Comprehensive Long-Term Environmental Action Navy

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INITIAL PHASE II
SITE CHARACTERIZATION REPORT
FLEET INDUSTRIAL SUPPLY CENTER
BULK FUEL STORAGE FACILITY
AT
RED HILL

Prepared for:

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LIST OF ACRONYMS

AVGAS Aviation Gasoline

BTEX Benzene, toluene, ethylbenzene, and xylene

BBL barrels

CLEAN Comprehensive Long-Term Environmental Action Navy

COC Chain of Custody
CTO Contract Task Order

EPA Environmental Protection Agency
FISC Fleet Industrial Supply Center

gpm gallons per minute

LEL Lower Explosive Level

LUST Leaking Underground Storage Tank

MDL Method Detection Limit

MSL Mean Sea Level

mg/kg Milligrams Per Kilogram
mg/L Milligrams Per Liter

ND Non Detect

NFSO Navy Special Fuel Oil

No. Number
NS No Standard

OEES Ogden Environmental and Energy Services Company, Inc.

OHSC Onsite Health and Safety Coordinator

PACNAVFACENGCOM Pacific Division, Naval Facilities Engineering Command

PAH Polynuclear Aromatic Hydrocarbons

PID Photoionization Detector
psi Pounds Per Square Inch
PVC Polyvinyl Chloride

RBCA Risk Based Corrective Action
SAI Salisbury and Associates, Inc.

SHDOH State of Hawaii Department of Health

SOP Standard Operating Procedure

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TGM	Technical Guidance Manual	agen de la constante de la con	
TPH	Total Petroleum Hydrocarbons		
μg/kg	Micrograms Per Kilogram		
USGS	United States Geologic Survey		
UST(s)	Underground Storage Tanks		

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EXECUTIVE SUMMARY

Ogden Environmental and Energy Services, Inc. (OEES) has completed the initial Phase II site characterization activities performed at the Fleet Industrial Supply Center (FISC), Pearl Harbor bulk storage facility located at Red Hill, Oahu Hawaii. OEES has prepared this report as authorized by the Pacific Division, Naval Facilities Engineering Command (PACNAVFACENGCOM) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N6742-90-D-0019, Contract Task Order (CTO), 0229. The engineering services were requested by PACNAVFACENGCOM to identify potential fuel product releases suspected at the facility which was constructed in the early 1940's and consist of 20 buried steel vertical tanks with a capacity of approximately 12.5 million gallons each.

In March 1998 the Navy authorized OEES to proceed with engineering services. The site characterization is being conducted in two phases: Phase I-Research Activities and Phase II-Investigation Activities. During April 1998, OEES personnel conducted the Phase I site reconnaissance and data gathering activities. The initial Phase II site characterization was performed during the period of October 19, 1998 through November 1, 1998. The objective of the Phase II investigation was to core bedrock immediately underlying the tanks in an attempt to intercept any petroleum release that may have occurred. Three borings each were advanced under Tanks 16 and 9. Core samples were collected at varied depths, based upon any physical characteristics that may be attributed to petroleum contamination. These characteristics included discoloration, odor, evident staining, physical change, and seam/void filled zones.

Petroleum staining/saturation was observed on core segments collected from borings B16A and B16C. The petroleum substance appeared to be a mixture of a thick, heavy oil with an odor similar to diesel. In addition, OEES was successful in collecting a product sample from B16C. Free phase petroleum product was encountered within a rock interval with an approximate thickness of 1.2 feet

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A total of 14 samples were submitted for offsite laboratory chemical analyses (12 core samples, 1 duplicate core sample, and 1 aqueous sample). All samples were analyzed for TPH Method-D-Triregional, Method 8260-Volatile Organics (BTEX) and Method 8270-Polynuclear Aromatic Hydrocarbons, GC MS. This battery of test was selected to aid in identifying the unknown petroleum contamination throughout the TPH range as well as to focus on diesel constituents

Laboratory evaluation of the core samples confirmed what was noted during the drilling activities. Contamination of the subsurface beneath Tank 16 was verified. Specifically borings B16A and B16C yielded results consistent with a mixture of diesel and a heavier oil. TPH Concentrations in these borings ranged from 2800 mg/kg to 11,000 mg/kg. The Tier I RBCA Action level for TPH is 5000 mg/kg. Contamination of samples with BTEX compounds was minimal. The highest BTEX concentration detected was sample B16A-4, which consisted of .240 mg/kg toluene, .310 mg/kg MP xylenes, and .220 O xylenes. PAH results supported the TPH data in identifying constituents associated with diesel and/or heavier fuels. TPH (8.1 mg/kg) was detected in the 16C ground-water sample.

The Phase I site characterization, conducted at Tanks 9 and 16 at the Red Hill Bulk Fuel Storage Facility, confirmed the presence of a petroleum mixture within the underlying bedrock of Tank 16. The laboratory evaluation of collected samples indicates that the petroleum is an unknown mixture of hydrocarbons eluting in the diesel and motor oil range.

Based on the results of this site characterization, FISC has authorized OEES to perform additional research of the fuel farm facility history, operations, surrounding geology and hydrogeology and to develop a comprehensive Work Plan for additional investigation.

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SECTION 1 INTRODUCTION

This document presents the findings of the initial Phase II site characterization performed at the Fleet Industrial Supply Center (FISC), Pearl Harbor bulk storage facility located at Red Hill, Oahu Hawaii. Ogden Environmental and Energy Services, Inc. (OEES) has prepared this report as authorized by the Pacific Division, Naval Facilities Engineering (PACNAVFACENGCOM) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N6742-90-D-0019, Contract Task Order (CTO), 0229. The engineering services were requested PACNAVFACENGCOM to identify potential fuel product releases suspected at the facility which was constructed in the early 1940's and consist of 20 buried steel vertical tanks with a capacity of approximately 12.5 million gallons each.

1.1 SITE BACKGROUND AND HISTORY

The FISC Pearl harbor bulk storage facility is located in Red Hill, Oahu, Hawaii. Constructed in the early 1940's, the fuel farm consists of 20 field constructed, steel, vertical underground storage tanks, with capacities between 285,000 barrels (BBL) and 300,000 BBL. Each tank is approximately 250'(h) by 100'(w), with the upper dome of the tanks approximately 100' to 175 feet below ground surface. The bulk tanks were constructed in a parallel series of two rows sloping south by southwest towards Pearl Harbor (Figure 1-1). The tanks are connected by main upper and lower subsurface service tunnels, which contain light rail systems, water and electrical utilities, and fuel pipelines. In the lower tunnel, each parallel tank is connected by a short access, which branches off the main service tunnel and terminates into a face-wall under each tank. Individual tank ancillary piping exits from each face-wall to connect to the fuel transmission lines. The fuel pipelines run approximately 2.5 miles from the bulk tanks to a Pearl Harbor pump station. It should be noted that down-gradient within the lower tunnel system, the Navy operates a Public Works Center water pumping station.

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Based on interviews and plan file drawings, construction of the bulk fuel farm began with the surface of Red Hill being removed to allow for vertical construction. Each tank pit was blasted from the basalt, utilizing a central vertical tunnel and radial blast tubes. Once the tank pits were opened, the steel tank segments were field constructed and placed into the pits in sections. The construction started with the lower dome being built in place. Once the lower dome was in place, the lowest portion was encased in a concrete bed. This method was generally followed for an entire tank as it progressed to the upper dome. Upon completion of the tank, small diameter holes were drilled in the sides of the tank and through the concrete bed. A 10 to 1 grout mixture was injected into the surrounding bedrock at approximately 300 pounds of pressure per square inch (psi). This method was utilized to close all possible seams and blasting fractures that may have been created during construction. (Please refer to Figure 1-2; Typical Red Hill Bulk Tank Section).

A leak monitoring system, referred to as 'tell-tale', was installed during tank construction. The tell-tale consists of a system of angle-iron ledges welded to the exterior diameter of each tank shell. The tank shell was generally constructed using 5' x 12' steel plates. The angle-iron was welded over the 12-foot horizontal joint between plates forming a continuous ledge along the tank diameter. A series of tell-tale ledges was constructed every five vertical feet corresponding with the plate dimension. Should product be lost through the steel plating, it would drain along a 'ledge' until intersecting a drain pipe. Each ledge drained into a series of small diameter pipes (11/4") which were vertically mounted within the interior of the tanks. Eleven vertical tell-tale pipes were spaced approximately every 28.5 feet extending to the tank bottom and connecting through 'jump pipes' to the exterior ledges at every five foot interval. A twelfth, circular, tell-tale pipe was constructed at the tank bottom. Each of the pipes exited the lower tank shell and the face-wall in the lower tunnel to be monitored and/or drained. Suspect leaks had been detected through the telltale system over the lifetime of the tanks. However the thick concrete barrier surrounding each tank was constructed to prevent migration. Due to the sensitive classification of the fuel farm as the primary storage facility for Pearl Harbor, public access was limited and independent investigations to confirm any suspect releases were not conducted. The Red Hill facility was declassified 1995.

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The tanks historically have contained Navy Special Fuel Oil (NSFO) Aviation Gasoline (AVGAS), Jet Propulsion Fuel (JP-5), and Diesel Fuel Marine (DFM). Based on interviews, FISC personnel stated that the storage of NSFO in the Red Hill facilities had been terminated during the mid-1980's. At present, the tanks contain JP-5 or Diesel Fuel Marine. Table 1-1 presents each tank's product service and dates of service for reference.

Table 1-1
Red Hill Bulk Fuel Farm Product Service Matrix

Tank ID	Contents	Date
1	Diesel Oil (DO)	10/26/42
	JP-5	2/4/70
2	DO	9/28/42
	JP-5	1962
3	Navy Special Fuel Oil (NSFO)	1/26/43
	Navy Distillate (ND)	8/27/70
	Diesel Fuel, Marine (DFM)	4/3/73
	JP-5	12/26/73
4	NSFO	11/15/42
	ND	2/17/71
	DFM	6/6/73
	JP-5	1/26/74 .
5	NSFO	12/19/42
	Empty	4/6/70
	ND	12/29/71
	JP-5	10/74
6	NSFO	12/30/42
	Empty	3/29/70
	ND	2/29/72
	JP-5	10/74
	DFM	1/15/82
	Empty	7/22/94
	JP-5	5/19/95
	Empty	4/15/98
7	NSFO	3/16/43
	ND	5/4/71
	DFM	9/11/73
	Empty	4/25/95
8	NSFO	3/2/43
	ND	5/21/71
	DFM	9/12/73
	Empty	4/13/95
9	NSFO	2/14/43
	ND	6/23/72
	DFM	9/13/73
	Empty	9/14/95

Table 1-1 Continued

Tank ID	Contents	Date
	JP-5	5/30/96
10	NSFO	1/26/43
	ND	6/29/72
	DFM	9/1/73
	Empty	10/3/95
11	NSFO	2/11/43
	ND	6/29/72
	DFM	10/73
12	NSFO	3/19/43
	Empty	4/28/70
	ND	5/26/72
	DFM	1/29/81
	Empty	8/24/94
	DFM	7/25/95
13	NSFO	3/23/43
	DFM	4/21/76
	Empty	12/1/94
	JP-5	10/4/95
14	· NSFO	3/21/43
	ND	3/13/73
	NSFO	10/25/73
	ND	8/26/75
	DFM	4/12/81
	Empty	1/19/95
	JP-5	4/29/96
15	NSFQ	4/29/43
	ND	10/27/72
-7-0000-00-00-00-00-00-00-00-00-00-00-00	DFM	9/14/73
	Empty	10/2/98
16	NSFO	5/8/43
	ND	11/10/71
	DFM	6/15/75
	Empty	5/25/94
	JP-5	10/1/98
	Empty	11/4/98
17	NSFO	5/23/43
	Empty	3/30/60
	AVGAS	12/11/64
	MOGAS	8/29/68
	JP-5	1/15/69
18	NSFO	6/13/42
 	Empty	3/30/60
 	JP-5 (for leak tests)	5/63
	AVGAS	8/18/64
	Empty	10/30/68
	JP-5	1/10/69
19	NSFO	6/13/43
	Empty	3/30/60

Table 1-1 Continued

Tank ID	Contents	Date
	JP-5	1/17/64
	Empty	10/85
20	NSFO	7/20/43
	Empty	3/30/60
	JP-5	6/14/64
	Empty	12/28/71
	JP-5	4/4/72
355	Slop Oil	1966

1.2 DEVELOPMENT OF OEES SCOPE

In April 1996, the Navy and FISC personnel initially discussed the proposed site characterization objectives with OEES. After a brief tour of the facility, a meeting was conducted to discuss potential approaches and difficulties to conducting an investigation within the lower tunnel area underlying the tanks. In March 1998, the Navy authorized OEES to proceed with engineering services to identify any product release from the Red Hill bulk fuel storage facility. The site characterization would be conducted in two phases: Phase I-Research Activities; Phase II-Investigation Activities. During April 1998, OEES personnel conducted Phase I site reconnaissance and data gathering activities. The Phase I requirements included "interviews and meetings with remedial-project-manager, facility and FISC representatives to determine the most cost effective method to accomplish the field work required to complete the site investigation." A significant amount of research was conducted within the lower tunnel and tank area to resolve unique technical requirements for subsurface tunnel drilling in an environmentally sensitive and potentially explosive location.

1.3 Initial Phase II Objectives

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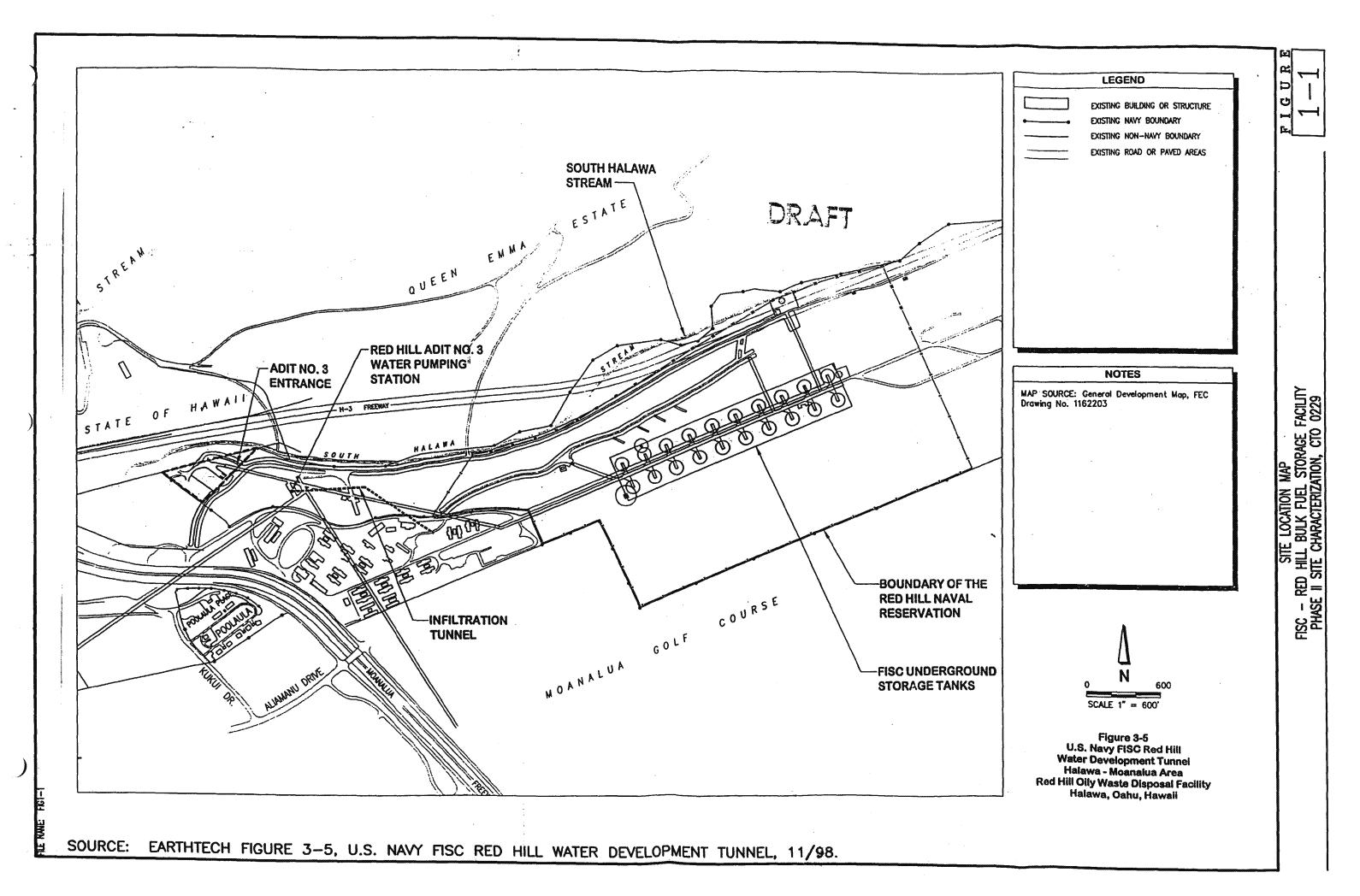
The objective of the Phase II investigation was to core bedrock immediately underlying the tanks in an attempt to intercept any petroleum release that may have occurred. Bedrock core and/or encountered soils, ground water, and petroleum product would be sampled and evaluated for petroleum constituents. The drilling would have to be accomplished through the lower tank face-wall or lower tunnel floor. The greatest

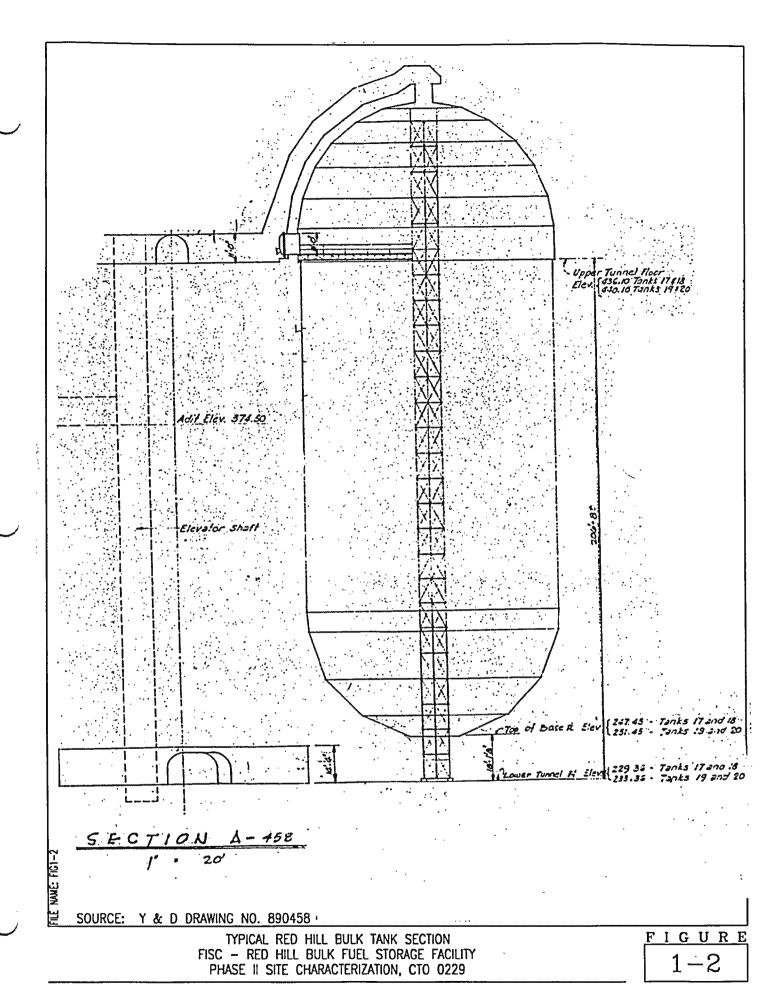
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limitation was identifying specific explosion proof, portable, drilling equipment that would accomplish horizontal/angular core drilling and meet the required weight and size restrictions to gain access, and operate throughout, the lower tunnel.

Once the drilling equipment was mobilized and set-up within the tunnel, OEES proposed to advance three borings under each tank. The three directed borings would allow for assessment of a greater horizontal area under each tank versus a single centerline boring. In addition, the borings could be directed at a zero degree deflection from vertical through the face-wall (straight line) or downward at a slight angle through the tunnel floor. After technical discussions with the Navy, a decision was made to implement this plan under Tank 16 which had been suspected of leaking. A second location would be determined after start-up. The primary focus of this drilling and sampling event would be to confirm the absence or presence of any petroleum product. In addition the Navy requested that OEES not penetrate the concrete and grout backfill surrounding the tank. Therefore the borings would be advanced through the tunnel floor at a slight downward angle directed under the tank.

The Navy authorized OEES to proceed with the above proposed limited Phase II site characterization in August 1998. The Phase II field activities, described by this document, were conducted during October-November 1998 by OEES and subcontract personnel.





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SECTION 2 ENVIRONMENTAL SETTING

2.1 Physical Features, Climate and Surface Water

The island of Oahu, part of the Hawaiian Island chain, lies at the northern margin of the tropics region. Oahu is one of the largest islands in the island chain and has extensive areas of mountainous land. The mountainous areas consist of two mountain ridges, one along the eastern side of the island, and one along the western side of the island, where elevation rises to about 4,000 feet above mean sea level (MSL). Most of the remainder of Oahu is less than 1,000 feet above MSL.

The prevailing northeast trade winds and the ocean currents cause the air and water of the region to be cooler than other areas of similar latitude. Ocean temperatures range from 75 to 85 degree (F) at Honolulu. Northeasterly winds persist most of the year and the northeastern, or windward, sides of the island are commonly the wettest. Southerly winds blow for only a few days at a time during the winter months. Most of the severe storms on the island come from the south, as southerly winds pick up moisture from the open ocean before they arrive at the islands. There are two seasons for precipitation on the island. October to April is the wet season, and May to September is the dry season. Precipitation is at a maximum between 2,000 feet and 4,000 feet above MSL on the island. Small areas of northeast Oahu have annual precipitation greater than 300 inches per year. Most of the island receives less than 75 inches, but greater than 20 inches of precipitation per year. Precipitation on the island is most commonly in the form of rain.

Surface water amounts for the island are directly related to precipitation and topography. Runoff for the island is approximately one third of the average annual precipitation, but will vary depending upon slope of the area and the soil matrix. Streams on the island are generally small with steep gradients. These streams usually flow only immediately after a heavy rainfall. Some streams with low gradients are hydraulically connected to the ground water aquifers and flow year round. Runoff for the island can range between less than 10 inches to greater than 160 inches annually.

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The project site is located on an elevated ridge (Red Hill) situated between the Halawa and Moanalua valleys. The site is located on the south of the North Halawa stream near Aiea, Oahu, Hawaii.

2.2 GEOLOGY AND HYDROGEOLOGY

The island of Oahu is 608 square miles in size and consists of two volcanic regions. The Waianae volcanics cover extensive areas in the west and the Ko'olau volcanics in the central and eastern parts of the island. The Ko'olau basalt overlaps the Waianae volcanics in the eastern central part of the island. The Red Hill area is located approximately three miles northeast of Pearl Harbor and is bordered on the south by the Salt Lake crater volcanic field. To the west is the Ewa Plain geomorphic province (Waianae volcanics) and to the north and east lies the Ko'olau Basalt flow. Red Hill is located on the southern edge of the Ko'olau basalt flow to the west of the Ko'olau fault zone and dike complex. The southern and western shorelines of Oahu are unconsolidated sediments and consolidated coralline limestone (Macdonald, 1983).

The aquifer bearing bedrock of the island of Oahu can be placed into two different general hydrogeologic categories. Volcanic rock aquifers are recognized as the most important, whereas consolidated deposit aquifers of limestone and sand are only locally important. On Oahu, volcanic rock aquifers are most extensive and consist of permeable theolotic basalt. On the southern coast of Oahu, the volcanic rock aquifers are overlain by caprock. Caprock is a confining unit consisting of consolidated and unconsolidated sediments and weathered volcanic rock. Inland ground water levels are at higher altitudes and the water lens is significantly thicker in areas covered by caprock. Caprock consolidated deposit aquifers are present in the southern, eastern and western coasts of Oahu. These limestone deposits are hydraulically connected to the Pacific Ocean and produce brackish water or saltwater.

The two main aquifers on Oahu are the Ko'olau Basalt aquifer and the Waianae Volcanics aquifer. The Ko'olau aquifer consists of basaltic lava flows and is unconfined. The Ko'olau aquifer has moderate to high permeability and is the principal source for

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domestic water and irrigation supply. The Waianae aquifer consists of the Kamailuelei and Lualuelei Members. Both members consist of basaltic lava flows with some breccia, and are partly confined. The Waianae aquifer has low to moderate permeability.

2.3 GROUND WATER AND WATER USE

Oahu is underlain by a large basal water body with brackish and saltwater zones in the near shore areas. Dike impounded water zones are located near the eastern and western sides of the island, underlying the central volcanic regions. There are areas of perched water in southern Oahu, but the perched water is not a significant source of supply.

Water levels in the southern Oahu region range from 14 feet above MSL, near shore to 30 feet above MSL at the southern Oahu and Schofield water region boundary. Nearshore the water is under artesian pressure because it is confined by caprock. The hydraulic head in the nearshore area remains high unless lowered by pumping or climatic conditions. In the Pearl Harbor area, including Red Hill, most of the ground water moves toward the harbor (USGS, 1997).

Water on Oahu is generally fresh, and chemically suitable for most uses. Dissolved solids concentrations on Oahu range from 80 to 3,700 milligrams per liter (mg/l). Water contained in the limestone aquifers on the southern coast is mostly brackish or saltwater. These limestone deposits are considered to be minor and used for cooling and industrial purposes only. Fresh ground water use on Oahu is primarily taken from the Ko'olau aquifer and totals approximately 334 million gallons per day. Public water demand accounts for 160 million gallons of that total. The totals for non-public use are 120 million gallons for agriculture, 37 million gallons for domestic and commercial, and 17 million gallons for industrial, mining and thermoelectric power (USGS, 1997).

2.4 LAND USE AND SURROUNDING POPULATION

The Red Hill site is located in the Halawa district of Honolulu, west of Halawa Heights. The FISC bulk fuel farm property is generally bordered by the Halawa Correctional

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Facilities to the west, the Security Department firing range to the north, the United States coast Guard Kai Kai Hale housing district to the east, and the State of Hawaii Animal Quarantine Yard to the south. There are no public facilities or buildings on the FISC property, and no public access points. Access of all personnel onto the facility is monitored by FISC.

Populated areas closest to the Red Hill facilities are Pearl City and Aiea, to the west, and Honolulu to the south and east. The population for Pearl City is 30,993 (1990), and for Aiea 8,906 (1990). The population of Honolulu is 365,272 (1990). Pearl Harbor lies to the southwest of the Red Hill facility, with the population of the military base unlisted.

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SECTION 3 PHASE II SITE CHARACTERIZATION PROGRAM

3.1 MOBILIZATION

The OEES project team mobilized to the FISC Red Hill bulk fuel farm on October 19, 1998 to implement the Phase II site characterization activities. The project team consisted of an OEES Drill Manager and OEES Geologist/Onsite Health and Safety Coordinator (OHSC). The subcontractor selected to perform the unique drilling and sampling was Salisbury and Associates, Incorporated (SAI) of Spokane, Washington. Salisbury personnel consisted of a Senior Driller and Drill Helper. All equipment, including the specialized drill rig, was shipped to Oahu from the mainland and ready for set-up by October 19, 1998.

The initial Phase II site characterization was performed during the period of October 19, 1998 through November 1, 1998. After meetings with PACNAVFACENGCOM and FISC personnel, the Drilling Manager secured the gate keys to the project area and proceeded to the site. Based on the Phase I planning, it was determined that the OEES team would enter through the upper tunnel entrance, Adit 5. Equipment was off loaded onto light rail cars and transported into the tunnel entrance to the facility elevator. An inventory of the equipment was performed before being moved into the tunnel. Equipment, including the drill rig components, was transported to the lower level via the elevator in several lifts. The elevator was utilized for movement to the lower tunnel, and was not altered or reconfigured, in accordance with the agreement between OEES and FISC. Equipment was again loaded onto lower level rail cars and hand pushed to the Tank 16 set-up area.

3.2 BORING EQUIPMENT

The drilling equipment utilized for this project consisted of a SAITECH EH5 portable hydraulic diamond tip core drill, a remote hydraulic pump system, an electrical converter, and a remote water supply assembly. The core drill was a conventional mobile system,

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utilizing a recovery tube capable of retrieving 1¼" diameter size rock core. This drill method was chosen based upon the shallow coring depths, and restricted tunnel height. The configuration of this rig allowed for the capacity to drill to a depth of 400 feet if needed.

The core drill was powered by a hydraulic motor, which fed a two-speed transmission and the drill head spindle. The drill rig motor is powered by the remote hydraulic system and the hydraulic system is powered by a twenty-horsepower electric motor. The hydraulics for this unit consisted of an eighteen gallons-per-minute (gpm), 3,000 pounds-per-square-inch (psi) load sensing hydraulic pump with a five gallon reservoir, that was cooled with a heat exchanger. The electrical converter powered the electric motor, for the hydraulic system. The electrical converter received all of the electric flow from the 440-volt outlet located in the lower tunnel.

Temporary placement and stabilization of the core rig was performed utilizing bolts and expanding bolt anchors inserted in the floor of the Red Hill facility. The core rig was adjusted to enter the tunnel floor at an agreed upon 11 degree angle, directed towards the face-wall of the tank. The casing was advanced into the tunnel flooring to an approximate depth of six feet. A stabilization plate was attached to the casing to prevent the casing from spinning during the drilling operations. The core recovery tube and drill rod were advanced down casing, and recovery activities were begun.

