LAW
ENGINEERING AND ENVIRONMENTAL SERVICES

REPORT OF PRELIMINARY SITE CONTAMINATION ASSESSMENT
PROPOSED BRANCH EXCHANGE SERVICE STATION EXPANSION
REDSTONE ARSENAL
HUNTSVILLE, ALABAMA

FOR

ARMY AND AIRFORCE EXCHANGE SERVICE
DALLAS, TEXAS

PREPARED BY

LAW ENGINEERING, INC.
401 FRANKLIN STREET
HUNTSVILLE, ALABAMA

LAW ENGINEERING PROJECT NUMBER 423-93-277-02

DECEMBER 7, 1993

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December 7, 1993

Ms. Nancy Nunez
Contracting Officer
HQ Army and Airforce Exchange Service (AAFES)
P.O. Box 225887
Dallas, Texas 75222-5887

Report of Preliminary Site Contamination Assessment
Proposed Branch Exchange Service Station Expansion
Redstone Arsenal - Huntsville, Alabama
AAFES Project No. PN 0887-92-006
Law Engineering Project No. 423-93-277-02

Ms. Nunez:

Law Engineering, Inc. (LAW) is pleased to present the Army and Airforce Exchange Service (AAFES) with this report describing the Preliminary Site Contamination Assessment (PSCA) completed at the above-referenced facility. Our services were provided in accordance with LAW Proposal No. 93-103P dated October 7, 1993 as authorized by AAFES Contract Number HQ 93-PZS-200, Amendment 2, dated November 4, 1993. This report is provided for the AAFES and should not be relied upon by others without the written consent of LAW.

We appreciate the opportunity to be of service on this project. Should you have any questions please contact Dale Rainey at (205) 535-9755.

Sincerely,
LAW ENGINEERING, INC.

A. Dale Rainey, P.G.
Project Geologist

Darral W. Kirby, P.G.
Principal Geologist

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LAW ENGINEERING, INC.
401 FRANKLIN STREET
P.O. BOX 2585
HUNTSVILLE, AL 35804

205-535-9755
FAX 205-535-9756

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EXECUTIVE SUMMARY

Law Engineering, Inc. (LAW) has completed a Preliminary Site Contamination Assessment (PSCA) at the location of the proposed branch exchange service station expansion at Redstone Arsenal in Huntsville, Alabama. These assessment services were requested by the Army and Airforce Exchange Service (AAFES) in Dallas, Texas after suspected contamination was detected in a soil-test boring during a geotechnical exploration at the site performed by LAW. The scope of services performed for the PSCA was presented in LAW Proposal No. 93-103P, dated October 7, 1993 which was authorized under AAFES Contract No. HQ 93-PZS-200, Amendment 2.

Seven soil-test borings were advanced at the site in the general area of the suspected contamination. Five of the soil borings (MW-1 through MW-5) were completed as Type II ground-water monitoring wells to depths ranging from approximately 15 to 30 feet below ground surface. The soil borings (SB-1 and SB-2) were terminated at approximately 16 feet and were backfilled with borehole cuttings. Free product was not observed during drilling or sampling activities although a sheen or film was observed on the sampling bailer at MW-3. Five shallow hand auger borings were also advanced at the site to collect near-surface soil samples.

One soil sample from each soil-test boring was submitted for Total Petroleum Hydrocarbons (TPH) analysis by U.S. Environmental Protection Agency (EPA) Method 8015 Modified (Cal-DHS), which has the capability to differentiate between the various petroleum hydrocarbons. We requested the laboratory analyze and report TPH-gasoline and TPH-diesel for the soil test boring samples. The hand auger samples were analyzed for metals utilizing the Toxicity Characteristics Leaching Procedure (TCLP), as well as oil and grease.

Five ground-water samples were submitted to the laboratory for analysis for Benzene, Toluene, Ethylbenzene and Xylene (BTEX) and Polynuclear Aromatic Hydrocarbons (PAH), in accordance with ADEM regulations for petroleum cleanups related to USTs. All of the samples had benzene detected at levels above the maximum contaminant level (MCL) of 5 parts per billion (ppb) for benzene established by the EPA and the Alabama Department of Environmental Management (ADEM) Primary Drinking Water Standards. Benzene levels were 130 ppb, 24 ppb, 4,000 ppb, 480 ppb and 2,100 ppb for MW-1 through MW-5, respectively. In addition, Monitoring Well MW-3 had all of the BTEX constituents present at levels above their respective MCL's.

Various PAH compounds were detected in water samples from Monitoring Wells MW-1 through MW-5. The total PAH concentrations were 22 ppb, 13 ppb and 990 ppb, 110 ppb and 64 ppb for MW-1 through MW-5, respectively. However, Benzo[a]pyrene, the only regulated PAH compound, was not detected in any of the samples analyzed.
The results of soil and ground water testing indicate the likely presence of gasoline constituents in the subsurface at the project site. Based on information provided to date and the results of our analyses we believe the probable source of the contamination is the USTs at the existing branch exchange service station, which is located in an interpreted upgradient location and slightly higher in elevation than the project site.

We understand that the tanks have recently been tested for tightness, and failed the test which was performed using overfill methods. We understand that the tanks were retested December 3, 1993 by underfill methods, and passed. The tanks had also passed a test by underfill methods in December, 1992.

We recommend that the ADEM be notified immediately of the petroleum contamination detected in the soil and ground water at the site. Under current regulations, timely notification (24 hours) is required when a petroleum release has occurred.

We also recommend that additional assessment be performed in the vicinity of the existing service station USTs. This assessment should initially include installation of a soil-test boring/monitoring well in or immediately down gradient to the existing tank pit to assess conditions at the pit location. Followup assessment should include soil and ground water sampling, as well as a review of inventory records, utility construction details, tank installation drawings and other pertinent information.

Based on our experience, below grade oil/water separator units such as those at the service station can be a potential source of contamination from oil, grease and other products which might enter floor drains connected to the unit. These units often malfunction causing overflows or leaks into the soil/ground-water surrounding the unit. We recommend that subsurface conditions also be assessed in the vicinity of the oil/water separator by the collection of soil and ground water samples.

1.0 PROJECT BACKGROUND

The project site is located on Redstone Arsenal at the junction of Goss Road and Vincent Drive, as shown on Drawing Number 1, and is the proposed site for the expansion of the existing base exchange service station. The site is presently an open, grassed area which is generally level, with a gentle slope toward the south. The site is bounded by the parking lot of the existing base exchange service station on the north, Vincent Drive on the west, a paved parking area to the east and undeveloped property to the south (refer to Drawing Number 2).

LAW previously performed a geotechnical investigation at the subject site for the AAFES under negotiated contract number HQ 93-PZS-200 (LAW Project Number 423-93-277-01, report dated September 3, 1993). During the drilling of soil-test borings at the site, a gasoline odor was noted in one of the borings. There were no obvious indications of an on-site source of gasoline or other petroleum products. The nearest apparent potential source was estimated to be the underground storage tanks (USTs) at the existing base exchange service station which are located approximately 150 feet northwest of the boring location where the suspect soils were encountered. The AAFES indicated that the USTs at the site had passed tightness tests performed in December of 1992. Mr. Jim Farmer of the AAFES further indicated that the project site may have been used in the past for surface storage of petroleum products, primarily oil products.

Mr. Farmer requested that Law Engineering submit a proposal to perform an environmental assessment of the potential contamination, including soil and ground-water sampling. The number of borings/monitoring wells was not specified, however specific laboratory analyses were requested and are discussed in a later section of this report.

2.0 OBJECTIVE

The objective of the Preliminary Site Contamination Assessment (PSCA) was to explore the suspected presence of petroleum hydrocarbons encountered in the previous geotechnical soil test boring. The scope of services outlined in Law Engineering Proposal No. 93-103P was designed to evaluate the identity of the contaminant(s), their concentration and their general location.

Soil and ground-water contamination assessments can be performed using different levels of effort, depending on the goals of the project. The PSCA is a detection level study, and is not intended to necessarily delineate the full lateral and vertical extent of the contamination. However, we located our soil borings and monitoring wells in a configuration around the suspected area in an attempt to delineate the extent as much as possible, with only a few borings.

The scope of services performed at the site is outlined below, with additional details provided in the report:

- Seven soil test borings were advanced at the site with soil samples collected at five foot intervals during the drilling. A LAW project professional was on site to direct the drilling, document conditions encountered, screen the samples, and select samples for laboratory analysis.

- Five hand auger borings were completed by a LAW professional to collect shallow soil samples at various locations. The shallow soil sampling was for the purpose of obtaining near-surface soil samples to evaluate the potential for contamination from surface spills.

- Six soil samples from the soil test borings were submitted to the laboratory for Total Petroleum Hydrocarbon (TPH) analysis by the Cal-DHS Method (EPA 8015 Modified). This analysis was selected by LAW based on a request from the AAFES that the analyses selected provide information on the identity of the petroleum hydrocarbons present. The Cal-DHS method can differentiate between petroleum hydrocarbons and other naturally occurring hydrocarbons, as well as differentiate between gasoline range and diesel range compounds.

- Five soil samples from the hand auger borings were submitted to the laboratory for Oil and Grease (O&G) analysis (EPA Method 9071) and metals (EPA Method 6010) utilizing the Toxicity Characteristics Leaching Procedure (TCLP). These analyses were specifically requested by the AAFES.

- Five ground-water quality monitoring wells (MW-1 through MW-5) were installed in the pre-drilled soil-test borings at the site. Monitoring well construction details are provided in a later section of this report and on the Test Boring Records in Appendix B. The monitoring wells were developed using bailing techniques to remove the water and sediment from the wells which remained in the well after the drilling and well installation processes.

- Ground water samples were collected from each of the five monitoring wells by a LAW project professional. The analyses performed were selected by LAW and included analysis for Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) by EPA Method 602, and Polynuclear Aromatic Hydrocarbons (PAH) by EPA Method 610. BTEX and PAH analyses are used, as required by Alabama Department of Environmental Management (ADEM) regulations, when the suspected ground-water contaminants are gasoline and diesel, respectively.

- Data collected from the above field and laboratory services were evaluated by a LAW project professional and were compiled into a report detailing our scope of services, field activities, results, conclusions and recommendations.

3.0 FIELD SERVICES

3.1 SOIL SAMPLING

The soil sampling performed at the site was in the form of soil test borings using a truck-mounted drill rig, supplemented by hand auger borings to collect surface samples. Details are provided in the following paragraphs.

3.1.1 Soil Test Borings

Seven soil test borings were drilled at the site on October 18 and 19, 1993, under the supervision of a LAW project professional. The borings were advanced using a truck mounted drill rig using hollow stem augers (4-1/4 inch I.D.) and split-spoon sampling techniques. The-down hole drilling tools were steam-cleaned between borings to prevent cross-contamination. The split-spoon sampler was cleaned before each sample by washing with phosphate-free soap, rinsing with tap water and a final rinsing with distilled water.

Borings MW-1, MW-2, and MW-5 were advanced to depths of 26 feet, 28 feet and 21 feet, respectively. Borings MW-3, MW-4, SB-1 and SB-2 were terminated at a depth of 16 feet. Boring locations are shown on Drawing Numbers 2 through 6, attached herewith.

Soil samples were collected during drilling at approximate five foot intervals in each boring using an 18-inch split spoon sampling device. Samples were logged in the field by a LAW project professional, and the Test Boring Records completed for the borings are included in Appendix B of this report. A portion of each sample was placed in a plastic quart-size plastic storage bag for field headspace analysis, as discussed below.

