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FINAL DRAFT

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING

OPERABLE UNIT 1
NAS JACKSONVILLE

Contract No. N62467-89-D-0317

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OU1-21

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1.0 INTRODUCTION

In December 1991, Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) issued a Contract Task Order (CTO #040) to ABB Environmental Services, Inc. (ABB-ES) for the execution of the Remedial Investigation (RI) field work at Operable Unit 1 (OU1) Jacksonville Naval Air Station (NAS) (Figure 1-1). OU1 includes two potential source of contamination (PSC), the Old Main Register Storage Area (PSC 26) and the former PCB Transformer Storage Area (PSC 27) (Figure 1-2).

Execution of CTO #040 began in early 1992 and was completed in the fall of 1992. As detailed in the Preliminary Characterization Summary Report (PCSR), which summarizes the field activities completed and the information gathered, several data gaps were identified during the field program. Resolution of these data gaps is necessary to define the nature and extent of contamination at the operable unit and complete the Remedial Investigation.

Data gaps identified during the field program are primarily associated with the boundaries of the operable unit. Investigation of groundwater, surface water, sediment and soil, has revealed that contamination, probably associated with the two PSCs, extends beyond the unit boundaries as they were understood during the development of the Work Plan for OU1 field work (Geraghty and Miller, Sept. 1991). The field work, as originally planned, did not provide sufficient characterization of areas formerly thought to be "off-site". Therefore, the original objectives of the OU1 field program cannot be met without the acquisition of additional information.

This Technical Memorandum (TM) presents ABB-ES' recommendations for additional field work at OU1 to achieve the original objectives of the field program. A detailed analysis of the information gathered during the 1992 field program is presented in the PCSR and is not reproduced here. Rather, a description of the data gaps identified for the various media will be provided with recommended field activities to resolve the data gaps. Each medium will be discussed in a separate section.

Additionally, the field program recommended in this TM is intended to achieve the objectives of the original Work Plan for OU1 (Geraghty and Miller, 1991). Only modifications to the original work Plan are included herein. These modifications are primarily expanded or enlarged sampling efforts and will be conducted in accordance with the procedures and protocols presented in the September, 1991 Work Plan. Procedures for site screening technologies, not present in September 1991 Work Plan, are appended to this document.

A brief summary of the intended field program is presented below.

- Surface Water and Sediment Sampling Surface water and sediment samples will be collected in off-site areas not previously characterized. These areas are mainly located northeast and east of OU1. Expanded surface water and sediment sampling will also be completed in areas,

