N00102.AR.000023
NSY PORTSMOUTH
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RCRA Facility Investigation (RFI) Proposal

Portsmouth Naval Shipyard

Kittery, Maine

Prepared for:

U.S. Department of the Navy
Naval Facilities Engineering Command
Philadelphia, Pennsylvania 19112-5094

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March 9, 1989

Revised August 1989

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INTRODUCTION

This RCRA Facility Investigation (RFI) Proposal for the Portsmouth Naval Shipyard, Kittery, Maine, has been prepared in response to the Hazardous and Solid Waste Amendments of 1984 (HSWA) Permit issued by the United States Environmental Protection Agency (USEPA). The permit was prepared after a RCRA Facility Assessment (RFA) of the Shipyard was conducted by the USEPA at the facility. The RFA identified specific Solid Waste Management Units (SWMUs) where known or potential releases of hazardous wastes or hazardous constituents have occurred. The final HSWA permit specifies plans and investigations to be carried out by the Shipyard to determine the extent and nature of the releases and to identify cleanup measures.

The primary objective of the RFI is to assess the potential releases of hazardous substances from thirteen SWMUs identified in the HSWA permit. If hazardous substances are identified in soil, sediment, or groundwater, it will be necessary to assess the risk imposed to human health or the environment. Additionally, the RFI has been designed to describe the hydrogeologic setting related to the SWMUs in order to understand potential migration pathways. All this information will be incorporated to support analysis of the feasible corrective measures, as necessary or appropriate, for each SWMU.

1.0 INITIAL FACILITY CHARACTERIZATION REPORT

1.1 Site Location And Description

The Portsmouth Naval Shipyard is composed of four islands located in the Piscataqua River within the town limits of Kittery, Maine. The Piscataqua River is a tidal estuary which forms the boundary between New Hampshire and Maine.

The shipyard is engaged in the conversion, overhaul, and repair of nuclear submarines for the U.S. Navy. The shipyard has a long history dating back to 1690 when the first warship launched in North America, the Falkland, was built. The Portsmouth Naval Shipyard was first established as a government facility in 1800. The yard served as a repair and building facility for ships during the Civil War. The first government-built submarine was designed and built at the yard during World War I and a large number of submarines were designed and constructed at the yard from 1917 through the advent of the nuclear submarines in 1958. The shipyard has continued servicing the modern U.S. nuclear fleet to this day.

The shipyard is now composed of 376 buildings on 278 acres of land. As the workload at the ship yard expanded, fill material was used to create made-land adjacent to the original islands. Today, continuous land surface extends between three of the original four islands and much of the facility is built on fill overlying former tidal flats (Figure 1-1).

1.1.1 Site Visit

A site visit was conducted by HART from 10/24/88 to 10/26/88. This visit included cursory field examination of all SWMUs, interviews with Navy personnel familiar with the facility design and operation and collection and review of pertinent documents and maps.

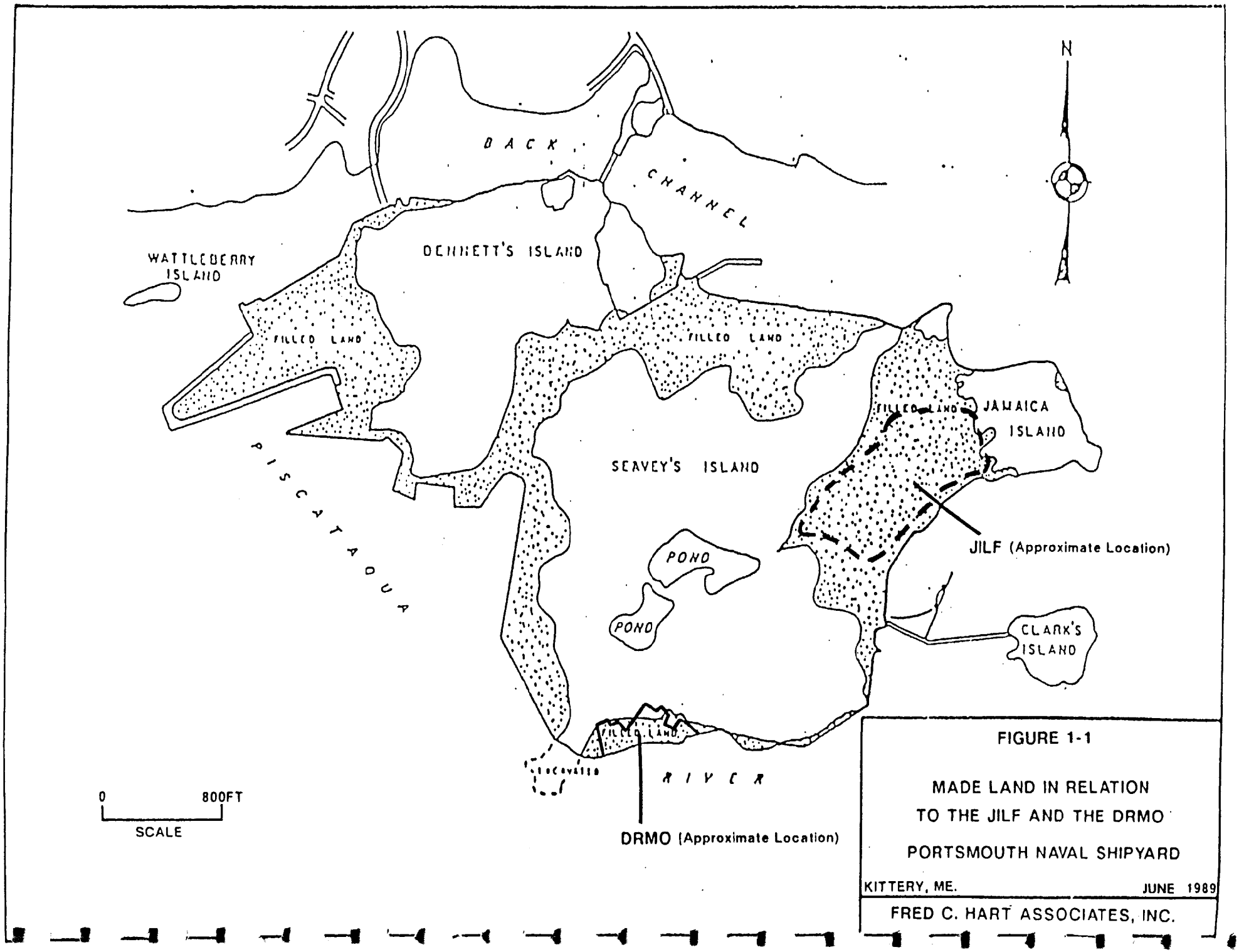


FIGURE 1-1

MADE LAND IN RELATION TO THE JILF AND THE DRMO

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. JUNE 1989

FRED C. HART ASSOCIATES, INC.

1.1.2 Site Map

Detailed topographic maps of the DRMO and the JILF were produced by Emery Engineering Associates under subcontract to HART. The maps will be used as base maps for all work to be conducted as part of this proposal. As the work progresses, mappable information will be added to the appropriate base maps for easy reference.

1.2 Physical Setting

1.2.1 Physiography

The Portsmouth Naval Shipyard is located on Seavey's Island in the Piscataqua River immediately south of the town of Kittery, Maine. The location of the shipyard is shown in Figure 1-2. The shipyard is built on an area comprising Dennett's, Seavey's, Jamaica, and Clark's Islands, as well as made-land between these islands. Approximate elevations on-site range from sea level to a maximum of sixty feet. Two-thirds of the site is high-density industrial area containing 376 buildings, while the remaining areas are flat-lying to gently sloping grass-covered fields. Minor wooded areas exist on the east side of Jamaica Island.

The shore line in the Portsmouth area is described geomorphologically as a ria shoreline (Strahler 1971). This is an embayed coast produced by partial submergence of a fluvially eroded land mass. Valleys show some degree of straightening and deepening by ice; hilltops are blunted by ice erosion; and deposits of till block smaller valleys in the Maine version of a ria shoreline.

This type of shoreline is closely associated with the drowned river valley type estuary. The Great Bay Estuary System would be classed as a drowned river valley in a geomorphological classification (Duxbury 1971).

FROM: USGS TOPOGRAPHIC 7.5MIN MAP SERIES;PORTSMOUTH QUADRANGLE, N.H.&ME. AND KITTERY QUADRANGLE, ME.&N.H.
SCALE 1:24,000

N

0 2,000FT
SCALE

QUADRANGLE LOCATION

QUADRANGLE LOCATION

FIGURE 1-2

LOCATION MAP
OF
PORTSMOUTH NAVAL SHIPYARD

KITTERY,ME. JUNE 1989

FRED C. HART ASSOCIATES, INC.

1.2.2 Geology

1.2.2.1 Bedrock

The islands composing the Portsmouth Naval Shipyard are formed on bedrock highs with thin veneers of glacial till and recent alluvium. Bedrock consists of tectonically deformed middle Ordovician volcanics and the highly fractured metamorphosed sandstones, shales, and siltstone 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. Between May 1983 and September 1985, four (4) test borings and seven (7) test pits were constructed by Geotechnical Engineers Inc. for the purpose of determining the suitability of subsurface materials for construction of a six-story building near Building No. 86. Bedrock encountered during these investigations was described as slightly to highly fractured quartzite with interbedded phyllite. Overburden material consisted of fill material, sand and gravel, and glacial till (Peterson, 1985). A 1987 geotechnical boring log from the JILF describes bedrock as a fractured phyllite (Goldberg-Zoino and Associates, 1987).

The bedrock of this area has undergone at least three periods of deformation resulting in multiple rock cleavages, planes of foliation, faults of various ages and types, and varied fold orientations and geometries: the Taconic Orogeny (440 million years before present), Acadian (360 mybp), and the Appalachian (260 mybp). Therefore, it is anticipated that the bedrock fracture pattern is highly complex.

Fracture Trace Study

Introduction

The fracture trace study described here was completed by the Army Corp of Engineers for the Department of the Navy, specifically for the Portsmouth Naval Shipyard RCRA Facility Investigation proposal. Description of the trace study and associated conclusions are those of the Army Corp of Engineers and do not reflect an interpretation by Fred C. Hart Associates. Information contained in the study has been incorporated in the design of this proposal. Data obtained from the DRMO and JILF subsurface investigations will be used to confirm the validity of this study if it is revealed that the bedrock aquifer has been adversely impacted. In the event that subsurface investigations at the various tank SWMUs are warranted, this study will be used to assist in the design of those investigations.

Purpose

The purpose of this study is to use aerial photography and/or images to interpret and delineate lineaments, some of which may be possible bedrock fractures and joints. The lineaments may indicate potential pathways for groundwater migration in the bedrock aquifer.

Background

Aerial photography is a pictorial representation of the pattern of the landscape. This pattern is composed of elements that reflect the physical, biological, and cultural features of the landscape. Similar geologic elements in similar environments will reflect similar patterns. However, the quantity and quality of information that can be obtained depends on the methods of analysis used and the knowledge, skill, and experience of the analyst.

The techniques for mapping geologic fracture traces using aerial photographs have been described by Lattman (1958) and have been followed in this study. Fracture traces or lineations include all natural linear features such as faults, joints, foliation, bedding, zones of fractured or weathered rock, dikes, portions or streambeds, etc. that can be traced for a distance on an aerial photograph or image. Fracture traces generally do not have topographic expression and are difficult to locate accurately in the field.

Method and Procedure

Imagery Used in the Analysis

The aerial photography used in this fracture trace study consisted of high altitude color infra red and black and white panchromatic prints with stereoscopic overlap. Scale of the photographs was 1:60,000. The date of the photo coverage was April 1986. An adequate number of photographs were obtained to ensure complete coverage of the Portsmouth Naval Shipyard and the surrounding terrain to a minimum radial distance of 8 miles. A cloud-free, color composite Landsat Image, scale 1:500,000, centered over Portsmouth, New Hampshire was also analyzed to provide regional, synoptic coverage of the study area. The photography was selected and ordered through the U.S.G.S. National Cartographic Information Center.

Method of Analysis

All imagery was analyzed using a hand lens, a stereoscope, and distant viewing. Fracture traces were plotted and measured directly from landforms,drainage, erosion forms, photo tones, vegetation, and other elements appearing as linear features on the photographs.

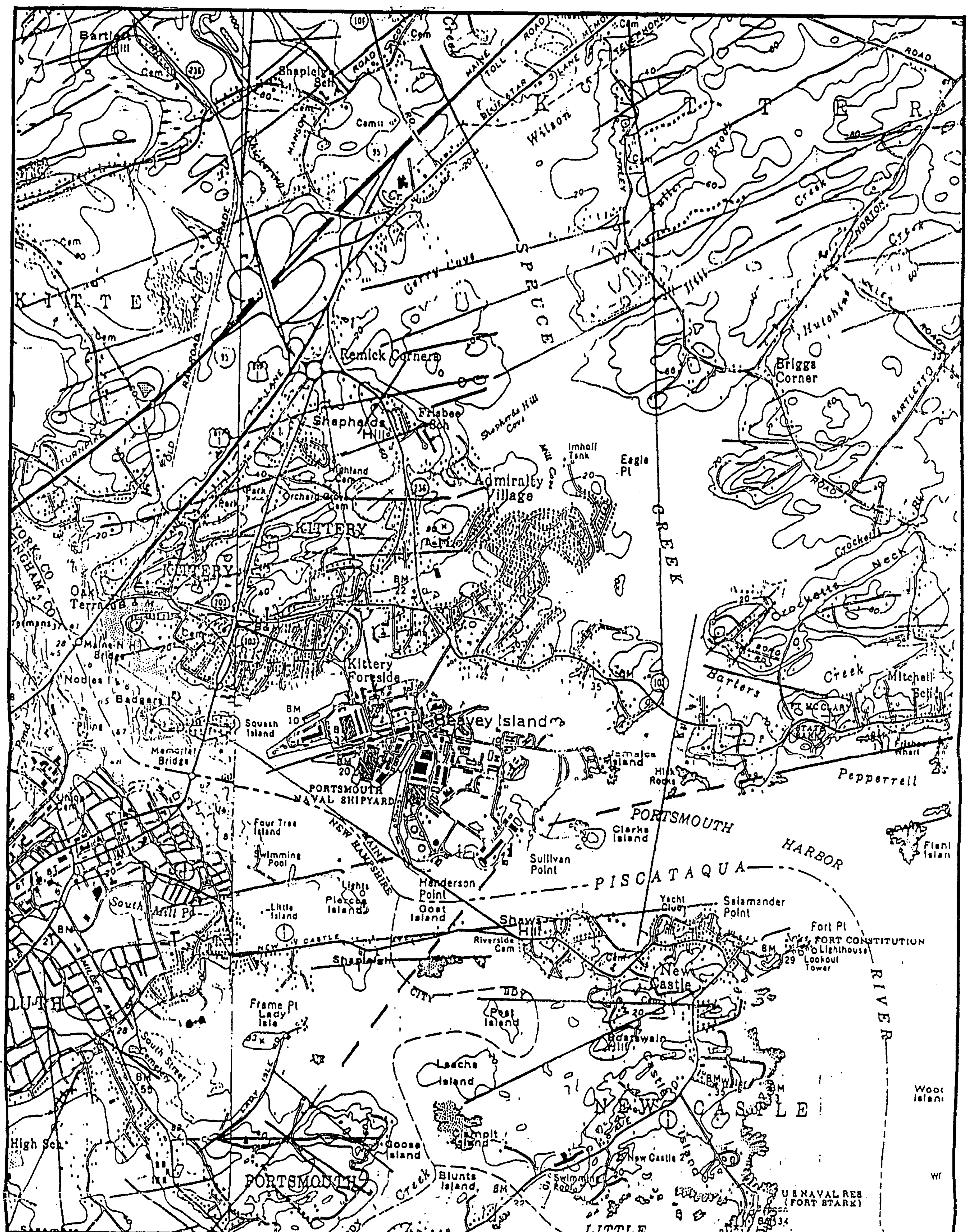
Method of Evaluation

Fracture traces were measured to an accuracy of one degree (measured clockwise from true north and then grouped in sets of five degrees to account for deviation due to photographic distortion, precision of measurement, and natural range of deviation. The length of each lineament was also measured and included, along with the number of lineaments, for each orientation in the evaluation procedure. Fracture traces within a one mile radius of the Portsmouth Naval Shipyard were evaluated separately and are shown in Figure 1-3. The number and length of lineaments in each group of orientations were statistically evaluated to determine significant fracture orientations. An attempt was made to relate these orientations to geologic features or processes.

Results and Conclusions

Results

This study indicates that as many as six significant fracture trace groups are present in the study area. The most significant are fractures which trend N46-50E. Ten percent of all lineations in the study area and 16 percent of all lineations greater than 10,000 ft. in length have this orientation. The second most significant orientation was fractures which trend N55-64E. This orientation closely parallels the coastline and several drainage features in the study area. These fractures appear to be the major trend of the most predominant joint set in the region; the minor trend in this joint set is N50-54W which also parallels several area lakes and other drainage features. The third most significant orientation, N71-80E, occurs locally in the area of the Ordovician volcanics, the oldest rock type in the study area, and may represent some foliation imposed during the Taconic Orogeny. Another significant orientation, N56-60E, also appears to reflect some tectonically imposed lineation. The last significant fracture group, NO-4W, accountsfor 20% of the large scale



USGS TOPOGRAPHIC 7.5 MINUTE SERIES, PORTSMOUTH, N.H.-ME. AND KITTERY, ME.-N.H. QUADRANGLES

Map of Fracture Traces Intersecting Portsmouth Naval Shipyard, ME

SCALE 1:24000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 7 FEET

N

N H

QUADRANGLE LOCATION

FIGURE 1-3

FRACTURE TRACE STUDY
PORTSMOUTH NAVAL SHIPYARD
1989

KITTERY, MAINE

FRED C. HART ASSOCIATES, INC.

FROM ARMY CORPS OF ENGINEERS,1989, FRACTURE TRACE STUDY, PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE.

linear features found on the air photos. Several smaller scale linear features appear to be offset when intersected by these large, NO-4W fractures indicating that movement may have occurred along faults with this NO-4W orientation.

Twenty-nine individual fractures were found within a one mile radius of the Portsmouth Naval Shipyard (see Figure 1-3). Two of these fractures actually pass through the facility while an additional five are interpreted as possibly extending through the facility. Eight of the twenty-nine are associated with the foliation found in the Ordovician volcanics (N71-80E); four are associated with the major regional joint set (N36-40E/N50-54); two are large scale linear features (NO-4W) which may be faults. Eight of the fractures range between N84W to N84E, a trend which appears to be locally associated with the Ordovician volcanics. Only one lineament has the most predominant regional orientation of N46-50E. Six of the twenty-nine fractures are unrelated to any significant trends found in this study. Thirteen points of fracture trace intersection occur within one mile of the facility. A list of all of these fractures is given in Table 1-1.

Table 1-1

Fracture Traces Within One Mile of the Portsmouth Naval Shipyard
(Shown in Figure 1-3)

Orientation	Length (feet)	Closest Approach to Facility (feet)
N89W	3,500	6,100
N89W	2,000	2,700
N87W	4,500	2,400
N84W	2,500	2400
N53W	34,000	through facility
N50W	3,000	4,600
N09W	5,800	400 *
N04W	5,200	5,700
N01W	51,0	800
N09E	6,500	800
N32E	1,500	2,200
N36E	4,000	4,300 *
N46E	1,900	2,500 *
N62E	2,500	6,800
N66E	1,900	3,600
N68E	600	3,600
N68E	5,000	3,700
N71E	1,600	5,200
N71E	6,500	4,300
N71E	800	3,100
N72E	3,900	through facility
N76E	3,900	2,700
N76E	4,100	1,600
N78E	3,600	1,000 *
N78E	8,000	3,300 *
N84E	9,200	1,000
N86E	3,400	1,700
N88E	3,000	2,400
N89E	2,500	3,500

*Fractures which could extend through the facility.

Summary and Conclusion

A total of 458 individual fracture traces totaling 2,156,400 linear feet were located within an eight mile radius of the Portsmouth Naval Shipyard as part of this study. Six significant trends were determined for the fracture traces: N50-54W, NO-4W, N36-40E, N46-50E, N56-60E, and N71-80E. Seven individual fractures were interpreted as extending through the facility. Any of these seven fractures could be possible pathways for groundwater migration in the bedrock aquifer. In the event that HART's subsurface investigations indicate that the bedrock aquifer has been adversely impacted by activities at the shipyard, information acquired from the "Fracture Trace Study" will be incorporated in the design of a bedrock investigation.

1.2.2.2 Surficial

Soils overlying the bedrock on the islands consists primarily of glacial till which ranges in thickness from zero to more than 20 feet. From zero to five feet of fine-grained, organic-rich, tidal flat sediment was deposited between and around the islands. The naturally occurring soil material at the shipyard is classified as Lyman fine sandy loam. Much of the tidal flat estuarine sediment has been buried by fill material of varying composition since the shipyard was established in 1800. Given the restricted areal dimension of the island, variations in bedrock elevation, complex fill history, and industrialized setting, the island's overall overburden hydrogeologic regime is probably complex. Limited boring information prevents an assessment of the continuity of any subsurface soil/sediment horizons.

1.2.3 Hydrology and Surface Water Quality

1.2.3.1 Great Bay Estuarine System

The Piscataqua River hydrology is not characteristic of traditional inland fluvial hydrology. The Piscataqua River, Little Bay, Great Bay, and the seven converging rivers form the Great Bay Estuarine System (Figure 1-4). The Great Bay system adheres to the Pritchard definition of an estuary: "An estuary is a semi-enclosed body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage." (Duxbury, 1971)

In estuarine circulation, fresh water flows into the estuary at the top of the water column and sea water enters the mouth at the bottom of the water column. The circulation is dependent on several factors including the amount of river runoff, tidal reach, and the character of the seaward water density distribution.

Estuaries can be divided into structural types according to their geomorphology. In a geomorphologic sense, the Great Bay System is classified a drowned river valley. This type of estuary is formed by land submergence, rise of sea level, or a combination of both. The Great Bay Estuary was most probably formed by a rise of sea level attributed to recession (i.e., melting) of continental glaciers approximately ten thousand years ago.

Estuaries have also been classified in terms of the distribution of water properties by Stommel (Pickard, 1979). The Great Bay system in the Stommel classification is a slightly stratified estuary (type B), which is also usually shallow. This type of estuary is essentially two layers with the upper layer less saline than the deeper, with a mixing layer between them. This type of estuary has a net seaward or outward flow in the upper layer and a net inward flow in the deeper layer. Salinity data from the Maine State Planning Office

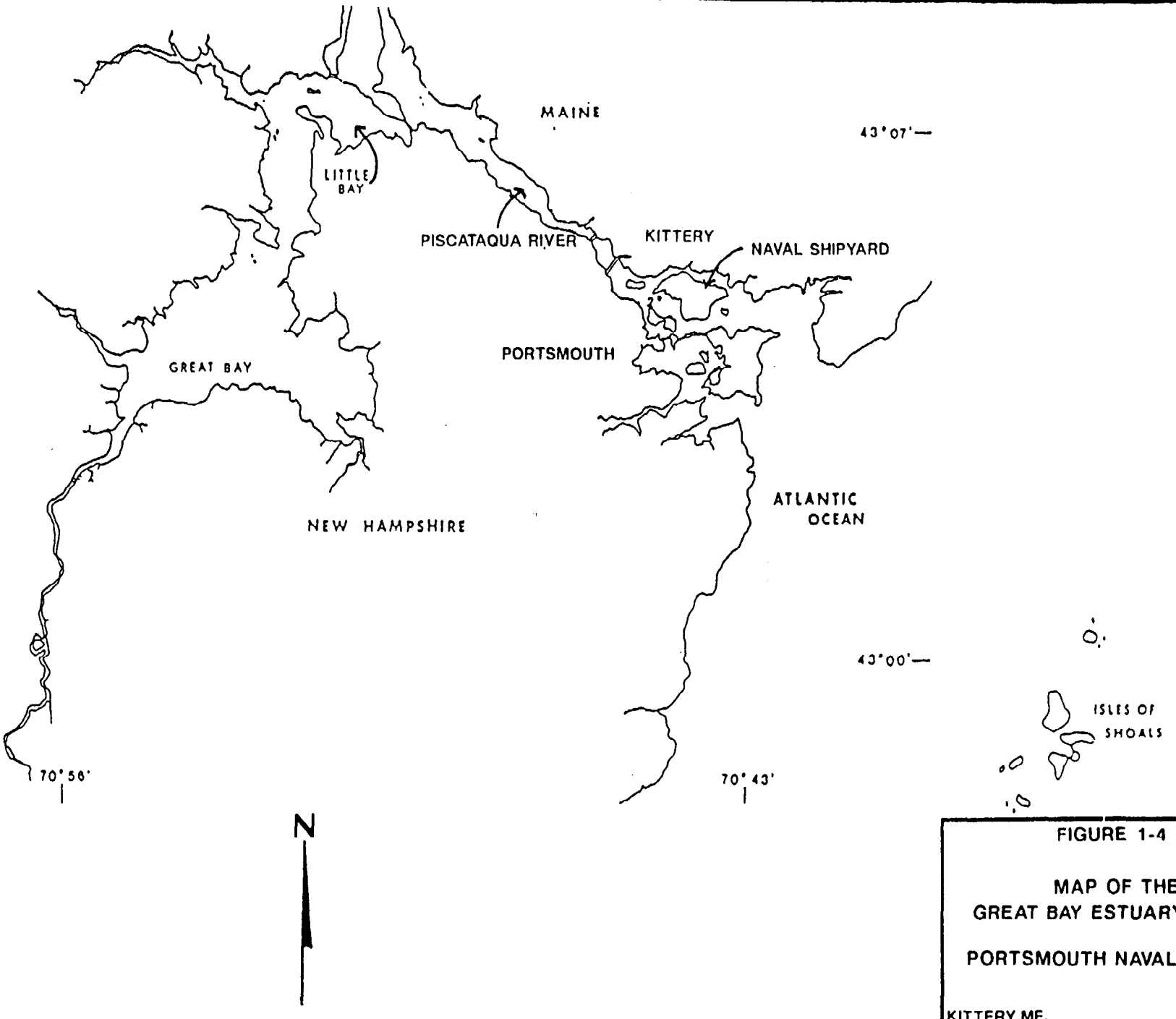


FIGURE 1-4

MAP OF THE
GREAT BAY ESTUARY SYSTEM

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. JUNE 1989

FRED C. HART ASSOCIATES, INC.

shows little variation in salinity values in the Great Bay Estuary and thus supports this classification type (Larsen, 1979). Since the water in the estuary near the shipyard may be only slightly stratified, it can be expected to be well mixed. It can be expected that contaminants entering the estuary from point and non-point sources will also become well mixed. Ultimately, this mixing may disguise the origin of contamination.

1.2.3.2 Portsmouth Harbor Hydrology

Seavey Island is located in the mouth of the Great Bay estuary, commonly referred to as the Portsmouth Harbor. The harbor's main channel is approximately 75 feet deep (mean low water) and the back channel is approximately 20 feet deep (mean low water) in the vicinity of Seavey Island (NOAA Chart, 1988). The water mass in the vicinity of the island is predominately marine (salinities greater than 20 parts per thousand).

The following information regarding estuary circulation comes from Parsons (1978).

Tidal currents and net circulation patterns at the time of contaminant releases will be a controlling factor when assessing the direction and range of contaminant dispersion in the harbor. Currents in estuaries are caused by differences in water density distribution, wind stress, tides, and stream runoff. Of these, tidal currents predominate in the harbor. Semidiurnal tides occur in the Portsmouth Harbor. Near Seavey Island, the mean tidal range is 8.1 feet. The spring tidal range is 9.3 feet. A tidal current, both ebb and flood, is the horizontal motion associated with the tidal change in water. The overall ebb and flood currents in the vicinity of shipyard are high. The average flood currents range from 3.0 knots south of Seavey Island to 3.3 knots southwest of Badgers Island. The average ebb currents are 3.8 knots south of Seavey Island and 3.7 knots southwest of Badgers Island (see Figure 1-5).

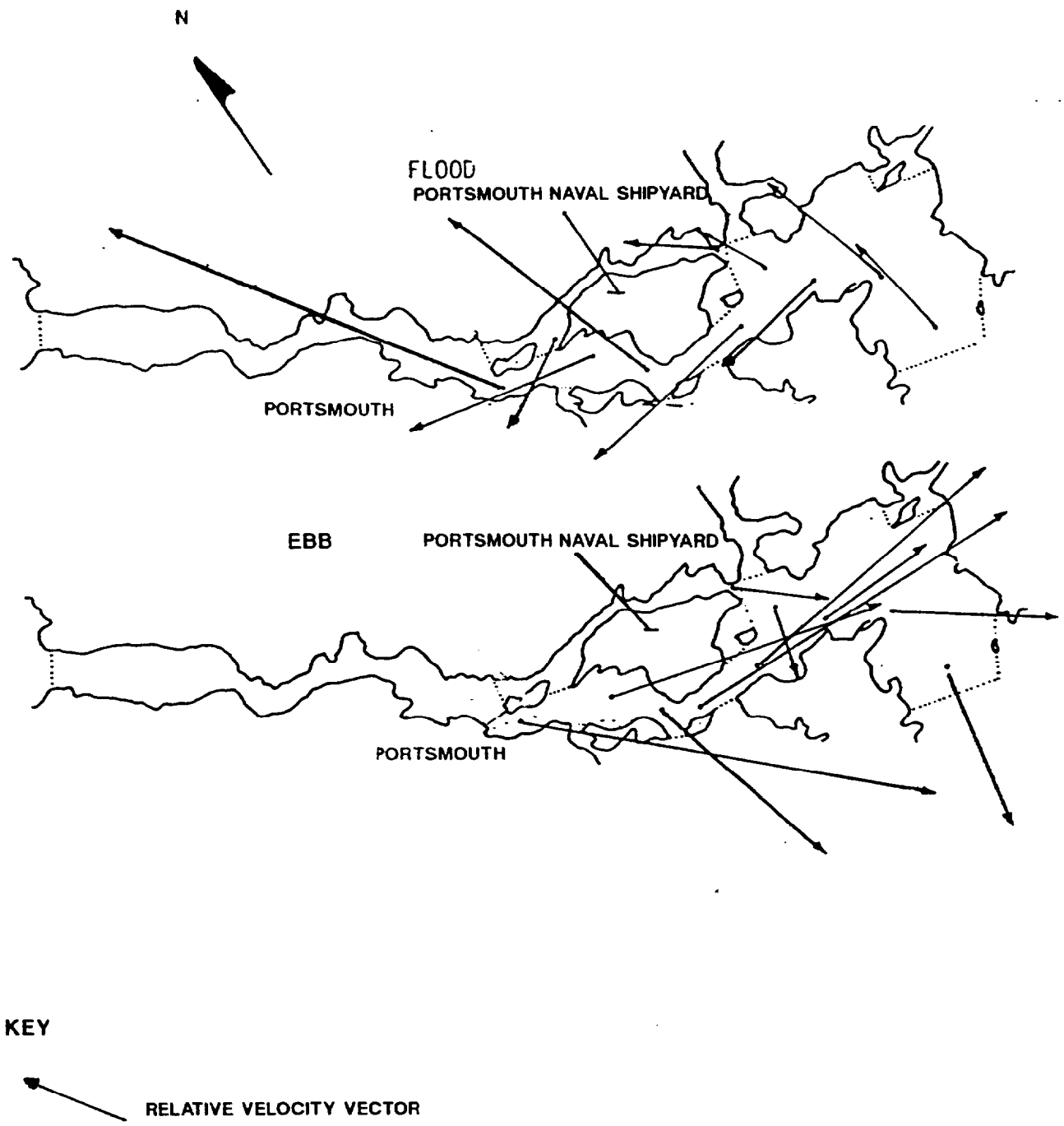


FIGURE 1-5
AVERAGE TIDE VECTORS
PORTSMOUTH HARBOR

PORTSMOUTH NAVAL SHIPYARD DREDGING STUDY,(PARSONS)-1978

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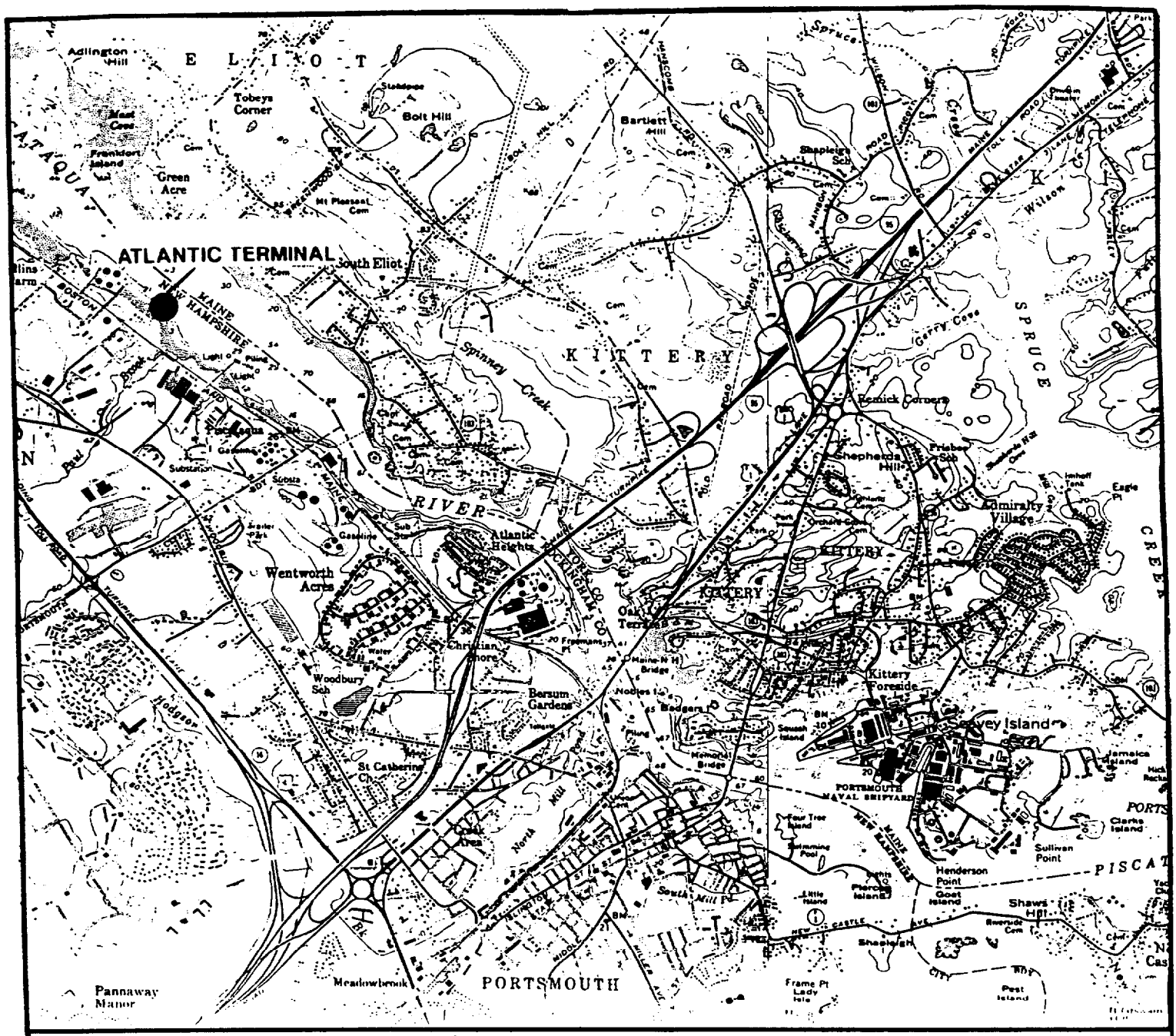
Studies estimating the flushing rate of Portsmouth Harbor and the lower reaches of the Great Bay estuarine system have been based upon (1) a dye study (Ebasco, Inc., 1968) and (2) estimates using Ketchum's flushing calculations (Ridley and Ostericher, 1960; Ebasco, Inc., 1968; Jackson and Moreland, 1969). The dye dispersion study occurred during a summer low-flow period when the fresh-water discharge was 7 percent of the average annual flow. The renewal rate based upon dye dispersion was 258 m^3/sec (9,100 cfs) for this segment of the Piscataqua River. The Ketchem calculation for this region estimated a renewal rate of 239 m^3/sec (8,450 cfs) (Ebasco, Inc., 1968). Average renewal rates for areas off Newington ranged from 439 m^3/sec (15,500 cfs) at Public Service Company of New Hampshire's (PSNH) Newington Station to 498 m^3/sec (17,600 cfs) at PSNH's Schiller Station. The renewal rates, if a linear rate of decrease of contaminant is assumed, represent flushing time of those segments of the estuary ranging from 3.3 to 6.3 tidal cycles (Jackson and Moreland, 1969). Ridley et al (1960) computed flushing rates for the lower reaches of the Great Bay estuarine system. Assuming no mixing, they calculated a flushing rate of 5.8 tidal cycles during average runoff (18 x 10^6 m^3/tidal cycle). Since the estuary is well mixed, the flushing rate will decrease. The flushing rate for a contaminant released in the area of the Atlantic Terminal (Figure 1-6) during extremely low runoff conditions (0.2 x 10^6 m^3/tidal cycle) calculated using a model presented by Ketchum (1951) and modified by Dyer and Taylor (1973) was found to be 10 to 12 tidal cycles (Parsons, 1978). All models confirm that the flushing process occurs in the Great Bay System and, therefore, that there is a limited residence time for contamination within estuary waters.

As part of the Portsmouth Naval Shipyard dredging study (Parsons, 1978), a field study was conducted to obtain hydrographic and current-velocity data within the vicinity of the dredging areas. The purpose of this study was to



1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET-DATUM IS MEAN LOW WATER
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 7 FEET

FIGURE 1-6

PORTSMOUTH HARBOR

TOPOGRAPHIC MAPS OF KITTERY, ME-N.H. AND PORTSMOUTH, N.H.-ME -- 7.5 MINUTE QUADRANGLES, 1956

FRED C. HART ASSOCIATES, INC.

determine the tidal variations of current distribution and to describe the water mass and stratification characteristics within the study area. This field study also provided current-velocity data for comparison with the model predictions to help assess the degree of uniformity of flow and hydrographic characteristics within the dredging area. Suspended sediments were also monitored to provide baseline data in the vicinity of Seavey Island. The near-surface and near-bottom velocity fields were observed during the hydrographic field survey on July 27, 1976 (see Figure 1-7).

A mathematical current model and a dispersion model for the Great Bay estuarine system were used to predict the current pattern in the vicinity of the Portsmouth Naval Shipyard and the resultant dispersal pattern of suspended matter from the dredging sites.

The dispersion model solves the dispersion equation for the concentration of a material in the estuary, given current data, boundary conditions, and the geometry of the estuary. The dispersion of material (in this case, sediments) in the estuary results from three basic processes: advection (movement of the sediment by currents), turbulent diffusion (movement of the sediment by eddies), and molecular diffusion. In the estuary the molecular diffusion effects are several orders of magnitude smaller than advection or turbulent diffusion.

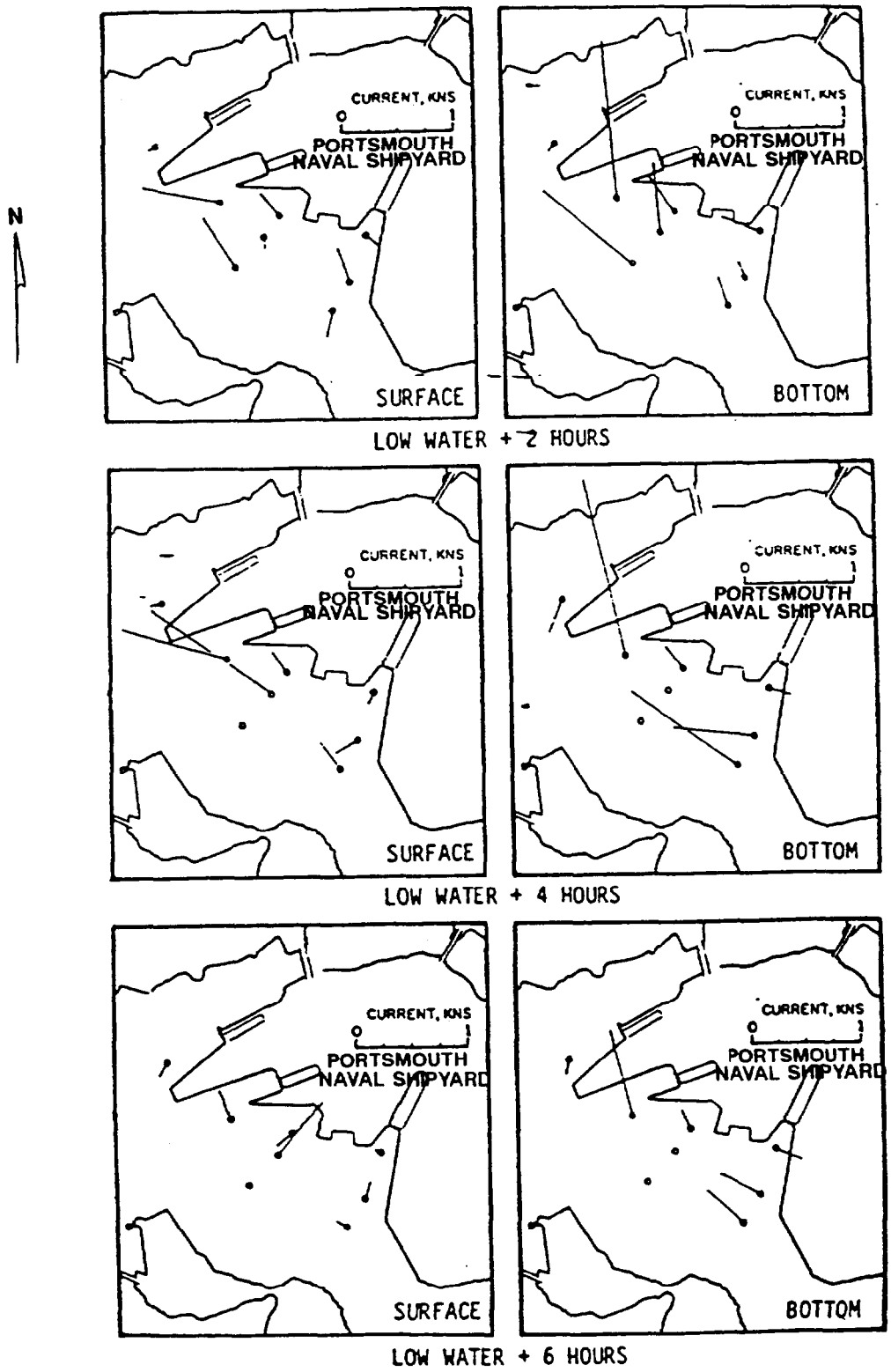
The results of the hydrodynamic model were used to provide current data for the dispersion model. Figures 1-8(a,b) and 1-9(a,b) show examples of dispersion model results.

The hydrodynamic model has also been applied to Portsmouth Harbor and the lower Piscataqua River to do the following.

a. Predict the flow patterns in the estuary near the Portsmouth Naval Shipyard.

b. Provide cross-sectional flow rates for areas of importance.

c. Calculate volume fluxes over flood and ebb tides.



KEY

0 1

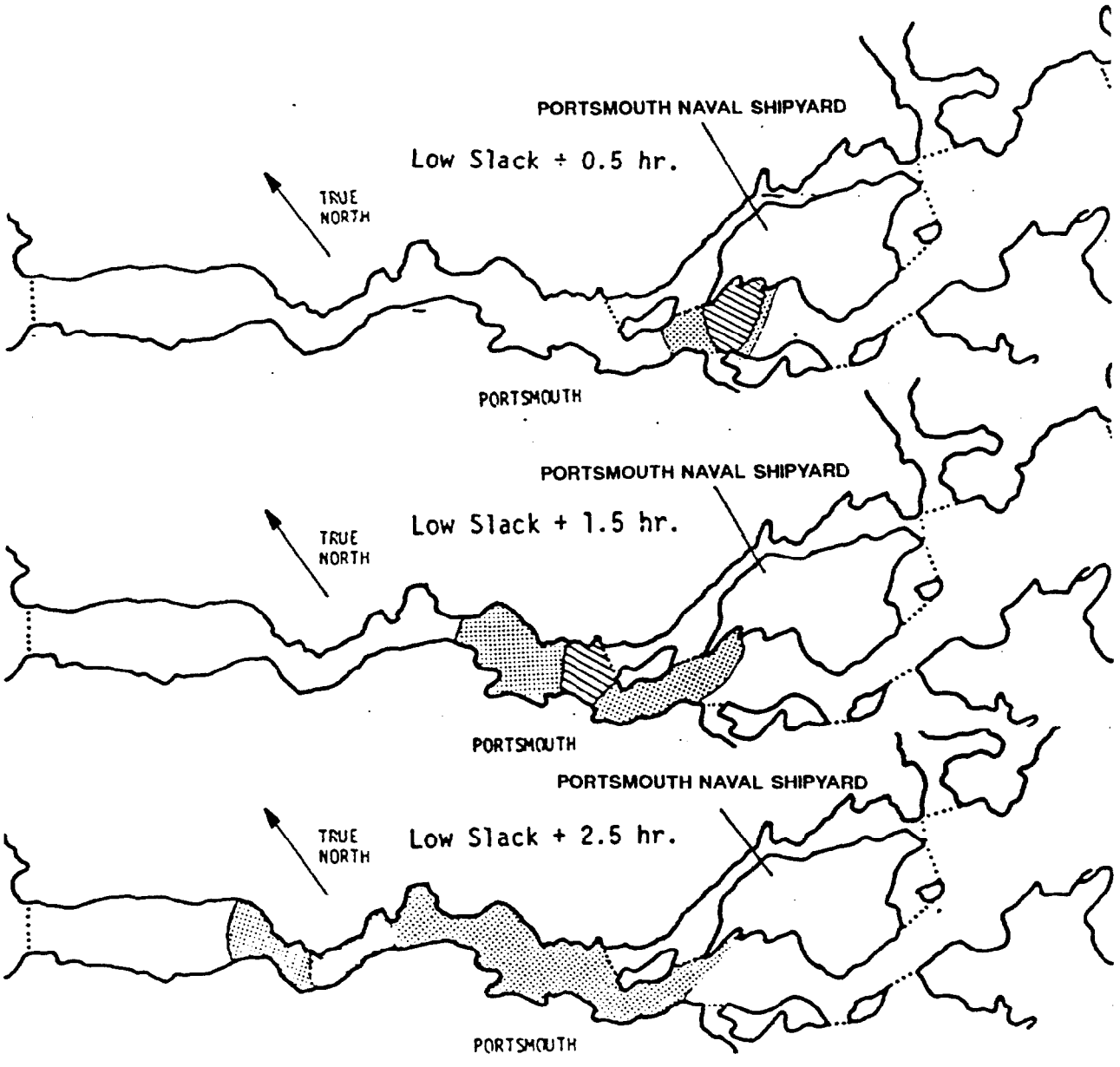
CURRENT SPEED IN KNOTS

FIGURE 1-7

CURRENT VELOCITY DISTRIBUTION WITHIN THE DREDGED AREA ON THE FLOOD TIDE OF JULY 27, 1976

PORTSMOUTH NAVAL SHIPYARD DREDGING STUDY,(PARSONS)1978.

FRED C. HART ASSOCIATES, INC.



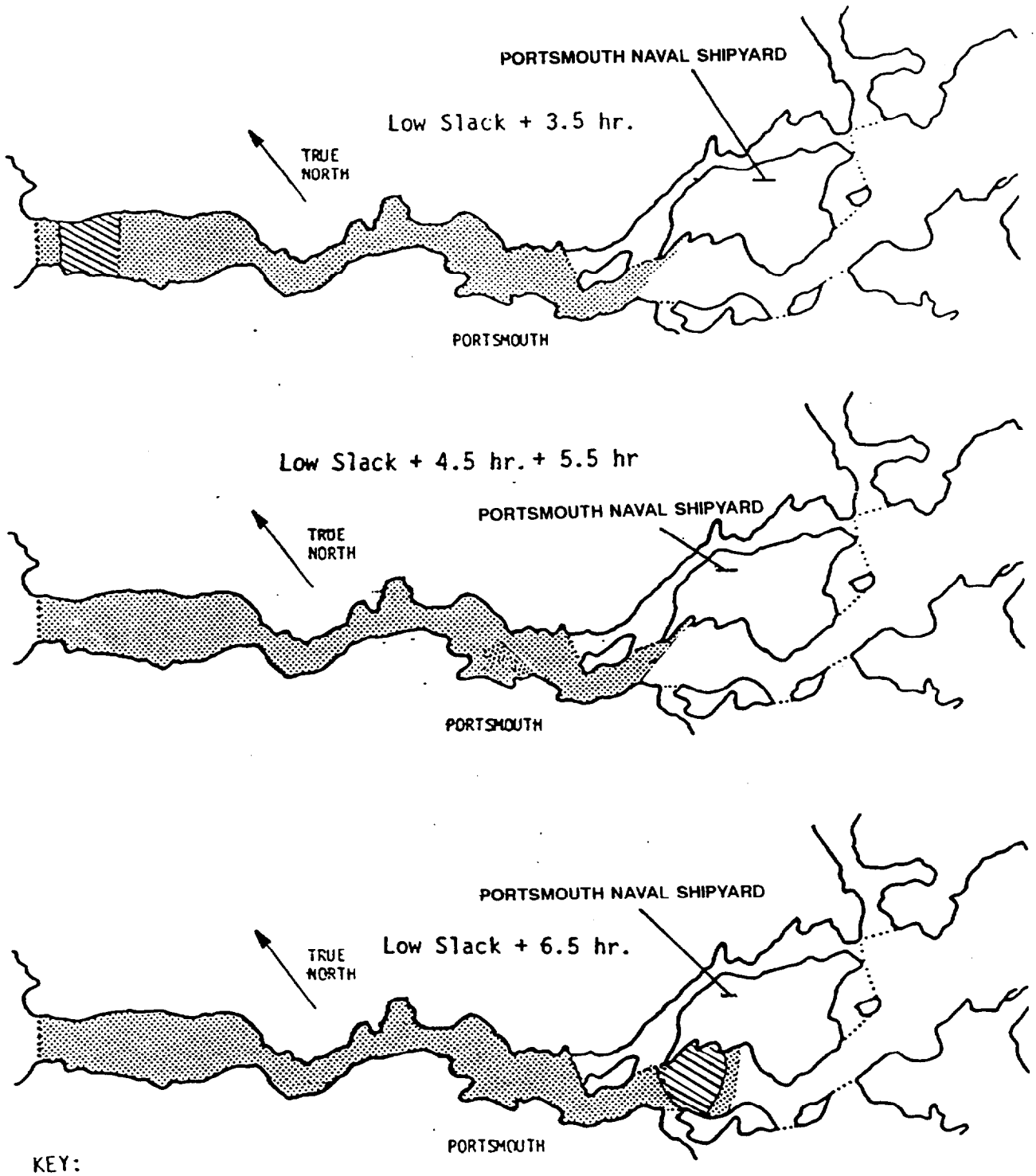
KEY:

- 6.6 - 8.0 mg/l
- 5.1 - 6.5 mg/l
- 5 gm/l (Background Concentration)

FIGURE 1-8a
DISPERSION MODEL RESULTS ILLUSTRATING THE MOVEMENT O PREDICTED SUSPENDED SEDIMENT CONCENTRATION DURING A FLOOD TID

PORTSMOUTH NAVAL SHIPYARD DREDGING STUDY,(PARSONS)-1978

FRED C. HART ASSOCIATES, INC



KEY:

6.6 - 8.0 mg/l

5.1 - 6.5 mg/l

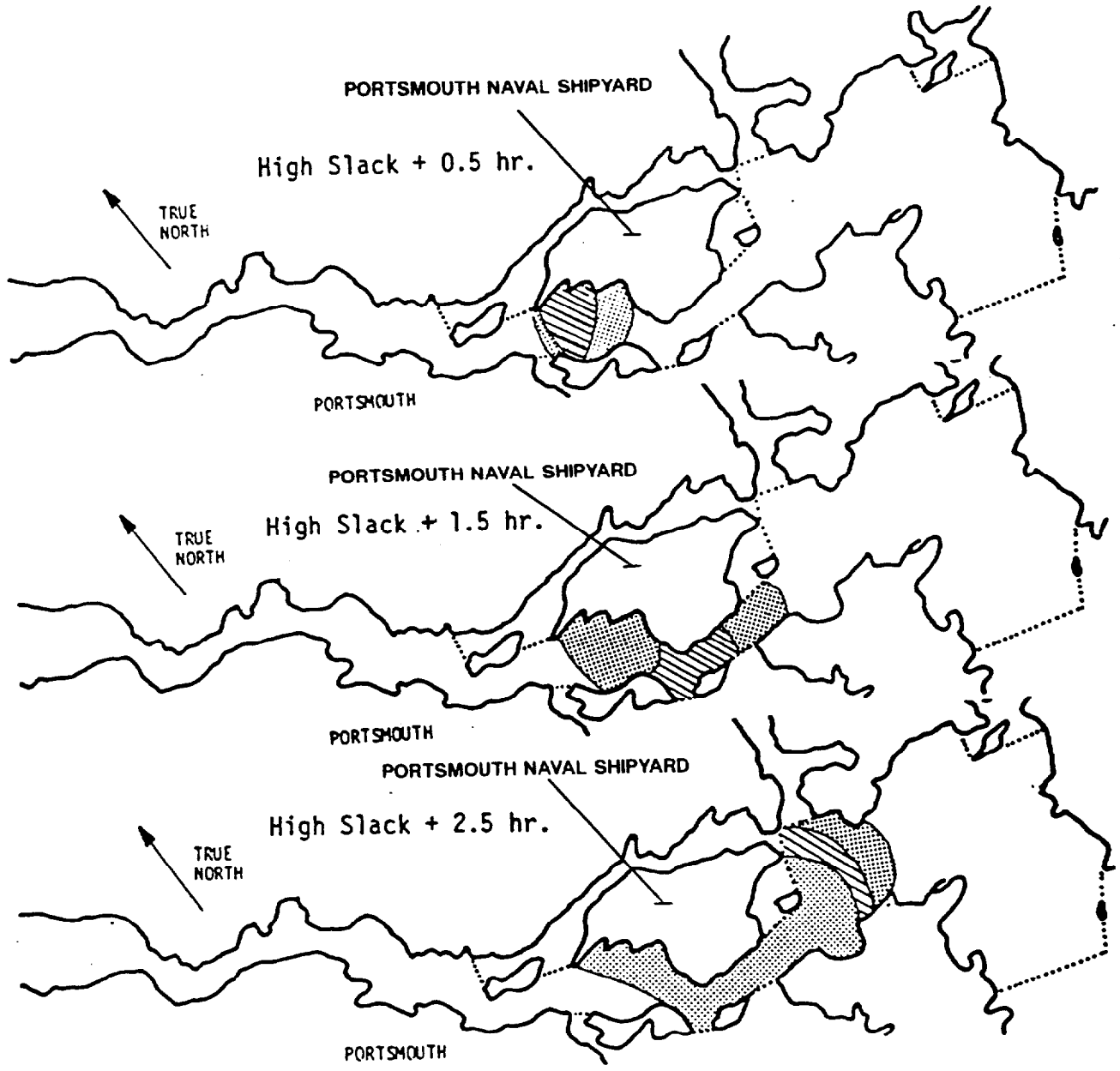
5 gm/l (Background Concentration)

FIGURE 1-8b

DISPERSION MODEL RESULTS ILLUSTRATING THE MOVEMENT OF PREDICTED SUSPENDED SEDIMENT CONCENTRATION DURING A FLOOD TIDE CONTINUED

PORTSMOUTH NAVAL SHIPYARD DREDGING STUDY,(PARSONS)-1978

FRED C. HART ASSOCIATES, INC.



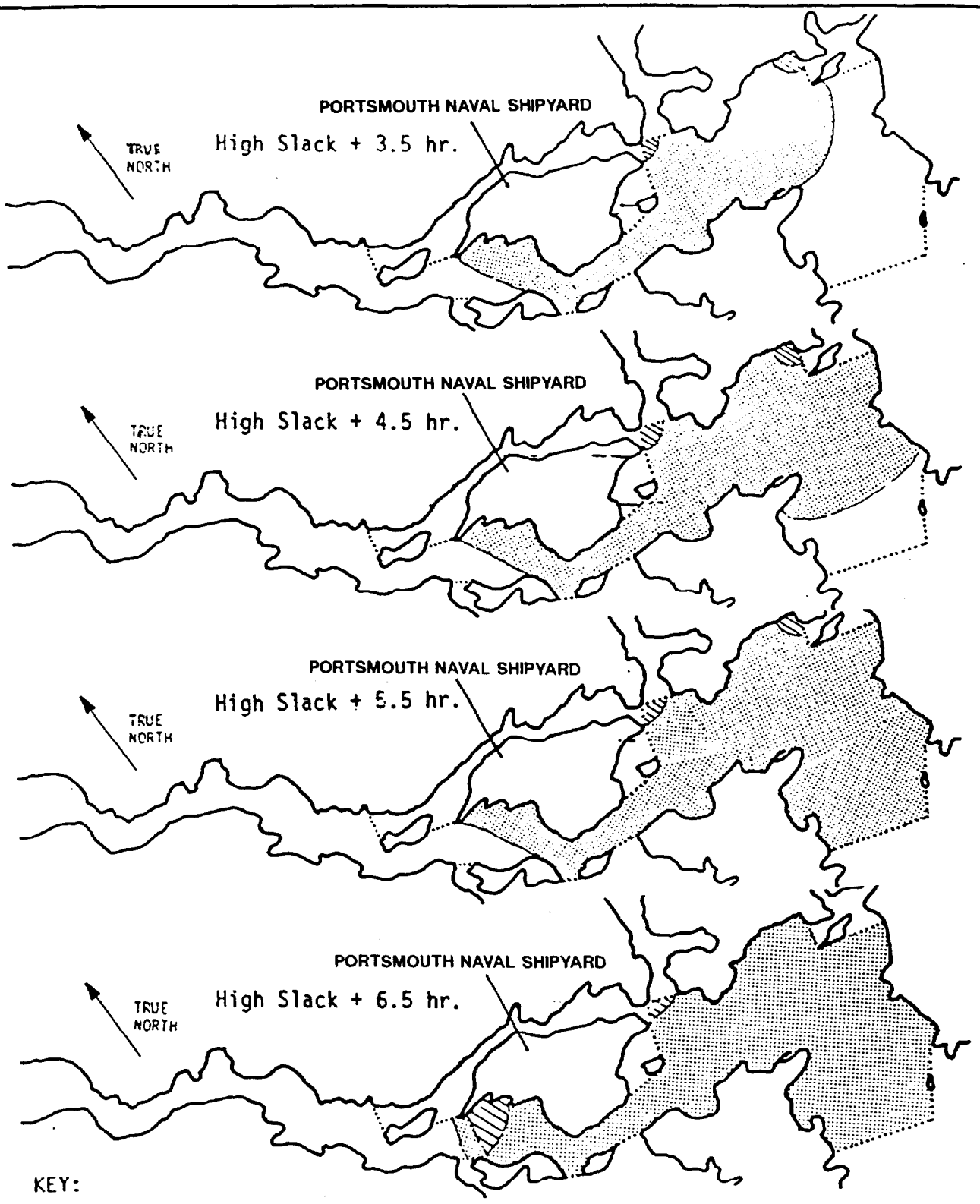
KEY:

- 6.6 - 8.0 mg/l
- 5.1 - 6.5 mg/l
- 5 gm/l (Background Concentration)

FIGURE 1-9a
DISPERSION MODEL RESULTS ILLUSTRATING THE MOVEMENT OF PREDICTED SUSPENDED SEDIMENT CONCENTRATION DURING AN EBB TIDE

PORTSMOUTH NAVAL SHIPYARD DREDGING STUDY (PARSONS)-1978

FRED C. HART ASSOCIATES, INC



KEY:

6.6 - 8.0 mg/l

5.1 - 6.5 mg/l

5 gm/l (Background Concentration)

FIGURE 1-9b
DISPERSION MODEL RESULTS ILLUSTRATING THE MOVEMENT OF PREDICTED SUSPENDED SEDIMENT CONCENTRATION DURING AN EBB TIDE
CONTINUED

PORTSMOUTH NAVAL SHIPYARD DREDGING STUDY,(PARSONS)-1978

FRED C. HART ASSOCIATES, INC.

The results of the model analysis compare with hydrographic field studies conducted in the lower Piscataqua River. The comparisons together with current-velocity comparisons indicate that the hydrodynamic model is sufficiently accurate for predictive purposes.

The predicted current pattern from the model showed good agreement with observed currents from the hydrographic field survey. The predicted velocity field in Portsmouth Harbor is characterized by strong mid-ebb and mid-flood currents south of Seavey Island. At the time of slow slack water in the dredging area, water is still ebbing around Henderson Point. Likewise, at the time of high slack water in the dredging area, water is still flooding around Henderson Point. In the vicinity of Seavey Island, predicted slack water lasts less than 1 hour.

1.2.3.3 Surface Water Quality

The Portsmouth Naval Shipyard is a well developed, highly industrialized area with limited natural surface-water drainage. Two ponds exist on Seavey Island. Water levels in the ponds is controlled by a drainage system which was constructed to control flooding. The drains carry water from the ponds directly to the Piscataqua River. The shipyard is equipped with an extensive storm water collection system which also drains to the Piscataqua River. Precipitation in the area of JILF or the DRMO will run directly into the Piscataqua River via surface runoff and storm sewers or may percolate through the overburden to the groundwater table.

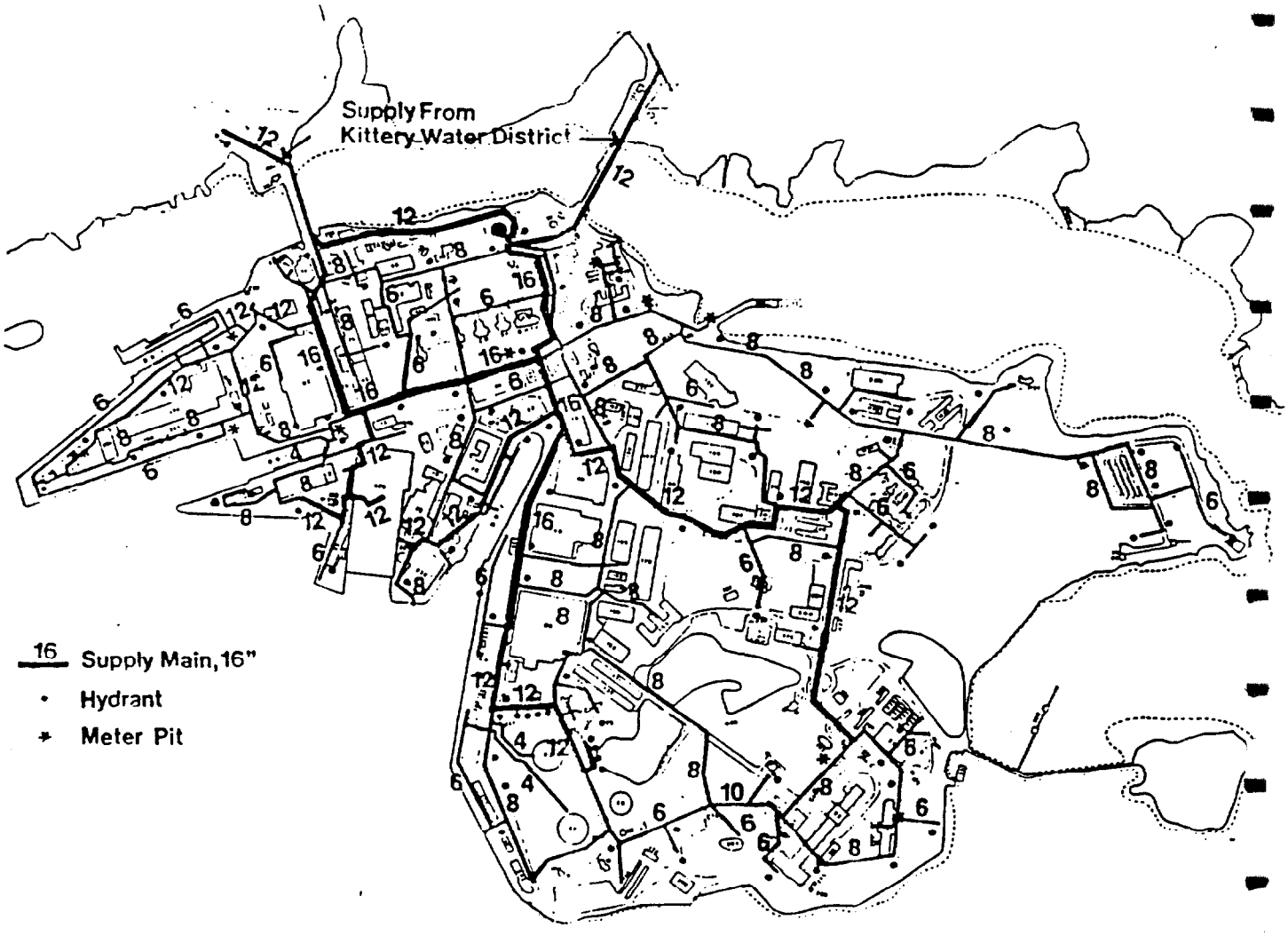
Surface water studies conducted in 1986 by Loureiro Engineering Associates found slightly elevated lead concentrations in harbor-water samples taken near the JILF. Chromium, cadmium, and nickel concentrations were lower than the control samples, while PCBs and VOCs were below detection limits. Analysis of harbor-water samples near the DRMO indicated metal concentrations

below control samples with the exception of one sample which showed slightly elevated lead concentrations. However, from the dispersion model study, it is inappropriate to assume that contamination can be attributed to the shipyard. The Portsmouth Harbor has been closed for shell-fish harvesting since August 1946, according to Mr. Walter Foster, Director of Division Industry Services (personal communication, June 1989). The reason for closure is elevated levels of coliform bacteria attributed to municipal sewage treatment plants in Dover, Portsmouth, and Kittery exceeding design capacity during periods of heavy rainfall. Additionally, residences not on sanitary sewer systems are allowed to discharge untreated sewage directly into the Piscataqua River (L. Fontaine, Water Dept., Maine DEP, personal communication). Reportedly, this practice will cease once the sewer system is expanded to meet demand.