Soil test boring MW-1, which was converted to a ground water monitoring well, was located adjacent to the location of the previous geotechnical boring (B-1) in which the petroleum odors were noted. Only a slight odor was noted in one soil sample (9'-11') from boring MW-1, therefore an additional boring (SB-1) was also advanced in the vicinity of the previous geotechnical boring as an additional check of conditions in the suspect area. Samples from boring SB-1 had similar physical characteristics and head space analysis results (see following paragraph) to those collected from MW-1, with only a slight odor noted in one sample (9'-11'). Therefore the boring was backfilled with borehole cuttings and was not used for installation of a monitoring well.

Soil samples were field screened for volatile hydrocarbon emissions using a photoionization detector (PID) to obtain field headspace readings on a portion of the collected sample. The PID readings noted during the field headspace analyses are summarized in Table 1, and are also shown on the Test Boring Records. The soil sample corresponding to the highest PID reading in each boring was forwarded to Law Environmental National Laboratory (LENL) in Pensacola, Florida for Total Petroleum Hydrocarbons (TPH) analysis (CAL-DHS, EPA 8015 Modified). Samples were placed on ice and shipped overnight to the lab, using proper chain-of-custody forms for the handling and transfer of the environmental samples (chain-of-custody forms are included in Appendix B).

3.1.2 Hand Auger Borings

Five shallow hand auger borings were completed at the site for the purpose of collecting near-surface soil samples to be analyzed for oil and grease (O&G, EPA Method 9071) and metals (EPA Method 6010) utilizing the Toxicity Characteristics Leaching Procedure (TCLP), EPA Method 1311. These chemical analyses were specifically requested by the AAFES.

The hand auger borings were advanced using a stainless steel hand auger, and samples were collected from a depth interval of approximately 0.5 feet to 1.0 feet. The samples were placed in laboratory-supplied jars and shipped to LENL in Pensacola, using the same procedures as discussed in the previous section. The hand auger was cleaned between samples as follows: 1) wash using phosphate-free soap; 2) rinse with isopropanol; 3) double rinse with distilled water.

3.2 GROUND-WATER MONITORING WELLS/GROUND-WATER SAMPLING

Soil Borings MW-1 through MW-5 were completed as two-inch diameter Type II ground-water monitoring wells to the approximate full depth of the soil test borings. The monitoring wells were installed on October 18 and 19, 1993 at the locations shown on Drawing Numbers 2 through 6. Monitoring well construction consisted of flush-joint Schedule 40 PVC casing, with a 10 foot section of 0.010 inch slotted screen at the bottom of each well, and solid flush-joint PVC riser casing to the ground surface.

Well annulus materials consisted of a washed silica sand pack to a level approximately two feet above the screen, with a two-foot thick seal of bentonite above the sand. The remainder of the annulus was backfilled with bentonite to the ground surface. Approximately 12 to 30 inches of the PVC riser was left above the ground surface, and a lockable sealing plug cap was placed on each well. Permanent protective well covers were not installed due to the planned construction. LAW surveyed elevations to the top of each well riser using an assumed site datum (ASD) of 100 feet. Well construction details are shown on the Test Boring Records in Appendix B.

The monitoring wells were developed on October 20, 1993 by removing in excess of five well volumes of water using dedicated disposable polyethylene bailers. The wells were developed until the bailed water was reasonably clear. The water bailed from the wells was containerized and left on site, pending laboratory results.

Prior to sampling, the monitoring wells were purged by removing in excess of three well volumes of water from the wells on October 21, 1993. Samples were collected from the wells on October 22, 1993 by a LAW professional using dedicated disposable teflon bailers. The samples were placed in laboratory-supplied sample jars, properly preserved, and placed on ice in the field. The samples were forwarded overnight in coolers, with ice, to LENL Pensacola for analysis. Chain-of-custody sheets are provided in Appendix C.

4.0 GEOLOGY AND HYDROGEOLOGY

4.1 REGIONAL GEOLOGY

According to the Geologic Map of Alabama, the site is situated within the Highland Rim section of the Interior Low Plateau Physiographic Province. The geology and hydrology of the area are controlled largely by limestone of Mississippian age, particularly the Tuscumbia Limestone and the Fort Payne Chert. The structure of the area is relatively simple, with the rocks dipping gently to the southeast.

The site is immediately underlain by the bedrock of the Tuscumbia Limestone. This formation is described as a light gray to light brownish-gray, thin to thick bedded, fossiliferous limestone containing chert lenses and nodules. Typical residual soils (weathered in-place) overlying the limestone formation consist of silty clays which typically range from 20 to 40 feet in thickness in the vicinity of the site. The Tuscumbia Limestone in conjunction with the Fort Payne Chert, which typically underlies the Tuscumbia, constitute the major ground-water aquifer in the Madison County area.

The Tuscumbia Limestone is composed largely of calcium carbonate containing little magnesia or other relatively insoluble impurities. Consequently, the formation is subject to a great amount of solution by percolation of slightly acidic water along bedding and joint planes and fractures in the formation. These extensive solution channels allow the ready passage of ground water through the formation, and make the Tuscumbia Limestone the best water-bearing formation in the area.

4.2 HYDROGEOLOGY

The Tuscumbia-Fort Payne aquifer includes the Monteagle Limestone, Tuscumbia Limestone, and the Fort Payne Chert. The aquifer name emphasizes the prominence of the Tuscumbia Limestone and the Fort Payne Chert, which are the most significant sources of water within it. The Tuscumbia-Fort Payne aquifer is the major aquifer for public water supply throughout its outcrop area. The aquifer is recharged throughout its outcrop by water that infiltrates and percolates through the soil. The base of the aquifer is the contact with the underlying Chattanooga Shale.

Water in the Tuscumbia-Fort Payne aquifer is partially confined because of the lower hydraulic conductivity of the overlying residual soil mantle. Cavernous porosity is present in many places where dissolution has enlarged joints and bedding planes in the rock. Wells that penetrate these features can produce large quantities of water.

Ground water at the subject site was encountered within the soil at a depth of about 5 feet during our exploratory drilling. Based on our experience, and the interpretation of ground-water elevation data from our monitoring wells (refer to table 2), we believe this shallow ground water represents a "perched" condition. The soils encountered in the near surface are typically higher in silt content, and are underlain by fat, highly plastic clays with lower permeability. The clays with lower permeability tend to retard the downward migration of water, causing the perched condition. Based on measured ground-water elevations from three wells (MW-3, MW-4, MW-5) the shallow ground water flow direction, or gradient, is interpreted to be toward the south-southeast. These three wells were selected due to the consistency of water level readings (four measurements) over a two week period.

Ground water was measured at a depth of approximately 18 feet in a deeper screened well (MW-2) at the site. This likely represents the true depth to ground water. The ground water within the soil is typically hydraulically connected to ground water within the bedrock. Only one monitoring well is screened below the upper perched zone, therefore the flow direction of the deeper ground water could not be evaluated. However, based on our experience, and published information, the hydraulic gradient is interpreted to be generally toward the southeast. The water level data used are presented on Drawing Number 4.

5.0 ANALYTICAL RESULTS

5.1 Soil Analytical Results - Soil Test Boring Samples

The TPH (Cal-DHS Method 8015 Modified) analysis on six soil samples from the soil test borings yielded the following concentrations:

	CAL-DHS RESULTS	
BORING NUMBER	GASOLINE TPH (ppm)	DIESEL TPH (ppm)
SB-2 (4' - 6')	ND	ND
MW-1 (9' - 11')	0.55	ND
MW-2 (4' - 6')	630	68
MW-3 (9' - 11')	180	37
MW-4 (9' - 11')	1.5	ND
MW-5 (12' - 21')	ND	ND

ND = below laboratory detection limits (refer to laboratory sheet for individual constituent detection limits.

The above samples were selected for analysis based on results of the field screening with a PID (see Table 1). The soil sample results show significant TPH concentrations (698 ppm combined) in the sample from MW-2, and elevated TPH concentrations (217 ppm combined) the sample from MW-3. The current Alabama Department of Environmental Management (ADEM) corrective action levels (CAL) are based on Total Recoverable Petroleum Hydrocarbon (TRPH) levels (EPA Method 9073/503E). The ADEM CAL for petroleum contaminated soils currently mandated through utilization of this particular method is 100 ppm TRPH. Based on our experience, TRPH levels are generally higher than TPH levels measured by the CAL-DHS Method, therefore the sample results would have been higher if the standard method had been used. Results of the TPH analysis indicate that the samples analyzed from MW-2 and MW-3 are above the ADEM CAL.

5.2 Soil Analytical Results - Hand Auger Borings

Five soil samples from the hand auger borings were analyzed for oil and grease (EPA Method 9071) and metals (EPA Method 6010) by the TCLP. The results are summarized on the following table:

	OIL AND GREASE (ppm)	BARIUM (ppb)	CHROMIUM (ppb)
HA-1	370	560	8
HA-2	260	390	ND
HA-3	300	540	120
HA-4	200	590	8
HA-5	23	590	ND

ND = below laboratory detection limits (refer to laboratory sheet for individual constituent detection limits).

Based on our experience, the results from the oil and grease analysis can be susceptible to interference from naturally occurring compounds and may not be representative of petroleum based compounds only.

Results of the metals analysis utilizing the TCLP indicates that chromium and barium were the only metals analyzed that were detected in the samples. The results for these two metals are well below the TCLP maximum contaminant level (MCL) of 5 ppm (5,000 ppb) for chromium and 100 ppm (100,000 ppb) for barium. Analytical results are provided in Appendix B, and the data is also shown on Drawing No. 3.

5.3 Ground-Water Analytical Results

The ground water samples collected from the five monitoring wells were analyzed for BTEX (EPA Method 602) and PAH (EPA Method 610). Results of the analyses are presented on Table 3 (BTEX), Table 4 (PAH), and on Drawing No. 6. Detailed analytical result sheets are provided in Appendix C and the results of the ground-water analyses are summarized below:

WELL NUMBER	BENZENE (ppb)	TOTAL BTEX (ppb)	TOTAL PAH (ppb)
RS 614 MW-1	130	200	22
615 MW-2	24	131	12.7
616 MW-3	4,000	31,200	990
617 MW-4	480	1,385	110
618 MW-5	2,100	3,180	64

Benzene levels detected in all of the samples exceeded the primary drinking water standard (EPA and ADEM) maximum contaminant level (MCL) of 5 ppb. The sample from well MW-3 exceeded the MCL's for Ethylbenzene, Toluene and total Xylene (see Table 2). Additionally, the sampling bailer utilized to obtain the ground-water sample from MW-3 had a notable sheen associated with it as well. Additionally, the presence of this sheen as well as the concentrations of the individual BTEX components indicates a likely gasoline source.

PAH compounds, which are indicative of diesel fuel, were detected in all of the ground water samples. Three PAH compounds were typically encountered (see Table 4), however none of these compounds have had MCL's established at this time.

During the analytical process, the laboratory noted that methyl tertiary-butyl ether (MTBE) was present in the water samples from all five of the wells. MTBE is a relatively new gasoline additive (in terms of common usage), and it does not degrade rapidly in ground water. We understand from Ms. Richie Marple of the AAFES that the base exchange service station began using gasoline with MTBE in early October, 1993.

6.0 DATA EVALUATION AND CONCLUSIONS

The following paragraphs present our evaluation of the field and laboratory data, a discussion of potential sources of the contamination, and our conclusions.

6.1 Soil Contamination Assessment - Soil Test Borings

Based on the results of TPH (Cal-DHS) analyses performed on selected soil samples from our soil test borings, petroleum hydrocarbons were detected in some of our borings. The presence of these petroleum hydrocarbons appears to have originated primarily from a gasoline source, with some heavier (diesel) compounds detected.

The vertical extent of the contamination appears to be limited, based on the PID headspace readings and analytical results. The higher PID readings generally occur in the samples collected in the depth interval from four to eleven feet (refer to Test Boring Records and Table 1).

