting petitions as well as land treatment demonstrations, including sampling procedures and data requirements.

(2) March, 1984 letter to delisting petitioners from Barbara Bush revising target parameters.

(3) April, 1984 memo from John Skinner to Permit Branch Chiefs concerning land treatment containing target parameters and analytical methods.

(4) May, 1984 memo from John Skinner clarifying previous memo.

(5) September, 1984 letter to Petitioners from Barbara Bush distributing Refinery Handbook.

(6) November, 1984 letter from Eileen Claussen to all delisting petitioners describing new RCRA requirements.

(7) May 3, 1985 RMAL Memo.

(8) January 8, 1985 RMAL letter to Eileen Claussen, EPA-OSW.

B. Documents Pertaining to Analytical Methods

(1) "Handbook for the Analysis of Petroleum Refinery Residuals and Waste", October, 1984 - prepared by Radian Corporation for EPA/OSW.

(2) "Evaluation of the Applicability of the SW-846 Manual To Support All RCRA Subtitle C Testing", December 20, 1984 - prepared by Rocky Mountain Analytical Laboratory for API.

(3) "Comments on the 'Handbook for the Analysis of Petroleum Refinery Residuals and Waste, October, 1984'", December 12, 1984 - Prepared by Rocky Mountain Analytical Laboratory for API.

(4) "Comments on the 'Handbook for the Analysis of Petroleum Refinery Residuals and Waste, April 2, 1984'", August 15, 1984 - Prepared by Rocky Mountain Analytical Laboratory for API.

(5) "Handbook for the Analysis of Petroleum Refinery Residuals and Waste", April 2, 1984 - prepared by S-Cubed for EPA/OSW.

(6) EPA document "Guidance for the Analysis of Refinery Wastes", July 5, 1985.

(7) "Recovery and Detection Limits of Organic Compounds in Petroleum Refinery Wastes", January 25, 1985.

(8) SW-846 - "Test Methods for Evaluating Solid Waste, Physical Chemical Methods" USEPA, 2nd Edition, 1982.

(9) 40 CFR 136 - "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act."

II. 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 five digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the five 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.

SAMPLE DESCRIPTION INFORMATION

for

DAMES AND MOORE

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
67161-001-00	BH-7 5'-7'	Solid	04/17/88	04/19/88
67161-002-00	BH-7 10'-12'	Solid	04/17/88	04/19/88
67161-003-00	BH-7 15'-17'	Solid	04/17/88	04/19/88
67161-004-00	BH-10 12'	Solid	04/17/88	04/19/88
67161-005-00	BH-10 15'	Solid	04/17/88	04/19/88
67161-006-00	BH-10 17'	Solid	04/17/88	04/19/88
67161-007-00	BH-2 5'-7'	Solid	04/18/88	04/19/88
67161-008-00	BH-2 7'	Solid	04/18/88	04/19/88
67161-009-00	BH-2 10'-12'	Solid	04/18/88	04/19/88
67161-010-00	BH-2 15'-17'	Solid	04/18/88	04/19/88
67161-011-00	BH-3 5'-7'	Solid	04/17/88	04/19/88
67161-012-00	BH-3 11'	Solid	04/17/88	04/19/88
67161-013-00	BH-3 10'-12'	Solid	04/17/88	04/19/88
67161-014-00	BH-3 15'-17'	Solid	04/17/88	04/19/88

IV. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, with tests reported in the following order: GC/MS, Chromatography, Metals and Inorganics.

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. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is given in Section V.

The analytical data reported are subject to the following limitations of the analytical methodology:

<u>GC/MS</u>

Volatile Organics

a) The cis- and trans-isomers of dichloroethylene cannot be distinguished using EPA Method 624. All dichloroethylene present is reported as trans-dichloroethylene.

Semivolatile Organics

a) Benzo(b) and benzo(k) fluoranthene cannot be differentiated based on their mass spectra; retention times are almost identical. The isomer which is the closest in retention time to the sample is reported.

b) 1,2-diphenylhydrazine is measured as azobenzene.

c) N-Nitrosodiphenylamine decomposes in the gas chromatographic inlet to diphenylamine.

Chromatography

Methods 601 and 8010

a) Dichlorodifluoromethane (Freon 12) and vinyl chloride coelute under the specified analytical conditions. All data are reported as a combined value for the two compounds.

b) Dibromochloromethane, cis-1,3-dichloropropene and 1,1,2-trichloroethane are unresolved. The three compounds are reported as a single combined value.

c) Tetrachloroethene and 1,1,2,2-tetrachloroethane coelute and are reported as a combined result.

Method 602 and 8020

a) The ortho and para isomers of xylene coelute and are reported as a single concentration value.

TOTAL CHROMATOGRAPHABLE ORGANICS

Total Chromatographable Organics (TCO) were determined from a methylene chloride extraction and subsequent analysis by capillary column gas chromatography with a flame ionization detector (GC/FID). The TCO result was based on the entire area under the chromatogram as compared to the response to eicosane. The detection limit is based on the response of diesel.

The pattern of the FID chromatogram (fingerprint) was compared to fingerprints of various petroleum products. If, on the judgement of the analyst, the fingerprint of the sample matched the fingerprint of a petroleum product, the concentration of the product was also reported. If components of a particular product were present, but the complexity of the overall chromatogram was such that it could not be reliably determined if the product was or was not present, then, the result for that product contains the following statement: "Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved."

In addition to reporting a TCO value, the results contain boiling point information. This boiling point range represents the range of 80 to 90 percent of the compounds detected in the sample.

Enseco

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-7 5'-7'

Laboratory ID: 67161-001 Enseco ID: 67161-001

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-7 5'-7'

Laboratory ID: 67161-001 Enseco ID: 67161-001

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-7 5'-7'

Laboratory ID: 67161-001 Enseco ID: 67161-001

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	2.3	%	0.1		05/03/88
Water	13.9	%	0.1		05/03/88
Solids	83.8	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-7 10'-12'

Laboratory ID: 67161-002 Enseco ID: 67161-002

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-7 10'-12'

Laboratory ID: 67161-002 Enseco ID: 67161-002

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

METALS PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-7 10'-12'

Laboratory ID: 67161-002 Enseco ID: 67161-002

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Total Organic Lead	N.D.	mg/kg	1	Enseco	05/03/88

N.D. = Not detected

Approved by: Will Pratt

Enseco

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: Dames & Moore
Client ID: BH- 7 (10-12')
Laboratory ID: 67161-002 Enseco ID: 67161-002
Matrix: Solid Sampled: 04/17/88 Received: 04/19/88
Authorized: 04/19/88 Prepared: 04/21/88 Analyzed: 04/25/88

	Value	Units	Detection Limit
Total Chromatographable Organics	ND	ug/kg	1,700
Initial Boiling Point*	-	°C	-
Final Boiling Point*	-	°C	-
Gasoline	ND	ug/kg	17,000
Stoddard Solvent	ND	ug/kg	17,000
Jet Fuel	ND	ug/kg	17,000
Kerosene	ND	ug/kg	17,000
Diesel	ND	ug/kg	17,000
Motor Oil	ND	ug/kg	330,000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

** Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved.

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-7 10'-12'

Laboratory ID: 67161-002 Enseco ID: 67161-002

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	2.7	%	0.1		05/03/88
Water	21.6	%	0.1		05/03/88
Solids	75.7	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-7 15'-17'

Laboratory ID: 67161-003 Enseco ID: 67161-003

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-7 15'-17'

Laboratory ID: 67161-003 Enseco ID: 67161-003

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-7 15'-17'

Laboratory ID: 67161-003 Enseco ID: 67161-003

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.5	%	0.1		05/03/88
Water	17.8	%	0.1		05/03/88
Solids	80.7	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-10 12'

Laboratory ID: 67161-004 Enseco ID: 67161-004

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

Sample: 67161-004

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-10 12'

Laboratory ID: 67161-004 Enseco ID: 67161-004

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	410	ug/kg	200
Chlorobenzene	N.D.	ug/kg	200
1,2-Dichlorobenzene	N.D.	ug/kg	200
1,3-Dichlorobenzene	N.D.	ug/kg	200
1,4-Dichlorobenzene	N.D.	ug/kg	200
Ethylbenzene	10000	ug/kg	200
Toluene	870	ug/kg	200
m-Xylene	63000	ug/kg	200
o & p-Xylene(s)	13000	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-10 15'

Laboratory ID: 67161-005 Enseco ID: 67161-005

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.7	%	0.1		05/03/88
Water	15.8	%	0.1		05/03/88
Solids	83.5	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

Enseco

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: Dames & Moore
Client ID: BH-10 17'
Laboratory ID: 67161-006 Enseco ID: 67161-006
Matrix: Solid Sampled: 04/17/88 Received: 04/19/88
Authorized: 04/19/88 Prepared: 04/21/88 Analyzed: 04/25/88

	Value	Units	Detection Limit
Total Chromatographable Organics	40,000	ug/kg	1,700
Initial Boiling Point*	100	°C	-
Final Boiling Point*	330	°C	-
Gasoline	ND	ug/kg	17,000
Stoddard Solvent	ND	ug/kg	17,000
Jet Fuel	ND	ug/kg	17,000
Kerosene	ND	ug/kg	17,000
Diesel	ND	ug/kg	17,000
Motor Oil	ND	ug/kg	330,000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

** Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved.

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-2 5'-7'

Laboratory ID: 67161-007 Enseco ID: 67161-007

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 05/02/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	10000
Carbon tetrachloride	N.D.	ug/kg	1000
Chlorobenzene	N.D.	ug/kg	4000
Chloroethane	N.D.	ug/kg	10000
Chloroform	N.D.	ug/kg	1000
Dibromochloromethane	N.D.	ug/kg	2000
Bromodichloromethane	N.D.	ug/kg	2000
1,1-Dichloroethane	N.D.	ug/kg	1000
1,2-Dichloroethane	N.D.	ug/kg	2000
1,1-Dichloroethene	N.D.	ug/kg	1000
1,2-Dichloropropane	N.D.	ug/kg	2000
cis-1,3-Dichloropropene	N.D.	ug/kg	4000
trans-1,3-Dichloropropene	N.D.	ug/kg	1000
Bromomethane	N.D.	ug/kg	10000
Chloromethane	N.D.	ug/kg	10000
Methylene chloride	N.D.	ug/kg	10000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	2000
Tetrachloroethene	N.D.	ug/kg	1000
trans-1,2-Dichloroethene	N.D.	ug/kg	1000
1,1,1-Trichloroethane	N.D.	ug/kg	1000
1,1,2-Trichloroethane	N.D.	ug/kg	2000
Trichloroethene	N.D.	ug/kg	2000
Vinyl chloride	N.D.	ug/kg	2000
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	2000
1,2-Dibromoethane (EDB)	N.D.	ug/kg	4000

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-2 5'-7'

Laboratory ID: 67161-007 Enseco ID: 67161-007

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 05/02/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	21000	ug/kg	1000
Chlorobenzene	N.D.	ug/kg	1000
1,2-Dichlorobenzene	N.D.	ug/kg	1000
1,3-Dichlorobenzene	N.D.	ug/kg	1000
1,4-Dichlorobenzene	N.D.	ug/kg	1000
Ethylbenzene	39000	ug/kg	1000
Toluene	170000	ug/kg	1000
m-Xylene	210000	ug/kg	1000
o & p-Xylene(s)	120000	ug/kg	1000

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-2 5'-7'

Laboratory ID: 67161-007 Enseco ID: 67161-007

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.0	%	0.1		05/03/88
Water	13.9	%	0.1		05/03/88
Solids	85.1	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

REFINERY HAZARDOUS CONSTITUENT VOLATILES

EPA METHOD 8240

Client Name: DAMES AND MOORE

Client ID: BH-2 7'

Laboratory ID: 67161-008 Enseco ID: 67161-008

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 05/18/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	5000
Carbon disulfide	N.D.	ug/kg	5000
Chlorobenzene	N.D.	ug/kg	5000
Chloroform	N.D.	ug/kg	5000
1,2-Dibromoethane	N.D.	ug/kg	5000
1,2-Dichloroethane	N.D.	ug/kg	5000
1,4-Dioxane	N.D.	ug/kg	100000
Methyl ethyl ketone	N.D.	ug/kg	25000
Styrene	N.D.	ug/kg	5000
Ethylbenzene	15000	ug/kg	5000
Toluene	65000	ug/kg	5000
m-Xylene	99000	ug/kg	5000
o & p-Xylene(s)	69000	ug/kg	5000
Surrogate			
Toluene-D8	100	%	-
Bromofluorobenzene(BFB)	99	%	-
1,2-Dichloroethane-D4	100	%	-

N.D. = Not detected

Reported by: Daniel Albritton Approved by: Jeffrey Lowry

REFINERY HAZARDOUS CONSTITUENT SEMIVOLATILES

Client Name: DAMES AND MOORE

Client ID: BH-2 7'

Laboratory ID: 67161-008 Enseco ID: 67161-008

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88 Prepared: 04/22/88 Analyzed: 04/26/88

Parameter	Result	Units (as received)	Reporting Limit
Anthracene	N.D.	ug/kg	990
Benzo(a)anthracene	N.D.	ug/kg	990
Benzo(b)fluoranthene	N.D.	ug/kg	990
Benzo(k)fluoranthene	N.D.	ug/kg	990
Benzo(a)pyrene	N.D.	ug/kg	990
bis(2-Ethylhexyl)phthalate	4400	ug/kg	990
Butylbenzyl phthalate	N.D.	ug/kg	990
Chrysene	N.D.	ug/kg	990
Dibenz(a,h)anthracene	N.D.	ug/kg	990
Di-n-butyl phthalate	N.D.	ug/kg	990
1,2-Dichlorobenzene	N.D.	ug/kg	990
1,3-Dicholrobenzene	N.D.	ug/kg	990
1,4-Dichlorobenzene	N.D.	ug/kg	990
Diethyl phthalate	N.D.	ug/kg	990
7,12-Dimethylbenzanthracene	N.D.	ug/kg	990
Dimethyl phthalate	N.D.	ug/kg	990
Di-n-octyl phthalate	N.D.	ug/kg	990
Fluoranthene	N.D.	ug/kg	990
Indene	N.D.	ug/kg	990
1-Methylnaphthalene	6500	ug/kg	990
Naphthalene	5800	ug/kg	990
Phenanthrene	1200	ug/kg	990
Pyrene	N.D.	ug/kg	990
Pyridine	N.D.	ug/kg	-
Quinoline	N.D.	ug/kg	990
Benzenethiol	N.D.	ug/kg	-
o-Cresol	N.D.	ug/kg	990
p & m-Cresol	N.D.	ug/kg	990
2,4-Dimethylphenol	N.D.	ug/kg	990
2,4-Dinitrophenol	N.D.	ug/kg	4800
4-Nitrophenol	N.D.	ug/kg	4800

N.D. = Not detected

REFINERY HAZARDOUS CONSTITUENT SEMIVOLATILES (CONT.)

Client Name: DAMES AND MOORE

Client ID: BH-2 7'

Laboratory ID: 67161-008 Enseco ID: 67161-008

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88 Prepared: 04/22/88 Analyzed: 04/26/88

Parameter	Result	Units (as received)	Reporting Limit
Phenol	N.D.	ug/kg	990
Surrogate			
Nitrobenzene-D5	93	%	-
2-Fluorobiphenyl	82	%	-
Terphenyl-D14	78	%	-
Phenol-D5	65	%	-
2-Fluorophenol	49	%	-
2,4,6-Tribromophenol	69	%	-

N.D. = Not detected

Reported by: Julie Niermann Approved by: Jeffrey Lowry

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-2 10'-12'

Laboratory ID: 67161-009 Enseco ID: 67161-009

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 05/02/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	3400
Carbon tetrachloride	N.D.	ug/kg	340
Chlorobenzene	N.D.	ug/kg	1300
Chloroethane	N.D.	ug/kg	3400
Chloroform	N.D.	ug/kg	340
Dibromochloromethane	N.D.	ug/kg	670
Bromodichloromethane	N.D.	ug/kg	670
1,1-Dichloroethane	N.D.	ug/kg	340
1,2-Dichloroethane	N.D.	ug/kg	670
1,1-Dichloroethene	N.D.	ug/kg	340
1,2-Dichloropropane	N.D.	ug/kg	670
cis-1,3-Dichloropropene	N.D.	ug/kg	1300
trans-1,3-Dichloropropene	N.D.	ug/kg	340
Bromomethane	N.D.	ug/kg	3400
Chloromethane	N.D.	ug/kg	3400
Methylene chloride	N.D.	ug/kg	3400
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	670
Tetrachloroethene	N.D.	ug/kg	340
trans-1,2-Dichloroethene	N.D.	ug/kg	340
1,1,1-Trichloroethane	N.D.	ug/kg	340
1,1,2-Trichloroethane	N.D.	ug/kg	670
Trichloroethene	N.D.	ug/kg	670
Vinyl chloride	N.D.	ug/kg	670
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	670
1,2-Dibromoethane (EDB)	N.D.	ug/kg	1300

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-2 10'-12'

Laboratory ID: 67161-009 Enseco ID: 67161-009

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 05/02/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	2500	ug/kg	340
Chlorobenzene	N.D.	ug/kg	340
1,2-Dichlorobenzene	N.D.	ug/kg	340
1,3-Dichlorobenzene	N.D.	ug/kg	340
1,4-Dichlorobenzene	N.D.	ug/kg	340
Ethylbenzene	7000	ug/kg	340
Toluene	27000	ug/kg	340
m-Xylene	39000	ug/kg	340
o & p-Xylene(s)	21000	ug/kg	340

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

METALS PARAMETERS
TOTAL METALS

Client Name: DAMES AND MOORE

Client ID: BH-2 7'

Laboratory ID: 67161-008 Enseco ID: 67161-008

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/kg	5	6010	04/25/88
Arsenic	1.0	mg/kg	0.3	7060	05/06/88
Barium	110	mg/kg	0.5	6010	04/25/88
Beryllium	0.2	mg/kg	0.1	6010	04/25/88
Cadmium	N.D.	mg/kg	0.5	6010	04/25/88
Chromium	3	mg/kg	1	6010	04/25/88
Cobalt	2	mg/kg	1	6010	04/25/88
Lead	13	mg/kg	5	6010	04/25/88
Mercury	N.D.	ug/kg	50	7471	04/29/88
Nickel	N.D.	mg/kg	4	6010	04/25/88
Selenium	N.D.	mg/kg	0.4	7740	05/05/88
Vanadium	10	mg/kg	1	6010	04/25/88

N.D. = Not detected

Approved by: Will Pratt

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-2 10'-12'

Laboratory ID: 67161-009 Enseco ID: 67161-009

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.8	%	0.1		05/03/88
Water	18.4	%	0.1		05/03/88
Solids	80.8	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-2 15'-17'

Laboratory ID: 67161-010 Enseco ID: 67161-010

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-2 15'-17'

Laboratory ID: 67161-010   Enseco ID: 67161-010

Matrix: Solid   Sampled: 04/18/88   Received: 04/19/88

Authorized: 04/19/88   Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse   Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-2 15'-17'

Laboratory ID: 67161-010 Enseco ID: 67161-010

Matrix: Solid Sampled: 04/18/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.9	%	0.1		05/03/88
Water	14.9	%	0.1		05/03/88
Solids	84.2	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-3 5'-7'

