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RCRA Facility Investigation Field Work

Phase I

Portsmouth Naval Shipyard

(Contract #N62472-86-C-1283)

Kittery, Maine

Prepared for:

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1.0 INTRODUCTION

Fred C. Hart Associates, Inc. (HART), was retained by the Department of the Navy, Northern Division to perform RCRA Facility Fieldwork-Phase I at the Portsmouth Naval Shipyard, Kittery, Maine. The scope of work performed is defined in Amendment #4 (revised) of Contract #N62472-86-C-1283. All field methodologies and procedures were performed in accordance with RCRA Facility Investigation (RFI) proposal (revised August 1989).

The Phase I work Field Work Investigation involved the DRMO facility (SWMU #6), the Jamaica Island Landfill (SWMU #8) and the Mercury Burial Sites (SWMU #9). Test borings were drilled and monitoring wells were installed at all three SWMUs and soil samples were collected and submitted for laboratory analyses. Groundwater samples were collected and analyzed from the Mercury Burial (SWMU #9) monitoring wells. A geophysical program consisting of magnetometry and ground penetrating radar was conducted at SWMUs #8 and #9.

This report summarizes all field activities, includes hydrogeological and geophysical interpretation and presents laboratory results.

2.0 EXECUTIVE SUMMARY

Fred C. Hart Associates, Inc. (HART), performed the RCRA Facility Investigation Fieldwork--Phase I at the Portsmouth Naval Shipyard, Kittery, Maine as described in Amendment #4 (revised) under Contract #N62472-86-C-1283. All methodologies and procedures as described in the RCRA Facility Investigation (RFI) proposal (August 1989) were followed during the performance of this work. As described in Amendment #4, the scope of work entails field work in the DRMO facility (SWMU #6), Jamaica Island Landfill (JILF, SWMU #8), and the Mercury Burial Sites (SWMU 9), and a written field report requirement. The following is a synopsis of Phase I Investigation.

<u>DRMO Facility</u>

Seven test borings were drilled at the DRMO and overburden monitoring wells were installed. Fourteen soil samples were collected from these borings and were analyzed for priority pollutant metals, total petroleum hydrocarbons (TPH) and PCBs. Bedrock was confirmed in all borings by rock cores. All monitoring wells were developed after installation. No water samples were collected from these wells for analysis pursuant to Contract Amendment #4.

Overburden beneath the DRMO consists of fill material composed of soil, rock fragments, and wood debris. Large subsurface void spaces were observed during drilling. Aquifer tests show that the overburden is very permeable. Water conductivity readings indicate the groundwater is saline. Water level monitoring results show that the groundwater table is strongly influenced by tidal fluctuation.

Soil analytical results show elevated levels of various metals including cadmium, lead and mercury. PCBs were detected in samples from five of the soil borings. Elevated levels of TPH were detected in 13 of the 14 soil samples. In addition to these compounds, pesticides (4,4'-DDE, 4,4'-DDD, 4,4'-DDT) were detected in three soil samples from one boring.

Twelve surface soil samples were collected from the exterior of the DRMO to assess the potential for wind dispersal from this SWMU. The samples were analyzed for priority pollutant metals, total petroleum hydrocarbons (TPH) and PCBs. Elevated levels of lead were detected in three of the samples. Elevated levels of nickel and silver were detected in one sample. One sample contained detectable amounts of PCBs (360 and 430 ppb). Ten samples and elevated levels of total petroleum hydrocarbons.

One sediment sample was collected beneath the DRMO's storm sewer outfall. The sample was analyzed for priority pollutant metals, total petroleum hydrocarbons, and PCBs. This sample contained PCBs (540 and 750 ppb), nine metals (including cadmium, chromium and lead) and TPH (380 ppm).

Jamaica Island Landfill

Eleven test borings were drilled at the perimeter of the JILF. Upon drill refusal, cores were cut to confirm the presence of bedrock. Twenty-eight soil samples were collected from the borings and were analyzed for volatiles, semi-volatiles, PCBs, pesticides, metals and cyanide. A total of eight shallow monitoring wells were installed; five in saturated overburden, one in bedrock, and two across the overburden/bedrock contact. All wells were developed subsequent to installation, but no samples were collected pursuant to Contract Amendment #4.

The boring program showed that fractured bedrock is overlain by both fill material and natural sedimentary sequences (beach and tidal flat deposits) at the JILF. The composition of the fill is highly variable and generally consists of soils, rock fragments, and anthropogenic materials. A strong petroleum odor and associated staining was observed in saturated soils from several borings.

Soil analytical results show elevated levels of volatiles, semi-volatiles, pesticides, and PCBs. Volatiles were detected in samples from two soil borings. Various semi-volatile compounds were detected in samples from six soil borings. Both volatile and semi-volatile compounds were detected in samples collected below the water table. Pesticide (DDT) was detected in samples from eight borings. PCBs were detected in samples from two borings. A variety of metals were detected in all samples. The metal results are probably largely related to soil materials.

The response of water levels to tidal fluctuations is variable. Generally, those wells adjacent to the estuary exhibit the greatest water level fluctuations. Higher water conductivities and lower temperatures in these wells also indicate estuary influence.

A surface geophysical program was conducted over the JILF as part of the Phase I field work. This program consisted of magnetometry and ground penetrating (GPR) surveys. Magnetometry results show that four strong anomalies exist beneath the JILF. The GPR survey proved ineffective and did not produce interpretive data to enhance interpretation of the magnetic anomalies.

Mercury Burial Sites

A geophysical and test boring program was conducted at the two mercury burial sites within the JILF. The geophysical program consisted of ground penetrating radar survey which was run over the reported mercury burial areas in an attempt to confirm the location of the vaults. Reportedly, the vaults were buried 10 to 18 feet below surface grade. No indication of the vaults were detected with this survey. During the survey, it was found that the penetration depth of this survey was limited to the near surface because of the highly conductive nature of shallow soils/fill.

The test boring program consisted of drilling a total of five soil borings in the vicinity of the burial sites and the installation of four overburden monitoring wells. Petroleum/solvent odors and oily sheen were observed in groundwater from the two upgradient wells. Nineteen soil samples were collected from the boring and were analyzed for RCRA metals. Soil analytical results show detectable RCRA metals throughout the soil column sampled, including mercury. However, there is no definitive relationship of mercury concentration with depth to indicate that the vaults might be leaking mercury.

Four water samples were collected from the wells, field filtered, and analyzed only for RCRA metals. No mercury was detected in these water samples.

Water analyses show low levels in arsenic in all well samples. Low levels of cadmium were detected in samples from the two downgradient wells which suggest that the landfill may be contributing cadmium to the groundwater regime.

3.0 DRMO (SWMU #6)

3.1 Field Program

The following section describes the field work program for the DRMO (SWMU #6) as addressed in the Contract Amendment 4 and specifically defined in the draft Portsmouth Naval Shipyard RCRA Facility Investigation Proposal (RFIP), August, 1989. The field programs related to this SWMU consist of:

- Shallow soil sampling exterior to the SWMU
- Storm sewer/outfall sediment sampling
- Test borings/rock coring
- Monitoring well installation and hydrogeologic evaluation

3.1.1 Surface Soil Sampling

On October 18, 1989, twelve surface soil samples, plus one replicate sample and one rinseate field blank, were collected along an approximately 300-foot arc east, north and west of the DRMO Storage Yard (see Figure 3-1). The objective of the soil sampling program was to assess the potential for contamination caused by wind dispersal of contaminants from the DRMO. Samples were collected from locations which were approximately equidistant from one another. Three of the sample locations (SS-02, SS-08, and SS-09) were moved approximately 20 feet because of asphalt pavement. The field notebook (see Appendix I) identifies the exact sample locations measured from fixed points.

A surface soil sample was obtained from the upper six-inches of the soil column at each location using a properly cleaned stainless-steel trowel. Each sample was placed in a stainless-steel mixing bowl, homogenized and transferred to laboratory-supplied sample bottles. The samples were stored on ice in a field cooler and transported to Resource Analysts, Inc. (RAI), of Hampton, New Hampshire, on a schedule which ensured compliance with holding times. The samples were analyzed for Priority Pollutant Metals, Total Petroleum Hydrocarbons (TPH) and Polychlorinated Biphenyls (PCBs).

railroad tracks
T1
T6
AVENUE
SEAVEY
ST
A25
304
207
68
SS-04
SS-05
SS-06
SS-07
SS-08
SS-09
SS-10
SS-11
SS-12
SS-03
SS-02
SS-01
A74
A20
S
N
fence
EDGE OF DRMO STORAGE YARD
EXISTING DRAINS
172
146
298
PISCATAQUA RIVER

LEGEND

● SURFACE SOIL SAMPLING LOCATIONS

FLOOD
EBB

N

200 0 200
100 FEET 100
GRAPHIC SCALE

FIGURE 3-1

DRMO (SWMU #6)
OFF-SITE SURFACE SOIL
SAMPLING LOCATIONS

FRED C. HART ASSOCIATES, INC.

The stainless-steel trowels and mixing bowls were decontaminated prior to use according to the following protocol:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with 10% nitric acid solution;
4) rinse with distilled water;
5) rinse with methanol; and
6) air dry

Following cleaning, the trowels and mixing bowls were wrapped in aluminum foil to prevent contamination prior to use. All decontamination liquids were collected and containerized during the investigation, stored and later disposed of at the Portsmouth Naval Shipyard (PNS) Hazardous Waste Storage Unit.

3.1.2 Outfall Sampling

On November 1, 1989, a sediment sample (SD-1) was obtained from the outfall at the DRMO Storage Yard (see Enclosure A). Sediment from the outfall was collected with a properly decontaminated stainless-steel hand trowel and placed directly into laboratory-supplied sample bottles.

Prior to sampling, the stainless-steel hand trowel was decontaminated according to the following protocol:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with 10% nitric acid solution;
4) rinse with distilled water;
5) rinse with methanol; and
6) air dry

The trowel was then wrapped in aluminum foil to prevent contamination prior to sampling.

Upon collection, the sediment sample was placed on ice in a cooler and transported to the laboratory on a schedule which ensured compliance with holding times. The sample was analyzed by RAI for Priority Pollutant Metals, TPH and PCBs.

3.1.3 Test Borings/Rock Coring

The test boring program was performed to provide information regarding the type, variability and total thickness of fill and unconsolidated indigenous materials and to locate and characterize the bedrock in the subsurface beneath the DRMO.

The drilling program at the DRMO began on October 31, 1989 and was completed on November 10, 1989. All work was performed under Level D safety conditions. During the drilling operation the ambient air was continuously monitored for organic vapors to determine the need to upgrade the level of safety. Seven test borings, identified as DW-1, DW-2, DW-3, DW-4, DW-5, and DW-6, were drilled and completed as monitoring wells at locations shown on Enclosure A. In addition, two other borings, identified as DSB-6A and DSB-6B, were drilled at locations as shown on Enclosure A. These borings terminated above the water table because of auger refusal, and were backfilled to grade with native material. Auger refusal was presumably caused by bedrock at 5.0 and 7.0 feet below grade, respectively.

Test borings were advanced using the hollow-stem auger drilling technique. CATOH Environmental Companies, Inc. (CATOH), of Weedsport, New York, performed all drilling under the supervision of a HART geologist. A truck-mounted Acker Soil Max boring rig utilizing 4¼-inch ID, hollow-stem augers and an NX-core barrel was used for drilling. Because of the coarseness of the subsurface materials encountered and associated void space, there were no auger cuttings generated.

Prior to drilling the first boring, the drilling equipment was steam-cleaned to remove possible contaminants. All drilling equipment which was to come in contact with the soil, as well as water tanks, pumps, and hoses, underwent the initial cleaning procedure. The drilling equipment was steam cleaned between borings to minimize the possibility of cross-contamination.

A standard two-foot steel split-spoon was used to obtain soil samples in advance of drilling. Samples were obtained at five-foot intervals. As each split-spoon soil sample was collected, the samples were immediately scanned with a photoionization analyzer (HNU) upon opening the sampler. Each sample was described in detail by the HART geologist. Detailed sample descriptions including blow counts, grain size, grain size distribution, moisture content, and color are included in the geologic logs in Appendix III. Because of the coarseness of the subsurface material encountered, poor recovery was frequently encountered thus limiting the number of samples for description and laboratory analyses.

Fourteen soil samples, plus three replicates and one rinseate field blank, were submitted to RAI for chemical analysis. The interval locations for the laboratory submitted samples are shown on the geologic cross-sections located in Section 3.2.1. All samples obtained at the DRMO were analyzed for the following parameters: Priority Pollutant Metals, Total Petroleum Hydrocarbons (TPH) and PCBs.

Prior to sampling, the split-spoons were decontaminated according to the following procedure:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with 1% nitric acid solution;
4) rinse with distilled water;
5) rinse with methanol; and
6) air dry

Samples to be submitted to the laboratory were placed into labeled, laboratory-supplied sample bottles and stored on ice in field coolers for transport to RAI.

Test borings were advanced with 4¼-inch ID, hollow-stem augers until auger refusal at competent bedrock. Upon auger refusal, five-foot bedrock cores were obtained at each location using an NX-core barrel and potable water provided by PNS. Exceptions occurred at location DW-3 where the core barrel

broke after 1.5 feet of coring and could not be retrieved and at DW-4 where coring was stopped after 3.5 feet because of continuous plugging of the core barrel bit. The cores were obtained to determine bedrock composition and the extent of weathering and fracturing. A description of each core was made and included lithology, color, mineralization, and rock quality using the Rock Quality Determination (RQD) method. Rock quality was represented as a percentage of the sum of rock pieces greater than four inches in length over the length of the run. Theoretically, the RQD number reflects the competency of the rock related to fracturing. A low RQD number suggests a high degree of fracturing and a high RQD suggests a low degree of fracturing. RQD numbers are contained in the rock core logs in Appendix III. The cores were stored in covered wooden boxes in a manner which preserved their relative position by depth. Each box was numbered, marked with the cored interval, and retained by HART for future reference.

3.1.4 Monitoring Wells

The monitoring well installation program was designed to supply scientifically valid information concerning the depth to groundwater on-site, the number of subsurface aquifers and their general characteristics, and the groundwater flow directions and their relationships to surface water conditions.

With the exception of DSB-6A and DSB-6B, a monitoring well was installed at each soil boring. Each test boring was backfilled with Hole Plug (bentonite chips) to fill the void left by the removal of cored rock. An exception occurred at DW-5 where 3.2 feet of cored rock was unretrievable and the remaining core hole collapsed.

With the exception of DW-5, each monitoring well was installed in saturated overburden. At DW-5 the well screen was set one foot below bedrock to allow for the appropriate amount of well construction materials. Each monitoring well

was installed within the 4¼-inch hollow-stem augers used to advance the soil boring. The monitoring wells were constructed with two-inch diameter, threaded, flush-joint schedule 40 PVC riser pipe and 10-slot (0.010-inch) manufactured well screen. Most screens were five feet in length, except DW-3 and DW-7 where the screen lengths were ten feet, and DW-6 where the screen length was seven feet. The five and seven foot screens were required because of the relatively shallow and thin nature of the overburden saturated zone and well construction design requirements. Prior to installing the monitoring well, 0.5 to 1.0 foot of sand (the same sand used as the sand pack) was placed through the augers as a base. Following placement of the sand base, the screen and riser pipe were placed in the augers. Clean silica sand (Morie grade 0) was subsequently added through the augers in increments as the augers were gradually withdrawn. This allowed placement of the sand pack around the screen without permitting the borehole to collapse around the screen. Sand pack was added to encase the entire screen and extended from one to two feet above the top of the screen. A one-foot "sand choker collar", consisting of very fine sand (Morie grade 00), was subsequently installed above the sand pack. A bentonite seal, two feet in length, was installed above the "sand choker collar" and hydrated with fresh water, effectively sealing off the screened interval from the rest of the aquifer.

The remainder of each borehole was grouted with a cement or cement/bentonite slurry to land surface while the augers were removed. A lockable protective steel casing was then cemented over each well to prevent unauthorized access and provide protection for the wells. The cement collar around the protective casing was sloped away from the well to divert surface run-off from the well. At DW-2 and DW-4, a curb box was cemented over the well instead of protective steel casing as requested by the Navy.

Well locations and elevations were subsequently surveyed by Frank Emery Engineers/Surveyors of Wells, Maine and a site survey map was produced (see Enclosure A). Well information is summarized in Table 3-1. Monitoring well completion diagrams are located in Appendix IV.

No sooner than 48 hours after grouting was completed, each well was developed to remove fine sediment from the well screen and sand pack to improve the hydraulic connection between the well and the water bearing formation. Wells were developed by utilizing a WaTerra inertial pump system to surge and purge recharging water from the well. The only portion of the WaTerra pump system to come into contact with the well or water was new, dedicated, development materials consisting of high density polyethylene (HDP) tubing and a Delrin foot valve. The tubing was actuated at the surface by hand. A rapid actuating motion simultaneously pumped and surged the well providing optimal development. Development continued until a minimum of 20 well volumes were produced. Only at one well (DW-3) did development produce clear discharge. Measurement of pH, specific conductance and temperature were taken of the discharge water at each monitoring well. Towards the end of development consecutive measurements of the above mentioned parameters were taken in immediate succession. When three consecutive measurements of these parameters indicated ten percent or less variation in specific conductance and temperature and ±0.2 pH-unit, development was considered complete. Table 3-2 summarizes stabilized field parameters obtained during well development. Well development activities are summarized in Table 3-3.

3.1.4.1 Water Level Measurements. Water levels were taken frequently during the field program in order to determine the effects tidal fluctuations had on groundwater. Static water levels were measured by means of steel tape and chalk. The steel tape was properly cleaned between wells to prevent cross-contamination. Water level measurements are recorded in the field notebooks (see Appendix I).

Table 3-1

DRMO (SWMU #6) Monitoring Well Details

Well Nº	Top of PVC Elevation (ft.)[1]	Ground Elevation (ft.)[1]	Screen Setting (ft.)[2]	Sand Pack (ft.)[2]	Sand Choker Collar (ft.)[2]	Bentonite Seal (ft.)[2]
DW-1	110.90	108.95	7-12	6-12.5	5-6	3-5
DW-2	107.94	108.37	10-15	8-16	7-8	5-7
DW-3	110.17	107.86	10-20	8-20.5	7-8	5-7
DW-4	109.11	109.70	10-15	8-15.5	7-8	5-7
DW-5	110.61	108.77	7-12	6-12.8	5-6	3-5
DW-6	111.60	109.55	8-15	6-15.5	5-6	3-5
DW-7	111.00	109.45	10-20	8-20.5	7-8	5-7

[1] Elevation 100.00' Mean High Tide, PNS System is equal to 3.804' U.S.G.S. System

[2] Below grade

Table 3-2

DRMO (SWMU #6) Well Development
Stabilized Field Parameters

Well Nº	Development Date	Time	Specific Conductivity (µmhos/cm)	pH	Temp. (°C)
DW-1	11/10/89	10:54	4,740	7.54	13.1
DW-2	11/07/89	08:50	Off-Scale*	7.10	9.8
DW-3	11/15/89	15:40	Off-Scale*	7.50	9.3
DW-4	11/17/89	16:48	13,800	7.02	13.1
DW-5	11/10/89	10:07	959	6.72	13.3
DW-6	11/14/89	14:30	Off-Scale*	7.77	9.9
DW-7	11/14/89	14:46	Off-Scale*	7.79	9.9

* = Maximum reading from TLC meter is 20,000 µmhos/cm.

NOTE:		
	High Tide on 11/07/89 at 05:18	Low Tide on 11/07/89 at 11:15
	" " " 11/10/89 at 08:04	" " " 11/10/89 at 14:20
	" " " 11/14/89 at 11:26	" " " 11/14/89 at 17:52
	" " " 11/15/89 at 12:18	" " " 11/15/89 at 18:47
	" " " 11/17/89 at 14:08	" " " 11/17/89 at 20:39

SOURCE: Tables of Tides, Sunrise and Sunset, Portsmouth Naval Shipyard, Portsmouth

Table 3-3

DRMO (SWMU #6) Well Development Details

Well Nº	Date	Well Volume (gallons)	Number of Well Volumes Evacuated	Total Volume of Water Removed (gallons)
DW-1	11/10/89	0.34	91.2	31
DW-2	11/07/89	0.75	50.7	38
DW-3	11/15/89	2.11	20.4	43
DW-4	11/17/89	1.05	55.2	58
DW-5	11/10/89	0.46	69.6	32
DW-6	11/14/89	0.47	78.7	37
DW-7	11/14/89	1.47	23.8	35

3.1.4.2 Water Level Monitoring. Two monitoring wells (DW-4 and DW-6) were monitored over an extended period of time to assess the effect of tidal fluctuations on groundwater levels. Water levels were monitored with an In-Situ Hermit data logger/processor (SE1000B) which employed a downhole pressure transducer suspended on a vented polyurethane cable. Water levels were obtained once every hour for 25 hours at DW-4 and once every hour for 40 hours at DW-6. Data logger data is located in Appendix II.

3.1.4.3 Slug Tests. Slug tests were performed in monitoring wells DW-4 and DW-7. Prior to the initiation of a slug test, the static level was measured by means of steel tape and chalk in the well to be tested and the measurement recorded. Water level measurements during the test were made by an In-Situ Hermit data logger/processor (SE1000B) which employed a down hole pressure transducer suspended on a vented polyurethane cable. The data logger allowed rapid acquisition of water level information at rates set by the user. For these tests, the unit was set to record data at a logarithmic rate. This provided a greater number of data points during the early portions of the test when recovery rates were faster. The measurement frequency is outlined as follows:

Hermit Data Logger Sampling Frequency

Elapsed Time	Sample Interval	Number of Points
0-2 sec	0.2 sec	11
2-20 sec	1 sec	18
20-120 sec	5 sec	20
2-10 min	0.5 min	16
10-100 min	2 min	45
100-1000 min	10 min	90

Volume displacement (the slug) was achieved using a cement filled piece of 1.25 inch O.D. PVC pipe with capped ends. The slug was 56.88 inches long and provided a displacement volume of 0.040 $ft.^3$ or 0.302 gallons. Prior to each test, the slug was decontaminated using the following procedure:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with distilled water;
4) rinse with methanol;
5) rinse with hexane; and
6) air dry

The slug was lowered into the well by means of a dedicated length of nylon rope attached to a stainless steel eye hook connected to one end of the slug.

Each test was conducted by measuring the static water level in the well, lowering the pressure transducer to near the bottom of the well, switching on the recorder, and immediately submerging the slug into the water column. Data were collected by the data logger until the water level in the well returned to its original static level. Water level information was then printed out on-site by a portable field printer (see Appendix II).

3.2 Findings

3.2.1 Geology/Stratigraphy

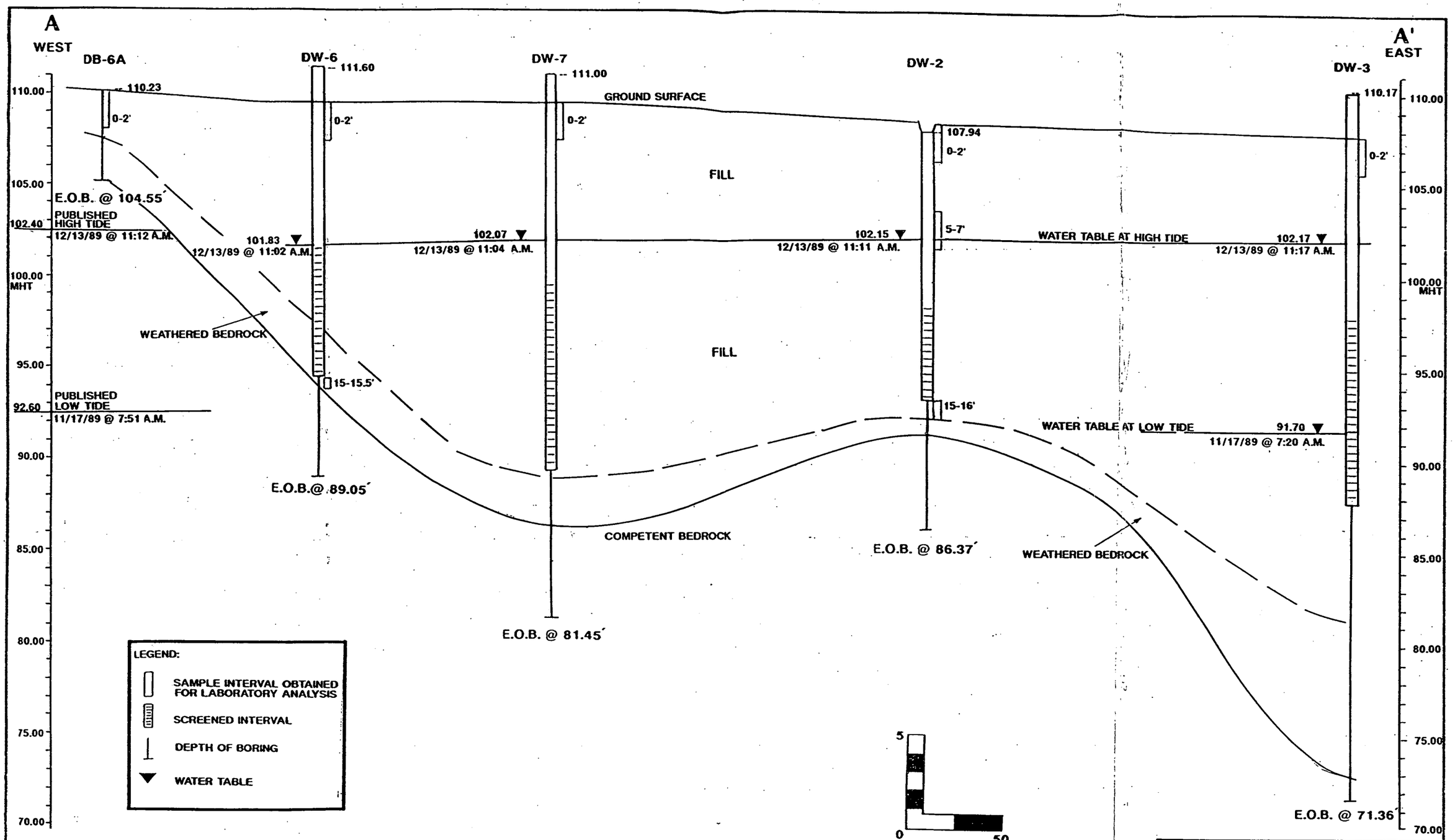
Information from the subsurface boring investigation verifies that the overburden beneath the DRMO is composed of fill material as discussed in the RFIP. The boring logs show that subsurface materials encountered consist of large angular rock fragments, scrap metal, wood debris, sand and gravel, and sandblasting grit (see Appendix III). Large surbsurface voids were observed from the surface during drilling activities. Poor recovery characterized split-spoon soil sampling and is attributed to the coarseness of subsurface materials.

Based on the core samples, bedrock beneath the DRMO consists of a highly fractured dark grey to greenish-grey, fine grained metamorphic rock (quartzite and phyllite). The bedrock surface generally slopes to the east and south towards the Piscataqua River (see Figures 3-2 and 3-3). As discussed in the RFIP, bedrock consists of tectonically deformed Middle Ordovician volcanics and highly fractured metamorphosed sandstones, shales, and siltstones of Silurian age belonging to the Kittery Formation (Hussey, 1985). Metamorphism has destroyed original interparticle porosity in the sedimentary rocks. Therefore, groundwater flow is controlled by fractures.