Our borings appear to have defined the lateral extent of residual petroleum constituents, except toward the north. Review of the soils data presented on Drawing Number 4 indicates petroleum hydrocarbon concentrations below detection limits in the western-most boring (SB-2) and the southern-most boring (MW-5). Data from the eastern-most boring indicates a significant decrease, with the gasoline TPH being less than detection limits, and the diesel TPH at only 1.5 ppm. The northern-most boring (MW-2) has the highest detected levels of gasoline TPH (630 ppm) and Diesel TPH (68 ppm). Based on the trend of the data, we anticipate that the detected petroleum constituents likely extend northward beyond the location of Monitoring Well MW-2.

6.2 Soil Contamination Assessment - Hand Auger Borings

The oil and grease analysis performed on shallow hand auger samples detected oil and grease levels in excess of 100 ppm for the samples from HA-1 through HA-4 (maximum of 370 ppm at HA-1), and a level of 23 ppm at HA-5 (see Drawing Number 3). We did not observe visual indications of oil contamination in the samples.

Interpretation of oil and grease results is difficult, due to the inaccuracy of the method in method. Based on our experience, and conversations with LENL laboratory personnel, results of the oil and grease analysis can be elevated by naturally occurring substances such as oils, humic acid and lipids. In addition, since the method is gravimetric (based on weight before and after evaporation) it is also susceptible to laboratory error. In our opinion the oil and grease results would likely decrease if the sample were analyzed using a method with less limitations. Therefore, we do not believe that the oil and grease results indicate a large scale problem, however, confirmation of our interpretation would require the use of more definitive analyses.

6.3 Ground Water Contamination Assessment

Laboratory results indicate that the level of benzene detected in all of the water samples is above the applicable ADEM regulatory MCL (EPA and ADEM Primary Drinking Water Standard). In addition, the sample from Monitoring Well MW-3 had all of the BTEX constituents detected at level above their respective MCL's. The presence and proportions of the individual BTEX constituents indicate that the primary contaminant is a likely a gasoline product. The levels detected indicate that a significant release has probably occurred, and that the quality of the shallow perched water zone (encountered at a depth of approximately five feet) has been impacted, as well as the ground water deeper in the soil zone (measured at a depth of approximately 18 feet).

6.4 Potential Contamination Sources

Two sources of contamination were considered during the initial stages of this assessment: 1) The USTs at the existing base exchange service station, due to their proximity to the site and upgradient location; and 2) The possible historical use of the site for surface storage of petroleum products (oil).

Observations during our field activities and the results of our analyses indicated that the contaminant was most likely a gasoline product, rather than a heavier oil product. In addition, in our opinion the benzene : xylene ratios, as well as the presence of MTBE, indicate that the contamination is from a relatively recent release. Therefore, we conclude that the most likely source of the gasoline contamination detected in the ground water is the USTs at the existing service station.

The tank pit area at the station is topographically approximately five feet higher in elevation than the subject site, and is approximately 150 feet northwest (estimated upgradient) of the boring where the contamination was first encountered. In our opinion, the perched water within the upper silty zone (possible fill) is functioning as a transport medium for the contamination. Utility line trenches can also serve as conduits for the transport of contamination, however, the determination of the routes of utilities at the service station was beyond the scope of services for this PSCA. During our field activities, however, we did observe at least one water line routed from the service station building and along the northern edge of the project site to service the existing air/water area west of the main building.

In addition to the USTs at the service station there is also a below grade oil/water separator located south of the existing service station building. According to personnel at the service station, the oil/water separator unit serves the floor drains inside the building and discharges the effluent water to the sanitary sewer. Prior to the oil/water separator unit being in place, the floor drain outlets discharged into the drainage swale along the east side of the site. We did not observe obvious areas of surface staining in this area at the time of our site activities.

7.0 RESPONSE ACTIONS BY AAFES

Law reported the results of our BTEX analysis on the ground water samples to Ms. Nancy Nunez on November 10, 1993, and also attempted to contact Mr. Jim Farmer and Ms. Richie Marple of the AAFES Construction Branch. Mr. Farmer contacted LAW on November 12 for an update, and LAW sent a copy of the BTEX results to Mr. Farmer by facsimile on that date. Based on the analytical data and the presence of the MTBE additive, Ms. Marple temporarily suspended the dispensing of fuel at the base exchange facility, pending tank integrity (i.e., "tightness") testing.

A tightness test (overfill methods) was performed on or about November 22, 1993. According to our December 2 and December 7, 1993 conversations with Mr. Scott Smith of the Department of Engineering and Housing (DEH) at Redstone Arsenal, the tanks failed the above-referenced tightness test, and fuel sales remained suspended. Mr. Smith further indicated that the tanks were retested (utilizing the underfill method) and passed on December 3, 1993.

8.0 RECOMMENDATIONS

Based on our PSCA of the subject site, we recommend the following:

- The ADEM should be notified of this probable release, if they have not been. As we have indicated during past conversations with AAFES personnel, we believe the findings of this PSCA are a sufficient indication that a release has occurred. In addition, we believe the release is largely associated with the USTs at the existing base exchange service station.

- We recommend that a preliminary investigation of the service station USTs be performed, including soil and ground water samples from around the UST pit area.

- We recommend that the purge water removed from the wells, which has been containerized and remains at the site, be removed and properly disposed by a qualified contractor. LAW can provide the AAFES with local contractor contacts, at your request.

- We recommend that subsurface conditions also be assessed in the vicinity of the oil/water separator by the collection of soil and ground-water samples. Based on our experience, below grade oil/water separator units such as those at the service station can be a potential source of contamination from oil, grease and other products which might enter floor drains connected to the unit. These units often malfunction causing overflows or leaks into the soil/ground-water surrounding the unit.

TABLES

TABLE 1

SOIL ANALYTICAL RESULTS
TOTAL PETROLEUM HYDROCARBONS (TPH)
PROPOSED BRANCH EXCHANGE SERVICE STATION EXPANSION
REDSTONE ARSENAL - HUNTSVILLE, ALABAMA
LAW ENGINEERING PROJECT NO. 423-93-277-02

SAMPLE	DEPTH (FT)	PID READING	TPH*	
			DIESEL (ppm)	GASOLINE (ppm)
SB-1	2.0-4.0	1.5	-	-
SB-1	4.0-6.0	3.5	-	-
SB-1	9.0-11-0	14.0	-	-
SB-1	14.0-16.0	3.0	-	-
SB-2	2.0-4.0	1.5	-	-
SB-2	4.0-6.0	1.5	ND	ND
SB-2	14.0-16.0	1.0	-	-
MW-1	2.0-4.0	1.0	-	-
MW-1	4.0-6.0	3.0	-	-
MW-1	9.0-11.0	8.0	ND	0.55
MW-1	14.0-16.0	1.0	-	-
MW-1	19.0-21.0	1.0	-	-
MW-2	2.0-4.0	21.0	-	-
MW-2	43.0-6.0	60.0	68	630
MW-2	9.0-11.0	9.0	-	-
MW-2	14.0-16.0	3.0	-	-
MW-2	19.0-20.0	1.0	-	-
MW-2	24.0-26.0	1.0	-	-
MW-3	2.0-4.0	4.5	-	-
MW-3	4.0-6.0	10.0	-	-
MW-3	9.0-11.0	50.0	37	180
MW-3	14.0-16.0	4.5	-	-
MW-4	2.0-4.0	<1	-	-
MW-4	4.0-6.0	1.5	-	-
MW-4	9.0-11.0	3.0	ND	1.5
MW-4	14.0-16.0	<1	-	-
MW-5	2.0-4.0	<1	-	-
MW-5	4.0-6.0	1.5	-	-
MW-5	9.0-11.0	1.5	-	-
MW-5	14.0-16.0	2.0	-	-
MW-5	19.0-21.0	2.5	ND	ND

NOTES:
* = EPA 8015 Modified (Cal-DHS)
\- = Not Analyzed
NR = No response
ND = Below Laboratory Detection Limits

TABLE 2
MEASURED GROUND-WATER LEVEL 11/3/93
PROPOSED BRANCH EXCHANGE SERVICE STATION EXPANSION
REDSTONE ARSENAL - HUNTSVILLE, ALABAMA
AAFES PROJECT NO. PN 0887-92-006
LAW ENGINEERING PROJECT NO. 423-93-277-02

MONITORING WELL	T.O.C. ELEVATION (*FT ASD)	WATER LEVEL MEASUREMENT	
		**DEPTH (FT)	ELEVATION (FT ASD)
614 MW-1	99.0	7.4	91.6
615 MW-2	101.3	19.7	81.6
616 MW-3	100.8	7.0	93.8
617 MW-4	99.2	5.7	93.5
618 MW-5	98.3	5.2	93.1

* - ARBITRARY SITE DATUM, BASED ON ASSUMED REFERENCE ELEVATION OF 100 FT.
** - MEASURED BELOW TOP OF CASING (RISER)

TABLE 3
GROUND-WATER ANALYTICAL RESULTS
BENZENE, TOLUENE, ETHYLBENZENE, XYLENE (BTEX)
PROPOSED BRANCH EXCHANGE SERVICE STATION EXPANSION
REDSTONE ARSENAL - HUNTSVILLE, ALABAMA
LAW ENGINEERING PROJECT NO. 423-93-277-02

	RESULTS (ppb)				
WELL NO.	BENZENE	ETHYLBENZENE	TOLUENE	XYLENE	TOTAL BTEX
MW-1	130*	17	16	37	200
MW-2	24*	12	34	61	131
MW-3	4,000*	3,200*	12,000*	12,000*	31,200
MW-4	480*	620	45	240	1,385
MW-5	2,100*	540	260	280	3,180
RINSATE	ND	ND	ND	ND	ND
TRIP BLANK	ND	ND	ND	ND	ND

NOTES EPA METHOD 602
ND -below laboratory detection limits (refer to laboratory sheet for individual constituent detection limits.

* - exceeds maximum contamination level (MCL) for EPA and ADEM Primary Drinking Water Standard:

COMPONENT	MCL
Benzene	5 ppb
Ethylbenzene	700 ppb
Toluene	1,000 ppb
Total Xylene	10,000 ppb

