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TO: Maria Peeler

THROUGH: Bill Yake

FROM: Randy Coots

SUBJECT: Sampling and Analysis Plan for a Survey of Creosote and
Pentachlorophenol in Ground Water at Cascade Pole, Port of
Olympia

DATE: February 27, 1989

INTRODUCTION

In response to your request a plan for sampling and chemical analysis has been developed to obtain additional data on wood preservatives and other contaminants in ground water at the Cascade Pole site in Olympia. The last comprehensive survey was conducted by Applied Geotechnology Inc. in late 1985 (AGI, 1986). A re-survey is required to determine current levels of contamination and to establish a basis for clean-up.

SITE DESCRIPTION

The Cascade Pole site is located on a small peninsula that extends into Budd Inlet in southern Puget Sound (see Figure 1). The property is owned by the Port of Olympia and has been the site of wood preserving operations since 1939. Power poles were preserved with creosote under high pressure and temperature until 1957 when Cascade Pole leased the land from the Port and operated the treating facility until October 1986, using a pentachlorophenol solution in aromatic oil. Plant facilities currently consist of a few small buildings including an office, shop, the treating plant and transfer table. The facility is now abandoned.

The site and surrounding area was originally a tidal flat that was filled to its present level. The Port of Olympia has deep-water loading docks along the West Bay side. Tide flats along the eastern and southeastern border of the treating facility were filled in the early 1980s and a marina was established in East Bay.

AGI (1986) has theorized there are three aquifers--a lower aquifer and two upper aquifers--beneath Cascade Pole. The two upper aquifers are located within the fill deposits--a pre-1980 fill underlying most of the site, and a post-1980 fill along the south and southeastern site boundaries. The properties of the boundary separating the two aquifers are not well defined; it may consist of an accumulation of fine

grained sediments with low permeability, bulkheads, or retaining structures along the old shorelines. The hydrology of the upper aquifers is not well understood due to the complex stratigraphy resulting from several fills placed over time, and the lack of detailed hydrogeologic data.

Based on borehole logs, the materials making up the fill are generally loose, fine-to-coarse interlayered sand, silty sand, and silt (AGI, 1984). The upper aquifers are unconfined and susceptible to contamination from the ground surface.

A survey to determine tidal influence on the ground water was conducted in May 1988 by Black & Veatch, consultants for Ecology (Black & Veatch, 1988). In the upper aquifer they determined a ground water mound exists in the south-central portion of the site having a northwest trending axis and ending around monitoring well AG-16. This appeared to be the dividing line for ground water flow to East and West Bays. Ground water elevations were highest under the facility and dropped off as the shoreline was approached. Ground water flow from the southwest mound is into East Bay at all tidal stages. Black & Veatch theorizes the seeps occurring offshore are probably a result of this predominant flow pattern. Tidal responses in lower aquifer monitoring wells were greatest along the northern site boundary adjacent to East Bay.

The lower aquifer consists primarily of greenish-gray sand, silty sand, and sandy gravel with minor amounts of silt and clay (AGI, 1986). The thickness of the lower aquifer reportedly averages 45 feet and ranges from roughly 25 to 50 feet. The top of the lower aquifer is approximately 30 to 34 feet below ground surface. An upper aquitard separates the upper and lower aquifers and consists of silts and clay (AGI, 1984). It ranges in thickness from 10 to 40 feet and was encountered in all well borings as a continuous layer across the site (AGI, 1986). The lower aquitard underlies the lower aquifer and consists of a thick sequence of lacustrine silts and clays. Borings on the site were terminated after encountering 32 feet of the stiff, laminated, slightly silty clays (AGI, 1986).

Thurston County Environmental Health records indicate 18 water supply wells exist within a one mile radius of the site (AGI, 1986). All of these wells reportedly are completed in confined aquifers and flow under artesian pressure. Two of these wells are known to be used currently by King Solomon's Reef and The Spar Restaurant on 4th Avenue. In addition, a water supply well was reportedly used at Cascade Pole (see Figure 2).

Ecology inspection reports document contaminant discharges from the Cascade Pole site to Budd Inlet from the early- to the mid-1970s. In 1983, extensive creosote contamination was discovered in a trench dug along the south end of the site during construction of East Bay Marina (Anderson and Pierce, 1983). Creosote discharge to Budd Inlet via the West Bay storm drain was also observed, apparently a result of the trench being dug (Anderson and Cloud, 1983). Ecology requested Cascade Pole conduct an investigation to determine the extent of the problem (Pierce, 1983). In response to this request, Cascade Pole excavated test pits and later installed ground water monitoring wells at the site.

REVIEW OF EXISTING DATA

A summary of available data on pentachlorophenol (PCP) and polyaromatic hydrocarbons (PAH) concentrations in ground water at Cascade Pole are included in Table 1. A total of 103 ground water samples have been collected at the site since August 24, 1983. Upper aquifer concentrations of PCP have ranged from <0.05 to 34,000 ug/L (well N-24; ERT, 1987) and total PAH from <4 to 400,000 ug/L (test hole 6; Stoddard, 1983). Thirteen water samples have been taken from the lower aquifer monitoring wells and have not had detectable contamination (AGI, 1986).

The most recent comprehensive data on distribution of contaminants in ground water at Cascade Pole is from AGI's previously mentioned survey of July 1985. Forty-one ground water samples were collected and indicated considerable variation in contaminant concentrations across the site (Figure 3 and 4). In the vicinity of the treating plant, PCP concentrations ranged from <1.6 to 31,000 ug/L and total PAH concentrations were between 4,600 and 360,000 ug/L, the highest concentrations being in well N-26. In the southwest portion of the property, concentrations ranged from <20 to 2,300 ug/L for PCP and from 25 to 6,400 ug/L for PAH; well A-7 had the highest concentrations.

Previous ground water samples at Cascade Pole have not had a complete EPA priority pollutant/hazardous substances list (HSL) compounds analysis. PCBs, pesticides and cyanide have never been analyzed. Volatiles and metals (copper and arsenic) analyses were limited to two wells sampled by Ecology in 1985 (Johnson and Norton, 1985); AGI sampled four wells the same year for lead (AGI, 1986). Results showed benzene, ethylbenzene, toluene, and total xylenes concentrations up to 700 ug/L in wells N-28 and N-4; copper and arsenic concentrations were 154 and 123 ug/L in well N-28, and 84 and 5 ug/L in well N-4, respectively. Results of lead analysis showed 46 ug/L in well AG-8 and <2 ug/L in wells AG-1, N-28, and AG-7.

Analyses of water samples from water/product seeps located in the East Bay intertidal zone between the NPDES discharge and northeast corner of the site showed PCP concentrations ranging from <99 to 190,000 ug/L and total PAH concentrations from 21 to 5,500,000 ug/L. Analysis of soil and product from the site has shown chlorinated dioxins up to 56,800 ng/g and 89,800 ng/ml, respectively, and dibenzofurans of up to 22,900 ng/g and 19,700 ng/ml, respectively; 2,3,7,8-tetrachlorodibenzo-dioxin has not been detected (Bradley, 1987b).

OBJECTIVES OF SURVEY

The objectives of the proposed survey will be as follows:

- o Obtain ground water samples from existing shallow and deep monitoring wells, and analyze for PCP, PAH, and (in selected wells) other EPA priority pollutants/HSL compounds.
- o Assess changes in concentrations and areal distribution of contaminants.

- o Provide baseline data to assess clean-up requirements and identify data gaps.

SELECTION OF SAMPLING WELLS

All monitoring wells will be sampled except those previously identified by Ecology as having floating product (i.e., N-24B, N-26, N-27). Only product thickness will be measured in these wells. Ground water samples will be collected from a total of 28 monitoring wells (Table 2). Two surface water discharges will also be sampled: the NPDES outfall to East Bay and the West Bay storm drain. Monitoring wells, NPDES outfall, and West Bay storm drain locations are identified on Figure 2.

As of this writing, the Port of Olympia is conducting a geologic investigation of the Cascade Pole site perimeter. If product is found, the present sampling plan will be expanded based on negotiation between McFarland Cascade and Ecology.

SAMPLING PROCEDURES¹

The integrity of each well must be determined before it is sampled. Only properly constructed monitoring wells will be sampled.

The following procedure will be used to reduce the possibility of cross-contamination of sampling equipment and wells. Deep monitoring wells will be sampled first. The sampling sequence will proceed from areas of low surface soil contamination to areas of high surface soil contamination (AGI, 1986). This sampling sequence is given in Table 2. The sampling sequence for shallow monitoring wells will proceed from the least contaminated wells to the most contaminated wells based on results from AGI's 1986 survey. This sampling sequence is shown in Table 2 and depicted graphically in Figure 2.

After well caps are removed, an interface probe will be used to determine if floating product is present. If floating product is found, its thickness will be measured and documented and a product sample collected for analysis of PAH, PCP and volatiles. Following determination of the presence or absence of floating product, the static water level will be measured with an electric measuring device and the well volume calculated. Well information is contained in Table 2, and well logs are in Attachment 2.

¹An adequate Site Safety and Health Plan will be followed during all field work.

Three well volumes will be purged from monitoring wells prior to sampling. Shallow monitoring wells will be purged with a teflon bailer. Deep monitoring wells will be purged with a centrifugal pump and dedicated polyethylene tubing. Purge waters will be drummed on-site, sampled for designation, and appropriately removed and treated within 90 days. Pumping rates will be adjusted to prevent overpumping of the well. If the recharge rate is determined to be too slow, additional time will be allowed for purging/sampling that well. The same procedure will be repeated for all 28 wells.

Ground water samples will be withdrawn with teflon bailers and transferred to the appropriate sample container. A separate, co-temporaneous grab sample will be used to measure temperature, pH, and specific conductivity. Significant color and odor will be noted. The West Bay storm drain will be sampled at low tide; a grab sample of this discharge will be analyzed for salinity. All samples will be preserved on ice immediately upon being sealed and labeled. All field procedures, sampling times, and other field data will be documented in field log books.

Appropriate sample containers, cleaning procedures, preservation, and required holding times to analysis are described in Table 3. Each sample will be tagged with the following information in indelible ink: name of collector, date and time of collection, station, sample number which uniquely identifies the sample, and type of analysis required. The chain of custody will be maintained for all samples taken at the site. Ecology chain-of-custody procedures are included in Attachment 1.

All equipment will be cleaned before it is brought on-site. Teflon bailers for purging/sampling will be cleaned between each well with sequential rinses of non-phosphate detergent, deionized water, acetone and methylene chloride. Equipment will then be allowed to air-dry. All decontaminated equipment will be placed in new polyethylene bags until used. The water level measuring tape and interface probe will be cleaned in the field after use at each well, with non-phosphate detergent and deionized water. The field temperature, pH, and specific conductivity meters will be cleaned after each use by prolonged flushing with deionized water. More extensive cleaning may be required if product is encountered. A list of equipment is contained in Table 4.