Geologic cross-sections of the DRMO are shown in Figures 3-2, 3-3, 3-4, and 3-5. Enclosure A shows cross-section locations. Figure 3-2 is an east-west cross-section (A-A', Enclosure A) along the southern margin of the DRMO. This section shows competent bedrock at depths varying from 5 to 35 feet below grade. Overlying the bedrock is a zone interpreted to consist of weathered bedrock of varying thickness. This weathered bedrock zone is interpreted from drilling parameters, torque and penetration rate and probably consists of highly fractured and weathered bedrock which is more competent than the overburden material but less competent than the underlying bedrock. This zone is believed to range in thickness from zero to 9 feet. Overlying the weathered bedrock is fill material containing bedrock fragments, metal scraps, cinders and wood fragments. As Figure 3-2 shows, overburden thickness along this section ranges from 3 to 26 feet.

Figure 3-3 is a northwest-southeast cross-section (B-B', Enclosure A) which shows competent bedrock surface dipping toward the southeast and ranging in depth from 11 to 20 feet below grade. A zone of weathered bedrock is interpreted to overlie competent bedrock at monitoring well location DW-2. Fill material similar to that described above is found overlying bedrock and the weathered zone.

Figure 3-4 is an east-west cross-section (C-C', Enclosure A) along the northern margin of the DRMO. This section shows a gently dipping bedrock surface overlain on the eastern end by a zone interpreted to be weathered bedrock. Fill material consisting of gravel, metal and wood fragments overlies both competent and weathered bedrock. Competent bedrock ranges in depth from 11 to 15 feet below grade. The weathered bedrock zone at well location DW-4 is approximately 5 feet thick.

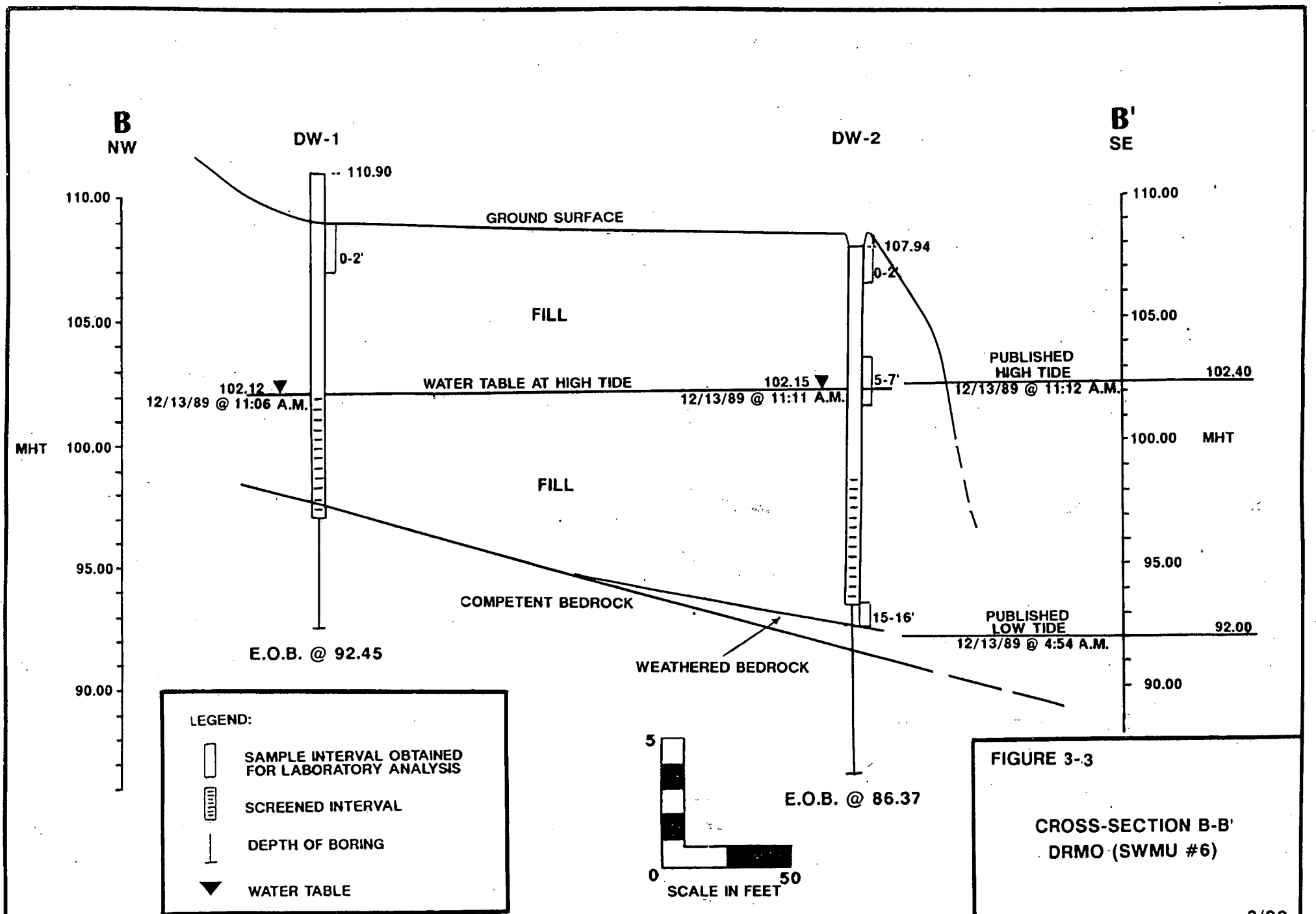


NOTE: ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM

HORIZONTAL SCALE 1 INCH = 50 FEET
VERTICAL SCALE 1 INCH = 5 FEET
VERTICAL EXAGGERATION = 10X

FIGURE 3-2
CROSS-SECTION A-A'
DRMO (SWMU #6)
3/90

FRED C. HART ASSOCIATES, INC.


B
NW
DW-1
DW-2
B'
SE
110.90
GROUND SURFACE
0-2'
FILL
107.94
0-2'
110.00
105.00
100.00
95.00
90.00
MHT
102.12
12/13/89 @ 11:06 A.M.
WATER TABLE AT HIGH TIME
102.15
12/13/89 @ 11:11 A.M.
5-7'
PUBLISHED
HIGH TIDE
12/13/89 @ 11:12 A.M.
102.40
FILL
COMPETENT BEDROCK
15-16'
PUBLISHED
LOW TIDE
12/13/89 @ 4:54 A.M.
92.00
E.O.B. @ 92.45
WEATHERED BEDROCK
E.O.B. @ 86.37
LEGEND:
SAMPLE INTERVAL OBTAINED FOR LABORATORY ANALYSIS
SCREENED INTERVAL
DEPTH OF BORING
WATER TABLE
5
0
50
SCALE IN FEET
HORIZONTAL SCALE 1 INCH = 50 FEET
VERTICAL SCALE 1 INCH = 5 FEET
VERTICAL EXAGGERATION = 10X
NOTE: ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM
FIGURE 3-3
CROSS-SECTION B-B'
DRMO (SWMU #6)
3/90
FRED C. HART ASSOCIATES, INC.

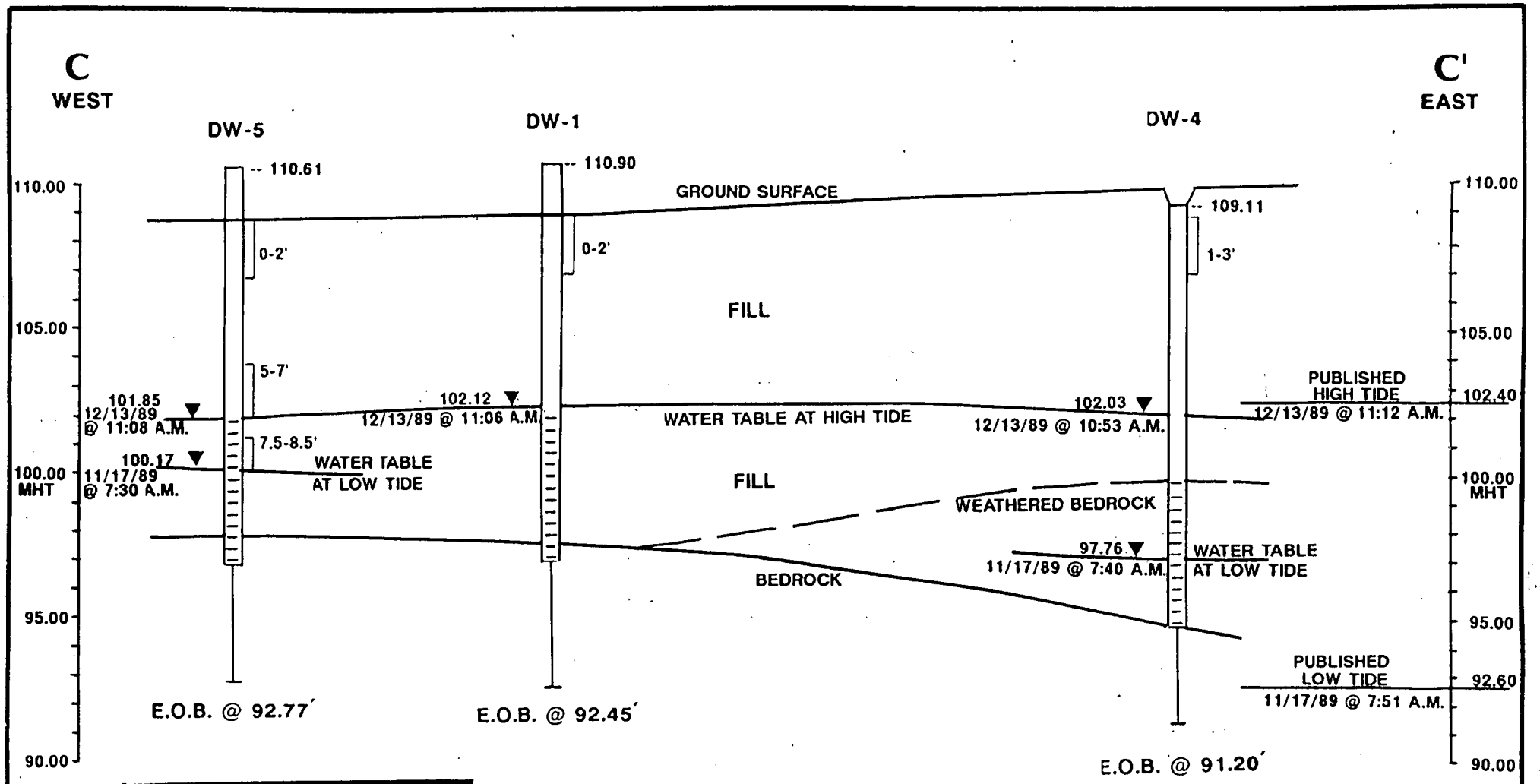


FIGURE 3-4

CROSS-SECTION C-C'
DRMO (SWMU #6)

3/90

FRED C. HART ASSOCIATES, INC.

NOTE: ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM

HORIZONTAL SCALE 1 INCH = 50 FEET
VERTICAL SCALE 1 INCH = 5 FEET
VERTICAL EXAGGERATION = 10X

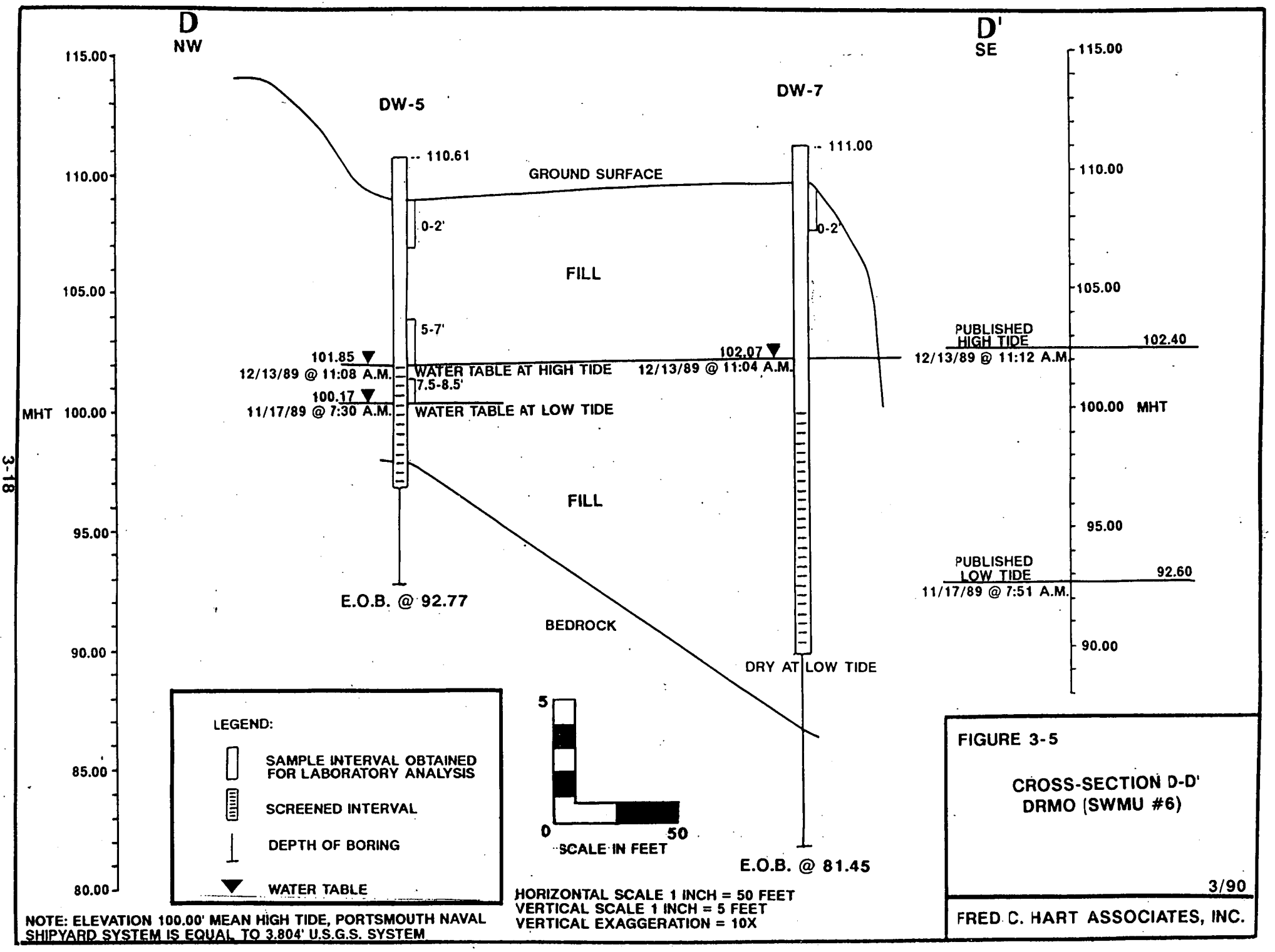

D
NW
D'
SE
115.00
110.00
105.00
MHT 100.00
95.00
90.00
85.00
80.00
DW-5
DW-7
110.61
111.00
GROUND SURFACE
0-2'
0-2'
FILL
5-7'
101.85
12/13/89 @ 11:08 A.M.
WATER TABLE AT HIGH TIME
7.5-8.5'
100.17
11/17/89 @ 7:30 A.M.
WATER TABLE AT LOW TIME
102.07
12/13/89 @ 11:04 A.M.
FILL
E.O.B. @ 92.77
BEDROCK
DRY AT LOW TIME
E.O.B. @ 81.45
PUBLISHED HIGH TIDE
12/13/89 @ 11:12 A.M.
102.40
MHT
PUBLISHED LOW TIDE
11/17/89 @ 7:51 A.M.
92.60
LEGEND:
SAMPLE INTERVAL OBTAINED FOR LABORATORY ANALYSIS
SCREENED INTERVAL
DEPTH OF BORING
WATER TABLE
5
0
50
SCALE IN FEET
HORIZONTAL SCALE 1 INCH = 50 FEET
VERTICAL SCALE 1 INCH = 5 FEET
VERTICAL EXAGGERATION = 10X
NOTE: ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM
FIGURE 3-5
CROSS-SECTION D-D'
DRMO (SWMU #6)
3/90
FRED C. HART ASSOCIATES, INC.

Figure 3-5 is a northwest-southeast cross-section (D-D', Enclosure A) through monitoring wells DW-5 and DW-7. This cross-section shows a dipping bedrock surface ranging in depth from 12 to 23 feet below grade. Fill material as described previously overlies bedrock along this section. No weathered bedrock zone was interpreted to be present in the areas of monitoring wells DW-5 or DW-7.

3.2.2 Groundwater Conditions

The cross-sections (Fig. 3-2, 3-3, 3-4, 3-5) show water table elevation variations in the monitoring wells measured during periods of published high and low tides (reference: Table of Tides). Water level elevations at high tide are essentially coincident with the published high tide information in all monitoring wells. There does not appear to be any overburden control on the movement of subsurface water during the flood tide.

During the attempt to measure water levels at low tide, monitoring wells DW-1, DW-2, DW-6 and DW-7 were found to be dry. Generally, the wells along the shoreline (Figure 3-2) appear to exhibit the greatest water level fluctuations, as a function of the tidal range, compared to the wells along the northern boundary of the SWMU. Water level fluctuations in wells DW-5 and DW-4 range from three to five feet in contrast to published tidal fluctuation for 11/17/89 (8.3 feet) and 12/13/89 (10.4 feet). No water level was detected in well DW-1 which suggests the water table is within bedrock fractures at low tide. The reason for the differences in water elevations in these wells (DW-4, DW-5 versus DW-1) at low tide is attributed to the rate at which water drains from the bedrock system. Subsurface water probably drains more slowly in the vicinity of DW-5 and DW-4 because of poorly developed bedrock fractures. The overburden in DW-1 is drained more effectively by better developed bedrock fractures. Therefore, groundwater flow during periods of ebb tide may be complicated by bedrock fracture systems.

Water level fluctuations in shoreline wells DW-2, DW-3, DW-6, and DW-7, is on the order of ten feet and compares with the published tidal fluctuations (see Figure 3-2). Overburden wells DW-6 and DW-2 are dry during the low tide period suggesting that the water level is within bedrock fractures. Well DW-7 is also dry during low tide but the bottom of the screen is below the published low tide elevation of 91.70 feet. This anomaly is unexplainable with the existing data base and further investigation is required.

The water level in DW-6 was continuously monitored for 40 hours with a Hermit Data-Logger. During times of high tide, the highest water levels were measured in the well (see Figure 3-6). During the ebb tide, the well went dry and stayed dry until after the flood tide began. The published low tide times correspond with the midpoint of the dry well periods. These low and high tide relationships indicate that there is virtually no lag time associated with the response of the well's water level.

The water level in monitoring well DW-4 also rises and falls with the tidal cycles with no detectable lag time (see Figure 3-7). As the figure shows, DW-4 did not go dry during low tide and the troughs of the curves correspond with the published low tides. The steep slopes of the curves during flood tide indicate an immediate response of the water level in the well. The relatively lower slope associated with the ebb tide suggests gravity drainage of water within the overburden saturated zone.

Slug tests were conducted on monitoring wells DW-4 and DW-7. These wells are screened in materials that represent the typical overburden materials beneath the DRMO. From the slug test data, the hydraulic conductivity in DW-4 was derived to be 43.7 feet/day and the hydraulic conductivity in DW-7 was derived to be 40.7 feet/day. Comparison with literature estimates (Driscoll, 1986; Todd, 1970) indicates that the grain size corresponding to these values is gravel. Therefore, the derived hydraulic conductivity values are supported by direct field observations as recorded in the boring logs and by published literature.

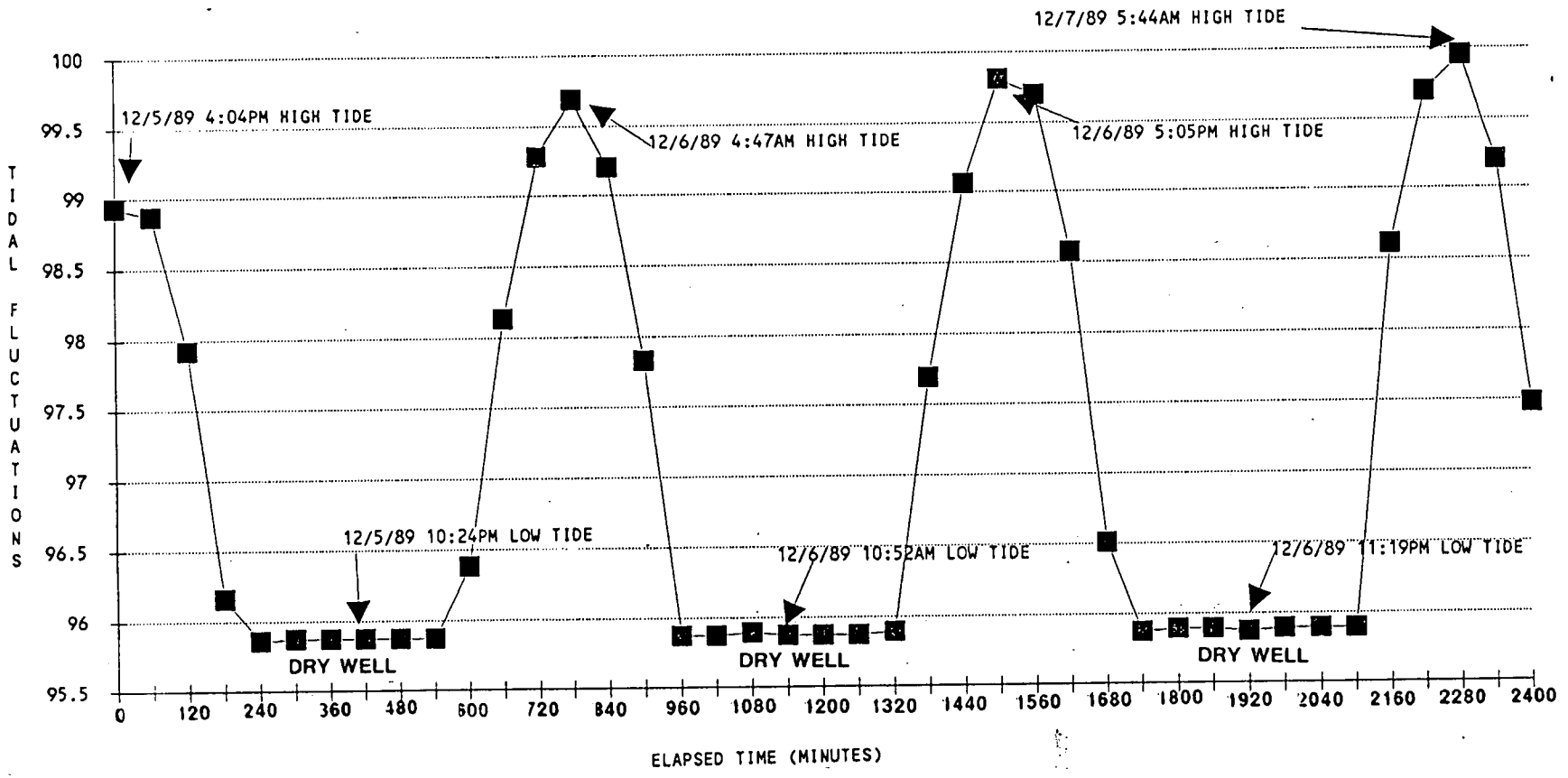


FIGURE 3-6

WATER LEVEL FLUCTUATIONS IN DW-6

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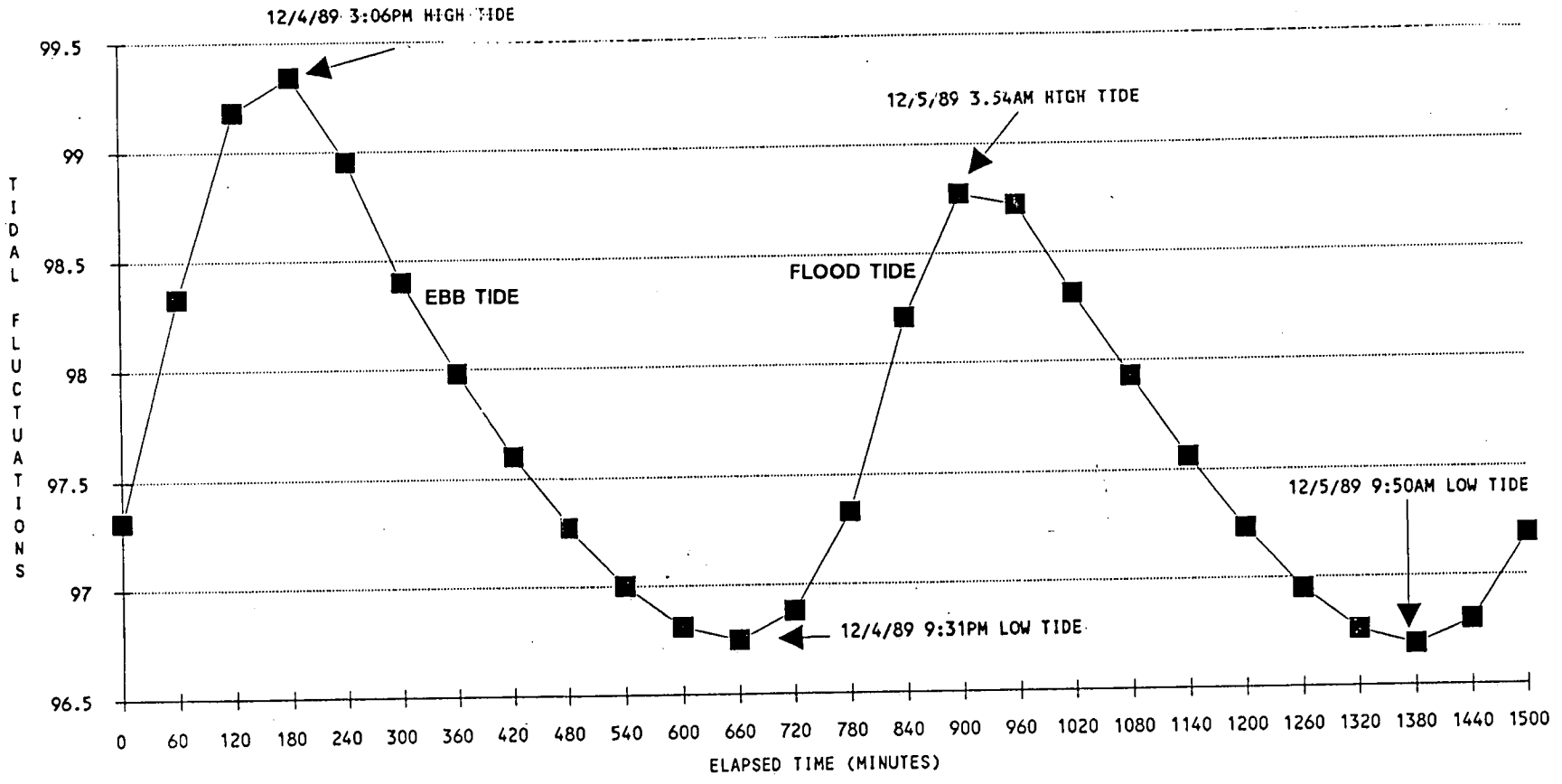


FIGURE 3-7

WATER LEVEL FLUCTUATIONS IN DW-4

FRED C. HART ASSOCIATES, INC.

