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27 September 1989

W-6364

Darling-Delaware Corporation
8737 King George Drive
Dallas, Texas 75235

Attention: Mr. Subba Rao

Subject: Subsurface Petroleum Hydrocarbon Evaluation
Puget Sound By Products Site
2041 Marc Avenue
Tacoma, Washington

Gentlemen:

We are pleased to present herein the results of our subsurface petroleum hydrocarbon evaluation for the above referenced site. Verbal authorization to proceed with this study was provided by Mr. Subba Rao in accordance with our revised proposal numbered P-3182B dated 4 August 1989. We appreciate this opportunity to be of service to you and would be pleased to discuss the contents of this report and other aspects of the project with you at your convenience.

Respectfully submitted,

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.

Daniel S. Whitman
Senior Environmental Geologist

SUBSURFACE PETROLEUM HYDROCARBON EVALUATION

Puget Sound By-Products Site
2041 Marc Avenue
Tacoma, Washington

Prepared For

Darling-Delaware Corporation
8737 King George Drive
Dallas, Texas 75235

Prepared by

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W-6364

TABLE OF CONTENTS
W-6364

	Page
1.0 SUMMARY_____	1
2.0 PROJECT DESCRIPTION_____	2
3.0 SUBSURFACE CONDITIONS_____	2
3.1 Subsurface soils_____	3
3.2 Groundwater_____	3
4.0 PETROLEUM HYDROCARBON OCCURRENCE_____	4
4.1 Field Test Procedures_____	4
4.2 Quantitative Analysis of Soil_____	5
4.3 Quantitative Analyses of Groundwater_____	5
5.0 CONCLUSIONS AND RECOMMENDATIONS_____	5
6.0 CLOSURE_____	6

- Figure 1: Site and Exploration Plan
Table 1: Summary of Groundwater Measurements
Table 2: Summary of Analytical Test Results
Appendix A: Subsurface Exploration Procedures and Logs
Appendix B: Laboratory Analytical Test Reports

SUBSURFACE PETROLEUM HYDROCARBON EVALUATION
PUGET SOUND BY-PRODUCT SITE
2041 MARC AVENUE
TACOMA, WASHINGTON

W-6364

1.0 SUMMARY

The following report presents the results of our subsurface exploration program and analytical laboratory testing of soils and groundwater at the subject site. The purpose of this evaluation was to provide information pertaining to qualitative and quantitative site characterization with respect to subsurface petroleum hydrocarbon concentrations. The scope of work consisted of field explorations and sampling, installation of three 2-inch diameter monitoring wells, surveying of well casings and measurement of water depths, analytical laboratory testing, data interpretation, and report preparation. A brief summary of the significant findings outlined in this report is presented below:

- Subsurface soils encountered in our exploratory borings consisted of fill soils extending to depths of 12 to 16 $\frac{1}{4}$ feet below the existing ground surface, underlain by what was interpreted to be native soils. Fill soils consisted of medium dense, gray to brown silty sand containing some gravel, to a depth of approximately 5 feet, underlain by loose to medium dense, black silty sand with abundant wood chip waste extending to depths of 12 to 16 $\frac{1}{4}$ feet. Glass, metal, and organics were also present in this material. These fill soils were underlain by soft to medium stiff, gray silt interpreted to be native.
- Groundwater is apparently present at the site in two water bearing zones separated by a silt layer present at an average depth of approximately 12 feet. Static water levels were measured at depths of 7-8 feet in the upper, perched zone, as indicated by the three monitoring wells installed for this study. Water levels in existing deeper wells were generally lower, indicating a hydrologic control which results in a perched ground water condition. The inferred groundwater migration direction of the upper zone is generally to the west.
- Monitoring wells MW-1, MW-2, and MW-3 were installed in a previous study by others to a depth of approximately 30 feet. The groundwater depth in these wells was approximately 10 $\frac{1}{2}$ to 11 $\frac{1}{2}$ feet and the inferred direction of groundwater migration is generally to the south. Although this water-bearing

zone appears to be separated from the upper perched water, there may be some intercommunication between these two water-bearing zones.