Laboratory ID: 67161-011 Enseco ID: 67161-011

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 05/02/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	5000
Carbon tetrachloride	N.D.	ug/kg	500
Chlorobenzene	N.D.	ug/kg	2000
Chloroethane	N.D.	ug/kg	5000
Chloroform	N.D.	ug/kg	500
Dibromochloromethane	N.D.	ug/kg	1000
Bromodichloromethane	N.D.	ug/kg	1000
1,1-Dichloroethane	N.D.	ug/kg	500
1,2-Dichloroethane	N.D.	ug/kg	1000
1,1-Dichloroethene	N.D.	ug/kg	500
1,2-Dichloropropane	N.D.	ug/kg	1000
cis-1,3-Dichloropropene	N.D.	ug/kg	2000
trans-1,3-Dichloropropene	N.D.	ug/kg	500
Bromomethane	N.D.	ug/kg	5000
Chloromethane	N.D.	ug/kg	5000
Methylene chloride	N.D.	ug/kg	5000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	1000
Tetrachloroethene	N.D.	ug/kg	500
trans-1,2-Dichloroethene	N.D.	ug/kg	500
1,1,1-Trichloroethane	N.D.	ug/kg	500
1,1,2-Trichloroethane	N.D.	ug/kg	1000
Trichloroethene	N.D.	ug/kg	1000
Vinyl chloride	N.D.	ug/kg	1000
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	1000
1,2-Dibromoethane (EDB)	N.D.	ug/kg	2000

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-3 5'-7'

Laboratory ID: 67161-011 Enseco ID: 67161-011

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 05/02/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	5200	ug/kg	500
Chlorobenzene	N.D.	ug/kg	500
1,2-Dichlorobenzene	N.D.	ug/kg	500
1,3-Dichlorobenzene	N.D.	ug/kg	500
1,4-Dichlorobenzene	N.D.	ug/kg	500
Ethylbenzene	26000	ug/kg	500
Toluene	13000	ug/kg	500
m-Xylene	17000	ug/kg	500
o & p-Xylene(s)	90000	ug/kg	500

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-3 5'-7'

Laboratory ID: 67161-011 Enseco ID: 67161-011

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.5	%	0.1		05/03/88
Water	14.0	%	0.1		05/03/88
Solids	84.5	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

METALS PARAMETERS
EPI TOXICITY METALS

Client Name: DAMES AND MOORE

Client ID: BH-3 11'

Laboratory ID: 67161-012 Enseco ID: 67161-012

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Arsenic	N.D.	mg/L	0.1	200.7	05/02/88
Barium	2.7	mg/L	0.005	200.7	05/02/88
Cadmium	N.D.	mg/L	0.005	200.7	05/02/88
Chromium	N.D.	mg/L	0.01	200.7	05/02/88
Lead	N.D.	mg/L	0.05	200.7	05/02/88
Mercury	N.D.	ug/L	1	245.1	04/29/88
Selenium	N.D.	mg/L	0.02	7740	05/05/88
Silver	N.D.	mg/L	0.005	200.7	05/02/88

N.D. = Not detected

Approved by: Will Pratt

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-3 10'-12'

Laboratory ID: 67161-013 Enseco ID: 67161-013

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-3 10'-12'

Laboratory ID: 67161-013 Enseco ID: 67161-013

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	140	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	240	ug/kg	50
Toluene	83	ug/kg	50
m-Xylene	170	ug/kg	50
o & p-Xylene(s)	730	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-3 10'-12'

Laboratory ID: 67161-013 Enseco ID: 67161-013

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.1	%	0.1		05/03/88
Water	18.4	%	0.1		05/03/88
Solids	81.5	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

Enseco

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-3 15'-17'

Laboratory ID: 67161-014 Enseco ID: 67161-014

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-3 15'-17'

Laboratory ID: 67161-014 Enseco ID: 67161-014

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88 Analyzed: 04/28/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	N.D.	ug/kg	50
Toluene	N.D.	ug/kg	50
m-Xylene	N.D.	ug/kg	50
o & p-Xylene(s)	N.D.	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-3 15'-17'

Laboratory ID: 67161-014 Enseco ID: 67161-014

Matrix: Solid Sampled: 04/17/88 Received: 04/19/88

Authorized: 04/19/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	1.6	%	0.1		05/03/88
Water	16.4	%	0.1		05/03/88
Solids	82.0	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	SCS
67161-008-00	Standard Soil	BNA	BNA 097AA	BNA 097CA
67161-008-00	Standard Soil	VOA	VOA 032AA	VOA 032DA

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: BNA on Standard Soil								
QC Lot: BNA 097AA								
Concentration Units: (ug/kg)								
Pentachlorophenol	6670	6100	5980	91	90	17-109	2.0	47
Phenol	6670	4620	4480	69	67	26- 90	3.1	35
2-Chlorophenol	6670	5720	5410	86	81	25-102	5.6	50
4-Chloro-3-methylphenol	6670	6370	5950	96	89	26-103	6.8	33
4-Nitrophenol	6670	4740	4510	71	68	11-114	5.0	50
1,2,4-Trichlorobenzene	3330	2760	2640	83	79	38-107	4.4	23
Acenaphthene	3330	3020	2920	91	88	31-137	3.4	19
2,4-Dinitrotoluene	3330	3180	2910	95#	87	28- 89	8.9	47
Pyrene	3330	3650	3500	110	105	35-142	4.2	36
N-Nitrosodi-n-propylamine	3330	2790	2860	84	86	41-126	2.5	38
1,4-Dichlorobenzene	3330	2530	2420	76	73	28-104	4.4	27
Test: VOA on Standard Soil								
QC Lot: VOA 032AA								
Concentration Units: (ug/kg)								
1,1-Dichloroethene	5000	5990	6030	120	121	59-172	0.7	22
Trichloroethene	5000	5160	5450	103	109	62-137	5.5	24
Chlorobenzene	5000	5240	5500	105	110	60-133	4.8	21
Toluene	5000	5000	5120	100	102	59-139	2.4	21
Benzene	5000	5320	5510	106	110	66-142	3.5	21

= Recovery outside standard QC limits.

SURROGATE CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: BNA on Standard Soil				
QC Lot: BNA 097CA				
Concentration Units: (ug/kg)				
Phenol-D5	3330	2740	82	24-113
2-Fluorophenol	3330	2870	86	25-121
2,4,6-Tribromophenol	3330	1810	54	19-122
Nitrobenzene-D5	1670	1510	90	23-120
2-Fluorobiphenyl	1670	1420	85	30-115
Terphenyl-D14	1670	1700	102	18-137
Test: VOA on Standard Soil				
QC Lot: VOA 032DA				
Concentration Units: (ug/kg)				
Toluene-D8	5000	5030	101	81-117
Bromofluorobenzene (BFB)	5000	4910	98	74-121
1,2-Dichloroethane-D4	5000	5070	101	70-121

QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	SCS
67161-001-00	Standard Soil	601	601 121AL	601 121AL
67161-001-00	Standard Soil	602	602 146AL	602 146AL
67161-002-00	Standard Soil	601	601 121AL	601 121AL
67161-002-00	Standard Soil	602	602 146AL	602 146AL
67161-003-00	Standard Soil	601	601 121AL	601 121AL
67161-003-00	Standard Soil	602	602 146AL	602 146AL
67161-004-00	Standard Soil	601	601 121AL	601 121AL
67161-004-00	Standard Soil	602	602 146AL	602 146AL
67161-007-00	Standard Soil	601	601 122AL	601 122AL
67161-007-00	Standard Soil	602	602 147AL	602 147AL
67161-009-00	Standard Soil	601	601 122AL	601 122AL
67161-009-00	Standard Soil	602	602 147AL	602 147AL
67161-010-00	Standard Soil	601	601 121AL	601 121AL
67161-010-00	Standard Soil	602	602 146AL	602 146AL
67161-011-00	Standard Soil	601	601 122AL	601 122AL
67161-011-00	Standard Soil	602	602 147AL	602 147AL
67161-013-00	Standard Soil	601	601 121AL	601 121AL
67161-013-00	Standard Soil	602	602 146AL	602 146AL
67161-014-00	Standard Soil	601	601 121AL	601 121AL
67161-014-00	Standard Soil	602	602 146AL	602 146AL

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: 601 on Standard Soil QC Lot: 601 121AL Concentration Units: (ug/kg)								
Chloromethane	2000	2700	2970	135	149#	59-140	9.5	25
Bromomethane	2000	2300	2490	115	125	58-141	7.9	25
Vinyl chloride	2000	1720	1980	86	99	68-132	14.1	25
Chloroethane	2000	2030	2300	102	115	77-123	12.5	20
Methylene chloride	2000	1900	2230	95	112	77-123	16.0	20
Trichlorofluoromethane	2000	1780	1970	89	99	66-134	10.1	25
1,1-Dichloroethene	2000	1840	2030	92	102	63-137	9.8	20
1,1-Dichloroethane	2000	1660	1790	83#	90	84-116	7.5	20
trans-1,2-Dichloroethene	2000	1640	1760	82	88	64-136	7.1	20
Chloroform	2000	1650	1770	83	89	75-125	7.0	20
1,1,2-Trichloro-1,2,2-trifluor	2000	1510	1560	76	78	67-134	3.3	20
1,2-Dichloroethane	2000	1730	1830	87	92	72-129	5.6	20
1,1,1-Trichloroethane	2000	1420	1510	71	76	71-129	6.1	20
Carbon tetrachloride	2000	1530	1620	77	81	68-131	5.7	20
Bromodichloromethane	2000	1630	1750	82	88	76-124	7.1	20
1,2-Dichloropropane	2000	1550	1670	78	84	74-126	7.5	20
trans-1,3-Dichloropropene	2000	1540	1670	77	84	64-136	8.1	20
Trichloroethene	2000	1690	1800	85	90	77-123	6.3	20
1,1,2-Trichloroethane	6000	5890	6530	98	109	69-132	10.3	20
Dibromochloromethane	6000	5890	6530	98	109	69-132	10.3	20
cis-1,3-Dichloropropene	6000	5890	6530	98	109	69-132	10.3	20
1,2-Dibromoethane (EDB)	2000	1470	1560	74	78	74-127	5.9	20
Bromoform	2000	1740	1890	87	95	74-127	8.3	20
1,1,2,2-Tetrachloroethane	4000	3430	3730	86	93	60-140	8.4	20
Tetrachloroethene	4000	3430	3730	86	93	60-140	8.4	20
Chlorobenzene	2000	2000	2040	100	102	72-128	2.0	20
1,3-Dichlorobenzene	2000	1800	1970	90	99	50-150	9.0	20
1,2-Dichlorobenzene	2000	1720	1870	86	94	70-130	8.4	20
1,4-Dichlorobenzene	2000	2070	2140	104	107	70-130	3.3	20
Test: 601 on Standard Soil QC Lot: 601 122AL Concentration Units: (ug/kg)								
Chloromethane	2000	3360	3520	168#	176#	59-140	4.7	25
Bromomethane	2000	2500	2730	125	137	58-141	8.8	25
Vinyl chloride	2000	1830	1890	92	95	68-132	3.2	25
Chloroethane	2000	2110	2340	106	117	77-123	10.3	20
Methylene chloride	2000	2150	2220	108	111	77-123	3.2	20

= Recovery outside standard QC limits.

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Test: 601 on Standard Soil
QC Lot: 601 122AL
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Trichlorofluoromethane	2000	1800	1900	90	95	66-134	5.4	25
1,1-Dichloroethene	2000	1890	1880	95	94	63-137	0.5	20
1,1-Dichloroethane	2000	1750	1860	88	93	84-116	6.1	20
trans-1,2-Dichloroethene	2000	1740	1830	87	92	64-136	5.0	20
Chloroform	2000	1620	1720	81	86	75-125	6.0	20
1,1,2-Trichloro-1,2,2-trifluor	2000	1530	1490	77	75	67-134	2.6	20
1,2-Dichloroethane	2000	1710	1800	86	90	72-129	5.1	20
1,1,1-Trichloroethane	2000	1460	1530	73	77	71-129	4.7	20
Carbon tetrachloride	2000	1550	1650	78	83	68-131	6.3	20
Bromodichloromethane	2000	1680	1720	84	86	76-124	2.4	20
1,2-Dichloropropane	2000	1570	1570	79	79	74-126	0.0	20
trans-1,3-Dichloropropene	2000	1650	1630	83	82	64-136	1.2	20
Trichloroethene	2000	1790	1750	90	88	77-123	2.3	20
1,1,2-Trichloroethane	6000	6040	5980	101	100	69-132	1.0	20
Dibromochloromethane	6000	6040	5980	101	100	69-132	1.0	20
cis-1,3-Dichloropropene	6000	6040	5980	101	100	69-132	1.0	20
1,2-Dibromoethane (EDB)	2000	1500	1530	75	77	74-127	2.0	20
Bromoform	2000	1780	1820	89	91	74-127	2.2	20
1,1,2,2-Tetrachloroethane	4000	3500	3510	88	88	60-140	0.3	20
Tetrachloroethene	4000	3500	3510	88	88	60-140	0.3	20
Chlorobenzene	2000	2050	1970	103	99	72-128	4.0	20
1,3-Dichlorobenzene	2000	1880	1880	94	94	50-150	0.0	20
1,2-Dichlorobenzene	2000	1960	1950	98	98	70-130	0.5	20
1,4-Dichlorobenzene	2000	1750	1930	88	97	70-130	9.8	20

Test: 602 on Standard Soil
QC Lot: 602 146AL
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Benzene	2000	1790	1780	90	89	77-123	0.6	20
Toluene	2000	1900	1920	95	96	77-123	1.0	20
Chlorobenzene	2000	1970	1990	99	100	81-119	1.0	20
Ethylbenzene	2000	1990	2020	100	101	63-137	1.5	20
m-Xylene	2000	1860	1880	93	94	77-123	1.1	20
o & p-Xylene(s)	4000	3880	3920	97	98	77-123	1.0	20
1,3-Dichlorobenzene	2000	2030	2050	102	103	77-123	1.0	20
1,2-Dichlorobenzene	2000	1860	1910	93	96	63-137	2.7	20
1,4-Dichlorobenzene	2000	1950	1960	98	98	70-130	0.5	20

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Test: 602 on Standard Soil
QC Lot: 602 147AL
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Benzene	2000	1660	1760	83	88	77-123	5.8	20
Toluene	2000	1780	1920	89	96	77-123	7.6	20
Chlorobenzene	2000	1830	1960	92	98	81-119	6.9	20
Ethylbenzene	2000	1840	1980	92	99	63-137	7.3	20
m-Xylene	2000	1730	1880	87	94	77-123	8.3	20
o & p-Xylene(s)	4000	3570	3880	89	97	77-123	8.3	20
1,3-Dichlorobenzene	2000	1780	1990	89	100	77-123	11.1	20
1,2-Dichlorobenzene	2000	1660	1840	83	92	63-137	10.3	20
1,4-Dichlorobenzene	2000	1710	1890	86	95	70-130	10.0	20

SURROGATE CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: 601 on Standard Soil QC Lot: 601 121AL Concentration Units: (ug/kg)				
Bromochloromethane	3000	3330	111	20-160
Test: 601 on Standard Soil QC Lot: 601 122AL Concentration Units: (ug/kg)				
Bromochloromethane	3000	2770	92	20-160
Test: 602 on Standard Soil QC Lot: 602 146AL Concentration Units: (ug/kg)				
a,a,a-Trifluorotoluene	3000	3220	107	20-160
Test: 602 on Standard Soil QC Lot: 602 147AL Concentration Units: (ug/kg)				
a,a,a-Trifluorotoluene	3000	3180	106	20-160

QC LOT ASSIGNMENT REPORT

INORGANICS - METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
67161-002-00	Standard Soil	FPBO	FPBO001AA
67161-008-00	Standard Soil	FAST	FAST206AA
67161-008-00	Standard Soil	FSET	FSET206AA
67161-008-00	Standard Soil	HGT	HGT 196AA
67161-008-00	Standard Soil	ICPT	ICPT235AA
67161-012-00	Reagent Water	EP1P	EP1P152AA
67161-012-00	Reagent Water	EPSE	EPSE166AA
67161-012-00	Reagent Water	HGT	HGT 334AA

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: EP1P on Reagent Water								
QC Lot: EP1P152AA								
Concentration Units: (mg/L)								
Aluminum	2.0	1.88	1.90	94	95	75-125	1.1	20
Antimony	0.5	0.55	0.54	110	108	75-125	1.8	20
Arsenic	2.0	2.36	2.39	118	120	75-125	1.3	20
Barium	2.0	1.95	1.97	98	99	75-125	1.0	20
Beryllium	0.05	0.045	0.046	90	92	75-125	2.2	20
Cadmium	0.05	0.040	0.040	80	80	75-125	0.0	20
Calcium	100	106	107	106	107	75-125	0.9	20
Chromium	0.2	0.18	0.18	90	90	75-125	0.0	20
Cobalt	0.5	0.46	0.47	92	94	75-125	2.2	20
Copper	0.25	0.23	0.24	92	96	75-125	4.3	20
Iron	1.0	0.96	0.98	96	98	75-125	2.1	20
Lead	0.5	0.49	0.51	98	102	75-125	4.0	20
Magnesium	50	46.4	46.9	93	94	75-125	1.1	20
Manganese	0.5	0.47	0.48	94	96	75-125	2.1	20
Nickel	0.5	0.49	0.50	98	100	75-125	2.0	20
Potassium	50	55.2	55.1	110	110	75-125	0.2	20
Silver	0.05	0.044	0.045	88	90	75-125	2.2	20
Sodium	100	108	106	108	106	75-125	1.9	20
Tin	0.5	0.49	0.51	98	102	75-125	4.0	20
Vanadium	0.5	0.46	0.46	92	92	75-125	0.0	20
Zinc	0.5	0.51	0.52	102	104	75-125	1.9	20
Test: EPSE on Reagent Water								
QC Lot: EPSE166AA								
Concentration Units: (mg/L)								
Selenium	0.02	0.021	0.020	105	100	75-125	4.9	20
Test: HGT on Reagent Water								
QC Lot: HGT 334AA								
Concentration Units: (ug/L)								
Mercury	1.0	1.07	1.05	107	105	75-125	1.9	20

LABORATORY CONTROL SAMPLE REPORT

INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: FAST on Standard Soil QC Lot: FAST206AA Concentration Units: (mg/kg)								
Arsenic	4	3.8	3.8	95	95	75-125	0.0	20
Test: FSET on Standard Soil QC Lot: FSET206AA Concentration Units: (mg/kg)								
Selenium	2	1.8	1.8	90	90	75-125	0.0	20
Test: HGT on Standard Soil QC Lot: HGT 196AA Concentration Units: (ug/kg)								
Mercury	500	516	532	103	106	75-125	3.1	20
Test: ICPT on Standard Soil QC Lot: ICPT235AA Concentration Units: (mg/kg)								
Antimony	0.5	0.45	0.47	90	94	75-125	4.3	20
Arsenic	2.0	1.78	1.81	89	91	75-125	1.7	20
Barium	2.0	2.01	2.03	101	101	75-125	1.0	20
Beryllium	0.05	0.047	0.048	94	96	75-125	2.1	20
Cadmium	0.05	0.052	0.050	104	100	75-125	3.9	20
Chromium	0.2	0.20	0.20	100	100	75-125	0.0	20
Cobalt	0.5	0.49	0.49	98	98	75-125	0.0	20
Copper	0.25	0.27	0.27	108	108	75-125	0.0	20
Lead	0.5	0.49	0.49	98	98	75-125	0.0	20
Manganese	0.5	0.53	0.53	106	106	75-125	0.0	20
Nickel	0.5	0.52	0.53	104	106	75-125	1.9	20
Silver	0.05	0.046	0.046	92	92	75-125	0.0	20
Tin	0.5	0.55	0.55	110	110	75-125	0.0	20
Vanadium	0.5	0.48	0.48	96	96	75-125	0.0	20
Zinc	0.5	0.50	0.51	100	102	75-125	2.0	20

Rocky Mountain Analytical Laboratory

4955 Yarrow Street, Arvada, CO 80002 (303) 421-6611

A DIVISION OF ENSECO INCORPORATED

CHAIN OF CUSTODY

RMAL Client: Dames & Moore

Sampling Co.: "

Project Name/No.: Caribou 4 Corners, Maverik

RMAL Project No.: 6716

Sampling Personnel: Larry Bardwell

Sampling Site: Solo

Date	Time	Sample ID/Description	Type	No. Containers	Parameters	RMA # Remarks
4/17/88	1100	BH-7 5'-7'	Soil	8	TCH 8010-8020 organic lead % oil	01
4/18/88	~~1000~~ 1330	BH-10 12'	"	3	8010-8020 TCH % oil	04
4/18/88	1000	BH-2 5'-7'	"	7	Skinner, 8010-8020 % oil	07
4/17	1630	BH-3 5'-7'	"	~~8~~ 7	EP Tox 8010-8020 % oil	11
		BH-7 10'-12'				02
		BH-7 15'-17'				03
		BH-10 15'				05
		BH-10 17'				06
		BH-2 7'				08
		BH-2 10'-12'				09
		BH-2 15'-17'				10
		BH-3 5'-7' 11'				12
		BH-3 10'-12'				13
		BH-3 15'-17'				14

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time
Larry Bardwell	4/18/88 1700	Fed-X World	4/18 1700				

Method of Shipment:	Shipped by: (Signature)	Delivered by: (Signature)	Received for Laboratory by: (Signature)	Date / Time
Fed-X	not sign		[illegible]	4/1/88

White Copy to Lab   Pink Copy to Client   Yellow Copy to Sampler

SS-001

Rocky Mountain
Analytical Laboratory

Enseco

ANALYTICAL RESULTS

FOR

DAMES & MOORE

MAY 26, 1988

Reviewed by: Jeannie B Howbert
Jeannie B. Howbert

Allen J Medine
Allen J. Medine, Ph.D.

