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CONTAMINATION ASSESSMENT PLAN FOR SITES G9, 323, 333 AND 362 NSA PANAMA CITY FL

5/24/1996

BROWN AND ROOT ENVIRONMENTAL

Rev. 0
05/24/96

Contamination Assessment Plan
for
Sites G9, 323, 333, and 362

at

Coastal Systems Station
Panama City, Florida

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0008

May 1996

Brown & Root Environmental

Rev. 0
05/24/96

CONTAMINATION ASSESSMENT PLAN
FOR
SITES G9, 323, 333, AND 362

COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
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Naval Facilities Engineering Command
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1.0 INTRODUCTION

Brown & Root Environmental (B&R Environmental) has prepared this Contamination Assessment Plan (CAP) for Sites G9, 323, 333 and 362 at the Coastal Systems Station (CSS) in Panama City, Florida. This CAP was prepared for the U.S. Navy (Navy) Southern Division (SouthDiv) Naval Facilities Engineering Command (NAVFAC) under Contract Task Order (CTO) 0008, for the Comprehensive Long-term Environmental Action Navy (CLEAN III) Contract Number N62467-94-D-0888.

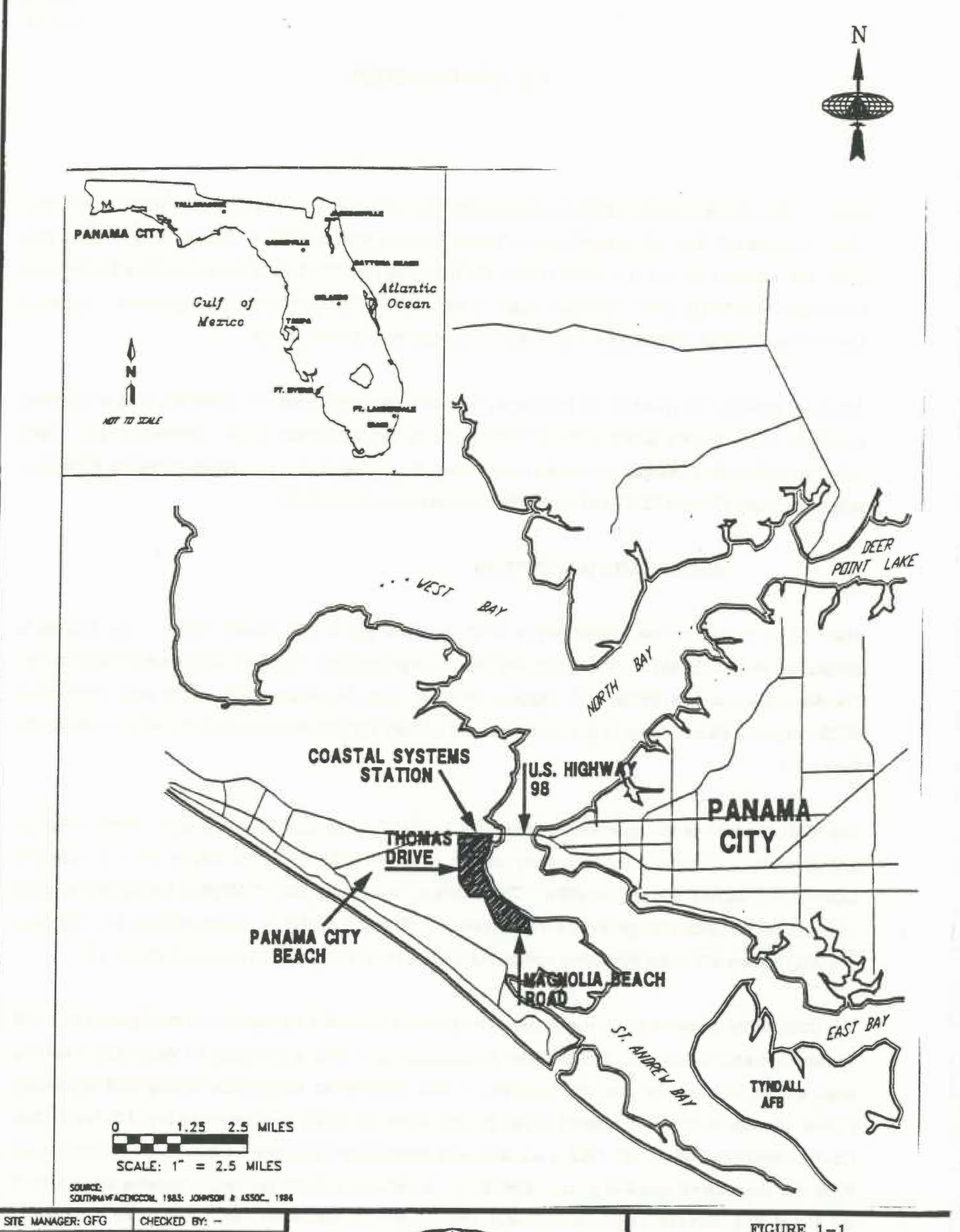
The CAP provides the rationale for performing field activities associated with collecting data to evaluate petroleum hydrocarbons and/or used oil constituents in the subsurface at the referenced sites. Data collected during the investigations will be used to prepare Contamination Assessment Reports (CARs) in accordance with Chapter 62-770 of the Florida Administrative Code (FAC).

1.1 GENERAL SITE DESCRIPTION

The CSS is located on the western shore of St. Andrews Bay in Bay County Florida. Bay County is situated on the Gulf of Mexico in Florida's Panhandle, approximately 100 miles southwest of Tallahassee. The Naval Base is bounded by U.S. Highway 98 to the north, St. Andrews Bay to the east, State Road 392B (Magnolia Beach Road) to the south, and State Road 392 (Thomas Drive) to the west as shown on Figure 1-1.

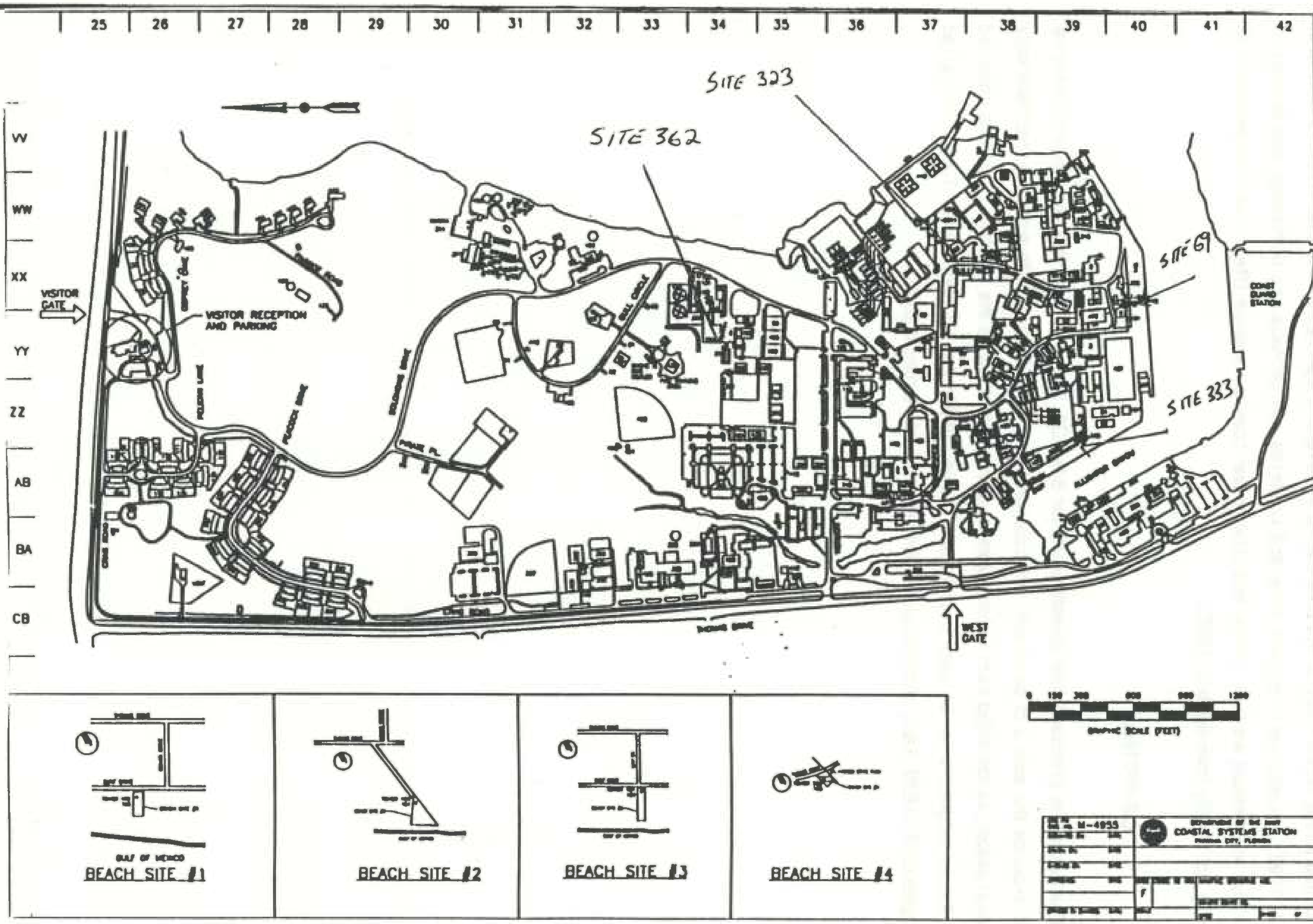
The CSS consists of two operational areas, the laboratory area and ordnance area, which comprise approximately 657 acres. The laboratory area is situated north of Alligator Bayou and has research facilities and various support activities. The ordnance area is south of Alligator Bayou and is used primarily for ordnance storage and for limited research. The sites under investigation (Sites G9, 323, 333, and 362) are located in the laboratory operational area of the Naval Base, as shown on Figure 1-2.

The CSS facility is one of seven major research, test, and evaluation laboratories of the Space and Naval Warfare Systems Command. The site was first established in 1942 as a harbor for World War II convoy ships and as a liaison for a nearby shipyard. It later became an amphibious landing craft operations school. Research and development began in 1945 when the facility was renamed the U.S. Navy Mine Countermeasures Station. In 1952 a research and development program for the use of helicopters for mine countermeasure operations was established. In November 1967 the facility became an activity of the Naval Ship Research and Development center based in Carderock, Maryland. The facility was



SOURCE:
SOUTHNAVFACENGCOM, 1983; JOHNSON & ASSOC., 1986

SITE MANAGER: GFG	CHECKED BY: –	Brown & Root Environmental	FIGURE 1-1
DRAWN BY: TCB	DRAWING DATE: 5/22/96		REGIONAL LOCATION MAP
SURVEYED BY:	SURVEY DATE:		COASTAL SYSTEMS STATION
SCALE: 1" = ±2.5 MILES			PANAMA CITY, FLORIDA
CAD DWG. NO.: 7113ESIT	PROJ. NO.: 7113		



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SCALE: AS SHOWN	
CAD DWG. NO.: 7113ESIT	PROJ. NO.: 7113

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FIGURE 1-2

BASEWIDE SITE LOCATION MAP

COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA

redesignated as the Naval Coastal Systems Center in 1978 and again as the Coastal Systems Station in January 1992. It continues to provide mine and undersea countermeasures technology and to support special and amphibious warfare, diving, and other naval coastal missions (Resource Conservation and Recovery Act Facility Investigation, 1995).

1.2 OBJECTIVE

The objective of the proposed field investigations for Sites G9, 323, 333, and 362 is to collect additional data to evaluate the extent of petroleum hydrocarbons and/or waste oil constituents in subsurface soils and groundwater, as identified from Closure Assessments conducted at the facilities. The data collected during the investigations will be used to prepare a Contamination Assessment Report (CAR) as required by Chapter 62-770.630, FAC, and to evaluate the need for future remediation.

2.0 SITE DESCRIPTIONS

Site G9 consisted of one 1,200-gallon underground storage tank (UST) which contained diesel fuel. The UST was used to supply diesel fuel to a generator located in Building 9. The tank was removed in March 1994 and the UST system dispenser lines were cut, capped and abandoned in place, where lines entered beneath structures. Soils generated during tank removal operations were placed back in the tank excavation (Underground Tank Closure Assessment, 1994). The present study area has a flat surface topography with a surface cover consisting of grass, crushed stone, and concrete drive areas. Potential site contaminants include diesel fuel related compounds.

Site 323 was an unregulated oil water separator tank located on the northeast side of Building 323. The oil water separator was excavated and removed in February 1994. Approximately 16 cubic yards of petroleum impacted soils were removed from the excavation for disposal. Prior to removal, the oil water separator collected fluids from both the motor pool catch basin for Building 5 and a floor drain for Building 323. It is unknown if solvents used in Building 323 during the prefabrication of hydraulic wenches entered the floor drain. The Discharge Reporting Form for the release indicates the type of contaminants as solvents, jet fuel, used/waste oil, and diesel fuel.

Site 333 consisted of an underground waste oil tank and oil/water separator associated with the CSS Spill Containment Boom Wash Area. Petroleum contaminated soils were identified during the excavation and removal of the underground storage tank and oil/water separator in November 1995. Dissolved hydrocarbons were also reported in a groundwater sample collected adjacent to the excavation. Visual staining of soils were also observed within the vadose zone (Closure Assessment Report, 1996). Due to the presence of an inactive landfill located upgradient and adjacent to the Site, battery acids, oil, solvents, photographic chemicals, and general household garbage and lumber materials maybe present in subsurface soil and water.

Site 362 is a fuel delivery system which consists of four 15,000-gallon UST tanks and a dispenser island. Two tanks currently contain diesel fuel with the remaining two tanks storing JP-5 fuel and gasoline, respectively. During the upgrade of the delivery system in May 1995, soil samples were collected and screened for hydrocarbon vapors using an organic vapor analyzer (OVA) equipped with a flame ionization detector (FID). Soil samples were collected along the underground product lines and from beneath the dispensers. Results of the soil assessment indicate that soils adjacent to the gasoline UST (Tank No. 4) have been impacted by gasoline. On June 6, 1995, a soil hydrocarbon vapor survey was conducted on soil samples collected adjacent to the southeast side of Tank No. 4 (Soil Screening for Upgrading Fueling System, 1995). Results of the soil vapor survey identified excessively contaminated soils near the fillport for Tank No. 4. Approximately 18 cubic yards of soils were excavated from the area near the fillport for disposal as part of an Initial Remedial Action.

3.0 TANK CLOSURE RESULTS

Site G9 Results of the Tank Closure Assessment performed by Southern Earth Sciences, Inc. during March of 1994 indicated no petroleum product odors were encountered in the excavation or in excavated soils during removal of the 1,200-gallon UST. Soils samples screened for hydrocarbon vapors detected the highest soil vapor concentration at 28 ppm in sample B-5, collected at the water table. Chapter 62-770. F.A.C., defines contaminated soils as having headspace hydrocarbon vapor readings of 10 ppm and excessively contaminated soils with readings greater than 50 ppm for soils impacted by diesel fuel. All excavated soils were placed back into the tank excavation.

During tank removal activities, a groundwater sample was collected from a temporary well installed within the tank excavation. The groundwater was tested using EPA Method 602 and 610 parameters. Total naphthalene and polynuclear aromatic hydrocarbons (PAHs) were detected at 113 ppb and 48 ppb, respectively. These concentrations exceeded State Target levels of 100 ppb and 10 ppb, respectively, as defined in Chapter 62-770, F.A.C.

Site 323 Approximately 16 cubic yards of soils were removed during the removal of the oil/water separator in February 1994. Hydrocarbon soil vapor readings were reported at concentrations ranging from 100 ppm to 240 ppm in soils collected within and adjacent to the tank pit. These soil vapor concentrations indicated the soils were excessively contaminated as defined by Chapter 62-770, F.A.C.

During removal of the tank, a sludge sample was collected from the tank and analyzed for Toxicity Characteristics Leaching Procedure (TCLP) 8 RCRA metals, TCLP volatile organics, TCLP semivolatiles, and TCLP herbicides and pesticides. All constituents tested were reported below laboratory detection limits.

Site 333 During removal of the underground storage tank, oil/water separator, and related underground piping in November 1995, soil samples were collected and screened for hydrocarbons using an OVA. Four soil sampling points were established at the corners of the UST excavation. Three sampling points were located along the pipeline trench and within the oil/water separator area. Results indicate excessively contaminated soils (as defined by Chapter 62-770, F.A.C) were identified in a soil sample collected within the UST excavation. The soil sample registered a hydrocarbon vapor concentration of 950 ppm. Visual inspection of the soil sample showed the sample to have a dark greenish gray oily sheen. Further investigation of the contaminated soil zone indicated that it may be within the capillary fringe, a groundwater - vadose "smear" zone. Two additional exploratory borings were advanced in an area between a drum containment area and the UST excavation. Soil hydrocarbon vapor concentrations were reported at concentrations of greater than 900 ppm in samples collected at approximately 4.5 feet below land surface (bls). Greenish gray oily soils were identified in one of the samples collected within the capillary fringe zone.

A composite soil samples for laboratory analysis was collected within the UST (waste oil tank) pit excavation. The sample was collected at a depth of 4 feet bls and analyzed for Volatile Organics (EPA Method 8240), Semivolatile Organics (EPA Method 8270), Total Recoverable Hydrocarbons (EPA Method 9073) and RCRA Metals. In addition, soil samples were collected from the excavation wall adjacent to the oil/water separator and from the area between the drum containment and UST area (sample collected at approximately 4.5 feet bls). These samples were subject to the laboratory analysis mentioned above. A composite sample was also collected from the excavated soils for lab analyses, including TCLP Volatiles and TCLP Metals.

Laboratory results of the soil analyses reported concentrations of RCRA metals, TRPH, 1-methyl naphthalene, 2- methyl naphthalene, and naphthalene in the soils. Lead, cadmium, silver, and mercury were detected at 30.4 mg/kg, 1.0 mg/kg, 3.8 mg/kg, and 0.104 mg/kg, respectively. The highest concentrations of barium and chromium were reported at 2.3 mg/kg and 3.2 mg/kg, respectively. The highest concentrations of TRPH, 1-methyl naphthalene, 2- methyl naphthalene, and naphthalene were reported in soils collected near the waste oil tank at concentrations of 960 mg/kg, 4,800 mg/kg, 7,500 mg/kg, and 1,300 mg/kg, respectively.

A temporary groundwater monitoring well was installed adjacent to the UST area during tank removal activities. The well was screened into the top of the water table located at approximately 5 feet bls. On December 15, 1995, a groundwater sample was collected from the well and analyzed for Volatile Aromatic Hydrocarbons (EPA Method 602), Polynuclear Aromatic Hydrocarbons (EPA Method 610) and TRPH (EPA Method 418.1). Results of the sampling reported benzene at 1.5 ug/l which is above the State Target level of 1 ug/l.

Site 362 Soil samples B-14 and B-19 collected during the fuel delivery system upgrade in May of 1994, detected hydrocarbon vapors at concentrations of 100 ppm and 340 ppm, respectively. These samples were collected adjacent to Tank No. 4 which stores gasoline. Additional soil samples were collected and screened for hydrocarbons in June 1994 which identified gasoline impacted soil adjacent to the fillport for the UST. During the soil vapor survey conducted in June, excessively contaminated soils as defined by

Chapter 62-770. F.A.C. were detected for gasoline parameters. Approximately 18 cubic yards of soil was excavated from the area adjacent to the fillport as part of an Initial Remedial Action.

The Discharge Reporting Forms for Sites G9, 323, and 362, and the Closure Report for Site 333 are provided in Appendix A.

4.0 SCOPE OF PROPOSED ASSESSMENTS

The proposed scope of work for assessment activities will take place in two phases. The first phase (Phase 1) will consist of performing a soil hydrocarbon vapor assessment, collecting groundwater samples from existing site wells, installing temporary well points, and collecting groundwater samples for field screening using a portable gas chromatograph (GC). Concurrent with this phase of work, a drill rig will be mobilized to the site and shallow monitoring wells will be installed and groundwater samples will be collected from the newly installed wells. Based on data provided from the Tank Closure Assessments, it is anticipated the first phase of field activities will provide sufficient data to complete CARs. It is anticipated that the CARs for Sites G9, 323, and 362 will conclude with No Further Action (NFA) proposals.

The second phase (Phase 2) will involve the mobilization of a drill rig to install two additional shallow monitoring wells and a vertical extent well at Site 333. The placement of these wells will be based on ground water flow gradients and water quality data collected during the first phase of site work. In addition, a recovery/test well will also be installed at Site 333 to be used in a pilot study for remedial design evaluation. Concurrent with this phase of work, groundwater samples will be collected from the newly installed wells. Slug tests will be performed on three shallow monitoring wells, and a tidal survey will be conducted on a shallow monitoring well.

A third phase of field work is anticipated in preparation for completing a Remedial Action Plan (RAP) for Site 333. During this field mobilization, a field pilot test will be conducted to select the appropriate remedial technology to address contaminants in soil and groundwater. During the field pilot tests, a State Registered Land Surveyor will be mobilized to CSS and all permanent monitoring wells installed during the contamination assessments will be surveyed with respect to horizontal and vertical datum. The datum to be used shall be in accordance with either USGS NAD'27 or base coordinator grid system as deemed appropriate by the Navy's Remedial Project Manager and the activity Public Works Office.

4.1 SOIL INVESTIGATION

A soil hydrocarbon vapor assessment will be conducted at each of the four sites. Soil borings will be advanced using the hand augured drill method. This method of drilling is preferred due to the subsurface lithology which is predominantly quartz sand, the presence of a shallow water table, and to minimize the amount of soil cuttings generated during boring activities. The borings will also be used to facilitate the installation of temporary well points at selected boring locations.

During borehole advancement soil samples will be collected at 2 foot intervals and screened for hydrocarbon vapors following procedures for headspace analysis as required by Chapter 62-770.200 F.A.C. The soil borings will be advanced until the water table is encountered. It is anticipated that groundwater will be encountered within 10 feet of the ground surface. The location of the proposed borings for each of the sites are provided on Figures 4-1 through 4-4, respectively

If soil contamination is identified above State Target Levels (soil hydrocarbon vapor readings greater than 10 ppm) at any proposed boring location, additional soil borings would be advanced to assess the areal extent of soil contamination. These borings would be established on a 20 x 20 ft. grid from the sample location where soil vapor concentrations were detected above the State Target Levels.

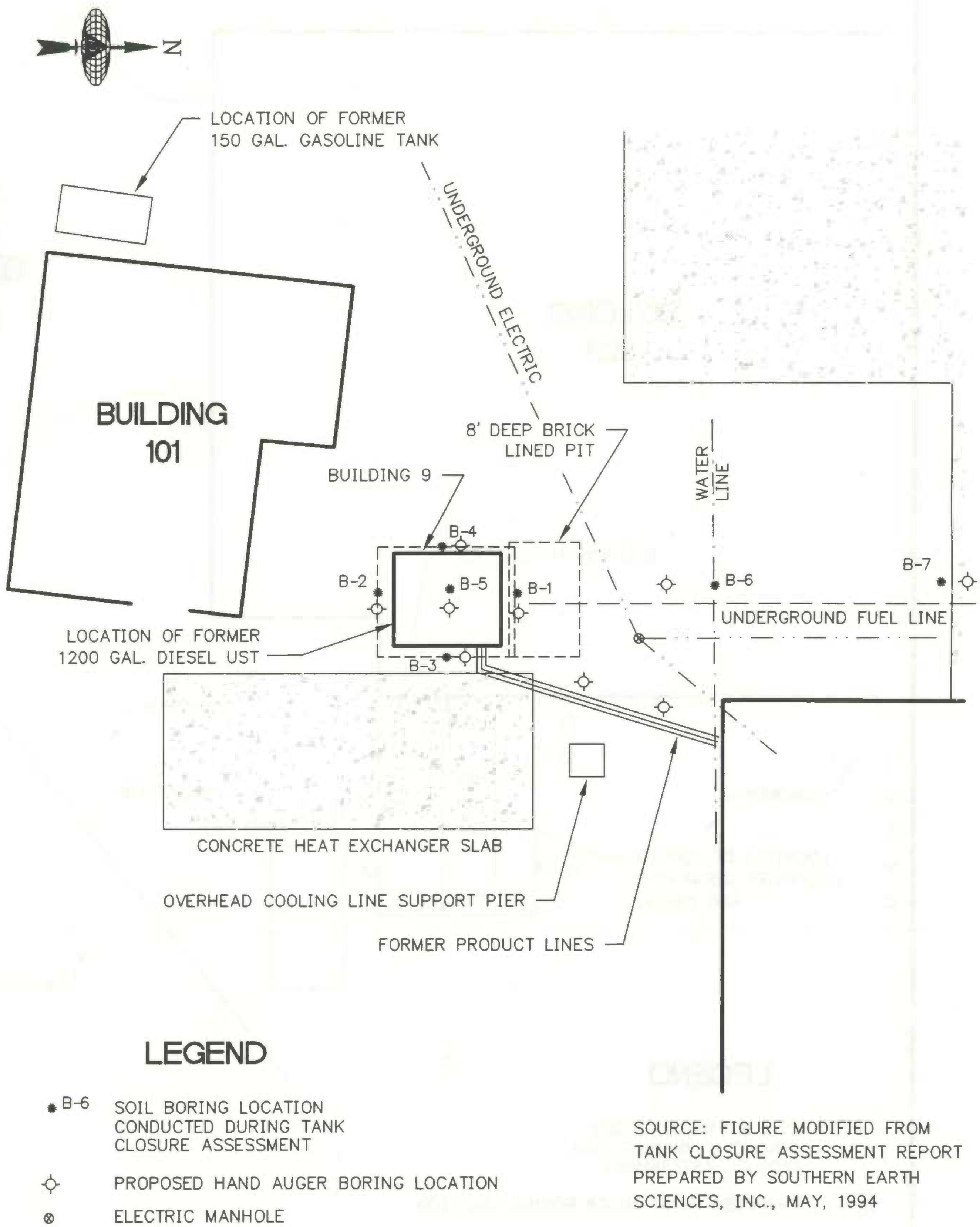
All hand augured soil borings will be abandoned by backfilling the borehole with the auger cuttings generated from the boring.

During drilling of the permanent monitoring wells and the recovery/test well (see Section 4.3), soil samples will be collected from the well borings. The borings will be sampled at 5-foot intervals from the ground surface to the proposed termination of the boring. The samplers will have a minimum diameter of 2-inches and will be at least 2 feet long to provide sufficient sample for headspace analysis and lithologic characterization. Due to the shallow water table (approximately 4 to 11 feet bls in the study areas) shallow water monitoring wells will terminated approximately 13 to 15 bls, and the recovery/test well (Site 333) will be completed at approximately 22 feet bls. Continuous split-spoon samples will be collected to a depth of 30 feet bls during advancement of the vertical extent well at Site 333. The split-spoon samples collected during the installation of the vertical extent well will be used to characterize the subsurface lithology in the vicinity of Site 333.

All soil samples obtained from the borehole will be monitored with and organic vapor analyzer and then collected for lithologic and/or chemical analysis.