- Analytical test results indicate that soil samples B-4/S-3 and B-6/S-2 contain total petroleum hydrocarbon (TPH) concentrations of 141 mg/kg and 645 mg/kg, respectively. Laboratory results indicate that petroleum hydrocarbons present in these samples may be aged gasoline or mineral spirits.
- Analytical test results indicate that water samples from monitoring wells MW-4, MW-5, MW-6 contain TPH concentrations below the 10 mg/kg laboratory detection limit.

This summary is presented for introductory purposes only and should be used in conjunction with the full text of this report. The project description, site conditions, investigative techniques, and evaluation results are presented within the remainder of this report.

2.0 PROJECT DESCRIPTION

The subject site is a rectangular parcel located on the northeast side of Marc Avenue southeast of Lincoln Avenue in Tacoma, Washington. The site has approximately 210 feet of frontage on Marc Avenue and is approximately 235 feet long on its northeast side. The site is currently occupied by an operating rendering plant, a work shop, an office, and three small waste water treatment lagoons. An underground storage tank reportedly containing diesel oil was formerly present just northeast of the work shop building. This tank had recently been removed and some residual soil contamination was suspected in the soils surrounding the excavation area. The purpose of our evaluation was to determine if soil and groundwater impacts extended a significant distance beyond the immediate tank area.

3.0 SUBSURFACE CONDITIONS

The subsurface exploration program for this project consisted of advancing 3 borings at the approximate locations shown on the Site and Exploration Plan, Figure 1. The borings were drilled on 11 September 1989 and were advanced to depths of approximately 14 to 16¹/₂ feet below the existing ground surface and were continuously observed and logged in the field by an experienced hydrogeologist from our firm. The

approximate boring locations shown on the Site and Exploration Plan, Figure 1, were obtained by pacing from existing site features. The indicated locations are accurate to the degree implied by the method used.

The exploration logs enclosed in Appendix A are based on interpretations made in the field and include as-built diagrams of the monitoring wells. The logs indicate the various types of soils and materials encountered in the borings. The relative densities indicated in the logs are based on the drilling action and the advancement rate of the drill rig, as well as the driving resistance measured during sampling (N-values). The logs also indicate the depths where the strata or characteristics of the strata change, although changes may be gradual. If the change occurred between sample intervals, the depth to the change was interpreted.

3.1 Subsurface Soils

Subsurface soils encountered in our exploratory borings consisted of fill soils extending to depths of 12 to 16¹/₄ feet below the existing ground surface, underlain by what was interpreted to be native soils. Fill soils present consisted of medium dense, gray to brown silty sand with some gravel to a depth of approximately 5 feet, underlain by loose to medium dense, black silty sand with abundant wood chip waste to depths of 12 to 16¹/₄ feet. Glass, metal, and organics were also present in this horizon. These fill soils were underlain by stiff to medium stiff, gray silt interpreted to be native.

3.2 Groundwater

Groundwater conditions on the site were evaluated utilizing data from previously existing monitoring wells, monitoring wells installed for our investigation, and conditions noted during drilling. Elevations of the wells installed for this study were surveyed relating to the measuring point on one of the existing wells in order to correlate water level data. A summary of the groundwater level measurements obtained during our evaluation is presented in Table 1.

Water level measurements obtained from monitoring wells on the site indicate that two water bearing zones may be present at the site, controlled by a silt layer present at a depth of 12 to 16¹/₄ feet. Monitoring wells MW-4, MW-5, and MW-6 were installed to a depth of approximately 15 feet, into the first groundwater encountered and were

terminated in the silt layer. The groundwater depth in these wells was approximately 7 to 8 feet below the surface and the inferred direction of groundwater migration is generally to the west.

Monitoring wells MW-1, MW-2, and MW-3 were installed in a previous study by others to a depth of approximately 30 feet. The groundwater depth in these wells was approximately 10 $\frac{1}{2}$ to 11 $\frac{1}{2}$ feet and the inferred direction of groundwater migration is generally to the south.