The drill rod was advanced utilizing a manual feed wheel. This allowed the driller to gauge resistance of the rock, and adjust techniques utilized, to maximize the performance of the drilling equipment on site. All drill rod was removed from the down hole location each time a core recovery sequence was completed. Manual removal was necessary based upon the angle that the drill rod was advanced.

3.3 Boring Locations and Methodology

As discussed in Section 2.0, OEES advanced three borings at two different tank locations. FISC representatives requested that OEES proceed with the drilling while observing the following:

- OEES drill set-up would minimize impact to FISC equipment and not impede tunnel entry or exit and posse no threat to evacuation routes.
- Borings would be located no closer than 5 feet from the face-wall underlying each tank and angled downward to avoid penetrating the concrete backfill surrounding the tank shell. OEES selected 11 degrees as the downward deflection angle.
- The center boring (A) would be placed slightly off center to avoid contact with the interior tank elevator shaft which proceeded into underlying bedrock. The 11 degree angle would also assure missing the shaft.
- Borings B and C would be placed at the toe of the tank tunnel side-wall and located no closer than 5 feet from the face-wall.
- The borings should be of adequate depth to reach the corresponding outer diameter tank shell distance based on the angle of each boring.

The work area at each tank location is approximately 15 feet in width, 9 feet in height, and 30 feet in length. Electricity and water was available at each tank location. A tunnel drainage system is covered with metal grating and extends the length of the tank side tunnels and main lower service tunnel. Using these, and the above listed restrictions as a guide, OEES initiated drilling at Tank 16. The SAITECH EH5 rig was anchored five feet from the face wall, offset from center and readied for coring. At this position, the drill rig could advance all three planned borings (A,B,C) at the 11 degree down angle by shifting the horizontal angle to the right 22 degrees or to the left 35 degrees. This same set-up protocol was utilized for the second location, Tank 9. This location was determined only after the borings at Tank 16 had been completed.

The borings were designated as B16-A,B,C and B09-A,B,C. Samples collected had these designations as well as a numerical attachment beginning with 1 and corresponding with

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the consecutive order of sample collection. The corresponding depth of each sample was recorded in the field notebook. (Appendix 3)

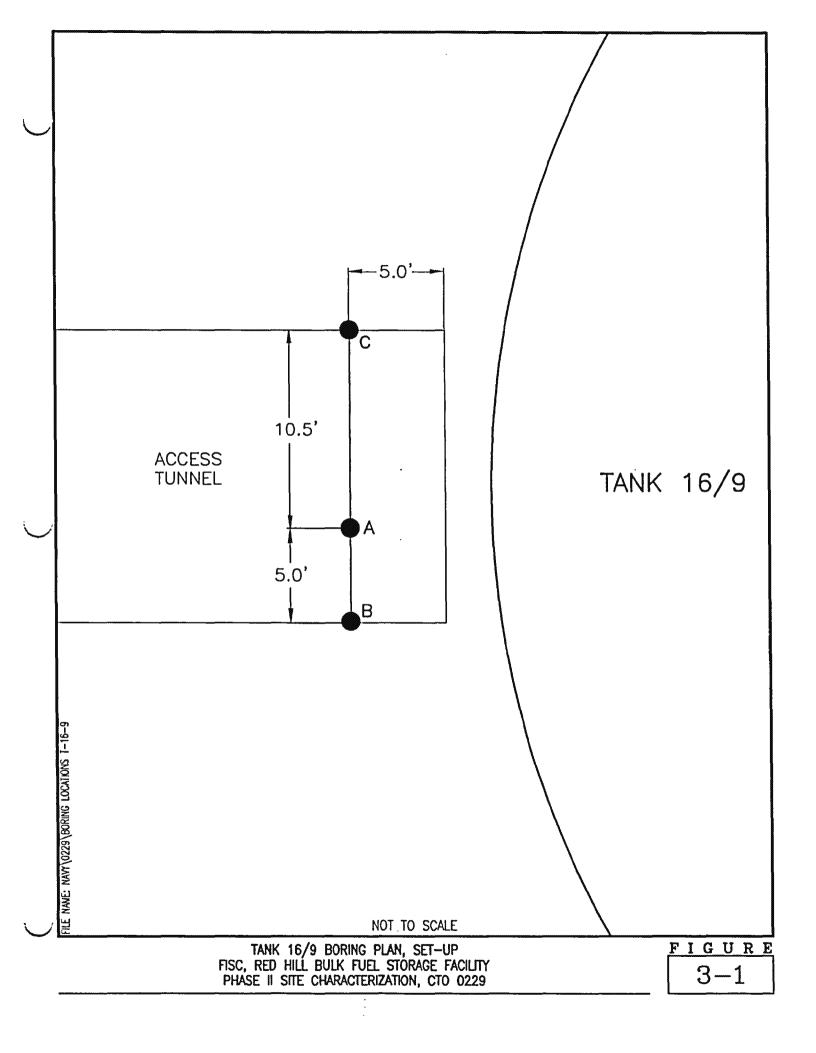
Please refer to Figure 3-1 for the Tank 16 and Tank 9 common set-up plan and Figures 3-2 (Tank 16) and 3-3 (Tank 9) for completed boring section views, completion depths, and angles.

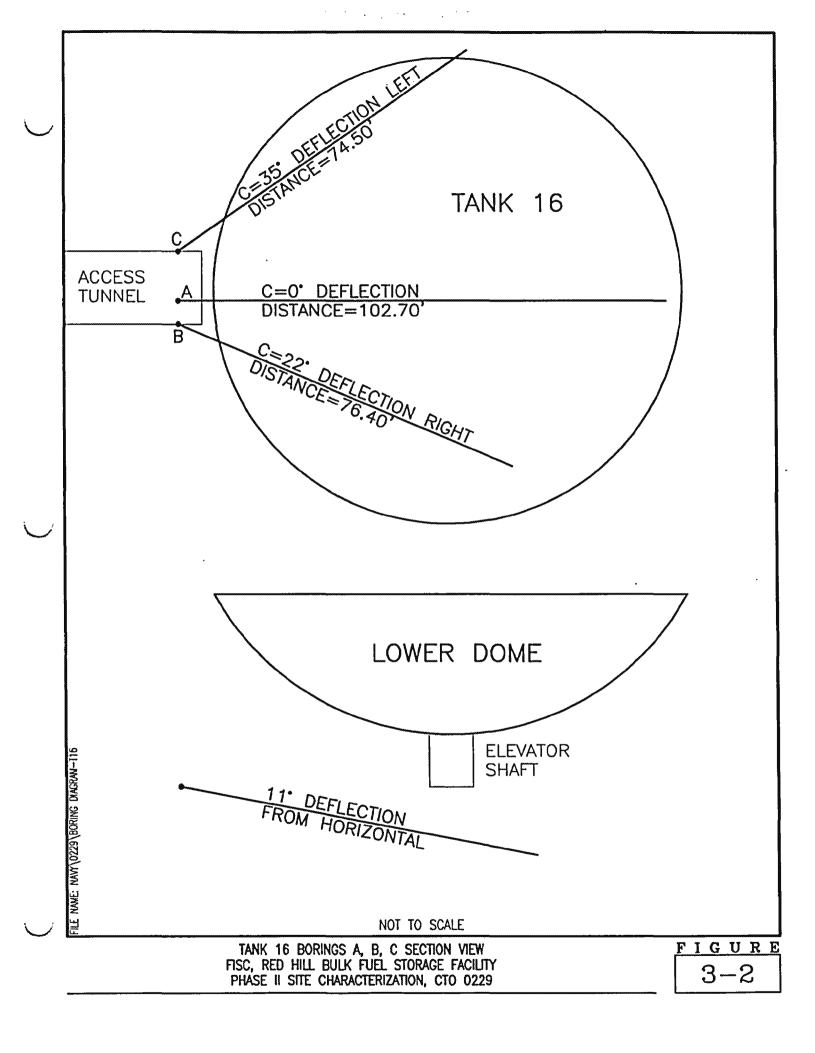
3.4 UTILITIES

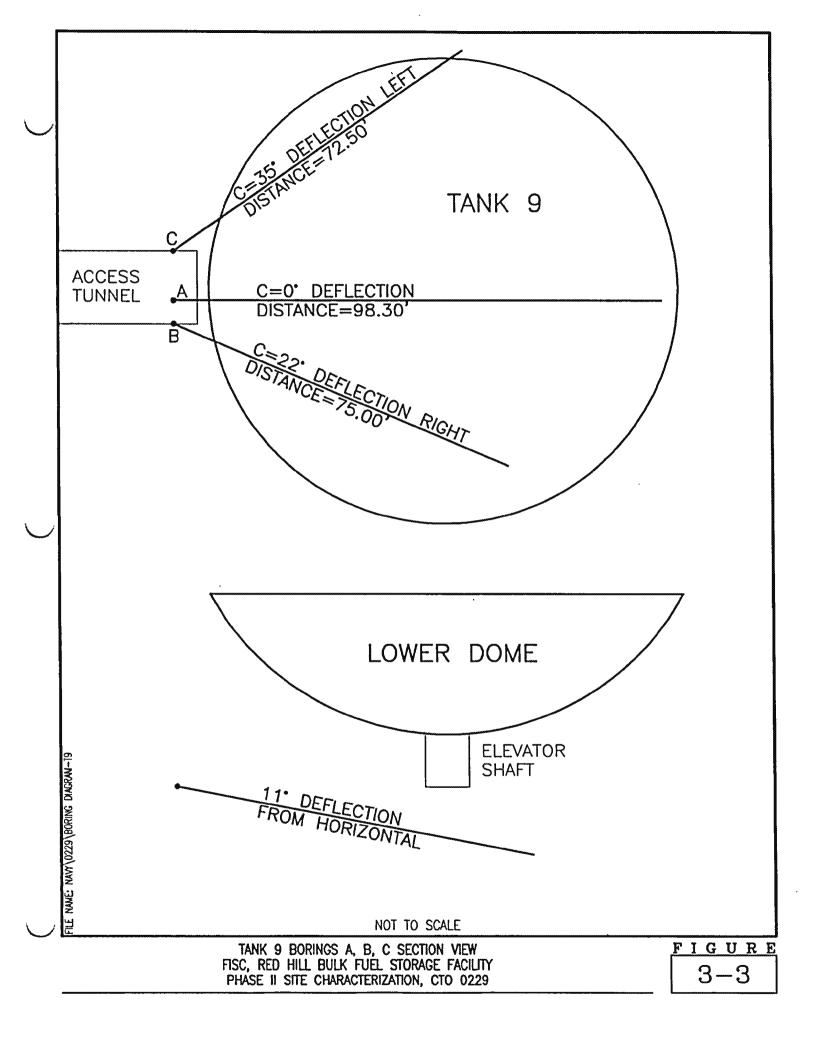
A geophysical survey of the Red Hill facility was not performed prior to drilling. All utilities throughout the fuel farm complex are contained in metal encased overhead harnesses. Verification of utilities was performed during the Phase I site research. Interviews provided information that no underground cables, pipes, or electrical and water supply lines existed below ground in the Red Hill facility.

3.5 Borehole Logging

Logging of all core removed was performed by OEES personnel. Initial logs were completed at the Red Hill facility as core was removed from the boring. Original logs contained recovery, descriptions of observed staining or saturation, and general description of rock type. The final core logs were recorded by OEES personnel in greater detail after shipment to the OEES Huntsville, Alabama office. Final logs included rock color, based on the Munsell rock color chart, hardness, physical description, and verification of sample points. (Please refer to the boring logs contained in Appendix 1)







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SECTION 4 DRILLING AND SAMPLING

4.1 SOIL/CORE MATRIX SAMPLING PROCEDURES AND OBSERVATIONS

The procedure for sample collection assumed that rock cores would be the primary solid matrix, but allowed for encountering soil-filled areas throughout the bedrock column. However, there was no soil encountered during the drilling operations underlying the fuel farm tanks. Therefore, the sampling program focused on the collection of core segments in key bedrock areas. Core samples were collected at varied depths, based upon any physical characteristics that may be attributed to petroleum contamination. These characteristics included discoloration, odor, evident staining, physical change, and seam/void filled zones. (Please refer to Figures 4-1 through 4-5, located at the end of this section for drilling photos.)

As previously stated, a bedrock core section was removed approximately every ten feet. Rock core was placed into a logging tray for field observation by the Site Geologist. Upon visual inspection and field logging, the core segment was placed into a core box for later, more detailed, study. As each ten-foot core segment was examined, core samples that met the criteria for collection were removed from the core length, measured for record keeping, and placed into a sterile ziplock bag. A total of 21 cores were initially selected (five from each of the Tank 16 boreholes and two from each of the Tank 9 boreholes). After approximately 30 minutes, each bag was punctured using the sampling probe/tube of the photoionization detector (PID). Ogden personnel collected a representative vapor sample from the collected rock core. Cores indicating a vapor reading above 100 parts per million (ppm), or the two highest readings from each boring, were noted and the data added to the selection criteria. Using this protocol, a total of 12 core samples was selected for laboratory evaluation. Table 4-1 presents the selected core characteristics. In addition, one core sample was selected for duplicate sampling. The core segment from boring B16A-4 was split as practically as possible to form the duplicate as well as a split sample turned over to representatives of FISC.

Table 4-1

I.D. Number and Rock Core Sample Depths

BORING	SAMPLE I.D.	SAMPLE
NO.	NO.	DEPTH
16A	B16A-4 †	83.75' – 85.75'
16A	B16A-5	101.83'
16B	B16B-4	66.15'
16B	B16B-5	75.58'
16C	B16C-4	60.00'
16C	B16C-5	67.00'
09A	B09A-1	3.20'
09A	B09A-2	97.10'
09B	B09B-1	55.00'
09B	B09B-2	74.6'
09C	B09C-1	50.00'
09C	B09C-2	66.00'

^{† -} Duplicate

A minimum of 40 grams of material was collected for each planned laboratory test and placed into a 16 ounce (oz.) glass jar and sealed with a teflon cap.

Geologic conditions were consistent with the United States Geologic Survey (USGS) report for Oahu and the Ko'olau Basalt flow. The basalt encountered during drilling activities varied from light medium gray to dark gray, hard to very hard, and had a varied range of vesicles sizes in the bedrock. Bedding, or alternate basalt flows, were not evident in the core recovered from the borings. Weathering (or decomposition of the bedrock) was evident along fractures and grout filled seams. Core recovery verified existence of two lava tubes, one which was grout filled, one which had grout inclusion. It should be noted that the observed grout is associated with injection grouting performed during construction.

Fractures in bedrock were classified as natural or man made (created by explosives) based upon the physical features viewed during core logging procedure. Woody debris was contained at sporadic locations within the bedrock, and classified as inclusive material, and not as deposition materials (Please refer to Figures 4-11 and 4-12 in Appendix 1 for detailed boring logs.)

Petroleum staining/saturation was observed on core segments collected from borings 16A and 16C. The petroleum substance appeared to be a mixture of a thick, heavy oil with an odor similar to diesel. Specifically, the stained segments were encountered in boring 16A at two locations (approximately 83' to 86' and 101' to 104') and in boring 16C between 60' and 69'. Core samples from these segments were retained for analytical evaluation. (Please refer to Figures 4-1 through 4-10, located at the end of this section for core sample photos.)

4.2 AQUEOUS MATRIX SAMPLING PROCEDURES AND OBSERVATIONS

Ogden assumed that the borings would generally maintain enough integrity to obtain a grab sample of any ground water or petroleum product leachate. Options ranged from the establishment of piezometers to open boring sampling. The primary objective for any leachate sampling was to confirm/verify the absence or presence of petroleum contamination not observed during the coring process.

Caving was not experienced during the coring activities, and soft soils were not encountered. Therefore, based upon field observations and integrity of the borehole and surrounding bedrock, Ogden personnel elected to perform open borehole sampling for leachate.

Upon completion of the drilling activities, forced air was directed into the borings to assist in the removal of any remaining drilling fluid. A 3-foot length of polyvinyl chloride (PVC) pipe was inserted into the borings and sealed in place with a thick grout mixture. A well cap was placed into the PVC once the grout mixture was dry, to keep foreign objects from entering the boring before leachate sampling activities could take place. The PVC stickup, from ground (floor) level, was approximately four inches.

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Ogden utilized an oil/water interface probe to measure any product or water present in the borings. Only boring B16C registered any type of liquid. A separated phase of petroleum product was encountered in Boring B16C with an approximate thickness of 1.2 feet. Calculation for this depth was performed utilizing the actual registered distance and the angle of the bore. Ogden was successful in collecting a product sample from B16C. The aqueous samples were placed into two 1 liter brown amber bottles (with no preservatives) and two 40-milliliter vials (with hydrochloric acid (HC1) preservative) and sealed with teflon lined caps. As with the core samples from 16A, this aqueous/product sample was split with FISC to be evaluated by a local testing laboratory. It should be noted that FISC was not able to evaluate the heavy product but did confirm the presence of fluoride within the water sample subnate. This tends to confirm that water observed in the sample matrix and confirmed by the interface probe was drill water residue and not an encountered ground water lens.

On December 17, 1998, local OEES personnel returned to the project site to record additional observations from the borings at Tanks 9 and 16. Following the same protocol as above, each boring was monitored for the presence of groundwater and product leachate. Only boring 16C yielded positive results. The heavy product was again encountered in 16C at 66.29' with water indicated at 66.54. It should be noted that the termination depth of boring 16C is 67'. Not enough aqueous matrix was present to sample. Therefore, no samples were collected or submitted for evaluation. The observations recorded during the second sampling event tend to indicate that no active ground-water seepage has occurred within the borings.

4.3 FIELD SCREENING

Samples were screened according to Ogden CLEAN Program Procedures. As stated above in Section 4.1, field screening was used as an aid to determine which soil samples to submit for laboratory analysis. Screening included visual observations, notation of odor, and headspace analysis. The initial 21 core samples from the Tank 16 and Tank 9 borings were placed in a ziplock bag, maintaining a small headspace and allowed to equilibrate for approximately 30 minutes. A Photovac 2020IS photoionization detector (PID) was used to obtain readings. The PID was calibrated daily with 100 ppm

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isobutylene. The PID tip was placed into the bag, maintaining as good a seal around the probe as possible. The maximum reading was recorded.

In addition to the headspace testing, the Onsite Health and Safety Coordinator (Site Geologist) monitored the boreholes with a variety of instruments. The site environment was monitored utilizing the PID and Oxygen (O2)/Lower Explosive Level (LEL) Meter. Drager (Hydrocarbon II) tubes were used to monitor for hydrocarbon vapors down-hole as each core barrel section was removed. In addition each core segment was monitored with the PID as it was logged and placed into the core boxes.

4.4 SAMPLE HANDLING AND PREPARATION

The field logbook is the primary record of field activities. A bound field logbook with consecutively numbered pages was used for this purpose and maintained according to Ogden CLEAN Program Procedures. The logbook was identified with the name of the project, the CTO Field Manager responsible for maintenance of the logbook, and the beginning and ending dates of the entries. Entries were chronological and in sufficient detail to allow reconstruction of each day's events. Each entry or group of entries was signed and dated by the person making the entry. In addition to the field logbook, field log sheets were used to record boring data.

Immediately following collection, a laboratory-supplied label was filled out in the field and placed on the sample container. The following information was on each label: project name and number, Sample ID number, date of collection, sampler's initials, analyses to be performed on that sample, and sample preservatives added.

Ogden personnel maintained sample custody through collection and transfer to the shipping company. After sample collection, each sample was placed in a cooler. From this point until the cooler was transferred to shipping personnel, the samples were always in a location visible to Ogden personnel, or were in a locked room or vehicle. Each sample was logged on the chain of custody (COC) form. The laboratory assumed custody responsibility upon receipt from the shipping company.

After sample collection, the samples were placed in an insulated cooler with "blue ice" or ice in double zip-lock bags. Sample containers were kept on the bottom and ice placed

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on top of the samples to keep them close to 4 degrees C. Glass containers were wrapped with padding to prevent breakage during shipment.

Before shipment, two copies of the COC were placed in a zip-lock bag and taped to the inside lid of the cooler. Four COC seals were placed on a cooler and covered with clear tape. The covers of coolers were secured with strapping tape. Samples were shipped to Quanterra Incorporated in Sacramento, California for analysis.

4.5 DECONTAMINATION

New core collection tubes were utilized during the advance of each of the three original Tank 16 bores. Upon completion of drilling activities, all tubes and drill rod were removed from the lower tunnel and taken to a pre-constructed decontamination pad, below the Adit 3 entrance. The drilling equipment was decontaminated for use in the Tank 9 borings. All materials were pressure steamed with water gained from the Red Hill water supply lines and washed with isopropyl alcohol. Alconox and detergents were not used to decon equipment, based upon requests by FISC personnel that detergents not be introduced into the runoff collection system utilized by the Red Hill facility. Decontamination activities were performed on drill rod and drilling system prior to the equipment being removed from the Red Hill site.

4.6 INVESTIGATIVE DERIVED WASTE

The drilling fluid utilized during the drilling operation was tap water, gained from the spigot in the lower tunnel. The drilling fluid was directed down the core barrel length through the casing. The drilling fluids that returned from the bottom of the casing were directed into a collection system constructed by Ogden and SAI personnel on site. The collection system allowed the fluids to settle in an undisturbed environment. Clean fluids were allowed to run into the floor drains for disposal through the Red Hill Facility treatment basin. Any residual by-products (mud, fragments, etc...) were collected at the termination of each boring. Due to the hard rock conditions at Red Hill, minimum soil and IDW was encountered. Approximately 4 gallons of spoil material was collected within a sealed 5-gallon bucket, labeled and stored onsite, pending verification of laboratory analysis, for future disposition.

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4.7 ANALYSES

A total of 14 samples were submitted for offsite laboratory chemical analyses (12 core samples, 1 duplicate core sample, and 1 aqueous sample). All samples were analyzed for TPH Method-D-Triregional, Method 8260-Volatile Organics (BTEX) and Method 8270-Polynuclear Aromatic Hydrocarbons, GC, MS. This battery of test was selected to aid in identifying the unknown petroleum contamination throughout the TPH range as well as to focus on diesel constituents.

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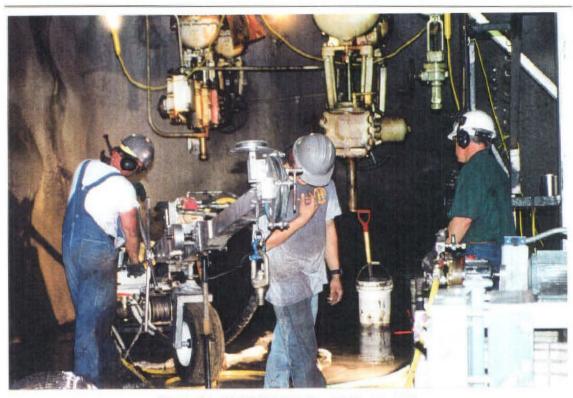


Figure 4-1 SAITECH EH5 Core Drill - Tank 16

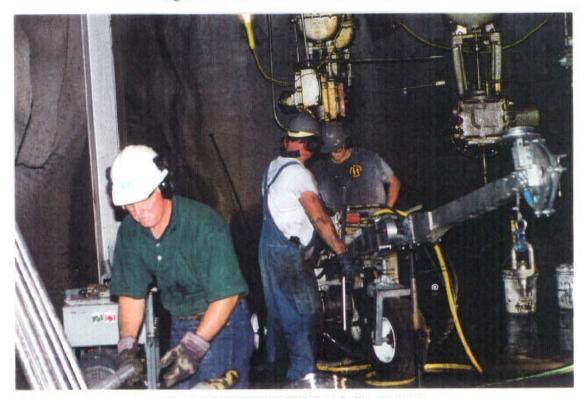


Figure 4-2 SAITECH EH5 Core Drill - Tank 16

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Figure 4-3 Advancing Boring B09A - Tank 9 Tunnel Floor

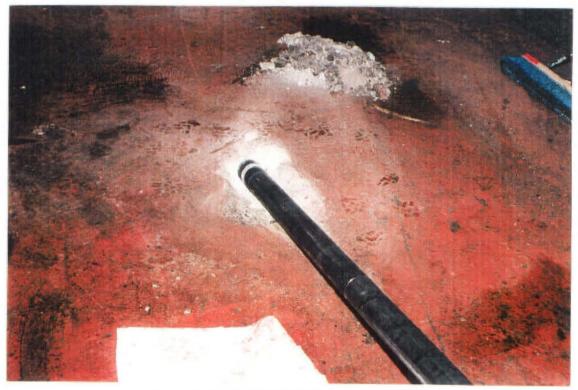


Figure 4-4 Advancing Boring B09A - Tank 9 Tunnel Floor

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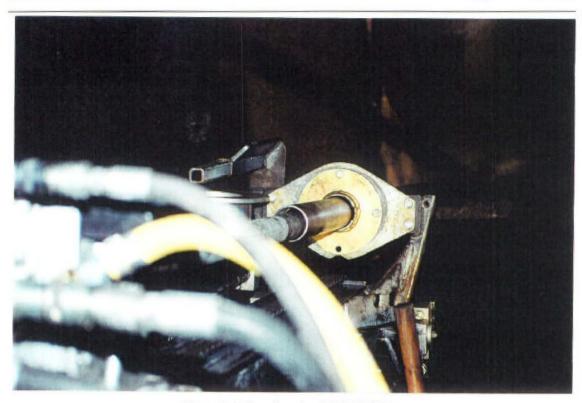


Figure 4-5 Core Barrel - SAITECH EH5



Figure 4-6 Typical Completed Boring with PVC CAP 4-10

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Figure 4-7 Petroleum Stained Core - B16C, 49' to 60'



Figure 4-8 Petroleum Stained Core - B16C, 60° to 69°



Figure 4-9 Petroleum Stained Core - B16A, 81' to 91'



Figure 4-10 Petroleum Stained Core - B16A, 100' to 104'

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SECTION 5 FINDINGS		***************************************

5.1 ANALYTICAL RESULTS

Analytical data was received from Quanterra Incorporated in three packages corresponding to the three general methods (TPH, BTEX, and PAH). The following tables (Tables 5-1, 5-2, and 5-3) present the laboratory evaluation findings.

Table 5-1
Rock Core Analytical Results (TPH)

Tank No.	Sample I.D. No.	Lab I.D. No.		TPH (mg/	kg)
			Diesel Fuel	Motor Oil	Unknown Hydrocarbon Mixture
Tank 16	B16A-4	302418-0012	ND	ND	11000
	DUPLICATE	302418-0007	ND	ND	6600
	B16A-5	302418-0013	ND	ND	2800
	B16B-4	302418-0008	ND	ND	6.4
	B16B-5	302418-0009	ND	ND	29
	B16C-4	302418-0010	ND	ND	9400
	B16C-5	302418-0011	ND	ND	4500
Tank 9	B09A-2	302418-0006	ND	ND	3.5
	B09A-1	302418-0005	ND	ND	600
	B09B-1	302418-0002	ND	ND	48
	B09B-2	302418-0001	ND	ND	2.3
	B09C-1	302418-0004	ND	ND	6.9
	B09C-2	302418-0003	ND	ND	3.1

ND - Non-Detect

Unknown Hydrocarbon Mixture – represents an unknown mixture of hydrocarbons eluting in the C9 to C36 hydrocarbon range.

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Table 5-2
Rock Core Analytical Results (BTEX)

Tank	Sample I.D.	Lab I.D. No.		вте	X (mg/kg)	
No.	No.		Benzene	Toluene	Ethyl benzene	Total Xylenes M&P/O
Tank 16	B16A-4	302418-0012	ND	.240	ND	.310/.220
	DUPLICATE	302418-0007	ND	ND	ND	.085/.071
	B16A-5	302418-0013	ND	ND	ND	ND
	B16B-4	302418-0008	ND	ND	ND	ND
	B16B-5	302418-0009	ND	ND	ND	ND
	B16C-4	302418-0010	ND	160	ND	.059/.082
	B16C-5	302418-0011	ND	.054	.048	.190/.130
Tank 9	B09A-2	302418-0006	ND	ND	ND	ND
	B09A-1	302418-0005	ND	ND	ND	ND
	B09B-1	302418-0002	ND	ND	NĎ	ND
	B09B-2	302418-0001	ND	ND	· ND	ND
	B09C-1	302418-0004	ND	ND	ND	ND
	B09C-2	302418-0003	ND	ND	ND	ND

ND - Non-Detect

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Table 5-3
Rock Core Analytical Results (PAH)

Tank No.		<u>alamananananana, d</u>	Glovenous von	000000000000000000000000000000000000000	00000000000000000000000000000000000000	000000 <u>000</u> 00000000000)	PAH (n	ng/kg)	ood Tobascoccocco	490000000000000000000000000000000000000	7860ccccccccccqqg5	hosaccasacaca _n ghade	000000000000000000000000000000000000000	00000000000000000000000000000000000000	
	Napthalene	Acenaphthylene	Acenaphthene	Flourene	Phenanthrene	Anthracene	Flouranthene	Pyrene	Benzo (a) anthracene	Chrysene	Benzo (b) flourenthane	Benzo (k) flourenthane	Benzo (a) pyrene	Ideno (1,2,3-cd) pyrene	Dibenz (a,h) anthracene	Benzo (g,h,l) perylene
Tank 16	43	ND	ND	10	23	ND	ND	22	ND	ND	ND	ND	ND	ND	ND	ND
	14	ND	ND	6.4	14	ND	ND	13	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	4.7	4.4	ND	ND	20	ND	ND	ND	ND	ND	ND	ND	ND
<u> </u>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	47	ND	ND	12	26	ND	ND	11	ND	6.3	ND	ND	ND	ND	ND	ND
	8.2	ND	ND	ND	6.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tank 9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
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	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND - Non-Detect

Laboratory evaluation of the core samples confirmed what was noted during the drilling activities. Contamination of the subsurface beneath Tank 16 was verified. Specifically, borings 16A and 16C yielded results consistent with a mixture of diesel and a heavier oil. Concentrations in these borings ranged from 2,800 mg/kg to 11,000 mg/kg. Contamination of samples with BTEX compounds was minimal. The highest BTEX concentration detected was in 16A-4, which consisted of .240 mg/kg toluene, .310 mg/kg

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MP xylenes and .220 O xylenes. PAH results supported the TPH data in identifying constituents associated with diesel and/or heavier fuels.