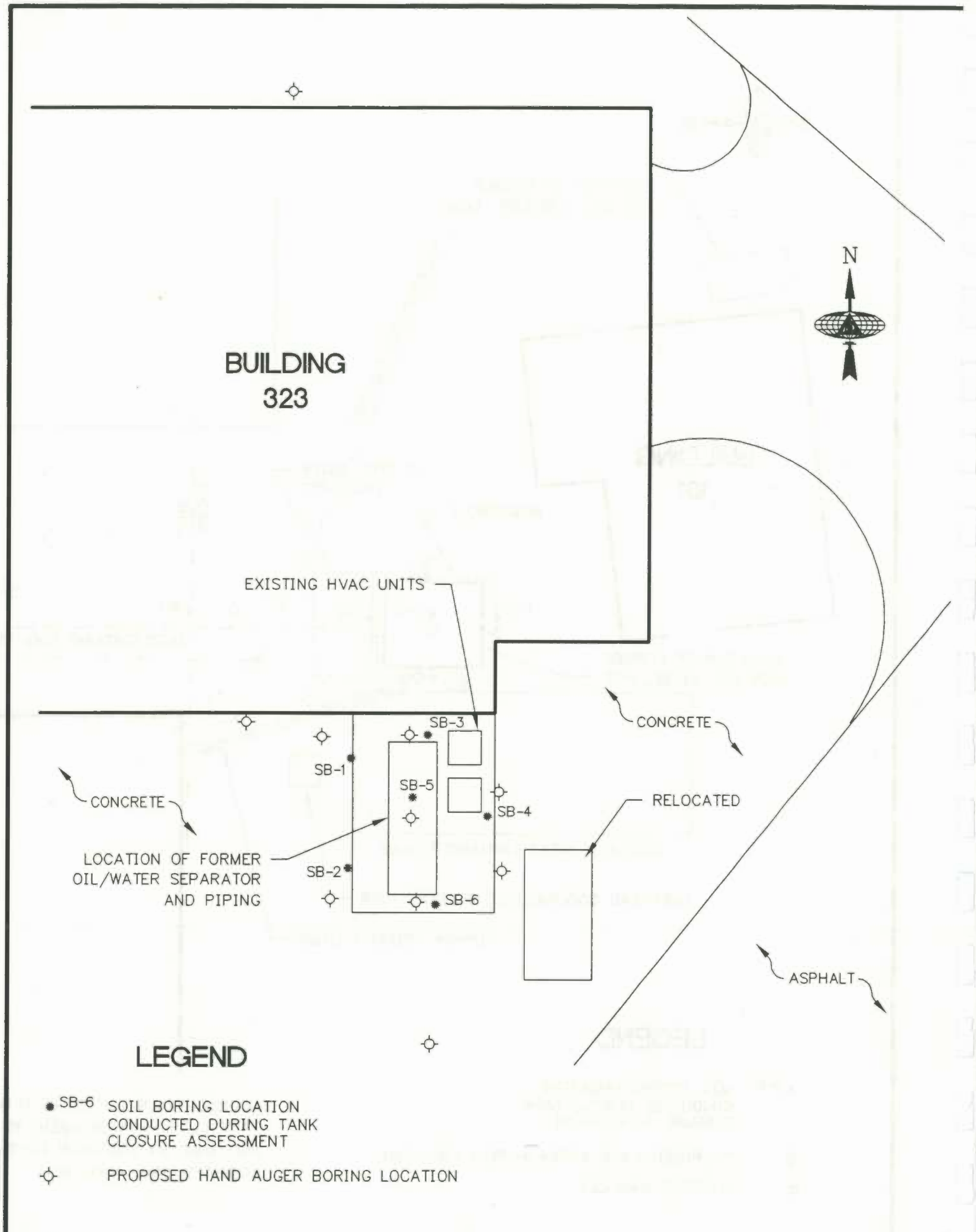
A lithologic description will be made of each split-spoon sample and/or grab sample collected and a completed log of each boring will be maintained by the on-site geologist in accordance with Standard Operating Procedure (SOP) GH 1.5 included in Appendix B. At a minimum, the boring log will contain the following information:

- Sample Numbers and Types
- Sample Depths



SOURCE: FIGURE MODIFIED FROM TANK CLOSURE ASSESSMENT REPORT PREPARED BY SOUTHERN EARTH SCIENCES, INC., MAY, 1994

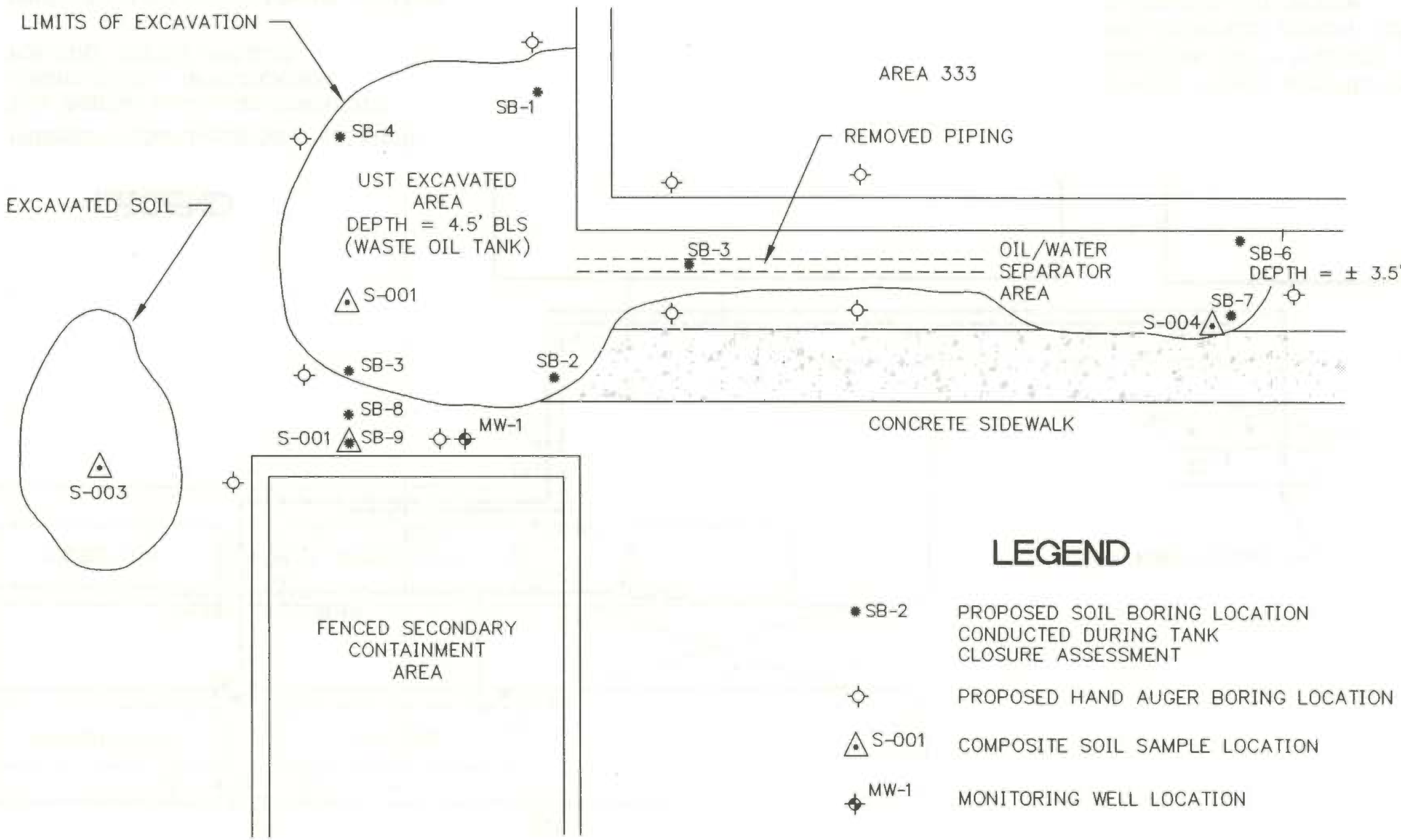
SITE MANAGER: GFG	CHECKED BY: –	Brown & Root Environmental	FIGURE 4-1
DRAWN BY: TCB	DRAWING DATE: 5/22/96		**PROPOSED SOIL BORING LOCATIONS SITE G9**
SURVEYED BY:	SURVEY DATE:		COASTAL SYSTEMS STATION PANAMA CITY, FLORIDA
SCALE: 1/8" = 1'			
CAD DWG. NO.: 7113ESIT	PROJ. NO.: 7113		



SITE MANAGER: GFG	CHECKED BY: –
DRAWN BY: TCB	DRAWING DATE: 5/22/96
SURVEYED BY:	SURVEY DATE:
SCALE: 1/4" = 1'	
CAD DWG. NO.: 7113ESIT	PROJ. NO.: 7113

Brown & Root Environmental

FIGURE 4-2
PROPOSED SOIL BORING LOCATIONS
SITE 323
COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA



LEGEND

Symbol	Description
SB-2	PROPOSED SOIL BORING LOCATION CONDUCTED DURING TANK CLOSURE ASSESSMENT
	PROPOSED HAND AUGER BORING LOCATION
S-001	COMPOSITE SOIL SAMPLE LOCATION
MW-1	MONITORING WELL LOCATION

SOURCE: FIGURE MODIFIED FROM CLOSURE ASSESSMENT REPORT PREPARED BY SOUTHERN EARTH SCIENCES, INC., JANUARY, 1996

SITE MANAGER: GFG	CHECKED BY: —
DRAWN BY: TCB	DRAWING DATE: 5/22/96
SURVEYED BY:	SURVEY DATE:
SCALE: N.T.S.	
CAD DWG. NO.: 7113ESIT	PROJ. NO.: 7113

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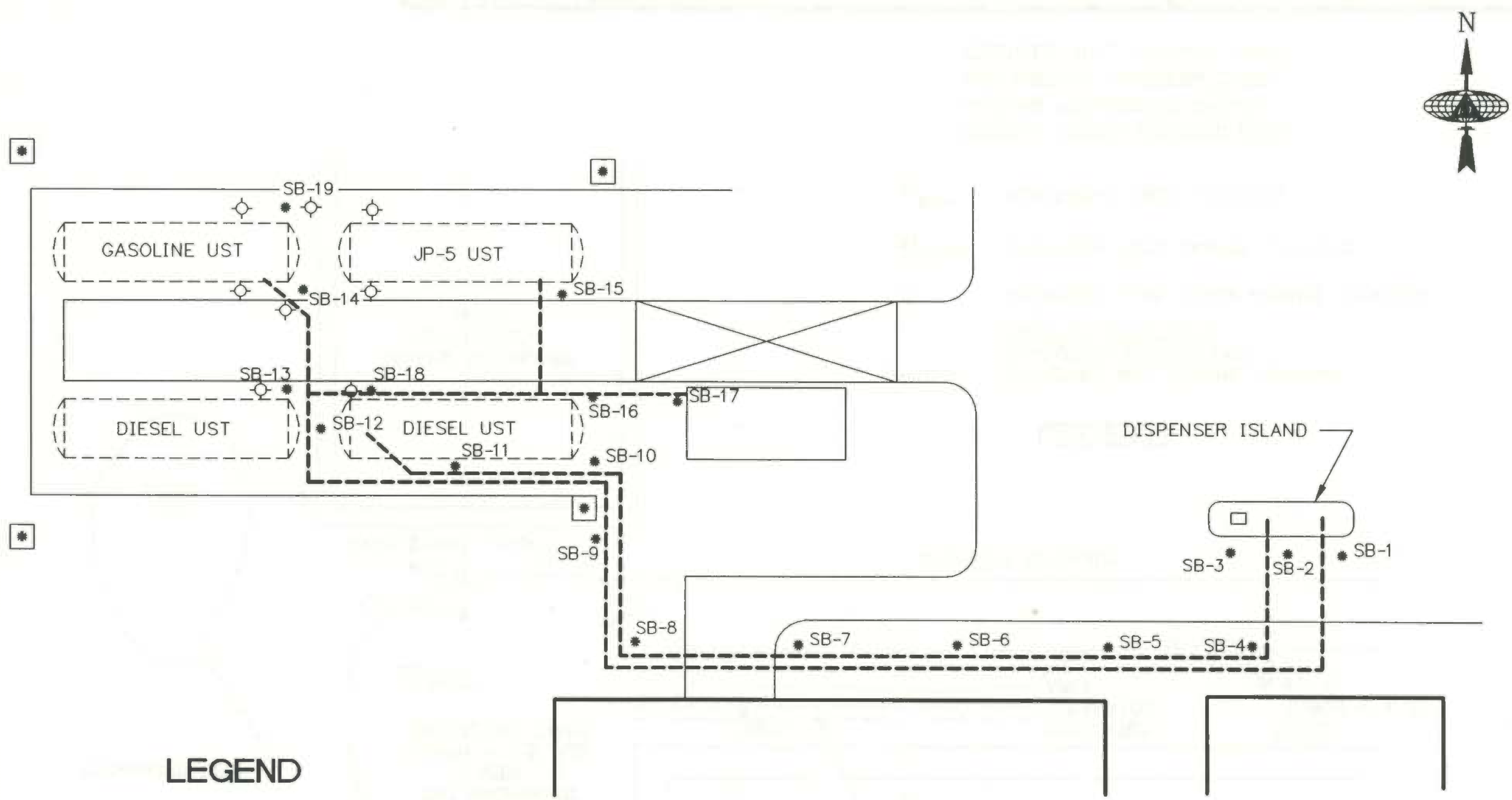
FIGURE 4-3
AREA 333 OIL/WATER SEPARATOR UST EXCAVATION
COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA



LEGEND

- PROPOSED COMPLIANCE WELL LOCATION
- SB-1 SOIL BORING LOCATIONS CONDUCTED DURING INITIAL INVESTIGATION FOR FUEL SYSTEM UPGRADE
- PROPOSED HAND AUGER BORING LOCATION

SOURCE: FIGURE MODIFIED FROM SOUTHERN EARTH SCIENCES, INC. SOIL SCREENING REPORT FOR UPGRADING FUEL SYSTEM AT 362, MAY, 1995

SITE MANAGER: GFG	CHECKED BY: —
DRAWN BY: TCB	DRAWING DATE: 5/22/96
SURVEYED BY:	SURVEY DATE:
SCALE: N.T.S.	
DWG. 13ES	PROJ. 13

Brown & Root Environmental

FIGURE 4-4

PROPOSED SOIL BORING LOCATIONS
SITE 362

COASTAL SYSTEMS STATION
MA C ORIDA

- Standard Penetration Test Data
- Sample Recovery/Sample Interval
- Soil Density or Cohesiveness
- Soil Color
- Unified Soil Classification System (USCS) Material Description

In addition, depths of changes in lithology, sample moisture observations, depth to water, OVA readings, drilling methods, and total depth of each borehole should be included on each log, as well as any other pertinent observations. An example of the boring log form is attached in Appendix B.

All split-spoon sampling shall be performed in accordance with ASTM D 1586-84, attached in Appendix C.

4.2 TEMPORARY WELL POINT INVESTIGATION

A groundwater screening investigation using temporary well points will be conducted at Sites G9, 323, and 333. The temporary well points will be installed in the vicinity of the former UST tank fields to evaluate the existence/extent of the contaminated groundwater plumes and assist in the selection of the permanent monitoring well locations. Temporary well points are the preferred method for the survey due to their ability to sample groundwater and monitor for free product in a rapid, cost effective manner without installing permanent monitoring wells.

Selected borings advanced during the hand augured soil assessment will be used to facilitate the installation of the temporary well points. Well point location selection will be determined based on hydrocarbon vapor concentrations detected during the soil vapor survey. The temporary wells will be installed at boring locations which exhibit elevated soil hydrocarbon vapor readings. If elevated hydrocarbons vapor readings are not detected, the temporary well points will be installed at boring locations to provide areal coverage over the study area to assess groundwater quality.

The proposed boring locations for each of the Sites are shown on Figures 4-1 through 4-4, respectively. Some sample locations may need to be altered in the field from the proposed locations due to surface and/or subsurface conditions such as underground utilities and/or structure constraints such as buildings, roadways etc. Holes will be advanced into the top of the water table from the ground surface using a hand auger. Groundwater samples will be collected using clear PVC bailers and then transferred into the appropriate sample bottles. The clear bailer is the preferred sampling tool since free phase hydrocarbons would be readily identified. Upon extraction of the groundwater sample from the well, the sample will immediately be analyzed for benzene, toluene, ethylbenzene, xylene, and naphthalene constituents using a field GC. If free product is encountered in the well, a groundwater sample will not be collected.

After all sampling tools are removed from the hole, the small diameter hole will be sealed from the bottom by pouring bentonite chips into the bottom of the boring to a thickness of approximately 1 foot. The chips will be hydrated and allowed to swell as per the manufacturers recommendation. The remainder of the borehole will be backfilled with the boring cuttings.

The sample results from the temporary well point investigation will be plotted on a map and permanent monitoring well locations will be selected based on spatial distribution of identified constituents and local groundwater flow patterns, identified during previous investigations conducted at CSS.

4.3 GROUNDWATER INVESTIGATION

Based on soil and/or water quality data collected during the Tank Closure Assessments, one monitoring well will be installed at the former UST location for Sites G9 and 323 to serve as a "worst case" well. The four existing tank field compliance wells located at Site 362 will be sampled to assess dissolved hydrocarbons in the area of the fuel delivery system. At Site 333, a minimum of six shallow monitoring wells will be drilled during the first phase of field activities, including one upgradient, three downgradient, and one well each at the location of the UST and oil/water separator tank pit locations., or at locations identified from the temporary well point investigation. Upgradient and downgradient monitoring well locations will be evaluated based on groundwater flow gradients identified at CSS from previous assessment investigations conducted at the Navy Base.

Results of the first phase of water quality sampling and the data collected from the temporary well point investigation will be used to assess if additional horizontal assessment wells (shallow monitoring wells) may be required to fill in data gaps. The Navy's Remedial Project Manager (RPM) will be contacted to discuss the locations of any proposed additional wells. The water quality results from the first phase of field work will also be used to select the location of the vertical extent well for Site 333. The vertical assessment and any additional horizontal assessment wells will be installed during the second phase of field work. Well installation permits will be obtained from the Northwest Florida Water Management District prior to drilling activities.

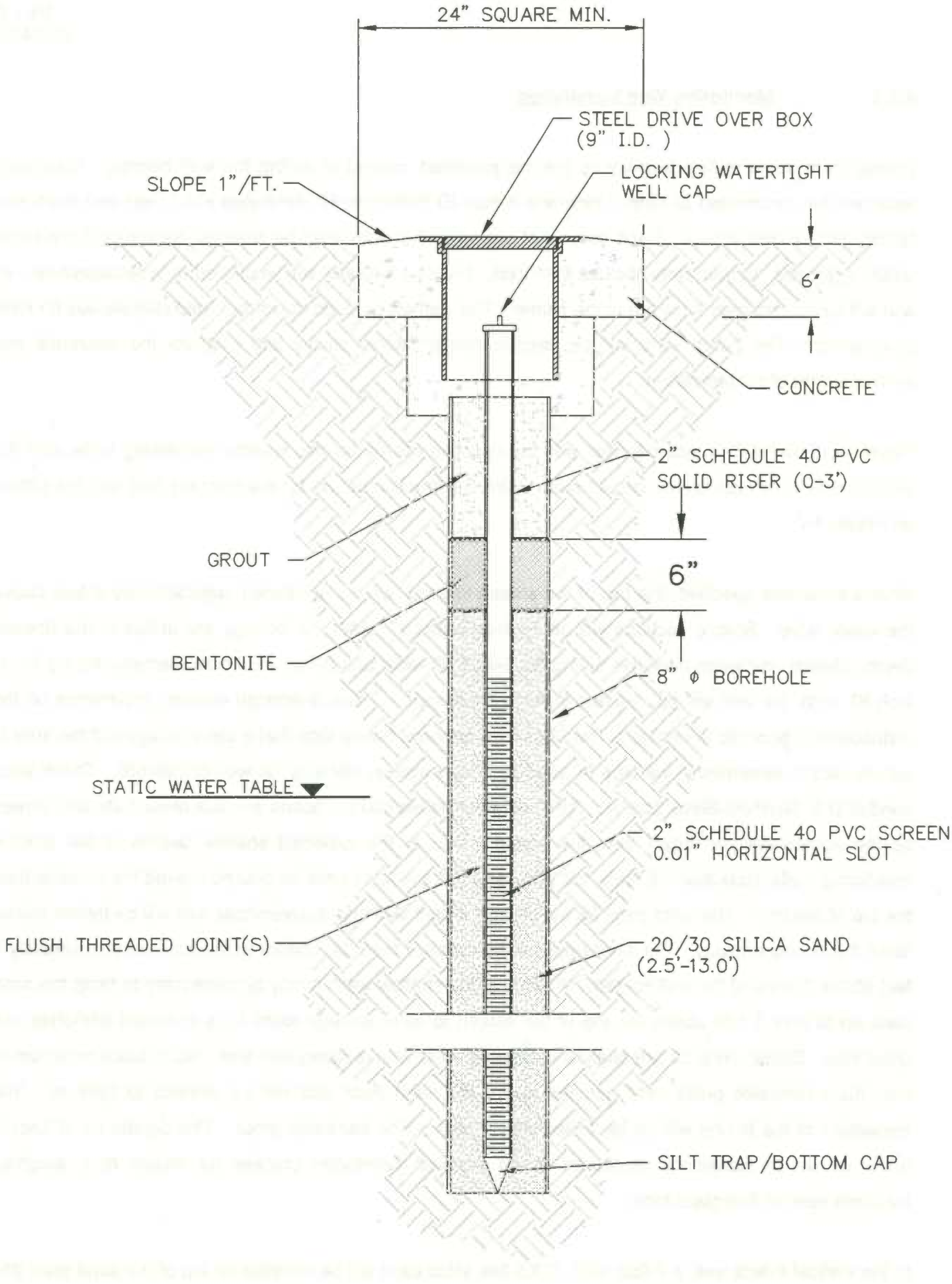
4.3.1 Monitoring Well Installation

Hollow stem auger drilling techniques are the preferred method of drilling the well borings. Monitoring wells will be constructed of both 2-inch and 4-inch ID Schedule 40, flush-joint PVC riser and flush-joint factory slotted well screen. Each section of casing and screen shall be National Sanitation Foundation (NSF) approved. Screen slots shall be 0.01 inch. The 4-inch ID well will be utilized as a recovery/test well and will be located near the edge of the plume . The well will be used to conduct field pilot studies for RAP development. The 2-inch wells will be used to monitor water quality and evaluate the horizontal and vertical extent of contamination.

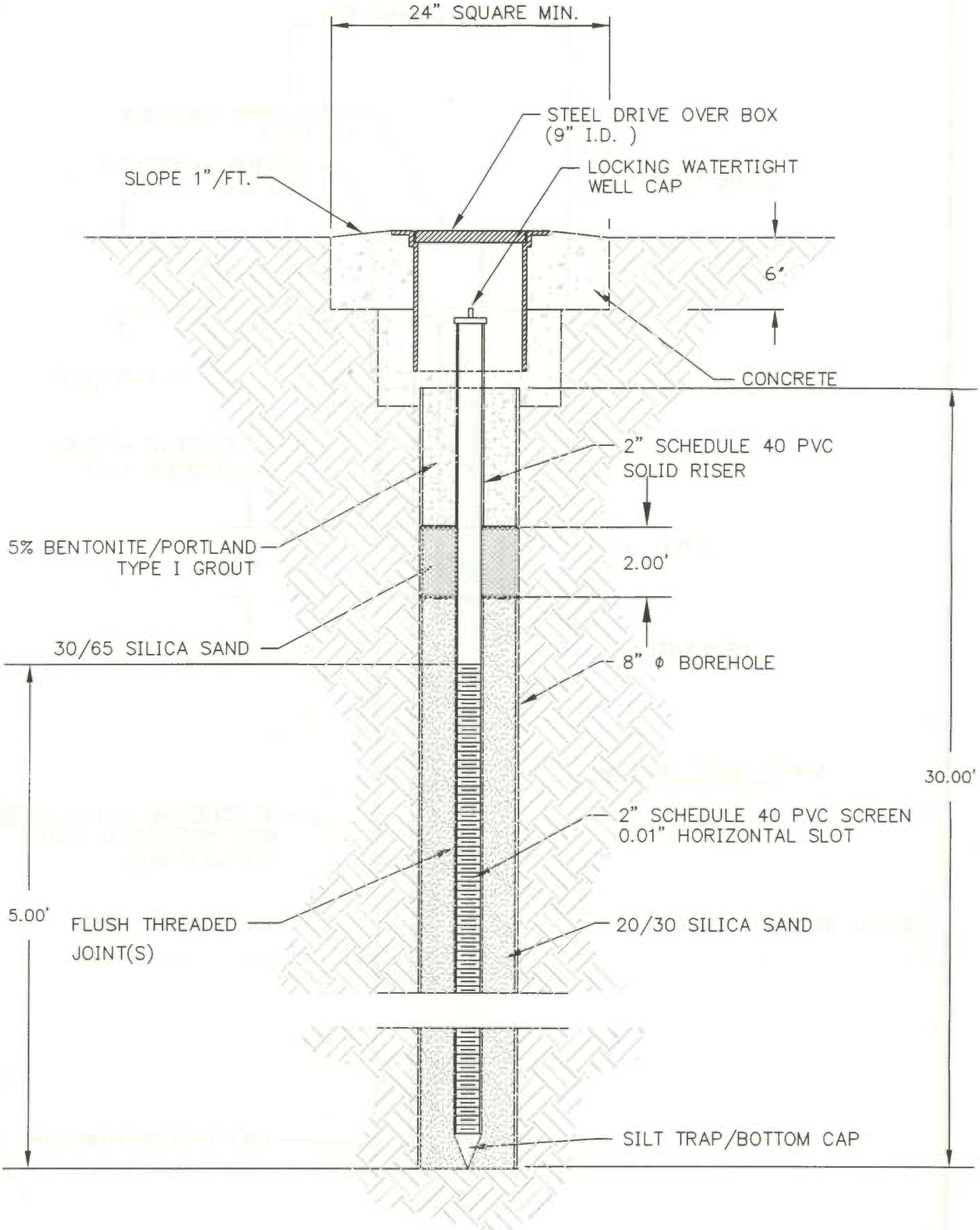
Figures 4-5 and 4-6 illustrate typical well construction details for the shallow monitoring wells and the vertical extent monitoring well, respectively. Well construction details for the recovery/test well are shown on Figure 4-7.

Unless otherwise specified, the top of the screen interval will be positioned approximately 4 feet above the water table. Screen sections will be 10 feet in length. After the borings are drilled to the desired depth, (6-inch minimum diameter boring for 2-inch ID wells and 8-inch minimum diameter boring for 4-inch ID well), the well will be installed through the augers. There is enough existing information on the distribution of geologic materials at the Sites form previous boring logs that a sieve analysis of the soils is not needed in determining the type of sand pack and screen slot size for well completion. Clean silica sand of U.S Standard Sieve Size No. 20/30 will be installed into the boring annulus around the well screen as the augers are withdrawn from the boring. Due to the expected shallow depths of the shallow monitoring wells, (less than 15 feet), it is proposed that the sand pack be poured around the annulus from the top of the hole. The sand pack for the vertical extent well and recovery/test well will be tremie placed down the boring annulus. The sand pack will be installed from the bottom of the hole to approximately 2 feet above the top of the well screen. In some of the shallow wells it may be necessary to bring the sand pack up to only 1 foot above the top of the screen to allow enough room for a sufficient bentonite and grout seal. Construction for the shallow monitoring wells and recovery/test well , will utilize a minimum 6-inch thick bentonite pellet seal installed above the sand pack and will be allowed to hydrate. The remainder of the boring will be backfilled with a high solids bentonite grout. The depths of all backfill materials will be constantly monitored during the well installation process by means of a weighted stainless steel or fiberglass tape.