Although this water-bearing zone appears to be separated from the upper perched water, there may be some intercommunication between these two water-bearing zones. Given the location of the site on the Tacoma tide flats it is possible this lower groundwater condition is tidally influenced, which could result in significant variations in ground water flow direction and gradient.

The groundwater gradients and inferred flow directions are based on simplified assessments, and should be viewed as a generalized estimation based on limited data. More long-term monitoring data would be required to determine the interrelationship of the water bearing zones.

4.0 PETROLEUM HYDROCARBON OCCURRENCE

4.1 Field Test Procedures

Qualitative field observations were performed by documenting recovered sample characteristics such as odor, sheen, and obvious discoloration. In addition to visual and olfactory sensing, field screening was performed with the aid of direct reading instruments. All samples were evaluated utilizing an Organic Vapor Meter (OVM) by means of the "head space" method. No obvious petroleum odors or discoloration were noted from the recovered samples. Head space measurements taken on recovered samples were generally less than 1.0 ppm, with the exception of samples S-2 and S-4 from boring B-6. These samples exhibited head space readings of 52 and 32 ppm, respectively. Head space measurements are presented on the boring logs, Appendix A. Head space measurements yield a semi-quantitative measurement of a volatile gas concentration in the volume of a closed container occupied with soil. The measured concentration is generally used as a screening aid to indicate the presence of volatile

organic compounds. The air quality in the head space of a container and olfactory sensing can vary, due to factors including temperature, moisture content, soil gradation, and olfactory fatigue.

4.2 Quantitative Analyses of Soil

All laboratory analyses were subcontracted to Sound Analytical Services, Inc., of Tacoma, Washington. The laboratory results are reported in milligrams per kilogram (mg/kg) and milligrams per liter (mg/l) units which are equivalent to parts per million (ppm) concentrations. The analytical results are summarized in Table 2 and the laboratory analytical results are presented in Appendix B.

One soil sample was selected for analysis from each boring on the basis of noticeable hydrocarbon staining, odor, depth, and or head space measurements. The procedure used to obtain head space readings is described above.

Selected soil samples were analyzed for total petroleum hydrocarbons (TPH) by EPA Method 8015 (Modified), a gas chromatography/flammation ionization technique. The analytical results indicate that sample S-3 obtained from boring B-4 at a depth of approximately 7 1/2 feet contained a TPH concentration of 141 mg/kg, sample S-2 from boring B-5 at 5 feet did not contain TPH concentrations above the laboratory detection limit of 10 mg/kg, and sample S-2 from boring B-6 at 5 feet contained a TPH concentration of 645 mg/kg. Laboratory results indicate that petroleum hydrocarbons present in B-4/S-3, and B-6/S-2 may be aged gasoline or mineral spirits.

4.3 Quantitative Analyses of Groundwater

Water samples obtained from monitoring wells MW-4, MW-5, MW-6 installed for this study were also analyzed by EPA Method 8015-Modified. Quantitative analytical results as performed by this method indicated TPH concentrations of all water samples tested are below the laboratory detection limit of 10 mg/kg.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Analytical test results indicate that soil samples B-4/S-3 and B-6/S-2 contained TPH concentrations of 141 mg/kg and 645 mg/kg, respectively. Laboratory results indicate that petroleum hydrocarbons present in these samples may be aged gasoline or mineral

spirits. This finding generally indicates the former on-site diesel fuel tank was apparently not the source of the noted hydrocarbons. No contaminants which could be directly attributed to the tank system were encountered, suggesting residual contamination from the removed system is not widespread.

Analytical test results indicate that water samples from monitoring wells MW-4, MW-5, and MW-6 contained TPH concentrations below the 10 mg/kg laboratory detection limit. The groundwater noted in these wells may be somewhat isolated from the lower groundwater conditions on-site by the silty native materials encountered in the borings.

We recommend that the next routine sampling round for monitoring wells MW-1 through MW-3 also include the three new wells MW-4 through MW-6. All wells should be analyzed for TPH by EPA Method 8015-Modified, in addition to the routine parameters for the site.