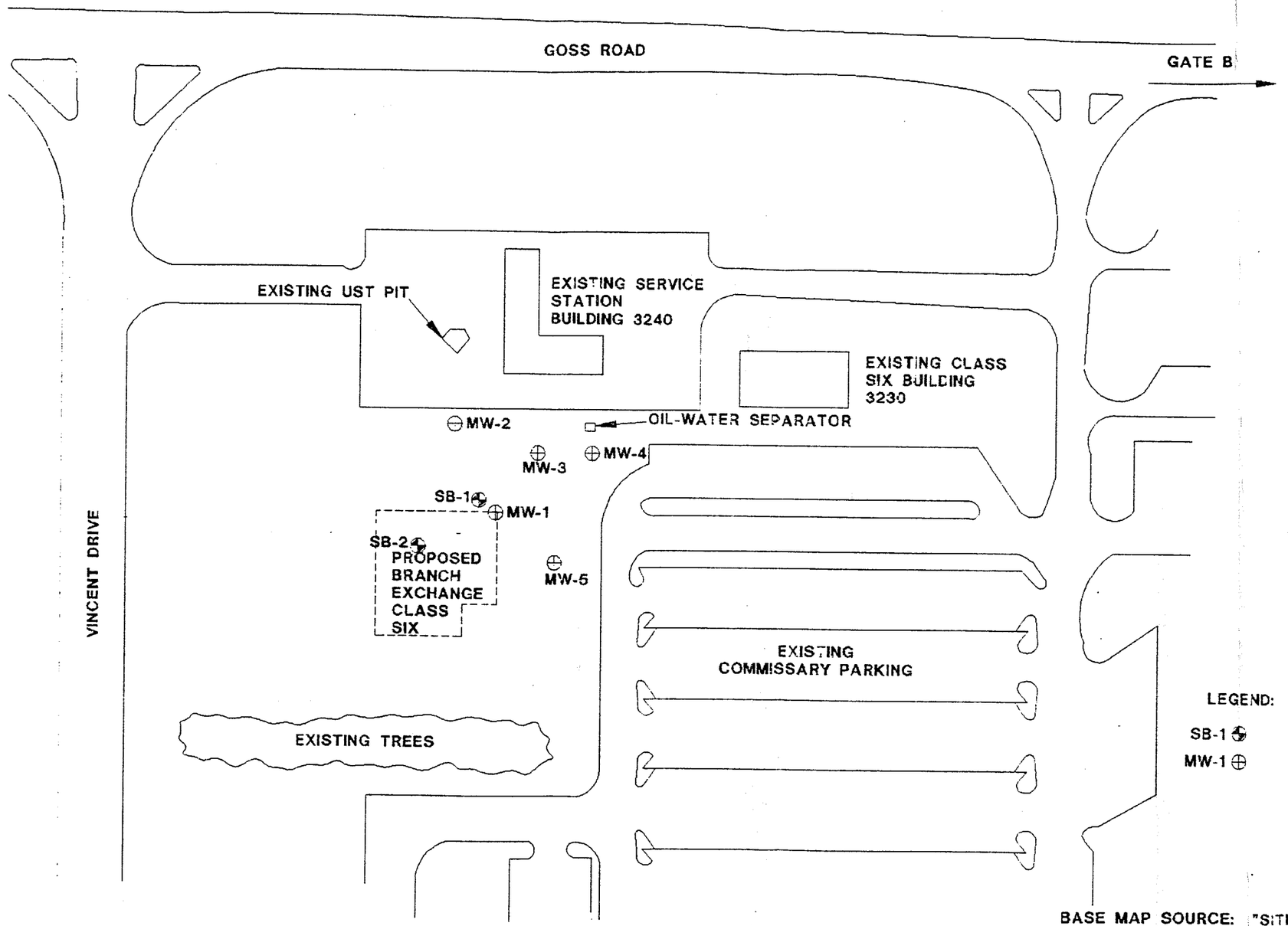
TABLE 4

GROUND-WATER ANALYTICAL RESULTS
POLYNUCLEAR AROMATIC HYDROCARBONS (PAH)
PROPOSED BRANCH EXCHANGE SERVICE STATION EXPANSION
REDSTONE ARSENAL - HUNTSVILLE, ALABAMA
LAW ENGINEERING PROJECT NO. 423-93-277-02

	PAH* RESULTS (ppb)				
PAH CONSTITUENT	MW-1	MW-2	MW-3	MW-4	MW-5
Acenapthalene	ND	ND	ND	1.3	ND
Acenapthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzo [a] anthracene	ND	ND	ND	ND	ND
Benzo [b] flouranthene	ND	ND	ND	ND	ND
Benzo [k] flouranthene	ND	ND	ND	ND	ND
Benzo [ghi] perylene	ND	ND	ND	ND	ND
Benzo [a] pyrene	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo [a,h] anthracene	ND	ND	ND	ND	ND
Flouranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Ideno [1,2,3-cd] pyrene	ND	ND	ND	ND	ND
1 - Methylnapthalene	5.5	1.9	110	27	32
2 - Methylnapthalene	6.7	3.6	200	19	32
Napthalene	10.0	7.2	680	64	ND
Phenanthrene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
TOTAL PAH	22.2	12.7	990	110	64

NOTES:
* EPA METHOD 610
ND -below laboratory detection limit (refer to laboratory data sheet for individual constituent detection limits).

DRAWINGS

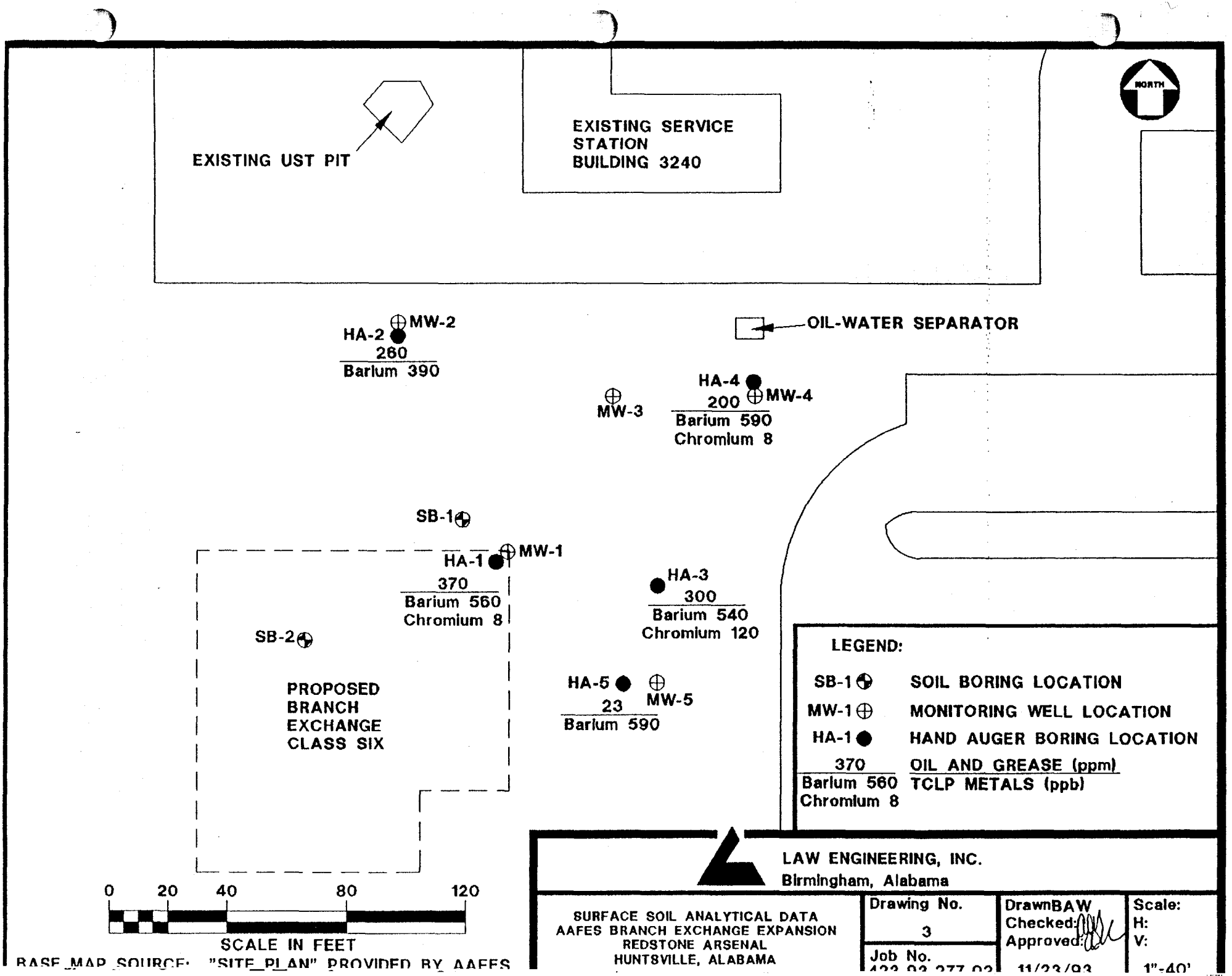


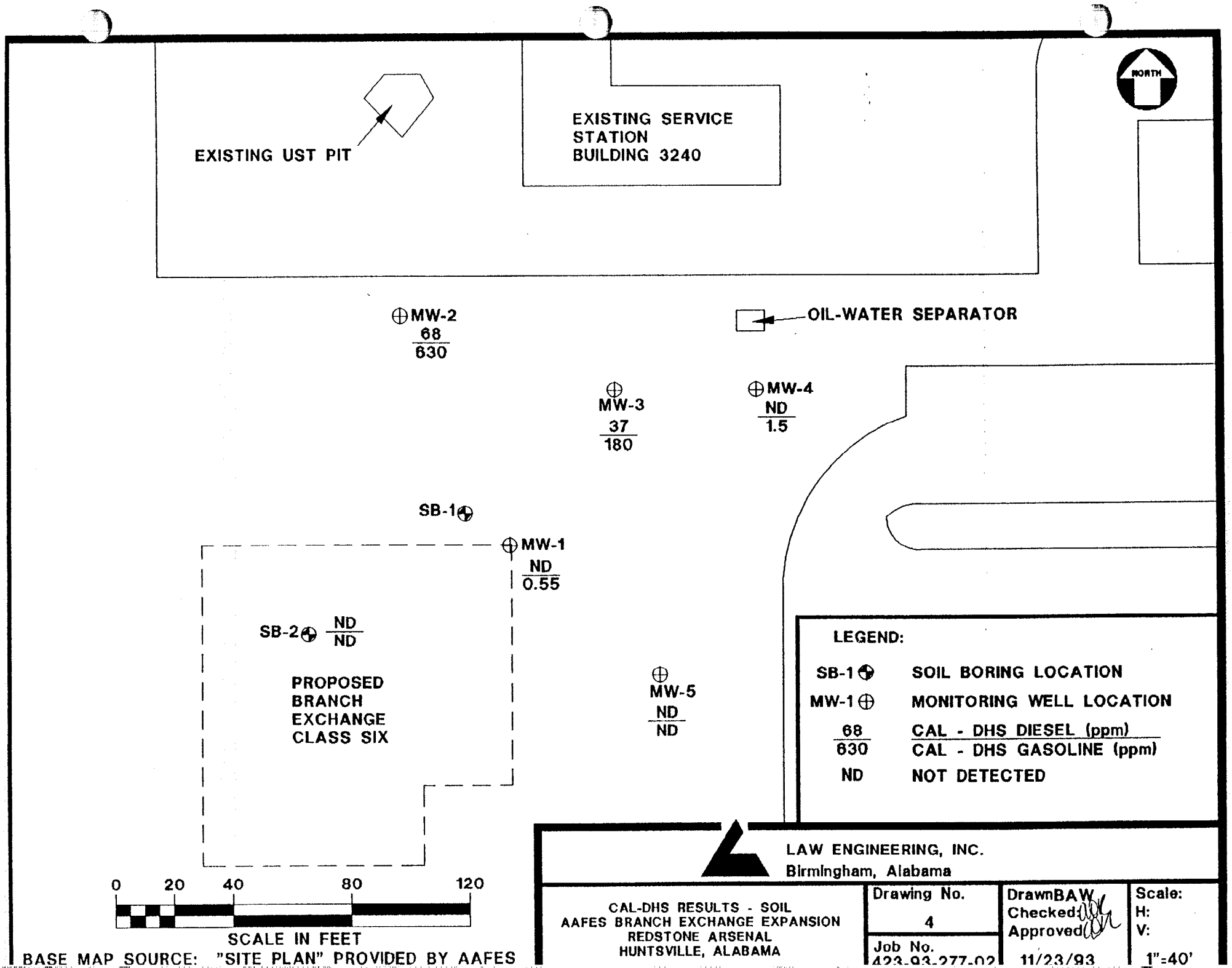
BASE MAP SOURCE: "SITE PLAN" PROVIDED BY AAFES.