There are both point source and non-point source discharges throughout the Great Bay Estuary system. The USEPA has issued 30 permits under the National Pollution Discharge Elimination System (Isaza, 1989) to discharge effluents into the estuary system .

1.2.4 Hydrogeology

Kittery's potable water supply originates from surface reservoirs located in the vicinity of York, Maine. Potable water is supplied to the Portsmouth Naval Shipyard (PNS) from the Kittery Water District through two twelve-inch mains. The fresh-water distribution system is shown in Figure 1-10. The shipyard is not using groundwater on-site for any purpose. Groundwater levels at the Portsmouth Naval Shipyard are probably shallow and are likely controlled by the thickness of glacial till and fill material overlying bedrock or former tidal flat areas. Groundwater flow directions on-site probably vary considerably depending on thickness and composition of overburden, bedrock-overburden



0 1000FT
SCALE

FIGURE 1-10

FRESH WATER DISTRIBUTION SYSTEM

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. MARCH 1985

FRED C. HART ASSOCIATES, INC

Source: 1985 Portsmouth Naval Shipyard Master Plan

contact-surface dip, and tidal influence. Specific flow directions at various locations on-site are unknown at this time and will be addressed as part of this RFI.

1.2.5 Groundwater Quality

No groundwater assessments have been conducted at the Portsmouth Naval Shipyard as of this writing. Three monitoring wells located within the JILF were installed for geotechnical reasons. No water quality samples were collected. Reportedly, these wells have been abandoned. Groundwater quality on-site will be addressed as part of this RFI. There is little likelihood that contaminants in the groundwater on the island can adversely impact groundwater on the mainland due to the fact that the shipyard is isolated from the mainland by the Piscataqua River. The river, which has strong tidal currents and significant saltwater/freshwater mixing, forms an effective hydraulic barrier to freshwater migration and a receptor for contamination from freshwater sources in the river's watershed.

1.2.6 Biota Characterization

The following information was obtained from the Initial Assessment Study of Portsmouth Naval Shipyard, 1983, Portsmouth, New Hampshire, Roy F. Weston, Inc., June 1983.

1.2.6.1 Terrestrial Characteristics

The Portsmouth Naval Shipyard is situated at the mouth of the Portsmouth Harbor in the Piscataqua River estuary. Like all estuarine environments there is some overlap between terrestrial and aquatic components. For example, the avifauna in this area are primarily waterfowl that include both aquatic and dry land areas in their range. The degree of overlap for other biological components, however, is related to shoreline conditions. Shorelines in the

Portsmouth Harbor area are a mixture of steep, rocky banks and low-lying marshlands. The tidal marshlands contain ecologically-important habitat, while the intertidal area along the rocky banks tends to be limited to a vertical zonation along the rocks. In this area the steep interface between shoreline and inland areas reduces vegetation zonation, making it possible for dry-land species to exist in close proximity to the shorelines.

The Portsmouth Harbor is in the Acadian Province, an area characterized by well-developed algal and boreal biota. The inland area is classified as a northern hardwoods/spruce forest.

Terrestrial wildlife in this area includes species common to northern forested areas, e.g., white tail deer, fox, and raccoon. Their abundance and distribution are controlled by the amount of development in the area.

An outstanding biological feature of the Portsmouth Harbor area is its avian population. The bay is a major wintering area for large numbers of waterfowl. It is reported that about three-quarters of all waterfowl wintering in the state of New Hampshire do so in this estuary. Although the heaviest populations occur in the winter, this area is used by some avian species during all parts of the year. Undeveloped areas serve as rookeries for birds, such as gulls, while mudflats around the islands provide feeding areas.

The shipyard is a highly-developed, industrial property, with limited vegetative growth. Most of its ground cover consists of landscaping plants, with only scattered remnants of naturally-occurring species. Because of its general lack of habitat, and the heavy human and industrial activity, the shipyard is unattractive for most species of wildlife. Some small mammals, however, have been seen, including mice and raccoons. Some gulls and passerine birds are common on the property.

Clark's Island, a small undeveloped land mass east of the shipyard, supports some biological resources. The vegetation here is composed primarily of herbaceous and shrub species such as rushes, jewelweed, skunk cabbage, spike grass, swamp azalea, bittersweet, witch hazel, and dogwood. There are also scattered low-land tree species, red maple, sycamore, willow, and poplar growing over the island.

Because Clark's Island is basically a field/meadow environment it provides habitat for a variety of small mammals such as mice, raccoons, and opossum. Its greatest use, however, is as a wintering and nesting area for a large variety of waterfowl. In addition to numerous seagulls, Canada geese, black duck, common goldeneye, bufflehead, and double-crested cormorant are the most common species. There are also some passerine birds and, to a lesser extent, raptors use the island during other parts of the year.

1.2.6.2 Aquatic Charcteristics

The Portsmouth Harbor area affords a variety of aquatic habitats. The harbor's physical conditions, coupled with the tidal influence, leads to local variations in substrate composition, salinity, water depth, and current velocity. Habitat variability also extends into low-lying intertidal areas that include mudflats, marshlands, and rock-littered shallows.

Benthic investigations, as part of a dredging study in 1976, revealed differences in faunal communities with respect to substrate characteristics. The soft-bottomed harbor areas were found to have the greatest species diversity. These areas were dominated by starfish, sand dollars, barnacles, gastropods, amphipods, polychaetes, mussels, and a number of clams. The hard substrates are inhabited by hydroids, bryzoans, gastropods, barnacles, and mussels. These areas also support a variety of macroalgae such as ascophyllum, fucus and laminaria. Lobsters, a commercially-important species, and several genus of

crabs (cancer, carcinus, and cagurus) occur in both soft- and hard-bottomed areas.

Fish communities in the Portsmouth Harbor area include both resident and migratory species. Common residents include flounders (winter, smooth, windowpane, and possibly yellowtail), Atlantic cod, sculpins (shorthorn and longhorn), sea raven, hakes (red, white, and silver), ocean perch, dogfish, skate (little clearnose and barndoor), pollock, and cunner. Another fish, the shortnose sturgeon, has also been identified as a resident of this estuarine system. Studies to date, however, have only encountered one shortnose sturgeon in 1971.

Migratory fish use this area as both a zone of passage by anadramous fish and as seasonal habitat by other species. Anadramous migrations generally occur from mid-April through mid-June and from mid-August through mid-November. Smelt, silversides, and blueback herring pass through this area seasonally.

Striped bass, although classified as an anadramous species, are considered summer residents of this area. Coho salmon, which are not native to the area, have recently been introduced into this estuary as part of an experimental program.

Seasonal migrants to the Portsmouth Harbor area include American sandlace, Atlantic mackerel, bluefish, Atlantic menhaden (summer residents), and Atlantic herring (winter residents). A complete list of fish native to the Portsmouth estuarine and coastline areas is given in Table 1-2 (refer to table at end of Section 1.0), which includes a representative list of benthic infauna by substrate.

1.2.6.3 Rare, Threatened or Endangered Species; Critical Habitats

The state of Maine has not made any state designation of rare, threatened, or endangered animal species beyond those contained on the Federal list. Several of these species may be present in the state, at least seasonally. Except for reports of shortnose sturgeon (Acipenser brevirostrum) being present in the Portsmouth Harbor area, no threatened or endangered species are known to inhabit the Portsmouth Naval Shipyard. The shipyard is not included in the critical habitats of any of these species.

The state of Maine has a floral protection program (Critical Areas Program) geared toward the protection of rare or significant floral species and their habitat throughout the state. None of these species is reported in the Portsmouth Shipyard area. Table 1-3 (refer to table at end of Section 1.0) lists the endangered and threatened species in Maine.

1.2.7 Potential Receptors

Current off-site migration of hazardous wastes from the shipyard is not known at this time. Therefore, the present impact on potential receptors can only be speculative. This speculation can apply to all industrial and commercial activities throughout the estuary.

Drinking water is supplied to the shipyard from a mainland municipal source. There is no groundwater use on site. It is anticipated that potentially contaminated groundwater would migrate from the site toward the estuary. Surface spills would ultimately enter the estuary via surface runoff or storm sewer system outfalls.

As potential contamination enters the estuary, it will undergo dilution in the water column. Further, it may undergo sorption in sediments, biogradation, volatilization, complexation, precipitation, or any combination of these. Ultimately, the contaminant may enter the food chain. Hazardous waste or

hazardous constituents in the estuary will initially affect benthic forms and filter feeders, eventually migrate up the food chain and ultimately could impact human health.

1.2.8 Climatology

The overall climate in the Portsmouth region is characterized as variable. Weather conditions can change dramatically over short intervals, such as alternating frontal systems on a day-to-day basis, widely-ranging diurnal and annual temperatures, and overall differences between the same seasons in different years.

Although this region is situated in the path of the prevailing westerly winds, the coastal area experiences a variety of air inversions over the course of a year. These include: cold dry arctic air from the north, warm land air from the Gulf states, and cool, damp air from the Atlantic Ocean. It is the combinations of, or switches between these conditions that generally cause the area's characteristic weather. Wind data collected by Public Service Company of New Hampshire (PSNH) at the 32.8 ft (10m) level at Seabrook, New Hampshire, from November 1971 through October 1972 (212) showed a predominance of winds from the west-northwest and northwest with speeds of more than 16kns (8.7m/sec). (See Figure 1-11.)

Weather conditions, especially temperature, in the Portsmouth general area are moderated by its maritime setting. The average daily temperature ranges from 80°F in July to 13°F in January and February. Temperatures can fluctuate outside this range, but they are not usually persistent.

Precipitation is fairly evenly distributed over the year, with 2.7 to 4.6 inches falling per month for a 42.6-inch annual total. On the average there are about 130 days each year having more than a trace of precipitation. Most

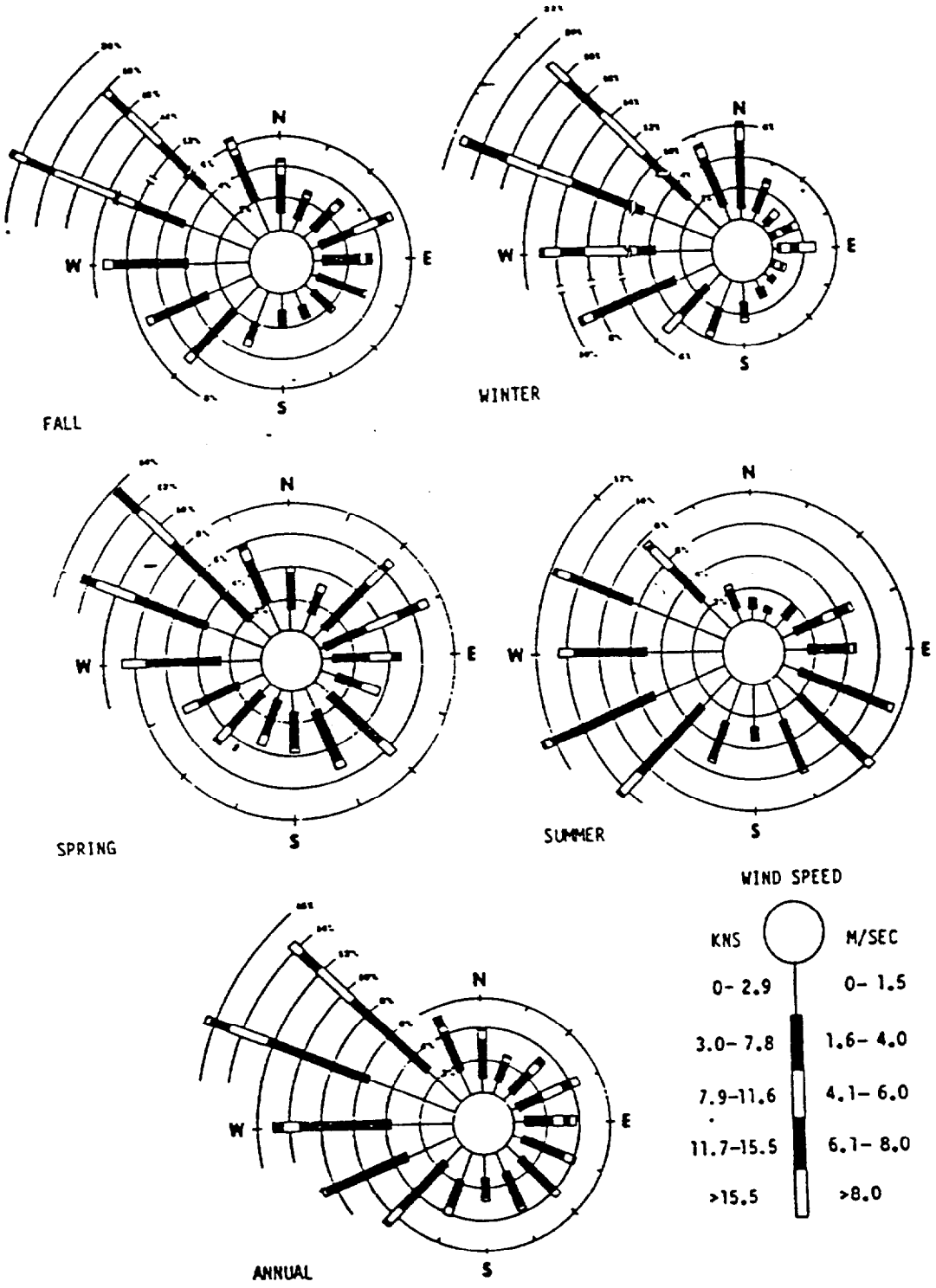


FIGURE 1-11

SEASONAL AND ANNUAL ROSE DIAGRAMS SHOWING PERCENTAGE FREQUENCY OF WIND DIRECTION

PORTSMOUTH NAVAL SHIPYARD

JUNE 1989

FROM NITIAL ASSESSMENT STUDY OF PORTSMOUTH NAVAL SHIPYARD PORTSMOUTH, NEW HAMPHIRE - WESTON

FRED C. HART ASSOCIATES, INC

summer precipitation results from showers and, infrequently, thunderstorms. Winter precipitation is generally associated with stormy conditions caused by air masses moving up along the coast. Heavy precipitation events are usually caused by storm centers that form along the east coast and move northeastward through the New England area.

The cool Atlantic waters can produce extensive advection fog when warmer moist air is carried over the cool water. With any persistent eastern component in the wind direction, the fog that often lies just offshore during the summer can reach the coast line. This situation is increased during the summer by local sea breezes. All months of the year have a fairly consistent occurrence of fog. Localized and continuous fog is observed at Pease Air Force Base an average of about 15 percent of the time and is dense enough to restrict visibility to 1.2 miles (2 km) or less, about 3.5 percent of the time.

The predominant wind direction for the Portsmouth Harbor area is a combination of the western, southwestern, and southern sectors for a combined total of 51.5 percent of the time. Differences in wind characteristics occur on a seasonal basis with west-northwest winds dominating in the winter, and southwest-southeast winds increasing in frequency during spring and summer.

The wind speed average 8.8 miles per hour in the Portsmouth Harbor area. Speeds greater than 40 miles per hour, however, can occur any time of the year. During the winter, increased wind speeds are normally caused by the northeast winds moving down the coast, while during the summer high winds are more often associated with thunderstorms or squall lines moving through the area. (Obtained from "Initial Assessment Study of Portsmouth Naval Shipyard, Portsmouth, New Hampshire," June 1983, Roy F. Weston, Inc.)

1.2.9 Regional Economy

The Portsmouth Naval Shipyard is one of the largest civilian employers in the states of Maine and New Hampshire. The significance of the shipyard in the regional economy can best be described with reference to the economic activity in the region's job centers from which the shipyard draws most of its employees. Five job centers in New Hampshire--Portsmouth, Exeter-Epping, Hampton, Dover-Somersworth, and Rochester--and two in Maine--Kittery and Biddeford--compose the "seacoast region."

Both New Hampshire and Maine enjoy an approximate equal share of PNS jobs. This state parity in PNS employment is carried through in the case of Portsmouth and Kittery with individual community PNS employment of 864 and 811 respectively. According to the 1980 U.S. Census, Kittery had a population of 9,314, yet it has approximately as many PNS employees as does Portsmouth with its 1980 Census population of 26,254. This fact underscores both the benefit of the PNS to Kittery and at the same time that community's strong reliance on the PNS for employment.

In the past the economy of the seacoast region of New Hampshire and southern Maine has been based on manufacturing. Textiles, shoes, and marine vessels were for many years the most important products of the region. Ship building, primarily at Portsmouth Naval Shipyard, maintained a dominant role in the economy. Textiles and shoe manufacturing have declined over the past 30 years, but have been supplanted in part by plastics, electronics, and metals manufacturers. The wages paid by these industries are low relative to those paid at the shipyard. On balance, the seacoast region has experienced consistent declines in manufacturing employment in recent years.

Non-manufacturing employment, especially in the trade and service sectors, is increasing. The coast communities in the Hampton, Portsmouth,

Kittery, and Biddeford job centers have experienced economic growth as vacation resorts. Communities close to Massachusetts--Hampton and Exeter-Epping--have grown as part of the Boston metropolitan area.

1.3 Previous Investigative Activities

HART has reviewed the following site-specific reports to formulate the Initial Facility Characterization Report (IFCR) and design the investigations for the Jamaica Island Landfill and the DRMO Storage Yard:

- Candidate Environmental Impact Statement, Portsmouth Naval Shipyard, March, 1978. Parsons, Brinckerhoff, Quade & Douglas, Inc.
- Initial Assessment Study of Portsmouth Naval Shipyard, Portsmouth, New Hampshire, June, 1983. Roy F. Weston, Inc. (Weston)
- Final Confirmation Study Report on Hazardous Waste Sites at Portsmouth Naval Shipyard, Kittery, Maine, June, 1986. Loureiro Engineering Associates (LEA).
- RCRA Facility Assessment Portsmouth Naval Shipyard, Phase II Report, July 1, 1986. A. T. Kearney, Inc. and Baker/TSA, Inc.
- Draft Environmental Assessment, Portsmouth Naval Shipyard, September 1986. Fay, Spofford & Thorndike, Inc.

These site-specific references are outlined below and pertinent information is referenced throughout the proposal.

1.3.1 Candidate Environmental Impact Statement (CEIS)

The Navy removed a large volume of dredge material, approximately 85,000 cubic yards of unconsolidated overburden and 23,000 cubic yards of drilled and dynamited bedrock from Berths 6, 11, and 13, as well as the approach to drydock 3. Dredged material was transported to an on-site disposal area at the eastern end of Seavey Island, where it was properly contained to minimize release of contaminants from the dredge spoils to the Piscataqua River. The dredged disposal site was dressed, followed by seeding and revegetation, and converted to a park-like setting at the completion of all dredging operations.

This environmental assessment was conducted to determine the effect of this dredging operation on the surrounding environment. The document contains the following information which is pertinent to this proposal:

- Point source discharges in the Portsmouth Harbor,
- Chemical contaminants in the overburden at the dredge sites,
- Occurrence of bacterial indicators in surface sediments,
- Water quality in the dredging area,
- Descriptions of natural environment existing at the JILF prior to dredge disposal and,
- Projected impacts of Dredge spoils on water quality.

1.3.2 Initial Assessment Study (IAS)

The IAS conducted by Weston identified and assessed sites posing a threat to human health or the environment resulting from hazardous waste contamination caused by previous practices. Based on Weston's review of historical data, aerial photographs, field inspections, and personnel interviews, it was determined that the Jamaica Island Landfill warranted further investigation to assess potential long-term environmental impacts. A supplemental IAS, presumably prepared by Weston and not made available to HART, reportedly determined that the DPDO storage yard (now referred to as the DRMO storage yard) also warranted further investigation.

The IAS identified four potentially contaminated sites at the shipyard. These sites were the Jamaica Island Landfill, two Mercury Burial areas, and the Industrial Waste Outfalls. It was concluded that only the Jamaica Island Landfill appeared to present a potential hazard to the environment.

Based on review of landfill history, dredge spoil containment design, site hydrogeology, and estuary hydrology it was inferred that the landfill was not secure. The IAS cites a Maine DEP denial (June, 1983) for sandblast grit

disposal because landfill containment integrity was questioned. Many types of hazardous materials were disposed of at this site. Some of the most significant wastes are shown in Table 1-4. It was reasoned that tidal activity could flush contaminants from the landfill due to lack of impermeable material at the base of the landfill and dredge spoil containment area. Due to restricted circulation, contaminants could possibly concentrate in the Clark's Island Embayment and ultimately enter the food chain and be a threat to human health.

1.3.3 Final Confirmation Study (FCS)

Based on the findings and recommendations of the IAS, the FCS was conducted to confirm or deny the presence of suspected contamination and to quantify the extent of any existing problem. The FCS states that the IAS identified two sites, the DRMO Storage Yard and Jamaica Island Landfill, which warranted further investigation. Apparently, the DRMO Storage Yard was the topic of an IAS Supplemental report. HART did not review the IAS Supplemental.

The FCS followed the recommendations of the IAS for the Jamaica Island Landfill, and presumably the IAS Supplemental's recommendations for the DRMO Storage Yard. The FCS contains results from a sampling and analysis program and recommendations for further work.

Specifically, the evaluation of Jamaica Island Landfill consisted of sampling and analysis of sediment and biota from Clark's Island Embayment and various control stations. From comparison with control data this program found:

- Chromium, lead, and nickel contamination in the embayment's sediments, with highest levels proximal to the landfill face.
- Elevated levels of nickel and PCBs in mussels.
- Elevated levels of chromium, cadmium, lead, and nickel in algae samples.
- Slightly elevated concentrations of lead in seawater.

Table 1-4

Hazardous Materials Disposed of at Site 1, Jamaica Island Landfill

Substance	Estimated Quantity	Time Period	Comments
Plating Sludges			
Chrome	5,000-10,000 pounds	1945-1972	Sludges were mixed in with normal refuse and were disposed of directly into the landfill. Exact location unknown.
Lead	5,000-10,000 pounds	1945-1972	
Cadmium	5,000-10,000 pounds	1945-1972	
Asbestos insulation	Several thousand pounds	1945-1960	Exact location unknown.
Volatile organics			
TCE, methylene chloride, toluene, MEK	20,000 gallons	1955-1975	Drums were taken to the landfill where wastes were drained out directly onto the ground.
Acetylene and chlorine gas cylinders	100-200 cylinders	1955	Cylinders were buried full.
Contaminated dredge spoils containing:		1978	Total spoils deposited was 108,000 cubic yards. Small amounts of PCBs and mercury were also found in dredge spoils. Dredge material came from sediments at Berths 6, 11, and 13.
Chromium	5,000 pounds		
Lead	20,000 pounds		
Waste paints and solvents	500,000 gallons	1945-1965	Probably disposed of in whole drums.
Spent sandblasting grit.	50,000 tons/year	1945-1975	Scattered throughout the site.

The source of the embayment contamination was inferred to be the Jamaica Island Landfill. It was recommended that additional investigations be conducted to ascertain the existence of landfill migration pathways and, if warranted, develop remedial programs to prevent further migration. It was recommended that the environmental and health effects of the embayment contamination and the effects of its removal be assessed.

The FCS further documents lead, cadmium, chromium, and nickel contamination of soils within the DPDO Storage Yard and vicinity. The upper few feet of soil throughout the yard is attributed to be the contamination source. Based on the distribution of contaminants in relation to the Storage Yard, transport mechanisms include wind dispersal, surface run-off, rainfall percolation, groundwater flow, tidal flushing, and snow removal. Elevated metal levels were found in downgradient mussels and in soils north of the site. The report recommends further soil sampling to define the lateral and vertical extent of contamination and remedial action involving shallow excavation of contaminated soil and capping to inhibit further infiltration and wind dispersal. Remedial actions to prevent contaminant migration at depth (e.g., cutoff walls) within the saturated zone are considered in the report but are not proposed.

1.3.4 RCRA Facility Assessment (RFA)

The Jamaica Island Landfill and DRMO storage yard were also reviewed in the RFA. Information from the IAS, the Confirmation Study Draft Report, and other sources pertaining to the Shipyard were incorporated into this report.The RFA concludes that there is high potential for hazardous air and groundwater/surface water releases, and subsurface gas generation at the Jamaica Island Landfill. The RFA recommends a comprehensive remedial investigation, ranging from periodic air monitoring to a risk assessment of commercial fishing in the area, to determine the extent of contaminants released

from the landfill. It also recommends that once the remedial investigation is complete, remediation activities should commence.

With respect to the DRMO Storage Yard, it is also concluded that the potential exists for contaminant releases to both ground and surface water and recommends further investigation in the form of soil sampling.

Specifically, the RFA evaluates the potential for air, groundwater, surface water and subsurface gas release potential for each site and recommends corrective actions. A review of shipyard hazardous waste generation activities and site conditions (e.g., physiography, hydrogeology) is also included in the report.

Based on disposal practices at the Jamaica Island Landfill and its proximity to Clark's Island Embayment, the report infers the landfill to be the primary contamination source. The RFA references the Confirmation Study Draft Report, which identifies the landfill as the source of the embayment's contamination. In addition to landfilled hazardous wastes identified by the IAS, the RFA also references a 1971 report that identifies incinerator waste at the landfill and its significant contribution to groundwater pollution. The RFA concludes that the potential for air, groundwater, and surface water contamination release is high and there is potential for subsurface methane and hazardous gas generation. The RFA recognizes that unknown quantities and types of gas tanks and cylinders have been landfilled in addition to known disposition of full acetylene and chlorine gas cylinders. The RFA questions the integrity of the dredge spoil containment area and infers tidal flushing to be a release mechanism. The report recommends initiation of a remedial investigation to assess the extent of contamination caused by the landfill in order to proceed with clean-up activities.

The RFA also references the Confirmation Study Draft Report's analyses of heavy metal contamination of soil (sediment), mussels and algae in the vicinity of the DRMO storage yard. The report concludes that release potential to the groundwater is high, contaminants have migrated into the saturated zone, and uncontrolled surface water run-off has contaminated estuary biota. The RFA recommends additional soil sampling to define the vertical and lateral extent of contamination within and beyond the DRMO boundaries and that contaminant analyses include PCBs and TOCs. Ultimately, remedial actions would include excavation of contaminated riverbank sediments and prevention of contaminant migration from the DRMO storage yard.

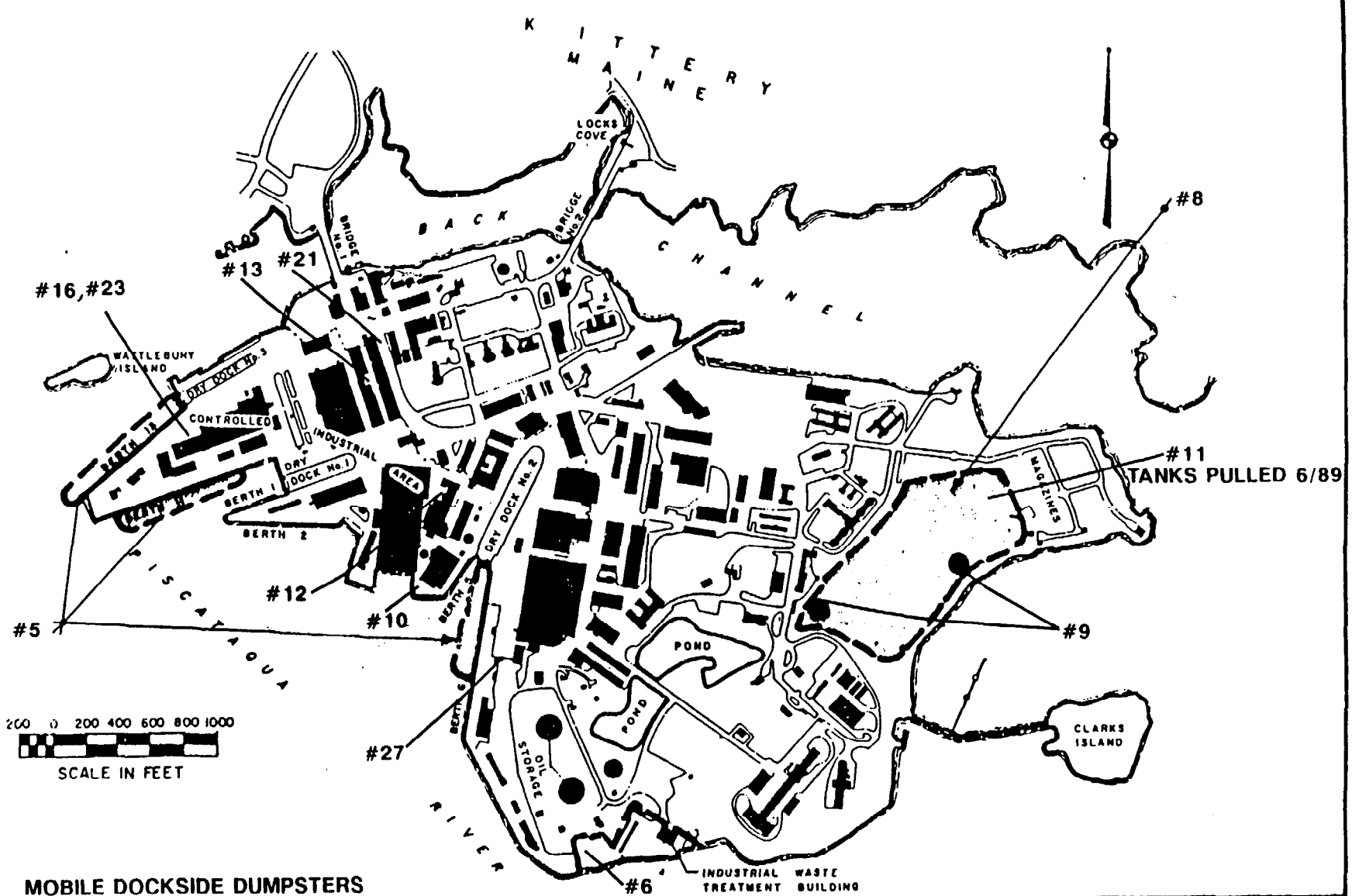
1.3.5 Draft Environmental Assessment

This environmental assessment was conducted to determine what affect the dredging of the P-172 submarine overhaul facility would have on the surrounding environment. The report includes sections covering historic and cultural resources of the area, zoning and land use, socioeconomics and fresh water, sewage, electrical and steam systems in use at the PNS. Sections concerning water resources, hydrodynamics, geology, harbor bathymetry, air quality, and aquatic biological features are especially pertinent to the development of this proposal.

1.4 Solid Waste Management Units

This RCRA Facility Investigation Proposal is focused on 13 solid waste management units as identified in the Portsmouth Naval Shipyard Hazardous and Solid Waste Amendments of 1984 (HSWA) permit (see Figure 1-12). The 13 SWMUs are identified below:

SWMU #5	Industrial Waste Outfalls
SWMU #6	DRMO Storage Yard
SWMU #8	Jamaica Island Landfill
SWMU #9	Mercury Burial Sites



#26 MOBILE DOCKSIDE DUMPSTERS

FIGURE 1-12

DISPOSAL SITES

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME JUNE 1989

FRED C. HART ASSOCIATES, INC.

SWMU #10	Battery Acid Tank No.24
SWMU #11	Waste Oil Tanks (2) No.12 (pulled June 1989)
SWMU #12	Boiler Blowdown Tank No. 6 & 7
SWMU #13	Rinse Water Tank No.27
SWMU #16	Rinse Water Tank No. 34
SWMU #21	Acid/Alkaline Drain Tank
SWMU #23	Chemical Cleaning Facility Tank (Building 174)
SWMU #26	Oil/Water Dumpsters
SWMU #27	Fuel Oil Spillage Area Southeast of Berth 6

The following is a brief summary of SWMUs 5, 6, 8, 9, and 10 from the RCRA Facility Assessment, Portsmouth Naval Shipyard, Phase II Report, Kearney, A.T., Inc. and Baker/TSA, Inc., July 1, 1986. Table 1-5 addresses the tank-related SWMUs: 11, 12, 13, 16, 21, 23, 26, and 27.

SWMU #5. Unit Name: Industrial Waste Outfalls

Description: Several discharge points along the Piscataqua River were located at the western end of the site. The outfalls were used to discharge liquid industrial wastes prior to construction of the Industrial Waste Treatment Plant. The outfalls were located near Berths 6, 11 and 13.

Period of Operation: 1945 to 1975

Wastes: Industrial wastewaters including wastes from plating and battery shops contained in Buildings 79 and 238.

Release Controls: None

History of Releases: In 1976 sediments in the outfall areas were sampled and tested. The results show heavy metals contamination including mercury, lead, cadmium, chromium, copper and zinc; high concentrations of oils and grease; PCBs; and concentrations of total cyanide and phenols. Dredging operations were conducted to remove contaminated sediment which were disposed in the Jamaica Island Landfill. The effectiveness of dredging operations is not known. Since that time discharges from the outfalls have ceased.

SWMU #6. Unit Name: DRMO Storage Yard

Description: The storage yard is a 4-acre site that serves as a temporary storage area for refuse prior to off-site recycling or disposal.

Period of Operation: The unit is presently active and has been in operation over 30 years.

Wastes: Lead and nickel-cadmium battery elements, motors, typewriters, paper products, and scrap metal.

Table 1-5. Tank Related Solid Waste Management Units

Underground Storage Tanks

SWMU No.	Name	Content Description	Tank Description	Analytical Parameters
10	Battery Acid Tank	Spent Battery Acid	Tank Pulled	Lead
11	Waste Oil Tank No. 6 and 7	Used Lubricating Oil and Degreasers	7,500 gal. each Capacity Steel Construction Inspected 11/86, pulled 6/89	PCB's, RCRA Metals, TCL Volatiles
12	Boiler Blowdown Tank No. 25	Heated Water	3,800 gal. Capacity 1974 to Present	TAL Metals, Cyanide
13	Rinse Water Tank No. 27	Unspecified Rinse Water	695 gal. Capacity Steel Construction 1974 to Present	TAL Metals, Cyanide
16	Rinse Water Tank No. 34	Unspecified Rinse Water	750 gal. Capacity Steel Construction 1978 to Present	TAL Metals, Cyanide
21	Acid/Alkaline Drain Tank	Spent Cleaning Solutions	695 gal. Capacity	TAL Metals, Cyanide and TPH
23	Chemical Cleaning Facility Tank	Spent Cleaning Solutions	2,270 gal. Capacity 1978 to Present	TAL Metals, Cyanide and TPH

Aboveground Storage Tanks

26	Oil/Water Dumpsters	Waste Oil	Mobile Dockside Dumpsters on Berth	TPH

Pipeline

27	Former Pipeline	Fuel Oil	Ruptured pipeline 1978. Pipeline and soil excavated.	TPH, PAH

Release Controls: There are no release controls. Visual inspection indicates ponding of precipitation in some areas and direct runoff to the river in other areas.

History of Releases: The facility characterization report documents elevated concentrations of chromium, cadmium, lead, and nickel in the soils. No soil remediation program has been conducted. Storage operations have been modified to prevent the potential for further releases of lead.

SWMU #8. Unit Name: Jamaica Island Landfill

Description: The landfill covers an area of 25 acres and contains an unknown amount of materials considered as hazardous waste.

Prior to landfilling activities, tidal flats separated Jamaica Island from Seavey Island. Over a 20-30 year period this area was filled with hazardous and nonhazardous wastes. In 1978, the shipyard received approval to dredge over 10,000 cubic yards of sediment from Berths 6, 11 and 13, and to dispose of the material in the area of the landfill illustrated in Figure 9-1. The material was placed on top of a portion of the landfill and was encapsulated by a clay barrier wall along the Piscataqua River and a clay cap to prevent infiltration.

Period of Operation: Approximately 1945 to 1978

Wastes: In addition to general refuse, trash and construction rubble, the unit accepted incinerator ash, plating sludges containing chrome, lead and cadmium; asbestos insulation; volatile organics including TCE, methylene chloride, toluene and MEK; acetylene and chlorine gas cylinders; contaminated dredge spoils containing chromium, lead, small amounts of PCB, mercury and possibly phenols; waste paints and solvents; and spent sandblasting grit. Personnel have indicated that waste oils containing PCBs may also have been disposed at the site prior to construction of a holding tank in 1972.

Corrective Actions: A 2-foot clay cap has been placed over the portion of the landfill that accepted contaminated dredge spoils. In addition, a clay barrier has been constructed lining the inside of the rock dike.

History of Releases: Sampling and testing of sediments along the face of the landfill have indicated elevated levels of chromium, lead, and nickel. However, this data does not confirm the landfill as the source of contamination.

SWMU #9. Unit Name: Mercury Burial Sites

Description: Two mercury burial areas are located within the Jamaica Landfill Area.

Period of Operation: 1973 to 1975

Wastes: Mercury contaminated wastes including fluorescent bulbs, thermometers, mercury switches and rags, brooms, and dust pans contaminated with mercury.

Release Controls: The wastes were encapsulated in 4-foot-diameter concrete pipe sections with the ends capped with one foot of poured concrete. The concrete vaults were buried under 8 to 10 feet of fill. There are approximately 6 vaults in each of the two areas. Visual inspection indicates that the areas are vegetated with no signs of erosion or distress.

History of Releases: There is no record of a release from the concrete capsules.

SWMU #10. Unit Name: Tank No. 24

Description: This unit is an underground, 9680-gallon holding tank for waste battery acid resulting from battery disposal operations. The tank has been removed.

Period of Operation: 1974 to 1984

Wastes: Sulfuric acid contaminated with lead (pH <2).

History of Releases: In 1984 a 2-inch hole was discovered at the bottom of the tank due to groundwater inflow when empty. The period of potential release is not known. The tank has since been taken out of service and removed.

TABLE 1-2

FISH OF THE PORTSMOUTH HARBOR AREA

Finfish Common to the Portsmouth Harbor and General Coastal Area

Common Name	Scientific Name
Yellowtail flounder	Limanda ferruginea
Smooth flounder	Liopsetta putnami
Winter flounder	Pseudopleuronectes americanus
Sand flounder	Hippoglossoides platessoides
Four-spot flounder	Paralichthys oblongus
Fluke (summer flounder)	Paralichthys dendatus
Windowpane	Scopthalmus aquosus
Hickory shad	Alosa mediocris
Alewife	Alosa pseudoharengus
Blueback herring	Alosa aestivalis
Atlantic herring	Clupea harengus harengus
Northern searobin	Prionotus carolinus
Cunner	Tautoglabrus adspersus
Atlantic silversides	Menidia menidia
Red hake	Urophycis regius
Blue hake	Antimora rostrata
Silver hake (whiting)	Merluccius bilinearlis
White hake	Urophycis tenuis
Tautog	Tautoga onitis
Atlantic mackerel	Scomber scombrus
Sea bass (black)	Centropristis striata
Atlantic cod	Gadus morhua

Common Name	Scientific Name
Striped bass	Morone saxatilis
Bluefish	Pomatomus saltratrix
Dogfish	Mustelus canis
Menhaden	Brevoortia tyrannus
Cusk	Brosme brosme
Little skate	Raja erinacea
Clearnose skate	Raja eglanteria
Barndoor skate	Raja laevis
Atlantic sturgeon	Acipenser oxyrhynchus
Shortnose sturgeon	Acipenser brevirostrum
American eel	Anguilla rostrada
Rainbow smelt	Osmerus mordax
Goosefish	Lophius americanus
Fourbeard rockling	Enchelyopus cimbrius
Haddock	Melanogrammus aeglefinus
Atlantic tomcod	Microgadus tomcod
Pollock	Pollachius virens
Mummichog	Fundulus heteroclitus
Striped killifish	Fundulus majalis
Fourspine stickleback	Apeltes quadracus
Threespine stickleback	Gastrosteus aculeatus
Black spotted stickleback	Gastrosteus wheatlandi

Common Name	Scientific Name
Ninespine stickleback	*Pungitius pungitius*
Northern pipefish	*Syngnathus fuscus*
Crevalle jack	*Caranx hippos*
Banded killifish	*Seriola zonata*
Striped mullet	*Mugil cephalus*
Radiated shanny	*Ulvaria subbifurcata*
Rock gunnel	*Pholis gunnellus*
Atlantic wolffish	*Anarchicas lupus*
Spotted wolffish	*Anarchicas minor*
American sand lace	*Ammodytes americanus*
Redfish (ocean perch)	*Sebastes marinus*
Sea raven	*Hemitripterus americanus*
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Shorthorn sculpin	*Myoxocephalus scorplius*
Lumpfish	*Cyclopterus lumpus*
Seasnail	*Liparis atlanticus*
Striped seasnail	*Liparis liparis*
Coho salmon	*Oncorhynchus kisutch*

Benthic Infauna by Substrate Type

Substrate	Organism
Intertidal -- mud and gravel	Polychaetes -- *Nereis*, *Nephtys*
	Molluscs -- *Mya*, *Macoma*, *Mytilus*, *Tellina*
	Gastropods -- *Lacuna*, *Nassarius*
	Amphipods -- *Ampelisca*, *Gammarus*
Harbor -- mud	Echinoderms -- *Echinarachnius*, *Asterias*
	Molluscs -- *Tellina*, *Cerastoderma*, *Anomia*
	Polychaetes -- *Nereis*, *Nephytys*, *Lepidonotus*, *Lumbrineris*
	Crustaceans -- *Ampelisca*, *Corophium*
Harbor -- rocky, shell litter	Hydroids -- *Tubularia*, *Thuiaria*, *Sertularia*
	Bryozoans -- *Callopora*, *Crisia*, *Electra*, *Hippothoa*
	Amphipods -- *Jassa*
	Isopods -- *Idotea*
	Polychaetes -- *Spirorbis*
Harbor -- hard bottom	Hydroids -- *Sertularia*
	Bryozoans -- *Callopora*
	Molluscs -- *Mytilus*, *Modiolus*
	Gastropods -- *Littorina*, *Thais*, *Acmaea*
	Echinoderms -- *Asterias*
	Crustaceans -- *Balanus*

TABLE 1-3

ENDANGERED AND THREATENED SPECIES IN MAINE

ENDANGERED AND THREATENED SPECIES IN MAINE

Common Name	Scientific Name	Status	Distribution
Fish			
Sturgeon, shortnose[1]	Acipenser brevirostrum	E	Kennebec River and Atlantic Coastal waters
Reptiles			
Turtle, loggerhead[1]	Caretta caretta	T	Oceanic summer resident
Turtle, leatherback[1]	Dermochelys coriacea	E	Oceanic summer resident
Turtle, Atlantic ridley[1]	Lepidochelys kempii	E	Oceanic summer resident
Birds			
Eagle, bald	Haliaeetus leucocephalus	E	Entire state -- nesting habitat
Falcon, American peregrine	Falco peregrinus anatum	E	Entire state -- reestablishment to former breeding range is in progress
Falcon, Arctic peregrine	Falco peregrinus tundrius	E	Entire state migratory -- no nesting
Mammals			
Cougar, eastern	Felis concolor cougar	E	Entire state -- may be extinct
Whale, blue[1]	Balaenoptera musculus	E	Oceanic
Whale, finback[1]	Balaenoptera physalus	E	Oceanic
Whale, humpback[1]	Megaptera novaeangliae	E	Oceanic
Whale, right[1]	Eubalaena spp. (all species)	E	Oceanic
Whale, sei[1]	Balaenoptera borealis	E	Oceanic
Whale, sperm[1]	Physeter catodon	E	Oceanic

[1]Except for the sea turtle nesting habitat, the principal responsibility for these species is vested with the National Marine Fisheries Service.

Source: U.S. Fish and Wildlife Service, Region 5

Common Name	Scientific Name	Status	Distribution
Mollusks			
None			
Plants			
Lousewort, Furbish's	*Pedicularis furbishiae*	E	Aroostook County

2.0 PRELIMINARY INVESTIGATION OF CORRECTIVE MEASURES

2.1 Introduction

The primary objective of a corrective measure study (CMS) is to evaluate all remediation methods and technologies that may be used to clean up a site in order to alleviate the risk the site poses to human health and the environment. Evaluation of available remedial methods and technologies leads to the development of a remedial action plan for the site. The selection of remedial methods and technologies is guided by data gathered during the RCRA Facility Investigation (RFI). Data generated from a well designed RFI allows for an in depth source/pathway/receptor analysis leading to a targeted corrective measure study and the most cost-effective remedial design.

To date, investigative activities at Portsmouth Naval Shipyard have suggested the potential for problems and have helped to identify contaminants of concern. However, more detailed investigations are required to adequately assess possible remedial alternatives, and determine final design for SWMUs of concern. Careful attention to quality assurance and quality control and a more definitive RFI is essential to develop a more complete data base to be used to evaluate the technical and financial aspects of alternative remedial solutions and ensure the success of any remediation effort.

Upon completion of the RFI as outlined in this proposal, data reduction and evaluation will be performed and will provide all the information necessary to accurately assess the risk to human health and the environment (PHERE). A comprehensive corrective measure study will then be conducted which will be composed of the following tasks:

Task 1 - Define Remedial Response Objectives

Task 2 - Identify and Screen Remedial Action Technologies

Task 3 - Develop and Evaluate Remedial Action Alternatives

Task 4 - Select Preferred Remedial Action Alternatives

Task 5 - Corrective Measure Study Report

Task 6 - Corrective Measure Study Report Quality Assurance Review

Task 7 - Progress Reports

2.2 Corrective Measure Study Overview

The first step (Task 1) of the corrective measure study is to define the objectives of the remedial action. This will be performed during the latter stages of the RFI and will be based on information made available through this investigation. Additional data collection during the RFI may be required to help refine these objectives. The risk to human health and the environment as defined in the Public Health and Environmental Risk Evaluation (PHERE) will also be considered in defining the objectives of the remedial action.

The remedial action technologies which can be used to achieve the remedial response objectives set forth in Task 1 will be identified in Task 2. The technologies will be screened for their technical applicability to the site.

The remedial alternatives will be developed by combining technologies applicable to each media in Task 3. These alternatives are general response actions which broadly define the nature of the response. Task 3 will address whether source control measures (measures designed to prevent or minimize migration of substances identified in the RFI from the source) and/or management of migration measures (measures designed to mitigate the impact of the substances identified in the RFI that have migrated into the environment) are necessary. The alternatives will be assessed on the basis of public health, environmental, and cost concerns as discussed in Section 2.3. A detailed

analysis of alternatives will be performed in order to select the most cost-effective alternative. Task 3 will cover the engineering analysis of the alternatives in terms of ease of construction and reliability to ensure the alternatives can be readily implemented. Task 3 covers the institutional analysis of alternatives in terms of the federal, state, or local standards, advisories, or guidance that must be attained or considered to protect the public health, welfare, and environment. Task 3 also covers the public health and exposure evaluation and includes the environmental analysis of alternatives.

The preferred remedial action alternative will be selected in Task 4. A comparison of the alternatives will be performed using the factors considered in Task 3. The alternatives will be ranked in accordance with EPA RCRA Corrective Action guidelines.

Task 5 describes how the information developed in analyses described in previous sections will be organized and summarized. The objective of this summary is to ensure that important information is presented in a concise format so that the remedy that provides the best balance of health and environmental protection and engineering reliability and cost can be selected. Task 5 also discusses the format of the report for the corrective measure study. It identifies the elements of the corrective measure study report, the rationale for their inclusion, the level of detail, and the documentation necessary to accompany the report.

2.3 Task 1--Define Remedial Response Objectives

Site-specific remedial response objectives and criteria will be developed based on the following:

- Results of the RCRA Facility Investigation (RFI) and Public Health and Environmental Risk Evaluation;
- Current USEPA policies and guidance, including the Superfund Exposure Assessment Manual (September 1987) and the Superfund Public Health Evaluation Manual (October, 1986);
- Other applicable or relevant and appropriate federal and state requirements;
- Local public health and environmental concerns.

The RFI and the PHERE will identify the substances and media (e.g., soil, groundwater, air) of interest and exposure pathways. Specific cleanup criteria will be developed in accordance with the requirements specified in the most current USEPA guidance documents. The cleanup criteria will be presented such that concentrations of the substances identified in the RFI are compared to these cleanup criteria. These criteria will be developed in consultation with the Navy, USEPA and the Maine Department of Environmental Protection (DEP) before proceeding on elements of the corrective measure study affected by the selection of cleanup criteria.

2.4 Task 2--Identify And Screen Remedial Action Technologies

Once the objectives of the remedial response have been determined, remedial action technologies will be identified. The chemical and physical characterization of the site will be considered in the identification of the remedial technologies. A number of technologies are currently available which can be used to address issues at the site. The purpose of this task is to identify, describe and determine which technologies can be used to satisfy, in whole or in combination, the remedial response objectives for the site. The remedial technologies that cannot be implemented at the site due to technical

constraints or which are not appropriate due to site conditions will be eliminated from further consideration.

Remedial technologies will be identified through a review of USEPA guidelines, relevant literature, and through HART's experience in developing remedial action plans for similar sites. Technologies will be identified to address both source control of the on-site materials and control of the off-site migration, if any, of the substances identified in the RFI. Innovative alternative technologies and resource recovery technologies will be given particular consideration.

Technologies to be considered for use in remediating air, soil, surface water and/or groundwater at the SWMUs are listed in the following tables:

Table 2-1: Jamaica Island Landfill (SWMU 8,9)
Table 2-2: DRMO Storage Yard (SWMU 6)
Table 2-3: Bulk Liquid Storage Tanks (SWMUs 10, 11, 12, 13, 16, 21, 23, 26, 27)

The environmental media are only tentatively identified as potential exposure pathways for substances of concern for each of the SWMUs. The PHERE (Section 15.0) will identify: (1) which chemicals found at each of SWMUs are substances of concern; and (2) which exposure pathways pose unacceptable risks and, as a result, would require remediation. Only the technologies that address the environmental media and exposure pathways which the EA identified as posing unacceptable risks will be evaluated in the CMS.

TABLE 2-1

REMEDIAL ACTION TECHNOLOGIES
TO BE CONSIDERED
FOR
JAMAICA ISLAND LANDFILL (SWMUs 8, 9)
PORTSMOUTH NAVAL SHIPYARD

Potential Environmental Media and Pathway of Concern	Technology	Description
Air	Gas/Vapor Collection	Shallow (1' - 2') extraction wells(1); permeable gas collection layer in cover (e.g., crushed stone); low permeability cover; connecting pipes (headers); and blowers.
Air	Gas/Vapor Treatment	Treatment of collected gas and vapors using incineration, activated carbon, condensation and/or wet air scrubber.
Soil	RCRA Cover	Multimedia cover (clay and/or liner, fill, topsoil, vegetation and a gas collection layer), to be designed assuming existing low permeable cover is at least partially functional.
Soil	Vacuum Extraction	Use of gas collection and treatment systems (described for air pathways, above) to remove VOCs and some SVOCs from waste materials. Air injection wells may be added to gas collection and treatment system described above.
Soil	In-Situ Stabilization	Mixing cement, fly ash and other pozzolanic material with upper layers of landfill material; limited by concerns over excavation(1).
Soil	Soil Flushing	Application of treated water to permeable areas of landfill and extraction and treatment of applied water after flushing through waste material (i.e., flushate).
Soil	Soil Cover	Installation of soil cover (e.g., 2-3' of uncontaminated soil, vegetation) over site areas containing waste material to prevent direct contact, ingestion and wind dispersal.
Soil	Surface Water Controls	Installation of berms and/or drainage swales and regrading of site to divert off-site and on-site surface water away from covered waste areas; to be considered in conjunction with: (a) in-situ stabilization; (b) RCRA Cover; or (c) soil cover
Soil	Radio Frequency	Application of radio frequency radiation (i.e., microwaves) to waste material using surface conductors; heating waste materials to 300/C to 400/C using microwaves; and removal of resulting gas and vapors with a surface recovery system.
Surface Water	Cover	Installation of soil or RCRA cover to prevent contact of storm water or other precipitation runoff with landfill material. To be used with drainage controls.
Surface Water	Drainage Controls	See surface water controls described for protection of soil media/pathway of concern.
Surface Water	Flood Controls	Inertial barriers (e.g., riprap, soil cover) to prevent erosion of landfill cover and waste materials during floods.

TABLE 2-1 (Continued)

REMEDIAL ACTION TECHNOLOGIES
TO BE CONSIDERED
FOR
JAMAICA ISLAND LANDFILL (SWMUs 8, 9)
PORTSMOUTH NAVAL SHIPYARD

Potential Environmental Media and Pathway of Concern	Technology	Description
Surface Water	Groundwater Controls	Use of one or more of the following to prevent chemicals from landfill waste materials from entering surface water through groundwater: - low permeability barriers (e.g., slurry walls, RCRA cover) - groundwater collection and treatment - in-situ bioremediation
Groundwater	Collection and Treatment	Collection (trenches or extraction wells), treatment (e.g., activated carbon, air-stripping, metals precipitation and filtration) and off-site discharge.
Groundwater	Groundwater Barriers	Slurry walls and/or injection wells to maintain hydraulic controls
Groundwater	Permeable Treatment Beds	Excavation of soil at perimeter of landfill to form trenches constructed perpendicular to groundwater flow. Trenches filled with material to treat groundwater as it flows through treatment bed, such as limestone, activated carbon or glauconitic green sands.
Groundwater	Monitoring	Collection and analysis of groundwater samples; groundwater monitoring wells, parameters to be tested, frequency and duration of monitoring to be determined.

Notes:

1. There are reports that full acetylene and chlorine gas cylinders were disposed at the Jamaica Island Landfill over thirty years ago (ca. 1955). Excavation of waste material or drilling into landfill to install gas extraction or injection wells is not possible without the risk of explosion or the release of toxic chlorine gas.

2. The RFI for the JILF will be a phased investigation because of the long, complex fill history combined with unknown hydrogeologic variables associated with the site. Results from the investigation program will permit design of a focused hydrogeologic investigation, at which time the character, both physical and chemical, of the soil and groundwater, and identification of potential migration pathways will permit refinement of the remedial action technology list. Subsequent investigation may be warranted to arrive at the most suitable alternative given the complexity of the site.

TABLE 2-2

REMEDIAL ACTION TECHNOLOGIES
TO BE CONSIDERED
FOR
DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO) (SWMU 6)
STORAGE YARD
PORTSMOUTH NAVAL SHIPYARD

Potential Environmental Media and Pathway of Concern	Technology	Description
Air	Cover	Installation of soil or RCRA cover or cement or asphaltic pavement to prevent wind dispersal of surface soil containing chemicals of concern.
Soil	RCRA Cover	Multimedia cover (clay and/or liner, fill, topsoil and crushed stone or vegetation).
Soil	Stabilization	Mixing cement, fly ash and other pozzolanic material with DRMO soil.
Soil	Soil Cover	Installation of soil cover (e.g., 2-3' of uncontaminated soil, crushed stone or vegetation) over affected DRMO areas to prevent direct contact, ingestion and wind dispersal.
Soil	Surface Water Controls	Installation of berms and/or drainage swales and regrading of site to divert off-site and on-site surface water away from covered waste areas; to be considered in conjunction with: (a) stabilization; (b) RCRA Cover; (c) soil cover; or (d) pavement.
Soil	On-site RCRA Landfill	Excavation of DRMO area soil containing chemicals of concern above acceptable levels and disposal in a RCRA-approved landfill to be constructed on-site. Includes longterm monitoring of groundwater at landfill unit.
Soil	Off-site RCRA Landfill	Excavation of DRMO area soil containing chemicals of concern above acceptable levels and disposal in an off-site RCRA-approved landfill.
Soil (See Table 2-3.)	Pavement	Construction of asphaltic or cement pavement, including subbase and binder course: (1) over DRMO areas containing chemicals of concern above acceptable levels; and (2) in areas to be used for future storage. Low permeability layer (synthetic liner or clay) may be added if groundwater protection is needed.
Surface Water	Cover	Installation of pavement or soil or RCRA cover to prevent contact of storm water or other precipitation runoff with DRMO area. To be used with drainage controls.
Surface Water	Drainage Controls	See surface water controls described for protection of soil media/pathway of concern.
Surface Water	Flood Controls	Inertial barriers (e.g., riprap, soil cover) to prevent erosion of DRMO area soil during floods.
Surface Water	Sewer Drain Rehabilitation	Tightness testing of existing stormwater drains and re-lining, sealing or replacing drains if infiltration is excessive.

TABLE 2-2 (Continued)

REMEDIAL ACTION TECHNOLOGIES
TO BE CONSIDERED
FOR
DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO) (SWMU 6)
STORAGE YARD
PORTSMOUTH NAVAL SHIPYARD

Potential Environmental Media and Pathway of Concern	Technology	Description
Surface Water	Groundwater Controls	Use of one or more of the following to prevent chemicals from DRMO area soil from entering surface water through groundwater: - low permeability barriers (e.g., slurry walls, RCRA cover) - groundwater collection and treatment - in-situ stabilization
Groundwater	Collection and Treatment	Collection (trenches or extraction wells), treatment and off-site discharge.
Groundwater	Groundwater Barriers	Slurry walls and/or injection wells to maintain hydraulic controls
Groundwater	Permeable Treatment Beds	Excavation of soil at perimeter of landfill to form trenches constructed perpendicular to groundwater flow. Trenches filled with material to treat groundwater as it flows through treatment bed, such as limestone, activated carbon or glauconitic green sands.
Groundwater	Monitoring	Collection and analysis of groundwater samples; groundwater monitoring wells, parameters to be tested, frequency and duration of monitoring to be determined.

Note: The RFI for the DRMO has been designed to augment existing soil investigation data by assessing the vertical and lateral extent of suspect metal contamination. Additionally, through the proposed groundwater investigation program an assessment of contaminant mobility will be attained. The data generated from the RFI will permit refinement of the remedial technology list.

TABLE 2-3

REMEDIAL ACTION TECHNOLOGIES
TO BE CONSIDERED
FOR
BULK LIQUID STORAGE TANKS (SWMUs 10, 11, 12, 13, 16, 21, 23, 26, 27)
PORTSMOUTH NAVAL SHIPYARD

Potential Environmental Media and Pathway of Concern	Technology	Description
Soil	RCRA Cover	Multimedia cover (clay and/or liner, fill, topsoil and vegetation).
Soil	Vacuum Extraction	Use of vapor collection (e.g., extraction wells) and treatment systems (e.g., incineration, activated carbon, condensation and/ or wet air scrubber) to remove VOCs and some SVOCs from affected tank soil. Air injection wells may be added to vapor collection and treatment system described above. (For SWMU No. 11 only; Waste Oil Tank No. 12).
Soil	Stabilization	Mixing cement, fly ash and other pozzolanic material with affected tank soil.
Soil	Soil Flushing	Application of treated water to affected soil and extraction and treatment of applied water after flushing through soil (i.e., flushate).
Soil	Bioremediation	Addition of microorganisms and nutrients to soil containing petroleum hydrocarbons (e.g., oil and grease) and/or other biodegradable substances (e.g., PAHs, PCBs).
Soil	Surface Water Controls	Installation of berms and/or drainage swales and regrading of site to divert off-site and on-site surface water away from covered waste areas; to be considered in conjunction with: (a) stabilization; (b) RCRA Cover; or (c) pavement.
Soil	Radio Frequency	Application of radio frequency radiation (i.e., microwaves) to affected tank soil areas using surface conductors; heating waste materials to 300/C to 400/C using microwaves; and removal of resulting gas and vapors with a surface recovery system. (For SWMU No. 11 only; Waste Oil Tank No. 12).
Soil	Pavement	Construction of asphaltic or cement pavement, including subbase and binder course: (1) over DRMO areas containing chemicals of concern above acceptable levels; and (2) in areas to be used for future storage. Low permeability layer (synthetic liner or clay) may be added if groundwater protection is needed.
Surface Water	Cover	Installation of soil or RCRA cover to prevent contact of storm water or other precipitation runoff with affected tank soil. To be used with drainage controls.
Surface Water	Drainage Controls	See surface water controls described for protection of soil media/pathway of concern.

TABLE 2-3 (Continued)

REMEDIAL ACTION TECHNOLOGIES
TO BE CONSIDERED
FOR
BULK LIQUID STORAGE TANKS (SWMUs 10, 11, 12, 13, 16, 21, 23, 26, 27)
PORTSMOUTH NAVAL SHIPYARD

Potential Environmental Media and Pathway of Concern	Technology	Description
Surface Water	Groundwater Controls	Use of one or more of the following to prevent chemicals from landfill waste materials from entering surface water through groundwater: - low permeability barriers (e.g., slurry walls, RCRA cover) - groundwater collection and treatment - in-situ bioremediation
Groundwater	Collection and Treatment	Collection (trenches or extraction wells), treatment (e.g., activated carbon, air-stripping, metals precipitation and filtration) and off-site discharge.
Groundwater	Groundwater Barriers	Slurry walls and/or injection wells to maintain hydraulic controls
Groundwater	Bioremediation	Addition of microorganisms and nutrients to groundwater containing petroleum hydrocarbons (e.g., oil and grease) and/or other biodegradable substances (e.g., PAHs, PCBs).
Groundwater	Monitoring	Collection and analysis of groundwater samples; groundwater monitoring wells, parameters to be tested, frequency and duration of monitoring to be determined.

Notes:

1. Environmental media and exposure pathways evaluated here for bulk liquid storage tanks are potential concerns if the tightness testing described in Section 3.3.4 (Release Detection) reports a system failure (i.e., leaking tanks) and subsurface soil samples collected adjacent to the tanks indicated that substances of concern have been released to the environment. The remedial actions described in this table, then, would only be considered for soil, surface water or groundwater affected by the release of substances of concern from a leaking above or below ground storage tank. Similarly, exposure pathways and remedial actions for the former fuel oil pipeline (Berth 6) will only be evaluated if the soil sampling described in Section 3.3.4 (Release Detection) determines that unacceptable levels of substances of concern still remain in soil.

2. If the initial phase of the tank investigation program reveals that environmental requirements may have resulted from tank failure, further investigation will be warranted. Subsequent investigation will be designed to assess the nature of contamination and collect pertinent data to facilitate selection of remedial alternatives.

Within each technology, several technology process options may exist. For example, an in-situ stabilization technology would include such process options as chemical injection or grouting with pozzolanic materials. The technology process options under consideration will be evaluated in greater detail before selecting a process(es) to represent each technology. In general, one representative process will be selected, if possible, for each technology to simplify the development and evaluation of the remedial action alternatives (Task 3). However, in some cases, more than one process option may be selected for a technology. For example, if groundwater remediation is identified as one of the remedial response objectives, technologies for groundwater recovery and treatment will be investigated in the CMS. Construction of groundwater barriers would be discussed along with groundwater monitoring, treatment and disposal options.

2.5 Task 3--Develop And Evaluate Remedial Action Alternatives

Individual technologies may satisfy some, but not all, of the remedial response objectives for the site. Several technologies may need to be combined to form a comprehensive approach that will adequately address the remedial response objectives for the site. The applicable remedial action technologies identified under Task 2 will be assembled into remedial action alternatives for the site. All significant site issues and pathways of migration of the substances identified in the RFI will be considered during the development of remedial action alternatives. Alternatives will be formulated that will range in purpose from those that achieve containment of the substances identified in the RFI to those that reduce the need for long-term management of treatment residuals through reduction of toxicity or destruction of target substances. The following types of alternatives will be developed:

- A no action alternative.
- A containment alternative which involves little or no treatment.
- Alternatives which upgrade the existing runoff management and erosion protection systems.
- Alternatives which utilize solutions and alternative treatment and resource recovery technologies to the maximum extent practical.
- Alternatives for treatment or disposal in an off-site or on-site facility.
- Alternatives which attain applicable or relevant and appropriate federal and state public health or environmental standards.
- Alternatives which exceed applicable or relevant and appropriate public health or environmental standards.
- Alternatives which do not comply with applicable or relevant and appropriate public health or environmental standards but will reduce the likelihood of present or future threat, if any, from the substances identified in the RFI.

It should be noted that a specific alternative may address more than one of the requirements discussed above. Further, alternatives outside of these categories may also be developed.

Each remedial action alternative will be assessed using the critical evaluation factors identified in the EPA guidelines:

Technical Feasibility. Bench and pilot treatability studies may be performed during this aspect of the alternative assessment, where appropriate. The technical feasibility analysis will include an evaluation of the reliability of the alternative, its implementability in terms of demonstrated success at similar sites or on a research and development basis, safety requirements that are necessary to limit exposure to the substances identified in the RFI during implementation, and risks should the alternative fail. In addition, the feasibility of upgrading options already implemented at facilities in similar settings will be evaluated to determine their applicability at the subject site. The RCRA Facility Investigation (RFI) will provide information to allow feasibility of such options to be determined.

Public Health and Environmental Factors. The Public Health and Environmental Risk Evaluation (PHERE) previously discussed will contain an evaluation of the No-Action remedial alternatives. Using the No-Action alternative as a baseline, a comparative analysis will be performed for the other alternative remedial measures. This analysis will include an evaluation of the extent to which each alternative can be expected to mitigate and minimize damage to, and provide adequate protection of, public health, welfare and the environment. The evaluation will focus on site conditions and pathways actually addressed by each alternative. It will also include an analysis of the extent and duration of exposure, if any, to the substances identified in the RFI as well as a comparison of their concentrations to applicable or relevant and appropriate standards and criteria. The reduction in public health impacts associated with each alternative will be evaluated in relation to the public health impacts identified in the PHERE (Section 15.0) to determine the potential level of exposure to contaminants and the reduction over time. A determination will also be made as to how effectively and significantly each alternative would reduce the toxicity, mobility and volume of the substances identified in the RFI. In addition, other possible effects of the various remedial alternatives will be evaluated; that is, certain actions may not necessarily result in a reduction in risk, particularly during the short-term remedial action period. For example, removal and off-site disposal of affected soils sometimes creates an additional exposure pathway. These and other appropriate factors will be considered in the assessment of alternatives.

Institutional Constraints. Institutional considerations include federal, state and local standards, rules, ordinances, advisories or guidance issued to protect public health, welfare, and/or the environment. Each alternative will be evaluated in terms of the effect that compliance and coordination with

institutions will have on the implementation of that alternative. The institutional evaluation will also consider the need for coordination with regulatory agencies as well as specific community/public relations needs.