Although TPH was confirmed, it has been identified as an unknown mixture of hydrocarbons eluting in the diesel and motor oil ranges. Preliminary notes indicate the pattern present in the samples represent an unknown mixture of hydrocarbons eluting in the C09 to C036 (diesel to motor oil) hydrocarbon range. All unknown peaks between this range were summed and quantitated based on a diesel fuel reference between C10 and C24.

Initial evaluation and comparison to the DOH Tier I Risk-Based Corrective Action levels for soil (Rainfall \leq 200 cm/year, drinking water threatened) yielded the following above the required levels. Please refer to Appendix 2 for original laboratory data sheets.

Table 5-4
Laboratory Results Exceeding RBCA Tier I

Contaminant	Action Level (mg/kg)	Sample No.	Result (mg/kg)
TPH – unknown mix	5,000	16A-4	11,000
TPH – unknown mix	5,000	Duplicate	6,600
TPH – unknown mix	5,000	16C-4	9,400
Napthalene	41	16C-4	47
Napthalene	41	16A-4	43

5.2 ANALYTICAL RESULTS – AQUEOUS MATRIX

TPH (8.1 mg/lg) was detected in the 16C water sample. All other constituents were not detected or below the Tier I RBCA Action levels. Please refer to Appendix 2 for original laboratory sheets.

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5.3 CHROMATOGRAM EVALUATION

The FISC Fuels Laboratory at Pearl Harbor was contacted to obtain information on fuels historically stored in the fuel tanks on site. The Fuels Laboratory indicated that four fuels JP-5 Reference, F-76 Reference, Gas Oil SD-016, and NSFO were potentially stored in the tanks. Chromatograms of the four reference fuels and Fuel Oil Reclaimed Reference (mixture of JP-5, F76, Lube Oil and NSFO) that were processed by a simulated distillation analysis were compared to the chromatograms from the site investigation that were analyzed by Quanterra, Inc. The site samples compared were identified as B16A-4 at 11000 mg/kg analyzed at a 100X dilution, and B16C at 8100 mg/kg analyzed at a 20X dilution. The laboratory also provided examples of a standard diesel fuel and motor oil.

Sample No. B16A-4 was characterized by the laboratory as an unknown hydrocarbon in the n-C8 to n-C40 n-alkane range. It contained significant levels of hydrocarbons eluting at the beginning of a diesel fuel range with a second maxima past the range of a motor oil. This sample showed what appeared to be a distinct n-alkane pattern riding on top of the unresolvable, chromatographical mass, (UCM.) The second sample, B16C, started into the diesel range, tapering off through a motor oil range. This second sample appeared to have a less distinct n-alkane pattern and more mass in the UCM. It did not contain a second maxima. B16C appeared to be a more weathered hydrocarbon product.

Future analysis and comparisons will be performed and included in a subsequent study. This effort may include analysis by the American Petroleum Institute (API) laboratory in Norman, Oklahoma.

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SECTION 6 CONCLUSIONS AND RECOMMENDATIONS

The Phase II site characterization, conducted at Tanks 9 and 16 at the Red Hill Bulk Fuel Storage Facility, confirmed the presence of a petroleum mixture within the underlying bedrock of Tank 16. The laboratory evaluation of collected samples indicates that the petroleum hydrocarbons is an unknown mixture eluting in the diesel and motor oil ranges.

Based on the results of this limited characterization, PACNAVFACENGCOM, FISC, and OEES have developed a scope of work to be completed by the spring of 1999. The Navy has requested that OEES expand the Phase II research program to include the entire Red Hill facility, surrounding geology, hydrogeology, construction data, and provide overall engineering services as needed to develop a Work Plan for future investigations and remedial actions. The new scope will consist of the following research engineering services:

- Identify data requirements to determine the extent, migration potential, and potential receptors of the contamination; and to support a recommendation for either no further action, corrective action, risk assessment, or exposure prevention management;
- Compile and evaluate existing geological, hydrogeological, geochemical, and water quality data for the Red Hill, Halawa, and Moanalua area;
- Consult with recognized experts on local geology and hydrogeology;
- Research UST construction methods which could affect the migration of contaminants;
- Define protocols to fingerprint contaminant relative to all previous products stored in tanks;
- Identify potential receptors of contamination;

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- Determine requirements for drilling and well installation with particular attention to the need to prevent cross contamination of multiple aquifers; and
- Prepare a Work Plan to conduct field investigations at the facility. The WP shall summarize the data gathered to date and provide a basis for the prescribed method of the proposed field investigation.

Upon approval of the proposed Work Plan, additional investigative activities will be implemented.

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SECTION 7 REFERENCES

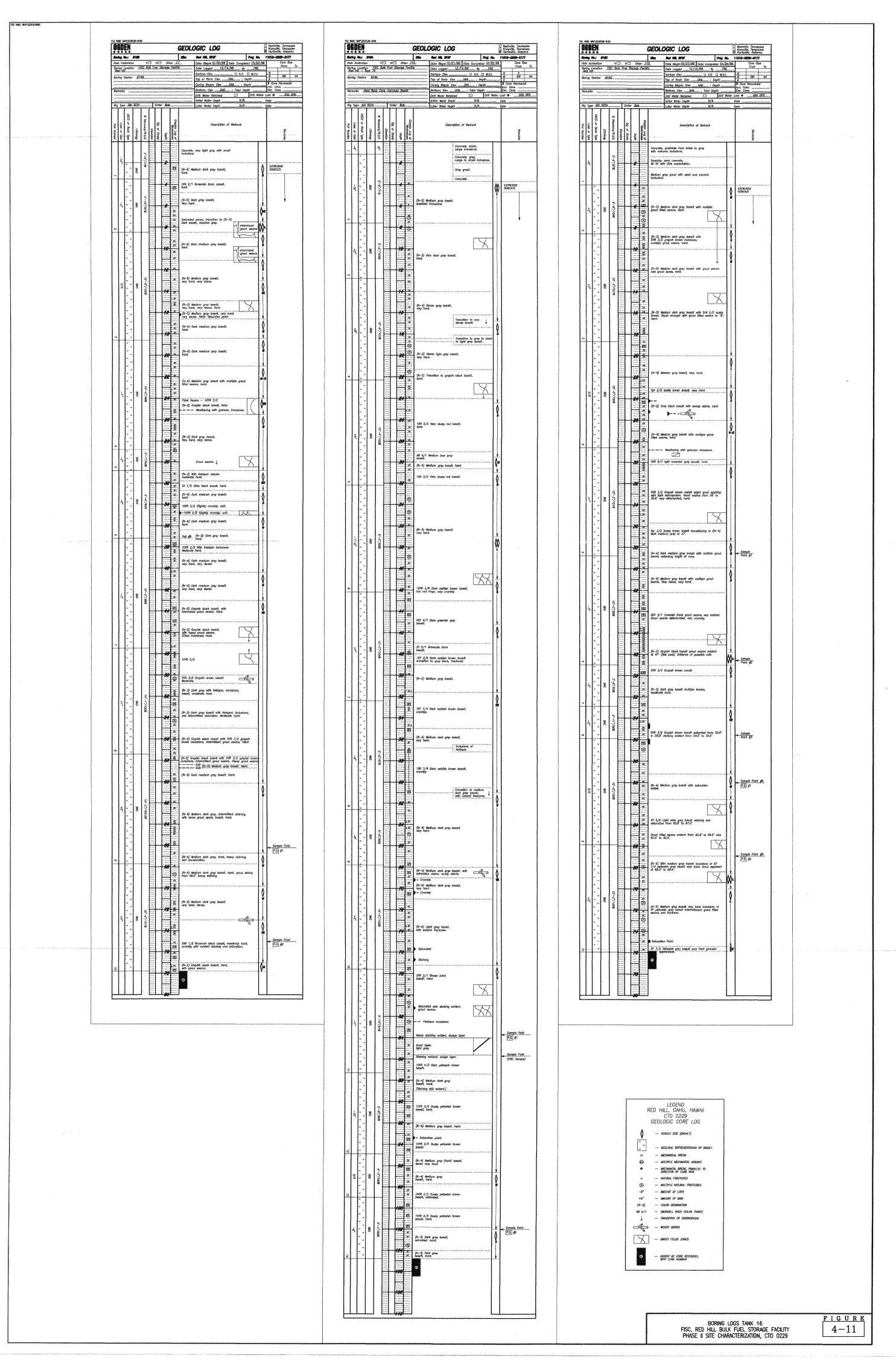
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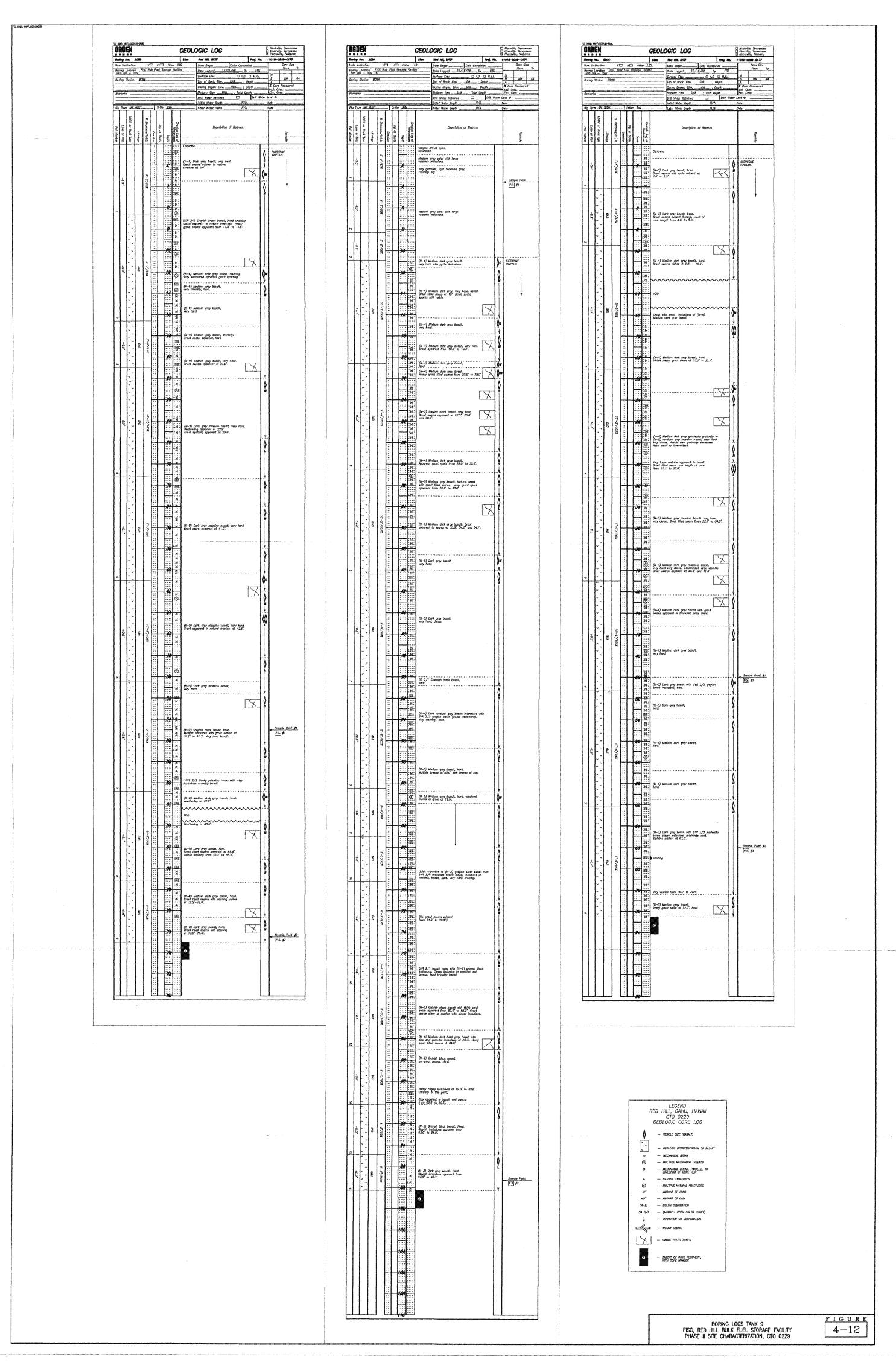
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Date: March 1999	Page:	2 of 2

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Dillbros Engineers, Inc. 1998. Red Hill Fire, Life Safety and Environmental Risk Assessment and Analysis, Section 5.







SAMPLE DESCRIPTION INFORMATION for Ogden Environmental and Energy Services

		Sam			
Lab ID	Client ID	Matrix	Date Time Da	te	
302418-0001-SA	B09B-2	SOIL	29 OCT 98 09:35 02 N		
302418-0002-SA	B09B-1	SOIL	29 OCT 98 08:20 02 N	OV 98	
302418-0003-SA	B09C-2	SOIL	28 OCT 98 12:15 O2 N	OV 98	
302418-0004-SA	B09C-1	SOIL	28 OCT 98 09:37 02 N	OV 98	
302418-0005-SA	B09A-1	SOIL	26 OCT 98 18:08 02 N	OV 98	
302418-0006-SA	B09A-2	SOIL	27 OCT 98 15:15 02 N	OV 98	
302418-0007-SA	B16-DUP	SOIL	23 OCT 98	OV 98	
302418-0008-SA	B16B-4	SOIL	23 OCT 98 10:53 02 N	OV 98	
302418-0009-SA	B16B-5	SOIL	23 OCT 98 11:18 02 N	OV 98	
302418-0010-SA	B16C-4	SOIL	26 OCT 98 08:30 02 N	OV 98	
302418-0011-SA	B16C-5	SOIL	26 OCT 98 09:15 02 N	OV 98	
302418-0012-SA	B16A-4	SOIL	22 OCT 98 10:55 02 N	OV 98	
302418-0013-SA	B16A-5	SOIL	22 OCT 98 15:40 02 N	OV 98	
302418-0014-SA	B16C	AQUEOUS	28 OCT 98 10:00 02 N	OV 98	





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OUA-4124																	
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Volatile Organics - Method 8260 (Aqueous)



STD-Volatile Organics, EPA 8260 Method 8260

Client Name: Ogden Environmental and Energy Services

Client ID:

B16C

LAB ID:

302418-0014-SA AQUEOUS

Matrix: Authorized:

02 NOV 98

Sampled: 28 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 11 NOV 98

75 - 121 85 - 111

Dilution Factor: 25

1,2-Dichloroethane-d4 Toluene-d8

4-Bromofluorobenzene

Parameter	Result	Units	Reporting Limit	Qualifier	
Benzene Toluene Ethylbenzene Xylenes (total)	ND ND ND 31	ug/L ug/L ug/L ug/L	25 25 25 25 25	G	
Surrogate	Recove	ry	Acceptab	le Range	

90 % 96 % 95 %

Note G = Reporting limit(s) raised due to matrix interference. $NA = Not \ Applicable \ ND = Not \ Detected$

Reported By: Michael Lucchesi

Approved By: Rose Harrelson



Volatile - Organics - Method 8260 (Soil)



Client Name: Client ID: LAB ID: Matrix: Ogden Environmental and Energy Services B09B-2

302418-0001-SA SOIL 02 NOV 98

Authorized:

Sampled: 29 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 10 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	

Surrogate	Recovery	Acceptable Range
Toluene-d8	88 %	84 - 110
4-Bromofluorobenzene	87 %	79 - 112
1,2-Dichloroethane-d4	82 %	80 - 120

NA = Not Applicable ND = Not Detected

Reported By: Scott Barmby

Approved By: Karin Yee



Client Name: Ogden Environmental and Energy Services

/Client ID:

BŎ9B-1

LAB ID:

302418-0002-SA

Matrix: Authorized: SOIL 02 NOV 98

Sampled: 29 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 10 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	·

Surrogate	Recovery	Acceptable Range
Toluene-d8	90 %	84 - 110
4-Bromofluorobenzene	94 %	79 - 112
1,2-Dichloroethane-d4	101 %	80 - 120

NA = Not Applicable ND = Not Detected

Reported By: Lisa Stafford

Approved By: Karin Yee



Client Name: Client ID: LAB ID: Ogden Environmental and Energy Services BO9C-2 302418-0003-SA

Matrix: Authorized: SOIL 02 NOV 98 Sampled: 28 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 10 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	
Surrogate	Recove	ry	Acceptabl	e Range
Toluene-d8 4-Bromofluorobenzene 1,2-Dichloroethane-d4		% % %		110 112 120

NA = Not Applicable ND = Not Detected

Reported By: Lisa Stafford

Approved By: Karin Yee



Client Name:
Client ID: Ogden Environmental and Energy Services B09C-1

LAB ID: Matrix:

302418-0004-SA SOIL

Authorized:

02 NOV 98

Sampled: 28 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 10 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier	
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0		
Surrogate	Recove	ry	Acceptabl	le Range	
Toluene-d8 4-Bromofluorobenzene 1,2-Dichloroethane-d4		% % %		110 112 120	

NA = Not Applicable ND = Not Detected

Reported By: Lisa Stafford

Approved By: Karin Yee



Client Name: Client ID: LAB ID: Ogden Environmental and Energy Services BO9A-1

302418-0005-SA

Matrix: Authorized: SOIL

02 NOV 98

Sampled: 26 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 11 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	

Surrogate	Recovery	Acceptable Range
Toluene-d8	90 %	84 - 110
4-Bromofluorobenzene	86 %	79 - 112
1,2-Dichloroethane-d4	91 %	80 - 120

NA = Not Applicable ND = Not Detected

Reported By: Lisa Stafford

Approved By: Karin Yee



Client Name: Client ID: LAB ID: Matrix: Ogden Environmental and Energy Services B09A-2 302418-0006-SA SOIL Sampled: 27 OCT S

Authorized:

02 NOV 98

Sampled: 27 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 21 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	

Surrogate	Recovery	Acceptable Range
Toluene-d8	105 %	84 - 110
4-Bromofluorobenzene	105 %	79 - 112
1,2-Dichloroethane-d4	92 %	80 - 120

NA = Not Applicable ND = Not Detected

Reported By: Min He

Approved By: Karin Yee



Ogden Environmental and Energy Services Client Name:

BI6-DUP Client ID:

LAB ID: 302418-0007-SA

Received: 02 NOV 98 Analyzed: 23 NOV 98 Sampled: 23 OCT 98 Prepared: NA Matrix: SOIL Authorized: 02 NOV 98

Dilution Factor: 5.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND 85 71	ug/kg ug/kg ug/kg ug/kg ug/kg	25 25 25 25 25 25	G
Surrogate	Recove	ry	Acceptab	le Range

Juliogace	Recovery	Acceptable Kan
Toluene-d8 4-Bromofluorobenzene 1,2-Dichloroethane-d4	103 % 95 % 97 %	84 - 110 79 - 112 80 - 120

Note G = Reporting limit(s) raised due to matrix interference. $NA = Not \ Applicable$ $ND = Not \ Detected$

Reported By: Min He

Approved By: Karin Yee



Ogden Environmental and Energy Services B16B-4 Client Name:

Client ID:

LAB ID: 302418-0008-SA

Matrix: SOIL Sampled: 23 OCT 98 Received: 02 NOV 98 Authorized: 02 NOV 98 Prepared: NA Analyzed: 11 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	

Surrogate	Recovery	Acceptable Range
Toluene-d8	86 %	84 - 110
4-Bromofluorobenzene	93 %	79 - 112
1,2-Dichloroethane-d4	87 %	80 - 120

NA = Not Applicable ND = Not Detected

Reported By: Lisa Stafford

Approved By: Karin Yee



Ogden Environmental and Energy Services B16B-5 302418-0009-SA Client Name: Client ID:

LAB ID:

Matrix: Authorized: SOIL 02 NOV 98 Sampled: 23 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 11 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	

Surrogate	Recovery	Acceptable Range
Toluene-d8	87 %	84 - 110
4-Bromofluorobenzene	95 %	79 - 112
1,2-Dichloroethane-d4	87 %	80 - 120

NA = Not Applicable ND = Not Detected

Reported By: Lisa Stafford

Approved By: Karin Yee



Client Name: Ogden Environmental and Energy Services

Client ID: B16C-4

LAB ID: 302418-0010-SA

Sampled: 26 OCT 98 Prepared: NA Received: 02 NOV 98 Analyzed: 21 NOV 98 Matrix: SOIL 02 NOV 98 Authorized:

Dilution Factor: 5.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene	ND	ug/kg	25	G
Ethylbenzene	160	ug/kg	25	
Toluene	ND	ug/kg	25	
M&P Xylene	59	ug/kg	25	
o-Xylene	82	ug/kg	25	

Surrogate	Recovery	Acceptable Range		
Toluene-d8	103 %	84 - 110		
4-Bromofluorobenzene	74 %	79 - 112		
1,2-Dichloroethane-d4	100 %	80 - 120		

Note G = Reporting limit(s) raised due to matrix interference. NA = Not Applicable ND = Not Detected

Reported By: Min He

Approved By: Karin Yee



Client Name: Ogden Environmental and Energy Services Client ID: B16C-5

Client ID:

LAB ID: 302418-0011-SA

Received: 02 NOV 98 Analyzed: 11 NOV 98 Sampled: 26 OCT 98 Prepared: NA Matrix: SOIL 02 NOV 98 Authorized:

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND 54 48 190 130	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	

Surrogate	Recovery	Acceptable Range
Toluene-d8	96 %	84 - 110
4-Bromofluorobenzene	86 %	79 - 112
1,2-Dichloroethane-d4	86 %	80 - 120

NA = Not Applicable ND = Not Detected

Reported By: Lisa Stafford Approved By: Karin Yee



Client Name: Ogden Environmental and Energy Services

Client ID: B16A-4

LAB ID: 302418-0012-SA

Sampled: 22 OCT 98 Prepared: NA Received: 02 NOV 98 Analyzed: 21 NOV 98 Matrix: SOIL 02 NOV 98 Authorized:

Dilution Factor: 5.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier	
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND 240 ND 310 220	ug/kg ug/kg ug/kg ug/kg ug/kg	25 25 25 25 25	G	
Surrogate	Recove	ry	Acceptab	le Range	
Toluene-d8 4-Bromofluorobenzene 1,2-Dichloroethane-d4	103 187 98	%		112	I

Note G = Reporting limit(s) raised due to matrix interference. Note I = Surrogate recovery outside of limits due to sample matrix interference. NA = Not Applicable ND = Not Detected

Reported By: Min He Approved By: Karin Yee

The cover letter is an integral part of this report.

Rev 230787



Ogden Environmental and Energy Services B16A-5Client Name:

Client ID:

LAB ID:

302418-0013-SA

Matrix: Authorized: SOIL 02 NOV 98 Sampled: 22 OCT 98 Prepared: NA

Received: 02 NOV 98 Analyzed: 11 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Benzene Ethylbenzene Toluene M&P Xylene o-Xylene	ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg	5.0 5.0 5.0 5.0	
Surrogate	Recove	ry	Acceptab	le Range
Toluene-d8 4-Bromofluorobenzene 1,2-Dichloroethane-d4	91 87 95	% % %	79 -	110 112 120

NA = Not Applicable ND = Not Detected

Reported By: Lisa Stafford

Approved By: Karin Yee



Polynuclear Aromatic Hydrocarbons - Method 8270 (Aqueous)



Polynuclear Aromatic Hydrocarbons, GC/MS Method 8270

Client Name: Client ID: LAB ID: Ogden Environmental and Energy Services

BI6C

302418-0014-SA AQUEOUS 02 NOV 98 Sampled: 28 OCT 98 Prepared: 03 NOV 98 Received: 02 NOV 98 Analyzed: 04 DEC 98 Matrix: Authorized:

Dilution Factor: 1.0

			Reporting	
Parameter	Result	Units	Limit	Qualifier
Naphthalene	ND	ug/L	10	
Acenaphthylene	ND	ug/L	10	
Acenaphthene	ND	ug/L	10	
Fluorene	ND	ug/L	10	
Phenanthrene	11	ug/L	10	
Anthracene	ND	ug/L	10	
Fluoranthene	ND	ug/L	10	
Pyrene	ND	ug/L	10	
Benzo(a)anthracene	ND	ug/L	10	
Chrysèné	ND	ug/L	īō	
Benzo(b)fluoranthene	ND	ug/L	10	
Benzo(k)fluoranthene	ND	ug/L	10	
Benzo(a)pyrene	ND	ug/L	iŏ	
Indeno(1,2,3-cd)pyrene	ND	ug/L	iŏ	
Dibenz(a,h)anthracene	ND		10	
Benzo(g,h,i)perylene	ND	ug/L	10	
benzo(g,n, r/per y rene	מאו	ug/L	10	

Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	78 %	36 - 114
2-Fluorobiphenyl	79 %	43 - 116
Terphenyl-d14	64 %	33 - 141

ND = Not Detected

Reported By: Donald Taylor

Approved By: Karin Yee



Polynuclear Aromatic Hydrocarbons - Method 8270 (Soil)



Polynuclear Aromatic Hydrocarbons, GC/MS Method 8270

Client Name: Ogden Environmental and Energy Services B09B-2

Client ID:

LAB ID: 302418-0001-SA

Matrix: SOIL Sampled: 29 OCT 98 Prepared: 05 NOV 98 Received: 02 NOV 98 Authorized: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 1.0

Naphthalene ND ug/kg 330	
Acenaphthylene	

Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	80 %	35 - 114
2-Fluorobiphenyl	85 %	39 - 115
Terphenyl-d14	100 %	40 - 127

ND = Not Detected

Reported By: Rose Harrelson Approved By: Karin Yee



Client Name: Client ID: Ogden Environmental and Energy Services BO9B-1

LAB ID:

302418-0002-SA

Matrix: Authorized:

SOIL 02 NOV 98 Sampled: 29 OCT 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND ND ND ND ND ND ND ND ND ND ND ND	ug/kg	330 330 330 330 330 330 330 330 330 330	

Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	81 %	35 - 114
2-Fluorobiphenyl	91 %	39 - 115
Terphenyl-d14	105 %	40 - 127

ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Client Name: Client ID: /LAB ID: Matrix:

Ogden Environmental and Energy Services BO9C-2 302418-0003-SA SOIL Sampled: 28 OCT S

Authorized:

02 NOV 98

Sampled: 28 OCT 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND ND ND ND ND ND ND ND ND ND	ug/kg	330 330 330 330 330 330 330 330 330 330	

Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	114 %	35 - 114
2-Fluorobiphenyl	82 %	39 - 115
Terphenyl-d14	83 %	40 - 127

ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Client Name: Ogden Environmental and Energy Services Client ID: B09C-1

LAB ID:

302418-0004-SA

Matrix: Authorized: SOIL

02 NOV 98

Sampled: 28 OCT 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND ND ND ND ND ND ND ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg	330 330 330 330 330 330 330 330 330 330	

Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	82 %	35 - 114
2-Fluorobiphenyl	91 %	39 - 115
Terphenyl-d14	106 %	40 - 127

ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Ogden Environmental and Energy Services BO9A-1 302418-0005-SA Client Name:

Client ID:

LAB ID: Matrix:

SOIL Authorized: 02 NOV 98

Sampled: 26 OCT 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ug/kg	330 330 330 330 330 330 330 330 330 330	qualifier

Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	85 %	35 - 114
2-Fluorobiphenyl	96 %	39 - 115
Terphenyl-dl4	96 %	40 - 127

ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Client Name: Client ID: LAB ID: Matrix: Ogden Environmental and Energy Services BO9A-2 302418-0006-SA SOIL Sampled: 27 OCT S

Authorized:

02 NOV 98

Sampled: 27 OCT 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND ND ND ND ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg	330 330 330 330 330 330 330 330 330 330	

Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	68 %	35 - 114
2-Fluorobiphenyl	72 %	39 - 115
Terphenyl-d14	94 %	40 - 127

ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Client Name: Client ID: LAB ID: Matrix: Ogden Environmental and Energy Services B16-DUP 302418-0007-SA

Authorized:

SOIL 02 NOV 98 Sampled: 23 OCT 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 15

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	14000 ND ND 6400 14000 ND ND 13000 ND ND ND ND ND ND ND	ug/kg	5000 5000 5000 5000 5000 5000 5000 500	G

Surrogate		Recovery	Acceptable Range	
Nitrobenzene-d5	•	ND %	35 - 114	H
2-Fluorobiphenyl		ND %	39 - 115	H
Terphenyl-d14		ND %	40 - 127	H

Note G = Reporting limit(s) raised due to matrix interference. Note H = Spiked analyte not detected because of required sample dilution. $ND = Not\ Detected$

Reported By: Rose Harrelson

Approved By: Karin Yee



Ogden Environmental and Energy Services B16B-4Client Name:

Client ID:

LAB ID:

302418-0008-SA

Matrix: Authorized:

SOIL 02 NOV 98 Sampled: 23 OCT 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND ND ND ND ND ND ND ND ND ND	ug/kg	330 330 330 330 330 330 330 330 330 330	

) Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	81 %	35 - 114
2-Fluorobiphenyl	90 %	39 - 115
Terphenyl-d14	103 %	40 - 127

ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Ogden Environmental and Energy Services B16B-5 Client Name:

Client ID:

LAB ID: 302418-0009-SA

Matrix: SOIL Sampled: 23 OCT 98 Prepared: 05 NOV 98 Received: 02 NOV 98 Analyzed: 02 DEC 98 Authorized: 02 NOV 98

Dilution Factor: 1.0

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND ND ND ND ND ND ND ND ND ND	ug/kg	330 330 330 330 330 330 330 330 330 330	

Surrogate	Recovery	Acceptable Range
Nitrobenzene-d5	80 %	35 - 114
2-Fluorobiphenyl	92 %	39 - 115
Terphenyl-d14	104 %	40 - 127

ND = Not Detected

Reported By: Rose Harrelson Approved By: Karin Yee



Client Name: Ogden Environmental and Energy Services

Client ID: LAB ID: B16C-4

Matrix: Authorized: 302418-0010-SA

SOIL Sampled: 26 OCT 98 O2 NOV 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 15

	Wet wt.		Reporting	
Parameter	Result	Units	Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene	47000 ND ND 12000 26000 ND ND 11000 ND 6300 ND ND ND	ug/kg	5000 5000 5000 5000 5000 5000 5000 500	0
Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND	ug/kg ug/kg	5000 5000	

Surrogate	Recovery	Acceptable Range	
Nitrobenzene-d5	ND %	35 - 114	H
2-Fluorobiphenyl	ND %	39 - 115	H
Terphenyl-d14	ND %	40 - 127	H

Note H = Spiked analyte not detected because of required sample dilution. Note o = Reporting limit(s) raised due to high level of analyte present in sample. ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Client Name: Client ID: LAB ID: Ogden Environmental and Energy Services

B16C-5

Matrix:

302418-0011-SA

SOIL Authorized: 02 NOV 98

Sampled: 26 OCT 98 Prepared: 05 NOV 98

Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 15

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	8200 ND ND ND 6500 ND ND ND ND ND ND ND	ug/kg	5000 5000 5000 5000 5000 5000 5000 500	G

Surrogate	Recovery	Acceptable Range	
Nitrobenzene-d5	ND %	35 - 114	H
2-Fluorobiphenyl	ND %	39 - 115	
Terphenyl-d14	ND %	40 - 127	

Note G = Reporting limit(s) raised due to matrix interference. Note H = Spiked analyte not detected because of required sample dilution. ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Client Name: Ogden Environmental and Energy Services

Client ID: B16

B16A-4

LAB ID:

302418-0012-SA

Matrix: SOIL Authorized: 02 NOV 98 Sampled: 22 OCT 98 Prepared: 05 NOV 98 Received: 02 NOV 98 Analyzed: 02 DEC 98

Dilution Factor: 15

Parameter	Wet wt. Result	Units	Reporting Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	43000 ND ND 10000 23000 ND ND 22000 ND ND ND ND ND ND ND ND	ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg ug/kg	5000 5000 5000 5000 5000 5000 5000 500	

/ Surrogate	Recovery	Acceptable Range	
Nitrobenzene-d5	ND %	35 - 114	H
2-Fluorobiphenyl	ND %	39 - 115	H
Terphenyl-d14	ND %	40 - 127	H

Note H = Spiked analyte not detected because of required sample dilution.