Enseco Incorporated
4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Fax: 303/431-7171

I. OVERVIEW

A. Project Overview

On April 22, 1988, Enseco-Rocky Mountain Analytical Laboratory received six samples from Dames & Moore. A complete listing of tests requested, by sample, is given in Section III.

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:

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

B. Regulatory Overview - Refinery

In 1984, the EPA distributed several versions of a subset of Appendix VIII constituents to be used principally for delisting petroleum refinery wastes (K048-K052). This list, commonly referred to as the "Skinner" list has been adapted for use in land treatment demonstrations, site closures and other related activities associated with petroleum refining RCRA programs. In early 1985, a modified version of the Skinner list appeared in "Petitions to Delist Hazardous Waste, A Guidance Manual" (EPA/530-SW-85-003). This revised list, as shown in Table I, consists of 12 metals and 43 organic compounds and currently forms the basis for analytical work on samples collected at petroleum refineries.

The organic compounds have been classified as volatile and semivolatile (base/neutral/acid) compounds. Three of the "compounds" listed (xylenes, dichlorobenzenes and cresols) are measured and reported in terms of their specific isomers. Analytical standards are not available for two of the compounds, dibenz(a,h)acridine and methyl chrysene. Therefore, these compounds cannot be measured and analytical results are not presented for these compounds. Two of the remaining compounds, benzenethiol and pyridine cannot be recovered consistently from environmental samples and consequently, method detection limits for these compounds cannot be established. This statement is made based on the results of a methods evaluation study sponsored by API.

Table 2 summarizes the analytical methods used to determine Appendix VIII refinery constituents. For the organic compounds, methods are listed for both the complete list and a subset of this list analyzed by alternate methods.

Between October, 1983 and July, 1985, the EPA released three methods manuals and a "Guidance Manual" which were compendiums of modified SW-846 methods specifically adapted for the analysis of Appendix VIII constituents in petroleum refining wastes. The most useful document was an October, 1984 draft methods manual which was released but never formally distributed by EPA. These documents did not contain many of the important details that are critical to the successful analysis of environmental samples relevant to petroleum refineries.

Thus, although the methods used by Enseco-RMAL in the analysis of petroleum refinery wastes are based on these various EPA documents, the actual details of each method have been modified in order to generate acceptable data. These modifications have been based on information given in numerous documents, some of which are cited in Table 3. In addition to the documents listed in the bibliography, Enseco-RMAL an ongoing dialogue with EPA/OSW to ensure that the latest EPA guidance is incorporated into the analytical approach.

The analytical data tables which follow present results for the Appendix VIII refinery hazardous constituents which are measurable.

TABLE 1. APPENDIX VIII HAZARDOUS CONSTITUENT SUBSET FOR PETROLEUM REFINERY STUDIES*

Metals

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Lead
Mercury
Nickel
Selenium
Vanadium

Volatile Organics

Benzene
Carbon disulfide
Chlorobenzene
Chloroform
1,2-Dibromoethane
1,2-Dichloroethane
1,4-Dioxane
Methyl ethyl ketone
Styrene
Ethyl benzene
Toluene
Xylenes[1]

Base/Neutral Organics

Anthracene
Benz(a)anthracene
Benzo(b)fluoranthene

Base/Neutral Organics (Cont.)

Benzo(k)fluoranthene
Benzo(a)pyrene
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Chrysene
Dibenz(a,h)acridine[2]
Dibenz(a,h)anthracene
Di-n-butyl phthalate
Dichlorobenzenes[1]
Diethyl phthalate
7,12-Dimethylbenz(a)anthracene
Dimethyl phthalate
Di-n-octyl phthalate
Fluoranthene
Indene
Methyl chrysene[2]
1-Methylnaphthalene
Naphthalene
Phenanthrene
Pyrene
Pyridine[3]
Quinoline

Acid Organics

Benzenethiol[3]
Cresols[1]
2,4-Dimethylphenol
2,4-Dinitrophenol
4-Nitrophenol
Phenol

*"Petitions to Delist Hazardous Wastes, A Guidance Manual," EPA/530-SW-85-003, April, 1985.
1) Reported as ortho-, meta-, and para-isomers.
2) No analytical standard available.
3) Not consistently recoverable using standard analytical methods.

TABLE 2. SUMMARY OF ANALYTICAL METHODS FOR REFINERY CONSTITUENTS

Metals	Method
Antimony	7041
Arsenic	7060
Lead	7421
Mercury	7470
Selenium	7740
ICP Scan (Ba, Be, Cd, Cr, Co, Ni, V)	6010

	GC/MS Method	Screening Method
Volatile Organics	8240	8020[a]
Semivolatile Organics	8270	8310[b]

a) Volatile Aromatics
b) Polynuclear Aromatic Hydrocarbons

Ens

TABLE 3. BIBLIOGRAPHY

A. Documents Pertaining to Appendix VIII Constituents

(1) January, 1984 letter from Myles Morse pertaining to delisting petitions as well as land treatment demonstrations, including sampling procedures and data requirements.

(2) March, 1984 letter to delisting petitioners from Barbara Bush revising target parameters.

(3) April, 1984 memo from John Skinner to Permit Branch Chiefs concerning land treatment containing target parameters and analytical methods.

(4) May, 1984 memo from John Skinner clarifying previous memo.

(5) September, 1984 letter to Petitioners from Barbara Bush distributing Refinery Handbook.

(6) November, 1984 letter from Eileen Claussen to all delisting petitioners describing new RCRA requirements.

(7) May 3, 1985 RMAL Memo.

(8) January 8, 1985 RMAL letter to Eileen Claussen, EPA-OSW.

B. Documents Pertaining to Analytical Methods

(1) "Handbook for the Analysis of Petroleum Refinery Residuals and Waste", October, 1984 - prepared by Radian Corporation for EPA/OSW.

(2) "Evaluation of the Applicability of the SW-846 Manual To Support All RCRA Subtitle C Testing", December 20, 1984 - prepared by Rocky Mountain Analytical Laboratory for API.

(3) "Comments on the 'Handbook for the Analysis of Petroleum Refinery Residuals and Waste, October, 1984'", December 12, 1984 - Prepared by Rocky Mountain Analytical Laboratory for API.

(4) "Comments on the 'Handbook for the Analysis of Petroleum Refinery Residuals and Waste, April 2, 1984'", August 15, 1984 - Prepared by Rocky Mountain Analytical Laboratory for API.

(5) "Handbook for the Analysis of Petroleum Refinery Residuals and Waste", April 2, 1984 - prepared by S-Cubed for EPA/OSW.

(6) EPA document "Guidance for the Analysis of Refinery Wastes", July 5, 1985.

(7) "Recovery and Detection Limits of Organic Compounds in Petroleum Refinery Wastes", January 25, 1985.

(8) SW-846 - "Test Methods for Evaluating Solid Waste, Physical Chemical Methods" USEPA, 2nd Edition, 1982.

(9) 40 CFR 136 - "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act."

II. 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 five digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the five 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.

SAMPLE DESCRIPTION INFORMATION

for

DAMES AND MOORE

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Receiv
67196-001-00	BH-20 5 - 7'	Soil	04/21/88	04/22/
67196-002-00	BH-21 0 - 1.25'	Soil	04/21/88	04/22/
67196-003-00	BH-22 0 - 0.5'	Waste	04/21/88	04/22/
67196-004-00	BH-23 10 - 12'	Soil	04/21/88	04/22/
67196-005-00	BH-24 5 - 11.5'	Soil	04/21/88	04/22/
67196-006-00	BH-26 0 - 1'	Waste	04/21/88	04/22/

IV. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, with tests reported in the following order: GC/MS, Chromatography, Metals and Inorganics.

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. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is given in Section V.

The analytical data reported are subject to the following limitations of the analytical methodology:

<u>GC/MS</u>

Volatile Organics

a) The cis- and trans-isomers of dichloroethylene cannot be distinguished using EPA Method 624. All dichloroethylene present is reported as trans-dichloroethylene.

Semivolatile Organics

a) Benzo(b) and benzo(k) fluoranthene cannot be differentiated based on their mass spectra; retention times are almost identical. The isomer which is the closest in retention time to the sample is reported.

Total Chromatographable Organics

Total Chromatographable Organics (TCO) were determined from a methylene chloride extraction and subsequent analysis by capillary column gas chromatography with a flame ionization detector (GC/FID). The TCO result was based on the entire area under the chromatogram as compared to the response to eicosane. The detection limit is based on the response of diesel.

The pattern of the FID chromatogram (fingerprint) was compared to fingerprints of various petroleum products. If, on the judgement of the analyst, the fingerprint of the sample matched the fingerprint of a petroleum product, the concentration of the product was also reported. If components of a particular product were present, but the complexity of the overall chromatogram was such that it could not be reliably determined if the product was or was not present, then, the result for that product contains the following statement: "Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved."

In addition to reporting a TCO value, the results contain boiling point information. This boiling point range represents the range of 80 to 90 percent of the compounds detected in the sample.

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-20

Laboratory ID: 67196-001 Enseco ID: 67196-001

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporti Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-20

Laboratory ID: 67196-001 Enseco ID: 67196-001

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporti Limit
Benzene	75	ug/kg	50
Chlorobenzene	N.D.	ug/kg	50
1,2-Dichlorobenzene	N.D.	ug/kg	50
1,3-Dichlorobenzene	N.D.	ug/kg	50
1,4-Dichlorobenzene	N.D.	ug/kg	50
Ethylbenzene	76	ug/kg	50
Toluene	120	ug/kg	50
m-Xylene	130	ug/kg	50
o & p-Xylene(s)	150	ug/kg	50

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: DAMES AND MOORE
Client ID: BH-20
Laboratory ID: 67196-001 Enseco ID: 67196-001
Matrix: Soil Sampled: 04/21/88 Received: 04/22/88
Authorized: 04/22/88 Prepared: 04/27/88 Analyzed: 04/29/88

	Value	Units	Detection Limit
Total Chromatographable Organics	54,000,000	ug/kg	830,000
Initial Boiling Point*	250	°C	-
Final Boiling Point*	450	°C	-
Gasoline	ND	ug/kg	8,300,000
Stoddard Solvent	ND	ug/kg	8,300,000
Jet Fuel	ND	ug/kg	8,300,000
Kerosene	ND	ug/kg	8,300,000
Diesel	54,000,000	ug/kg	8,300,000
Motor Oil	ND	ug/kg	83,000,000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

** Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved.

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-20

Laboratory ID: 67196-001 Enseco ID: 67196-001

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analy
Oil	10.3	%	0.1		05/03
Water	10.9	%	0.1		05/03
Solids	78.8	%	0.1		05/03

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 67196-001

REFINERY HAZARDOUS CONSTITUENT VOLATILES

EPA METHOD 8240

Client Name: DAMES AND MOORE

Client ID: BH-21

Laboratory ID: 67196-002 Enseco ID: 67196-002

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/14/88

Parameter	Result	Units (as received)	Reporti Limi
Benzene	N.D.	ug/kg	500
Carbon disulfide	N.D.	ug/kg	500
Chlorobenzene	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	500
1,2-Dibromoethane	N.D.	ug/kg	500
1,2-Dichloroethane	N.D.	ug/kg	500
1,4-Dioxane	N.D.	ug/kg	10000
Methyl ethyl ketone	N.D.	ug/kg	2500
Styrene	N.D.	ug/kg	500
Ethylbenzene	N.D.	ug/kg	500
Toluene	N.D.	ug/kg	500
m-Xylene	2600	ug/kg	500
o & p-Xylene(s)	2300	ug/kg	500
Surrogate			
Toluene-D8	101	%	-
Bromofluorobenzene(BFB)	107	%	-
1,2-Dichloroethane-D4	102	%	-

N.D. = Not detected

Reported by: Daniel Albritton Approved by: Jeffrey Lowry

Sample: 67196-002

REFINERY HAZARDOUS CONSTITUENT SEMIVOLATILES

Client Name: DAMES AND MOORE

Client ID: BH-21

Laboratory ID: 67196-002 Enseco ID: 67196-002

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Prepared: 05/02/88 Analyzed: 05/20/88

Parameter	Result	Units (as received)	Reporting Limit
Anthracene	N.D.	ug/kg	990
Benzo(a)anthracene	N.D.	ug/kg	990
Benzo(b)fluoranthene	N.D.	ug/kg	990
Benzo(k)fluoranthene	N.D.	ug/kg	990
Benzo(a)pyrene	N.D.	ug/kg	990
bis(2-Ethylhexyl)phthalate	1200	ug/kg	990
Butylbenzyl phthalate	N.D.	ug/kg	990
Chrysene	N.D.	ug/kg	990
Dibenz(a,h)anthracene	N.D.	ug/kg	990
Di-n-butyl phthalate	N.D.	ug/kg	990
1,2-Dichlorobenzene	N.D.	ug/kg	990
1,3-Dicholrobenzene	N.D.	ug/kg	990
1,4-Dichlorobenzene	N.D.	ug/kg	990
Diethyl phthalate	N.D.	ug/kg	990
7,12-Dimethylbenzanthracene	N.D.	ug/kg	990
Dimethyl phthalate	N.D.	ug/kg	990
Di-n-octyl phthalate	N.D.	ug/kg	990
Fluoranthene	N.D.	ug/kg	990
Indene	N.D.	ug/kg	990
1-Methylnaphthalene	N.D.	ug/kg	990
Naphthalene	N.D.	ug/kg	990
Phenanthrene	1400	ug/kg	990
Pyrene	N.D.	ug/kg	990
Pyridine	N.D.	ug/kg	-
Quinoline	N.D.	ug/kg	990
Benzenethiol	N.D.	ug/kg	-
o-Cresol	N.D.	ug/kg	990
p & m-Cresol	N.D.	ug/kg	990
2,4-Dimethylphenol	N.D.	ug/kg	990
2,4-Dinitrophenol	N.D.	ug/kg	4800
4-Nitrophenol	N.D.	ug/kg	4800

N.D. = Not detected

REFINERY HAZARDOUS CONSTITUENT SEMIVOLATILES (CONT.)