Specific conductivity readings, obtained during well development, exceed the TLC meter's maximum reading of 20,000 µmhos/cm in wells DW-2, DW-3, DW-6, and DW-7 (see Table 3-2). This high conductivity indicates saltwater conditions in the wells that border the Piscataqua River. Water in monitoring wells DW-1 and DW-4 is less conductive, ranging from 4,740 to 13,800 µmhos/cm, and indicates brackish conditions. The salinity values of brackish water range from 0.50 to 17.0 . Based on these salinity values, specific conductivity of fresh water is calculated to be ± 1,100 µmhos/cm (Ingmanson, and Wallace, 1973). Therefore, the reading of 959 µmhos/cm at DW-5 indicates fresh water. Water temperatures in the wells bordering the river are relatively cool (9.3 to 9.9°C) in comparison to the inland wells (13.1 to 13.3°C). These conductivity and temperature relationships suggest that the shoreline wells are influenced by estuary water. Conductivity and temperature relationships in the inland wells, indicate mixing of warmer fresh water with the cooler saline estuary water.

3.2.3 Analytical Results

Surface soil samples, soil boring samples, and the outfall sediment sample, were analyzed for priority pollutant metals, total petroleum hydrocarbons (TPH), and polychlorinated biphenyls (PCBs).

The standard procedure for analysis of Target Compound List (TCL) organic compounds, which includes TPH and PCB analyses for soil samples, can be found in the most current USEPA "Statement of Work (SOW), Organic Analysis, Multi-Media Multi-Concentration". The standard procedure for analysis of Target Analyte List (TAL) inorganic compounds, which encompasses the priority pollutant metal analysis for soil samples, can be found in the most current USEPA "Statement of Work (SOW), Inorganic Analysis, Multi-Media Multi-Concentration".

The analytical laboratory (RAI) used methods and submitted the required deliverables as stated in the July 1987 Revision of the "Statement of Work of the EPA Contract Laboratory Program" (CLP) and follow-up revisions to the "Statement of Work of the EPA Contract Laboratory Program".

It should be noted that data flags Q, J, and R, in the analytical tables are indications of data quality as defined in the February 1988 "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses" and the July 1988 "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses" prepared for the Hazardous Site Evaluation Division of the USEPA.

As presented in the tables, values that stand alone (without a qualifier) are the most accurate results, and possess both qualitative and quantitative connotations. Numbers that are flagged with a "J" represent qualitative but only semi-quantitative results. Values flagged with a "Q" indicate results that are qualitative only. Finally, the qualifier "R" signifies a result that is unusable based on the QA/QC data validation.

RAI accidentally reported pesticide results for two of the four analytical cases of DRMO soil samples even though pesticide results were not requested by HART. Pesticide results for the other two cases were not reported by RAI but can still be retrieved. Samples associated with RAI job numbers 19491 and 19314 reported pesticides and PCBs on the Pesticide Organic Analysis Data Sheet, Form I. This error was corrected for RAI job numbers 19600 and 19491. Samples associated with these jobs reported only PCB's results as requested by HART.

Three samples analyzed in RAI job number 19600 had associated interferents thus making quantitation difficult. The chemist performancing the analysis qualitated and quantitated the interferents. The following interferents were detected in samples:

Sample ID	Pesticide	Estimated Concentration (ppb)
DSB-6C (0-2')	4,4'-DDE	51
	4,4'-DDD	21
	4,4'-DDT	130
DSB-6C (2-4')	4,4'-DDE	150
	4,4'-DDD	110
	4,4'-DDT	430
DSB-6C (15-15.5')	4,4'-DDD	700

These results were discussed in the data pack's case narrative and not reported on the Form I's.

3.2.3.1 Surface Soils. Surface soil sampling surrounding the DRMO Storage Yard involved collection of twelve surface soil samples at locations equidistant from one another along an approximately 300-foot band east, north and west of the storage yard. These samples were analyzed for priority pollutant metals, TPH, and PCBs. A summary of the valid results of these twelve surface soil samples is provided in Tables 3-4, 3-5, and 3-6.

In 1986, Loureiro Engineering Associates (LEA) collected soil samples at the DRMO as part of their Final Confirmation Study Report (FCS). Soil samples collected by LEA were analyzed for the following metals: chromium, cadmium, lead, and nickel. In addition to the DRMO soil samples, two control samples were also collected by LEA on the shipyard and analyzed for the same metals. The results of LEA's soil analyses were compared to the surface soil samples collected by HART. Lead concentrations in samples SS-01 and SS-10, collected by HART, are an order of magnitude higher than the highest surface soil concentrations for lead in LEA's control samples. Sample SS-02 has a lead concentration two orders of magnitude higher than LEA's control samples. Nickel concentrations are an order of magnitude higher in HART sample SS-10 and two orders of magnitude higher in HART sample SS-11 than LEA's control samples. Analytical results for chromium and cadmium in HART's surface soil samples are comparable to LEA's control samples.

Table 3-4

Summary of Priority Pollutant Metal Concentrations
in Surface Soil Samples: DRMO
Concentration Values = ppm

HART I.D. LAB I.D.	FB-01 1931405	SS-01 1931401	SS-02 1931402	SS-03 1931403	SS-04 1931404	SS-05 1931406	SS-06 1931407	SS-07 1931408	SS-08 1931409	SS-09 1931410	SS-10 1931411	SS-11 1931412	SS-12 1931413	SS-13* 1931414
Antimony	—	35.5J	60.9J	R	R	R	R	1.9Q	R	R	8.3Q	7.4Q	3.0Q	1.9Q
Arsenic	—	10.6J	11.8J	16.4J	21.4J	14.4J	83.8J	32.5J	14.3J	12.1J	13.0J	13.3J	9.2J	9.5J
Beryllium	—	0.34Q	0.43Q	—	0.45Q	0.48Q	0.73Q	—	0.68Q	—	0.65Q	0.50Q	—	—
Cadmium	—	1.4J	2.2J	0.74Q	0.90Q	0.96Q	1.5J	2.0J	—	0.71Q	2.6J	2.5J	0.99J	1.0J
Chromium	—	48.7J	44.6J	38.1J	61.6J	44.9J	79.6J	45.2J	23.6J	35.3J	54.5J	95.3J	19.7J	12.9J
Copper	—	250J	238J	30.5J	52.5J	42.1J	59.7	71.4J	52.3J	559J	5740J	4550J	83.8J	66.6J
Lead	.004	2290	12100	88.9	168	257	417	257	52.0	148	3490	221	301	190
Mercury	—	0.06Q	0.24	0.04Q	0.11	0.10	0.17	0.09	—	0.05Q	0.26	0.75	0.03Q	—
Nickel	—	84.4J	44.6J	38.4J	53.9J	35.6J	41.0J	55.2J	20.7J	41.7J	152J	4970J	27.8J	17.5J
Selenium	—	0.37Q	0.51Q	0.33Q	0.63Q	0.50Q	1.1Q	0.23Q	0.22Q	0.23Q	0.35Q	0.20Q	0.53Q	0.32Q
Silver	—	—	—	—	—	—	—	2.3J	—	—	2.4	8.1	—	—
Thallium	—	R	R	R	R	R	R	R	R	R	R	R	R	R
Zinc	—	299J	714J	64.9J	117J	171J	149J	214J	224J	138J	1030J	805J	250J	349J

J = Qualitative and Semi-Quantitative

Q = Qualitative only

R = Unusable result

— = Not detected

* = HART replicate sample of SS-12

Table 3-5

Summary of Total Petroleum Hydrocarbon Concentrations
in Surface Soil Samples: DRMO
Concentration Values = ppm

HART I.D.	FB-01	SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10	SS-11	SS-12	SS-13*	SS-13DUP**
LAB I.D.	193145	193141	193142	193143	193144	193146	193147	193148	193149	1931410	1931411	1931412	1931413	1931414	1931414DUP
TPH	—	590J	260J	94J	—	93J	190J	130J	—	260J	93J	450J	610J	810J	680J

J = Qualitative and Semi-Quantitative

— = Not detected

* = HART replicate sample of SS-12

** = RAI duplicate per NEESA Program 20.2-047B

Table 3-6

Summary of PCB Concentrations
in Surface Soil Samples: DRMO
Concentration Values = ppb

HART I.D. LAB I.D.	FB-01 193145	SS-01 193141	SS-02 193142	SS-03 193143	SS-04 193144	SS-05 193146	SS-06 193147	SS-07 193148	SS-08 193149	SS-09 1931410	SS-10 1931411	SS-11 1931412	SS-11D** 1931412D	SS-12 1931413	SS-13* 1931414
AROCLOR 1254	—	360J	—	—	—	—	—	—	—	—	—	—	—	—	—
AROCLOR 1260	—	430J	—	—	—	—	—	—	—	—	—	—	—	—	—

J = Qualitative and Semi-Quantitative

— = Not detected

* = HART replicate sample of SS-12

** = RAI duplicate per NEESA Program 20.2-047B

The state of Maine does not have published clean-up guidelines for contamination in soils, therefore New Jersey's Environmental Cleanup Responsibility Act (ECRA) guidance values are used for comparison purposes. Surface soil samples with metal concentrations above ECRA guidance values are shown with the corresponding guidance value concentration as follows:

Inorganic Constituent	ECRA Guidance Value in ppm	Surface Soil Samples Above ECRA Values
Antimony	10	SS-01, SS-02
Arsenic	20	SS-04, SS-06, SS-07
Copper	170	SS-01, SS-02, SS-09, SS-10, SS-11
Lead	1,000	SS-01, SS-02, SS-10
Nickel	100	SS-10, SS-11
Silver	5	SS-11
Zinc	350	SS-02, SS-10

Detectable concentrations of total petroleum hydrocarbons were found in most surface soil samples with the exception of samples SS-04 and SS-08. The concentrations range from 93 to 810 ppm. Seven surface soil samples (SS-01, SS-02, SS-06, SS-07, SS-09, SS-11 and SS-12) exceed the ECRA guidance value of 100 ppm TPH in soil.

Only one surface soil sample (SS-01) had detectable concentrations of PCBs. The PCB level in this sample is below ECRA's guidance value range of 1 to 5 ppm for total PCBs in soil.

3.2.3.2 Outfall Sediment. Sediment sample (SD-1) collected from the outfall of the DRMO Storage Yard was analyzed for priority pollutant metals, TPH and PCBs. A summary of the valid results for the sediment sample and associated ECRA guidance values are provided in Table 3-7.

Table 3-7

Summary of Priority Pollutant Metals, Total Petroleum Hydrocarbons, and PCB Concentrations from Sediment Sample SD-1 (Lab I.D. 1949107 and 194917)

Metal and TPH Concentration Values = ppm
PCB Concentration Values = ppb

	SAMPLE RESULT	NJ ECRA GUIDANCE
Antimony	8.3Q	10
Arsenic	0.71Q	20
Beryllium	0.53Q	1.0
Cadmium	1.1	3.0
Chromium	184J	100
Copper	1460	170
Lead	959	250-1000
Mercury	--	1.0
Nickel	479J	100
Selenium	--	4.0
Silver	--	5.0
Thallium	--	5.0
Zinc	260	350
TPH	380	100
Aroclor 1242	--	
Aroclor 1254	540	1000-5000 Total PCB
Aroclor 1260	750	
Aroclor 1248	--	

J = Qualitative and Semi-Quantitative

Q = Qualitative only

-- = Not detected

For comparison purposes, analytical results for the sediment sample are compared to New Jersey ECRA guidance values. There are three inorganic constituents; chromium, copper, and nickel, which are above their respective ECRA guidance values. The concentration of TPH detected in this sediment sample is above the ECRA guidance value of 100 ppm. PCBs detected in the sediment sample are well below ECRA's guidance value range (1.0 to 5.0 ppm) for total PCBs.

3.2.3.3 Soil Borings. Fourteen soil samples were collected from the test borings drilled at the DRMO Storage Yard. These samples were analyzed for priority pollutant metals, TPH, and PCBs. A summary of valid soil results is provided in tables 3-8, 3-9, and 3-10.

As part of the FCS report prepared by LEA in 1986, numerous soil samples obtained from test borings were analyzed for the following metals: chromium, cadmium, lead, and nickel. LEA determined that analytical data from shallow soil samples (0-2 feet) showed high concentrations of all four metals tested. Their data indicate that contamination in the western half of the DRMO is lower than in the eastern half. The metal concentrations found in LEA's DRMO soil samples were compared to data generated by HART. Analytical results from the two studies show comparably high concentrations of chromium, cadmium, lead, and nickel in the shallow soil samples. However, there were not enough samples obtained in the current study to substantiate LEA's conclusion that contamination levels in the western half of the site are lower than those in the eastern half.

Data from the subsurface soil samples as shown in tables 3-8, 3-9 and 3-10 have been compared to New Jersey's ECRA guidance values. Soil samples with metal concentrations above ECRA guidance values are shown with the corresponding guidance value concentration as follows:

Table 3-8

Summary of Priority Pollutant Metal Concentrations
in DRMO Soil Samples: DRMO
Concentration Values = ppm

HART I.D.	FB-02	DSB-1 (0-2')	DSB-1D* (0-2')	DSB-2 (0-2')	DSB-2+ (2-4')	DSB-2 (5-7')	DSB-2 (15-16')	DSB-3 (0-2')	DSB-4 (1-3')	DSB-5 (0-2')	DSB-5 (5-7')	DSB-5 (7.5'-8.5')	DSB-5D* (7.5'-8.5')
LAB I.D.	1956112	1956101	1956102	1949103	1949104	1949105	1949106	1960004	1949108	1956103	1956104	1956105	1956106
Antimony	--	--	157J	23.0J	28.8J	13.6J	--	2470	2.1Q	8.3J	--	--	--
Arsenic	--	15.3J	12.2J	14.4	17.4	11.3	6.4	13.3	7.2	13.1J	6.9J	8.5J	10.4J
Beryllium	--	0.51	0.45	1.0	2.4	1.6	0.31Q	--	--	--	--	0.42	0.60
Cadmium	--	4.8	4.3	7.8	10.3	5.4	1.1	3.3	2.0	4.6	2.8	1.1	0.81
Chromium	--	92.6J	105J	134J	133J	50.8J	79.3J	71.7J	51.8J	27.3J	41.1J	27.2J	36.9J
Copper	.009	410J	341J	1460	1410	979	33.4	412J	542	113J	109J	24.9J	24.8J
Lead	--	3140J	4330J	26300	26600	9310	206	130000	911	1960J	2360J	131J	98.2J
Mercury	--	0.30	0.31	1.8J	1.9J	2.1J	--	20.0J	0.61J	--	--	--	--
Nickel	--	153	68.4	957J	872J	660J	64.2J	134J	192J	34.4	57.2	30.0	31.2
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--
Silver	--	4.0	--	--	2.8	--	--	7.8	--	--	--	--	--
Thallium	.0014	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	.042	415	471	1400	2960	1390	82.1	630	474	147	154	75.2	73.0

J = Qualitative and Semi-Quantitative

Q = Qualitative only

-- = Not detected

* = RAI duplicate per NEESA Program 20.2-047B

+ = HART replicate sample of DSB-2 (0-2')

++ = HART replicate sample of DSB-6C (0-2')

+++= HART replicate sample of DSB-7 (0-2')

Table 3-8 (continued)

Summary of Priority Pollutant Metal Concentrations
in DRMO Soil Samples: DRMO
Concentration Values = ppm

HART I.D.	DSB-6A (0-2')	DSB-6B (5-7')	DSB-6C (0-2')	DSB-6C++ (2-4')	DSB-6C (15-15.5')	DSB-7 (0-2')	DSB-7+++ (2-4')
LAB I.D.	1949101	1949102	1960001	1960002	1960003	1949109	1949110
Antimony	6510J	1.2Q	--	13.3Q	--	7.7Q	4.8Q
Arsenic	3.7	14.3	8.1	7.0	10.6	10.7	13.0
Beryllium	0.33Q	0.45Q	--	--	--	0.78Q	0.82Q
Cadmium	1.6	1.1	4.2	8.2	0.95	--	8.8
Chromium	48.5J	92.9	23.6J	15.2J	58.3J	41.8J	57.3J
Copper	193	29.2	541J	223J	21.6J	477	1180
Lead	59500	138	2680	5330	61.1	5980	7570
Mercury	--	--	0.59J	0.78J	--	0.85J	0.72J
Nickel	80.6J	77.8J	162J	41.5J	53.2J	82.5J	402J
Selenium	--	--	--	--	--	--	--
Silver	2.9	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--
Zinc	824	60.6	1160	2310	39.3	1440	2000

J = Qualitative and Semi-Quantitative

Q = Qualitative only

-- = Not detected

* = RAI duplicate per NEESA Program 20.2-047B

+ = HART replicate sample of DSB-2 (0-2')

++ = HART replicate sample of DSB-6C (0-2')

+++= HART replicate sample of DSB-7 (0-2')

Table 3-9

Summary of Total Petroleum Hydrocarbon Concentrations
in DRMO Soil Samples: DRMO
Concentration Values = ppm

HART I.D.	FB-02	DSB-1 (0-2')	DSB-1D* (0-2')	DSB-2 (0-2')	DSB-2+ (2-4')	DSB-2 (5-7')	DSB-2 (15-16')	DSB-3 (0-2')	DSB-4 (1-3')	DSB-5 (0-2')	DSB-5 (5-7')	DSB-5 (7.5'-8.5')	DSB-5D* (7.5'-8.5')
LAB I.D.	1956112	195611	195612	194913	194914	194915	194916	196004	194918	195613	195614	195615	195616
TPH	--	190	3500	820	1400	1100	--	140J	80	5200	7500	110	--

J = Qualitative and Semi-Quantitative

-- = Not detected

* = RAI duplicate per NEESA Program 20.2-047B

+ = HART replicate sample of DSB-2 (0-2')

++ = HART replicate sample of DSB-6C (0-2')

+++= HART replicate sample of DSB-7 (0-2')

Table 3-9 (continued)

Summary of Total Petroleum Hydrocarbon Concentrations
in DRMO Soil Samples: DRMO
Concentration Values = ppm

HART I.D. LAB I.D.	DSB-6A (0-2') 194911	DSB-6B (5-7') 194912	DSB-6C (0-2') 196001	DSB-6C++ (2-4') 196002	DSB-6C (15-15.5') 196003	DSB-7 (0-2') 194919	DSB-7+++ (2-4') 1949110
TPH	570	420	810J	700J	930J	1300	1800

J = Qualitative and Semi-Quantitative

-- = Not detected

* = RAI duplicate per NEESA Program 20.2-047B

+ = HART replicate sample of DSB-2 (0-2')

++ = HART replicate sample of DSB-6C (0-2')

+++= HART replicate sample of DSB-7 (0-2')

Table 3-10

Summary of PCB Concentrations
in DRMO Soil Samples: DRMO
Concentration Values = ppb

HART I.D.	FB-02	DSB-1 (0-2')	DSB-1D* (0-2')	DSB-2 (0-2')	DSB-2+ (2-4')	DSB-2 (5-7')	DSB-2 (15-16')	DSB-3 (0-2')	DSB-4 (1-3')	DSB-5 (0-2')	DSB-5 (5-7')	DSB-5 (7.5'-8.5')	DSB-5D* (7.5'-8.5')
LAB I.D.	1956112	195611	195612	194913	194914	194915	194916	196004	194918	195613	195614	195615	195616
Aroclor 1242	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1254	--	D	--	2300	3400	1500	--	6600J	--	8100	12000	--	--
Aroclor 1260	--	D	--	1800	2100Q	1400	--	1100J	--	3000	3800	--	--
Aroclor 1248	--	--	--	730Q	1300	330	--	--	--	--	1800	--	--

DSB-7 (0-2')DL and DSB-7 (2-4')DL are x-fold dilutions of DSB-7 (0-2') and DSB-7 (2-4') respectively.

J = Qualitative and Semi-Quantitative

Q = Qualitative only

D = Detected, but below the quantitation limit

-- = Not detected

* = RAI duplicate per NEESA Program 20.2-047B

+ = HART replicate sample of DSB-2 (0-2')

++ = HART replicate sample of DSB-6C (0-2')

+++= HART replicate sample of DSB-7 (0-2')

Table 3-10 (continued)

Summary of PCB Concentrations
in DRMO Soil Samples: DRMO
Concentration Values = ppb

HART I.D. LAB I.D.	DSB-6A (0-2') 194911	DSB-6B (5-7') 194912	DSB-6C (0-2') 196001	DSB-6C++ (2-4') 196002	DSB-6C (15-15.5') 196003	DSB-7 (0-2') 194919	DSB-7 (0-2')DL 194919DL	DSB-7+++ (2-4') 1949110	DSB-7 (2-4')DL 1949110DL
Aroclor 1242	370	--	--	--	--	--	--	--	--
Aroclor 1254	1100	--	--	830J	--	30000	40000	37000	43000
Aroclor 1260	350	--	--	--	--	5700	6700Q	6900	8800Q
Aroclor 1248	--	--	--	--	--	12000	17000	15000	18000

DSB-7 (0-2')DL and DSB-7 (2-4')DL are x-fold dilutions of DSB-7 (0-2') and DSB-7 (2-4') respectively.

J = Qualitative and Semi-Quantitative

Q = Qualitative only

D = Detected, but below the quantitation limit

-- = Not detected

* = RAI duplicate per NEESA Program 20.2-047B

+ = HART replicate sample of DSB-2 (0-2')

++ = HART replicate sample of DSB-6C (0-2')

+++= HART replicate sample of DSB-7 (0-2')

Inorganic Constituent	ECRA Guidance Value in ppm	Soil Samples Above ECRA Values
Antimony	10	DSB-2 (0-2'), DSB-2 (5-7'), DSB-3 (0-2'), DSB-6A (0-2')
Beryllium	1	DSB-2 (0-2'), DSB-2 (5-7')
Cadmium	3	DSB-1 (0-2'), DSB-2 (0-2'), DSB-2 (5-7'), DSB-3 (0-2'), DSB-5 (0-2'), DSB-6C (0-2')
Chromium	100	DSB-2 (0-2')
Copper	170	DSB-1 (0-2'), DSB-2 (0-2'), DSB-2 (5-7'), DSB-3 (0-2'), DSB-4 (1-3'), DSB-6A (0-2'), DSB-6C (0-2'), DSB-7 (0-2')
Lead	1,000	DSB-1 (0-2'), DSB-2 (0-2'), DSB-2 (5-7'), DSB-3 (0-2'), DSB-5 (0-2'), DSB-5 (5-7') DSB-6A (0-2'), DSB-6C (0-2'), DSB-7 (0-2')
Mercury	1	DSB-2 (0-2'), DSB-2 (5-7'), DSB-3 (0-2')
Nickel	100	DSB-1 (0-2'), DSB-2 (0-2'), DSB-2 (5-7'), DSB-3 (0-2'), DSB-4 (1-3'), DSB-6C (0-2')
Silver	5	DSB-3 (0-2')
Zinc	350	DSB-1 (0-2'), DSB-2 (0-2'), DSB-2 (5-7'), DSB-3 (0-2'), DSB-4 (1-3'), DSB-6A (0-2'), DSB-6C (0-2'), DSB-7 (0-2')

Detectable concentrations of total petroleum hydrocarbons were found in most soil samples with the single exception being sample DSB-2 (15-16'). TPH concentrations range from 80 to 7,500 ppm. With the exception of DSB-2 (15-16') and DSB-4 (1-3'), all soil samples exceed the ECRA guidance value of 100 ppm TPH.

Detectable concentrations of PCBs were found in several soil samples. The following soil samples meet or exceed the ECRA guidance value range of 1.0 to 5.0 ppm total PCBs in soil: DSB-2 (0-2'), DSB-2 (5-7'), DSB-3 (0-2'), DSB-5 (0-2'), DSB-5 (5-7'), DSB-6A (0-2'), and DSB-7 (0-2').

As discussed previously, detectable concentrations of pesticides were found in soil samples DSB-6C (0-2'), DSB-6C (2-4') which is a replicate of DSB-6C (0-2'), and DSB-6C (15-15.5).

3.3 DRMO Conclusions

HART has drawn the following conclusions from the field investigation of the DRMO (SWMU #6).

1. The DRMO is built on man-made land composed of coarse sand, gravel and fill debris. This fill overlies bedrock which is highly weathered and fractured in places and generally slopes south and east towards the main channel of the Piscataqua River.
2. All wells at the DRMO respond to fluctuations in the river water levels as a result of tidal action. Wells located near the shoreline exhibit the greatest tidal fluctuation. Conductivity measurements indicate water beneath the DRMO is saline.
3. Slug tests performed on the overburden sediment indicate high conductivities which are indicative of coarse, permeable sediment. These results are supported by direct field observation and published literature.
4. Analytical results for the 12 surface soil samples around the DRMO indicate that 8 of the 12 samples exceed New Jersey ECRA guidance values for one or more metals in soil; 7 of the 12 samples exceed New Jersey ECRA guidance values for TPH in soil and none of the samples showed elevated concentrations of PCBs. *(NOTE: New Jersey ECRA guidance values are used for comparison only since the state of Maine does not have published clean up criteria. Actual clean up criteria for this site could be more or less stringent than the guidance used for comparison.)*
5. The outfall sediment sample contained levels of chromium copper and nickel which exceeds New Jersey ECRA guidance values for these metals in soil. This sample also contains TPH in concentrations above the New Jersey ECRA guidance value. PCB concentrations were below the New Jersey ECRA guidance value range. *(See note in item 4 above.)*

6. Nine of 14 soil samples collected from subsurface borings at the DRMO exceeded New Jersey ECRA guidance values for one or more metals in soils; 9 of the 14 samples exceeded the New Jersey ECRA guidance value for TPH in soil and 7 of the 14 met or exceeded the New Jersey ECRA guidance value range for PCBs in soil.

7. Two soil samples showed detectable levels of the pesticide DDT. This pesticide was found as an interferent during PCB analysis. The source of this pesticide is unknown at this time.

4.0 JILF (SWMU #8)

4.1 Field Program

4.1.1 Geophysical Program

A surface geophysical investigation was conducted at the PNS as part of the Phase I field work. Both a magnetic field survey and a ground penetrating radar survey were conducted in an attempt to determine the location and extent of subsurface disposal features without the potential danger of drilling/ excavating into unknown landfilled materials. The concept of this program is discussed in detail in the draft RCRA Facility Investigation Proposal (RFIP).

Establishment of Grid System. Prior to initiation of the geophysical investigation a grid was established at the JILF. A licensed surveyor prepared one primary base line and two perpendicular base lines across the JILF. The surveyed base lines were established using wooden stakes, survey tape and paint. HART's field team then expanded the grid system in all directions across the accessible areas of the JILF. Intersections of grid lines were marked with survey flags. The grid system was flagged on 100 foot centers and was labeled using the following identification system. Letters were assigned alphabetically to one axis at 100 foot increments which increased to the east. Numbers were assigned to the north/south axis. For example, coordinate point C-8 is near the southeastern corner of the JILF. Consequently, coordinate point E-5 is located 200 feet north and 300 feet west of coordinate point C-8 (see Enclosure A).

4.1.1.1 Magnetometry. The magnetic survey was completed at the JILF using a UNIMAG II portable proton magnetometer, model G-846, manufactured by EG & G Geometrics. The instrument was operated in two modes, one with a resolution of 10 gammas and the other with a resolution of 1 gamma. The primary purpose of the survey was to locate buried drums, cylinders, or other ferrous materials which may be associated with subsurface disposal of waste material.

An initial reconnaissance survey of the site was conducted using a grid developed from the existing base lines as shown in Enclosure B. The 100-foot grid spacing provided adequate coverage for reconnaissance purposes while ensuring timely performance of the program. Certain areas were not covered, in particular, the Equipment Lay-Down area and Hazardous Waste Storage area where drums and other ferrous metal are stored and near fences such as the one surrounding the baseball field, the ballfield backstop and the fence near Mercury Burial Site II. Surface metal in these areas caused interference with the operation of the magnetometer.