In the vertical extent well, a 2-foot thick 30/65 fine silica sand will be installed on top of the sand pack (the 30/65 fine silica sand is used in replacement of the bentonite pellet seal installed above the sand pack in the shallow monitoring wells and recovery/test well). The remainder of the boring will be tremie grouted



SITE MANAGER: GFG	CHECKED BY: –	Brown & Root Environmental	FIGURE 4-5
DRAWN BY: TCB	DRAWING DATE: 5/22/96		**TYPICAL 2" DIAMETER SHALLOW MONITORING WELL DETAIL**
SURVEYED BY:	SURVEY DATE:		COASTAL SYSTEMS STATION PANAMA CITY, FLORIDA
SCALE: N.T.S.			
CAD DWG. NO.: 7113ESIT	PROJ. NO.: 7113		



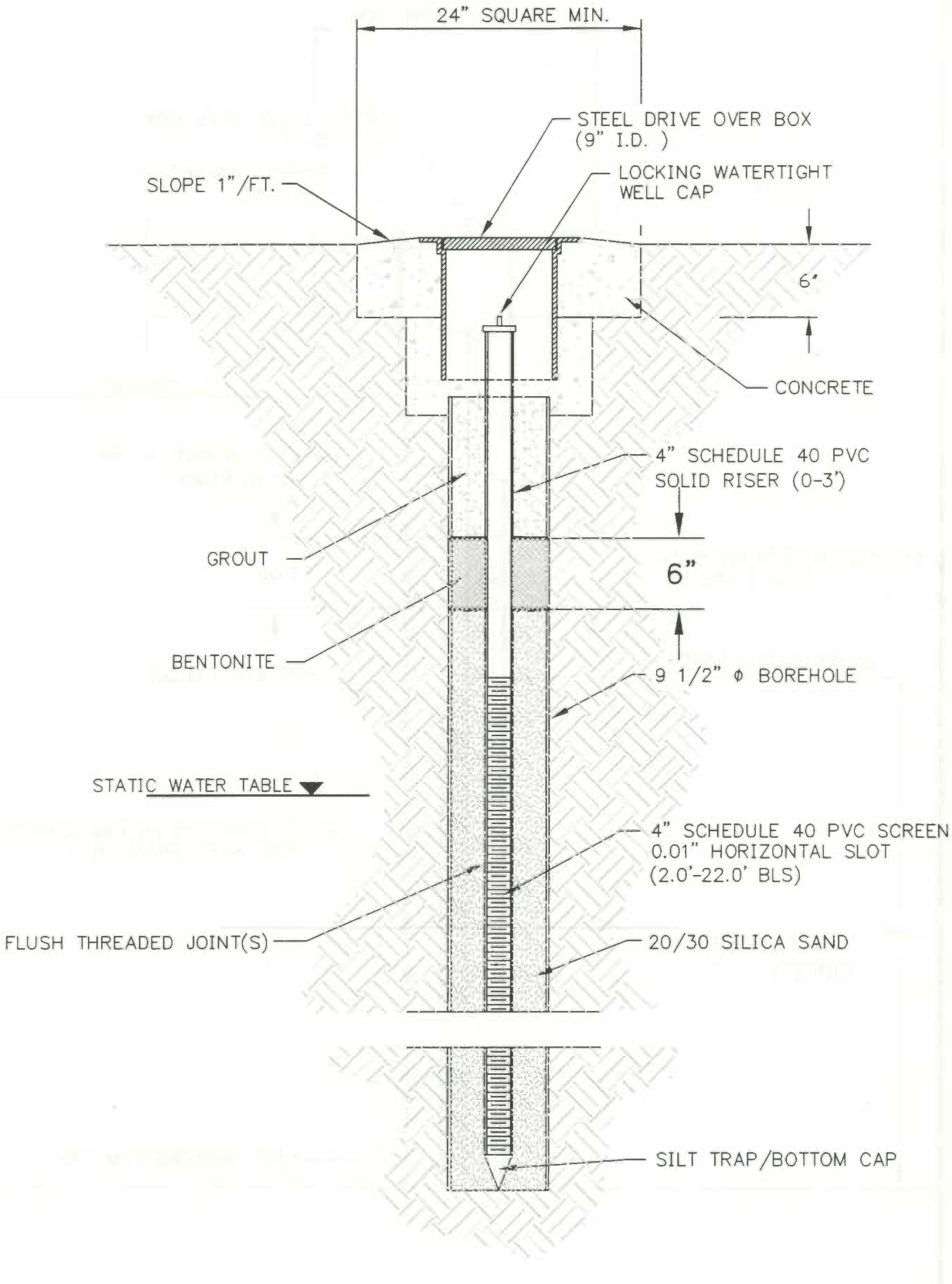
SITE MANAGER: GFG	CHECKED BY: –
DRAWN BY: TCB	DRAWING DATE: 5/22/96
SURVEYED BY:	SURVEY DATE:
SCALE: N.T.S.	
CAD DWG. NO.: 7113ESIT	PROJ. NO.: 7113

Brown & Root Environmental

FIGURE 4-6

MONITROING WELL
TYPICAL CONSTRUCTION DETAIL

COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA



SITE MANAGER: GFG	CHECKED BY: –	Brown & Root Environmental	FIGURE 4-7
DRAWN BY: TCB	DRAWING DATE: 5/22/96		**RECOVERY/TEST WELL DETAIL**
SURVEYED BY:	SURVEY DATE:		COASTAL SYSTEMS STATION
SCALE: N.T.S.			PANAMA CITY, FLORIDA
CAD DWG. NO.: 7113ESIT	PROJ. NO.: 7113		

from the top of the 30/65 sand to the surface with a high solids bentonite grout. The depth of all backfill materials will be constantly monitored during installation of the vertical extent well using a weighted stainless steel or fiberglass tape.

Flush mounted steel well covers and manholes will be installed around the 2-inch and 4-inch ID wells. The manhole will consist of flush mounted 22-gauge steel, water resistant, welded box with 3/8-inch steel lid, locking device, and padlock. A 2-foot by 2-foot by 6-inch thick concrete apron will be constructed around the manhole. The manhole shall be completed 2 inches above existing grade and the apron tapered to be flush with the existing grade at the edges such that water will run off of the apron. A detail of a typical flush-mounted well is shown on Figure 4-5. All locks supplied for the wells will be keyed alike. After installation, the ground surface, and the top of the PVC riser pipe will be surveyed to within 0.01-foot vertical accuracy using datum points as discussed previously in Section 4.0.

A monitor well construction diagram will be completed for each well installed. A sample of the monitoring well construction form is provided in Appendix B.

The monitoring wells will be developed no sooner than 24 hours after installation to remove fine material from around the monitored interval of the well. Wells will be developed by bailing and surging, or by pumping, as determined by the field geologist. The pH, temperature, and specific conductance measurements will be collected from the purge water. Wells will be developed up to a maximum of one hour or until these measurements become stable and the purge water is visibly clear. Water quality stabilization will be determined using the following criteria: temperature +/-0.5^{o}C, pH +/-0.1unit, and specific conductivity +/-10 *u*mhos/cm. Wells will be developed until approved by the field geologist.

4.3.2 Groundwater Sampling

Groundwater samples will be obtained from monitoring wells used in the assessment investigations in accordance with B&R Environmental Comprehensive Quality Assurance Plan (FDEP Comp QA Plan No. 870055) included in Appendix D. Prior to obtaining samples, water levels will be measured and the wells will be purged using a Teflon bailer or appropriate pump. Three to five well volumes will be purged. If wells are purged dry with less than three well volumes removed, the water level in the well will be allowed to recover at least 80 percent, then a sample will be collected. Field measurements of pH, temperature, and specific conductance will be taken after each volume of water is purged. Stabilization of the above parameters is defined in the previous paragraphs. If these parameters do not stabilize after three 3 volumes, up to five volumes will be removed. Before purging, a clear bailer or an oil water interface probe will be used to check for free product. No samples will be collected from a well that exhibits measurable free product. The thickness of the free product will be measured and recorded. Teflon bailers attached to nylon rope will be used for sample collection. The samples will be transferred directly from the bailer into the appropriate (pre-preserved) sample bottles for analysis. Samples to be analyzed for volatile constituents shall be taken first and immediately sealed in the vial so that no headspace exists. The sample constituents analyzed for each of the Sites are summarized in Table 4-1.

All pertinent field and sampling data shall be recorded using a groundwater sample form, attached in Appendix B.

4.3.3 Groundwater Level Measurements

Synoptic water level measurements will be taken from all monitoring wells at the Sites. Static water level measurements will be measured from the north rim of the top of the PVC riser pipe using an electronic water level indicator. The newly installed wells shall be notched and marked so that the same point will be referenced for all measurements. The depth to water will be measured to the nearest 0.01 foot below the top of the PVC riser pipe. Three consecutive water level readings will be recorded from the well to the nearest 0.01 foot to assure an accurate water level is recorded. Water level measurements will be recorded to the nearest 0.01 foot in the appropriate field log book.

4.4 AQUIFER TESTS

B&R Environmental will perform a series of aquifer slug tests on three selected shallow monitoring wells at Site 333. Each of these tests will be performed by removing a volume ("slug") of water from the well and measuring the recharge of the well back to equilibrium. The Bouwer and Rice methodology for partial penetrating wells in unconfined aquifers will be utilized to calculate the hydraulic conductivity values for the three monitoring wells as described by Bouwer, 1989, and Rice, 1976. Calculations will be performed using Aqtesolve™ aquifer characterizations program as described in Duffield and Rumbaugh, 1991.

A tidal influence survey will also be conducted on one shallow monitoring well at Site 333 to assess if tidal fluctuations are apparent in the study area. Static water levels in the well will be measured during a 24-hour period (or one complete tide cycle) using an electronic data logger.

TABLE 4-1

ENVIRONMENTAL SAMPLE SUMMARY
COASTAL SYSTEMS STATION, PANAMA CITY, FLORIDA

CAP Preliminary Field Investigation:

Soil Analyses: Site 323

Analyte	Proposed Method (1)	Env. Samples	Duplicate Samples	Rinsate Blanks	Trip Blanks	Total Samples
RCRA 8 Total Metals	SW-846/7060 /6010/7471/7740	1	0	1	0	2
EPTC Metals (TCLP metals) (2)	SW-846/6010	1	0	0	0	1
Priority Pollutants Volatile Organics (3)	SW-846 /5030/8260	1	0	1	1	3
Priority Pollutants Extraction Organics (3)	SW-846 /3510/8250	1	0	1	NA	2
Total Recoverable Petroleum Hydrocarbons	418.1	1	0	1	0	2
TOTAL:		5	0	4	1	10

(1) Method referenced reflects FDEP Chapter 62-770.200(8) requirements.

(2) EPTC metals (one soil sample shall be collected from the area of highest contaminant concentration for extraction by EPA Method 1311 prior to 8 RCRA total metal parameter analyses).

(3) Priority Pollutant Analyses (one soil sample from area of highest contaminant concentration shall be collected and analyzed). Tentatively Identified Compounds (TICs) will also be reported to determine the presence of non-priority pollutant organics.

Waste disposal analyses for water and drill cuttings not included.

One matrix spike and one laboratory duplicate sample aliquot will be collected per 20 environmental samples of like matrix.

All analyses are analyzed using standard laboratory turn around time.

NA = Not applicable

TABLE 4-1 (Continued)

ENVIRONMENTAL SAMPLE SUMMARY
COASTAL SYSTEMS STATION, PANAMA CITY, FLORIDA

CAP Preliminary Field Investigation:

Groundwater Analyses: Site 362

Analyte	Proposed Method (1)	Env. Samples	Duplicate Samples	Rinsate Blanks	Trip Blanks	Total Samples
1-2-Dicloroethane, and Volatile Organic Halocarbons (2)	E 601	4	0	1	0	5
Total Volatile Organic Aromatics, BTEX, and MTBE (2)	E 602	4	0	1	0	5
1-2 Dibromoethane (EDB)	E 504	4	0	1	0	5
Lead (3)	E 239.2	8	0	2	NA	10
TOTAL:		20	0	5	0	25

(1) Method referenced reflects FDEP Chapter 62-770.200(8) requirements.
(2) Volatile Organic Halocarbons should be analyzed for listed priority pollutant compounds by EPA Method 601 or 602 as stipulated. Reporting of Tentatively Identified Compounds (TICs) will be requested from the laboratory.
(3) Includes total and dissolved lead analysis.

Waste disposal analyses for water and drill cuttings not included.

One matrix spike and one laboratory duplicate sample aliquot will be collected per 20 environmental samples of like matrix.

All analyses are analyzed using standard laboratory turn around time.

NA = Not applicable

TABLE 4-1 (Continued)

ENVIRONMENTAL SAMPLE SUMMARY
COASTAL SYSTEMS STATION, PANAMA CITY, FLORIDA

CAR Field Investigation:

Groundwater Analyses: Site 323

Analyte	Proposed Method (1)	Env. Samples	Duplicate Samples	Rinsate Blanks	Trip Blanks	Total Samples
1-2-Dicloroethane, and Volatile Organic Halocarbons (2)	E 601	1	0	1	0	2
Total Volatile Organic Aromatics, BTEX, and MTBE (2)	E 602	1	0	1	0	2
1-2 Dibromoethane (EDB)	E 504	1	0	1	0	2
Polynuclear Aromatic Hydrocarbons (PAH)	E 610	1	0	1	NA	2
Lead (3)	E 239.2	2	0	2	NA	4
Metals: Arsenic, Cadmium, and Chromium	SW-846/7060 /6010	1	0	1	0	2
Priority Pollutants Volatile Organics (4)	SW-846 /5030/8260	1	0	1	NA	2
Priority Pollutants Extraction Organics (4)	SW-846 /3510/8250	1	0	1	0	2
Total Recoverable Petroleum Hydrocarbons	E 418.1	1	0	1	NA	2
TOTAL:		10	0	10	0	20

(1) Method referenced reflects FDEP Chapter 62-770.200(8) requirements.
(2) Volatile Organic Halocarbons should be analyzed for listed priority pollutant compounds by EPA Method 601 or 602 as stipulated. Reporting of Tentatively Identified Compounds (TICs) will be requested from the laboratory.
(3) Includes total and dissolved lead analysis.
(4) Tentatively Identified Compounds (TICs) will also be reported to determine the presence of non-priority pollutants organics.

Waste disposal analyses for water and drill cuttings not included.

One matrix spike and one laboratory duplicate sample aliquot will be collected per 20 environmental samples of like matrix.

All analyses are analyzed using standard laboratory turn around time.

NA = Not applicable

TABLE-4-1 (Continued)

ENVIRONMENTAL SAMPLE SUMMARY
COASTAL SYSTEMS STATION, PANAMA CITY, FLORIDA

CAR Field Investigation:

Groundwater Analyses: G9

Analyte	Proposed Method (1)	Env. Samples	Duplicate Samples	Rinsate Blanks	Trip Blanks	Total Samples
1-2-Dicloroethane, and Volatile Organic Halocarbons (2)	E 601	1	0	1	0	2
Total Volatile Organic Aromatics, BTEX, and MTBE	E 602	1	0	1	0	2
Polynuclear Aromatic Hydrocarbons (PAH)	E 610	1	0	1	NA	2
1-2 Dibromoethane (EDB)	E 504	1	0	1	0	2
Lead (3)	E 239.2	2	0	2	NA	4
Total Recoverable Petroleum Hydrocarbons	E 418.1	1	0	1	NA	2
TOTAL:		7	0	7	0	14

(1) Method referenced reflects FDEP Chapter 62-770.200(8) requirements.
(2) Volatile Organic Halocarbons should be analyzed for listed priority pollutant compounds by EPA Method 601 or 602 as stipulated. Reporting of Tentatively Identified Compounds (TICs) will be requested from the laboratory.
(3) Includes total and dissolved lead analysis.

Waste disposal analyses for water and drill cuttings not included.

One matrix spike and one laboratory duplicate sample aliquot will be collected per 20 environmental samples of like matrix.

All analyses are analyzed using standard laboratory turn around time.

NA = Not applicable

TABLE 4-1 (Continued)

ENVIRONMENTAL SAMPLE SUMMARY
COASTAL SYSTEMS STATION, PANAMA CITY, FLORIDA

CAR Field Investigation:

Groundwater Analyses: Site 333

Analyte	Proposed Method (1)	Env. Samples	Duplicate Samples	Rinsate Blanks	Trip Blanks	Total Samples
1-2-Dicloroethane, and Volatile Organic Halocarbons (2)	E 601	9	1	2	1	13
Total Volatile Organic Aromatics, BTEX, and MTBE (2)	E 602	9	1	2	1	13
1-2 Dibromoethane (EDB)	E 504	9	1	2	1	13
Polynuclear Aromatic Hydrocarbons (PAH)	E 610	9	1	2	NA	12
Lead (3)	E 239.2	18	2	4	NA	24
Metals: Arsenic, Cadmium, and Chromium	SW-846/7060 /6010	9	1	2	0	12
Priority Pollutants Volatile Organics (4)	SW-846 /5030/8260	9	1	2	1	13
Priority Pollutants Extraction Organics (4)	SW-846 /3510/8250	9	1	2	NA	13
Total Recoverable Petroleum Hydrocarbons	E 418.1	9	1	2	NA	13
TOTAL:		90	10	20	4	113

(1) Method referenced reflects FDEP Chapter 62-770.200(8) requirements.
(2) Volatile Organic Halocarbons should be analyzed for listed priority pollutant compounds by EPA Method 601 or 602 as stipulated. Reporting of Tentatively Identified Compounds (TICs) will be requested from the laboratory.
(3) Includes total and dissolved lead analysis.
(4) Tentatively Identified Compounds (TICs) will also be reported to determine the presence of non-priority pollutants organics.

Waste disposal analyses for water and drill cuttings not included.

One matrix spike and one laboratory duplicate sample aliquot will be collected per 20 environmental samples of like matrix.

All analyses are analyzed using standard laboratory turn around time.

NA = Not applicable

TABLE 4-1 (Continued)

INVESTIGATIVE DERIVED WASTE (IDW) CHARACTERIZATION ANALYSES
COASTAL SYSTEMS STATION, PANAMA CITY, FLORIDA

Parameter	Method	No. Of Samples
TCLP Organics and Metals	SW-846/1311/40 CFR 261	4
Ignitability	SW-846/1010	NA
Corrosivity	SW-846/1110	4
Reactivity	SW-846/7.7.3	4

Note: Ignitability analysis is not typically performed for solid matrix waste characterization

NA = Not applicable

4.5 EQUIPMENT DECONTAMINATION

The equipment involved in field sampling activities will be decontaminated prior to and during drilling and sampling activities. This equipment includes drill rigs, downhole tools, augers, well casing and screens, and soil and water sampling equipment.

4.5.1 Major Equipment

All downhole drilling equipment used in the construction and sampling of permanent monitoring wells, including downhole drill and sampling tools shall be steam cleaned prior to beginning work, between boreholes, any time the drill rig leaves the drill Site prior to completing a boring, and at the conclusion of the drill program.

These decontamination operations will consist of washing equipment using a high-pressure steam wash from a potable water supply and Alconox. Then the equipment will be rinsed with tap water. All decontamination activities will take place at a predetermined location. Additional requirements for drilling equipment decontamination can be found in SOP SA-7.1 included in Appendix B.

4.5.2 Sampling Equipment

All equipment such as trowels, bailers, and split spoon samplers used for collecting samples will be decontaminated prior to beginning field sampling and between sample locations. The following decontamination steps will be taken:

- Tap water and Alconox or liquinox detergent rinse.
- Tap water rinse.
- If trace metals are to be sampled rinse with 10-15% reagent grade nitric acid (the nitric acid should not be used on steel sampling equipment).
- Rinse thoroughly with de ionized water.
- Rinse with isopropanol
- Rinse thoroughly with analyte-free water
- Air dry.
- Wrap equipment in aluminum foil until use.

Field meters such as pH, conductivity and temperature instrument probes will be rinsed first with tap water, then with Reagent Grade II water, and finally with the sample liquid.

4.6 WASTE HANDLING

In all areas, drill cuttings from monitoring well installations, well development water, and purge water will be collected and containerized in DOT approved (Specification 17C) 55-gallon drums. Each drum will be sealed and labeled and left at a drum staging area pending groundwater analytical results and/or composite waste sample results for disposal. Waste staging areas will be established at each Site location to keep investigated derived waste separated during the site assessment investigations (except soil cuttings from G9 and 323 will be composted due to only one drum of soil being generated during the first phase of field work). Decontamination water generated during site investigation activities at 362 and G9 will be disposed of on site. All decontamination materials generated during the Site investigations at 323 and 333 will be containerized due to the potential of hazardous constituents associated with used oil. All soils and water will be disposed of properly at a later date.

Lined decontamination pads will be constructed and used to collect the water from steam cleaning of drilling equipment for Sites 323 and 333 due to the potential of hazardous constituents associated with used oil.

4.7 SAMPLE HANDLING

Sample handling includes the field-related consideration concerning the selection of sample containers, preservatives, allowable holding times and analysis requested. In addition, sample identification, packaging, and shipping will be addressed. All sample handling procedures will be in accordance with B&R Environmental's Comprehensive Quality Assurance Plan (CompQAP No. 870055) which has been approved by the Florida Department of Environmental Protection (FDEP).

The CompQAP address the topics of containers and sample preservations. A summary of bottle ware requirements, preservation requirements, and sample holding times are provided in Table 4-2.

Table 4-2
Summary of Analysis, Bottleware Requirements, Preservation Requirements, and Holding Times
Coastal Systems Station, Panama City, Florida

Parameter	Analytical Method	Sample Container	Volume	Preservation	Maximum Holding Time (1)
Aqueous Samples					
VOCs Plus TICs	EPA Method 601	Glass Volatile Vial	40 ml	Add HCl to pH < 2; Chill to 4 degrees Celcius	14 days
VOCs Plus MTBE and TICs	EPA Method 602	Glass Volatile Vial	40 ml	Add HCl to pH < 2; Chill to 4 degrees Celcius	14 days
VOCs Plus TICs	SW-846 Method 8260	Glass Volatile Vial	40 ml	Add HCl to pH < 2; Chill to 4 degrees Celcius	14 days
1,2-Dibromomethane	EPA Method 504	Glass Volatile Vial	40 ml	Add HCl to pH < 2; Chill to 4 degrees Celcius	28 days
PAHs Plus TICs	EPA Method 610	Amber Glass	2.5 L	Chill to 4 degrees Celcius	7 days until extraction; 40 days to analysis
SVOCs Plus TICs	SW-846 Method 8270	Amber Glass	2.5 L	Chill to 4 degrees Celcius	7 days until extraction; 40 days to analysis
Lead (Total and dissolved) Arsenic Cadmium and Chromium Iron and Manganese	EPA Method 239.2 SW-846 Method 7060 SW-846 Method 6010 SW-846 Method 7131 and 6010	High Density Polyethylene	500 ml	Chill to 4 degrees Celcius	180 days
TRPH	EPA Method 418.1	Glass	1L	Add H2SO4 to pH <2; Chill to 4 degrees Celcius	28 days
TDS	EPA Method 160.1	High Density Polyethylene	250 ml	Chill to 4 degrees Celcius	7 days
TSS	EPA Method 160.2	High Density Polyethylene	250 ml	Chill to 4 degrees Celcius	7 days
Hardness	EPA Method 130.2	High Density Polyethylene	250 ml	Add H2SO4 to pH <2; Chill to 4 degrees Celcius	180 days
TOC	EPA Method 415.1	High Density Polyethylene	60 ml	Add H2SO4 to pH <2; Chill to 4 degrees Celcius	28 days

Table 4-2 (Continued)
Summary of Analysis, Bottleware Requirements, Preservation Requirements, and Holding Times
Coastal Systems Station, Panama City, Florida

Parameter	Analytical Method	Sample Container	Volume	Preservation	Maximum Holding Time
Solid Samples					
VOCs Plus TICs	SW-846 Method 8260	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	14 days
SVOCs Plus TICs	SW-846 Method 8270	Clear Wide Mouth Glass	8 ounces	Chill to 4 degrees Celcius	7 days to extraction; 40 days to analysis
RCRA Metals	SW-846 Method 6010/7000 series	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	180 days; except mercury 28 days
TCLP RCRA Metals	SW-846 Method 6010/7000 series	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	7 days to extract/ 180 days to analysis
TRPH	EPA Method 418.1	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	28 days
TCLP Organic and Inorganic	SW-846 Methods 8260, 8270, 8080, 8150, and 6010/7000 series	Clear Wide Mouth Glass	16 ounces	Chill to 4 degrees Celcius	7 days to extract; 14 days to volatile analysis 7 days to semivolatile/pesticide/herbicide extraction and 40 days to analysis; 180 days for metals
Corrosivity	SW-846 Method 1110	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	7 days
Reactivity	SW-846 Chapter 7.3.3.2 and 7.3.4.2	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	7 days

VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
TICs - Tentatively Identified Compounds
MTBE - Methyl-tert-butyl-ether
TRPH - Total Recoverable Petroleum Hydrocarbons
TDS - Total Dissolved Solids
TSS - Total Suspended Solids
TOC - Total Organic Carbon
RCRA - Resource Conservation and Recovery Act
TCLP - Toxicity Characterization Leaching Procedure

H2SO4 - Sulfuric acid
HCl - Hydrochloric acid

(1) - Holding time is measured from date of sample collection to date of sample analysis.

Note: Parameters TDS, TSS, TOC, Iron and Manganese will be sampled during RAP Development.

4.8 SAMPLE IDENTIFICATION

Each sample collected will be assigned a unique sample tracking number. The sample tracking number will consist of a three-segment, alpha-numeric code that identifies the building number (the Site), sample medium, location, the sampling event identifier or sample depth (in case of soil samples) and the QC designation, if applicable. Any other pertinent information regarding sample identification will be recorded in the field logbook.

The alpha-numeric coding to be used in the sample system is explained in the subsequent definitions:

NN(N or A)	-	(Building Designation)
AA	-	(Medium)
AANN	-	(Location)
NNN(N)	-	QC Designation, if applicable)

Character Type:

A = Alpha
N = Numeric

Medium:

GW = Groundwater sample form a monitoring well
SS = Subsurface soil sample taken via soil boring
TW = Temporary well groundwater sample

Sample Location:

Subsurface soil sample locations (SS) will correspond to the boring number (i.e., SB02)

Groundwater sample locations (GW) will correspond to the well number (i.e, 58-1)

Temporary well groundwater sample locations (TW) will correspond to the temporary well number (i.e, 58-TW1)

Sample Identifier:

For soil samples = Sample depth interval, in feet

For groundwater = Sampling round

QA Sample Designation:

D = Duplicate
F = Field Blank
B = Equipment Rinsate Blank
T = Trip Blank

For example, a groundwater sample collected from monitoring well MW-01 at Building 362 UST would be designated as 362-GW-MW01-001.

A duplicate sample from that same well would be 362-GW-MW01-001D.

A subsurface soil sample taken from Monitoring Well Boring 01 at Building 362 UST, at a depth of 4 to 6 feet bls would be 362-SS-MW01-0406.

Information regarding sample labels to be attached before shipment to a laboratory is contained SOP SA-6.3 included in Appendix B. Examples of sample labels, chain of custody seals, and chain-of-custody forms are included in Appendix B.

4.9 SAMPLE PACKAGING AND SHIPPING

Samples will be packaged and shipped in accordance with B&R Environmental's CompQAP (FDEP Comp QA Plan No. 870055). The Field Operations Leader will be responsible for completion of the following forms when samples are collected for shipping.

- Sample labels
- Chain-of-Custody labels
- Appropriate labels applied to shipping coolers
- Chain-of Custody Forms
- Federal Express Air Bills

4.10 SAMPLE CUSTODY

The chain-of-custody begins with the release of the sample bottles from the laboratory and must be documented and maintained from that point forward. To maintain custody of the sample bottles or samples, they must be in someone's physical possession, in a locked room or vehicle, or sealed with an intact custody seal. When the possession of the bottles or samples is transferred from one person to another it will be documented on the field logbook and on the chain-of-custody. An example of a chain-of-custody record is provided in Appendix B.

4.11 QUALITY CONTROL (QC) SAMPLES

In addition to periodic calibration of field equipment and appropriate documentation, quality control samples will be collected or generated during environmental sampling activities. Quality control samples include field blanks, field duplicates, field replicates, and trip blanks. Each type of field quality control sample is defined as follows:

Rinsate Blank - Rinsate blanks are obtained under representative field conditions by running organic free water through sample collection equipment (bailer, split-spoon, etc.) after decontamination and placing it in the appropriate containers for analysis. Rinsate blanks will be used to assess the effectiveness of decontamination procedures. Rinsate blanks will be collected for each type of non-dedicated sampling equipment used and will be submitted as shown in Table 4-1.

Field Duplicate - Field duplicate(s)are two water samples collected independently at a sample location during a single act of sampling under representative field conditions. Field duplicates sample frequencies are provided in Table 4-3. The duplicates shall be analyzed for the same parameters in the laboratory as indicated in Table 4-1.

Trip Blanks - Trip blank(s) will be prepared at the laboratory facility and will accompany the VOA vials to the sampling site and back to the laboratory. Trip blanks are not required by the FDEP unless 10 or more volatiles samples are collected during a given sampling event. Trip blank sample frequency are provided in Table 4-3.

TABLE 4-3

QUALITY CONTROL SAMPLE FREQUENCY
COASTAL SYSTEMS STATION, PANAMA CITY, FLORIDA

# of Samples	Precleaned quipment BLK	Field cleaned quipment BLK	Trip BLK (VOCs)	Duplicate
10+	minimum of one then 5%	minimum of one then 5%	one per cooler	minimum one then 10%
5-9	one*	one*	NR	one
< 5	one*	one*	NR	NR

NR = Not required
BLK = Blank

* Note: For 9 or fewer samples, a precleaned equipment blank <u>or</u> a field cleaned equipment blank is required. A field cleaned equipment blank must be collected if equipment is cleaned in the field.

4.12 FIELD MEASUREMENTS

Certain field measurements will be recorded during sampling activities including groundwater temperature, pH, and specific conductance. Instruments used in the field to record this data and additional instruments will be calibrated according to the procedures described below.

4.12.1 Parameters

- Air monitoring - OVA
- Temperature - Temperature probe
- Specific conductance - Specific conductance meter
- pH - pH meter
- Depth to water table - interface probe

4.12.2 Equipment Calibration

The electronic water-level indicator will be calibrated prior to mobilization and periodically at the discretion of the Field Operations Leader. The remaining instruments will be calibrated daily and/or according to the manufacturer's operation manual.

Calibration will be documented on an Equipment Calibration Log as shown in Appendix B. During calibration, an appropriate maintenance check will be performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have an impact on the instrument's performance, the instrument will be removed from service until defective parts are repaired or replaced.

4.12.3 Equipment Maintenance

Measuring equipment used in environmental monitoring or analysis and test equipment used for calibration and maintenance shall be controlled by established procedures. Measuring equipment shall have an initial calibration and shall be recalibrated at scheduled intervals against certified standards. Equipment will be calibrated periodically.