ANALYTICAL PROTOCOLS

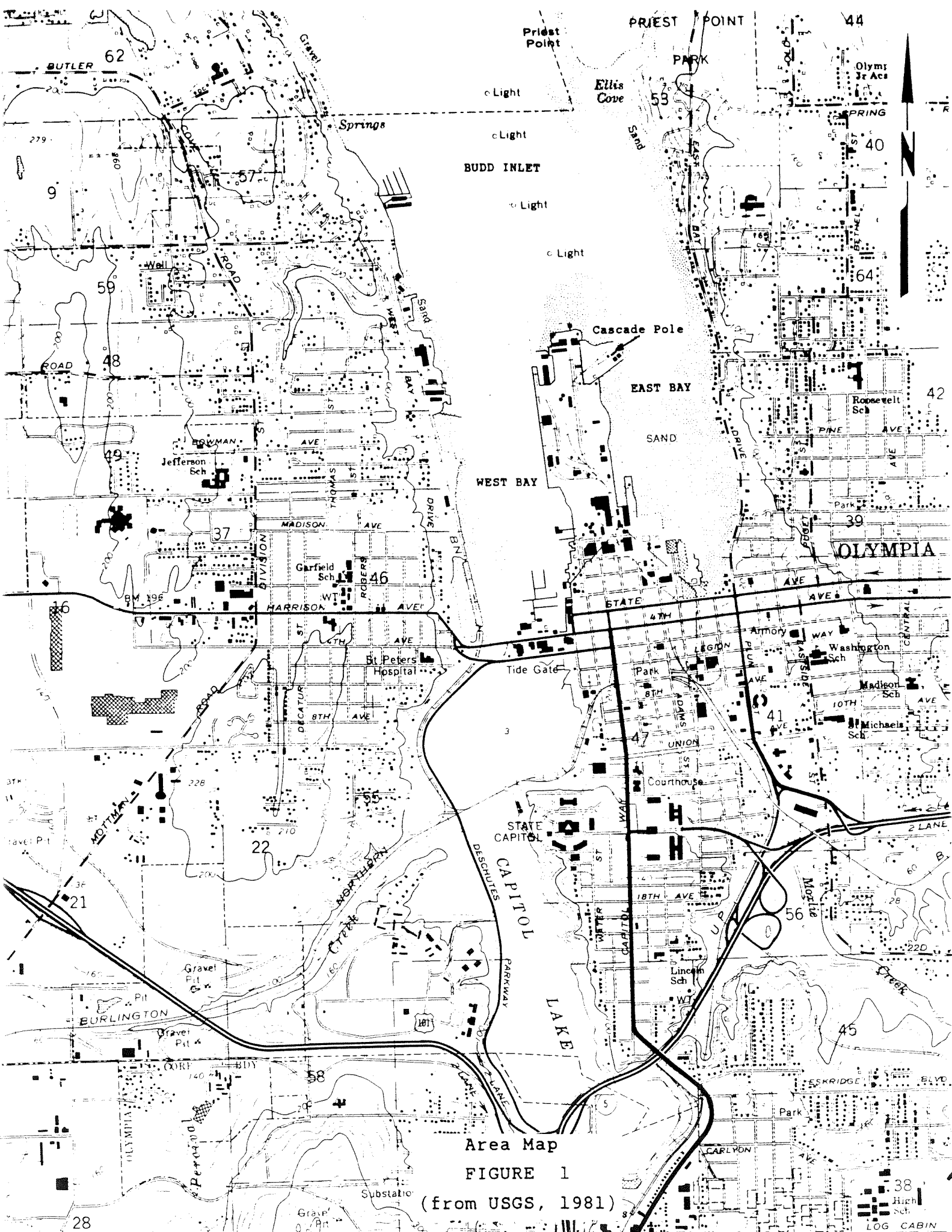
Ground water samples from all wells will be analyzed for PCP, PAH, volatiles and chlorides. A complete priority pollutant scan (i.e., acid/base/neutrals, volatiles, metals [13], pesticides/PCBs, and cyanide, in addition to PCP and PAH) will be done for deep monitoring wells AG-7D and AG-1D, shallow wells AG-12S, AG-4S, S-4, AG-16S, AG-7S, AG-1S, and the NPDES outfall and West Bay storm drain discharges. These sites were selected to include some of the most contaminated wells (based on AGI's 1985 survey) and give broad spatial coverage. The analytical methods to be employed are shown in Table 5. Low detection limits will be required for PCP (0.01-0.1 ug/L), PAH (0.013-2.3 ug/L), and metals (0.05-3.0 ug/L).

QUALITY ASSURANCE

Field sampling	<p>Quality assurance samples will be collected by field personnel. There will be two transport blanks each for PCP, PAH, and volatiles, and one transport blank each for acid/base/neutrals, metals, pesticides/PCBs and cyanide. Transport blanks will consist of the appropriate sample container filled with carbon-free water, carried into the field unopened, and shipped as a sample. There will also be two bailer blanks each for PCP, PAH, and volatiles, and one bailer blank each for acid/base/neutrals, metals, pesticides/PCBs, and cyanide. Bailer blanks will be prepared by pouring carbon-free water into bailers following decontamination, transferring to sample containers, and shipping as a sample.</p> <p>Field replicate samples will be taken at wells AG-16S and AG-7S. Duplicate laboratory analysis will be done for each field replicate. Replicate samples should be collected in sufficient volume to achieve target detection limits on split samples.</p>
Laboratory	<p>EPA Contract Laboratory Program requirements will be followed for sample holding times, matrix spikes and surrogate compound recoveries, and method blanks. In addition, standard reference materials (SRMs) for PCP and PAH will be submitted in duplicate, as a portion of the normal sample shipment. SRM 1584, Phenols in Methanol, at a certified PCP concentration of 15,400 ug/L, and SRM 1647, Priority Pollutant PAH (in Acetonitrile), with certified PAH concentrations of 3,290 to 22,500 ug/L will be used. These concentrations are within ranges observed in the study area. Results of SRM analyses will be compared to certified values to evaluate the accuracy of the data. These SRMs can be obtained from the National Bureau of Standards.</p> <p>Table 6 contains a summary of the number of samples to be analyzed and an estimate of analytical costs.</p>
QA review	<p>Complete CLP package of deliverables will be reviewed by an outside expert.</p>

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Area Map
 FIGURE 1
 (from USGS, 1981)

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 High Sch
 LOG CABIN

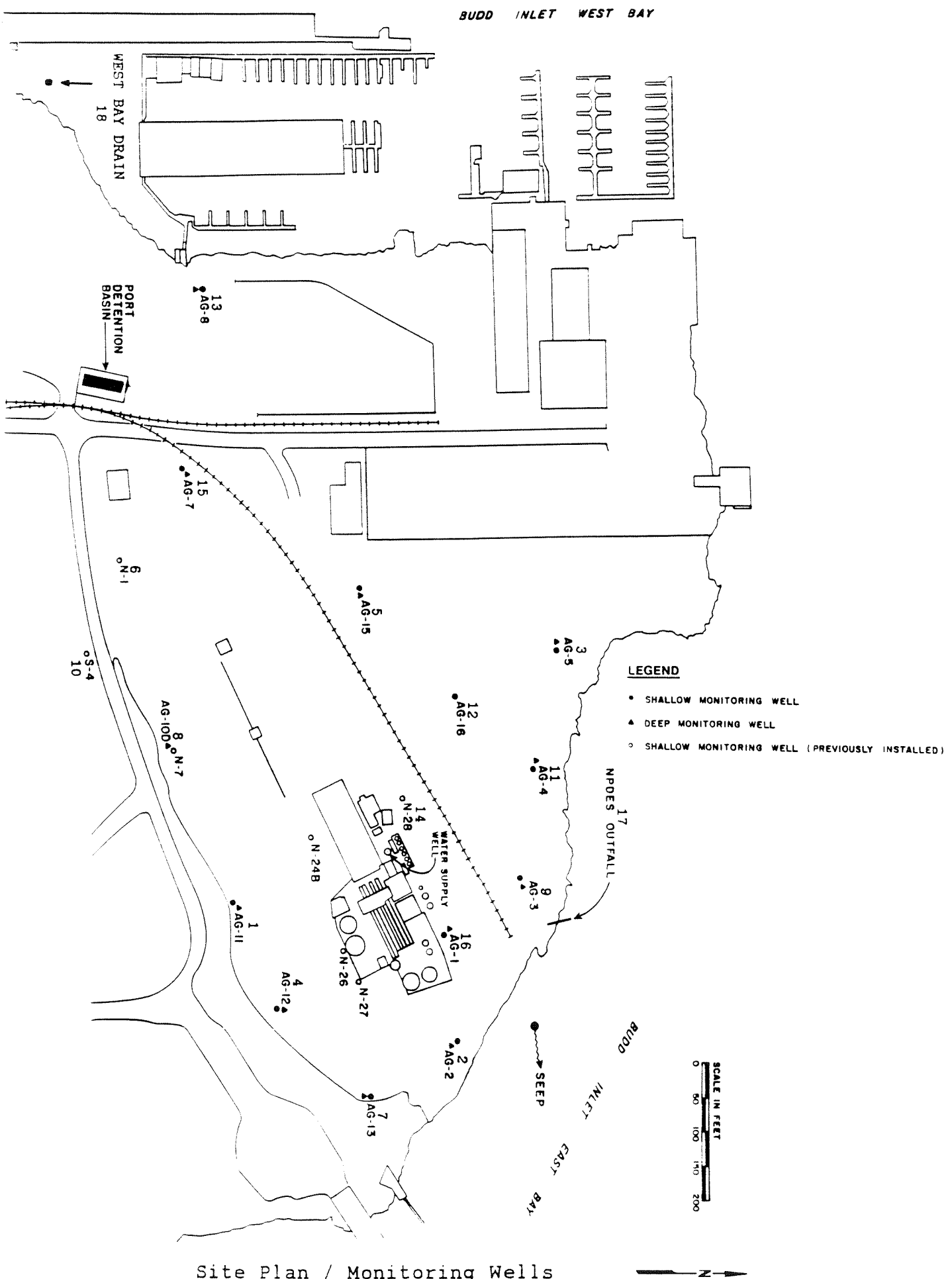
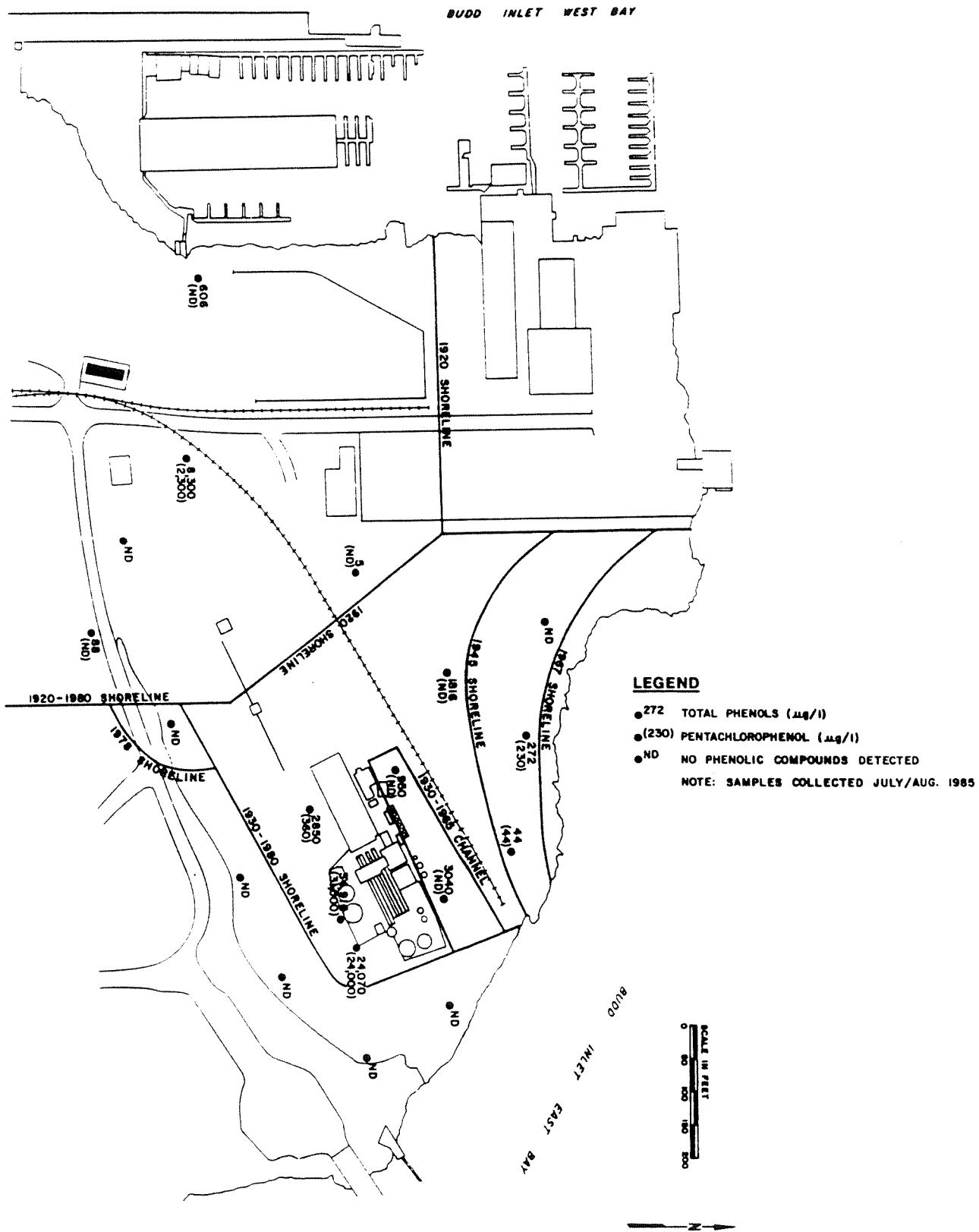