Client Name: DAMES AND MOORE

Client ID: BH-21

Laboratory ID: 67196-002 Enseco ID: 67196-002

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Prepared: 05/02/88 Analyzed: 05/20/88

Parameter	Result	Units (as received)	Reporting Limit
Phenol	N.D.	ug/kg	990
Surrogate			
Nitrobenzene-D5	88	%	-
2-Fluorobiphenyl	107	%	-
Terphenyl-D14	103	%	-
Phenol-D5	59	%	-
2-Fluorophenol	73	%	-
2,4,6-Tribromophenol	120	%	-

N.D. = Not detected

Reported by: Julie Niermann Approved by: Jeffrey Lowry

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-21

Laboratory ID: 67196-002 Enseco ID: 67196-002

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	500
Carbon tetrachloride	N.D.	ug/kg	50
Chlorobenzene	N.D.	ug/kg	200
Chloroethane	N.D.	ug/kg	500
Chloroform	N.D.	ug/kg	50
Dibromochloromethane	N.D.	ug/kg	100
Bromodichloromethane	N.D.	ug/kg	100
1,1-Dichloroethane	N.D.	ug/kg	50
1,2-Dichloroethane	N.D.	ug/kg	100
1,1-Dichloroethene	N.D.	ug/kg	50
1,2-Dichloropropane	N.D.	ug/kg	100
cis-1,3-Dichloropropene	N.D.	ug/kg	200
trans-1,3-Dichloropropene	N.D.	ug/kg	50
Bromomethane	N.D.	ug/kg	500
Chloromethane	N.D.	ug/kg	500
Methylene chloride	N.D.	ug/kg	500
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	100
Tetrachloroethene	N.D.	ug/kg	50
trans-1,2-Dichloroethene	N.D.	ug/kg	50
1,1,1-Trichloroethane	N.D.	ug/kg	50
1,1,2-Trichloroethane	N.D.	ug/kg	100
Trichloroethene	N.D.	ug/kg	100
Vinyl chloride	N.D.	ug/kg	100
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	100
1,2-Dibromoethane (EDB)	N.D.	ug/kg	200

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-21

Laboratory ID: 67196-002 Enseco ID: 67196-002

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	110	ug/kg	100
Chlorobenzene	N.D.	ug/kg	100
1,2-Dichlorobenzene	N.D.	ug/kg	100
1,3-Dichlorobenzene	N.D.	ug/kg	100
1,4-Dichlorobenzene	N.D.	ug/kg	100
Ethylbenzene	N.D.	ug/kg	100
Toluene	N.D.	ug/kg	100
m-Xylene	3400	ug/kg	100
o & p-Xylene(s)	1700	ug/kg	100

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

Enseco

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: DAMES AND MOORE
Client ID: BH-21
Laboratory ID: 67196-002 Enseco ID: 67196-002
Matrix: Soil Sampled: 04/21/88 Received: 04/22/88
Authorized: 04/22/88 Prepared: 04/27/88 Analyzed: 04/29/88

	Value	Units	Detection Limit
Total Chromatographable Organics	60,000,000	ug/kg	170,000
Initial Boiling Point*	290	°C	-
Final Boiling Point*	500	°C	-
Gasoline	ND	-	1,700,000
Stoddard Solvent	ND	-	1,700,000
Jet Fuel	ND	-	1,700,000
Kerosene	ND	-	1,700,000
Diesel	ND	-	1,700,000
Motor Oil	ND	-	17,000,000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

** Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved.

METALS PARAMETERS
TOTAL METALS

Client Name: DAMES AND MOORE

Client ID: BH-21

Laboratory ID: 67196-002 Enseco ID: 67196-002

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/kg	5	6010	04/29/88
Arsenic	1.2	mg/kg	0.3	7060	05/06/88
Barium	110	mg/kg	0.5	6010	04/29/88
Beryllium	0.2	mg/kg	0.1	6010	04/29/88
Cadmium	N.D.	mg/kg	0.5	6010	04/29/88
Chromium	2	mg/kg	1	6010	04/29/88
Cobalt	2	mg/kg	1	6010	04/29/88
Lead	8	mg/kg	5	6010	04/29/88
Mercury	N.D.	ug/kg	50	7471	04/29/88
Nickel	N.D.	mg/kg	4	6010	04/29/88
Selenium	N.D.	mg/kg	0.2	7740	05/05/88
Vanadium	12	mg/kg	1	6010	04/29/88

N.D. = Not detected

Approved by: Will Pratt

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-21

Laboratory ID: 67196-002 Enseco ID: 67196-002

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	2.6	%	0.1		05/03/88
Water	6.0	%	0.1		05/03/88
Solids	91.4	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

REFINERY HAZARDOUS CONSTITUENT VOLATILES

Client Name: DAMES AND MOORE

Client ID: BH-22

Laboratory ID: 67196-003 Enseco ID: 67196-003

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/20/88

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	mg/kg	1.0
Carbon disulfide	N.D.	mg/kg	1.0
Chlorobenzene	N.D.	mg/kg	1.0
Chloroform	N.D.	mg/kg	1.0
1,2-Dibromoethane	N.D.	mg/kg	1.0
1,2-Dichloroethane	N.D.	mg/kg	1.0
1,4-Dioxane	N.D.	mg/kg	20
Methyl ethyl ketone	N.D.	mg/kg	5.0
Styrene	N.D.	mg/kg	1.0
Ethylbenzene	N.D.	mg/kg	1.0
Toluene	4.4	mg/kg	1.0
m-Xylene	3.8	mg/kg	1.0
o & p-Xylene(s)	2.5	mg/kg	1.0
Surrogate			
Toluene-D8	94	%	-
Bromofluorobenzene(BFB)	104	%	-
1,2-Dichloroethane-D4	106	%	-

N.D. = Not detected

Reported by: Stephen Siegal Approved by: Jeffrey Lowry

REFINERY HAZARDOUS CONSTITUENT
SEMIVOLATILE ORGANICS

Client Name: DAMES AND MOORE

Client ID: BH-22

Laboratory ID: 67196-003 Enseco ID: 67196-003

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Prepared: 05/02/88 Analyzed: 05/19/88

Parameter	Result	Units	Reporting Limit
Anthracene	N.D.	mg/kg	10
Benzo(a)anthracene	N.D.	mg/kg	10
Benzo(b)fluoranthene	N.D.	mg/kg	10
Benzo(k)fluoranthene	N.D.	mg/kg	10
Benzo(a)pyrene	N.D.	mg/kg	10
bis(2-Ethylhexyl)phthalate	N.D.	mg/kg	10
Butylbenzyl phthalate	N.D.	mg/kg	10
Chrysene	28	mg/kg	10
Dibenz(a,h)anthracene	N.D.	mg/kg	10
Di-n-butyl phthalate	N.D.	mg/kg	10
1,2-Dichlorobenzene	N.D.	mg/kg	10
1,3-Dichlorobenzene	N.D.	mg/kg	10
1,4-Dichlorobenzene	N.D.	mg/kg	10
Diethyl phthalate	N.D.	mg/kg	10
7,12-Dimethylbenzanthracene	N.D.	mg/kg	10
Dimethyl phthalate	N.D.	mg/kg	10
Di-n-octyl phthalate	N.D.	mg/kg	10
Fluoranthene	N.D.	mg/kg	10
Indene	N.D.	mg/kg	10
1-Methylnaphthalene	N.D.	mg/kg	10
Naphthalene	N.D.	mg/kg	10
Phenanthrene	30	mg/kg	10
Pyrene	N.D.	mg/kg	10
Pyridine	N.D.	mg/kg	-
Quinoline	N.D.	mg/kg	10
Benzenethiol	N.D.	mg/kg	-
o-Cresol	N.D.	mg/kg	10
p & m-Cresol	N.D.	mg/kg	10
2,4-Dimethylphenol	N.D.	mg/kg	10
2,4-Dinitrophenol	N.D.	mg/kg	50
4-Nitrophenol	N.D.	mg/kg	50

N.D. = Not detected

REFINERY HAZARDOUS CONSTITUENT
SEMIVOLATILE ORGANICS (CONT.)

Client Name: DAMES AND MOORE

Client ID: BH-22

Laboratory ID: 67196-003 Enseco ID: 67196-003

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Prepared: 05/02/88 Analyzed: 05/19/88

Parameter	Result	Units	Reporting Limit
Phenol	N.D.	mg/kg	10
Surrogate			
Nitrobenzene-D5	98	%	-
2-Fluorobiphenyl	111	%	-
Terphenyl-D14	102	%	-
Phenol-D5	47	%	-
2-Fluorophenol	58	%	-
2,4,6-Tribromophenol	91	%	-

N.D. = Not detected

Reported by: Julie Niermann Approved by: Jeffrey Lowry

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-22

Laboratory ID: 67196-003 Enseco ID: 67196-003

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	1000
Carbon tetrachloride	N.D.	ug/kg	100
Chlorobenzene	N.D.	ug/kg	400
Chloroethane	N.D.	ug/kg	1000
Chloroform	N.D.	ug/kg	100
Dibromochloromethane	N.D.	ug/kg	200
Bromodichloromethane	N.D.	ug/kg	200
1,1-Dichloroethane	N.D.	ug/kg	100
1,2-Dichloroethane	N.D.	ug/kg	200
1,1-Dichloroethene	N.D.	ug/kg	100
1,2-Dichloropropane	N.D.	ug/kg	200
cis-1,3-Dichloropropene	N.D.	ug/kg	400
trans-1,3-Dichloropropene	N.D.	ug/kg	100
Bromomethane	N.D.	ug/kg	1000
Chloromethane	N.D.	ug/kg	1000
Methylene chloride	N.D.	ug/kg	1000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	200
Tetrachloroethene	N.D.	ug/kg	100
trans-1,2-Dichloroethene	N.D.	ug/kg	100
1,1,1-Trichloroethane	N.D.	ug/kg	100
1,1,2-Trichloroethane	N.D.	ug/kg	200
Trichloroethene	N.D.	ug/kg	200
Vinyl chloride	N.D.	ug/kg	200
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	200
1,2-Dibromoethane (EDB)	N.D.	ug/kg	400

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-22

Laboratory ID: 67196-003 Enseco ID: 67196-003

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	2000	ug/kg	100
Chlorobenzene	N.D.	ug/kg	100
1,2-Dichlorobenzene	N.D.	ug/kg	100
1,3-Dichlorobenzene	N.D.	ug/kg	100
1,4-Dichlorobenzene	N.D.	ug/kg	100
Ethylbenzene	1800	ug/kg	100
Toluene	11000	ug/kg	100
m-Xylene	10000	ug/kg	100
o & p-Xylene(s)	6100	ug/kg	100

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

Enseco

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: DAMES AND MOORE
Client ID: BH-22
Laboratory ID: 67196-003 Enseco ID: 67196-003
Matrix: Waste Sampled: 04/21/88 Received: 04/22/88
Authorized: 04/22/88 Prepared: 04/27/88 Analyzed: 04/29/88

	Value	Units	Detection Limit
Total Chromatographable Organics	130,000,000	ug/kg	830,000
Initial Boiling Point*	100	°C	-
Final Boiling Point*	500	°C	-
Gasoline	ND	-	8,300,000
Stoddard Solvent	ND	-	8,300,000
Jet Fuel	ND	-	8,300,000
Kerosene	ND	-	8,300,000
Diesel	ND	-	8,300,000
Motor Oil	ND	-	83,000,000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

** Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved.

METALS PARAMETERS
TOTAL METALS

Client Name: DAMES AND MOORE

Client ID: BH-22

Laboratory ID: 67196-003 Enseco ID: 67196-003

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/kg	5	6010	04/29/88
Arsenic	N.D.	mg/kg	0.3	7060	05/06/88
Barium	9.4	mg/kg	0.5	6010	04/29/88
Beryllium	N.D.	mg/kg	0.1	6010	04/29/88
Cadmium	N.D.	mg/kg	0.5	6010	04/29/88
Chromium	N.D.	mg/kg	1	6010	04/29/88
Cobalt	N.D.	mg/kg	1	6010	04/29/88
Lead	N.D.	mg/kg	5	6010	04/29/88
Mercury	N.D.	ug/kg	50	7471	04/29/88
Nickel	N.D.	mg/kg	4	6010	04/29/88
Selenium	N.D.	mg/kg	0.2	7740	05/05/88
Vanadium	N.D.	mg/kg	1	6010	04/29/88

N.D. = Not detected

Approved by: Will Pratt

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-22

Laboratory ID: 67196-003 Enseco ID: 67196-003

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	93.7	%	0.1		05/03/88
Water	2.0	%	0.1		05/03/88
Solids	4.3	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-23

Laboratory ID: 67196-004 Enseco ID: 67196-004

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	5000
Carbon tetrachloride	N.D.	ug/kg	500
Chlorobenzene	N.D.	ug/kg	2000
Chloroethane	N.D.	ug/kg	5000
Chloroform	N.D.	ug/kg	500
Dibromochloromethane	N.D.	ug/kg	1000
Bromodichloromethane	N.D.	ug/kg	1000
1,1-Dichloroethane	N.D.	ug/kg	500
1,2-Dichloroethane	N.D.	ug/kg	1000
1,1-Dichloroethene	N.D.	ug/kg	500
1,2-Dichloropropane	N.D.	ug/kg	1000
cis-1,3-Dichloropropene	N.D.	ug/kg	2000
trans-1,3-Dichloropropene	N.D.	ug/kg	500
Bromomethane	N.D.	ug/kg	5000
Chloromethane	N.D.	ug/kg	5000
Methylene chloride	N.D.	ug/kg	5000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	1000
Tetrachloroethene	N.D.	ug/kg	500
trans-1,2-Dichloroethene	N.D.	ug/kg	500
1,1,1-Trichloroethane	N.D.	ug/kg	500
1,1,2-Trichloroethane	N.D.	ug/kg	1000
Trichloroethene	N.D.	ug/kg	1000
Vinyl chloride	N.D.	ug/kg	1000
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	1000
1,2-Dibromoethane (EDB)	N.D.	ug/kg	2000

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-23

Laboratory ID: 67196-004 Enseco ID: 67196-004

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	670	ug/kg	500
Chlorobenzene	N.D.	ug/kg	500
1,2-Dichlorobenzene	N.D.	ug/kg	500
1,3-Dichlorobenzene	N.D.	ug/kg	500
1,4-Dichlorobenzene	N.D.	ug/kg	500
Ethylbenzene	12000	ug/kg	500
Toluene	19000	ug/kg	500
m-Xylene	72000	ug/kg	500
o & p-Xylene(s)	35000	ug/kg	500

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

Enseco

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: DAMES AND MOORE
Client ID: BH-23
Laboratory ID: 67196-004 Enseco ID: 67196-004
Matrix: Soil Sampled: 04/21/88 Received: 04/22/88
Authorized: 04/22/88 Prepared: 04/27/88 Analyzed: 04/29/88

	Value	Units	Detection Limit
Total Chromatographable Organics	2,900,000	ug/kg	1,700
Initial Boiling Point*	100	°C	-
Final Boiling Point*	470	°C	-
Gasoline	ND	ug/kg	117,000
Stoddard Solvent	ND	ug/kg	17,000
Jet Fuel	ND	ug/kg	17,000
Kerosene	ND	ug/kg	17,000
Diesel	ND	ug/kg	17,000
Motor Oil	ND	ug/kg	170,000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

** Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved.

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-23

Laboratory ID: 67196-004 Enseco ID: 67196-004

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.1	%	0.1		05/03/88
Water	11.4	%	0.1		05/03/88
Solids	88.5	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

HALOGENATED VOLATILE ORGANICS

EPA METHOD 8010

Client Name: DAMES AND MOORE

Client ID: BH-24

Laboratory ID: 67196-005 Enseco ID: 67196-005

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporting Limit
Bromoform	N.D.	ug/kg	1000
Carbon tetrachloride	N.D.	ug/kg	100
Chlorobenzene	N.D.	ug/kg	400
Chloroethane	N.D.	ug/kg	1000
Chloroform	N.D.	ug/kg	100
Dibromochloromethane	N.D.	ug/kg	200
Bromodichloromethane	N.D.	ug/kg	200
1,1-Dichloroethane	N.D.	ug/kg	100
1,2-Dichloroethane	N.D.	ug/kg	200
1,1-Dichloroethene	N.D.	ug/kg	100
1,2-Dichloropropane	N.D.	ug/kg	200
cis-1,3-Dichloropropene	N.D.	ug/kg	400
trans-1,3-Dichloropropene	N.D.	ug/kg	100
Bromomethane	N.D.	ug/kg	1000
Chloromethane	N.D.	ug/kg	1000
Methylene chloride	N.D.	ug/kg	1000
1,1,2,2-Tetrachloroethane	N.D.	ug/kg	200
Tetrachloroethene	N.D.	ug/kg	100
trans-1,2-Dichloroethene	N.D.	ug/kg	100
1,1,1-Trichloroethane	N.D.	ug/kg	100
1,1,2-Trichloroethane	N.D.	ug/kg	200
Trichloroethene	N.D.	ug/kg	200
Vinyl chloride	N.D.	ug/kg	200
1,1,2-Trichloro-1,2,2-trifluoroethane	N.D.	ug/kg	200
1,2-Dibromoethane (EDB)	N.D.	ug/kg	400

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

AROMATIC VOLATILE ORGANICS

EPA METHOD 8020

Client Name: DAMES AND MOORE

Client ID: BH-24

Laboratory ID: 67196-005 Enseco ID: 67196-005

Matrix: Soil Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88 Analyzed: 05/03/88

Parameter	Result	Units (as received)	Reporting Limit
Benzene	N.D.	ug/kg	100
Chlorobenzene	N.D.	ug/kg	100
1,2-Dichlorobenzene	N.D.	ug/kg	100
1,3-Dichlorobenzene	N.D.	ug/kg	100
1,4-Dichlorobenzene	N.D.	ug/kg	100
Ethylbenzene	2400	ug/kg	100
Toluene	2100	ug/kg	100
m-Xylene	17000	ug/kg	100
o & p-Xylene(s)	10000	ug/kg	100

N.D. = Not detected

Reported by: Helmer Morse Approved by: Susan Brillante

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: DAMES AND MOORE
Client ID: BH-24
Laboratory ID: 67196-005 Enseco ID: 67196-005
Matrix: Soil Sampled: 04/21/88 Received: 04/22/88
Authorized: 04/22/88 Prepared: 04/27/88 Analyzed: 04/29/88

	Value	Units	Detection Limit
Total Chromatographable Organics	250,000	ug/kg	1,700
Initial Boiling Point*	100	°C	-
Final Boiling Point*	400	°C	-
Gasoline	ND	ug/kg	17,000
Stoddard Solvent	ND	ug/kg	17,000
Jet Fuel	ND	ug/kg	17,000
Kerosene	ND	ug/kg	17,000
Diesel	ND	ug/kg	17,000
Motor Oil	ND	ug/kg	170,000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

** Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved.

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE
Client ID: BH-24
Laboratory ID: 67196-005 Enseco ID: 67196-005
Matrix: Soil Sampled: 04/21/88 Received: 04/22/88
Authorized: 04/22/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	0.2	%	0.1		05/03/88
Water	10.6	%	0.1		05/03/88
Solids	89.2	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

Enseco

ANALYTICAL RESULTS FOR TOTAL CHROMATOGRAPHABLE ORGANICS

Client Name: DAMES AND MOORE
Client ID: BH-26
Laboratory ID: 67196-006 Enseco ID: 67196-006
Matrix: Waste Sampled: 04/21/88 Received: 04/22/88
Authorized: 04/22/88 Prepared: 04/27/88 Analyzed: 04/29/88

	Value	Units	Detection Limit
Total Chromatographable Organics	130,000,000	ug/kg	170,000
Initial Boiling Point*	170	°C	-
Final Boiling Point*	500	°C	-
Gasoline	ND	ug/kg	1,400,000
Stoddard Solvent	ND	ug/kg	1,400,000
Jet Fuel	ND	ug/kg	1,400,000
Kerosene	ND	ug/kg	1,400,000
Diesel	**	ug/kg	1,400,000
Motor Oil	ND	ug/kg	17,000,000

* The initial and final boiling points define the range of compounds detected. The method is capable of detecting compounds between 100°C and 500°C.

** Primary components of this product were detected in the sample. Due to the overall complexity of the chromatogram, reliable identification of this product cannot be achieved.

METALS PARAMETERS
TOTAL METALS

Client Name: DAMES AND MOORE

Client ID: BH-26

Laboratory ID: 67196-006 Enseco ID: 67196-006

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88

Parameter	Result	Units (as received)	Reporting Limit	Analytical Method	Analyzed
Arsenic	9.0	mg/kg	0.6	7060	05/06/88
Barium	63	mg/kg	0.5	6010	04/29/88
Cadmium	N.D.	mg/kg	0.5	6010	04/29/88
Chromium	12	mg/kg	1	6010	04/29/88
Lead	98	mg/kg	5	6010	04/29/88
Mercury	N.D.	ug/kg	50	7471	04/29/88
Selenium	N.D.	mg/kg	0.2	7740	05/05/88
Silver	N.D.	mg/kg	0.5	6010	04/29/88

N.D. = Not detected

Approved by: Will Pratt

INORGANIC PARAMETERS

Client Name: DAMES AND MOORE

Client ID: BH-26

Laboratory ID: 67196-006 Enseco ID: 67196-006

Matrix: Waste Sampled: 04/21/88 Received: 04/22/88

Authorized: 04/22/88

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Oil	51.3	%	0.1		05/03/88
Water	9.0	%	0.1		05/03/88
Solids	39.7	%	0.1		05/03/88

N.D. = Not detected

Approved by: Lindsay Breyer

V. QUALITY CONTROL REPORT

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 Laboratory Control Samples (LCS) at frequent, well-defined intervals. An LCS 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 LCS 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 LCS 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 Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

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

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

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

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, LCS 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. The test codes assigned are defined in Section VI., Analytical Methodology.

QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	SCS
67196-002-00	Standard Soil	BNA	BNA 098AA	BNA 098CA
67196-002-00	Standard Soil	VOA	VOA 032AA	VOA 032AA
67196-003-00	Standard Soil	BNA	BNA 098AA	BNA 098CA
67196-003-00	Standard Soil	VOA	VOA 031AK	VOA 031AK

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: BNA on Standard Soil								
QC Lot: BNA 098AA								
Concentration Units: (ug/kg)								
Pentachlorophenol	6670	4260	3180	64	48	17-109	29.0	47
Phenol	6670	5580	4440	84	67	26- 90	22.8	35
2-Chlorophenol	6670	5790	4830	87	72	25-102	18.1	50
4-Chloro-3-methylphenol	6670	6490	5880	97	88	26-103	9.9	33
4-Nitrophenol	6670	6810	4770	102	72	11-114	35.2	50
1,2,4-Trichlorobenzene	3330	2600	2490	78	75	38-107	4.3	23
Acenaphthene	3330	3210	2390	96	72	31-137	29.3*	19
2,4-Dinitrotoluene	3330	2860	2130	86	64	28- 89	29.3	47
Pyrene	3330	3300	2200	99	66	35-142	40.0*	36
N-Nitrosodi-n-propylamine	3330	2820	2460	85	74	41-126	13.6	38
1,4-Dichlorobenzene	3330	2510	2160	75	65	28-104	15.0	27
Test: VOA on Standard Soil								
QC Lot: VOA 031AK								
Concentration Units: (ug/kg)								
1,1-Dichloroethene	5000	5020	5380	100	108	59-172	6.9	22
Trichloroethene	5000	5240	5620	105	112	62-137	7.0	24
Chlorobenzene	5000	5560	5780	111	116	60-133	3.9	21
Toluene	5000	5090	5380	102	108	59-139	5.5	21
Benzene	5000	5170	5520	103	110	66-142	6.5	21
Test: VOA on Standard Soil								
QC Lot: VOA 032AA								
Concentration Units: (ug/kg)								
1,1-Dichloroethene	5000	5990	6030	120	121	59-172	0.7	22
Trichloroethene	5000	5160	5450	103	109	62-137	5.5	24
Chlorobenzene	5000	5240	5500	105	110	60-133	4.8	21
Toluene	5000	5000	5120	100	102	59-139	2.4	21
Benzene	5000	5320	5510	106	110	66-142	3.5	21

* = RPD outside standard QC limits.

SURROGATE CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: BNA on Standard Soil				
QC Lot: BNA 098CA				
Concentration Units: (ug/kg)				
Phenol-D5	3330	2650	80	24-113
2-Fluorophenol	3330	2730	82	25-121
2,4,6-Tribromophenol	3330	2150	65	19-122
Nitrobenzene-D5	1670	1290	77	23-120
2-Fluorobiphenyl	1670	1350	81	30-115
Terphenyl-D14	1670	1570	94	18-137
Test: VOA on Standard Soil				
QC Lot: VOA 031AK				
Concentration Units: (ug/kg)				
Toluene-D8	5000	4820	96	81-117
Bromofluorobenzene (BFB)	5000	6000	120	74-121
1,2-Dichloroethane-D4	5000	4980	100	70-121
Test: VOA on Standard Soil				
QC Lot: VOA 032AA				
Concentration Units: (ug/kg)				
Toluene-D8	5000	5110	102	81-117
Bromofluorobenzene (BFB)	5000	5020	100	74-121
1,2-Dichloroethane-D4	5000	5360	107	70-121

QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	QC Lot Number SCS
67196-001-00	Standard Soil	601	601 123AL	601 123AL
67196-001-00	Standard Soil	602	602 148AL	602 148AL
67196-002-00	Standard Soil	601	601 123AL	601 123AL
67196-002-00	Standard Soil	602	602 148AL	602 148AL
67196-003-00	Standard Soil	601	601 123AL	601 123AL
67196-003-00	Standard Soil	602	602 148AL	602 148AL
67196-004-00	Standard Soil	601	601 123AL	601 123AL
67196-004-00	Standard Soil	602	602 148AL	602 148AL
67196-005-00	Standard Soil	601	601 123AL	601 123AL
67196-005-00	Standard Soil	602	602 148AL	602 148AL

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: 601 on Standard Soil								
QC Lot: 601 123AL								
Concentration Units: (ug/kg)								
Chloromethane	2000	2320	2410	116	121	59-140	3.8	25
Bromomethane	2000	2310	2330	116	117	58-141	0.9	25
Vinyl chloride	2000	1720	1700	86	85	68-132	1.2	25
Chloroethane	2000	2040	2050	102	103	77-123	0.5	20
Methylene chloride	2000	2150	2320	108	116	77-123	7.6	20
Trichlorofluoromethane	2000	1660	1530	83	77	66-134	8.2	25
1,1-Dichloroethene	2000	1780	1780	89	89	63-137	0.0	20
1,1-Dichloroethane	2000	1860	1790	93	90	84-116	3.8	20
trans-1,2-Dichloroethene	2000	1750	1690	88	85	64-136	3.5	20
Chloroform	2000	1790	1740	90	87	75-125	2.8	20
1,1,2-Trichloro-1,2,2-trifluor	2000	1640	1540	82	77	67-134	6.3	20
1,2-Dichloroethane	2000	1860	1860	93	93	72-129	0.0	20
1,1,1-Trichloroethane	2000	1570	1500	79	75	71-129	4.6	20
Carbon tetrachloride	2000	1680	1600	84	80	68-131	4.9	20
Bromodichloromethane	2000	1860	1750	93	88	76-124	6.1	20
1,2-Dichloropropane	2000	1730	1660	87	83	74-126	4.1	20
trans-1,3-Dichloropropene	2000	1720	1620	86	81	64-136	6.0	20
Trichloroethene	2000	1830	1740	92	87	77-123	5.0	20
1,1,2-Trichloroethane	6000	6540	6110	109	102	69-132	6.8	20
Dibromochloromethane	6000	6540	6110	109	102	69-132	6.8	20
cis-1,3-Dichloropropene	6000	6540	6110	109	102	69-132	6.8	20
1,2-Dibromoethane (EDB)	2000	1560	1510	78	76	74-127	3.3	20
Bromoform	2000	1840	1780	92	89	74-127	3.3	20
1,1,2,2-Tetrachloroethane	4000	3600	3490	90	87	60-140	3.1	20
Tetrachloroethene	4000	3600	3490	90	87	60-140	3.1	20
Chlorobenzene	2000	2210	2090	111	105	72-128	5.6	20
1,3-Dichlorobenzene	2000	2000	2100	100	105	50-150	4.9	20
1,2-Dichlorobenzene	2000	2050	1990	103	100	70-130	3.0	20
1,4-Dichlorobenzene	2000	2090	2320	105	116	70-130	10.4	20
Test: 602 on Standard Soil								
QC Lot: 602 148AL								
Concentration Units: (ug/kg)								
Benzene	2000	1690	1680	85	84	77-123	0.6	20
Toluene	2000	1880	1830	94	92	77-123	2.7	20
Chlorobenzene	2000	2000	1950	100	98	81-119	2.5	20
Ethylbenzene	2000	2020	1960	101	98	63-137	3.0	20
m-Xylene	2000	1870	1840	94	92	77-123	1.6	20

LABORATORY CONTROL SAMPLE REPORT

GAS CHROMATOGRAPHY

Test: 602 on Standard Soil
QC Lot: 602 148AL
Concentration Units: (ug/kg)

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
o & p-Xylene(s)	4000	3880	3820	97	96	77-123	1.6	20
1,3-Dichlorobenzene	2000	2020	1970	101	99	77-123	2.5	20
1,2-Dichlorobenzene	2000	1840	1830	92	92	63-137	0.5	20
1,4-Dichlorobenzene	2000	2000	1920	100	96	70-130	4.1	20

SURROGATE CONTROL SAMPLE REPORT

GAS CHROMATOGRAPHY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: 601 on Standard Soil QC Lot: 601 123AL Concentration Units: (ug/kg)				
Bromochloromethane	3000	2780	93	20-160
Test: 602 on Standard Soil QC Lot: 602 148AL Concentration Units: (ug/kg)				
a,a,a-Trifluorotoluene	3000	3020	101	20-160

QC LOT ASSIGNMENT REPORT
INORGANICS - METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
67196-002-00	Standard Soil	FAST	FAST212AA
67196-002-00	Standard Soil	FSET	FSET212AA
67196-002-00	Standard Soil	HGT	HGT 196AA
67196-002-00	Standard Soil	ICPT	ICPT240AA
67196-003-00	Standard Soil	FAST	FAST212AA
67196-003-00	Standard Soil	FSET	FSET212AA
67196-003-00	Standard Soil	HGT	HGT 196AA
67196-003-00	Standard Soil	ICPT	ICPT240AA
67196-006-00	Standard Soil	FAST	FAST212AA
67196-006-00	Standard Soil	FSET	FSET212AA
67196-006-00	Standard Soil	HGT	HGT 196AA
67196-006-00	Standard Soil	ICPT	ICPT240AA

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: FAST on Standard Soil QC Lot: FAST212AA Concentration Units: (mg/kg)								
Arsenic	4	4.1	4.1	103	103	75-125	0.0	20
Test: FSET on Standard Soil QC Lot: FSET212AA Concentration Units: (mg/kg)								
Selenium	2.0	2.0	1.9	100	95	75-125	5.1	20
Test: HGT on Standard Soil QC Lot: HGT 196AA Concentration Units: (ug/kg)								
Mercury	500	516	532	103	106	75-125	3.1	20
Test: ICPT on Standard Soil QC Lot: ICPT240AA Concentration Units: (mg/kg)								
Antimony	0.5	0.51	0.50	102	100	75-125	2.0	20
Arsenic	2.0	1.96	1.95	98	98	75-125	0.5	20
Barium	2.0	2.09	2.06	105	103	75-125	1.4	20
Beryllium	0.05	0.050	0.049	100	98	75-125	2.0	20
Cadmium	0.05	0.055	0.054	110	108	75-125	1.8	20
Chromium	0.2	0.20	0.20	100	100	75-125	0.0	20
Cobalt	0.5	0.52	0.51	104	102	75-125	1.9	20
Copper	0.25	0.26	0.25	104	100	75-125	3.9	20
Lead	0.5	0.51	0.50	102	100	75-125	2.0	20
Manganese	0.5	0.54	0.54	108	108	75-125	0.0	20
Nickel	0.5	0.55	0.54	110	108	75-125	1.8	20
Silver	0.05	0.050	0.048	100	96	75-125	4.1	20
Tin	0.5	0.61	0.59	122	118	75-125	3.3	20
Vanadium	0.5	0.50	0.49	100	98	75-125	2.0	20
Zinc	0.5	0.55	0.53	110	106	75-125	3.7	20

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

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CHAIN OF CUSTODY

67196

RMAL Client Dames & Moore

RMAL Project No. Kirtland N.M.

Sampling Co.

Sampling Personnel Larry Bardwell

Project Name/No. Caribou 4 Corners, Maverik Stores

Sampling Site

Date	Time	Sample ID/Description	Type	No. Containers	Parameters	Remarks
4/20/88	1300	BA-20	Soils	5	8010-8020 % oil TCH	01
4/20/88	1330	BH-21	"	6	8010-8020 % oil TCH Skinner List	02
4/20/88	1400	BH-22 Sludge Pit North	"	6	Same as above (BH-21)	03
4/21/88	1430	BH-23	"	5	8010-8020 % oil TCH	04
4/21/88	1500	BH-24	"	5	as above (BH-23)	05
4/21/88	1600	#26 Sludge Pit East	"	4	% oil TCH RCRA metals	06

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time
LRB	4/21 1300	would not sign					
Method of Shipment: Fed-X		Shipped by: (Signature) Fed-X		Delivered by: (Signature)		Received for Laboratory by: (Signature) [illegible]	Date / Time 4/22/88 0800

White Copy to Lab Pink Copy to Client Yellow Copy to Sampler

SS - 001

APPENDIX D

CHROMATOGRAMS

APPENDIX D

CHROMATOGRAMS

Included herein are the chromatograms from the 10 borehole samples analyzed for total chromatographable organics (TCO) and "type" chromatograms for gasoline, diesel fuel, oil, kerosene and a C10-C36 sample. Analyses for TCO involved a methylene chloride extraction and subsequent analysis by capillary column gas chromatography with a flame ionization detector. This test is designed to detect the maximum concentration of hydrocarbons (which include refinery-related semivolatiles and additional non-hazardous aliphatic hydrocarbons). The type and concentration of common petroleum products (gasoline, stoddard solvent, jet fuel, kerosene, diesel, motor oil) can be defined if there is a good match. If a match to a specific petroleum product can be assigned, the product identification is then reported. The GC conditions measure compounds in the boiling point range of 100°C (212°F) to 500°C (932°F). The initial and final boiling points reported represent the boiling point of 80 to 90 percent of compounds in the sample.

This extraction technique and GC analysis serve as a screen for semivolatile compounds and as mentioned, provide only an indication of the maximum concentration of the semivolatile compounds, since the concentration includes many other hydrocarbons. Details of the test are included in RMAL's report, "Section IV, Analytical Results."

Results of the laboratory analyses for the 10 samples tested for TCO are summarized in Table 2. RMAL's complete report is included in Appendix C.

The sample analyses from BH-7 from 10 to 12 feet did not indicate any TCO at the detection limit of 1,700 ug/kg. This is consistent with the other data results for this sample in that no other organic parameters were detected at this site.

A high concentration of TCO was detected at BH-4 near the gasoline blending tanks, from 5 to 7 feet, at 2,800,000 ug/kg. The chromatogram indicated light end product, diesel fuel and/or gasoline. The boiling point ranged from 100°C to 340°C with a carbon (C) range of about C4 to C22 within RMAL's standard for diesel. The chromatogram generally indicated the presence in the sample of a considerable quantity of light end hydrocarbon product.

A very low concentration of TCO of 2,100 ug/kg was detected at BH-8 to the east of BH-4 near the berm and the gasoline tanks. The final boiling points were low, at 100°C to 170°C and the chromatogram also indicated light end product, primarily in the C4 to C12 range probably gasoline.

Moderately high levels of TCO were detected at BH-10 near the No. 5 Fuel Oil tank and at BH-24 near the No. 2 diesel fuel, crude oil and no-lead tanks. TCO levels were 40,000 ug/kg and 250,000 ug/kg and the boiling point ranges (100°C to 330°C) and (100°C to 400°C), respectively. The chromatograms indicated primarily light end products, probably diesel fuel and gasoline, with some oil. However, the complexity of the chromatogram would not permit reliable identification of the product.

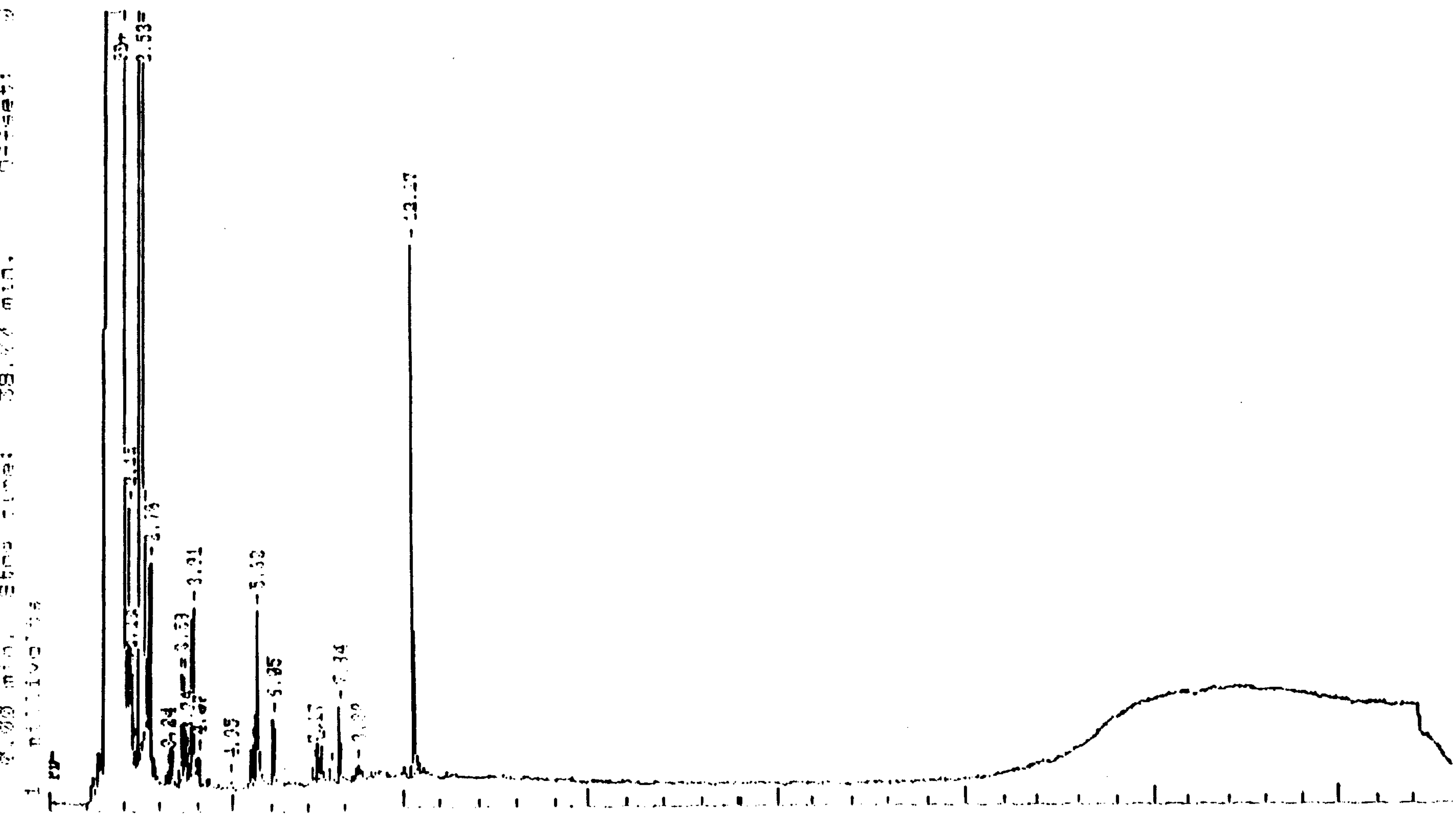
The TCO levels and chromatograms for the borehole samples to the northwest at BH-20 and BH-21 near the No. 5 Fuel Oil tank were high at 54,000,000 ug/kg and 60,000,000 ug/kg, respectively. The chromatograms and boiling point ranges (250°C to 450°C) and (270°C to 500°C), respectively, indicated light and heavy-end hydrocarbons (i.e., possibly diesel fuel and stove oil). RMAL matched the chromatogram from BH-20 to their diesel standard at a 100 percent match.

The solid waste sludges at BH-22 in the northwest corner of the tank farm and BH-26 in the eastern sludge pit, had very high TCO levels, both measuring 130,000,000 ug/kg with boiling point ranges of 100°C to 500°C and 170°C to 500°C, respectively. The primary hydrocarbons appear to include fuel oil and diesel fuel as well as heavier oil product.

The TCO level at BH-23 near the No. 5 Fuel Oil tank measured 2,900,000 ug/kg with a boiling point range from 100°C to 470°C ug/kg. The chromatogram was very complex but indicated gasoline and fuel oil as the primary hydrocarbons present.