Data generated during the initial reconnaissance survey was reviewed and reduced daily. Anomalies discovered were then resurveyed using a finer grid pattern (i.e. either 50-foot or 10-foot intervals) to define the buried metal locations.

Both Direct Magnetic Field (DMF) and Gradient Magnetic Field (GMF) measurements were made during the initial reconnaissance survey. DMF and GMF surveys were conducted simultaneously by obtaining three magnetometer readings at each grid location. DMF measurements were obtained by averaging two readings taken with the instrument held at three feet above grade in a configuration which provided a maximum resolution of 10 gammas. This technique checks instrument repeatability and increases data reliability. After the first two readings were averaged, a third reading was obtained with the instrument held approximately six feet above grade. Subtracting the six-foot reading from the average of the three-foot readings results in a measurement of the GMF. This technique permits an indication of interference caused by ferrous debris at or near the surface. All magnetometer readings were obtained with the instrument pointing north which results in greater pole-to-pole anomalies. All data were recorded in gammas.

Diurnal variations in the magnetic field intensity were recorded by taking readings at a base station (Station E8--Enclosure B) prior to the start of each survey. The difference in measured field intensity of the base station readings was used as a correction factor which was applied to each data set. Diurnal variations were factored out to obtain comparable readings for mapping and interpretation purposes.

A second DMF survey was performed in sections of the site where the reconnaissance survey data indicated buried ferrous metals. A six-foot staff was attached to the instrument which increased the maximum possible resolution to 1 gamma. Four detailed surveys were performed with the instrument in this configuration. The detailed surveys were centered around the following survey grid points: L8, MB-1 (Mercury Burial I), H_8-H_9, and E_8 (see Figures 4-3 through 4-6). These locations were chosen after reviewing data derived from the reconnaissance survey. These surveys were conducted using either a 10 foot grid spacing or a 50 foot spacing depending on the size of the area which needed to be covered.

After completion of the surveys the data was corrected for diurnal variations, plotted and contoured using a Compaq 386 microcomputer.

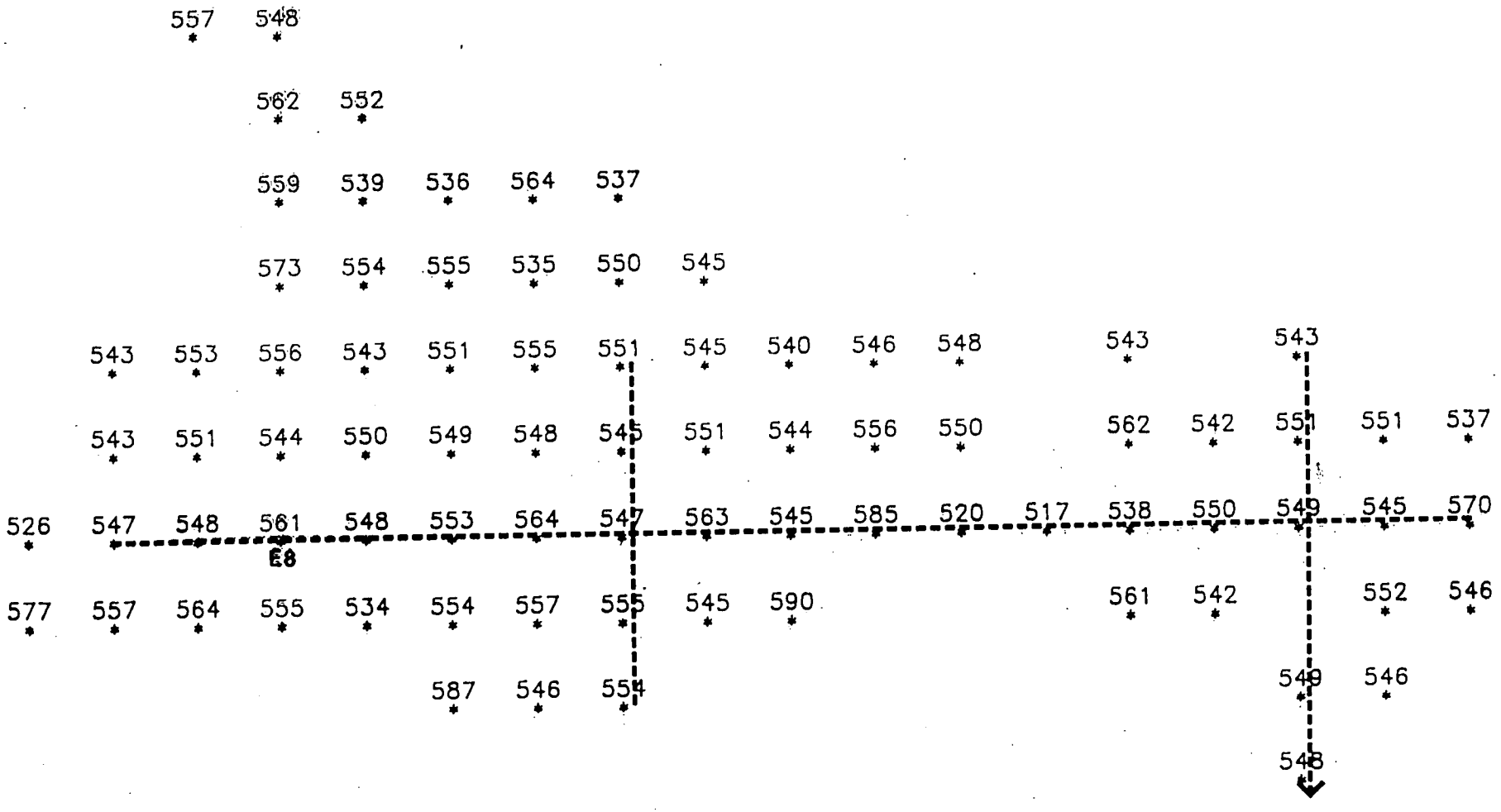
Findings (Magnetometer Survey). Data from the DMF reconnaissance survey was corrected for diurnal variations and plotted by microcomputer with map resolutions of 1, 10, 100 and 1000 gammas. Because of variations in the magnetic field strength across the landfill, it was determined that the smallest anomaly which could be mapped accurately was (±) 100 gammas. These wide variations in magnetic field strength are believed to result from the fill material which consists of a variety of soil types, iron rich bedrock clasts, and a large number of varied metallic objects. These objects range in size from steel reinforcing bars, to chain-link fencing, to a small two-man submarine known to be buried on the site. Evidence for the disposal of this material comes from

information obtained in preparation of the IFCR and from historic photographs shown to HART on 10/19/89, after the initiation of the field program. As a result of these magnetic fluctuations no discernible loss of information results from contouring the DMF data to the nearest 100 gammas.

Figure 4-1 is a contour map showing the results of the average of two DMF measurements made at an elevation of three feet above grade. The field strength varies from a low of 51,700 gammas to a high of 59,000 gammas across the JILF. A change in field strength of 6,500 gammas can be seen between grid location L_8 and M_8 suggesting the presence of ferrous metal in this vicinity. These grid points are located near the center of the baseball field. Magnetic anomalies of 1000 gammas or more are common throughout the JILF and appear to be randomly distributed. This result was not entirely unexpected after reviewing the historic photographs supplied by the Navy during the magnetometer survey. The random distribution of buried metallic debris makes determination of distinct target areas difficult.

Figure 4-2 is a contour map of GMF data generated by subtracting a DMF measurement taken at an elevation of six feet above grade from the average of two DMF readings taken at approximately three feet above grade. The magnitude of this difference indicates the presence of near surface ferrous metallic objects while the sign is simply dependent on the orientation of the object and its position relative to the observer.

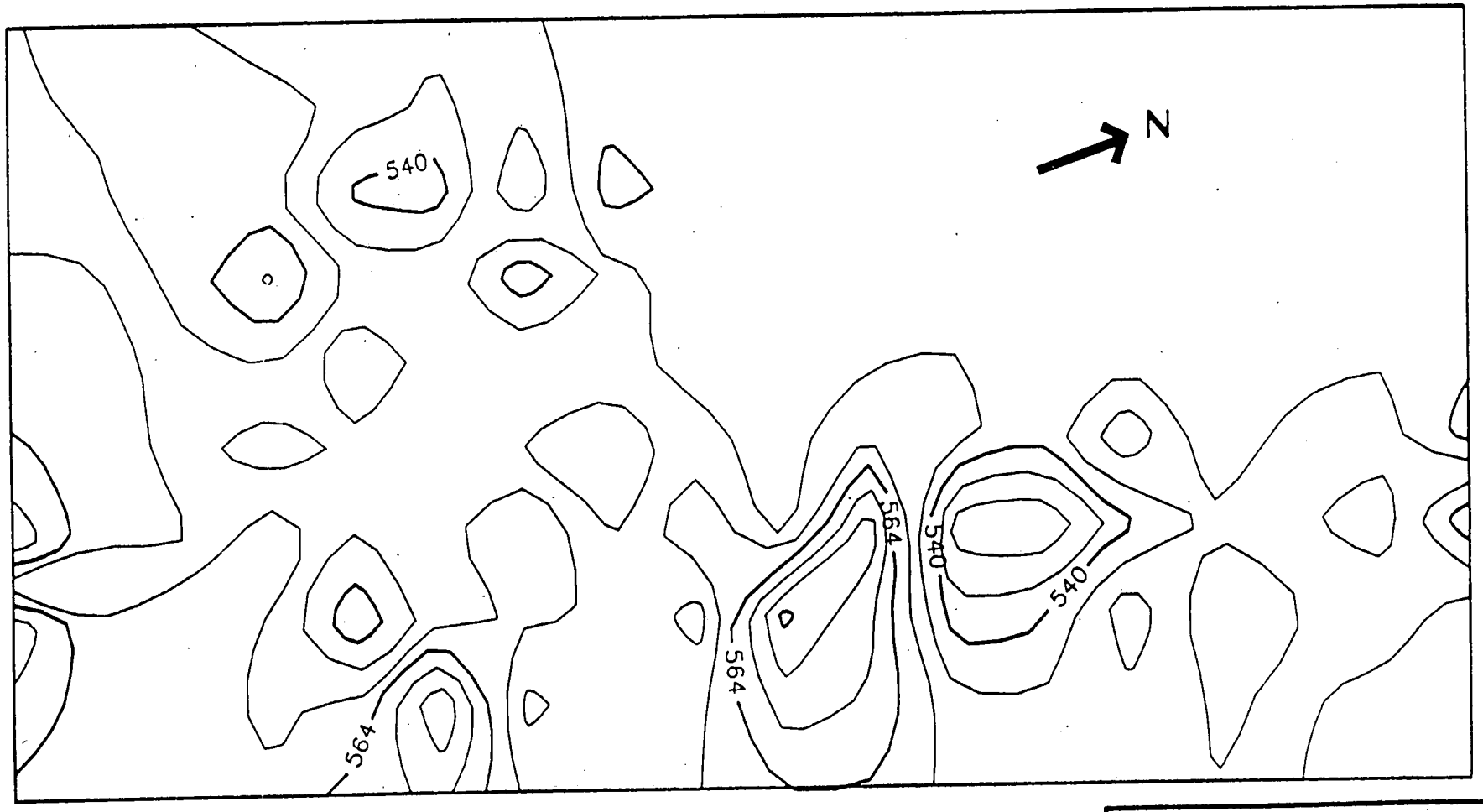
A large GMF value of 3,004 gammas was recorded at grid point K_6 (see Figure 4-2). This data strongly suggests the presence of ferrous metal objects in the shallow subsurface in this area although no large anomalies were recorded here during the reconnaissance survey. A GMF measurement of 1,923 gammas was recorded at grid point L_8 suggesting the presence of shallow targets in this area also. This grid point is also the source location of a strong DMF anomaly further indicating the presence of foreign material in the subsurface.



577 DATA POINT AND MAGNETOMETER READING (x100 GAMMAS)

SURVEYED GRID BASELINE

E8 BASE STATION



SCALE

100 FEET

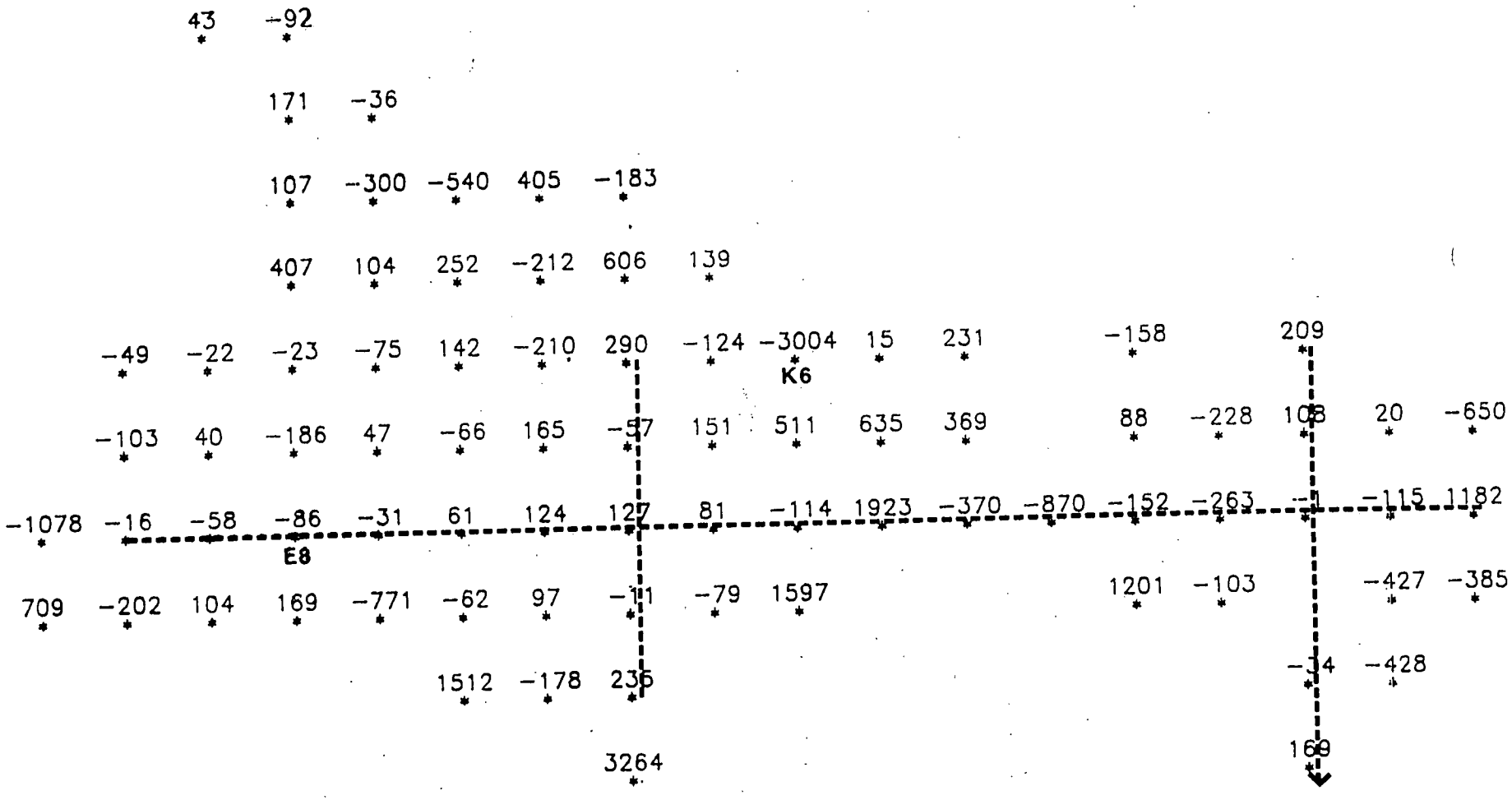
KEY

CONTOUR LINE (800 GAMMA CONTOUR INTERVAL)

FIGURE 4-1

JAMAICA ISLAND LANDFILL
DIRECT MAGNETIC FIELD SURVEY
(DMF)

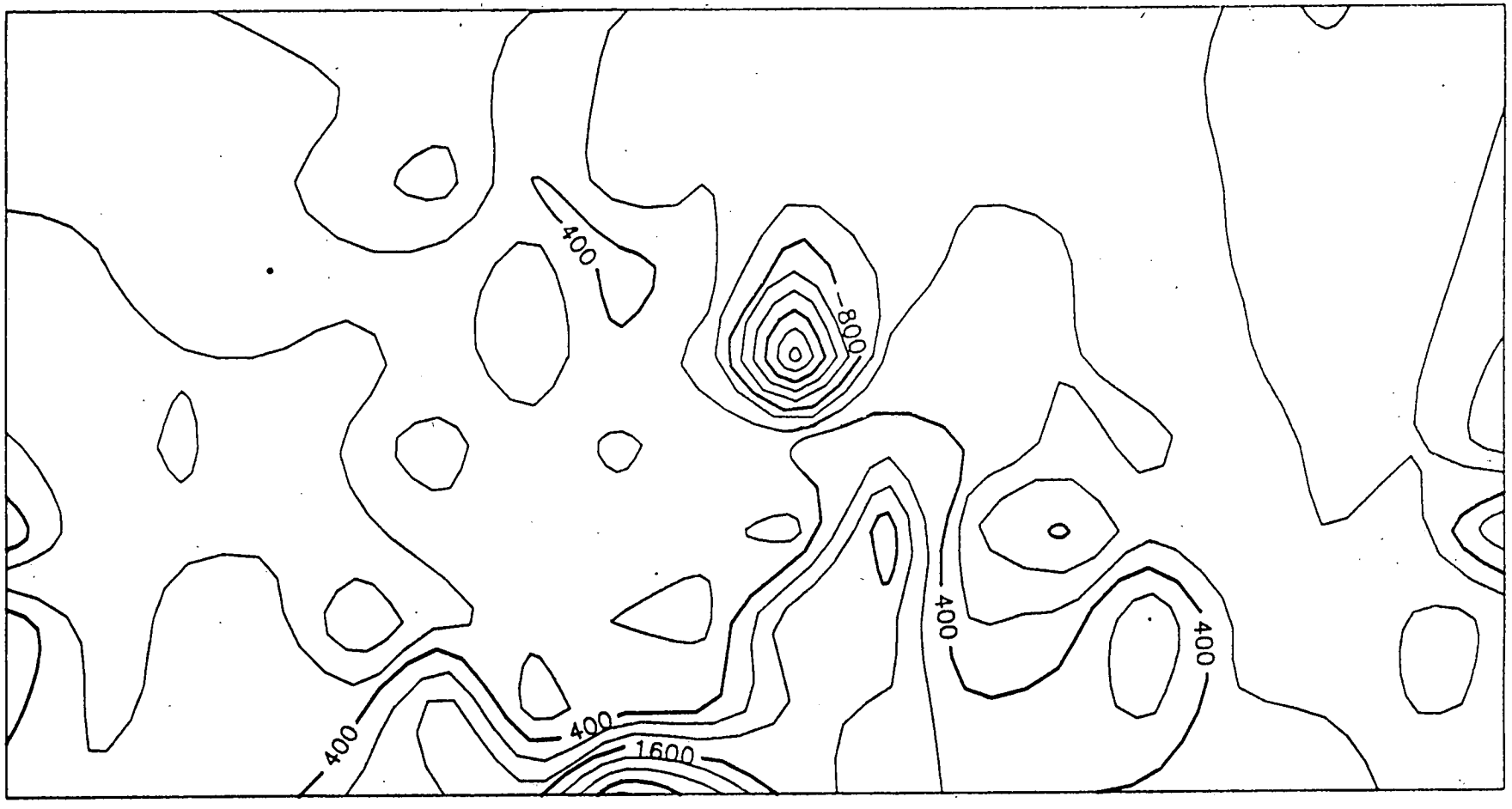
FRED C HART ASSOCIATES, INC.



709 DATA POINT AND RESULT OF SUBTRACTING THE MAGNETOMETER READING TAKEN SIX FEET ABOVE GROUND SURFACE FROM THE AVERAGE OF THE TWO READINGS TAKEN AT THREE FEET ABOVE GROUND SURFACE

SURVEYED GRID BASELINE

E8 BASE STATION



N

SCALE

100 FEET

KEY

CONTOUR LINE (400 GAMMA CONTOUR INTERVAL)

FIGURE 4-2

JAMAICA ISLAND LANDFILL
GRADIENT MAGNETIC FIELD SURVEY
(GMF)

FRED C HART ASSOCIATES, INC.

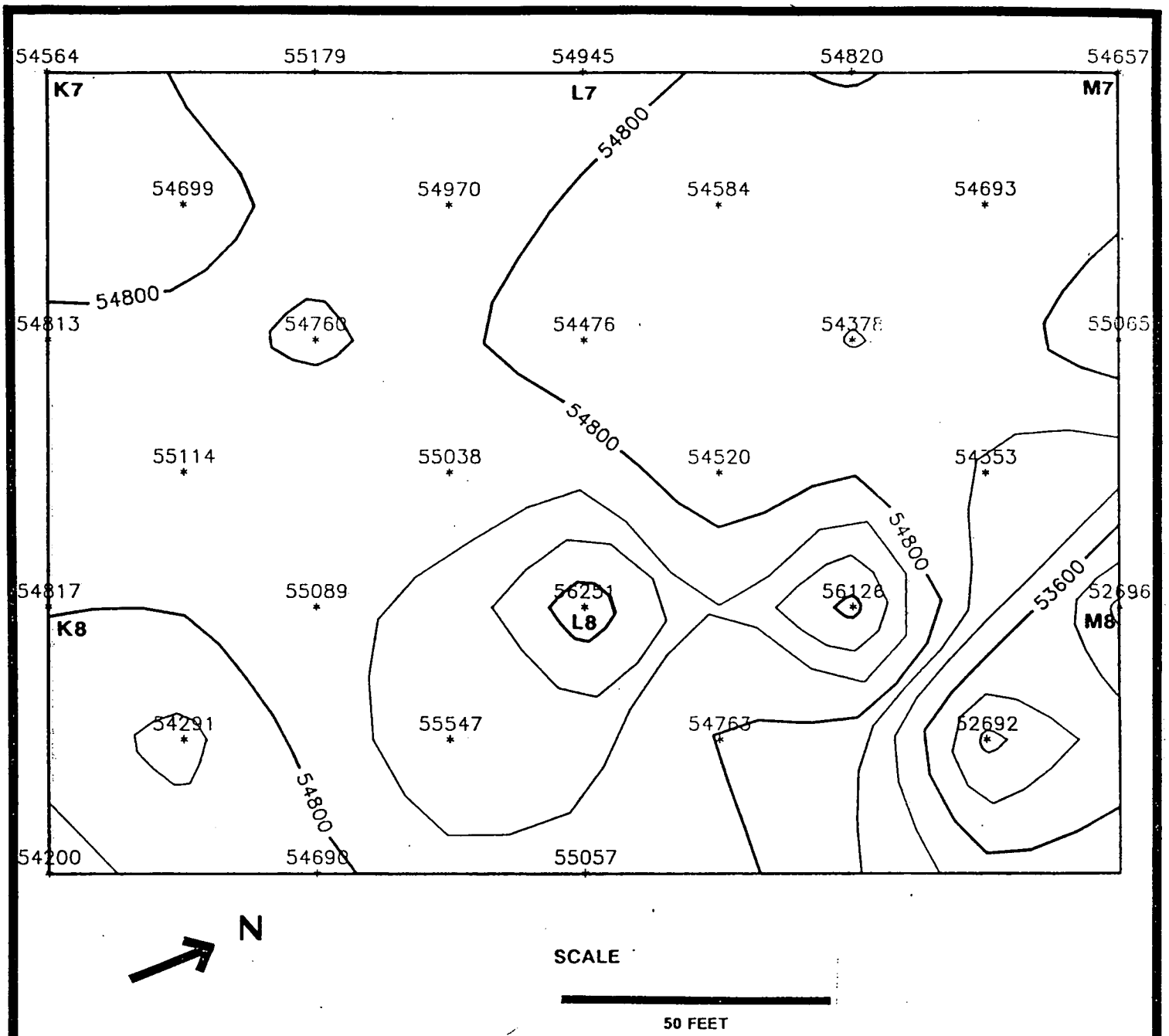
A detailed DMF survey (50' centers) was conducted over this area in an attempt to identify the source of the anomaly. Figure 4-3 is a contour map prepared from data derived from this detailed survey of the "L_8" anomaly. The greatest DMF variations occur between grid point L_8 and M_8 confirming the results of the reconnaissance survey. This detailed survey was conducted with the magnetometer configured to provide a maximum resolution of ± 1 gamma although 10 gamma variations were noted in the field.

Because a significant magnetic anomaly was recorded in this area on successive surveys it was felt that additional information should be acquired from this area using ground penetrating radar GPR as described in (see section 4.1.1.2).

A detailed DMF survey on 10 foot centers was conducted near Mercury Burial Site I. This survey revealed an anomaly of near 1,980 gammas south of the concrete marker (MB-1--Figure 4-4). A metal detector was then used to scan this area for shallow metal objects. The detector revealed no indication of target objects south of MB-1 but did signal the presence of metal in the subsurface between MB-1 and grid location I_9. No large anomalies were measured in this area using the magnetometer suggesting the presence of non-ferrous metal objects in the subsurface in this area.

Two additional DMF surveys were conducted on 50 foot centers and were located near the grid point H_8-H_9 and E_8. A large anomaly on the order of 3,600 gammas was recorded at a point approximately 35 feet west of grid point H_8 (Figure 4-5). An anomaly of approximately 2,550 gammas was recorded 35 feet southeast of grid location E_8 (Figure 4-6). These large anomalies suggest the presence of buried ferrous metal objects in these locations. It is expected that anomalies of similar magnitude could be found in a great number of locations across the JILF.

Metal fences and other metallic objects at the surface near Mercury Burial Site II prohibited the effective use of the magnetometer in this area.