B&R Environmental maintains a large inventory of sampling and measurement equipment. In the event that failed equipment cannot be repaired replacement equipment can be shipped to the Site by overnight express carrier to minimize downtime.

4.13 FIELD QA/QC PROGRAM

4.13.1 Control Parameters

Field control parameters and limits, which address various field blanks and duplicate samples, are described in Section 4.10 QC Samples. Control checks and sampling frequency are also presented in Section 4.10.

4.13.2 Control Limits

QA/QC specifications for field measurements are summarized on Table 4-4. This table shows control parameters to be assessed, control limits, and corrective actions to be implemented.

The B&R Environmental representative on site at each well and boring will confirm measurements of total depth of holes, dimensions and placement of well screens and casings, and volume and placement of filter pack and grout materials by independent measurement. The Field Operations Leader will examine field laboratory records and field log books on a weekly basis during field activities.

4.13.3 Corrective Actions

The need for corrective actions may become apparent during surveillance of field activities, procurement of services and supplies, or other operations that may affect the quality of work. The identification of significant conditions adverse to quality, the cause of the conditions, and the corrective actions shall be documented and reported to the appropriate levels of management. The B&R Environmental Project Manager will have overall responsibility for implementing corrective actions, and must identify those from initiating corrective action to remedy immediate effects of the problem.

The corrective action program covers the analysis of the cause of any negative findings and the corrective actions required. This program includes the investigation of the case of significant or repetitious unsatisfactory conditions relating to the quality of sampling service, or the failure to implement adhere to required quality assurance practices such as Standard Operating Procedures.

TABLE 4-4

FIELD QA/QC SPECIFICATIONS
COASTAL SYSTEMS STATION, PANAMA CITY, FLORIDA

Analysis	Control Parameter	Control Limit	Corrective Action
Air Monitoring	Check calibration of OVA daily	Calibrate to manufacturers specifications	Recalibrate. If unable to calibrate, replace
Specific Conductance of Water	ontinuing calibration check of standard solution	+1% of standard	Recalibrate
pH of Water	ontinuing calibration heck of pH 7.0 buffer	pH = 7.0 + 0.1	Recalibrate. If unable to calibrate, replace electrode

4.14 RECORD KEEPING

In addition to chain-of-custody records associated with sample handling and packaging and shipping, certain standard forms will be completed for sample description and documentation. These shall include sample log sheets (for soil and groundwater samples), daily record subsurface investigation reports, and logbooks. An example of theses forms can be found in Appendix B.

A bound/weatherproof field notebook shall be maintained by each sampling event leader. The field team leader or designee, shall record all information related to sampling or field activities. This information may include sampling time, weather conditions, unusual events (e.g., well tampering), field measurements, descriptions of photographs, ect.

A site logbook shall be maintained by the Field Operations Leader. The requirements of the logbook are referenced in Appendix B. This book will contain an summary of the day's activities and will reference the field notebooks when applicable.

Each field team leader who is supervising a drilling subcontractor activity must complete a Daily Record Subsurface Investigation Report (DRSIR). The DRSIR documents the activities and progress of the daily drilling activities. The information contained within this report is used for billing verification and progress reports. The driller's signature is required at the end of each working day to verify work accomplished, hours worked, standby time. and material used. An example of this form is provided in Appendix B.

At the completion of field activities, the Field Operations Leader shall submit to the Project Manager all field records, data, field notebooks, logbooks, chain-of-custody receipts, sample log sheets, drilling logs, daily logs, ect.

4.15 SITE MANAGEMENT AND BASE SUPPORT

B&R Environmental will perform this project with support from the Navy. This section of the Work Plan describes the project contacts, support personnel, project milestones and time frames of all major events.

Throughout the duration of the investigation activities, work on the CSS Naval Base will be coordinated through SouthDiv and CSS personnel. The primary contacts are as follows:

1. SouthDiv Engineer in Charge
   Mr. Nick Ugolini
   (803) 820-5596

2. CSS Environmental Engineer
   Mr. Mike Clayton
   (904) 235-5859

4.15.1 Support From CSS

The following support functions will be provided by CSS personnel

- Assist B&R Environmental in locating underground utilities prior to the commencement of drilling operations.
- Provide existing engineering plans, drawings, diagram, files, ect., to facilitate evaluation of the Sites under investigation.
- Provide all historical data, background geological and hydrogeological information, and initial Site investigation documents.

4.15.2 Assistance From CSS

CSS personnel will aid in arranging the following:

- Personnel identification badges, vehicle passes, and/or entry permits.
- A secure staging area (approximately 1,000 square feet) for storing equipment and supplies.
- A supply (e.g., fire hydrant, stand pipe, ect.) of large quantities of potable water for equipment cleaning etc.
- As required, provide escorts for contract personnel working in secured areas (all contract personnel working at the Naval Base will be U.S. citizens).

- Establish decontamination areas and waste staging areas for each of the Sites that are located adjacent or near the study area.

4.15.3 Support From B&R Environmental

The project will be staffed with personnel from the B&R Environmental Tallahassee Florida office. During field activities, B&R Environmental will provide a senior level geologist and/or staff geologist, and equipment technician.

Mr. Jerry Goode, P.G., is the Task Order Manager (TOM) for CTO 0008 and will be the primary point of contact. He is responsible for cost and schedule control as well as technical performance. Mr. Goode will serve as the TOM and will provide senior level review and oversight during field activities. Mr. Goode will be the primary point of contact for the Field Operations Leader.

4.15.4 Contingency Plan

In the event of problems which may be encountered during site activities, the SouthDiv point of contact will be notified immediately, followed by the B&R Environmental project manager and the CSS point of contact. The project manger will determine a course of action so as to not interfere with the schedule or budget. All contingency plans will be approved through the SouthDiv point of contact before being enacted.

5.0 PROPOSED LABORATORY ANALYSIS

Temporary well groundwater samples, soil samples, and monitoring well groundwater samples will be collected during the assessment investigations. The temporary well groundwater samples will be sampled for benzene, toluene, ethylbenzene, xylene, and naphthalene. Groundwater and soil samples collected for laboratory analyses will be analyzed in accordance with parameters as identified in Chapter 62-770.800 (see Sections 5.2 and Section 5.3 below for specific sampling requirements regarding soil and groundwater).

5.1 TEMPORARY WELL POINT INVESTIGATION

Approximately 13 groundwater samples will be collected form the temporary well point investigations and analyzed for benzene, toluene, ethylbenzene, xylene, and naphthalene. Additional samples may be collected should the size of the survey expand. No QA/QC samples will be collected since the temporary well point samples are to be used for field screening results only. Samples will be analyzed in the field using a portable GC. The samples will be collected in two-40 ml vials.

5.2 SOIL INVESTIGATION

In accordance with Chapter 62-770.800, F.A.C. one soil sample will be collected at Site 333 during the advancement of hand auger borings and analyzed for parameters in the Kerosene and Used Oil Analytical Groups. Parameters within these groups are identified on Table 4-1. The soil sample will be collected from the 'worse case' soil boring based on visual oil staining and/or hydrocarbon vapor readings detected in soil samples.

5.3 GROUNDWATER INVESTIGATION

Groundwater samples will be collected from each newly installed permanent monitoring well. Groundwater samples will also be collected from the existing compliance wells located at the fuel delivery system for Site 362. The specific groundwater sampling at each of the Sites and a summary of Investigative Derived Waste sample parameters are summarized in Table 4-1.

6.0 PROPOSED SCHEDULE

Phase 1 of the field work is proposed to begin in early June of 1996 and take approximately 5 days to complete. The CARs associated with Phase 1 (Sites G9, 323, and 362) will be completed and submitted to the Navy for review approximately 30 days after sampling activities are completed. Phase 2 of the field work will begin immediately upon approval of the permanent monitoring wells by the FDEP following review of Phase I soil and groundwater quality data. Phase 2 work is anticipated to begin in early to mid July 1996. The CAR developed with the completion of Phase 2 field activities will be completed and submitted to the Navy for review approximately 30 days after Phase 2 sampling activities are completed.

Upon approval of the CAR for Site 333, the field pilot test and RAP development will be initiated. It is anticipated the RAP will be submitted to the Navy for review approximately 60 days after the field pilot test is completed. The field pilot test will be used to select the appropriate remedial technology for site remediation.

7.0 REPORT

Upon completion of all field work and laboratory analysis, a CAR summarizing the results of the investigation will be submitted to the FDEP. Basic UST system information including site Facility Identification Number, facility name and address, date closed, area, type of system and tank capacity will be provided. Data recorded during tank removal will be included. Also included in the report will be graphical presentations of the groundwater screening results, and complete summaries of the soil and groundwater analytical results. The locations of the soil samples and monitoring wells will be presented on scaled figures. Boring logs, chain-of-custody forms, field forms, field screening results, and analytical reports will be included in Appendices of the report.

The report will include a determination if remediation is required in accordance with Chapter 62.770 F.A.C action levels for soil and groundwater remediation. If remediation is deemed appropriate, a recommended remediation technique will be presented with an implementation schedule. A Responsibility Assignment Matrix, and meeting with Remedial Action Contractors (RACs) to discuss the results of the contamination assessment will be developed, scheduled, and implemented.

8.0 REFERENCES

ABB Environmental Services, Inc., January 1995. Resource Conservation And Recovery Act Facility Investigation Coastal Systems Station Panama City, Florida.

American Society for Testing and Materials, October 1992. Designation: D 1586 - 84 (Reapproved 1992).

Bouwer, H., 1989. The Bouwer and Rice Slug Test - an Update. Groundwater, v. 27, pp. 304-309.

Bouwer, H. and R. C. Rice, 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. Water Resources Research, V. 12, pp. 423-428.

Brown & Root Environmental, 1995 Revision. Comprehensive Quality Assurance Plan, FDEP COMP QA PLAN # 870055.

Southern Earth Sciences, Inc., May 2, 1994. Underground Storage Closure Assessment at Coastal Systems Station Building #9, Panama City, Florida.

Southern Earth Sciences, Inc., May 10, 1995. Soil Screening for Upgrading Fueling System at Systems Station Building 362, Panama City, Florida.

SWS Environmental First Response, January 2, 1996. Closure Assessment Report, FAC. #333 Waste Oil Tank & Oil/Water Separator, Coastal Systems Station, Panama City, Florida.

APPENDIX A

DISCHARGE REPORTING FORMS FOR SITES G9, 323, AND 362, AND THE CLOSURE REPORT FOR SITE 333

DER Form # 17-761.900(1)
Form Title Discharge Reporting Form
Effective Date December 10, 1990
DER Application No. ____________ (Filled in by DER)

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Discharge Reporting Form

Use this form to notify the Department of Environmental Regulation of:

1. Results of tank tightness testing that exceed allowable tolerances within ten days of receipt of test result.
2. Petroleum discharges exceeding 25 gallons on pervious surfaces as described in Section 17-761.460 F.A.C. within one working day of discover
3. Hazardous substance (CERCLA regulated), discharges exceeding applicable reportable quantities established in 17-761.460(2) F.A.C., with one working day of the discovery.
4. Within one working day of discovery of suspected releases confirmed by: (a) released regulated substances or pollutants discovered the surrounding area, (b) unusual and unexplained storage system operating conditions, (c) monitoring results from a leak detection metho or from a tank closure assessment that indicate a release may have occurred, or (d) manual tank gauging results for tanks of 550 gallor or less, exceeding ten gallons per weekly test or five gallons averaged over four consecutive weekly tests.

Mail to the DER District Office in your area listed on the reverse side of this form

PLEASE PRINT OR TYPE
Complete all applicable blanks

1. DER Facility ID Number: 038518667 2. Tank Number: G9 3. Date: 5/20/94
4. Facility Name: Coastal Systems Station

Facility Owner or Operator: U.S. Navy

Facility Address: 6703 West Highway 98, Panama City, FL 32407-7001

Telephone Number: (904) 235-5859 County: Bay

Mailing Address: Commanding Officer, Coastal Systems Station, Code 3610MC, 6703 West Highway
Panama City, FL 32407-7001

5. Date of receipt of test results or discovery: 5-6-94 month/day/ye
6. Method of initial discovery. (circle one only)
   - A. Liquid detector (automatic or manual)
   - B. Vapor detector (automatic or manual)
   - C. Tightness test (underground tanks only).
   - D. Emptying and inspection.
   - E. Inventory control.
   - F. Vapor or visible signs of a discharge in the vicin
   - (G.) Closure: Groundwater Analysis explai
   - H. Other: ____________
7. Estimated number of gallons discharged: ____________
8. What part of storage system has leaked? (circle all that apply) A. Dispenser B. Pipe C. Fitting D. Tank E. Unknc
9. Type of regulated substance discharged. (circle one)
   - A. leaded gasoline
   - B. unleaded gasoline
   - C. gasohol
   - D. vehicular diesel
   - F. aviation gas
   - G. jet fuel
   - L. used/waste oil
   - (M.) diesel
   - O. new/lube oil
   - V. hazardous substance includes pesticides, ammor chlorine and derivatives (write in name or Chemical Abs Service CAS number) ____________
   - Z. other (write in name) ____________
10. Cause of leak. (circle all that apply)
    - A. Unknown
    - B. Split
    - C. Loose connection
    - D. Corrosion
    - E. Puncture
    - F. Installation failure
    - G. Spill ____________
    - H. Overfill
    - (I.) Other (specify) Suspect Contamination from adjacent contamina site being investi
11. Type of financial responsibility. (circle one)
    - A. Third party insurance provided by the state insurance contractor
    - B. Self-insurance pursuant to Chapter 17-769.500 F.A.C.
    - (C.) Not applicable
    - D. None
12. **To the best of my knowledge and belief all information submitted on this form is true, accurate, and complete.**

W. O. WALKER, LIEUTENANT COMMANDER, PWO
Printed Name of Owner, Operator or Authorized Representative

W. O. W[signature]
Signature of Owner, Operator or Authorized Representati

Florida Department of Environmental Regulation

Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Form No.: Discharge Reporting Form
Effective Date: December 10 1990
DER Application No.: (Filled in by DER)

Discharge Reporting Form

Use this form to notify the Department of Environmental Regulation of:

1. Results of tank tightness testing that exceed allowable tolerances within ten days of receipt of test result.
2. Petroleum discharges exceeding 25 gallons on pervious surfaces as described in Section 17-761.460 F.A.C. within one working day of discovery.
3. Hazardous substance (CERCLA regulated), discharges exceeding applicable reportable quantities established in 17-761.460(2) F.A.C., within one working day of the discovery.
4. Within one working day of discovery of suspected releases confirmed by: (a) released regulated substances or pollutants discovered in the surrounding area, (b) unusual and unexplained storage system operating conditions, (c) monitoring results from a leak detection method or from a tank closure assessment that indicate a release may have occurred, or (d) manual tank gauging results for tanks of 550 gallons or less, exceeding ten gallons per weekly test or five gallons averaged over four consecutive weekly tests.

Mail to the DER District Office in your area listed on the reverse side of this form

PLEASE PRINT OR TYPE
Complete all applicable blanks

1. DER Facility ID Number: 038518667 2. Tank Number: 323(Unregulated) 3. Date: 2/16/94
4. Facility Name: Coastal Systems Station
   Facility Owner or Operator: U. S. Navy
   Facility Address: 6703 W. Highway 98, Panama City, FL 32407-7001
   Telephone Number: (904) 234-4743 County: Bay
   Mailing Address: Commanding Officer, Code 3610AM, 6703 W. HWY 98, Panama City, FL 32407-7001
5. Date of receipt of test results or discovery: 16 February 1994 month/day/yea
6. Method of initial discovery. (circle one only)
   A. Liquid detector (automatic or manual) D. Emptying and Inspection. F. Vapor or visible signs of a discharge in the vicinit
   B. Vapor detector (automatic or manual) E. Inventory control. G. Closure: ______ (explai
   C. Tightness test (underground tanks only). (H) Other: Tank(Oil Water Separator Remo
7. Estimated number of gallons discharged: UNKNOWN
8. What part of storage system has leaked? (circle all that apply) A. Dispenser. B. Pipe C. Fitting D. Tank (E.) Unknown
9. Type of regulated substance discharged. (circle one)
   A. leaded gasoline D. vehicular diesel (L.) used/waste oil V. hazardous substance includes pesticides, ammonia, chlorine and derivatives (write in name or Chemical Abstract Service CAS number) ______
   B. unleaded gasoline F. aviation gas (M.) diesel
   C. gasohol (G.) jet fuel Q. new/lube oil Z. other (write in name) ______
10. Cause of leak. (circle all that apply)
    (A.) Unknown C. Loose connection E. Puncture G. Spill ____ I. Other (specify) ____
    B. Split D. Corrosion F. Installation failure H. Overfill
11. Type of financial responsibility. (circle one)
    A. Third party insurance provided by the state insurance contractor (C.) Not applicable
    B. Self-insurance pursuant to Chapter 17-769.500 F.A.C. D. None
12. To the best of my knowledge and belief all information submitted on this form is true, accurate, and complete.

W. O. WALKER, PUBLIC WORKS OFFICER
Printed Name of Owner, Operator or Authorized Representative

W. O. Walker
Signature of Owner, Operator or Authorized Representative

southern earth sciences, inc.
Environmental Consultants

Thickstun Brothers Equipment Company
8411 Alton Avenue
Columbus, OH 43219

May 10, 1995
File No.: F-95-196

ATTENTION: Mr. Ken Thickstun

SUBJECT: Soil Screening for Upgrading Fueling System at Coastal Systems Station Building 362, Panama City, Florida

Dear Mr. Thickstun:

As requested, Southern Earth Sciences, Inc. has completed soil screening for upgrading the fuel delivery system at the Coastal Systems Station Building 362 in Panama City, Florida.

On May 2, 1995, personnel with our firm mobilized to the subject site with an organic vapor analysis (OVA) instrument with a flame ionization detector (FID). Soil samples were collected at each pump dispenser and along the underground lines and screened in the field using an OVA with and without a carbon filter. Field OVA data are reported in Table I. Sixteen (16) soil brings were performed along the underground piping lines to a depth of 2.0 feet below the bottom of the lines, every 20 feet. Three (3) soil borings were performed at the pump dispensers to a depth of 4.0 feet. This field testing was performed in accordance with Florida Chapter 62-770 and Comprehensive QA Plan #9200016 procedures.

Groundwater was encountered at a depth of 6.0 feet below existing grade on the date of our testing. Note: soil borings B-14 and B-19 had corrected OVA readings greater than 10 ppm.

Should additional information be required, please do not hesitate to contact us.

SOUTHERN EARTH SCIENCES, INC.

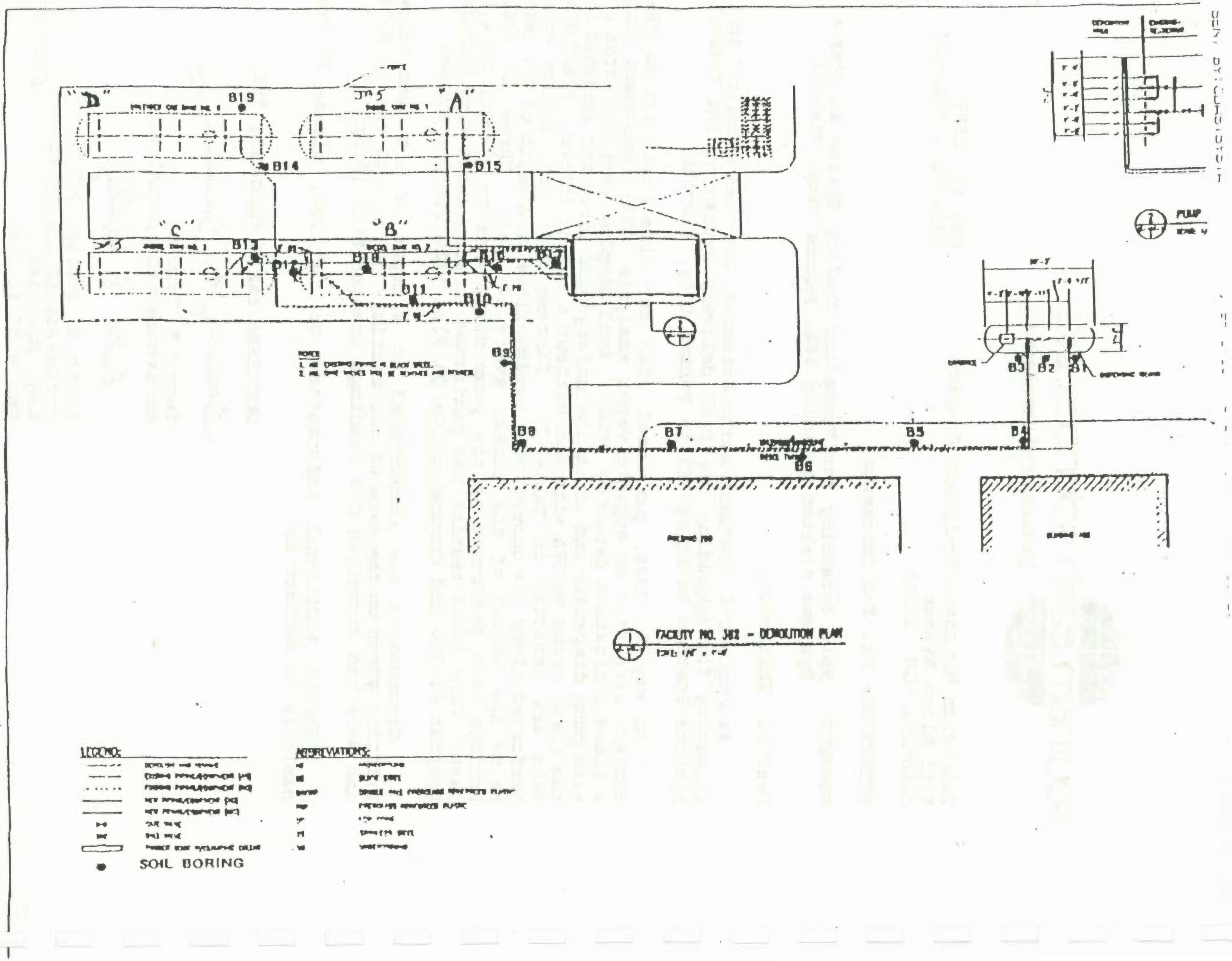
Terry K Barnes TKB

Terry K. Barnes
Environmental Specialist

Keith E. Sibley

Keith E. Sibley, P.G.
Professional Geologist
Reg. No: 1366
State of Florida

5-10-95


"D"
B19
"A"
B14
B15
"C"
"B"
B13
B12
B18
B16
B17
B11
B10
B9
B8
B7
B6
B5
B4
B3
B2
B1
PUMP
FACILITY NO. 3?2 - DEMOLITION PLAN
LEGEND:
ABBREVIATIONS:
SOIL BORING

SOIL INVESTIGATION RESULTS
May 2, 1995

LOCATION	DEPTH (FEET)	OVA W/OUT FILTER (PPM)	OVA W/ FILTER (PPM)	CORRECTED OVA (PPM)
*B-1	2'	0	0	0
	4'	0	0	0
*B-2	2'	0	0	0
	4'	0	0	0
*B-3	2'	0	0	0
	4'	0	0	0
B-4	1'	0	0	0
	2'	0	0	0
B-5	1'	0.1	0	0.1
	2'	0	0	0
B-6	1'	0	0	0
	2'	0	0	0
B-7	1'	0	0	0
	2'	0	0	0
B-8	1'	0.1	0	0.1
	2'	0.1	0	0.1
B-9	1'	0	0	0
	2'	0	0	0
B-10	1'	0	0	0
	2'	0	0	0
B-11	1'	0.4	0	0.4
	2'	0	0	0
B-12	1'	0	0	0
	2'	0	0	0
B-13	1'	0	0	0
	2'	0	0	0
B-14	1'	100	0	100
	2'	150	0	150
B-15	1'	0.6	0	0.6
	2'	0	0	0
B-16	1'	0	0	0
	2'	0	0	0
B-17	1'	0	0	0
	2'	0	0	0

LOCATION	DEPTH (FEET)	OVA W/OUT FILTER (PPM)	OVA W/ FILTER (PPM)	CORRECTED OVA (PPM)
B-18	1' 2'	0 0	0 0	0 0
B-19	1' 4'	340 190	0 0	340 190

* Sample locations were under fuel dispensers

PPM = Parts per million

Water Table = [illegible].0 feet below existing grade on the date of our testing

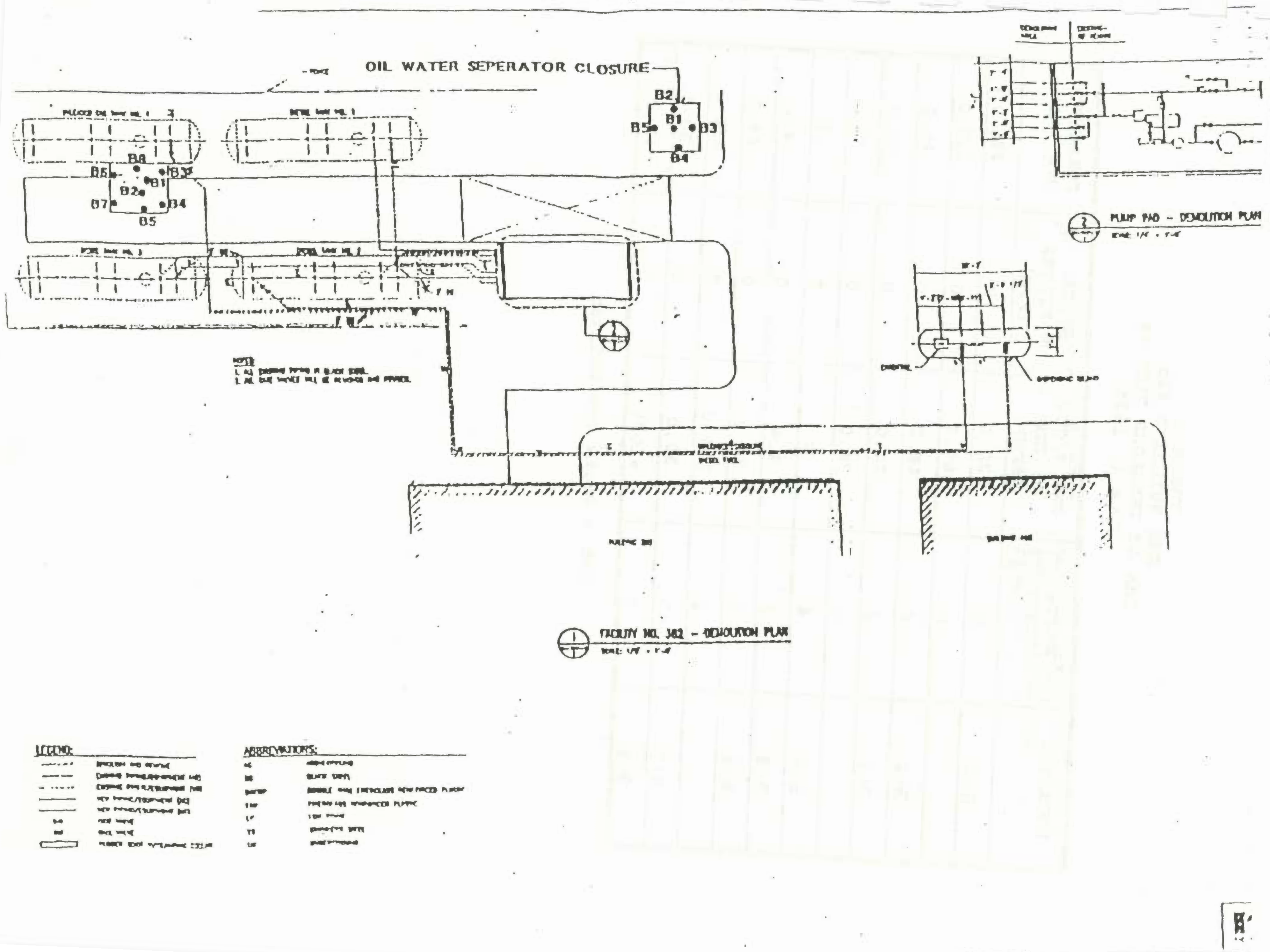
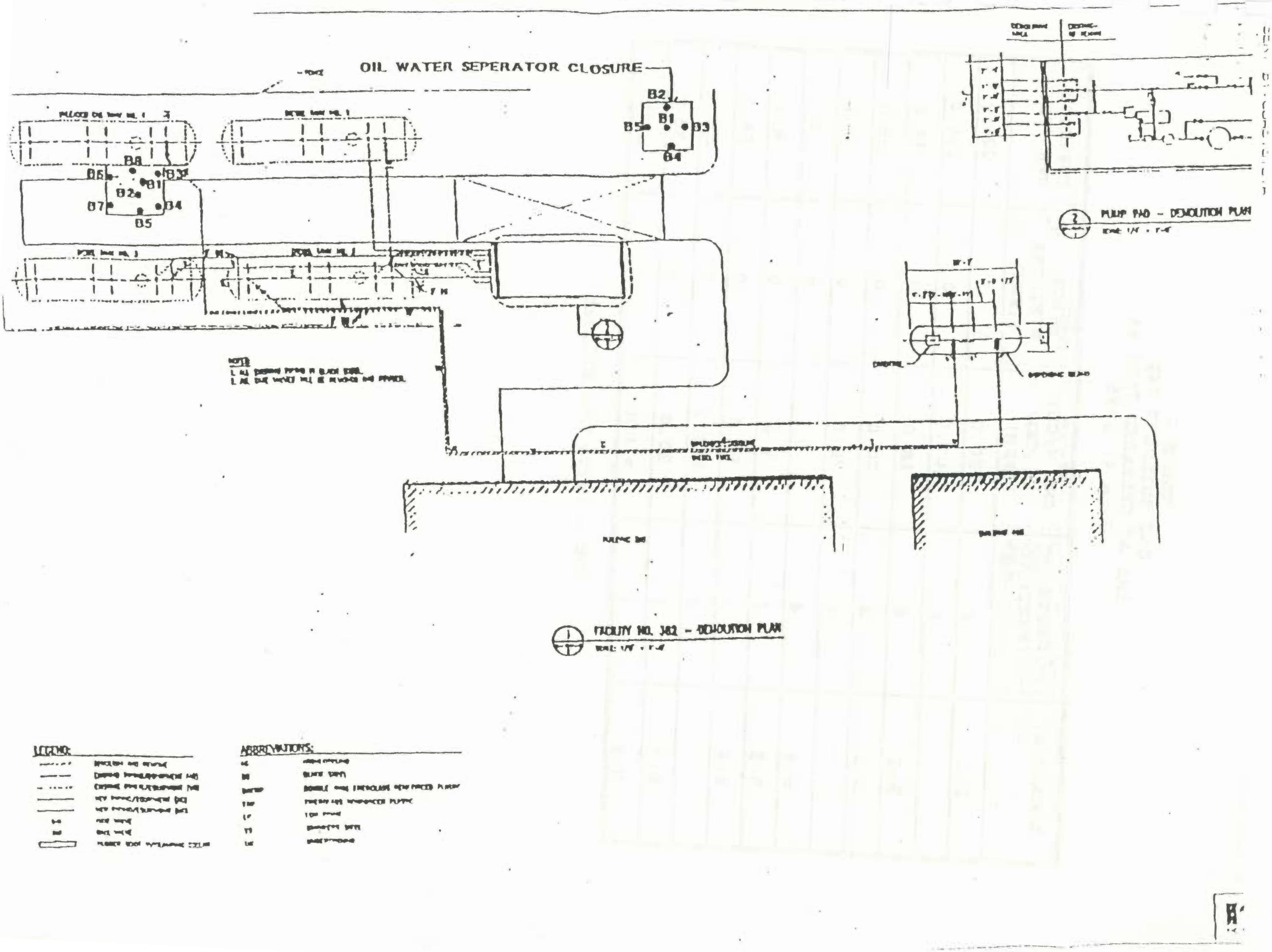