FIGURE 2

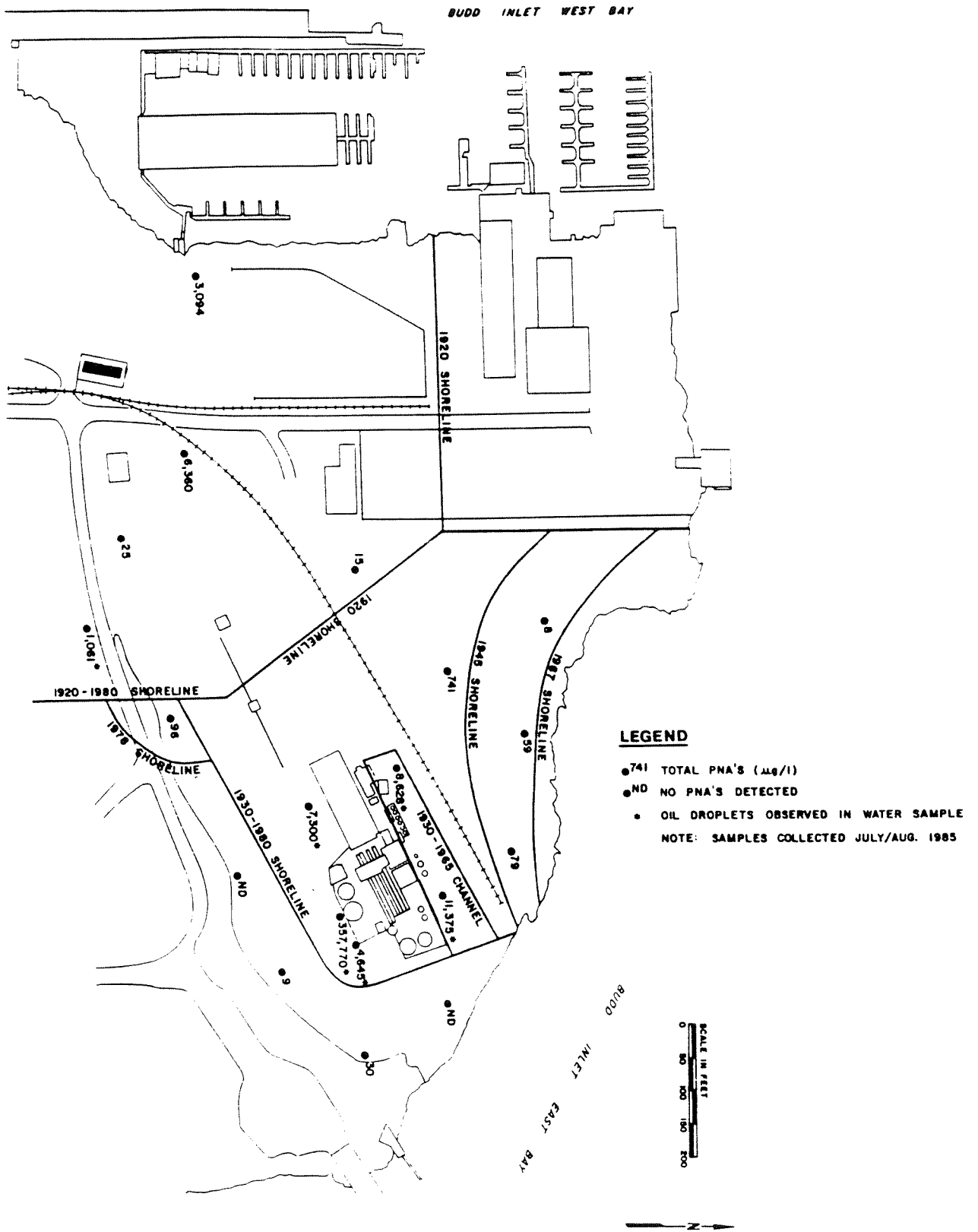
(from AGI, 1986)



Distribution of Pentachlorophenol and Total Phenols
in Shallow Monitoring Wells at Cascade Pole

FIGURE 3

(from AGI, 1986)



Distribution of Total PAH (PNA's) in Shallow
Monitoring Wells at Cascade Pole

FIGURE 4

(from AGI, 1986)

Table 1. History of Ground Water Sampling for PCP and PAH at Cascade Pole and Range of Concentrations Observed.

Sampling Date	Investigator (Reference)	Number of Samples	Pentachlorophenol (ug/L)	Total PAH (ug/L)
08-24-83	Cascade Pole (Stoddard, 1983)	12	<0.05-18,000	10-400,000
11-22-83	AGI (AGI, 1985)	35	4.0-29,000	200-24,100
02-13-85	ECOLOGY (Johnson and Norton, 1985)	2	92-1,900	7,900-39,000
07-17-85	AGI (AGI, 1986)	41	6-31,000	<4-360,000
10-01-86	AGI (ERT, 1987)	3	<10-2,800	2,100-10,000
10-02-86	AGI (ERT, 1987)	3	<100-34,000	3,400-6,200
12-04-86	ECOLOGY (Bradley, 1987a)	1	190,000 (a)	5,500,000 (a)
06-24-87	ECOLOGY (McCall, 1987)	4	<99 (a)	21J-4,100,000 (a)
03-10-88	ECOLOGY (Peeler, 1988)	1	11,000 (a)	NA
05-04-88	ECOLOGY (Peeler, 1988)	1	0.008 (b)	2.4 (b)
07-29-88	ECOLOGY (Huntamer, 1988)	1	9,300,000 (a)	>10,000,000 (a)

(a) = two phase sample, concentration may or may not represent ground water quality

(b) = sample from open ditch adjacent to Cascade Pole

J = estimated concentration

NA = not analyzed

Table 2. Monitoring Well Information and Suggested Sampling Sequence (from personal communication with Teri Floyd, AGI).

Well Number	Sampling Sequence	Total Depth (feet)	Screen Depth (feet)	Well Diameter
<u>Lower Aquifer</u>				
AG-8D	1	49.5	42.3 to 47.6	2 " PVC
AG-7D	2	46.9	40.7 to 46.0	2 " PVC
AG-2D	3	39.8	33.5 to 38.8	2 " PVC
AG-13D	4	39.0	33.0 to 38.3	2 " PVC
AG-12D	5	39.0	30.8 to 36.1	2 " PVC
AG-11D	6	38.6	32.7 to 38.0	2 " PVC
AG-10D	7	41.0	35.1 to 40.5	2 " PVC
AG-5D	8	41.8	36.1 to 41.4	2 " PVC
AG-4D	9	44.5	38.1 to 43.4	2 " PVC
AG-15D	10	61.0	54.8 to 60.3	2 " PVC
AG-3D	11	41.5	35.1 to 40.4	2 " PVC
AG-1D	12	41.5	35.7 to 40.7	2 " PVC
<u>Upper Aquifer</u>				
AG-11S	13	15.0	3.9 to 13.9	2 " PVC
AG-2S	14	13.7	3.1 to 13.1	2 " PVC
AG-5S	15	14.0	3.5 to 13.5	2 " PVC
AG-12S	16	14.6	4.3 to 14.3	2 " PVC
AG-15S	17	15.2	4.0 to 14.0	2 " PVC
N-1	18	20.0	0 to end of hole	2.5 " PVC
AG-13S	19	14.7	4.2 to 14.2	2 " PVC
N-7	20	20.0	0 to end of hole	2.5 " PVC
AG-3S	21	14.7	4.1 to 14.1	2 " PVC
S-4	22	19.9	0 to end of hole	2.5 " PVC
AG-4S	23	14.0	3.5 to 13.5	2 " PVC
AG-16S	24	15.0	4.0 to 14.0	2 " PVC
AG-8S	25	16.6	3.8 to 13.8	2 " PVC
N-28	26	19.8	0 to end of hole	2.5 " PVC
AG-7S	27	14.7	4.1 to 14.1	2 " PVC
AG-1S	28	13.4	3.0 to 13.0	2 " PVC

Table 3. Sample Container Preparation, Preservation, and Handling.

Analysis	Container	Container Preparation	Sample Preservation and Handling
PAH, PCP, Acid/Base/Neutrals	1/2 gallon glass bottle (1 gallon for A/B/N) w/ teflon-lined cap (separate containers for each analysis)	Wash bottles, teflon liners, and caps with non-phosphate detergent in hot tap water. Rinse 3 times w/tap water. Rinse with 1:1 nitric acid. Rinse 3 times w/deionized water (Type I or purer water). Rinse w/pesticide grade methylene chloride or hexane. Oven dry. Wearing gloves, place teflon liners in caps teflon-side down and screw onto bottle.	Leave headspace. Keep in dark on ice (4°C). Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Volatiles	40 mL glass vial w/teflon-lined septum	Wash vials, setpa, & closures with non-phosphate detergent in hot tap water. Rinse 3 times w/tap water. Rinse 3 times w/deionized water. Oven dry vials, septa, and closures. Remove vials, septa, and closures from oven. Place septa in closures, teflon side down and place on vials. Attendant to wear gloves and vials not to be removed from preparation room until sealed.	Overfill vial, avoiding air bubbles. When full cap immediately making sure bubbles are not present. Keep in dark on ice (4°C). Analyze within 14 days.
Priority Pollutant Metals (dissolved)	1000 mL acid-washed polyethylene cubitainer/w teflon lined lids	Wash bottles, teflon liners, and caps with non-phosphate detergent in hot tap water. Rinse 3 times w/tap water. Rinse with 1:1 nitric acid. Rinse 3 times w/deionized water. Air dry in contaminant-free environment. Wearing gloves, place teflon liners in caps teflon-side down and screw onto bottles.	Keep in dark on ice (4°C). Samples must be received by lab, filtered, and acidified with HNO ₃ to pH <2.0, within 24 hours. Analyze within 6 months.
Cyanide	250 mL polyethylene bottle	Wash containers and caps with hot tap water. Then wash with non-phosphate detergent and hot tap water. Rinse with hot tap water. Rinse with distilled water. Air dry and place caps on containers.	Preserve with NaOH to pH 12 and keep in dark on ice (4°C). Analyze within 14 days.

Table 3 (continued).

Analysis	Container	Container Preparation	Sample Preservation and Handling
Pest/PCB	1-gallon glass bottle w/teflon-lined cap	Wash bottles, teflon liners, and caps with non-phosphate detergent in hot tap water. Rinse 3 times w/tap water. Rinse with 1:1 nitric acid. Rinse 3 times w/deionized water (Type I or purer water). Rinse w/pesticide grade methylene chloride or hexane. Oven dry. Wearing gloves, place teflon liners in caps teflon-side down and screw onto bottle.	Leave headspace. Keep in dark on ice (4°C). Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Chlorides	250 mL polyethylene bottle	Wash containers and closures in hot tap water. Wash with non-phosphate detergent and hot tap water. Rinse with hot tap water. Rinse w/distilled water. Rinse with 10% HCl. Rinse 3 times w/deionized water. Air dry and place closures on containers.	Rinse the bottle with sample before filling. Fill to bottle neck. Cool to 4°C immediately. Analyze within 28 days of sampling.

Table 4. Equipment List.