KEY

CONTOUR LINE (400 GAMMA CONTOUR INTERVAL)

55089 DATA POINT AND MAGNETOMETER READING (GAMMAS)

K7 GRID POINT

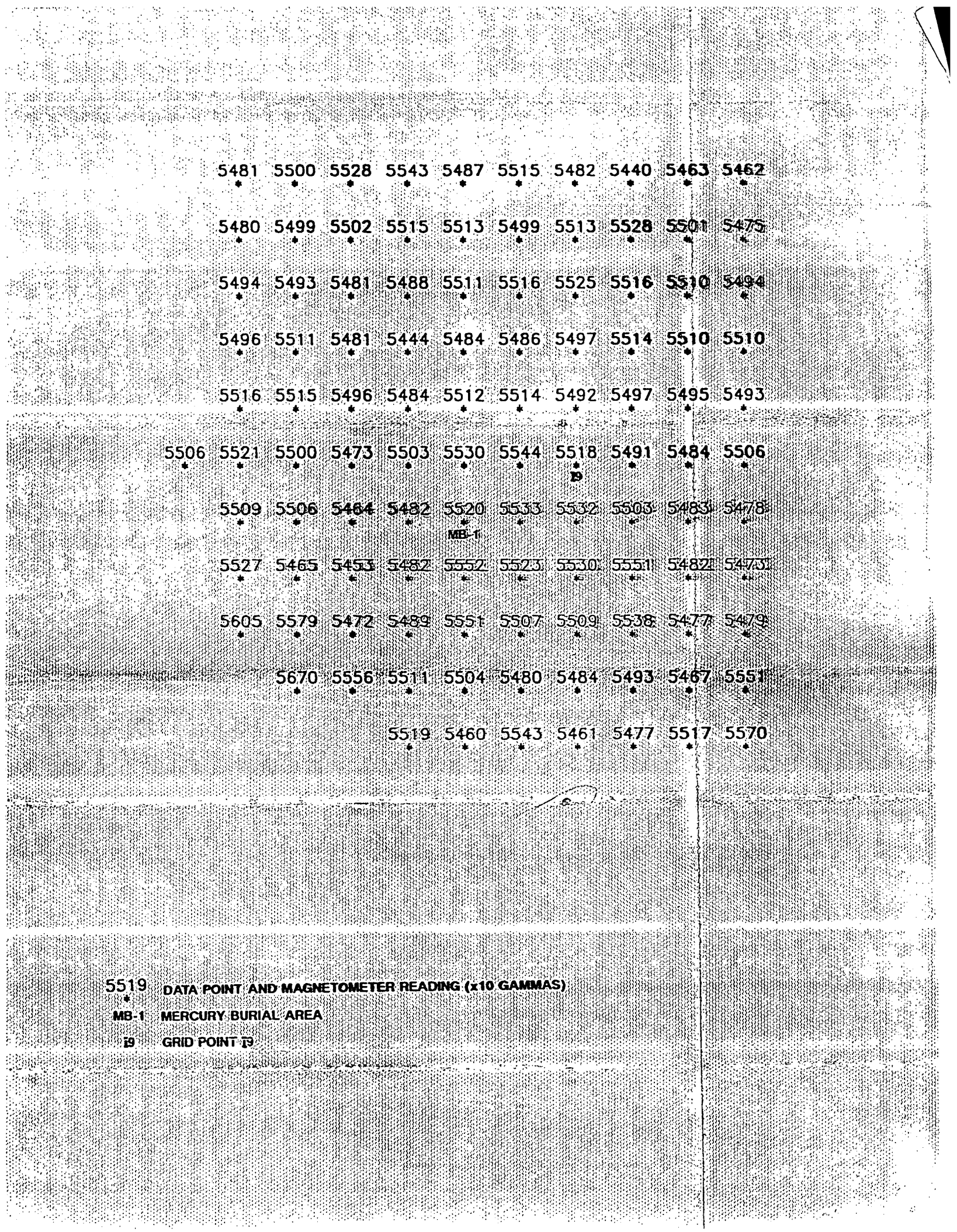
FIGURE 4-3

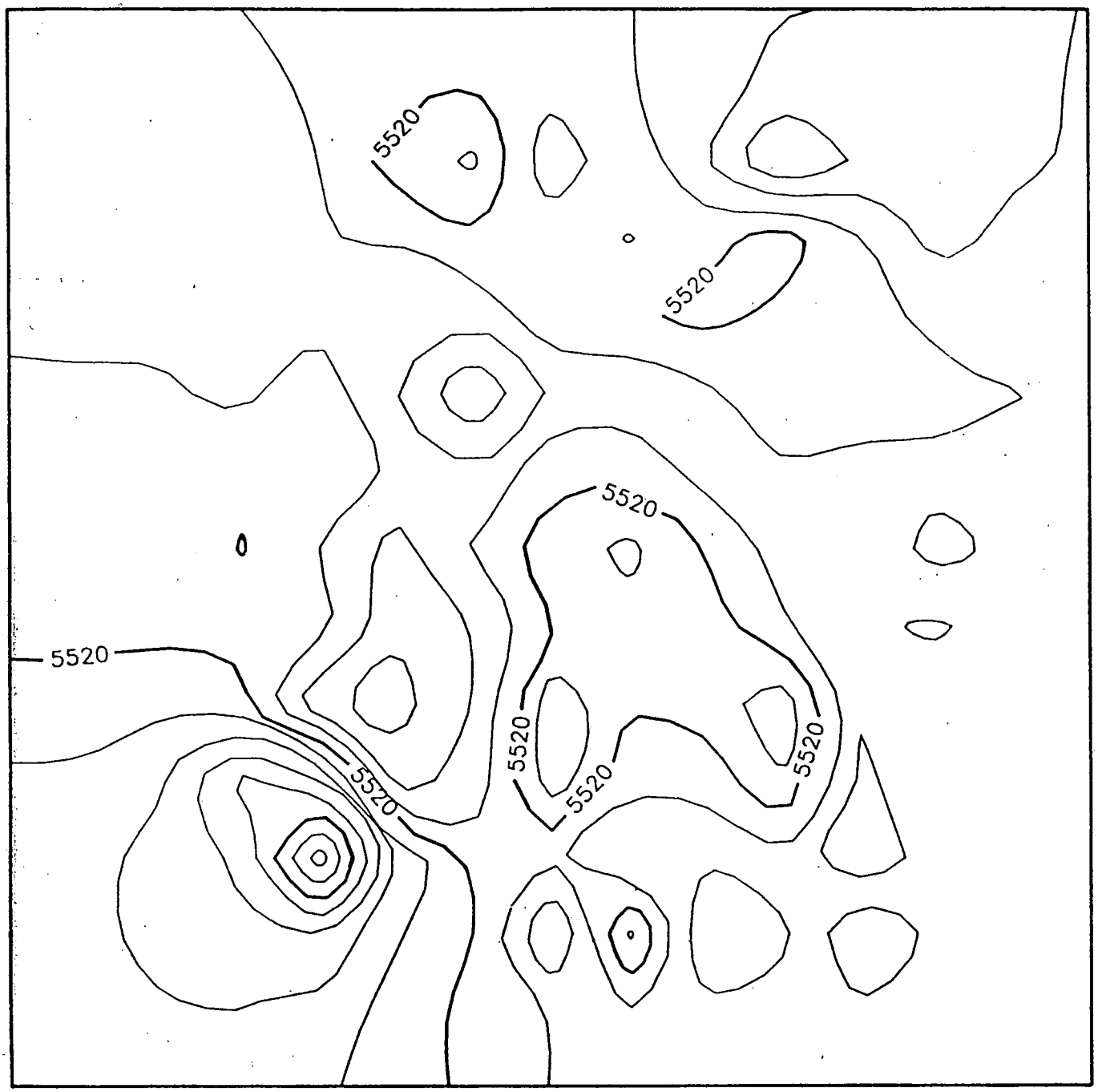
"L8" BALLFIELD ANOMALY

DIRECT MAGNETIC FIELD MEASUREMENT

10γ RESOLUTION-50 FT. CENTERS (DMF)

FRED C HART ASSOCIATES, INC.


5481 5500 5528 5543 5487 5515 5482 5440 5463 5462
5480 5499 5502 5515 5513 5499 5513 5528 5501 5475
5494 5493 5481 5488 5511 5516 5525 5516 5510 5494
5496 5511 5481 5444 5484 5486 5497 5514 5510 5510
5516 5515 5496 5484 5512 5514 5492 5497 5495 5493
5506 5521 5500 5473 5503 5530 5544 5518 5491 5484 5506
i9
5509 5506 5464 5482 5520 5533 5532 5503 5483 5478
MB-1
5527 5465 5453 5482 5552 5523 5530 5551 5482 5453
5605 5579 5472 5489 5551 5507 5509 5538 5477 5479
5670 5556 5511 5504 5480 5484 5493 5467 5551
5519 5460 5543 5461 5477 5517 5570
5519 DATA POINT AND MAGNETOMETER READING (x10 GAMMAS)
MB-1 MERCURY BURIAL AREA
i9 GRID POINT i9



N

SCALE

10 FEET

KEY

CONTOUR LINE

200 GAMMA CONTOUR INTERVAL

FIGURE 4-4

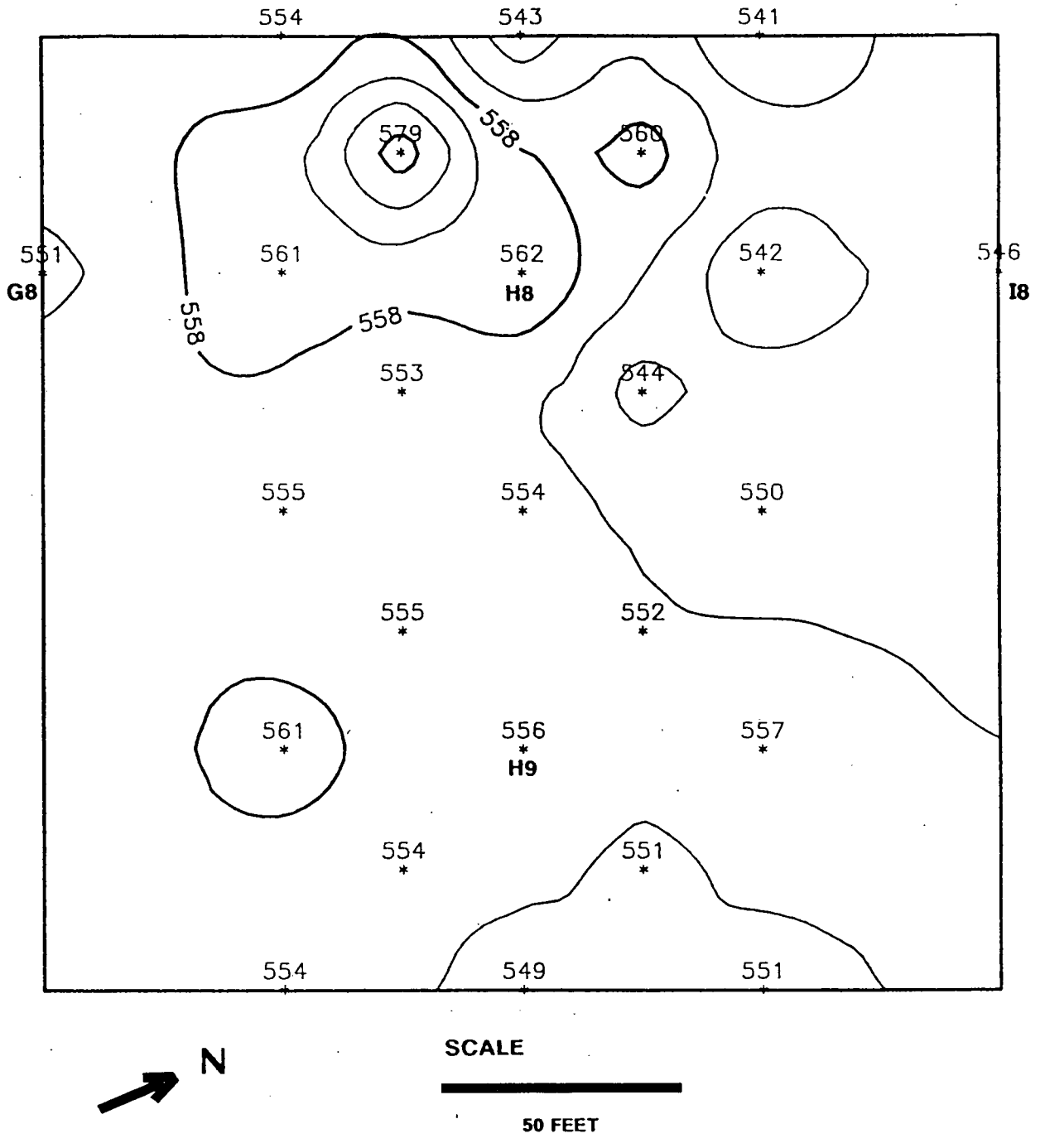
MERCURY BURIAL SITE I

DIRECT MAGNETIC FIELD SURVEY

100 γ RESOLUTION-10 FT. CENTERS

(DMF)

FRED C HART ASSOCIATES, INC.



KEY

CONTOUR LINE (600 GAMMA CONTOUR INTERVAL)

555 DATA POINT AND MAGNETOMETER READING (x100 GAMMAS)

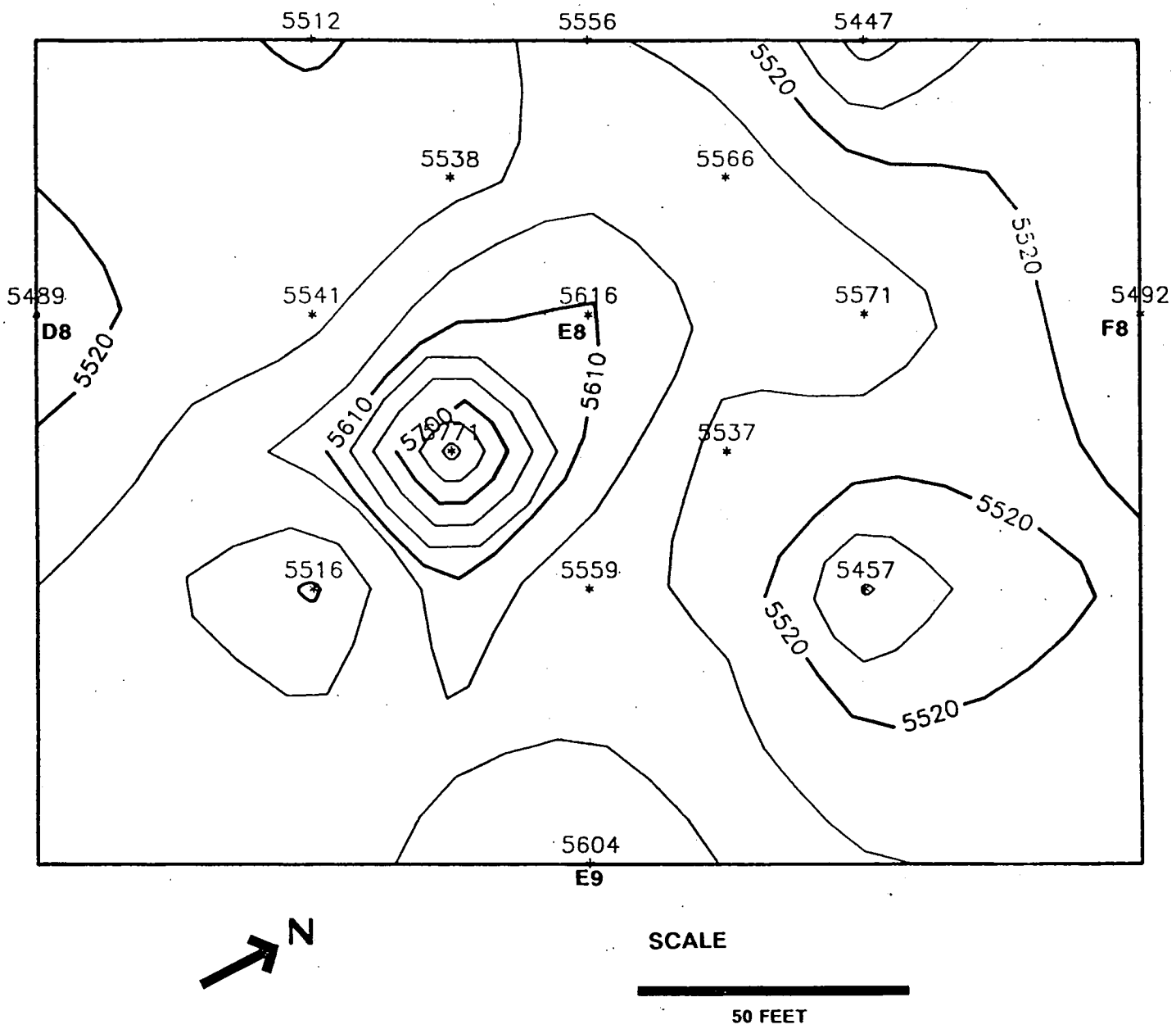
G8 GRID POINT

FIGURE 4-5

"H8-H9" ANOMALY

DIRECT MAGNETIC FIELD MEASUREMENT
100γ RESOLUTION-50 FT. CENTERS
(DMF)

FRED C HART ASSOCIATES, INC.



KEY

CONTOUR LINE (300 GAMMA CONTOUR INTERVAL)

5571 * DATA POINT AND MAGNETOMETER READING (x10 GAMMAS)

E8 GRID POINT

FIGURE 4-6

"E8" ANOMALY

DIRECT MAGNETIC FIELD MEASUREMENT

10γ RESOLUTION-50 FT. CENTERS (DMF)

FRED C HART ASSOCIATES, INC.

4.1.1.2 Ground Penetrating Radar. The Ground Penetrating Radar (GPR) Survey was primarily conducted in an attempt to locate the Mercury Burial Sites. However, since these sites are coincident with the JILF and since time allowed, the survey was expanded in the vicinity of these sites. The general location of the sites is known and the GPR survey was designed to cover these locations to confirm the presence, depth and dimensions of the concrete vaults.

The survey was conducted by Geophysical Survey Systems, Inc. of Hudson, New Hampshire, using a SIR System 3, impulse radar. Real time imaging was provided by a line scanning recorder with a 500 MHz shielded transducer.

Temporary grids were established at the suspected vault locations and were tied into the surveyed grid. The antenna was towed by hand across the grid and the grid modes were noted for later reference. The data was interpreted on-site and adjustments were made to the signal gain, towing speed and survey pattern (towing direction) to improved instrument response.

An additional survey was run at grid location L_8 in an attempt to determine the source of the magnetic anomaly noted in the area.

Findings (Ground Penetrating Radar). The penetration depth with the SIR-3 and 500 MHz transducer was limited to approximately three feet as a result of the conductive nature of the landfill material and soil properties. Possible explanations for this high conductivity include the wet clay cap covering the southern end of the JILF, diffused metal fragments or other conductive material in the fill and a relatively shallow saline water table which is influenced by tides.

As a result of the limited signal penetration no useful subsurface information was obtained using the GPR at any survey location. The original data has been forwarded under separate cover to Northern Division, Naval Facilities Engineering Command U.S. Naval Base, Philadelphia, Pennsylvania.

4.1.2 Test Borings/Rock Coring

The test boring program was performed to provide information regarding the type, variability, and total thickness of fill, indigenous unconsolidated materials, and bedrock in the vicinity of the JILF.

The drilling program at the JILF began on November 8, 1989 and was completed on December 1, 1989. Eleven test borings were drilled, with eight borings completed as monitoring wells. Locations JB-1, JB-2 and JB-11 were not completed as monitoring wells (see Enclosure B). These borings were tremie grouted to the surface with cement/bentonite grout upon completion.

Test borings were advanced using the hollow-stem auger drilling technique. CATOH Environmental Companies, Weedsport, New York, performed all drilling under the supervision of HART's geologist. A truck-mounted Acker Soil Max boring rig utilizing 4¼-inch ID, hollow-stem augers and an NX-core barrel was used for drilling. In addition, a 3¾-inch tricone roller bit was used at location JB-1. Auger cuttings produced by the drilling of test borings were placed in approved DOT 55 gallon drums, supplied by the Portsmouth Naval Shipyard (PNS), labeled and later transferred to the PNS Hazardous Waste Storage Unit.

Prior to drilling the first boring, the drilling equipment was steam-cleaned to remove possible contaminants. All drilling equipment which was to come in contact with the soil, as well as water tanks, pumps, and hoses, underwent the initial cleaning procedure. The drilling equipment was decontaminated between borings to prevent cross-contamination.

A standard, two-foot, steel split-spoon was used to obtain soil samples in advance of drilling. Samples were obtained at five-foot intervals. As each split-spoon soil sample was collected, the samples were immediately scanned with an HNU photoionization detector and a Geiger counter upon opening the sampler. Each sample was described in detail by the HART geologist. Detailed

sample descriptions including blow counts, grain size, grain size distributions, and color are included in the geologic logs in Appendix III. When coarse material was encountered in the subsurface, soil sample recovery was generally poor. Poor recovery limited the number of samples collected and submitted for laboratory analyses.

Twenty-eight soil samples, plus three replicates and two rinseate field blanks, were submitted to RAI for chemical analysis. The interval locations for the laboratory submitted samples are shown on the geologic cross-sections located in Section 4.2.1. All samples obtained at the JILF were analyzed for Target Compound List (TCL) Organics and Target Analyte List (TAL) Inorganics.

Prior to sampling, the split-spoons were decontaminated according to the following protocol:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with 1% nitric acid solution;
4) rinse with distilled water;
5) rinse with methanol; and
6) air dry.

Samples to be submitted to the laboratory were placed into labeled, laboratory-supplied sample bottles and stored on ice in field coolers for transport to RAI.

Test borings were advanced with 4¼-inch ID, hollow-stem augers until auger refusal at competent bedrock. An exception occurred at JB-1 where drilling techniques were modified because of a clay layer encountered 20.0 feet below grade. At this location, the hollow-stem augers were advanced five feet into the clay and used as temporary casing. An undisturbed, two-foot, soil sample was collected immediately below the augers utilizing a Shelby tube. ASTM standard method D1587-74, "Thin-Walled Tube Sampling of Soils", was followed for obtaining the undisturbed sample. In order to advance the test boring to bedrock, a mud-rotary drilling technique was implemented. In this drilling technique, drilling mud, consisting of a bentonite/water mixture, is recirculated from a recirculation tank, through drill rods and a 3¾-inch tricone roller bit. The drilling mud aids in keeping the borehole open.

Upon auger refusal, five-foot bedrock cores were obtained at each location using an NX-core barrel and water provided by PNS. Exceptions occurred at locations JW-3, where 10.5 feet of core was obtained so that a monitoring well could be constructed in the bedrock; location JW-9, where coring was stopped after 4 feet because of plugging of the core barrel bit; and location JW-10, where coring was stopped after 2.7 feet because of plugging of the core barrel bit. The cores were obtained to determine bedrock composition and the extent of weathering and fracturing. A description of each core was made and included lithology, color, mineralization, and rock quality using the RQD method. Rock quality was represented as a percentage of the sum of rock pieces greater than four inches in length over the length of the run. RQD numbers are contained in the rock core logs in Appendix III. The cores were stored in covered wooden boxes in a manner which preserved their relative position by depth. Each box was numbered, marked with the cored interval, and retained by HART for future reference.

4.1.3 Monitoring Wells

The monitoring well installation program was designed to supply scientifically valid information concerning the depth to groundwater on-site, the number of subsurface aquifers and their general characteristics, and the groundwater flow directions and their relationships to surface water conditions.

A monitoring well was installed at each soil boring location with the exception of locations JB-1, JB-2, and JB-11, as previously described. Each test boring was backfilled with Hole Plug (bentonite chips) to fill the void left by the removal of cored rock. Exceptions occurred at JW-3, where a monitoring well was constructed in the core hole and at JW-4 and JW-7, where collapse of the core holes occurred and monitoring wells were constructed in a portion of the core holes.

Each monitoring well was installed in saturated overburden. Exceptions occurred at JW-3, JW-4 and JW-7. At JW-3 the overburden was not saturated. Therefore, the screened portion of the well was set in bedrock. At locations JW-4 and JW-7 there was not enough saturated overburden to install a monitoring well. Therefore, well screens were set to straddle the overburden/ weathered bedrock interface.

Monitoring wells were installed within the 4¼-inch hollow-stem augers used to advance the soil boring. The monitoring wells were constructed of two-inch diameter, threaded, flush-joint schedule 40 teflon riser pipe and 10-slot (0.010-inch) manufactured well screen. At JW-10, a four foot section of PVC riser pipe was used in well construction above the saturated zone. The screens were five feet in length, except at JW-3 and JW-6, where the screen lengths were ten feet, and at JW-9, where the screen length was eight feet. Prior to installing the monitoring well, 0.3 to 0.85 feet of sand (the same sand used as the sand pack) was placed through the augers as a base. An exception occurred at JW-3, where the well was installed directly on bedrock. Following placement of the sand base, the screen and riser pipe were placed in the augers. Clean silica sand (equivalent to Morie grade 0) was subsequently added through the augers in increments as the augers were gradually withdrawn. This allowed placement of the sand pack around the screen without permitting the borehole to collapse around the screen. Sand pack was added to encase the entire screen and extend from one to two feet above the top of the screen. A 0.5 to one-foot "sand choker collar", consisting of very fine sand (Morie grade 00), was subsequently installed above the sand pack. A bentonite seal, two feet in length, was installed above the "sand choker collar" and hydrated with fresh water, effectively sealing off the screened interval from the rest of the aquifer.

The remainder of each borehole was grouted with a cement or cement/ bentonite slurry to land surface while the augers were removed. A lockable protective steel casing was then cemented over each well to prevent unauthorized access and provide protection for the wells. The cement collar around the protective casing was sloped away from the well to divert surface run-off from the well. A curb box was cemented over the well instead of protective steel casing at the following locations: JW-4, JW-5, and JW-6. Monitoring well completion diagrams are located in Appendix IV.

Well and test boring locations and elevations were subsequently surveyed by Frank Emery Engineers/Surveyors of Wells, Maine and a site survey map was produced (see Enclosure B). Well information is summarized in Table 4-1.

No sooner than 48 hours after grouting was completed, each well was developed to remove fine sediment from the well screen and sand pack to improve the hydraulic connection between the well and the water bearing formation. Wells were developed by utilizing a WaTerra inertial pump system to surge and purge recharging water from the well. The only portion of the WaTerra pump system to come into contact with the well or water was new, dedicated, development material consisting of high density polyethylene tubing and a Delrin foot valve. The tubing was actuated at the surface by hand. A rapid actuating motion simultaneously pumped and surged the well, providing optimal development. Development continued until a minimum of 20 well volumes were produced. Wells JW-3 and JW-6, went dry during development. At these locations, the wells were allowed to recover and were subsequently purged until five well volumes of water were produced. Measurements of pH, specific conductance and temperature were taken of the discharge water at each monitoring well. Towards the end of development, consecutive measurements of the above mentioned parameters were taken in immediate succession. When three consecutive measurements of these parameters indicated ten percent or less variation in specific conductance and temperature and ±0.2 pH unit, development was considered complete. Table 4-2 summarizes stabilized field parameters obtained during well development. Well development activities are summarized in Table 4-3.

Table 4-1

JILF (SWMU #8) Monitoring Well Details

Well Nº	Top of Casing Elevation (ft.)[1]	Ground Elevation (ft.)[1]	Screen Setting (ft.)[2]	Sand Pack (ft.)[2]	Sand Choker Collar (ft.)[2]	Bentonite Seal (ft.)[2]
JW-3	110.43	108.72	7-17	6-17	5-6	3-5
JW-4	105.29	105.70	7-12	6-12.3	5-6	3-5
JW-5	106.32	106.52	10-15	8-15.5	7-8	5-7
JW-6	107.42	107.99	10.5-20.5	8.5-21	7.5-8.5	5.5-7.5
JW-7	108.53	106.66	6.8-11.8	5-12.65	4.5-5	2.5-4.5
JW-8	112.33	110.59	9-14	7-14.5	6-7	4-6
JW-9	106.04	104.63	7-15	6-15.5	5-6	3-5
JW-10	108.80	106.63	7-12	6-12.5	5-6	3-5

[1] Elevation 100.00' Mean High Tide, PNS System is equal to 3.804' U.S.G.S. System

[2] Below grade

Table 4-2

JILF (SWMU #8) Well Development
Stabilized Field Parameters

Well Nº	Development Date	Time	Specific Conductivity (µmhos/cm)	pH	T mp. (°C)
JW-3	12/06/89	12:12	469	6.37	10.3
JW-4	12/06/89	13:59	370	6.72	10.3
JW-5	12/06/89	13:46	5,140	7.19	10.7
JW-6	11/18/89	--	--	--	--
JW-7	11/18/89	10:45	1,408	6.63	12.3
JW-8	11/18/89	11:06	1,315	7.40	15.0
JW-9	11/17/89	14:46	Off-Scale*	7.04	11.0
JW-10	11/30/89	11:53	Off-Scale*	7.89	5.3

* = Maximum reading from TLC meter is 20,000 µmhos/cm.

NOTES: Field parameters were not obtained at JW-6 after the well dried during development.