OIL WATER SEPERATOR CLOSURE
B2
B1
B5
B3
B4
B8
B6
B3
B1
B2
B7
B4
B5
PUMP PAD - DEMOLITION PLAN
FACILITY NO. 382 - DEMOLITION PLAN
LEGEND:
ABBREVIATIONS:

TABLE I
CSS BUILDING 362
IRA AT UNLEADED TANK #4
June 6, 1995

LOCATION	DEPTH (FEET)	OVA W/OUT FILTER (PPM)	OVA W/FILTER (PPM)	CORRECTED OVA (PPM)
B-1	6	220.0	0	220.0
	8	100.0	0	100.0
B-2	6	48.0	0	48.0
B-3	3	20.0	0	20.0
	6	76.0	0	76.0
B-4	4	0	0	0
B-5	3	4.4	0	4.4
B-6	3	68.0	0	68.0
	6	200.0	0	200.0
B-7	3	30.0	0	30.0
B-8	7	>1000	0	>1000

PPM = Parts Per Million



OIL WATER SEPERATOR CLOSURE
B2
B1
B5
B3
B4
B8
B6
B3
B1
B2
B7
B4
B5
PUMP PAD - DEMOLITION PLAN
FACILITY NO. 382 - DEMOLITION PLAN
LEGEND:
ABBREVIATIONS:

From: ENVIROCHEM, INC.
4320 MIDMOST DRIVE
POST OFFICE BOX 160012
MOBILE, ALABAMA 36616

May 23, 1995

To: SOUTHERN EARTH SCIENCES, INC.
POST OFFICE BOX 816
PANAMA CITY, FL 32402

ATTN: MR. RUSSELL GOIN

The following analytical results have been obtained for the indicated sample which was submitted to this laboratory:

Sample I.D. AA3F04B Location code: 012-PC
Purchase order number: F95-196 Account code: 012
Location description: CSS/BLDG.362 T-1
Sample collector: CLIENT/TB
Sample collection date: 05/15/95 Time: 10:00
Lab submittal date: 05/16/95 Time: 12:50
Sample type: GW
Received by: BS

Parameter: (17) AROMATIC VOLATILES - 8020
Method reference: EPA 8020 Unit: ppb
Result: see below
Date started: 05/22/95 Date finished: 05/22/95
Time started: 21:54 Analyst: MH

Data for (17) AROMATIC VOLATILES - 8020 ppb:

Component Name	Result	Component MDL
BENZENE	250	50
TOLUENE	1600	50
CHLOROBENZENE	bdl	50
XYLENE-total	4300	250
ETHYLBENZENE	500	50
1,3-DCB	bdl	50
1,4-DCB	bdl	50
1,2-DCB	bdl	50
METHYL T-BUTYL ETHER	340	250

Sample comments:

PO# 1786

ENVIRONMENTAL FIRST RESPONSE

CLOSURE ASSESSMENT REPORT
FAC. #333 WASTE OIL TANK & OIL/WATER SEPARATOR
COASTAL SYSTEMS STATION
PANAMA CITY, FLORIDA

Prepared By:

SWS Environmental First Response
January 2, 1996

ENCL (1)

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1.0 INTRODUCTION

This is a report summarizing SWS's work in completing an assessment of the soils related to the removal of a 550 gallon underground storage tank (UST), oil water separator, and related underground piping at the Naval Surface Warfare Center Coastal Systems located in Panama City Beach, Florida. The work was completed at the site adjacent to the concrete wall labeled area #333, November 28, 1995 (see site map attached).

1.1 SCOPE OF WORK

SWS's investigative efforts included the following elements within the scope of work:

1. Excavated Area Assessment and organic vapor analysis(OVA) of soils.

2. Sampling and Lab Analyses of: a) a composite of waste oil tank Soils b) soils located three feet east of the waste oil tank c) soils adjacent to the oil water separator location and d) a composite soil sample of the excavated soils.

3. Sampling of groundwater if contaminants are found present in the soil during UST removal.

4. Completion of this report.

2.0 EXCAVATED AREA ASSESSMENT

As mentioned above, Southern Waste Services was mobilized to the naval facility to assess the contaminated soils, and transport them to a proper disposal facility. Upon arrival at the site ground water was noticed to be at 5.5 feet below land surface(BLS)at the bottom of the excavation and above a concrete slab upon which the underground storage tank had rested (See Appendix A, Field Notes). All associated piping along with the UST and oil/water separator had been subsequently removed and excavated soil piled on top of visquene and covered to ensure no migration due to precipitation.

2.1 Soil Sampling Within the UST Pit

As shown on the site map (Attached) four sampling points labeled S-1, S-2, S-3, S-4, were picked at the corners of the UST excavation at approximately four feet BLS (See Site Map, Attached). All samples showed corrected values less than 10 ppm excessive hydrocarbon contamination in soil except for sample S-3 which exhibited a corrected value of 950 ppm. The soil sample at S-3 appeared to have a greenish dark gray oily sheen. Further investigation of the contaminated soil zone indicated that it may be within a groundwater - vadose "smear" zone.

2.2 Soil Sampling within the Pipeline trench and Oil/Water Separator

Three soil sampling points were located along the pipeline trench and within the oil/water separator area. As Shown on the site map they all exhibited a corrected value of less than 10 ppm excessive hydrocarbon contamination in the soil.

2.3 Exploratory Boring of Area between Containment and UST Area

Hand auger borings #8 and #9 were installed to the top of ground water found to be approximately five feet BLS. Both Hand auger borings found clean soil to the depth of 4.5 feet BLS. Hand auger boring #8 located 3.5 feet east of sample S-3 discovered contaminated soil at 4.5 feet BLS with a corrected organic reading of 2100 ppm (See Field Notes, Appendix A). Hand auger boring #9 located adjacent to the fenced in waste and drum containment area found greenish, gray oily soil 4.5 feet BLS. Soil samples taken from the contaminated zone gave readings of 900 ppm for total hydrocarbons and 1200 ppm filtered hydrocarbon for a corrected value of -300 ppm. This is indicative of a break through in the filter. All soil samples appeared to dramatically increase in their corrected hydrocarbon levels at 4.5 feet BLS, diesel or old hydrocarbon fuel odors were very apparent. Soil samples from the 4.5 foot deep zone were taken for lab analysis from Hand auger boring #9 (see the following lab analysis discussion).

3.0 SAMPLING AND LAB ANALYSES OF SITE SOILS

During the course of the field sampling, soil samples for laboratory analysis were collected from soils within the UST excavated area adjacent to sample sites S-1 through S-4. All samples of environmental media were collected in accordance with SWS's State approved CompQAPP #920203. All samples were properly contained, labeled and placed on ice for transport to the laboratory under chain-of-custody (See Appendix B). Results of analyses are discussed below.

3.1 Soil Sampling Within the UST (Waste Oil Tank) Pit

A composite soil sample for lab analysis was taken from borings S-1, S-2, S-3 and S-4 from a depth of four feet BLS and composited (see Site Map, Appendix B, Chain of Custody, Sample 001). These samples were analyzed by GEOS, Inc. for *Volatile Organics* (EPA Method 8240), *Semivolatile Organics* (EPA Method 8270), *Total Recoverable Petroleum Hydrocarbons* (EPA Method 9073) and *RCRA Metals*.

3.2 Soil Sampling adjacent to oil/water Separator Area

A soil sample S-004 was taken from the excavation wall adjacent to the oil/water separator by field sample location S-7 and subjected to lab analyses mentioned above (See Site Map attached, sample S-004).

3.3 Soil Sampling of Unscheduled Location

A third unscheduled sample S-002 (see Site Map, Appendix B, Lab Analyses) was taken for lab analyses EPA Methods 8240, 8270, 9073 and *RCRA Metals* from Hand auger boring S-9 and the potentially contaminated soil zone at 4.5 feet BLS.

3.4 Composite soil Sample of Excavated Soil

A composite soil sample S-003 was taken from the excavated soils for lab analysis including *TCLP Volatiles* and *TCLP Metals* for disposal characterization.

4.0 LAB ANALYSES OF SOIL SAMPLES

Analyses from the composite soil sample S-001 taken at the waste oil tank area exhibited abnormal concentrations of RCRA metals, lead 30.4 mg/Kg, *barium* 2.3 mg/Kg, *and chromium* 2.7 mg/Kg. All analyses for organic constituents this sample returned below detection limits (BDL), except for *total recoverable hydrocarbons (TRPH) 960* mg/Kg, *1-methyl naphthalene* 4800 µg/Kg, *2-methyl naphthalene* 7500 µg/Kg, and *naphthalene* 1300 µg/Kg for *total naphthalene* 13,600 µg/Kg or 13.6 mg/Kg(see lab analyses Appendix B).

Analyses from the soil sample S-002 taken at Hand auger boring S-9 (See attached Site Map) located three feet east of the waste oil tank area exhibited concentrations of RCRA metals, *barium* 1.4 mg/Kg, *and chromium* 3.2 mg/Kg. All analyses for organic constituents this sample returned BDL except for *TRPH* 320 mg/Kg, *1-methyl naphthalene* 520 µg/Kg, and *2-methyl naphthalene* 410 µg/Kg for *total naphthalenes* 930 µg/Kg (see lab analyses Appendix B).

Analyses from the soil sample S-004 taken beside soil boring S-7 (See attached Site Map) located adjacent to the oil/water separator excavation area exhibited concentrations of RCRA metals, *barium* 26 mg/Kg, *cadmium* 1.0 mg/Kg, *chromium* 3.2 mg/Kg, *silver* 3.8 mg/Kg, and *mercury* 0.104 mg/Kg. All analyses for organic constituents this sample returned below detection limits except for *TRPH* 12 mg/Kg (see lab analyses Appendix B).

5.0 PLACEMENT AND TESTING OF INITIAL MONITOR WELL

Monitor well MW-1 was placed December 12, 1995. The location is shown on the site map attached. MW-1 was placed to test conditions in the surficial aquifer. The temporary monitor was screened from three feet BLS to eight feet BLS, extending both above and below the water table found at approximately 4.5 feet BLS.

Following the placement of temporary monitor well MW-1, a ground water sample was collected December 15, 1995. Lab testing data and Chain-of-Custody for this sampling date are included in Appendix B. The levels of contamination that were detected during this initial sampling were found to be high for *benzene* 1.5 µg/L. The "Monitor Only" for Perimeter well in G-II groundwater criteria for benzene is 1 µg/L if public or private drinking water wells are located within a half mile or quarter mile radius respectively.

6.0 CONCLUSION

Under the limits of the specified scope of work listed in the proposal and contract for this environmental cleanup, the site has shown indication of contamination by petroleum products at the UST area and adjacent Hand auger boreholes S-8 & S-9. The constituents discovered at this location are believed to have resulted from contamination migrating within the "smear zone caused by rise and fall of the surficial aquifer.

This concludes SWS's report of the environmental assessment and cleanup at Area 333, Naval Surface Warfare Center Coastal Systems Station, Panama City Beach, Florida.

7.0 CERTIFICATION

This Contamination Assessment Report was prepared by or under the personal direction of the undersigned registered professional. All parts of this Plan that are concerned with the practice of professional geology were prepared by Mr. Julian C. Cooey, P.G. Field sampling was conducted under the Florida State approved comprehensive quality assurance project plan (CompQAPP #920203). The site-specific health and safety plans were prepared by Mr. Julian C. Cooey, a certified Site Safety Supervisor and certified Environmental Trainer, per 29 CFR 1910.

Respectfully Submitted,

Julian C. Cooey, P.G., CET
Florida Registration #32

APPENDIX B

BROWN & ROOT ENVIRONMENTAL STANDARD OPERATING PROCEDURES AND STANDARD FIELD FORMS

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1.0 PURPOSE

The purpose of this document is to establish standard procedures and technical guidance on borehole and sample logging.

2.0 SCOPE

These procedures provide descriptions of the standard techniques for borehole and sample logging. These techniques shall be used for each boring logged to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist/engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Geologist. Responsible for supervising all boring activities and assuring that each borehole is completely logged. If more than one rig is being used on site, the Site Geologist must make sure that each field geologist is properly trained in logging procedures. A brief review or training session may be necessary prior to the start up of the field program and/or upon completion of the first boring.

5.0 PROCEDURES

The classification of soil and rocks is one of the most important jobs of the field geologist/engineer. To maintain a consistent flow of information, it is imperative that the field geologist/engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

5.1 Materials Needed

When logging soil and rock samples, the geologist or engineer may be equipped with the following:

- Rock hammer
- Knife
- Camera
- Dilute hydrochloric acid (HCl)
- Ruler (marked in tenths and hundredths of feet)
- Hand Lens

5.2 Classification of Soils

All data shall be written directly on the boring log (Figure 1) or in a field notebook if more space is needed. Details on filling out the boring log are discussed in Section 5.5.

5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).

FIGURE 1

BORING LOG (EXAMPLE)

BORING LOG

Page ___ of ___

PROJECT NAME: ____________________ BORING NUMBER: ____________________
PROJECT NUMBER: ____________________ DATE: ____________________
DRILLING COMPANY: ____________________ GEOLOGIST: ____________________
DRILLING RIG: ____________________ DRILLER: ____________________

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION			USCS*	Remarks	PID/FID Reading (ppm)			
					Soil Density/ Consistency or Rock Hardness	Color	Material Classification			Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Drilling Area Background (ppm): ______

Remarks: ____________________

Converted to Well: Yes ______ No ______ Well I.D. #: ____________________

FIGURE 1 (CONTINUED)

SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

COARSE-GRAINED SOILS — More Than Half of Material is LARGER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES
GRAVELS (50%(+)>1/4"Ø	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
	GRAVELS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel sand-clay mixtures.
SANDS 50%(+)<1/4"Ø	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see MCL)	SM	Silty sands, poorly graded sand silt mixtures.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand clay mixtures.

FINE-GRAINED SOILS — More Than Half of Material is SMALLER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights) — Identification Procedures on Fraction Smaller than No. 40 Sieve Size	DRY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)	GROUP SYMBOL	TYPICAL NAMES
SILTS AND CLAYS Liquid Limit <50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
	Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Slight to Medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.
SILTS AND CLAYS Liquid Limit >50	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
	Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other organic soils

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS

DESIGNATION	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNC COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENNESS		
Descriptive Terms	Screwdriver or Knife Effects	Hammer Effects	Descriptive Terms	Abbreviation	Spacing
Soft	Easily Gouged	Crushes when pressed with hammer	Very Broken	(V. Br.)	0-2"
Medium Soft	Can be Gouged	Breaks (one blow); crumbly edges	Broken	(Br.)	2"-1'
Medium Hard	Can be scratched	Breaks (one blow); sharp edges	Blocky	(Bl.)	1'-3'
Hard	Cannot be scratched	Breaks conchoidally (several blows); sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES

S-2" Split-Barrel Sample
ST-3" O.D. Undisturbed Sample
O - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES

X-NX (Conventional) Core (-2-1/8" O.D.)
Q-NQ (Wireline) Core (-1-7/8" O.D.)
Z - Other Core Sizes, Specify in Remarks

WATER LEVELS

12/18 ▽ 12.6' Initial Level w/Date & Depth
12/18 ▼ 12.6' Stabilized Level w/Date & Depth

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as "(1/4 inchΦ-1/2 inchΦ)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

5.2.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

Soil Color Charts shall not be used unless specified by the project manager.

5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split-barrel sampling performed according to the methods detailed in Standard Operating Procedures GH-1.3 and SA-1.2. Those designations are:

Designation	Standard Penetration Resistance (Blows per Foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-inch outside diameter 12 inches into the material using a 140-pound hammer falling freely through 30 inches. The sampler is driven through an 18-inch sample interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This shall be noted on the log and referenced to the sample number. Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined either by blow counts, a pocket penetrometer (values listed in the table as Unconfined Compressive Strength), or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample in the split-barrel sampler. The sample shall be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. Consistency shall not be determined solely by blow counts. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

FIGURE 2

CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

5.2.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

5.2.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory tests for water content shall be performed if the natural water content is important.

5.2.6 Stratification

Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is depending on grain size and composition. The classification to be used for stratification description is shown in Figure 3.

5.2.7 Texture/Fabric/Bedding

The texture/fabric/bedding of the soil shall be described. Texture is described as the relative angularity of the particles: rounded, subrounded, subangular, and angular. Fabric shall be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure shall also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

FIGURE 3

BEDDING THICKNESS CLASSIFICATION

Thickness (metric)	Thickness (Approximate English Equivalent)	Classification
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick Bedded
10 cm - 30 cm	4" - 1.0'	Medium Bedded
3 cm - 10 cm	1" - 4"	Thin Bedded
1 cm - 3 cm	2/5" - 1"	Very Thin Bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly Laminated
< 1 mm	<1/32"	Micro Laminated

(Weir, 1973 and Ingram, 1954)

5.2.8 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Stratification
- Texture, fabric, bedding
- Other distinguishing features

5.3 Classification of Rocks

Rocks are grouped into three main divisions: sedimentary, igneous and metamorphic. Sedimentary rocks are by far the predominant type exposed at the earth's surface. The following basic names are applied to the types of rocks found in sedimentary sequences:

- Sandstone - Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.

- Siltstone - Made up of granular materials less than 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.

- Claystone - Very fine-grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.

- Shale - A fissile very fine-grained rock. Fractures along bedding planes.

- Limestone - Rock made up predominantly of calcite ($CaCO_3$). Effervesces strongly upon the application of dilute hydrochloric acid.

- Coal - Rock consisting mainly of organic remains.

- Others - Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record. The local abundance of any of these rock types is dependent upon the depositional history of the area. Conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

In classifying a sedimentary rock the following hierarchy shall be noted:

- Rock type
- Color
- Bedding thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

5.3.1 Rock Type

As described above, there are numerous types of sedimentary rocks. In most cases, a rock will be a combination of several grain types, therefore, a modifier such as a sandy siltstone, or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain size is the basis for the classification of clastic sedimentary rocks. Figure 4 is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks. For example, the division between siltstone and claystone may not be measurable in the field. The boundary shall be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a claystone.

5.3.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples shall be classified while wet, when possible, and air cored samples shall be scraped clean of cuttings prior to color classifications.

Rock color charts shall not be used unless specified by the Project Manager.

5.3.3 Bedding Thickness

The bedding thickness designations applied to soil classification (see Figure 3) will also be used for rock classification.

5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

- Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).

- Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.

- Medium hard - No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.

- Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the works "scratch" and "gouge." A scratch shall be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

FIGURE 4

GRAIN SIZE CLASSIFICATION FOR ROCKS

Particle Name	Grain Size Diameter
Cobbles	> 64 mm
Pebbles	4 - 64 mm
Granules	2 - 4 mm
Very Coarse Sand	1 - 2 mm
Coarse Sand	0.5 - 1 mm
Medium Sand	0.25 - 0.5 mm
Fine Sand	0.125 - 0.25 mm
Very Fine Sand	0.0625 - 0.125 mm
Silt	0.0039 - 0.0625 mm

After Wentworth, 1922

5.3.5 Fracturing

The degree of fracturing or brokenness of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

- Very broken (V. BR.) - Less than 2-inch spacing between fractures
- Broken (BR.) - 2-inch to 1-foot spacing between fractures
- Blocky (BL.) - 1- to 3-foot spacing between fractures
- Massive (M.) - 3 to 10-foot spacing between fractures

The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run, to obtain a percentage.

Method of Calculating RQD
(After Deere, 1964)

$$RQD\ \% = r/l \times 100$$

r = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.

l = Total length of the coring run.

5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

- Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.

- Slight - Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.

- Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.

- Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

5.3.7 Other Characteristics

The following items shall be included in the rock description:

- Description of contact between two rock units. These can be sharp or gradational.
- Stratification (parallel, cross stratified).

- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic).
- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs shall be neat to the point where it can be reproduced on a copy machine for report presentation. The data shall be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

- Seam - Thin (12 inches or less), probably continuous layer.

- Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."

- Few - Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."

- Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."

- Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

The preceding sections describe the classification of sedimentary rocks. The following are some basic names that are applied to igneous rocks:

- Basalt - A fine-grained extrusive rock composed primarily of calcic plagioclase and pyroxene.

- Rhyolite - A fine-grained volcanic rock containing abundant quartz and orthoclase. The fine-grained equivalent of a granite.

- Granite - A coarse-grained plutonic rock consisting essentially of alkali feldspar and quartz.

- Diorite - A coarse-grained plutonic rock consisting essentially of sodic plagioclase and hornblende.

- Gabbro - A coarse-grained plutonic rock consisting of calcic plagioclase and clinopyroxene. Loosely used for any coarse-grained dark igneous rock.

The following are some basic names that are applied to metamorphic rocks:

- Slate - A very fine-grained foliated rock possessing a well developed slaty cleavage. Contains predominantly chlorite, mica, quartz, and sericite.
- Phyllite - A fine-grained foliated rock that splits into thin flaky sheets with a silky sheen on cleavage surface.
- Schist - A medium to coarse-grained foliated rock with subparallel arrangement of the micaceous minerals which dominate its composition.
- Gneiss - A coarse-grained foliated rock with bands rich in granular and platy minerals.
- Quartzite - A fine- to coarse-grained nonfoliated rock breaking across grains, consisting essentially of quartz sand with silica cement.

5.4 Abbreviations

Abbreviations may be used in the description of a rock or soil. However, they shall be kept at a minimum. Following are some of the abbreviations that may be used:

C	-	Coarse	Lt	-	Light	Yl	-	Yellow
Med	-	Medium	BR	-	Broken	Or	-	Orange
F	-	Fine	BL	-	Blocky	SS	-	Sandstone
V	-	Very	M	-	Massive	Sh	-	Shale
Sl	-	Slight	Br	-	Brown	LS	-	Limestone
Occ	-	Occasional	Bl	-	Black	Fgr	-	Fine-grained
Tr	-	Trace						

5.5 Boring Logs and Documentation

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections shall be used to complete the logs. A sample boring log has been provided as Figure 5.

The field geologist/engineer shall use this example as a guide in completing each boring log. Each boring log shall be fully described by the geologist/engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided either on the back of the boring log or on a separate sheet, for field use.

FIGURE 5
COMPLETED BORING LOG (EXAMPLE)

BORING LOG

Page 1 of 1

PROJECT NAME: NSB - SITE
PROJECT NUMBER: 9594
DRILLING COMPANY: SOILTEST CO.
DRILLING RIG: CME - 55
BORING NUMBER: SB/MW 1
DATE: 3/8/96
GEOLOGIST: SJ CONTI
DRILLER: R. ROCK

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0.0	7/6	1.5/2.0		M DENSE	BRN	SILTY SAND - SOME	SM	MOIST SL. ORG.	5	0	0	0
@ 0800	2.0	9/10				TO BLK	ROCK FR.; TR BRICKS		ODOR				
							(FILL)		FILL TO 4'±				
	4.0			4.0									
S-2 @		5/7	2.9/2.0		M DENSE	BRN	SILTY SAND - TR FINE	SM	MOIST - W ODOR	10	0	-	-
0810	6.0	9/8					GRAVEL		NAT. MATL. TOOK SAMPLE				
	•			7' ▽ ±					SB01-0406 FOR ANALYSIS				
	8.0			8.0									
S-3 @		6/8	1.9/2.0		DENSE	TAN BRN	FINE TO COARSE SAND	SW	WET	0	0	0	0
0820	10.0	17/16					TR. F. GRAVEL		HIT WATER ≈ 7'±				
	12.0			12.0									
S-4 @		7/6	1.6/2.0		STIFF	GRAY	SILTY CLAY	CL	MOIST → WET	0	.5	-	-
0830	14.0	5/8											
	15.0			15.0					AUGER REF @ 15'				
				[illegible]	M HARD	BRN	SILTSTONE	VBR	WEATHERED				
				16					LO & JNTS @ 15.5				
9/5	①		4.0/5.0						WATER STAINS @ 16.5, 17.1, 17.5	0	0	0	0
				19'					LOSING SOME				
	20.0				HARD	GRAY	SANDSTONE - SOME	BR	DRILL H2O @ 17'±				
							SILTSTONE		SET TEMP 6" CAS TO 15.5				
4.9/5.0	②		5.0/5.0						SET 2"Φ PVC SCREEN 16-25	0	0	0	0
									SAND 14-25				
	25.0			25					PELLETS 12-14				

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

• 1-20± 1-80±

Drilling Area Background (ppm): 0

Remarks: CME-55 RIG, 4¼" ID HSA - 9" OD±
2" SPLIT SPOONS - 140 LB HAMMER - 30" DROP
NX CORE IN BEDROCK RUN ① = 25 min. RUN ② = 15 min.

Converted to Well: Yes ✓ No ______ Well I.D. #: MW-1

5.5.1 Soil Classification

- Identify site name, boring number, job number, etc. Elevations and water level data to be entered when surveyed data is available.

- Enter sample number (from SPT) under appropriate column. Enter depth sample was taken from (1 block = 1 foot). Fractional footages, i.e., change of lithology at 13.7 feet, shall be lined off at the proportional location between the 13- and 14-foot marks. Enter blow counts (Standard Penetration Resistance) diagonally (as shown). Standard penetration resistance is covered in Section 5.2.3.

- Determine sample recovery/sample length as shown. Measure the total length of sample recovered from the split-spoon sampler, including material in the drive shoe. Do not include cuttings or wash material that may be in the upper portion of the sample tube.

- Indicate any change in lithology by drawing a line at the appropriate depth. For example, if clayey silt was encountered from 0 to 5.5 feet and shale from 5.5 to 6.0 feet, a line shall be drawn at this increment. This information is helpful in the construction of cross-sections. As an alternative, symbols may be used to identify each change in lithology.