1. Teflon bailers
2. Sample bottles
3. Disposable nylon line for supporting bailers
4. Polyethylene ground cover sheets
5. Centrifugal pump and polyethylene tubing
6. pH meter, thermometer, and conductivity bridge
7. Water level measuring tape
8. Interface probe
9. Deionized and organic-free water
10. Nitric acid, methylene chloride, acetone, and Liquinox detergent
11. Calibrated bucket and stopwatch to measure purging/flow rate.
12. Coolers for sample transport
13. Freezer packs or ice
14. Zip-lock plastic bags
15. Sample tags and chain-of-custody seals
16. Field books
17. Barrels for purge water
18. Disposable gloves
19. TIP meter
20. Benzene and hexane for TIP meter calibration

Table 5. Summary of Analytical Methods and Required Detection Limits.

Analysis	Method	Method Description	Detection Limit
PAH	EPA No. 610	HPLC or GC w/silica gel clean-up	0.013 to 2.3 ug/L
PCP	EPA Herbicide	GC/ECD	0.01 to 0.1 ug/L
Acid/Base/ Neutrals	EPA No. 625	Capillary GC/MS	1-5 ug/L
Volatiles	EPA No. 624	Purge and trap, GC/MS	1-5 ug/L
Priority Pollutant Metals (dissolved)	CLP-SOW No.785 (July 1985) Exhibit D 1A.	Atomic absorption spectroscopy	0.05 to 3.0 ug/L
Cyanide	Adaptation of EPA No. 335.2	Titrimetric/ Spectrophotometric	5 ug/L
Pest/PCB's	EPA No. 608	GC/ECD	Pesticides: 0.01 to 0.1 PCB's: 0.1 to 1.0 ug/L
Chlorides	Standard Methods No. 429	Ion Chromatography	0.05 to 0.1 mg/L

Table 6. Summary of Sample Numbers and Estimate of Analytical Costs.

Sampling:

Analysis	Number of Field Samples	Field Replicates/ Duplicates	Transport Blanks	Bailer Blanks	Standard Reference Material	Total
PAH	30	4	2	2	2	40
PCP	30	4	2	2	2	40
Acid/Base/ Neutrals	10	2	1	1		14
Volatiles	30	4	2	2		38
Metals (13)	10	2	1	1		14
Pest/PCBs	10	2	1	1		14
Cyanide	10	2	1	1		14
Chlorides	30	4				34

Estimated Laboratory Costs:

Analysis	Number of Samples	Cost ^(a) per Sample	Total
PAH	48(b)	\$425	\$20,400
PCP	48(b)	\$200	\$9,600
Acid/Base/Neutrals	17(b)	\$650	\$9,100
Volatiles	46(b)	\$275	\$12,655
Metals (13)	15(c)	\$260	\$3,900
Pest/PCBs	16(b)	\$250	\$3,500
Cyanide	14	\$35	\$490
Chlorides	38	\$18	\$612
Total costs			\$60,257

(a) = Ecology Manchester Environmental Laboratory (Huntamer, 1986)

(b) = Includes one duplicate and one matrix spike for every ten field samples

(c) = Includes one sample for laboratory filter blank

DEPARTMENT OF ECOLOGY
CHAIN-OF-CUSTODY PROCEDURES

BACKGROUND

A documented record of sample handling is necessary for special studies involving compliance monitoring or other enforcement-related activities in which the data may be used in litigation. The evidence-gathering portion of a survey is characterized by the minimum number of samples required to give a fair representation of the effluent, or water body, air shed, or other media, from which they are taken.

The procedures described in this section represent the optimum method. The failure in any particular instance to follow one or more steps does not necessarily render evidence either inadmissible or unusable. Consequently, there should be no hesitancy to mention any deviation in procedure in any given case.

DEFINITION OF CUSTODY

Chain-of-custody procedures are followed to establish sample possession from the time it is taken until the results are introduced as evidence into court. A sample is in your "custody" when:

1. It is in your actual physical possession.
2. It is in your view, after being in your physical possession.
3. It was secure beyond a reasonable doubt if not in your view.

SAMPLE COLLECTION

1. As few people as possible should handle the sample.
2. Preprinted sample tags are filled out in waterproof ink and attached to the sample container at the time the complete sample is collected. The tags contain, as a minimum, the following information: station identification, station location, date-time-type of sample (grab

ATTACHMENT 1
(continued)

or composite), and initials of the sample collector and any observing witness. It is desirable that witnesses be present.

3. Blank samples, using distilled water with preservatives added, may be prepared at the time of sample collection and later analyzed to establish the lack of container or preservative contamination.

4. Bound Field Data Record logbooks with numbered pages are used to record field measurements and other pertinent information. These notes may be used to refresh the sampler collector's memory in the event he/she later takes the stand to testify regarding his/her actions during the evidence-gathering activity. Data entered in the logbooks are recorded with ballpoint pen or waterproof ink. Each page is signed by the sample collector and any available witnesses. Any errata in making entries should be lined out with a single line and then initialed.

5. The sample collector is responsible for the care and custody of the samples until properly dispatched to the receiving laboratory or turned over to an assigned custodian. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or locked or sealed in such a place and manner that no one can tamper with it.

6. If colored slides, photographs, or other related evidence are obtained to show the impact of the pollutant or substantiate any other conclusions of the investigation, the following documentation is required on the back of each photo or in the Field Data Record Logbook: time, date, and location of the photographer when taking the photo; film type; and the signatures of the photographer and any witnesses.

ATTACHMENT 1
(continued)

TRANSFER OF CUSTODY AND SHIPMENT

1. Samples are accompanied by a Chain-of-Custody record which includes the name of the survey, sample collector's signature, station number, and description of the samples. When turning over the possession of a part or all of the samples to a field analysis station or to a laboratory transferer and transferee will sign and record the time and date on the sheet.

2. All packages are accompanied by the sample custody record showing identification of the contents. The original accompanies the shipment, and a copy is retained by the survey coordinator. The Chain-of-Custody record is signed by the sample collector. The date and time are recorded also. It is then placed inside the shipping container.

3. Samples are carefully packed for shipment in suitable containers to avoid damage. The shipping containers are locked for shipment, or sealed in such a manner that the container cannot be opened without breaking the seal. This lock or seal is not removed until the shipping container is opened by the laboratory custodian or an alternate.

4. If sent by mail, the package is sent via Registered Mail with Return Receipt Requested. If sent by common carrier, all shipping receipts are retained as part of the permanent Chain-of-Custody documentation.

LABORATORY CUSTODY PROCEDURES

1. Couriers picking up samples at the bus depot, post office, etc., sign and retain the shipping documents to acknowledge receipt of the samples.

ATTACHMENT 1
(continued)

2. All incoming samples are received only by the laboratory sample custodian or an alternate who indicate receipt by signing the Chain-of-Custody record accompanying the samples and retaining it as part of the permanent record. Samples are then logged into the laboratory and assigned a laboratory number.

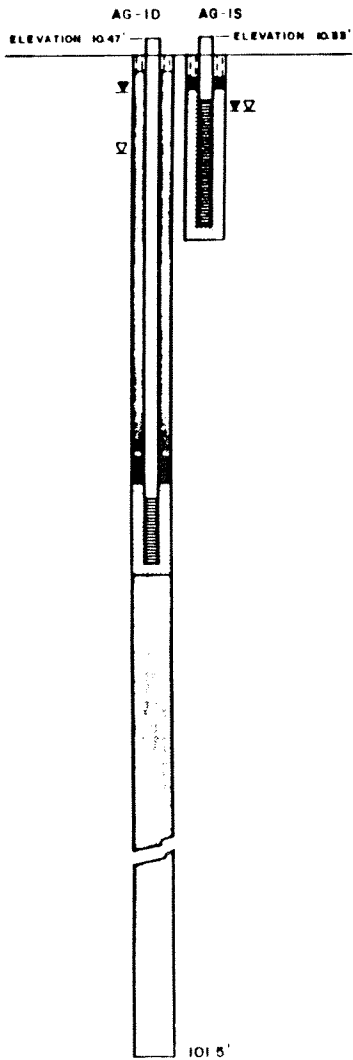
3. Laboratory personnel are responsible for the care and custody of the sample once it is distributed by the sample custodian.

4. Once the sample analyses are completed, the unused portion of the samples, together with all identifying tags and laboratory records, are returned to the sample custodian. The tagged sample is retained in locked or sealed cabinets or refrigerators until it is required for trial.

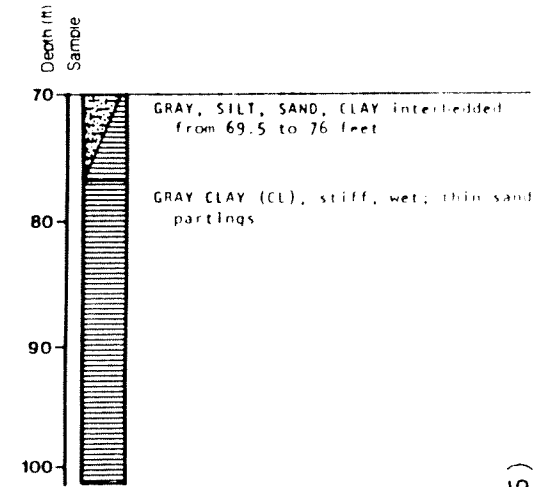
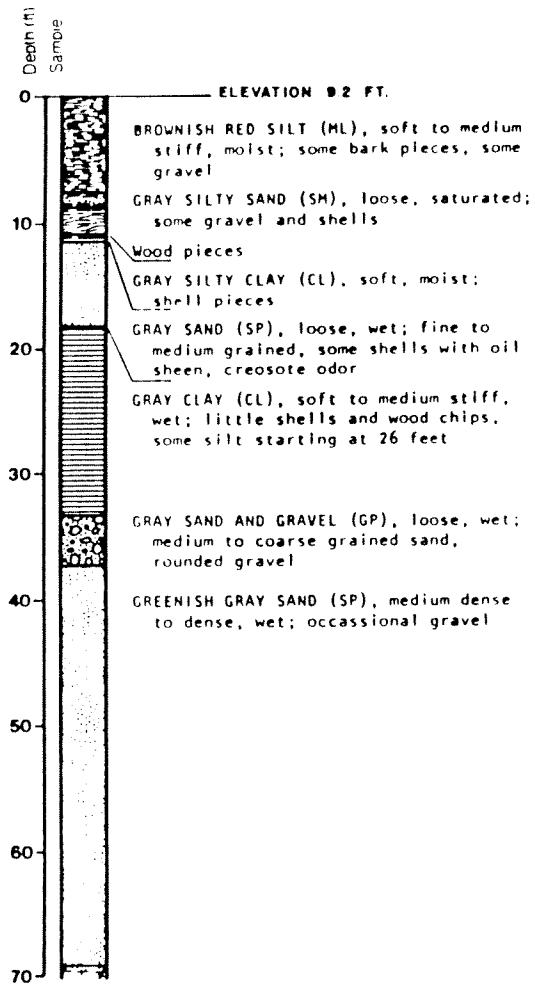
5. Analytical results are checked and initialed by senior laboratory personnel. The original lab bench sheets are stored in the laboratory files.

6. Samples and tags are discarded only upon the order of the Laboratory Director, after conferring with appropriate personnel in the Enforcement Division or the Assistant Attorney General handling the case to make certain that these items are no longer needed.