High Tide on 11/17/89 at 14:08	Low Tide on 11/17/89 at 20:39
" " " 11/18/89 at 15:08	" " " 11/18/89 at 08:51
" " " 11/30/89 at 12:11	" " " 11/30/89 at 05:57
" " " 12/06/89 at 17:05	" " " 12/06/89 at 10:52

SOURCE: Tables of Tides, Sunrise and Sunset, Portsmouth Naval Shipyard, Portsmouth

Table 4-3

JILF (SWMU #8) Well Development Details

Well Nº	Date	Well Volume (gallons)	Number of Well Volumes Evacuated	Total Volume of Water Removed (gallons)
JW-3	12/06/89	2.00	5.25	10.5
JW-4	12/06/89	1.27	41.7	53
JW-5	12/06/89	1.27	32.3	41
JW-6	11/18/89	2.24	8.5	19
JW-7	11/18/89	1.22	41.0	50
JW-8	11/18/89	0.90	72.2	65
JW-9	11/17/89	1.52	37.5	57
JW-10	11/30/89	0.89	74.2	66

4.1.3.1 Water Level Measurements. Water levels were taken frequently during the field program in order to determine the effects tidal fluctuations had on groundwater. Static water levels were measured by means of steel tape and chalk. The steel tape was properly cleaned between wells to prevent cross-contamination. Water level measurements are recorded in the field notebooks (see Appendix I).

4.1.3.2 Slug Tests. Slug tests were performed in monitoring wells JW-3, JW-8 and JW-9. Prior to the initiation of a slug test, the static level was measured by means of steel tape and chalk in the well to be tested and the measurement recorded. Water level measurements during the test were made by an In-Situ Hermit data logger/processor (SE1000B) which employed a down hole pressure transducer suspended on a vented polyurethane cable. The data logger allowed rapid acquisition of water level information at rates set by the user. For these tests, the unit was set to record data at a logarithmic rate. This provided a greater number of data points during the early portions of the test when recovery rates are faster. The measurement frequency is outlined as follows:

Hermit Data Logger Sampling Frequency

Elapsed Time	Sample Interval	Number of Points
0-2 sec	0.2 sec	11
2-20 sec	1 sec	18
20-120 sec	5 sec	20
2-10 min	0.5 min	16
10-100 min	2 min	45
100-1000 min	10 min	90

Volume displacement (the slug) was achieved using a cement filled piece of 1.25 inch O.D. PVC pipe with capped ends. The slug was 56.88 inches long and provided a displacement volume of 0.040 $ft.^3$ or 0.302 gallons. Prior to each test, the slug was decontaminated using the following procedure:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with distilled water;
4) rinse with methanol;
5) rinse with hexane; and
6) air dry.

The slug was lowered into the well by means of a dedicated length of nylon rope attached to a stainless steel eye hook connected to one end of the slug.

Each test was conducted by measuring the static water level in the well, lowering the pressure transducer to near the bottom of the well, switching on the recorder, and immediately submerging the slug into the water column. Data were collected by the data logger until the water level in the well returned to its original static level. Water level information was then printed out on-site by a portable field printer (see Appendix II).

4.2 Findings

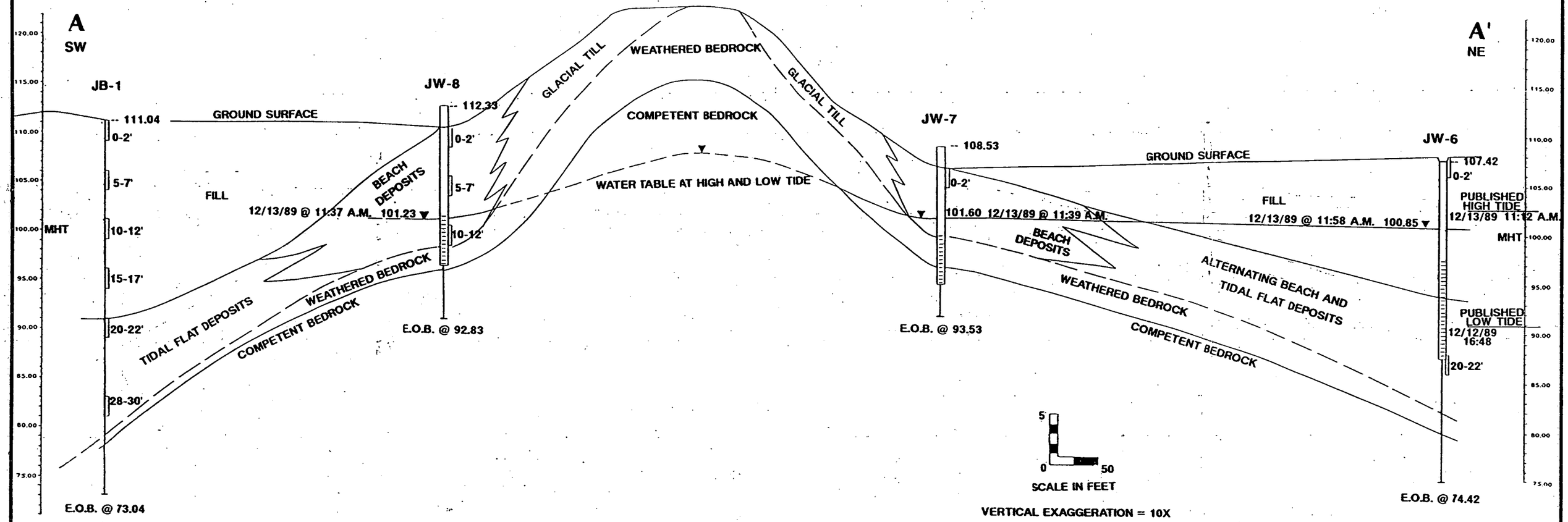
4.2.1 Geology/Stratigraphy

Information from the subsurface boring investigation shows that the overburden beneath the JILF is composed of fill material, beach deposits, and tidal flat deposits. The boring logs (see Appendix III) show fill varying in composition depending on location. Beach deposits consist of tan to brown, fine to coarse grained sand with approximately 1% to 35% silt content. Tidal flat deposits consist of organic rich grey silt and clay.

Based on the core samples, bedrock beneath the JILF consists of a highly fractured dark grey to greenish-grey, fine grained metamorphic rock (quartzite and phyllite). As discussed in the RFIP, bedrock consists of tectonically deformed Middle Ordovician volcanics and highly fractured metamorphosed sandstones, shales, and siltstones of Silurian age belonging to the Kittery Formation (Hussey, 1985). Metamorphism has destroyed original interparticle porosity in the sedimentary rocks. Therefore, groundwater flow is controlled by fractures.

Geologic cross-sections are shown in Figures 4-7, 4-8, 4-9, and 4-10. Enclosure B shows cross-section locations. Figure 4-7 is a southwest-northeast cross-section (A-A', Enclosure B) along the western (landward) margin of the JILF. This cross-section depicts competent bedrock at depths varying from 10 to 33 feet below grade. Bedrock surface slopes away from the bedrock-controlled topographic high on which the hospital is located. Overlying the bedrock is a zone interpreted to consist of weathered bedrock of varying thickness. This weathered bedrock zone is interpreted from drilling parameters, torque and penetration rate, and is believed to consist of highly fractured and weathered bedrock which is more competent than the overburden material, but less competent than the underlying bedrock. This zone ranges in thickness from 1 to 3 feet. Overlying the weathered bedrock on the flanks of the bedrock controlled hill is an inferred veneer of glacial till as discussed in the RFIP. Both southwest and northeast of the bedrock high, beach deposits overlie the weathered bedrock zone. Northeast of the beach deposits weathered bedrock is overlain by thin alternating layers of beach and tidal flat deposits. Southwest of the beach deposits weathered bedrock is overlain by tidal flat deposits only. Fill material overlies the tidal flat deposits and beach deposits to the southwest as well as overlying beach deposits and alternating beach and tidal flat deposits to the northeast. Fill material to the southwest consists of sand, gravel, rock fragments, sandblast grit and wood. A strong petroleum odor was detected and black staining observed in the saturated fill at JB-1. Fill northeast of the hill consists of sand, silt, gravel and rock fragments. There was no indication of debris, staining, or odors in this fill material.

Figure 4-8 is a southwest-northeast cross-section (B-B', Enclosure B) along the eastern (riverside) margin of the JILF. The section depicts competent bedrock at depths varying from 6 to 32 feet below grade. A topographic low exists in the bedrock surface in the vicinity of JB-11. This low corresponds



LEGEND:

- SAMPLE INTERVAL OBTAINED FOR LABORATORY ANALYSIS
- SCREENED INTERVAL
- DEPTH OF BORING
- WATER TABLE

FIGURE 4-7

JILF (SWMU #8)

GEOLOGIC CROSS-SECTION A-A'

MARCH, 1990

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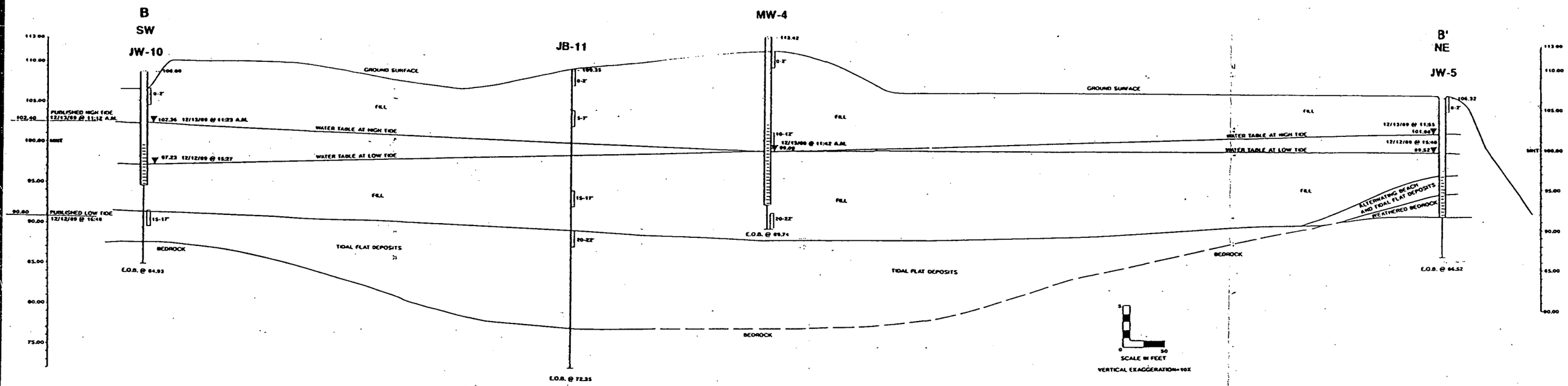
NOTE: ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM



LEGEND:

- SAMPLE INTERVAL OBTAINED FOR LABORATORY ANALYSIS
- SCREENED INTERVAL
- DEPTH OF BORING
- WATER TABLE

NOTE: ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM

FIGURE 4-8

JILF (SWMU #8)

GEOLOGIC CROSS-SECTION B-B'

MARCH, 1990

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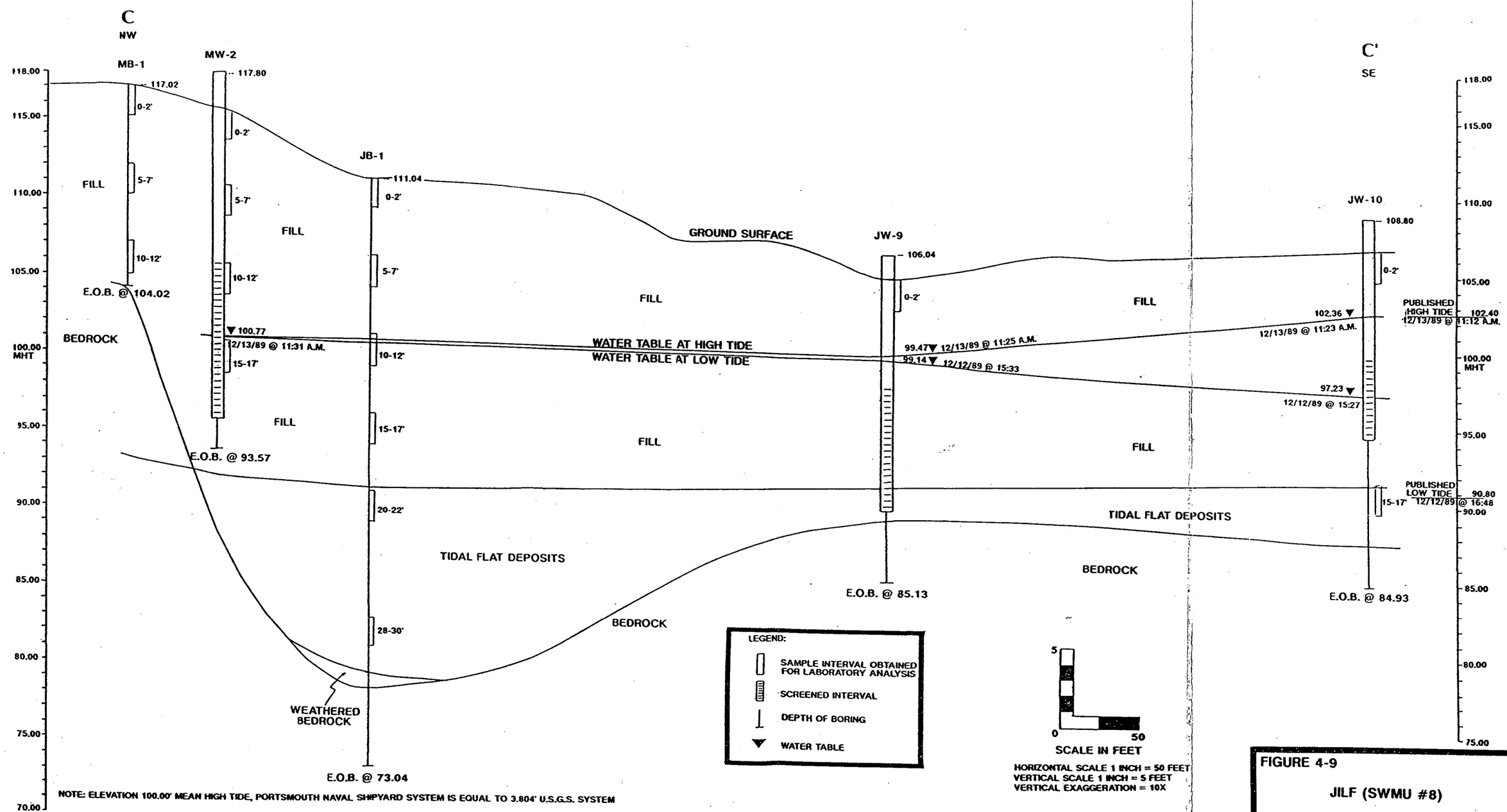


NOTE: ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM

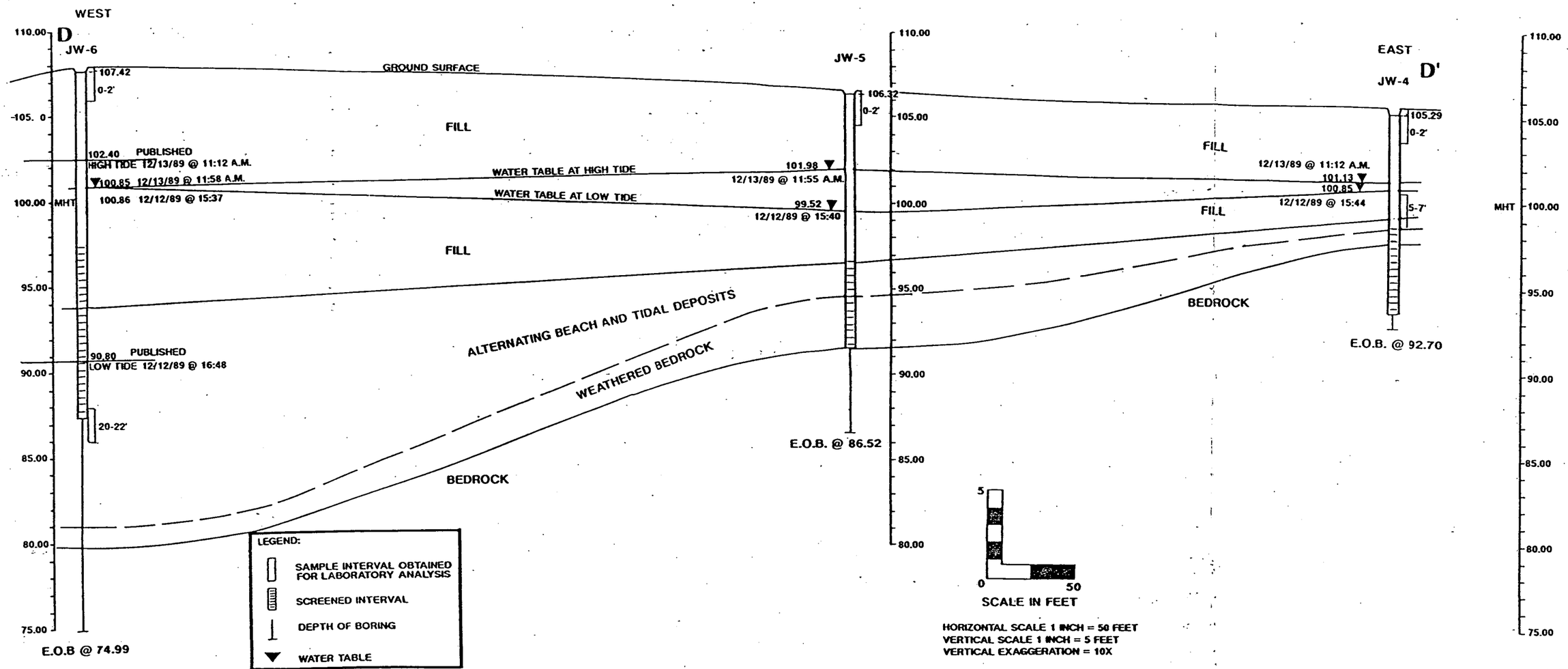
FIGURE 4-9

JILF (SWMU #8)

GEOLOGIC CROSS-SECTION C-C'

MARCH, 1990

FRED C. HART ASSOCIATES, INC.



NOTE: ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM

FIGURE 4-10

JILF (SWMU #8)

GEOLOGIC CROSS-SECTION D-D'

MARCH, 1990

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with the inferred location of the former tidal channel which existed between Seavey and Jamaica Islands. A zone of weathered bedrock is interpreted to overly competent bedrock at monitoring well location JW-5. Tidal flat deposits overlie bedrock in all boring and monitoring well locations except JW-5. At JW-5 the weathered bedrock zone is overlain by alternating layers of beach and tidal flat deposits. Fill material, ranging in thickness from 10 to 20 feet, overlies the tidal flat deposits as well as the alternating beach and tidal flat deposits at JW-5. Fill consists of sand, silt, gravel and rock fragments. In addition, the fill at JB-11 includes sandblast grit, metal shavings, paper, cinders, plastic, paint residue, and wood. A strong petroleum odor was detected and black staining observed in the saturated fill at JB-11.

Figure 4-9 is a northwest-southeast cross-section (C-C', Enclosure B) along the southern limits of the JILF. The section shows competent bedrock surface dipping sharply to the southeast from MB-1. Bedrock surface forms a trough, with its deepest portion in the vicinity of JB-1. Bedrock surface then rises to the southeast and becomes nearly horizontal near JW-9. Depth to competent bedrock varies from 13 to 32 feet below grade. Weathered bedrock is interpreted to overlie competent bedrock at all locations. Tidal flat sediments immediately overlie the weathered bedrock. Fill material, varying in thickness from approximately 13 to 22 feet, overlies the tidal deposits. Fill material consists of sand, silt, gravel, and rock fragments. In addition, the fill at MB-1, MW-2, and JB-1 includes sandblast grit, herculite, wood, plastic, glass, brick, coal, and paint residue. A strong petroleum odor was detected and black staining observed in the fill at MW-2 and JB-1.

Figure 4-10 is a west-east cross-section (D-D', Enclosure B) along the northern limits of the JILF. The section depicts competent bedrock at depths varying from 8 to 28 feet below grade. Bedrock surface slopes from east to northwest. Overlying the bedrock is a zone interpreted to consist of weathered

bedrock 1 to 3 feet in thickness. Alternating beach and tidal deposits, varying in thickness from 1 to 14 feet, overlie weathered bedrock. Fill material consisting of sand, silt, gravel and rock fragments overlies the alternating beach and tidal deposits. There was no indication of debris, staining, or odors in the fill material.

4.2.2 Groundwater Conditions

The cross-sections (see Figures 4-7, 4-8, 4-9, 4-10) show water table elevation variations in the monitoring wells measured during periods of published high and low tides. Wells JW-5, JW-9 and JW-10 exhibit changes in water level as a result of tidal fluctuation. Wells shown in Figure 4-7 (cross-section A-A') exhibited little or no fluctuation in water levels. These wells (JW-8, JW-7, JW-6) are located landward of the JILF, and with the exception of JW-6, are relatively remote from the estuary water. The water level in these wells is one to two feet below the published high tide elevation for that date.

Cross-section B-B' (Figure 4-8) includes wells JW-10, MW-4 and JW-5. JW-10 shows a relatively large fluctuation in water levels generally corresponding with tidal changes.

Specific conductivity measured in well JW-10 exceeded the maximum reading of the TLC meter (i.e. great than 20,000 µmhos/cm) indicating the presence of estuary water in this well. The interpretation is also supported by the low water temperature of 5.3°C. Monitoring well MW-4 is located within the boundary of the capped portion of the JILF and did not show any water level fluctuation. The lack of water level fluctuation in this well indicates that there is only a limited connection between MW-4 and the estuary. A more significant effect was expected due to the well's location. The explanation for this anomaly most likely involves the grain size and permeability of the overburden material at this location. The specific conductivity of water in MW-4 is 2,270 µmhos/cm indicating brackish conditions in the vicinity of this well.

Monitoring well JW-5 exhibited a water level fluctuation of 2.4 feet in contrast with the publish tidal change of 11.6 feet. Water in this well has a specific conductance of 5,140 µmhos/cm and a temperature of 20.7°C indicating brackish conditions.

Cross-section C-C' (Figure 4-9) includes monitoring wells MW-2, JW-9 and JW-10. MW-2 is located inland near Mercury Burial Site II and as expected exhibited no measurable water level fluctuation. Water quality in this well (discussed in detail in section 5.0) has a conductivity below 1,100 µmhos/cm suggesting and a relatively high temperature suggesting the presence of fresh water. Well JW-9 displayed a very small fluctuation in water level corresponding to the tidal cycle. Conductivity is greater than 20,000 µmhos/cm but the temperature is fairly warm at 11°C. This suggests that JW-9 has a poor (i.e., low permeability) connection with the estuary water. As described previously, JW-10 shows the greatest fluctuation of any of the JILF wells and has high conductivity and low temperature water indicative of the estuary.

Cross-section D-D' (Figure 4-10) depicts the water levels measured in wells JW-6, JW-5 and JW-4. No water level fluctuations were recorded in JW-6 suggesting that this well is not in hydraulic communication with estuary water. As described earlier, well JW-5 exhibits a water level fluctuation of 2.46 feet and has a conductance of 5,140 µmhos/cm suggestive of brackish conditions. The greater conductivity and water level fluctuations in well JW-5 suggest that this well has some degree of hydraulic communication with the estuary. JW-4, also described earlier, displayed a small variation in water level and very low conductance suggesting fresh water conditions.

4.2.3 Analytical Results

Soil samples at the JILF were analyzed for Target Compound List (TCL) organic compounds and Target Analyte List (TAL) inorganic compounds. The standard procedure for analysis of TCL organic compounds can be found in the most current USEPA "Statement of Work (SOW), Organic Analysis, Multi-Media Multi-Concentration". The standard procedure for analysis of TAL inorganic compounds can be found in the most current USEPA "Statement of Work (SOW), Inorganic Analysis, Multi-Media Multi-Concentration".

RAI used methods and submitted the required deliverables stated in the July 1987 revision of the "Statement of Work of the EPA Contract Laboratory Program" (CLP) and follow-up revisions to the "Statement of Work of the EPA Contract Laboratory Program".

It should be noted that data flags Q, J, and R, in the analytical tables, are indications of data quality as defined in the February 1988 "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses" and the July 1988 "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses" prepared for the Hazardous Site Evaluation Division of the USEPA.

As presented in the tables, values that stand alone (without a qualifier) are the most accurate results, and possess both qualitative and quantitative connotations. Numbers that are flagged with a "J" represent qualitative but only semi-quantitative results. Values flagged with a "Q" indicate results that are qualitative only. Finally, the qualifier "R" signifies a result that is unusable based on the QA/QC data validation.

Twenty-eight subsurface soil samples were collected from the test borings drilled around the perimeter of the JILF. These samples were analyzed for TCL organics and TAL inorganics. A summary of valid soil results are provided in tables 4-4, 4-5, 4-6, and 4-7.

Table 4-4

Summary of TCL Volatile Concentrations
in Soil Borings: JILF
Concentration Values = ppb

HART I.D.	FB-03	FB-04	JSB-1 (0-2')	JSB-1 (5-7')	JSB-1 (10-12')	JSB-1 (15-17')	JSB-1 (20-22')	JSB-1 (28-30')	JSB-2 (0-2')	JSB-2 (5-7')	JSB-2 (15-17')	JSB-3 (0-2')	JSB-3 (5-6')	JSB-4 (0-2')
LAB I.D.	197082	1972719	195617	195618	195619	1956110	1956111	1956113	197088	197089	1970810	1983423	1983425	197271
Carbon Disulfide	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1,1-Dichloroethane	—	—	—	—	—	—	—	17	—	—	—	—	—	—
1,2-Dichloroethene (total)	—	—	—	—	—	—	—	5Q	—	—	—	—	—	—
Trichloroethene	—	—	—	—	—	—	—	11	—	—	—	—	—	—
4-Methyl-2-Pentanone	—	—	—	—	—	2300	—	—	—	—	—	—	—	—
1,1,2,2,-Tetrachloroethane	—	—	—	—	—	330Q	—	—	—	—	—	—	—	—
Toluene	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ethylbenzene	—	—	—	—	3700J	440Q	—	—	—	—	—	—	—	—
Xylene (total)	—	—	3Q	—	140000J	7100	23	—	—	—	—	—	—	—

JSB-9 (0-2') was reanalyzed (RE) because of a poor surrogate recovery and an internal standard area outside control limits.

J = Qualitative and Semi-Quantitative
Q = Qualitative only
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-4 (continued)

Summary of TCL Volatile Concentrations
in Soil Borings: JILF
Concentration Values = ppb

HART I.D. LAB I.D.	JSB-4D* (0-2') 197274	JSB-4 (5-7') 197277	JSB-5 (0-2') 197086	JSB-5+ (2-4') 197087	JSB-6 (0-2') 197083	JSB-6++ (2-4') 197084	JSB-6 (20-22') 197085	JSB-7 (0-2') 197081	JSB-8 (0-2') 196391	JSB-8D* (0-2') 196392	JSB-8 (5-7') 196393	JSB-8 (10-12') 196394
Carbon Disulfide	—	—	—	—	—	—	—	—	—	—	—	—
1,1-Dichloroethane	—	—	—	—	—	—	—	—	—	—	—	—
1,2-Dichloroethene (total)	—	—	—	—	—	—	—	—	—	—	—	—
Trichloroethene	—	—	—	—	—	—	—	—	—	—	—	—
4-Methyl-2-Pentanone	—	—	—	—	—	—	—	—	—	—	—	—
1,1,2,2,-Tetrachloroethane	—	—	—	—	—	—	—	—	—	—	—	—
Toluene	—	—	—	—	—	—	—	—	—	—	—	—
Ethylbenzene	—	—	—	—	—	—	—	—	—	—	—	—
Xylene (total)	—	—	—	—	—	—	—	—	—	—	—	—

JSB-9 (0-2') was reanalyzed (RE) because of a poor surrogate recovery and an internal standard area outside control limits.