6.0 CLOSURE

The information in this report is based on the explorations and laboratory analyses accomplished for this study. The presented conclusions are professional opinions and reflect our interpretation of the analytical laboratory test results, as well as our experience and observation during project field studies. The number, locations, and depths of the explorations, including the analytical testing scope, were completed within the site and proposal constraints so as to yield the information required to formulate our conclusions.

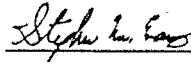
Darling-Delaware Corporation
27 September 1989

W-6364
Page 7

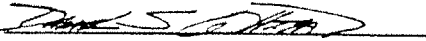
We appreciate this opportunity to be of service to Darling-Delaware Corporation. If you have any questions, please do not hesitate to call at your earliest convenience.

Respectfully submitted,

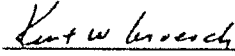
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SME:cao1

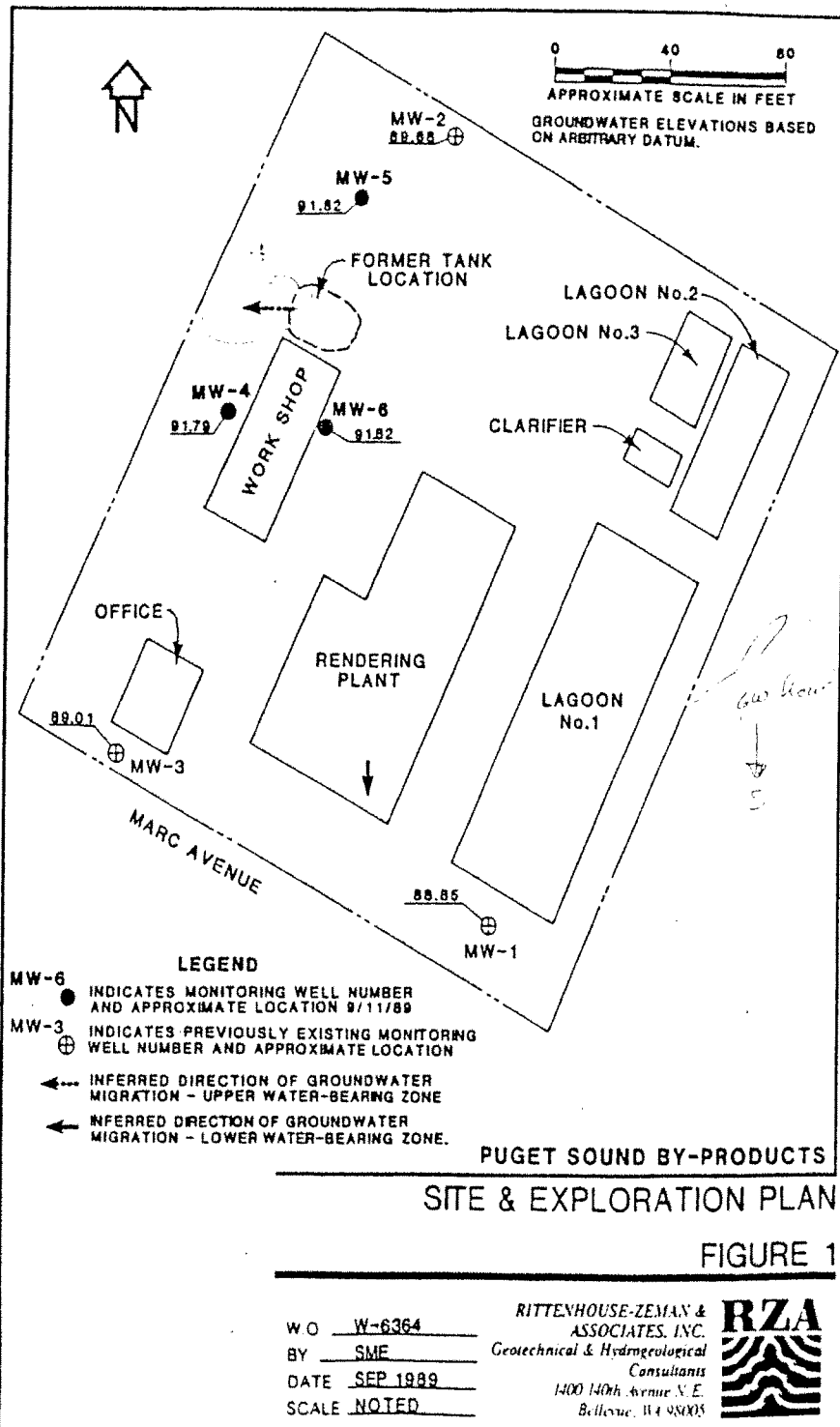


TABLE 1
GROUNDWATER MEASUREMENTS IN WELLS
Puget Sound By-Products
W-6364

Well Number	Casing Elevation(Ft)*	Measured Water Depth(ft) (Below Well Casing)	Groundwater Elevation(Ft)*
MW-1	100.47	11.62	88.85