LAW ENGINEERING, INC.
Huntsville, Alabama

SITE VICINITY PLAN
AAFES BRANCH EXCHANGE EXPANSION
REDSTONE ARSENAL
HUNTSVILLE, ALABAMA

Drawing No.	Drawn: BAW	Scale:
2	Checked:	
Job No. 423-93-277-02	Approved: 11/4/93	1"=100'


EXISTING UST PIT
EXISTING SERVICE STATION BUILDING 3240
NORTH
HA-2
MW-2
260
Barium 390
OIL-WATER SEPARATOR
MW-3
HA-4
200
MW-4
Barium 590
Chromium 8
SB-1
HA-1
MW-1
370
Barium 560
Chromium 8
HA-3
300
Barium 540
Chromium 120
SB-2
PROPOSED BRANCH EXCHANGE CLASS SIX
HA-5
23
MW-5
Barium 590
LEGEND:
SB-1 SOIL BORING LOCATION
MW-1 MONITORING WELL LOCATION
HA-1 HAND AUGER BORING LOCATION
370 OIL AND GREASE (ppm)
Barium 560 TCLP METALS (ppb)
Chromium 8
0 20 40 80 120
SCALE IN FEET
BASE MAP SOURCE: "SITE PLAN" PROVIDED BY AAFES
LAW ENGINEERING, INC.
Birmingham, Alabama
SURFACE SOIL ANALYTICAL DATA
AAFES BRANCH EXCHANGE EXPANSION
REDSTONE ARSENAL
HUNTSVILLE, ALABAMA
Drawing No. 3
Job No. 423-93-277.02
Drawn BAW
Checked:
Approved:
11/23/93
Scale:
H:
V:
1"=40'



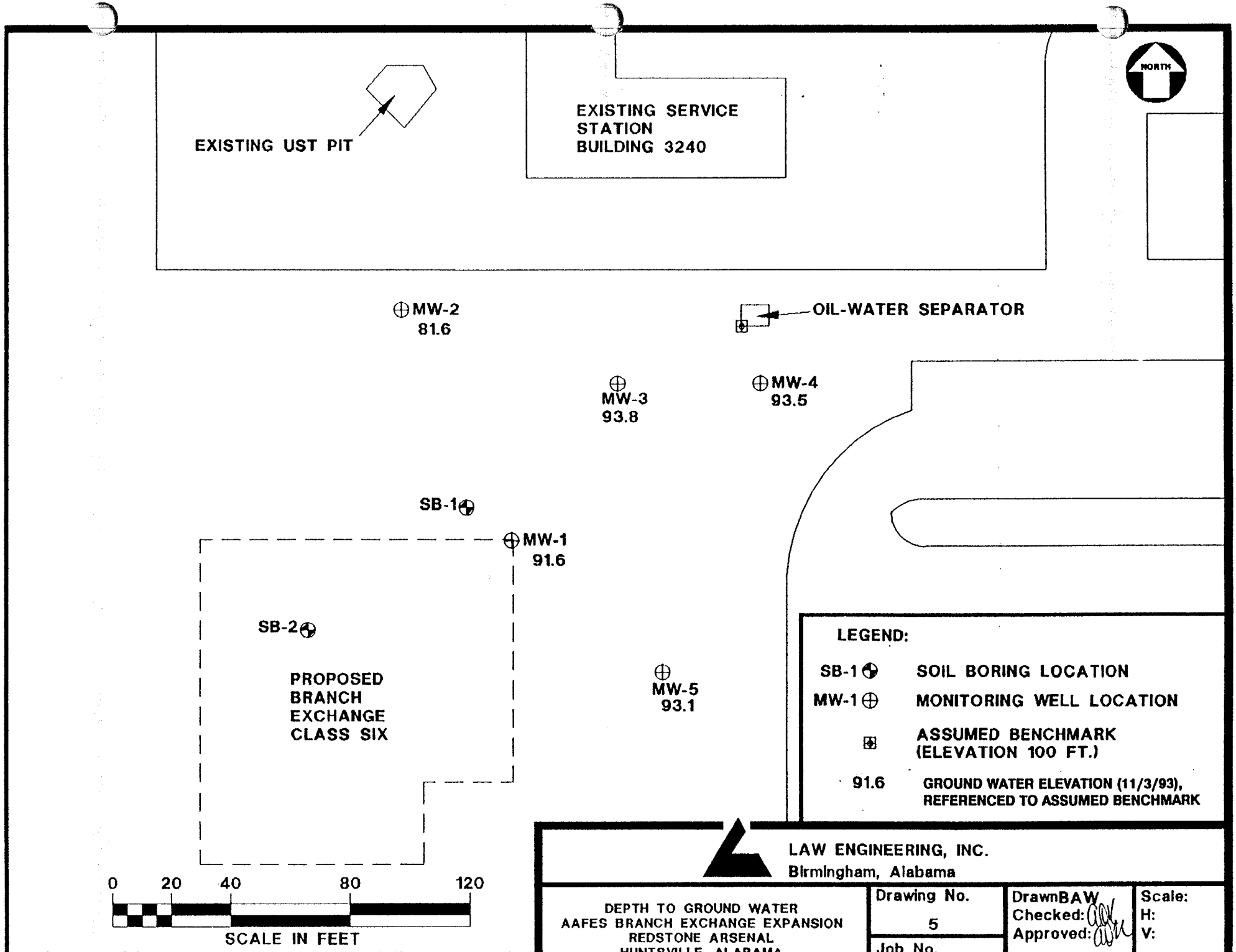
BASE MAP SOURCE: "SITE PLAN" PROVIDED BY AAFES

LAW ENGINEERING, INC.
Birmingham, Alabama

CAL-DHS RESULTS - SOIL
AAFES BRANCH EXCHANGE EXPANSION
REDSTONE ARSENAL
HUNTSVILLE, ALABAMA

Drawing No.	Drawn BAW
4	Checked:
Job No. 423-93-277-02	Approved 11/23/93

Scale:
H:
V: 1"=40'

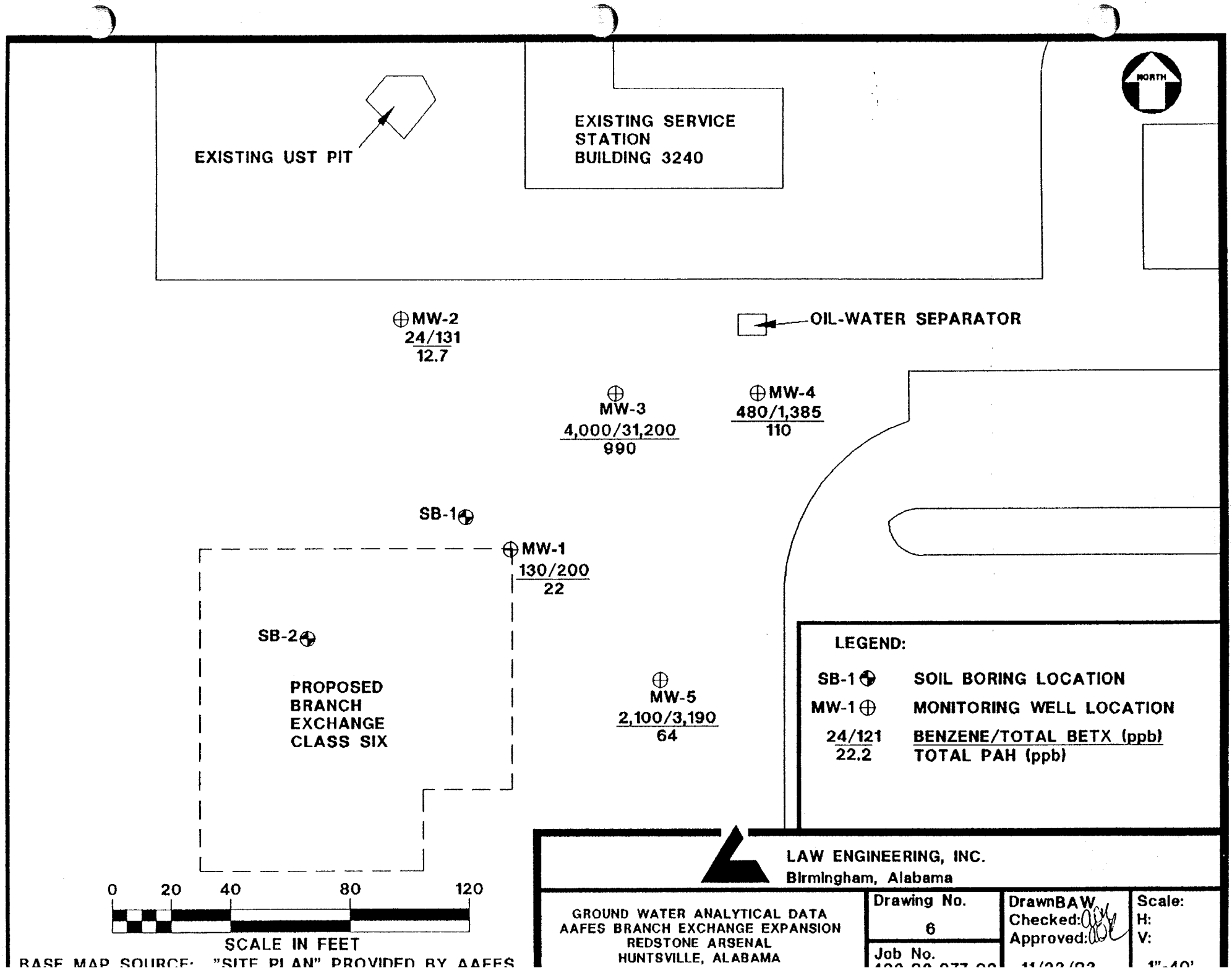


BASE MAP SOURCE: "SITE PLAN" PROVIDED BY AAFES

LAW ENGINEERING, INC.
Birmingham, Alabama

DEPTH TO GROUND WATER
AAFES BRANCH EXCHANGE EXPANSION
REDSTONE ARSENAL
HUNTSVILLE, ALABAMA

Drawing No.	Drawn BAW	Scale:
5	Checked:	H:
Job No. 423-93-277-02	Approved: 12/1/93	V: 1"=40'