TYPE GRAPH

Sample Name: GASOLINE 100 ug/ml



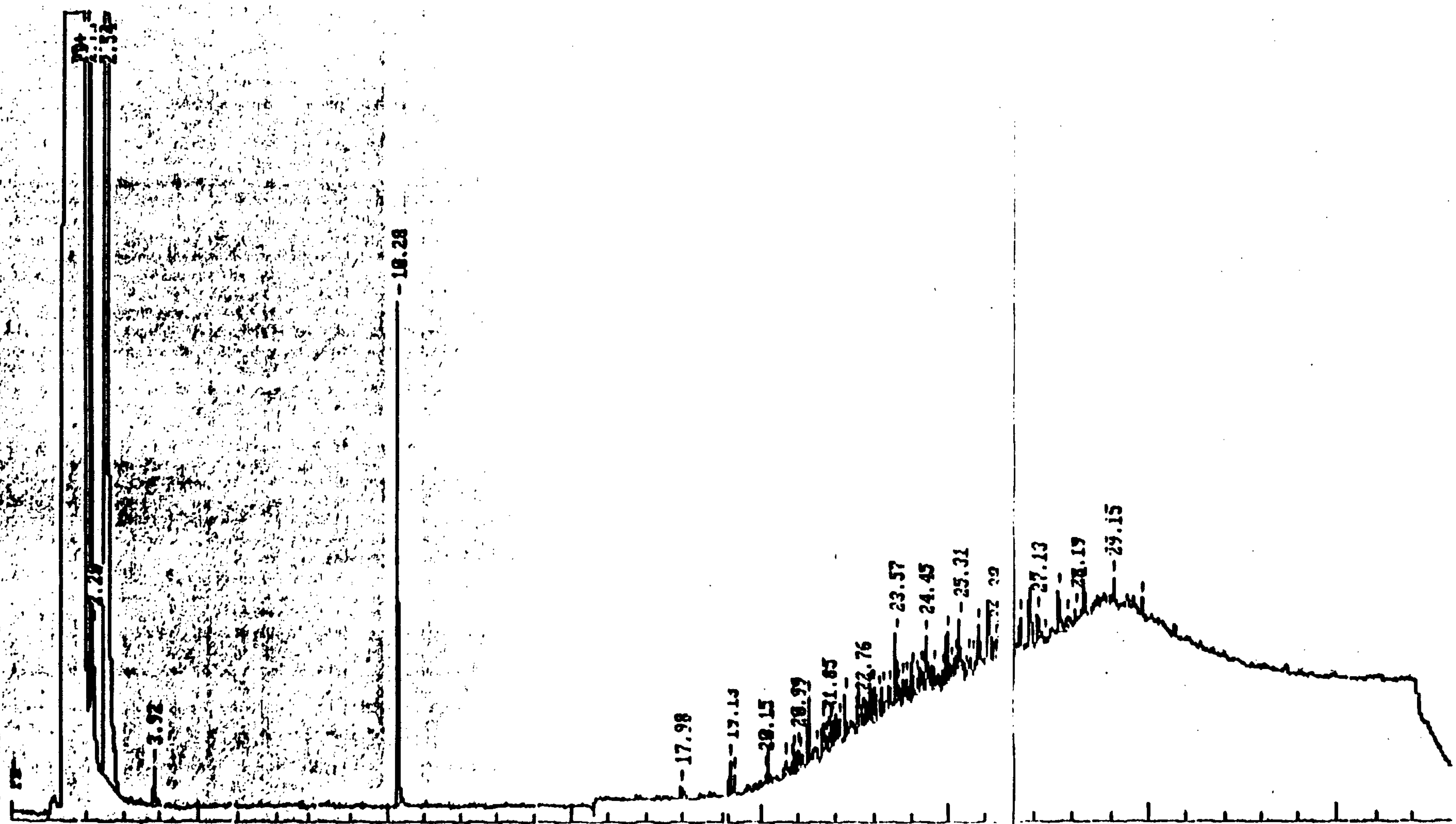
TYPE GRAPH

Sample Name: DIESEL FUEL 100 ug/ml

TYPE GRAPH

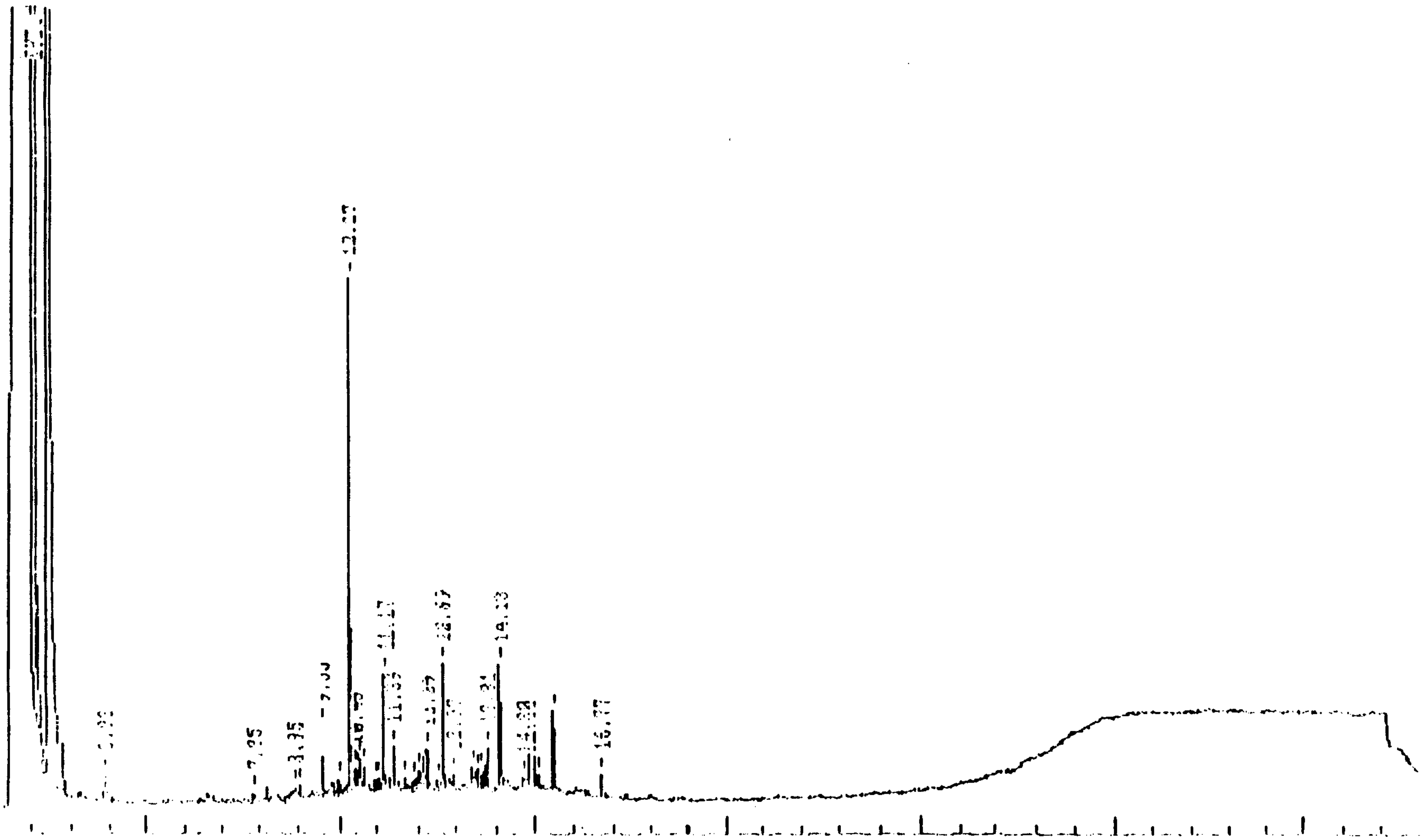
Sample Name: PENNZOIL 1000 ug/ml

Areas, times, and heights stored in: Q:G1162.ATB
Data File = Q:G1162.PTS   Printed on Ø4-25-1988 at 15:13:46
Start time: Ø.ØØ min.   Stop time: 38.ØØ min.   Offset: Ø mv.
Full Range: 1   millivolts



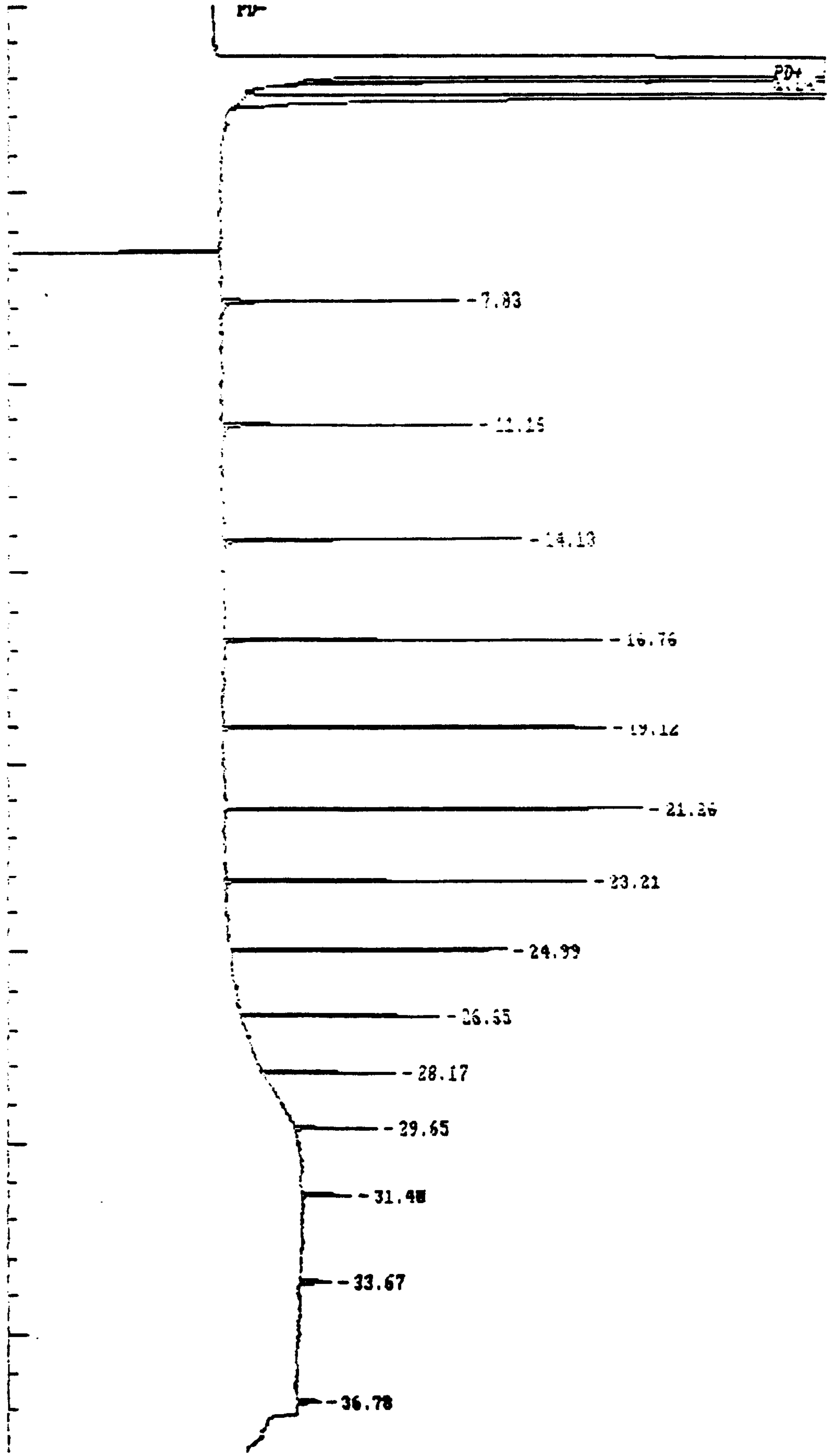
TYPE GRAPH

Sample Name: KEROSENE 100 ug/ml



Total Area: 27619 Area Reject: 0 One sample per 0.400 sec.

Areas, times, and heights stored in: Q:G11619.ATB
Data File = Q:G11619.PTS Printed on 04-26-1988 at 14:28:31
Start time: 0.00 min. Stop time: 38.00 min. Offset: 0 mv.
Full Range: 1 millivolts



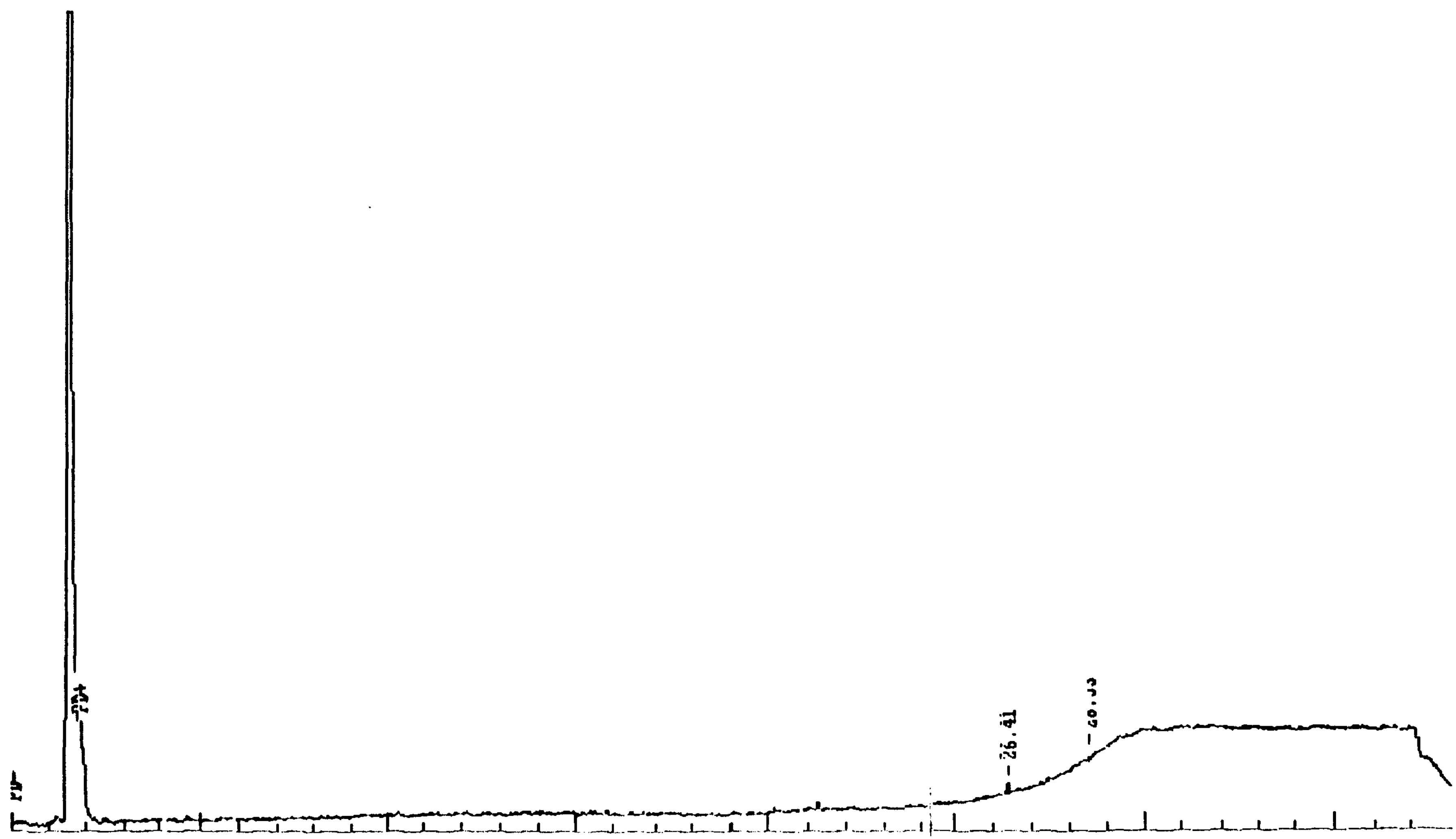
Sample Name: C10-C36 10 ug/ml

TYPE GRAPH

TYPE GRAPH

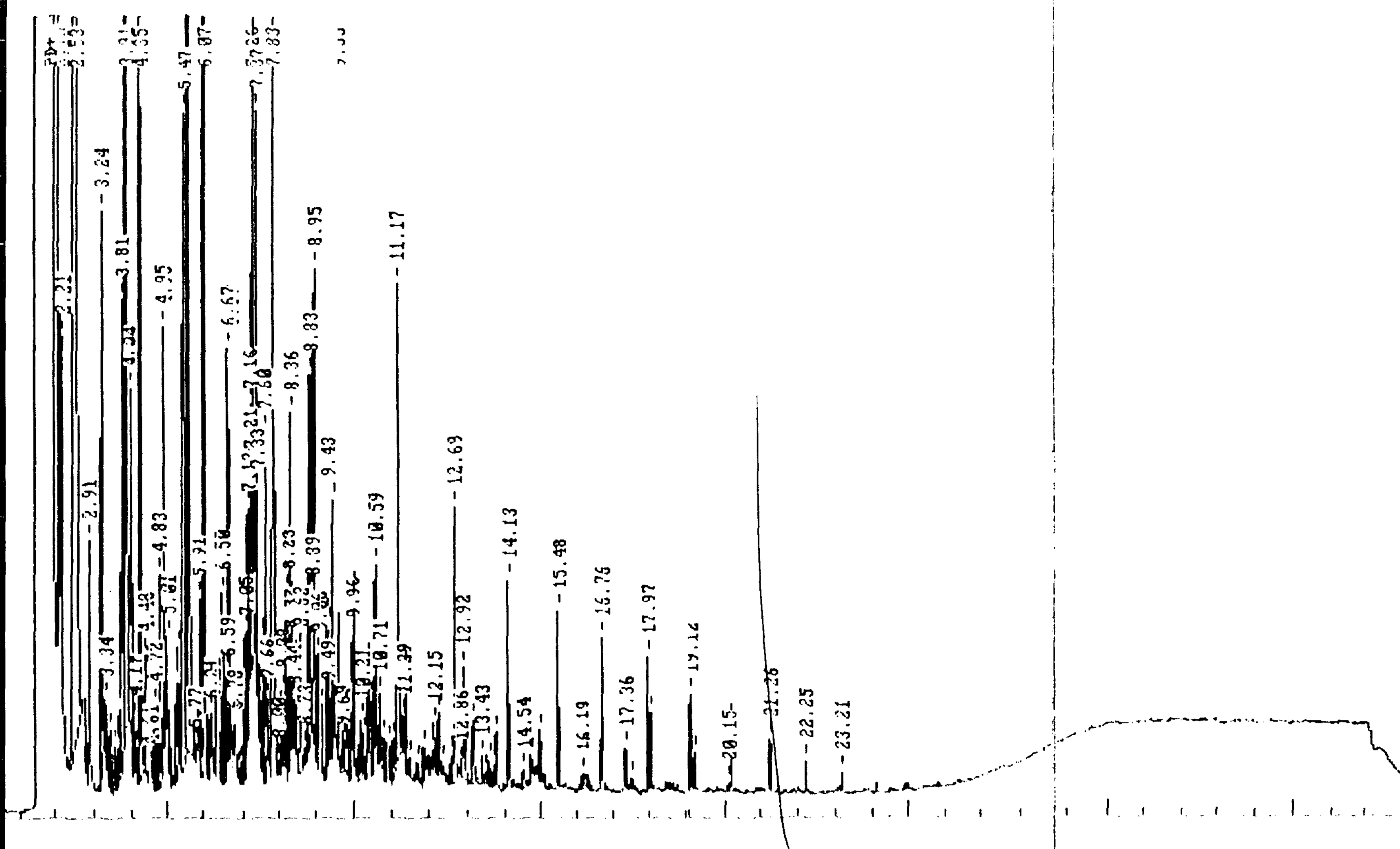
Sample Name: 67161 Blank 4/21/88 100%

Areas, times, and heights stored in: Q:G11615.ATB
Data File = Q:G11615.PTS Printed on 04-26-1988 at 10:43:43
Start time: 0.00 min. Stop time: 38.00 min. Offset: 0 mv.
Full Range: 1 millivolts