Cost. This analysis will entail the development of a present-worth analysis for each remedial alternative with an overall accuracy of minus 50% to plus 100%. The accuracy of the components of the cost estimate (capital, operations, maintenance, etc.) will be identified in the CMS report. The sources of information for the cost estimates will include literature references (MEANS, ACOE, etc.), vendor contacts and cost estimates for similar problems (adjusted for site-specific conditions). Cost information from dated literature will be converted to 1989 dollars using an appropriate cost index issued by the Federal Government. The analysis will include capital cost (both direct and indirect) and annual operation and maintenance cost reduced to a present worth basis using the current discount rate. The total cost of a given alternative will be the sum of the capital costs and the present worth of the O & M costs.

A detailed analysis of the alternatives will be performed to provide the rationale for the remedy selection process. The detailed evaluation will include at a minimum the following criteria:

The component treatment and disposal technologies that comprise a specific alternative, as well as any permanent facilities required, will be described. The description will include analysis of runoff management/erosion protection system upgrading, site regrading and capping.

Specific engineering considerations required to implement each alternative (design efforts or additional information needed) will be defined.

The degree to which each alternative would permanently and significantly reduce the volume, toxicity and mobility of the substances identified in the RFI will be analyzed.

The evaluation will include an analysis of whether recycling/ reuse, waste minimization, waste biodegradation or destruction or other advanced, innovative or alternative technologies would be appropriate to reliably minimize present or future threats, if any, to public health or welfare or the environment.

Each alternative will be compared to the remedial response objectives. Environmental impacts and proposed methods for mitigating any adverse effects, as well as the costs of such mitigation efforts, will be defined. Operation, maintenance and monitoring requirements of the remedial measures will be defined. Off-site disposal needs and transportation plans will be included.

The evaluation will include a discussion of health and safety considerations during remedial implementation including requirements for safety plans. This section will address both long-term and acute health and safety considerations for the on-site workers as well as the nearby residents. A description of how the alternative will be divided into functional components to allow for a possible phased approach to implement the alternative will be included.

Permits needed for each alternative, if any, will be identified.

In assessing the various remedial action alternatives, the following factors will also be taken into account:

1) the long-term uncertainties of all remedial alternatives, particularly those associated with land disposal;

2) the goals, objectives, and requirements of the Resource Conservation and Recovery Act and the regulations promulgated thereunder (for example, the land ban requirements);

3) the persistence, toxicity, mobility and propensity to bio-accumulate of the substances identified in the RFI;

4) the short- and long-term potential for adverse health effects from human exposure;

5) the potential for future remedial action costs if the remedial alternatives in question fail; and

6) the potential threat to human health and the environment associated with excavation, transportation, and redisposal or containment.

2.6 Task 4--Select Preferred Remedial Action Alternatives

Upon completion of the alternative assessment, a comparison of the remedial alternatives will be performed. This will include determining the relative importance of both cost and non-cost criteria including the potential concerns related to feasibility, institutional, public-health and environmental constraints. This information will also be used to determine the ability of each alternative to address the remedial response objectives. Based on the factors considered in the alternative assessments, each of the alternatives will be ranked. This ranking will take into account the preferences established by the Superfund Amendments and Reauthorization Act of 1986 for remedial actions which involve treatment to permanently and significantly reduce the volume, toxicity or mobility of the hazardous substances as a principal element and which use alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

A rationale for selecting the preferred alternative will be prepared, stating the advantage over the alternatives considered based on the individual evaluation criteria, as well as considering the entire effect of the alternative. Additionally, this rationale will include a discussion and reasons regarding the inability, if any, of the recommended alternative to satisfy or exceed the remedial response objectives.

2.7 Task 5--Corrective Measure Study Report

Following completion of Task 4, ten copies of a preliminary draft corrective measures study report will be submitted to the Navy and USEPA Region I for review. An outline of a generalized CMS report is provided for guidance:

Executive Summary

1.0 Introduction
- 1.1 Site background information
- 1.2 Nature and extent of problems

2.0 Remedial Response Objectives
- 2.1 Summary of PHERE Report
- 2.2 Remedial Response Objectives

3.0 Identification and Screening of Remedial Action Technologies
- 3.1 Identification of Remedial Action Technologies
- 3.2 Description and Evaluation of Remedial Action Technologies
- 3.3 Screening of Remedial Action Technologies

4.0 Development and Evaluation of Remedial Action Alternatives
- 4.1 Alternative 1 (No Action)
- 4.2 Alternative 2
- 4.N Alternative N

5.0 Selection of Preferred Remedial Action Alternative
- 5.1 Comparison of Alternatives
- 5.2 Selection of Recommended Alternative

References

Appendices

Upon receipt of comments from the Navy and the USEPA, revisions to the preliminary draft CMS will be made which will include a responsiveness summary on any public comments received. Ten copies of the final draft RFI/CMS report will then be submitted to USEPA Region I.

2.8 Task 6--Corrective Measure Study Report QA Review

A technical review team consisting of one or more geologists, chemists, biologists, toxicologists, public health specialists, and engineers will review the relevant portions of the CMS. The reviewers will make any necessary changes to the report before delivery of a preliminary draft report to the Navy and the USEPA.

2.9 Task 7--Progress Reports

Monthly progress reports will be prepared starting thirty (30) days after the RCRA Facility Investigation and the Public Health and Environmental Risk Evaluation reports are approved by the USEPA. The progress reports will continue every thirty (30) days thereafter until the Corrective Measure Study (CMS) report is approved by the USEPA.

3.0 SURFACE GEOPHYSICAL INVESTIGATION

3.1 Geophysics--Jamaica Island Landfill (JILF)

3.1.1 Introduction

The geophysical investigation consists of two phases. Phase I will be the use of Ground Penetrating Radar (GPR) to help locate the buried vaults containing mercury waste. This survey will be conducted to confirm monitoring well locations. Phase II consists of seismic refraction and magnetometry surveys. A decision to implement or modify the Phase II program will follow after review of data obtained from the exploratory boring and soil gas investigations. The Phase II program will be pursued if it can be concluded that these surveys will provide meaningful information that will enhance knowledge of the subsurface and achieve the goals of the RFI. Factors that will be considered in the decision to pursue this program include soil gas plumes, the existence of confining layers, bedrock structure, and overburden stratigraphy and composition.

A description of the methods to be used in Phase I and which may be used in Phase II follows.

Geophysical methods offer a way to rapidly characterize subsurface conditions with minimal to no impact on a large site, and provide better overall understanding of complex site conditions. The use of geophysics as required by USEPA would help to:

- determine general geologic features of the study area (depth to bedrock, profile of bedrock surface, etc.);
- determine the location and extent of subsurface disposal features without the danger of drilling into hazardous materials;
- improve accuracy and confidence levels in hydrogeologic investigations;
- locate monitoring wells to gain maximum benefit;
- locate areas to avoid when drilling; and
- reduce project time and costs.

3.1.2 Geophysics Phase I

Ground Penetrating Radar Survey

Theory

Ground-penetrating radar (GPR) uses high frequency radio waves to gain subsurface information. Energy is radiated downward into the subsurface from a small antenna which is slowly moved across the ground surface. The radar waves are reflected from interfaces of materials having different electrical properties. The reflections are then picked up by the receiving antenna where variations are continuously recorded. This produces a continuous cross-sectional picture or profile of shallow subsurface conditions. Buried pipes and other discrete objects will also be detected.

Purpose/Approach

GPR will be used on this site to pinpoint the location of the mercury burial vaults. The general location of these vaults is known. GPR survey will be performed at these estimated locations to accurately assess the location, depth and dimensions of the vaults.

Procedure

The survey will be conducted by Geophysical Survey Systems, Inc., Hudson, New Hampshire, using a SIR system A, impulse radar system. The frequency used will be determined on-site based on geologic parameters and will be between 100 and 500 MHz. Real time imaging will be provided by a line scanning recorder and data will also be stored on digital tape.

Temporary grids will be established at areas of suspected buried vaults. These grids will be tied into the main site grid. The survey will be conducted by towing the instrument by hand or with a vehicle across the grid so that locations can be later referenced. Hard copy results of the survey will be interpreted on-site to indicate the suspected vault locations. The field results

will be confirmed at the office to accurately locate the vaults. Once located, stakes will be placed on the surface over the vaults and the position will be referenced to the established grid and recorded on a site map.

GPR may also be used over areas of large magnetometry anomalies if such anomolies are found during a Phase II geophysical investigation. In the event a Phase II geophysical investigation is implemented, GPR responses will be interpreted, referenced to the site grid and mapped. Mapped GPR responses will be compared to the magnetometry map. This will increase the level of confidence in the magnetometry survey and may help confirm the extent, depth and configuration of any major subsurface disposal areas.

3.1.3 Establishment of Grid System

As stated in Perket, Cary L. (ed.), Quality Control in Remedial Site Investigation: Hazardous and Industrial Solid Waste Testing, ASTM--STP 925, Fifth Volume, pp. 37-38, in a paper entitled "A Review of Quality Control Considerations in Soil Sampling":

> "Sampling locations can be selected authoritatively, systematically, or randomly depending on the purpose of the collection. Authoritative or judgemental sampling site selection is generally used during reconnaissance investigations and site screening investigations. This procedure requires knowledge and judgement by the sampler and often involves intentional sample biasing. Systematic sample site selection is normally used when attempting to determine areal extent of contamination or when evaluating spatial variations. Sampling locations are defined by a grid or coordinate system and samples are collected at preselected locations in a uniform pattern. Random sample site selection is used when attempting to determine statistical parameters such as mean and variance. Random site selection involves the use of a random number generator to select sampling locations based on a grid system or transect."

HART chooses the two most appropriate methods according to the USEPA's Soil Sampling Quality Assurance User's Guide (EPA 600/4-84-043) for the optimum approach in an exploratory study. The two sample selection methods suggested are judgemental (the hot spot samples) and systematic (the grid

locations). Using the data generated, a model may be hypothesized describing a likely spatial distribution of contamination as well as identifying a likely control area.

Prior to the initiation of remote sensing techniques, a grid shall be established at the JILF. A licensed surveyor has surveyed in one primary base line and two perpendicular base lines across the JILF and 200 foot intervals were marked along these base lines with metal or wooden stakes and survey tape. The consultant shall expand the grid system in all directions across the entire JILF. Intersections of grid lines will be marked with survey flags. All survey flagging will be marked according to the following identification system. Letters are assigned alphabetically to one axis at 100-foot increments which increase to the east. Numbers are assigned to the north/south axis. For example, coordinate point C-1 is near the extreme southwestern corner of the property. Consequently, coordinate point D-5 shall be located 100 feet north and 400 feet east of coordinate point C-1 (see Enclosure A).

3.1.4 Geophysics Phase II

<u>Magnetometer Survey</u>

Theory

Magnetometers measure the intensity of the earth's magnetic field. Variations in this field may be caused by natural iron oxides in the soil and rock or by buried iron or steel objects. These variations are detected by the magnetometer.

HART will use a proton magnetometer to perform the magnetometer survey at this site if Phase II is implemented. This instrument operates by applying an excitation voltage to a coil around a cylinder containing kerosene. The field produced reorients the protons in the kerosene. When the voltage is removed, the protons reorient to line up with the earth's magnetic field. By nuclear

precession they generate a signal, the frequency of which is proportional to the strength of the field. The signal is amplified, measured by the use of counter circuits, and the output is fed to a digital display. Proton magnetometers measure the earth's total field intensity, and are not sensitive to orientation.

Response of the instrument is directly proportional to the mass of the ferrous object and inversely proportional to the distance to the object to the third power. This "inverse cubed relationship" can be written as follows:

$$\textit{Intensity of Response} = 1 \div \textit{distance}^3$$

The magnetometer is useful at waste disposal sites because it is sensitive enough to detect relatively small masses of ferrous materials at depth. For example, the magnetic disturbance caused by a single steel drum buried 25 feet deep can be detected by the subject instrument.

Purpose/Approach

The instrument that will be used on this site is a Unimag II portable proton magnetometer, model G-846, manufactured by EG&G Geometrics. Unit resolution is one gamma. The primary purpose of the survey is to locate buried drums, cylinders, or other ferrous materials which may be associated with subsurface disposal of hazardous waste. It will allow identification of potential disposal areas which may require additional investigation.

An initial reconnaissance survey of the site will be conducted using a grid developed from the existing base lines as shown in Enclosure A. The 100-foot grid spacing should provide adequate coverage for reconnaissance purposes while ensuring timely performance of the program. Certain areas will not be covered, in particular, the Equipment Lay Down area and Hazardous Waste Storage areas where drums or other ferrous metal is stored, as surface metal interferes with the operation of the unit. The magnetometer will not be used near transmission or electrical lines or proximal to metal fencing.

Data from the initial survey will be reviewed and reduced, including adjustments for diurnal variations in the earth's ambient magnetic field. Results will be mapped and any anomalies noted. Anomalous areas will then be resurveyed using a finer grid pattern (i.e., 10-foot intervals) to pinpoint the buried metal locations. All such locations where buried ferrous materials are detected will be plotted on a map and recommendations made regarding further investigation.

If Phase II is implemented, GPR surveys may also be run at areas of major magnetometry anomalies to confirm the shape, depth and extent of the subsurface materials causing these anomalies.

Procedure

Direct Magnetic Field (DMF) and Gradient Magnetic Field (GMF) surveys which traversed the target areas of the site will be conducted. DMF surveys will directly measure the intensity of the total magnetic field at monitored locations. This will be accomplished by obtaining magnetometry readings with the proton magnetometer held a set distance above grade (approximately three feet). Areas of anomalous readings will indicate the presence of ferrous metals.

A GMF survey will be designed for this site based on the previously described "inverse cubed relationship". This survey technique will utilize magnetometry readings obtained with the instrument held at varying distances above ground level. If intensity of the magnetometer's response decreases greatly with increased distance above ground level at some locations, the presence of surface and near-surface ferrous debris at these locations will be indicated.

The procedure used to perform these surveys will be as follows:

1) A 100 x 100 foot grid will be established based on existing baselines as discussed in Section 3.2.

2) DMF and GMF surveys will be performed by obtaining three magnetometry readings at each grid point.

3) Preliminary data reduction will be performed.

Prior to initiating the magnetometer surveys, a grid location which is level and removed from hills, fill material, and surface metal will be selected as a base station. Background magnetometry readings will be collected at the base station prior to starting these surveys. Additional readings will be obtained at the base station hourly throughout the course of the surveys to monitor diurnal variations in the magnetic field at the background location. Diurnal variations will be graphed and used in the data reduction procedure.

DMF and GMF surveys will be conducted simultaneously by obtaining three magnetometer readings at each grid location. To obtain DMF data, two readings will be obtained and averaged with instrument held at three feet above grade. This technique checks instrument repeatability and increases data reliability. The resulting number indicates the Direct Magnetic Field at that point. Anomalous DMF data indicate the presence of buried ferrous metal.

A third reading will be obtained with the instrument held six feet above grade. Subtracting the six-foot reading from the average of the three-foot readings will result in Gradient Magnetic Field data. Anomalous GMF data will indicate interference caused by ferrous debris at or near the surface.

All magnetometry readings will be obtained with the magnetometer pointing north. Although the instrument operation is not dependent on orientation, this orientation results in greater pole-to-pole anomalies. Data will be recorded in gammas.

DMF and GMF data will be reduced by comparing the values obtained at each grid point to background data obtained at the base station. Any diurnal variations will be factored out to obtain true readings for each location. Values for each grid point will be plotted and preliminary direct and gradient magnetic

field contour maps will be hand-drafted. The resulting map will be used to determine if a second survey should be conducted on a tighter grid at certain locations.

A second DMF survey will be performed in sections of the site which may be areas of potential buried metal. Magnetometry data will be obtained at 10-foot intervals within these sections of the existing grid. Survey procedures previously described will be followed.

Golden Software's SURFER Graphics package will be run on a Compaq 386 microcomputer to reduce survey data and produce DMF and GMF contour maps. The use of these instruments will reduce drafting time and result in accurate maps showing areas of anomalous survey results which indicate buried ferrous metals.

Seismic Refraction Survey

Theory

Compressional seismic waves transmitted to the ground by an energy source travel through the subsurface strata at velocities which are dependent upon the subsurface materials density and elasticity. When the wave front strikes a bed in the subsurface which has a higher density or significantly different elastic properties than the near surface sediment, some of the energy is refracted along the interface. This refracted energy in turn generates a second wave front which moves upward through the overlying material and is eventually detected by the geophone. The geophone converts the impulse to an electrical signal which is amplified and displayed by the seismograph.

Compressional wave travel time is plotted against source-to-geophone distance producing a time/distance plot. This plot is then used to determine the number of contrasting layers (reflectors) in the subsurface, the interval

velocities for each layer, and the depth to each reflector. By relating interval velocities to subsurface material visually documented in borings or coreholes, the seismic survey may be used to determine the geological characteristics of each interval in areas where the drill has not penetrated.

Purpose/Approach

Logs from boreholes drilled in connection with the dredge disposal site indicate that depth to bedrock is variable in the vicinity of the JILF (Parsons, 1978). Overburden materials consist of clay-deficient till overlying the bedrock, a clay layer or silty clay, and fill material at the surface. The primary purpose of the seismic refraction survey is to characterize the surface of the bedrock in the area of the JILF. This will provide a means to assess the thickness of overburden materials and potential migration pathways related to bedrock lows. In addition, Figure 3-1 indicates that a tidal channel is present beneath the JILF. This channel may provide a specific contaminant migration route in that area. The seismic refraction survey may provide better definition of the channel configuration with a larger margin for personnel safety than would be expected from an extensive soil boring program. Additional information regarding the depth to water and the thickness and extent of the clay may also be obtained.

Procedure

The seismic refraction survey will be conducted by HART along the base lines established by the surveyor as well as along additional lines, some of which will be perpendicular to the main base line as shown in Enclosure A. The equipment used will be an ABEM Terraloc MK-3 seismograph which records the seismic data on computer disks. Small explosive charges will be used as a wave source. Data interpretation will be performed by both HART and ABEM Geophysics to ensure accuracy.

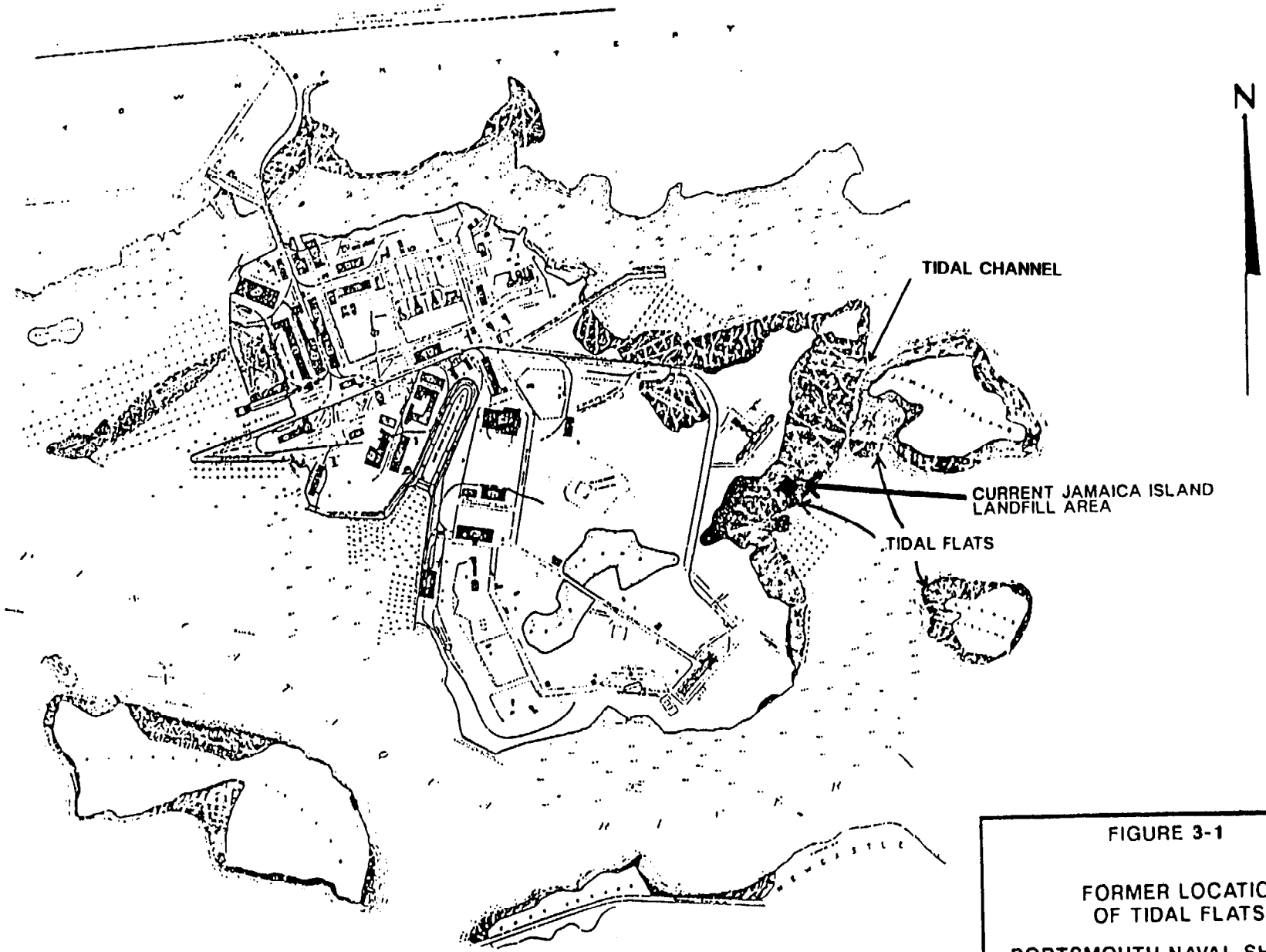


FIGURE 3-1

FORMER LOCATION
OF TIDAL FLATS

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. JUNE 1989

FRED C. HART ASSOCIATES, INC.

Up to 11 seismic lines approximately 400 to 450 feet in length are proposed as shown in Enclosure A. Seismic lines SL-1, -2, -4, -7, and -8 are dip lines. Seismic lines SL-3, -5, -6, -9, -10, and -11 are strike lines. This seismic pattern will provide information concerning the configuration of the bedrock, or continuity of shallow reflectors (i.e., intertidal mud flats), and possibly the location of the former intertidal channel. Twenty-four geophones will be placed along each line 10 to 20 feet apart and about 6 inches below grade. Each geophone will be wired to the seismograph. A small explosive charge will be placed in the ground at both ends and at the middle of each line, resulting in three shot points per seismic line. The exact location of each line and shot point will be referenced to the existing grid and mapped on the site base map.

Each explosive charge will consist of approximately one-quarter pound of 40% gel dynamite. Charges will be initiated one at a time with seismic quality, instantaneous electric blasting caps. All explosives handling and detonation will be performed by a certified blaster. If this technique is not permitted, shock waves will be generated by dropping a standard weight from a height of 30 inches. However, explosives result in much clearer resolution and better seismic records.

All seismic records will be stored on disk and printed as hard copy records. The first arrival time at each geophone will be selected by computer and confirmed by the project geophysicist. First arrival times will be used to determine the depth to bedrock (or high density layer) at each shot point. These data will be plotted on the site map and a bedrock surface contour map will be generated using the previously-referenced SURFER software and Compaq hardware.

3.2 DRMO Storage Yard

The use of geophysical methods to investigate the DRMO storage yard isdeemed inappropriate, given the size of the site, saltwater intrusion, contaminants of concern, and surface interference factors. Eight borings have been drilled to refusal within the yard. Based on historical use of the site and analytical data, metal contamination is the primary concern. Access and interference problems associated with the large piles of metal preclude the effective use of geophysical methods in this area. Finally, the small size of the yard area and its proximity to the shoreline and associated saltwater intrusion make direct investigative methods more appropriate and cost-effective.

3.3 Fuel Oil Pipeline (SWMU #27)

The use of geophysical methods to investigate SWMU #27 is also considered inappropriate. The problem involved leakage from an underground #6 fuel oil pipeline. Remediation involved the removal of the pipe and contaminated soils. The area was subsequently repaved. Geophysical investigation would provide no useful information since the location is known, the pipe was removed, and the area remediated. Additionally, there are numerous surface and subsurface interference sources in this dockside area.

4.0 SOILS INVESTIGATION

4.1 DRMO (SWMU #6)

4.1.1 Test Borings/Rock Coring

Purpose

The subsurface geology at the DRMO Storage Yard is not well defined. The DRMO is located on made-land (Figure 4-1). Boring data from the Final Confirmation Study Report (FCS) prepared by Loureiro Engineering Associates, show that unconsolidated subsurface materials consist of fill and glacial till deposits. The FCS borings terminated upon auger refusal and the cause for refusal was inferred to be bedrock. Figure 4-2 shows the location of the borings. Geologic cross section A-A' (Figure 4-3) shows that there is a large percentage of fill material in the vertical sequence.

The cross section shows the water table to range from 8 to 14 feet below surface grade. Analytical data (Table 4-1) shows elevated levels of metals to 20 feet below grade. Additionally, an extensive shallow soil sampling program revealed elevated levels of metals throughout the site (see Figure 4-2 and Table 4-2).

Test borings will provide information regarding the type, variability and total thickness of fill and unconsolidated indigenous material in the shallow subsurface beneath the DRMO. Additionally, the test borings will provide information regarding the physical character of the contact (e.g., the existence of aquicludes) between unconsolidated sediments and bedrock.

Methodology

Seven test borings will be drilled to the top of the Kittery Formation utilizing a continuous-flight, hollow-stem auger drilling technique. Based upon available information, it is estimated that these borings will be approximately 20 feet deep. Enclosure B shows the proposed locations of these seven test

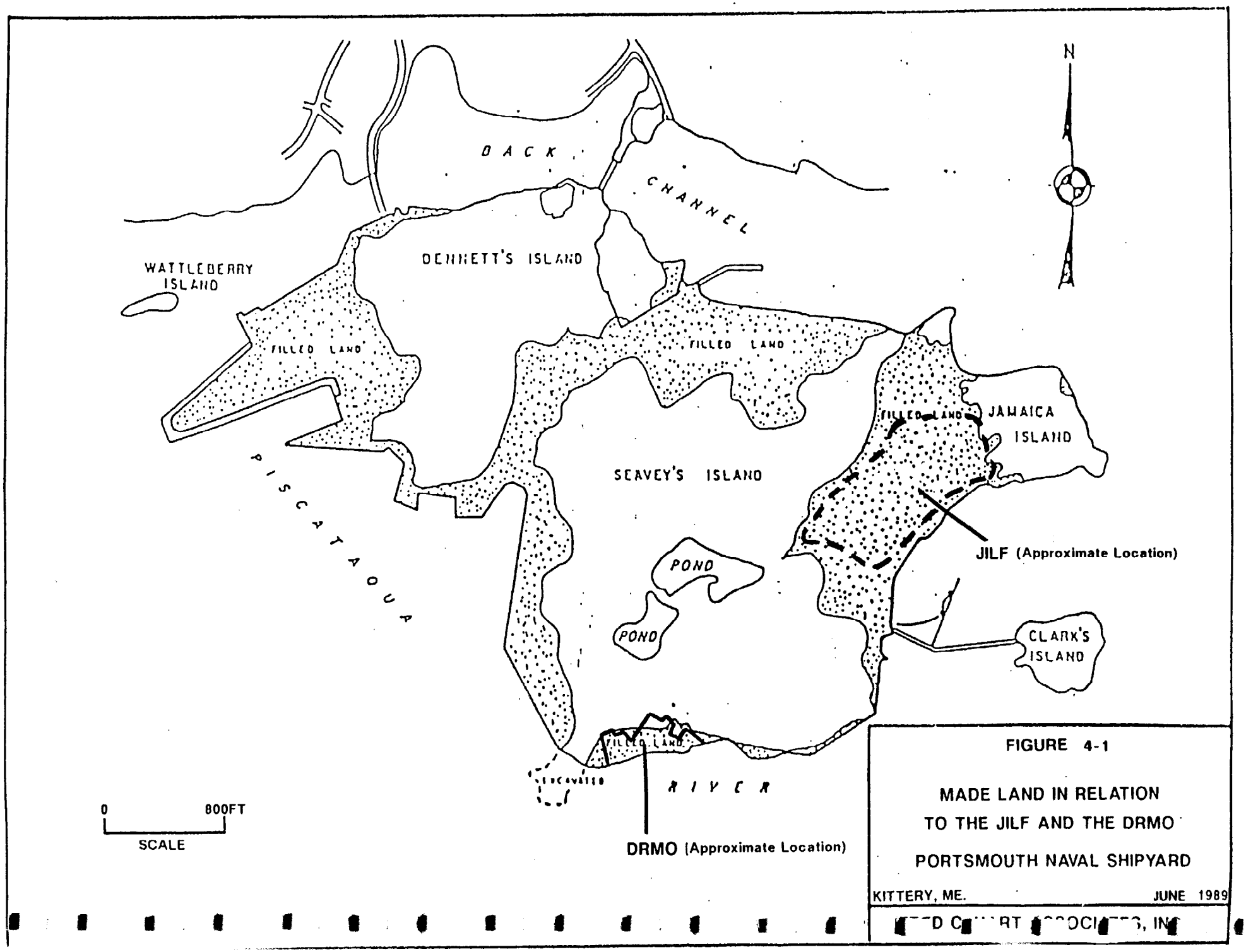


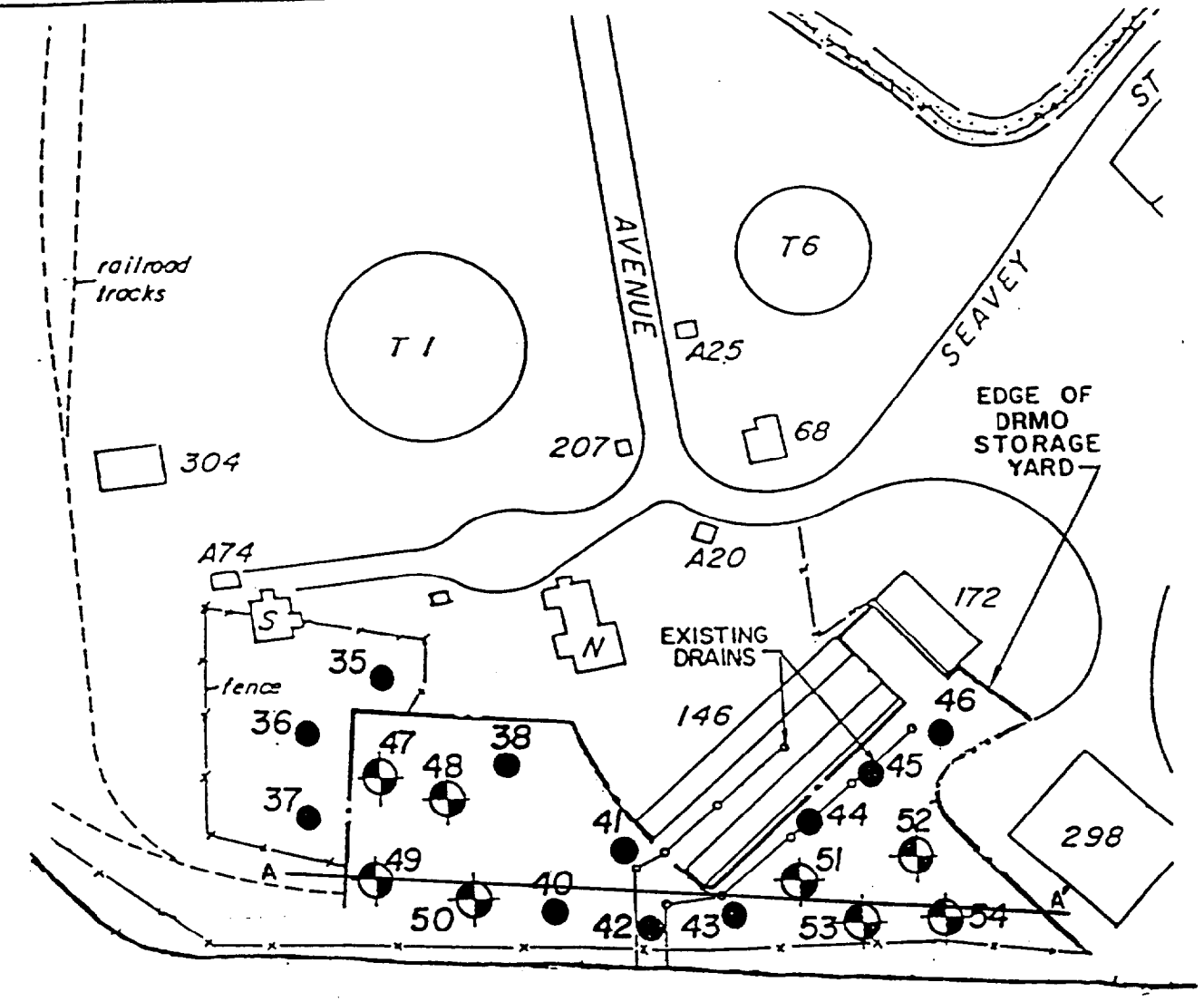
FIGURE 4-1

MADE LAND IN RELATION TO THE JILF AND THE DRMO

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. JUNE 1989

[illegible]D C[illegible]RT [illegible]OCI[illegible], IN[illegible]



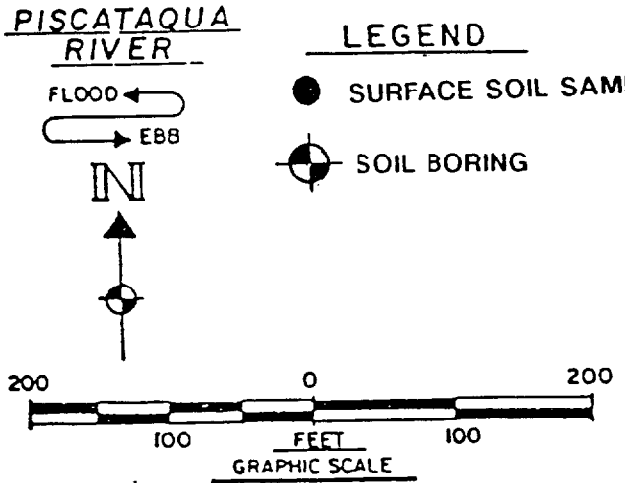


FIGURE 4-2

PREVIOUS SUBSURFACE INVESTIGATIONS
DRMO
PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME JUNE 198

From Final Confirmation Study (FCS) prepared by LEA

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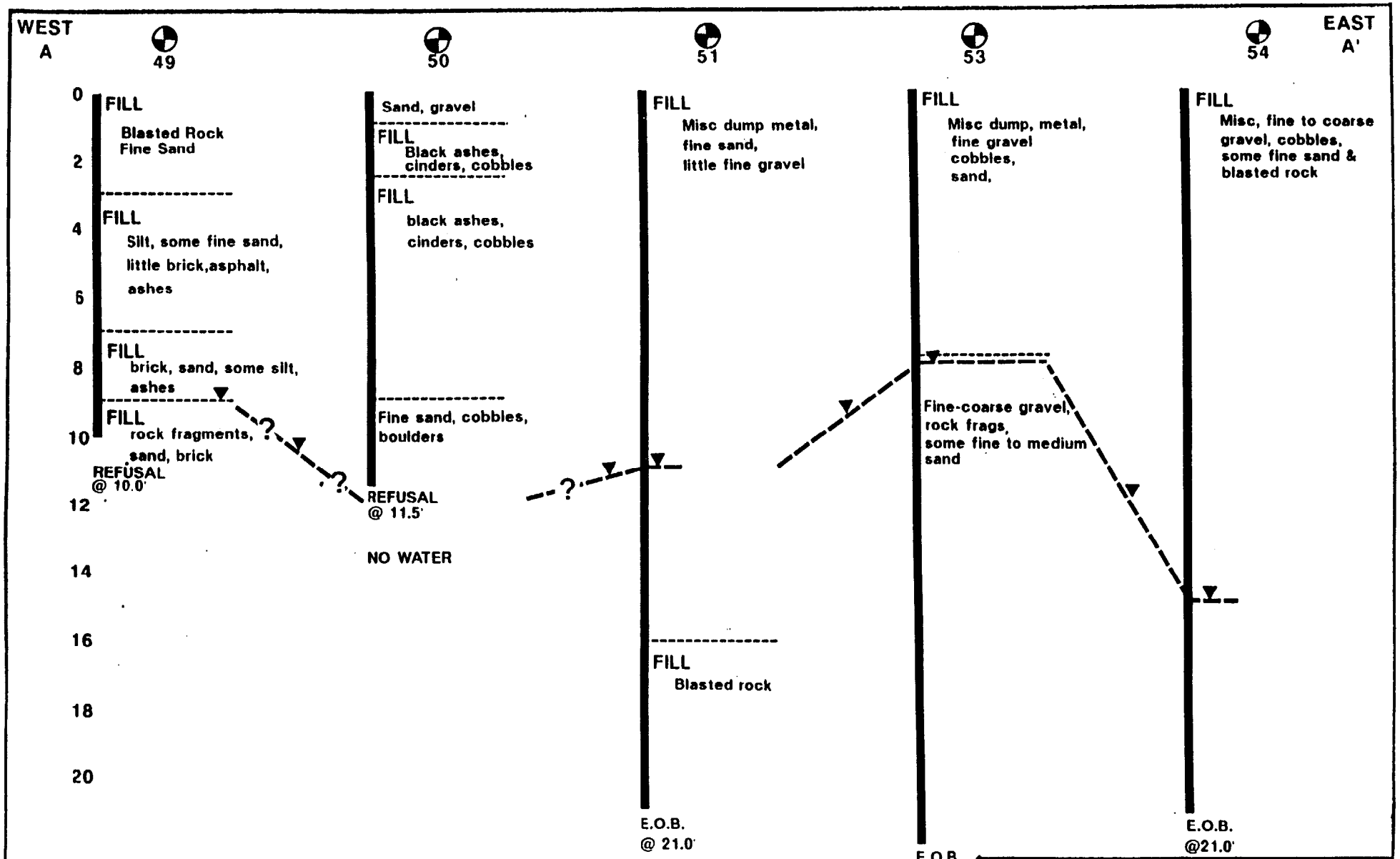

FIGURE 4-3

DRMO
CROSS-SECTION
A-A'

KITTERY, ME JUNE 1989

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SOURCE: FINAL CONFIRMATION STUDY

TABLE 4-1

SUMMARY OF DEEP SOIL SAMPLE ANALYTICAL DATA
DRMO STORAGE YARD - CHARACTERIZATION STEP
(All results in ppm - dry weight basis)

Parameters & Depth		Site Specific Station Numbers							
		47	48	49	50	51	52	53	54
Chromium	2	51.1	56.5	45.6	12.6	NS	NS	NS	NS
	4	43.0	51.8	NS	36.2	NS	NS	NS	NS
	6	NS	NS	33.0	NS	NS	NS	NS	70.7
	8	NS	NS	42.9	71.4	NS	NS	70.4	NS
	10	21.1	NS	41.1	NS	NS	NS	NS	NS
	12	27.6	NS	NS	NS	81.1	67.6	NS	NS
	14	16.6	NS	NS	NS	NS	NS	NS	NS
	16	23.6	75.4	NS	NS	99.0	79.0	NS	NS
	18	NS	45.3	NS	NS	NS	NS	NS	NS
	20	NS	NS	NS	NS	72.5	NS	NS	NS
Cadmium	2	0.73	0.78	1.69	8.56	NS	NS	NS	NS
	4	0.97	2.61	NS	2.04	NS	NS	NS	NS
	6	NS	NS	0.63	NS	NS	NS	NS	1.79
	8	NS	NS	0.88	1.61	NS	NS	0.74	NS
	10	0.53	NS	0.70	NS	NS	NS	NS	NS
	12	0.59	NS	NS	NS	3.32	1.60	NS	NS
	14	0.50	NS	NS	NS	NS	NS	NS	NS
	16	0.44	0.49	NS	NS	3.12	1.73	NS	NS
	18	NS	0.54	NS	NS	NS	NS	NS	NS
	20	NS	NS	NS	NS	1.54	NS	NS	NS

SAMPLED NOV. 1984

NS - No Sample Collected

From Final Confirmation Study Report (FCS) prepared by LEA

TABLE 4-1 (cont'd)

SUMMARY OF DEEP SOIL SAMPLE ANALYTICAL DATA
DRMO STORAGE YARD - CHARACTERIZATION STEP
(All results in ppm - dry weight basis)

Parameters & Depth		Site Specific Station Numbers							
		47	48	49	50	51	52	53	54
Lead	2	580	42.9	1,580	11,200	NS	NS	NS	NS
	4	4,040	1,370	NS	18,200	NS	NS	NS	NS
	6	NS	NS	383	NS	NS	NS	NS	14,300
	8	NS	NS	589	3,670	NS	NS	3,320	NS
	10	15.9	NS	82.5	NS	NS	NS	NS	NS
	12	19.2	NS	NS	NS	10,300	2,960	NS	NS
	14	12.5	NS	NS	NS	NS	NS	NS	NS
	16	7.4	10.3	NS	NS	3,960	5,060	NS	NS
	18	NS	12.7	NS	NS	NS	NS	NS	NS
	20	NS	NS	NS	NS	449	NS	NS	NS
Nickel	2	38.6	56.2	48.5	107	NS	NS	NS	NS
	4	50.8	56.7	NS	49.5	NS	NS	NS	NS
	6	NS	NS	39.5	NS	NS	NS	NS	744
	8	NS	NS	41.3	85.9	NS	NS	68.4	NS
	10	17.3	NS	43.6	NS	NS	NS	NS	NS
	12	30.6	NS	NS	NS	333	80.9	NS	NS
	14	22.4	NS	NS	NS	NS	NS	NS	NS
	16	28.0	44.3	NS	NS	5,690	92.3	NS	NS
	18	NS	34.8	NS	NS	NS	NS	NS	NS
	20	NS	NS	NS	NS	3,670	NS	NS	NS

NS - No Sample Collected

From FCS

TABLE 4-2

SUMMARY OF SHALLOW SOIL SAMPLE ANALYTICAL DATA
DRMO STORAGE YARD - CHARACTERIZATION STEP
(All results in ppm - dry weight basis)

SAMPLED NOV. 1984

Parameters & Depth		Site Specific Station Numbers										
		35	36	37	38	40	41	42	43	44	45	46
Chromium	0.5'	36.6	11.4	14.1	44.7	18.6	55.5	62.2	171	32.1	24.1	174
	1'	57.4	44.8	35.8	59.8	48.2	56.5	63.9	16.4	56.3	59.0	91.8
	2'	31.5	33.1	37.1	23.9	60.0	32.9	63.8	29.1	54.6	51.3	62.2
Cadmium	0.5'	0.89	<0.25	<0.25	2.99	0.89	2.09	10.56	2.38	0.97	0.55	12.30
	1'	0.90	0.84	0.40	2.55	2.64	18.45	10.33	1.90	37.61	4.15	4.17
	2'	3.53	0.65	0.45	1.20	0.60	23.11	2.52	0.96	15.42	2.54	1.19
Lead	0.5'	649	21.0	33.0	1,600	1,270	5,950	35,400	10,700	5.0	62.0	3,060
	1'	322	205	740	4.8	50.1	1,630	35,600	13.5	147,760	35,190	5,340
	2'	1,120	608	131	344	649	1,240	3,210	9.6	80,760	17,260	9,010
Nickel	0.5'	38.9	13.2	14.5	60.1	30.0	643	500	15,800	195	100	5,730
	1'	63.1	54.5	31.1	70.2	36.0	202	462	55.8	64.8	570	460
	2'	422	45.6	30.9	37.8	36.5	94.9	2,270	40.5	793	309	167

FROM FCS

borings. Upon completion of the borings, groundwater monitoring wells will be installed in the same locations. The proposed test borings/monitoring well locations were selected based on information generated by the FCS boring program.

Soil samples will be obtained in advance of the hollow stem augers from every 5 foot interval by means of a split-spoon sampler. A standard 140-pound drop hammer will be used to drive the split-spoon sampler and blow counts will be recorded for every six inches of drive. Soil samples, composited from a two-foot sample interval, will be retained from every five feet for analyses of TPH, PCBs, and Priority Pollutant Metals. HART will attempt to collect 35 samples. Replicates and field blanks will be obtained as specified in the QAPP. Split-spoon samplers will be decontaminated between samples as follows (see Table 4-3 for a summary of all field decontamination procedures):

- wash in soapy water solution of Alconox or equivalent
- rinse with tap water
- rinse with 1% nitric acid solution
- rinse with distilled water
- rinse with methanol
- air dry.

A visual description of the split-spoon sample will be logged in the field. Observations noted in the field will be written on a test boring log (Figure 4-4). All borings will be described using the Unified Soil Classification System as adopted by the U.S. Corps of Engineers and Bureau of Reclamation (U.S. Bureau of Reclamantion, 1963). Examples of observations to be included in the description of soils are as follows:

1. Color.
2. The mineral and/or lithologic components of the material as: quartz, shale, mica, granite, shells, etc.
3. Organic components as roots, humus, wood fragments, peat, etc.
4. Grain shape as angular, sub-angular, rounded.
5. Grain size (significant for sand and gravel only) as fine, medium, coarse.
6. Degree of sorting as very well sorted, well sorted, moderately sorted, poorly sorted, very poorly sorted.

Table 4-3

Decontamination Procedures

A. Sampling devices made of carbon steel (split-spoon samplers), stainless-steel, teflon, glass, and plastic (See note.)

1. Wash equipment using phosphate-free, laboratory-grade detergent (Alconox or equivalent) and potable water.

2. Rinse thoroughly with potable water.

3. Rinse with 10% nitric acid for everything except carbon steel (1% nitric acid for carbon steel) followed by another potable water rinse.

4. Rinse with distilled or deionized water.

5. Applicable only when sampling organic compounds:

   a. Rinse with a pesticide-grade solvent. (Isopropyl is recommended; methanol is acceptable).

   b. Allow to air dry (when possible oven dry at 105 °C for at least 1 hour).

6. Wrap in aluminum foil if not ready for immediate use.

B. Off-shore sampling equipment dredges and core cutter and catcher.

1. Wash equipment using phosphate-free, laboratory-grade detergent (Alconox or equivalent) and potable water.

2. Rinse thoroughly with potable water.

3. Rinse with distilled or deionized water.

C. Drill rigs and large equipment will be steam-cleaned between sampling points and before leaving the site.

Note: This procedure modifies the decontamination outline found in Quality Control in Remedial Site Investigation (Perket, 1986).

Page ____ of ____

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TEST BORING LOG

BORING/WELL LOCATION SKETCH MAP

N

BORING NO.

PROJECT NO./NAME | LOCATION

DRILLING CONTRACTOR/DRILLER

HART GEOLOGIST/OFFICE

DRILLING EQUIPMENT/METHOD | SIZE/TYPE OF BIT | SAMPLING METHOD | START/FINISH DATE

WELL INSTALLED? YES ☐ NO ☐ | CASING MAT./DIA. | SCREEN: TYPE | MAT. | LENGTH | DIA. | SLOT SIZE

ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE | TOP OF WELL CASING | TOP & BOTTOM SCREEN | GW SURFACE | DATE

REMARKS:

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/FT	LOG OF TEST BORING: DESCRIPTION	LOG OF TEST BORING: REMARKS	WELL CONST.	GRAPHIC LITHO LOG
5							5
10							10
15							15
							20

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

FIGURE 4-4

TEST BORING LOG

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. JUNE 198[illegible]

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7. Stratification. Samples should be examined for the presence of stratification. The thickness of each layer, regardless of how small, should be recorded, as well as the characteristics of the stratum in accordance with items above.

8. Degree of saturation as dry, damp, moist, wet, saturated.

9. Obvious presence of contamination such as discoloration, odor, organic vapor readings, etc.

A representative aliquot of all split-spoon samples will be placed in jars for visual record. Upon completion of the shallow test boring/monitoring well installation activities, representative samples will be selected for grain size distribution, Atterburg limits, and moisture content.

Confining Layer

Based on the FCS boring data, it appears that clay layers or aquicludes will not be encountered beneath the DRMO. However, should a clay layer be encountered, HART will collect an undisturbed sample of the clay.

The undisturbed sample will be collected by forcing a shelby thin wall sampling tube into the clay. This steel sampling device is two feet long with an inside diameter of 2-7/8 inches. The plug will be removed from the augers and the inside of the auger will be cleaned out if necessary. The shelby tube will then be forced into the undisturbed clay below the auger bit with one smooth stroke. The tube will be brought to the surface and sealed with approximately two inches of paraffin wax at both ends. Prior to sealing, the sample recovery will be measured and the soil exposed at each end of the tube will be described. The tube will then be capped for transport to the soil testing laboratory.

The undisturbed clay sample will be analyzed by a soils testing laboratory certified by the American Society for Testing and Materials. The sample will be analyzed for vertical permeability using either a falling head or constant head triaxial method.

The thickness of the clay layer will be determined once an undisturbed sample of this unit is obtained. This will be accomplished by drilling through the clay layer to the top of the underlying material (expected to be bedrock). HART will be sure that all materials above the clay layer are sealed off by using the following procedure:

1. Remove the 4 1/4-inch I.D. augers upon the completion of undisturbed soil sampling.
2. Ream the borehole with 10 1/4-inch I.D. hollow stem augers.
3. Set 8-inch threaded casing inside the 10 1/4-inch auger stem and drive the casing one to two feet into the clay to provide an effective seal.
4. Use 4 1/4-inch I.D. augers with plug in place to drill through the casing to the base of the clay layer.

HART's on-site hydrogeologists will log all cuttings and note all observations made during drilling.

Upon the completion of drilling, the drill tools and casing will be removed. The portion of borehole drilled through the clay will be sealed with bentonite/cement grout prior to the removal of the casing. All drilling equipment will be decontaminated prior to use at each location as previously described.

Field Personnel

A minimum of two HART personnel will be on-site for all drilling activities. In addition to other responsibilities, the team will be responsible for screening the ambient air, the drill cuttings and the split-spoon samples for volatile organic compounds using an Organic Vapor Analyzer or another suitable piece of field equipment. At the onset of drilling at each boring location in the DRMO, all personnel near the rig will be outfitted in modified Level D protective clothing. Specific permissible levels of organic vapors for upgrading to Level C will be set forth in the Health and Safety Plan.

Disposal of Cuttings

Auger cuttings produced by the drilling of test borings will be temporarily placed in a bermed area in the storage yard and covered with polyethylene to prevent wind dispersal of cuttings and infiltration of potential contaminants (i.e., metals) into the Piscataqua River. Three (3) composite samples of the cuttings will be obtained with decontaminated stainless-steel trowels and analyzed for PCBs, TPH, and RCRA metals. Upon completion of field investigative activities, arrangements will be made for appropriate disposal. The requirements for proper disposal will be determined based on the sampling results.

Rock Coring

Upon auger refusal, each boring will be cored. Rock cores will allow confirmation of bedrock and evaluation of aquifer properties. Bedrock will be continuously cored with an NX core barrel from the top of the Kittery Formation to a maximum depth of 5 feet. All rock cores will be examined and logged in the field. Information regarding the core time, recovery, condition of cracks or fractures, staining, fracture angle and rock quality designation (RQD) will be recorded. Upon completion of coring, the corehole will be filled to the top of bedrock with bentonite. A monitoring well will then be constructed above the bedrock.

4.1.2 Surface Soil Sampling Plan

Introduction

The soil sampling plan for the DRMO Storage Yard involves a systematic surface soil sampling program. The objective of this program is to provide onshore coverage surrounding the DRMO Storage Yard by sampling in a regular pattern. The sampling plan will allow for characterization and estimation of the extent and magnitude of inorganic constituents in surface soils.

The soil sampling program involves the collection of soil samples from the upper six inches of the soil column. This approach is justified by the results of the FCS, which documents elevated levels of metals in soils adjacent to the storage yard at higher topographic elevations. Based on these analytical results, elevated concentrations of metals are also noticeable in the eastern portion of the DRMO storage yard (see Figure 4-3 for sampled locations). Wind dispersal is suspected to be a migration pathway. The implementation of this sampling plan is described in the following sections which include details of sample collection, handling, shipment and documentation.

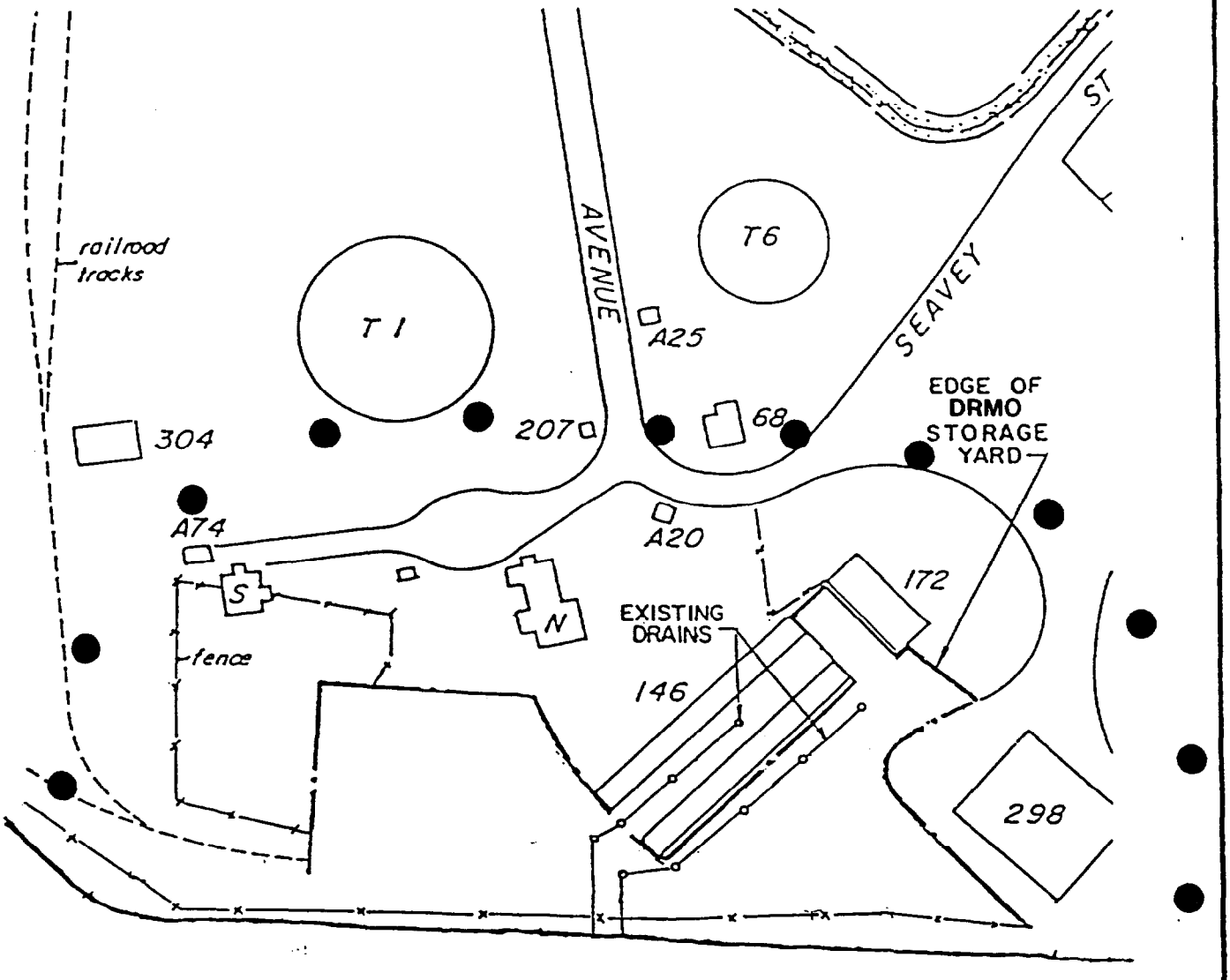
Sampling Locations

A total of 12 locations have been proposed for the collection of off-site (exterior to the storage yard) surface soil samples. These locations are noted in Figure 4-5. These locations were chosen in order to characterize the presence of inorganic constituents in surface soils along an approximately 300-foot band east, north, and west of the storage yard. Specific sample locations will be determined in the field. No sampling grid will be established for soil samples to be collected from the exterior of the DRMO. Instead, the samples will be collected from locations which are equidistant from one another (if possible) and which surround the scrap yard. Sampling locations may have to be moved due to obstructions such as concrete surfaces, steep slopes, or buildings.

In the event that significant contamination is discovered at these off-site locations, the sampling program will be expanded to determine the extent of contamination.

Field Supplies/Equipment

For the efficient implementation of the soil sampling plan, field supplies/equipment shall include but not be limited to the following:



PISCATAQUA RIVER

FLOOD

EBB

LEGEND

● SURFACE SOIL SAMPLING LOCATIONS

N

200 0 200

100 FEET 100

GRAPHIC SCALE

FIGURE 4-5

DRMO Off-Site Surface Soil Sampling Locations

Portsmouth Naval Shipyard

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- stainless-steel trowels
- stainless-steel mixing bowls
- laboratory prepared sample bottles
- scrub brushes
- buckets
- metal wash basin
- soap (Alconox or equivalent)
- nitric acid
- methanol
- distilled water
- spray bottles
- appropriate protective clothing
- 100' measuring tape
- orange flag markers
- coolers
- aluminum foil
- labels
- field notebook.

Sampling Methodology

A surface soil sample shall be obtained from the upper six-inches of the soil column, where practical, at each location using a properly decontaminated stainless-steel trowel. Decontamination methodologies are detailed in the following section. Each sample shall be placed in a stainless-steel mixing bowl, homogenized and transferred to laboratory prepared sample bottles. If necessary, samples shall be split with USEPA after the soil is homogenized in the mixing bowls. Samples shall be sent to RAI, a CLP-approved laboratory, for analyses.

Should it be impossible to obtain a soil sample at any of the proposed locations due to surficial obstructions (i.e., bedrock outcrops, concrete surfaces, etc.) a sample shall be obtained at a location in closest proximity to the original proposed location. The new location shall be measured and noted for subsequent plotting on the sample location plan. Replicate off-site surficial soil samples will also be collected to allow HART's chemist to monitor laboratory performance. The number of replicate samples is specified in the QAPP. When soil samples are being collected for replicate analysis, an aliquot of soil will be homogenized in stainless steel mixing bowls and equal portions will be placed into two sets of laboratory prepared sample bottles. One set of sample bottles

will be given the sample identifier indicative of the sample location and the second set of sample bottles will be given a false sample identifier to disguise the identity of the replicate sample. Actual sample identifiers for replicate samples will be noted in the field log books.

Decontamination Methodology

In order to prevent cross-contamination of samples and sampling locations, all sampling equipment shall be decontaminated prior to and after each use as specified herein. The decontamination procedures shall be as follows (see Table 4-3 for a summary of all field decontamination procedures):

- wash in soapy water solution of Alconox or equivalent
- rinse with tap water
- rinse with 10% nitric acid solution
- rinse with distilled water
- rinse with methanol
- air dry.

All decontamination liquids will be collected and containerized during the investigation, stored and later disposed of at an EPA-approved facility. If not used immediately, all sampling equipment shall be wrapped in clean aluminum foil and stored until needed for sampling. Sample bottles shall be cleaned and prepared by RAI prior to shipment to the site.

To provide a means to assess decontamination procedures employed for sampling equipment, one rinseate blank will be collected during the surficial soil sampling program. The rinseate blank will be collected by pouring laboratory pure water over decontaminated sampling trowels or mixing bowls and allowing the water to run directly into a laboratory-prepared sample bottle. All information relevant to the collection of the rinseate blank will be noted in the field log book. The rinseate blank will be denoted by the letters "RB."

Soils Analyses

Samples obtained during the surficial soil sampling program shall be sent to RAI, a CLP laboratory, for chemical analyses. All soil samples shall be analyzed for Priority Pollutant Metals and PCBs. These analyses shall be conducted in accordance with CLP protocols and applicable Standard Operating Procedures (SOPs).

Sample Preservation, Packaging and Shipment

Details for sample preservation, packaging and shipment are provided in the Quality Assurance Project Plan (QAPP) (Attachment A).

Sample Documentation

Sample documentation, labeling and chain-of-custody procedures are detailed in the QAPP (Attachment A).

4.2 Storage Tanks and Pipe Line

4.2.1 Underground Storage Tanks (UST)

If a tightness test confirms a tank system failure, test results will be reported as required in 40 CFR 280, Subpart E, and applicable state of Maine regulations. A soil investigation will be conducted involving soil borings or excavation of soil, which may have been contaminated by product loss. Soil samples will be collected and analyzed for contaminants of concern. Further investigation or appropriate remedial action will be recommended based on the analytical results.

4.2.2 Fuel Oil Pipeline, Berth 6 (SWMU #27)

As part of the RFI, a subsurface soil investigation will be conducted at Berth 6 to determine if contaminated soil still exists in the vicinity of the former pipeline. Hart's investigation will include visual inspection and sampling of soils from test pits to be located along the former pipeline route. The former

pipeline route will be located using the available construction engineering diagrams supplied by the Navy. The pits will be dug using a backhoe or by hand excavation if necessary for safety and protection of buried utilities. The number, location, depth and width of the test pits will be determined in the field and will be based on the subsurface materials encountered, such as depth of bedrock, and the visible extent of contamination. If visible contamination extends to the water table, a groundwater investigation may be necessary. Laboratory analyses of the soil samples will be conducted to determine the concentration of potential contaminants. The analytical parameters for the soils from SWMU #27 are listed in Table 9-1.

4.3 JILF (SWMU #8)

4.3.1 Test Borings/Rock Coring

Purpose

The JILF occupies a former intertidal flat between Seavey and Jamaica Islands (Figure 4-6). This area of made-land has a complex fill history. The test boring program will provide information regarding the type, variability, and total thickness of fill, indigenous unconsolidated materials, and bedrock peripheral to the JILF.

There is limited subsurface geological information in the vicinity of the JILF. Ten test borings were drilled in the vicinity of the dredge spoil disposal site. Five shallow test borings were drilled for geotechnical purposes at a proposed construction site near the north end of the JILF. Monitoring wells were installed in three of the test borings for geotechnical reasons. Reportedly, the wells have been abandoned. While these data provide information on localized areas, additional borings will provide information over the entire area to encompass the entire landfill area.

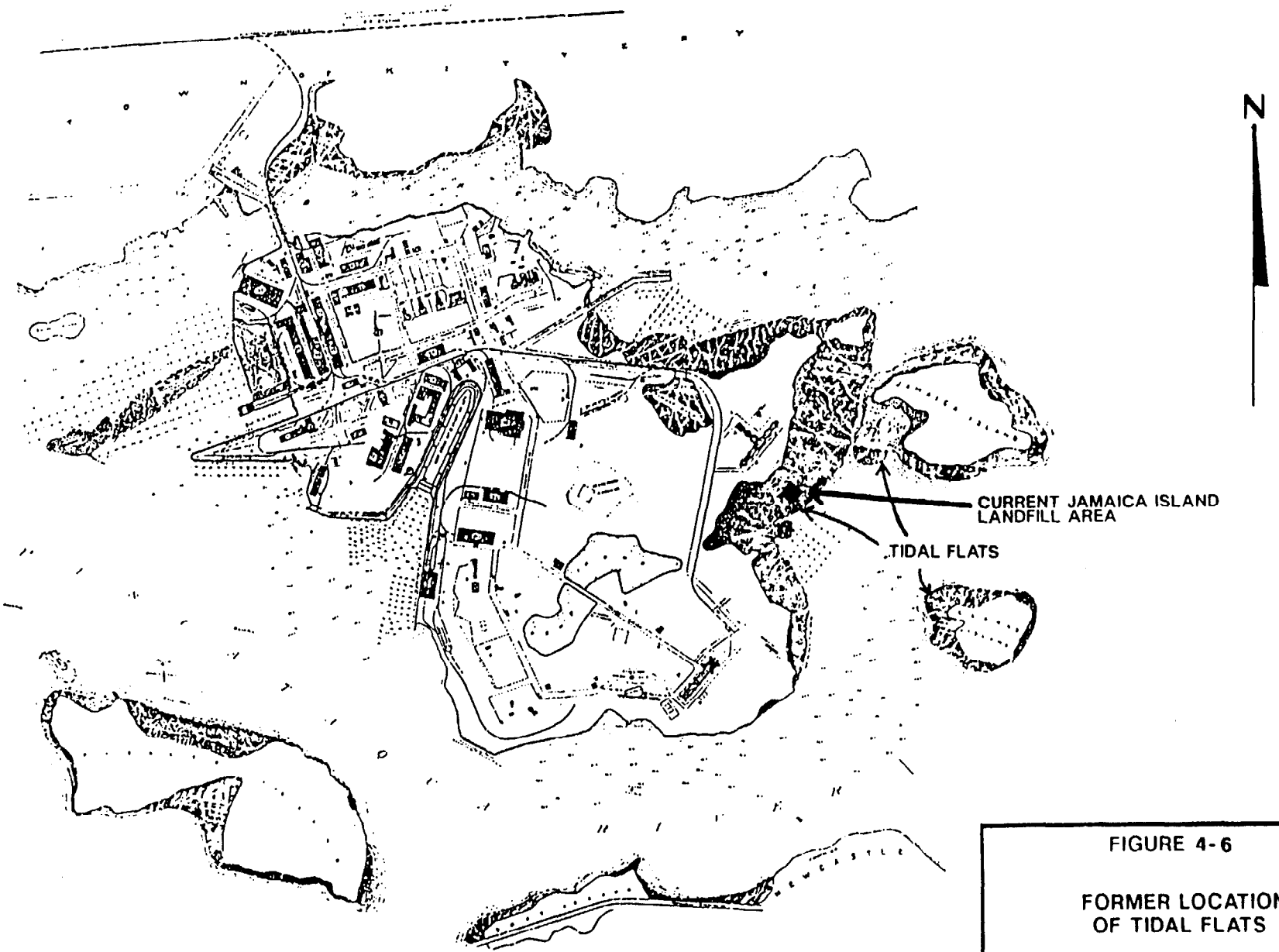

FIGURE 4-6

FORMER LOCATION
OF TIDAL FLATS

PORTSMOUTH NAVAL SHIPYARD

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The boring/coring data will be incorporated with the geophysical data in the design of the subsequent groundwater investigation. Numerous hydrogeological questions must be answered prior to design of a groundwater investigation. Both natural and artificial variables must be understood prior to designing and locating monitoring wells. These variables include fluctuations in groundwater elevation due to tidal fluctuations, the presence of freshwater/saltwater interfaces, the existence of confining layers, and the identification of preferred migration pathways.