J = Qualitative and Semi-Quantitative
Q = Qualitative only
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-4 (continued)

Summary of TCL Volatile Concentrations
in Soil Borings: JILF
Concentration Values = ppb

HART I.D.	JSB-9 (0-2')	JSB-9 (0-2')RE	JSB-9 (5-7')	JSB-10 (0-2')	JSB-10+++ (2-4')	JSB-10 (15-17')	JSB-11 (0-2')	JSB-11 (5-7')	JSB-11 (15-17')	JSB-11 (20-22')
LAB I.D.	196395	19639-5RE	196396	1972710	1972713	1972716	1983415	1983417	1983419	1983421
Carbon Disulfide	—	—	—	—	—	—	—	—	—	7
1,1-Dichloroethane	—	—	—	—	—	—	—	—	—	—
1,2-Dichloroethene (total)	—	—	—	—	—	—	—	—	—	—
Trichloroethene	—	—	—	—	—	—	—	—	—	—
4-Methyl-2-Pentanone	—	—	—	—	—	—	—	11000	13	3Q
1,1,2,2,-Tetrachloroethane	—	—	—	—	—	—	—	—	—	—
Toluene	—	—	—	—	—	—	—	—	—	6
Ethylbenzene	—	—	—	—	—	—	—	1600	24	—
Xylene (total)	—	—	—	—	—	—	5Q	16000	120	7

JSB-9 (0-2') was reanalyzed (RE) because of a poor surrogate recovery and an internal standard area outside control limits.
J = Qualitative and Semi-Quantitative
Q = Qualitative only
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-5

Summary of TCL Semi-Volatile Concentrations
in Soil Borings: JILF
Concentration Values = ppb

HART I.D.	FB-03	FB-04	JSB-1 (0-2')	JSB-1 (5-7')	JSB-1 (10-12')	JSB-1 (15-17')	JSB-1 (15-17')RE	JSB-1 (20-22')	JSB-1 (28-30')	JSB-2 (0-2')	JSB-2 (5-7')	JSB-2 (15-17')	JSB-3 (0-2')
LAB I.D.	197082	1972722	195617	195618	195619	1956110	1956110RE	1956111	1956113	197088	197089	1970810	1983424
1,2-Dichlorobenzene	—	—	—	—	—	850Q	—	—	—	—	—	—	—
Naphthalene	—	—	—	—	—	—	280Q	—	—	—	—	—	—
2-Methylnaphthalene	—	—	—	—	4300Q	—	310Q	—	—	—	—	—	—
Acenaphthylene	—	—	—	—	6200Q	630Q	540Q	—	—	—	—	—	—
Dibenzofuran	—	—	—	—	4000Q	—	410Q	—	—	—	—	—	—
Fluorene	—	—	—	—	6700Q	790Q	720Q	—	—	—	—	—	—
Phenanthrene	—	—	950	—	29000	4000	3500J	—	—	—	180Q	—	—
Anthracene	—	—	230Q	—	7000Q	920Q	830J	—	—	—	—	—	—
Di-n-butylphthalate	—	—	340Q	—	—	—	—	—	—	—	—	—	—
Fluoranthene	—	—	2300	210Q	23000	3200	2800J	—	—	—	250Q	—	—
Pyrene	—	—	1900	—	16000Q	2500	2100J	—	—	—	230Q	—	—
Butylbenzylphthalate	—	—	1000	—	—	—	—	—	—	—	1600	—	—
Benzo(a)anthracene	—	—	1000	—	6900Q	1300Q	1000J	—	—	—	—	—	—
Chrysene	—	—	880	—	5700Q	1100Q	1100J	—	—	—	—	—	—
Di-n-octylphthalate	—	—	—	—	—	—	—	—	—	—	1300	—	—
Benzo(b)fluoranthene	—	—	1200	250Q	7700Q	1500Q	1300J	—	—	—	—	—	—
Benzo(k)fluoranthene	—	—	—	—	—	—	—	—	—	—	—	—	—
Benzo(a)pyrene	—	—	590Q	—	4800Q	890Q	860J	—	—	—	—	—	—
Indeno(1,2,3-cd)pyrene	—	—	260Q	—	—	—	430Q	—	—	—	—	—	—
Dibenz(a,h)anthracene	—	—	—	—	—	—	—	—	—	—	—	—	—
Benzo(g,h,i)perylene	—	—	200Q	—	—	—	420Q	—	—	—	—	—	—

JSB-1 (15-17') was reanalyzed (RE) to achieve a lower detection limit.
However, extraction took place beyond the allowed holding time.
J = Qualitative and Semi-Quantitative
Q = Qualitative only
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-5 (continued)

Summary of TCL Semi-Volatile Concentrations
in Soil Borings: JILF
Concentration Values = ppb

HART I.D.	JSB-3 (5-6')	JSB-4 (0-2')	JSB-4D* (0-2')	JSB-4 (5-7')	JSB-5 (0-2')	JSB-5+ (2-4')	JSB-6 (0-2')	JSB-6++ (2-4')	JSB-6 (20-22')	JSB-7 (0-2')	JSB-8 (0-2')	JSB-8D* (0-2')	JSB-8 (5-7')
LAB I.D.	1983426	197272	197275	197278	197086	197087	197083	197084	197085	197081	196391	196392	196393
1,2-Dichlorobenzene	—	—	—	—	—	—	—	—	—	—	—	—	—
Naphthalene	—	—	—	—	—	—	—	—	—	2100	—	—	—
2-Methylnaphthalene	—	—	—	—	—	—	—	—	—	880Q	—	—	—
Acenaphthylene	—	—	—	—	—	—	—	—	—	2600	—	—	—
Dibenzofuran	—	—	—	—	—	—	—	—	—	2100	—	—	—
Fluorene	—	—	—	—	—	—	—	—	—	3300	—	—	—
Phenanthrene	—	—	—	—	—	—	—	—	—	16000	—	—	—
Anthracene	—	—	—	—	—	—	—	—	—	4300	—	—	—
Di-n-butylphthalate	—	—	—	—	—	—	—	—	—	—	—	—	—
Fluoranthene	—	—	—	—	—	—	—	—	—	16000	—	—	—
Pyrene	—	—	—	—	—	—	—	—	—	15000	—	—	—
Butylbenzylphthalate	—	—	—	—	—	—	—	—	—	—	—	—	—
Benzo(a)anthracene	—	—	—	—	—	—	—	—	—	10000	—	—	—
Chrysene	—	—	—	—	—	—	—	—	—	9500	—	—	—
Di-n-octylphthalate	—	—	—	—	—	—	—	—	—	—	—	—	—
Benzo(b)fluoranthene	—	—	—	—	—	—	—	—	—	7800	—	—	—
Benzo(k)fluoranthene	—	—	—	—	—	—	—	—	—	5100	—	—	—
Benzo(a)pyrene	—	—	—	—	—	—	—	—	—	7900	—	—	—
Indeno(1,2,3-cd)pyrene	—	—	—	—	—	—	—	—	—	4600	—	—	—
Dibenz(a,h)anthracene	—	—	—	—	—	—	—	—	—	2600	—	—	—
Benzo(g,h,i)perylene	—	—	—	—	—	—	—	—	—	3200	—	—	—

JSB-1 (15-17') was reanalyzed (RE) to achieve a lower detection limit.
However, extraction took place beyond the allowed holding time.
J = Qualitative and Semi-Quantitative
Q = Qualitative only
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-5 (continued)

Summary of TCL Semi-Volatile Concentrations
in Soil Borings: JILF
Concentration Values = ppb

HART I.D. LAB I.D.	JSB-9 (0-2') 196395	JSB-9 (5-7') 196396	JSB-10 (0-2') 1972711	JSB-10+++ (2-4') 1972714	JSB-10 (15-17') 1972717	JSB-11 (0-2') 1983416	JSB-11 (5-7') 1983418	JSB-11 (15-17') 1983420	JSB-11 (20-22') 1983422
1,2-Dichlorobenzene	—	—	—	—	—	—	—	—	—
Naphthalene	—	—	—	—	—	—	—	—	—
2-Methylnaphthalene	—	—	—	—	—	—	—	—	—
Acenaphthylene	—	—	—	—	—	—	—	—	—
Dibenzofuran	—	—	—	—	—	—	—	—	—
Fluorene	—	—	—	—	—	—	—	—	—
Phenanthrene	220Q	—	—	—	—	290Q	260Q	340Q	—
Anthracene	—	—	—	—	—	—	240Q	—	—
Di-n-butylphthalate	—	—	—	—	—	—	—	—	—
Fluoranthene	230Q	250Q	170Q	—	—	450Q	1400	480Q	—
Pyrene	200Q	230Q	150Q	—	—	390Q	1300	530Q	—
Butylbenzylphthalate	—	210Q	—	—	—	—	—	—	—
Benzo(a)anthracene	—	—	—	—	—	210Q	680Q	230Q	—
Chrysene	220Q	—	—	—	—	300Q	850	550Q	—
Di-n-octylphthalate	—	—	—	—	—	—	—	430Q	—
Benzo(b)fluoranthene	—	190Q	—	—	—	—	920	—	—
Benzo(k)fluoranthene	—	—	—	—	—	—	—	—	—
Benzo(a)pyrene	—	—	—	—	—	200Q	450Q	—	—
Indeno(1,2,3-cd)pyrene	—	—	—	—	—	—	210Q	—	—
Dibenz(a,h)anthracene	—	—	—	—	—	—	—	—	—
Benzo(g,h,i)perylene	—	—	—	—	—	—	180Q	—	—

JSB-1 (15-17') was reanalyzed (RE) to achieve a lower detection limit.
However, extraction took place beyond the allowed holding time.
J = Qualitative and Semi-Quantitative
Q = Qualitative only
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-6

Summary of TCL Pesticide/PCB Concentrations
in Soil Samples: JILF
Concentration Values = ppb

HART I.D.	FB-03	FB-04	JSB-1 (0-2')	JSB-1 (5-7')	JSB-1 (10-12')	JSB-1 (15-17')	JSB-1 (20-22')	JSB-1 (28-30')	JSB-2 (0-2')	JSB-2 (5-7')	JSB-2 (15-17')	JSB-3 (0-2')	JSB-3 (5-6')
LAB I.D.	197082	1972723	195617	195618	195619	1956110	1956111	1956113	197088	197089	1970810	1983424	1983426
4,4'-DDE	--	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDD	--	--	76	--	--	--	--	--	--	--	--	--	--
4,4'-DDT	--	--	290	45	--	--	--	--	76	--	--	--	--
Endrin Ketone	--	--	--	--	--	--	--	--	100	--	--	--	--
Aroclor 1254	--	--	--	--	1500	--	--	--	--	--	--	--	--
Aroclor 1260	--	--	--	--	--	--	--	--	--	--	--	--	--

J = Qualitative and Semi-Quantitative
Q = Qualitative only
D = Detected but below the Contract Required Quantitation Limit (CRQL)
-- = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-6 (continued)

Summary of TCL Pesticide/PCB Concentrations
in Soil Samples: JILF
Concentration Values = ppb

HART I.D.	JSB-4 (0-2')	JSB-4D* (0-2')	JSB-4 (5-7')	JSB-5 (0-2')	JSB-5+ (2-4')	JSB-6 (0-2')	JSB-6++ (2-4')	JSB-6 (20-22')	JSB-7 (0-2')	JSB-8 (0-2')	JSB-8D* (0-2')	JSB-8 (5-7')	JSB-9 (0-2')
LAB I.D.	197272	197275	197278	197086	197087	197083	197084	197085	197081	196391	196392	196393	196395
4,4'-DDE	--	--	--	67J	83	230	--	--	130J	--	--	--	--
4,4'-DDD	--	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDT	51	--	--	68J	88	270	--	--	94J	--	--	--	--
Endrin Ketone	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1254	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1260	--	--	--	--	--	--	--	--	--	--	--	--	--

J = Qualitative and Semi-Quantitative
Q = Qualitative only
D = Detected but below the Contract Required Quantitation Limit (CRQL)
-- = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-6 (continued)

Summary of TCL Pesticide/PCB Concentrations
in Soil Samples: JILF
Concentration Values = ppb

HART I.D. LAB I.D.	JSB-9 (5-7') 196396	JSB-10 (0-2') 1972711	JSB-10+++ (2-4') 1972714	JSB-10 (15-17') 1972717	JSB-11 (0-2') 1983416	JSB-11 (5-7') 1983418	JSB-11 (15-17') 1983420	JSB-11 (20-22') 1983422
4,4'-DDE	--	--	--	--	D	--	--	--
4,4'-DDD	--	--	--	--	D	--	--	--
4,4'-DDT	--	40	--	--	96J	--	--	--
Endrin Ketone	--	--	--	--	--	--	--	--
Aroclor 1254	--	--	--	--	--	13000J	1100J	--
Aroclor 1260	--	--	--	--	--	--	1100J	--

J = Qualitative and Semi-Quantitative
Q = Qualitative only
D = Detected but below the Contract Required Quantitation Limit (CRQL)
-- = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-7

Summary of TAL Inorganic Concentrations
in Soil Samples: JILF
Concentration Values = ppm

HART I.D.	FB-03	FB-04	JSB-1 (0-2')	JSB-1 (5-7')	JSB-1 (10-12')	JSB-1 (15-17')	JSB-1 (20-22')	JSB-1 (28-30')	JSB-2 (0-2')	JSB-2 (5-7')	JSB-2 (15-17')
LAB I.D.	1970802	1972720	1956107	1956108	1956109	1956110	1956111	1956113	1970808	1970809	1970810
Aluminum	—	—	11400J	6050J	28800J	21500J	11000J	9910J	9130J	7840J	16300J
Antimony	—	—	—	—	—	—	—	—	5.5Q	0.64Q	1.3Q
Arsenic	—	—	—	6.7J	7.1J	—	6.0J	9.8J	3.9J	4.2J	9.2J
Barium	—	—	144	—	319	232	36.5	47.6	134	67.3	80.3
Beryllium	—	—	0.76	—	1.4	0.97	0.49	0.47	2.9	3.5	0.38Q
Cadmium	—	—	1.0	—	2.0	1.4	0.97	0.70	1.3	1.2	1.9
Calcium	0.095Q	.152Q	4790	610	16800	9870	10000	3660	16900J	9040J	12400J
Chromium	—	.003Q	53.7J	7.6J	67.0J	39.7J	31.4J	30.1J	39.7J	33.7J	61.4J
Cobalt	—	—	—	—	—	—	—	—	18.8	30.4	13.3
Copper	—	—	568J	27.9J	759J	304J	19.5J	23.5J	1670	231	220
Iron	0.217J	.118	18400J	8000J	42300J	32500J	18700J	19800J	24700J	21100	29500J
Lead	—	.001Q	247J	94.0	929J	375J	20.3	9.0	353	193	81.4
Magnesium	—	—	2440J	—	6130J	3390J	5750J	6270J	1720J	4590J	12200J
Manganese	—	—	119	81.7	249	139	183	287	184J	254J	350J
Mercury	—	—	0.15	—	9.5	0.61	—	—	0.11	0.18	0.38
Nickel	—	—	32.6	—	42.9	64.6	18.5	26.3	194	62.8	70.8
Potassium	—	—	1260	450	3040	2230	3380	3610	1330	1900	4020
Selenium	0.0012Q	—	—	—	—	—	—	—	0.54Q	0.38Q	0.44Q
Silver	—	—	—	—	—	—	—	—	—	—	—
Sodium	0.353Q	.336Q	660	42.1	2020	1610	2920	1130	635Q	537Q	2160
Thallium	—	—	—	—	—	—	—	—	—	—	0.27Q
Vanadium	—	—	—	—	50.6	37.7	—	—	18.6	20.5	54.9
Zinc	0.022	.038	266	35.2	778	419	58.2	50.8	2030	1390	237
Cyanide	—	.0029Q	—	—	0.19	—	—	—	—	—	—

J = Qualitative and Semi-Quantitative
Q = Qualitative only
R = Data unusable
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-7 (continued)

Summary of TAL Inorganic Concentrations
in Soil Samples: JILF
Concentration Values = ppm

HART I.D.	JSB-3 (0-2')	JSB-3 (5-6')	JSB-4 (0-2')	JSB-4D* (0-2')	JSB-4 (5-7')	JSB-5 (0-2')	JSB-5+ (2-4')	JSB-6 (0-2')	JSB-6++ (2-4')	JSB-6 (20-22')	JSB-7 (0-2')
LAB I.D.	1983424	1983426	1972703	1972706	1972709	1970806	1970807	1970803	1970804	1970805	1970801
Aluminum	17300	9870	13600J	8590J	8370J	15700J	18200J	8820J	15100J	9520J	12600J
Antimony	—	—	21.6Q	0.87Q	—	—	0.77Q	—	—	—	1.4Q
Arsenic	6.0J	7.9J	4.7J	4.4J	5.1J	6.9J	8.4J	10	8.2J	5.4J	4.5J
Barium	64.1	37.2Q	90.9	40.3Q	37.9	45.6	49.7	21.1Q	52.0	37.3Q	61.6
Beryllium	0.43Q	—	—	—	0.27Q	0.44Q	0.48Q	—	0.44Q	0.38Q	1.3
Cadmium	1.1	—	1.3	0.87Q	0.53Q	1.1	0.96Q	0.98	0.89Q	0.94	1.3
Calcium	2280	1860	2000	2390	789	1410J	1460J	64700J	8090J	1530J	2040J
Chromium	36.4J	37.6J	64.9J	33.0J	21.1J	55.4J	56.0J	18.9J	41.8J	25.8J	46.6J
Cobalt	11.3	7.4Q	12.6	8.2Q	6.6	10.5Q	13.3	—	11.3	13.9	18.6
Copper	17.5	9.9	16.9	16.5	9.7	20.1	22.4	244	31.1	15.2	238
Iron	25300J	13600J	23400J	14200J	10600J	20800J	23900J	9300J	18600J	16900J	22800J
Lead	41.7J	7.5	61.7J	45.2	6.3	41.2	51.1	32.2	57.6	6.7	206
Magnesium	6170	4610	9240J	4620J	2720J	6240J	7040J	6400J	5910J	4690J	5910J
Manganese	413J	262J	387J	286J	234J	266J	338J	143J	384J	286J	304J
Mercury	—	—	—	—	—	0.04Q	0.07Q	0.12	0.11	—	0.09
Nickel	27.7	19.9	30.5	23.4	15.8	30.3	33.8	7.6Q	29.3	22.2	59.1
Potassium	2090	1380	5410	1910	1100	1350	1380	608Q	1380	3630	1820
Selenium	R	R	0.18Q	0.58Q	—	0.59Q	0.76Q	0.57Q	0.63Q	0.29Q	0.31Q
Silver	—	—	—	—	—	—	—	—	—	—	—
Sodium	97.7Q	86.0Q	110Q	69.6Q	88.0Q	158Q	205Q	60.8Q	83.6Q	909Q	164Q
Thallium	0.22Q	0.23Q	—	—	0.22Q	—	—	—	0.34Q	0.21Q	0.45Q
Vanadium	39.0J	24.0J	49.4J	35.6J	16.1J	39.7	42.9	16.4	30.2	26.2	47.9
Zinc	70.7	23.8	58.4J	64.2J	18.5J	60.4	68.3	47.1	66.4	40.8	903
Cyanide	—	—	—	—	0.15Q	—	—	—	—	—	—

J = Qualitative and Semi-Quantitative
Q = Qualitative only
R = Data unusable
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

Table 4-7 (continued)

Summary of TAL Inorganic Concentrations
in Soil Samples: JILF
Concentration Values = ppm

HART I.D.	JSB-8 (0-2')	JSB-8D* (0-2')	JSB-8 (5-7')	JSB-9 (0-2')	JSB-9 (5-7')	JSB-10 (0-2')	JSB-10+++ (2-4')	JSB-10 (15-17')	JSB-11 (0-2')	JSB-11 (5-7')	JSB-11 (15-17')	JSB-11 (20-22')
LAB I.D.	1963901	1963902	1963903	1963905	1963906	1972712	1972715	1972718	1983416	1983418	1983420	1983422
Aluminum	4910	8440	4510	12700	9480	9710J	11100J	16500J	8890	14800	7990	11100
Antimony	—	—	—	0.70J	0.69	—	—	—	—	27.8J	—	—
Arsenic	8.5J	6.2J	7.5J	17.9J	6.7	4.2J	7.7J	7.7J	5.1J	4.8J	8.0J	4.7J
Barium	12.2	29.2	14.4	105	43.9	24.9Q	34.1Q	33.1Q	51.8	147	36.6Q	29.0Q
Beryllium	—	0.41	—	0.44	0.43	—	—	0.69Q	0.46Q	1.3	0.48Q	—
Cadmium	—	—	—	1.5	0.65	0.71Q	—	—	1.1	1.7	—	—
Calcium	467	1470	335	6030	2240	1240	1810	3680	9160	6560	2650	2560
Chromium	7.7	14.9	8.5	51.2	25.4	25.1J	21.3J	30.8J	36.9J	75.1J	36.4J	37.4J
Cobalt	3.8	5.4	—	9.5	6.5	5.2Q	5.6Q	12.2	8.5	11.8	9.8Q	—
Copper	8.4	12.0	7.3	60.7	43.3	18.8	17.8	20.2	187	878	101	14.1
Iron	8450J	11500J	8510J	25700J	13000J	10000J	11200J	23000J	14800J	36200J	20600J	18900J
Lead	14.0	21.7	9.0	161	83.3	46.1J	39.7J	27.6	77.2J	592J	120J	47.6
Magnesium	1360	2340	1540	6110	3490	2680J	2950J	5860J	4890	4340	4690	5600
Manganese	101	232	78.6	306	263	110J	173J	531J	213J	288J	246J	174J
Mercury	—	—	—	—	—	0.05Q	0.03Q	0.04Q	0.14	0.17	0.20	0.13
Nickel	6.6	12.2	5.8	34.3	18.5	12.0	15.2	31.0	38.6	139	38.0	19.8
Potassium	—	1260	—	2200	1740	1050Q	1460	3950	2750	1920	1680	3470
Selenium	—	—	—	—	—	—	—	—	R	1.6Q	R	2.4Q
Silver	—	2.5	—	—	—	—	—	—	—	—	—	—
Sodium	98.4	65.8	36.2	453	282	86.7Q	117Q	2530	264Q	501Q	256Q	3590
Thallium	—	0.28J	—	—	—	—	—	0.02Q	—	—	—	—
Vanadium	11.8	23.4	10.2	33.0	26.1	17.6J	18.7J	34.2J	26.4J	34.7J	24.6J	35.0J
Zinc	22.0	46.6	22.0	255	204	45.8J	50.7J	56.1J	185	1160	309	63.2
Cyanide	—	—	—	—	—	—	—	—	—	—	—	—

J = Qualitative and Semi-Quantitative
Q = Qualitative only
R = Data unusable
— = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of JSB-5 (0-2')
++ = HART replicate sample of JSB-6 (0-2')
+++ = HART replicate sample of JSB-10 (0-2')

The state of Maine does not have any clean-up guidelines for contamination in soils. For comparison purposes only, New Jersey's ECRA guidance values are used where applicable.

Detectable concentrations of volatile organic compounds (VOCs) were found in subsurface soil samples obtained from borings JSB-1 and JSB-11. The New Jersey ECRA guidance value for total VOCs in soils is 1.0 ppm. This value is exceeded in soil samples JSB-1 (10-12'), JSB-1 (15-17'), and JSB-11 (5-7').

Elevated concentrations of semi-volatile compounds were detected in soil samples JSB-1 (0-2'), JSB-1 (10-12'), JSB-1 (15-17'), JSB-2 (5-7'), JSB-7 (0-2'), and JSB-11 (5-7'). Qualitative concentrations were detected in samples JSB-1 (5-7'), JSB-9 (0-2'), JSB-9 (5-7'), JSB-10 (0-2'), JSB-11 (0-2'), and JSB-11 (15-17'). New Jersey ECRA guidance values for total acid extractables and total base neutrals are exceeded in soil from borings JSB-1, JSB-7 and JSB-11.

Detectable concentrations of pesticides were found in most soil samples collected from 0 to 2' below grade with the exception of JSB-3 (0-2'), JSB-8 (0-2'), and JSB-9 (0-2'). The only detectable pesticide concentration found below a depth of two feet is at JSB-1 (5-7'). PCBs were detected in three samples, JSB-1 (10-12'), JSB-11 (5-7'), and JSB-11 (15-17'). Two samples, JSB-1 (10-12') and JSB-11 (15-17'), have total PCB concentrations that fall within the 1.0 to 5.0 ppm New Jersey ECRA guidance value range. Total PCB concentrations in JSB-11 (5-7') exceed the New Jersey ECRA guidance value range.

Soil samples with inorganic constituent concentrations above New Jersey ECRA guidance values are shown below with the corresponding guidance value concentration.

Inorganic Constituent	ECRA Guidance Value in ppm	Soil Samples Above ECRA Values
Antimony	10	JSB-11 (5-7')
Beryllium	1	JSB-1 (10-12'), JSB-2 (0-2'), JSB-2 (5-7'), JSB-7 (0-2')
Copper	170	JSB-1 (0-2'), JSB-1 (10-12'), JSB-1 (15-17'), JSB-2 (0-2'), JSB-2 (5-7'), JSB-2 (15-17'), JSB-7 (0-2'), JSB-11 (0-2'), JSB-11 (5-7')
Mercury	1	JSB-1 (10-12')
Nickel	100	JSB-2 (0-2'), JSB-11 (5-7')
Zinc	350	JSB-1 (10-12'), JSB-1 (15-17'), JSB-2 (0-2'), JSB-2 (5-7'), JSB-7 (0-2'), JSB-11 (5-7')

4.3 JILF Conclusions

HART has drawn the following conclusions from the field investigation of the JILF (SWMU #8).

1) Wide variations in magnetic field strength across the landfill are the result of landfilled material consisting of ferrous metallic objects including steel reinforcing bars, railroad rails, fencing and a two-man submarine. Particularly strong anomalies occur near grid locations K_6, L_8, E_8 and H_8.
2) Ground penetrating radar has proven ineffective in an around the JILF due to a limited signal penetration depth resulting from the conductive nature of the landfill material and subsurface soils.
3) Difficulties arose during bedrock coring at well locations JW-9 and JW-10. Core barrel plugging limited bedrock core recovery to 4 feet in JW-9 and 2.7 feet in JW-10. Plugging of the core barrel is likely to have resulted from highly fractured and/or weathered bedrock at these drilling locations.
4) Fill material and groundwater encountered in borings at locations JB-1 and JB-11 and in monitoring well MW-2 showed visual and olfactory evidence of petroleum contamination. The source of this contamination is unknown at this time.

5) Laboratory analytical results indicate the following:

a) Soil samples from borings JSB-1 and JSB-11 show significant concentrations of volatile organic compounds at depths ranging from 5 to 30 feet below grade.

b) Soil samples from borings JSB-1, JSB-2, JSB-7, JSB-9, JSB-10 and JSB-11 show significant concentrations of semi-volatile organic compounds at depths ranging from near surface to 17 feet below grade.

c) Pesticides were found in soils from borings JSB-1, JSB-2, JSB-4, JSB-5, JSB-6, JSB-7, JSB-10 and JSB-11 at depths ranging from near surface to 17 feet below grade.

d) PCBs were detected in soil samples from borings JSB-1 and JSB-11 at depths ranging from 5 to 17 feet below grade.

e) Soil samples from borings JSB-1, JSB-2, JSB-7 and JSB-11 contain one or more metals in concentrations which exceed the New Jersey ECRA guidance values. Cyanide was detected JSB-1 and JSB-4.