Note o = Reporting limit(s) raised due to high level of analyte present in sample.

ND = Not Detected

Reported By: Rose Harrelson

Approved By: Karin Yee



Ogden Environmental and Energy Services B16A-5Client Name:

Client ID:

LAB ID: 302418-0013-SA

Sampled: 22 OCT 98 Prepared: 05 NOV 98 Matrix: SOIL Received: 02 NOV 98 Analyzed: 02 DEC 98 Authorized: 02 NOV 98

Dilution Factor: 10

	Wet wt.		Reporting	
Parameter	Result	Units	Limit	Qualifier
Naphthalene Acenaphthylene Acenaphthene Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenz(a,h)anthracene Benzo(g,h,i)perylene	ND ND 4700 4400 ND ND 20000 ND ND ND ND ND ND ND	ug/kg	3300 3300 3300 3300 3300 3300 3300 330	G

Surrogate	Recovery	Acceptable Range	
Nitrobenzene-d5	ND %	35 - 114	H
2-Fluorobiphenyl	ND %	39 - 115	H
Terphenyl-d14	ND %	40 - 127	H

Note G = Reporting limit(s) raised due to matrix interference. Note H = Spiked analyte not detected because of required sample dilution. $ND = Not\ Detected$

Reported By: Rose Harrelson Approved By: Karin Yee



Total Petroleum Hydrocarbons -Method THP-D-TRIREGIONAL (Aqueous)



Total Petroleum Hydrocarbons by GC/FID (Triregional)

Method TPH-D-TRIREGIONAL

Client Name: Ogden Environmental and Energy Services

Client ID:

B16C

Lab ID: 302418-0014-SA

Matrix: AQUEOUS Sampled: 28 OCT 98 Received: 02 NOV 98 Authorized: 02 NOV 98 Prepared: 03 NOV 98 Analyzed: 14 NOV 98

Parameter	Result	Units	Reporting Limit	
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 8100	ug/L ug/L ug/L	1000 4000 1000	o 1
Surrogate	Recovery			
o-Terphenyl	ND	%		Н

Note o : Reporting limit(s) raised due to high level of analyte present in sample.

Note 1: The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C08 to n-C40. All unknown peaks in the chromatogram between n-C08 and n-C36 were summed and quantitated based on a diesel fuel reference between n-C10 and n-C24.

Note H: Spiked analyte not detected because of required sample dilution.

ND = Not detected NA = Not applicable

Approved By: Kris Rogers Reported By: Lisa Stafford



Total Petroleum Hydrocarbons -Method TPH-D-TRIREGIONAL (Soíl)



Ogden Environmental and Energy Services B09B-2 Client Name:

Client ID: LAB ID:

302418-0001-SA SOIL

Matrix: Authorized:

02 NOV 98

Sampled: 29 OCT 98 Prepared: 06 NOV 98

Received: 02 NOV 98 Analyzed: 30 NOV 98

Dilution Factor: 1.0

Parameter	Result	Units	Reporting Limit	Qualifier
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 2.3	mg/kg mg/kg mg/kg	1.0 5.0 1.0	1
Surrogate	Recovery		Acceptab	le Range
o-Terphenyl	90 %		61 - 135	

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C14 to n-C38. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a diesel fuel reference between n-C10 and n-C24.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Ogden Environmental and Energy Services Client Name:

Client ID:

BÖ9B-1

LAB ID:

302418-0002-SA

Matrix: Authorized: SOIL 02 NOV 98

Sampled: 29 OCT 98 Prepared: 06 NOV 98 Received: 02 NOV 98 Analyzed: 30 NOV 98

Dilution Factor: 5.0

Parameter	Result	Units	Reporting Limit	Qualifier
Diesel Fuel Motor Oil(n-Cl9 through n-C36) Unknown hydrocarbon	ND ND	mg/kg mg/kg	5.0 25	0
Unknown hydrocarbon	48	mg/kg	5.0	1
Surrogate	Recovery		Acceptable Range	
o-Terphenyl	104 %		61 - 135	

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C10 to n-C38. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a diesel fuel reference

between n-C10 and n-C24. Note o = Reporting limit(s) raised due to high level of analyte present in sample.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

Client ID: B09C-2

LAB ID: 302418-0003-SA

Matrix: SOIL Sampled: 28 OCT 98 Received: 02 NOV 98 Authorized: 02 NOV 98 Prepared: 06 NOV 98 Analyzed: 30 NOV 98

Dilution Factor: 1.0

Parameter	Result	Units	Reporting Limit	Qualifier
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 3.1	mg/kg mg/kg mg/kg	1.0 5.0 1.0	1
Surrogate	Recovery		Acceptable Range	
o-Terphenyl	92 %		61 - 135	

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C12 to n-C38. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a diesel fuel reference between n-C10 and n-C24.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

Client ID: E

BŎ9C-1 302418-0004-SA

Matrix: Authorized: SOIL 02 NOV 98 Sampled: 28 OCT 98 Prepared: 06 NOV 98

Received: 02 NOV 98 Analyzed: 30 NOV 98

Dilution Factor: 1.0

Parameter	Result	Units	Reporting Limit	Qualifier
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 6.9	mg/kg mg/kg mg/kg	1.0 5.0 5.0	1
Surrogate	Recovery		Acceptable Range	
o-Terphenyl	98 %		61 - 135	

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C12 to n-C38. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a motor oil reference between n-C19 and n-C36.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

Client ID:

B09A-1

LAB ID:

302418-0005-SA

Matrix:

SOIL

02 NOV 98

Sampled: 26 OCT 98 Prepared: 06 NOV 98

Received: 02 NOV 98 Analyzed: 01 DEC 98

61 - 135

Authorized:

o-Terphenyl

ND %

Dilution Factor: 10

Parameter	Result	Units	Reporting Limit	Qualifier	
Diesel Fuel Motor Oil(n-C19 through n-C36)	ND ND	mg/kg mg/kg	10 50	0	
Unknown hydrocarbon	600	mg/kg	10	1	
Surrogate	Recovery		Acceptable Range		

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C09 to n-C40. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a diesel fuel reference between n-C10 and n-C24.

Note o = Reporting limit(s) raised due to high level of analyte present in sample.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Ogden Environmental and Energy Services BO9A-2 Client Name:

Client ID:

LAB ID: 302418-0006-SA

Sampled: 27 OCT 98 Prepared: 06 NOV 98 Received: 02 NOV 98 Analyzed: 01 DEC 98 Matrix: SOIL 02 NOV 98 Authorized:

Dilution Factor: 1.0

Parameter	Result	Units	Reporting Limit	Qualifier
Diesel Fuel	ND	mg/kg	1.0	1
Motor Oil(n-C19 through n-C36)	ND	mg/kg	5.0	
Unknown hydrocarbon	3.5	mg/kg	1.0	

Surrogate	Recovery	Acceptable Range
o-Terphenyl	133 %	61 - 135

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C15 to n-C38. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a diesel fuel reference between n-C10 and n-C24.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

Client ID:

Authorized:

BI6-DUP 302418-0007-SA

LAB ID: Matrix:

SOIL 02 NOV 98

Sampled: 23 OCT 98 Prepared: 06 NOV 98 Received: 02 NOV 98 Analyzed: 01 DEC 98

Dilution Factor: 170

Parameter	Result	Units	Reporting Limit	Qualifier
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 6600	mg/kg mg/kg mg/kg	170 840 170	o 1
Surrogate	Recovery		Acceptabl	e Range
o-Terphenyl	ND %		61 -	135 H

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C09 to n-C40. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a motor oil reference between n-C19 and n-C36.

Note H = Spiked analyte not detected because of required sample dilution.

Note o = Reporting limit(s) raised due to high level of analyte present in sample.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Total Petroleum Hydrocarbons by GC/FID (Triregional) Method TPH-D-TRIREGIONAL

Client Name: Ogden Environmental and Energy Services

Client ID: B16B-4

302418-0008-SA LAB ID:

Matrix: SOIL Sampled: 23 OCT 98 Received: 02 NOV 98 Prepared: 06 NOV 98 Authorized: 02 NOV 98 Analyzed: 01 DEC 98

Dilution Factor: 1.0

Parameter	Result	Units	Reporting Limit	Qualifier	
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 6.4	mg/kg mg/kg mg/kg	1.0 5.0 1.0	1	
Surrogate	Recovery		Acceptable Range		
o-Terphenyl	97 %		61 - 135		

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C12 to n-C40. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a motor oil reference between n-C19 and n-C36.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

Client ID:

B16B-5

LAB ID:

302418-0009-SA

Matrix: Authorized: SOIL

Sampled: 23 OCT 98

Received: 02 NOV 98 Analyzed: 01 DEC 98

02 NOV 98 Prepared: 06 NOV 98

Dilution Factor: 5.0

Parameter	Result	Units	Reporting Limit	Qualifier
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 29	mg/kg mg/kg mg/kg	5.0 25 5.0	o 1
Surrogate o-Terphenyl	Recovery 92 %		Acceptable Range 61 - 135	

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-ClO to n-C38. All unknown peaks in the chromatogram between n-C08 and n-C36 were summed and quantitated based on a motor oil reference between n-Cl9 and n-C36.

Note o = Reporting limit(s) raised due to high level of analyte present in sample.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

Client ID:

B16C-4

LAB ID:

302418-0010-SA

Matrix: Authorized: SOIL 02 NOV 98 Sampled: 26 OCT 98

Received: 02 NOV 98

Prepared: 06 NOV 98

Analyzed: 02 DEC 98

Dilution Factor: 200

Parameter	Result	Units	Reporting Limit	Qualifier	
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 9400	mg/kg mg/kg mg/kg	200 1000 200	o 1	
Surrogate	Recovery		Acceptab	le Range	
o-Terphenyl	ND %		61 -	135 I	Н

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C09 to n-C40. All unknown peaks in the chromatogram between n-C08 and n-C36 were summed and quantitated based on a diesel fuel reference between n-C10 and n-C24.

Note H = Spiked analyte not detected because of required sample dilution. Note o = Reporting limit(s) raised due to high level of analyte present in sample.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

B16C-5 Client ID:

302418-0011-SA LAB ID:

Matrix: SOIL Sampled: 26 OCT 98 Received: 02 NOV 98 02 NOV 98 Prepared: 06 NOV 98 Analyzed: 01 DEC 98 Authorized:

Dilution Factor: 170

Parameter	Result	Units	Reporting Limit	Qualifier	ŀ
Diesel Fuel Motor Oil(n-C19 through n-C36) Unknown hydrocarbon	ND ND 4500	mg/kg mg/kg mg/kg	170 840 170	o 1	
Surrogate	Recovery		Acceptable Range		
o-Terphenyl	ND %		61 -	135	Н

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C09 to n-C40. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a diesel fuel reference between n-C10 and n-C24.

Note H = Spiked analyte not detected because of required sample dilution.

Note o = Reporting limit(s) raised due to high level of analyte present in sample.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

Client ID:

B16A-4

LAB ID:

302418-0012-SA

Matrix: Authorized:

o-Terphenyl

SOIL 02 NOV 98

Sampled: 22 OCT 98 Prepared: 06 NOV 98

ND %

Received: 02 NOV 98

61 - 135

Н

Analyzed: 01 DEC 98

Dilution Factor: 170

Parameter	Result	Units	Reporting Limit	Qualifier	
Diesel Fuel Motor Oil(n-C19 through n-C36)	ND ND	mg/kg mg/kg	170 840	o	
Unknown hydrocarbon	11000	mg/kg	170	1	
Surrogate	Recovery		Acceptable Range		

Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C09 to n-C40. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a diesel fuel reference between n-C10 and n-C24.

Note H = Spiked analyte not detected because of required sample dilution. Note o = Reporting limit(s) raised due to high level of analyte present in sample.

ND = Not Detected

Reported By: Lisa Stafford

Approved By: Emily Uebelhoer



Client Name: Ogden Environmental and Energy Services

Client ID:

BĬ6A-5

LAB ID:

Matrix:

o-Terphenyl

302418-0013-SA

SOIL 02 NOV 98 Authorized:

Sampled: 22 OCT 98 Prepared: 06 NOV 98

ND %

. . .

Received: 02 NOV 98 Analyzed: 01 DEC 98

61 - 135

Н

Dilution Factor: 170

Parameter	Result	Units	Reporting Limit	Qualifier	
Diesel Fuel Motor Oil(n-C19 through n-C36)	ND ND	mg/kg mg/kg	170 840	0	
Unknown hydrocarbon	2800	mg/kg	170	1	
Surrogate	Recovery		Acceptable Range		

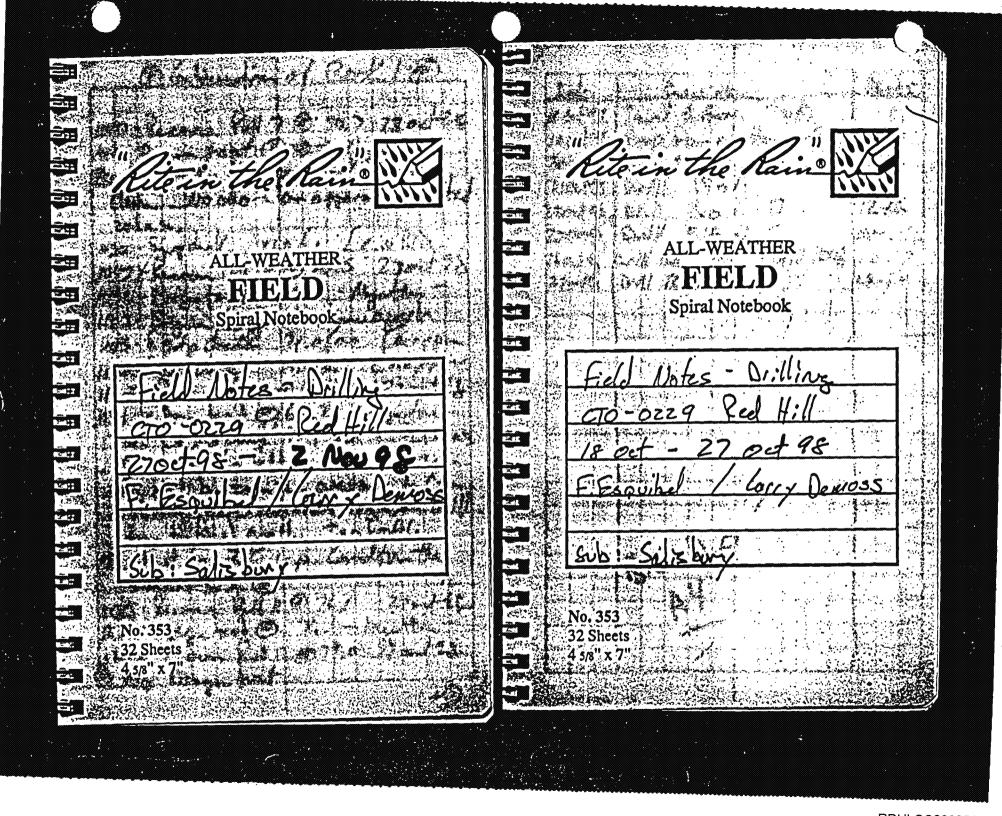
Note 1 = The hydrocarbon pattern present in this sample represents an unknown mixture in the range of n-C09 to n-C40. All unknown peaks in the chromatogram between n -C08 and n-C36 were summed and quantitated based on a motor oil reference between n-C19 and n-C36.

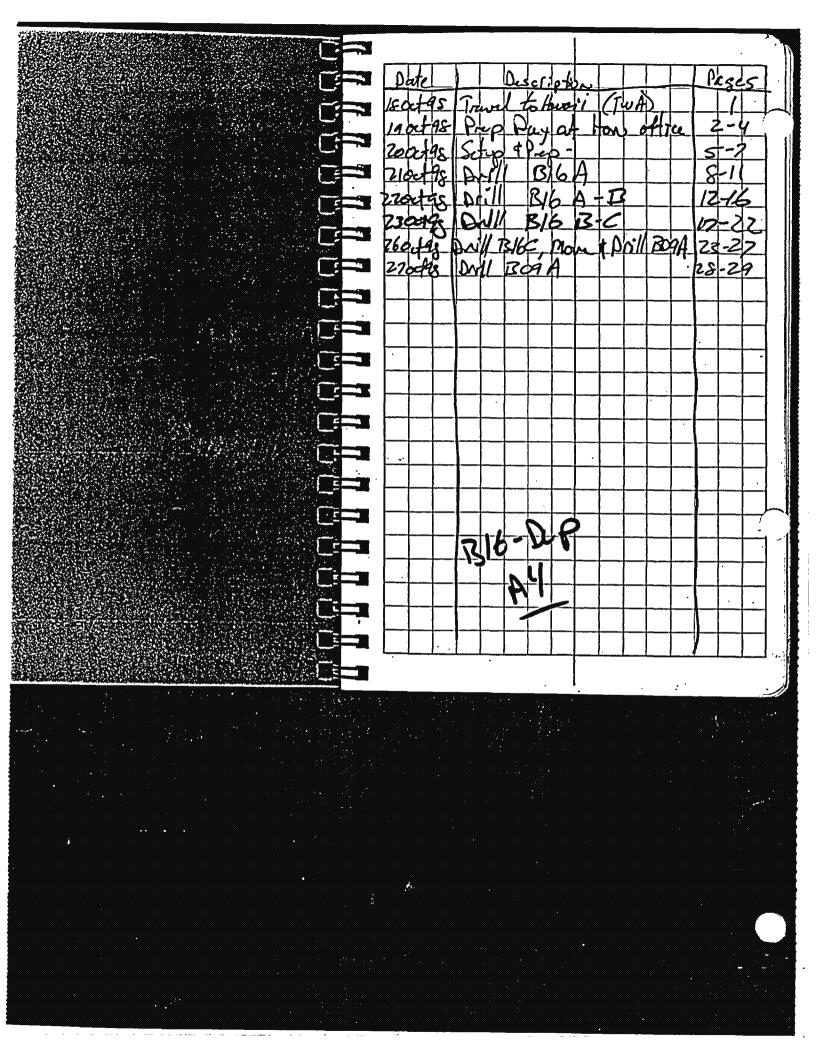
Note H = Spiked analyte not detected because of required sample dilution.
Note o = Reporting limit(s) raised due to high level of analyte present in sample.