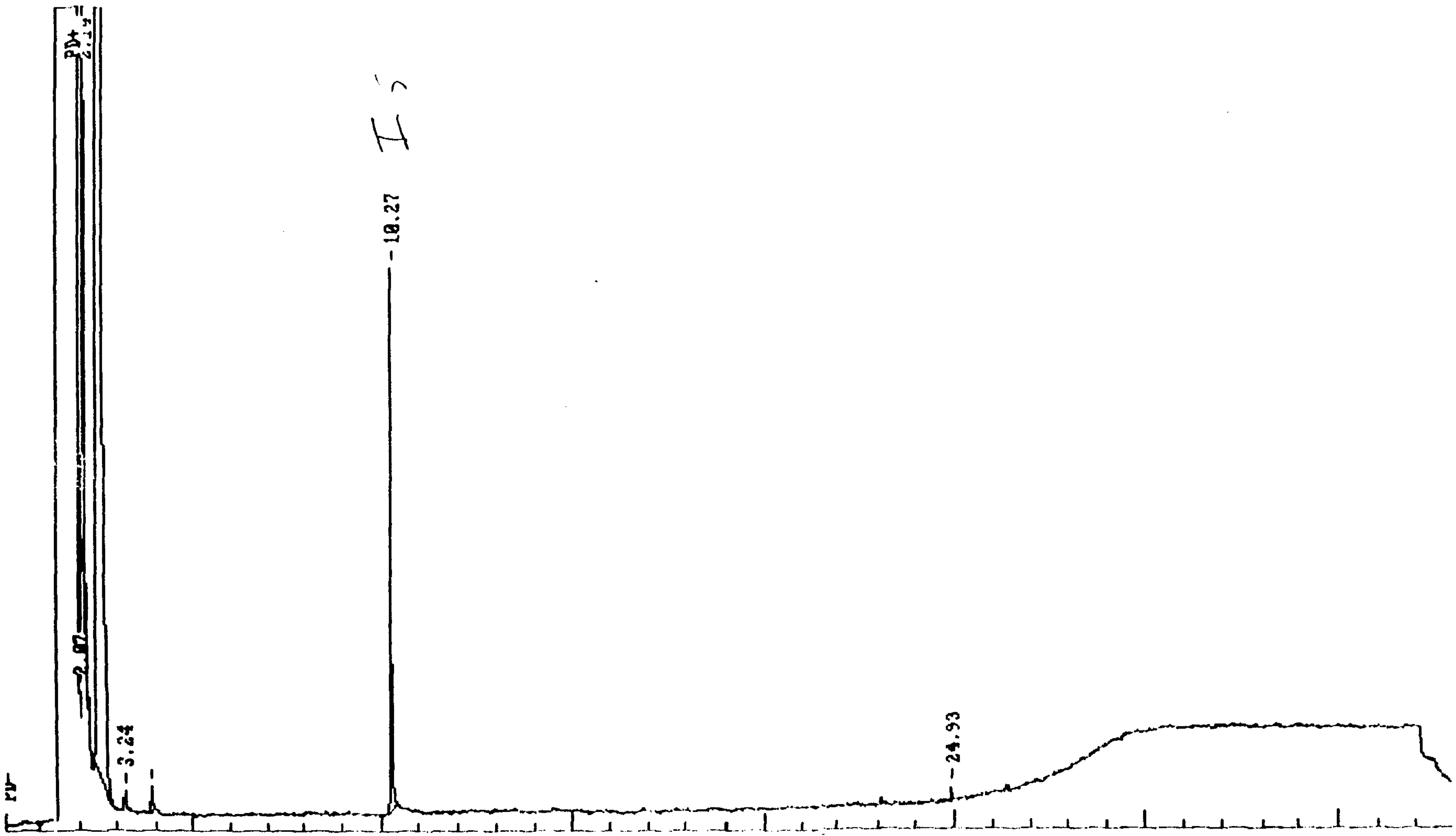
Sample Name: 67123-04 100%
BH-4 (5-7')

Initial Boiling Point 100°C
Final Boiling Point 340°C
TCO = 2,800,000 ug/kg



Sample Name: 67161 02 100%
BH-7 (10-12')

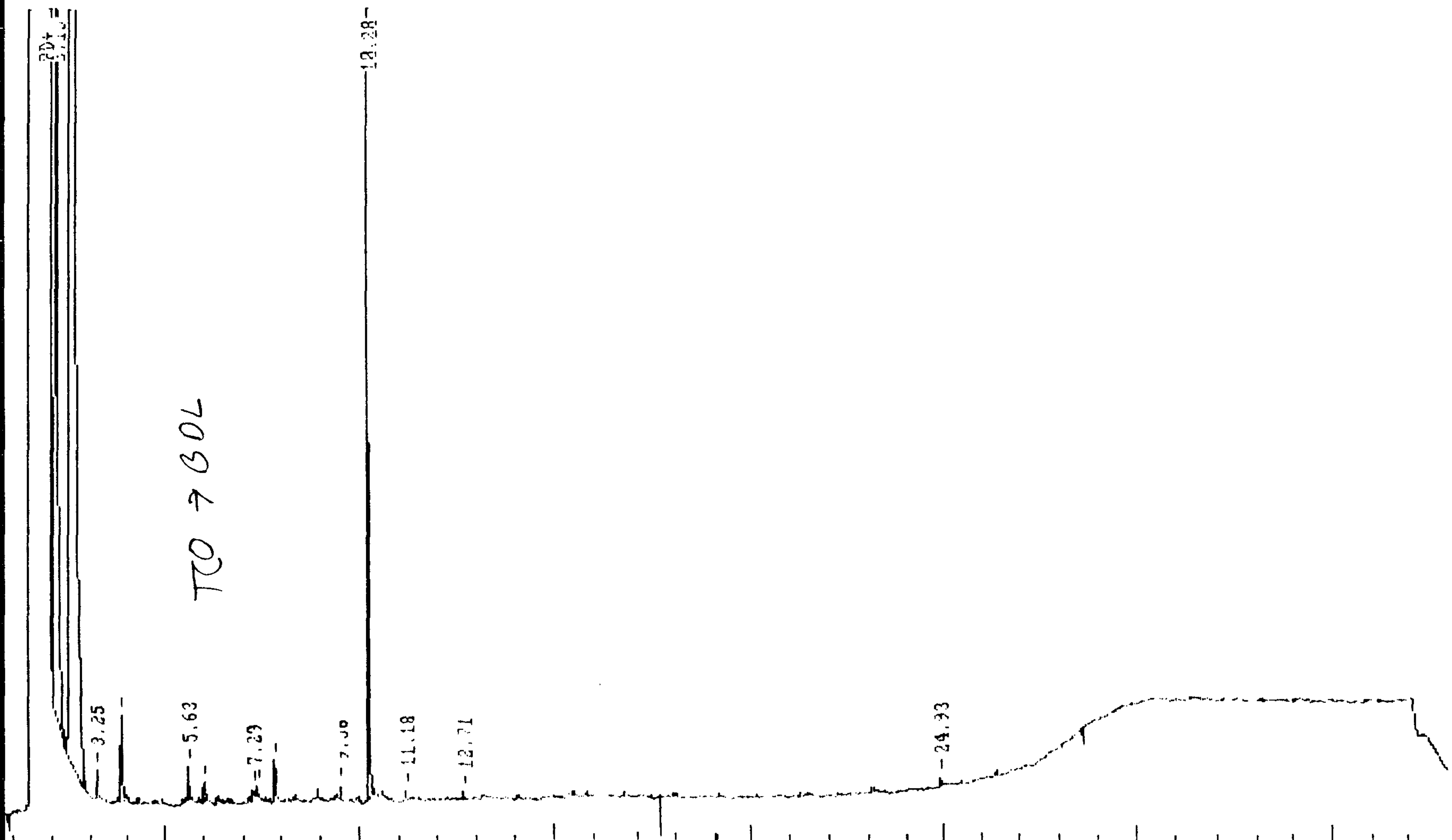
Initial Boiling Point -
Final Boiling Point -
TCO <1700 ug/kg



Areas, times, and heights stored in: Q:G11616.ATB
Data File = Q:G11616.PTS Printed 04-26-1988 at 11:37:36
Start time: 0.00 min. Stop time 38.00 min. Offset: 0 mv.
Full Range: 1 millivolts

Sample Name: 67123 14 100%
BH-8 (10-12')

Initial Boiling Point 100°C
Final Boiling Point 170°C
TCO = 2100 ug/kg

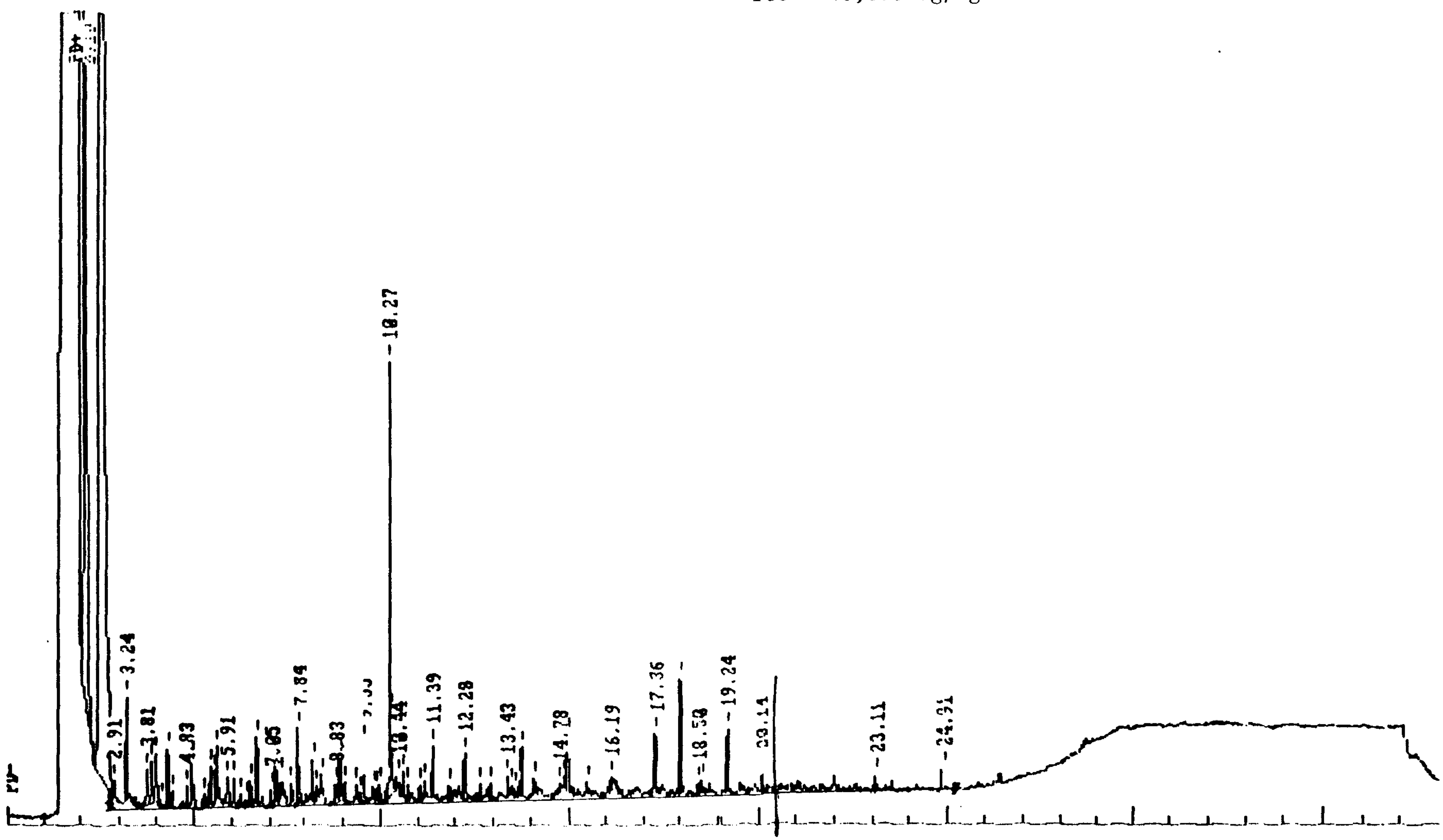


TCO > GOL

Areas, times, and heights stored in: Q:G11617.ATB
Data File = Q:G11617.PTS Printed on 04-26-1988 at 12:35:48
Start time: 0.00 min. Stop time: 38.00 min. Offset: 0 mv.
Full Range: 1 millivolts

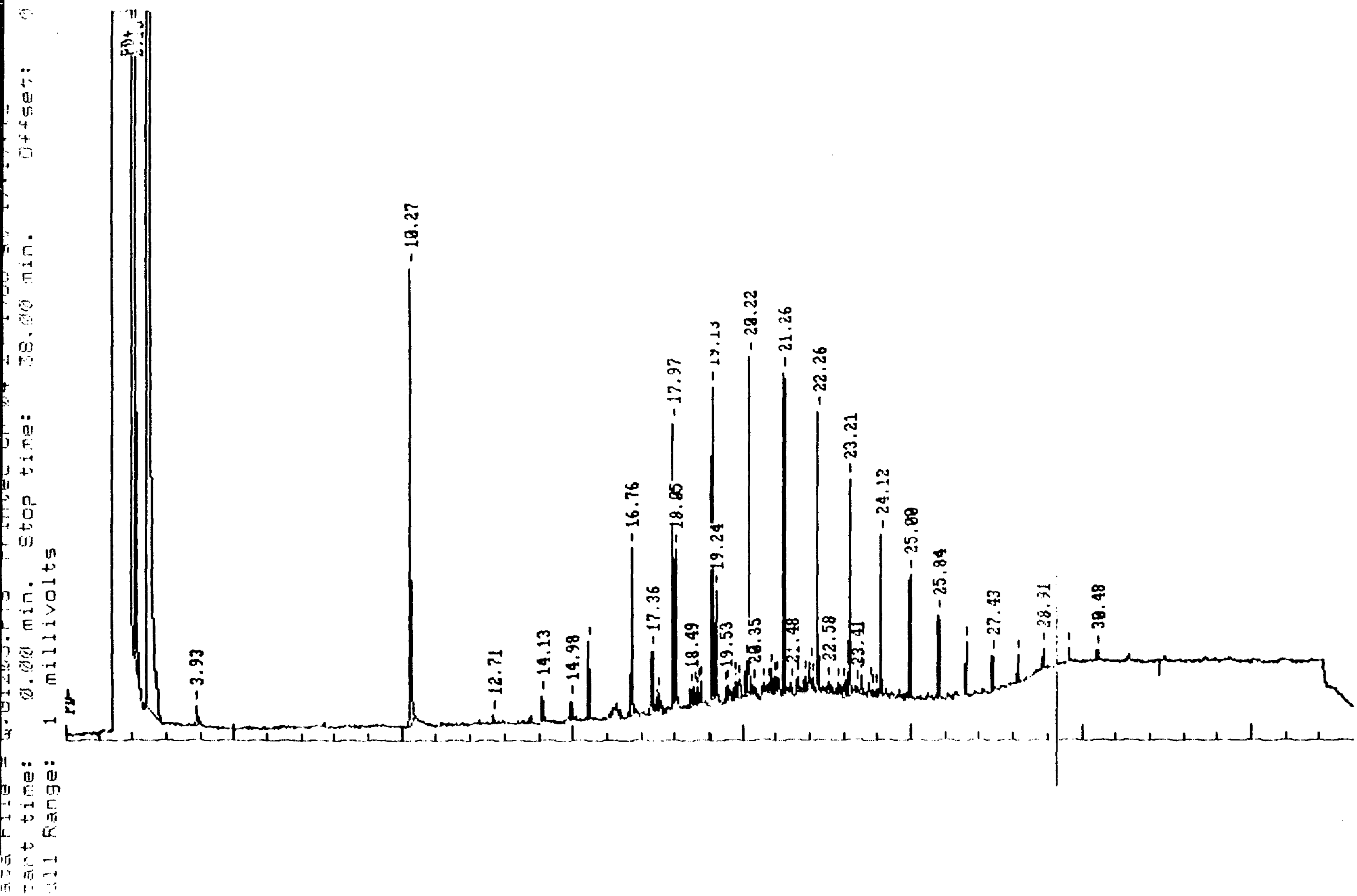
Sample Name: 67161 06 100%
BH-10 (17')

Initial Boiling Point 100°C
Final Boiling Point 330°C
TCO = 40,000 ug/kg



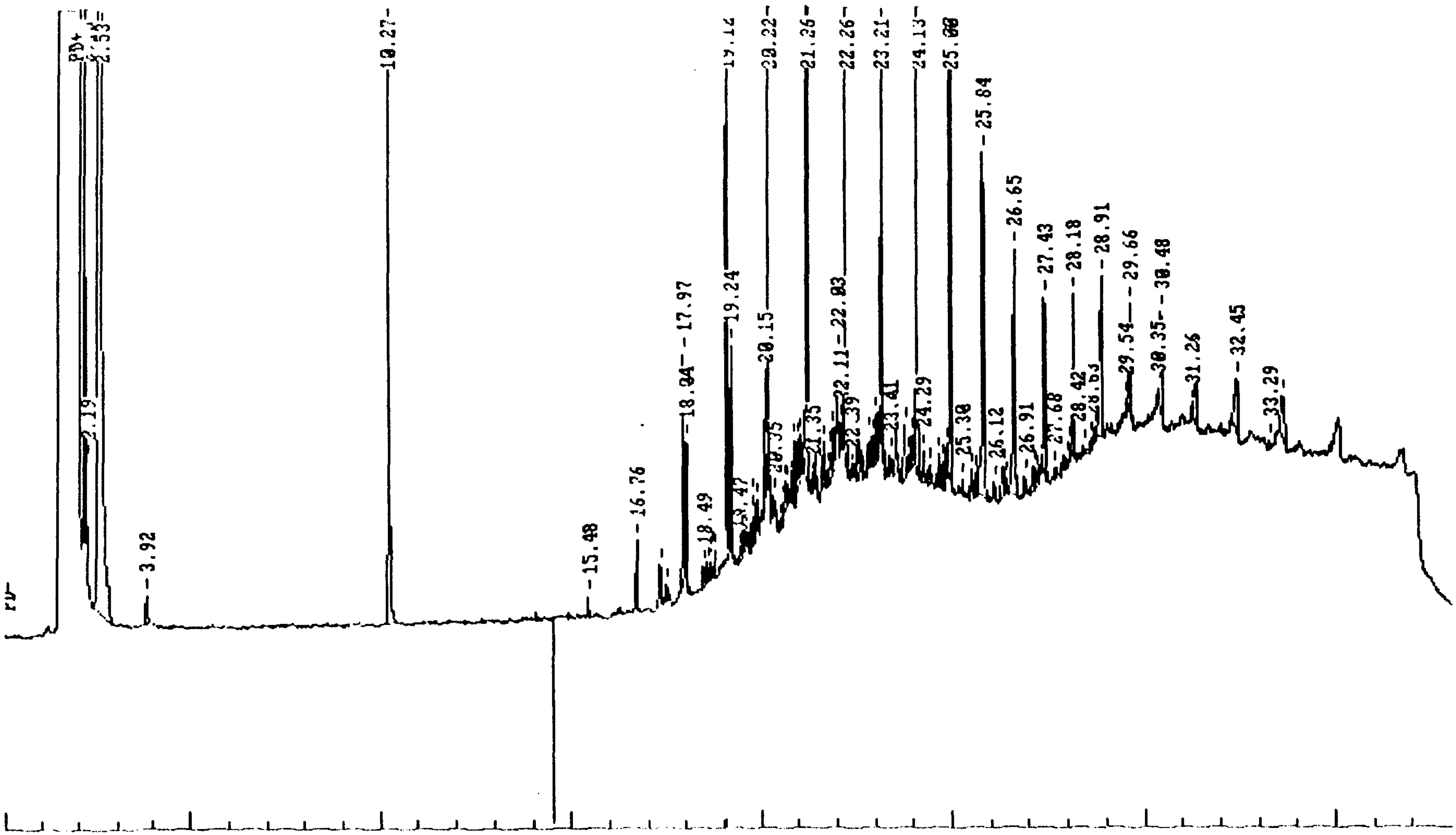
Sample Name: 67196 01 1.0%
BH-20 (5-7')