Methodology

Eleven test borings will be drilled to the top of the Kittery Formation utilizing a continuous-flight, hollow-stem auger drilling technique. Enclosure A shows the proposed locations of these eleven shallow test borings peripheral to the known landfill. Because the locations of potentially hazardous and dangerous materials are unknown, the interior of the landfill will not be investigated during this program. A metal detector and magnetometer will be used to check each location for shallow-buried metal objects. Upon completion of the borings, each boring will be tremie grouted with cement/bentonite grout. Proposed test boring locations were selected to provide the maximum information possible about the site. An organic vapor analyzer (OVA) and a Geiger counter will be used for Health and Safety monitoring. Action levels based on these monitoring instruments are discussed in the Health and Safety Plan (Attachment B).

Soil samples will be obtained in advance of the hollow-stem augers at 5-foot intervals by means of a split-spoon sampler. A standard 140 pound drop hammer will be used to drive the split-spoon sampler and blow counts will be recorded for every six inches of drive. Based on the discretion of HART's on-site hydrogeologist, one sample per boring may be collected and analyzed for health and safety reasons. The laboratory analysis of any samples collected will

be based on visual, olfactory, and OVA information. Split-spoon samplers will be cleaned between samples with a detergent wash and tap water rinse, 1% nitric acid rinse, rinse with distilled water, rinse with methanol, and air dry to prevent cross-contamination of sample intervals. (See Table 4-3 for a summary of all field decontamination procedures). A visual description of the split-spoon sample will be logged in the field. Observations noted in the field will be written on a test boring log (Figure 4-4). All borings will be described using the Unified Soil Classification System as adopted by the U.S. Corps of Engineers and Bureau of Reclamation (U.S. Bureau of Reclamation, 1963). Examples of observations to be included in the description of soils are as follows:

1. Color.
2. The mineral and/or lithologic components of the material as: quartz, shale, mica, granite, shells, etc.
3. Organic components as roots, humus, wood fragments, peat, etc.
4. Grain shape as angular, sub-angular, rounded.
5. Grain size (significant for sand and gravel only) as fine, medium, coarse.
6. Degree of sorting as very well sorted, well sorted, moderately sorted, poorly sorted, very poorly sorted.
7. Stratification. Samples should be examined for the presence of stratification. The thickness of each layer, regardless of how small, should be recorded, as well as the characteristics of the stratum in accordance with items above.
8. Degree of saturation as dry, damp, moist, wet, saturated.
9. Obvious presence of contamination such as discoloration, odor, organic vapor readings, etc.

A representative aliquot of all split-spoon samples will be placed in jars for visual record. Upon completion of the shallow test boring activities, representative samples will be selected for grain size distribution, Atterburg limits, and moisture content. Grain size analyses will assist in determining the relative permeability of any potential aquiclude encountered.

To evaluate the possibility of a clay or confining layer, the first two borings will consist of an upgradient (JB-1) and a downgradient (JB-2) location (Enclosure B). In the event a clay layer is encountered in the upgradient boring, the boring will be advanced a maximum of three feet into the layer (if thickness is sufficient) with a hollow-stem auger. If the confining layer is greater than three feet thick, an undisturbed soil sample will be collected and the confining layer will be sealed off from overlying units with steel casing. Drilling will resume as discussed in Section 4.1.1. This will prohibit the potential of cross-contamination from overlying units. This procedure will be followed during the drilling of the downgradient location. If the two borings suggest the presence of a continuous confining layer, all borings will be drilled as described above. However, Shelby tubes will not be taken.

Once refusal is encountered in the test borings, an attempt will be made to obtain a five foot rock core to verify bedrock. Rock cores will allow for a detailed examination of the bedrock stratigraphy and structure. The rock will be continuously cored with an NX core barrel from the top of the Kittery Formation to a depth of five feet into the formation. All rock cores will be examined and logged in the field. Information regarding the core time, recovery, condition of cracks or fractures, staining, fracture angle and rock quality designation (RQD) will be recorded.

A minimum of two HART personnel will be on-site for all drilling activities. All drilling locations will be screened with a metal detector and magnetrometry to reduce the chance of drilling into buried metallic objects. In addition to other responsibilities, the team will be responsible for screening the ambient air, the drill cuttings and the split-spoon samples for volatile organic compounds using an organic vapor analyzer (OVA) or another suitable piece of field equipment. Drill cuttings and split-spoon samples will also be screened for

radioactivity using a Geiger Counter. At the onset of drilling at each test boring location in the JILF, all personnel near the rig will be outfitted in modified Level D protective clothing. Specific permissible levels of organic vapors for upgrading to Level C are set forth in the Health and Safety Plan.

Auger cuttings produced by the drilling of test borings will be temporarily placed in a bermed area and covered in such a manner that surface runoff or wind dispersal will not introduce possible contaminants to the environment. Three (3) composite samples of the cuttings will be obtained with decontaminated stainless steel trowels and analyzed for the appropriate parameters. The samples will be collected upon completion of the test boring program. Upon completion of field investigative activities, arrangements will be made for appropriate disposal as determined by the sampling results.

Information obtained from the exploratory test boring program will assist in the interpretation of the geophysical and soil gas data and help determine likely migration pathways. After the analysis of geochemical, geophysical, and test boring data, placement of monitoring wells will be determined.

Eleven exploratory test borings will be drilled at the periphery of the JILF. At each test boring location, a soil sample will be obtained for analyses of TCL Organics and Target Analyte List (TAL) Inorganics. The sampling interval for these parameters will be at the discretion of the on-site hydrogeologist.

Drilling and soil sampling for the subsequent phase of monitoring well installation will be performed in the same manner as described in Section 4.1.1. Soil samples, composited from each split-spoon interval, will be retained from every 5 feet for analyses of PCBs, Priority Pollutant Metals, and Target Compound List (TCL) Volatiles. Once tidal deposits are encountered, soil samples will still be obtained every 5 feet, but samples for analytical analyses

will be collected every 10 feet. The change in sampling frequency reflects the nature of the tidal flat deposits, which are less permeable and much more organic rich than the overlying fill material. These physical properties restrict contaminant migration to the overburden material and limit the need for the collection of tidal flat sediment samples. If a confining layer is encountered, shallow monitoring wells will be constructed in the unconsolidated material overlying the aquiclude (see section 6.2).

A summary of samples, including replicates and field blanks, is located in Table A-3 of the Quality Assurance Project Plan (QAPP).

4.3.2 Mercury Burial Sites

Two mercury burial sites located in the JILF (see Figure 6-4) will be investigated to assess the potential for environmental contamination as addressed in Section 6.3.2. Borings for well construction will be drilled either to a total depth of eighteen (18) feet below grade or until bedrock is encountered, whichever is shallower. Soil samples will be collected at five (5)-foot intervals using a split-spoon sampler and detailed boring logs will be constructed.

5.0 GROUNDWATER HYDRAULICS INVESTIGATION

5.1 Introduction

Accurate interpretations regarding the rate of groundwater flow and contaminant migration in the shallow aquifers at the DRMO and JILF are dependent upon a thorough understanding of the variables which define each aquifer system. Key to this understanding is a knowledge of the hydraulic conductivity of the aquifer. Slug tests will be performed on each of the groundwater monitoring wells installed by HART at the DRMO and JILF to estimate the hydraulic conductivity of the associated aquifer in the vicinity of each well.

5.2 Methodology

Slug tests will be conducted at the site upon the completion of groundwater sampling. An initial static water level measurement will be obtained and then the water level in the well will be raised or lowered by quickly adding or removing a solid object of a known volume to or from the water column in the well. The response of the water level in the well will be measured through time until equilibrium is again reached in the well. Analysis of this data through solutions developed by Cooper, Bouwer, Bredehoeft, Papadopulos, Rice and others will provide estimates of the hydraulic conductivity of the aquifer in the vicinity of the well.

Instantaneous raising or lowering of the water level in the wells at the DRMO or JILF sites will be achieved by utilizing a decontaminated, cylindrical, solid object of a known volume. This object will be constructed of a water filled PVC pipe (1.5 inch diameter) with capped ends. One end of this object will be fitted with a stainless steel eye hook for attachment of a suitable length of nylon rope to be dedicated to each well. This object will be decontaminated between wells with the following procedure: a detergent

(Alconox or Liquinox) and water wash, a tap water rinse, a distilled water rinse, a methanol rinse, followed by a hexane rinse and a complete air dry.

Water level measurements will be recorded during the slug test by utilizing an IN-SITU HERMIT (SE1000B) data logger/processor and an in-situ pressure transducer. The data logger is programmed by the user to obtain measurements at a desired frequency and store these measurements in a built in memory capable of storing up to 8000 data points. The pressure transducer, mounted on a polyurethane cable vented to the atmosphere, is located at the bottom of the well and measures the water level through accurate detection of the pressure exerted by the overlying column of water. Utilizing the logarithmic sampling mode, the HERMIT will collect 11 data points in the first two seconds of the test and a total of 49 points in the first two minutes, thus providing high resolution, early time data. Table 5-1 outlines the logarithmic sampling frequency. Water level data will be printed out on-site by a portable field printer and will be included in the report. All other pertinent information will be recorded in the field log book.

Table 5-1. 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
2-100 min	0.5 min	16
10-100 min	2 min	45
100-1000 min	10 min	90

A maximum of two HART personnel will conduct slug tests. Personnel will be outfitted in appropriate Level D protective clothing unless data collected during well installation suggest that a higher level of protection is required. Although it is not anticipated that water will be generated during slug testing, any water generated will be discharged to the site.

6.0 HYDROGEOLOGIC MONITORING PLAN

6.1 Introduction

The site hydrogeologic investigation will be the primary method of gathering information regarding the presence, concentration, and possible migration of contaminants at the Portsmouth Naval Shipyard. This investigation will be designed to supply scientifically valid information concerning the depth to groundwater on-site, the number of subsurface aquifers and their general characteristics, groundwater flow directions and their relationships to surface water conditions, the concentration and extent of contaminants in soil and groundwater, and the direction of contaminant migration as it exists.

6.1.1 Field Office/Field Screening Facility

A temporary office will be set up at the Portsmouth Naval Shipyard to serve as a command post and an equipment storage facility. A trailer will be used which will contain a total of four offices. One office will be used for equipment storage and sample preparation and shipment and another office will be used by the field team leader and field personnel for record keeping and desk work. Two offices will be used as field crew debriefing areas. Desks, tables and shelves will be installed as necessary. The trailer will be equipped with a refrigerator, lights, heat, and air conditioning. Electricity will be connected to the office trailer, bottled water will be provided as well as separate sanitary services. Since the site is secured, it will not be necessary to construct a chain-link fence around the trailer.

6.1.2 Monitoring Well Installation

The on-site HART hydrogeologist will be responsible for determining the depth of borings and the interval to be screened at each well location. Shallow well screens will be placed to cover the full vertical extent of saturated

sediments, taking into account tidal fluctuations. A generalized overburden-well construction diagram is shown in Figure 6-1.

Wells at the DRMO may be constructed of 2-inch diameter, flush-joint, schedule 40 PVC screen and riser pipe with a screen slot size of 0.01 inch. Site history suggests that the primary contaminants of concern are metals and therefore the use of PVC is not expected to pose a problem.

Well construction materials to be used at the JILF will be determined after more subsurface information is available concerning the variety of contaminants at this SWMU. Generally, well construction will involve:

1) Backfilling the borehole with 0.5 feet of sand (the same sand to be used as the sand pack) as a base.

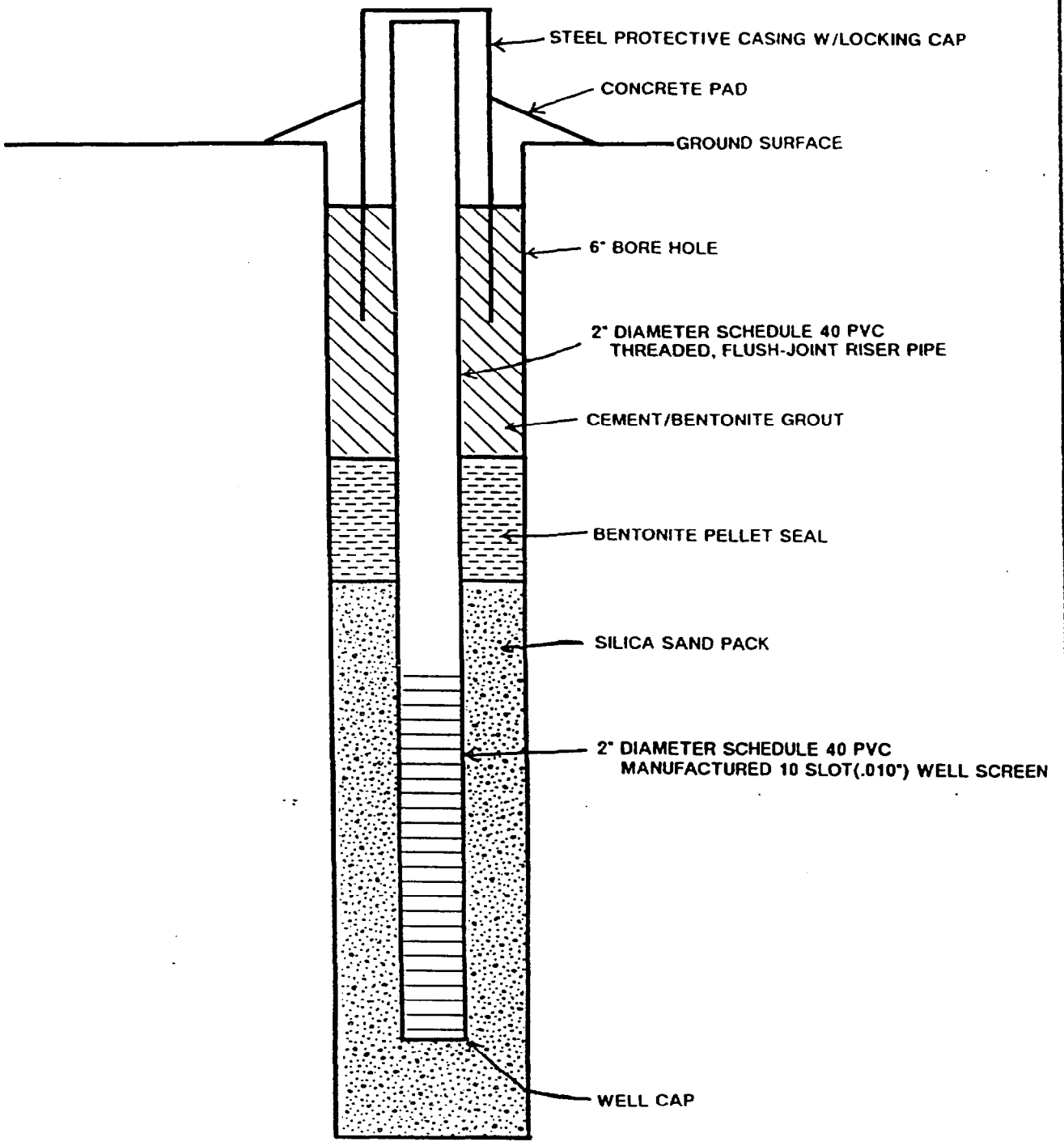
2) Emplacing the appropriate length of well screen and casing (casing length will be such that it provides for 2 feet of stick-up above the ground surface and the casing top will be capped to prevent material from entering the well).

3) Emplacing a clean, silica sand pack (Morie grade 0 or an equivalent) to a height of 2 feet above the top of the screen while simultaneously retracting the augers, thus allowing the sand to settle into the annular space between the well screen and borehole wall while preventing any significant cave-in.

4) Emplacing a 1.0-foot "sand choker collar" directly above the sand pack. The "sand choker collar" will consist of a very fine sand (Morie grade 00 or an equivalent). The collar, with its smaller pore size, will assist in preventing bentonite and/or cement from migrating to the underlying sand pack and affecting water quality.

5) With the auger bottom now located approximately at the top of the "sand choker collar," one of two scenarios will occur. In fresh water, a 2-foot bentonite pellet or granular bentonite seal will be installed to prevent vertical migration of grout into the well. The bentonite seal will then be hydrated with fresh water. In salt water or brackish water, a 2-foot layer of a high-solids bentonite clay grout (hydrated with fresh water) will be tremie grouted into place.

6) In fresh water, the remaining annular space will be tremie grouted from the bottom up with a Portland type I cement mixed with 5 percent powdered bentonite while completely retracting the augers from the borehole. Fresh water will be used when mixing the grout. Grout may be placed on the bentonite seal immediately after the seal has been hydrated. Approximately 15 to 30 minutes will be allowed for the bentonite to hydrate. In salt water or brackish water, the remaining annular space will be grouted from the bottom up with a Portland type I cement, using a tremie tube while completely retracting the augers from the borehole. Grout may be placed on the hydrated bentonite seal immediately after placement of the seal.



NOT TO SCALE

FIGURE 6-1

GENERALIZED OVERBURDEN-WELL CONSTRUCTION DIAGRAM

PORTSMOUTH NAVAL SHIPYARD

KITTERY,ME. JUNE 1989

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7) A locking, protective, steel casing will be installed around the well and extend a minimum of 3 feet into the ground.

8) A cement pad which expands to the depth of the frost line will be installed around the protective steel casing.

9) In high-traffic areas secure curb boxes will be installed instead of the casing stick-up. All screen and casing will be steam cleaned prior to well construction to prevent the introduction of contaminants to the subsurface.

6.1.3 Monitoring Well Development

No sooner than 48 hours after grouting is completed (United States Department of Energy, 1985), each well will be 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 will be 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 will be new, dedicated, development materials consisting of one-inch, high density polyethylene (HDPE) tubing and a 1-3/4 inch Delrin foot valve which will be steam cleaned prior to development of each well. The tubing will be connected at the surface to the WaTerra power unit which will actuate the tubing and valve at approximately 60 to 100 strokes per minute. This stroke rate produces a pumping rate of 2 to 3 gallons per minute (gpm). The rapid actuating motion will simultaneously pump and surge the well to provide optimal development. The development will continue until a steady, clear discharge is apparent. Measurement of pH, specific conductance and temperature will be taken of the discharge water. Consecutive measurements of these parameters will be taken in immediate succession. When three consecutive measurements of these parameters indicate ten percent or less variation in specific conductance and temperature and ± 0.2 pH unit, development will be considered complete. However, development will not be conditional on the stabilization (as defined) of these parameters. If the

parameters do not reach stabilization, the extent of development will be based on a field decision as to the quality of the discharge and yield of the well. If the well goes dry during development it will be allowed to recover and subsequently bailed until three to five well volumes are produced. In the event of a highly productive well not reaching stabilization, development may continue until 10 to 15 well volumes are produced.

Given the unconfined nature of the aquifer and the contaminants of concern (metals in soil) at the DRMO, development water will be discharged to the surface. If necessary, berms will be constructed to prevent surface runoff from entering the Piscataqua River.

6.2 DRMO (SWMU #6)

6.2.1 Monitoring Well Installation

Purpose

The hydrogeology of the DRMO Storage Yard is poorly defined. According to the boring data generated for the Final Confirmation Study Report (FCS) prepared by Loureiro Engineering Associates, the water table was determined to be between 8 and 15 feet below ground level. The FCS did not confirm the presence of a fresh water layer and evidence suggests that the water table probably fluctuates significantly with the estuary's tidal cycle. Because of the composition and location of the fill material, it is expected that groundwater flows from beneath the storage yard to the Piscataqua River during ebb tide. However, during flood tide the reverse situation probably exists in which the Piscataqua River serves to elevate the groundwater level beneath the DRMO.

Shallow groundwater monitoring wells will provide information regarding the depth to the water table, the existence of a freshwater lens, the extent of tidal fluctuations, the direction and rate of groundwater flow and the extent of

potential contamination in the shallow groundwater system. To assess the tidal influence, a downhole data-logger will be used to obtain continuous water level readings in select wells (i.e., one upgradient and one down gradient) for a 24-hour period.

Methodology

Seven test borings will be drilled to the top of the Kittery Formation utilizing a continuous-flight, hollow-stem auger drilling technique. Based upon available information, it is estimated that these borings will be approximately 20 feet deep. Enclosure B shows the proposed locations of these seven test borings. Upon completion of the borings, groundwater monitoring wells will be installed in the same locations. Proposed test borings/ monitoring well locations were selected to provide as much subsurface information as possible.

6.3 JILF (SWMU #8)

6.3.1 Monitoring Well Installation

Purpose

The hydrogeological conditions at the JILF are poorly defined. The JILF occupies a former intertidal flat between Seavey and Jamaica Islands (Figure 6-2). This area of made-land has a complex fill history. The thickness of fill and tidal deposits is unknown. Also, depth to water and the existence of the freshwater-saltwater interface is unknown.

The test boring program will provide information regarding the type, variability and total thickness of fill and tidal sediment peripheral to the JILF. Preliminary water salinity information will be acquired from the borings to evaluate the presence and thickness of a fresh water lense. This boring data will be incorporated with geophysical and soil gas data to optimally place groundwater monitoring wells. Due to the poorly defined geologic and hydrogeologic conditions and the variety of contaminants of concern at the JILF,

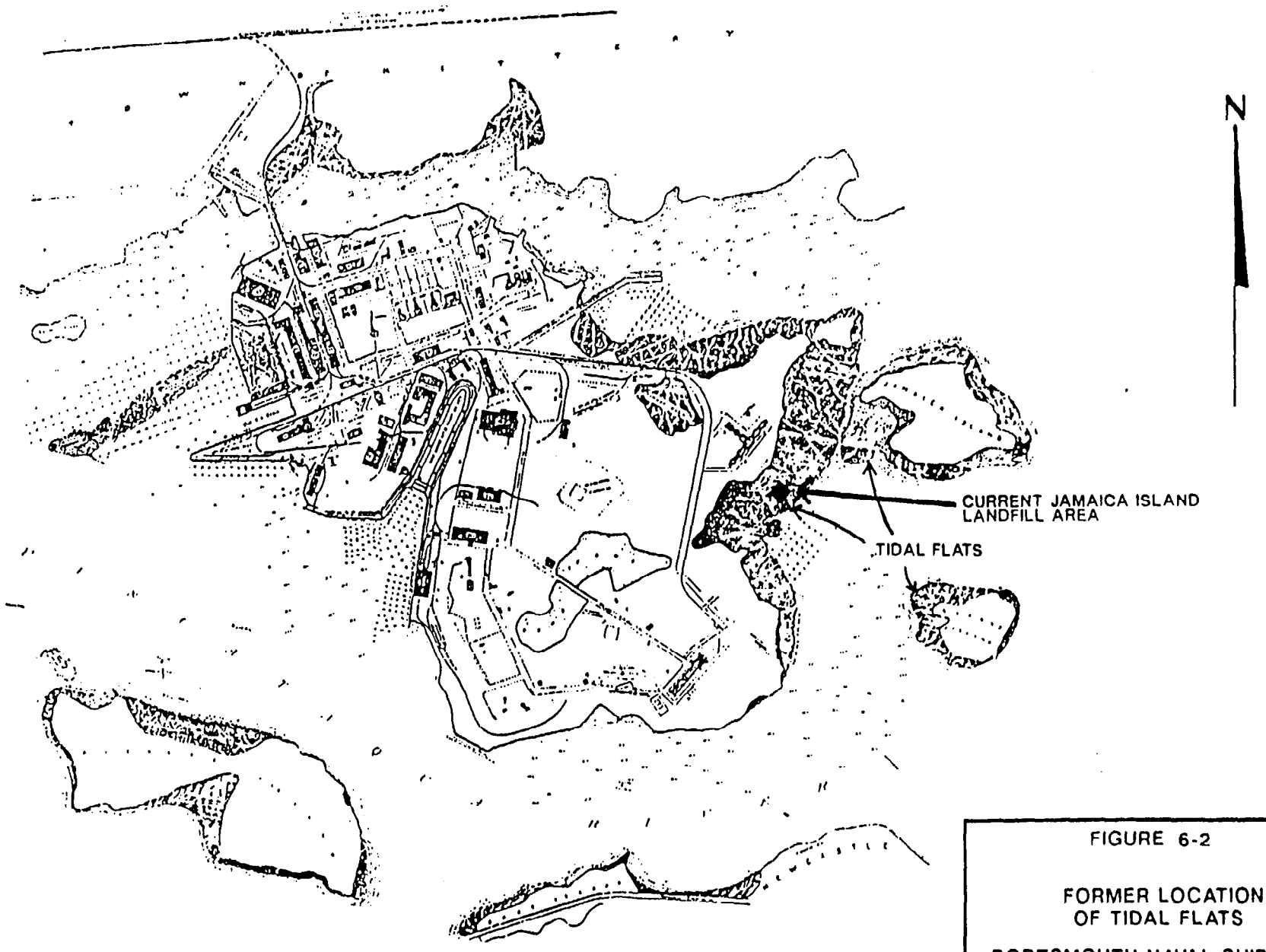

FIGURE 6-2

FORMER LOCATION
OF TIDAL FLATS

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. JUNE 1989

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it is premature to recommend well construction materials at this time. A proposal containing recommended construction materials will be presented under separate cover once the necessary subsurface information is available. The exact location and depth of the monitoring wells, the length and placement of the screened interval, the type of screen/riser material to be used, the sand pack grain size and the type of grout and cement to be used will be determined after initiation of the field work as additional subsurface data becomes available.

During test boring drilling, conductivity readings of the groundwater will be obtained after each split-spoon sample is collected. This will help evaluate the fresh water/salt water interface and assist in well screen placement once monitoring wells are installed.

The number and placement of monitoring wells can not be determined in this work plan because of the current lack of information. It is anticipated that 8 wells (3 upgradient and 5 downgradient) may be installed.

If a confining layer is encountered above bedrock, shallow monitoring wells will be constructed in the unconsolidated material overlying the aquiclude. Monitoring wells will be constructed and developed in the same manner as that described in Section 6.1 as shown in Figure 6-1. If an aquiclude is not encountered, bedrock monitoring wells will be constructed as well as shallow overburden monitoring wells. The number and location of bedrock monitoring wells to be constructed depends on the variability of sedimentary and man-made materials encountered as well as variations in the structural geology and fracture patterns as determined from the literature review. As additional information becomes available from existing wells, the number of wells and their locations may vary. Well construction for bedrock wells (see Figure 6-3) will involve:

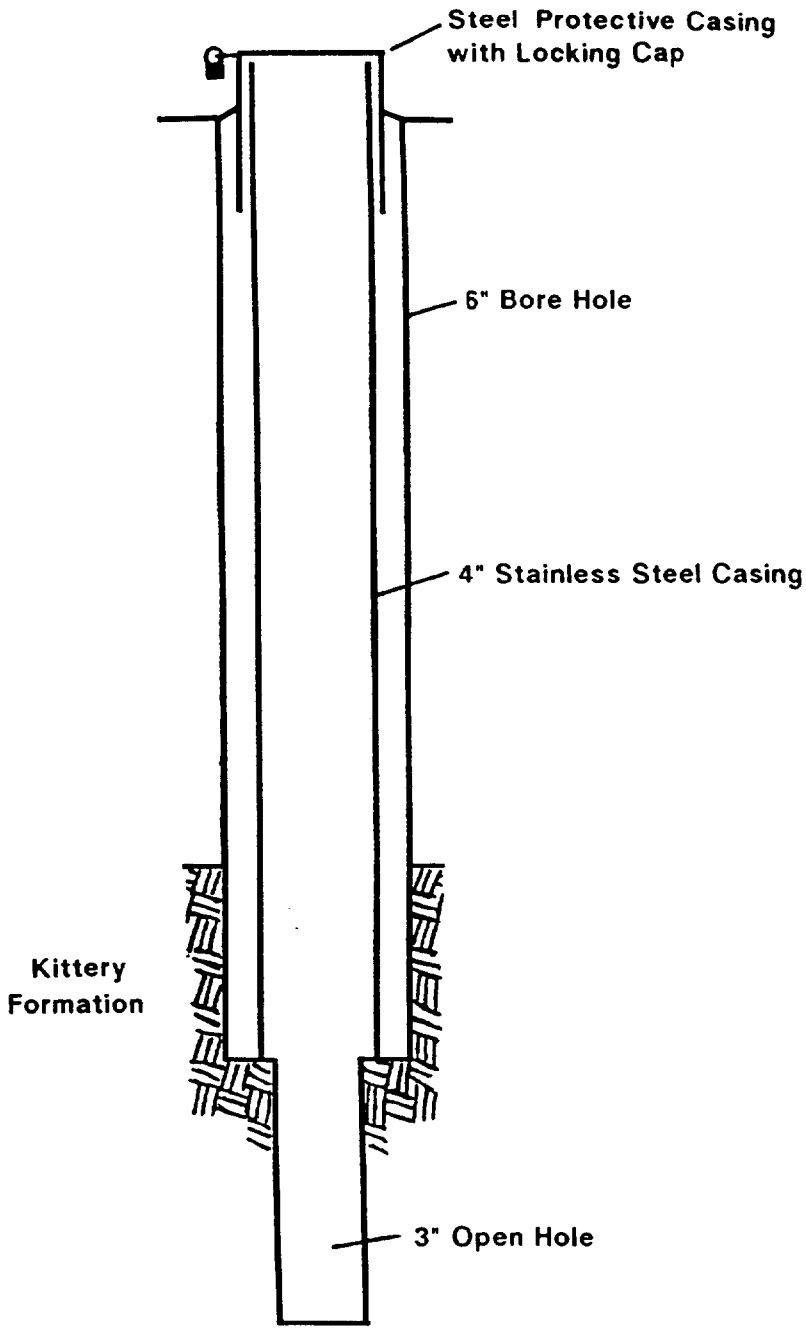

FIGURE 6-3

GENERALIZED BEDROCK
WELL CONSTRUCTION DIAGRAM

PORTSMOUTH NAVAL SHIPYARD

KITTERY,ME. JUNE 1989

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1) spinning 4" steel casing approximately two feet into bedrock;

2) cleaning out casing to the bottom of the drive shoe with a 3-3/4-inch tricone roller bit; and

3) obtain a continuous 10-foot bedrock core utilizing a NX core barrel.

Following construction, monitoring wells will be developed as detailed in Section 6.1. This investigative phase of the RFI is intended to characterize groundwater contamination peripheral to the JILF and assess the potential for off-site migration. Once this phase is completed, an interim assessment period is warranted to interpret data and define a detailed approach to assess contaminant source, extent, and migration behavior. The size, long operational history, and undefined hydrogeologic setting of the JILF precludes a complete analysis at this stage of the RFI. Further work, if warranted, may include additional monitoring wells.

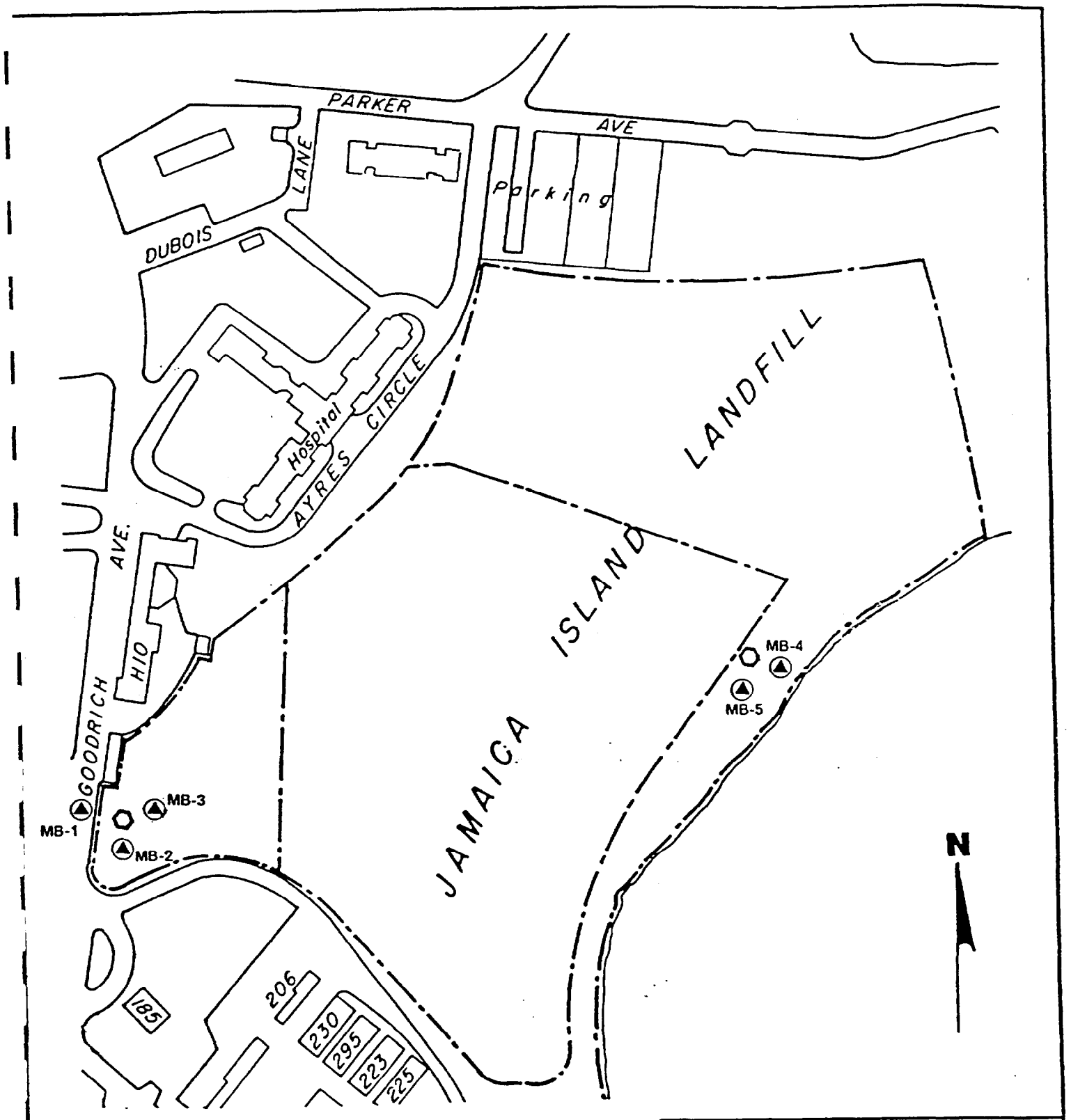
The overburden monitoring wells may be constructed in the same general manner as that described in Section 6.1 as shown in Figure 6-1. The wells will be screened from a depth of eight (8) to eighteen (18) feet or to the top of bedrock if encountered.

6.3.2 Mercury Burial Sites

Introduction

Two mercury burial sites were identified by the Navy in an EPA notification under CERCLA in June 1981. The sites are located in what is now considered to be part of the JILF as shown in Figure 6-4 and Enclosure A.

Each site consists of approximately six buried concrete pipe sections with capped ends containing the mercury waste. The concrete vaults are each approximately four feet long with one foot thick concrete end caps. The vaults are buried under eight to ten feet of fill material.



KEY

MB-1 MONITORING WELL LOCATION

MERCURY BURIAL SITE

NOT TO SCALE

FIGURE 6-4

MERCURY BURIAL LOCATION MAP

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. MARCH 1989

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The vaults contain mercury-contaminated waste such as fluorescent bulbs, thermometers, mercury switches and rags, brooms and dust pans used to clean up broken items containing mercury. According to previous reports nearly 1,000 pounds of this bulk waste was disposed of, but the actual amount of elemental mercury included probably ranged from one to two pounds.

Site Assessments

As part of this RFI each of the burial sites will be investigated to assess the potential for environmental contamination as a result of their presence at the JILF.

The burial sites will be located by means of GPR as described in Section 3.1.4, Remote Sensing Techniques. Once their locations have been established five (5) monitoring wells will be constructed in the overburden sediment to provide a means of monitoring groundwater near the vaults for mercury. Two wells will be constructed downgradient of each burial vault in order to intersect any potential contaminant plume. One upgradient well will be constructed near the western burial site to compare upgradient and downgradient mercury concentrations. Borings for well construction will be drilled either to a total depth of eighteen (18) feet or until bedrock is encountered, whichever is shallower. The overburden monitoring wells may be constructed in a similar manner as that described in Section 6.1 and as shown in Figure 6-1. The wells will be screened from a depth of eight (8) to eighteen (18) feet or to the top of bedrock if encountered.

6.4 Groundwater Sampling

6.4.1 Introduction

Samples will be obtained from all of the monitoring wells installed by HART to assess potential contamination within the groundwater aquifers at the

DRMO and JILF. Information regarding the types of waste disposed of at the DRMO and JILF suggests that the potential exists for both organic and inorganic contaminants to be present. Groundwater samples at the DRMO will be analyzed for Priority Pollutant Metals, PCBs, and TCL Volatiles (Table A-4, QAPP). Groundwater samples at the JILF will be analyzed for TCL Organics, TAL Inorganics and RCRA Metals (Table A-3, QAPP).

6.4.2 Methodology

All sampling procedures will conform to EPA protocols (RCRA, Groundwater Monitoring TEGD, 1986). Sampling of a well will occur no sooner than five days following the development of that well, thus allowing adequate time for the stabilization of the groundwater system in the vicinity of that well.

Prior to sampling, a groundwater level measurement and depth sounding will be taken at each well to calculate the volume of standing water in that well. Water levels in all wells will be measured in immediate succession for the purpose of groundwater mapping in order to minimize the potential tidal effect. However, prior to actually sampling an individual well a second water level will be measured to ensure accurate purge volume calculation. Water level measurements will be obtained with a factory calibrated electronic water level indicator (Model 3000 T-L-C meter) or a steel measuring tape to the nearest 0.01 of a foot and converted to common datum. Three to five well volumes will be removed from each well prior to sampling. A stainless steel, bottom loading bailer with a teflon check valve will be dedicated to each well for purging and sampling activities. These bailers will be cleaned by a detergent (Alconox or Liquinox) and water wash, a tap water rinse, 10% nitric acid rinse, distilled water rinse, and a methanol rinse. (See Table 4-3 for a summary of all field decontamination procedures.) Each bailer will be fitted with a clean piece of nylon rope prior to placement in the well. The measuring tape and water-level

indicator will be decontaminated before and after use using the procedure stated for cleaning bailers. All purge water removed from wells will be wasted on-site.

Following removal of the appropriate volume of water from the well, the well will be allowed to recharge and will be sampled within two hours of purging where practical. The samples will be poured directly from the bailers to laboratory prepared sample bottles. Field parameters will be measured at this time. Field parameters include pH, temperature, conductance, and turbidity. Samples for filtered metals analysis will be poured directly from bailers into a Geotech barrel filter. The sample is forced under pressure through a 0.45-micron filter directly into laboratory prepared sample bottles. The barrel filter will be cleaned prior to and after use by the following procedure: a detergent (Alconox or Liquinox) and water wash, a tap water rinse, 10% nitric acid rinse, a distilled water rinse, and a methanol rinse. (See Table 4-3 for a summary of all field decontamination procedures.) A summary of the groundwater samples to be collected is shown in the QAPP. All sample bottles will be properly labeled and placed on ice while on-site. Accurate records will be kept of all sampling activities and will include, at a minimum, the following information: date, time, location, sample identification code, depth to water measurement, method and volume of water evacuation and sampling technique. Following completion of each days sampling activities, samples will be packed on ice in sealed coolers and shipped by overnight courier to the EPA approved CLP laboratory. Proper chain-of-custody procedures will be strictly followed.

Groundwater replicate samples will be obtained during groundwater sampling to monitor laboratory performance. The replicate will be collected by splitting each aliquot of water in half and pouring half of the water into one bottle and half into the replicate bottle. This sample will be given a false sample identifier and the actual sample identifier will be noted in the field log

book. Field blanks will also be obtained during groundwater sampling. A field blank will be obtained prior to dedicating the bailer to their respective wells by pouring distilled water through the clean bailer and into laboratory prepared sample bottles. Replicate samples and field blanks will be analyzed for the same parameters as the groundwater samples. A summary of samples, including replicates and field blanks, is located in the QAPP.

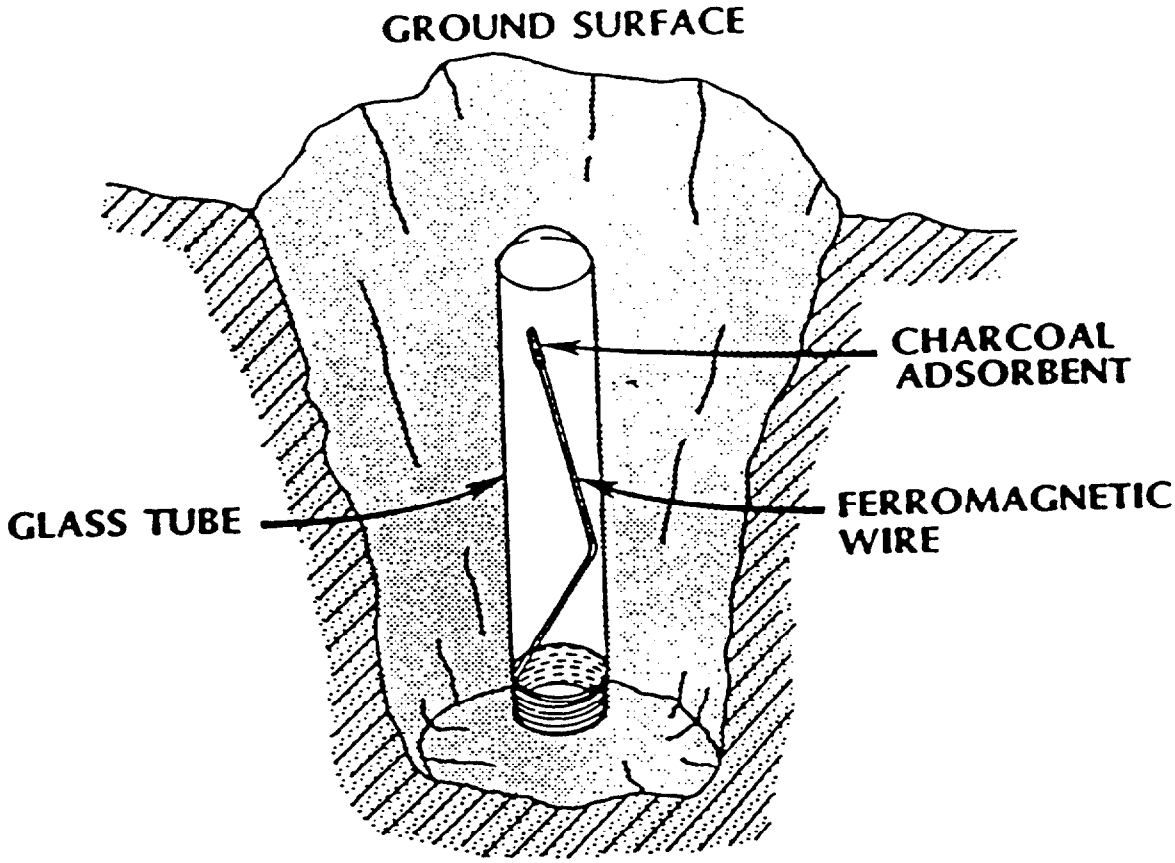
7.0 SUBSURFACE GAS CHARACTERIZATION

7.1 Purpose

A soil gas survey will be conducted at the JILF to determine whether or not volatile organic compounds (VOC's) are emanating from the fill material through the surface soils. The survey will provide a preliminary characterization of the subsurface contamination and assist in the determination of migration pathways. This information combined with geophysical and exploratory boring data will permit accurate placement of the groundwater monitoring wells.

7.2 Methodology

The survey will be conducted using Petrex Soil Gas Sampling tubes placed at grid nodes at 200-foot intervals. There will be approximately 40 survey points. Final locations will be subject to field call. The Petrex method involves the use of a specially constructed static collector combined with analyses by mass spectrometry. The static collectors are placed in cored holes to a depth of 45 cm and backfilled. The collectors then equilibrate with the soil gases for a period of 7 to 30 days. After this period the collectors are retrieved from the field and returned to the laboratory for analyses by Curie point desorption mass spectometry. Previous research has shown time-integrated collection techniques yield statistically superior results when measuring flux rates compared to instantaneous collection methods (Voorhees, et al, 1985; Klusman, et al, 1985). This time-integrated technique will be necessary to average the natural soil gas fluctuations resulting from the tidal influence. A schematic diagram of the static collector used with this sampling method is shown in Figure 7-1. The occurrence, extent, composition and concentration of VOC's will be determined and will allow HART to focus future remedial investigations. Data results will be compiled and presented in tabular and map formats. Mapping will permit ready identification of potential plumes and migration direction.



ISOMETRIC VIEW

Schematic diagram of static collector used for trapping volatile organic compounds

FIGURE 7-1

SKETCH OF SOIL GAS COLLECTOR

PORTSMOUTH NAVAL SHIPYARD

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SOURCE: PETREX MAPS, A CASE HISTORY:SURFACE STATIC COLLECTION AND ANALYSIS OF CHLORINATED HYDROCARBONS FROM CONTAMINATED GROUND WATER. MALLEY, BATH,& BONGERS 1985.

MEMORANDUM

TO: Pamela Parker, ESII, Uncontrolled Sites

FROM: Donald Robbins, Geologist, Technical Services

DATE: April 27, 1989

RE: Review and comments of draft work plan, Portsmouth Naval Shipyard, Kittery, Maine, March 1989.

****

I have reviewed the RCRA Facility Investigation (RFI) Work Plan, Portsmouth Naval Shipyard, Kittery, Maine, March 1989, prepared by Fred C. Hart Associates, Inc. of Albany, New York. I have the following comments:

General Comments

1. In light of the fact that this document is currently in revision, due to changes in the finalized HSWA permit, this review was exploratory. A more detailed review will occur when the revised document is delivered.

2. By Maine State Statute, all geological work within the state must be supervised/approved by a Maine certified geologist. I do not believe Fred C. Hart Associates has met this legal requirement.

3. ME DEP strongly prefers that any split spoon sampling be conducted continuously for the length of all soil borings, monitoring wells, etc.

Specific Comments

Page 3-14 Section 3.4.2.1, Disposal of Cuttings

Temporary storage of boring cuttings in a bermed area under tarps until lab tested is unacceptable. I recommend the temporary storage of the cuttings in sealed steel drums inside the bermed area until testing has determined the lack, or extent of, contamination present. Cuttings that are "clean", or below action levels, can be safely disposed of on site and the respective drums reused. Cuttings contaminated above action levels are already separated from the environment at the time of drilling, and are ready for safe removal from the area.

Page 3-14 Section 3.4.2.1, Rock Coring

The work plan does not adequately investigate the possibility of bedrock "aquifer" contamination. Monitoring wells should be placed and screened within bedrock only, as well as the overburden wells that are proposed.

Page 3-16 Section 3.4.2.1, Monitoring Well Development

I recommend screening the purge water with at least an OVA for the safety of field personnel. Discharging the purge water to the site soils is questionable. In the past ME DEP has allowed the site discharge of water only upgradient and within the contaminant plume's area.

Page 3-40 Section 3.4.3.3, Site Assessments

Justify the reason that no bedrock water is sampled or monitored near the mercury vaults. Mercury is heavier than water, and would infiltrate any bedrock fissures.

Page 3-41 Section 3.4.4.2, Methodology, third paragraph
Justify the cleaning and reuse of the 45 micron filters. The particulates could be of interest if analyzed by a laboratory.

Page 3-43 Section 3.4.5.2, Methodology, first paragraph
Provide the complete citation for all references, (i.e. Cooper, et al.).

Page 3-46 Section 3.5.2 SWMU #8, first paragraph
Specify the maximum length of time, and the environment, in which a sample will be held in reserve. Degradation of many contaminants over time is well documented.

Page 3-46 Section 3.5.2 SWMU #8, fourth paragraph
I recommend retaining the unsampled portions of the sediment cores, at in-situ conditions, for possible analysis in the future. This procedure is outlined in Section 3.5.6 River/Control of this work plan. I recommend extending this procedure to all seafloor/riverbed cores.

Figures

Figure 3-6
Specify in much more detail the construction materials and packing/sealing materials and the ranges or minimums of lengths and depths of: riser, screening, guard pipe, casings, etc.

DR/kcc
DRPPARKER

8.0 SEDIMENT CHARACTERIZATION

8.1 Catch Basin Survey/Sampling

Nine catch basins are located on the DRMO Storage Yard survey map (Enclosure B). A field survey of the catch basins will be undertaken and information recorded relating to the amount and appearance of sediment or free liquids apparent in any basin. The outfall will be inspected for sediment content.

The FCS documents inorganic constituents in surface soils at the DRMO Storage Yard. It is evident that most, if not all of the basins are collection points for soil that is transported via surface water runoff. A sediment sample will be collected for laboratory analysis at the furthest downgradient catch basin containing sediment. If present, sediment will be collected from within, or in the vicinity of, the outfall. The sediment will be sampled with a clean sediment sampling device designed to obtain a representative sample of as much of the sediment column as possible. Decontamination of the sediment sampler will follow the methodology outlined in Table 4-3, Decontamination Procedures. Once collected, the sediment sample will be homogenized and placed in the appropriate sample containers and shipped to the laboratory. The two samples will be analyzed for PCBs, TPH, and Priority Pollutant Metals. Replicates and field blanks will be obtained as specified in the QAPP.

8.2 Offshore Sediment Sampling/Surface Water Characterization

8.2.1 Introduction

Sediments are the ultimate repository for pollutants in the marine environment through adsorption onto detrital particles as oxide coatings (Trefry and Shokes, 1980) and/or ingestion by organisms and subsequent deposition as feces or shell material (Wheeler et al., 1978). Clay minerals have the greatest sorption capabilities of any material in the sedimentary column due to their

large surface area/volume ratio and their high cation exchange capacity (C.E.C.) (Jackson, 1979). Therefore, the sediments of an area are a more useful long-term indicator of any net pollutant accumulation rather than the short-term variations signified by the analyses of water and organisms (Meyer, 1981). The following sections (8.2.2 through 8.2.7) describe the sediment sampling/ characterization program. Data generated from this program will be combined with the existing data base (Loureiro, 1986) and used for comparison with data generated from the onshore RFI. The information may serve to enhance the design of appropriate surface water and biota characterization programs.

Surface water characterization has been reported in the Loureiro (1986) and New Hampshire (Isaza, 1989) reports. The Loureiro report indicated that the metal contaminant levels from the samples collected and analyzed from around the shipyard were below the levels detected in the control samples. Further, the study indicated the runoff samples had substantially lower concentrations in filtered samples versus the unfiltered samples. Loureiro concluded that this was an indication that metals were being carried by the suspended solids. The New Hampshire study calculated contaminant levels in water using levels detected in organisms and bio-concentration factors. The report states that the numbers were generated assuming worst case conditions. The estimates calculated that most of the surveyed contaminants do not exceed the USEPA recommended values for the protection of marine aquatic life. Parameters that did exceed criteria were located at stations in the upper part of the estuary, away from the shipyard. Monitoring studies by the New Hampshire Water Supply and Pollution Control Commission indicate improvement in water quality during the late 1970s throughout much of the estuary, in most cases to Class B water quality, suitable for fishing and swimming (Nelson, 1981).

There are both point and non-point source discharges throughout the Great Bay Estuary System. Through the National Pollutant Discharge Elimination System, 30 permits have been issued to facilities to discharge effluents into the estuary (Isaza, 1989). Kittery residences not on the public sanitary sewer system are allowed to directly discharge into the Piscataqua River until the sewer system is expanded to include these residences (L. Fontaine, Water Dept. Maine DEP, personal communication). Additionally, commercial and recreational vessels operating in the estuary may affect water quality by discharging water from bilges, ballasts, and holding tanks.

As stated in section 1.2.3.1, the Great Bay Estuary System is a slightly stratified estuary (type B). The shipyard is located near the mouth of the estuary in a well mixed, dynamic environment. The circulation pattern around the shipyard has been described as being tidally influenced (Parsons et al, 1978). This study further states that the estuary near the shipyard is flushed every 6 to 12 tidal cycles. Therefore, any contaminants entering the estuary from the shipyard would be rapidly diluted and mixed with contaminants from other sources.

Such complex and variable factors as estuarine circulation, fresh water input, salt water influx, strong tidal currents, and point and non-point source discharges would tend to mask any analytical results that could be directly attributed to the shipyard. Therefore, a surface water characterization program should be developed using a clear understanding of the existing database coupled with the site-specific findings of the RFI. Due to the complex circulation patterns of the estuary and based on the findings of previous investigations, water sampling will not provide useful information until on-site contaminant sources are defined. It is proposed that the surface water characterization program be developed by the Navy with input from the

Technical Review Committee and in close consultation with EPA and DEP as contamination sources and available pathways are identified during the RFI. In this manner, the source constituents and the available pathways to the estuary system will be characterized prior to the development of the receptor (biota) characterization. Given the complex nature of the physical systems and the strong likelihood of biological impacts from other sources, this approach will have the highest potential for adequately addressing the potential contribution to the estuary from the shipyard. Finally, once the impacts on the estuary are understood and appropriate remedial action implemented, a site-specific monitoring program can be developed.

Recommendations for a surface water characterization will be developed as a separate draft work plan to be submitted to USEPA for approval. It is anticipated that this plan will be developed concurrently with the first draft of the RFI report. Following EPA review and approval, the plan will be implemented as a separate phase and integrated into a final RFI report. Recommendations for short- and long-term monitoring will be developed for the final report and implemented following EPA approval.

This proposed approach makes the most use of historical data, integrates the site-specific information which characterizes the potential contaminant sources and available pathways, and can directly impact the development of appropriate monitoring programs. Development of a program in the absence of this site-specific data is not likely to adequately address the long term goals of the study. The Navy is totally committed to the development and implementation of an appropriate study as outlined above.

8.2.2 Sediment Sampling Methodology

All sediment sampling to be conducted in the Piscataqua River will be performed from a boat approximately 40-75 feet in length. The vessel will have

a winch and boom to lower and retrieve sampling devices (i.e., corers and dredges). Radar and two way radio communication capabilities will be required of any vessel to be used for sampling. Sample locations will be defined using a navigational chart with headings taken from fixed point observations.

The preference is to use a local captain familiar with the sampling locations chosen, sampling techniques and the river's tides and currents. There will be a pre-sampling meeting between HART and the contracted captain. All aspects of the sampling will be discussed to ensure a smooth operation and the maximum efficiency for each day spent offshore.

A ponar dredge, or equivalent dredge type, will be used in collecting surface sediment samples. The ponar dredge will sample the top several inches of sediment (0-4") depending on degree of compaction and grain size). The dredge may determine whether coring is feasible in the Clark's Island Embayment.

Sediment from the dredge will be placed into a clean stainless steel bowl. The sediment will be mixed with a stainless steel trowel to ensure a homogeneous sample before transferring the sample to laboratory containers. Sufficient sample must be collected before the mixing and dividing of the sample into containers. This may involve collecting more than one dredge at each location.

Between sample locations, the dredge will be cleaned. This will consist of an Alconox and water wash followed by a water rinse. (See Table 4-3 for a summary of all field decontamination procedures.) The dredge will undergo further rinsing as it is lowered through the water column.

Stainless-steel bowls and trowels will be cleaned before use. Trowels and bowls will be washed with Alconox and water then rinsed with water, followed by 10% nitric acid rinse, a distilled water rinse, and a methanol rinse. (See Table 4-3 for a summary of all field decontamination procedures.) The solvents must be allowed to evaporate before use. Trowels and bowls that are not going to be used immediately, will be wrapped in aluminum foil.

A gravity core will be used to take subsurface sediment samples. A new three foot plastic core barrel will be used for each sample. The core cutter and core catcher will be washed with Alconox and water and rinsed with water between sample locations. (See Table 4-3 for a summary of all field decontamination procedures.)

Cores will be sampled at specified intervals using stainless steel spatulas. The samples will be placed in containers for shipment to the laboratory. Specifics for the sampling of each SWMU are discussed in the following proposals. Table 8-1 summarizes the sediment sampling program.

Table 8-1. Summary of Offshore Sediment Sample Analyses

Location	Surface Sediments	Core[1] Intervals	Appendix IX	Priority Pollutant Metals	Total Petroleum Hydrocarbons (TPH)	Polychlorinated Biphenyls (PCBs)	TCL Volatiles	Total Organic Carbon (TOC)	Phenols
SWMU 5	6	--	1	5	5	5	5	6	5
SWMU 8	20	6	1	25 [2]	19	25 [2]	19	29	19
SWMU 10	2	--	--	-- 2	--	--	2	--	
SWMU 27	3	--	--	--	3	3	--	--	--
River	14	12	3	23 [2]	11	23 [2]	3	--	3

All analyses will follow methods defined in SW-846, 3rd Edition, Nov. 1986.
1. Two intervals per core location
2. Core analyses

8.2.3 SWMU 8 Jamaica Island Landfill (Clark's Island Embayment)

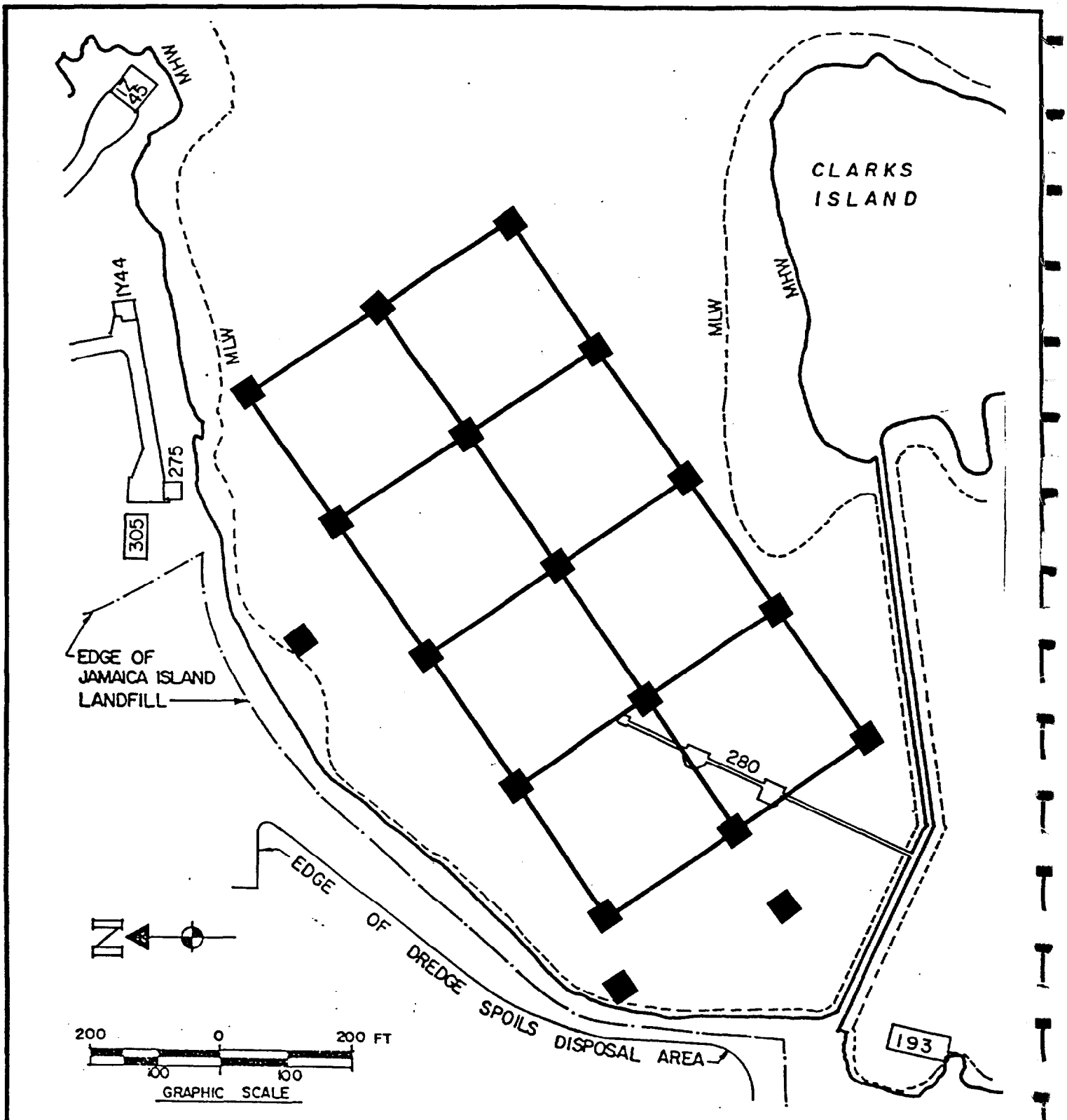
As stated in Perket, Cary L. (ed.), 1986, Quality Control in Remedial Site Investigation: Hazardous and Industrial Solid Waste Testing, ASTM--STP 925, Fifth Volume, pp. 37-38, in a paper entitled "A Review of Quality Control Considerations in Soil Sampling":

> Sampling locations can be selected authoritatively, systematically, or randomly depending on the purpose of the collection. Authoritative or judgemental sampling site selection is generally used during reconnaissance investigations and site screening investigations. This procedure requires knowledge and judgement by the sampler and often involves intentional sample biasing. Systematic sample site selection is normally used when attempting to determine areal extent of contamination or when evaluating spatial variations. Sampling locations are defined by a grid or coordinate system and samples are collected at preselected locations in a uniform pattern. Random sample site selection is used when attempting to determine statistical parameters such as mean and variance. Random site selection involves the use of a random number generator to select sampling locations based on a grid system or transect.

HART chooses the two most appropriate methods according to the USEPA's Soil Sampling Quality Assurance User's Guide (EPA 600/4-84-083) for the optimum approach in an exploratory study. The two sample selection methods suggested are judgmental (the hot spot samples) and systematic (the grid locations). Using the data generated, a model may be hypothesized describing a likely spatial distribution of contamination as well as identifying a likely control area.

A two hundred foot grid will be developed for the Clark's Island Embayment (Enclosure A and Figure 8-1). A total of fifteen surface sediment samples will be collected from the grid. Another three surface sediment samples will be collected in the area of the "hot spot" defined in the Loureiro Report (1986). Two additional surface sediment samples will be held in reserve. Three core samples will be collected from the Clark's Island Embayment. Two cores will be collected in the vicinity of the "hot spot" and one sample on the grid away from the "hot spot" (Enclosure A).

Surface sediment samples will be collected using a dredge. Core samples will be obtained using a gravity core with a three foot core barrel. Sample locations will be described using a combination of electronic and fixed point navigation.



KEY

■ SEDIMENT SAMPLE LOCATION

MODIFIED AFTER LOUREIRO

FIGURE 8-1

CLARKS ISLAND EMBAYMENT SEDIMENT SAMPLES (APPROXIMATE LOCATIONS)

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One surface sediment sample will be analyzed for all compounds listed in Appendix IX (40 CFR Part 264) and TOC. Nineteen surface sediment samples will be analyzed for phenols, TPH, PCBs, TCL volatiles, TOC and priority pollutant metals.

The three cores will be sampled at the 10"-12" and 16"-18" intervals. Each interval will be analyzed for priority pollutant metals and PCBs. Any portion of core remaining will be retained for possible further analyses. These analyses will be contingent upon core recovery and density of the material sampled. A minimum of 150 grams are necessary for metals and PCB analyses.

Positions of core and dredge samples are suggested locations. Locations may change due to conditions (i.e., sediment thickness, navigability) at each point.

8.2.4 SWMU 10 Battery Acid Tank No. 24 (Vicinity Of Building 238)

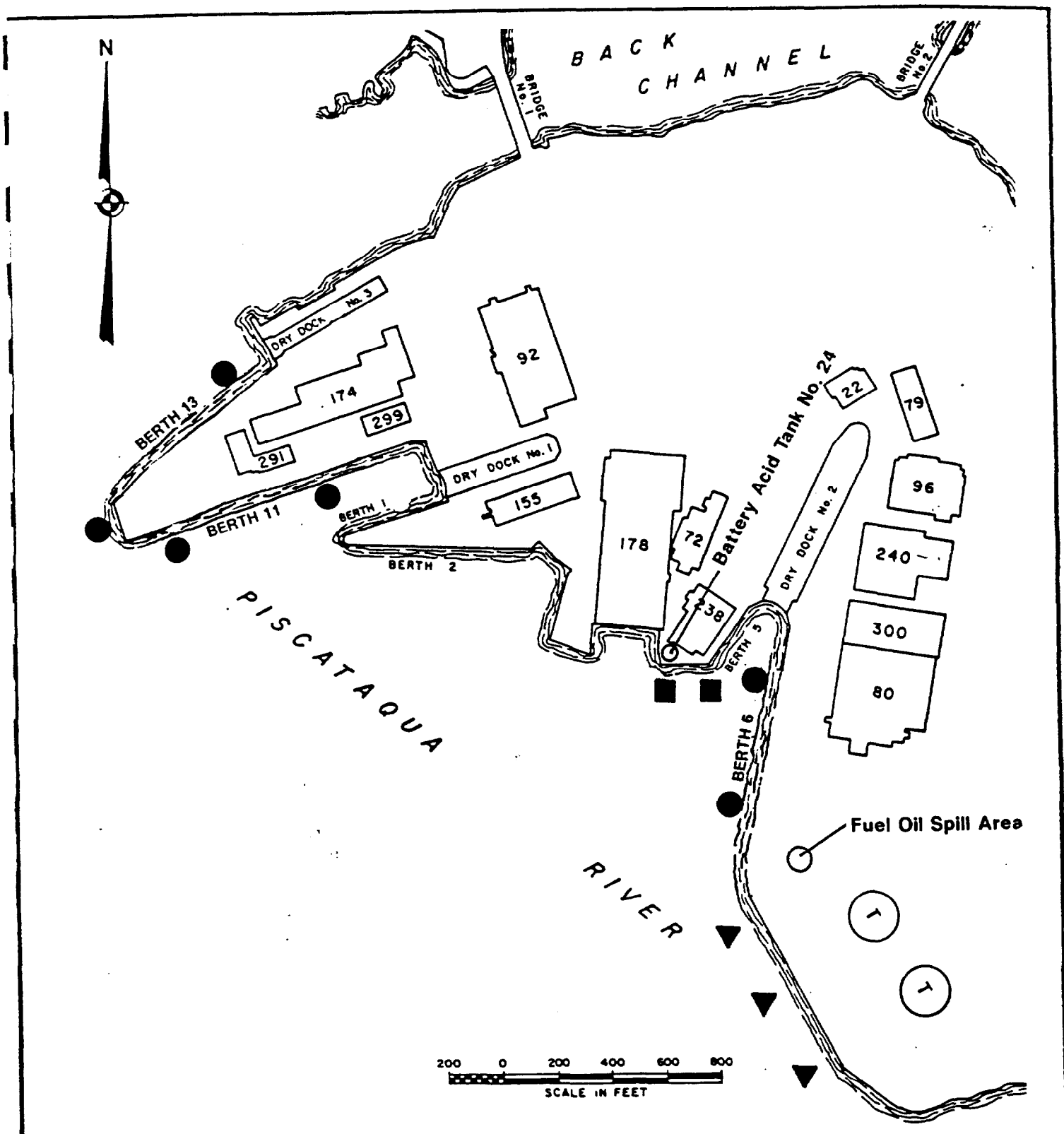
Two surface sediment samples will be collected approximately 50 feet off the bulkhead at Berth No. 4 (Figure 8-2). Samples will be collected using a dredge. The sample location will be defined using a combination of fixed point and electronic navigation coordinates. The two samples will be analyzed for TOC and priority pollutant metals.