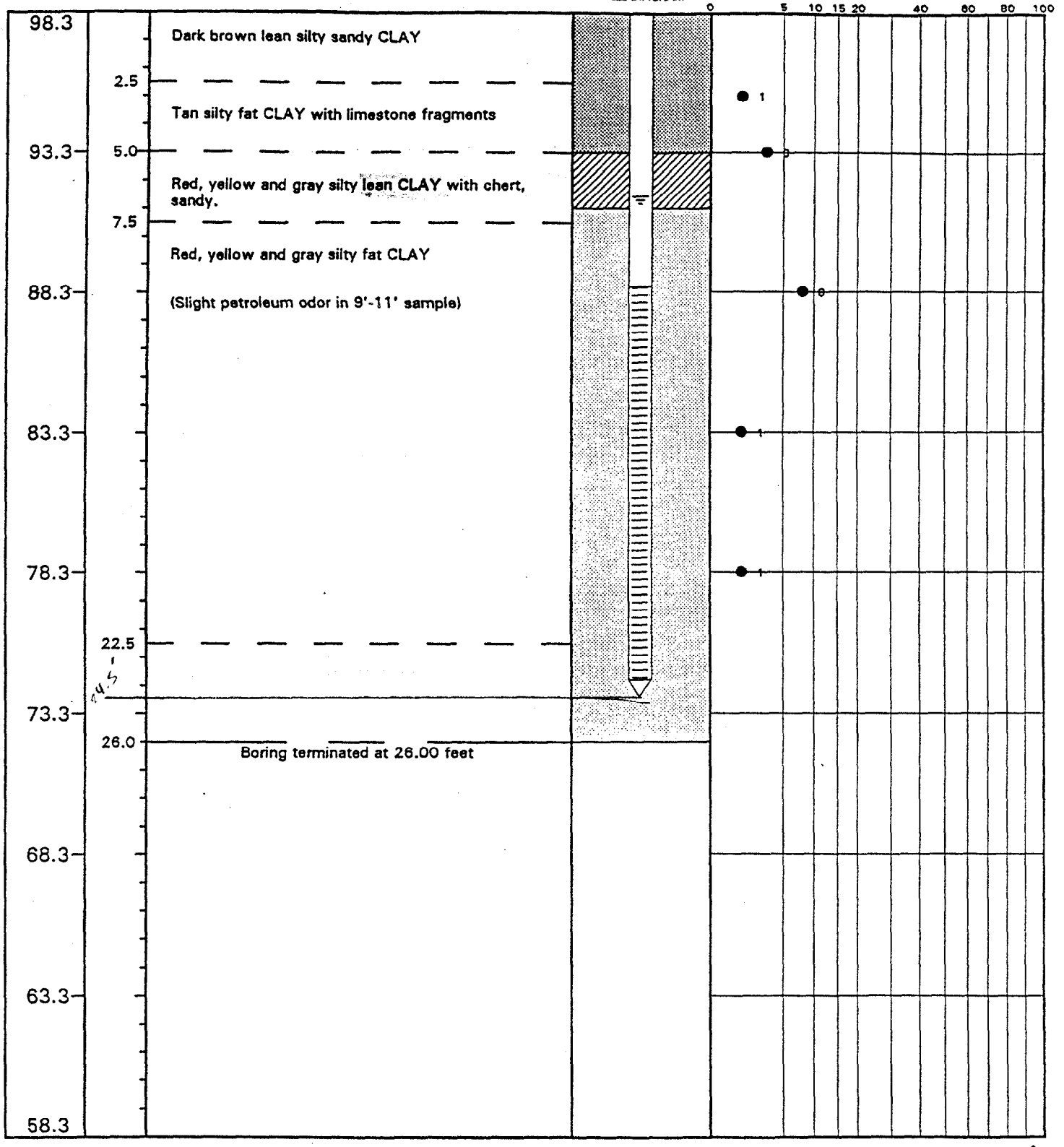

EXISTING UST PIT
EXISTING SERVICE STATION BUILDING 3240
NORTH
MW-2
24/131
12.7
OIL-WATER SEPARATOR
MW-3
4,000/31,200
990
MW-4
480/1,385
110
SB-1
MW-1
130/200
22
SB-2
PROPOSED BRANCH EXCHANGE CLASS SIX
MW-5
2,100/3,190
64
LEGEND:
SB-1 SOIL BORING LOCATION
MW-1 MONITORING WELL LOCATION
24/121 BENZENE/TOTAL BETX (ppb)
22.2 TOTAL PAH (ppb)
0 20 40 80 120
SCALE IN FEET
BASE MAP SOURCE: "SITE PLAN" PROVIDED BY AAFES
LAW ENGINEERING, INC.
Birmingham, Alabama
GROUND WATER ANALYTICAL DATA
AAFES BRANCH EXCHANGE EXPANSION
REDSTONE ARSENAL
HUNTSVILLE, ALABAMA
Drawing No. 6
Job No.
Drawn BAW
Checked:
Approved:
11/22/93
Scale:
H:
V:
1"=40'

APPENDIX A
TEST BORING RECORDS

RS 614

TEST BORING RECORD

AAFES-BRANCH EXTENSION



REMARKS:
- Well Diameter: 2"
- Well Material: SCH 40 PVC
- Screen Size: 0.010"
- Drilling Method: HSA
- Sampling Method: Split Spoon
- PID: Photoionization Detector
- ⏚ Stabilized Water Level 11/3/93

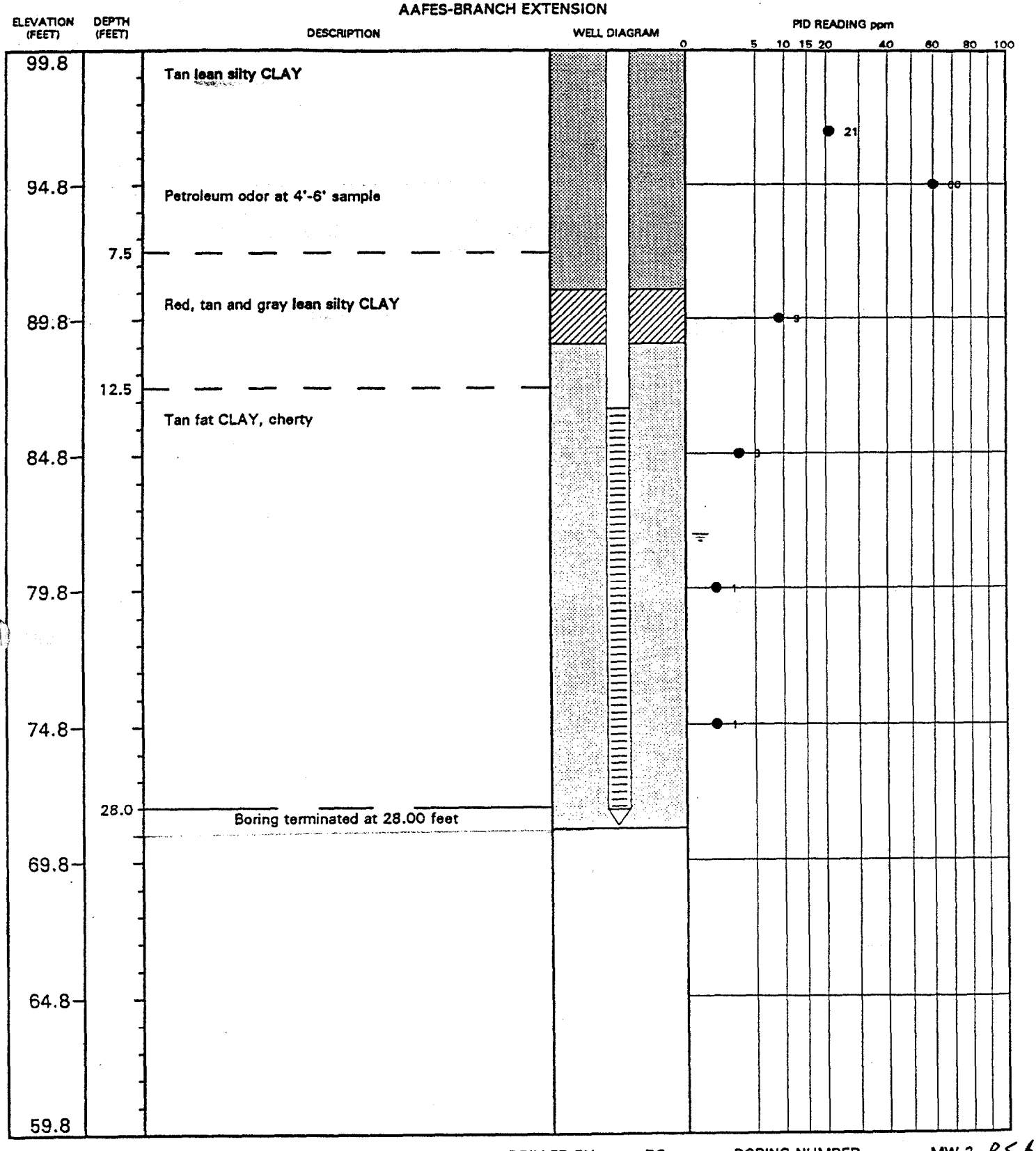
DRILLED BY	DC
LOGGED BY	ADR
CHECKED BY	
BORING NUMBER	MW-1 RS-61
DATE STARTED	10/18/93
DATE COMPLETED	10/18/93
JOB NUMBER	423-93-277-02

Law Engineering Inc.

RS 615

TEST BORING RECORD

AAFES-BRANCH EXTENSION



REMARKS:
Well Diameter: 2"
Well Material: PVC
Screen Size: 0.010"
Drilling Method: HSA
Sampling Method: Split Spoon
PID: Photoionization Detector
Stabilized Water Level 11/3/93

DRILLED BY	DC
LOGGED BY	ADR
CHECKED BY	acl

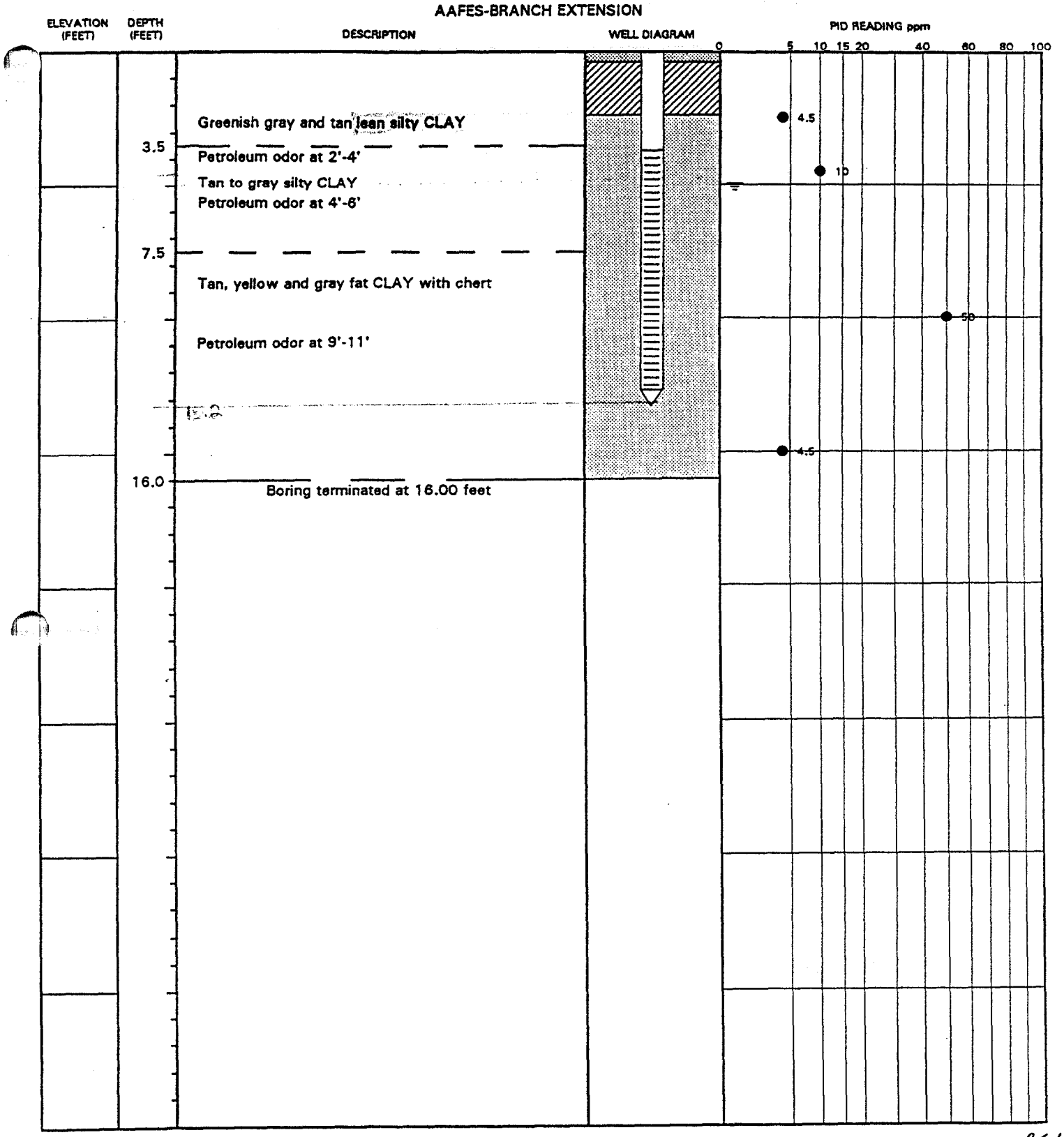
BORING NUMBER	MW-2 RS 615
DATE STARTED	10/19/93
DATE COMPLETED	10/19/93
JOB NUMBER	423-93-277-02

Law Engineering Inc.