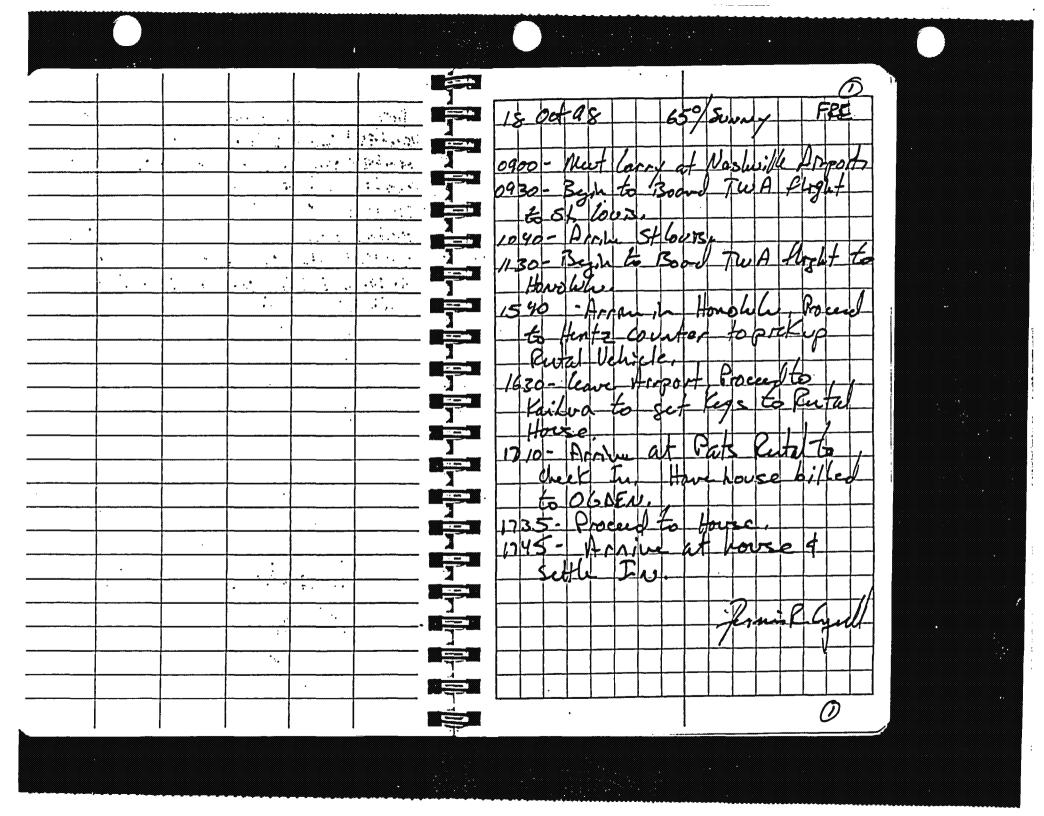
ND = Not Detected

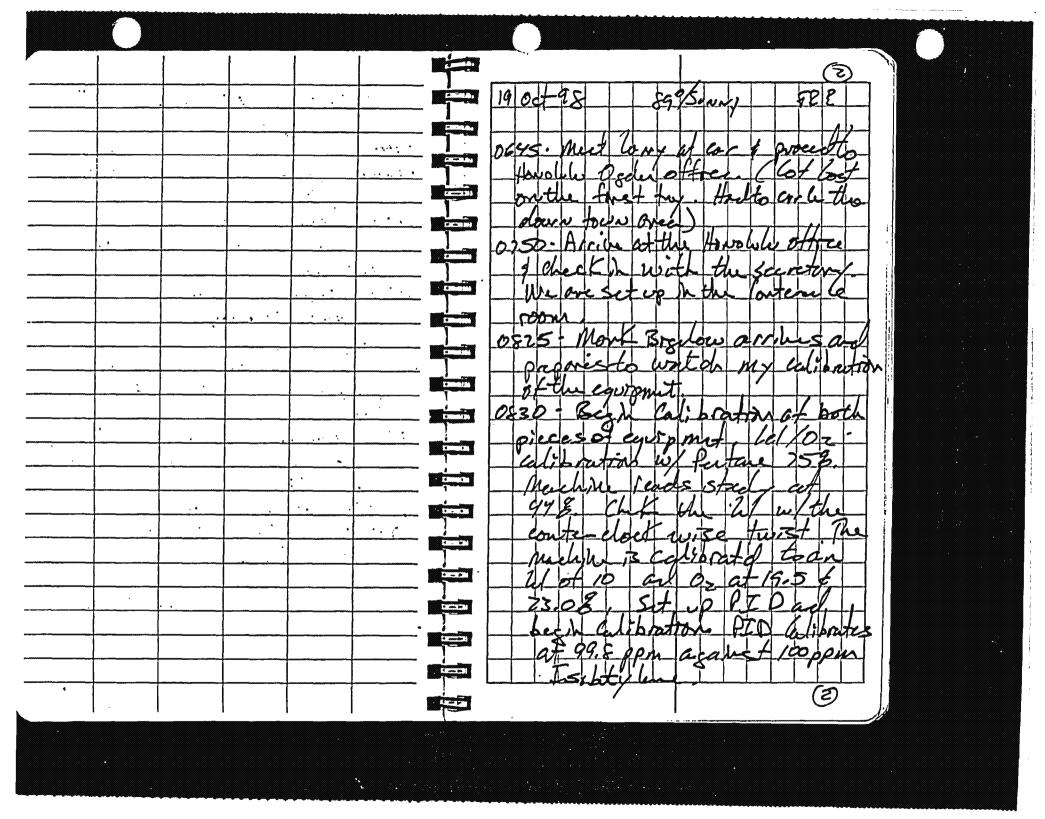
Reported By: Lisa Stafford

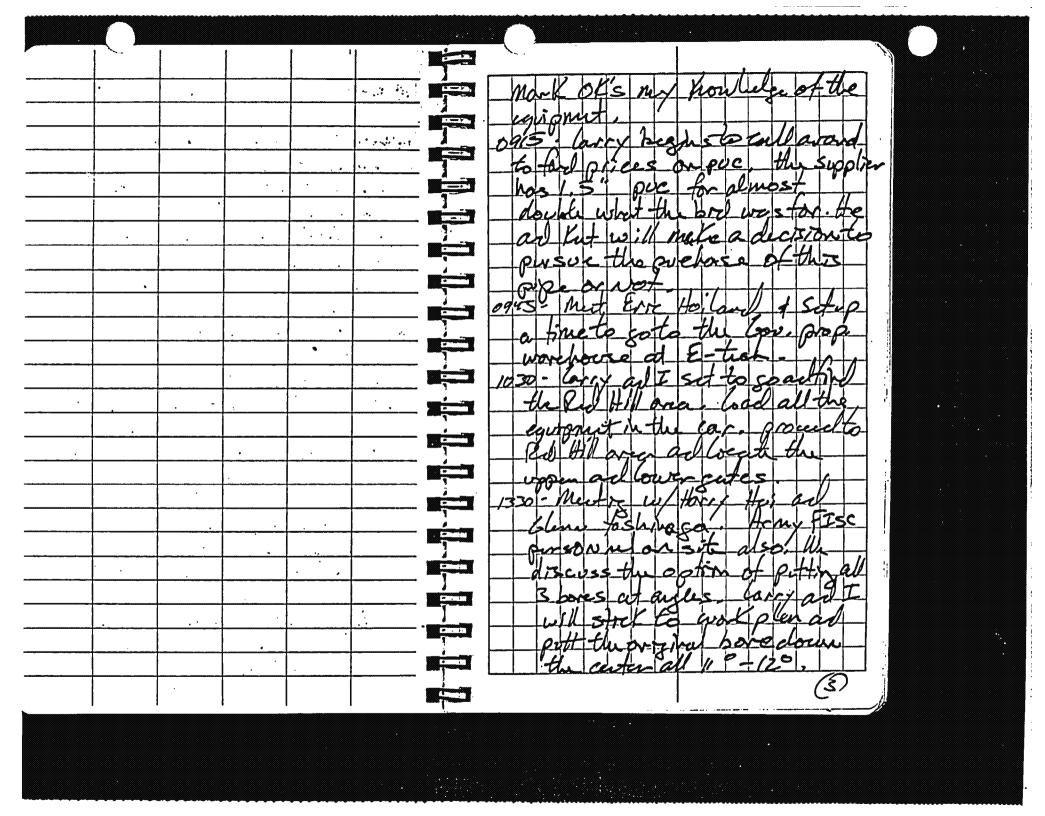
Approved By: Emily Uebelhoer

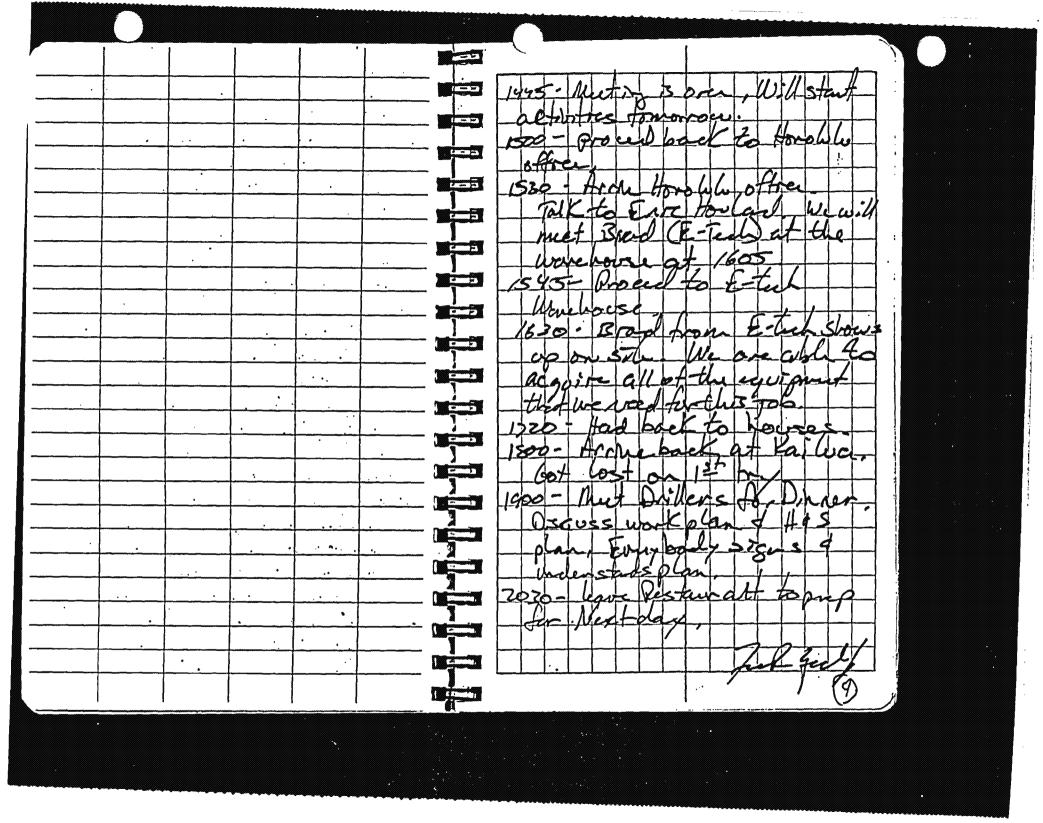


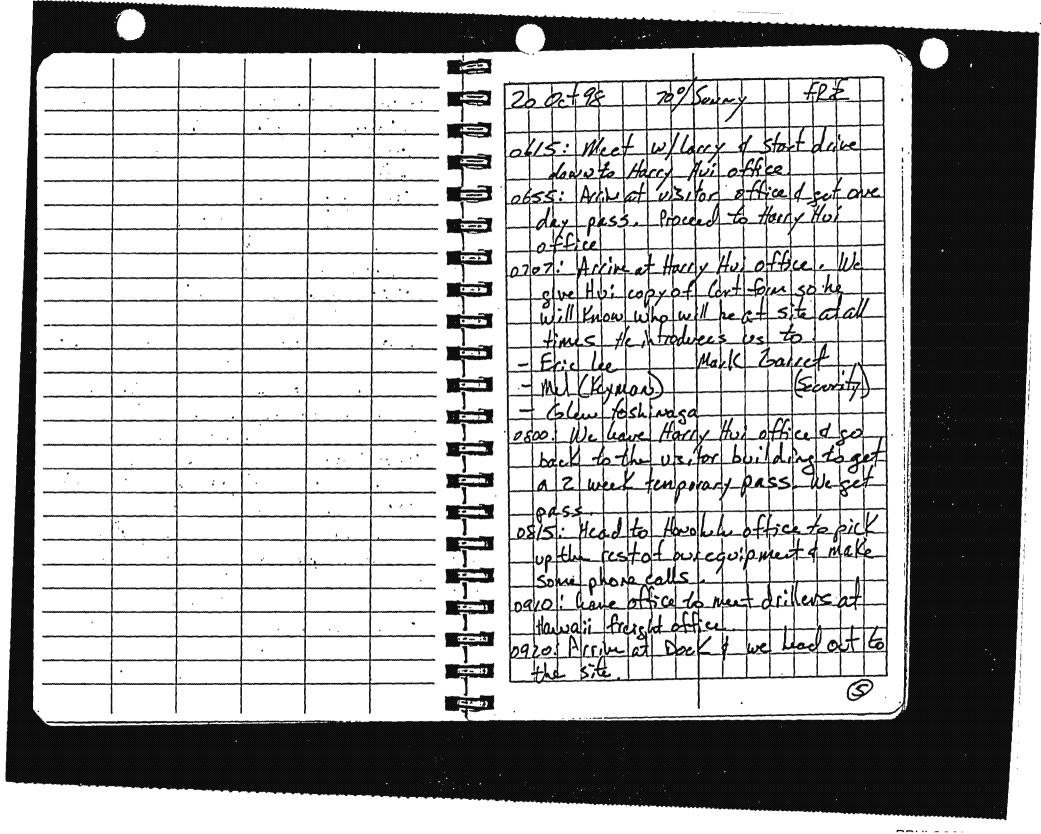


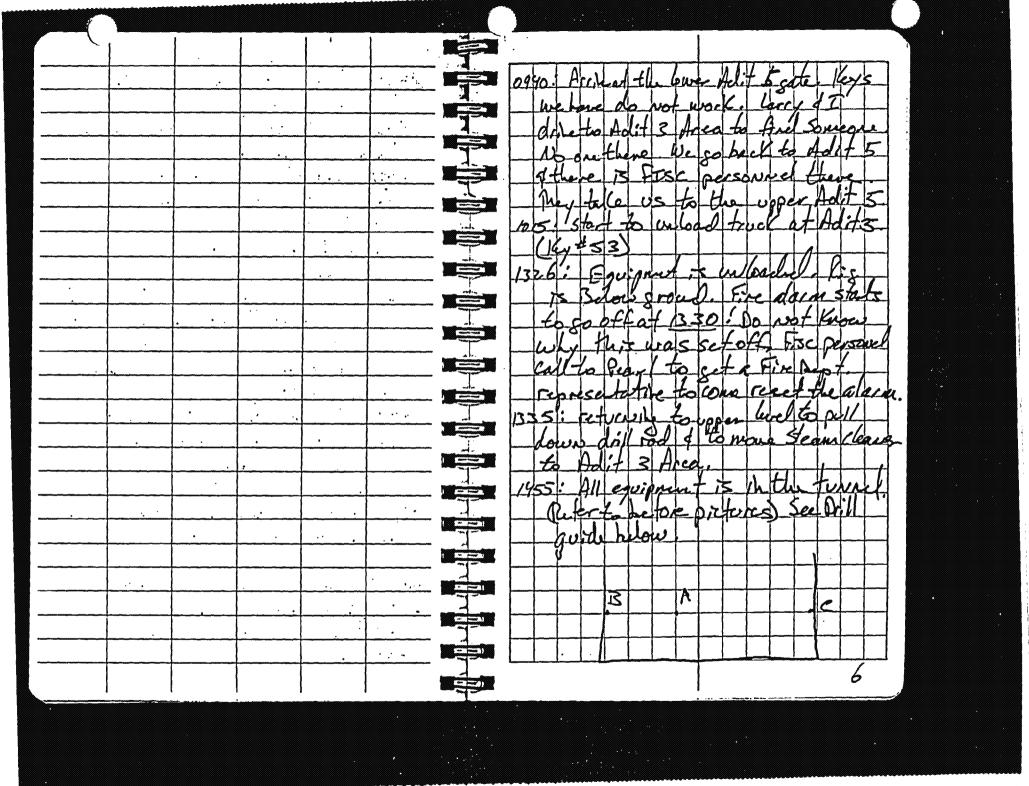


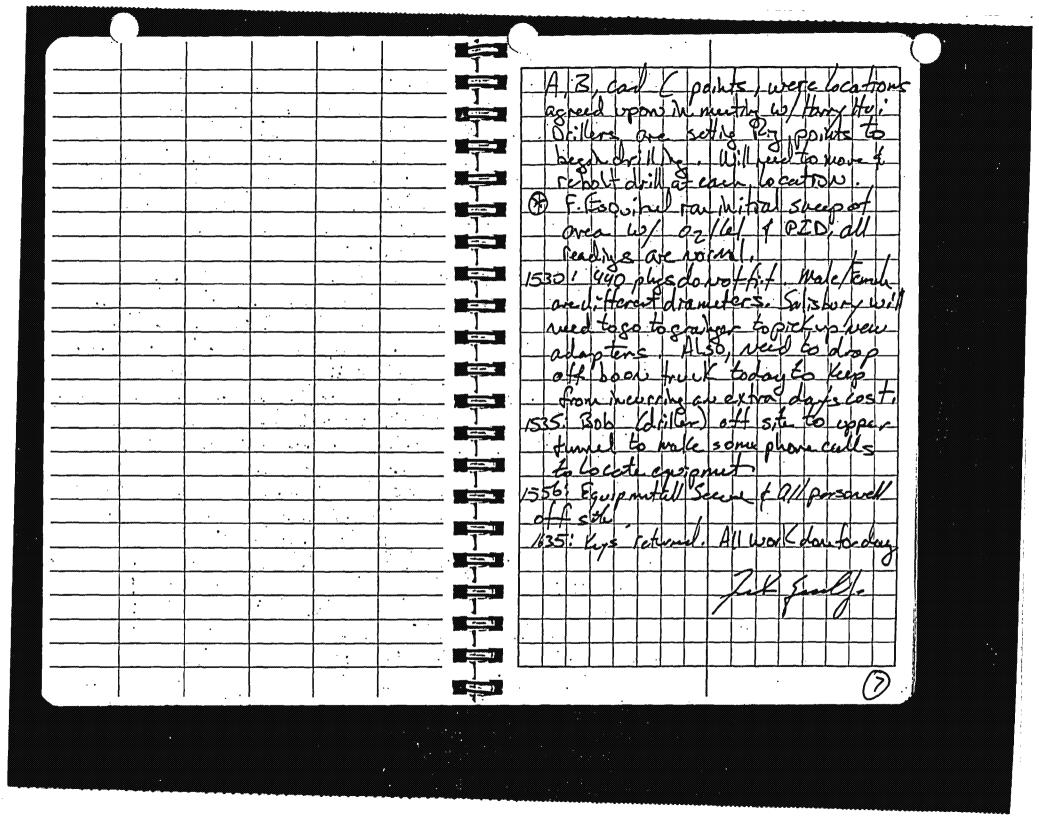


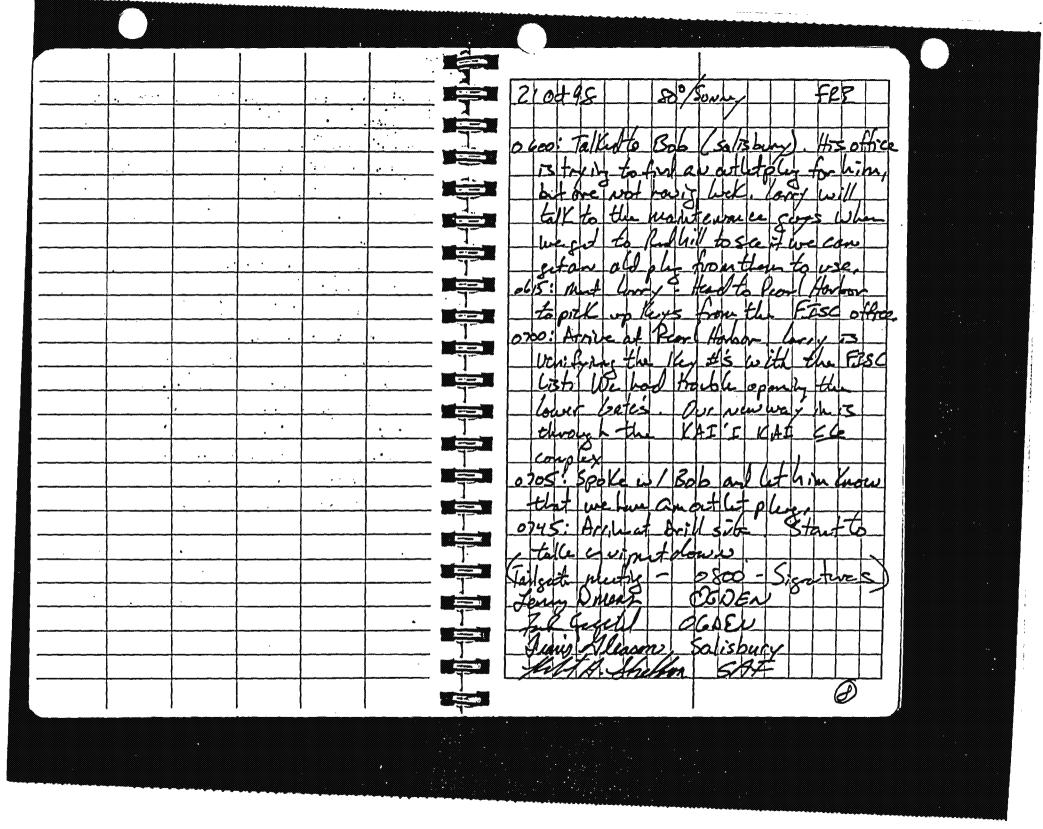


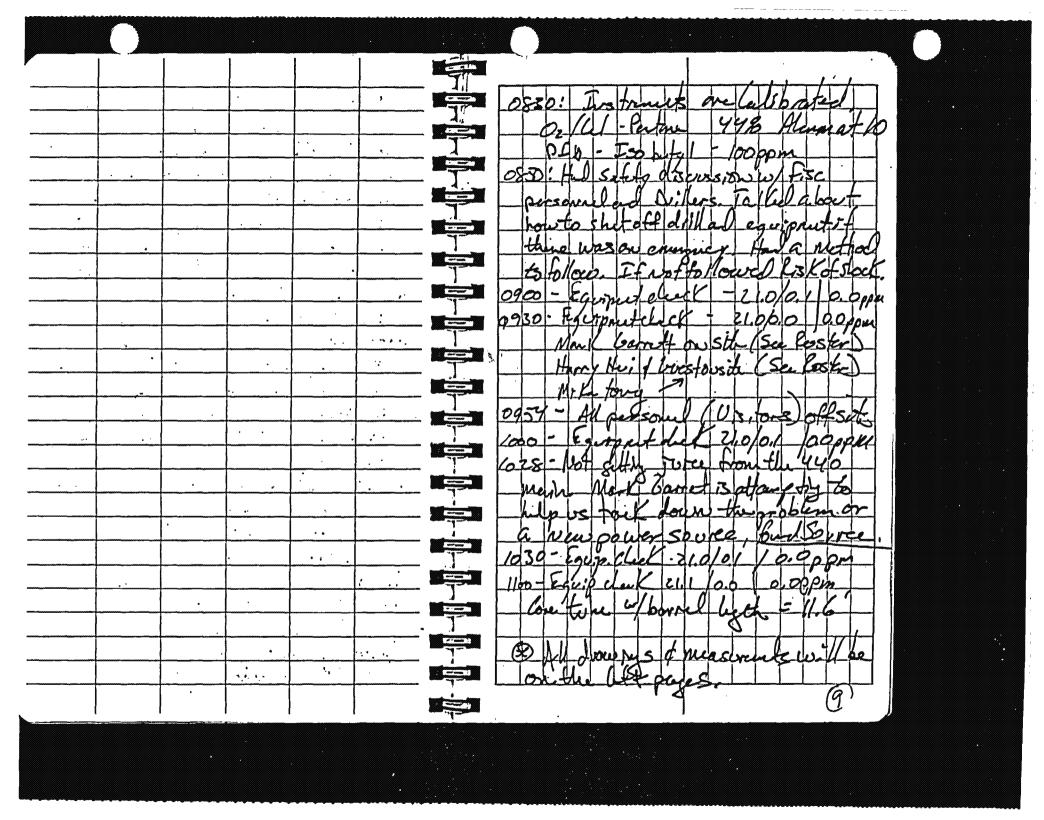


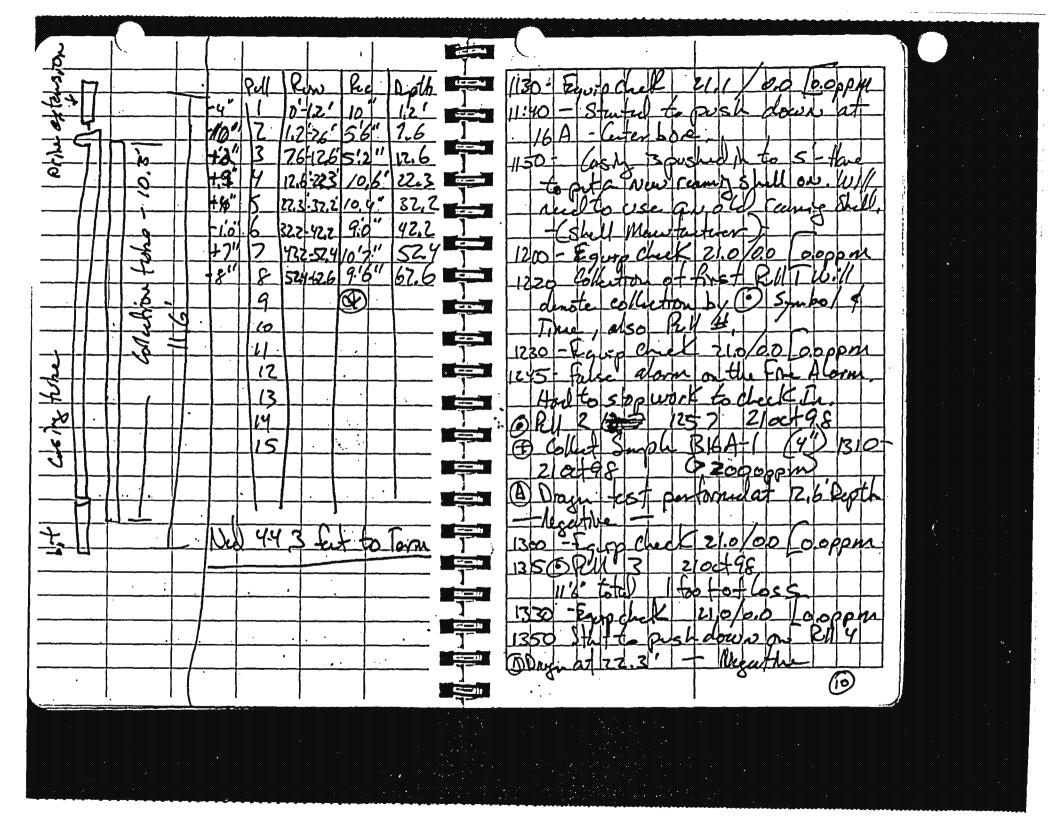


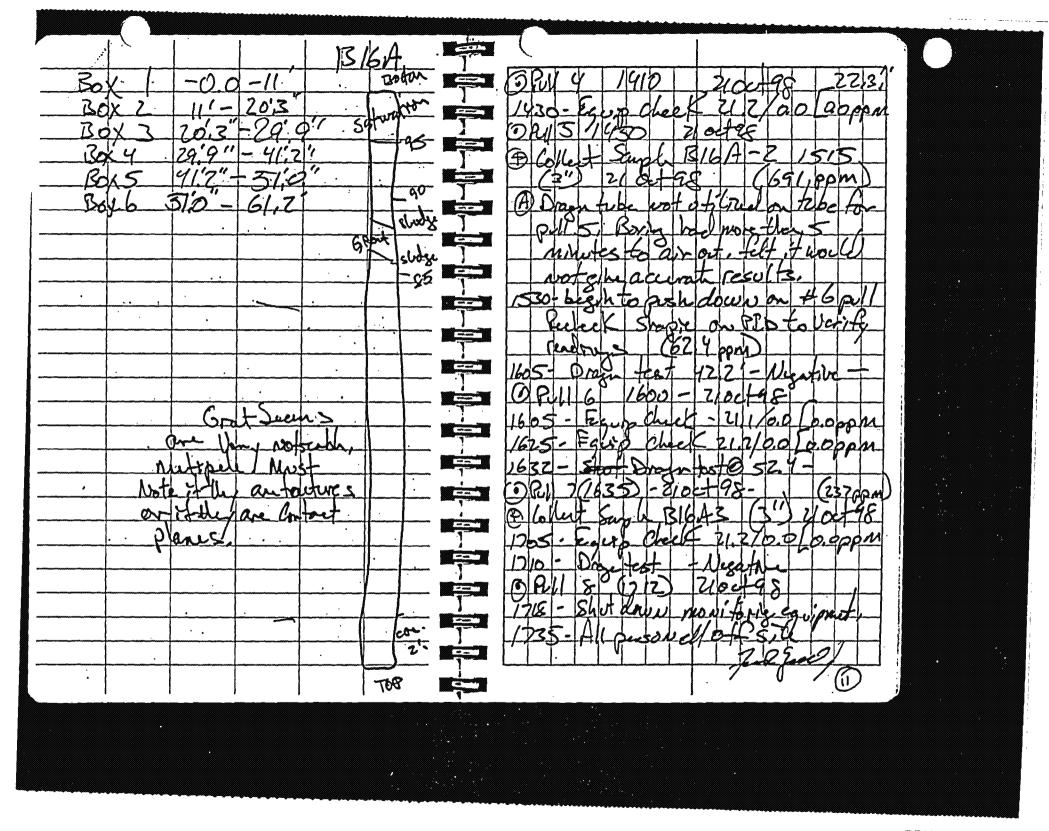


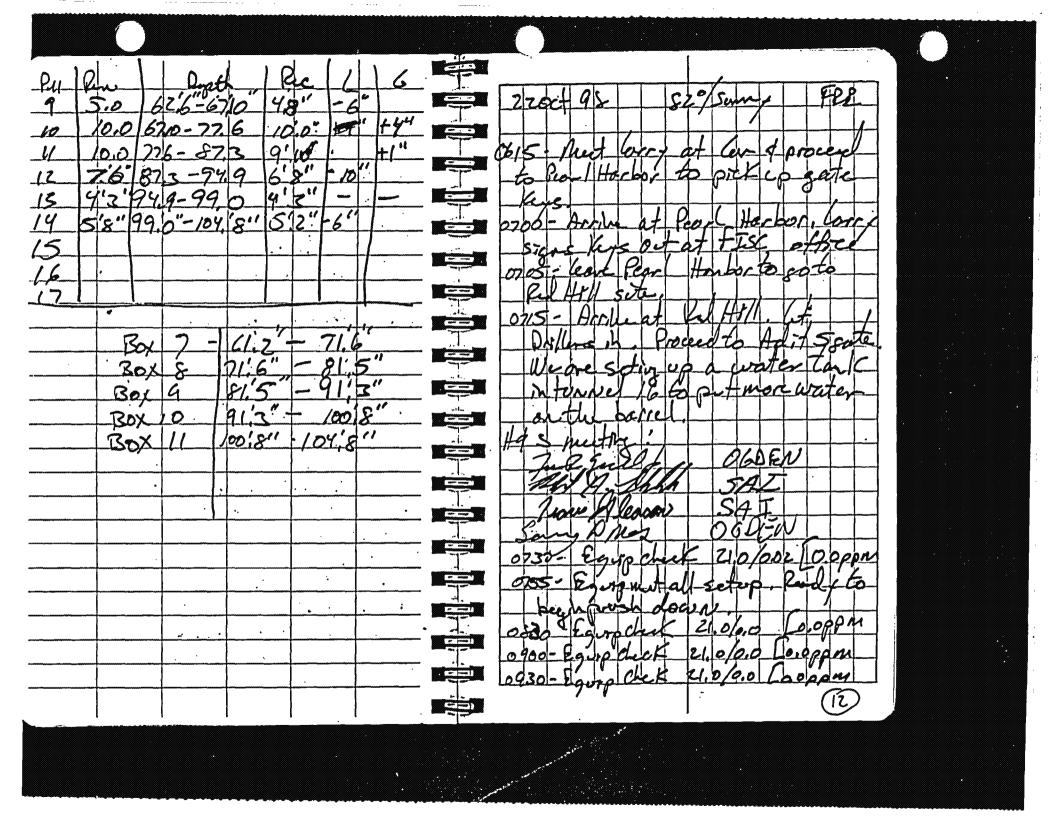


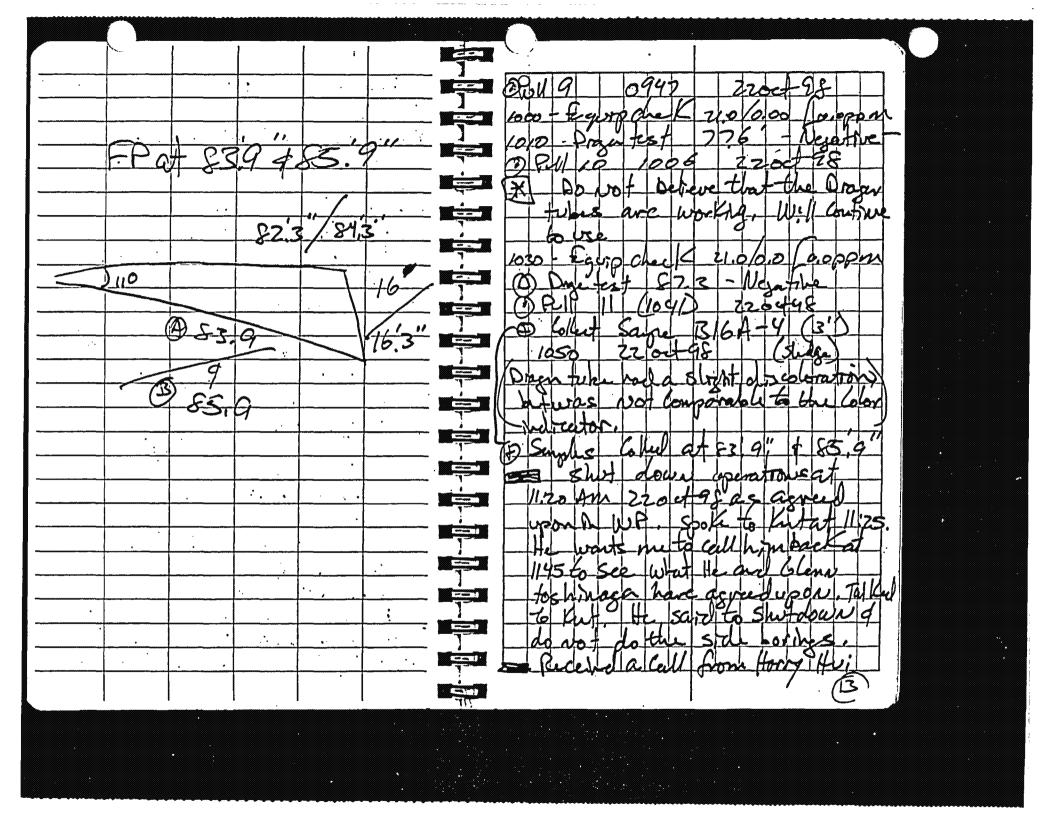


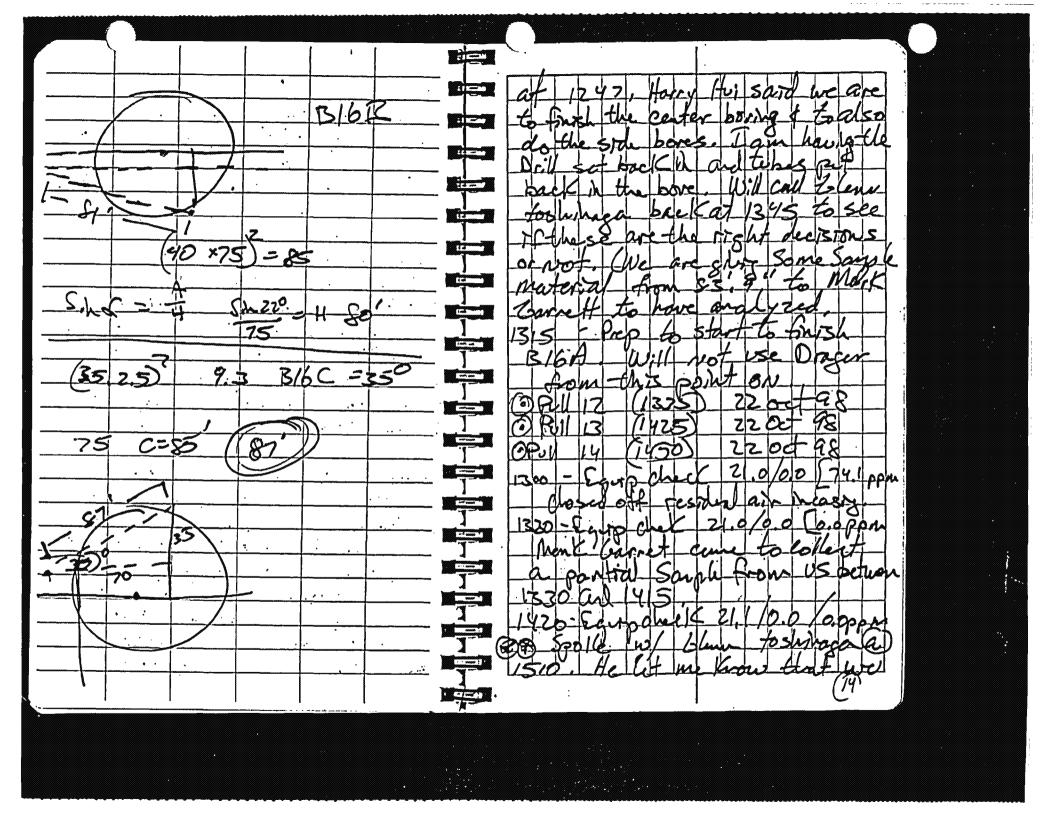


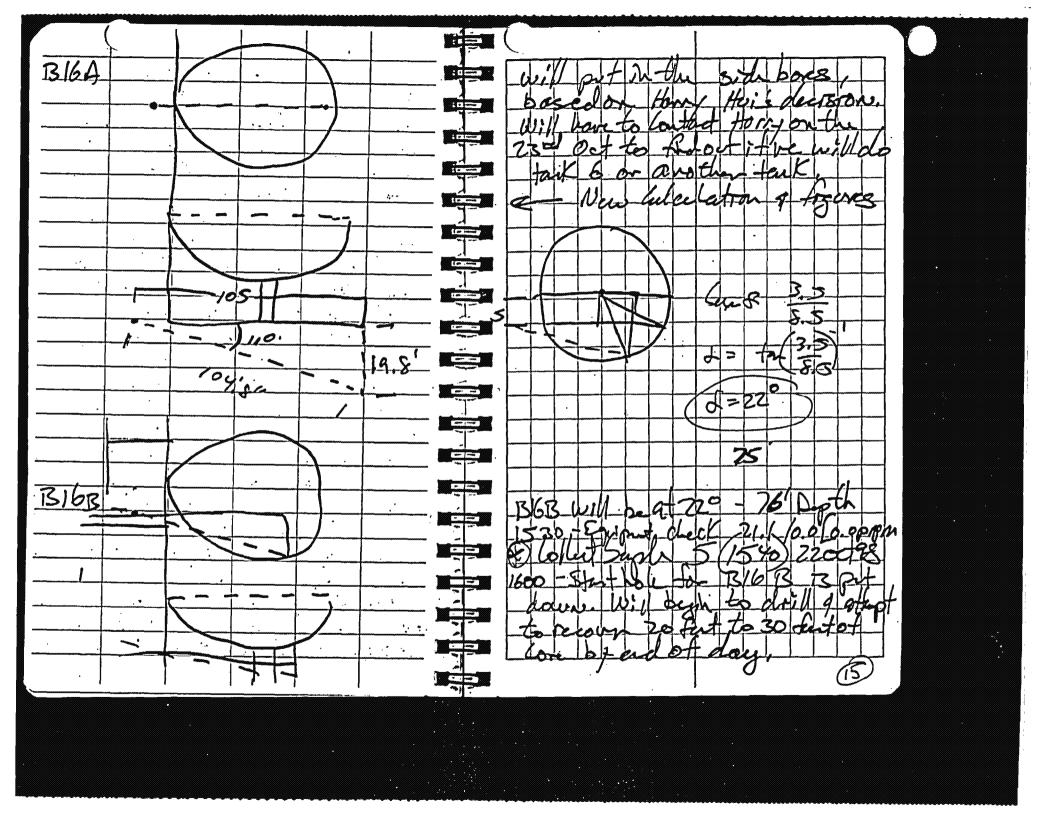


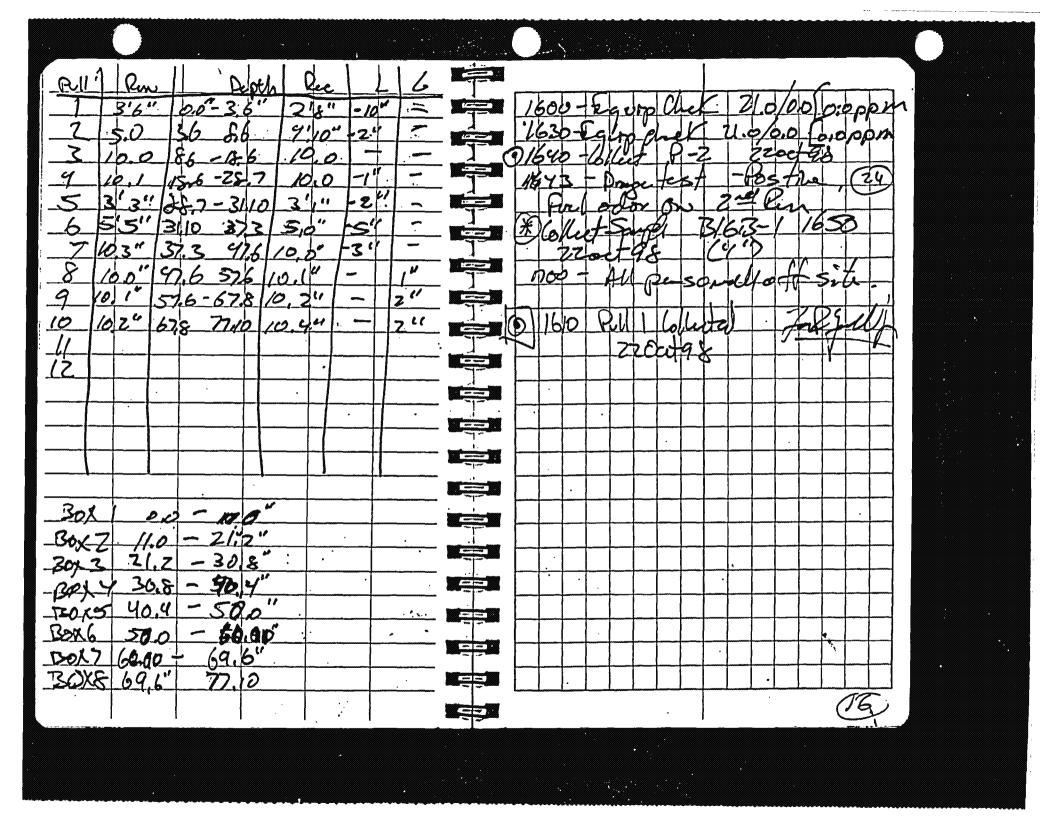


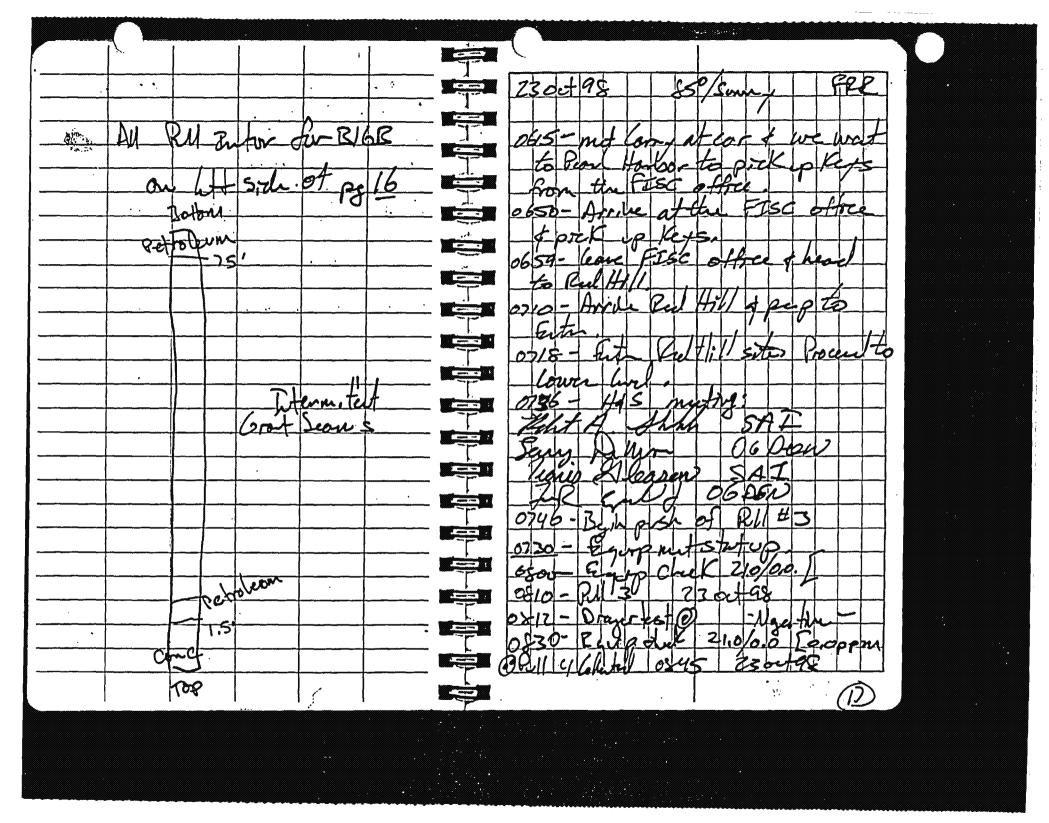


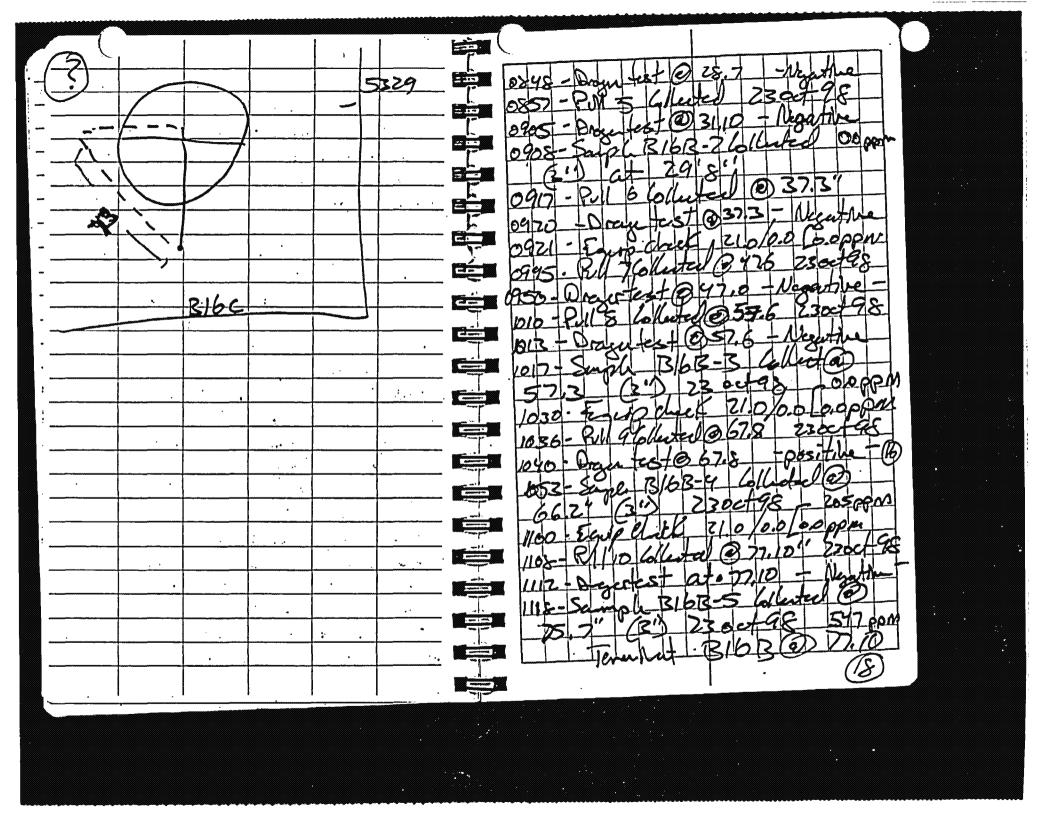


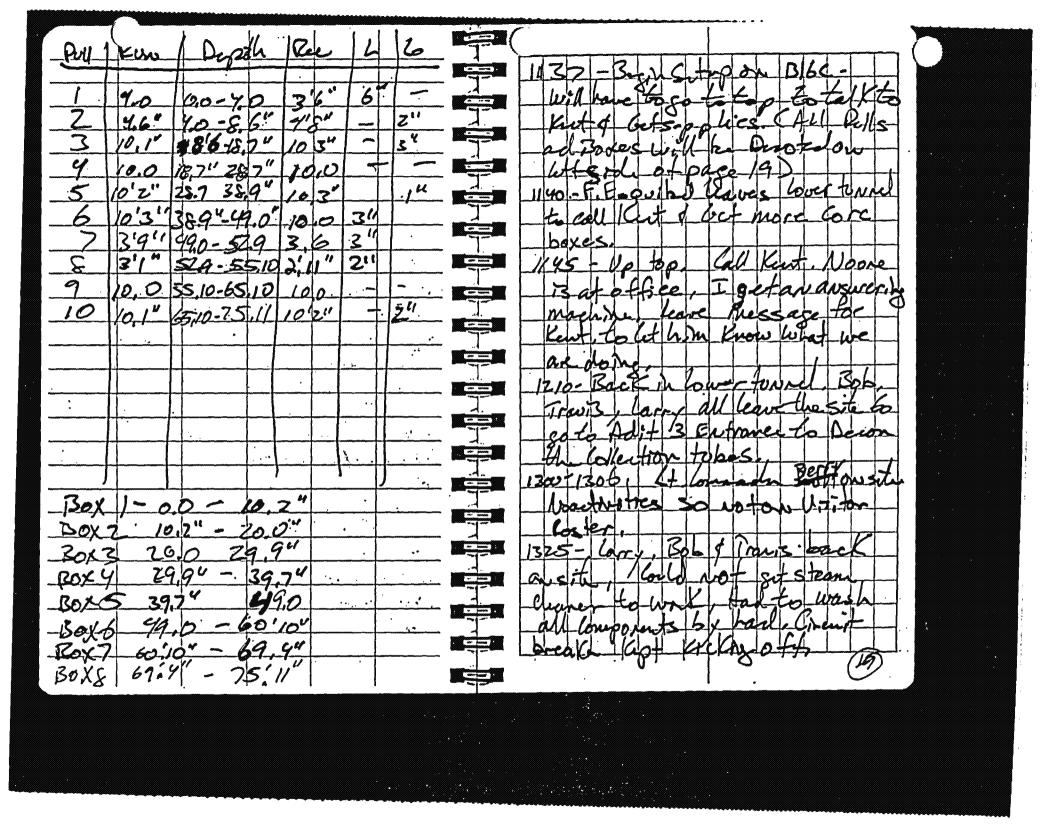


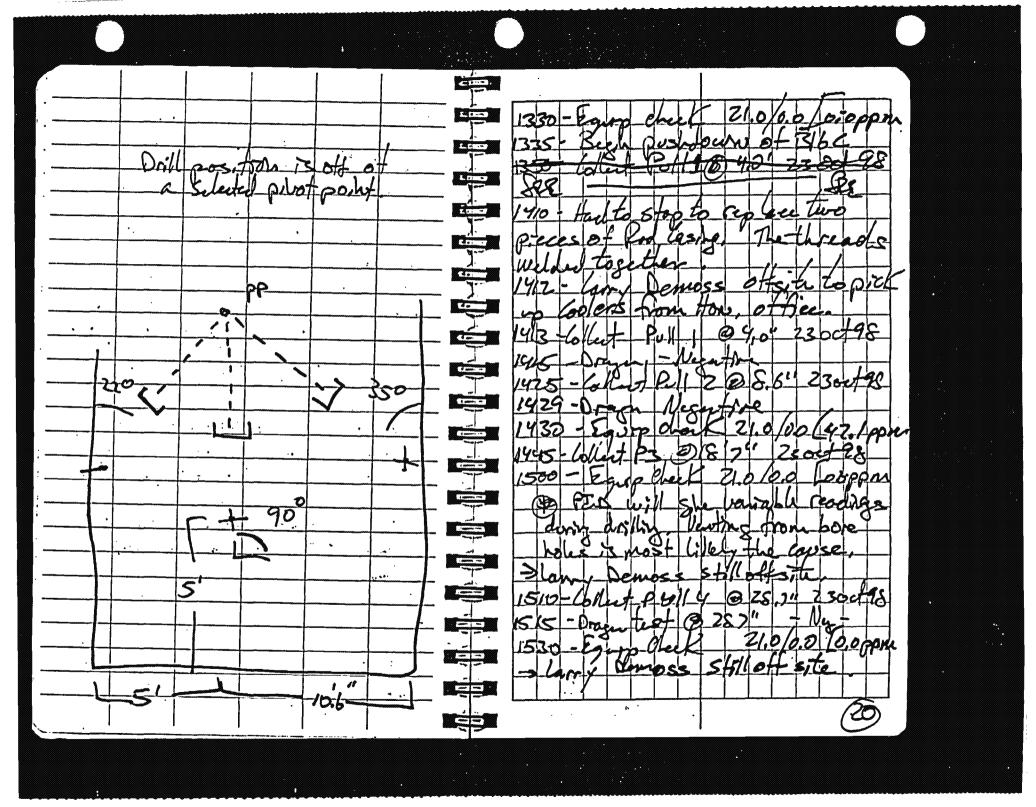


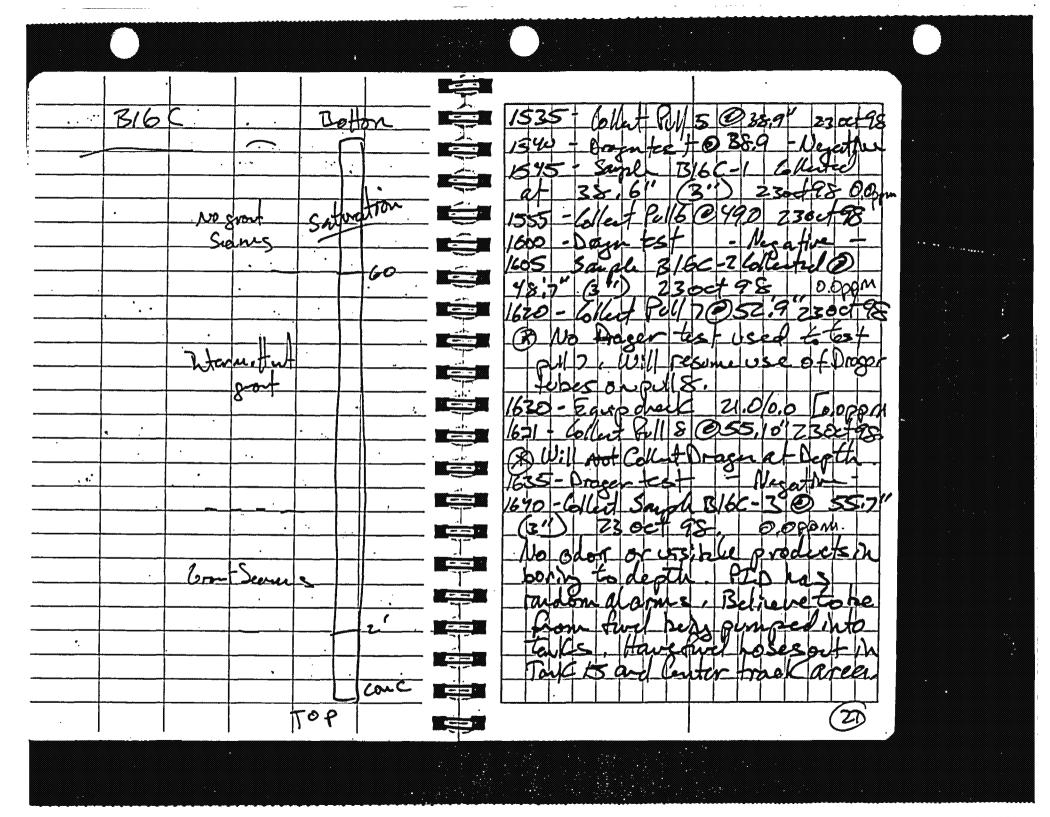


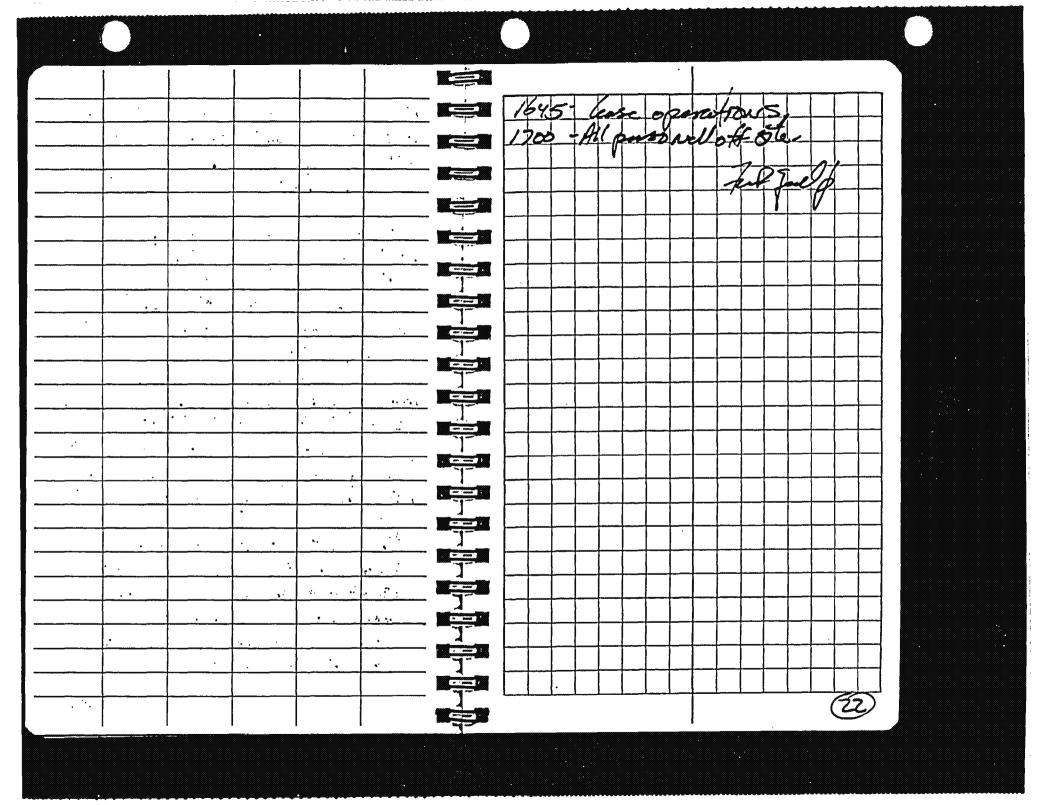


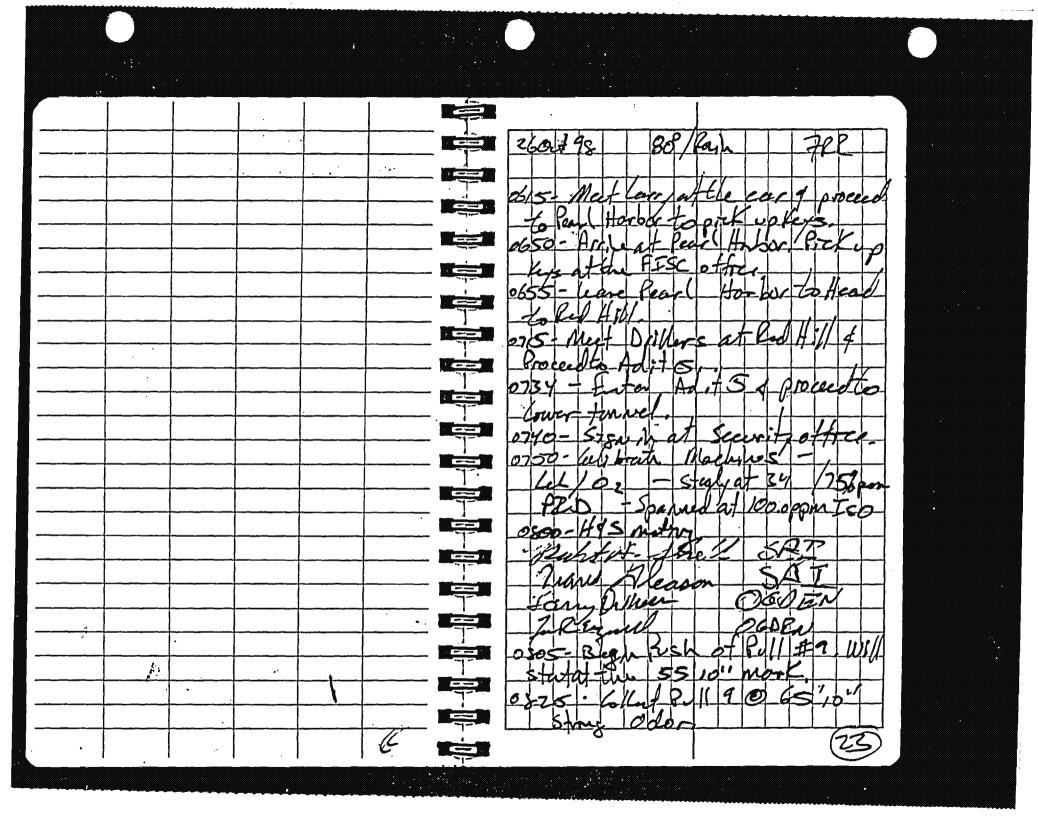


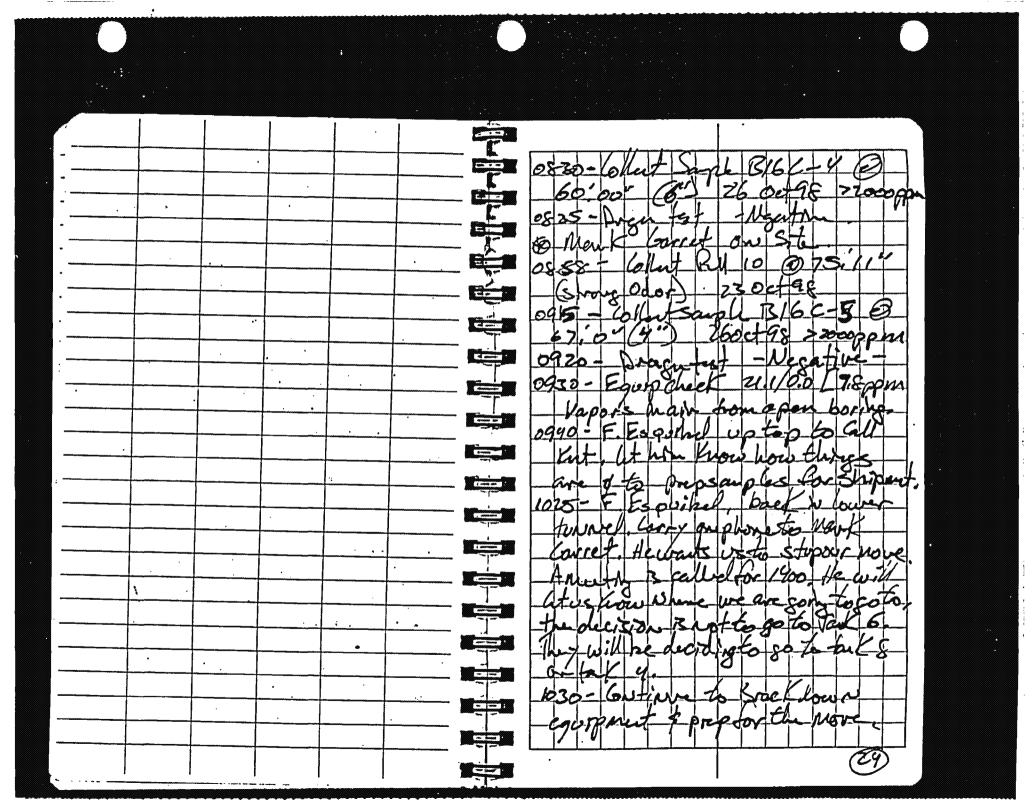


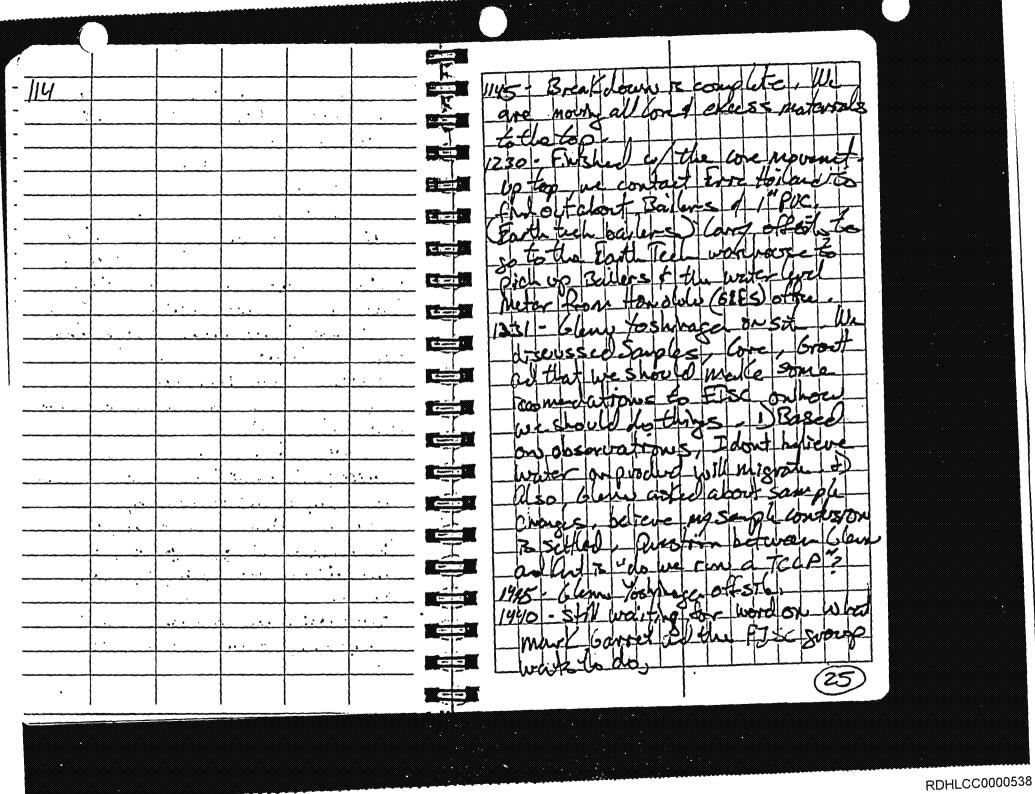


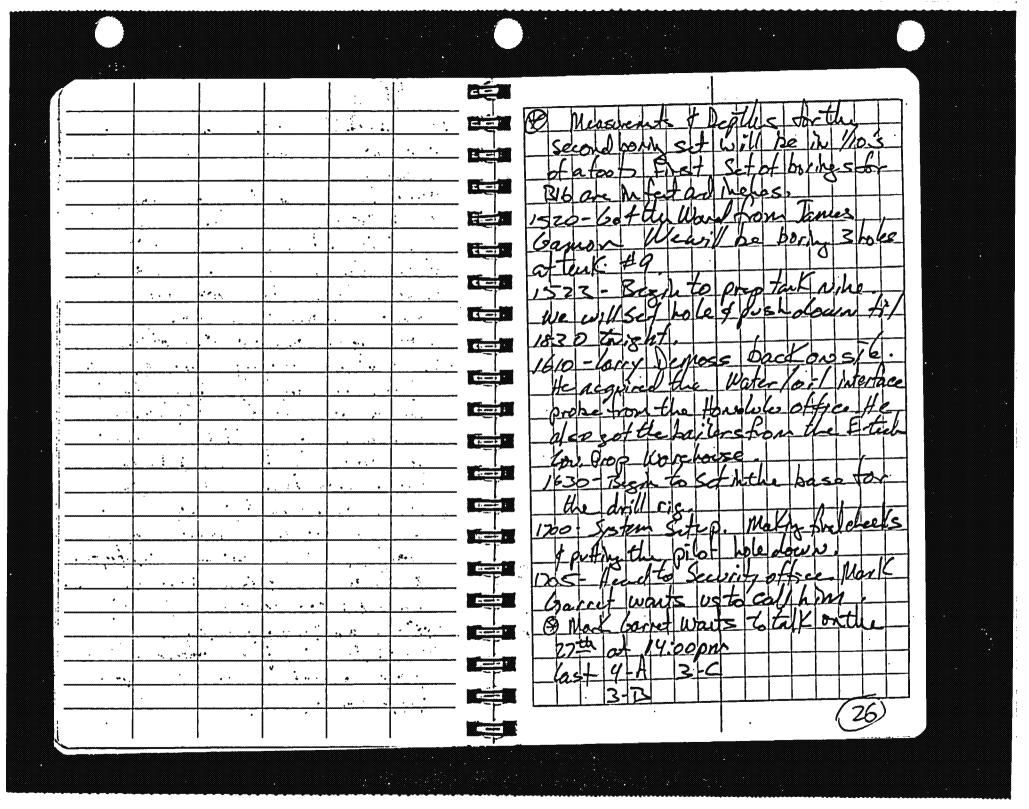


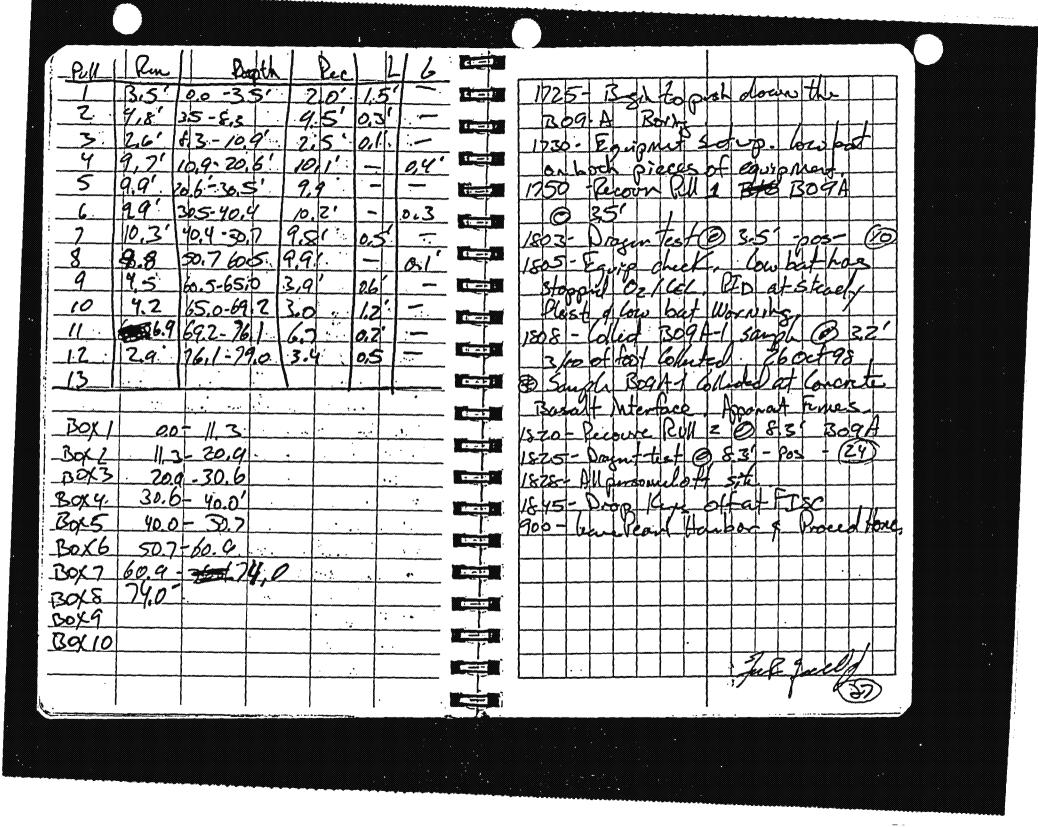


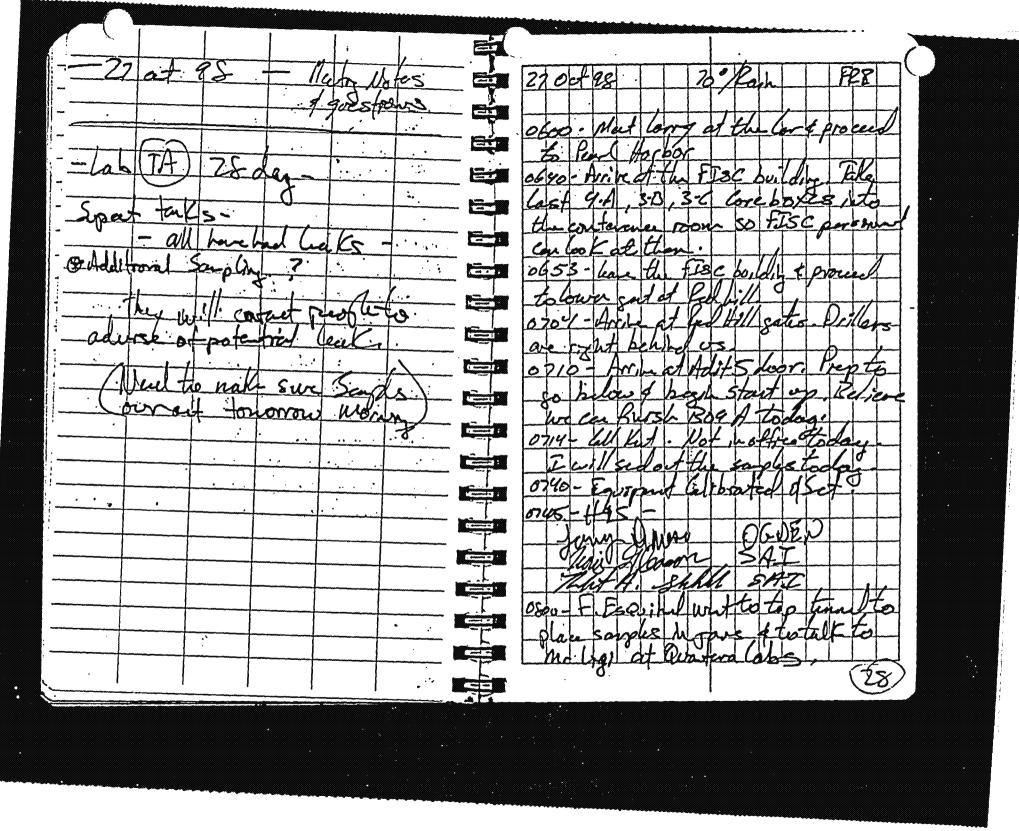


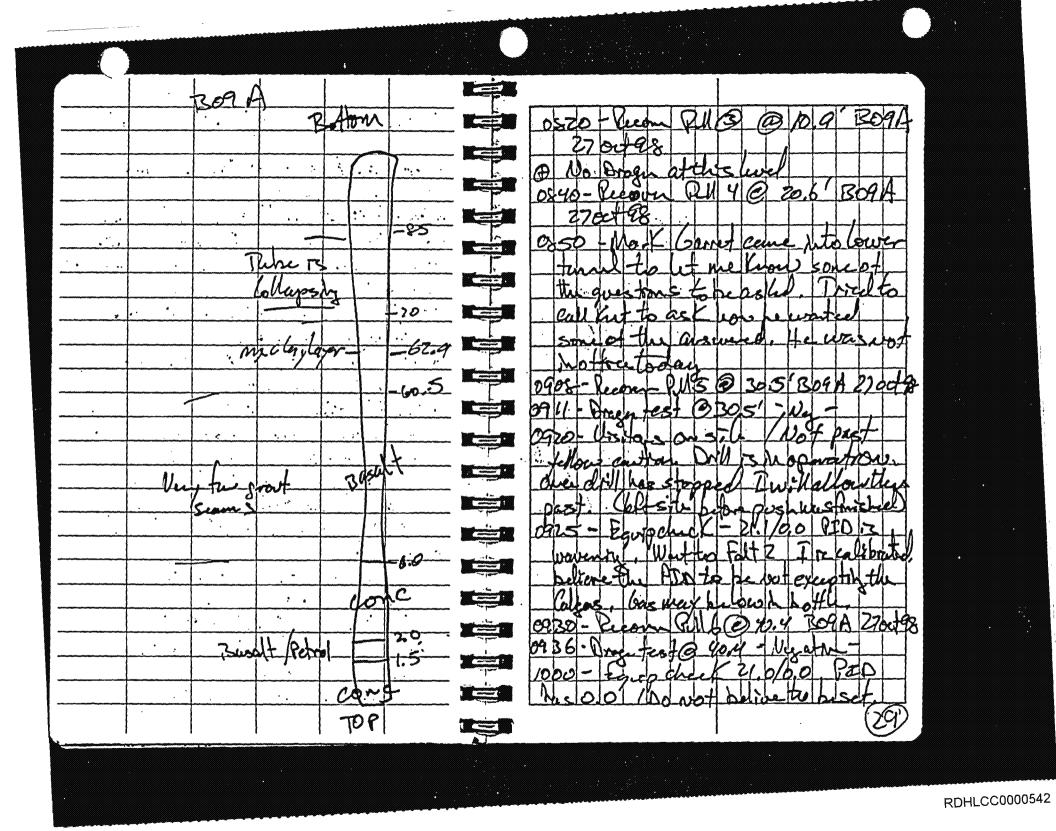


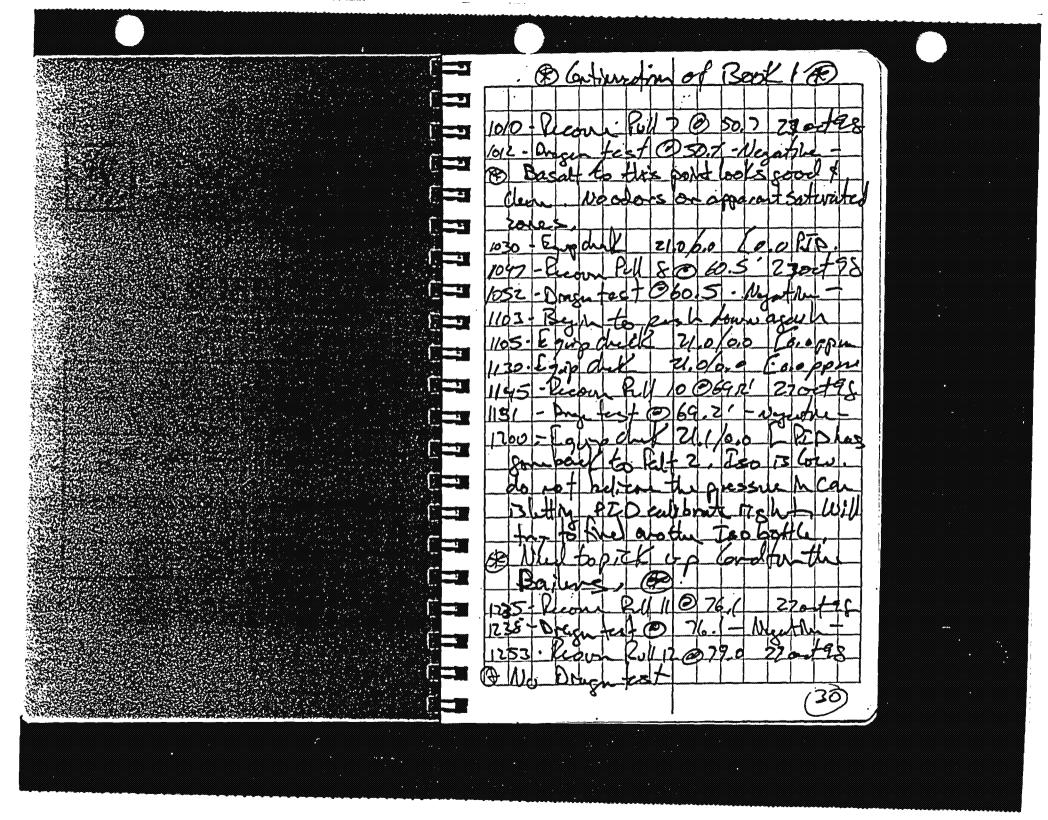


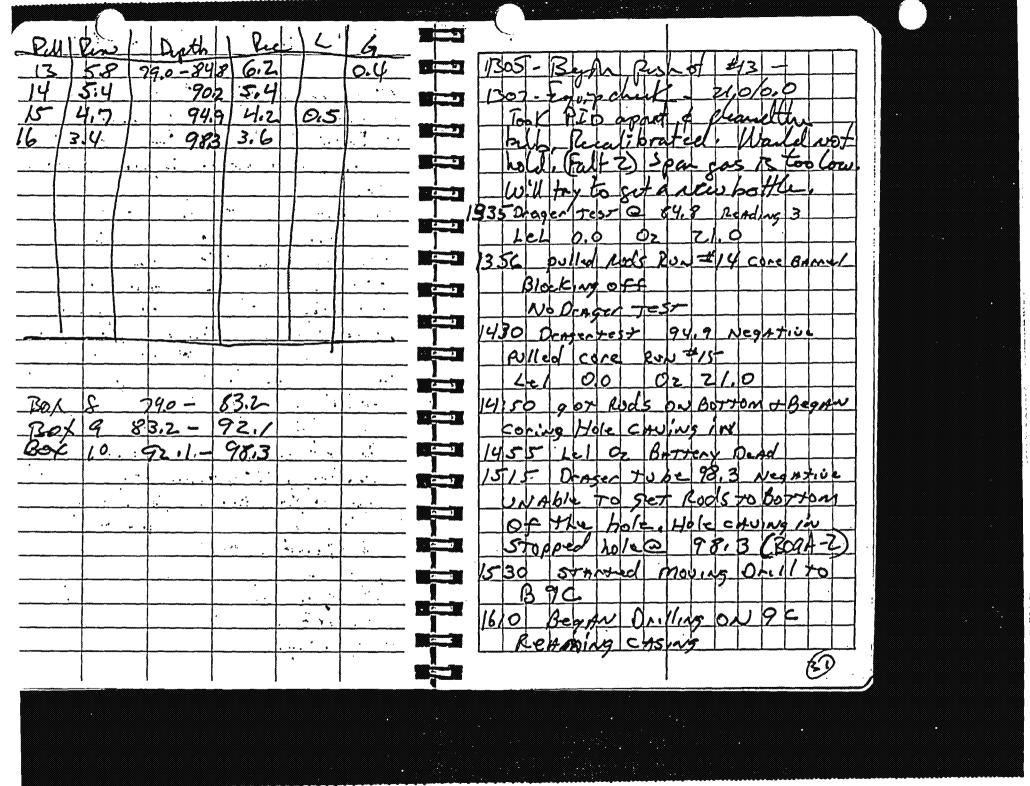


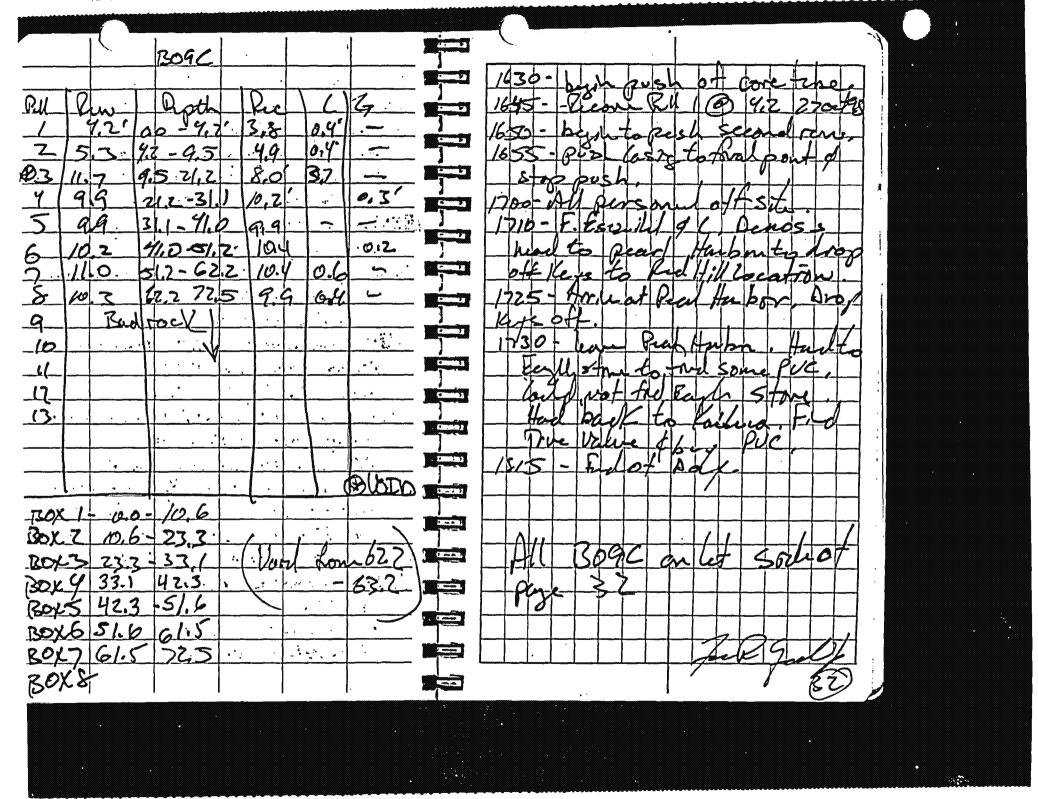


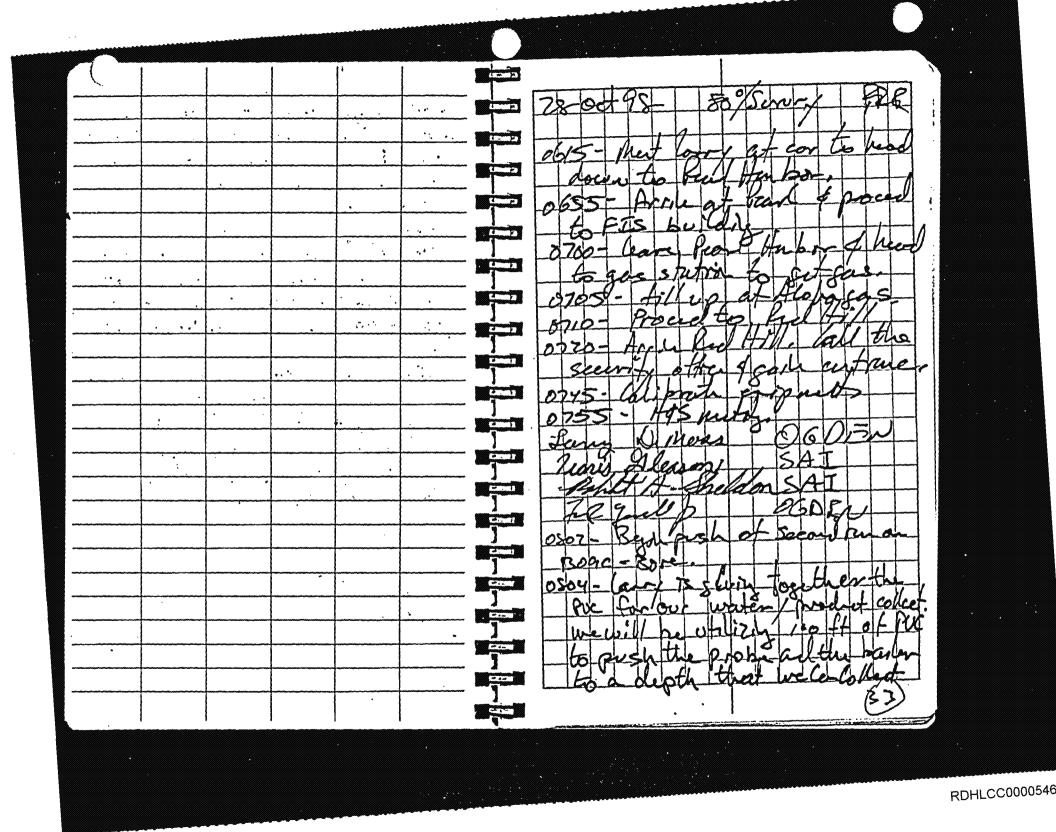


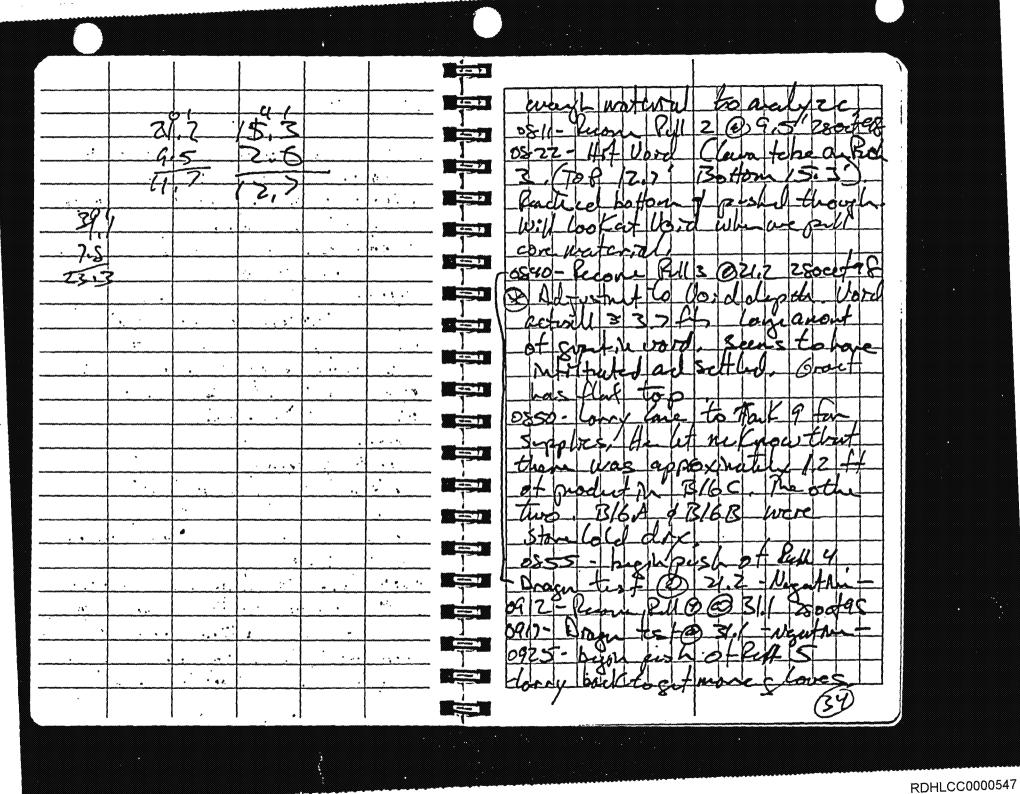


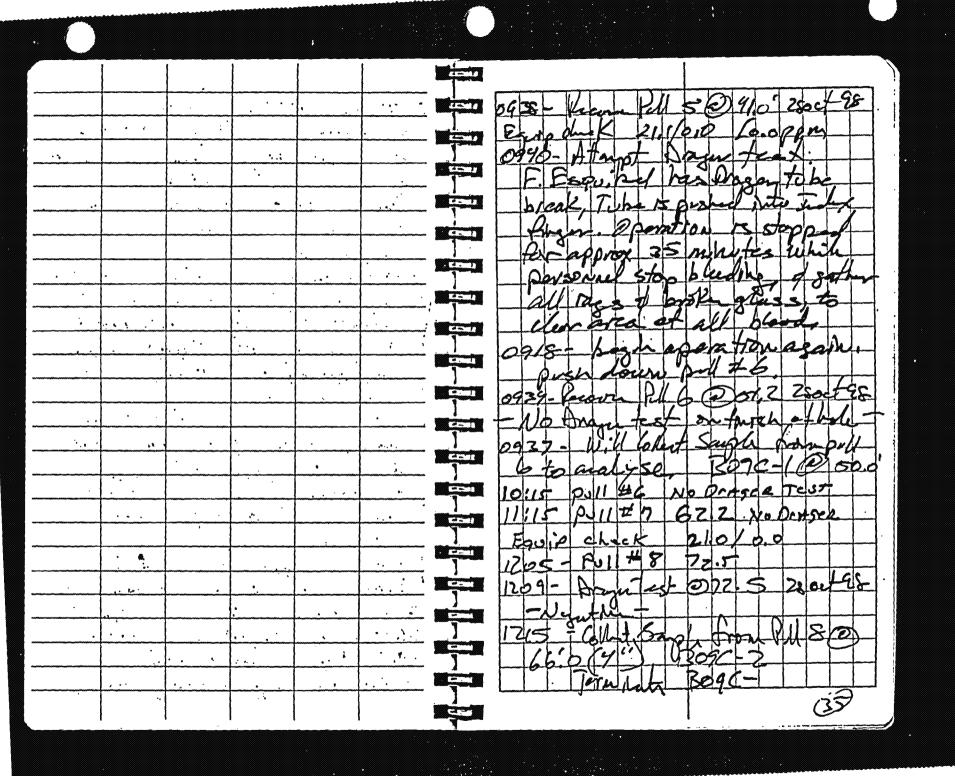


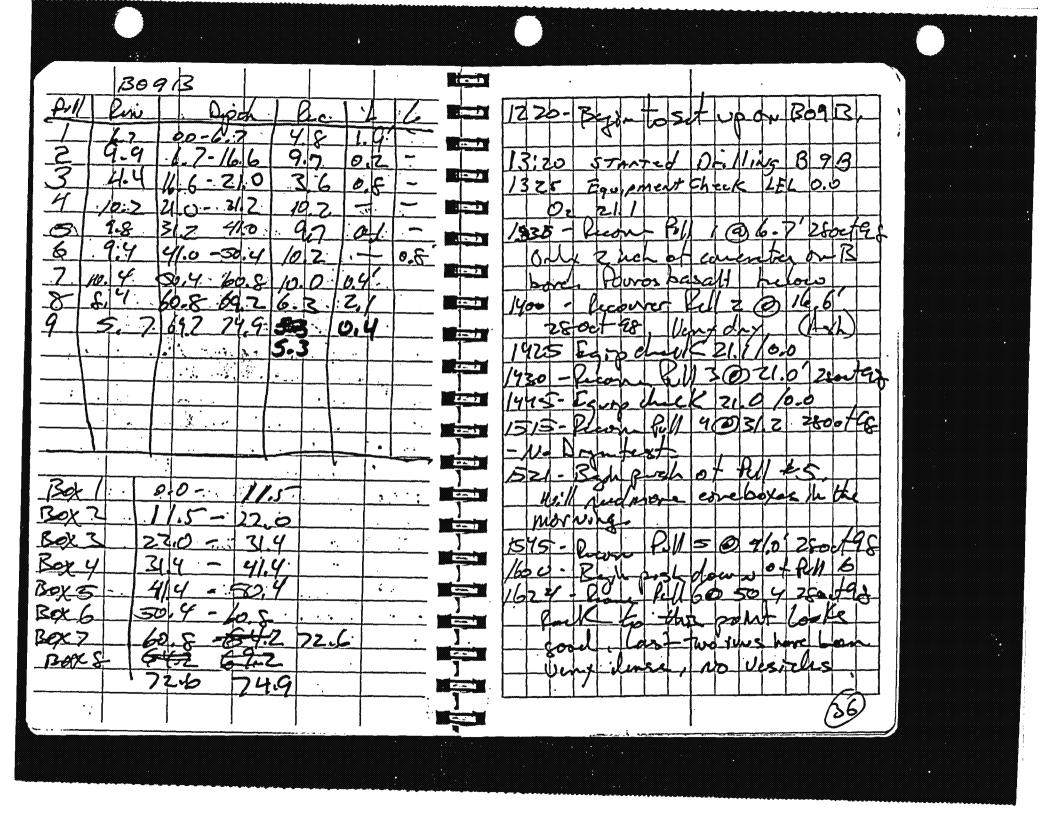


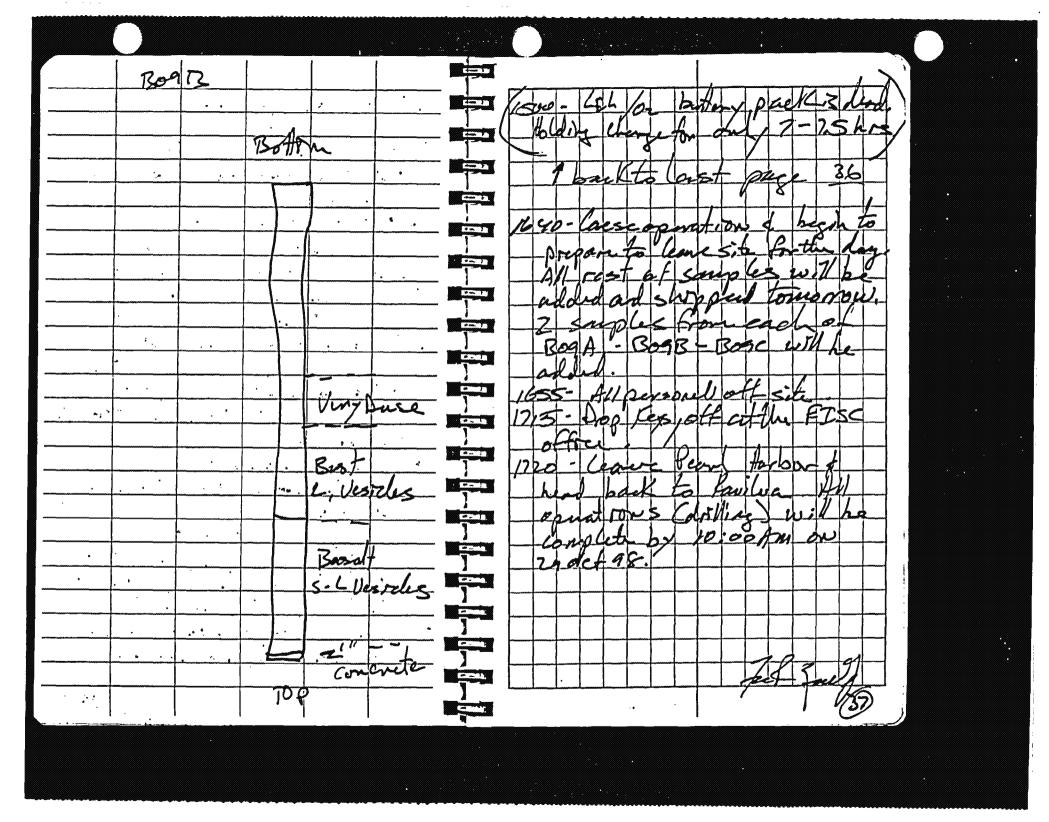


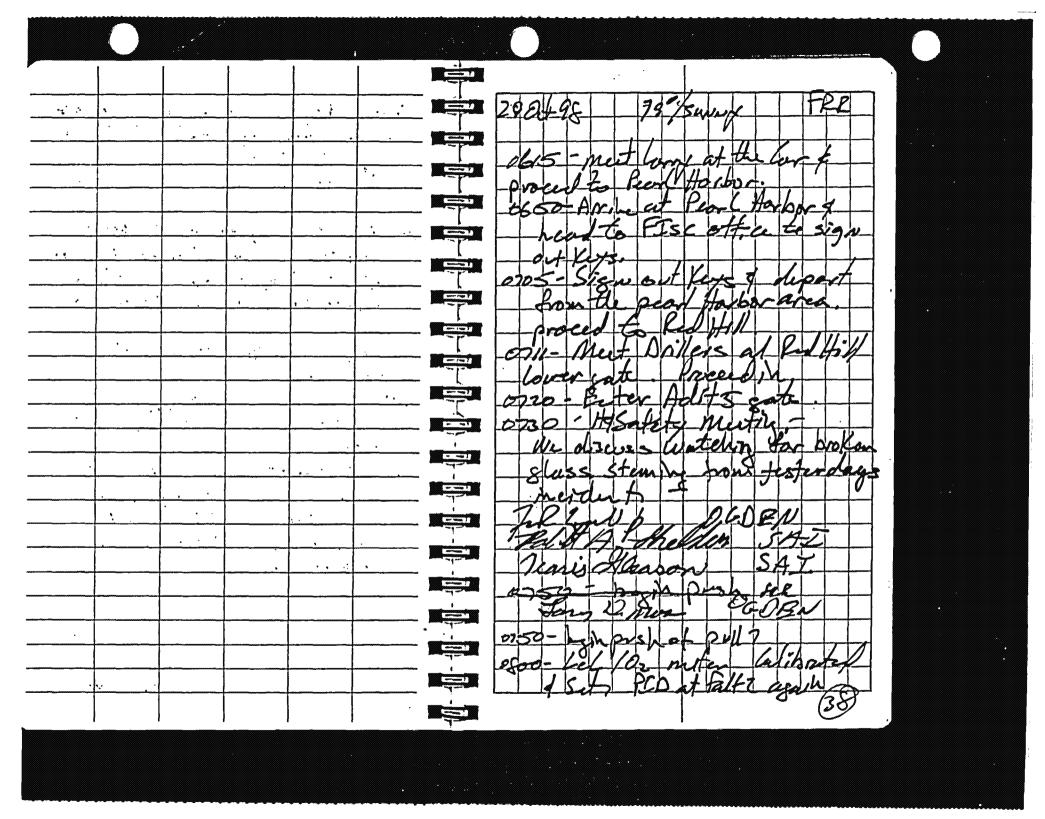


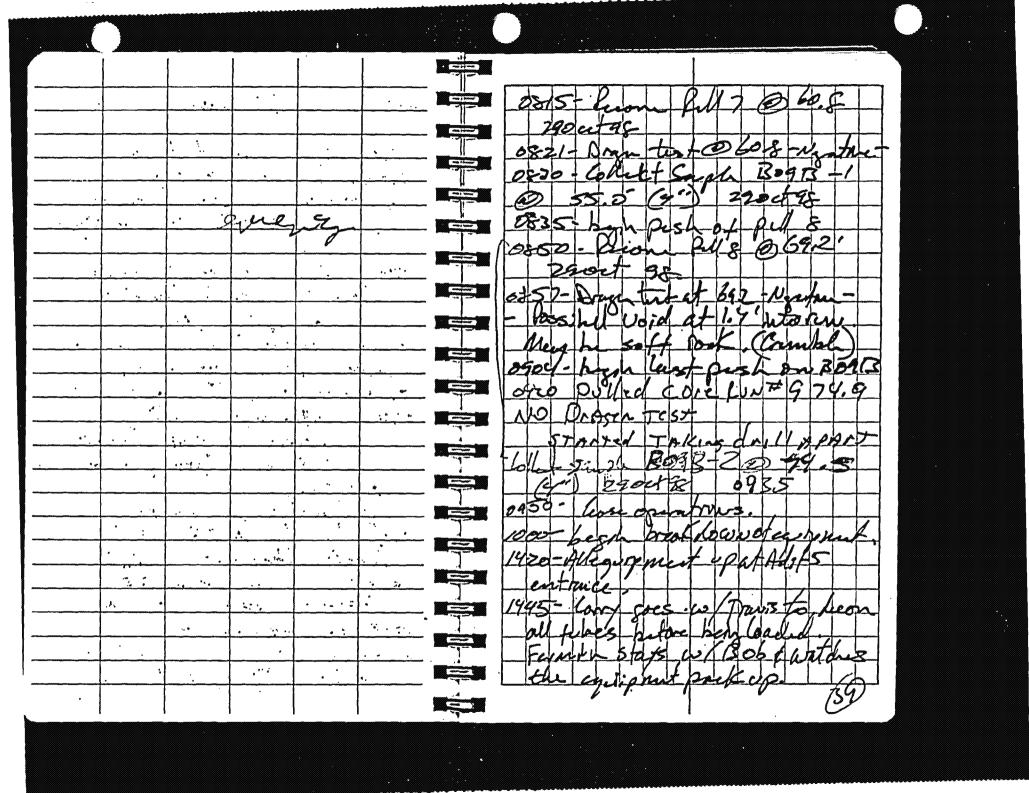


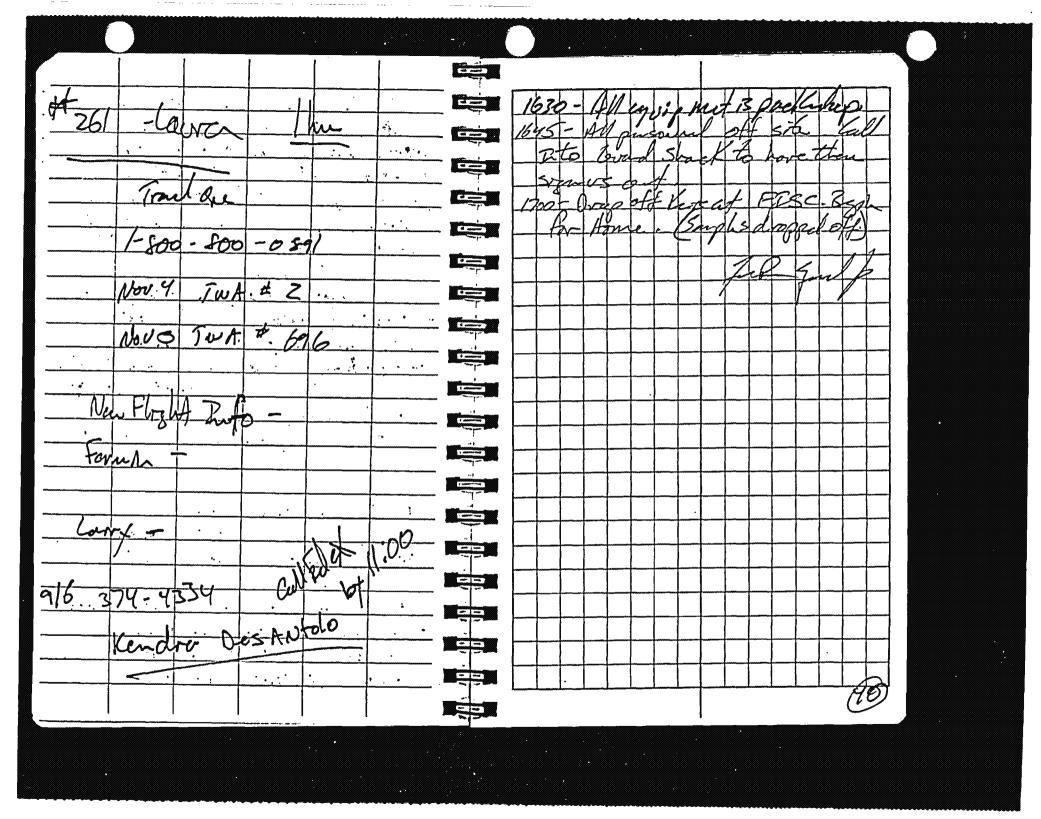


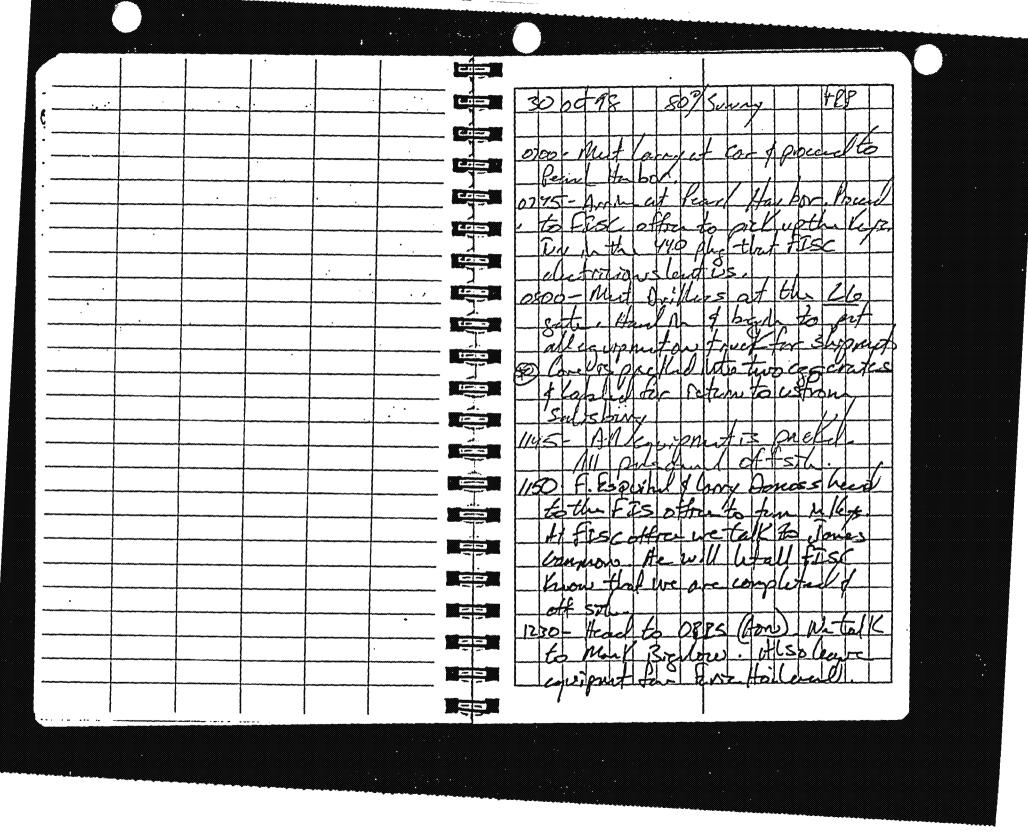


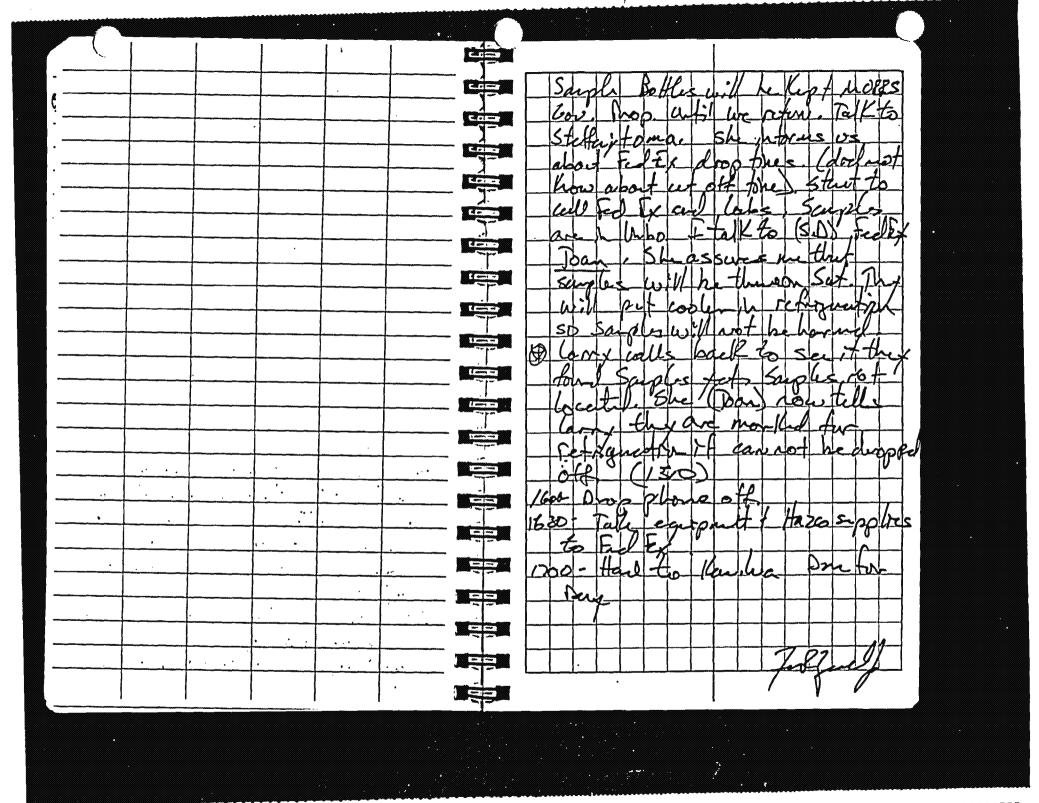


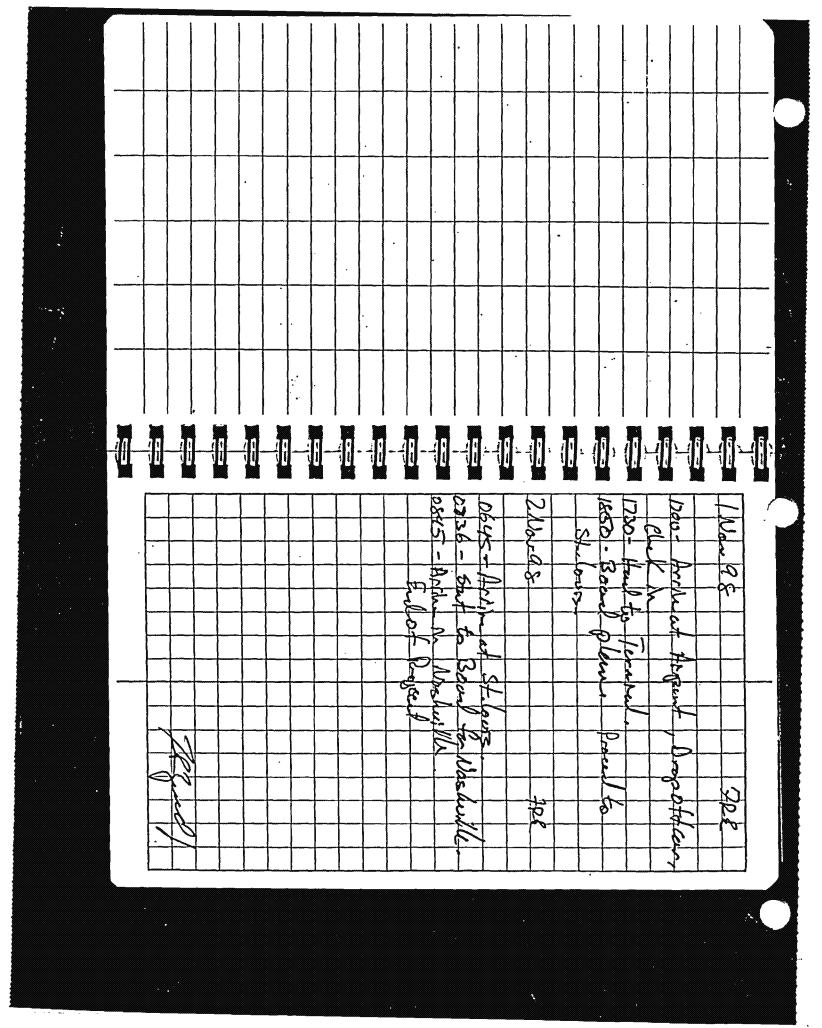


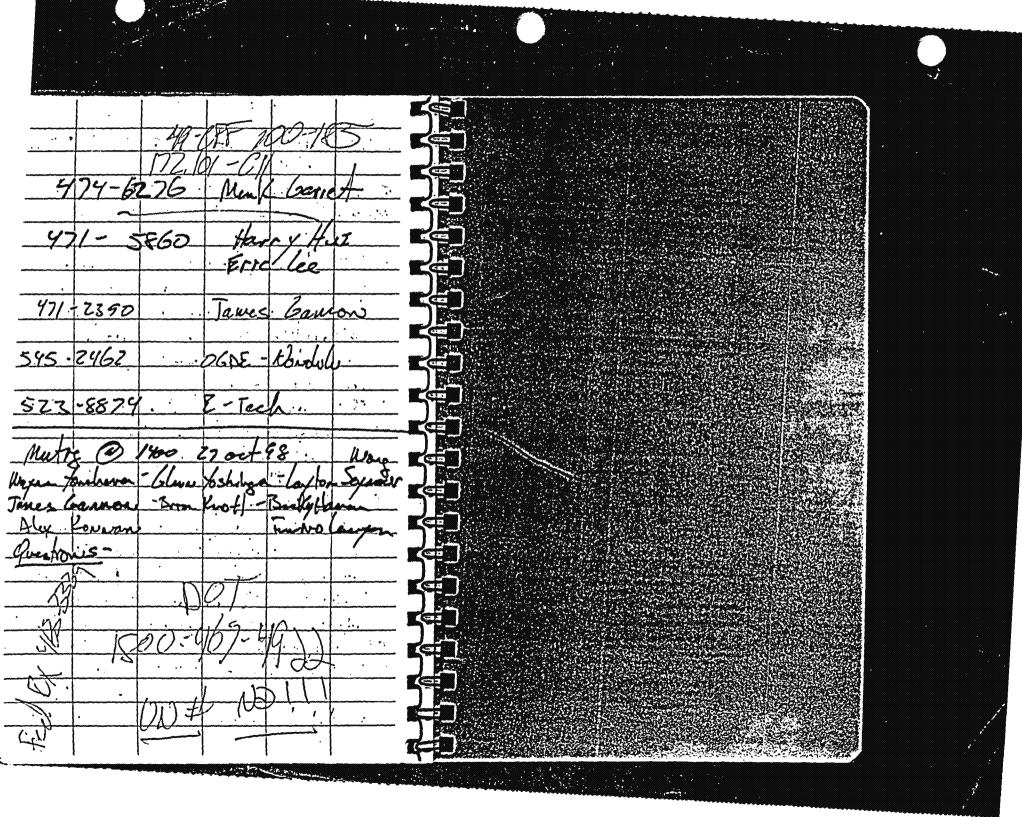














99C0128 March 19, 1999

Commander, Pacific Division Naval Facilities Engineering Command 258 Makalapa Drive, Ste. 100 Pearl Harbor, HI 96860-7300

Attention:

Ms. Linda Yoneshige

Contracting Officer

Code 0231

Reference:

Contract N62742-90-D-0019; Comprehensive Long-Term Environmental Action

Navy (CLEAN), for Pacific Division, Naval Facilities Engineering Command

(PACNAVFACENGCOM), Pearl Harbor, Hawaii

Subject:

Submittal of Initial Phase II Site Characterization Report, FISC Bulk Fuel Storage

Facility at Red Hill, Contract Task Order (CTO) No. 0229

Gentlemen:

Enclosed for your review are 4 copies of the above referenced deliverable. It should be noted that, due to an accelerated reporting schedule, this document is considered Final. Portions of the narrative have been reviewed for technical content with additional information suggested during meetings conducted on February 26, 1999. Future revisions can be made by replacing specific pages. A Response to Comment document is attached highlighting indicated revisions. Any questions regarding the technical content of this submittal should be directed to the CTO Manager, Kent Evetts, in the Ogden Huntsville, AL office, at (256) 539-3016. Upon completion of your review, please return your comments to the Program Management Office.

Sincerely,

Jonathan C. Herwig, R.G.

Program Manager

CC: Debra Loo, Contracting Officer Technical Representative (COTR)

Glenn Yoshinaga, Remedial Project Manager

Kent Evetts, CTO Manager Mitra Eskandari-Luick

Inenten C. Herwy

CTO File 0229

Initial Phase II Site Characterization Report (DRAFT) FISC Bulk Fuel Storage at Red Hill

RESPONSE TO COMMENTS

Comments By: Glenn Yoshinaga, PACDIV; Response by Kent B. Evetts March 17, 1999

No.	Page	Reviewer's Comments	Response to Comments
I	Pg.1-1	Tank diameter is incorrect	The text has been revised to reflect the correct diameter of 100'.
2	Pg. 1-2	Tell-tale system: Your description is hard to understand. Please clarify.	The tell-tale description has been revised based on further interviews and drawing research.
3	Pg. 5-4, Table 5-4	The DOH action level for napthalene is 41 mg/kg 9ppm). The table shows napthalene at 43-47 mg/kg (ppm). This is not the same as Table 5-3 which shows napthalene at 43-47 ug/kg (ppb). Please verify which is correct.	ug/kg. It should have stated that the indicated results were in mg/kg. Correction has been made.