8.2.5 SWMU 27 Fuel Oil Spill Area (Southeast Of Berth No. 6)

Three surface sediment samples will be collected 50 feet off the bulkhead in the vicinity of the fuel oil spill area (Figure 8-2). Surface sediment samples will be collected with a dredge. The sample location will be defined using a combination of fixed point and electronic navigation coordinates. Samples will be analyzed for TPH and PCBs.

8.2.6 SWMU 5 Industrial Waste Outfalls (Berth No. 6, 11, 13)

Surface sediment samples will be collected approximately 50 feet off the bulkhead in the vicinity of six industrial outfalls (Figure 8-2). Surface sediment



KEY

- ● SWMU 5
- ▲ SWMU 27
- ■ SWMU 10

FIGURE 8-2

OFF-SHORE SEDIMENT SAMPLES FOR SWMUs 5,10,&27

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samples will be collected using a combination of fixed point and electronic navigation coordinates.

One surface sediment sample will be analyzed for TOC and Appendix IX (40 CFR Part 264) compounds. Five surface sediment samples will be analyzed for TOC, TPH, PCBs, phenols, TCL volatiles and priority pollutant metals.

8.2.7 River

Surface sediment and core samples associated with the main channel will be collected at two locations upstream, two downstream, and two adjacent to the Portsmouth Naval Shipyard (Figure 8-3). Surface sediment will be sampled using a dredge and cores will be sampled using a gravity core. Eight intertidal flat samples will be collected along the back channel (see Figure 8-3). Samples will be collected from the upper six inches of the sediment column. Samples will be collected with stainless-steel trowels. Sample locations will be defined by using fixed points.

Three surface sediment samples, one adjacent, one downstream and one upstream, will be analyzed for Appendix IX (40 CFR Part 264) compounds. Three surface sediment samples, one adjacent, one downstream and one upstream, will be analyzed for TPH, PCBs, phenols, TCL volatiles and priority pollutant metals.

Six gravity cores will be sampled at the 10"-12" and 16"-18" intervals. Each interval will be analyzed for priority pollutant metals and PCBs. Any portion of core remaining will be retained for possible further analysis. All analyses will be contingent upon core recovery and density of the sediment. Metals and PCB analyses require a total of 150 grams.

All back-channel sediment samples will be analyzed for priority pollutant metals, total petroleum hydrocarbons, and PCBs. Positions of core dredge and intertidal samples are contingent upon favorable environmental conditions.

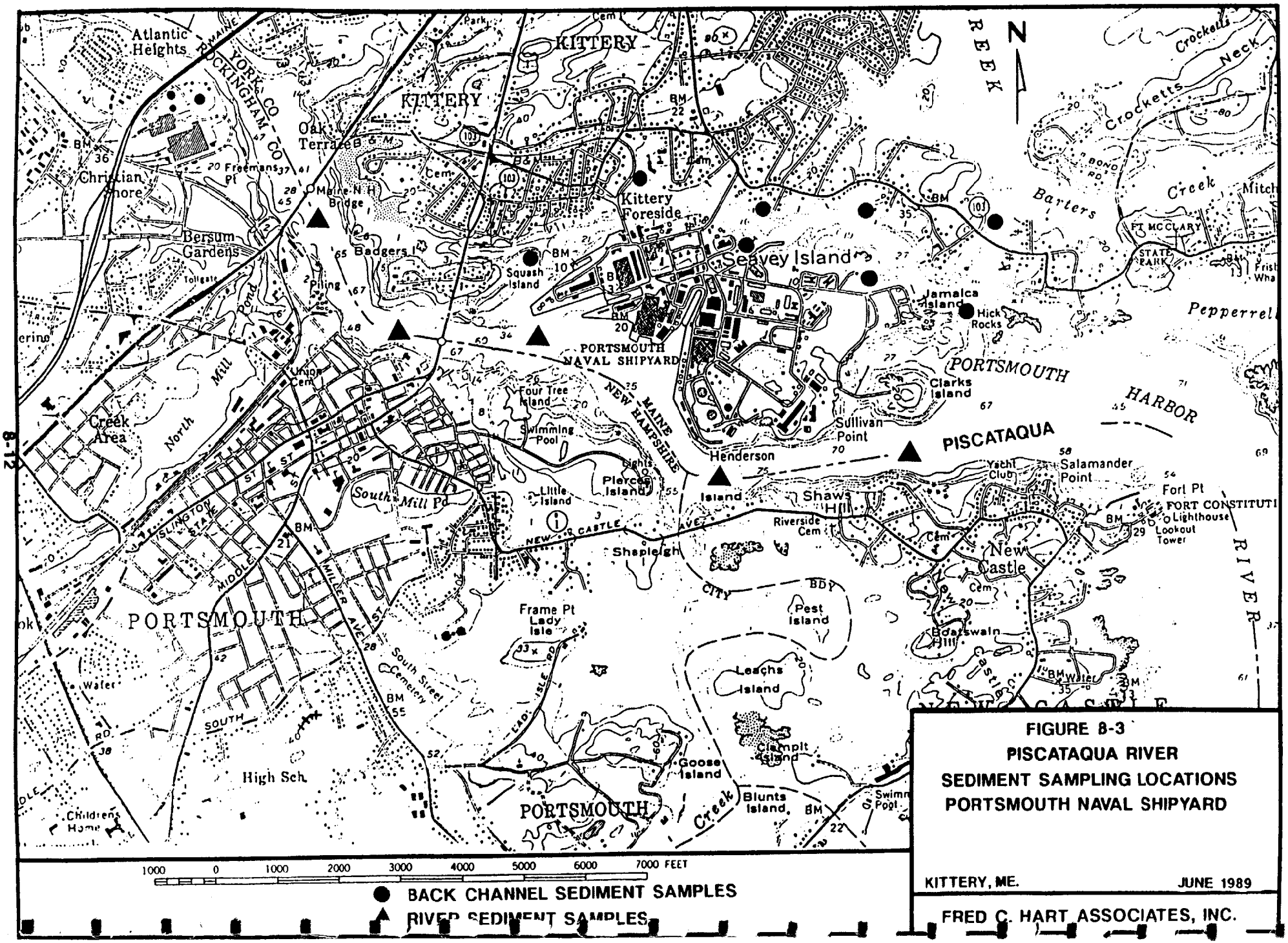

FIGURE 8-3
PISCATAQUA RIVER
SEDIMENT SAMPLING LOCATIONS
PORTSMOUTH NAVAL SHIPYARD

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9.0 TANK INVESTIGATION

9.1 Introduction

A total of nine of the solid waste management units (SWMUs) described in the HSWA permit are tank-related. Of the nine, seven are underground storage tanks (USTs). The tanks related to SWMU 11 have been removed. Of the two remaining SWMUs, #26 is a mobile dockside dumpster and #27 is an abandoned subsurface pipeline with a history of leaks. A brief description of each of the tank related SWMUs is given in Table 9-1.

The purpose of the tank investigation is threefold. The first is to assess the integrity of the storage tanks through inventory records and tightness testing to determine tank system tightness and evidence of unusual inventory variations. The second is to determine through chemical analyses the present chemical characteristics of the tank contents. The third is to conduct a soils investigation, and if indications are that the tank system may be leaking, to verify the presence of contamination and to determine the most appropriate means of remediation.

All investigations and recommendations will conform to current EPA and state of Maine underground tank regulations.

9.2 Records Search

The general approach to tank investigations will be an initial review of available tank information concerning inventory control, documentation of corrosion protection equipment, system repairs, inspection of as-built diagrams, maintenance records, and results of tank closure. The records search will thus provide preliminary information regarding historic tank use, past and present condition and the tanks overall potential for product leaks or spills.

Table 9-1. Tank Related Solid Waste Management Units

Underground Storage Tanks

SWMU No.	Name	Content Description	Tank Description	Analytical Parameters
10	Battery Acid Tank	Spent Battery Acid	Tank Pulled	Lead
11	Waste Oil Tank No. 6 and 7	Used Lubricating Oil and Degreasers	7,500 gal. each Capacity Steel Construction Inspected 11/86, pulled 6/89	PCB's, RCRA Metals, TCL Volatiles
12	Boiler Blowdown Tank No. 25	Heated Water	3,800 gal. Capacity 1974 to Present	TAL Metals, Cyanide
13	Rinse Water Tank No. 27	Unspecified Rinse Water	695 gal. Capacity Steel Construction 1974 to Present	TAL Metals, Cyanide
16	Rinse Water Tank No. 34	Unspecified Rinse Water	750 gal. Capacity Steel Construction 1978 to Present	TAL Metals, Cyanide
21	Acid/Alkaline Drain Tank	Spent Cleaning Solutions	695 gal. Capacity	TAL Metals, Cyanide and TPH
23	Chemical Cleaning Facility Tank	Spent Cleaning Solutions	2,270 gal. Capacity 1978 to Present	TAL Metals, Cyanide and TPH

Aboveground Storage Tanks

26	Oil/Water Dumpsters	Waste Oil	Mobile Dockside Dumpsters on Berth	TPH

Pipeline

27	Former Pipeline	Fuel Oil	Ruptured pipeline 1978. Pipeline and soil excavated.	TPH, PAH

9.3 Waste Characterization

Samples will be collected from all existing tank related SWMUs listed in the HSWA permit (Table 9-1). Any sludge or liquid samples collected as part of this investigation will be analyzed for parameters appropriate to the type of wastes likely to be contained in each tank. A list of the tanks, their contents and the analytical parameters can be found in Table 9-1. Knowledge of the composition and concentration of waste in conjunction with an estimate of the volume of sludge and/or liquids present will allow an evaluation of the options to handle this material. For the purpose of this work plan, it is estimated that one sludge and one free liquid sample will be collected for laboratory analysis from each tank.

Sludge, if present, will be sampled with a sludge sampling device to obtain a representative sample of as much of the sludge column as possible. The sludge samples will be homogenized and placed in the appropriate sample containers and shipped to the laboratory. However, sludge samples for volatile organic analysis will not be homogenized. Any free liquids in the tank will be sampled with a transparent coliwasa device to ensure a representative sample of the liquid column is obtained. The coliwasa sample will be inspected to determine if any multiple phase liquids are present. The sample from the coliwasa will be placed in prepared containers and shipped to the laboratory. If multiple phase liquids are present, the laboratory will be instructed to separate and analyze each phase.

9.4 Release Detection

In conjunction with the document review and waste sampling, tank tightness tests will be performed on USTs in compliance with EPA technical standards as outlined in 40 CFR 280, Subpart D, and appropriate state of Maine regulations. Tightness testing will require the following conditions be met to insure accuracy:

1. Tank should be level and full of test liquid. If the tank is not level a vertical vent pipe must be installed at the high end of the tank to bleed off trapped air.

2. Product in the tank must be of a single composition with a known specific gravity and must be at thermal equilibrium with the tank. Tanks containing mixtures must be emptied, cleaned and refilled with a suitable product (clean water will suffice).

3. A minimum of a two inch diameter direct-fill riser pipe must be used on tanks up to 3,999 gallon capacity. For tanks with a greater capacity the minimum pipe diameter is three inches.

4. A soil boring will be drilled near each tank prior to testing in order to determine the depth to ground water. Pressure exerted on the tank by ground water can have dramatic effect on test results. If the water table is determined to be at the level of the tank extra care must be taken to ensure that all essential test parameters are carefully monitored.

The two ASTs located at the PNS will be visually inspected for leaks and corrosion damage using standard inspection methods such as ultrasonic testing equipment.

Underground storage tanks may be tested by any number of commercially available test methods including:

- Tank Auditor
- Petrotight
- Leak Lokator
- Mooney
- Ainlay or equivalent.

The method to be used at the PNS will be determined by contractor availability, cost and applicability to site conditions upon approval by the Navy.

If a UST fails the tightness test, a second test will be conducted to confirm the results and to determine whether the tank or the piping system had

failed. If the retest confirms tank system failure, test results will be reported as required in 40 CFR 280, Subpart E and a soil investigation will be conducted involving soil borings or excavation of soil, which may have been contaminated by product loss (see Section 4.2.1).

SWMU #27 (Former Fuel Oil System, Berth 6) will also be addressed during the tank investigative activities, but will not involve tightness testing. It is Hart's understanding that the pipeline was in use from the mid 1920s until 1978. A 3,000 gallon release occurred in 1978 which required immediate remediation. Remedial efforts reportedly included plugging and draining the existing pipeline and excavation of oil contaminated soil.

As part of this RFI, a subsurface soil investigation will be conducted at Berth 6 to determine if contaminated soil still exists in the vicinity of the former pipeline. (See Section 4.2.2)

9.5 Field Supplies And Equipment

In order to complete the investigative and sampling tasks outlined above, the following equipment and supplies will be necessary:

- calibrated metal rod
- steel tape
- bottom loading sludge sampling device
- Coliwasa sampler(s)
- stainless steel mixing bowls
- measuring tape (300+ ft.)
- laboratory prepared sample bottles
- scrub brushes
- buckets
- metal wash basins
- soap (Alconox or equivalent)
- methanol
- 10% nitric acid solution
- spray bottles
- appropriate protective clothing
- coolers
- aluminum foil
- labels
- field notebook.

9.6 Decontamination Methodology

The sludge sampler and/or coliwasa device to be used for each required sampling point will be decontaminated to avoid the potential for cross-contamination. The calibrated metal rod will be used at each underground installation identified. This piece of equipment will also be decontaminated between use. The decontamination procedures shall be as follows (See Table 4-3 for all field decontamination procedures):

- wash in soapy water solution of Alconox or equivalent
- rinse with tap water
- rinse with 10% nitric acid solution
- rinse with distilled water
- rinse with methanol
- air dry.

All decontamination liquids will be collected and contained during the investigation and later disposed of at an EPA-approved facility. Since this equipment is not being used to directly obtain the samples, there is no reason to obtain field blanks for laboratory analysis to assess the decontamination procedures.

9.7 Corrective Action

Upon verification of a product release corrective action for UST systems will be taken following 40 CFR 280, Subpart F, and state of Maine UST regulations, whichever is more stringent.

10.0 BIOTA CHARACTERIZATION

10.1 Background

Studies which generally describe the biological resources of the Great Bay Estuary System are incorporated in the IFCR (Section 1.0). These reports, which characterize the distribution and abundance of estuarine species in the Piscataqua River, discuss organisms from algae to birds and mammals (Parsons 1978, Loureiro 1986, Fay 1986). Additional information on biota is contained in the Initial Assessment Study of the Portsmouth Naval Shipyard, prepared in 1983 by Roy F. Weston, Inc.

Several studies have also dealt with the impacts of potential releases of contaminants from the shipyard (Isaza, 1989; Frakes, undated). These studies address the chemical contaminants which were known or suspected to be present at the shipyard. These studies concluded that identified contamination of biota could not be specifically attributed to the shipyard based on inconclusive results and insufficient sampling.

However, the Great Bay Estuary system is extremely complex, as discussed in the IFCR and Offshore Sediment Sampling/Surface Water Characterization (Sections 1.0 and 8.2, respectively). The estuary is well mixed and is affected by the components of seven fresh water rivers and numerous point/non-point contaminant sources. The shipyard is located in an area which is flushed every 6-12 tidal cycles. Clearly, the physical and biological characteristics of this system cannot be adequately determined without a focused, well-conceived plan of study.

10.2 Approach

The biota characterization for this study will be developed using a clear understanding of the existing database coupled with the findings of the site-specific findings of the RFI. It is proposed that the biota characterization

program be developed by the Navy with input from the Technical Review Committee and in close consultation with EPA and DEP as contaminant sources and available pathways are identified during the RFI. In this manner, the source constituents and the available pathways to the estuary system will be characterized prior to the development of the receptor (biota) characterization. Given the complex nature of the physical systems and the strong likelihood of biological impacts from other sources, this approach will have the highest potential for adequately addressing the potential contribution to the estuary from the shipyard. Finally, once the impacts on the estuary are understood and appropriate remedial action implemented, a site-specific monitoring program can be developed.

Recommendations for biota characterization will be developed as a separate draft work plan to be submitted to USEPA for approval. It is anticipated that this plan will be developed concurrently with the first draft of the RFI report. Following EPA review and approval, the plan will be implemented as a separate phase and integrated into a final RFI report. Recommendations for short- and long-term monitoring will be developed for the final report and implemented following EPA approval.

This proposed approach makes the most use of historical data, integrates the site-specific information which characterizes the potential contaminant sources and available pathways, and can directly impact the development of appropriate monitoring programs. Development of a program in the absence of this data is not likely to adequately address the long term goals of the study. The Navy is totally committed to the development and implementation of an appropriate study in full cooperation with USEPA and the appropriate state of Maine agencies.

11.0 DATA COLLECTION QUALITY ASSURANCE PLAN

The Quality Assurance Project Plan is provided as Attachment A to this proposal. The QAPP presents the organization, objectives, functional activities, and specific Quality Assurance (QA) and Quality Control (QC) activities associated with the RFI Proposal developed for the Portsmouth Naval Shipyard. This proposal has described procedures such that the precision, accuracy, completeness, representativeness, comparability, and all other QA/QC objectives of the collected data are known and documented.

12.0 DATA MANAGEMENT PLAN

12.1 Introduction

The Data Management Plan presents a program for managing data acquired during the RFI activities to be conducted at the Portsmouth Naval Shipyard. In the context of this plan, data are defined as 1) technical or analytical information that are either generated by or the result of specific RFI tasks, and 2) information that must be tracked in order to monitor, manage and document the actual performance of RFI tasks. This plan will also provide a computerized mechanism for tracking, retaining and retrieving data in a manner which will not compromise its integrity.

12.2 Technical Database Management System

12.2.1 Background

HART has developed and implemented several customized database management systems (DBMS) for the microcomputer (PC) environment for both in-house and client use. These systems commonly have networking capabilities, support for graphics, and integration with other in-house developed applications including applications running on laptops designed for on-site data entry and analysis. Other system features include compatibility with commercial spreadsheet and database packages such as Lotus 123, Excel, dBase and Oracle, etc.; however, the database systems do not require commercial software to implement. HART has also modularized several key features including a prioritized security system, data validation routines, and file import/export utilities.

12.2.2 Purpose

The data management system will be designed to store, process, analyze and report data. This involves:

- Data collection, transformation, storage and organization.
- Editing and updating of data files.
- Manipulation, analysis and retrieval of entire files or selected portions of one or several files.
- Generation of a variety of outputs, including displays and statistical reports.
- Considerations of data back-up and system security.

12.2.3 Approach/Procedures

The database management system which will be implemented for the Portsmouth Naval Shipyard RFI will be developed by HART on a local area network consisting of six IBM PCs and compatibles. The primary hardware includes two Compaq 386/20's, an IBM AT, and an AT-compatible. The DBMS will be developed primarily using a high level data base language with extensions written in other languages including C, Assembly, SQL, and DOS. The DBMS will use state-of-the-art user interfaces such as pull-down and bounce-bar menus, windowing, context-sensitive help screens, and support for color graphics.

HART's computer support staff will create the initial input system and assist in organizing data base files and report-ready tables and graphics. The data files will be compatible with dBase III+ or Oracle. HART currently operates both systems in-house. Oracle compatibility allows for the development of distributed data files across PCs, mini, and mainframe computers. Once established, the DBMS will allow for any additional chemical or physical data to be incorporated into the files as the data is generated.

12.2.4 Analytical Software And Applications

A FORTRAN program developed in-house by HART will be used to analyze data in the DBMS statistically, or export files will be created for processing by commercial software. The DBMS developed by HART will manage all field and laboratory data and generate output files for export to a number of client data base management systems, including Oracle.

Where appropriate, data in the DBMS will also be analyzed using two and three dimensional contouring software such as SURFER graphics, by Golden Software, Golden, Colorado. The SURFER package uses graphical methods to present physical or analytical data, thus creating a visual picture of the magnitude and spatial distribution of data values at a point in time. SURFER also allows for the overlay of separate data sets or components of individual data sets. Physical data such as bedrock surfaces, depth of overburden, water table attitude, and geophysical anomalies will also be analyzed and presented graphically.

Where appropriate, the validated laboratory analyses generated from the soil, sediment, soil gas, and groundwater investigation programs will be statistically evaluated to determine possible correlations between the sample matrices. The evaluation may include the use of mathematical and/or graphical methods, as applicable to the data. The relationships ascertained during the analysis of the data will be presented graphically or in two or three dimensional plots and overlays whenever possible in order to provide a visual picture of the data and facilitate data interpretation.

Examples of the kinds of correlations (or relationships) that may be evaluated include, but are not limited to, the following:

1. Evaluation of data within the same matrix; e.g., correlation between sets of groundwater flow and quality data collected over time to assist in evaluating tidal influence, potential contaminant migration pathways, and spatial relationships within possible discreet hydrostratigraphic zones of groundwater.
2. Evaluation of data between multiple matrices; e.g., correlations between sets of soil and soil gas data collected within the same time interval to determine possible source-migration relationships.
3. Evaluation of multiple matrix data sets over time; e.g., correlation between two sets of surface water drainage and surface sediment data to determine changes in quality or spatial relationships over time.
4. Evaluation of different analyte components within the same matrix; e.g., correlation among values of pH, conductance, chlorides, metals, volatiles, etc., for a given set of groundwater samples.

12.3 Data Types

As defined in the introduction, information associated with this RFI will be identified as either technical or management data and will require certain procedures regarding documentation. These procedures will ensure that field investigations and data collection activities are properly conducted; that data reduction, validation, and reporting techniques are controlled; and that data collected are representative of the setting and that proper sampling techniques are implemented.

Technical data will be generated in the field and at the analytical laboratory. Documentation will consist of field log books, field sampling and activity forms, chain-of-custody records and seals, laboratory log books and

data sheets, calculations and graphs. Some or all of this data may be commited directly to components of the DBMS residing on laptop computers in the field.

All technical data compiled during the review of the existing data and through the RFI activities will be input to the previously described technical DBMS. Examples of data will include results of geophysical surveys, groundwater levels, aquifer tests, geologic logs of boreholes, sampling data, QA/QC laboratory data, and survey information.

The appropriate technical data will be output as report quality tables, charts, and graphics. The raw data will be presented in dBase III+, ASCII, or Oracle file formats on 5-1/4" disks according to client specifications.

Management data will be generated in the field and at the home office. Managerial data will be tracked and stored with the use of the commercial software package, Time Line, by Symantec Corporation. Items tracked on the managerial database will include, but not be limited to, task scheduling, project budgets and costs-to-date, budget and task percent completion, analytical schedules and costs, manpower and equipment resources, and subcontractor schedules and costs. Project status reports will be prepared and issued periodically to document RFI technical progress and task scheduling.

12.4 Analytical Data Management Procedures

Documentation procedures are discussed in the QAPP and in the following sections. This section presents the fundamental elements of analytical data management required for this RFI.

12.4.1 Scheduling

Upon initiation of the RFI, a number of activities will commence, some in sequence and others concurrently. In order that documentation of these activities progresses with minimal delay or problems, pre-data collection operations need to be identified and scheduled. These operations include identification of sample types and quantities (including blanks and duplicates); location of sampling points; methods of sample collection; ranking of samples for particular analyses (priority and critically); coordination of sampling with the analytical laboratory to include obtaining sample containers, packing material, preservatives and shipping containers; and, preprocessing of sample labels and chain-of-custody forms. Additionally, this operation should assign numbers to samples followed by initial entry of these sample numbers into the computerized data management system or database.

12.4.2 Field Recording

Field measurement results and observations will be recorded in field log books, boring logs, sample data sheets or other suitable record keeping books required of a particular data gathering activity using waterproof ink. Field log books will provide the means of recording data collection activities performed. Entries will be described in as much detail as necessary so that persons going to the site could reconstruct a particular situation without reliance on memory. Data will be recorded directly and legibly in field log books with all entries signed and dated. If entries must be changed, the change should not obscure the original entry. The reason for the change will be stated and the change and explanation signed and dated or identified at the time the change is made. Boring logs and sample data sheets will include

information on the sample locations, sample identification and sampling conditions. They will also include all field measurements and any information specific to the sample. Boring logs and sample data sheets will be organized into standard formats and retained in permanent files.

12.4.3 Sample Identification And Chain-Of-Custody

Field samples will be identified by a sample tag or other appropriate labeling technique. The information on the sample tag will include: the project number, the sampling location, the sample number, the date and time the sample was collected, the names of sampling personnel, the sampling method, the depth interval, type of analyses, types of preservatives (if any) and any instructions or pertinent remarks.

In order for the sample to be processed within the stated QA/QC guidelines and to maintain sample integrity, sample possession must be traceable from the time the sample is collected. Chain-of-custody procedures will provide the method of tracking samples and minimize any subsequent tampering of the sample while it is in transit from the site to the analytical laboratory. These procedures will address field custody, transfer of custody and shipment, and receipt of samples and laboratory custody procedures. One copy of the chain of custody form will be placed in the site file and eventually the permanent project file. The second copy will accompany the samples during transportation to the sample carrier and, ultimately, the laboratory.

As the samples are received by the analytical laboratory, the computerized database will be updated to include the date of sample collection and shipment for each discrete sample. Following laboratory analysis, the raw

13.0 HEALTH AND SAFETY PLAN

A Health and Safety Plan is provided as Attachment B to this proposal. The Health and Safety Plan has been prepared to address hazards that the investigative activities may present to the investigating team and to the surrounding community. The responsibilities of the personnel, protective equipment, procedures, and protocols are addressed in the plan. The Health and Safety Plan also identifies potential problems or hazards that may be encountered and possible solutions, as well as procedures for protecting third parties.

14.0 PROJECT MANAGEMENT PLAN

14.1 Report Preparation

A draft of the RCRA Facility Investigation (RFI) report will be prepared upon completion of the investigation. The draft report will characterize the site and summarize the data collected and the conclusions drawn from all investigative areas. The report will contain applicable site background information, a description of the geologic and hydrogeologic conditions and a discussion of the extent of contamination integrating all available data. In addition, the report will contain the Public Health and Environmental Risk Evaluation with a summary of potential impacts of the shipyard's SWMUs on human health and the environment.

Copies of the draft report will be submitted to the Navy, the USEPA and the Maine Department of Environmental Protection. The report will be submitted no later than three (3) months after completion of the RFI. Following review, comments will be addressed by HART. Within three (3) months of USEPA approval of the draft, copies of the final RFI report will be distributed to the parties listed above. Upon approval of the final RFI report, work will commence on the Corrective Measure Study.

14.2 Project Organization

The following sections describe the project organization for the Portsmouth Naval Shipyard Remedial Investigation/Feasibility Study in Kittery, Maine. Figure 14-1 shows the project organization.

14.2.1 Project Management

The following HART personnel have been designated as Remedial Investigation/Feasibility Study team members for this project:

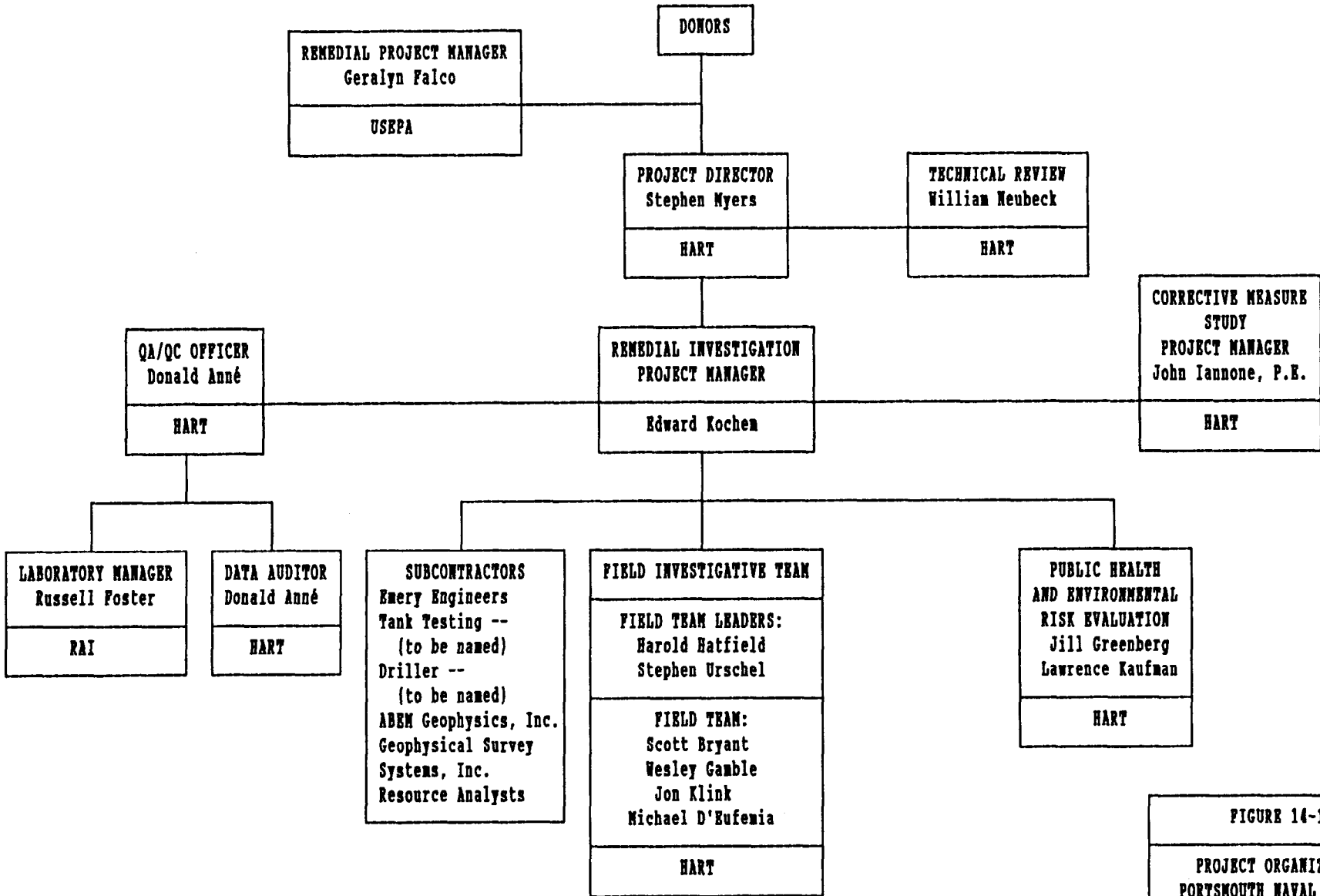


FIGURE 14-1

PROJECT ORGANIZATION
PORTSMOUTH NAVAL SHIPYARD

FRED C. HART ASSOCIATES, INC.

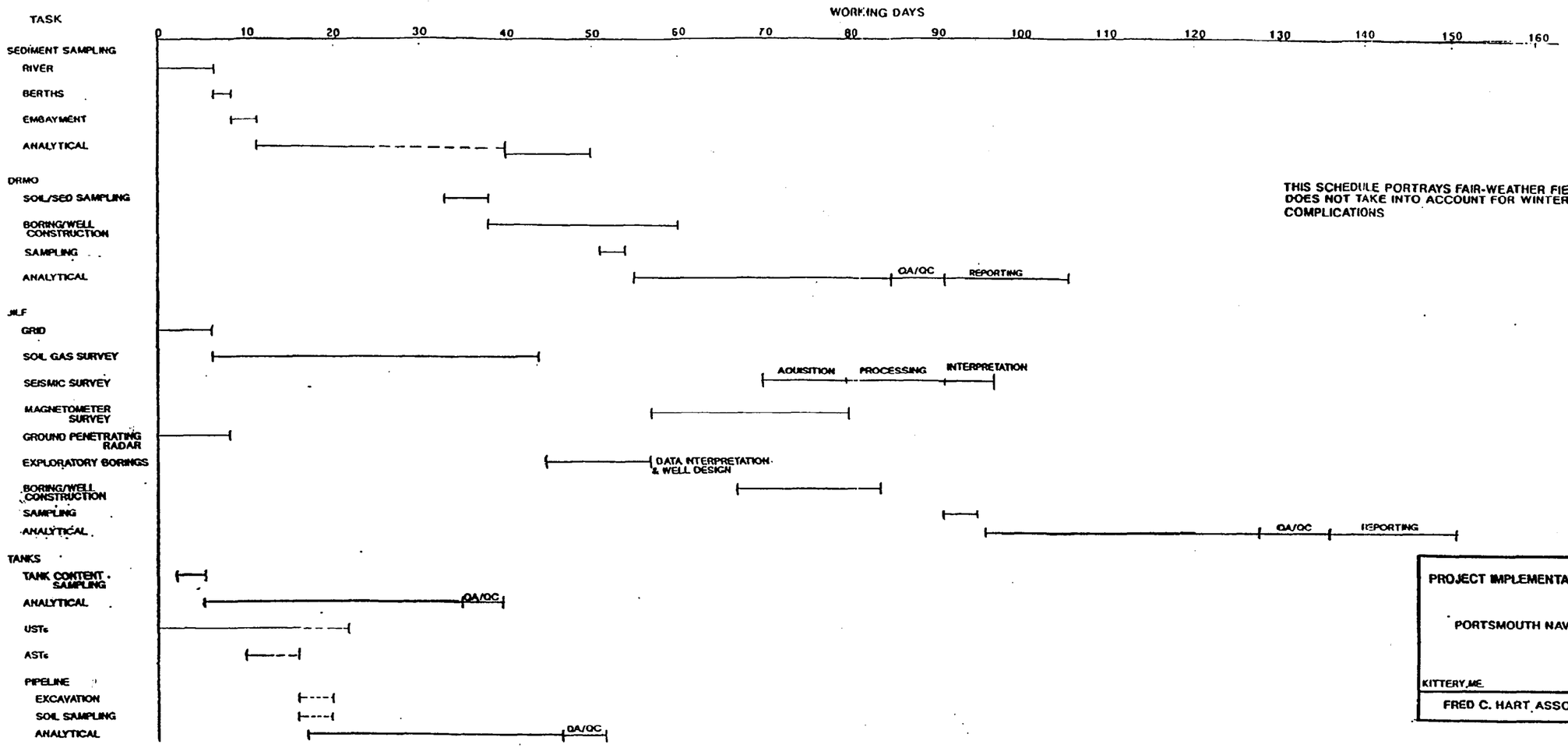
Name	Responsibility
Stephen J. Myers	Project Director
Edward Kochem	RFI Project Manager
John J. Iannone	CMS Project Manager
Donald Anné	Quality Assurance Officer
Jill Greenberg	Public Health and Environmental Risk Evaluation
Harold Hatfield Stephen Urschel	Field Team Leader
Wesley Gamble	Site Safety Officer
William Neubeck	Technical Reviewer

Subcontractors

The following subcontractors will be working on the investigation at the Portsmouth Naval Shipyard:

Subcontractor	Service
Resource Analysts, Inc. (RAI) Hampton, New Hampshire	Laboratory
(Pending)	Tank Testing, Excavation
(Pending)	Drilling
Geophysical Survey Systems, Inc. Hudson, New Hamphire	Ground-Penetrating Radar

14.3 Project Implementation Schedule



THIS SCHEDULE PORTRAYS FAIR-WEATHER FIELD ACTIVITIES. THE SCHEDULE DOES NOT TAKE INTO ACCOUNT FOR WINTER WEATHER OPERATIONAL COMPLICATIONS

PROJECT IMPLEMENTATION SCHEDULE

PORTSMOUTH NAVAL SHIPYARD

KITTERY, ME. JUNE 1989

FRED C. HART ASSOCIATES, INC.

15.0 PUBLIC HEALTH AND ENVIRONMENTAL RISK EVALUATION (PHERE)

15.1 Introduction

A Health and Environmental Assessment (HEA) will be performed for the Portsmouth Naval Shipyard. The HEA will be based on hydrogeological and chemical data obtained during the RFI at the site. The assessment will define the environmental and human health risks associated with the presence of organic and inorganic constituents found within the groundwater, soil, sediment, and surface water at or adjacent to the site.

In order for a risk to occur, there must be parameters having known toxic characteristics present, there must be actual or potential exposure pathways, and there must be human and environmental receptors in the exposure paths. The risk assessment procedure described here addresses these issues by analyzing the site from a source-pathway-receptor viewpoint and by evaluating possible health effects in the context of probable exposure scenarios.

The endangerment assessment will be based on validated chemical analytical data, environmental conditions found during the RFI, and the assessment of migration pathways and exposure scenarios. The endangerment assessment will be designed to quantitatively assess current and future risks posed by the site; however, certain factors are inherently difficult to accurately quantify and therefore will be assessed qualitatively.

15.2 Purpose

The objective of performing an HEA or quantitative risk assessment is to evaluate the potential pathways of migration from all sources of inorganic and

organic constituents attributable to activities at the Portsmouth Naval Shipyard and to determine potential receptors that may be exposed along those pathways.

By conducting an HEA or quantitative risk assessment, the long-term prospects for remedial action at the Portsmouth Naval Shipyard will also be ascertained. The HEA will allow for early definition of the degree of remedial efforts required at particular areas of the site. The HEA has become the driving force for the development and selection of remediation alternatives and, therefore, can greatly influence the cost or remedial measures. A properly prepared HEA that adequately evaluates the risks posed by the site will help minimize remedial costs and reduce future liabilities at the site.

15.3 Methodology

After completion of the RFI analysis and data validation procedures, the HEA will be conducted to assess the presence of contaminants at the site and to what extent they may be released from the site and present a current and/or future danger to public health, welfare and the environment. The assessment will consist of the following four components:

- Contaminant Identification,
- Exposure Assessment,
- Toxicity Assessment, and
- Risk Characterization.

The HEA will evaluate conditions at the site in the absence of any further remedial actions and will constitute an assessment of the No-Action remedial alternative. The assessment will be performed in accordance with USEPA risk assessment methodology established under the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan, as amended. These procedures are described in the RFI document, chapter 8,

HEA reference volume; USEPA Guidelines for Carcinogen Risk Assessment, 51, Federal Register (33992-34003, Sept. 24, 1986); Superfund Public Health Evaluation Manual (SPHEM) (EPA/540/1-86/060, October 1986, as amended); the Endangerment Assessment Handbook (USEPA, August 1985), the Superfund Exposure Assessment Manual (OSWER Directive 9285.5-1, April 1988, as amended); and the Toxicity Handbook--Principles Related to Hazardous Waste Site Investigations (USEPA, August 1985). However, the recommendations for performance of the HEA may be modified to reflect HART's experience in completing risk assessments and the specific concerns at the site.

The results of the Endangerment Assessment will be summarized and reported incorporating the following items into the four basic HEA components:

- contaminants found at the site
- factors affecting contaminant migration
- exposure pathways
- environmental fate and transport of indicator chemicals
- toxicity evaluation of indicator chemicals
- exposed population analysis
- assumptions and extrapolations made with RFI or toxicity data
- the concept of risk vs. safety, and "acceptable" risk
- selection of applicable or relevant and appropriate requirements (ARARs).

15.3.1 Contaminant Identification

Site-derived contaminants of concern or "indicator chemicals" will be identified based on their inherent toxicological properties (e.g., acute and chronic toxicity, carcinogenic potency), migration potential in various media (physical and chemical parameters related to environmental fate and transport; e.g., bioaccumulation potential, environmental partitioning), site specific concentrations or estimation of representative values (based upon a review of all valid environmental monitoring data obtained during the RFI), degree of exposure, and implications for public health.

Contaminant identification will consist of a computer-based screening process that allows for the selection of site-specific contaminants of concern in order to focus subsequent efforts in the risk assessment process. By identifying the chemicals which pose the greatest public health risk at the site, the selection process reduces to a manageable amount the number of chemicals which will be assessed throughout the remainder of the endangerment assessment. The initial list of chemicals will be derived from a comparison of environmental concentrations to known USEPA-established exposure limit criteria and standards.

15.3.2 Exposure Assessment

Identification of Exposure Pathways

The purpose of the exposure assessment is to define actual and potential receptors and possible effects to those receptors from indicator chemicals found on-site. The process will consist of identifying probable exposure pathways and defining exposed populations under a No-Action remedial alternative. A combination of RFI generated data and exposure modeling will be utilized for this step. The most appropriate exposure model will be selected from the Superfund Exposure Assessment Manual. Current and future exposure scenarios will be developed for both a probable case and a realistic worst case scenario. The predicted concentrations will be compared to ARARs, criteria, advisories, guidances or standards (e.g., ambient water quality criteria, or drinking water standards, etc.).

For example, it may be determined that contaminant transport through soil or groundwater could reach the estuary sediments offshore. Exposure routes might include incidental ingestion, dermal absorption, and uptake by

aquatic organisms. This exposed population in this scenario could be site users, aquatic organisms, and terrestrial organisms that ingest aquatic organisms or water from the Piscataqua River, and people who fish at the site. This will be used to determine which populations on or adjacent to the site are potentially at risk.

For each significant exposure pathway (i.e., contaminant release to groundwater, soil, sediments or surface water), the location at which the greatest individual exposure occurs will be identified. Assumptions for a most probable case and a realistic worst case scenario will be formulated. The realistic worst case scenario will be developed for comparison purposes during the risk management decision-making process in order to provide a conservative overestimate of potential risks.

Estimation of Exposure Point Concentrations and Exposed Population

To assess the potential adverse health effects associated with the site, the amount of human and environmental exposure to indicator chemicals must be determined. Therefore, the final step in the exposure assessment process will be to integrate this information, along with an analysis of environmental fate and transport, to develop a quantitative estimate of the exposure point concentration (i.e., chronic daily intake) for each significant exposure pathway using site monitoring data from the RFI and exposure modeling of contaminant transport (i.e., through surface water or groundwater). Chronic daily intakes will be calculated incorporating human intake factors, short/long term concentrations, exposure duration, and bioconcentration factors.

The calculation of human chemical intake considers environmental concentrations estimated in the exposure assessment and intakes from groundwater, surface water, and ingestion of impacted soil and fish. Standard assumptions regarding human body weight and quatitities of water, soil, and fish ingested will be used and identified.

HART has the capability to access the National Computer Center Graphical Exposure Modeling System (GEMS), which provides a simple interface to environmental modeling, physiochemical property estimation, statistical analysis, and graphic display capabilities; the GEMS access also provides data manipulation capabilities supporting all of these functions.

15.3.3 Toxicity Assessment

To assess the potential risks at the site, a toxicity assessment will be developed which describes the quantitative relationship between exposure and degree of toxic effect. A toxicity evaluation will be performed for all indicator chemicals selected during contaminant identification. The process for performing the toxicity evaluation and the dose-response assessment will consist of a literature survey, a computer search (e.g., using the Integrated Risk Information System (IRIS) or other on-line scientific data bases), and a screening of exposure pathways.

Comparison to Standards and Criteria/Identification of ARARs

Contaminant-specific applicable or relevant and appropriate requirements (ARARs), when available, will be identified and used to assess acceptable levels of contaminant exposure and to develop target clean-up levels for the site. To identify ARARs, the following process will be applied: a) define each matrix and exposure pathway of concern (e.g., soil, groundwater or surface water);

b) identify applicable regulatory requirements; c) identify requirements which may be relevant and appropriate; d) identify alternate concentration limits (ACLs) or risk comparison levels (e.g., reference dose levels for noncarcinogens) when ARARs are not available or ARARs represent a risk greater than 1 x 10-4 (one excess lifetime cancer death per 10,000 persons). Acceptable levels will then be based on contaminant levels that would yield exposures less than or equal to USEPA reference dose values (RfDs) for non-carcinogens, and specific risk levels based on potency factors for carcinogens. The EPA's interactive on-line database, IRIS (Integrated Risk Information System), will be used to obtain current reference dose values for noncarcinogens and potency factors for carcinogens. According to current EPA risk assessment methodology, acceptable risk levels for carcinogens generally fall between a 1 x 10-4 (one in 10,000) and a 1 x 10-7 (one in 10,000,000) excess lifetime cancer risk.

15.3.4 Risk Characterization

The purpose of the risk characterization component is to assess the potential for adverse health effects using the information data base developed during the exposure and toxicity assessment. Measured concentrations in media are compared to USEPA-established exposure limit criteria (e.g., reference dose values for noncarcinogens or potency factors for carcinogens) to judge the degree and extent of risk to public health and welfare and the environment for each of the exposure scenarios developed in the exposure assessment.

The Hazard Index approach will be used for estimating non-carcinogenic effects posed by multiple chemicals. This index combines multiple sub-threshold exposures for indicator non-carcinogens which are assumed to yield an adverse effect whose magnitude is proportional to the sum of the ratios of sub-threshold exposures to acceptable exposures. For potential carcinogens, risks will be calculated using chronic daily intakes and respective cancer potency factors. The total potential carcinogenic risk including its reliability will be summarized.

The final assessment will include a summary of the risks associated with the site, including each projected exposure route for contaminants of concern. Quantitative estimates of risk will be evaluated in conjunction with qualitative factors to determine whether present risks are "acceptable" or "unacceptable". These factors are included in an uncertainty analysis and include the accuracy and completeness of site-specific data used to determine potential exposures, the strength of evidence which indicates that a chemical produces a particular toxic effect, modeling assumptions and extrapolations, assumptions contained within the risk estimates, and the estimated uncertainty of the components of the HEA. All assumptions and known uncertainties used in the public health evaluation will be clearly stated.

Risk assessment is composed of two parts: (1) the HEA or estimatation of risk level and (2) the risk management decision. Therefore, an assessment of present and future risks in terms of their relationship to ARARs or other appropriate risk comparison levels is an essential component of this process. It will enable PNS to make risk management decisions regarding the interpretation of predicted risk for the site. These risk assessment

conclusions will allow for the definition of remedial action goals for the site, which will be used in the development of site-specific remediation alternatives in the Corrective Measure Study.

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ATTACHMENT A

QUALITY ASSURANCE PROJECT PLAN FOR THE RCRA FACILITY INVESTIGATION AT THE PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE

Prepared for:

UNITED STATES NAVY
NAVAL FACILITIES ENGINEERING COMMAND
PHILADELPHIA, PENNSYLVANIA

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August 1989

QUALITY ASSURANCE PROJECT PLAN & DATA MANAGEMENT PLAN
FOR THE
RCRA FACILITY INVESTIGATION
AT THE
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

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Approved by:

Project Director: _____
Stephen Myers (HART) Date

Project Manager: _____
Edward Kochem (HART) Date

Quality Assurance Officer:

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Donald Anné (HART) Date

Reviewed by:

Laboratory Quality Assurance Officer:

_____
(RAI) Date

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B. YSI Model 3000 T-L-C Meter Instruction Manual

C. RAI Quality Assurance Plan

Distribution List

Stephen Myers	Project Director (HART)
Ronald Springfield	Project Coordinator (NAVFAC)
Geralyn Falco	Project Coordinator (USEPA)
Donald Anné	Quality Assurance Officer (HART)
	Quality Assurance Officer (USEPA)

1.0 PROJECT DESCRIPTION

The objective of this work is to determine whether or not specific toxic or hazardous materials have contaminated the environment at the Navy Shipyard, Portsmouth, Kittery, Maine. The work will include identification and quantification of pollutant concentrations; extent of, or potential for, migration from suspected sites; and possible effects on human health and the environment. The study will consist of field investigations and may include monitoring well installation, collection and analysis of water, soil, and sediment samples, and preparation of contamination concentration profiles.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The project organizational structure is shown in Figure A-1. The individuals who are responsible for ensuring the collection of valid measurement data and the routine assessment of measurement systems for precision and accuracy include the project manager, the field team leader, the project and laboratory quality assurance officers and the internal reviewer. This chart depicts the organizational relationships between the USEPA Project Coordinator, NAVFAC's Project Coordinator, HART and its subcontractors. The responsibilities of the HART personnel filling these positions are detailed in the following subsections.

2.1 Project Director

The Project Director will be responsible for coordinating HART's implementation of the elements in the Proposal. The Project Director will serve as liaison between NAVFAC's Project Coordinator and the ongoing investigation. Additionally, the Project Director will be responsible for ensuring completion of the monthly reports as well as participating in meetings with the USEPA or its contractor during the course of the project.

2.2 Project Manager

The Project Manager will be responsible for adherence to project schedules; preparation of monthly reports; reviewing and assessing the adequacy of the performance of technical staff and drilling and laboratory subcontractors assigned to the project; maintaining full orderly project documentation; interaction with NAVFAC and EPA during the progress of the project as necessary; and preparing the RFI Proposal. The Project Manager will be responsible for ensuring that EPA personnel and/or EPA authorized representatives are allowed access to the laboratory, records and personnel utilized for analyses of samples collected.

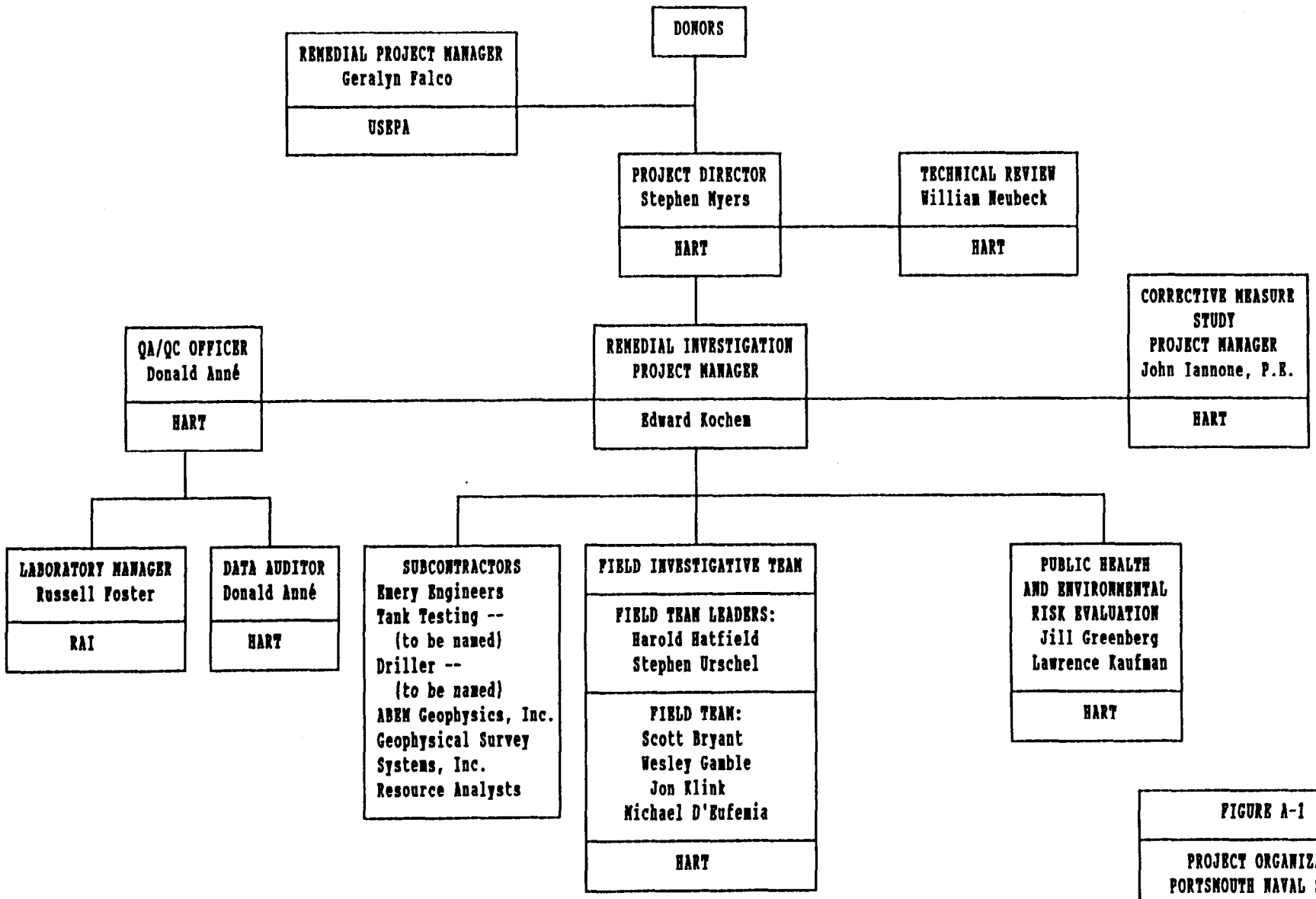


FIGURE A-1

PROJECT ORGANIZATION
PORTSMOUTH NAVAL SHIPYARD

FRED C. HART ASSOCIATES, INC.

2.3 Field Team Leader

The field team leader will be responsible for coordinating the activities of field personnel and drilling contractors; adherence of the field work to project plans; documentation of field work; and management of sampling team and sampling activities from sampling to shipping. The field team leader will also have supervisory authority in the event any components of the Site Safety Contingency Plan have to be implemented.

2.4 Project Quality Assurance Officer

The project quality assurance officer will be responsible for review of field and laboratory data for compliance with QA objectives (precision, accuracy and completeness criteria) as stated in this QAPP, notification to the project manager of any QC deficiencies and conducting the performance and systems audits on the field team.

The project quality assurance officer will conduct at least one appropriate field audit, as described in the approved QAPP, during initial sampling activities to verify that field samplers are correctly following sampling procedures described in the quality assurance and/or sampling plans. A report of the field audit shall be sent to the EPA Project Coordinator within fifteen (15) calendar days of completion of the audit. NAVFAC shall report serious deficiencies and corrective actions to be immediately taken within twenty-four (24) hours of the time NAVFAC knew of the deficiency.

2.5 Laboratory Quality Assurance Officer

The laboratory quality assurance officer will be responsible for quality control procedures and QC checks in the laboratory and will ensure that laboratory protocols are strictly adhered to. The selected laboratory for the RFI is Resource Analysts, Inc. (RAI). RAI is a participant in the Contract Laboratory Program, and has undergone a laboratory audit by Martin-Marietta on behalf of the Navy.

2.6 QC/Sample Tracking

The movement of each sample will be tracked from the time the sampling program begins until the final analytical data are assembled in the report. Test result reports and data management reports, including analytical results, quality control data, chain-of-custody, the appropriate chromatograms and spectra and any historical data, will be assembled by computer. All calculations will be given a final check by the laboratory QA/QC officer.

2.7 Internal Reviewer

An internal reviewer, who is independent of the project team, will be responsible for providing review of project documents and reports with respect to technical adequacy and conformance to the scope of work.

3.0 QA OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, field analysis, laboratory analysis and reporting. Specific procedures to be used for sampling, chain-of-custody, calibration, field and laboratory analysis, reporting, internal quality control, audits, preventative maintenance and corrective actions are described in other sections of this QAPP. The characteristics of major importance to quality measurement data are accuracy, precision, completeness, representativeness and comparability.

3.1 Data Accuracy and Precision

Accuracy is the degree of agreement of a measurement with an accepted reference or true value and is a measure of bias in a system. Precision is a measure of mutual agreement among individual measurements of the same properties and is best expressed in terms of the standard deviation or relative percent difference (RPD). QA targets for accuracy and precision are stipulated in the "Standard Operating Procedure" (standard procedure) for each analytical parameter. The standard procedures for analysis parameters are discussed in Section 4.3 of this QAPP, Analytical Procedures.

3.2 Data Completeness

Due to accessibility problems, the potential exists that less than 100 percent of the samples will be collected. It is expected that the laboratory will provide data meeting QC acceptance criteria for 95 percent or more of all samples analyzed. Laboratory data will be reviewed by the laboratory and project QA officer for completeness. Completely valid data are required for samples designated as "background samples". Corrective actions to achieve a complete data set may include any of the following: 1) re-analysis; 2) re-extraction; or 3) resampling.

3.3 Data Representativeness

Provisions to ensure data representativeness are discussed more fully in the sampling plans presented in Section 3.0 of the RFI Proposal. Sampling locations have been chosen to provide a valid approximation of the nature, types and quantities of inorganic or organic constituents at the site. The following discussion covers the highlights of the program.

Regularly spaced sampling locations along a band 300 feet from the DRMO provide for unbiased sampling of surficial soils. The sampling plan will allow for characterization and estimation of the extent and magnitude of inorganic constituents in surface soils. Soil samples will be analyzed for Priority Pollutant Metals and PCBs.

During test boring and monitoring well installation at the DRMO, soil samples will be obtained in advance of the hollow stem augers from every five-foot interval by means of a split-spool sampler. Soil samples, composited from a two-foot sample interval, will be retained from every five feet for analyses of TPH, PCBs, and Priority Pollutant Metals.

Catch basins at the DRMO are collection points for soil that is transported via surface water runoff. A sediment sample will be collected at the furthest downgradient catch basin containing sediment. If present, sediment will also be collectd from within, or in the vicinity of, the outfall. The two samples will be analyzed for PCBs, TPH, and Priority Pollutant Metals.

Samples will be obtained from all of the monitoring wells installed by HART to assess potential contamination within the groundwater aquifer at the DRMO. Groundwater samples at the DRMO will be analyzed for Priority Pollutant Metals, PCBs, and TCL Volatiles.

Regularly spaced sampling locations along established grid lines throughout the JILF will provide for unbiased sampling of soil gas. Soil gas will be analyzed for Total Volatiles.

Following the exploratory test boring program at the JILF, drilling and soil sampling will be undertaken prior to monitoring well installation. Soil samples, composited from a two-foot sample interval, will be retained from every five feet for analyses of PCBs, Priority Pollutant Metals, and TCL Volatiles. Once tidal deposits are encountered, soil samples will still be obtained every 5 feet, but samples for analytical analyses will be collected every 10 feet. At each test boring location, a soil sample will be obtained for analyses of TCL Organics and TAL Inorganics. The sampling interval for these parameters will be at the discretion of the on-site hydrogeologist.

Samples will be obtained from all of the monitoring wells installed by HART to assess potential contamination within the groundwater aquifer at the JILF. Groundwater samples will be analyzed for TCL Organics and TAL Inorganics.

Samples from within the Clark's Island Embayment will be analyzed for TAL inorganics and Full TCL organics in order to adequately characterize the occurrence, extent, and concentration of contaminants in the shallow tidal-flat sediment of the Piscataqua River in the immediate vicinity of the JILF.

3.4 Data Comparability

The methods used for the collection and analysis of samples from this site, as documented in the RFI Proposal and this QAPP, are expected to provide comparable data. All aqueous sample analysis results will be reported in ug/L (ppb) or mg/L (ppm). All soil and sediment sample analysis results will be reported in ug/kg (ppb) or mg/kg (ppm).

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Sampling Procedures

Procedures for collecting samples during the RFI to be conducted at this site are described in the following sections of the Site Hydrogeologic Investigation Proposal (SHIP):

- Subsurface Gas Analysis Plan (SGAP)
- Soils Investigation Plan (SIP)
- Groundwater Investigation Plan (GIP)
- Surface Water Evaluation Plan (SWEP).

Procedures for sampling equipment decontamination are also specified in these plans. The types of containers used for soil and water samples for specified analyses as well as the required preservation and applicable holding times are detailed in Table A-1.

At the request of EPA, HART shall allow split or duplicate samples to be taken by EPA or its authorized representatives, of any samples collected by HART, pursuant to the approved SOW and/or WPs. HART shall notify EPA not less than ten (10) days in advance of any such sample collection activity. EPA shall allow split or duplicate samples to be taken by HART or its authorized representatives, of any samples collected by the EPA that relate to matters referenced in the SOW or approved WP. EPA shall give NAVFAC ten (10) days notice of its proposed sampling date.

4.2 Analytical Procedures

The standard procedure for analysis of TCL organic compounds for both liquid and solid 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 TAL inorganic compounds for both liquid and solid samples can be found in the most current USEPA "Statement of Work (SOW), Inorganic Analysis, Multi-Media Multi-Concentration". These analyses will be conducted under CLP reporting requirements.

Table A-1. Sample Containers, Preservation and Holding Times

Parameter	Media	Container	Sample Preservation	Holding Time
TCL Volatiles	Water	40 ml glass vials with teflon-lined septums	Cool at 4°C Acidify to pH<2 with HCl	10 days
TCL Semi-Volatiles	Soil	8 oz glass bottles with Teflon-lined caps	Cool at 4°C	10 days until extraction; analysis within 40 days of extraction.
	Water	One liter amber glass bottles with Teflon-lined caps	Cool at 4°C	5 days until extraction; analysis within 40 days of extraction.
TCL Pesticides/PCBs	Water	One liter amber glass bottles with Teflon-lined caps	Cool 4°C	5 days until extraction; analysis within 40 days of extraction
TAL Inorganics	Soil Water	8 oz glass bottles One liter polyethylene bottles	Cool at 4°C Acidify to a pH < 2 with HNO_3	6 months** 6 months*
Priority Pollutant Metals	Soil Water	8 oz glass bottles One liter polyethylene bottles	Cool at 4°C Acidify to a pH < 2 with HNO_3	6 months** 6 months*
Cyanide	Soil Water	8 oz glass bottles 8 oz glass bottles	Cool at 4°C Addition of NaOH to a pH > 12	14 days** 14 days
Phenols	Soil	8 oz glass bottles with Teflon-lined caps	Cool at 4°C	10 days until extraction; analysis within 30 days of extraction
Total Organic Carbon	Soil	One liter glass bottles with Teflon-lined glass caps	Cool at 4°C	5 days until extraction; analysis within 30 days of extraction

* - Holding time for mercury is 28 days.
** - Recommended holding time.
TCL - Target Compound List
TAL - Target Analyte List

The laboratory analyzing samples collected during the RFI will use the methods and submit deliverables delineated in the 7/87 Revision of the "Statement of Work of the EPA Contract Lab Program" (CLP) and any future revisions to the "Statement of Work of the EPA Contract Lab Program" that are provided by EPA to NAVFAC and/or the laboratory.

5.0 SAMPLE HANDLING, SHIPPING AND CUSTODY

5.1 Field Documentation

Following sampling, the sealed sample container, as specified in Table A-1, will be wiped with a moist paper towel, dried and labeled. The sample labels will contain, at a minimum, the following information:

- Media
- Sample ID Number
- Sample Location
- Name of Sampling Personnel
- Name of Sampling Organization
- Date and Time Sampled
- Type of Preservative, if any
- Analysis Requested.

Sample labels shall be completed in waterproof ink. Following labeling, sample containers will be placed in sealed clear plastic zip lock type bags and placed in a cooler for storage and shipment. At least two bags of ice, sealed in double plastic bags, will be placed in each cooler and cushioned using vermiculite, foam rubber or other similar packaging material to maintain all samples at 4 °C.

A chain-of-custody form will be maintained for each sample collected. The chain-of-custody procedure will provide accurate written records which can be used to trace the possession and holding of samples from the time of collection through data analysis and reporting. The following information will be specified for each sample on the chain-of-custody form: 1) sequential sample number; 2) sample media; 3) sample date and time; 4) sample location; and, 5) analysis requested. A sample chain-of-custody form is provided in Figure A-2.

The chain-of-custody form will be signed by each participant. The forms will be placed in a water tight plastic bag and taped to the underside of the lid of the cooler containing the samples designated on the form. The lid of the cooler will be securely taped shut. Sample coolers will be shipped the same day as sampling for next day delivery to the analytical laboratory.

FIGURE A-2 D.C. No.: A 1981

HART

Name: _____

Affiliation: _____

Phone: _____

Address: _____

Client/Job No: _____

Job Name: _____ Location: _____

CHAIN OF CUSTODY RECORD

Sample No.	Lab I.D. No.	Date	Time	Matrix	No. of Containers	Analysis Requested/Remarks

Comments: _____

Relinquished by: _____ Date: _____ Shipment Method: _____
Time: _____ Airbill No.: _____

Received by: _____ Date: _____ Relinquished by: _____ Date: _____
Time: _____ Time: _____

Received by: _____ Date: _____ Relinquished by: _____ Date: _____
Time: _____ Time: _____

Final Disposition of Samples: _____

Received by: _____ Date: _____ Time: _____

HART Form 400 Pink/Field Copy - Yellow/Lab Copy - White/Original - To be returned with results.

Field log books will provide the means of recording data collection activities performed. Entries into the field log book will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field log books will be bound field survey notebooks. Log books will be assigned to field personnel but will be stored in the field project file when not in use. Each log book will be identified by a project specific number. The title page of each notebook will contain 1) person or organization to whom the book is assigned; 2) the book number; 3) project name; and, 4) start and end dates.

Measurements made and samples collected will be recorded in field log books. All entries will be made in waterproof ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and intialed. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station, which includes compass and distance measurements, will be recorded. The number of photographs taken of the station will also be documented. All equipment used to make measurements will be identified, along with the date and person doing the calibration. All persons involved with the sampling must be identified in the field log book.