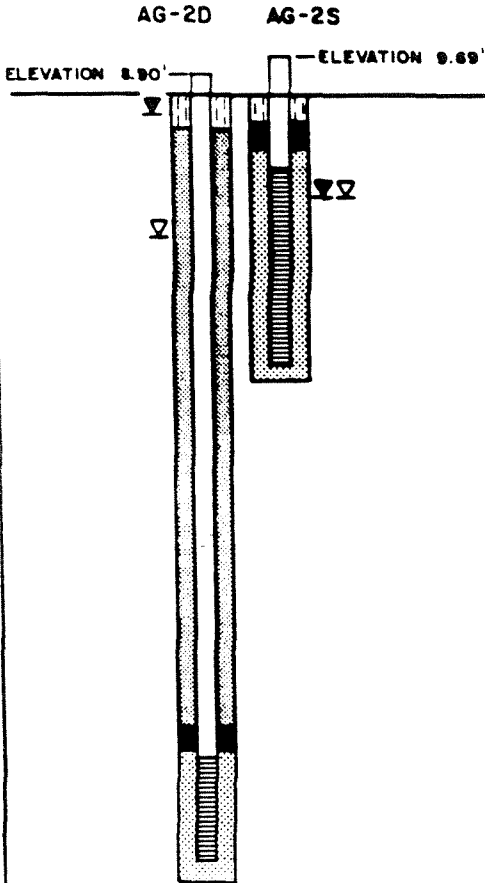
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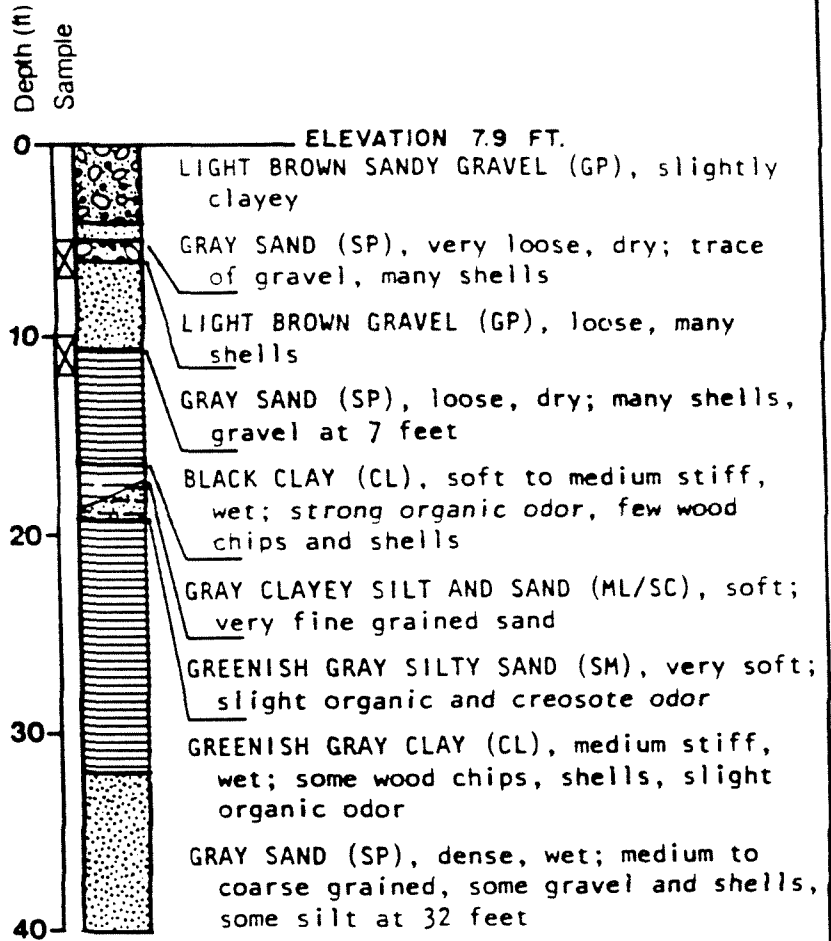
GEOLOGIC LOG OF BORING AG-10



WELL CONSTRUCTION SUMMARY

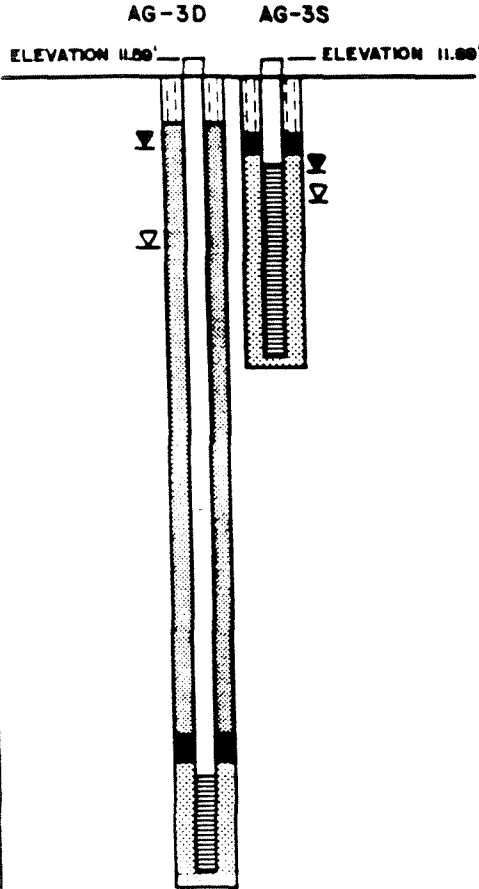


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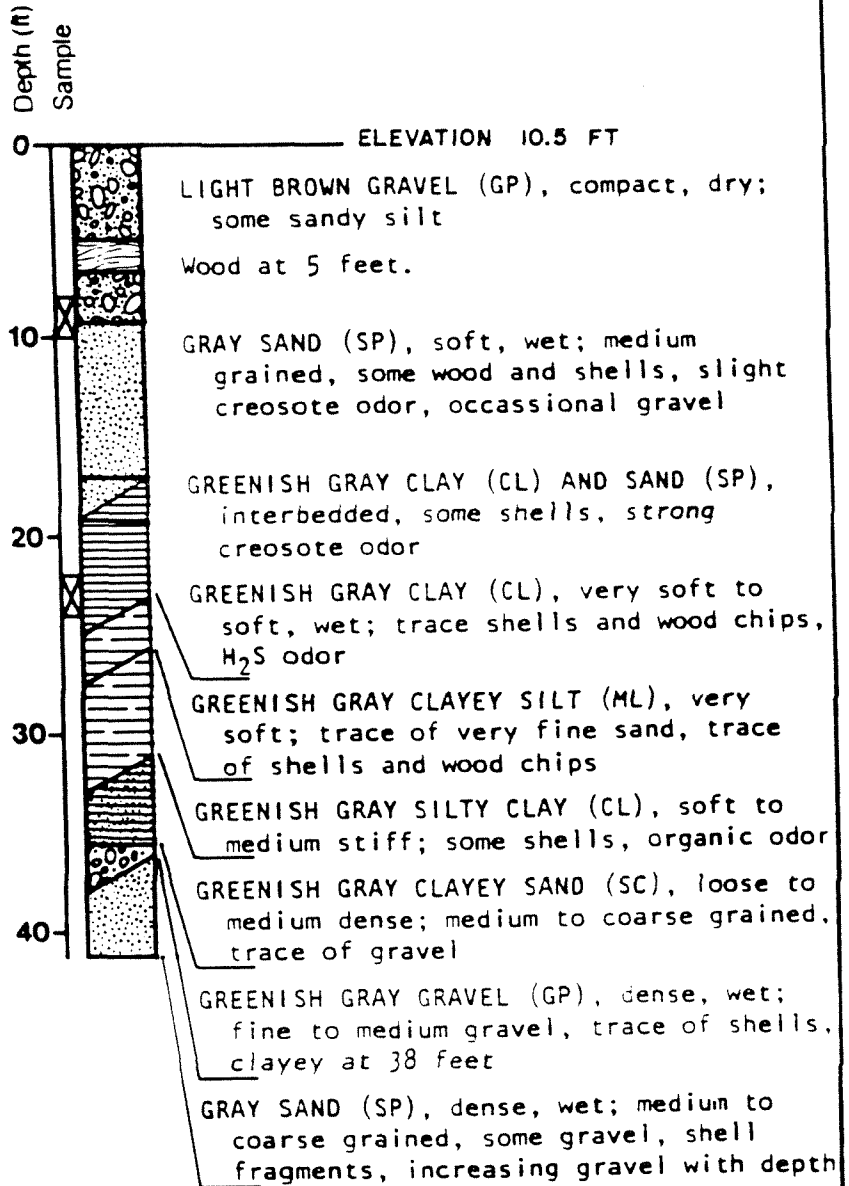


(from AGI, 1986)

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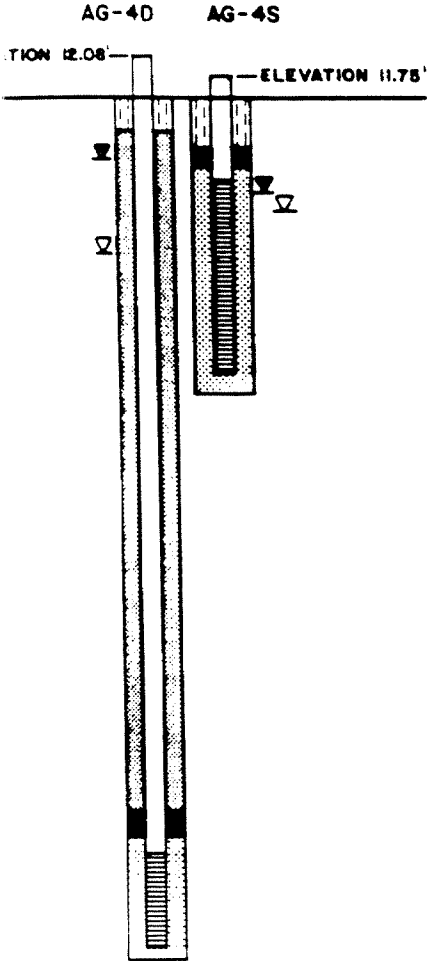


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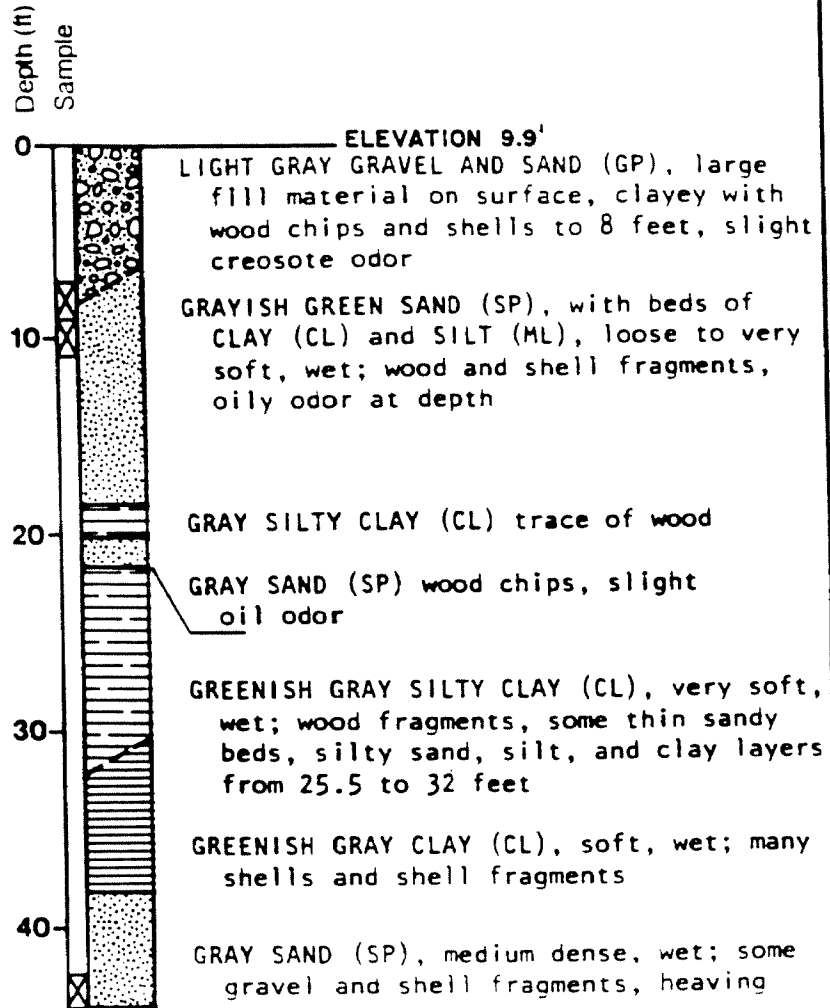