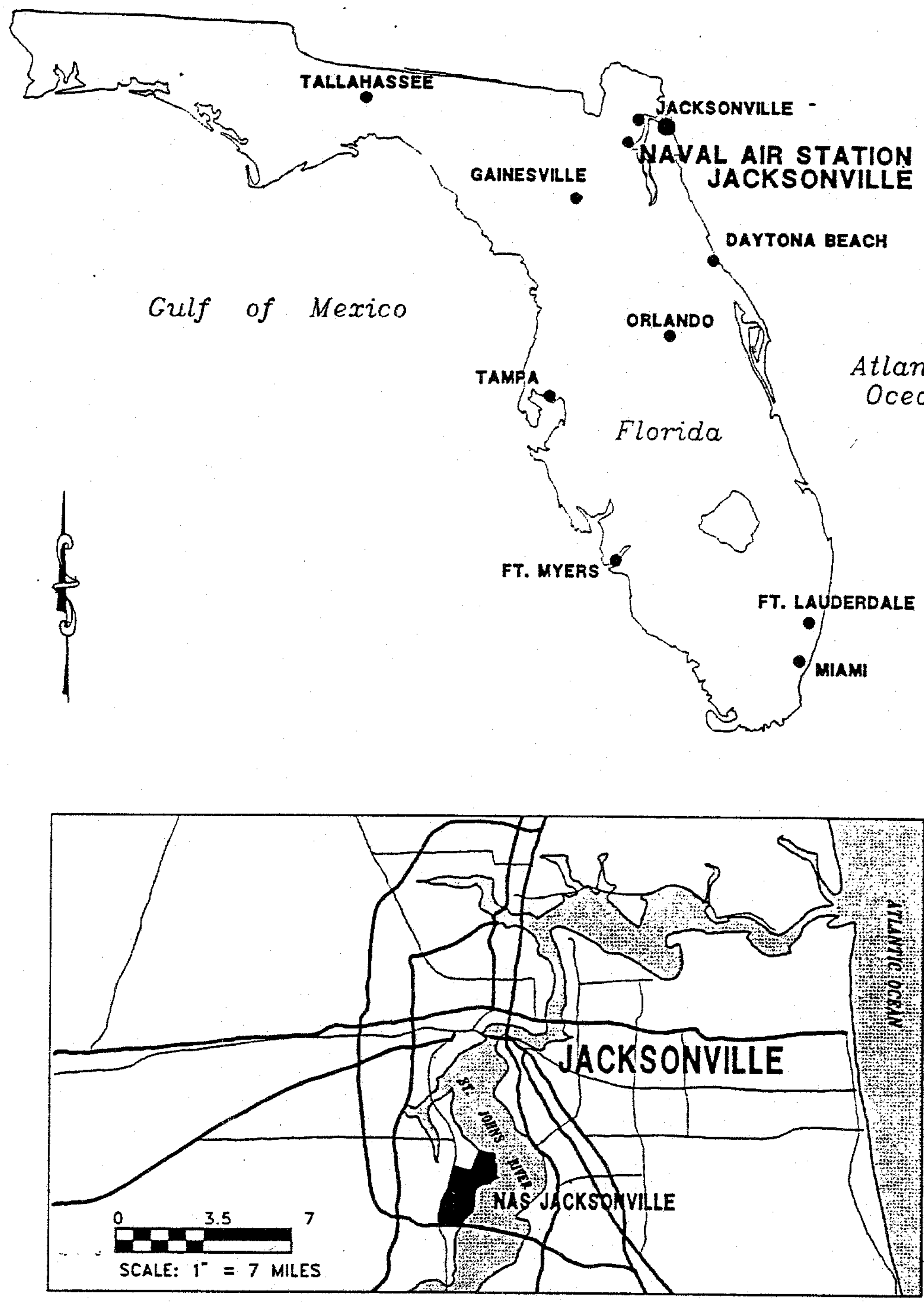

FIGURE 1-1
FACILITY LOCATION MAP
NAVAL AIR STATION
JACKSONVILLE, FLORIDA

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FOR SUPPLEMENTAL
SAMPLING OU1

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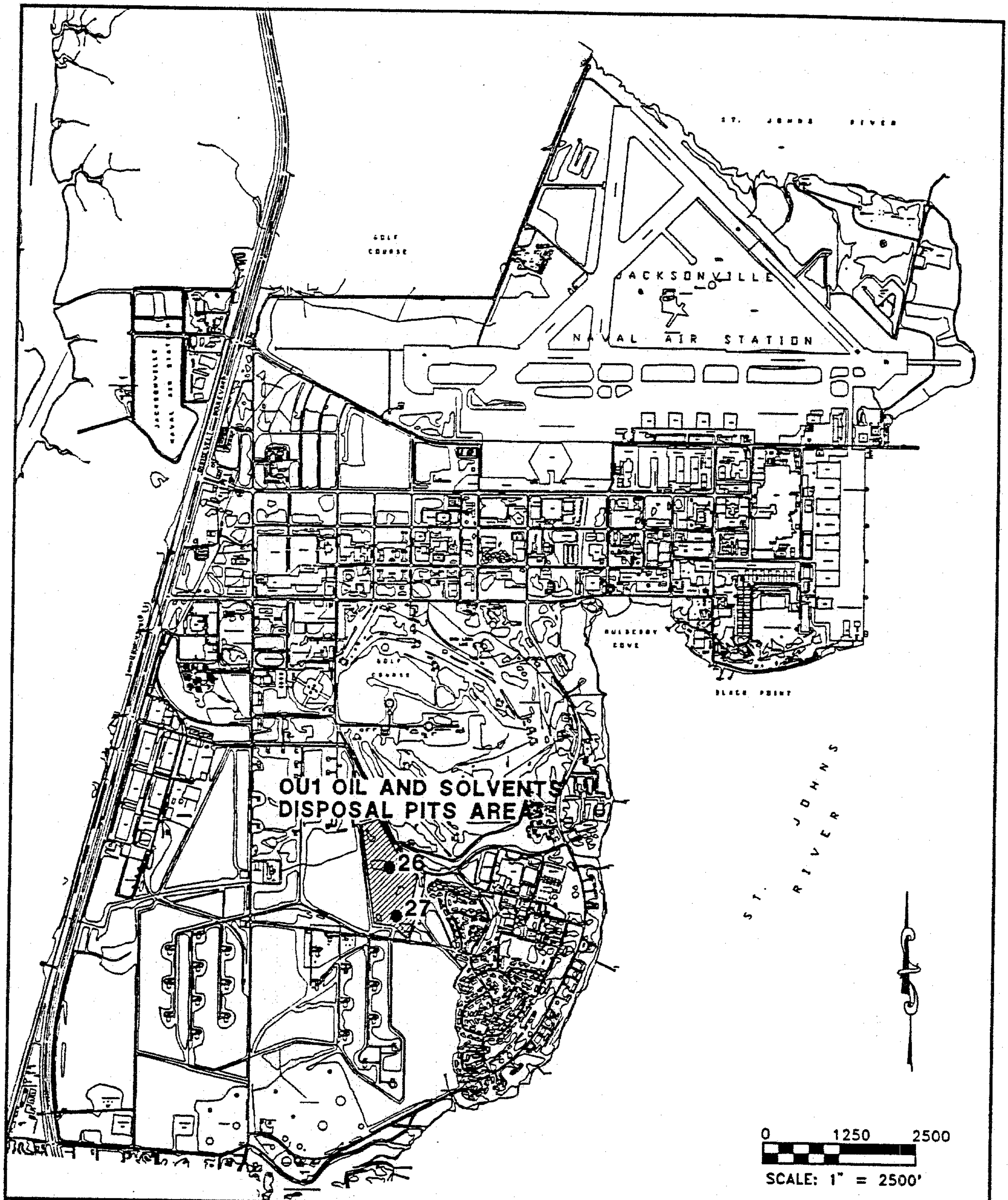

FIGURE 1-2
LOCATION OF OU1, OIL AND SOLVENTS DISPOSAL PITS AREA PSC 26 AND PSC 27

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identified during the initial field program, where elevated levels of polychlorinated biphyenols (PCBs) and/or radionuclides were reported.