5.2 Laboratory Documentation

The preparation of all sample containers (i.e., cleaning, addition of preservatives) prior to their use is described in Appendix C.

Upon arrival to the laboratory, samples will be checked in by the laboratory representative and pH of sample containers will be recorded. All samples contained in the shipment will be compared to the chain-of-custody form to ensure that all samples designated have been received. Sample custody within the laboratory includes:

- Identification of responsible party to act as sample custodian at the laboratory facility authorized to sign for incoming field samples, obtain documents of shipment and verify the data entered onto the sample custody records.

- Provision for a laboratory sample custody log consisting of serially numbered standard lab-tracking report sheets.
- Specifications of laboratory sample custody procedures for sample handling, storage and dispersement for analysis.

Soil, sediment and groundwater samples for inorganics analyses will be retained by the laboratory for a period of 3 months after analysis or until permission to discard is received to provide an opportunity for retesting if necessary. Samples must be protected from light and refrigerated at 4 °C until extraction. Soil, sediment and groundwater samples for organic analyses will be properly disposed of by the laboratory once the applicable holding times have been exceeded.

5.3 Project Documentation

A project file will be maintained by the Project Manager which will contain complete project documentation. This file will include: project plans and specifications; field log books and data records; photographs; maps and drawings; sample identification documents; chain-of-custody records; the entire analytical data package provided by the laboratory including QC documentation; copies of raw data computer printouts; gas chromatograms; mass spectra; data validation notes; references and literature; report notes and calculations; progress and technical reports; correspondence; and other pertinent information.

6.0 EQUIPMENT CALIBRATION/MAINTENANCE

A maintenance, calibration and operation program is implemented to ensure that routine calibration and maintenance is performed on all field instruments. The program provides equipment of the proper type, range, accuracy and precision to provide data compatible with the specified requirements and desired results. Calibration of measuring and test equipment is performed internally using in-house reference standards or externally by agencies or manufacturers.

6.1 Responsibility

The project quality assurance officer is responsible for ensuring that the field instruments used in this RFI are calibrated and maintained according to manufacturers specifications. Field instrument manuals describing calibration, maintenance and field operating procedures for these instruments are provided in Appendices A and B for easy reference by field personnel and government project personnel.

Team members shall be familiar with the field calibrations, operation and maintenance of the equipment, and will perform the prescribed field operating procedures outlined in the operation and field manuals accompanying the respective instruments. They will keep records of all field instrument calibrations and field checks in the field log books.

6.2 Calibration

The pH and conductivity meters will be calibrated daily as described in the field manuals (Appendices A and B).

Equipment that fails calibration or becomes inoperable during use shall be removed from service and tagged to prevent inadvertent use. If on-site monitoring equipment should fail, the Site Safety Officer will be contacted immediately and will either provide replacement equipment or have the

malfunction repaired immediately.

Records shall be prepared and maintained for each piece of calibrated measuring and test equipment to indicate that established calibration procedures have been followed (e.g. results of calibration, problems, corrective action). Records for field equipment used only for this specific project shall be kept in the project files.

6.3 Preventative Maintenance

Periodic preventive maintenance is required for sensitive equipment. Instrument manuals are kept on file for reference purposes should equipment need repair. Troubleshooting sections of manuals are often useful in assisting personnel in performing maintenance tasks (see Appendices A and B).

7.0 DATA REDUCTION, VALIDATION AND REPORTING

The analytical laboratory will review appropriate quality control data to assure the validity of the analytical results. The analytical laboratory will prepare and retain full analytical and QC documentation as required by the Contract Laboratory Program (CLP). Such documentation need not be hard copy, but may be in other storage media (e.g., magnetic tape). The analytical laboratory will supply one hard copy of the analytical and QC documentation to HART for storage in the project file.

The analytical laboratory will provide the following information to HART in each analytical data package they submit:

- Analytical test methods and results for submitted samples, with appropriate data quality notations.
- Narrative including statement of samples received, description of any deviation from the QAPP, explanation of qualifications regarding data quality and other significant items encountered during analysis.
- According to CLP protocol, the laboratory is required to tentatively identify unknown compounds not included in the TCL list. This includes twenty (20) semi-volatile organic compounds, ten (10) volatile organic compounds and ten (10) pesticide/PCB compounds.
- A QA/QC report including:

  Organic Parameters

  - surrogate spike results for each sample
  - matrix spike and matrix spike duplicate results
  - method blank results
  - initial calibration
  - continuous calibration check
  - GC/MS tuning and mass calibration
  - compound identification spectra

  Inorganic Parameters

  - spike and duplicate results
  - method blank results
  - initial calibration verification results
  - instrument detection limits
  - laboratory control sample results
  - ICP interference check sample analysis.

Data assessment will be accomplished by the joint efforts of the Project QA Officer and Project Manager. The data assessment by the Project Manager will be based on the criteria that the sample was properly collected and handled according to the sampling plans and this QAPP.

The Project QA Officer will conduct a systematic review of the data for compliance with the established QA/QC criteria based on the spike, duplicate and blank results provided by the laboratory. An evaluation of data accuracy, precision, sensitivity and completeness will be performed and presented in the RFI report. This evaluation will be based on the following EPA documents:

1. Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, May 28, 1985.
2. Laboratory Data Validation, Functional Guidelines for Evaluating Pesticides/PCBs Analyses, May 28, 1985 (Supplemented on June 24, 1985).
3. Draft Inorganic Data Validation Standard Procedure, May 14, 1985.

The Project QA Officer will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Project Manager based on the extent of the deficiencies and their importance in the overall context of the project.

The Project QA Officer will provide data validation of analyses done by the laboratory, as described in the approved QAPP. This data validation shall determine data usability and shall be performed in accordance with the EPA Functional Guidelines for Data Review for data derived by CLP methods, or with the QA/QC criteria set forth in the method, if other than a CLP Method. For methods lacking QA/QC data validation protocols, HART will establish validation criteria such as those in Section 8 of the EPA Series Methods in 40 CFR 136. The appropriate quality assurance data validation summary reports will be submitted, along with sample data and summary sheets, to the EPA Project Coordinator at the time final sample results are provided to EPA.

NAVFAC will make available to EPA the results of all validated sampling and/or tests or other data generated by NAVFAC in conducting the RFI. NAVFAC will submit these validated results in monthly progress reports as described in Section VIII of the Consent Order and the approved, attached SOW.

Following data review, all data generated for the Portsmouth Naval Shipyard RFI will be entered into a computer in a format organized to facilitate data review and evaluation. The computerized data set will include the data flags provided by the laboratory in accordance with the CLP Statement of Work as well as additional comments of the data reviewer. The laboratory provided data flags include such items as: 1) concentrations below required detection limit; 2) estimated concentration due to poor spike recovery; and, 3) concentration of chemical also found in laboratory blanks. Additional comments will address if the data is: 1) usable as a quantitative concentration; 2) usable with caution as an estimated concentration; or, 3) unusable due to out-of-control QA results.

The Portsmouth Naval Shipyard RFI data set will be available for controlled access by the Project Manager and other authorized personnel. The completed data set will be incorporated into the RFI report.

Further details concerning the management of the Portsmouth Naval Shipyard RFI data set and files are addressed in the Data Management Plan (Section 12.0 to the RFI Proposal).

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Laboratory Internal QC Checks

RAI, the laboratory selected to conduct analyses of samples taken at the Portsmouth Naval Shipyard, is a participant in EPA's CLP. The laboratory has a documented Quality Assurance Program that complies with EPA Guidance Document QAMS-005/80. Inorganic and organic testing will be performed in accordance with the procedures specified in the CLP Statements Of Work. There are two types of quality assurance used by the CLP to ensure the production of analytical data of known and documented usable quality: 1) analytical method quality control (QC); and, 2) program quality assurance (QA).

It will be the responsibility of the laboratory, specifically the laboratory QA offices, to document, in each data package provided, that both initial and ongoing instrument and analytical QC function have been met. Any samples analyzed in non-conformance with QC criteria will be re-analyzed by the laboratory when sufficient sample volume is available and the allowed holding time is not exceeded.

8.2 Field Internal QC Checks

For field quality control, replicate samples and field or equipment blanks will be obtained for each of four sampling categories (surface soil, surface water, sediment and groundwater) and trip blanks will be used in conjunction with groundwater sampling. The procedures for obtaining these QA/QC samples are included in their respective sampling plans (Proposal Sections 4.1.1, 4.1.2, 4.3.1, and 6.4.2). The standard procedure for obtaining replicates is one replicate for every ten to twenty samples. Field blanks will be collected throughout the sampling events for each matrix. Field blanks for soil will be obtained by pouring distilled water obtained from the laboratory or a chemical supply house over decontaminated sampling equipment (trowels or mixing bowls).

The water will pass over this equipment and be allowed to run directly into laboratory prepared bottles. All information relative to the field blank will be noted in the field log book and each field blank will be given sequential numbers preceded by the letters "FB". One trip blank for TCL volatiles will be sent with each shipment of groundwater samples. Tables A-2, A-3, and A-4 summarize the number and types of replicate and field blank samples to be collected during the Portsmouth Naval Shipyard RFI.

Table A-2. Summary of Offshore QA/QC Samples

Sample Media	Analytical Parameters	Number of Sample Points	Number of QA/QC Samples	
			Replicates	Field Blanks*
Surface Sediment (SWMU 5)	PP Metals	5	1	-
	TPH	5	1	-
	PCBs	5	1	-
	TCL Volatiles**	5	1	-
	TOC	6	1	-
	Phenols***	5	1	-
	Appendix IX**	1	-	-
Surface Sediment (SWMU 8)	PP Metals	19	2	1
	TPH	19	2	1
	PCBs	19	2	1
	TCL Volatiles**	19	2	1
	TOC	20	2	1
	Phenols***	19	2	1
	Appendix IX**	1	-	-
Surface Sediment (SWMU 10)	PP Metals	2	-	-
	TOC	2	-	-
Surface Sediment (SWMU 27)	TPH	3	-	-
	PCBs	3	-	-
Surface Sediment (River)	PP Metals	11	2	-
	TPH	11	2	-
	PCBs	11	2	-
	TCL Volatiles**	3	1	-
	Phenols***	3	1	-
	Appendix IX**	3	-	-
Core Sediment (SWMU 8)	PP Metals	6	1	-
	PCBs	6	1	-
Core Sediment (River)	PP Metals	12	1	1
	PCBs	12	1	1

* For soil/sediment sample, a rinsate blank will be used for a field blank.
** One trip blank per sampling day will be analyzed for TCL volatiles.
*** Phenols by Method 604 or 8040.

TCL--Target Compound List
TOC--Total Organic Carbon
TPH--Total Petroleum Hydrocarbons
PCBs--Polychlorinated biphenyls, Method 608 or 8080
PP--Priority Pollutant

Table A-3. Summary of JILF QA/QC Samples

Sample Media	Analytical Parameters	Number of Sample Points	Number of QA/QC Samples	
			Replicates	Field Blanks
Soils				
Test Borings	TCL Organics*	11	1	1
	TAL Inorganics	11	1	1
Mercury Burial	RCRA Metals	20	2	1
Well Borings**	PP Metals	48	5	1
	TCL Volatiles*	48	5	1
	PCBs	48	5	1
Groundwater				
JILF	TCL Organics*	8	1	1
JILF	TAL Inorganics	8	1	1
Mercury Burial	RCRA Metals	5	1	1

*One trip blank for TCL Volatile Organics will be sent with each shipment of groundwater samples.

**The final number of sampling points is contingent upon the results of the exploratory test boring, geophysical, and soil gas programs.

PP--Priority Pollutant
TCL--Target Compound List
TAL--Target Analyte List

Table A-4. Summary of DRMO QA/QC Samples

Sample Media	Analytical Parameters	Number of Sample Points	Number of QA/QC Samples	
			Replicates	Field Blanks
Surface Soil	PP Metals	14	1	1
	PCB	14	1	1
	TPH	14	1	1
Sediment (Offshore)	PP Metals	2	1	0
	PCB	2	1	0
	TPH	2	1	0
Soil Borings	PP Metals	35	4	1
	PCB	35	4	1
	TPH	35	4	1
Groundwater	PP Metals	7	1	1
	PCB	7	1	1
	TCL Volatiles**	7	1	1

*Field blanks for soil and sediment samples will be rinsate blanks.

**One trip blank for TCL Volatiles/day of sampling.

PP--Priority Pollutant
PCBs--Polychlorinated biphenyls, Method 608 or 8080
TPH--Total Petroleum Hydrocarbons
TCL--Target Compound List

9.0 PERFORMANCE AND SYSTEMS AUDITS

9.1 Laboratory Performance and Systems Audits

The analytical laboratory will conduct both internal and external quality control checks. External quality control checks may include participation in various certification programs with various governmental agencies and/or analysis of QC samples of known concentrations received from the USEPA. Internal quality control checks (replicates, spikes and duplicates) are performed in accordance with specific methods and criteria required by the state in which analyses are performed. A Laboratory Quality Assurance Plan is provided in Appendix C.

9.2 Field Team Performance and Systems Audits

The Project QA officer will be responsible for conducting three audits: a performance audit; an evidence audit, and a performance evaluation of the field analysis team. The audits will evaluate the implementation of the project QA program.

A minimum of one performance audit will be conducted early in the remedial investigation to ensure that proper procedures are followed and that subsequent data will be valid. It will focus on the details of the QA program. The audit checklist, which begins on the following page, will serve as the guide for the performance audit for field procedures. The audit will evaluate the following:

- Project Responsibilities
- Sample Custody Procedures
- Document Control
- Sample Identification System
- QC Corrective Action Procedures

The QA officer will also be responsible for conducting one evidence audit. The purpose of the evidence audit is to ensure that proper project documentation is maintained. An example of an evidence audit checklist follows the audit checklist. This document will serve as the guide for the evidence audit.

PERFORMANCE AUDIT CHECKLIST

PORTSMOUTH NAVAL SHIPYARD

Field Investigation Audit

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members: _____

Yes ___ No ___ 1) Has a project coordinator been appointed?

Comments _____

Yes ___ No ___ 2) Was a project plan prepared?

Comments _____

Yes ___ No ___ 3) Was a briefing held for project participants?

Comments _____

Yes ___ No ___ 4) Were additional instructions given to project participants?

Comments _____

Yes ___ No ___ 5) Is there a written list of sampling locations and descriptions?

Comments _____

Yes ___ No ___ 6) Is there a list of accountable field documents checked out to the project coordinator?

Comments _____

Yes ___ No ___ 7) Is the transfer of field documents from the coordinator to field participants documented in a logbook?

Comments _____

Yes ___ No ___ 8) Are samples collected as stated in the project plan or as directed by the coordinator?

Comments _____

Yes ___ No ___ 9) Are samples collected in the type of containers specified in the project plan or as directed by the coordinator?

Comments _____

Yes ___ No ___ 10) Are samples preserved as specified in the project plan or as directed by the coordinator?

Comments _____

Yes ___ No ___ 11) Are the number, frequency, and type of samples collected as specified in the project plan or as directed by the coordinator?

Comments _____

Yes ___ No ___ 12) Are the number, frequency, and type of measurements and observations taken as specified in the project plan or as directed by the coordinator?

Comments _____

Yes ___ No ___ 13) Are samples identified with sample tags?

Comments _____

Yes ___ No ___ 14) Are blank and duplicate samples properly identified?

Comments _____

Yes ___ No ___ 15) Are sample and serial numbers for samples split with other organizations recorded in a logbook or on a chain-of-custody record?

Comments _____

Yes ___ No ___ 16) Are samples listed on a chain-of-custody record?

Comments _____

Yes ___ No ___ 17) Is chain-of-custody documented and maintained?

Comments _____

Yes ___ No ___ 18) Are quality assurance checks performed as directed?

Comments _____

Yes ___ No ___ 19) Are photographs documented in logbooks as required

Comments _____

Yes ___ No ___ 20) Have any accountable documents been lost?

Comments _____

Yes ___ No ___ 21) Have any accountable documents been voided?

Comments _____

Yes ___ No ___ 22) Have any accountable documents been disposed of?

Comments _____

EVIDENCE AUDIT CHECKLIST

PORTSMOUTH NAVAL SHIPYARD

Document Control Audit

Project No.: _____

Project Location: _____ Date: _____

File Location: _____ Signature: _____

Yes ___ No ___ 1) Have the individual files been assembled (field investigation, laboratory)?

Comments _____

_____

_____

Yes ___ No ___ 2) Is there a list of accountable field documents?

Comments _____

_____

_____

Yes ___ No ___ 3) Are all accountable field documents present or accounted for? (Fill out additional checklist.)

Comments _____

_____

_____

10.0 PREVENTATIVE MAINTENANCE

For preventative maintenance procedures in the field see Appendices A and B. Preventative maintenance procedures for laboratory instruments are provided in the Laboratory Quality Assurance Plan (Appendix C).

11.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS PRECISION, ACCURACY AND COMPLETENESS OF DATA

The procedures have been presented in previous sections of this QAPP (Sections 3.0, 4.0, 5.0, 6.0, 7.0, 8.0 and 9.0). It will be the responsibility of the Project QA Officer and the laboratory QA Officer to ensure that these procedures are followed.

12.0 CORRECTIVE ACTION

Corrective action on a day-to-day basis for field sampling will be handled by consultation between team members and the team leader. The team leader will make immediate decisions with the team members on new protocols to be followed. All changes in field sampling procedures will be documented in the field log book and reported to the Project QA officer and in the final report. The field team leader will make decisions concerning site safety emergencies without further consultation.

Corrective action in the laboratory will be handled by consultation between the laboratory QA Officer and the Project QA Officer. All changes in laboratory procedures will be documented in the final report.

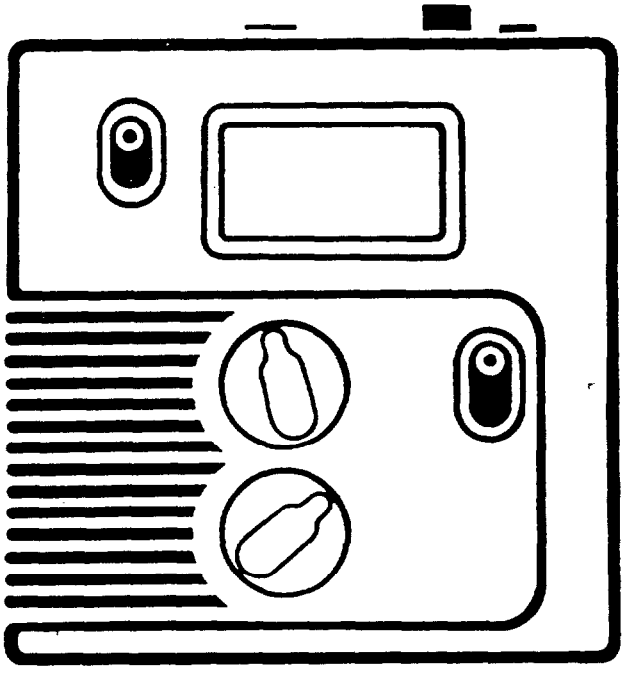
Appendix A

Orion Model 210 Digital pH Meter Manual

ORION

Laboratory Products Group
Orion Research Incorporated

MODEL 210 DIGITAL pH METER
INSTRUCTION MANUAL



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GENERAL INFORMATION

Introduction

The ORION SA 210 is a portable battery-operated digital pH meter for field, plant or laboratory use. It is designed for versatile, easy operation, and can be used in or out of the accompanying carrying case. The instrument is lightweight and is designed to fit comfortably in the hand. All controls are on the meter face, which allows one hand calibration.

The instrument measuring range is −1999 to + 1999 mV, and pH is displayed to two decimal places. The meter has a large easy to read LCD display.

Instrument Description See **Figure 1**.

1 **ON/OFF Switch** Controls power to meter.

2 **LCD Display** Automatically displays data in large numerals with negative polarity sign and decimal point. pH values are displayed from 0 to 14 with 0.01 pH unit resolution. Millivolt range is −1999 to + 1999. Dissolved oxygen is measured from 0 to 14 ppm when meter is used with Model 97-08 Oxygen Electrode.

3 **Mode Control** Provides operator with choice of measuring sample in either pH or mV mode.

4 **Calibration Control** Used to standardize the meter/electrode system in buffers of known pH.

5 **Temperature/Slope Control** Compensates for variation in electrode slope or solution temperature.

6 **Electrode Connection** Accepts BNC connector from combination electrodes and pin tip jack available for use with separate half-cell reference electrodes.

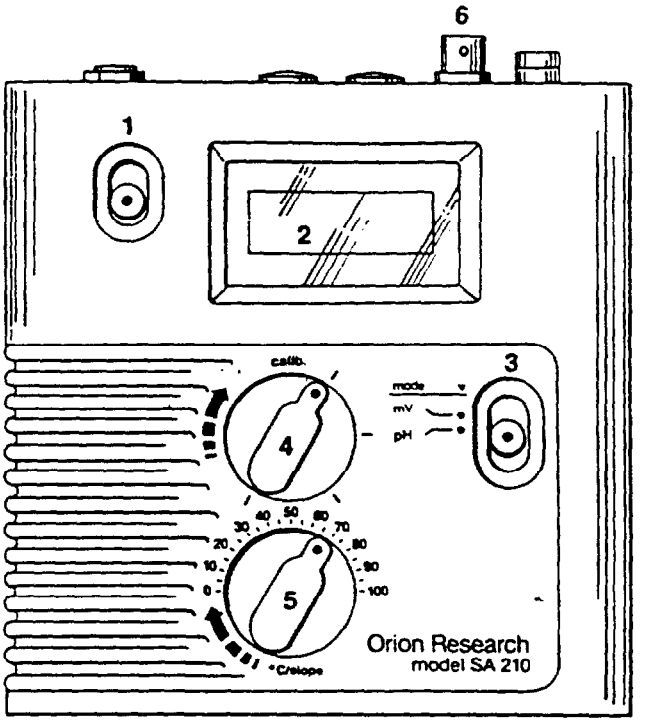

Figure 1
Face of the SA 210

INSTRUMENT SET-UP

Support Rod See Figure 2.

1. Attach support rod base to side of meter carrying case and tighten clamp screw.
2. Insert support rod into base. Tighten by turning rod clockwise.
3. Attach electrode holder to top of support rod.

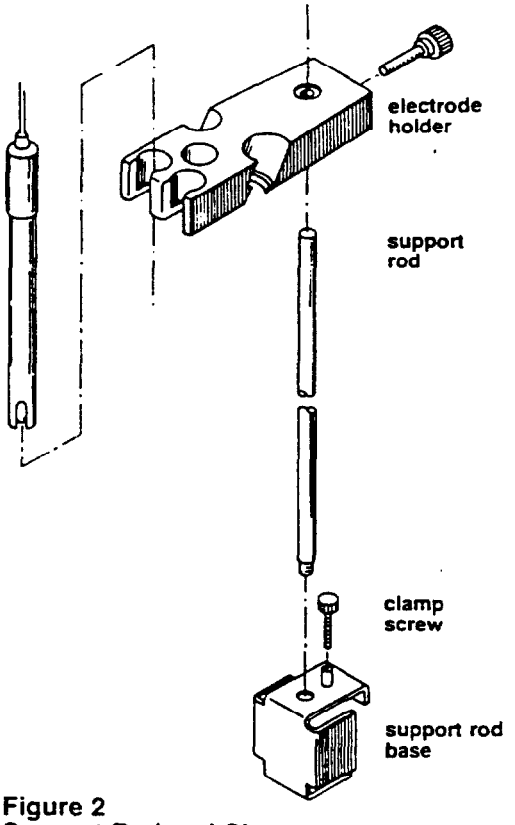

Figure 2
Support Rod and Clamp

Power Source

ORION SA 210 operates on one non-rechargeable 9-volt alkaline battery. Optional AC line adapters are available for both 110 and 220 volt mains. Refer to **ACCESSORIES**, page 7.

Battery Installation See Figure 3.

1. Remove access panel on back of meter. No tools are required, simply slide cover towards bottom of meter.
2. Attach battery connector clip of meter to battery terminals, install battery and replace access panel.

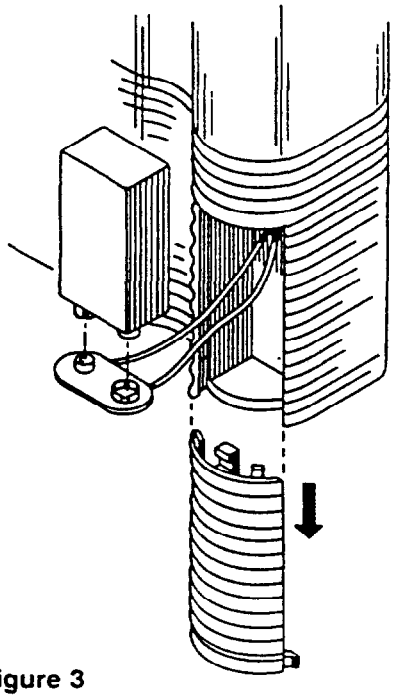

Figure 3
Rear Access Panel Removed

INSTRUMENT SET-UP (continued)

Electrode Connections

1. Attach electrodes with BNC connectors directly to the top of the meter. Refer to **Figure 4**.
2. Electrodes without BNC connectors may be used with a commercially available BNC adapter (Orion Cat. No. 090033). See **Figure 5**.

   If using a combination electrode, electrode connection **3** is not used.

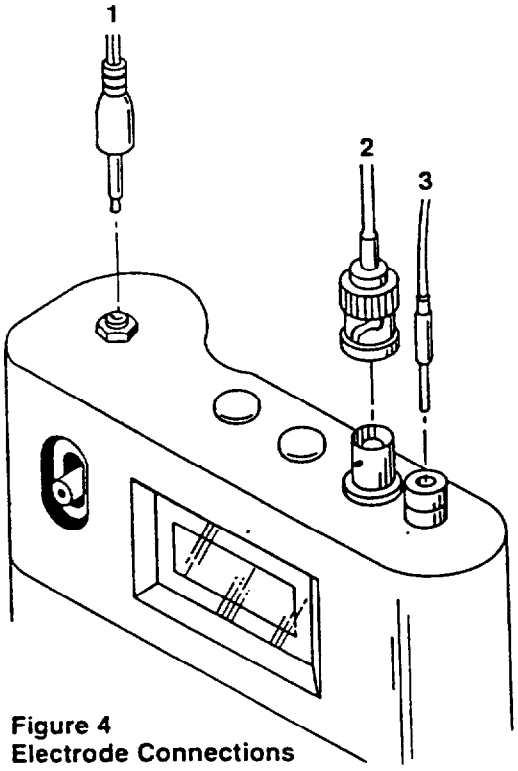

Figure 4
Electrode Connections

Legend

1 AC line adapter
2 BNC connector
3 Reference pin-tip connector

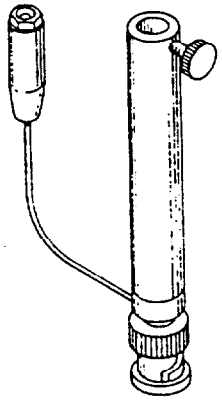

Figure 5
U.S. Standard Connector To BNC Adapter

Meter Check-Out Procedure

1. Slide power switch to ON position.
2. Slide mode switch to pH. If LO BATT indicator on LCD remains on, battery must be replaced.
3. When using optional AC line adapter, disregard step 2. Connect line adapter to meter and appropriate power source.
4. Attach BNC shorting plug (Orion Cat. No. 090045) to BNC connector on top of meter. Slide mode switch to pH. Adjust calib knob to read a steady 7.00. If this cannot be done, refer to **TROUBLE-SHOOTING**, page 6.
5. Remove the shorting plug. After successful completion of steps 1-4, the meter is ready for use with an electrode.

MEASUREMENT PROCEDURES

pH Measurements See Figure 6.

Single Buffer Standardization

1. Sample and buffer temperature must be equal. Set temp/slope control to buffer temperature (°C).
2. Place electrode in a buffer solution with pH value within 1.5 units of the expected sample value and stir moderately.
3. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that correct buffer value at that temperature is displayed.
4. Remove electrodes from the buffer solution and rinse.
5. Place electrodes into sample and stir moderately. Allow reading to stabilize.
6. Record pH value displayed.

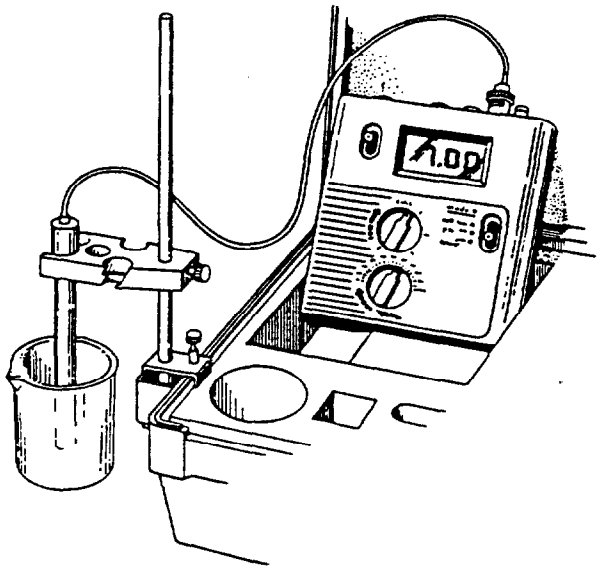

Figure 6
SA 210 Meter Set Up For Sample Measurement

Two Buffer Standardization

NOTE: For maximum accuracy, perform a two buffer calibration once at the beginning of each day. This procedure provides the correct setting for temp/slope control. Subsequent measurements are made after a single buffer calibration.

1. Sample and buffer temperature must be equal. Set temp/slope control to buffer temperature (°C).
2. Place electrode in pH 7 buffer and stir moderately.
3. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that correct buffer value at that temperature is displayed.
4. Remove electrode from the buffer solution and rinse.
5. Place electrode in second buffer and stir moderately. Allow reading to stabilize.
6. Adjust temp/slope control until correct value of second buffer is displayed. Remove electrode from solution and rinse.
7. Place electrode in sample and stir moderately. Allow reading to stabilize.
8. Record pH value displayed.

If sample temperature differs significantly from the buffer temperatures used to calibrate, an adjustment can be made. Raise or lower the **temp/slope** control from its current setting, described in step 6, by the difference between the actual temperature and the sample temperature. For maximum accuracy use ATC probe.

MEASUREMENT PROCEDURES (continued)

Potentiometric Measurements

Potentiometric titrations are performed in mV mode using either ion selective or redox electrodes with BNC connectors. Detailed instructions for any ORION electrode are given in the electrode instruction manual. Titration instructions are included in ORION Redox Electrode (Model 96-78) Instruction Manual, or in standard analytical chemistry texts. U.S. Standard to BNC adapters are available from Orion (Cat.No. 090033).

Dissolved Oxygen Measurement

Dissolved oxygen measurements are displayed in ppm when ORION Model 97-08-99 Dissolved Oxygen Electrode is used with the SA 210 Meter. Follow the instructions in the electrode manual. Be sure to set meter mode switch to pH.

TROUBLESHOOTING GUIDE

The following section covers troubleshooting that can be performed without special tools or skills. The Orion Technical Service Personnel can be consulted for troubleshooting advice by calling 1-800-225-1480 or 617-864-5400. Outside North America contact your local authorized ORION Representative.

Malfunction	Possible Cause	Remedy
No Display	No power to meter	Check that switch is in ON position. Replace battery. Check that adapter is receiving power and is plugged in securely.
More than one decimal displayed	mode switch is between positions	Adjust switch to proper position.
Erratic readings or drift. Readings out of range.	Electrode failure	Follow meter checkout procedure. If meter okay, check electrode.

INSTRUMENT WARRANTY

ORION RESEARCH INCORPORATED warrants this instrument will operate for one year from the date of purchase when used under normal laboratory conditions, and in accordance with the operating limitations and maintenance procedures given in the instruction manual. In the event of failure within the warrant period, Orion, or its Authorized Dealer, will, at Orion's option, repair or replace the non-conforming instrument at no charge to the customer.

THE WARRANTY DESCRIBED ABOVE IS EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTY, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, EXCEPT TITLE. THE BUYER'S SOLE AND EXCLUSIVE REMEDY IS FOR REPAIR, OR REPLACEMENT OF THE DEFECTIVE INSTRUMENT OR PART, OR REFUND OF THE PURCHASE PRICE; BUT IN NO EVENT SHALL ORION (ITS CONTRACTORS AND SUPPLIERS OF ANY TIER) BE LIABLE TO THE BUYER OR ANY PERSON, IN CONTRACT OR IN TORT (INCLUDING NEGLIGENCE) FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Representations and warranties made by any person, including dealers, representatives and employees of Orion, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Orion unless in writing and signed by one of its officers.

NOTICE OF COMPLIANCE

This meter may generate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type-tested and found to comply with the limits for a Class B computing device in accordance with specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If the meter does cause interference to radio or television reception, which can be determined by turning the unit off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the meter with respect to the receiver
- Move the meter away from the receiver.
- Plug the meter into a different outlet so that the meter and receiver are on different branch circuits.

If necessary, the user should consult the manufacturer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems."

This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 004-000-00345-4.

REPAIR AND SERVICE

A Return Authorization Number must be obtained from Orion Laboratory Products Customer Service before returning any product for in-warranty repair, replacement or credit. Contact ORION by calling 1-800-225-1480 (USA outside Mass.) or 617-864-5400. Outside the USA and Canada consult your local in-country, authorized Orion Laboratory Products Distributor for product service information.

OPTIONAL ACCESSORIES

Cat. No.	Description
815600	ROSS* epoxy body, bulb guard combination pH electrode
9104BN	Laboratory grade combination pH electrode (BNC connector)
910600	GX-series epoxy body, gel-filled combination pH electrode (BNC connector)
912600	GX-series epoxy body, gel-filled flask combination pH electrode (BNC connector)
913600	GX-series epoxy body, gel-filled flask combination pH electrode (BNC connector)
915600	RX-series refillable, epoxy body combination pH electrode (BNC connector)
9162BN	Combination pH electrode with rugged bulb (BNC connector)
9163BN	Combination pH electrode with needle shape (BNC connector)
910004	pH 4 buffer packets, box of 25 packets, each packet making 200 ml of buffer
910007	pH 7 buffer packets, box of 25 packets, each packet making 200 ml of buffer
910009	pH 9 buffer packets, box of 25 packets, each packet making 200 ml of buffer
910104	pH 4.01 buffer, 475 ml bottle
910107	pH 7.00 buffer, 475 ml bottle
910110	pH 10.01 buffer, 475 ml bottle
970899	Dissolved oxygen electrode
910002	Electrode holder
090033	U.S. Standard to BNC connector adapter
090045	Shorting plug
020120	110V AC line adapter
020121	220V AC line adapter
020041	Shoulder strap and meter holder for *hands free* operation
020042	Carrying case with foam insert, without meter or accessories
020043	Support rod and guide
020044	Accessory pack includes two 60 ml bottles and one 150 ml beaker
020045	Electrode rod stand for bench-top meter use outside carrying case

If the line converters that Orion supplies, Cat. No. 020121 and 020120, are not available, any line converter meeting the following specifications may be used.

Converter for 120 VAC to 9 VDC

This specification describes an AC-to-DC power supply for use with ORION products.

Electrical Specifications

1. The power supply shall furnish rectified, filtered, unregulated DC voltage.
2. The input voltage shall be 100-130 VAC, 47-63 Hz.
3. The open circuit output voltage shall not exceed 15.5 VDC at an input voltage of 130 VAC, 60 Hz.
4. The unit shall produce an output voltage not less than 9.0 VDC with a load of 200 MADC at an input voltage of 115 VAC, 60 Hz.

Mechanical Specifications

1. The power supply shall plug into two blade wall outlets that are standard in North America for 115 VAC service.
2. Output cord shall terminate in a standard 3.5 mm diameter phone plug. The tip shall be negative, the sleeve positive.

Safety

1. The power supply shall be UL listed and CSA approved.

Converter for 220 VAC to 9 VDC

This specification describes an AC-to-DC power supply for use with ORION Products.

Electrical Specifications

1. The power supply shall furnish rectified, filtered, unregulated DC voltage.
2. The input voltage shall be 200-240 VAC, 47-63 Hz.
3. The open circuit output voltage shall not exceed 15.5 VDC at an input voltage of 240 VAC, 50 Hz.
4. The unit shall produce an output voltage not less than 9.0 VDC with a load of 200 MADC at an input voltage of 220 VAC, 50 Hz.

Mechanical Specifications

1. The power supply shall plug into wall outlets that are appropriate for the area.
2. Suggested cord length is 1.5 meters long.
3. Output cord shall terminate in a standard 3.5 mm diameter phone plug. The tip shall be negative, the sleeve positive.

SPECIFICATIONS

The SA 210 Portable pH/mV Meter (Orion Cat. No. 021000) is for hand-held and bench-top use.

Modes
pH, mV, O_2 (with O_2 probe)

pH range
pH 0 to 14

pH resolution
0.01

mV range
−1999 to + 1999 mV showing negative polarity sign

mV resolution
1 mV

Temperature compensation
Manual

Sample temperature range
−5 to 105°C

Input impedance
>100,000 megohms

Instrument drift
<50 microvolts/°C

Input bias current
< ± 1 pico amp at 25°C and < ± 4 pico amps over full operating range

Environmental requirements
5 to 45°C and 5 to 80% relative humidity, non-condensing

Isopotential point
pH 7 (fixed)

Power requirement
One 9 volt battery. Optional 110 or 220 volt line adapter(s) available for AC line use.

Inputs
BNC combination and separate pin tip reference jack

Meter dimensions
14 cm X 14 cm X 4 cm

Meter weight
0.5 kg

Meter case
Splash-proof, chemical resistant

Carrying case dimensions
38.1 cm x 27.9 cm x 11.4 cm

Carrying case weight
1.8 kg

Appendix B

YSI Model 3000 T-L-C Meter Instruction Manual

YSI MODEL 3000 T-L-C METER INSTRUCTION MANUAL

Scientific Division
Yellow Springs Instrument Co., Inc.
Yellow Springs, Ohio 45387 USA • Phone 513 767-7241 • Telex 205437

PRICE $10.00

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GENERAL DESCRIPTION

The YSI Model 3000 System

The YSI Model 3000 T-L-C Meter is a self-contained field instrument and probe system that measures temperature, water level, conductivity and temperature compensated conductivity for water quality applications.

The digital meter uses a 3½ digit LCD with ½ inch high characters for easy reading. This watertight instrument is housed in the center of the easy-to-use cable reel and can be removed when necessary for replacement of batteries. A low battery indicator signals when the batteries need to be changed. The case is made of tough molded nylon and ABS. It is bright yellow for easy visibility. Abbreviated instructions are printed on the back of the instrument. An integral clipboard offers convenience in carrying papers and notes.

The probe is designed to fit easily into well boreholes, but is equally functional in general surface water applications. The probe and cable are of materials generally accepted for borehole use.

Temperature is measured by means of a precision thermistor assembly built into the probe housing, and is expressed in degrees Celsius (°C).

Conductivity is displayed in millimhos/centimeter (m℧/cm). The YSI Model 3000 is direct reading for conductivity with a sensor which has a cell constant of K = 5.0/cm. Overrange is indicated by a 1 followed by blank spaces on the display.

By convention, the conductivity of a solution is referenced to 25°C. Two temperature compensated conductivity ranges are provided on the Model 3000 which permit the reading to be corrected to 25°C. This automatic correction uses a temperature coefficient of 2%/°C*, calculated by the following formula:

$$\text{Compensated Conductivity} = \frac{\text{Uncompensated Conductivity}}{[(P\ 4\%)(.04T - 1)] + 1}$$

T = temperature in °C
P = temperature coefficient (2%/°C)

The probe cable is marked at one foot intervals. When the probe is lowered into a well casing, level can be easily determined by watching the instrument display for a significant rise in the reading as the sensor comes into contact with the water. Level may then be read directly from the cable.

Probe Description

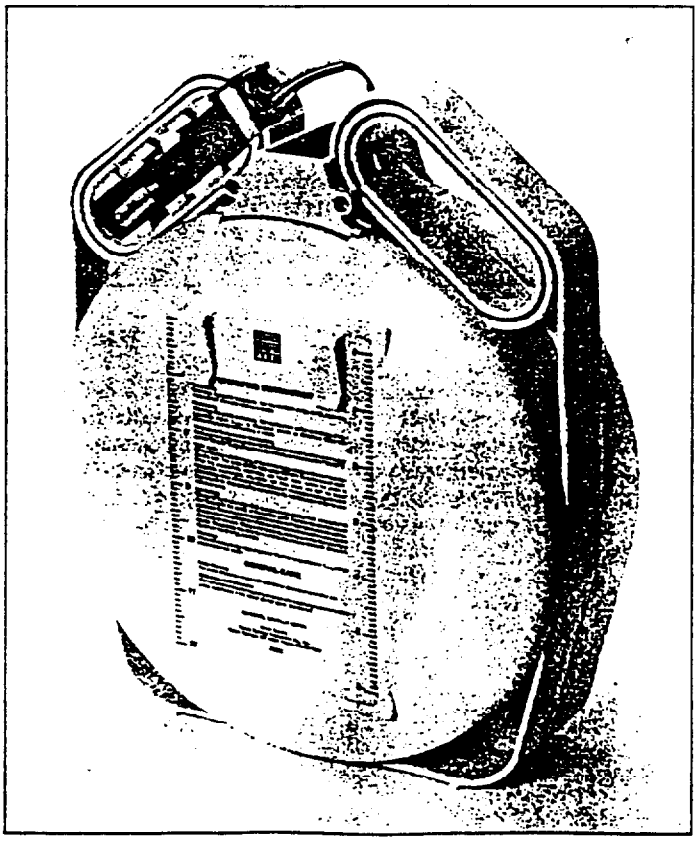
The YSI Model 3050 is an integral conductivity/temperature probe of rigid and durable chlorinated polyvinyl chloride. Its stainless steel weight facilitates lowering it into a borehole or well casing. The CPVC body is 1 inch in diameter by 4¾ inches in length.

Two platinized electrodes measure conductivity, and a precision thermilinear thermistor measures temperature.

A 150 foot polyurethane jacketed cable is attached to the probe body to permit deep immersion. This four conductor cable is marked every foot with numbers and a pointer in the form of the letter V to indicate the depth of the probe. A watertight MS type connector terminates the cable.

The probe is accurate for temperature changes in 40 to 60 seconds, and to conductivity changes in 10 seconds.

*Recommended in *Official Methods of Analysis of the Association of Official Analytical Chemists*, Ed. Sidney Williams, 14th edition, 1984, Arlington.



Back view of the Model 3000, showing the Instruction Label.

SYSTEM SPECIFICATIONS

Conductivity

Ranges: 0.0 through 1.999 m℧/cm conductivity
0.0 through 19.99 m℧/cm conductivity

0.0 through 1.999 m℧/cm conductivity temperature compensated to 25°C.
0.0 through 19.99 m℧/cm conductivity temperature compensated to 25°C.

Accuracy of Conductivity Measurements: ± 3% of full scale at 25°C.

Accuracy of Temperature Compensated Conductivity Measurements: ± 4% of full scale over normal ambient temperature range.

Temperature Compensated Conductivity: automatically corrected to 25.0°C (77.0°F) with a temperature coefficient of 2%/°C.

Resolution: 1 part in 2000 in conductivity or temperature compensated conductivity.

Temperature

Measurement Range: – 5.0 to 50.0°C (23.0 to 122.0°F). Measurements beyond this range will not be within specification accuracy.

Accuracy of Temperature Measurements: ± 0.3°C.

Resolution: 0.1°C.

Probe

Cable Length: 150 feet ± .3 feet: ± .1 foot per 50 feet

Cell Constant: K = 5.0/cm ± 2%, at 25.0°C (77.0°F), at 0.0 to 20.00 m℧/cm, referenced to a 0.01 normal KCl solution.

Instrument

Size: 31.2 h by 25.4 w by 15.2 d centimeters (12.3 h by 10.0 w by 6.0 d inches)

Weight: 3.4 kilograms (7.5 pounds) maximum.

Ambient Operating Temperature Range: 0.0 to 50.0°C (32.0 to 122.0°F)

Humidity: Will operate under any humidity condition as long as seals are intact and dessicant is in place.

Watertight: Impervious to rain or well water (tested according to procedures in MIL-T-28800 C)

Shock and Vibration: Shock tested to 30 G and vibration tested to 3 G (per MIL-T-28800 C)

EMI: Complies with FCC emanation rules (47CFT part 15 subpart J) as applicable for Class A and Class B environments

Battery

Voltage: 9 VDC (six 1.5 VDC heavy-duty "C" cells)

Indicator: display will indicate "BAT" when combined batteries fall below 7.2 ± 0.2 VDC; approx. 8 hours of use left.

Life: 1200 hours minimum, at 4 hours per day use. Alkaline batteries will provide approximately 1700 hours of use.

ACCESSORIES

3040 Test Probe
3045 Platinizing Instrument
3050 Probe and Reel Assembly
3140 Platinizing Solution
3167 Conductivity Calibrator Solution, 1 m℧/cm, 8 one pint bottles
3168 Conductivity Calibrator Solution, 10 m℧/cm, 8 one pint bottles

Accessories may be purchased from your YSI dealer.

REPLACEMENT PARTS

060885	Probe Weight	060857	Knob
060854	Switch PC Board	060845	Amplifier PC Board Assembly
060852	1⅜" O-ring	060851	6¼" O-ring
001495	Switch Nut	060829	⅞" O-ring
060836	Dessicant	060850	¼-turn Stud
060923	Maintenance Kit		

Replacement parts may be purchased from your YSI dealer or directly from the YSI Product Service Department.

Required Notice

The Federal Communications Commission defines this product as a computing device and requires the following notice:

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- reorient the receiving antenna
- relocate the computer with respect to the receiver
- move the computer away from the receiver
- plug the computer into a different outlet so that the computer and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio-television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 0004-000-00345-4.

OPERATION

Temperature

(a) To measure temperature, set the function switch to °C.
(b) Completely submerge the probe in the water to be measured.
(c) Once submerged, allow time for the probe to come to temperature equilibrium with the water. This usually takes about three minutes.
(d) Read the displayed value after the reading is stable.

Conductivity

(a) To measure conductivity, set function switch to **2 m℧/cm.**
(b) Completely submerge the probe and observe the displayed value after reading is stable. This usually takes from 10 to 20 seconds.
(c) If the overrange signal is displayed (1.---), then the conductivity of the water is in excess of 1.999 m℧/cm. Reset the switch to **20 m℧/cm.** If the overrange signal is still displayed, the conductivity is greater than 19.99 m℧/cm.

Measurements are not temperature compensated in this mode.

Temperature Compensated Conductivity

(a) To measure temperature compensated conductivity, set the function switch to **2 m℧/cm TC to 25°C.**
(b) Completely submerge the probe and allow sufficient time for it to reach equilibrium with the water. This usually takes from 10 to 20 seconds.
(c) Observe the displayed value after the reading is stable.
(d) If the overrange signal is displayed (1.---), then the temperature compensated conductivity of the water is in excess of 1.999 m℧/cm. Reset the switch to **20 m℧/cmTC to 25°C.** If the overrange signal is still displayed, the conductivity is greater than 19.99 m℧/cm.

Table 1 shows corrections for 2%/°C change from 25°C at 1 m℧/cm.

Table 2 shows correction values applied to two typical solutions.

Level

(a) To measure water level, set the function switch to any of the conductivity modes.
(b) Lower the probe into the well or borehole just until the displayed value rises suddenly from about zero to some higher value. The probe begins to measure conductivity when the conductivity cell electrodes just touch the water. The reading at this point will be about ½ of the actual conductivity. When the probe is completely submerged, the reading will be about double the value displayed at the original contact point, where the probe just touches the water.
(c) Raise the probe slowly out of the water until the displayed value goes back to approximately zero.
(d) Lower the probe very slowly until the reading rises suddenly to about ½ the full conductivity value read above.
(e) Compare cable marking to the well reference point to determine the water level. Read the number of feet from the probe cable and measure tenths and hundredths of a foot with the .5 foot scale printed on the instruction label. Note that the rule is calibrated in tenths and hundredths of a foot and is designed to make it easy either to add or to subtract hundredths of a foot from a cable foot marker.

REWINDING THE CABLE: The cable winds into its housing like fishing line onto a reel. However, since there is no level-wind mechanism to distribute the probe cable evenly, the user must control its winding and unwinding. Regulate the motion of the cable by feeding it through your fingers. Don't let the reel spin too rapidly when paying out cable; distribute the cable evenly over the reel when reeling it back in.

Errors

The maximum error of a meter reading will be a worst case combination of temperature and conductivity specification tolerances. Errors can be minimized by calibrating the Model 3000 with YSI conductivity standards. (See Calibration.)

(a) Temperature – The maximum error in this instrument when used to measure temperature between the measuring limits of −5.0° and 50.0°C is ±0.3°C. Example:

Meter Reading: 16.5°C
Error: ±0.3°C
Accuracy: 16.5 ± .3°C

(b) Conductivity – The maximum instrument error (not including temperature error) when used to measure conductivity in either range is ±3% of the full scale range limit. This represents the combined instrument and probe errors. Example:

Meter Reading: 9.00 m℧/cm
% Error: .03 × 20.00 m℧/cm
Accuracy: 9.00 m℧/cm ± .60 m℧/cm

(c) Temperature Compensated Conductivity: The maximum error when measuring temperature compensated conductivity in either range is ±4% of the full scale range limit. This represents the combined instrument, probe and temperature errors. Example:

Meter Reading: 11.00 m℧/cm
% Error: .04 × 20.00 m℧/cm
Accuracy: 11.00 m℧/cm ± .80 m℧/cm

(d) Level: The maximum error for water level measurement is ±1 inch 50 feet. This represents the combined errors due to the cable foot indicators, the 6 inch rule on the label and the cable stretch when fully suspended in a well casing. Example:

Cable Reading: 87.4 feet
Error: ± .2 feet
Accuracy: 87.4 ± .2 feet

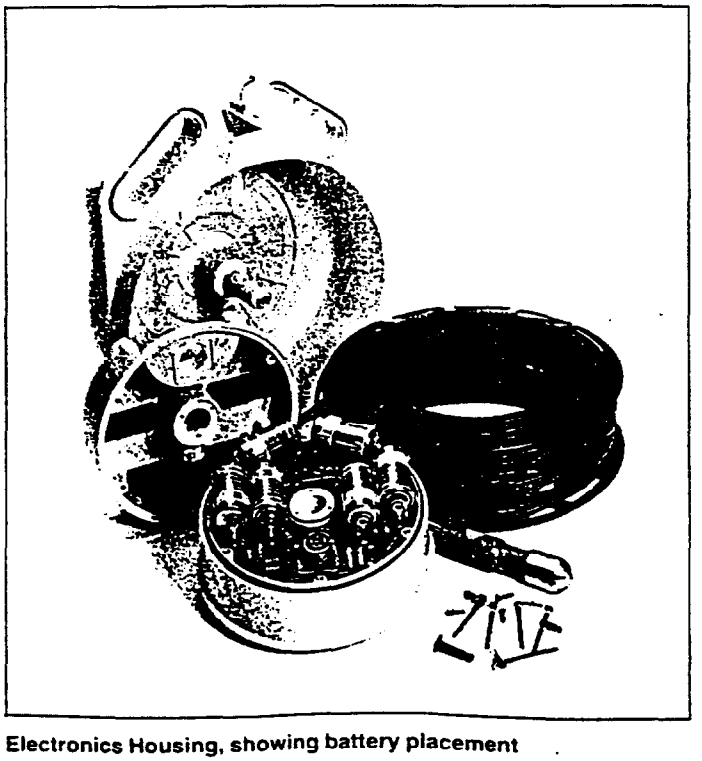
MAINTENANCE

Instrument

The Model 3000 requires only battery replacement, dessicant replacement, seal replacement and occasional cleaning. A kit for annual maintenance is available from your dealer or from YSI. See Replacement Parts.

Battery Replacement: The six heavy-duty "C" cell batteries supplied with the instrument will last approximately 1200 hours when used about 4 hours a day. Alkaline batteries will provide about 1700 hours of use. When BAT appears in the upper left corner of the display, about 8 hours of use remain. However, it is wise to replace the batteries as soon as possible after this signal appears. Follow these procedures:

(a) Rotate the reel handle to uncoil about one foot of the cable.
(b) Next, with coin or screwdriver, turn in a counterclockwise direction the ¼-turn screw located in the face of the instrument.
(c) Remove the electronics and probe reel assemblies from the housing and disconnect the probe connector (located on the back of the electronics assembly) by turning its sleeve counterclockwise. Carefully note, or mark, the side of the reel into which the electronics assembly is inserted; the probe connector will not reach the jack, or the reel will not properly engage into the handle if the reel is reversed.
(d) Remove the nine screws on the back of the electronics assembly.
(e) Remove the probe reel from the electronics assembly.
(f) Separate the front and back halves, being careful not to damage the three o-rings that provide watertight integrity.
(g) Remove the old batteries and replace with new batteries in the battery holders. Be careful to observe the correct polarity; red indicators mark the positive terminals. Turn on the unit after the batteries are installed to make sure that the instrument is in working order before it is reassembled.
(h) Remove, dry and replace, or install a new dessicant container.
(i) Reassemble the instrument by reversing the dissassembly steps. Be very careful not to damage or misalign the o-rings.



Electronics Housing, showing battery placement

Dessicant Replacement: When the case is opened for any reason, the interior will have the same relative humidity as the surrounding air. Re-sealed and later operated at a lower temperature, internal condensation might occur. The dessicant prevents this. The dessicant container should be removed for replacement annually. Do not remove the new dessicant container from its protective bag until ready for instrument reassembly.

Seal Replacement: To insure watertight integrity, the three o-rings and nine screw seals should be replaced annually. See Battery Replacement for disassembly and reassembly procedures. The third o-ring is located on the socket side of the MS type connector.

Cleaning: When it is necessary to clean off dirt and collected films, simply wipe the case with a solution of liquid detergent and water. Rinse the instrument with clean water. Do not disassemble. If a stubborn stain cannot be removed with soap and water, alcohol may be used. Do not use ketones or chlorinated solvents to clean the case as they will damage it.

Storage: When the Model 3000 is to be stored for more than few months, the batteries should be removed to reduce the risk of corrosion damage.

Probe

Cleaning: The probe cable may be cleaned by wiping with a wet sponge. Isopropyl alcohol may be used for stubborn residues.

The probe must be kept clean at all times to assure proper operation and accuracy. A dirty probe will contaminate the sample and cause the conductivity to change. Any of the foaming acid tile cleaners such as Dow Chemical "Bathroom Cleaner" will clean the probe adequately. When a stronger cleaning preparation is required, use a solution of equal parts of isopropyl alcohol and 10 normal HCl. Do not clean the probe in aqua regia or in any solution known to etch platinum or gold.

Dip the probe into the cleaning solution and agitate for two or three minutes. Rinse the probe in several changes of distilled or deionized water. Inspect the platinum black electrode coating to determine whether replatinizing is required. CAUTION: Do not use anything to touch the electrodes inside the probe body. Platinum black is soft and can be easily scraped off.

Storage: It is best to store conductivity probes in deionized water. Probes stored in water require less frequent platinizing. When probes are stored dry, it is necessary to soak them in deionized water for 24 hours before use.

Replatinizing: If cleaning does not restore probe performance, or if flaking or other defects in the platinum black coating are apparent, replatinizing is necessary. A YSI 3045 Platinizing Instrument and YSI 3140 Platinizing Solution are available for this procedure. Clean the probe thoroughly and replatinize as follows:

(a) Uncoil about two feet of cable and remove the electronics and probe reel assemblies from the instrument housing. Remove the probe cable connector from its jack.

(b) Immerse the probe's electrodes in the platinizing solution, either in the bottle provided, or in another suitable, non-reactive vessel. Do not submerge the entire probe body; the thermistor housing located beside the bend relief spring should not come in contact with the platinizing solution.

(c) Connect the probe's MS connector to the Platinizing Instrument and hand tighten the connector sleeve. Once this connection is made, the LED on the Model 3045 will light to indicate that there is good continuity to the electrodes and enough life in the battery to complete the replatinizing. If the LED does not light, replace the battery.

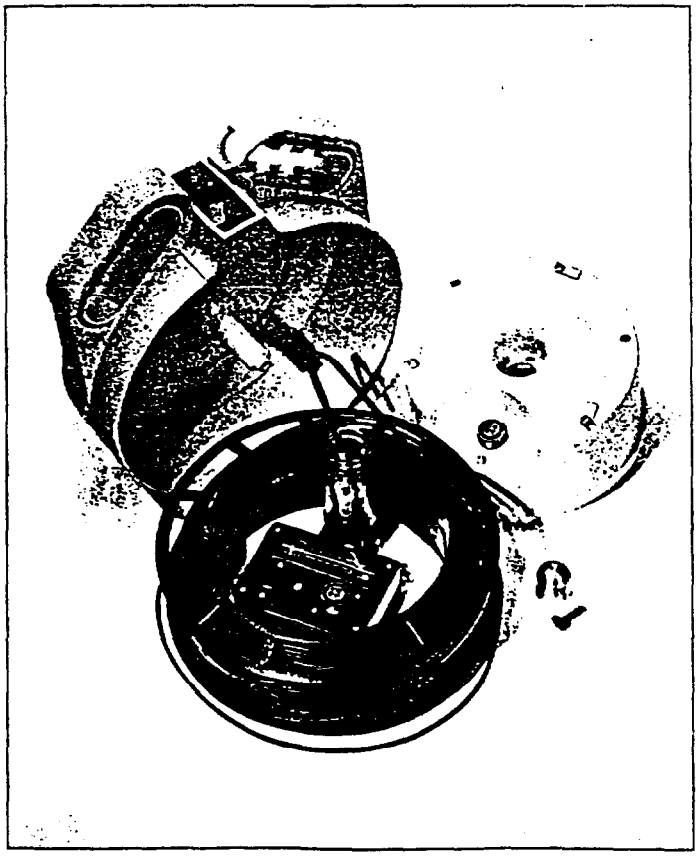
(d) Using the slide switch, reverse the polarity every 30 seconds until both electrodes are covered with a thin layer of platinum black (about 4 to 5 minutes). Do not over-platinize.

(e) Remove the probe from the solution; disconnect it from the Platinizing Instrument.

(f) Reassemble and reconnect the probe and reassemble the YSI 3000. Rinse the probe electrodes with flowing tap water for about 15 minutes followed by a distilled water rinse for 2 minutes.

(g) Return the platinizing solution to its container. This 2 ounces of solution should be sufficient for 50 treatments. It is expensive and should not be wasted. Replace it only when it will no longer deposit a layer of platinum black.

(h) Test probe and instrument with calibration solution. (See CALIBRATION.)



Replatinizing the Probe

CALIBRATION

Instrument

The Model 3000 is calibrated at the factory. There are no user adjustments inside the instrument. Should you suspect that your instrument is out of calibration, either send it to the factory for calibration or test it with the YSI 3040 Test Probe.

Remove the electronics and probe reel assemblies from the instrument housing and disconnect the probe.

First, check for the following readings with no probe connected:

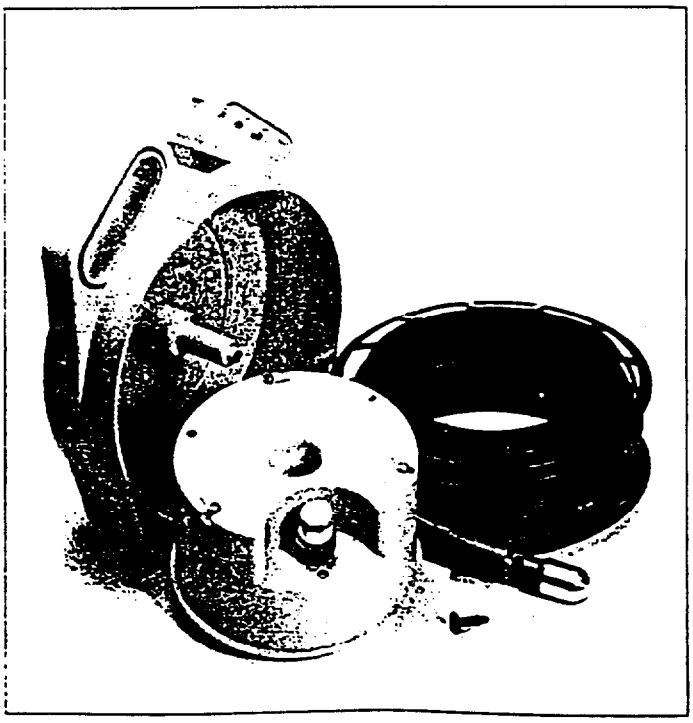
SWITCH POSITION	CORRECT READING
°C	−34.0 ± .2°C
2 m℧/cm	.000 ± .002 m℧/cm
20 m℧/cm	0.00 ± .02 m℧/cm
2 m℧/cm TC to 25°C	1.---
20 m℧/cm TC to 25°C	1.---

If these readings are observed, then plug the YSI 3040 Test Probe into the probe jack. The 3040 is a probe substitute that simulates a temperature and a conductivity. Test for the following readings:

SWITCH POSITION	CORRECT READING
°C	15.1 ± .2°C
2 m℧/cm	1.563 ± 0.020 m℧/cm
20 m℧/cm	1.56 ± 0.20 m℧/cm
2 m℧/cm TC to 25°C	1.954 ± 0.040 m℧/cm
20 m℧/cm TC to 25°C	1.95 ± 0.40 m℧/cm

Remove the Test Probe and reassemble the instrument.

If the instrument failed to meet these specifications, refer to Warranty and Shipping.



Electronics Housing with Test Probe installed

Probe

The YSI 3050 Probe is calibrated at the factory. The cell constant of any conductivity probe may vary slightly with the conductivity of the solution being measured. Calibration may also be affected by electrode fouling, the need for replatinizing, or by mechanical shock. The Model 3050 Probe can be calibrated together with the Model 3000 Instrument as a system with YSI 3167 or 3168 Conductivity Calibrator Solutions. These solutions are specially packaged in unbreakable plastic one pint bottles for field use. They are packaged eight bottles to a box. The solutions are manufactured to approximately 1 m℧/cm or 10 m℧/cm concentrations with the accuracy printed on each label.

Confirm the calibration of the YSI 3000 system as follows:

(a) Rinse the probe with some of the solution to remove any contamination. Be careful to leave not less than 8 ounces of the solution in the bottle; it must be at least half full.

(b) Immerse the probe in the remaining solution, in its own bottle, and switch to either 2 m℧/cm TC to 25°C or to 20 m℧/cm TC to 25°C according to the range necessary for the solution used.

(c) Take note of the displayed value. By comparing this to the conductivity calibrator solution value, the accuracy of the YSI 3000 can be determined. If the displayed value is within 4% of the calibrator value, then the Model 3000 is within its specifications and can be used. The percent error calculated can also be used as a correction factor to improve the accuracy of measurement of the samples being tested. If the error is greater than 4%, the instrument should be tested with the YSI 3040 Test Probe (see Instrument Calibration). If it passes these tests, replatinize the probe (see Probe Maintenance).

The following shows how to make a corrected determination of improved accuracy. In this example, YSI 3167 Conductivity Calibrator Solution is used, and the T-L-C Meter is set to 2 m℧/cm TC to 25°C.

$$\text{Corrected Sample Value} = \frac{\text{Calibrator Value}}{\text{Displayed Value}} \times \text{Sample Value}$$

Displayed Value = .978 m℧/cm
Calibrator Value = .996 m℧/cm
Sample Value = .634 m℧/cm

(.996 m℧/cm) / (.978 m℧/cm) × (.634 m℧/cm) = .646 m℧/cm

(d) Once the accuracy of the Model 3000 has been determined, discard the calibrator solution. It has been contaminated and should not be reused.

WARRANTY AND SHIPPING INFORMATION

All YSI products are warranted for one year against defects in workmanship and materials when used for their intended purposes and maintained according to manufacturer's instructions. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. This warranty is limited to repair or replacement.

If Service Is Required:

Contact the YSI dealer from whom you bought the instrument, or the YSI Product Service Department. You may also call the factory; YSI's toll free number is (800) 343-4357 (343-HELP). Report the date purchased, model, serial number, and the nature of the failure. If the repair is not covered by warranty, you will be notified of the charge for repair or replacement.

When shipping any instrument, be sure that it is properly packaged and insured for complete protection. In communications regarding this instrument or accessories please mention the model and serial number.

CIRCUIT DESCRIPTION

Three board assemblies are used. By means of J101, J103 and P102, the Amplifier Board is connected to P201 on the Switch Board, to P302 on the probe, and to J402 on the Display Board. Each board can be purchased separately (see Replacement Parts).

Switch PC Board: This board controls the signal switching through S201, a 4-6t switch. Section 1 of the switch controls the decimal point and the applied power from BT 101 through BT 106. When the switch is in other than the OFF mode, Q101 is forward biased via Q201, Q202 or Q203 and R201. This in turn generates + V for the instrument with − V always being present. This board also provides space for selected resistors. Other switch functions are described below.

Amplifier PC Board: This board controls signal conditioning for the instrument through the use of four basic circuits. U104, Q102, R114 and R115 take the 40 KHz clock from the display (M401) and frequency divide the signal down to 1000 (Y) and 2000(X) Hz. The 1000 Hz signal in turn is voltage limited and shaped by U101A, − B, and − C, R101, R102, R103 and C101 which form a modulator circuit. This circuit generates a 200 mv p/p square wave which will be the reference for the rest of the signal conditioning. This square wave is regulated to 100 mv DC by R105 and C103 for the temperature measuring circuit.

U102A and U102B are operational amplifiers that determine the voltage level to the display in proportion to the measured resistance of the thermistors in the probe. Gain is determined by R107, R109, R110, R111 and R112. C104, C107, and C108 provide circuit stability.

R301 and R302 are thermistors and with R303 form the temperature measuring sensor in the probe. When the instrument is in the temperature compensating modes, R202, R205 and R206 are placed in the circuit to form voltage divider networks which change the reference voltage to the display in proportion to the temperature shift away from 25°C. This is accomplished by sections 2 and 3 of S201. R106 buffers the output to the display.