(from AGI, 1986)

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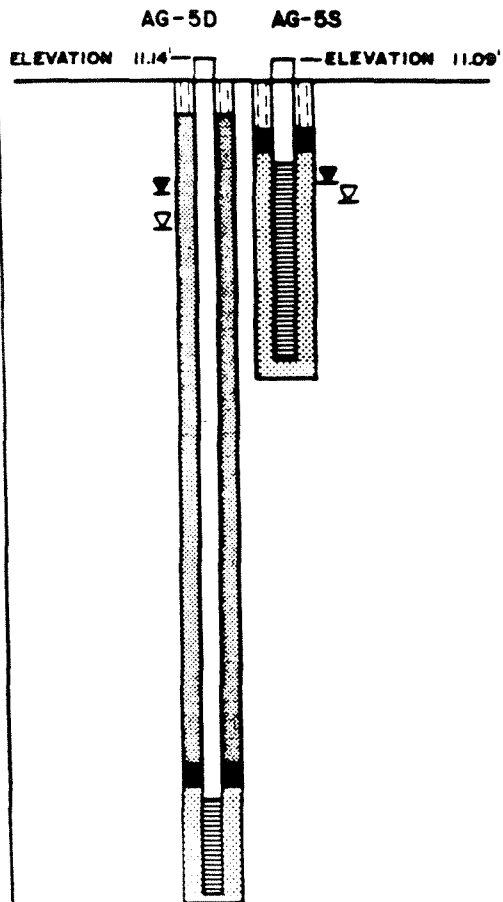


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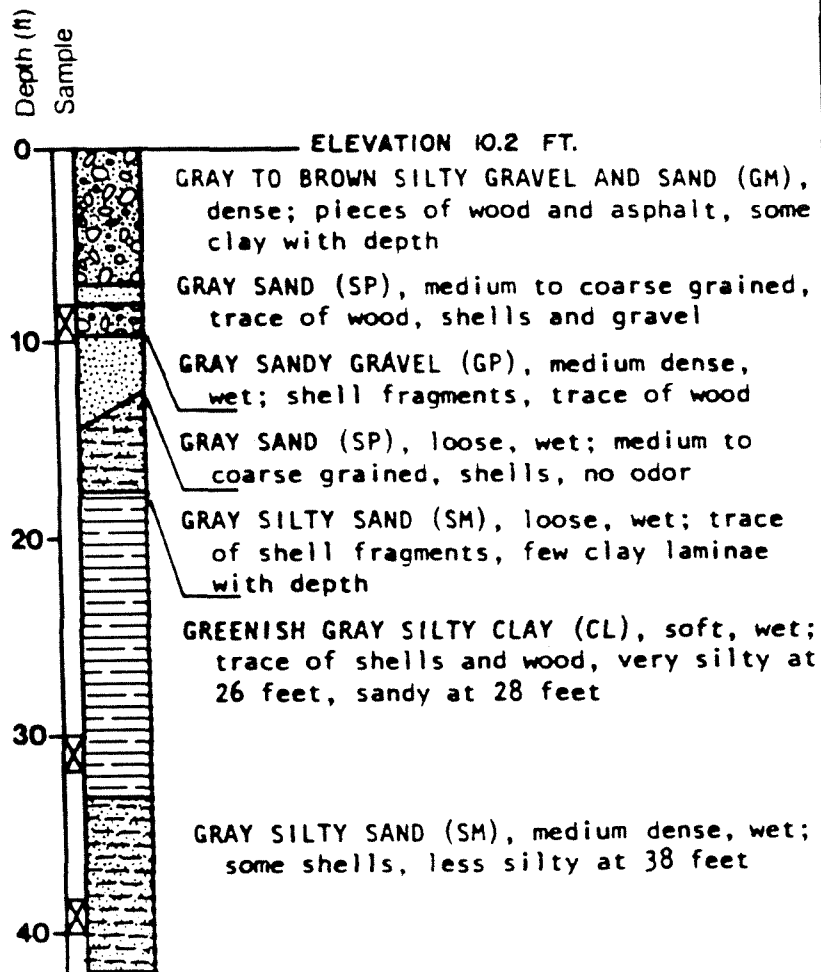


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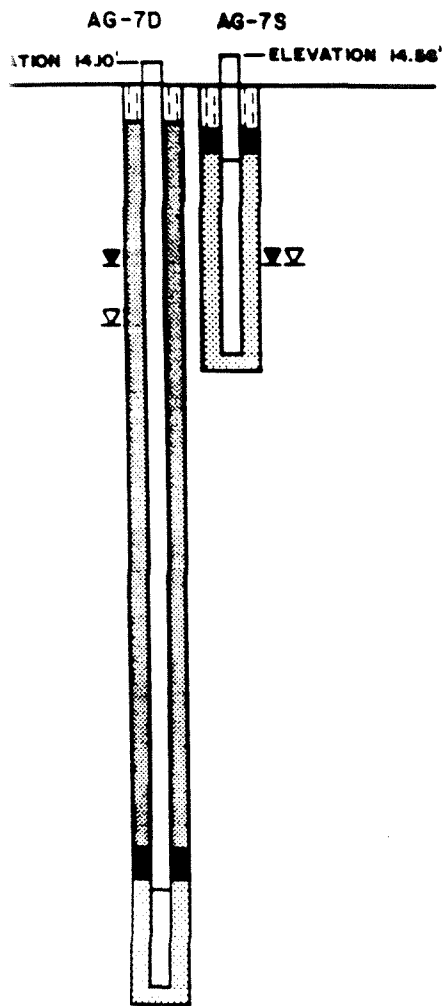


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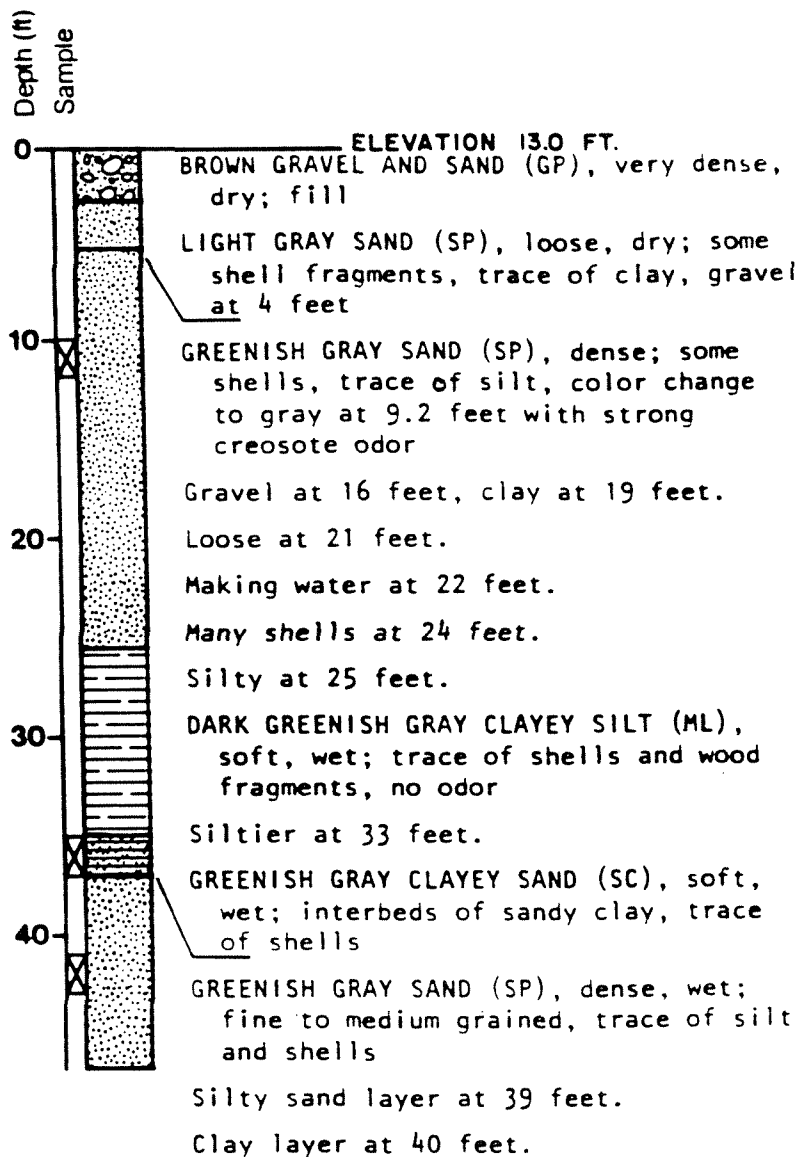


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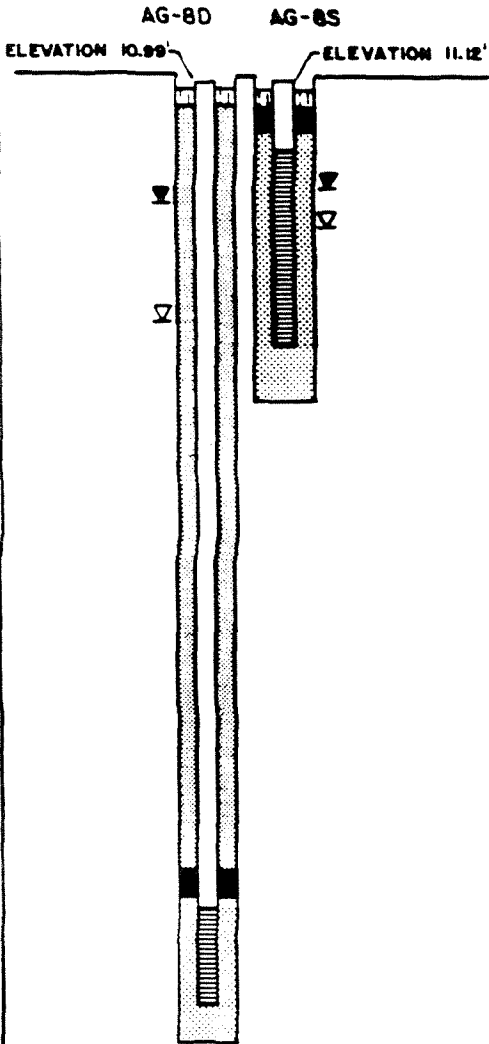


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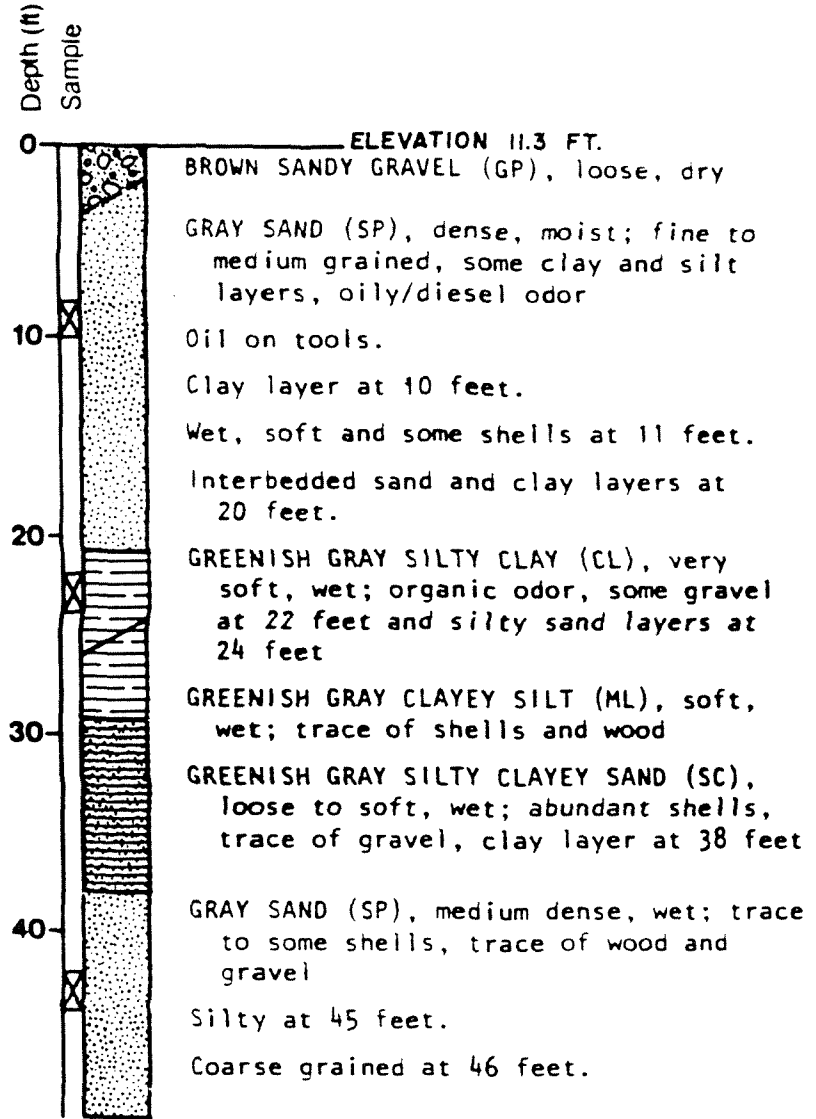