- The density of granular soils is obtained by adding the number of blows for the last two increments. Refer to Density of Granular Soils Chart on back of log sheet. For consistency of cohesive soils refer also to the back of log sheet - Consistency of Cohesive Soils. Enter this information under the appropriate column. Refer to Section 5.2.3.

- Enter color of the material in the appropriate column.

- Describe material using the USCS. Limit this column for sample description only. The predominate material is described last. If the primary soil is silt but has fines (clay) - use clayey silt. Limit soil descriptors to the following:

    - Trace: 0 - 10 percent
    - Some: 11 - 30 percent
    - And/Or: 31 - 50 percent

- Also indicate under Material Classification if the material is fill or natural soils. Indicate roots, organic material, etc.

- Enter USCS symbol - use chart on back of boring log as a guide. If the soils fall into one of two basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example ML/CL or SM/SP.

- The following information shall be entered under the "Remarks" column and shall include, but is not limited by, the following:

    - Moisture - estimate moisture content using the following terms - dry, moist, wet and saturated. These terms are determined by the individual. Whatever method is used to determine moisture, be consistent throughout the log.

- Angularity - describe angularity of coarse grained particles using the terms angular, subangular, subrounded, or rounded. Refer to ASTM D 2488 or Earth Manual for criteria for these terms.

- Particle shape - flat, elongated, or flat and elongated.

- Maximum particle size or dimension.

- Water level observations.

- Reaction with HCl - none, weak, or strong.

• Additional comments:

- Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.

- Indicate odor and Photoionization Detector (PID) or Flame Ionization Detector (FID) reading if applicable.

- Indicate any change in lithology by drawing a line through the lithology change column and indicate the depth. This will help when cross-sections are subsequently constructed.

- At the bottom of the page indicate type of rig, drilling method, hammer size and drop, and any other useful information (i.e., borehole size, casing set, changes in drilling method).

- Vertical lines shall be drawn (as shown in Figure 5) in columns 6 to 8 from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines shall be drawn if there is a change in lithology, then vertical lines drawn to that point.

- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.2 Rock Classification

• Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate RQD, core run number, RQD percent, and core recovery under the appropriate columns.

• Indicate lithology change by drawing a line at the appropriate depth as explained in Section 5.5.1.

• Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.

- Enter color as determined while the core sample is wet; if the sample is cored by air, the core shall be scraped clean prior to describing color.

- Enter rock type based on sedimentary, igneous or metamorphic. For sedimentary rocks use terms as described in Section 5.3. Again, be consistent in classification. Use modifiers and additional terms as needed. For igneous and metamorphic rock types use terms as described in Sections 5.3.8.

- Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M as explained in Section 5.3.5 and as noted on the back of the Boring Log.

- The following information shall be entered under the remarks column. Items shall include but are not limited to the following:

  - Indicate depths of joints, fractures and breaks and also approximate to horizontal angle (such as high, low), i.e., 70° angle from horizontal, high angle.

  - Indicate calcareous zones, description of any cavities or vugs.

  - Indicate any loss or gain of drill water.

  - Indicate drop of drill tools or change in color of drill water.

- Remarks at the bottom of Boring Log shall include:

  - Type and size of core obtained.

  - Depth casing was set.

  - Type of rig used.

- As a final check the boring log shall include the following:

  - Vertical lines shall be drawn as explained for soil classification to indicate consistency of bedrock material.

  - If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying soil and rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that shall be followed when logging cuttings are:

- Obtain cutting samples at approximately 5-foot intervals, sieve the cuttings (if mud rotary drilling) to obtain a cleaner sample, place the sample into a small sample bottle or "zip lock" bag for future reference, and label the jar or bag (i.e. hole number, depth, date, etc.). Cuttings shall be closely examined to determine general lithology.

- Note any change in color of drilling fluid or cuttings, to estimate changes in lithology.
- Note drop or chattering of drilling tools or a change in the rate of drilling, to determine fracture locations or lithologic changes.
- Observe loss or gain of drilling fluids or air (if air rotary methods are used), to identify potential fracture zones.
- Record this and any other useful information onto the boring log as provided in Figure 1.

This logging provides a general description of subsurface lithology and adequate information can be obtained through careful observation of the drilling process. It is recommended that split-barrel and rock core sampling methods be used at selected boring locations during the field investigation to provide detailed information to supplement the less detailed data generated through borings drilled using air/mud rotary methods.

5.6 Review

Upon completion of the borings logs, copies shall be made and reviewed. Items to be reviewed include:

- Checking for consistency of all logs.
- Checking for conformance to the guideline.
- Checking to see that all information is entered in their respective columns and spaces.

6.0 REFERENCES

Unified Soil Classification System (USCS).

ASTM D2488, 1985.

Earth Manual, U.S. Department of the Interior, 1974.

7.0 RECORDS

Originals of the boring logs shall be retained in the project files.

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		Effective Date 03/01/96	Revision 0
		Applicability B&R Environmental, NE	
		Prepared Earth Sciences Department	
Subject FIELD DOCUMENTATION		Approved D. Senovich	

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs and reports generally initiated and maintained for documenting Brown & Root Environmental field activities.

2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Brown & Root Environmental field activities, as applicable. Other or additional documents may be required by specific client contracts.

3.0 GLOSSARY

None

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for obtaining hardbound, controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all forms used in site activities (i.e., records, field reports, and upon the completion of field work, the site logbook) in the project's central file.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate forms and field reports illustrated in this guideline (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time-frame.

5.0 PROCEDURES

5.1 Site Logbook

5.1.1 General

The site logbook is a hard-bound, paginated controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of borehole/trench/monitoring well installation or sampling activities
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues (level of protection observed, etc.)
- Weather conditions

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that onsite activities take place which involve Brown & Root Environmental or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

The following information must be recorded on the cover of each site logbook:

- Project name
- Brown & Root Environmental project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2), but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the site notebook in which the measurements are recorded (see Attachment A).

All logbook, notebook, and log sheet entries shall be made in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, the data shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used must be signed and dated. The site logbook must also be signed by the Field Operations Leader at the end of each day.

5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook. If possible, such techniques shall be avoided, since they can adversely affect the admissibility of photographs as evidence. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Adequate logbook notation and receipts must be compiled to account for routine film processing. Once processed, the slides of photographic prints shall be consecutively numbered and labeled according to the logbook descriptions. The site photographs and associated negatives must be docketed into the project's central file.

5.2 Site Notebooks

Key field team personnel may maintain a separate dedicated notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate site notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a site notebook.

5.3 Sample Forms

A summary of the forms illustrated in this procedure is shown as the listing of Attachments in the Table of Contents for this SOP. Forms may be altered or revised for project-specific needs contingent upon client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOP.

5.3.1 Sample Collection, Labeling, Shipment and Request for Analysis

5.3.1.1 Sample Log Sheet

Sample Log Sheets are used to record specified types of data while sampling. Attachments B-1 to B-4 are examples of Sample Log Sheets. The data recorded on these sheets are useful in describing the waste source and sample as well as pointing out any problems encountered during sampling. A log sheet must be completed for each sample obtained, including field quality control (QC) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B-5. Adhesive labels must be completed and applied to every sample container. Sample labels can usually be obtained from the appropriate Program source or are supplied from the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record Form

The Chain-of-Custody (COC) Record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site. One part of the completed form is retained by the field crew while the other two portions are sent to the laboratory. An example of a Chain-of-Custody Record form is provided as Attachment B-6. A supply of these forms are purchased and stocked by the field department of the various Brown & Root Environmental offices. Alternately, COC forms supplied by the laboratory may be used. Once the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed COC form (any discrepancies between the sample labels and COC form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the Brown & Root Environmental Project Manager). The COC form is signed and one of the remaining two parts are retained by the laboratory while the last part becomes part of the samples' corresponding analytical data package. Internal laboratory chain-of-custody procedures are documented in the Laboratory Quality Assurance Plan (LQAP).

5.3.1.4 Chain-of-Custody Seal

Attachment B-7 is an example of a custody seal. The Custody seal is also an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. The COC seals are signed and dated by the samplers and affixed across the opening edges of each cooler containing environmental samples. COC seals may be available from the laboratory; these seals may also be purchased from a supplier.

5.3.2 Geohydrological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

A groundwater level measurement sheet, shown in Attachment C-1 must be filled out for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The pumping test data sheet (Attachment C-2) facilitates this task by standardizing the data collection format, and allowing the time interval for collection to be laid out in advance.

5.3.2.3 Packer Test Report Form

A packer test report form shown in Attachment C-3 must be completed for each well upon which a packer test is conducted following well installation.

5.3.2.4 Summary Log of Boring

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring (Attachment C-4) is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples or cuttings from the borehole (using HNU or OVA detectors), these results must be entered on the boring log (under the "Remarks" column) at the appropriate depth. The "Remarks" column can also be used to subsequently enter the laboratory sample number and the concentration of a few key analytical results. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well piezometer or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock), different forms are used (see Attachments C-5 through C-9). Similar forms are used for flush-mount well completions. The Monitoring Well Construction Details Form is not a controlled document.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log (Attachment C-10) must be filled out by the responsible field geologist or sampling technician.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log (Attachment D) which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device used in the field; entries must be made for each day the equipment is used.

5.4 Field Reports

The primary means of recording onsite activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation, but are not easily useful for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain onsite for extended periods of time and are thus not accessible for timely review by project management.

5.4.1 Weekly Status Reports

To facilitate timely review by project management, Xeroxed copies of logbook/notebook entries may be made for internal use. To provide timely oversight of onsite contractors, Daily Activities Reports are completed and submitted as described below.

It should be noted that in addition to the summaries described herein, other summary reports may also be contractually required.

5.4.2 Daily Activities Report

5.4.2.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. This report must be filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors (Attachment E is an example of a Daily Activities Report).

5.4.2.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.2.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DAR reports are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the Project Manager.

6.0 ATTACHMENTS

Attachment A	TYPICAL SITE LOGBOOK ENTRY
Attachment B-1	EXAMPLE GROUNDWATER SAMPLE LOG SHEET
Attachment B-2	EXAMPLE SURFACE WATER SAMPLE LOG SHEET
Attachment B-3	EXAMPLE SOIL/SEDIMENT SAMPLE LOG SHEET
Attachment B-4	CONTAINER SAMPLE LOG SHEET FORM
Attachment B-5	SAMPLE LABEL
Attachment B-6	CHAIN-OF-CUSTODY RECORD FORM
Attachment B-7	CHAIN-OF-CUSTODY SEAL
Attachment C-1	EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET
Attachment C-2	EXAMPLE PUMPING TEST DATA SHEET
Attachment C-3	PACKER TEST REPORT FORM
Attachment C-4	EXAMPLE BORING LOG
Attachment C-5	EXAMPLE OVERBURDEN MONITORING WELL SHEET
Attachment C-5A	EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)
Attachment C-6	EXAMPLE CONFINING LAYER MONITORING WELL SHEET
Attachment C-7	EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL
Attachment C-8	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK
Attachment C-8A	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK (FLUSHMOUNT)
Attachment C-9	EXAMPLE TEST PIT LOG
Attachment D	EXAMPLE EQUIPMENT CALIBRATION LOG
Attachment E	EXAMPLE DAILY ACTIVITIES RECORD
Attachment F	FIELD TRIP SUMMARY REPORT

ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY

START TIME: ______________________ DATE: ______________________

SITE LEADER: ______________________

PERSONNEL:

BROWN & ROOT ENV.	DRILLER	EPA
________	________	________
________	________	________
________	________	________

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well ____ resumes. Rig geologist was ______________. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well ______.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _______.
4. Well ______ drilled. Rig geologist was __________________. See Geologist's Notebook, No. 2, page ____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _________.
8. Test pit _______ dug with cuttings placed in dump truck. Rig geologist was ______________. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit ___ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

____

Field Operations Leader

ATTACHMENT B-1
EXAMPLE GROUNDWATER SAMPLE LOG SHEET

GROUNDWATER

SAMPLE LOG SHEET

Page ____ of ____

Project Site Name: ____________________ Sample ID No.: ____________________

Project No.: ____________________ Sample Location: ____________________

☐ Domestic Well Data
☐ Monitoring Well Data
☐ Other Well Type: ____________________
☐ QA Sample Type: ____________________

Sampled By: ____________________

C.O.C. No.: ____________________

Sampling Data

	pH	S.C.	Temp. (°C)	Turbidity	Color	TBD	TBD	TBD
Date: ______ Time: ______ Method: ______								

Purge Data

	Volume	pH	S.C.	Temp. (°C)	Turbidity	Color	TBD	TBD
Date: ______ Method: ______	Initial							
Monitor Reading (ppm):	1							
Well Casing Dia. & Material Type:	2							
	3							
Total Well Depth (TD):	4							
Static Water Level (WL):	5							
TD-WL (ft.) =								
One Casing Volume: (gal/L)								
Start Purge (hrs.):								
End Purge (hrs.):								
Total Purge Time (min):								
Total Amount Purged (gal/L):								

Analysis	Preservative	Container Requirements	Collected (✓)

Observations/Notes:

Circle If Applicable:		Signature(s):
MS/MSD	Duplicate ID No:	

TBD: To Be Determined

ATTACHMENT B-2
EXAMPLE SURFACE WATER SAMPLING LOG SHEET

SURFACE WATER SAMPLING LOG SHEET

Page ___ of ___

Project Site Name: ______________________ Sample ID No.: ______________________

Project No.: ______________________ Sample Location: ______________________

☐ Spring ☐ Pond Sampled By: ______________________

☐ Stream ☐ Lake

☐ Other ______________________

☐ QA Sample Type: ______________________ C.O.C. No.: ______________________

Sample Data

Date and Time				Method		Depth	
pH	S.C.	Temp. (°C)	Turbidity	Color	TBD	TBD	TBD

Analysis	Preservative	Container Requirements	Collected (✓)

Observations/Notes:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	

TBD: To Be Determined

ATTACHMENT B-3
EXAMPLE SOIL/SEDIMENT SINGLE SAMPLE LOG SHEET

SOIL/SEDIMENT
SINGLE SAMPLE LOG SHEET

Page ___ of ___

Project Site Name: ______________ Sample ID No.: ______________

Project No.: ______________ Sample Location: ______________

☐ Surface Soil
☐ Subsurface Soil
☐ Sediment
☐ Other ________
☐ QA Sample Type: ________

Sampled By: ______________

C.O.C. No.: ______________

	Composite Sample Data		
Sample Method:	Sample	Time	Color/Description
Depth Sampled:			
Sample Date and Time:			
Type of Sample ☐ Grab ☐ Composite ☐ Grab-Composite ☐ High Concentration ☐ Low Concentration			
	Grab Sample Data		
	Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)	

Analysis	Container Requirements	Collected (✓)	Map:

Observations/Notes:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No:	

ATTACHMENT B-4
CONTAINER SAMPLE LOG SHEET FORM

Brown & Root Environmental

Page ___ of _

☐ Container Data

Case #: ______

By: ______________________

Project Site Name: ______________________ Project Site No. ______________________

Brown & Root Env. Source No. ______________ Source Location: ______________________

Container Source	Container Description
☐ Drum ☐ Bung Top ☐ Lever Lock ☐ Bolted Ring ☐ Other ________ ________ ☐ Bag/Sack ☐ Tank ☐ Other ________ ________	Color: ________ Condition: ________ Markings: ________ Vol. of Contents: ________ Other: ________
Disposition of Sample	Sample Description
☐ Container Sampled ☐ Container opened but not sampled. Reason: ________ ________ ☐ Container not opened. Reason: ________ ________	

	Layer 1	Layer 2	Layer 3
Phase	☐Sol. ☐Liq.	☐Sol. ☐Liq.	☐Sol. ☐Liq.
Color	________	________	________
Viscosity	☐L ☐M ☐H	☐L ☐M ☐H	☐L ☐M ☐H
% of Total Volume	________	________	________
Other ________	________	________	________

	Type of Sample
Monitor Reading:	☐ Low Concentration ☐ High Concentration
Sample Method:	☐ Grab ☐ Composite ☐ Grab-composite

	Sample Identification	Organic	Inorganic
Sample Date & Time:			
Sampled by:			
Signature(s):			
	Date Shipped		
Analysis:	Time Shipped		
	Lab		
	Volume		

ATTACHMENT B-5

SAMPLE LABEL

Brown & Root Environmental PROJECT: ____________________

STATION LOCATION: ____________________

DATE: ___/___/___ TIME: ________ hrs.

MEDIA: WATER ☐ SOIL ☐ SEDIMENT ☐ ________ ☐

CONCENTRATION: LOW ☐ MEDIUM ☐ HIGH ☐

TYPE: GRAB ☐ COMPOSITE ☐

ANALYSIS	PRESERVATION
VOA ☐ BNAs ☐	Cool to 4°C ☐
PCBs ☐ PESTICIDES ☐	HNO_3 to pH < 2 ☐
METALS: TOTAL ☐ DISSOLVED ☐	NaOH to pH > 12 ☐
CYANIDE ☐	________ ☐
________ ☐	

Sampled by: ____________________

Remarks:

ATTACHMENT B-6

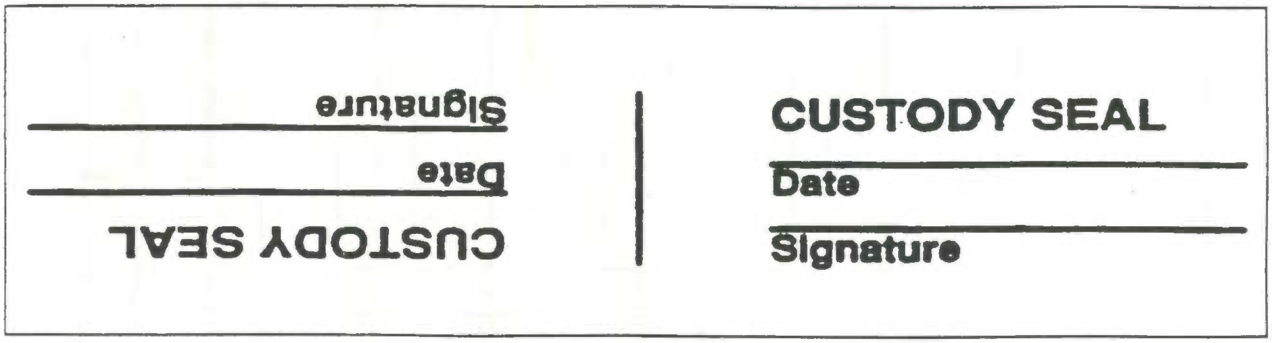
CHAIN-OF-CUSTODY RECORD FORM
(Original is 8.5 x 11")

PROJECT NO.	PROJECT NAME					NO. OF CONTAINERS								REMARKS
SAMPLERS: *(Signature)*														
STA NO.	DATE	TIME			STATION LOCATION									

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks:	

ATTACHMENT B-7

CHAIN-OF-CUSTODY SEAL



ATTACHMENT C-1
EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET

GROUNDWATER LEVEL MEASUREMENT SHEET Page ___ of ___

PROJECT NAME: ____________________ LOCATION: ____________________
PROJECT NUMBER: ____________________ MEASURING DEVICE: ____________________
PERSONNEL: ____________________ ADJUSTMENT FACTOR: ____________________
DATE: ____________________ REMARKS: ____________________
WEATHER CONDITIONS: ____________________

Well or Piezometer Number	Time	Elevation of Reference Point (Feet)*	Water Level Indicator Reading (Feet)*	Groundwater Elevation (Feet)*	Comments

*Measurements to nearest 0.01 foot.

Signature(s): ____________________

ATTACHMENT C-2
EXAMPLE PUMPING TEST DATA SHEET

PUMPING TEST DATA SHEET

Page ___ of ___

PROJECT NAME: ____________________
PROJECT NUMBER: ____________________
PUMPING TEST: [ ]
TEST NUMBER: ____________________
METHOD OF MEASUREMENT: ____________________
DATE(s): ____________________
STATIC H_2O LEVEL (ft) (SO) ____________________

PUMPING WELL NUMBER: ____________________
MEASURED WELL NUMBER: ____________________
STEP DRAW DOWN TEST [ ]
MONITORING POINT: ____________________
DEPTH CORRECTION (ft) ____________________
PUMP SETTING (Ft. below monitoring point): ____________________
DISTANCE FROM PUMPING WELL (ft) (r): ____________________

PUMPING TEST PERFORMED BY: ____________________
REMARKS: ____________________

MILITARY TIME	ELAPSED TIME SINCE PUMP START OR STOP (Min.)	WATER LEVEL (Ft.)	CORRECTION (Ft.)	DRAW DOWN OR RECOVERY (Ft.)	FLOW METER READING (Gals.)	PUMPING RATE (GPM)	REMARKS

SIGNATURE(s): ____________________

ATTACHMENT C-3

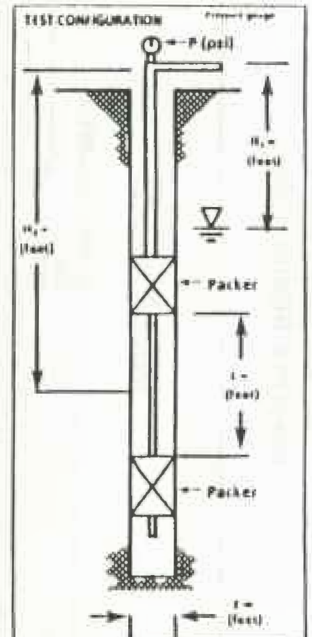
PACKER TEST REPORT FORM

PROJECT: ______________________ PROJECT NO.: ____________ TEST NO: ____________ PAGE ____ OF ____

BORING NO.: ____________ CASING DEPTH: ____________ CONTRACTOR: ______________________ STATIC WATER LEVEL ____________

TEST INTERVAL: ____________ BY: ______________________ CHECKED: ______________________ PACKER PRESSURE ____________

Flow Test					Calculated Results							
Pressure, p (psi)	Elapsed Time (min)	Flow Reading	Δ Flow, ΔQ (ft³)	Δ Flow, ΔQ (gal)	Flow Rate Q (gal/min)	H_1* (ft)	Hp(ft) = 2.31 (psi)	H_2* (ft)	H = Hp + (H1 or H2)	Cp	K (ft/yr) = Cp Q/H	K (cm/sec) = 9.67 x 10⁷ K (ft/yr)



Length of Test Section (in feet), L	Cp			
	[illegible]	[illegible]	[illegible]	[illegible]
1	[illegible]	[illegible]	[illegible]	[illegible]
2	18 [illegible]	16 300	[illegible]	[illegible]
4	[illegible]	9 300	[illegible]	[illegible]
8	[illegible]	6 500	[illegible]	[illegible]
10	[illegible]	5 400	[illegible]	[illegible]
15	4 100	3 900	[illegible]	[illegible]
20	3 200	[illegible]	[illegible]	[illegible]

CP = [1/(2 x L)] ln[L/r] (70,315.5)
7.48 Gallons = 1 Ft³
1 psi = 2.31 ft head

* H_1 is used when the test length is below the water table
H_2 is used when the test length is above the water table

Remarks ____

ATTACHMENT C-4
EXAMPLE BORING LOG

BORING LOG

Page___ of___

PROJECT NAME: ____________________ BORING NUMBER: ____________________
PROJECT NUMBER: ____________________ DATE: ____________________
DRILLING COMPANY: ____________________ GEOLOGIST: ____________________
WATER LEVEL DATA: ____________________

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows/ 6" or RQD (%)	Sample Recovery/ Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	* USCS	Remarks	PID or FID Reading (ppm)

*When rock coring enter rock brokeness.

CONVERTED TO WELL: ___ Yes ___ No: WELL I.D.#: ____________________
REMARKS: ____________________

Signature(s): ____________________

LEGEND

SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

COARSE-GRAINED SOILS — More Than Half of Material is LARGER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES
GRAVELS (50%(+)>1/4"∅)	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
	GRAVELS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
SANDS 50%(+)<1/4"∅	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see MCL)	SM	Silty sands, poorly graded sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.

FINE-GRAINED SOILS — More Than Half of Material is SMALLER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights) — Identification Procedures on Fraction Smaller than No. 40 Sieve Size	DRY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)	GROUP SYMBOL	TYPICAL NAMES
SILTS AND CLAYS Liquid Limit <50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
	Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Slight to Medium	Slow	Slight	OL	Organic silts and organic silt clays of low plasticity.
SILTS AND CLAYS Liquid Limit >50	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
	Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			PT	Peat and other organic soils

Boundary Classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS

DESIGNATION	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNC COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily puntrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENESS		
Descriptive Terms	Screwdriver or Knife Effects	Hammer Effects	Descriptive Terms	Abbreviation	Spacing
Soft	Easily Gouged	Crushes when pressed with hammer	Very Broken	(V. Br.)	0-2"
Medium Soft	Can be Gouged	Breaks (one blow); crumbly edges	Broken	(Br.)	2"-1'
Medium Hard	Can be scratched	Breaks (one blow); sharp edges	Blocky	(Bl.)	1'-3'
Hard	Cannot be scratched	Breaks conchoidally (several blows); sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES	ROCK SAMPLES - TYPES	WATER LEVELS
S-2" Split-Barrel Sample	X-NX (Conventional) Core (-3-1/8" O.D.)	12/18 ▼ 12.6' Initial Level w/Date & Depth
ST-3" O.D. Undisturbed Sample	Q-NQ (Wireline) Core (-1-7/8" O.D.)	12/18 ▼ 12.6' Stabilized Level w/Date & Depth
O - Other Samples, Specify in Remarks	Z - Other Core Sizes, Specify in Remarks	

ATTACHMENT C-5
EXAMPLE OVERBURDEN MONITORING WELL SHEET

BORING NO.: ______

OVERBURDEN
MONITORING WELL SHEET

PROJECT ______ LOCATION ______ DRILLER ______
PROJECT NO. ______ BORING ______ DRILLING METHOD ______
ELEVATION ______ DATE ______ DEVELOPMENT METHOD ______
FIELD GEOLOGIST ______

GROUND ELEVATION

ELEVATION OF TOP OF SURFACE CASING: ______
ELEVATION OF TOP OF RISER PIPE: ______
STICK - UP TOP OF SURFACE CASING. ______
STICK - UP RISER PIPE. ______
TYPE OF SURFACE SEAL: ______
I.D. OF SURFACE CASING: ______
TYPE OF SURFACE CASING: ______
RISER PIPE I.D. ______
TYPE OF RISER PIPE: ______
BOREHOLE DIAMETER: ______
TYPE OF BACKFILL: ______
ELEVATION / DEPTH TOP OF SEAL: ____/____
TYPE OF SEAL: ______
DEPTH TOP OF SAND PACK: ______
ELEVATION / DEPTH TOP OF SCREEN: ____/____
TYPE OF SCREEN: ______
SLOT SIZE x LENGTH: ______
I.D. OF SCREEN: ______
TYPE OF SAND PACK: ______
ELEVATION / DEPTH BOTTOM OF SCREEN: ____/____
ELEVATION / DEPTH BOTTOM OF SAND PACK: ____/____
TYPE OF BACKFILL BELOW OBSERVATION WELL: ______
ELEVATION / DEPTH OF HOLE: ____/____

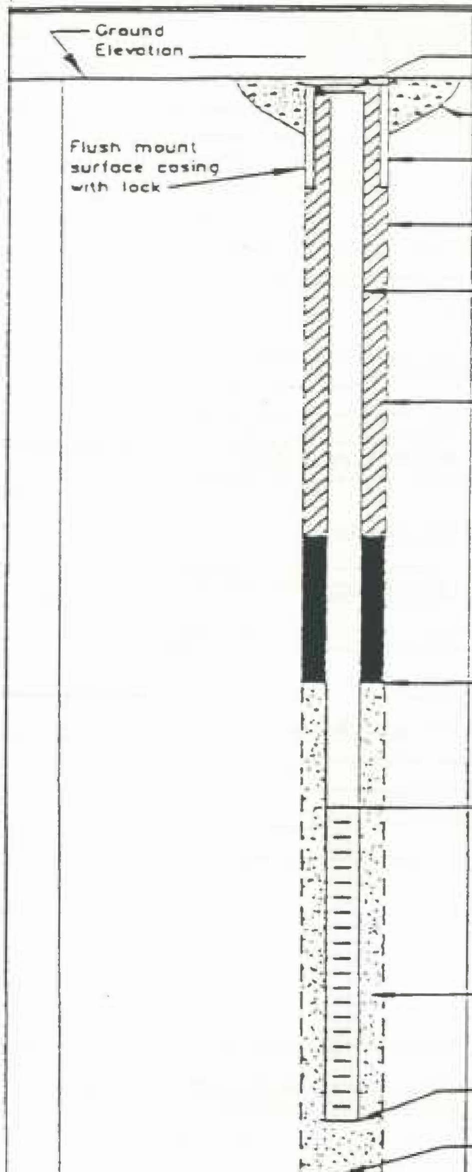
ATTACHMENT C-5A
EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)