The 200 mv square wave is coupled to the conductivity measuring circuit via R104 and C102. U105 is an operational amplifier which acts as a buffer and gain circuit for the conductivity probe. The gain of this circuit is determined by section 4 of S201 which selects R203 or R204 to set the instrument range.

A square wave is used across the electrodes (K301 and K302) of the probe to avoid a polarizing field between them.

U103, U101-d, C105 and C106 form a demodulating circuit using the 1000 and 2000 Hz signals to change the square wave into a DC voltage proportional to the conductivity of the fluid tested. R113 is used as a buffer to isolate the conductivity and temperature circuits. C110 helps provide circuit stability.

Display PC Board: This board has no user serviceable components. It supplies a 40 KHz signal for the amplifier board as well as the voltage common for the entire system. This common is 2.8 VDC below + V and is held constant to the rest of the "lo" inputs. The display receives the analog input and compares it with the 100 mv dc reference voltage supplied in the temperature circuit and in turn determines the value to be displayed by proportional comparison. When temperature compensation is selected, the reference voltage changes proportionally with the temperature.

TABLES

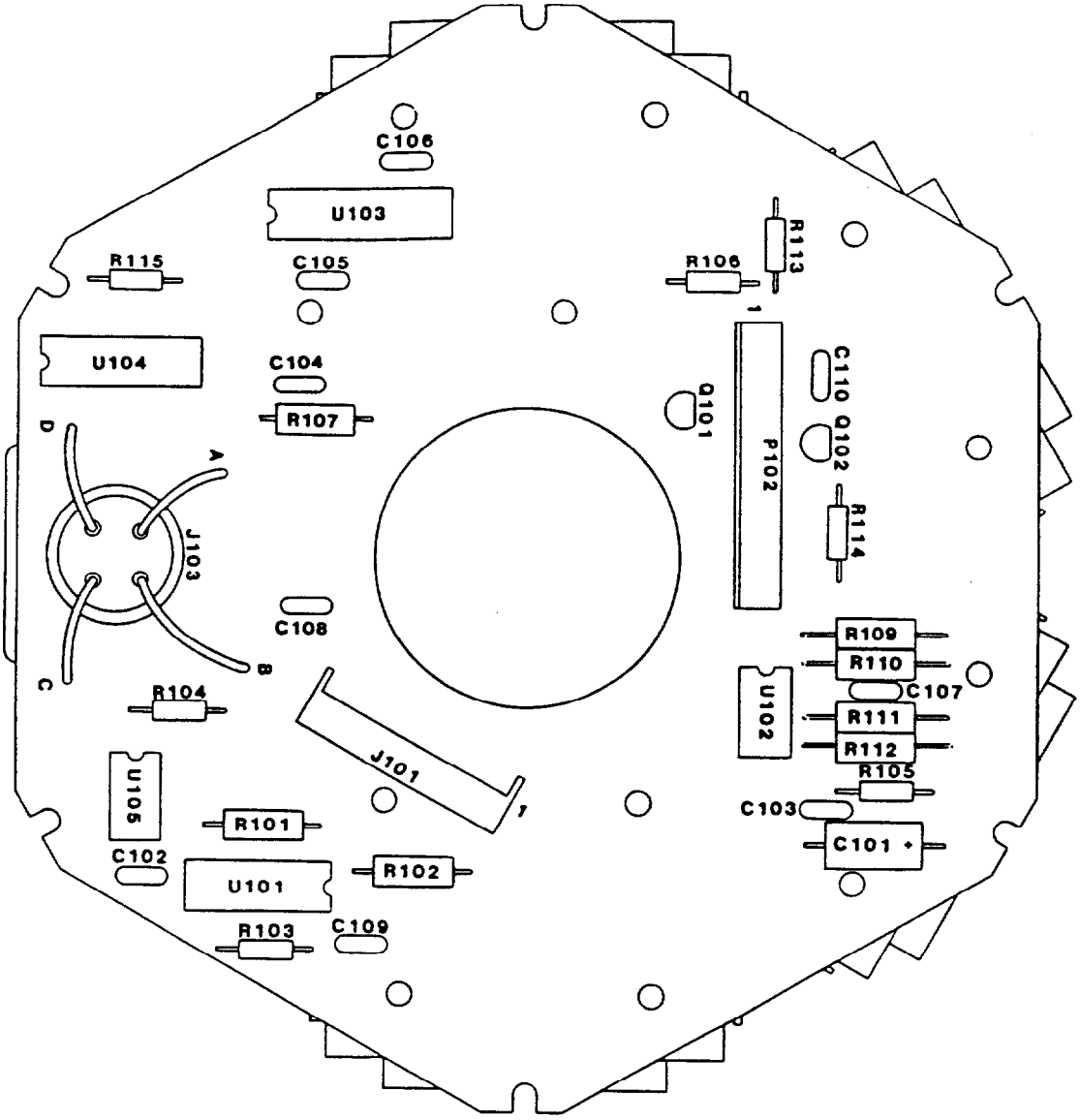
1 Temperature Correction Values Used for Automatic Temperature Compensation By the Model 3000

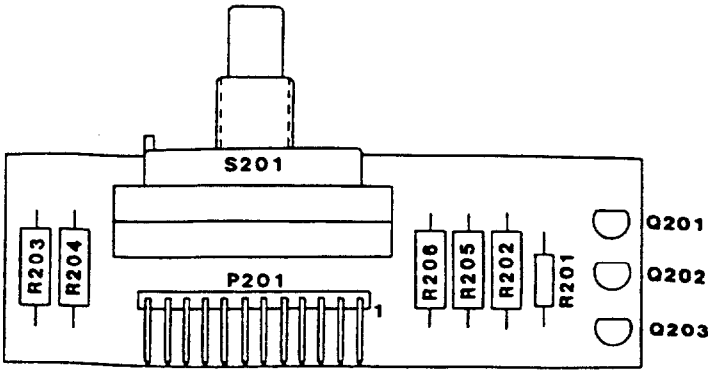
TEMPERATURE °C	CONDUCTIVITY in m℧ cm TC to 25°C
−5	2.500
0	2.000
−5	1.667
10	1.429
11	1.389
12	1.351
13	1.316
14	1.282
15	1.250
16	1.219
17	1.191
18	1.163
19	1.136
20	1.111
21	1.087
22	1.064
23	1.042
24	1.020
25	1.000
26	.980
27	.962
28	.943
29	.926
30	.909
35	.833
40	.769
45	.714
50	.667

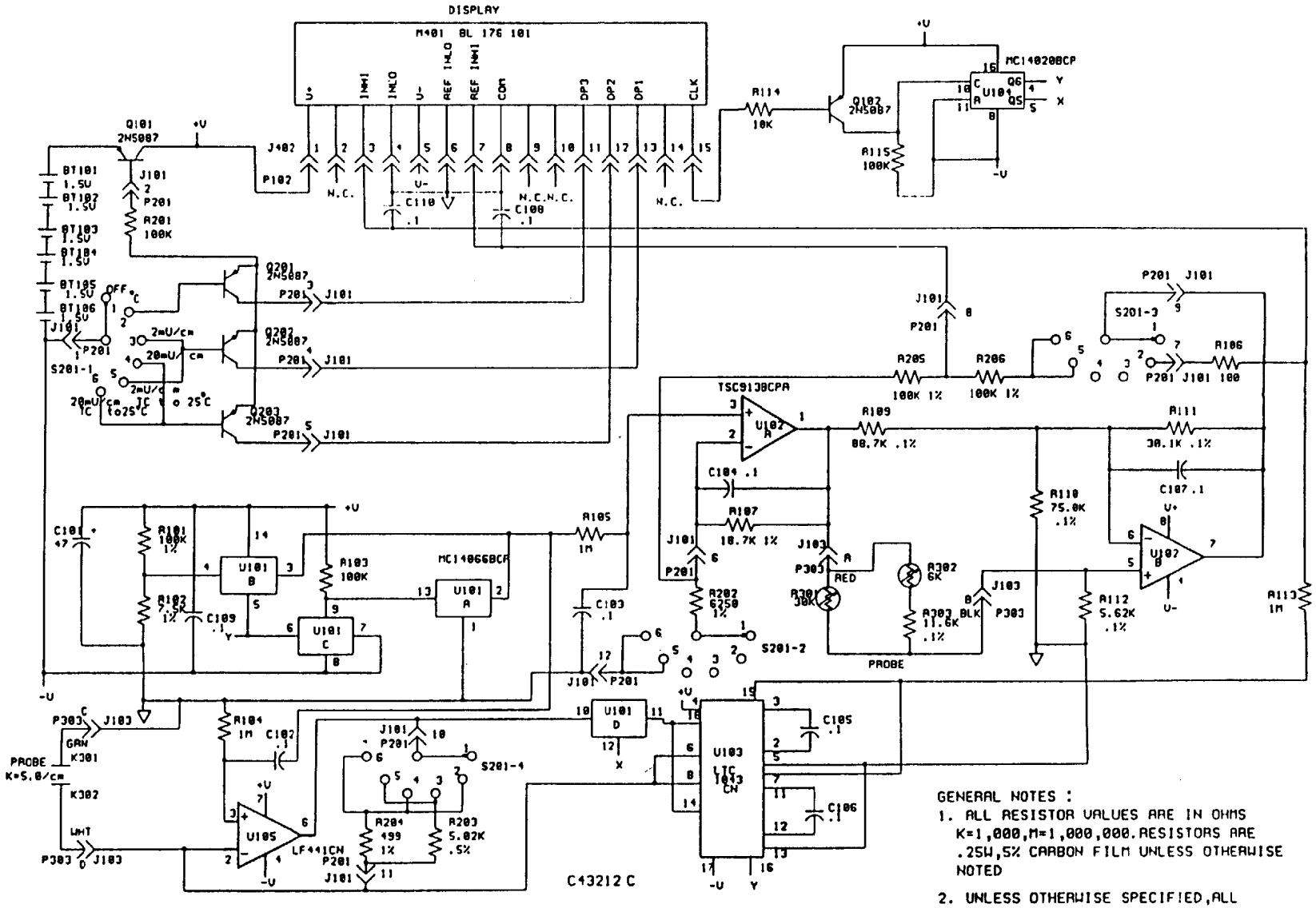
2 Temperature Correction Value of Two Typical Solutions (0.007 Normal and 0.089 Normal Potassium Chloride)

TEMPERATURE	0.007N KCl 1.000 m℧/cm	0.089N KCl 10.00 m℧/cm
−5	.455	4.71
0	.541	5.54
+5	.628	6.39
10	.718	7.26
11	.736	7.44
12	.754	7.61
13	.773	7.79
14	.791	7.97
15	.810	8.15
16	.829	8.33
17	.847	8.52
18	.866	8.70
19	.885	8.88
20	.904	9.07
21	.923	9.25
22	.942	9.44
23	.961	9.62
24	.981	9.81
25	1.000	10.00
26	1.020	10.19
27	1.039	10.38
28	1.059	10.57
29	1.079	10.76
30	1.098	10.96
35	1.199	11.93
40	1.302	12.93
45	1.406	13.95
50	1.513	14.99

AMPLIFIER BOARD AND SWITCH BOARD COMPONENTS







GENERAL NOTES :

1. ALL RESISTOR VALUES ARE IN OHMS K=1,000,M=1,000,000.RESISTORS ARE .25W,5% CARBON FILM UNLESS OTHERWISE NOTED
2. UNLESS OTHERWISE SPECIFIED,ALL CAPACITOR VALUES ARE IN uF
3. S201 SHOWN IN OFF POSITION

This schematic is representative only, and may be slightly different from the circuit in your instrument.

Appendix C

RAI Quality Assurance Plan

RAI

Resource Analysts, Inc.
P.O. Box 778
1 Lafayette Road
Hampton, N.H. 03842
(603) 926-7777

Doc. No. 01-01-001

QUALITY ASSURANCE OPERATIONS MANUAL

TITLE: RAI Quality Assurance Manual

Prepared By/Date
D.S.Newhouse 7/88
Approved By/Date
7/28/88 QA Officer
7/28/88 Tech. Director
7/28/88 President

Revision No.: 0
Date of Issue: 7/88
Supersedes No.:ALL

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1.0 Introduction

1.1 QA Policy and Objectives of the Program

The staff of Resource Analysts, Inc. and its subsidiaries is dedicated to the production of analytical results of known, appropriate, acceptable and documented quality. Our analytical and aquatic toxicology laboratories are fundamentally in the business of producing data. Our environmental field sampling and aquatic research organisms facilities produce samples and/or organisms from which data are ultimately generated. These data are subsequently used by our clients for purposes related to design, regulation, or evaluation of risk or liability. Often, these data will be the cornerstones of significant legal, public health or engineering decisions. The efforts of RAI must at all times be consistent with these needs, so that analytical results will be produced which are useful for the intended purpose.

RAI is committed to quality as priority number one. RAI stands committed to providing data of quality consistent with client needs and requirements. This commitment recognizes the need for data to be representative of the environmental conditions under consideration, and for data to be generated within a system of functions that meet applicable regulatory compliance criteria. To this end, RAI has developed a company-wide Quality Assurance (QA) Plan and maintains an ongoing QA Program. Our Quality Assurance Program contains provisions for establishing, maintaining and executing protocols which lead to results of known, appropriate and acceptable quality; documentation of these activities is an integral part of the QA program. No other concern will be permitted to interfere with the quality of data RAI provides to clients.

This manual describes the set of policies and principles which guide day-to-day operations. Specific protocols are included by reference and are contained in a series of volumes cited in Section 13.0 of this document.

1.2 Quality Assurance Documents

1.2.1 QA Manual

This document describes management policies related to operation of the analytical and aquatic toxicology laboratories, the environmental field sampling facility and the aquatic research organisms facility. It provides overall guidance regarding acceptable practices and discusses each element of the Quality Assurance Program. It functions as the Project QA Manual where no other Quality Assurance Project Plan, Statement of Work or other contractually mandated project plan has been specified. Adherence to the practices described in this manual is required of all employees. This manual may be revised and/or superseded only with the written authority of the RAI President. Copies of this manual are controlled and distribution is administered by the QA Officer.

1.2.2 Standard Operating Procedures Manuals

All procedures related to sample collection, storage, preparation, analysis, disposal, data validation, data reporting and employee training and safety shall be contained in written Standard Operating Procedures Manuals (SOP's). Each SOP shall contain the elements outlined in Doc. 01-02-029, Preparation of SOP Manuals and QA Project Plans. All sections shall be structured in a step-wise manner using numbered paragraphs. All record-keeping requirements shall be described at each step in the SOP Examples of all forms used shall be included as tables or figures and referenced within the text. Preparation of SOP's shall be the responsibility of each Department Manager. SOP's shall be assigned a number from the Inventory List for SOP's (Section 13.0). This number shall become part of the document control number when the SOP is accepted for implementation by RAI corporate management. SOP's shall be reviewed and approved by the Group Manager (and Lab Director for all SOP's related to analytical procedures) and the QA Officer, and submitted by the QA Department to the Technical Director and the President for approval prior to implementation.

1.2.3 Project QA Manuals

Project QA Manuals shall be implemented as required for regulatory compliance. These shall include such documents as Quality Assurance Project Plans (QAPP's) and Study Protocols. For those projects which require specific QA/QC criteria, a QAPP which has been approved by a regulatory agency, usually the EPA, is provided to RAI by the client. A Study Protocol refers to an EPA-approved document which contains information regarding the conduct of an experimental analysis of a test substance regulated under TSCA or FIFRA as described in the legislation (40 CFR Part 160; 40 CFR Part 792).

1.2.4 Document Control, Distribution and Revision

1.2.4.1 Copies of SOP's, QAPP's, Study Protocols and other Project QA Manuals shall be maintained by the QA Department.

1.2.4.2 Provisions shall be made for documenting significant revisions to existing procedures.

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2.0 QA Organization and Personnel

The QA organization and the assignment of quality assurance functions at RAI and its subsidiaries are designed to assure compliance with the "Good Laboratory Practices" (GLP's) rules as promulgated by the Environmental Protection Agency and published in the Federal Register as 40 CFR Part 160 (FIFRA), 40 CFR Part 792 (TSCA) and the Proposed Rules of December 28, 1987 (52 FR 48920 ff).

2.1 Within the Laboratories

2.1.1 It is the individual responsibility of each analyst and technician to perform their assigned tasks according to the specified SOP manuals and QA Project Plans. This includes responsibility for performing quality control analyses as specified in the method SOP and for entering the QC data in the appropriate method control file system. The analyst shall report out-of-control results to the Group Manager.

2.1.2 Group Managers shall assure that analysts and technicians are instructed in the requirements of the RAI QA Manual, study-specific QA Project Plans and SOP's for the analytical method or other procedure. Group Managers shall review sample QC data at frequent intervals designed to assure that QC analyses are being performed at the required frequency, that data are documented in the method control file system and that established corrective action procedures for out-of-control situations are followed and the results documented. It is the responsibility of the Group Manager to assure that data have been validated and reported to the Laboratory Director. Group Managers shall report to Laboratory Directors.

2.1.3 Laboratory Directors shall assure that Group Managers are instructed in the requirements of the RAI QA Manual, study-specific QA Project Plans and SOP's. Laboratory Directors approve standards for QC control limits for methods and work with Group Managers to bring out-of-control methods back to within established acceptance limits. Laboratory Directors shall also function as Study Directors or Project Officers as designated by the corporate President or Technical Director. Laboratory Directors shall report to a Technical Director.

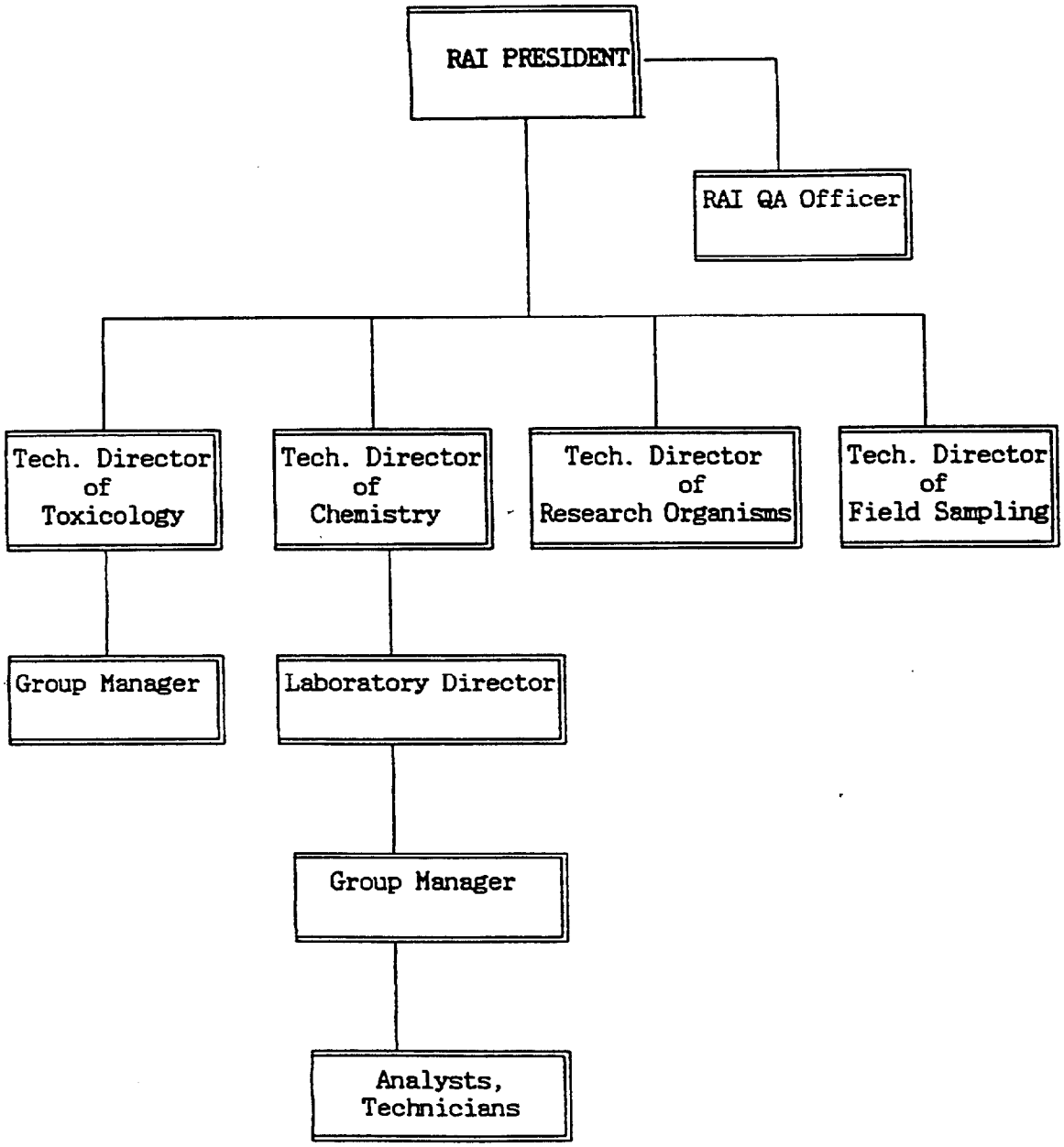
2.1.4 Technical Directors shall take overall responsibility for technical conduct, evaluation and reporting of all analytical tasks associated with each study. Technical Directors assure that approved procedures are documented and followed, that all data are recorded and verified, and that all deviations from approved procedures are documented. Technical Directors shall report to the RAI President or a subsidiary President.

2.1.5 The Quality Assurance Department, under the direction of the Quality Assurance Officer, shall be responsible for conducting systems audits and inspections for compliance with this manual, SOP's and QA Project Plans or other project-specific protocols; maintaining the archives, maintaining historical files of all QA documents, reviewing QC charts, documenting findings and corrective action, and reporting findings to management. The Quality Assurance Officer shall report directly to the President of RAI.

2.1.6 The RAI President shall designate Technical Director(s) and replace if necessary. The RAI President shall assure that there is a Quality Assurance Department, that personnel and other resources are adequate, that personnel have been informed of their responsibilities, that deficiencies are reported to Laboratory and Technical Directors and that corrective actions are taken and documented. Any significant changes to written SOP's shall be authorized in writing by the President of RAI and its subsidiaries.

RESOURCE ANALYSTS, INC.
QUALITY ASSURANCE
ORGANIZATION CHART

RESOURCE ANALYSTS, INCORPORATED
QUALITY ASSURANCE ORGANIZATION CHART



2.2 Outside the Laboratories

RAI analytical laboratories shall participate in the analysis of Performance Evaluation Samples managed by the U.S. Environmental Protection Agency as well as additional performance evaluation sample analysis as authorized by the RAI President.

2.3 Field Operations

[Reserved]

2.4 Test Animal Production

[Reserved]

3.0 Standard Practices

3.1 Laboratory Safety

3.1.1 Sample receiving areas and laboratories shall be equipped with suitable hoods, respirators, protective clothing and eyewear, gloves, barrier creams and other measures to prevent or minimize staff contact with hazardous substances. Safety equipment such as eyewash stations, drench showers, spill adsorbents and neutralizers, fire extinguishers, first aid materials, and breathing oxygen shall be available.

3.1.2 Unknown hazardous waste samples may be received and screened in a mobile laboratory or similar facility as an exclusion and containment measure. This facility may be staffed only with personnel judged to be thoroughly familiar with health and safety requirements. This staffing decision shall be made by the Safety Manager. Protective equipment, such as full-face respirators, shall be worn as a matter of routine. Procedures shall be described in an RAI SOP and shall be strictly followed.

3.1.3 As a matter of policy, RAI shall not accept radioactive materials, known explosives, known dioxin-contaminated materials or unusual biohazard materials.

3.1.4 A laboratory staff member shall be designated as Safety Manager by the Technical Director in consultation with the President. The Safety Manager prepares and maintains safety-related SOP's, conducts safety and occupational health orientation, training and review sessions as required, and maintains up to date familiarity with safety and occupational health issues pertinent to the laboratory.

3.1.5 The Safety Manager prepares and maintains educational programs as required to comply with state and federal "right to know" legislation.

3.1.6 The Safety Manager or his designee shall conduct an orientation session with each new staff member to familiarize him/her with routine and emergency safety procedures and equipment. Generally, the first one to three days shall be devoted primarily to health and safety concerns. Eye protection, a respirator, and a lab coat shall be issued to the employee. A baseline physical shall be scheduled, and a tour of the laboratory shall be conducted. During the tour, needs for eye, skin, and respiratory protection shall be discussed as well as the use of safety glasses, face shields, goggles, partial and full-face respirators, ventilated work areas, fume hoods, gloves, barrier creams, Tyvek coveralls and overboots. The location of eye wash stations, drench showers, fire extinguishers, and first aid equipment shall be shown to the employee and their use shall be described or demonstrated. Fire and spill notification, emergency procedures, and evacuation stations shall be taught during this session. The orientation concludes with an introduction to potential chemical hazards and the Material Safety Data Sheet. MSDS shall be made available for review.

3.1.7 Health services shall be contracted from a local hospital, which provides emergency care, outpatient care and referral, training, and baseline physical examinations. Examinations shall include:

Occupational history
Health history
Physician's examination
Pulmonary function test
Liver and kidney function
Trace metal screen
EKG
Chest X-Ray

Physical examinations shall be repeated annually. Results shall be placed in personnel files and shall be available to the employee at all times.

3.1.8 Employees shall be responsible for their own safety. Laboratory Directors and Group Managers may require that certain levels of protective equipment be worn when in their judgement it is appropriate. Failure of an employee to wear required protective equipment will result in immediate disciplinary action.

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3.2 Training

3.2.1 Technical Director(s) shall be responsible for staff training programs, which may be administered by the Laboratory Directors and Group Managers.

3.2.2 Training shall be conducted for each individual on each procedure that he or she is to perform.

3.2.3 No individual shall conduct any analysis, experimental procedure or other professional function without continuous direct supervision until training in that procedure has been completed and the individual's ability to produce acceptable results has been documented.

3.2.4 Written records of training activities shall be maintained by the Laboratory Directors and Group Managers.

3.2.5 Records of attendance at professional development seminars, conferences, courses and the like shall be kept by the Personnel Department.

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3.3 Security and Confidentiality

3.3.1 Three tiers of security shall be maintained within all Resource Analysts, Inc. facilities with the purpose of controlling external influences on samples, analytical processes, and data. This helps assure the completeness, representativeness, accuracy, and precision of analytical results.

3.3.2 The first tier of security maintained shall be controlled access to laboratory buildings. Exterior doors to laboratory buildings shall remain either locked or continuously monitored by a Resource Analysts, Inc. staff member. Posted signs shall direct visitors to the reception office and mark all other areas as off limits to unauthorized personnel. All visitors to the facilities must sign the Visitors' Logbook maintained by the receptionist. All visitors shall be accompanied by a staff member during the duration of their stay on the premises. The staff member shall escort the visitor from the facility and report the visitor's departure to the receptionist who shall note this in the Visitor's Logbook. Prior to departure of the last staff member at the close of each day, all windows shall be locked and all doors checked and locked by the last staff member.

3.3.3 The second security level shall be within the facility and will be designated as required by the Technical Director in consultation with the President. Individual Laboratory Directors or Group Managers will close specific areas under their responsibility to entry by unauthorized persons. A list of authorized persons shall be prepared and signed by the President. "Closed Areas" shall be designated by prominent postings at all points of access.

3.3.4 The final tier of security shall be comprised of specific secure areas for sample, data and client report storage which shall be lockable within the facilities, and to which access shall be limited to specific individuals or their designees. Security of sample storage areas shall be the responsibility of the Sample Manager. Security of samples and data during analysis and data reduction shall be the responsibility of Laboratory Group Managers and Directors. Security of client report archives shall be the responsibility of the Quality Assurance Officer. These secure areas will be locked whenever these individuals or their designees are not present in the facility.

3.3.4.1 Designated laboratory sample storage locations are designed to limit access to authorized personnel only, and provisions for lock and key access shall be provided. No samples are to be removed without authorization, which consists of having a lab sheet requesting analysis on an aliquot.

3.3.4.2 Duplicate keys to any secure areas, including filing cabinets, shall be kept and regulated by the Support Services Manager or his/her designee. A logbook of all individuals who have been issued keys shall be maintained.

3.3.4.3 A master log of all individuals who have been issued keys to the facility or to any secure areas of the facility shall be maintained in the office of the President.

3.3.5 Standard business practices of confidentiality shall apply to all documents and information regarding client analyses. Specific protocols for handling confidential documents are described in RAI SOP QA-017.1. Additional protocols for internal identification of samples and data by number only shall be implemented as required under contract-specific Quality Assurance Project Plans.

3.4 Traceability of standards, instrumentation, and data

3.4.1 Since standard solutions used for analytical method calibration affect all data derived from the method, the importance of quality and traceability shall be paramount.

3.4.1.1 All materials requisitioned for calibration standard use shall be requested as such.

3.4.1.2 Purchasing staff may order only materials of certified purity from reputable suppliers. Records of reference material purchased shall be maintained by the Purchasing Department.

3.4.1.3 If assayed materials are unavailable, the material of highest purity available shall be obtained and assayed in-house before use.

3.4.1.4 Reference material containers shall be identified with the standard serial reference number and dated upon receipt.

3.4.1.5 Bound laboratory notebooks shall be used by analysts and technicians to record preparation of working standards from identified reference material. The following information shall be recorded:

date of preparation
analyst's initials
source of reference material
amounts used
final volume
serial reference number of that stock solution.

3.4.1.6 All standards containers shall be labelled with, at minimum, the standard serial reference number (small glass ampules); when possible, the name, concentration, date of preparation and expiration date of the stock standard.

3.4.1.7 All diluted working standards not consumed during an analytical session shall be labelled fully, including the serial reference number of any stock standard used in its preparation.

3.4.2 Instrumentation used shall be as prescribed in the SOP for the analytical method.

3.4.2.1 All instruments used to collect samples, generate sample results and/or reduce data shall be designated by a unique alphanumeric identifier. This instrument identifier shall appear in the analysts' notebooks, instrument logbooks and/or computer-generated hardcopy for all sample analyses.

3.4.2.2 Preventive maintenance shall be provided for all instruments and equipment as specified by the manufacturer, or as established by the Laboratory Director (or Group Manager), whichever is more frequent. Preventive maintenance shall be conducted in order to assure timely, accurate and reproducible analytical processes in a safe laboratory or field environment.

3.4.2.3 All maintenance activities shall be recorded in either the instrument run log or a separate logbook unique to the instrument.

3.4.3 All data generated in and/or reported from the laboratory shall include reference to the person(s) who performed the analysis, the date of analysis, the method used, the identification of the instrument (whenever more than one instrument is used for a method) and the acceptabilty of the results in the context of the QC system.

3.4.3.1 The Laboratory Control Sheet issued to laboratory departments shall be used to initiate a laboratory data file for the project.

3.4.3.2 All data pertinent to sample preparation shall be recorded by the laboratory staff in bound notebooks with numbered pages. During the sample preparation process, a preparation sheet shall be prepared for the project by the preparation specialist. It shall contain the following information:

sample identification numbers,
date of preparation,
method reference,
analyst's initials,
final volumes of sample extracts,
relevant blank, spike and surrogate data, including the serial reference number,
the instrumental analysis to be performed on eaoh extract.

3.4.3.3 The preparation sheet shall be filed with the Laboratory Control Sheet in the Laboratory Project File.

3.4.3.4 At the time of sample analysis, the laboratory identification number, amount injected or otherwise analyzed, any dilution of the original sample and/or extract and other relevant sample data shall be entered into either an analyst's notebook or instrument logbook, or if possible into the instrument header.

3.4.3.5 All data relevant to the calculations should, where possible, be entered onto the instrument header including sample weight or volume, final volume, dilution, and spike level.

3.5 Accountability

All areas of the laboratory in which samples are received, stored, processed, or analyzed shall be kept in a condition that minimizes the risk of samples becoming lost or accidentally destroyed, contaminated, degraded, misidentified, improperly handled or otherwise compromised. The following practices shall be followed to assure that data reported represent results on the sample as submitted to the facility.

3.5.1 All employees shall be responsible for the cleanliness and order of their work areas. The Technical Director of the laboratory shall routinely tour the facilities noting major and minor infractions. These shall be brought to the attention of the respective lab supervisors who formulate and institute corrective action through their staff.

3.5.2 Each sample, defined as a unit of matrix enclosed by a single container, shall be assigned a Laboratory Control Number by the Sample Management staff member who receives the sample. Provisions to identify field replicates and additional sample volume shall be incorporated into this procedure as described in Standard Operating Procedure QA-001, Sample Receiving and Identification.

3.5.3 Cross-referencing of Laboratory Control Numbers and Client Sample ID's shall be implemented in Sample Management documents as described in Standard Operating Procedure QA-001, Sample Receiving and Identification.

3.5.4 Sample analyses shall be identified by Laboratory Control Number in analysts' notebooks or instrument logbooks, which shall consist of bound laboratory notebooks with prenumbered pages.

3.5.5 Transfers of samples in and out of storage shall be recorded in Storage Logbooks maintained by the Sample Manager.

3.5.6 Standards shall be stored separately from samples and extracted samples.

3.5.7 Test, control and reference substances for use in experimental studies mandated under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) or the Toxic Control Substances Act (TSCA) shall be stored separately from the test system plants, animals or other components.

3.5.8 Computerized systems for data generation shall be validated prior to implementation and shall contain provisions for password access and additional security measures as required.

3.6 Sample Analysis

3.6.1 Samples shall be analyzed within holding times as specified in Table 3.1, unless a more restrictive holding time is prescribed under a contract-specific Quality Assurance Project Plan.

3.6.2 Samples shall be analyzed and experimental procedures conducted following written Standard Operating Procedures Manuals (SOP's) which have been approved in writing by management. Substantial changes to established procedures shall be authorized in writing by management via an SOP Manual revision process as described in Standard Operating Procedure QA-029, Preparation of SOP's and QA Project Plans.

3.6.3 Departures from SOP's shall be recorded with the raw data.

3.6.4 Laboratory Directors shall assure that samples shall be scheduled for analysis in compliance with the analytical request as issued by the Sample Manager in the form of a Laboratory Control Sheet(s).

3.6.5 A written Worklist System approved by the Technical Director shall be used to assign work to preparatory and instrumentation lab staff members.

Table 3.1 Sampling and Preservation of Samples.

SAMPLING & PRESERVATION REQUIREMENTS

Revision 1.1 12/22/88

Parameter	Methods	Required Volume & Containers Water (Soil)	Preservation	Holding Times
ORGANICS				
Volatiles:				
Drinking water GC/MS	EPA 524.1	3 x 40 mL G/T	4C	7/14
Wastewater GC/MS	EPA 624/8240	2 x 40 mL G/T	4C	7/14
Purgeables	EPA 601/8010	2 x 40 mL G/T	4C	7/14
Aromatics	EPA 602/8020	2 x 40 mL G/T	4C	7/14
Acrolein, Acrylonitrile	EPA 603	2 x 40 mL G/T	4C	
TOX (Total Organic Halides)	9020	2 x 40 mL G/T	4C	7/14
Semivolatiles:				
Acids/Base Neutrals	EPA 625/8250/8270	1L (30 gms) G/T	4C	7/40
Pesticides/PCB's	EPA 608/8080	1L (30 gms) G/T	4C	7/40
Herbicides (SDWA)	509A/8150	1L (30 gms) G/T	4C	7/40
Petroleum Hydrocarbons - GC/FID	3510 (Capillary GC/FID)	1L (30 gms) G/T	4C	7/40
Petroleum Hydrocarbons - IR	418.1	1L (30 gms) G/T	4C	7/40
Polynuclear Aromatics	EPA 610/8100	1L (30 gms) G/T	4C	7/40
Oil & Grease - Gravimetry	413.1	1L (30 gms) G/T	HCl pH<2;4C	28
Oil & Grease - IR	413.2	1L (30 gms) G/T	HCl pH<2;4C	28
NM2P		1L (30 gms) G/T	4C	
Phenols	420.3	200 (30 gms) G/T	H2SO4,pH<2;4C	28
Dioxins	8270	2 x 1L(100 gms) G/T	4C	
INORGANICS				
Metals:				
Total Metals		100 mL (10 gms) P	HNO3,pH<2;4C	60
Dissolved Metals	**100 mLs of sample are used per digest. Separate digests are done for Ag, Hg, As &Se, and then one digest is done for remaining metals and hardness		(Dissolved samples must be filtered before adding HNO3)	
Hardness 130.2				
Extraction Procedure Toxicity (EP Tox)	1310	100 gms 4C	N/A	
TCLP		3 x 250 gms(3 separate containers)	N/A	
Wet Lab:				
Acidity	305.1	100 (2 gms) P,G/T	Fill, 4C	14
Alkalinity	310.1	100 (2 gms) P,G/T	Fill, 4C	14
Anions (Cl, Br, SO4, O-PO4, NO2, NO3)	300.0	50 (20 gms) P,G/T	O-PO4, NO2 2 days	28
Asbestos				
BOD	405,1	1000 mL G/T	4C	1
BTU	D240 ASTM	5 mLs (2 gms) P,G/T	4C	N/A
COD (Chemical Oxygen Demand)	410.1/410.2	100 mL P,G/T	4C	28
Coliform bacteria		Whirlpack	4C	6 hours
Color	110./3	100 mL P,G/T	4C	2
% Chloride	D123-64 ASTM	(20 gms) P,G/T	4C	N/A
Conductance	SM 205	175 mL P,G/T	4C	28
Cyanide, Total	335.2/9010	1000 (25 gms) P,G/T	NaOH pH>12; 4C	14
Cyanide, Ammenable	335.1	1000 (25 gms) P,G/T	NaOH pH>12; 4C	14
Flashpoint	D93-77 ASTM	80 mL (80 gms) P,G/T	4C	N/A
Fluoride	340.1/340.2	50 mL P,G/T	4C	28
Formaldehyde	NIOSH	40 mL (2 gms) P,G/T	4C	
Grain size (dry sieving)		30 gms P		
Hexavalent Chromium	218.4	200 mL (2 gms) P,G/T	4C	1
Ignitability	1010	50 mL (2 gms) P,G/T	4C	
MBAS (Surfactants)	425.1	250 mL P,G/T	4C	2
Nitrogen - Ammonia	350.2	500 mL (5 gms) G/T	H2SO4,pH<2; 4C	28
" Nitrate	300.0	50mL (20 gms) P,G/T	4C	2
" Nitrite	300.0	50mL (20 gms) P,G/T	4C	2
" TKN	351.3	500 mL (5 gms) G/T	H2SO4,pH<2; 4C	28
" TON (NH4 & TKN)		500 mL (5 gms) G/T	H2SO4;pH<2, 4C	28
Particle size (wet digestion)	Stockman & Fochman	(30 gms) G/T	4C	N/A
pH	150.1	25 mL P,G/T	4C	IMMEDIATE
Phosphorus, Total	365.4	100 mL (0.5 gms) G/T (Specially Cleaned)		

Radiology - Radium 226/228 Uranium, Alpha scan		1 gallon P		4C	
Radon		2 x 40 mL G/T		4C	2
Reactivity - Sulfide Spot Test	SM 427.3C	10 mL (7 gms)		4C	N/A
" - Cyanide Spot Test	SM 412J	10 mL (7 gms)		4C	N/A
Silicate Reactive	370.1	100 mL (2 gms) P Only		4C	28
Specific Gravity	SM 213	30 mL		4C	N/A
Solids, Settleable	160	1000 mL		4C	IMMEDIA
Solids, Total (TS)	160.3	100 mL		4C	7
Solids, Total Suspended (TSS)	160.2	100 mL		4C	7
Solids, Total Dissolved (TDS)	160.1	100 mL		4C	2
Solids, Total Volatile (TVS)	160.4	100 mL		4C	7
Solids, Total Suspended Volatile (TSVS)		100 mL		4C	7
Sulfide	376.2	250 mL P	ZnAc		7
Sulfite	377.1	100 mL P	EDTA		IMMEDIA
% Sulfur	D 129-64 ASTM	(2 gms)		4C	
TIC (Total Inorganic Carbon)	415.1	100 mL G/T		4C	
TOC (Total Organic Carbon)	415.1	100 mL G/T	H2SO4,pH<2; 4C		28
Turbidity	180.1	100 mL P,G/T		4C	2
Viscosity	D445 ASTM	175 mL P,G/T		4C	
% Solids		(30 gms) P,G/T		4C	
Tannic Acid	SM 513	100 mL P,G/T		4C	

CLP CLP documentation and protocol are available at Resource Analysts. For every 10 samples a matrix spike matrix spike duplicate must be performed. Therefore one sample in every batch of 10 samples must have three times the volume necessary to do one test. Please contact RAI for more information on CLP requirements.

This is a partial list of tests available at Resource Analysts, Inc. Please contact us for more information.

3.6.6 The following is a partial listing of references used to establish analytical protocols.

1. "Method of Chemical Analysis of Water and Wastes", USEPA. 1979 (EPA-600/4-79-020).

2. "Method for Evaluating Solid Waste, Physical/Chemical Methods", 3rd edition, USEPA November, 1986. (SW-846).

3. "Standard Methods for the Examination of Water and Wastewater", 15th, 16th Editions, 1976-1984. APHA.

4. "Annual Book of Standards, Part 31, Water", ASTM.

5. "Official Methods of Analysis of the Association of Official Analytical Chemists", Methods Manual. 14th Edition, 1984.

6. "NIOSH Manual of Analytical Methods" U.S. Department of Health and Human Services, February 1984.

7. "Statement of Work for Organic Analysis, Multimedia, Multiconcentration", USEPA Contract Laboratory Program. IFB WA-85-J178, January 1985; October 1986.

8. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act." 40 CFR Part 136.

9. "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms." EPA-600/4-85/013. 3rd Edition.

3.7 Data Validation

3.7.1 Each department shall have written procedures for data validation which incorporate the quality assurance goals of traceability, accountability completeness, precision and accuracy.

3.7.2 No written reports shall be issued which have not undergone the data validation process.

3.7.3 For those studies conducted subject to GLP compliance, data shall be independently validated under the direction of the Quality Assurance Officer to provide assurance that the reported data accurately reflects the raw data.

3.8 Documentation

3.8.1 All information related to the quality assurance practices outlined in this manual shall be contained in records. This shall include, but not be limited to, standard operating procedures, study protocols, results of instrument calibrations, analysis of quality control samples, analysis of samples, sample custody and disposal, preparation of standards, corrective action, audits and inspections.

3.8.2 The Quality Assurance Office shall keep written inventories of quality-related documents which include a description of the document, the general type of analysis to which it applies, the date(es) of origin and the storage location.

3.9 Audits, Inspections, Performance Evaluations and Corrective Action

[Reserved]

4.0 Sample Custody

4.1 Sample Receipt, Handling and Chain-of-Custody

4.1.1 Samples shall be received at the laboratory by the Sample Manager or designee who removes the samples from shipping containers together with all accompanying documentation such as chain-of-custody forms, sample inventory, analysis request form, etc. The samples shall be inspected for general condition; if seals are present, whether or not they are intact; and discrepancies between package contents and sample inventory sheets or analysis sheets/analysis request forms. If discrepancies, ommissions, or inappropriate samples are noted, the client shall be contacted and an effort shall be made to resolve the problems. If the client cannot be reached, the samples in question shall be assigned to cold storage (4 C) and no further action shall be taken until the problem is resolved. Samples shall be then entered into the Master Log. A project number shall be assigned to the sample group and unique individual sample numbers shall be assigned to each sample container. The Master Log serves to document the following:

- Date and time of receipt
- Priority status to be assigned to the sample group
- Client and responsible individual (together with client project reference number when applicable).
- Individual sample numbers
- Client sample identification/sample description
- Preservation during shipment
- Preservation by RAI Sample Management
- Container type and volume
- Chain-of-custody requirements
- Analysis requested
- Date due

4.1.2 The Sample Manager prepares a set of laboratory control sheets for the sample group, which includes a project control sheet and individual laboratory group control sheets for the samples. The project sheet initiates the project file into which all documentation accompanying the sample group shall be placed. All removable tags shall be detached and kept with the project sheet. The laboratory control sheets include information on any preservation/refrigeration that occurs when the sample group arrives.

4.2 Sample Preservation and Storage

4.2.1 The Sample Manager appropriately preserves and/or refrigerates all samples and delivers the control sheets to the appropriate person responsible for the analysis. The samples shall be logged into each storage location by making an entry in the Storage Logbook which includes the project number (RAI Lab Number), the RAI Laboratory Control Number, the client's project or case number if required by the client, the date and time, and the initials of the sample management staff member who stores the samples. When samples are removed for analysis or work-up, they shall be logged out of storage by the analyst with notations of any alterations which may compromise the sample integrity.

4.2.2 All samples shall be stored so as to minimize physical or chemical alterations of the sample prior to analysis. The type of storage and preservation applied to a sample shall be determined from the analytical method reference when applicable. In the absence of these specific storage/preservation requirements, the requirements in Table 1 shall be followed.

4.2.3 Designated laboratory sample storage locations shall be designed to limit access to authorized personnel only, and provisions for lock and key access shall be provided. No samples shall be to be removed without authorization, which consists of having a lab sheet requesting analysis on an aliquot.

4.3 Sample Disposal

4.3.1 Samples shall be kept for 15 days from issue date of the final report to the client when practical, unless the client specifies alternative arrangements as part of a written contract. After the 15-day or other contractually determined post-report storage time, the samples shall be either disposed of or returned to the client.

4.3.2 At the time of reporting, a copy of the report shall be made. This copy goes to the accounting department for billing and the date reported shall be recorded in the Master Log by the Reporting Supervisor. The copy of the report shall be sent to the designated Safety and Sample Disposal Officer for authorization of disposal.

4.3.3 Documentation of disposal shall be contained in the laboratory disposal record which shall include the date and method of disposal. Laboratory disposal records shall be the responsibility of the Safety and Sample Disposal Officer who determines the method of disposal and disposes or supervises disposal of the appropriate samples.

5.0 Materials and Apparatus

5.1 Reagents, Solvents and Gases

5.1.1 All chemical reagents used for analyses shall be "Analytical Reagent Grade". Individual method references may indicate specific reagent requirements.

5.1.2 All solvents and gases used shall be chosen to assure compliance with specific SOP's.

5.2 Laboratory Containers

5.2.1 All volumetric glassware used in sample preparation, sample analysis and calibration of instruments and other equipment shall be Class A or better.

5.2.2 All glassware shall be cleaned following written procedures which assure that inorganic and/or organic contamination is minimized.

5.3 Instruments

5.3.1 Laboratory instrumentation used shall be as specified in the protocol for the analytical method.

5.3.2 Preventative maintenance shall be conducted according to a written schedule for each instrument and the activities documented in a bound instrument maintenance logbook.

5.3.3 Corrective maintenance shall be provided as required for all instruments and equipment. Factory replacement parts, trained service technicians and first quality materials shall be used whenever available. It is RAI's policy to conduct repairs at the lowest level of complexity necessary and to obtain parts directly from primary manufacturers whenever possible. This purpose of this policy is to maintain efficiency, economy and reliability of quality maintenance.

6.0 Calibration

6.1 Calibration verifications shall be used to confirm the ratio of instrument response to true parameter value.

6.2 All instruments, instrumental systems and other equipment used to acquire sample data shall be calibrated following the protocols described in the Standard Operating Procedures Manual for the method of interest. In general, instrumental protocols require the preparation of a calibration curve using solutions of known standards followed by measurement of instrument response to these standards. Continuing calibration verification shall be made at a frequency specified in each SOP. Protocols for other equipment such as ovens, thermometers, automatic pipettors, temperature-controlled water baths, etc. require calibration via comparison with an independently certified standard.

6.3 Standards shall be prepared as indicated in the applicable method reference. The preparation of all stock standards shall be documented in a Standards Notebook which is used to record the date of preparation, the analyst, the source of the reference material, amounts used, final volume, etc. and the serial reference number of that stock solution. All standards shall be labelled with the standard serial reference number (small glass ampules), and when possible, with the name, concentration, date of preparation and expiration date of the stock standards. All diluted working standards not consumed during an analytical session shall be labelled fully, including the serial reference number of any stock standard used in its preparation.

6.4 All calibration protocols for instruments and instrumental systems shall include a calibration verification standard, certified by the EPA if available or, at a minimum, prepared from reference materials from an alternate source which is used to verify the initial calibration. A series of calibration solutions shall be used to prepare a calibration curve over an appropriate range of concentrations. Continuing calibration verifications shall be performed during each analytical session at a frequency specified in the method SOP.

6.5 The frequency of performance of continuing calibration verifications is mandated by the analytical method in most cases; where such is not the case, a continuing calibration verification shall be performed at least once per day in which samples are analyzed and once for each batch of 20 samples (including blanks, spikes and other quality control samples) analyzed.

6.6 Calibration frequency for equipment other than instruments or instrumental systems whose calibration is specified in an analytical SOP will depend on the frequency of use and the sensitivity of the equipment. The Group Manager shall be responsible for establishing equipment calibration schedules using a combination of manufacturer's recommendations and scientific judgement. The following guidelines shall be used:

6.6.1 Analytical Balances. Every six months calibration of the entire analytical range is checked by a qualified service technicain. Each day that the balance is used, the calibration shall be chcked for gross malfunction or trends using a Class S weight.

6.6.2 pH/Electrometer. Before use each day, and once after each four hours of use, the meter shall be calibrated useing pH 4 and pH 10 buffer solutions. The calibration shall be checked using a pH 7 buffer. If agreement between the three buffer solutions cannot be made to 0.05 units, the entire analytical unit shall be checked for the source of the problem.

6.6.3 Spectrophotometer. Each day that measurements are to be made, the instrument shall be checked with a minimum of one standard color cuvette.

6.6.4 Atomic Absorption Spectrometer. Initial calibration shall be made using at least three points. The calibration shall be checked every ten determinations using at least one standard. The calibration shall be checked at all three points at least once during each hour of use. If a calibration check shows a change of >10%, the calibration shall be rejected and a new curve established.

6.6.5 Gas chromatograph. Each GC system shall be initially calibrated at two points bracketing the expected sample concentrations; if the difference between response factors for the calibration points is greated than 5% a third point shall be used and a calibration curve calculated. The system shall be checked for calibration drift or variability with check standards daily or one check sample per 20 samples, whichever is more frequent.

6.6.6 Gas Chromatograph/ Mass Spectrometer. Each GC/MS system shall be initially calibrated at three points bracketing the working range of the system. Calibration shall be checked daily with a mid-range standard. If the instrument is to be used for two or more working shifts, the calibration shall be checked once each shift. Calibration may be checked during each sample run via surrogate standard spikes which include MS calibration check compounds.

6.6.7 Pensky Martens Closed Cup Flash Point Apparatus. Once each month the thermometer shall be checked against an NBS traceable certified thermometer.

6.7 Written records of all calibrations shall be kept in the appropriate instrument logbook.

6.8 Calibrated internal standards, which check system performance with each sample, shall be used when appropriate.

7.0 Analysis of Quality Control Samples

7.1 Analytical quality control (QC) measures shall be taken to maintain reliability in analytical determinations required to control accuracy and precision. Primary Analytical QC measures shall consist of laboratory control samples, duplicates and spiked samples.

7.1.1 Accuracy shall be monitored through the analysis of laboratory control samples and spiked samples.

7.1.1.1 Laboratory Control Samples shall be analyzed at a frequency specified by the analytical method.

7.1.1.2 For each sample batch, or at least once for every set of 10 samples, a matrix spike shall be prepared and analyzed.

7.1.1.3 Accuracy shall be calculated and expressed as percent recovery and evaluated with respect to predetermined upper and lower performance limits.

7.1.2 Precision shall be assessed by replicate analyses.

7.1.2.1 Duplicates shall be analyzed at a ratio of one duplicate for every ten sample analyses.

7.1.2.2 Data shall be evaluated as percent difference or relative range.

7.2 A duplicate or spiked sample shall be analyzed at a minimum frequency of once per sample batch (defined as a single analytical sequence) or once for every 10 samples analyzed.

7.3 Results from analyses of QC samples as described in Section 7.1 shall be used to prepare control charts which document the accuracy and precision of the analytical method as performed.

7.4. For certain analyses as specified by the analytical method, a surrogate standard(s) shall be added to each sample/blank prior to preparation. Percent recovery shall be determined on the surrogate standard(s) and shall be evaluated with respect to predetermined uppper and lower performance limits.

7.5 Comparative evaluation of the matrix spike and the surrogate standard will aid in resolution of the source of any unacceptable recoveries.

7.6 Method Blanks shall be analyzed at a ratio of one blank per batch of samples.

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8.0 Analytical Procedures

8.1 All analytical procedures shall be conducted in strict adherence with written Standard Operating Procedures Manuals which have been reviewed and approved by the Laboratory Director, the Technical Director, the RAI QA Officer and the RAI President. Documents from which SOP's are developed include the references listed in Table 8.1. Additional SOP's may be adapted from other sources or generated in-house as project needs require.

Table 8.1

1. "Method of Chemical Analysis of Water and Wastes", USEPA. 1979 (EPA-600/4-79-020).

2. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", 3rd edition, USEPA November, 1986. (SW-846).

3. "Standard Methods for the Examination of Water and Wastewater", 15th, 16th Edition, 1976-1984. APHA.

4. "Annual Book of Standards, Part 31, Water", ASTM.

5. "Official Methods of Analysis of the Association of Official Analytical Chemists ", Methods Manual. 14th Edition, 1984.

6. "NIOSH Manual of Analytical Methods" U.S. Department of Health and Human Services, February 1984.

7. "Statement of Work for Organic Analysis, Multimedia, Multiconcentration", USEPA Contract Laboratory Program. IFB WA-85-J178, January 1985; October 1986.

8. "Statement of Work for Inorganics Analysis, Multimedia, Multiconcentration", ESEPA Contract Laboratory Program. IFB WA87-K025, July 1987.

9. "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act". 40 CFR Part 136.

10 "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms." EPA-600/4-85/013. 3rd Edition.

9.0 Data Reduction, Validation and Reporting

9.1 All primary analytical data, otherwise known as "raw data", shall be recorded in bound notebooks with prenumbered pages. Entries shall be made in black ink and shall be initialled by the individual who makes the entry. Errors shall be corrected by drawing a single line through the entry; this change shall be initialled by the individual who makes the change. The use of white-out is prohibited on all raw data, including instrumental hardcopy.

9.2 The analyst who completes the analysis shall assemble all relevant raw data and results together with strip chart recordings, instrument settings and other information essential to data interpretation.

9.2.1 For data which are reduced by manual calculations, the calculations shall be documented in a laboratory notebook.

9.2.2 The results shall be transferred to a standard laboratory reporting form which has been approved by the Group Manager and Lab Director. Reporting forms shall include at a minimum the sample identification number, the date analyzed, the result expressed per unit volume, the method reference and the analyst's initials.

9.3 Group Managers shall check calculations for at least 10% of the analyses and document this data validation step in the analytical notebook. If a problem is discovered, the Group Manager shall check all calculations retroactively to the last date of the 10% check.

9.4 For data which are reduced via computer, calculations shall be checked by the analyst (or designee) assigned to this task at a frequency designed to assure that the data manipulations are valid. This data validation step shall be documented by the analysts' initials on the hardcopy of the raw data. The results shall either be manually transferred to a standard reporting form or reported via computer generation of forms.

9.5 The Group Manager shall submit the validated data package, including the reporting forms and the appropriate laboratory control sheets, to the Laboratory Director who shall review the package for QC requirements and completeness. If any errors are discovered, the entire package shall be returned to the Group Manager for full reworking.

9.6 When accepted, the Laboratory Director shall assemble the data with other data from the sample set, draft any narrative comments if required by the Quality Assurance Project Plan, and forward the report and the data package to the Technical Director.

9.7 The Technical Director shall examine the report for method appropriateness, detection limits and whether or not QC criteria were satisfied. Any deviations from the referenced methods shall be checked for documentation and validity, and QC corrective actions shall be reviewed for successful resolution.

9.8 Upon acceptance, the Technical Director shall release the report to the Reporting Department for typing and assembly. The Technical Director shall sign the completed reports prior to their release.

9.9 Each department shall have written procedures for data reduction, validation and reporting.

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10.0 Records Management
[Reserved]

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11.0 Corrective Action

11.1 Corrective action involves several activities designed to resolve a problem identified through an internal audit, an audit by a regulatory agency, a performance evaluation sample or routine analysis of QC samples.

11.1.1 Investigation of problems revealed by laboratory analysis of routine QC samples shall be the responsibility of the Laboratory Director and Group Manager(s). Managers may delegate investigative tasks to Senior Technicians and Analysts.

11.1.2 Group Managers, in conjunction with the Laboratory Director, shall be responsible for determining the cause of the problem and corrective action(s) needed for resolution.

11.1.3 Corrective action shall be implemented by the Laboratory Director and Group Manager(s), who shall evaluate whether the action taken has resolved the problem. The Technical Director shall be advised of situations for which corrective action fails to resolve the problem in a timely manner.

11.1.4 The Group Managers and Laboratory Directors shall confirm that the corrective action taken has eliminated the problem.

11.1.5 The QA Officer shall assure that corrective action is taken and that it has resolved the problem.

11.2 The steps in the corrective action process described above, namely:

identification of the problem
investigation
determination of cause and corrective action
verification that action taken has eliminated the problem
follow - up by the QA Officer

shall be documented by the individual who performed the task.

11.3 Documentation of the problem and outcome of the corrective action may be recorded on a form such as Figure 11.1 or in a memo to the Technical Director and the QA Officer.

11.4 Specific corrective action practices regarding routine analysis of QC samples shall be described in the Standard Operating Procedures Manual for the analytical method.

11.5 Corrective action shall be taken and documented in the following situations:

11.5.1 Analysis of routine QC samples related to an EPA method in which the acceptance limits specified are exceeded.

11.5.2 Results of a performance evaluation study are outside the study's acceptance criteria.

11.5.3 Audit Reports by a regulatory or certifying agency reveal deficiencies noted during either a site inspection or a data audit.

11.5.4 An internal audit by the Technical Director, a Lab Director, a Group Manager or a QA Officer which reveals an irregularity, deficiency or other non-compliance with this manual or a Standard Operating Procedures Manual.

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Figure 11.1 Quality Assurance Irregularity Report

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Quality Assurance Irregularity Report

Part I (To be completed by QA Auditor)

Date: _____

Sample ID Number(s) Involved: _____

_____

Description of QA irregularity: _____

_____

_____

Signed _____
Auditor

Signed _____
QA Officer

Part II (To be Completed by Department Supervisor)

Steps taken to investigate irregularity: _____

_____

_____

_____

Explanation of probable cause of irregularity: _____

_____

_____

_____

Steps taken to prevent future occurrence: _____

_____

_____

_____

Name of employee who performed work: _____

Signed _____

Date _____

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12.0 Internal QA/QC Audits and Reports to Management

12.1 The Quality Assurance Officer assures the President that all quality control measures are in place. The QA Officer and President shall meet on a regular basis to review lab workload, personnel performance and training, instrument requirements and maintenance, analytical methods, non-routine analyses, safety and QA/QC procedural involvement. Any items pertinent to QC shall be assigned to individuals for resolution. The QA Officer shall perform s a monthly lab audit inspecting:

- Sample storage
- Chain of custody documentation
- QC precision activities
- QC accuracy activities
- Instrument maintenance
- Documentation

12.2 Any non-compliances shall be listed by the QA Officer and discussed with the Laboratory Director. Oversights shall be discussed with the analyst and his/her Laboratory Director while the Laboratory Director decides how to correct systematic errors or misunderstandings. Modifications too cumbersome to be handled by the Laboratory Director alone are handled by the Laboratory Director, QA Officer, and President.

12.3 Quarterly, or more frequently as required, the QA Officer reviews program and audit performance at his/her discretion. Audit reports and program reviews shall be provided to the President.

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Table 13.1. Directory of RAI Standard Operating Procedures.