MW-2	100.14	10.46	89.68
MW-3	99.98	10.97	89.01
MW-4	99.49	7.70	91.79
MW-5	100.20	8.38	91.82
MW-6	98.82	7.00	91.82

* - Based on an arbitrary datum of 100.00

TABLE 2

SUMMARY OF ANALYTICAL LABORATORY RESULTS (PPM)

Puget Sound By-Products

W-6364

Soil Samples	Sample Number	Depth (ft)	TPH
B-4	S-3	3.0	141*
B-5	S-2	5.5	<10
B-6	S-2	8.0	645*

Water Samples	Sample Number	TPH
MW-4	W-1	<10
MW-5	W-2	<10
MW-6	W-3	<10

APPENDIX A
SUBSURFACE EXPLORATION PROCEDURES AND LOGS

APPENDIX A

W-6364

SUBSURFACE EXPLORATION

The field exploration program conducted for this study consisted of advancing a series of 3 hollow stem auger borings. The approximate locations are illustrated on the Site and Exploration Plan, Figure 1. These locations were obtained in the field by taping and pacing from existing features.

The borings were drilled on 11 September 1989 by a local exploration drilling company under subcontract to our firm. Each boring consisted of advancing a 4-inch inside diameter hollow-stem auger with a truck mounted Mobile M-61 drill rig. During the drilling process, samples were generally obtained at 2 $\frac{1}{2}$ foot depth intervals. Borings were continuously observed and logged by a hydrogeologist from our firm.