(from AGI, 1986)

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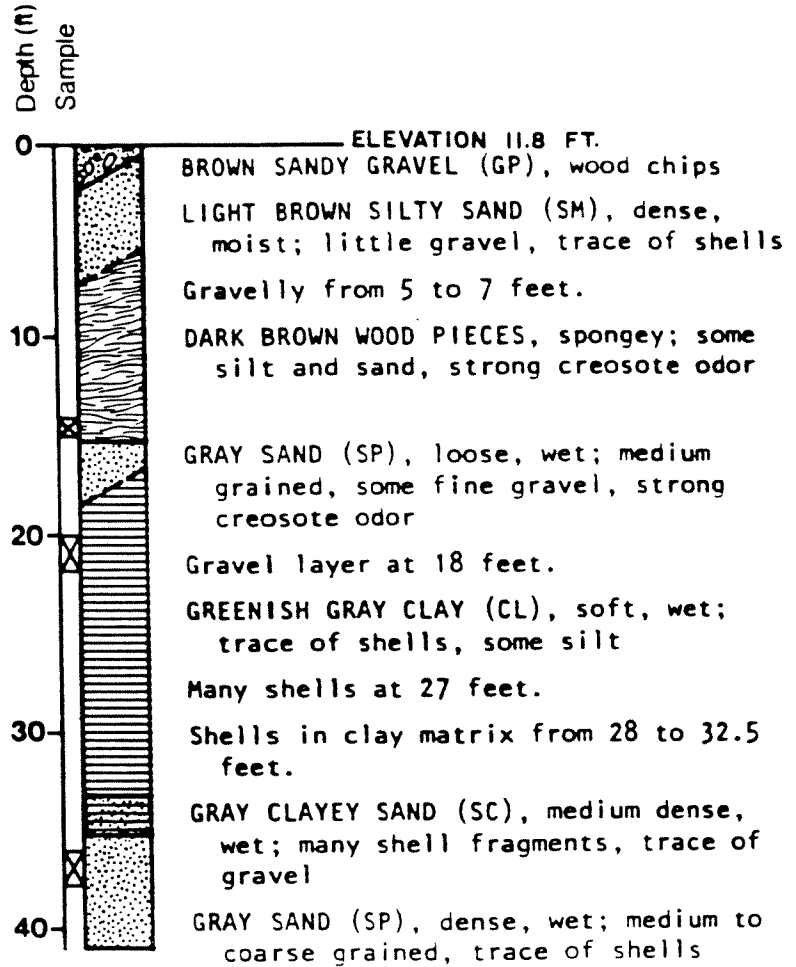
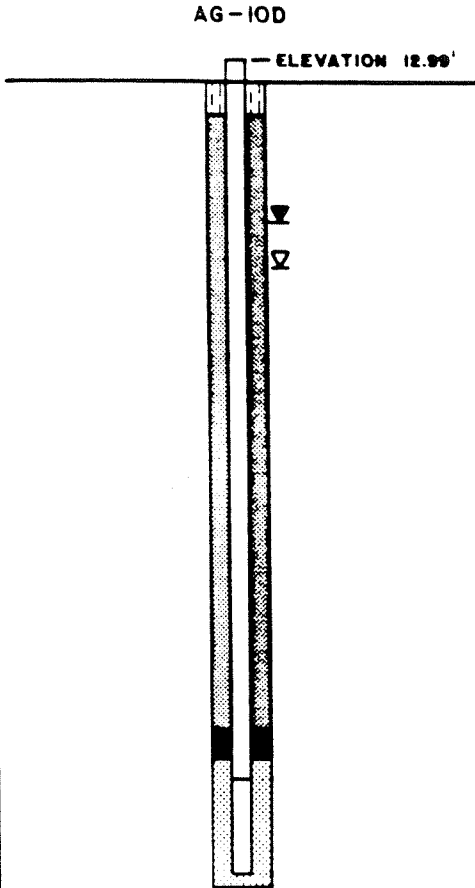
GEOLOGIC LOG OF BORING AG-8D



(from AGI, 1986)

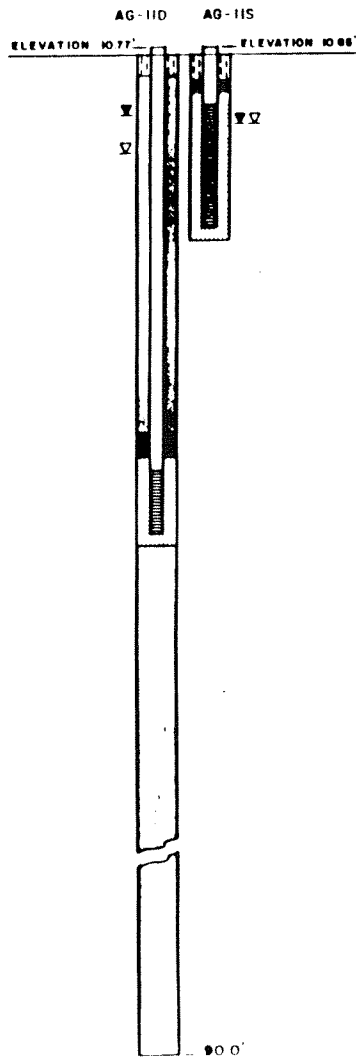
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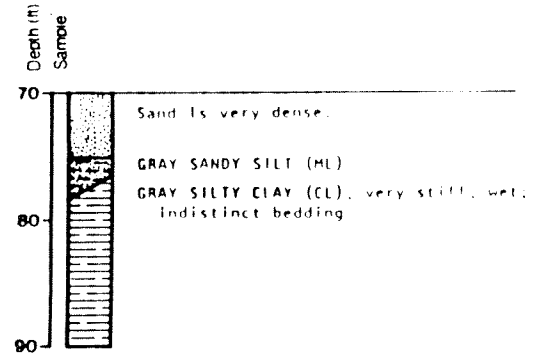
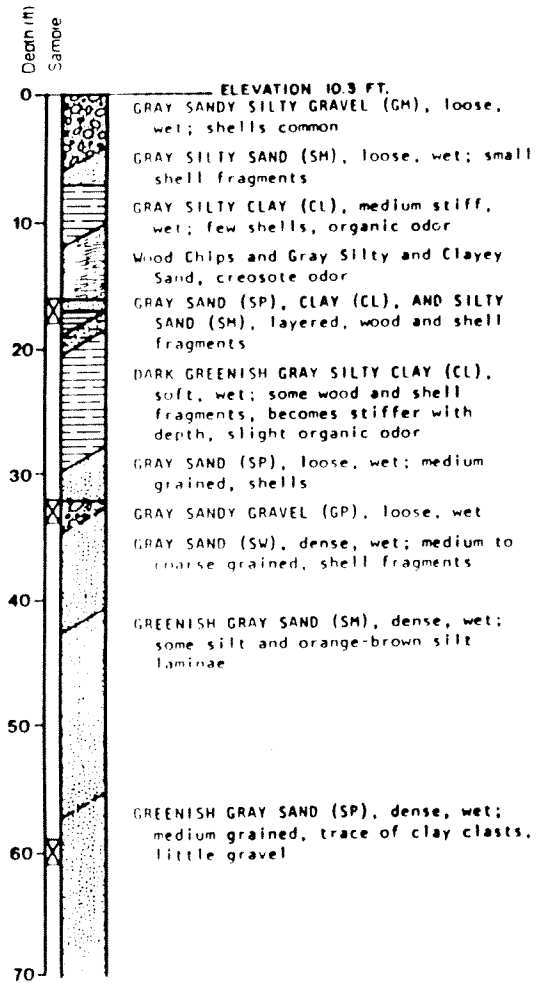


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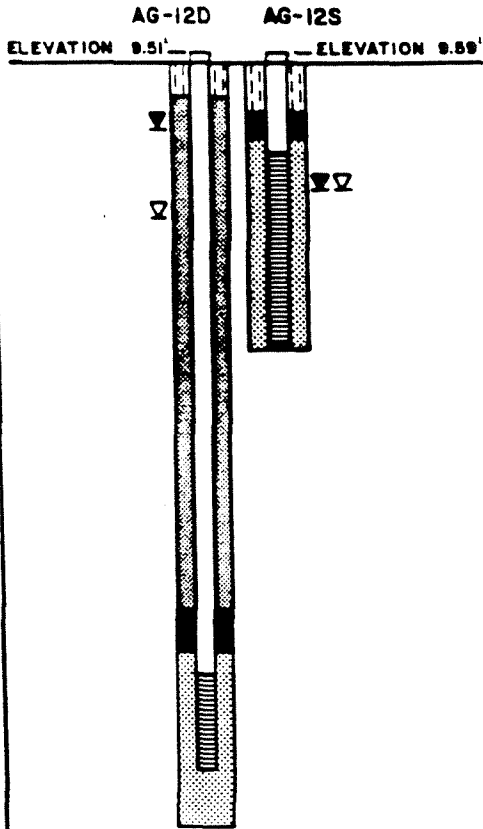
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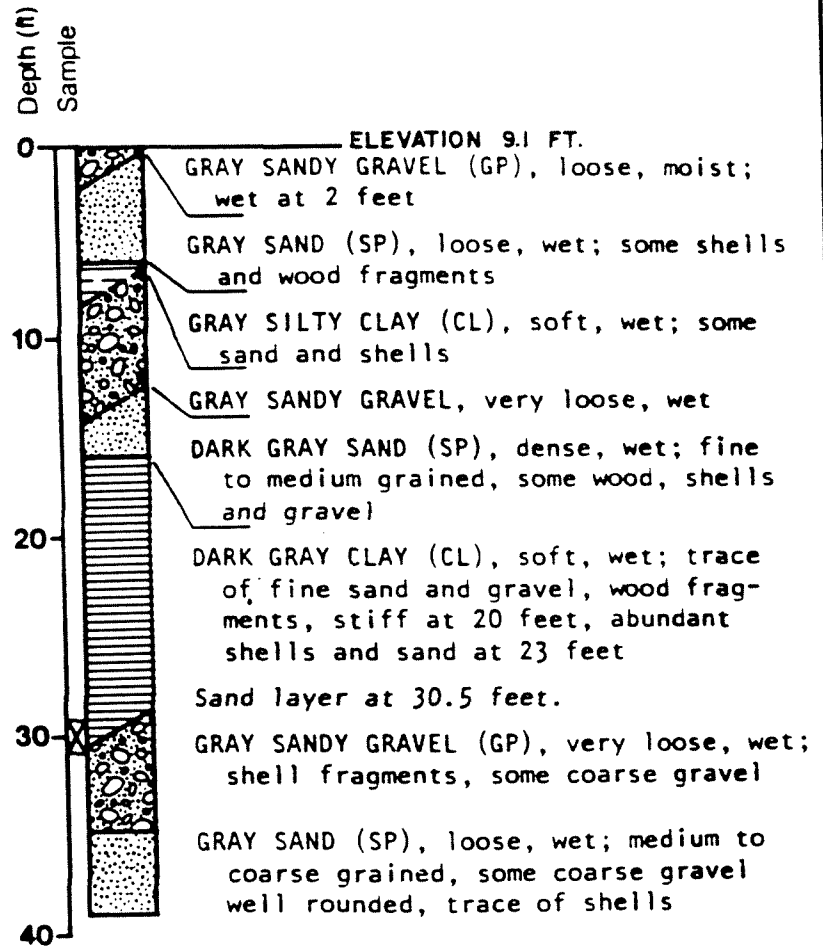
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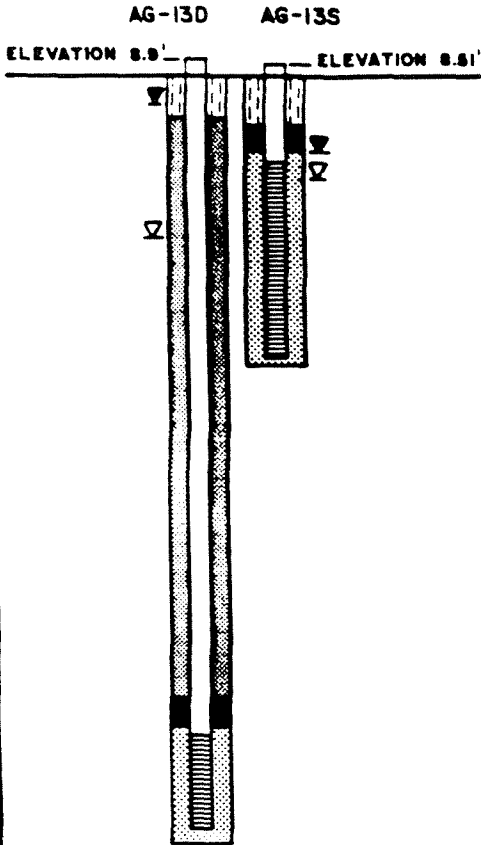