- Direct-Push Technology Screening This includes the collection of groundwater and subsurface soil samples to delineate the horizontal extent of contamination in areas outside the current boundaries of OU1. Use of direct-push technology screening will focus the placement of additional monitoring wells by providing real-time data analysis and interpretation. Data generated during the screening will be analyzed in the field by gas chromatography (GC) for selected target constituents, with 10% of the samples being submitted for confirmatory laboratory analysis.

- PCB Screening Several of the soil sampling locations from the initial field program reported detections of PCBs in excess of 5 mg/kg. As the grid spacing used was set on 175 foot centers, additional sampling of identified "hot spots" is required to support the development of volume estimates during the Feasibility Study. PCB screening will be accomplished using an immunoassay screening technique by EnSys, Inc., of Research Triangle Park, North Carolina.

- Soil Sampling Soil samples will be collected and submitted for laboratory analysis as part of the PCB investigation. The samples are intended to served as confirmation of the screening activities used to completed the delineation of the PCB "hot spots" identified during the initial field program.

- Piezometers/Monitoring Wells The analytical results of the groundwater sampling during the initial field program indicate that site-related contaminants are present in areas formerly thought to be upgradient (i.e., located northwest and west of OU1) and may have migrated to downgradient areas east and southeast of the OU1. The installation of groundwater monitoring wells, both at predetermined locations and at locations dictated by direct-push screening results, will define the extent of contamination in these areas. Additional monitoring wells will also be installed to define the extent of floating product in the northern portion of the OU. Piezometers will be installed in several areas beyond the periphery of the site to provide suitable input data for USGS groundwater flow modelling efforts.

- Groundwater Sampling Collection of groundwater samples from the newly installed monitoring wells and existing monitoring wells in which contaminants either were not detected or were detected at low concentrations. Analyses of groundwater samples from new wells and existing wells will be completed using methods capable of achieving lower than what detection limits to facilitate comparison of water quality information from OU1 and Applicable or Relevant and Appropriate Requirements (ARARs).

- Water Level Measurements In order to provide information on the hydrogeology and geohydrology of OU1 for both the contaminant assessment and USGS groundwater flow modelling efforts, it is necessary to collect water level measurements from the existing wells and installed newly wells during the proposed investigation. Water level measurements will be collected throughout the field program at an interval of approximately one round per month; a round being a measurement from every well on and around OU1 during the same day.

- Air Sampling Additional air samples will be collected to further evaluate the risks associated with inhalation of ambient air and to characterize ambient air quality during site excavation activities in the vicinity of the former disposal pits.

- Geophysical Investigation An investigation of OU1 boundaries will be completed using Electromagnetic Terrain Conductivity technologies to define the lateral extent of disposal activities at OU1. Additionally, based on an interview with a former NAS Jacksonville bulldozer operator, Ground Penetrating Radar will be used in an attempt to locate the drum burial site purportedly within the boundaries of OU1.

- Ecological Inventory Will include the inventory and biocharacterization of habitat areas that are outside the current boundary of OU1, but are now believed to be within the area affected by past disposal practices at PSCs 26 and 27. Additional ecological assessment activities will include: sediment bioassays, clam toxicity and bioaccumulation analysis, and food web/toxicity analysis for invertebrates, minnows, and plants.

2.0 SURFACE WATER/SEDIMENT

During the 1992 field program, paired surface water and sediment samples were collected from 33 locations on and around Operable Unit 1 (OU1) (Figure 2-1). Detailed analysis of analytical results from the surface water and sediment sampling completed is presented in the Preliminary Characterization Summary Report (PCSR) for OU1. Only the appropriate PCSR section references are provided here. They are:

- Section 2.2.6.1, *Regional Hydrology: Surface Water*
- Section 3.2.4, *Surface Water and Sediment Sample Collection*
- Section 4.3.3, *Remedial Investigation (RI) Findings: Surface Water and Sediment Sample Results*
- Section 5.4, *Conclusions and Recommendations: Surface Water and Sediment Sampling*
- Appendix C, *Surface Water and Sediment Sample Analytical Results*

A listing of the appropriate PCSR figure references of the surface water and sediment analytical program is provided here. They are:

- Figure 3-5, *Surface Water and Sediment Sample Locations*;
- Figure 3-13, *Aquatic Sampling Locations*;
- Figure 4-9, *Volatile Organic Compounds in Surface Water Samples*;
- Figure 4-10, *Semivolatile Organic Compounds in Sediment Samples*;
- Figure 4-11, *Pesticides in Sediment Samples*;
- Figure 4-12, *PCBs in Surface Water Samples*;
- Figure 4-13, *PCBs in Sediment Samples*;
- Figure 4-14, *Inorganic Target Analytes in Surface Water Samples*;
- Figure 4-15, *Inorganic Target Analytes in Sediment Samples*; and
- Figure 4-16, *Radionuclides in Surface Water Samples*.