CHARACTERIZATION OF SOIL

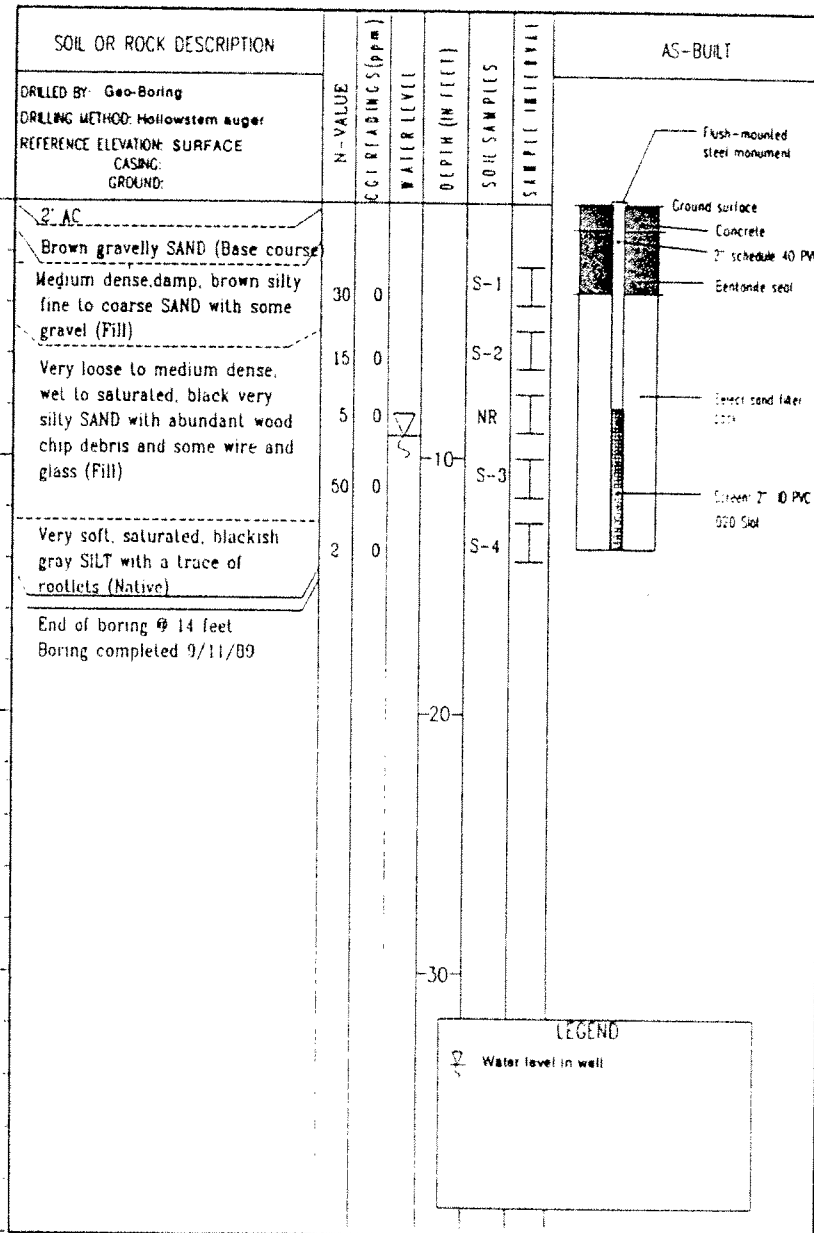
Disturbed soils were obtained by using the Standard Penetration Test procedure as described in ASTM:D 1586. This test and sampling method consists of driving a standard 2-inch outside diameter split barrel sampler a distance of 18 inches into the soil with a 140 pound hammer free falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded. The number of blows required to drive a sampler the final 12 inches is considered the Standard Penetration resistance ("N") or blow count. The blow count is presented graphically on the boring logs in this Appendix. If a total of 50 blows is recorded within one 6 inch interval, the blow count is recorded as 50 blows for the actual number of inches of penetration. The blow count, or "N" value, provides a measure of the relative density or granular soils with a relative consistency of cohesive soil.

SOIL SAMPLING PROCEDURES

The soil samples were recovered at each interval using procedures designed to minimize the risk of cross contamination. Prior to each boring, the drilling equipment and sampling tools were steam cleaned. Between each sampling attempt, sampling tools were scrubbed with a stiff brush and a detergent solution consisting of Alconox and warm water, and then rinsed with potable water and liberal quantities of deionized water. The samples were classified in the field and immediately transferred to laboratory treated glass bottles, and tightly sealed with a Teflon lined threaded cap. Samples were stored and transported in a chilled chest throughout the field program. Selected soil samples were subsequently transferred to the chemical testing laboratory in accordance with RZA chain-of-custody procedures.