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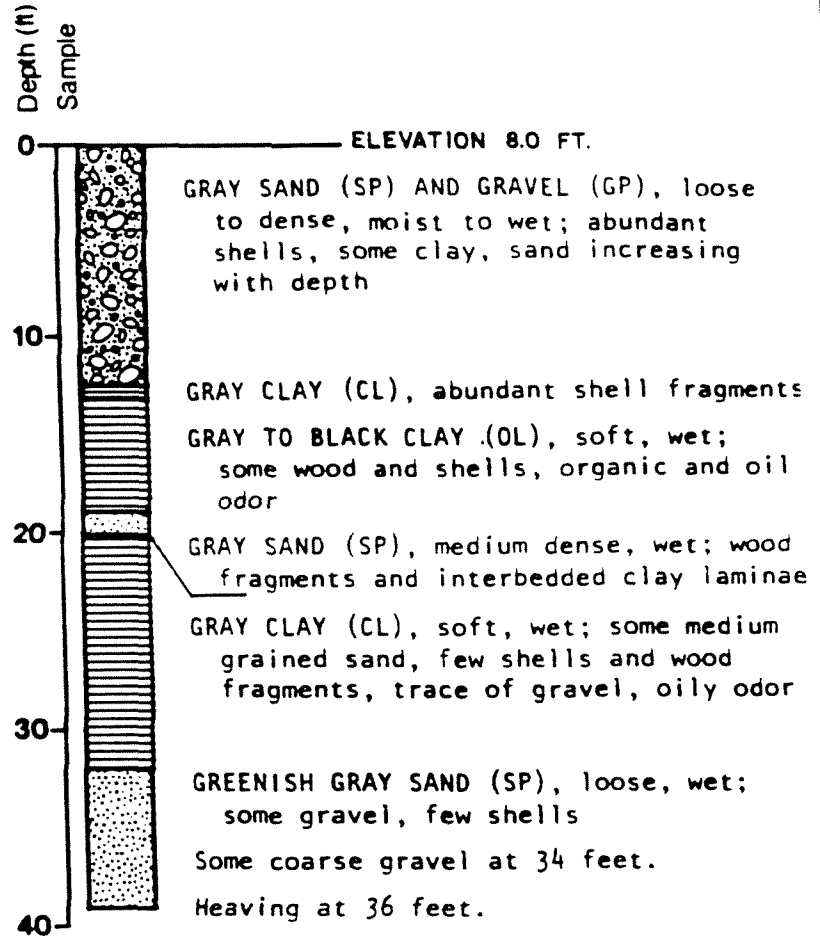


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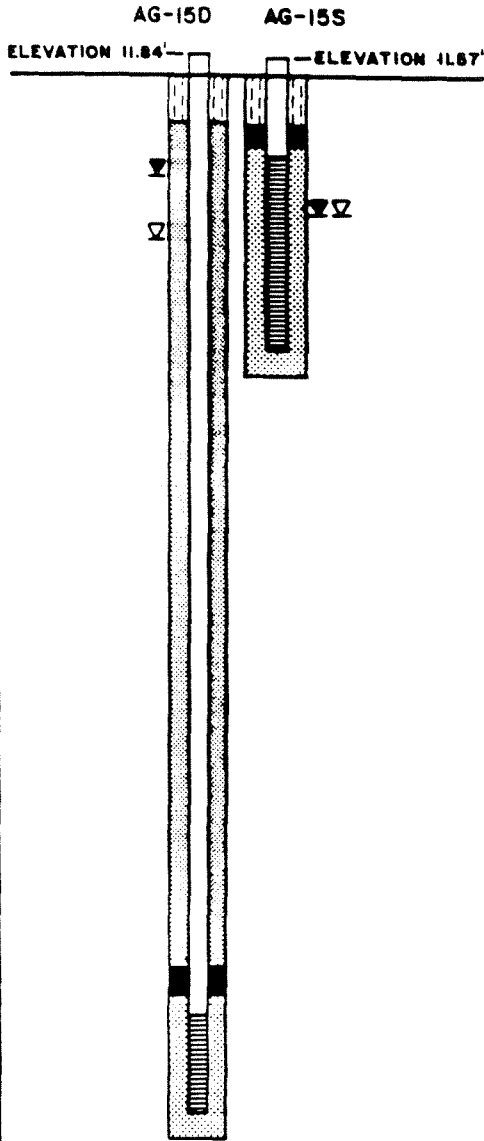


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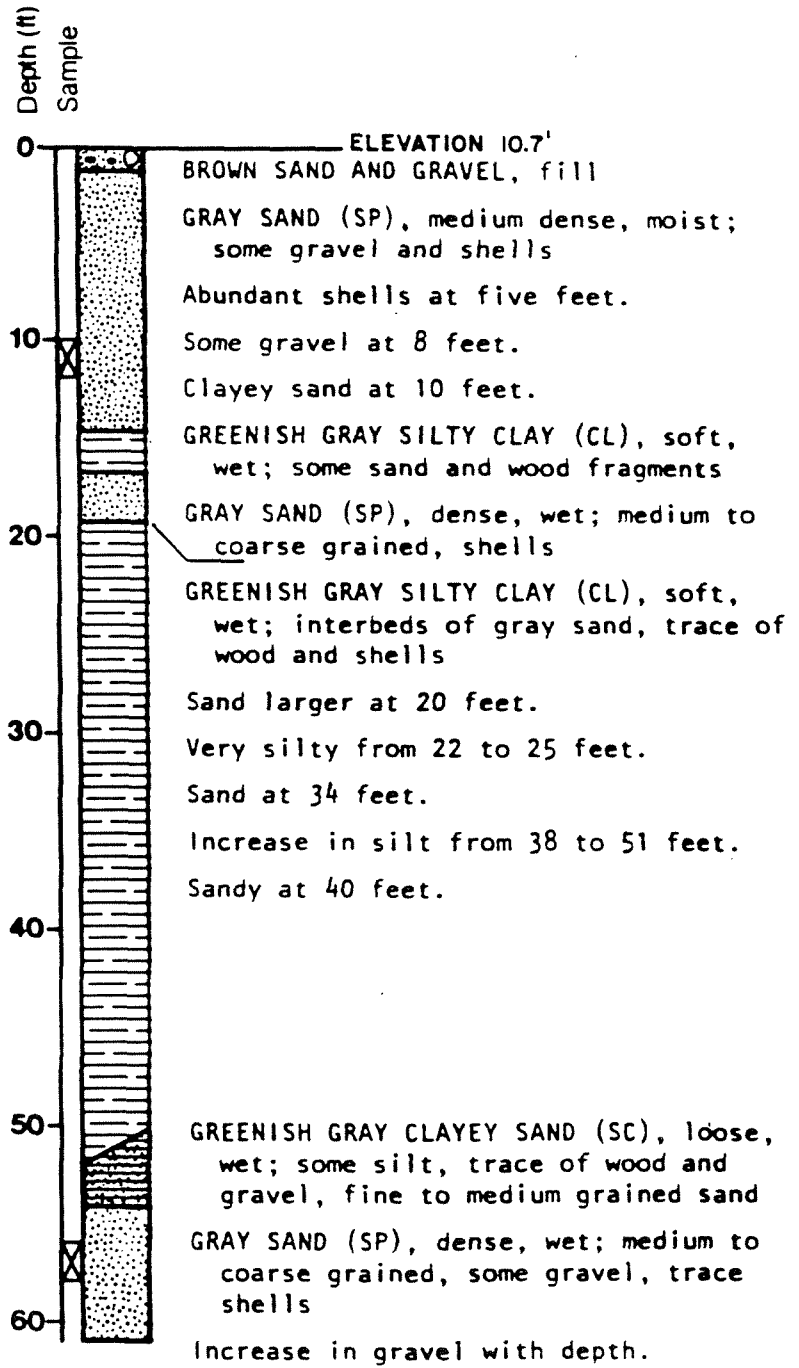


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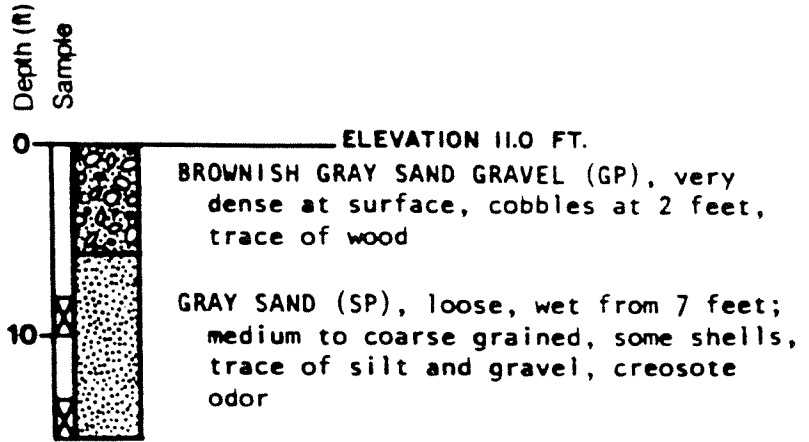
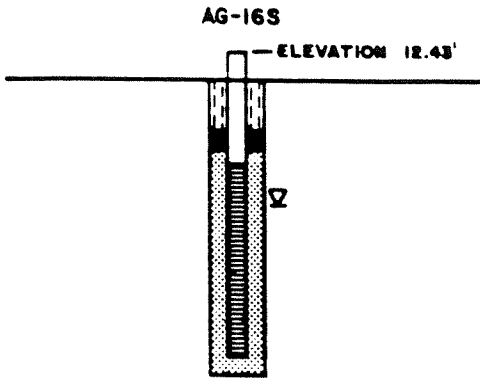
GEOLOGIC LOG OF BORING AG-15D



(from AGI, 1986)

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GEOLOGIC LOG OF BORING AG-16S



(from AGI, 1986)