Based on the results of surface water/sediment sampling from the 1992 field program, several target areas needing further clarification have been identified. Additional characterization of these areas is required to fulfill the objectives of the RI/FS Work Plan for OU1. Each area targeted for further characterization is briefly described below. Figure 2-2 shows the locations which have been

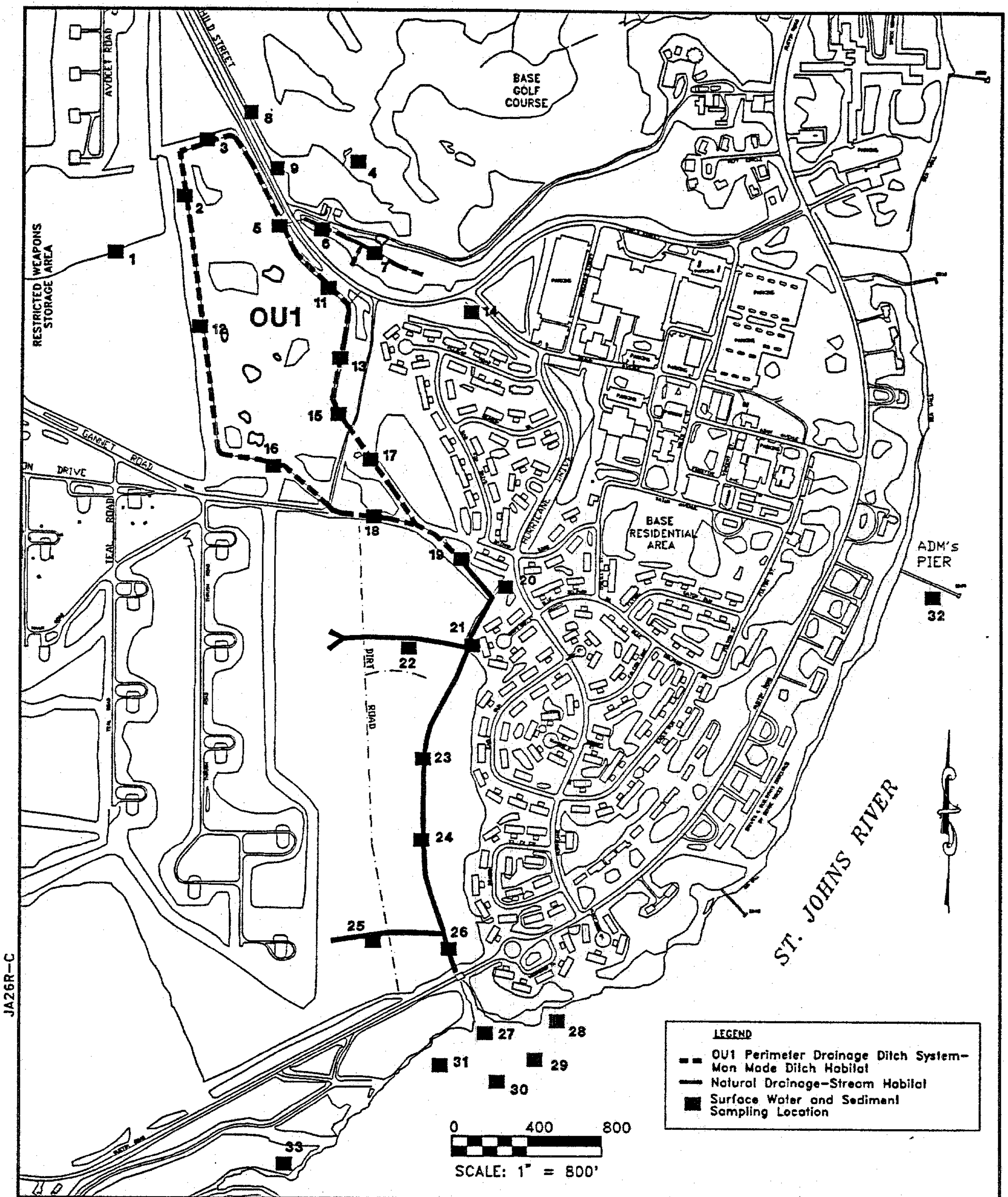

FIGURE 2-1

SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS 1992 FIELD PROGRAM

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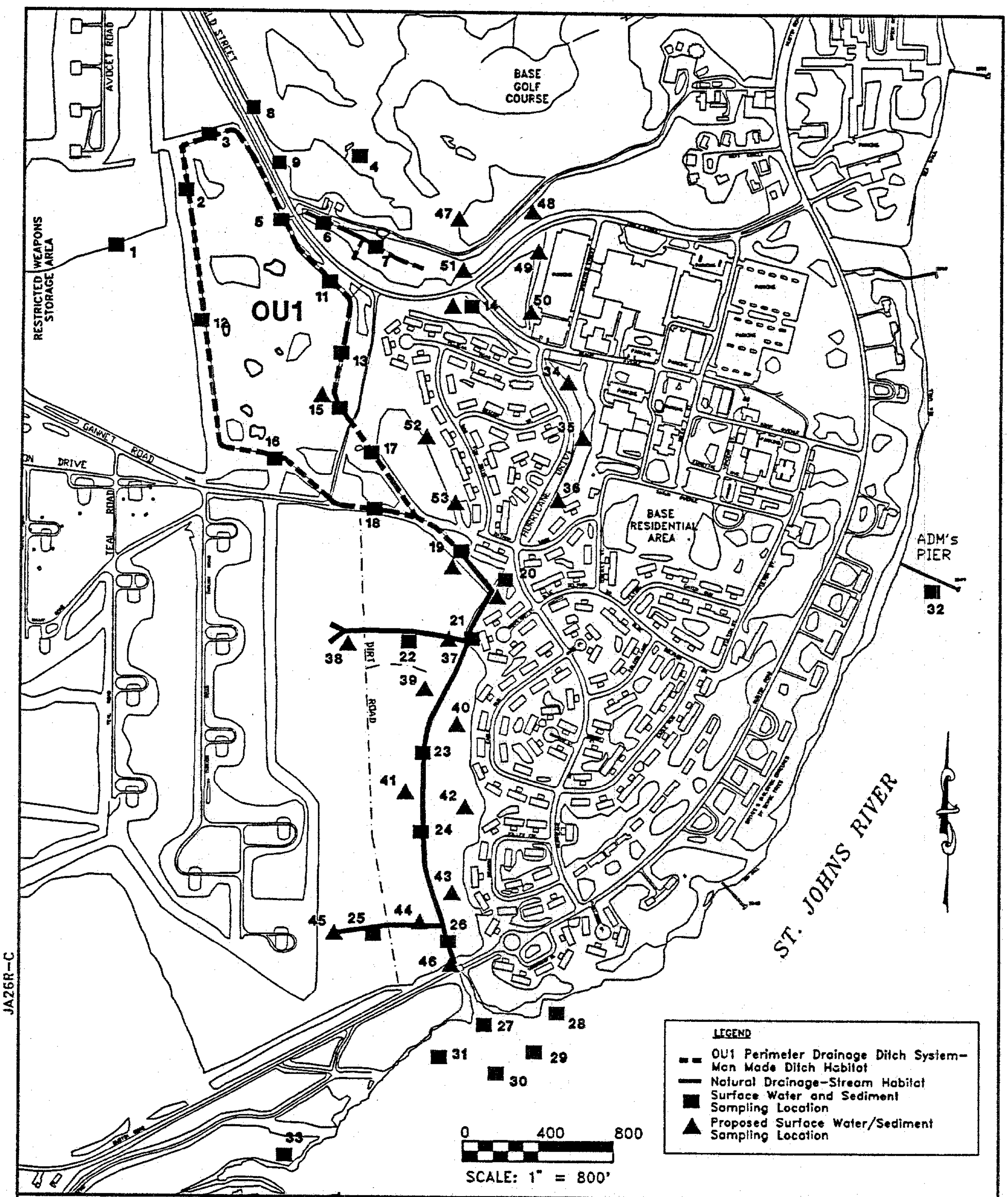

FIGURE 2-2

PROPOSED SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS

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selected for the collection of additional surface water/sediment samples during supplemental sampling. Proposed analyses for surface water/sediment samples are discussed in Section 11.1.1; Tables 2-1 and 2-2 summarized the sampling and QC programs. Surface water and sediment samples will be collected in accordance with the following volumes and sections of the NAS Jacksonville NIRP Plan.

- Volume 1, Organization and Planning, Section 2.5, *Data Reduction and Presentation*
- Volume 1, Appendix 1.5, *Site Health and Safety Plan*
- Volume 5, Work Plan, Section 2.1.3, *Hydrology*
- Volume 5, Section 4.3, *Surface Water and Sediment Quality*
- Volume 5, Appendix 5.4.1, Section 3.0, *Quality Assurance Objectives*
- Volume 5, Appendix 5.4.1, Section 8.0, *Internal Quality Control Checks*
- Volume 5, Appendix 5.4.2, Section 4.5, *Surface Water and Sediment Sampling*
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*

The first target area concerns surface water results from locations SW14, SW15, SW19 and SW20 (Figure 2-1). Surface water collected at each of these locations was found to contain concentrations of Gross Alpha and Radium 226 that exceed the 15 pCi/L maximum contaminant levels established by the FDER. One surface water sample, SW15, was determined to contain concentrations of Gross Beta radiation that exceeds the 4 millirem per hour (equivalent to 50 pCi/L) standard established by FDER drinking water regulations. The discovery of radionuclides at these concentrations requires additional information concerning their source, i.e., whether the radionuclides observed in the samples are a breakdown product of naturally occurring radioactive elements and therefore represent random variation in the natural background, or whether they are related to radium paint wastes.