Field Analysis of Soil Contaminants

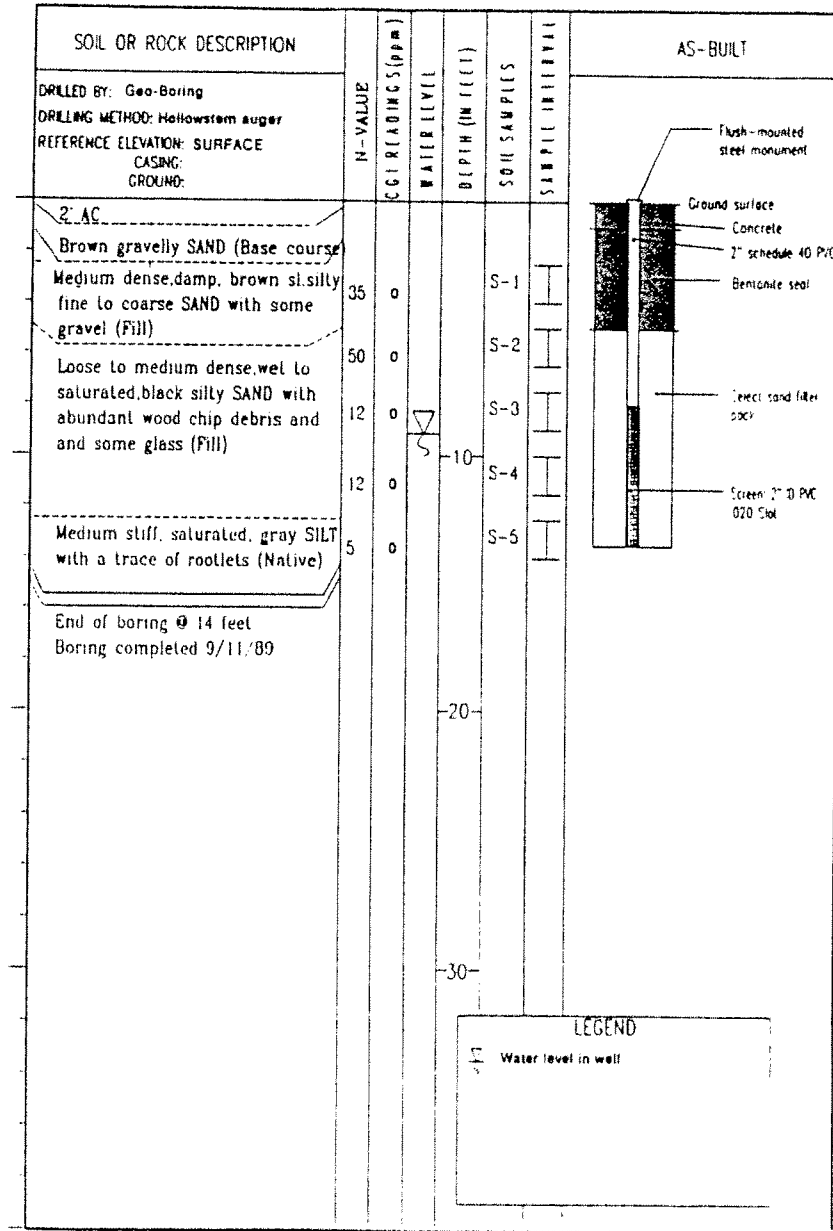
Each soil sample was screened for the presence of volatile organic compounds, to facilitate selecting an appropriate soil sample to submit for chemical analysis. The screening involved placing approximately 4 ounces of sampled soil directly into an 8 ounce glass jar with an aluminum foil cover secured by a lid band. The sample was then shaken vigorously for about 15 seconds and a head space reading was taken after plunging the probe of a combustible gas indicator through the foil cover. Field head space analysis was performed on each sample utilizing an Organic Vapor Meter (OVM). The highest dial value displayed by the instrument was recorded for each sample. The OVM is not capable of determining the species of these compounds or their actual concentrations in the soil samples. This method is considered a rough screening tool that aids in detecting the presence of soil contaminants.