BORING NO.: ______

MONITORING WELL SHEET

PROJECT ______ LOCATION ______
PROJECT NO. ______ BORING ______
ELEVATION ______ DATE ______
FIELD GEOLOGIST ______

DRILLER ______
DRILLING METHOD ______
DEVELOPMENT METHOD ______



ELEVATION TOP OF RISER: ______

TYPE OF SURFACE SEAL: ______

TYPE OF PROTECTIVE CASING: ______
I.D. OF PROTECTIVE CASING: ______

DIAMETER OF HOLE: ______

TYPE OF RISER PIPE: ______
RISER PIPE I.D.: ______

TYPE OF BACKFILL/SEAL: ______
______

DEPTH/ELEVATION TOP OF SAND: ____/____

DEPTH/ELEVATION TOP OF SCREEN: ____/____
TYPE OF SCREEN: ______
SLOT SIZE x LENGTH: ______

TYPE OF SAND PACK: ______

DIAMETER OF HOLE IN BEDROCK: ______

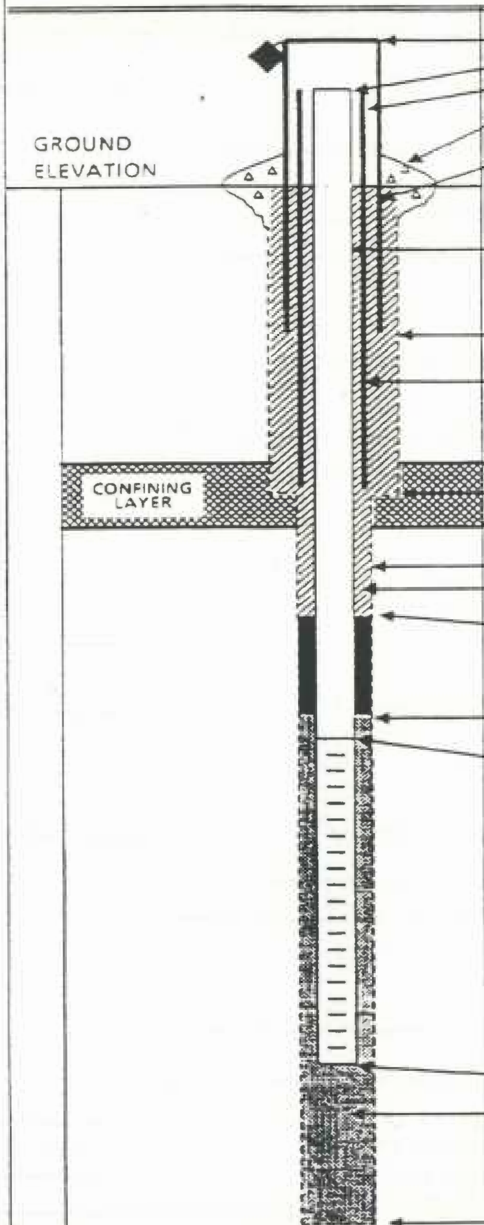
DEPTH/ELEVATION BOTTOM OF SCREEN: ____/____
DEPTH/ELEVATION BOTTOM OF SAND: ____/____
DEPTH/ELEVATION BOTTOM OF HOLE: ____/____
BACKFILL MATERIAL BELOW SAND: ______

ATTACHMENT C-6
EXAMPLE CONFINING LAYER MONITORING WELL SHEET

BORING NO.: ____________

CONFINING LAYER
MONITORING WELL SHEET

PROJECT ____________ LOCATION ____________ DRILLER ____________
PROJECT NO. ____________ BORING ____________ DRILLING METHOD ____________
ELEVATION ____________ DATE ____________ DEVELOPMENT METHOD ____________
FIELD GEOLOGIST ____________



ELEVATION OF TOP OF SURFACE CASING: ____________
ELEVATION OF TOP OF RISER PIPE: ____________
ELEVATION TOP OF PERM. CASING: ____________
TYPE OF SURFACE SEAL: ____________
____
I.D. OF SURFACE CASING: ____________
TYPE OF SURFACE CASING: ____________
____
RISER PIPE I.D. ____________
TYPE OF RISER PIPE: ____________
____
BOREHOLE DIAMETER: ____________
PERM. CASING I.D. ____________
TYPE OF CASING & BACKFILL: ____________
____
ELEVATION / DEPTH TOP CONFINING LAYER: ____________
ELEVATION / DEPTH BOTTOM OF CASING: ____________
ELEVATION / DEPTH BOT. CONFINING LAYER: ____________
BOREHOLE DIA. BELOW CASING: ____________
TYPE OF BACKFILL: ____________
____
ELEVATION / DEPTH TOP OF SEAL: ____________
TYPE OF SEAL: ____________
____
DEPTH TOP OF SAND PACK: ____________
ELEVATION/DEPTH TOP OF SCREEN: ____________
TYPE OF SCREEN: ____________
____
TYPE OF SAND PACK: ____________
____
ELEVATION / DEPTH BOTTOM OF SCREEN: ____________
ELEVATION / DEPTH BOTTOM OF SAND PACK: ____________
TYPE OF BACKFILL BELOW OBSERVATION WELL: ____________
____
ELEVATION / DEPTH OF HOLE: ____________

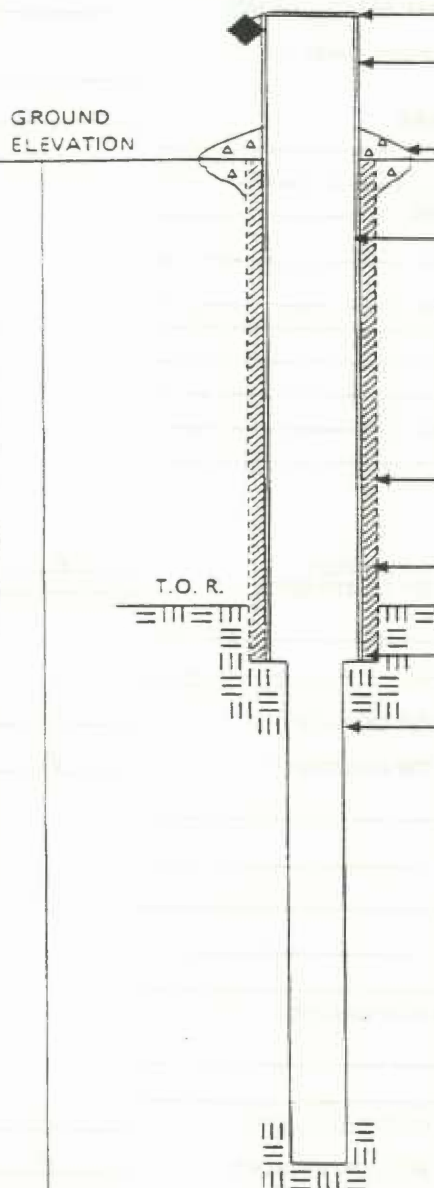
ATTACHMENT C-7
EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL

BORING NO.: ________

BEDROCK
MONITORING WELL SHEET
OPEN HOLE WELL

PROJECT ________ LOCATION ________
PROJECT NO. ________ BORING ________
ELEVATION ________ DATE ________
FIELD GEOLOGIST ________

DRILLER ________
DRILLING METHOD ________
DEVELOPMENT METHOD ________



ELEVATION OF TOP OF CASING: ________

STICK UP OF CASING ABOVE GROUND SURFACE: ________

TYPE OF SURFACE SEAL: ________
____

I.D. OF CASING: ________
TYPE OF CASING: ________

TEMP. / PERM.: ________

DIAMETER OF HOLE: ________

TYPE OF CASING SEAL: ________

DEPTH TO TOP OF ROCK: ________

DEPTH TO BOTTOM CASING: ________

DIAMETER OF HOLE IN BEDROCK: ________

DESCRIBE IF CORE / REAMED WITH BIT:
____
____
____

DESCRIBE JOINTS IN BEDROCK AND DEPTH:
____
____
____

ELEVATION / DEPTH OF HOLE: ____/____

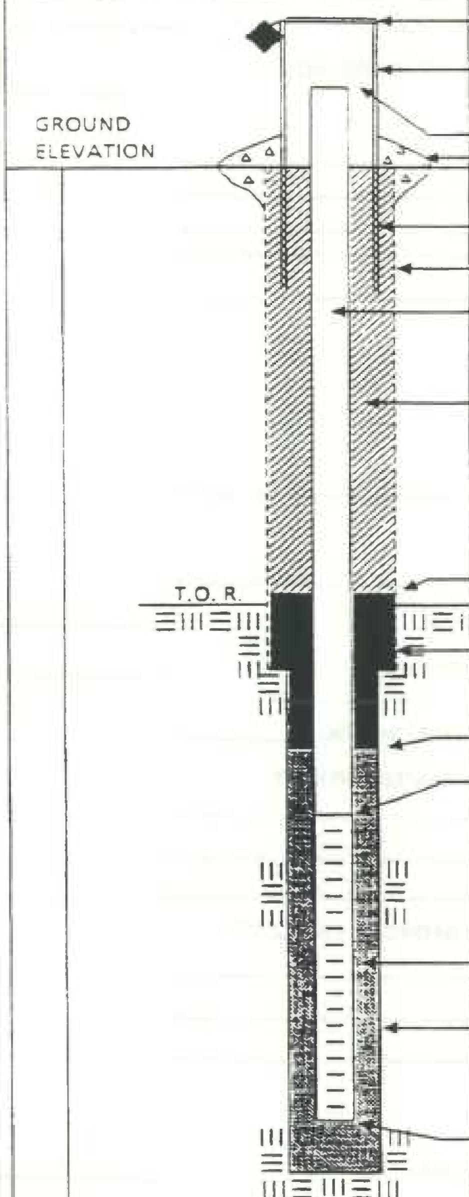
ATTACHMENT C-8
EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK

BORING NO.: ____________

BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT ____________ LOCATION ____________
PROJECT NO. ____________ BORING ____________
ELEVATION ____________ DATE ____________
FIELD GEOLOGIST ____________

DRILLER ____________
DRILLING METHOD ____________
DEVELOPMENT METHOD ____________



ELEVATION OF TOP OF SURFACE CASING: ____________

STICK UP OF CASING ABOVE GROUND SURFACE: ____________

ELEVATION TOP OF RISER: ____________

TYPE OF SURFACE SEAL: ____________

I.D. OF SURFACE CASING: ____________

DIAMETER OF HOLE: ____________

RISER PIPE I.D.: ____________

TYPE OF RISER PIPE: ____________

TYPE OF BACKFILL: ____________

ELEVATION / DEPTH TOP OF SEAL: ______ / ______

ELEVATION / DEPTH TOP OF BEDROCK: ______ / ______

TYPE OF SEAL: ____________

ELEVATION / DEPTH TOP OF SAND: ______ / ______

ELEVATION / DEPTH TOP OF SCREEN: ______ / ______

TYPE OF SCREEN: ____________

SLOT SIZE x LENGTH: ____________

I.D. SCREEN: ____________

TYPE OF SAND PACK: ____________

DIAMETER OF HOLE IN BEDROCK:

CORE / REAM: ____________

ELEVATION / DEPTH BOTTOM SCREEN: ______ / ______

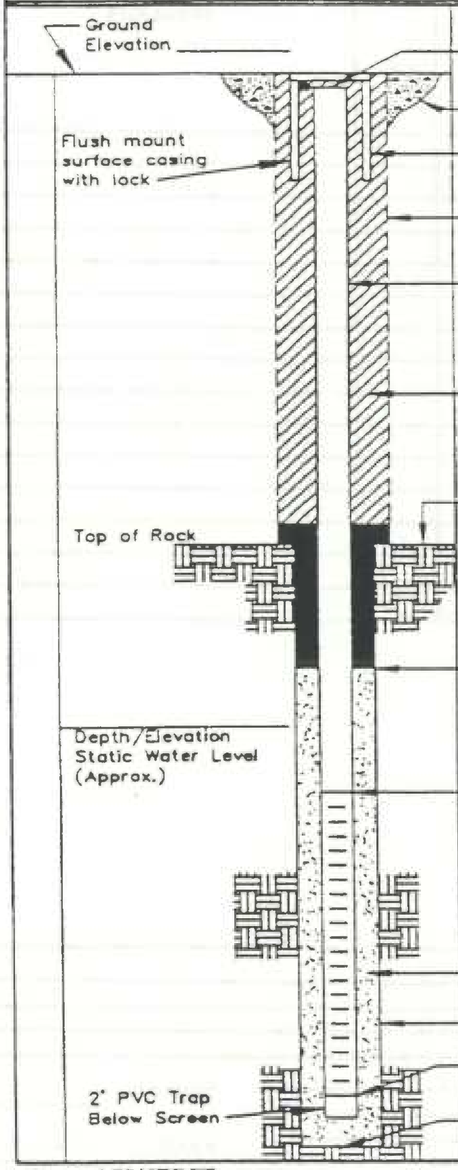
ELEVATION / DEPTH BOTTOM OF HOLE: ______ / ______

ATTACHMENT C-8A
EXAMPLE BEDROCK MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK (FLUSHMOUNT)

BORING NO.: ______

BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT: ______	LOCATION: ______	DRILLER: ______
PROJECT NO.: ______	BORING: ______	DRILLING METHOD: ______
ELEVATION: ______	DATE: ______	DEVELOPMENT METHOD: ______
FIELD GEOLOGIST: ______		



ELEVATION TOP OF RISER: ______

TYPE OF SURFACE SEAL: ______

TYPE OF PROTECTIVE CASING: ______

I.D. OF PROTECTIVE CASING: ______

DIAMETER OF HOLE: ______

TYPE OF RISER PIPE: ______

RISER PIPE I.D.: ______

TYPE OF BACKFILL/SEAL: ______

______

DEPTH/ELEVATION TOP OF BEDROCK: ____/____

DEPTH/ELEVATION TOP OF SAND: ____/____

DEPTH/ELEVATION TOP OF SCREEN: ____/____

TYPE OF SCREEN: ______

SLOT SIZE x LENGTH: ______

TYPE OF SAND PACK: ______

DIAMETER OF HOLE IN BEDROCK: ______

DEPTH/ELEVATION BOTTOM OF SCREEN: ____/____

DEPTH/ELEVATION BOTTOM OF SAND: ____/____

DEPTH/ELEVATION BOTTOM OF HOLE: ____/____

BACKFILL MATERIAL BELOW SAND: ______

ACFILE: L670\GEOL\BEDRK1.DWG

ATTACHMENT C-9
EXAMPLE TEST PIT LOG

TEST PIT LOG

Brown & Root Environmental

PROJECT: ____________________ TEST PIT NO.:

PROJECT NO ____________ DATE: ____________

LOCATION: ____________________

FIELD GEOLOGIST ____________________

DEPTH (Ft.)	LITHOLOGY CHANGE (Depth/Ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS

Test Pit Cross Section and / or Plan View

REMARKS ____________________

PHOTO LOG ____________________ TEST PIT ________

PAGE ____ OF ____

ATTACHMENT D
EXAMPLE EQUIPMENT CALIBRATION LOG

Brown & Root Environmental

EQUIPMENT CALIBRATION LOG

INSTRUMENT NAME / MODEL : ____________

JOB NAME : ____________

MANUFACTURER : ____________

JOB NUMBER : ____________

CALIBRATION DATE	INITIAL SETTINGS	STANDARDS USED	PROCEDURE	ADJUSTMENTS MADE	FINAL SETTINGS	SIGNATURE	COMMENTS

ATTACHMENT E
EXAMPLE DAILY ACTIVITIES RECORD

Brown & Root Environmental

DAILY ACTIVITIES RECORD

PROJECT ______ LOCATION ______
CLIENT ______ ARRIVAL TIME ______ JOB NO. ______
DATE ______ DEPARTURE TIME ______
CONTRACTOR ______ DRILLER ______
BORING NO. ______ HNUS REPRESENTATIVE ______

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS: ______

APPROVED BY:

______ HNUS FIELD REPRESENTATIVE

______ DRILLER OR REPRESENTATIVE

ATTACHMENT F
FIELD TRIP SUMMARY REPORT
PAGE 1 OF 2

SUNDAY

Date: ____________________ Personnel: ____

Weather: ____________________ Onsite: ____

____

Site Activities: ____________________

____

____

____

MONDAY

Date: ____________________ Personnel: ____

Weather: ____________________ Onsite: ____

____

Site Activities: ____________________

____

____

____

TUESDAY

Date: ____________________ Personnel: ____

Weather: ____________________ Onsite: ____

____

Site Activities: ____________________

____

____

____

WEDNESDAY

Date: ____________________ Personnel: ____

Weather: ____________________ Onsite: ____

____

Site Activities: ____________________

____

____

____

ATTACHMENT F
PAGE 2 OF 2
FIELD TRIP SUMMARY REPORT

THURSDAY

Date: ____________________ Personnel: ____

Weather: ____________________ Onsite: ____

____

Site Activities: ____________________

____

____

____

FRIDAY

Date: ____________________ Personnel: ____

Weather: ____________________ Onsite: ____

____

Site Activities: ____________________

____

____

____

SATURDAY

Date: ____________________ Personnel: ____

Weather: ____________________ Onsite: ____

____

Site Activities: ____________________

____

____

____

BROWN & ROOT ENVIRONMENTAL	STANDARD OPERATING PROCEDURES	Number SA-7.1	Page 1 of 9
		Effective Date 03/01/96	Revision 0
		Applicability B&R Environmental, NE	
		Prepared Earth Sciences Department	
Subject	DECONTAMINATION OF FIELD EQUIPMENT AND WASTE HANDLING	Approved D. Senovich	

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1.0 PURPOSE

The purpose of this procedure is to provide guidelines regarding the appropriate procedures to be followed when decontaminating drilling equipment, monitoring well materials, chemical sampling equipment and field analytical equipment.

2.0 SCOPE

This procedure addresses drilling equipment and monitoring well materials decontamination, as well as chemical sampling and field analytical equipment decontamination. This procedure also provides general reference information on the control of contaminated materials.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved Standards Operating Procedures or as otherwise dictated by the approved project plan(s).

5.0 PROCEDURES

To ensure that analytical chemical results reflect actual contaminant concentrations present at sampling locations, the various drilling equipment and chemical sampling and analytical equipment used to acquire the environment sample must be properly decontaminated. Decontamination minimizes the potential for cross-contamination between sampling locations, and the transfer of contamination offsite.

5.1 Drilling Equipment

Prior to the initiation of a drilling program, all drilling equipment involved in field sampling activities shall be decontaminated by steam cleaning at a predetermined area. The steam cleaning procedure shall be performed using a high-pressure spray of heated potable water producing a pressurized stream of steam. This steam shall be sprayed directly onto all surfaces of the various equipment which might contact environmental samples. The decontamination procedure shall be performed until all equipment is free of all visible potential contamination (dirt, grease, oil, noticeable odors, etc.) In addition, this decontamination procedure shall be performed at the completion of each sampling and/or drilling location, including soil borings, installation of monitoring wells, test pits, etc. Such equipment shall include drilling rigs, backhoes, downhole tools, augers, well casings, and screens. Where the drilling rig is set to perform multiple borings at a single area of concern, the steam-cleaning of the drilling rig itself may be waived with proper approval. Downhole equipment, however, must always be steam-cleaned between borings. Where PVC well casings are to be installed, decontamination is not required if the manufacturer provides these casings in factory-sealed, protective, plastic sleeves (so long as the protective packaging is not compromised until immediately before use.

The steam cleaning area shall be designed to contain decontamination wastes and waste waters and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be provided which is connected to a holding facility. A shallow above-ground tank may be used or a pumping system with discharge to a waste tank may be installed.

In certain cases such an elaborate decontamination pad is not possible. In such cases, a plastic lined gravel bed pad with a collection system may serve as an adequate decontamination area. Alternately, a lined sloped pad with a collection pump installed at the lower end may be permissible. The location of the steam cleaning area shall be onsite in order to minimize potential impacts at certain sites.

Guidance to be used when decontaminating drilling equipment shall include:

- As a general rule, any part of the drilling rig which extends over the borehole, shall be steam cleaned.

- All drilling rods, augers, and any other equipment which will be introduced to the hole shall be steam cleaned.

- The drilling rig, all rods and augers. and any other potentially contaminated equipment shall be decontaminated between each well location to prevent cross contamination of potential hazardous substances.

Prior to leaving at the end of each work day and/or at the completion of the drilling program, drilling rigs and transport vehicles used onsite for personnel or equipment transfer shall be steam cleaned, as practicable. A drilling rig left at the drilling location does not need to be steam cleaned until it is finished drilling at that location.

5.2 Sampling Equipment

5.2.1 Bailers and Bailing Line

The potential for cross-contamination between sampling points through the use of a common bailer or its attached line is high unless strict procedures for decontamination are followed. For this reason, it is preferable to dedicate an individual bailer and its line to each sample point, although this does not eliminate the need for decontamination of dedicated bailers. For non-dedicated sampling equipment, the following conditions and/or decontamination procedures must be followed.

Before the initial sampling and after each successive sampling point, the bailer must be decontaminated. The following steps are to be performed when sampling for organic contaminants. Note: contract-specific requirements may permit alternative procedures.

- Potable water rinse
- Alconox or Liquinox detergent wash
- Scrubbing of the line and bailer with a scrub brush (may be required if the sample point is heavily contaminated with heavy or extremely viscous compounds)
- Potable water rinse
- Rinse with 10 percent nitric acid solution*
- Deionized water rinse

---

* Due to the leaching ability of nitric acid on stainless steel, this step is to be omitted if a stainless steel sampling device is being used and metals analysis is required with detection limits less than approximately 50 ppb.

- Acetone or methanol rinse (in some EPA Regions, isopropanol is used instead)
- Hexane rinse**
- Copious distilled/Deionized water rinse
- Air dry

If sampling for volatile organic compounds (VOCs) only, the nitric acid, acetone, methanol, and hexane rinses may be omitted. Only reagent grade or purer solvents are to be used for decontamination. When isopropanol is used, the bailer must be thoroughly dry before using to acquire the next sample.

In general, specially purchased pre-cleaned disposable sampling equipment is not decontaminated (nor is an equipment rinsate blank collected) so long as the supplier has provided certification of cleanliness. If decontamination is performed on several bailers at once (i.e., in batches), bailers not immediately used may be completely wrapped in aluminum foil (shiny-side toward equipment) and stored for future use. When batch decontamination is performed, one equipment rinsate is generally collected from one of the bailers belonging to the batch before it is used for sampling.

It is recommended that clean, dedicated braided nylon or polypropylene line be employed with each bailer use.

5.2.2 Sampling Pumps

Most sampling pumps are low volume (less than 2 gpm) pumps. These include peristaltic, diaphragm, air-lift, pitcher and bladder pumps, to name a few. If these pumps are used for sampling from more than one sampling point, they must be decontaminated prior to initial use and after each use.

The procedures to be used for decontamination of sampling pumps compare to those used for a bailer except that the 10 percent nitric acid solution is omitted. Each of the liquid factions is to be pumped through the system. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge hoses. Certain types of pumps are unacceptable for sampling purposes. For peristaltic pumps, the tubing is replaced rather than cleaned.

An additional problem is introduced when the pump relies on absorption of water via an inlet or outlet hose. For organic sampling, this hose should be Teflon. Other types of hoses leach organics (especially phthalate esters) into the water being sampled or adsorb organics from the sampled water. For all other sampling, the hose should be Viton, polyethylene, or polyvinyl chloride (listed in order of preference). Whenever possible, dedicated hoses should be used. It is preferable that these types of pumps not be used for sampling, only for purging.

5.2.3 Filtering Equipment

On occasion, the sampling plan may require acquisition of filtered groundwater samples. Field-filtering is addressed in SOP SA-6.1 and should be conducted as soon after sample acquisition as possible. To this end, three basic filtration systems are most commonly used: the in-line disposable Teflon filter, the inert gas over-pressure filtration system, and the vacuum filtration system.

For the in-line filter, decontamination is not required since the filter cartridge is disposable, however, the cartridge must be disposed of in an approved receptacle and the intake and discharge lines must still be decontaminated or replaced before each use.

** If sampling for pesticides, PCBs, or fuels.

For the over-pressure and the vacuum filtration systems, the portions of the apparatus which come in contact with the sample must be decontaminated as outlined in the paragraphs describing the decontamination of bailers. (Note: Varieties of both of these systems come equipped from the manufacturer with Teflon-lined surfaces for those that would come into contact with the sample. These filtration systems are preferred when decontamination procedures must be employed.)

5.2.4 Other Sampling Equipment

Field tools such as trowels and mixing bowls are to be decontaminated in the same manner as described above.

5.3 Field Analytical Equipment

5.3.1 Water Level Indicators

Water level indicators that come into contact with groundwater must be decontaminated using the following steps:

- Rinse with potable water
- Rinse with deionized water
- Acetone or methanol rinse (unless otherwise directed by manufacturer)
- Rinse with deionized water

Water level indicators that do not come in contact with the groundwater but may encounter incidental contact during installation or retrieval need only undergo the first and last steps stated above.

5.3.2 Probes

Probes (e.g., pH or specific-ion electrodes, geophysical probes, or thermometers) which would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise (e.g., dissolved oxygen probes). Probes that contact a volume of groundwater not used for laboratory analyses can be rinsed with deionized water. For probes which make no direct contact, (e.g., OVA equipment) the probe is self-cleaning when exposure to uncontaminated air is allowed and the housing can be wiped clean with paper-towels or cloth wetted with alcohol.

5.4 Waste Handling

For the purposes of these procedures, contaminated materials are defined as any byproducts of field activities that are suspected or known to be contaminated with hazardous substances. These byproducts include such materials as decontamination solutions, disposable equipment, drilling muds, well-development fluids, and spill-contaminated materials and Personal Protection Equipment (PPE).

The procedures for obtaining permits for investigations of sites containing hazardous substances are not clearly defined at present. In the absence of a clear directive to the contrary by the EPA and the states, it must be assumed that hazardous wastes generated during field activities will require compliance with Federal agency requirements for generation, storage, transportation, or disposal. In addition, there may be state regulations that govern the disposal action. This procedure exclusively describes the technical methods used to control contaminated materials.

The plan documents for site activities must include a description of control procedures for contaminated materials. This planning strategy must assess the type of contamination, estimate the amounts that would be produced, describe containment equipment and procedures, and delineate storage or disposal methods. As a general policy, it is wise to select investigation methods that minimize the generation of contaminated spoils. Handling and disposing of potentially hazardous materials can be dangerous and expensive. Until sample analysis is complete, it is assumed that all produced materials are suspected of contamination from hazardous chemicals and require containment.

5.5 Sources of Contaminated Materials and Containment Methods

5.5.1 Decontamination Solutions

All waste decontamination solutions and rinses must be assumed to contain the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. The waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility. Larger equipment such as backhoes and tractors must be decontaminated in an area provided with an impermeable liner and a liquid collection system. A decontamination area for large equipment could consist of a bermed concrete pad with a floor drain leading to a buried holding tank.

5.5.2 Disposable Equipment

Disposable equipment that could become contaminated during use typically includes PPE, rubber gloves, boots, broken sample containers, and cleaning-wipes. These items are small and can easily be contained in 55-gallon drums with lids. These containers should be closed at the end of each work day and upon project completion to provide secure containment until disposed.

5.5.3 Drilling Muds and Well-Development Fluids

Drilling muds and well-development fluids are materials that may be used in groundwater monitoring well installations. Their proper use could result in the surface accumulation of contaminated liquids and muds that require containment. The volumes of drilling muds and well-development fluids used depend on well diameter and depth, groundwater characteristics, and geologic formations. There are no simple mathematical formulas available for accurately predicting these volumes. It is best to rely on the experience of reputable well drillers familiar with local conditions and the well installation techniques selected. These individuals should be able to estimate the sizes (or number) of containment structures required. Since guesswork is involved, it is recommended that an slight excess of the estimated amount of containers required will be available.

Drilling muds are mixed and stored in what is commonly referred to as a mud pit. This mud pit consists of a suction section from which drilling mud is withdrawn and pumped through hoses, down the drill pipe to the bit, and back up the hole to the settling section of the mud pit. In the settling section, the mud's velocity is reduced by a screen and several flow-restriction devices, thereby allowing the well cuttings to settle out of the mud/fluid.

The mud pit may be either portable above-ground tanks commonly made of steel (which is preferred) or stationary in-ground pits as depicted in Attachment A. The above-ground tanks have a major advantage over the in-ground pits because the above-ground tanks isolate the natural soils from the contaminated fluids within the drilling system. These tanks are also portable and can usually be cleaned easily.