Additional surface water/sediment samples will be collected at these four locations (SW14, SW15, SW19, and SW20) to verify the concentrations reported and to provide concurrent data for additional analyses planned. This additional analysis will consist of a uranium scan of the surface water and sediment to determine the source of the alpha and beta radiation observed during the 1992 field program.

The second target area concerns sediment analytical results from locations originally intended to represent "background" conditions (locations SD22 and SD25, Figure 2-1). Both of these locations are in small tributaries to the unnamed drainage from OU1 and do not receive OU1 runoff. Elevated levels of the pesticide DDE were reported at each location (see Figure 4-11 in the PCSR).

Table 2–1
Selected Constituents, Methods of Analysis, and Numbers of Surface–Water and Sediment Samples
OU1, NAS Jacksonville, FL.

Parameter	Methods[1]	Surface–Water Samples	Sediment Samples	Total Samples
Total Petroleum Hydrocarbon	9073	30	30	60
Volatile Organic Compounds [2]	624 CLP	30	30	60
Semi–volatile Organic Compounds [3]	625 CLP	30	30	60
Polychlorinated Biphenyls [4]	608 CLP	30	40	70
Metals	SW846, TAL	30	30	60
Cyanide	SW846, TAL	30	30	60
Radiological Parameters				
Gross Alpha	9310 (water) 3050/9310 (soil/ sediment)	30	30	60
Gross Beta	9310 (water) 3050/9310 (soil/ sediment)	30	30	60
Radium–226	9315 (water) 3050/9315 (soil/ sediment)	30	30	60
Radium–228	9320 (water) 3050/9320 (soil/ sediment)	30	30	60
Uranium Scan		4	4	8

Notes:
[1] EPA Contract Laboratory Program (CLP) methods – sample preparation will be in accordance with procedures specified in the CLP statement of work (most current version).
[2] Volatile Organic Compounds (VOC) to be analyzed are the Target Compound List (TCL) presented in Table 3–2 of Volume 5, Book 1.
[3] Semi–volatile Organic Compounds to be analyzed are presented in Table 3–2 of Vol
[4] PCB's to be analyzed are presented in Table 3–2 of Volume 5, Book 1.
Neesa Level D applies to all lab work.
Neesa Level B applies to soil and water field screening.

Table 2–2
Surface Water and Sediment Field Quality Control Samples
OU1 NAS Jacksonville, FL.

	Equipment Blanks	Field Blanks	Trip Blanks	Field Replicates	Matrix Spike	Matrix Spike Duplicate	Total Samples
Sediment							
Volatile Organic Compounds	10	10	10	3	3	3	39
Base, Neutral and Acid Extractable Compounds	10	10		3	3	3	29
Total Metals	10	10		3	3	3	29
Polychlorinated Biphenyls	10	10		3	3	3	29
Uranium scan/Radiological	10	10		3	3	3	29
Total Petroleum Hydrocarbon	10	10		3	3	3	29
Surface Water							
Volatile Organic Compounds	10	10	10	3	3	3	39
Base, Neutral and Acid Extractable Compounds	10	10		3	3	3	29
Total Metals	10	10		3	3	3	29
Polychlorinated Biphenyls	10	10		3	3	3	29
Uranium scan/Radiological	10	10		3	3	3	29

Currently it is not known if the detected contaminants are attributable to OU1 or are related to another potential source of contamination (PSC). Surface water and sediment samples will be collected at locations upstream and downstream of the "background" sample locations (samples 37 and 38 at location 22, and samples 44 and 45 at location 25) to assess the relationship between the pesticides detected and OU1. This assessment of the relationship between detections at locations 22 and 25 and OU1 will be further augmented by other sampling to be completed in the natural drainage area south of OU1 (discussed below). Figure 2-2 shows surface water and sediment sampling locations. Sample analyses are discussed in Section 11.1.1.

The third target area for expanded surface water/sediment sampling is located in the natural drainage area south of OU1 (Figure 2-2). During the 1992 field program, several surface water/sediment sampling locations were dedicated to evaluating potential migration, via surface water runoff, of contaminants beyond the OU1 boundary. Drainage from OU1, as detailed in Section 2.2.6 of the PCSR, leaves OU1 and runs south into the St. Johns River via man-made ditches and existing natural drainages. Sampling completed during the 1992 field program, however, focused on the sediments and surface water located in the channel south of OU1, and did not address other potential areas of deposition in this drainage system. It is probable that the unnamed drainage from OU1 may have deposited contaminants in areas adjacent to the channel during times of heavy precipitation and subsequent flooding south of OU1.

Therefore, several "low lying areas" and "high water sloughs," which were not sampled during the initial assessment activities, will be included in the proposed investigation. Locations 39, 40, 41, 42, and 43 (Figure 2-2) in the natural drainage area south of OU1 will be sampled to assess this potential.