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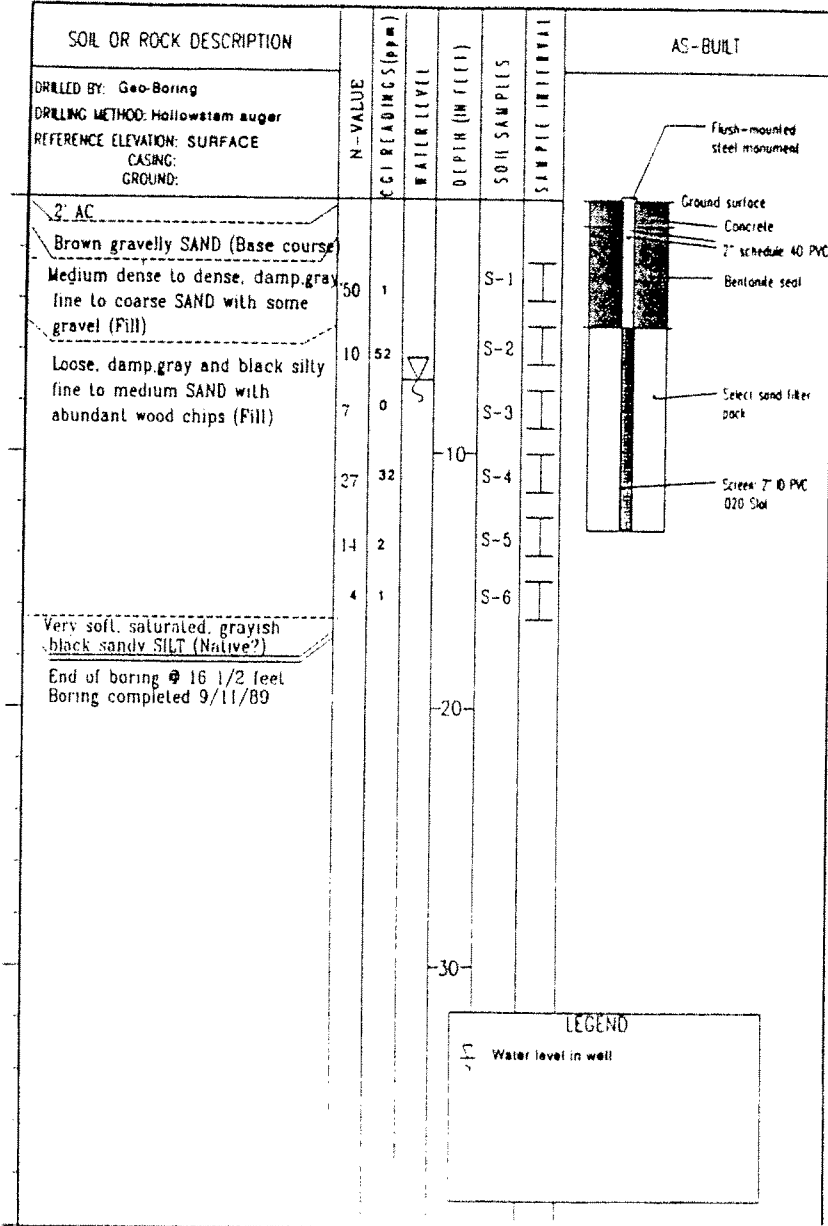
WELL NUMBER MW-5 PAGE 1 OF 1
 PROJECT NAME PSBP W.O. W-8364





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WELL NUMBER MW-6 PAGE 1 OF 1
PROJECT NAME PSBP W.O. W-6364



SOUND ANALYTICAL SERVICES, INC.

SPECIALIZING IN INDUSTRIAL & TOXIC WASTE ANALYSIS

4300 PACIFIC HIGHWAY EAST, SUITE B-14, TACOMA, WASHINGTON 98404 - TELEPHONE (206) 922-3328 - FAX (206) 922-5947

Report To: Rittenhouse-Zeman Date: September 21, 1989

Report On: Analysis of Soil & Water Lab No.: 7610

IDENTIFICATION:

Samples Received on 9-12-89

Project: W-6364 PSBP

ANALYSIS:

<u>Lab Sample No.</u>	<u>Client ID</u>	<u>Matrix</u>	<u>Total Petroleum Fuel Hydrocarbons, ppm</u>
1	B-4, S-3	Soil	141*
2	B-5, S-2	Soil	< 10
3	B-6, S-2	Soil	645*
4	MW-4, W-1	Water	< 10
5	MW-5, W-2	Water	< 10
6	MW-6, W-3	Water	< 10

not low enough detection limit

(TPH by EPA SW-846 Modified Method 8015)

* = Aged Gasoline or Mineral Spirits

SOUND ANALYTICAL SERVICES


STAN P. PALMQUIST