RS616

TEST BORING RECORD

AAFES-BRANCH EXTENSION



REMARKS:
Well Diameter: 2"
Well Material: PVC
Screen Size: .010"
Drilling Method: HSA
Sampling Method: Split Spoon
PID: Photoionization Detector
Stabilized Water Level 11/3/93

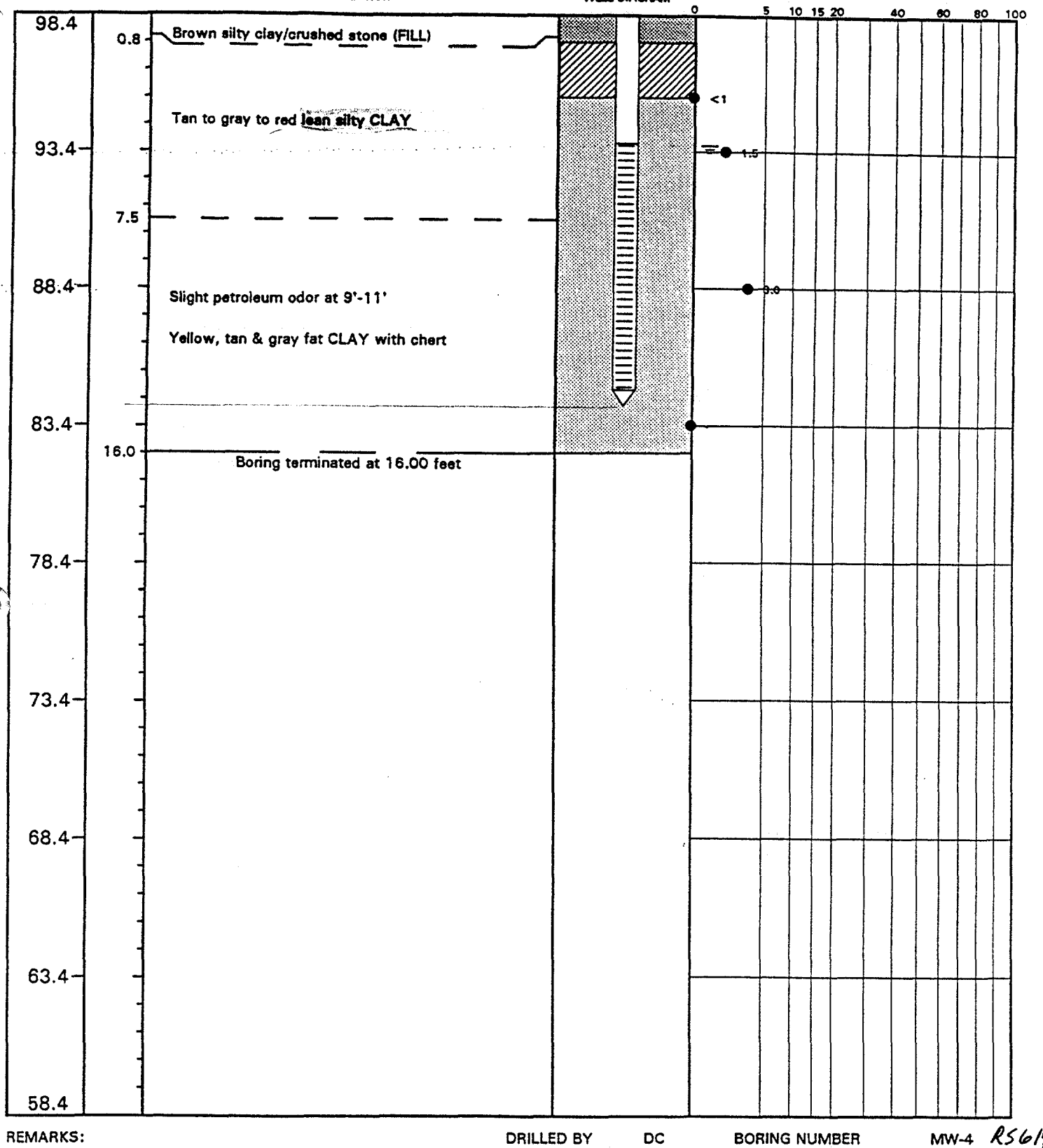
DRILLED BY	DC	BORING NUMBER	MW-3 RS616
LOGGED BY	ADB	DATE STARTED	10/19/93
CHECKED BY		DATE COMPLETED	10/19/93
		JOB NUMBER	423-93-277-02

Law Engineering Inc.

RS617

TEST BORING RECORD

AAFES-BRANCH EXTENSION



REMARKS:
- Well Diameter: 2"
- Well Material: PVC
- Screen Size: 0.010"
- Drilling Method: HSA
- Sampling Method: Split Spoon
- PID: Photoionization Detector
- ⌯ Stabilized Water Level 11/3/93

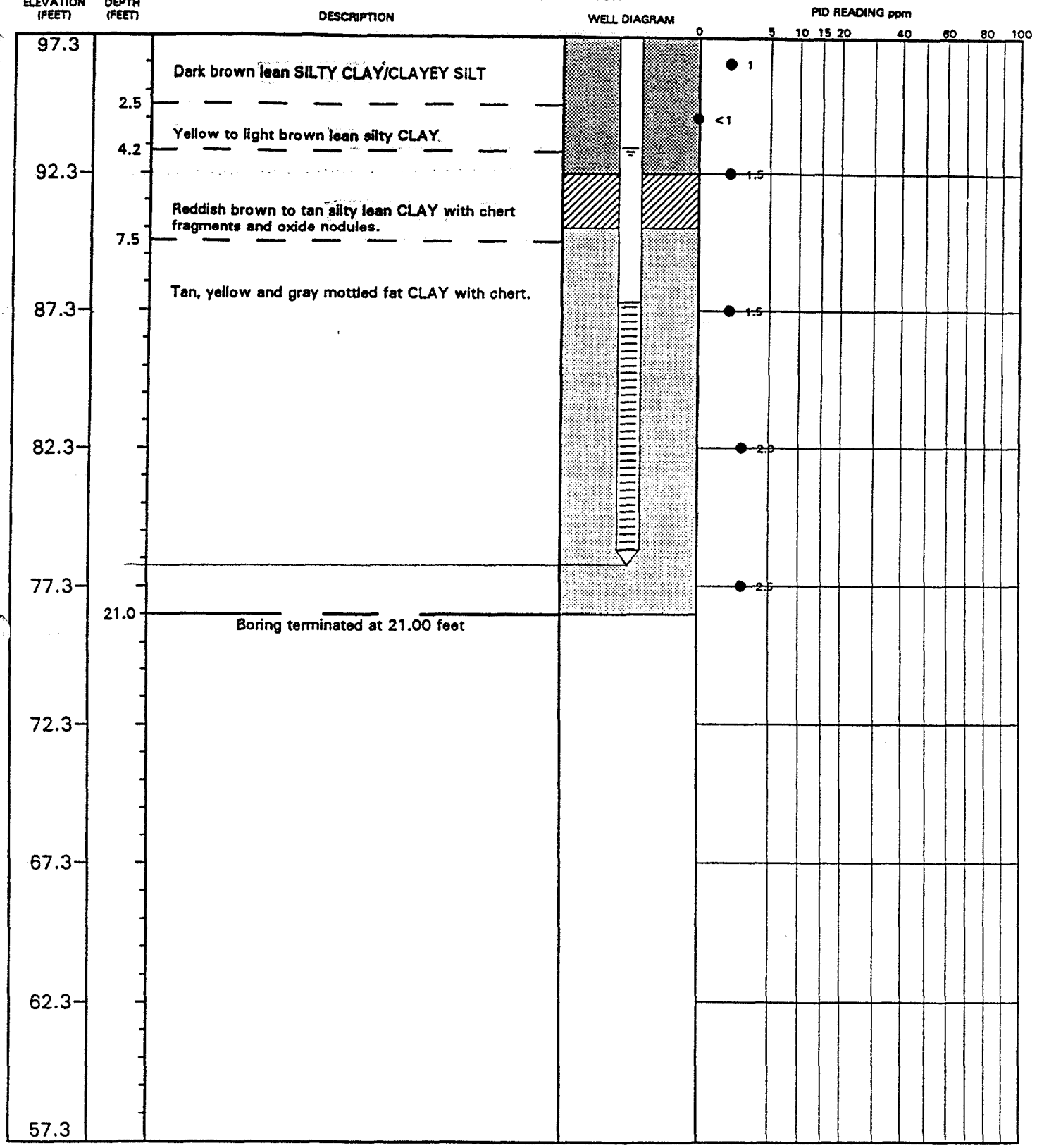
DRILLED BY	DC	BORING NUMBER	MW-4 RS619
LOGGED BY	ADR	DATE STARTED	10/19/93
CHECKED BY	ADR	DATE COMPLETED	10/19/93
		JOB NUMBER	423-93-277-02

Law Engineering Inc.

R5618

TEST BORING RECORD

AAFES-BRANCH EXTENSION



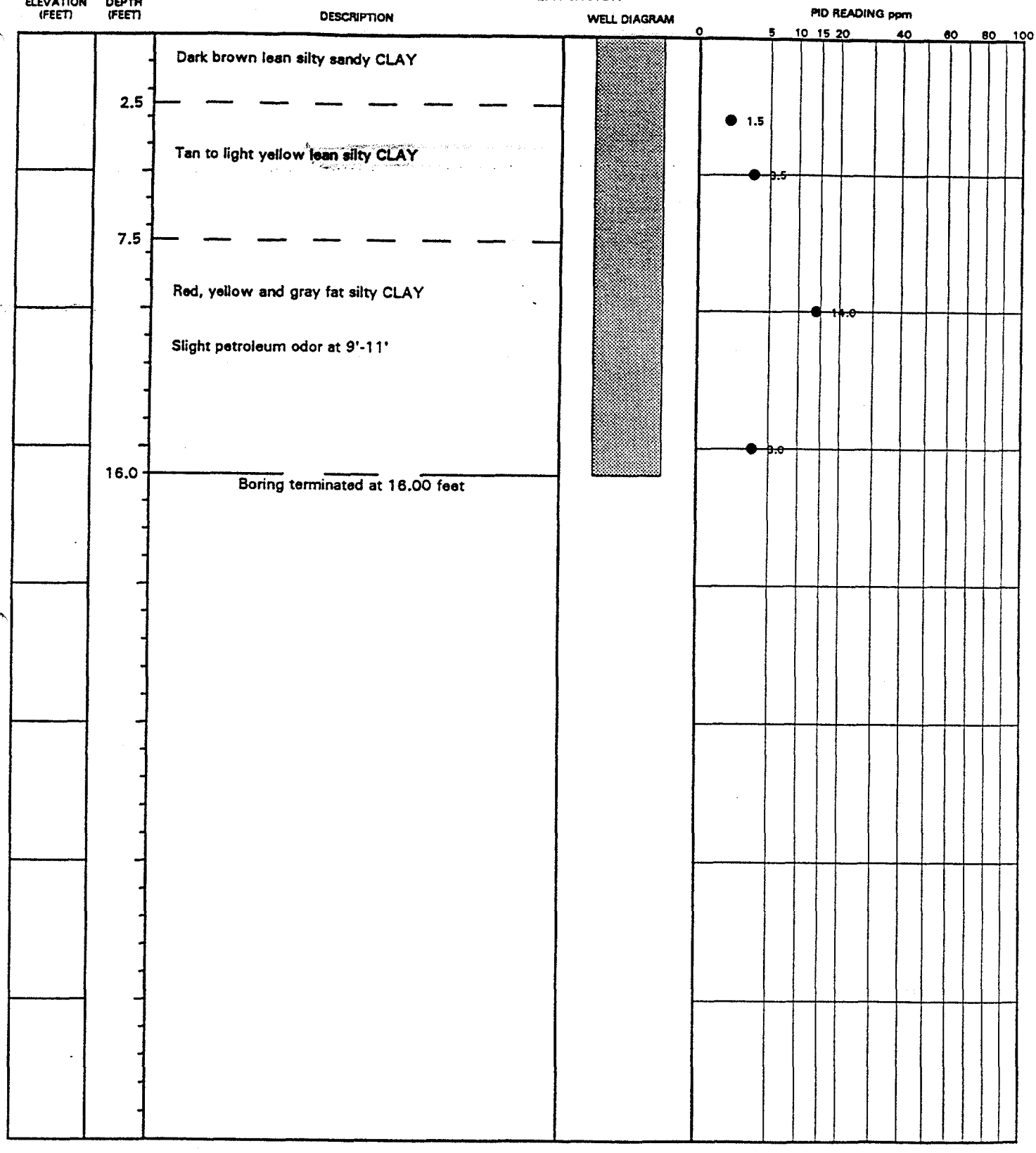
REMARKS:
Well Diameter: 2"
Well Material: PVC
Screen Size: 0.010"
Drilling Method: HSA
Sampling Method: Split Spoon
PID: Photoionization Detector
⌯ Stabilized Water Level 11/3/93

DRILLED BY	DC
LOGGED BY	ADR
CHECKED BY	ADR
BORING NUMBER	MW-5 R5618
DATE STARTED	10/19/93
DATE COMPLETED	10/19/93
JOB NUMBER	423-93-277-02

Law Engineering Inc.