The fourth target area concerns the former drainage channel along Hurricane Drive. This area was not sampled during the 1992 field program. Drainage from areas north of Child Street formerly flowed east and then south along Hurricane Drive to enter the unnamed drainage south of OU1. Section 2.2.6 of the PCSR presents a detailed discussion of flow in the canal around OU1. Because of the detected presence of contaminants attributable to OU1 at surface water/sediment sample locations 14 and 20, and current understanding of former flow patterns from and around OU1, expanded sampling of surface water and sediment along Hurricane Drive is necessary to fulfill the objectives of the RI/FS Work Plan for OU1. Sampling locations 34, 35 and 36 (Figure 2-2) have been selected to characterize the Hurrican Drive drainage system.

The fifth target area is at sampling location 26 (Figure 2-1), where PCBs and petroleum-related compounds were detected, as discussed in Section 4.3.3 of the PCSR. Additional sampling of surface water and sediments is required to delineate the extent of the impacted area and characterize contamination found at this location. Ten sediment samples will be collected in the vicinity of sampling location 26 (Figure 2-2) and submitted for analysis as discussed in Section 11.1.1.

Two other areas are targeted for the collection of surface water/sediment samples. Sampling locations 52 and 53 (Figure 2-2) located in a previously unsampled drainage which formerly served the main portion of OU1. Sampling locations 47 through 51 have also been selected for sampling during the proposed investigation. These areas, located in the northeastern portion of the OU1, formerly received runoff from disposal areas.

The proposed surface water and sediment will serve to define further the characterize potential impacts to human health and the environment associated with OU1. Analyses to be completed on surface water/sediment samples are discussed in Section 11.1.1. Data validation is discussed in Section 11.2.

Background Surface Water and Sediment Sampling. The PCSR provides a detailed discussion of the results of surface water and sediment sampling during the 1992 field program which was intended to be representative of existing background conditions for OU1. The locations sampled as "background" contained contaminants which may be related to waste-disposal activities at OU1. Therefore, an expanded surface water and sediment background sampling effort will be included in the proposed investigation.

A total of six locations will be sampled to better define existing background conditions of surface water and sediments. The six locations will be selected based on discussions to be held with the Florida Natural Resource Trustees, and following a reconnaissance of drainageways on the southern portion of NAS Jacksonville. Selection will be based on the degree of similarity in terms of flow volumes, bed load, and biotic characteristics to the drainageway south of OU1 and least affected by current and historical facility operations. Tables 2-1 and 2-2 have included the collection of samples from the six background locations to be selected.

3.0 SITE SCREENING

Site screening will be completed during the present investigation for two primary purposes. First, screening will be used in areas around the periphery of OU1 to complete the water quality assessment and to guide the placement of additional monitoring wells. The second objective of the proposed screening efforts will be used during the Feasibility Study to develop additional data for estimating the volume of PCB-contaminated soil. Two separate screening programs will be completed to achieve these objectives.

Screening to support the water quality assessment will be completed using direct-push technology and in-field analysis of volatiles using a gas chromatograph. A PCB test kit will be used to refine estimates of contaminated soil volume. Site screening, using direct-push technology and field PCB test kits, is being proposed because the use of such technologies, will aid in quickly gathering the informaiton necessary to complete the RI for OU1 by providing real-time data analysis and interpretation to make effecient field decisions.

3.1 DIRECT-PUSH TECHNOLOGY. Direct-push technology screening will include the collection of in-situ groundwater samples to further delineate the horizontal and vertical extent of contamination attributable to OU1 and to select locations for additional monitoring wells. The data will be analyzed in the field for selected target constituents using gas chromatography. This screening approach will allow the assessment of portions of OU1, including areas outside of the current site boundary, not previously considered. Appendix A presents a discussion of direct-push technology screening.

The volumes and sections of the NIRP Plan applicable to this screening effort are:

- Volume 1, Organization and Planning, Section 2.5, *Data Reduction and Presentation*;
- Volume 5, Appendix 5.4.1, Table 1-3, *Field Quality Control Samples to be Collected During the RI at OU1, NAS Jacksonville*;
- Volume 5, Appendix 5.4.1, Section 3.0, *Quality Assurance Objectives*;
- Volume 5, Appendix 5.4.1, Table 8-1, *Field QC Samples Required for Each Matrix per Sampling Event*;
- Volume 5, Appendix 5.4.2, Section 4.7, *Collection of Field Quality Control Samples*;
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*.

Figure 3-1 presents the locations which have been selected for direct-push technology screening. The locations have been divided into five target areas for discussion purposes. Sampling locations within the grids will be labeled with an alpha-numeric designation, according to the locations coordinates within the

LEGEND

▲ PROPOSED FLOATING PRODUCT BOUNDARY DEFINITION SCREENING LOCATIONS

● PROPOSED GROUNDWATER SCREENING LOCATION

0 250 500

SCALE: 1" = 500'

FIGURE 3-1
DIRECT-PUSH TECHNOLOGY SCREENING LOCATIONS

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grid. The location at the intersection of north-south grid line A and east-west grid line 1 would be designated sampling location A1.