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Table 1. Inventory of RAI Standard Operating Procedures

TITLE	Number
Sample Receiving and Identification	QA-001
Sample Storage	QA-002
Bottle Orders	QA-003
Sample Disposal	QA-004
Sample Preservation	QA-005
Sample Preservation:	
Sulfur & Chlorine Spot Tests for Cyanide Samples	QA-005.1
Sample Custodian Duties	QA-006
Tracking Sample Analysis:	
Metals	QA-007
Wet Lab	QA-008
Organics:	
Volatiles and 601/602	QA-009
ABN's--instrumental	QA-010
--extractables	QA-010.1
Pesticides and PCB's--instrumental	QA-011
--extractables	QA-011.1
Other,including o&g,phenols, PHC	QA-012
General Organics	QA-013
Instrument Records,Logbooks,Notebooks, Benchsheets	QA-014
Data Assembly	QA-015
Data Auditting	QA-016
Case File Assembly-CLP	QA-017
Handling Confidential Data	QA-017.1
Document Inventory Procedures-CLP	QA-017.2
Document Data Shipping	QA-018
Reagents and Solutions	QA-019
Glassware Cleaning/Inorganics	QA-020
Metals Glassware Prep.	QA-020.1
Glassware Prep./Organics	QA-021
Glassware Cleaning/Organics	QA-021.1
Quality Assurance Archives	QA-022
Dishwashing Machine	QA-023
Tracking Results Assembly and Reporting	QA-024
Billing Form Preparation	QA-025
Report Preparation	QA-026
Purchasing	QA-027
DI Water System	QA-028
Preparation of S.O.P's and QA Project Plans	QA-029

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Volatile Techs.	QA-030 to 039
Method 624 (GC/MS)	QA-030
Method 601/602 (GC)	QA-031
% Solvents in Liquids	QA-033
ASTM (GC)	QA-032
CLP low-level soil	QA-034.1
CLP medium-level soil	QA-034.2
CLP water	QA-034.3
SDWA <<500 series>>	
EPA 524.1	QA-035.1
EPA 501.3	QA-035.2
EPA 524; low-level	QA-035.3
EPA 501.1; TTHM's	QA-035.4
EPA 501.2 TTHM's	QA-035.5
EPA 8240	QA-038
Unassigned: 036, 037, 039	
ABN Techs	QA-040 to 049
Extractions:	
Low and Medium Liquids	QA-040.1
Low and Medium Solids	QA-040.2
N-methyl-2-pyrrolidone	QA-040.3
Low Soil; CLP	QA-041
Med. Soil; CLP	QA-042
Water; CLP	QA-043
Analytical	
CLP	QA-044
EPA 625	QA-045
Chlorinated Hydrocarbons 8120	QA-046
N-aromatics & C. Ketones 8090	QA-047
Phthalate Esters 8060	QA-048
Pesticides, Herbicides and PCB Techs	QA-050 to 059
Extractions:	
P/P Low level waters	050.1
P/P Low and Medium Level Solids	050.2
Herbicides-liquids	050.3
Herbicides-solids	050.4
P/P Liquids (oils)	050.5
PCB screens	050.6
Alumina Clean-up	050.7

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Extractions:	
Sulfur Clean-up	050.8
Acid Clean-up	050.9
Florisil Clean-up	050.10
P/P solid screens-CLP	050.11
PCB Swabs	050.12
PCB Screen, Rapid	050.13
Low Level Soil; CLP	QA-051
Med. Level Soil; CLP	QA-052
Water; CLP	QA-053
Analytical:	
CLP	QA-054
EPA 608/8080	QA-055
EPA 608/8080 (modified) tissues	QA-055.1
SDWA Pesticides	
SDWA Herbicides (water) APHA 509	
SDWA Herbicides (soil) EPA 8150	
SDWA others	
Organophosphorus Pesticides; EPA 8140	QA-058
Organics Special Projects	060-069
Non-target Compounds by 624/625	QA-060
Petroleum Hydrocarbons: (PHC)	
Analytical by GC/FID	QA-070
Extractions for GC/FID:	
Waters	QA-070.1
Solids	QA-070.2
Polynuclear Aromatics EPA 610/8100	QA-071
Bioassay Preparations:	
P/P, Aromatics, Aliphatics	QA-072.1
% Lipids	QA-072.2
P/P in milk	QA-072.3
Marine Tissue extractions for PHC,P/P	QA-072.4
P/P in Fish tissue	QA-072.5
Oil and Grease/PHC by Gravimetry	
Analytical	QA-073
Extractions	
Liquids	QA-073.1
Solids	QA-073.2

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Phenols	
Analytical	QA-074
Extractions	
Liquids	QA-074.1
Solids	QA-074.2
Ethylene Thiourea (ETU) GC with FPD	QA-080
Meneb by GC/FPD Analysis of Carbon Disulfide	QA-081
Benchmark (RE-40885) in water by GC	QA-082

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Inorganics		QA-100 to 399
(Wet Lab):		100-199
	EPA Method	
Acidity	305.1	QA-100
Alkalinity	310.1	QA-101
Anions by IC	300.0	QA-102.1
(SO4, Cl, Br, NO2, NO3, PO4)		
Anions in Solids		QA-102.2
Iodide		QA-102.3
Boron	212.3	QA-103
Carbon - total inorganic	415.1	QA-104.1
total organic	415.2	QA-104.2
Chemical oxygen demand	410.1/410.2	QA-105.1
	SM508A	QA-105.2
	SM508C	QA-105.3
Chloride	325.3	QA-106
Chlorine Demand	SM409A	QA-107
Color	110.3	QA-108.1
	SM204A	QA-108.2
Chromium - hexavalent	218.4	QA-109
	SM312B	
Cyanide - total	335.2/9010	QA-110.1
- total & ammenable	335.1	QA-110.2
- weak acid dissociable		QA-110.3
- after chlorination		QA-110.4
- Cyanide Spot Test		QA-110.5
Flashpoint	ASTM	QA-111
Fluoride	340.1/340.2	QA-112
Formaldehyde	NIOSH	QA-113
Halogens/Sulfur in oil prep		QA-114
Hardness	130.2	QA-115
Heat of Combustion		QA-116
Ignitability		QA-117
Nitrogen - ammonia	350.2	QA-118.1
- nitrate	352.1	QA-118.2
- nitrite	354.1	QA-118.3
- Kjeldhal	351.3	QA-118.4
- total organic	350.2/351.3	QA-118.5
pH	150.1	QA-119
Particle Size		QA-120
Phosphorus - total	365.4	QA-121.1
- ortho	365.2	QA-121.2
Reactivity/RCRA		QA-122
Silica by Colorimetry		QA-123
Silicate - reactive	370.1	QA-124

Other Inorganics 351-399

Safety	QA-400 to 499
Waste Disposal	QA-500-599
Solvent Water Disposal	QA-501
Training	QA-600-699
Instrument Maintenance	QA-700-899

*currently subcontracted parameter

Biochemical oxygen demand*	405.1
TOX*	9020

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14.0 Location List of Instruments and Manuals

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Inorganics (continued)

Solids		
- total	160.3	QA-125
- suspended	160.2	
- dissolved	160.1	
- volatile	160.4	
- fixed		
- settleable		
Specific conductance	120.1 SM205	QA-126
Sulfate	375.4	QA-127
Sulfide	376.2	QA-128
Sulfite	377.1	QA-129
Surfactants - MBAS	425.1	QA-130
Turbidity	180.1	QA-131

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Metals Instrumentation 200-299

Analyte	EPA Method	
Antimony	204.1/7040	QA-200
Antimony(furnace)	*204.2/7041	QA-201
Arsenic(furnace)	*206.2/7060	QA-202
Beryllium	*210.1/7090	QA-203
Beryllium(furnace)	210.2/7091	QA-204
Cadmium	*213.1/7130	QA-205
Cadmium(furnace)	213.2/7131	QA-206
Chromium	*218.1/7190	QA-207
Copper	*220.1/7210	QA-208
Lead	*239.1/7420	QA-209
Lead(furnace)	239.2/7421	QA-210
Mercury(cold vapor)	*245.1/7470	QA-211
Nickel	*249.1/7520	QA-212
Selenium(furnace)	*270.2/7740	QA-213
Silver	*272.1/7760	QA-214
Silver(furnace)	272.2/7761	QA-215
Thallium(furnace)	*279.2/7841	QA-216
Zinc	*289.1/7950	QA-217
Barium	7080	QA-218
As/Se (Furnace)		QA-219
Sb/Th (Furnace)		QA-220
Trace Metals by ICP		QA-230
Barium	200.7	
Chromium	200.7	
Copper	200.7	
Sodium	200.7	
Beryllium	200.7	
Cadmium	200.7	
Cobalt	200.7	
Iron	200.7	
Lead	200.7	
Manganese	200.7	
Vanadium	200.7	
Zinc	200.7	
Nickel	200.7	
Molybdenum	200.7	
Calcium	200.7	
Magnesium	200.7	
Priority Pollutant Metals	as asterisked above	

RAI LABORATORY EQUIPMENT

Location Abbreviations:

GC/MS	OI
Organic Prep	OP
Inorganics	IN
Metals Instrumentation	MI
Metals Prep	MP
EnviroSystems, Inc.	ESI
Environmental Field Services, Inc.	EFSI

EQUIPMENT	NUMBER	MAKE AND MODEL	APPROX. AGE	USE	LOCATION
Bailers	7	SS & Teflon	3 yrs.	Bailing Wells	EFSI
Bailers - wire set ups	3	SS & Teflon	1-3 yrs.	Bailing Wells	EFSI
Batteries	4	NiCad	3 yrs.	Samplers or flowmeters	EFSI
Battery Chargers-120V adapters	2		4 yrs.	Charging batteries	EFSI
Bladder-type pump	1	ISCO - Model 2600	2 yrs.	Monitoring Wells	EFSI
Composite Wastewater Sampler	4	ISCO - Model 1580	2-4 yrs.	Time or flow programs	EFSI
Discrete Wastewater Sampler	1	ISCO - holds 28 bottles-Mod. 1680	3 yrs.	Time or flow programs	EFSI
Filtering Set ups	3		<1 yr.	Filter metal samples	EFSI
Flowmeter Bubbler	1	ISCO - Model 1870	3 yrs.	Flow measurements	EFSI
Flowmeter Transducer	1	ISCO - with Plotter Models 2300 & 2310	4 yrs.	Flow measurements	EFSI
Flumes and Weirs		Several assortments	2-4 yrs.	Flow measurements	EFSI
Jeep - 4 Wheel Drive	1	Cherokee	4 yrs.		EFSI
Peristaltic pump	1		4 yrs.	Monitoring Wells	EFSI
pH meters	2	Beckman - Model pHI 10	<1 yr.	pH	EFSI
Specific Conductance Meter	1	YSI	>4 yrs.	Specific Cond.	EFSI
Stirring Plates	2		<1 yr.	Field data	EFSI
Tools		SS to Stainless Steel		Various	EFSI
Truck - 4 Wheel Drive	1	Ford	<1 yr.		EFSI
Van - Front Wheel Drive	1	Chrysler Voyager	<1 yr.		EFSI
Ammonia Electrode	1	Orion Research - Model 95-12	<1 yr.	Measure Ammonia	ESI
Amperometric Titrator	1	Wallace & Tiernan	<1 yr.	Measure Chlorine	ESI
Analytical Balance	1	American Scientific - S/P 182	<1 yr.	Measure Weight	ESI
Conductivity Meter	1	YSI Model 35	<1 yr.	Measure Conductivity	ESI
Dissolved Oxygen Meter	1	Yellow Springs Instrument - Model 51B	3 yrs.	Dissolved Oxygen	ESI
Dissolved Oxygen Meter	1	Yellow Springs Instrument - Model 57	3 yrs.	Dissolved Oxygen	ESI
Hand Refractometer	1	Atago - Model S-10	1 yr.	Measure Salinity	ESI
Laboratory Computing Integrator	1	Perkin-Elmer LC1-100	2 yrs.	Various/Pesticides	ESI
Liquid Chromatograph	1	Perkin-Elmer Series 400	2 yrs.	Various/Pesticides	ESI
Microscope - Bristolscope	1	(Bristoline) Bristol HWF10)X, #753413	3 yrs.	Microscopy	ESI
Microscope - Olympus	1	(Olympus Optical Co) #241491	5 yrs.	Microscopy	ESI
Microscope - Stereozoom 7	1	Bausch & Lomb - 10xWF Stereo	1 yr.	Microscopy	ESI
pH Combination Electrode	3	Beckman - #39831	2 yrs.	pH	ESI
pH meters	2	Beckman 021	1 yr.	pH	ESI
SpectroMonitor Z Detector (UV)	1	LDC	2 yrs.	Chromatography	ESI
Top-loader Balance	1	Fisher - Series 700, Model 7302D	3 yrs.	Measure Weight	ESI
Analytical Balance	1	Mettler H31 AR	6 yrs.	Mass Determinations	IN
Automatic Liquid Samp.	1	Dionex	2 yrs.	Anions	IN
Conductance Meter	1	YSI Model 32	1 yr.		IN
Dedicated Reflux Set-up	8	Kimble/Corning	2 yrs.	Chemical Oxgen Demand	IN
Dedicated Reflux Set-up	4	Kimble	2 yrs.	Oil Digests	IN
Distillation Apparatus	1	Labconco Still II	<1 yr.	Total Kjeldahl Nitrogen/Ammonia	IN
DO Meter	1	YSI Model 57	5 yrs.	Dissolved Oxygen	IN
Filtration Apparatus	4	Kimble/Gelman	2-3 yrs.	Vacuum Filtrations	IN
Ion Chromatograph	1	Dionex 2000 i	2 yrs.	Anion Analysis	IN

RESOURCE ANALYSTS, INCORPORATED
TITLE: Preparation of S.O.P Manuals
and QA Project Plans

Tungsten (AA)		QA-235
Titanium (AA)	283.1	QA-236
Tin (AA)	282.1	QA-237
Platinum (AA)		QA-238
Manganese (AA)	243.1	QA-239
Magnesium (AA)	242.1	QA-240
Iron (AA)	236.1	QA-241
Calcium (AA)	213.1	QA-242
Aluminum (AA)	202.1	QA-243
Potassium (AE)	SM 322B	QA-244
Sodium (AE)	SM 325B	QA-245
Lithium (AE)	SM 317B	QA-246
Vanadium (AA)	286.1	QA-247

Metals Digests: QA-300-350

4/88 SOP's

Total Protocol		
"Worksheets"		
Metals Digest Labelling		
Digest Lab Books		
Waters, total or diss., FLAA or ICP	EPA 3005	QA-300
Waters, total, FLAA or ICP	EPA 3010	QA-301
Waters, total, GFAA	EPA 3020	QA-302
Oils	EPA 3030	QA-303
Soilds	EPA 3050	QA-305
Arsenic, acid digest of liquids, GFAA	EPA 7060	QA-306
Silver, acid digest of liquids, AA	EPA 7760	QA-307
Mercury, acid digest of liquids,cold vapor	EPA 7470	QA-308
Mercury, acid digest of solids, cold vapor	EPA 7471	QA-309
EPTOX	EPA 1310	QA-310
TCLP		QA-311
Reagent List for Metals Digestion, EPTOX,TCLP		QA-312
Spiking Solutions		QA-313
Post-filtering Digests for ?		QA-314
Percent Solids		QA-315
Hydrofluoric Digest, soils for cations		QA-316
Hex Chrome/Seawater		QA-317
Waters, Furnace AA, CLP		QA-321
Waters, Flame AA or ICP, CLP		QA-322
Soils, Furnace AA, CLP		QA-323
Soils, Flame AA or ICP, CLP		QA-324
Mercury, Waters, CLP		QA-325
Mercury, Soils, CLP		QA-326
Mercury, tissues	EPA 600;245.5 RAI Digest #3	QA-340
Metals, tissues	EPA 3050 RAI Digest #4	QA-341
Lead in Milk		QA-342

Unassigned QA-304
QA-318-319
QA-330-350

Muffle Furnace	1	Lindberg 51848	7 yrs.	Solids/Ash Analyses	IN
Organic Carbon Analyzer	1	Astro 2001		Total Organic	IN
Oven	1	Blue M Transite	3 yrs.	Sample Drying/Solids	IN
Oven	1	Blue M	3 yrs.	Sample Drying/Solids	IN
Oven	1	Fisher ISO temp	3 yrs.	In-Hood Sample Drying	IN
Oxygen Bomb & Accessories	1	Parr 1901	4 yrs.	Colorimetry, Waste Oil Analysis	IN
Pensky Marten	1	Herzog semiautomatic		Flashpoint	IN
Persky Martens Flash Point	2	Precision Scientific 74537	1-5 yrs.	Flash Points	IN
pH Meter	1	Corning 6 and other	2-6 yrs.	pH	IN
pH meter	2	Beckman pH 43	3 yrs.	pH	IN
Purging and Sealing Module	1	Oceanographic International 0524S	7 yrs.	Total Organic Carbon	IN
Rotap	1	Tyler	5 yrs.	Particle Size	IN
SCT Meter	1	YSI Model 33	5 yrs.	Spec. Cond/Salinity/Temp.	IN
Standard Sieve Set	1	Fisher Scientific ASTM-E-11	3 yrs.	Particle/Grain Size	IN
Titration Set-up	1/6/6	Various	1-4 yrs.	Titrimetry	IN
Total Kjeldahl Digestion	1	Labconco - 4 Position	<1 yr.	Total Kjeldahl Nitrogen	IN
Total Kjeldahl Nitrogen Set-up	1	Precision Scientific-2 Position	6 yrs.	Total Kjeldahl Nitrogen	IN
Turbidimeter	1	HF Instruments DRT100	3 yrs.	Turbidity	IN
UV Spectrophtometer	1	LDC Spectromonitor II	4 yrs.	LC	IN
AA Spectrophotometer	1	IL Video 22	4 yrs.	Flame/Furnace AA	MI
AA Spectrophotometer		Varian SpectraAA 20AA	<1 yr.	Trace Metals Analysis	MI
AA Spectrophotometer		Varian Spectra 400AA GZAA; Zeeman Furn.	<1 yr.	Trace Metals Analysis	MI
AA Spectrophotometer	1	Perkin-Elmer 5000	9 yrs.	Flame/Flameless AA	MI
Aerosol Deposition System	1	IL FASTAC II	4 yrs.	Furnace AA	MI
Auto Sampler		PS 56	<1 yr.	Trace Metals Analysis	MI
Auto Sampler	1	Varian 400	<1 yr.	Furnace AA	MI
Auto Sampler	1	IL 254	4 yrs.	Furnace AA	MI
Auto Sampler	1	Perkin-Elmer AS50	9 yrs.	Flame AA	MI
Auto Sampler	1	Perkin-Elmer HGA 500	9 yrs.	Furnace AA	MI
Automatic Burner Control	1	Perkin-Elmer 5000	9 yrs.	Flame AA	MI
EDL Power Supply	1	Perkin Elmer	9 yrs.	As, Se, +Cd Furnace AA	MI
Electrode Less Discharge Lamps	3	Perkin Elmer	9 yrs.	As, Se, Cd Furnace AA	MI
Furnace Atomizer	1	IL 655	4 yrs.	Furnace AA	MI
Furnace Atomizer	1	Perkin-Elmer HGA 500	9 yrs.	Furnace AA	MI
Hollow Cathode Lamps.	3	Buck Scientific	4 yrs.	Flame AA	MI
Hollow Cathode Lamps.	2	Westinghouse	4 yrs.	Flame AA	MI
Hollow Cathode Lamps.	17	Perkin-Elmer Intensitron	2-6 yrs.	Flame/Flameless AA	MI
Hollow Cathode Lamps.	10	IL Visimax II	2-3 yrs.	Flame/Furnace AA	MI
ICP		Leeman Labs Plasma Spec.	<1 yr.	Trace Metals Analysis	MI
Mercury/Hydride System	1	Perkin-Elmer MHS 20	9 yrs.	Cold Vapor Hg AA	MI
Refrigerated Recirculator	1	Neslab CFT 33	4 yrs.	Furnace Coolant	MI
BOD Bottles/Water Bath	30/1	Wheaton/Custom	2 yrs.	Mercury Digestions	MP
Cyanide Stills	4	Wheaton 377 160	2 yrs.	Cyanide sample Prep.	MP
Digestion Set-up	1	Kimble/Corning up to 20 Sample, cap.	1-4 yrs.	Metals Digestions	MP
EPTox Extractor	1	Custom, 10 Position	4 yr.	Extraction Procedure Toxicity	MP
EPTox Extractor	2	Lars Lande Rotary, 10 Position	1 yr.	Extraction Procedure Toxicity	MP
Filtration Devices	8	Millipore High Pressure System	<1 yr.	EPTox and TCLP	MP
Filtration Set-up	1/15	American Scientific/Various	1-3 yrs.	Gravity Filtration of Digestates	MP
Filtraton Station	1	Custom, 4 Position	4 yrs.	Vacuum Filtrations	MP
Rotary Extractor	1	Millipore	3 yrs.	TCLP	MP
Zero Headspace EXT	4	Millipore Zero Headspace	1 yr.	TCLP	MP
Auto Sampler	6	Hewlett-Packard 7673A	1 yr.	Various	OI
Auto Sampler	5	Teckmar ALS	3 yrs.	Volatiles	OI
Auto Sampler	2	Hewlett-Packard 7672	1 yr.	Various	OI
Auto Sampler	1	Varian 8050	2 yrs.	A/B/N	OI
Auto Sampler	1	Oceanographic International Corp.	1 yr.	Volatiles	OI
Auto Sampler	1	Hewlett-Packard-7971,99 place	4 yrs.	Various	OI
Data System	1	Spectra Physics Minigrator	9 yrs.	Chromatography	OI

Data System	1	Spectra Physics 4270	3 yrs.	Chromatography	OI
Dynamic Headspace Concentrator	1	Tekmar 4000/4200	1 yr.	Volatiles	OI
GC (ECD)	3	Hewlett-Packard 5890	1 yr.	Various Organics	OI
GC (FC, NPD)	1	Hewlett-Packard-5880 single channel	6 yrs.	Pesticides GC	OI
GC (FID, Cap)	1	Hewlett-Packard 5890	<1 yr.	Various Organics	OI
GC (FID, FC)	1	Hewlett-Packard-5840	4 yrs.	Various	OI
GC (FID, TCD)	1	Hewlett-Packard-5890 dual channel	4 yrs.	Volatile GC	OI
GC (HECD)	1	Tracor 540	3 yrs.	PCB's, Pesticides	OI
GC (PID< HECD)	1	Hewlett-Packard 5890 Dual Channel	2 yrs.	Volatile (601, 602)	OI
GC/MS/DS	2	Hewlett-Packard-5970 on RTE A HP-1000	2 yrs.	Volatile GC/MS	OI
GC/MS/DS	1	Hewlett-Packard-5992B on RTE 6 HP-1000	7 yrs.	Volatile GC/MS	OI
GC/MS/DS	1	Hewlett-Packard-5992B on RTE 6 HP-1000	4 yrs.	Volatile GC/MS	OI
GC/MS/DS	1	Extrel, ELQ 400	2 yrs.	A/B/N GC/MS	OI
Integrator	1	Spectrophysics SP4270	3 yrs.	Chrom, Data	OI
Lab Automation System (LAS)	1	Hewlett-Packard 3350 on RTE A HP-1000	1 yr.	Various Organics	OI
Liquid Sample	18	Various	<1 yr.	Acid/Base Neutrals/Pesticides	OI
Mag Tape Archive	1	Hewlett-Packard-7376	4 yrs.	GC/MS Data	OI
Purge & Trap	5	Teckmar LSC 2	3 yrs.	Volatiles	OI
Purge & Trap	1	Teckmar LSC 1	1 yr.	Volatiles in air	OI
Thermal Desorber	1	Century ATD	3 yrs.	Volatiles in air	OI
Centrifuge	1	Fisher	4 yrs.	Extract Processing	OP
Data System	1	Perkin Elmer LC-100	2 yrs.	Chromatography	OP
Dedicated Distillation Set-up	4	Kimble/Corning	2 yrs.	Phenols/NH3 Sample Prep.	OP
GPC System	1	Waters Assoc.	<1 yr.	A/B/N, Pesticides Extr. Proc.	OP
IC		Perkin Elmer 400	2 yrs.	Various/Pesticides	OP
IR Spectrophotometer	1	Perkin-Elmer 1420	2 yrs.	Oil & Grease/Qualitative	OP
LC System - Auto Sampler	2	Waters Assoc. - 48 position 712 WISP	1 yr.		OP
LC System - Chromatography Pumps	3	Waters Assoc. - 510/590	1 yr.		OP
LC System - Electrochemical Detect.	1	Waters Assoc.	1 yr.		OP
LC System - Fluorescence Detector	1	Waters Assoc. - 420	1 yr.		OP
LC System - Pump Controller	1	Waters Assoc. - Gradient Controller	1 yr.		OP
LC System - RI Detector	1	Waters Assoc. - 410	1 yr.		OP
LC System - UV Spec.	2	Waters Assoc. - 490E/441	1 yr.		OP
LC System:	1	Waters Assoc.	<1 yr.	Pesticides	OP
Separatory Funnels	24	Kimble 250 mL	2 yrs.	Phenols Extraction	OP
Separatory Funnels	36	Kimble 21	2 yrs.	Oil & Grease Extractions	OP
Solids Sample Prep Stations	12	Various	<1 yr.	Acid/Base Neutrals/Pesticides	OP
Sonicator	1	Branson B-220	2 yrs.	Solids Extraction	OP
Soxhlet Set-up	6	Kimble	2 yrs.	Oil & Grease Analysis	OP
Toploading Balance	1	American Scientific PTL 2500	7 mos.	General Purpose Weighings	OP
Burettes/Stirrers					SM
Compressor	1	Dayton Speedaire	3 yrs.	Air for AA, GC ect.	SM
Deonizer	1	Corning LD5A	3 yrs.	Preparation of	SM
Freezers	4	Various	1-5 yrs.	Sample Storage	SM
Funnels				Various	SM
Hoods	8	Various	1-3 yrs.	Various	SM
IBM Compatible XT and AT	36	Various		Various	SM
Reagent Water System	1	Xenopure	1 yr.	All Laboratories	SM
Rerigerator	10	Various	1-5 yrs.	Sample Storage	SM
Still	1	Corning AG3	3 yrs.	Type II Water	SM

ATTACHMENT B

HEALTH AND SAFETY PLAN FOR THE RCRA FACILITY INVESTIGATION AT THE PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE

Submitted to:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
Boston, Massachusetts

Prepared for:

UNITED STATES NAVY
NAVAL FACILITIES ENGINEERING COMMAND
PHILADELPHIA, PENNSYLVANIA

Prepared by:

FRED C. HART ASSOCIATES, INC.
28 Madison Avenue Extension
Albany, New York 12203

August 1989

HEALTH & SAFETY PLAN
RCRA FACILITY INVESTIGATION
AT THE PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

Approved By:

Project Manager: _____
Edward Kochem Date

Site Safety Officer: _____
Wesley O. Gamble Date

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1.0 INTRODUCTION

This Health and Safety Plan is intended to comply with Section III(c) of CERCLA, EPA Order 1440.1-Respiratory Protection, EPA Order 1440.3--Health and Safety Requirements for Employees Engaged in Field Activities, the December 19, 1986 OSHA regulations in 29 CFR Part 1910, the Occupational Health and Safety Act (OSHA) of 1970, 5 U.S.C. 7902(c)(1), the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities prepared by NIOSH, OSHA, USCG and EPA, October 1985, and any applicable Maine Health Statutes.

In order to implement the RFI outlined in this Proposal certain administrative policies and procedures must be adhered to. These include the use of properly trained personnel who regularly participate in a health surveillance program, specific criteria for field team organization and size, site characterization to establish level of worker protection, proper selection, use and maintenance of personal protective equipment and basic safety procedures.

2.0 ACTIVITY HAZARD ANALYSIS

The four major activities at the site, as described in the Proposal, are:

1. On-shore soil and sediment sampling.

2. Off-shore sediment sampling.

3. Groundwater sampling.

4. In-situ testing, drilling and well installation.

These activities share a number of similar potential hazards. These potential hazards include:

1. Exposure to soils containing volatile organic compounds and heavy metals.

2. Cold and/or heat stress due to wearing protective clothing.

3. Common construction site hazards (electrical, motorized equipment, fire, excavation, etc.).

Site conditions have been evaluated based on available information to identify potential effects upon site workers and the surrounding community during proposed activities. The evaluation has considered three major factors:

1. Properties of volatile organic liquids, heavy metals, asbestos, and acetylene and chlorine gases.

2. Exposure potential for personnel during site activities.

3. Known effects of these contaminants on human beings.

The potential hazards posed by chemicals present at the site depend on the relative abundance of these chemicals (i.e., concentrations in air, soil waste, groundwater, and surface water), and the potential for workers or the public to be exposed to the chemicals and the nature of the chemicals (e.g., toxicity, reactivity).

The chemicals known at the site are discussed in Table B-1 of this document. The levels of these materials may pose a potential hazard from chronic exposure (Table B-1).

To mitigate all of the above potential hazards, the combination of protective clothing, safer work practices and engineering safeguards are proposed in subsequent sections of this plan.

For more specifics on how this health and safety plan relate to the site see the SITE SAFETY PLAN. A copy of the SITE SAFETY PLAN will be posted on-site and discussed with all field personnel.

3.0 HEALTH SURVEILLANCE AND TRAINING PROGRAM

HART and all contract personnel used at the site participate in Health Surveillance Programs designed to monitor the health of employees and comply with all training requirements stipulated for workers at hazardous waste sites. These health surveillance and training requirements apply to situations covered by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the December 19, 1986 OSHA Regulations in 29 CFR 1910.120. Such work typically involves the handling of potentially hazardous waste, material and/or substances, hereinafter referred to as "regulated materials".

3.1 Health Surveillance

All workers at the site participate in Health Surveillance Programs established by their employer in accordance with paragraph f of OSHA Regulation 29 CFR 1910.120. These programs include medical examination and consultations that include medical and work histories and medical examination prior to entering the programs and at least once every twelve months thereafter. Medical examinations are also required at termination of employment, upon notification by an employee either that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, and if the examining physician determines that an increased frequency of examination is medically necessary. The programs also require that records of the medical surveillance be maintained for the period specified and meet the criteria of 29 CFR 1910.20.

3.2 Training

All workers at the Portsmouth Naval Shipyard will participate in a training program that will provide initial indoctrination and continued safety training. This program will help ensure that no person will work under conditions that are unsafe or dangerous.

3.2.1 Initial Training

The Health and Safety Officer or his designee will be responsible for providing occupational hazard training to all employees as required by OSHA 29 CFR 1910.120 and specifications prior to the commencement of work. The length and content of training programs shall be consistent with the requirements of OSHA Standard 29 CFR 1910.120. This training includes:

a) Potential hazards,
b) Biology, chemistry and physics of hazardous materials,
c) Rights and responsibilities of workers under OSHA,
d) Standard safety operating procedures,
e) Types of monitoring equipment to be used,
f) Site Safety Plan,
g) Internal and external communications,
h) Medical surveillance program,
i) Personal protective clothing and equipment,

j) Respiratory equipment including training and qualitative fit-testing for half and full facepiece respirators and use of self contained breathing apparatus,
k) Air monitoring program,
l) Decontamination procedures,
m) Evacuation, first aid and emergency procedures dealing with fire and medical situations,
n) Work zones established at the site,
o) Safe work practices associated with employee's work assignment, including dust control measures, hazardous materials recognition, and use of the buddy system,
p) Basic operation safety, emphasizing hazards expected on site, and,
q) Prohibitions (inside Exclusion and Transition zones), including:
   1) Glasses or facial hair, such as beards or long sideburns, which interfere with respirator fit,
   2) Contact lenses,
   3) Eating, drinking, smoking, chewing in the Exclusion or Transition Zones,
   4) Personal articles, e.g., watches, rings, etc., and,
   5) Working when ill.

3.2.2 Visitor Training

HART will be responsible for training visitors to the site, to inform them of the hazards associated with the site, to explain emergency procedures and instruct them in the use of protective gear required during the visit. No visitors or employees will be permitted in the Exclusion and Transition Zones without documented training and inclusion in a medical surveillance program.

4.0 FIELD TEAM ORGANIZATION

A field team will be organized to efficiently and safely carry out the objectives of the project. These objectives include but are not limited to such activities as sampling of soil, sediment, surface water and groundwater, monitoring well installation and site mapping. The team will include individuals with many different technical skills, such as chemists, geologists and engineers. In addition to performing its task objectives, the team will provide for its own safety to prevent injury or exposure to any regulated materials. This is accomplished by assignment of specific roles and responsibilities to members of the field team and by assuring that the proper team size is used to effectively accomplish specific objectives.

There are a number of roles which are required for the safe and competent operation of a field investigation team. The five roles which are necessary at every site where a field team will be working are: Project Manager, Field Team Leader, Site Safety Officer, Equipment Specialist, and the Work Party. A team member may take on more than one role, but the roles must be clearly assigned and must cover all those required rather than describe one team organization for all the different types of field investigations. Guidelines are presented here for assignment of responsibilities to team members to ensure safety and to establish the team size.

4.1 Project Manager

The Project Manager is responsible for the overall effectiveness of remedial investigation activities. The specific responsibilities of the Project Manager include preparing and organizing all project work assignments, briefing team personnel on specific duties, ensuring that the health and safety requirements of the field team are complete and approved by the Health and Safety Director, completing reports and maintaining the evidentiary file, complying with chain-of-custody procedures and coordinating with government representatives and subcontractors.

4.2 Field Team Leader

The Field Team Leader is accountable for the organization, operation and safety of the field team. The Field Team Leader is responsible for proper field operations, maintaining a field notebook which records all site activities, completion of the objectives of the Site Proposal, compliance with document control procedures, proper field documentation of operating procedures, and performing the duties of the emergency coordinator. If subcontractors or outside observers are present, the Field Team Leader in conjunction with the Site Safety Officer (see Section 4.3 below) must ensure that they comply with health and safety procedures.

Names of all personnel on-site will be documented daily as well as air monitoring readings and confirmation of daily tailgate safety meetings by the site safety officer. Anytime a level of protection is upgraded or downgraded it will be documented in the field notebook.

4.3 Site Safety Officer

The Site Safety Officer has primary responsibility for all safety procedures and operations on-site. The Site Safety Officer is responsible for upgrading, if necessary, the level of personal protection based upon observations, continuous ambient air monitoring and, changing circumstances during the field investigation; enforcing the buddy system (personnel working in pairs); posting and briefing the field team of an approved safety plan which outlines locations, routes and telephone numbers of the closest medical facilities and poison control centers; posting other emergency telephone numbers, such as the fire and police departments and the Health and Safety Director, verifying that team members have met the health and safety requirements for field assignment; controlling site entry and exit at the personnel decontamination station; and, monitoring the work party for signs of stress such as changes in complexion, coordination, demeanor or speech patterns through observation. During adverse weather conditions, the Site Safety Officer will implement special precautions to guard against heat stress or cold exposure as described in USEPA's "Standard Operating Safety Guidelines" (November 1984). The Site Safety Officer has the authority to halt any operation that threatens the health or safety of the team. The Site Safety Officer is also responsible for reporting any accidents to HART's Corporate Health and Safety Director and the Albany Office Safety Director as well as the Navy's contacts listed in the Site Safety Plan.

4.4 Equipment Specialist

The Equipment Specialist is responsible for obtaining, inspecting and maintaining all equipment in proper operating order. This requires specialized training in maintenance of equipment. The Equipment Specialist is responsible for preparing all sampling containers and equipment.

4.5 Work Party

The Work Party is ultimately responsible for the safe and successful completion of the work assignment. The members of the Work Party share many active and important functions which are necessary to fulfill the objectives of the investigation. These include setting up the personnel decontamination station, performing site characterization, taking photographs, collecting samples of various media, decontaminating sample containers, packaging and shipping the samples in accordance with chain-of-custody procedures and decontaminating the entire Work Party prior to leaving the site.

5.0 FIELD INVESTIGATION TEAM SIZE

The size of an investigation team is determined by the investigation objectives, site characteristics and the required level of safety protection. The team must be large enough to ensure safety, but not so excessively large as to sacrifice economy.

Depending on the specific tasks, a two to three person team (excluding drilling and surveying personnel) will be adequate at the Portsmouth Naval Shipyard for the remedial investigative activities. The three person team will perform all activities in Level D protective equipment unless organic vapor monitoring equipment indicates the presence of organic vapors in concentrations consistently within the range of 5 to 10 ppm above background within the breathing zone or personal monitoring indicates a potential exposure to airborne particulates (see Section 6.1.1), which will require Level C protective equipment. A two-person team may be appropriate for tasks which do not require extensive personal decontamination and where the likelihood of emergency rescue is minimal.

For all tasks requiring Level C and above, the field team will consist of a minimum of three personnel and, when applicable, a minimum of two additional drilling personnel. Specific field tasks which require Level C protection are discussed in Section 6.2.2. In addition, tasks requiring Level C and above will require that the field team leader check in with the field team more frequently to ensure all operations are running smoothly. In the event of an emergency, a team member shall summon outside assistance. Team responsibilities for this investigation are identified in the attached Site Safety Plan.

6.0 SELECTION, USE, AND MAINTENANCE OF PERSONAL PROTECTIVE EQUIPMENT

Proper selection, use and maintenance of respiratory protective equipment and other personal protective equipment is extremely important in protecting the health and safety of field investigation personnel. An excessively high level of protection may encumber field personnel unnecessarily and result in decreased efficiency, fatigue and other hazards. Improper use or maintenance of protective equipment also exposes field personnel to unnecessary risks.

The site assessment for worker protection is based on a site characterization obtained from previous site investigations. The appropriateness of the level of protection will be assessed continually during all field investigative tasks. This level must be approved by both the Site Safety Officer and the Corporate Health and Safety Director. The selection is based on the potential for exposure to substances in air, splashes of liquids or other direct contact with material due to work being done, the toxicity of the suspected or measured chemical substances and professional experience and judgment. Criteria used to determine the level of protection are discussed below.

6.1 Respiratory Protection

The selection of adequate respiratory protection depends primarily on the type of regulated material which may be encountered. Proper respirator use requires formal training and continued maintenance of the equipment in accordance with 30 CFR Part 11 and provisions of the National Institute for Occupational Safety and Health. OSHA regulations pertaining to respiratory protection require a training program that encompasses user responsibilities, training for proper use and respirator maintenance. OSHA also requires qualitative fit testing of face-pieces. Facial hair (beards) and wearing contact lenses are prohibited.

At the Portsmouth Naval Shipyard, a photoionization detector (PID) or flame ionization detector (FID) will be used to assess ambient organic concentrations in air before and during field activities. In addition, airborne particulate monitoring will be implemented to assess the potential for on-site personnel to be exposed to particulates.

Field investigation activities at the Portsmouth Naval Shipyard will be conducted in Level D as long as organic vapor concentrations remain below 5 ppm. However, if concentrations of organic vapors consistently exceed 5 ppm for a sustained period of time then safety protection will be upgraded to Level C or B. (See Sections 6.2.1 and 6.2.2 for a more complete discussion of Levels C and B).

6.1.1 Air-Purifying Respirator (APR)

The APR will be used at the site during on-site investigative activities depending upon the results of organic vapor monitoring and personal particulate monitoring at the site. APRs will have organic vapor or high efficiency particulate adsorption filters or both depending on determined site characteristics. The APR can be used only in atmospheres containing sufficient oxygen to sustain life (in open air this is usually not a problem) and when other criteria, discussed below, are met.

Specific organic vapor and particulate metals concentration limitations exist for specific devices. The chemical-cartridge respirator provides respiratory protection against certain gases, vapors and particulates in concentrations not to exceed those labeled on the cartridge. An APR can only be used in an area where minimal concentrations might occur and where a SCBA has been determined unnecessary. Ambient air organic concentrations at the site will be determined by monitoring with a photoionization detector (PID) or a flame ionization detector (FID). Combination HEPA/organic cartridges will be used with the APRs.

Air purifying respirators or cartridge respirators are worn when:

- Greater than 5 ppm and less than 50 ppm non-methane continuous reading in the breathing zone. (5 ppm is 1/2 the TWA-threshold limit value for benzene, the lowest TWA-TLV compound that maybe encountered. 50 ppm is 1/20 the maximum recommended concentration level of organic vapors for the organic vapor respirator cartridge.)

- Any unidentified odor is detected.

- Regulated materials in the air are not greater than 10 times the permissible exposure limit (PEL) and have good warning properties.

- The Site Safety Officer judges that respirators are needed as a precaution against generation of low levels of regulated materials in air due to sampling, handling, decontaminating or other operations.

- The capacity of the cartridge will not be exceeded by extended periods of use on-site. (If used for extended periods, cartridges must be changed.)

Users of air purifying respirators must comply with the following:

- At least 19.5 percent oxygen must be present for respirator use, or unprotected breathing.

- Air purifying respirators must be NIOSH-approved.

- Cartridges must also be NIOSH-approved and shall be matched to the respirator by the manufacturer.

- Cartridges must not be used past the expiration date.

- Air purifying respirators will provide adequate protection only if they have good face seals. A qualitative fit test is required for each employee using these respirators.

- Upon experiencing any warning property such as difficulty with breathing, dizziness or other distress, strong taste, or smell, the user must immediately leave the Site. The Field Team Leader or Site Safety Officer may require that a user of an air purifying respirator carry an emergency escape air mask.

- Users of air purifying respirators must follow the manufacturer's instructions on the donning and use of the equipment.

- Cartridges must sometimes be replaced as often as each hour of use or when the user senses or smells a vapor. If the organic constituent of concern does not have warning properties, the APR cartridge must not be used.

6.1.2 Self-Contained Breathing Apparatus (SCBA)

The SCBA will be used when continuous non-methane readings in the breathing zone exceeds 50 ppm or when an APR is not adequate respiratory protection. The SCBA is required if the safety officer determines that Level B personnel protection is needed.

6.2 Protective Clothing

Protective clothing will be worn by all personnel at the Portsmouth Naval Shipyard to prevent skin exposure and to minimize spread of organic or inorganic constituents. All on-site operations require protective clothing. Protective clothing may include, but is not limited to, chemical-resistant pants and jackets or coveralls, disposable coveralls, steel toe and shank boots, protective gloves, hard hats, face shields or chemical safety glasses (if a full face respirator is not worn). Once adequate protective clothing is chosen, employees must also note that alertness is a significant safety factor. Since protective clothing is cumbersome, it hastens the onset of fatigue and heat exhaustion, decreases alertness, and limits stay-time.

The following sections describe Level B, C, and D protective equipment.

6.2.1 Level B

It is not anticipated that Level B protective clothing will be required for any of the activities to be conducted at the Portsmouth Naval Shipyard. If detected organic vapor concentrations in air consistently exceed 50 parts per million (ppm) above background within the breathing zone in any area at the site, Level B protective clothing may be required for work that is to be conducted within that (those) areas(s) at the discretion of the Site Safety Officer. A PID or FID will also be used to continuously monitor concentrations of organic vapor within the breathing zone during drilling operations. If, during drilling, detected organic vapor concentrations significantly and consistently exceed 50 ppm above background within the breathing zone, Level B protective clothing may be required at the discretion of the Site Safety Officer.

Level B protection consists of:

- Open-circuit pressure-demand SCBA;

- Chemical protective overalls and long-sleeved jacket or Tyvek coveralls;

- Gloves, inner, surgical type;

- Gloves, outer, chemical protective;

- Boots, safety, steel toe and shank;
- Booties, chemical protective; and,
- Butyl rubber apron or rain gear.

6.2.2 Level C

Prior to conducting any of the subsequent investigative activities, the field team will perform a walk through using a PID or FID to determine ambient organic vapor concentrations in air. If detected organic vapor concentrations are consistently within the range of 5-50 ppm above background within the breathing zone in any area at the site or a total particulate concentration of 12.5 mg/m^3 is exceeded in the breathing zones in the previously identified areas, Level C protective clothing will be required for work that is conducted within that area. A PID or FID will also be used to continuously monitor concentrations of organic vapors within the breathing zone during drilling operations. If, during drilling, detected organic vapor concentrations are consistently within the range of 5-50 ppm above background within the breathing zone, Level C protective equipment may be required by the Site Safety Officer.

Level C protection consists of:

- Full face or half face air-purifying respirator (previously described) with appropriate cartridges for organic vapors with HEPA filters;
- Tyvek coveralls;
- Boots/shoes, safety, with steel toe and shank;
- Hard hat with optional face-shield;
- Gloves, inner, surgical type; and,
- Gloves, outer, chemical protective.

6.2.3 Level D

Based upon a review of the types and concentrations of inorganic and organic constituents which may be present on the Site (see Background Information, Section 2.0 of the RFI Proposal), at least Level D protective clothing will be required for all activities to be conducted at the Site. Level D is the basic work uniform and is used where significant exposure to regulated materials is unlikely. Field personnel must not be permitted to work in civilian clothes.

Level D protection consists of:

- Cotton coveralls;
- Boots/shoes, safety with steel toe and shank;
- Safety glasses;

- Hard hat with optional face shield (during drilling only);
- Air-purifying respirator (readily available and may be worn during surficial soil sampling); and,
- Gloves.

7.0 BASIC SAFETY PRACTICE AND RECORDKEEPING

Field personnel will observe basic safety practices. The Site Safety Officer is responsible for informing all field personnel of these practices. They include, but are not limited to, the following:

- Observe the buddy system (work in pairs);
- Eating, drinking and smoking are prohibited in the transition and exclusion zone (work areas);
- Contact lenses cannot be worn with any respirators;
- Practice contamination avoidance by avoiding obviously contaminated objects/areas and by not sitting or kneeling on the ground; and,
- Maintain contact with the Site Safety Officer.

HART will also provide the following:

- Rules for safe operation of heavy equipment.
- Safety inspection checklist.
- Accident prevention program.

In addition, a tailgate safety meeting will be conducted at the beginning of each shift or whenever new employees arrive at the site once the job commences. This meeting discusses daily operational activities and the health and safety considerations for that day's activities, and outlines protective equipment necessary. The Project Manager and Site Safety Officer will conduct these meetings

Certain records will be maintained on-site. These include:

1. Accident/Incident Reports. All accidents will be reported to the Site Safety Officer who will then investigate the accidents and make recommendations to prevent its reoccurrence.

2. Site Inspection Lists. HART will provide a Site inspection list to be completed daily by the Site Safety Officer. The list will include information on the presence or appropriate use of:

   a. respirators
   b. emergency equipment
   c. protective clothing
   d. portable/hand tools
   e. electrical equipment
   f. heavy equipment
   g. air monitoring instruments.

8.0 SITE SAFETY PLAN

A Site Safety Plan has been prepared. This plan provides information about the site, and an evaluation of the hazards present. It is designed to protect the field personnel and to help prepare for emergency action.

The Site Safety Plan has five parts. The first part provides general information including the name and location of the site and the objective(s) of the investigation. The second part provides information on the site and waste characteristics, including a description of the facility and its history. The third part is a hazard evaluation, which assesses the potential hazards to site investigation personnel, based on available information. The fourth part is the work plan. It establishes the work area, the personal protection (level of protection and equipment) to be used, decontamination procedures, Site entry procedures and work limitations. The last part is an emergency response plan which provides emergency information including emergency contacts and resources and emergency routes.

8.1 Reporting Incidents Involving Personal Injury or Exposure to Hazardous Materials

All incidents involving personal injury or exposure to potentially hazardous materials during any field activity must be documented and reported immediately to the Health and Safety Director. A standardized incident report is used for this purpose.

It is important to report all exposures and injuries, even though the incident is not considered serious or no adverse health effects or symptoms are apparent at the time. Often, exposure to a toxic agent may have delayed or latent effects which may only be detected by specific diagnostic tests. Documenting an exposure may aid in identifying the cause of symptoms or changes in health status indicators (diagnostic blood tests or pulmonary function, for example) at a later time. Likewise, an injury, such as an eye injury caused by dust particles, may result in delayed damage to the eye.

8.2 Site Safety Plan

The Site Safety Plan for the Portsmouth Naval Shipyard has been prepared and attached. The safety plan provides information on site characteristics and potential hazards, as well as work plan tasks and emergency information.

SITE SAFETY PLAN

(posted on site and discussed with all field personnel)

A. GENERAL INFORMATION

Site: Portsmouth Navy Shipyard Project No. 00009-01 00001-02

Street/City/State: Kittery, Maine

Plan Prepared By: Donald Anné Date: June 30, 1989

Plan Approved By: Stephen J. Myers Date: June 30, 1989

Project Objectives(s): Characterization of wastes associated with solid waste management units.

Proposed Date(s) of Investigation: August 1989

Previous Site Characterization for Safety Purposes:

Inadequate Adequate _X_ Complete

Overall Hazard Assessment:

Serious Moderate _X_ Low Unknown

B. SITE/WASTE CHARACTERISTICS

Waste Type(s): Liquid _X_ Solid _X_ Sludge _X_ Gas/Vapor _XX_

Characteristic(s): Corrosive _X_ Ignitable _X_ Radioactive _X_

Volatile _X_ Toxic _X_ Reactive _X_ Unknown

- Other Characteristics:

Chemical Names(s): TCE, MEK, Toluene, MeCl, Chrome, Lead, Cadmium, Asbestos, Acetylene, Chlorine

Facility Description: Major service is the overhaul, conversion, and repair of the nuclear propulsion fleet ballistic missile and attack submarines.

Principal Disposal Method (type and location): Landfilling at Jamaica Island Landfill; metal scrap staging at Defense Reutilization and Marketing Office.

Unusual Features (dike integrity, power lines, terrain, etc.): The facility is an island in an estuary.

Status (active, inactive, unknown): Active naval facility.

History (worker or non-worker injury; complaints from public; previous agency action): The entire area of the landfill was at one time a tidal flat. The area was used for the disposal of general refuse, trash, and other materials from 1946 to 1976. Many types of material now considered hazardous were disposed of in the landfill.

C. HAZARD EVALUATION

(toxic effects, reactivity, flammability, stability, operational hazards from sampling and decontaminating)

There area several different types of hazards on-site. All these hazards will only be a problem when digging or drilling into the Jamaica Island Landfill (JILF). Soil gas and geotechnical surveys will preceed any soil borings or monitor well installation. This should help pinpoint any potential problems. Extreme caution will be used when drilling or digging in the JILF. The list of material buried includes plating sludges, dredging spoils, asbestos insulation, drummed waste paints, drummed waste solvents, sand blasting grit, and full cylinders of acetylene and chlorine gas. The Jamaica Island Landfill is the most potentially hazardous environment in which field work will be performed. A special hazard case will be the offshore sampling. This is more an awareness of the increased hazard associated with working with heavy equipment on an unstable platform. Life jackets will be worn during all offshore work.

D. SITE SAFETY WORK PLAN

Perimeter Establishment: Map/Sketch Attached? Yes Site Secured? Yes

Perimeter Identified? Yes Zone(s) of Contamination Identified? Yes

Personal Protection: Level of Protection A B C D X

Modifications: Tyvek, gloves, steel-toe shoes, overboots, and hard hat. Level C or B may be necessary at the discretion of the site safety officer.

Surveillance Equipment, Clothing, and Materials: Ambient air monitoring equipment will be either an OVA with GC option or an HNU or both. The air monitoring will be continuously in the breathing zone. Both instruments are factory calibrated and checked routinely against standards. The OVA uses methane in air and the HNU benzene in air.

A Geiger Counter will be used to monitor for ionizing radiation. If Geiger Counter readings exceed 2.5 millirem/hour, personnel will immediately leave the working area.

Decontamination and Disposal Procedures:

A decontamination station will be located in the vicinity of the drilling and soil sampling areas and will be used to decontaminate personnel, and equipment prior to exiting the work site. All equipment will be washed with detergent and water and then rinsed with clean water. Sampling equipment may additionally require rinses of methanol and hexane.

An effort will be made to minimize the volume of liquids used for decontamination. All water used for decontamination will be contained at the work site. After completion of Phase I, the water will be tested prior to disposal. Chemicals used for decontamination will be handled in a similar manner but will be contained separately.

An effort will be made to reduce the amount of contaminated disposable solid waste such as overalls, gloves, respirator filters, etc. Waste of this nature generated during Phase I will be bagged, labled and properly disposed on a timely basis.

Site Entry Procedures:

Because field work will be conducted on government property, access to the work site will be limited to military and civilian personnel with passes for the PNS. Access to the individual work sites will be resticted to those persons having the fourty-hour safety training course as described in the Health and Safety Plan (see attachment). Border tape will be used to restrict access to potentially contaminated zones (hot zones) at each work site. Below is a list of team members authorized to be on-site and their responsbilities.

Team Member	Responsibility
Field Team Leader	Supervise all field activities.
Site Safety Officer	Continuous ambient monitoring, sample management, decontamination. Responsible for overall safety.
Additional Team Members	Assist in all field activities.

Work Limitations (time of day, etc.): Work will be limited to daylight hours.

E. EMERGENCY INFORMATION

Local Resources

Ambulance: (Shipyard) (207) 438-2555 or Ext. 2555

Hospital Emergency Room: (Shipyard) (207) 438-2555 or Ext. 2555 (Figure B-1)
(Portsmouth) (603) 433-4042 (Figure B-2)

Poison Control Center: (Maine) 1-800-442-6305
(New Hampshire) 1-800-562-8236

Police: (Shipyard) (207) 438-2444 or Ext. 2444

Fire Department: (Shipyard) (207) 438-2333 or Ext. 2333

Airport: Little Brooke Airpark, Elliot, Maine (small craft) (207) 439-4922
Portland International (commercial) (207) 774-7301

Explosives Unit: Contact shipyard police. They will activate Brunswick Explosives Ordinance Division.

Site Resources

Water Supply: City of Kittery water on-site

Telephone: Available on-site

Radio: Not available on-site

Other:

Emergency Contacts

Corporate Health and Safety Director: Larry Kaufman (609) 663-0440

Office Safety Director: Donald C. Anné (518) 869-6192

Project Manager: Edward J. Kochem (518) 869-6192

Client Contact: Ronald Springfield (215) 897-6431
Jim Tayon (207) 438-1218 Code 410.5

EPA Site Managers: Geralyn Falco and Joel Balmat (617) 573-5778

State Site Managers: Cynthia Kuhns and Scott Cyr (207) 289-2651

Chemtrec (Chemical Emergencies 24 hours) 1-800-424-9300

F. EMERGENCY PROCEDURES

1. If person exposed to hazardous material via:

   Skin, Inhalation, and Ingestion: Waste characteristics will be identified on-site. First aid will be administered by trained personnel. Depending on the nature of the exposure, the ambulance or hospital may be notified for assistance.

2. If person injured: First aid will be administered by trained personnel. Depending on the nature of the injury, the ambulance or hospital may be notified for assistance.

3. If potential or actual fire or explosion: Fire Department or Explosive Unit will be notified immediately and all personnel will move to a place of safety.

4. If radiation exposure or yellow bag material encountered: Contact Shipyard Radiological Control Division Code 105 at (207) 438-2222 or Ext. 2222.

5. If contaminant spreads beyond site: Call State of Maine 1-800-482-0777.

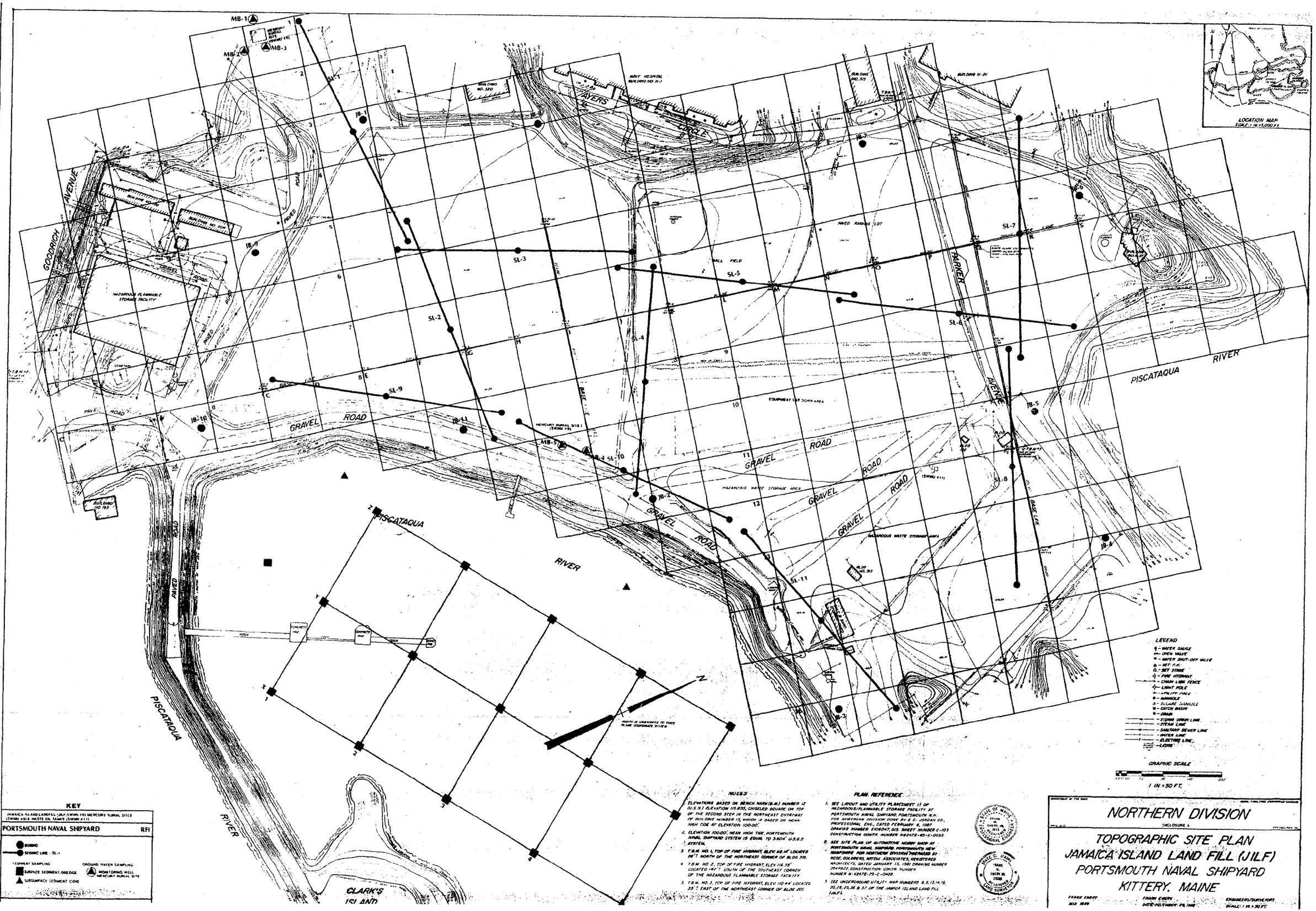
G. EMERGENCY ROUTES

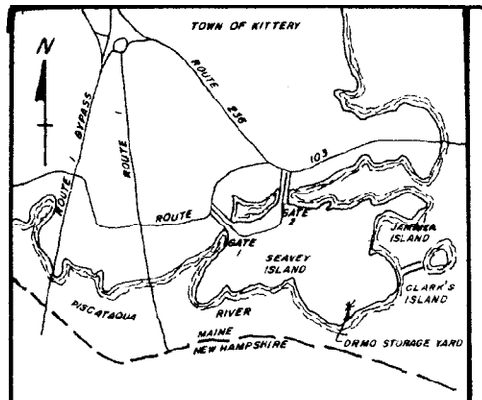
Hospital: Portsmouth Regional Hospital

Exit Shipyard through Gate #1. At lights, go straight down Walker Street. At second set of lights, go straight until road ends at Route 1 Bypass. Enter underpass rotary on left side. Go under Route 1 Bypass and loop onto Route 1 Bypass South. Go over bridge and continue straight to traffic circle. At traffic circle go around to the right 270°, 3/4 circle from entrance to traffic circle. Exit right. At first set of lights go straight. At second set of lights turn right on Borthwick Avenue Ext. Follow Borthwick Ave. Ext. 1/2 to 1 mile. Look for Portsmouth Regional Hospital on right side (Figure B-2).

ABBREVIATIONS AND ACRONYMS

ACL	Alternate Concentration Limits
ACOE	Army of Corps of Engineers
ARAR	Applicable or Relevant and Appropriate Requirement
AST	Aboveground Storage Tank
CEC	Cation Exchange Capacity
CEIS	Candidate Environmental Impact Assessment
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CLP	Contract Laboratory Program
CMS	Corrective Measure Study
DBMS	Data Base Management System
DEA	Draft Environmental Assessment
DEP	Maine Department of Environmental Protection
DMF	Direct Magnetic Field
DRMO	Defense Reutilization and Marketing Office
FCS	Final Confirmation Study
GEMS	Graphical Exposure Modeling System
GMF	Gradient Magnetic Field
GPR	Ground Penetrating Radar
HEA	Health and Environmental Assessment
HDPE	High Density Polyethylene
HMP	Site Hydrogeologic Investigation Plan
HSWA	Hazardous and Solid Waste Amendment of 1984
IAS	Initial Assessment Study
IRIS	Integrated Risk Information System
JILF	Jamaica Island Land Fill
O&M	Operations and Maintenance
OSSP	Offshore Sediment Sampling Plan
OVA	Organic Vapor Analyzer
PCB	Polychlorinated Biphenyls
PHERE	Public Health and Environmental Risk Evaluation
PNS	Portsmouth Naval Shipyard
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
RAI	Resource Analysts Incorporated
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RQD	Rock Quality Designation
SARA	Superfund Amendments and Reauthorization Act
SIR	Sidescan Imaging Radar
SOP	Standard Operating Procedure
SPHEM	Superfund Public Health Evaluation Manual
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TIP	Tank Investigation Plan
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound


LOCATION MAP
SCALE: 1 IN = 3,000 FT.
MB-1
MB-2
MB-3
MB-7
JB-1
JB-2
JB-3
JB-4
JB-5
JB-6
JB-7
JB-9
JB-10
JB-11
SL-1
SL-2
SL-3
SL-4
SL-5
SL-6
SL-7
SL-8
SL-9
SL-10
SL-11
GOODRICH AVENUE
AYERS CIRCLE
PARKER AVENUE
PISCATAQUA RIVER
GRAVEL ROAD
PAVED ROAD
BASE LINE
HAZARDOUS FLAMMABLE STORAGE FACILITY
HAZARDOUS WASTE STORAGE AREA
EQUIPMENT LAY DOWN AREA
PAVED PARKING LOT
BALL FIELD
NAVY HOSPITAL BUILDING NO. H-1
BUILDING NO. 320
BUILDING NO. 303
BUILDING H-20
BUILDING NO. 193
MERCURY BURIAL SITE (SWMU #8)
(SWMU #11)
CLARK'S ISLAND
NORTH IS UNKNOWN TO TRUE PLANE COORDINATE SYSTEM
LEGEND
WATER GAUGE
OPEN VALVE
WATER SHUT-OFF VALVE
SET P.K.
SET STONE
FIRE HYDRANT
CHAIN LINK FENCE
LIGHT POLE
UTILITY POLE
MANHOLE
SULCARE CLEANOUT
CATCH BASIN
DRAIN
STORM DRAIN LINE
STEAM LINE
SANITARY SEWER LINE
WATER LINE
ELECTRIC LINE
LEDGE
GRAPHIC SCALE
1 IN = 50 FT.
KEY
JAMAICA ISLAND LANDFILL (JILF) (SWMU #3) MERCURY BURIAL SITES (SWMU #8) & WASTE OIL TANKS (SWMU #11)
PORTSMOUTH NAVAL SHIPYARD
RFI
BORING
SEISMIC LINE - SL-1
SEDIMENT SAMPLING
SURFACE SEDIMENT, DREDGE
SUBSURFACE SEDIMENT CORE
GROUND WATER SAMPLING
MONITORING WELL
MERCURY BURIAL SITE
NOTES
1. ELEVATIONS BASED ON BENCH MARK (B.M.) NUMBER 12 (U.S.N.) ELEVATION 115.833, CHISELED SQUARE ON TOP OF THE SECOND STEP IN THE NORTHEAST ENTRANCE OF BUILDING NUMBER 13, WHICH IS BASED ON MEAN HIGH TIDE AT ELEVATION 100.00'.
2. ELEVATION 100.00', MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.604' U.S.G.S. SYSTEM.
3. T.B.M. NO. 1, TOP OF FIRE HYDRANT, ELEV. 118.14' LOCATED 98'± NORTH OF THE NORTHEAST CORNER OF BLDG 310.
4. T.B.M. NO. 2, TOP OF FIRE HYDRANT, ELEV. 116.38' LOCATED 147'± SOUTH OF THE SOUTHEAST CORNER OF THE HAZARDOUS FLAMMABLE STORAGE FACILITY.
5. T.B.M. NO. 3, TOP OF FIRE HYDRANT, ELEV. 110.44' LOCATED 33'± EAST OF THE NORTHEAST CORNER OF BLDG 201.
PLAN REFERENCE
1. SEE LAYOUT AND UTILITY PLAN (SHEET 1) OF HAZARDOUS/FLAMMABLE STORAGE FACILITY AT PORTSMOUTH NAVAL SHIPYARD, PORTSMOUTH N.H. FOR NORTHERN DIVISION (DONE BY F. E. JORDAN CO., PROFESSIONAL ENG., DATED FEBRUARY 6, 1987 DRAWING NUMBER X104047, DIS. SHEET NUMBER C-103 CONSTRUCTION CONTR. NUMBER N62472-87-C-0033.
2. SEE SITE PLAN OF AUTOMOTIVE WORKS SHOP AT PORTSMOUTH NAVAL SHIPYARD, PORTSMOUTH, NEW HAMPSHIRE FOR NORTHERN DIVISION PREPARED BY ROSE, GOLDBERG, NITOU ASSOCIATES, REGISTERED ARCHITECTS, DATED JANUARY 13, 1981 DRAWING NUMBER 204862, CONSTRUCTION CONTR. NUMBER N-62472-79-C-0428.
3. SEE UNDERGROUND UTILITY MAP NUMBERS 8, 9, 13, 14, 19, 20, 28, 29, 36 & 37 OF THE JAMAICA ISLAND LAND FILL (JILF).
STATE OF MAINE
FRANK EMERY JR.
NO. 5000
REGISTERED PROFESSIONAL ENGINEER
STATE OF MAINE
FRANK W. EMERY JR.
NO. 1000
REGISTERED LAND SURVEYOR
NORTHERN DIVISION
ENCLOSURE A
TOPOGRAPHIC SITE PLAN
JAMAICA ISLAND LAND FILL (JILF)
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
FRANK EMERY
ENGINEERS/SURVEYORS
SCALE: 1 IN. = 50 FT.



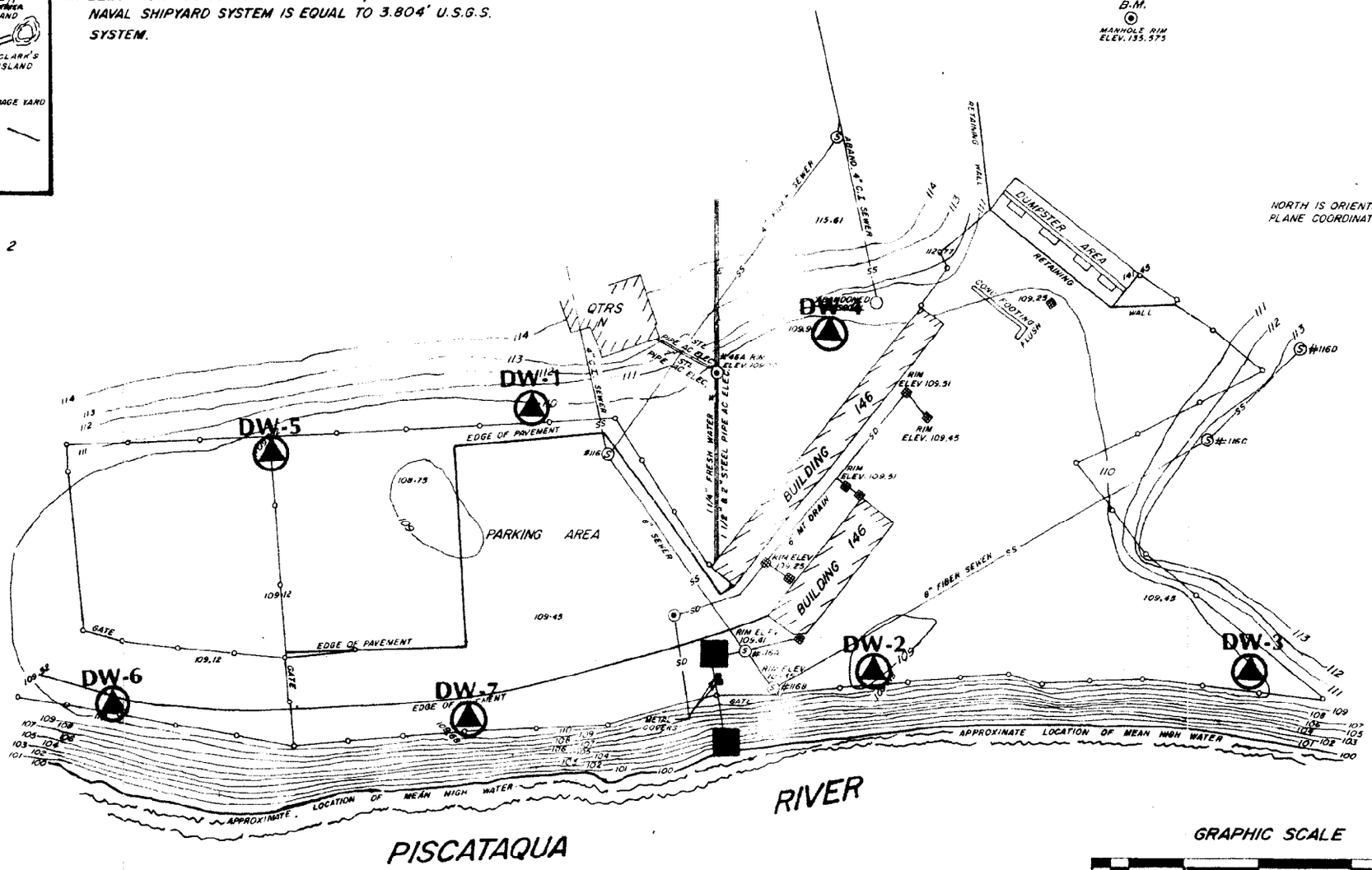
LOCATION MAP
SCALE: 1 IN.=3,000 FT.

NOTES

1. BENCH MARK (B.M.) TRANSFERRED FROM BENCH MARK NUMBER 12 (U.S.N.) ELEVATION 115.855, CHISELED SQUARE ON TOP OF THE SECOND STEP IN THE NORTHEAST ENTRYWAY OF BUILDING NUMBER 13, WHICH IS BASED ON MEAN HIGH TIDE AT ELEVATION.
2. ELEVATION 100.00' MEAN HIGH TIDE, PORTSMOUTH NAVAL SHIPYARD SYSTEM IS EQUAL TO 3.804' U.S.G.S. SYSTEM.

PLAN REFERENCE

SEE UNDERGROUND UTILITY MAP NUMBER 2
DRMO STORAGE YARD.



GRAPHIC SCALE
0 10' 20' 50' 90' 140' 200'
1 IN. = 50 FT.

STATE OF MAINE
FRANK M. EMERY, JR.
3613
REGISTERED PROFESSIONAL ENGINEER

STATE OF MAINE
FRANK M. EMERY JR.
1028
REGISTERED LAND SURVEYOR

Frank M. Emery Jr.

LEGEND

- MANHOLE
- SEWER MANHOLE
- CATCH BASIN
- CHAIN LINK FENCE
- ELECTRIC LINE
- SANITARY SEWER LINE
- STORM DRAIN
- WATER LINE

KEY	FRED C. HART ASSOCIATES, INC.
DW-1 MONITORING WELL LOCATION SEDIMENT SAMPLING LOCATION	ENCLOSURE B DRMO STORAGE YARD (SWMU #6) TEST BORING/MONITORING WELL LOCATION MAP 6/89

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NORTHERN DIVISION

NAVAL BASE — PHILADELPHIA, PA.

TOPOGRAPHIC SITE PLAN
DRMO STORAGE YARD
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

FRANK EMERY
BOX 1649
BOURNE AVENUE
WELLS, MAINE 04090

FRANK EMERY
DATE: JANUARY 4, 1989
DRAWN BY JAS

ENGINEERS/SURVEYORS
SCALE: 1 IN.=50 FT.
DRAWING NO. 11488

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