4	Pg. 5-4	Results for aqueous matrix was reported in mg/kg units. Should this be mg/l instead?	Yes. Noted revision incorporated

RESPONSE TO COMMENTS

Comments By: FISC; Response by Kent B. Evetts March 17, 1999

No.	Page	Reviewer's Comments	Response to Comments
1	General	Reconsider terminology describing the 'unknown mixture' of petroleum.	FISC representative Norman Kowamoto and Ogden representative Elizabeth Wessling agreed to the following terminology: 'An unknown mixture of hyrdrocarbons eluting in the diesel and motor oil ranges.' This has been incorporated in all applicable sections.
2	Pg. 1-1, 1.1	The approximate size of the tankage is incorrect.	The text has been revised to reflect the correct diameter of 100'.
3	Pg. 1-2	The description of construction and the telltale need to be revised.	The tell-tale description has been revised based on further interviews and drawing research.
4	Pg. 1-2	Need to provide a matrix of tanks, product service and dates of product service.	Table 1-1 has been added based on the history document provided by Jim Gammons.
5	Figure 3-5	Delete Red Hill Oily Waste Disposal Facility reference	Noted revision incorporated.
6	Pg. 2-1, 2.1	Indicate 'feet' after 2000 and 4000.	Noted revision incorporated
7	Pg. 2-2, 2.2	Is the paragraph discussing rocks or aquifers?.	A revision has been made to reflect the paragraph's intent of discussing aquifer bearing bedrock.
8	Pg. 2-3, 2.4	Delete 'Customs' and replace with Security.	Noted revision incorporated
9	Pg. 3-2	Is there an 'N' sized rock core? And what do the letters 'BW' mean?	To avoid confusion these drilling designations have been removed from the report. The N size of 1 1/2" was stated within the text. However, the designations N and BW are standard drilling designations.
10	Pg. 4-2	What does the term "weathering" mean?	A statement as been added defining the term weathering as used in this paragraph. (decomposition of the bedrock)
11	Pg. 4-3, Pg. 4-4	Is there any conclusions that can be obtained from analyzing the before and after results described in these paragraphs?	The following statement has been added. "The observations recorded during the second sampling event tend to indicate that no active ground water seepage has occurred within the