As the well is drilled, the cuttings that accumulate in the settling section must be removed. This is best done by shoveling them into drums or other similar containers. When the drilling is complete, the contents of the above-ground tank are likewise shoveled or pumped into drums, and the tank is cleaned and made available for its next use.

If in-ground pits are used, they should not extend into the natural water table. They should also be lined with a bentonite-cement mixture followed by a layer of flexible impermeable material such as plastic sheeting. Of course, to maintain its impermeable seal, the lining material used would have to be nonreactive with the wastes. An advantage of the in-ground pits is that well cuttings do not necessarily have to be removed periodically during drilling because the pit can be made deep enough to contain them. Depending on site conditions, the in-ground pit may have to be totally excavated and refilled with uncontaminated natural soils when the drilling operation is complete.

When the above-ground tank or the in-ground pit is used, a reserve tank or pit should be located at the site as a backup system for leaks, spills, and overflows. In either case, surface drainage should be such that any excess fluid could be controlled within the immediate area of the drill site.

The containment procedure for well-development fluids is similar to that for drilling muds. The volume and weight of contaminated fluid will be determined by the method used for development. When a new well is pumped or bailed to produce clear water, substantially less volume and weight of fluid result than when backwashing or high-velocity jetting is used.

5.5.4 Spill-Contaminated Materials

A spill is always possible when containers of liquids are opened or moved. Contaminated sorbents and soils resulting from spills must be contained. Small quantities of spill-contaminated materials are usually best contained in drums, while larger quantities can be placed in lined pits or in other impermeable structures. In some cases, onsite containment may not be feasible and immediate transport to an approved disposal site will be required.

5.6 Disposal of Contaminated Materials

Actual disposal techniques for contaminated materials are the same as those for any hazardous substance, that is, incineration, landfilling, treatment, and so on. The problem centers around the assignment of responsibility for disposal. The responsibility must be determined and agreed upon by all involved parties before the field work starts. If the site owner or manager was involved in activities that precipitated the investigation, it seems reasonable to encourage his acceptance of the disposal obligation. In instances where a responsible party cannot be identified, this responsibility may fall on the public agency or private organization investigating the site.

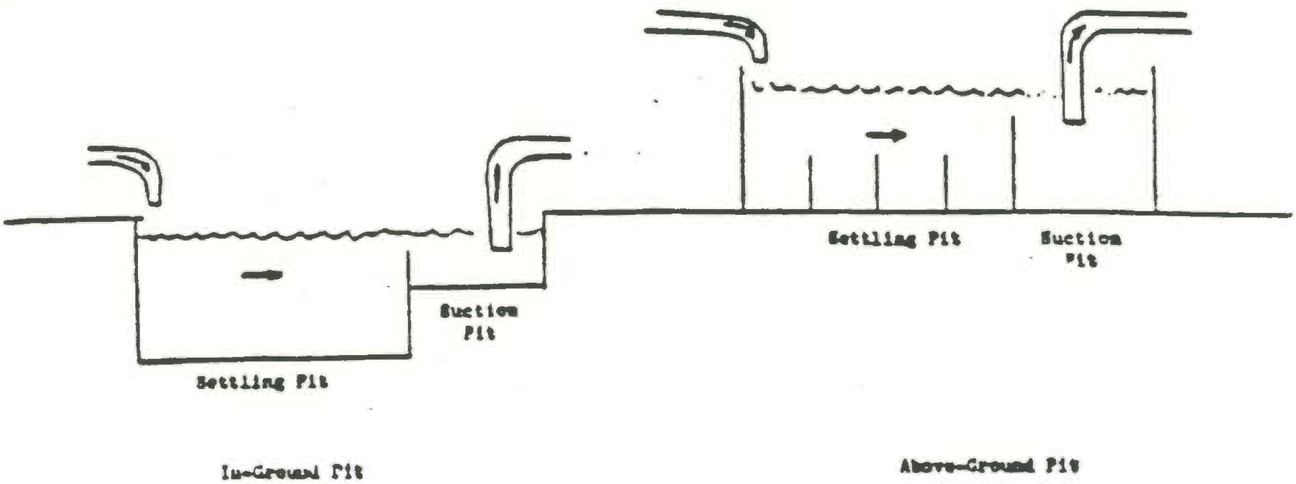
Another consideration in selecting disposal methods for contaminated materials is whether the disposal can be incorporated into subsequent site cleanup activities. For example, if construction of a suitable onsite disposal structure is expected, contaminated materials generated during the investigation should be stored at the site for disposal with other site materials. In this case, the initial containment structures should be evaluated for use as long-term storage structures. Also, other site conditions such as drainage control, security, and soil type must be considered so that proper storage is provided. If onsite storage is expected, then the containment structures should be specifically designed for that purpose.

6.0 REFERENCES

Brown & Root Environmental: Standard Operating Procedure No. 4.33, Control of Contaminated Material.

ATTACHMENT A

TWO TYPES OF MUD PITS USED IN WELL DRILLING



APPENDIX C

ASTM D 1586-84

Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils[1]

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DOD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

$^{\epsilon1}$ NOTE—Editorial changes were made throughout October 1992.

1. Scope

1.1 This test method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D 4220 Practices for Preserving and Transporting Soil Samples[2]

D 4633 Test Method for Stress Wave Energy Measurement for Dynamic Penetrometer Testing Systems[2]

3. Terminology

3.1 *Descriptions of Terms Specific to This Standard*

3.1.1 *anvil*—that portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

3.1.2 *cathead*—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope turns around the drum.

3.1.3 *drill rods*—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.1.4 *drive-weight assembly*—a device consisting of the hammer, hammer fall guide, the anvil, and any ha[illegible] drop system.

3.1.5 *hammer*—that portion of the drive-weight ass[illegible] consisting of the 140 ± 2 lb (63.5 ± 1 kg) impact [illegible] which is successively lifted and dropped to provi[illegible] energy that accomplishes the sampling and penetratio[illegible]

3.1.6 *hammer drop system*—that portion of the [illegible] weight assembly by which the operator accomplish[illegible] lifting and dropping of the hammer to produce the b[illegible]

3.1.7 *hammer fall guide*—that part of the drive[illegible] assembly used to guide the fall of the hammer.

3.1.8 *N-value*—the blowcount representation of th[illegible] tration resistance of the soil. The *N*-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.1.9 *ΔN*—the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.1.10 *number of rope turns*—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer, divided by 360° (see Fig. 1).

3.1.11 *sampling rods*—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.1.12 *SPT*—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

4. Significance and Use

4.1 This test method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This test method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or *N*-value, and the engineering behavior of earthworks and foundations are available.

5. Apparatus

5.1 *Drilling Equipment*—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be

[1] This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D 1586 – 58 T. Last previous edition D 1586 – 67 (1974).

[2] *Annual Book of ASTM Standards*, Vol 04.08.

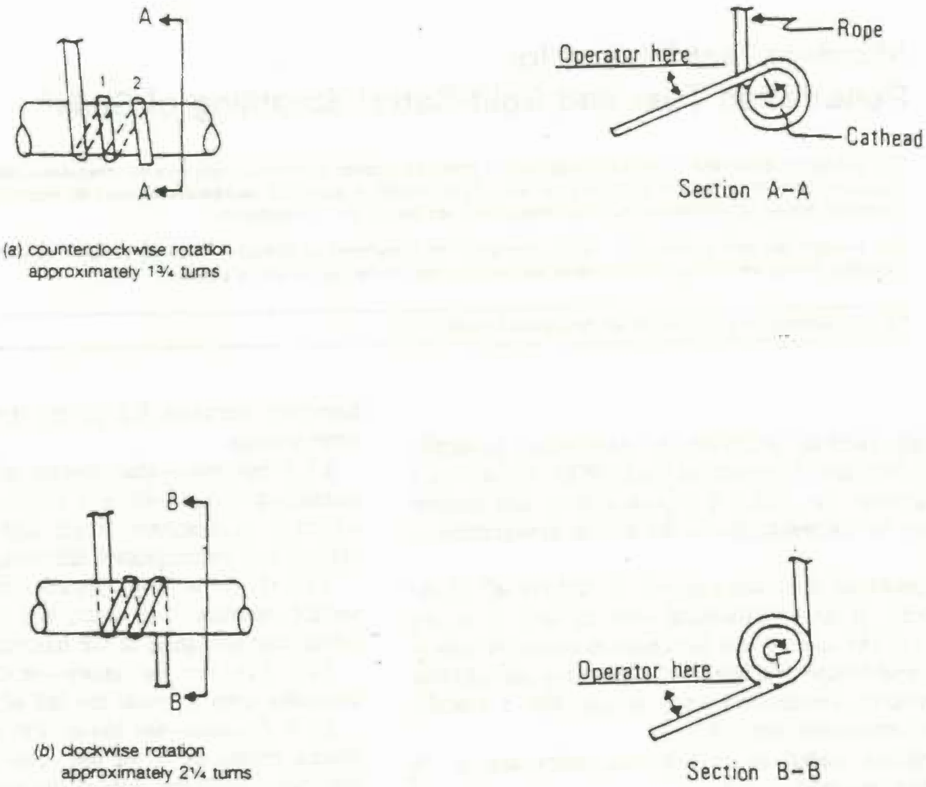


FIG. 1 Definitions of the Number of Rope Turns and the Angle for (*a*) Counterclockwise Rotation and (*b*) Clockwise Rotation of the Cathead

suitable for advancing a borehole in some subsurface conditions.

5.1.1 *Drag, Chopping, and Fishtail Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjuction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharge bits are permitted.

5.1.2 *Roller-Cone Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.

5.1.3 *Hollow-Stem Continuous Flight Augers*, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).

5.1.4 *Solid, Continuous Flight, Bucket and Hand Augers*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not cave onto the sampler or sampling rods during sampling.

5.2 *Sampling Rods*—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod which has an outside diameter of 1⅝ in. (41.2 mm) and an inside diameter of 1⅛ in. (28.5 mm).

NOTE 1—Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the *N*-values to depths of at least 100 ft (30 m).

5.3 *Split-Barrel Sampler*—The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 1⅜ in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sample retainer basket is permitted, and should also be noted on the penetration record if used.

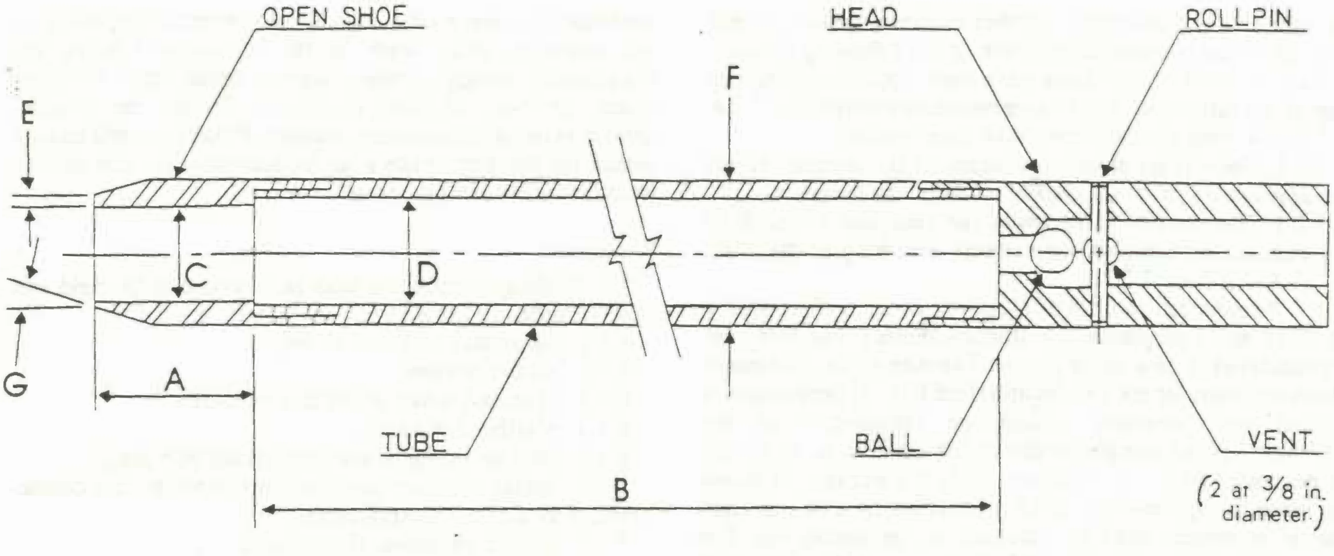
NOTE 2—Both theory and available test data suggest that *N*-values may increase between 10 to 30 % when liners are used.

5.4 *Drive-Weight Assembly:*

5.4.1 *Hammer and Anvil*—The hammer shall weigh 140 ± 2 lb (63.5 ± 1 kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged.

NOTE 3—It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 *Hammer Drop System*—Rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of



A = 1.0 to 2.0 in. (25 to 50 mm)
B = 18.0 to 30.0 in. (0.457 to 0.762 m)
C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
D = 1.50 ± 0.05 − 0.00 in. (38.1 ± 1.3 − 0.0 mm)
E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
F = 2.00 ± 0.05 − 0.00 in. (50.8 ± 1.3 − 0.0 mm)
G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

the sampler while re-engaging and lifting the hammer.

5.5 *Accessory Equipment*—Accessories such as labels, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.5 mm) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid level within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into the borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-

kg) hammer and count the number of blows applied in each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.3 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance," or the "*N*-value." If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6-in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lb (63.5-kg) hammer shall be accomplished using either of the following two methods:

7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5-kg) hammer and allows it to drop 30 ± 1.0 in. (0.76 m ± 25 mm) unimpeded.

7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.

7.4.2.3 No more than 2¼ rope turns on the cathead may be used during the performance of the penetration test, as shown in Fig. 1.

NOTE 4—The operator should generally use either 1¾ or 2¼ rope turns, depending upon whether or not the rope comes off the top (1¾ turns) or the bottom (2¼ turns) of the cathead. It is generally known and accepted that 2¾ or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76-m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or the length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 6-in. (0.15-m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the sampler, make a jar for each stratum and note its location in the sampler barrel.

8. Report

8.1 Drilling information shall be recorded in the field and shall include the following:

8.1.1 Name and location of job,

8.1.2 Names of crew,

8.1.3 Type and make of drilling machine,

8.1.4 Weather conditions,

8.1.5 Date and time of start and finish of boring,

8.1.6 Boring number and location (station and coordinates, if available and applicable),

8.1.7 Surface elevation, if available,

8.1.8 Method of advancing and cleaning the boring,

8.1.9 Method of keeping boring open,

8.1.10 Depth of water surface and drilling depth at the time of a noted loss of drilling fluid, and time and date when reading or notation was made,

8.1.11 Location of strata changes,

8.1.12 Size of casing, depth of cased portion of boring,

8.1.13 Equipment and method of driving sampler,

8.1.14 Type sampler and length and inside diameter of barrel (note use of liners),

8.1.15 Size, type, and section length of the sampling rods, and

8.1.16 Remarks.

8.2 Data obtained for each sample shall be recorded in the field and shall include the following:

8.2.1 Sample depth and, if utilized, the sample number,

8.2.2 Description of soil,

8.2.3 Strata changes within sample,

8.2.4 Sampler penetration and recovery lengths, and

8.2.5 Number of blows per 6-in. (0.15-m) or partial increment.

9. Precision and Bias

9.1 *Precision*—A valid estimate of test precision has not been determined because it is too costly to conduct the necessary inter-laboratory (field) tests. Subcommittee D18.02 welcomes proposals to allow development of a valid precision statement.

9.2 *Bias*—Because there is no reference material for this test method, there can be no bias statement.

9.3 Variations in *N*-values of 100 % or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller, *N*-values in the same soil can be reproduced with a coefficient of variation of about 10 %.

9.4 The use of faulty equipment, such as an extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in *N*-values obtained between operator-drill rig systems.

9.5 The variability in N-values produced by different drill rigs and operators may be reduced by measuring that part of the hammer energy delivered into the drill rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N-value adjustment is given in Test Method D 4633.

10. Keywords

10.1 blow count; in-situ test; penetration resistance; split-barrel sampling; standard penetration test

STANDARD FIELD FORMS

AS A MINIMUM, THE FOLLOWING ITEMS MUST BE INCLUDED IN THE FIELD LOGBOOK

o All entries must be made in blue or black indelible ink.

o Errors must be lined out ONCE and INITIALED.

o Each page must be sequentially numbered, dated, signed and the project number must be written at the top of each page. No blank pages.

o List the time of arrival at work site, and the names of all BRE personnel.

o State the level of personal protection required (level D, level D mod. , level C, etc.)

o Designation of the Field Team Leader and a Site Safety Officer.

o State that a Site Safety Meeting/Briefing was conducted and who was present.

o List weather conditions and update as necessary.

o List specific reason(s) for site visit (sampling, drilling, etc...).

o List Subcontractor(s) present at the site and time of arrivals to the site, list all heavy equipment (such as drilling rig, back hoe, jackhammer, etc....).

o List name(s) and time(s) of arrival/departure of anyone visiting the site (such as BRE or subcontractor personnel, Client, regulators, inspectors.....)

o Describe the method of decontamination for drilling tools, bailers, and other equipment. Site the reference(s) that you use for decontamination (i.e., In accordance with Section 5 of BRE's FDEP -approved CompQAP, etc...)

o Indicate that the field instruments have been calibrated and indicate where the calibration information can be found if it is not listed in this logbook. Identify field instruments used by model number and I.D. number or serial number.

o A physical description of all samples must be recorded. Give location of samples, boreholes, etc... A diagram or map would be most appropriate.

o Describe the condition of the site prior to departure (such as wells locked, pump operational, diffused aerator down, barricades properly located, boreholes properly abandoned, etc.....)

o Handling of drill cuttings, development/purge water, and other site derived wastes (e.g., drumming, spreading on plastic, etc.)

o Reference all field forms that are used.

UNDER NO CIRCUMSTANCES SHOULD THE FIELD LOGBOOK BE IN ANYONE'S POSSESSION OTHER THAN BRE PERSONNEL.

Arnold C. Lamb
District Manager of Quality Assurance
February 2, 1995

DAILY ACTIVITIES RECORD

PROJECT NAME: ______________________ PROJECT NUMBER: ____________

CLIENT: ______________________ LOCATION: ____________

DATE: ______________________ ARRIVAL TIME: ____________

B&RE PERSONNEL: ______________________ DEPARTURE TIME: ____________

CONTRACTOR: ______________________ DRILLER: ____________

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS: ______________________

APPROVED BY:

B&RE REPRESENTATIVE

DRILLER

DATE: ____________

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: ______________________ PROJECT NO.: ______________

Date of Calibration	Instrument Name and Model	B & R Environmental Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		

Brown & Root Environmental

MULTIPLE SAMPLE LOG SHEET

☐ SURFACE SOIL
☐ SUBSURFACE SOIL
☐ SEDIMENT
☐ LAGOON/POND
☐ OTHER

SAMPLER(S) SIGNATURE ____________

PROJECT NAME: ____________

PROJECT NUMBER: ____________

AREA DESIGNATION ____________

Sample No.	SAMPLE METHOD	DEPTH (FT)	DATE	TIME	SAMPLED BY	CONCENTRATION (L)LOW (H)HIGH	(G)GRAB (C)COMPOSITE	ANALYSES							No. OF CONT. TOTAL	SOIL DESCRIPTION

REMARKS:

LAB:

COC NO:

ACAD: C:\FORMS\SAMPLOG.DWG 02/17/95 ID

SINGLE SAMPLE LOG SHEET

Project Site Name: ________________

Project No.: ________________

- ☐ Surface Soil
- ☐ Subsurface Soil
- ☐ Sediment
- ☐ Other ________
- ☐ QA Sample Type: __________

Sample ID No.: ________________

Sample Location: ________________

Sampled By: ________________

C.O.C. No.: ________________

	Composite Sample Data		
Sample Method:	Sample	Time	Color/Description
Depth Sampled:			
Sample Date and Time:			
Type of Sample ☐ Grab ☐ Composite ☐ Grab-Composite ☐ High Concentration ☐ Low Concentration			
	Grab Sample Data		
	Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)	

Analysis	Container Requirements	Collected (✓)	Map:

Observations/Notes:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No:	

BORING NO.: ____________

MONITORING WELL SHEET

PROJECT ______________________ LOCATION ______________________

PROJECT NO. __________________ BORING ________________________

ELEVATION ____________________ DATE __________________________

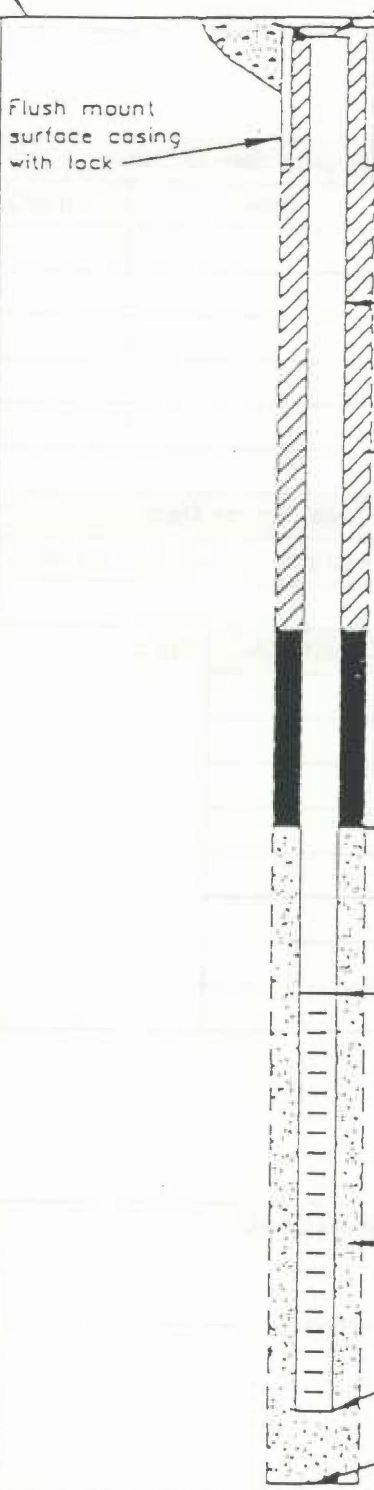
FIELD GEOLOGIST ____

DRILLER ______________

DRILLING METHOD ______________

DEVELOPMENT METHOD ______________

Ground Elevation __________



ELEVATION TOP OF RISER: ____________

TYPE OF SURFACE SEAL: ____________

TYPE OF PROTECTIVE CASING: ____________

I.D. OF PROTECTIVE CASING: ____________

DIAMETER OF HOLE: ____________

TYPE OF RISER PIPE: ____________

RISER PIPE I.D.: ____________

TYPE OF BACKFILL/SEAL: ____________

____

DEPTH/ELEVATION TOP OF SAND: ______/______

DEPTH/ELEVATION TOP OF SCREEN: ______/______

TYPE OF SCREEN: ____________

SLOT SIZE x LENGTH: ____________

TYPE OF SAND PACK: ____________

DIAMETER OF HOLE IN BEDROCK: ____________

DEPTH/ELEVATION BOTTOM OF SCREEN: ______/______

DEPTH/ELEVATION BOTTOM OF SAND: ______/______

DEPTH/ELEVATION BOTTOM OF HOLE: ______/______

BACKFILL MATERIAL BELOW SAND: ____________

Brown & Root Environmental
455 FAIRWAY DRIVE, SUITE 200
DEERFIELD BEACH, FLORIDA 33441
(305) 570-5885 (305) 570-5974 (FAX)

SITE MANAGER: ______
PROJECT NAME: ______
BRE PROJECT NO.: ______ CODE: ______
P.O. NO.: ______

SHIPPED TO: PAGE ___ OF ___

______
(LABORATORY NAME, CITY)

CHAIN OF CUSTODY RECORD

LABORATORY ANALYSIS

SAMPLED BY (PRINT): ______
SAMPLER SIGNATURE: ______

☐ STANDARD TAT ☐ RUSH
☐ 24 HR. ☐ 48 HR. ☐ 72 HR. ☐ 7 DAYS
RESULTS DUE DATE: ______

LAB NO.	DATE	TIME	SAMPLE IDENTIFICATION	SAMPLE TYPE: COMP.	SAMPLE TYPE: GRAB	MATRIX	PRES. TYPE / PARAMETERS										NUMBER OF CONTAINERS	COMMENTS:
TOTAL NUMBER OF CONTAINERS																		

EMPTY BOTTLES RELINQUISHED BY (SIGNATURE) ①	SEAL INTACT? YES NO N/A	DATE: TIME:	EMPTY BOTTLES RECEIVED BY (SIGNATURE) ②	SEAL INTACT? YES NO N/A	DATE: TIME:
RELINQUISHED BY (SIGNATURE) ③	SEAL INTACT? YES NO N/A	DATE: TIME:	RECEIVED BY (SIGNATURE) ④	SEAL INTACT? YES NO N/A	DATE: TIME:
RELINQUISHED BY (SIGNATURE) ⑤	SEAL INTACT? YES NO N/A	DATE: TIME:	RECEIVED BY (SIGNATURE) ⑥	SEAL INTACT? YES NO N/A	DATE: TIME:

SPECIAL INSTRUCTIONS:

LABORATORY REMARKS:

SAMPLE CONTAINERS PRECLEANED BY:
☐ BRE ☐ LABORATORY ☐ MANUFACTURER

METHOD OF SHIPMENT: ______

BILL OF LADING NO.: ______

WHITE-FULLY EXECUTED COPY
YELLOW-RECEIVING LABORATORY COPY
PINK-SAMPLERS' COPY/QA COPY
GOLDENROD-SITE MANAGERS' COPY

SAMPLING TEAM:

RECEIVED FOR LABORATORY BY (SIGNATURE):

DATE: ______ TIME: ______

No. 0257

NO. 39150 (9/95)

Brown & Root Environmental	SAMPLING LOG	Page of
BRE Project No:	Date: Sampler(s):	
Client Site ID:	Facility Address:	
Weather:	Sampling Method: Teflon Bailer Y N Other ____________	SOP Cleaning Y N

Comments:

GROUNDWATER SYSTEM PERFORMANCE AND QUALITY CONTROL SAMPLES											TEST PARAMETERS			
A	B	C	D	E	Sample ID	Time	Source	pH	Temp.	Sp. Cond.		Test Method	Container Type	Preserv. Type
							GWS Influent				A			
							GWS Effluent				B			
							Equipment Blank				C			
							Equipment Blank				D			
							Trip Blank				E			
							Duplicate ( )							
							Duplicate ( )							

GROUNDWATER SAMPLES											TD	Csg Dia (in)	DTW	Purge Vol

UNITS: TEMPERATURE = DEGREES CELSIUS/pH = STANDARD UNITS/SPECIFIC CONDUCTANCE = UMHOS/CM

WELL CASING VOLUMES (GALLONS/FT OF SATURATED CASING, FOR 5x PURGE) 1.25" = 0.32 / 2" = 0.82 / 4" = 3.27 / 6" = 7.35

NOTE: A 3x PURGE IS OK FOR: 4" = 1.96 / 6" = 4.41, PROVIDED 3 CONSISTENT REPEAT FIELD METER READINGS ARE OBSERVED

SHEET ________ OF ________

PROJECT:		BORING NO.:	
		TOTAL DEPTH:	
JOB NO.:		LOGGED BY:	
PROJ. MGR:		EDITED BY:	
DRILLING CONTRACTOR:			
DRILL RIG TYPE:			
DRILLERS NAME:			
SAMPLING METHODS:			
DRILLING TECHNIQUE :			
HAMMER WT:		DROP:	
STARTED TIME:		DATE:	
COMPLETED TIME:		DATE:	
BORING DEPTH (ft.)		BOREHOLE DIA.:	
CASING DEPTH (ft.)			
WATER DEPTH (ft.)			
TIME:			
DATE:			
BACKFILLED TIME:	DATE:	BY:	
TOP OF CASING ELEV.:		DATUM:	
AMOUNT OF FREE PROCUCT :			
RISE/FALL OF WATER TABLE :		TIME INTERVAL :	

SAMPLE DEPTH	SAMPLER TYPE	BLOWS/6-IN.	INCHES DRIVEN	INCHES RECOVERED	MOISTURE	ODOR	UNFILTERED OVA (PPM)	FILTERED OVA (PPM)	CORRECTED OVA (PPM)	DEPTH IN FEET	USCS OR ASTM CODE	LITHOLOGIC DESCRIPTION :
										1		
										2		
										3		
										4		
										5		
										6		
										7		
										8		
										9		
										10		

DEPTH

TYPE

BLOWS

DRIVEN

REC'V'D'

MOISTURE

ODOR

UNFILTER

FILTERED

CORRECT

DEPTH

1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0

USCS OR ASTM CODE

LITHOLOGIC DESCRIPTION :

PROJECT:

NO.

BORING NO.

SHEET ____ OF ____