5.0 MERCURY BURIAL SITE (SWMU #9)

5.1 Field Program

5.1.1 Geophysical Program

A surface geophysical investigation was conducted at the PNS as part of the Phase I field work. Both a magnetic field survey and a ground penetrating radar survey were conducted in an attempt to determine the location of the buried vaults containing mercury waste without the danger of drilling into unknown waste materials. The concept of this program is discussed in detail in the RFIP.

5.1.1.1 Magnetometry. As described in section 4.1.1.1 a detailed DMF survey was conducted near Mercury Burial Site I using a 10 foot grid spacing. This survey revealed an anomaly of nearly 1,980 gammas south of the concrete marker (MB-1 -- Figure 4-4). A metal detector was then used to scan this area for shallow metal objects. The detector revealed no indication of target objects south of MB-1 but did signal the presence of metal in the subsurface between MB-1 and grid location I_9. No large anomalies were measured in this area using the magnetometer suggesting the presence of non-ferrous metal objects in the subsurface in this area.

Metal fences and other metallic objects at the surface near Mercury Burial Site II prohibited the effective use of the magnetometer in this area.

5.1.1.2 Ground Penetrating Radar. The Ground Penetrating Radar (GPR) Survey was conducted in an attempt to locate the Mercury Burial Sites. The general location of the sites is known and the GPR survey was designed to cover these locations to confirm the presence, depth and dimensions of the concrete vaults.

The survey was conducted by Geophysical Survey Systems, Inc. of Hudson, New Hampshire, using a SIR System 3, impulse radar. Real time imaging was provided by a line scanning recorder with a 500 MHz shielded transducer.

Temporary grids were established at the suspected vault locations and were tied into the surveyed grid. The antenna was towed by hand across the grid and the grid modes were noted for later reference. The data was interpreted on-site and adjustments were made to the signal gain, towing speed and survey pattern (towing direction) to improved instrument response.

An additional survey was run at grid location L_8 in an attempt to determine the source of the magnetic anomaly noted in the area.

Findings (Ground Penetrating Radar). The penetration depth with the SIR-3 and 500 MHz transducer was limited to approximately three feet as a result of the conductive nature of the landfill material and soil properties. Possible explanations for this high conductivity include the wet clay cap covering the southern end of the JILF, diffused metal fragments or other conductive material in the fill and a relatively shallow saline water table which is influenced by tides.

As a result of the limited signal penetration no useful subsurface information was obtained using the GPR at any survey location.

All data has been sent to Northern Division, Naval Facilities Engineering Command, U.S. Naval Base, Philadelphia, PA under separate cover.

5.1.2 Test Borings

The test boring program at the two mercury burial sites was performed to assess the potential for environmental contamination as a result of the presence of the sites at the JILF.

The drilling program at the mercury burial sites began on November 28, 1989 and was completed on December 5, 1989. Five test borings were drilled, with four borings completed as monitoring wells. Location MB-1 was not completed as a monitoring well (see Enclosure B). A monitoring well was not installed at MB-1 because the overburden above the bedrock was dry. This boring was tremie grouted to the surface with cement/bentonite grout upon completion.

Test borings were advanced using the hollow-stem auger drilling technique. CATOH Environmental Companies, Weedsport, New York, performed all drilling under the supervision of a HART geologist. A truck-mounted Acker Soil Max boring rig utilizing 4¼-inch ID, hollow-stem augers was used for drilling. Auger cuttings produced by the drilling of test borings were placed in approved DOT 55 gallon drums, supplied by PNS, labeled, and later transferred to the PNS Hazardous Waste Storage Unit.

Prior to drilling the first boring, the drilling equipment was steam-cleaned to remove possible contaminants. All drilling equipment which was to come in contact with the soil underwent the initial cleaning procedure. The drilling equipment was decontaminated between borings to prevent cross-contamination.

A standard, two-foot, steel split-spoon was used to obtain soil samples in advance of drilling. Samples were obtained at five-foot intervals. As each split-spoon soil sample was collected, the samples were immediately scanned with an HNU and a Geiger counter upon opening the sampler. Each sample was described in detail by HART's geologist. Detailed sample descriptions including blow counts, grain size, grain size distributions, and color are included in the geologic logs in Appendix III.

Nineteen soil samples, plus two replicates and one rinseate field blank, were submitted to RAI for chemical analysis. The interval locations for the laboratory-submitted samples are shown on the geologic cross-sections located in Section 5.2.1. All samples obtained at the mercury burial sites were analyzed for RCRA metals.

Prior to sampling, the split-spoons were decontaminated according to the following protocol:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with 1% nitric acid solution;
4) rinse with distilled water;
5) rinse with methanol; and
6) air dry

Samples to be submitted to the laboratory were placed into labeled, laboratory-prepared sample bottles and stored on ice in field coolers for transport to RAI.

5.1.3 Monitoring Wells

The monitoring well installation program at the two mercury burial sites was performed to assess the potential for environmental contamination as a result of the presence of the sites at the JILF.

Test borings were advanced with 4¼-inch ID, hollow-stem augers to a maximum depth of 22.0 feet. A monitoring well was installed at each soil boring location with the exception of location MB-1, as previously described. Each monitoring well was installed in saturated overburden.

Monitoring wells were installed within the 4¼-inch hollow-stem augers used to advance the soil boring. The monitoring wells were constructed of two-inch diameter, threaded, flush-joint schedule 40 PVC riser pipe and 10-slot (0.010-inch) manufactured well screen. Ten feet of teflon screen and five feet of teflon riser was installed at MW-4. Ten feet of teflon screen was installed at MW-5. The screens were set to straddle the water table in both wells. Clean silica sand (equivalent to Morie grade 0) was subsequently added through the augers in increments as the augers were gradually withdrawn. This allowed placement of the sand pack around the screen without permitting the borehole to collapse around the screen. Sand pack was added to encase the entire screen and extend two feet above the top of the screen. A one-foot "sand choker collar", consisting of very fine sand (Morie grade 00), was subsequently installed above the sand pack. A bentonite seal, two feet in length, was installed above the "sand choker collar" and hydrated with fresh water, effectively sealing off the screened interval from the rest of the aquifer.

The remainder of each borehole was grouted with a cement or cement/bentonite slurry to land surface while the augers were removed. A lockable protective steel casing was then cemented over each well to prevent unauthorized access and provide protection for the wells. The cement collar around the

protective casing was sloped away from the well to divert surface run-off from the well. A curb box was cemented over the well instead of protective steel casing at MW-3 to prevent interference in this high traffic area. Monitoring well completion diagrams are located in Appendix IV.

Well and test boring locations and elevations were subsequently surveyed by Frank Emery Engineers/Surveyors of Wells, Maine and a site survey map was produced (see Enclosure B). Well construction information is summarized in Table 5-1.

No sooner than 48 hours after grouting was completed, each well was developed to remove fine sediment from the well screen and sand pack to improve the hydraulic connection between the well and the water bearing formation. Wells were developed by utilizing a WaTerra inertial pump system to surge and purge recharging water from the well. The only portion of the WaTerra pump system to come into contact with the well or water was new, dedicated, development material consisting of high density polyethylene tubing and a Delrin foot valve. The tubing was actuated at the surface by hand. A rapid actuating motion simultaneously pumped and surged the well, providing optimal development. Development continued until a minimum of 20 well volumes were produced. Measurement of pH, specific conductance and temperature were taken of the discharge water at each monitoring well. Towards the end of development, consecutive measurements of the above mentioned parameters were taken in immediate succession. When three consecutive measurements of these parameters indicated ten percent or less variation in specific conductance and temperature and ±0.2 pH unit, development was considered complete. Table 5-2 summarizes stabilized field parameters obtained during well development. Well development information is summarized in Table 5-3.

Table 5-1

Mercury Burial (SWMU #9) Monitoring Well Details

Well Nº	Top of Casing Elevation (ft.)[1]	Ground Elevation (ft.)[1]	Screen Setting (ft.)[2]	Sand Pack (ft.)[2]	Sand Choker Collar (ft.)[2]	Bentonite Seal (ft.)[2]
MW-2	117.80	115.57	10-20	8-20	7-8	5-7
MW-3	115.80	116.07	10-20	8-20	7-8	5-7
MW-4	113.42	111.74	9-19	7-19	6-7	4-6
MW-5	113.76	111.88	10-20	8-20	7-8	5-7

[1] Elevation 100.00' Mean High Tide, PNS System is equal to 3.804' U.S.G.S. System

[2] Below grade

Table 5-2

Mercury Burial (SWMU #9) Well Development
Stabilized Field Parameters

Well Nº	Development Date	Time	Specific Conductivity (µmhos/cm)	pH	Temp. (°C)
MW-2	12/06/89	11:45	1,086	7.95	13.4
MW-3	12/06/89	11:57	1,311	7.05	13.6
MW-4	12/07/89	09:55	2,270	7.49	11.0
MW-5	12/07/89	09:43	12,040	8.22	10.7

NOTE: High Tide on 12/06/89 at 17:05 Low Tide on 12/06/89 at 10:52
" " " 12/07/89 at 05:44 " " " 12/07/89 at 11:55

SOURCE: Tables of Tides, Sunrise and Sunset,
Portsmouth Naval Shipyard, Portsmouth

Table 5-3

Mercury Burial (SWMU #9) Well Development Details

Well Nº	Date	Well Volume (gallons)	Number of Well Volumes Evacuated	Total Volume of Water Removed (gallons)
MW-2	12/06/89	0.80	48.7	39
MW-3	12/06/89	0.69	56.5	39
MW-4	12/07/89	1.03	48.5	50
MW-5	12/07/89	1.12	26.8	30

5.1.3.1 Water Level Measurements. Water levels were taken frequently during the field program in order to determine the effects tidal fluctuations had on groundwater. Static water levels were measured by means of steel tape and chalk. The steel tape was properly cleaned between wells to prevent cross-contamination. Water level measurements are recorded in the field notebooks (see Appendix I).

5.1.3.2 Slug Tests. A slug test was performed in monitoring well MW-5. Prior to the initiation of the slug test, the static level was measured by means of steel tape and chalk in the well to be tested and the measurement recorded. Water level measurements during the test were made by an In Situ Hermit data logger/processor (SE1000B) which employed a down hole pressure transducer suspended on a vented polyurethane cable. The data logger allowed rapid acquisition of water level information at rates set by the user. For these tests, the unit was set to record data at a logarithmic rate. This provided a greater number of data points during the early portions of the test when recovery rates are faster. The measurement frequency is outlined as follows:

Hermit Data Logger Sampling Frequency

Elapsed Time	Sample Interval	Number of Points
0-2 sec	0.2 sec	11
2-20 sec	1 sec	18
20-120 sec	5 sec	20
2-10 min	0.5 min	16
10-100 min	2 min	45
100-1000 min	10 min	90

Volume displacement (the slug) was achieved using a cement filled piece of 1.25 inch O.D. PVC pipe with capped ends. The slug was 56.88 inches long and provided a displacement volume of 0.040 $ft.^3$ or 0.302 gallons. Prior to each test, the slug was decontaminated using the following procedure:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with distilled water;
4) rinse with methanol;
5) rinse with hexane; and
6) air dry

The slug was lowered into the well by means of a dedicated length of nylon rope attached to a stainless steel eye hook connected to one end of the slug.

Each test was conducted by measuring the static water level in the well, lowering the pressure transducer to near the bottom of the well, switching on the recorder, and immediately submerging the slug into the water column. Data were collected by the data logger until the water level in the well returned to its original static level. Water level information was then printed out on-site by a portable field printer (see Appendix II).

5.1.4 Groundwater Sampling

On December 12, 1989, HART personnel collected groundwater samples from four monitoring wells (MW-2, MW-3, MW-4, and MW-5) installed around the two reported mercury burial sites. A replicate sample (MW-1) taken at MW-2 and one rinseate field blank were included in the groundwater sampling. Prior to collecting groundwater samples, static water levels in each of the monitoring wells were measured, and the volume of water in the well was calculated. The wells were then evacuated using separate, precleaned, bottom-filling teflon bailers with teflon check valves for each well. Wells were bailed until five well volumes were removed. All purge water was containerized in DOT approved 55 gallon drums, supplied by PNS, labeled, and later taken to the PNS Hazardous Waste Storage Unit.

Groundwater samples were collected using the same precleaned, teflon bailers used for purging and attached to a clean nylon cord. Bailers were decontaminated prior to use according to the following protocol:

1) wash in soapy water solution of Alconox;
2) rinse with tap water;
3) rinse with 10% nitric acid solution;
4) rinse with distilled water;
5) rinse with methanol; and
6) air dry

Following cleaning, the bailers were wrapped in aluminum foil to prevent contamination prior to use.

All wells were sampled immediately upon evacuation. All samples were collected in a manner to minimize agitation and other disturbing conditions which might cause physiochemical changes and bring about losses due to volatilization, adsorption, redox changes or degradation. The samples were analyzed for RCRA metals. All groundwater samples were field analyzed for temperature, conductivity, pH, Eh, and turbidity at the time of sample collection; results were recorded in the field notebook. A summary of groundwater sampling and field parameter information is contained in Table 5-4. Samples collected for metal analyses were field filtered through 0.45 micron cellulose prior to nitric acid preservation in laboratory supplied bottles.

Upon collection, samples were placed in coolers and kept chilled using ice. Groundwater sample coolers were transported to RAI on a schedule which ensured compliance with holding times.

5.2 Findings

5.2.1 Geology/Stratigraphy

Results from the test boring program verifies that the overburden within the vicinity of the mercury burial sites is composed of fill material. Fill material encountered in the borings consists of fine to coarse sand and gravel, silt, rock fragments, sandblast grit, wood, plastic, metal shavings, paint debris, glass, and herculite (blue and white fabric). A water saturated zone was encountered within MSB-2, MSB-3, and MSB-4 at approximately 15 feet below grade. Water was encountered within MSB-5 at approximately 12 feet below grade.

Competent bedrock was encountered at a depth of 13 feet below grade within MSB-1. Water was not encountered above bedrock, therefore no monitoring well was constructed at this location. Bedrock was not encountered at boring locations MSB-2, MSB-3, MSB-4, and MSB-5. The total depth of these borings were approximately 21 to 22 feet below grade. Geologic information obtained from the test borings is included in Figures 4-8 and 4-9 (geologic cross-sections B-B' and C-C'). This information has been incorporated in the text of section 4.2.1. Enclosure B shows the cross-section locations as they relate to the JILF.

Table 5-4

Mercury Burial (SWMU #9)
Groundwater Sampling and Field Parameter Information

December 12, 1989

Well Nº	Well Volume (gallons)	Number of Well Volumes Evacuated	Temp. (°C)	Specific Conductivity (µmhos/cm)	pH	Eh (mv)	Turbidity (NTU)
MW-2	0.78	5	12.1	1,175	8.19	-70	111.8
MW-3	0.67	5	13.5	1,262	6.83	-94	115.1
MW-4	1.05	5	10.6	2,210	7.11	-47	44.8
MW-5	1.21	5	10.4	7,130	7.73	6	23.5

5.2.2 Groundwater Conditions

Figure 4-8 (cross-section B-B') includes monitoring well MW-4 located near Mercury Burial Site I. As discussed in section 4.2.2, monitoring well MW-4 is located within the boundary of the capped portion of the JILF and did not exhibit measurable water level fluctuations. The water in MW-4 has a specific conductivity of approximately 2,200 µmhos/cm indicating brackish conditions in the vicinity of this well. Water temperature in MW-4 ranged from 10.6 °C to 11 °C (see Tables 5-2 and 5-4).

Monitoring well MW-5 is located near MW-4 and also exhibited little or no water level fluctuation. MW-5 contains brackish to saline water with a specific conductance of approximately 7,100 to 12,000 µmhos/cm and temperature of 10.4 °C to 10.7 °C. The difference in specific conductivity between the groundwater in MW-4 and MW-5 may be attributed to a difference in hydraulic connection with estuary water (i.e. MW-5 being influenced more than MW-4 by estuary water), or MW-5 may contain suspended solids/contaminants unrelated to the estuary which have increased the electrical conductance in this well.

A slug test performed on MW-5 revealed a hydraulic conductivity measurement (k) of 18 ft./day. Literature estimates (Driscoll, 1986; Todd, 1970) indicate that this value should correspond to grain sizes in the range of medium sand. This result supports previously reported information concerning the disposal of dredge spoils in this area of the JILF.

Figure 4-9 (cross-section C-C') includes monitoring well MW-2 located near Mercury Burial Site II. MW-2 is located well inland and is screened in fill material. As shown in Figure 4-9, no water level fluctuation was measured in MW-2. Groundwater in this well has a low specific conductivity indicative of fresh to slightly brackish water and a temperature of 12.1 °C. As described in section 4.0, sediment encountered when constructing monitoring well MW-2 had a black oil appearance and a petroleum odor. Analytical data generated for boring

JB-1 (located nearby MW-2) indicates elevated concentrations of volatile organic compounds (VOC) and polynuclear aromatic hydrocarbons in the soils. Although no VOC analyses were performed on samples from MW-2, similar results should be expected. Monitoring well MW-3, located near MW-2, is also screened in the fill and has similar field parameters and reaction to tidal effects.

As discussed in section 3.2.2 the salinity values of brackish water range from 0.50 to 17.0‰. Based on these values the specific conductivity of fresh water is calculated to be ≤ 1,100 µmhos/cm (<0.50‰) (Ingmanson, Wallace, 1973) and that of sea water is 27,000 µmhos/cm or greater (> 17.0‰).

The lower conductivities and higher temperature in monitoring wells MW-2 and MW-3 suggest that these wells contain a mixture of fresh water and cooler saline estuary water. The generally high conductivities and lower water temperatures in MW-4 and particularly MW-5 suggest that these wells may be influenced to a greater degree by estuary water than inland wells.

5.2.3 Analytical Results

Soil samples and groundwater samples at the Mercury Burial sites were analyzed for RCRA metals. The standard procedure for analysis of Target Analyte List (TAL) compounds, which encompasses the RCRA metal analysis for soil samples, can be found in the most current USEPA "Statement of Work (SOW), Inorganic Analysis, Multi-Media Multi-Concentration".

RAI used methods and submitted the required deliverables stated in the July 1987 revision of the "Statement of Work of the EPA Contract Laboratory Program" (CLP) and follow-up revisions to the "Statement of Work of the EPA Contract Laboratory Program".

It should be noted that data flags Q, J, and R, in the analytical tables, are indications of data quality as defined in the July 1988 "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses" prepared for the Hazardous Site Evaluation Division of the USEPA.

Table 5-5

Summary of RCRA Metal Concentrations
in Soil Samples: Mercury Burial
Concentration Values = ppm

HART I.D.	FB-05	MSB-1 (0-2')	MSB-1D* (0-2')	MSB-1 (5-7')	MSB-1 (10-12')	MSB-2 (0-2')	MSB-2+ (2-4')	MSB-2 (5-7')	MSB-2 (10-12')	MSB-2 (15-17')	MSB-3 (0-2')	MSB-3 (10-12')
LAB I.D.	1983414	1983401	1983402	1983403	1983404	1983405	1983406	1983407	1983408	1983409	1983410	1983411
Arsenic	--	4.2J	7.6J	2.8J	2.9J	4.0J	2.7J	2.2J	1.4Q	5.7J	4.7J	3.0J
Barium	--	61.5	65.1	108	393	388	73.0	270	825	214	59.7	162
Cadmium	--	0.80Q	1.4	0.52Q	2.0	1.5	0.70Q	1.4	2.0	1.1	1.7	0.87
Chromium	--	34.2J	35.9J	26.5J	81.7J	68.6J	28.9J	50.8J	73.0J	46.3J	40.5J	33.9J
Lead	.002Q	143	276J	42.7J	138J	93.7J	157J	98.0J	82.5J	127J	218J	95.4J
Mercury	--	0.07Q	0.34	0.06	0.25	0.25	0.08	--	--	--	0.80	0.58
Selenium	--	R	R	R	R	R	R	R	R	R	R	R
Silver	--	--	--	--	2.4	--	--	--	--	--	2.6	--

J = Qualitative and Semi-Quantitative
Q = Qualitative only
R = Data is unusable
-- = Not detected
* = RAI duplicate per NEESA Program 20.2-047B
+ = HART replicate sample of MSB-2 (0-2')
++ = HART replicate sample of MSB-4 (0-2')

Table 5-5 (continued)

Summary of RCRA Metal Concentrations
in Soil Samples: Mercury Burial
Concentration Values = ppm

HART I.D. LAB I.D.	MSB-3 (15-17') 1983412	MSB-3 (20-22') 1983413	MSB-4 (0-2') 1989901	MSB-4++ (2-4') 1989902	MSB-4 (10-12') 1989903	MSB-4 (20-22') 1989904	MSB-5 (0-2') 1989905	MSB-5 (5-7') 1989906	MSB-5 (10-12') 1989907	MSB-5 (15-17') 1989908	MSB-5 (20-22') 1989909
Arsenic	3.5J	4.2J	5.9	8.3	8.4	1.2Q	4.1	8.2	5.6	5.3	1.9Q
Barium	128	239	33.0Q	28.9Q	36.2	12.6Q	21.7Q	39.7	86.6	23.3Q	15.0Q
Cadmium	0.65Q	1.6	0.64Q	0.70Q	0.85	0.62Q	--	0.59Q	0.92	0.49Q	--
Chromium	29.6J	40.6J	36.5	38.0	19.7	6.2	38.9	40.2	49.6	22.6	10.7
Lead	104J	235J	25.2J	23.2J	45.9J	37.5	45.9	34.0	183	34.6	71.7J
Mercury	--	0.40	0.21	0.05Q	--	--	0.21	0.35	--	0.30	--
Selenium	R	4.0Q	--	--	--	--	--	--	--	--	--
Silver	--	--	--	--	--	--	--	--	--	--	--

J = Qualitative and Semi-Quantitative
Q = Qualitative only
R = Data is unusable
-- = Not detected
* = RAI duplicate per NRESA Program 20.2-047B
+ = HART replicate sample of MSB-2 (0-2')
++ = HART replicate sample of MSB-4 (0-2')

As presented in the tables, values that stand alone (without a qualifier) are the most accurate results, and possess both qualitative and quantitative connotations. Numbers that are flagged with a "J" represent qualitative but only semi-quantitative results. Values flagged with a "Q" indicate results that are qualitative only. Finally, the qualifier "R" signifies a result that is unusable based on the QA/QC data validation.

5.2.3.1 Soils. Nineteen soil samples were collected from the test borings drilled at the two mercury burial sites. These samples were analyzed for RCRA metals. A summary of valid soil results is provided in Table 5-5.

The state of Maine does not have any clean-up guidelines for contamination in soils, therefore, New Jersey's ECRA guidance values are used for comparison. Only one inorganic constituent, barium, exceeded the ECRA guidance value of 400 ppm in soil. Sample MSB-2 (10-12') was the only sample to exceed the ECRA guidance value for barium.

5.2.3.2 Groundwater. Four groundwater samples were collected from the monitoring wells at the mercury burial sites. These samples were field filtered and analyzed for RCRA metals. A summary of valid groundwater results is provided in Table 5-6.

There were no detectable concentrations of mercury in any of the samples collected. There were no concentration values of inorganic constituents above National Interim Primary Drinking Water Regulations.

During groundwater sampling activities, a noticeable petroleum/solvent odor and an oil sheen was observed in monitoring wells MW-2 and MW-3.

5.3 Conclusions

HART has drawn the following conclusions from the field investigation of the mercury burial sites at the JILF.

1. A magnetic anomaly of 1,980 gammas was measured just south of Mercury Burial Site I. A follow-up investigation using a metal detector revealed no indication of targets in the area of the magnetic anomaly but the detector did signal the presence of buried metal between the mercury burial site plaque and grid location I_9. No large magnetic anomalies were measured in this area suggesting that the buried metal is non-ferrous.
2. Fill material was encountered at all drilling locations near the mercury burial sites.
3. A slug test at monitoring well MW-5 (near Mercury Burial Site I) indicated a hydraulic conductivity (k) of 18.0 ft/day at this location. This (k) value corresponds to material with a grain size of medium sand which is expected since MW-5 is located in an area of the JILF reported to have received dredge spoils from the submarine berths.
4. Monitoring wells MW-2 and MW-3 contain fresh to slightly brackish water with relatively high temperatures indicating that these wells have little or no hydraulic communication with the estuary. (Soils in MW-2 showed visual and olfactory evidence of contamination). Monitoring wells MW-4 and MW-5 contain water with much higher conductivity and lower temperature indicating brackish conditions.
5. MW-4 and MW-5 exhibit similar water levels and reaction. MW-5 has a much higher specific conductivity than MW-4 but similar temperature. This implies that either MW-5 is influenced more by estuary water than MW-4, or more likely, MW-5 is in an area with greater concentration of dissolved solids or contaminants in the groundwater.
6. Of 19 soil samples collected, only sample MSB-2 (10-12') contained an inorganic constituent (barium) in concentration which exceeds the New Jersey ECRA guidance value.

7. Four water samples were collected and analyzed for RCRA metals. These samples did not contain any detectable concentrations of mercury. No samples analyzed for RCRA metals exceeded the National Interim Primary Drinking Water Standard. Arsenic was detected in all samples. Arsenic is relatively mobile in groundwater. Cadmium was detected in the two downgradient samples and not in the upgradient samples. The occurrence of downgradient cadmium suggests the landfill may be contributing cadmium to the groundwater regime.
8. A noticable petroleum/solvent odor and an oily sheen were observed in monitoring wells MW-2 and MW-3.
9. Because of interference, neither magnetometry nor ground penetrating radar (GPR) were effective in the vicinity of Mercury Burial Site II. In addition, GPR was not effective at Mercury Burial Site I. No direct evidence yet exists which confirms the reported presence and location of the Mercury Burial vaults.

REFERENCES

Driscoll, F. G., 1986. Groundwater and Wells: Johnson Division, St. Paul, Minn., 1089p.

Hussey, Arthur M. II, 1985, Plate I--Bedrock Geology of the Bath and Portland 2° Map Sheets, Maine; Maine Geological Survey Department of Conservation, Open File No. 85-87.

Hussey, Arthur, M. II, 1985, Plate II--Generalized Tectonic Map of the Bath and Portland 2° Map Sheets, Maine; Maine Geological Survey Department of Conservation, Open File No. 85-87.

Hvorslev, J. M., 1951, Time Lag and Soil Permeability in Ground-Water Observation: U.S. Corps of Engineers, Bulletin 36, Waterways Exp. Sta., Vicksburg, Miss., 50p.

Ingmanson, D. E., Wallace, W. J., 1973. Oceanology: An Introduction. Wadsworth Publishing Company, Inc., Belmont, CA, 302p.

Loureiro Engineering Associates (LEA), June 1986, Final Confirmation Study Report on Hazardous Waste Sites at Portsmouth Naval Shipyard, Kittery, Maine.

Tables of Tides, Sunrise and Sunset, Portsmouth Naval Shipyard, Portsmouth, New Hampshire--Provided by Jim Tayon, PNS.

Todd, D. K., 1970. The Water Encyclopedia: Water Information Center, Port Washington, NY, 559p.

United States Environmental Protection Agency, July 1988, Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, 19p.

United States Environmental Protection Agency, February 1988, Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, 43p.

United States Environmental Protection Agency Contract Laboratory Program, October 1986, Statement of Work for Organic Analysis--Multi-Media--Multi-Concentration.

United States Environmental Protection Agency Contract Laboratory Program, December 1987, Statement of Work for Inorganics Analysis--Multi-Media--Multi-Concentration.