			borings."
12	Pg. 4-6, 4.5	Was the drilling equipment decontaminated before drilling at Tank 9?	Yes, that was the purpose of the decontamination after Tank 16. A statement has been added to clarify this.
13	Pg. 4-7	Recommend, that future analysis of samples be conducted by the API lab in Norman OK.	Noted revision incorporated
14	Pg. 6-1	Second paragraph add " and remedial actions." In the next to last sentence.	Noted revision incorporated
15	General	What are the definitions of weathering, voids and erosion?	As utilized within the context of this report; Weathering = decomposition or diagenisis of the surrounding bedrock due to chemical process. Void = A measurable gap in the rock boring column (Weathering has completely removed less consolidated rock and created a gap). Erosion = In this report the term erosion was used to describe the deterioration of the injected grout.

RESPONSE TO COMMENTS
Comments By: John Herwig; Response by Kent B. Evetts
March 17, 1999

No.	Page	Reviewer's Comments	Response to Comments
1	Gen	Incorporate comments in text.	Noted revisions incorporated
2	Section 2.2	 Provide references for material 2nd P - Describe aquifers as "caprock" vs. "consolidated deposits". 	 References from Section 7 have also been denoted in text. Noted revision incorporated
3	Section 2.3	 Provide references. 2nd P, last sentence – PH is seaward. Not clear what you mean. 	See above response Noted revision incorporated
4	p. 4-2, 2 nd P, 3 nd P	 Indicate grout associated with injection during construction. Indicate man-made fractures associated with blasting during construction. 	Noted revision incorporated Noted revision incorporated
5	Section 4.1	 X-sections showing stained and saturated intervals would be very useful. Last P – indicate if stained intervals/saturation associated with unusual fracturing. 	 This suggestion will be considered for the next drilling phase.
6	p. 4-7, 1 st P	Indicate if visible contamination associated with all samples.	 Noted revision incorporated
7	Section 5.1	On p. 4-7, you mentioned a sample with 8100 TPH. Not apparent here. Clarify.	• The 8100 is for aqueous results as described by section 5.2.