TEST BORING RECORD

AAFES-BRANCH EXTENSION



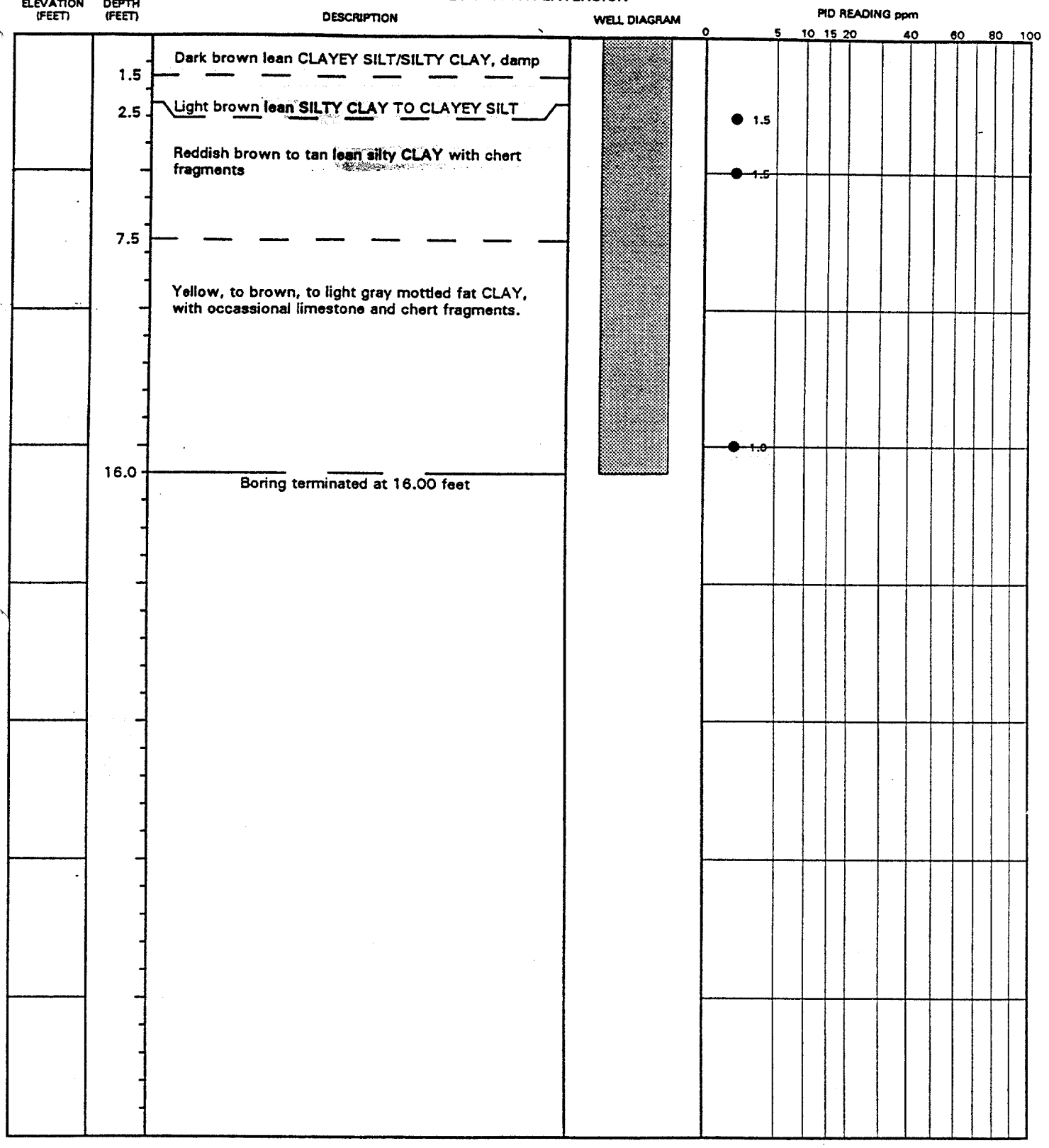
REMARKS:
Drilling Method: HSA
Sampling Method: Split Spoon
PID: Photoionization Detector

DRILLED BY	DC	BORING NUMBER	SB-1
LOGGED BY	ADR	DATE STARTED	10/19/93
CHECKED BY	adr	DATE COMPLETED	10/19/93
		JOB NUMBER	423-93-277-02

Law Engineering Inc.

TEST BORING RECORD

AAFES-BRANCH EXTENSION



REMARKS:
Drilling Method: HSA
Sampling Method: Split Spoon
PID: Photoionization Detector

DRILLED BY	DC	BORING NUMBER	SB-2
LOGGED BY	ADR	DATE STARTED	10/19/93
CHECKED BY	ADR	DATE COMPLETED	10/19/93
		JOB NUMBER	423-93-277-02

Law Engineering Inc.

APPENDIX B
SOIL ANALYTICAL DATA SHEETS

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526

November 11, 1993

Mr. Dale Rainey
Law Engineering, Inc.
401 Franklin Street
Huntsville, AL 35801
Clt.#12024 Proj.#423-93-277-02

Dear: Mr. Rainey:

Below are the results of analysis of 6 samples received for examination on October 23, 1993:

Sample I.D. AA45171 Location code: BRANCH
Purchase order number: 42393277 Project account code: 12024
Location Description: MW-1 9-11ft
Sample collector: RAINEY
Sample collection date: 10/18/93 Time: 14:30
Lab submittal date: 10/23/93 Time: 17:16

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
2323-Tot. Pet. Hydro. Prep. Soil		Done	
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel	mg/Kg	Not detected	3.2
Multicomponent analysis: 2321-TPHVS Cal-DHS Gasoline	mg/Kg	.55	.26

Sample I.D. AA45172 Location code: BRANCH
Purchase order number: 42393277 Project account code: 12024
Location Description: MW-2 4-6ft Sample collector: RAINEY
Sample collection date: 10/19/93 Time: 10:00
Lab submittal date: 10/23/93 Time: 17:16

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
2323-Tot. Pet. Hydro. Prep. Soil		Done	
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel	mg/Kg	68	34
Multicomponent analysis: 2321-TPHVS Cal-DHS Gasoline	mg/Kg	630	25

Sample I.D. AA45173 Location code: BRANCH
Purchase order number: 42393277 Project account code: 12024
Location Description: MW-3 9-11ft
Sample collector: RAINEY
Sample collection date: 10/19/93 Time: 13:25
Lab submittal date: 10/23/93 Time: 17:16

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
2323-Tot. Pet. Hydro. Prep. Soil		Done	
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel	mg/Kg	37	35
Multicomponent analysis: 2321-TPHVS Cal-DHS Gasoline	mg/Kg	180	13

Sample I.D. AA45174 Location code: BRANCH
Purchase order number: 42393277 Project account code: 12024
Location Description: MW-4 9-11ft
Sample collector: RAINEY
Sample collection date: 10/19/93 Time: 12:30
Lab submittal date: 10/23/93 Time: 17:16

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
2323-Tot. Pet. Hydro. Prep. Soil		Done	
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel	mg/Kg	Not detected	3.3
Multicomponent analysis: 2321-TPHVS Cal-DHS Gasoline	mg/Kg	1.5	.26

Sample I.D. AA45175 Location code: BRANCH
Purchase order number: 42393277 Project account code: 12024
Location Description: MW-5 19-21ft
Sample collector: RAINEY
Sample collection date: 10/19/93 Time: 15:30
Lab submittal date: 10/23/93 Time: 17:16

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
2323-Tot. Pet. Hydro. Prep. Soil		Done	
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel	mg/Kg	Not detected	3.

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
Multicomponent analysis: 2321-TPHVS Cal-DHS Gasoline	mg/Kg	Not detected	.26

Sample I.D. AA45176
Location code: BRANCH
Purchase order number: 42393277
Project account code: 12024
Location Description: B-2 4-6ft
Sample collector: RAINEY
Sample collection date: 10/19/93
Time: 16:20
Lab submittal date: 10/23/93
Time: 17:16

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
2323-Tot. Pet. Hydro. Prep. Soil		Done	
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel	mg/Kg	Not detected	3.
Multicomponent analysis: 2321-TPHVS Cal-DHS Gasoline	mg/Kg	Not detected	.2

Please advise should you have questions concerning these data.

Respectfully submitted,

D. Abbott for
James M.G. Tucci, Laboratory Manager

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526

November 16, 1993

Mr. Dale Rainey
Law Engineering, Inc.
401 Franklin Street
Huntsville, AL 35801
Clt.#12024 Proj.#423-93-277-02

Dear: Mr. Rainey:

Below are the results of analysis of 5 samples received for examination on October 27, 1993:

Sample I.D. AA45362 Location code: AAFES2
Purchase order number: 42393277 Project account code: 12024
Location Description: HA-1 0.4-0.8ft
Sample collector: RAINEY
Sample collection date: 10/25/93 Time: 16:25
Lab submittal date: 10/27/93 Time: 08:11

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
2323-Tot.Rec. O&G Grav. EPA 9071	mg/Kg	370	10.0
2310-LDRL Ext. Met. S. EPA 1311		Done	
Multicomponent analysis: 2310-LDRL Metals EPA 6010			
Arsenic	ug/L	Not detected	42
Barium	ug/L	560	30
Cadmium	ug/L	Not detected	4.0
Chromium	ug/L	8.0	8.0
Lead	ug/L	Not detected	37
Selenium	ug/L	Not detected	79
Silver	ug/L	Not detected	8.0
Multicomponent analysis: 2310-LDRL Mercury Cold Vapor			
Mercury	ug/L	Not detected	0.2

Sample I.D. AA45363 Location code: AAFES2
Purchase order number: 42393277 Project account code: 12024
Location Description: HA-2 0.4-0.8ft
Sample collector: RAINEY
Sample collection date: 10/25/93 Time: 16:45
Lab submittal date: 10/27/93 Time: 08:11

TEST PARAMETER	UNITS	TEST RESULT	DETECTIO
2323-Tot.Rec. O&G Grav. EPA 9071	mg/Kg	260	10.