Initial Boiling Point 250°C
Final Boiling Point 450°C
TCO = 54,000,000 ug/kg



Sample Name: 67196 02 1.0%
BH-21 (0-1.25')

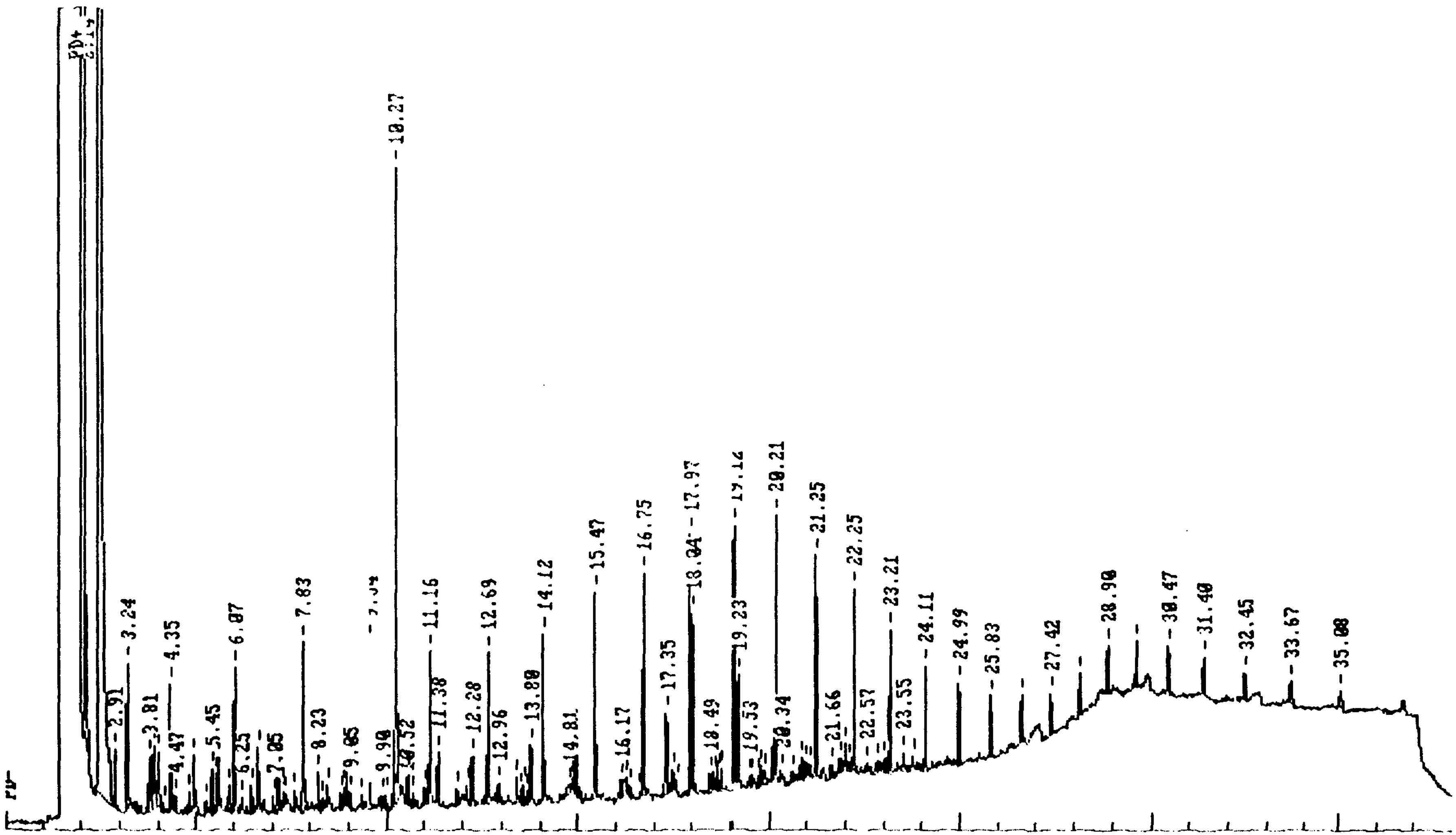
Initial Boiling Point 290°C
Final Boiling Point 500°C
TCO = 60,000,000 ug/kg



Total Area: 48256 Area Reject: 0 One sample per 0.400 sec.
Areas, times, and heights stored in: Q:G1206.ATB
Data File = Q:G1206.PTS Printed on 04-29-1988 at 18:13:52
Start time: 0.00 min. Stop time: 38.00 min. Offset: 0 mv.
Full Range: 1 millivolts

Sample Name: 67196 03 1.0%
BH-22 (0-.5')

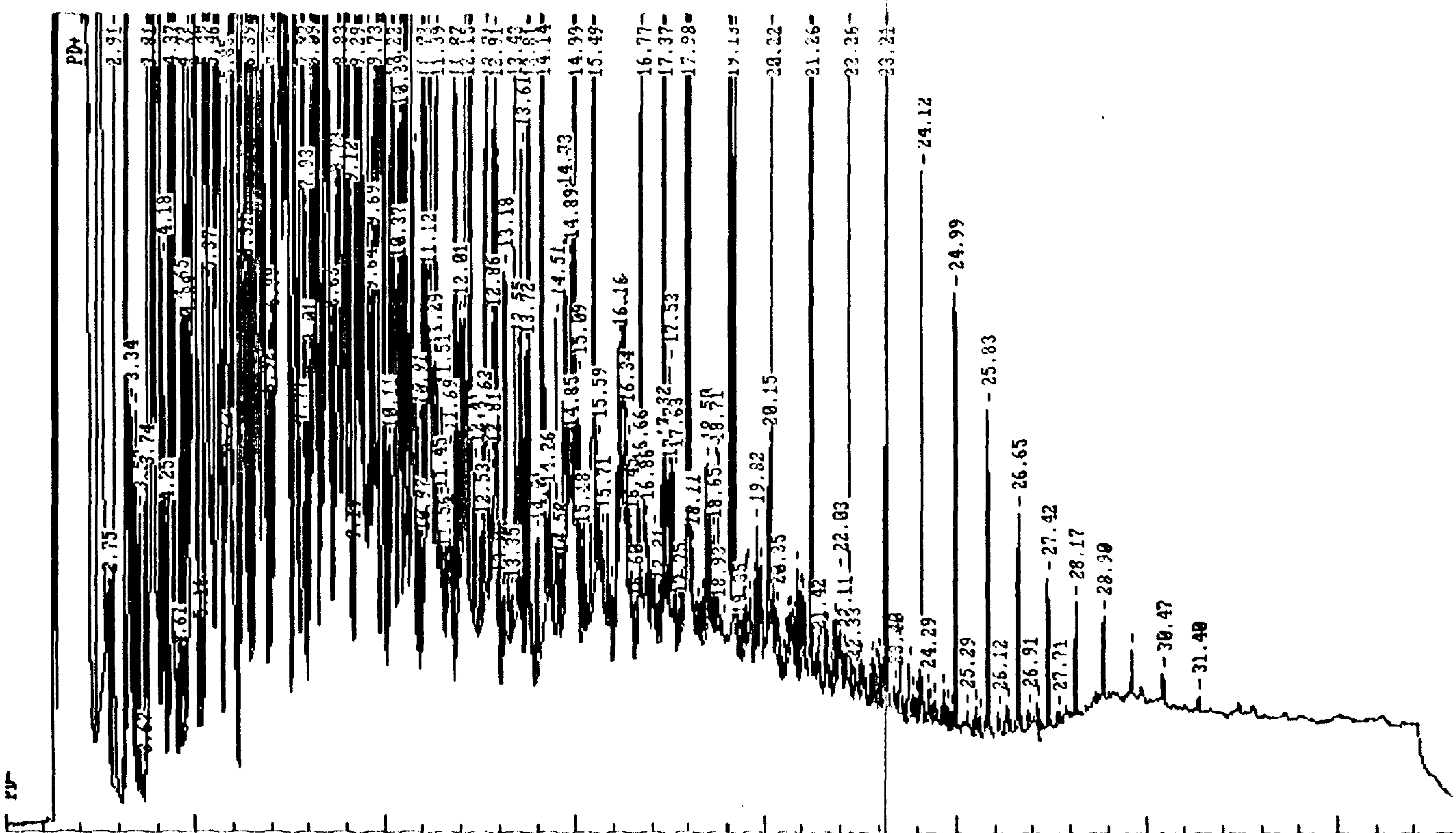
Initial Boiling Point 100°C
Final Boiling Point 500°C
TCO = 130,000,000 ug/kg



reas, times, and heights stored in: Q:G1207.ATB
ata File = Q:G1207.PTS Printed on 04-29-1988 at 19:08:24
tart time: 0.00 min. Stop time: 39.00 min. Offset: 0 mv.
ull Range: 1 millivolts

Sample Name 67196 04 100%
BH-23 (10-12')

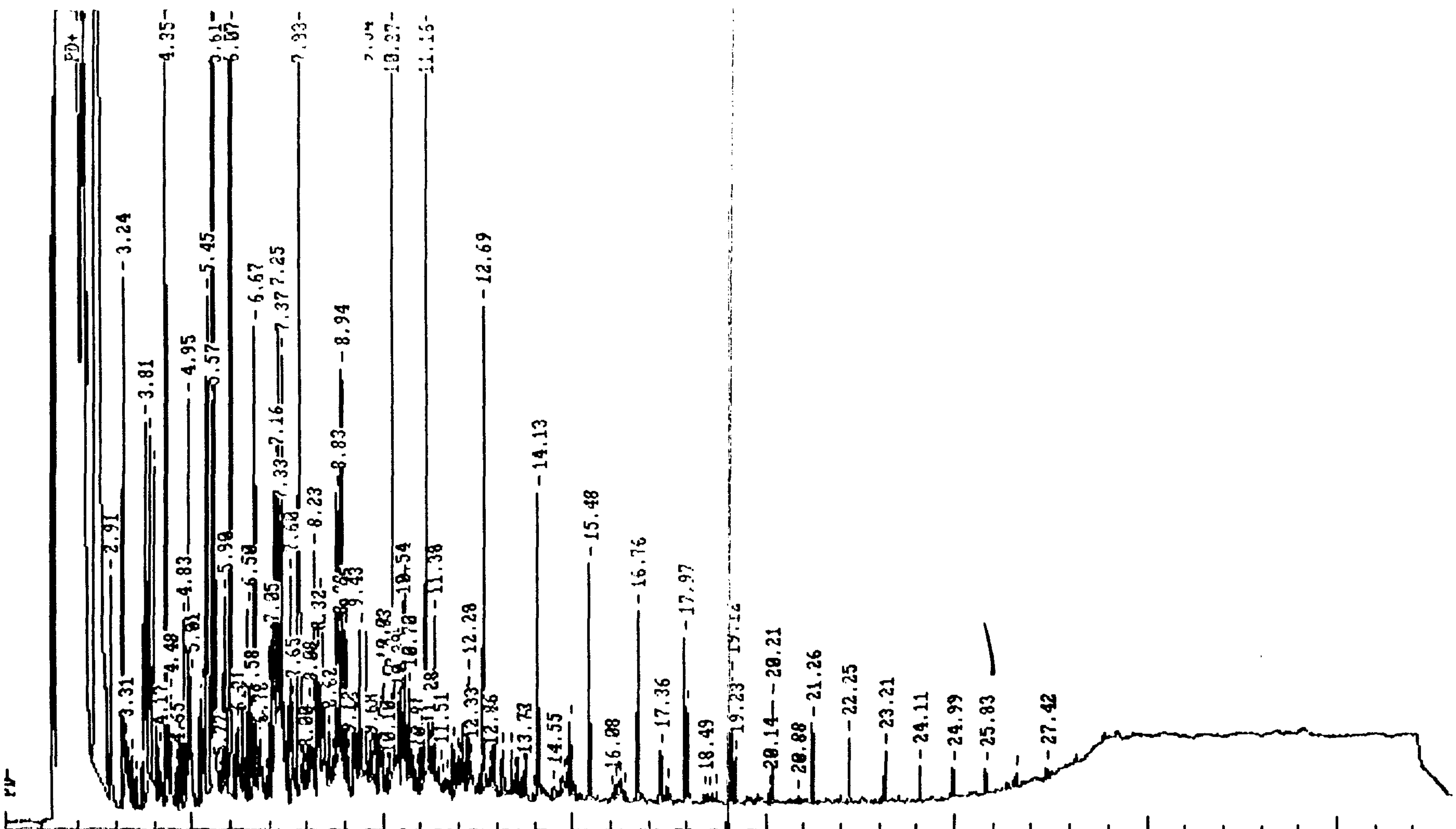
Initial Boiling Point 100°C
Final Boiling Point 470°C
TCO = 2,900,000 ug/kg



...eas, times, and heights stored in: Q:G1208.ATB
...ata File = Q:G1208.PTS Printed on 04-29-1988 at 20:03:09
...tart time: 0.00 min. Stop time: 38.00 min. Offset: 0 mv.
...ll Range: 1 millivolts

Sample Name: 67196 05 100%
BH-24 (5-11.5')

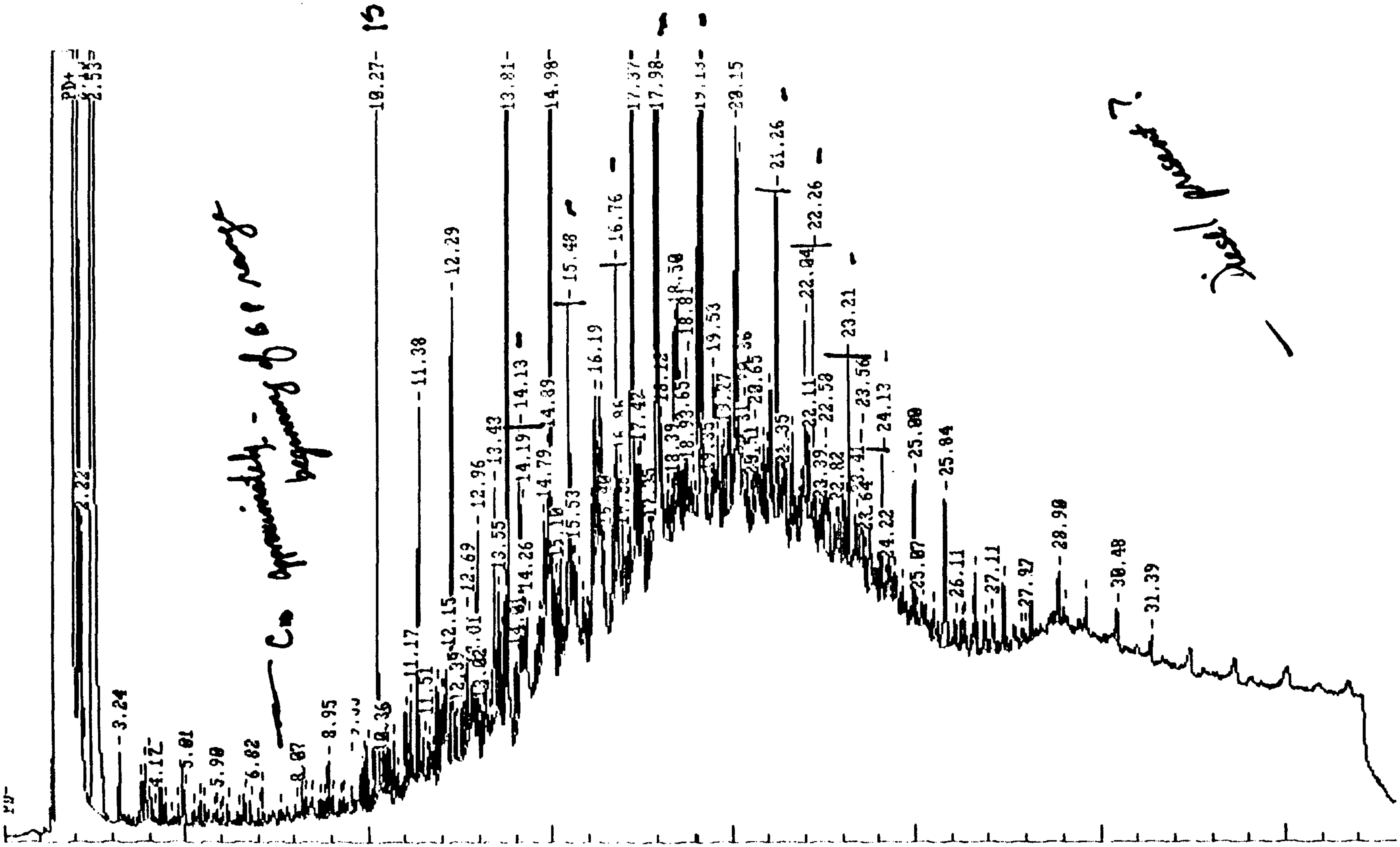
Initial Boiling Point 100°C
Final Boiling Point 400°C
TCO = 250,000 ug/kg



eas, times, and heights stored in: Q:G1209.ATB
ata File = Q:G1209.PTS Printed on 04-29-1988 at 20:57:12
tart time: 0.00 min. Stop time: 38.00 min. Offset: 0 mv.
ill Range: 1 millivolts

Sample Name: 67196 06 10.0%
BH-26 (0-1')

Initial Boiling Point 100°C
Final Boiling Point 340°C
TCO = 2,800,000 ug/kg



0.00 min. Stop time: 30.00 min.
1 millivolts