The first target area is located on the west side of OU1. Screening in this area will establish and define the westward extent of contamination resulting from former waste-disposal activities. This area has also been targeted for geophysical surveying. Borings completed during the 1992 field program, encountered evidence of waste disposal beyond the current boundaries of OU1. Sample grid lines will extend along the (north-south) length of OU1 and include several locations on the east and west sides of the perimeter drainage ditch. A second line of samples will be taken west of the fence that separates OU1 from the weapons storage are (see Figure 3-1).

The second area has been selected to establish and define the extent of contamination northwest of the site (west of Child Street). Soil borings and monitoring wells drilled north of OU1 provided evidence of elevated OVA readings (3000 to 5000 ppm) between land surface and the water table. Review of historical areal photographs (July, 1961) also identified a potential pond or seepage pit in this area. This area was thought to be upgradient of OU1 during the development of the Work Plan. Screening samples will be taken along the east-west grid lines, as shown in Figure 3-1, and further out if necessary.

The third area is located north and east of Child Street. Free-phase product was encountered at the location of monitoring well MW13 (see Figure 4-1; Section 4.0). Monitoring well MW13 was placed in a location that was thought (during the development of the RI/FS Work Plan) to be an upgradient background location. MW-13 is located outside of the former "Main Registered Disposal Area" and may be related to another smaller disposal area. Fifteen samples are proposed to assess the extent of contamination in this site area.

The fourth area is located to the southeast of OU1 in the residential area. Analysis of monitoring well data (fully discussed in Section 4.3.5 of the PCSR) from wells in this area indicate that the extent to which contaminants from OU1 have migrated can not be fully encountered with the current information. Screening will define and establish the extent of contamination in this area and guide the location of permanent monitoring wells.

The fifth area is located south of OU1 along the unnamed drainage. Screening in this area will establish and define the extent to which OU1 contaminants have migrated to the south toward the St. Johns River and guide the location of permanent monitoring wells.

Once the initial grid has been completely sampled and results analyzed, a finer grid will be established around any "hot" spots. These locations will be annotated as decimal extensions of the gross grid system. (A sampling location that is halfway between A2 and A3 would be designated as A2.5 for example).

Field screening of the samples will be conducted using two gas chromatographs. One of the GCs will be equipped with a flame ionizaion detecter (FID) and the other with a electron capture detecter (ECD). The method of analysis to be used during the field screening is USEPA Methods 8010. The GC will be calibrated to detect certain chlorinated compounds identified during the 1992 groundwater sampling investigation. They are:

- trichloroethene,
- tetrachloroethene,
- vinyl chloride,
- 1,1-dichloroethene, and
- 1,2-dichloroethene.

Ten percent of the field screeening samples will be duplicated and submitted for laboratory analysis. Samples for laboratory analysis will be sent under proper chain of custody to the laboratory by overnight delivery services. Table 3-1 summarizes this confirmatory laboratory sampling program and Table 3-2 describes the QA/QC sampling which will be conducted to support the confirmatory laboratory analysis. The total of 20 confirmatory samples estimated in Table 3-1 includes initial grid sampling (100 samples) and subsequent tightening of the sampling grid based on the field results (100 samples).

<u>3.2 PCB SCREENING</u>. Soil sampling completed during the 1992 field program indicated that certain areas within the boundaries of OU1 had PCB present at levels above 5 mg/kg. These soil sampling results are fully discussed in Section 4.3.4 of the PCSR and presented in the following PCSR table and figure:

- Table 4-6, *Soil Samples with PCBs Exceeding USEPA PRG of 83 ug/kg*

- Figure 4-20, *PCBs in Soil Samples*

Field sampling at a grid spacing smaller than the 175-foot centers used in the initial field effort is necessary to identify the "hot spots" and thus support the development of soil volume estimates to be used during the Feasibility Study.

There were no provisions for field PCB screening in the RI/FS Work Plan for OU1. As such, the procedures for using field testing kits are included in this document as Appendix B.

Approximately 550 soil samples will be collected to further delineate the horizontal and vertical extent of the PCB contamination. Figure 3-2 presents the initial grid locations which will be sampled during the screening effort. A total of not greater than five screens will be taken around each node identified in Figure 3-2. As with the direct-push screening discussed above, this first round of information will be reduced and interpreted in the field. Following analysis of this initial data, additional PCB screening samples will be collected as needed to complete the definition of the targeted areas. The soil samples will be analyzed in the field using the immunoassay screening technique by EnSys, Inc., of Research Triangle Park, North Carolina.

The proposed field screening method is a semi-quantitative colorimetric method (RISc™) which incorporates immunoassay technology. The RISc™ test uses tubes (12x75mm) coated with a chemical (antibody) that specifically binds to PCBs. The molecular structure of antibody has a preferential affinity for absorbing the PCBs. As the PCBs are absorbed by the antibody, the enzyme conjugate that is

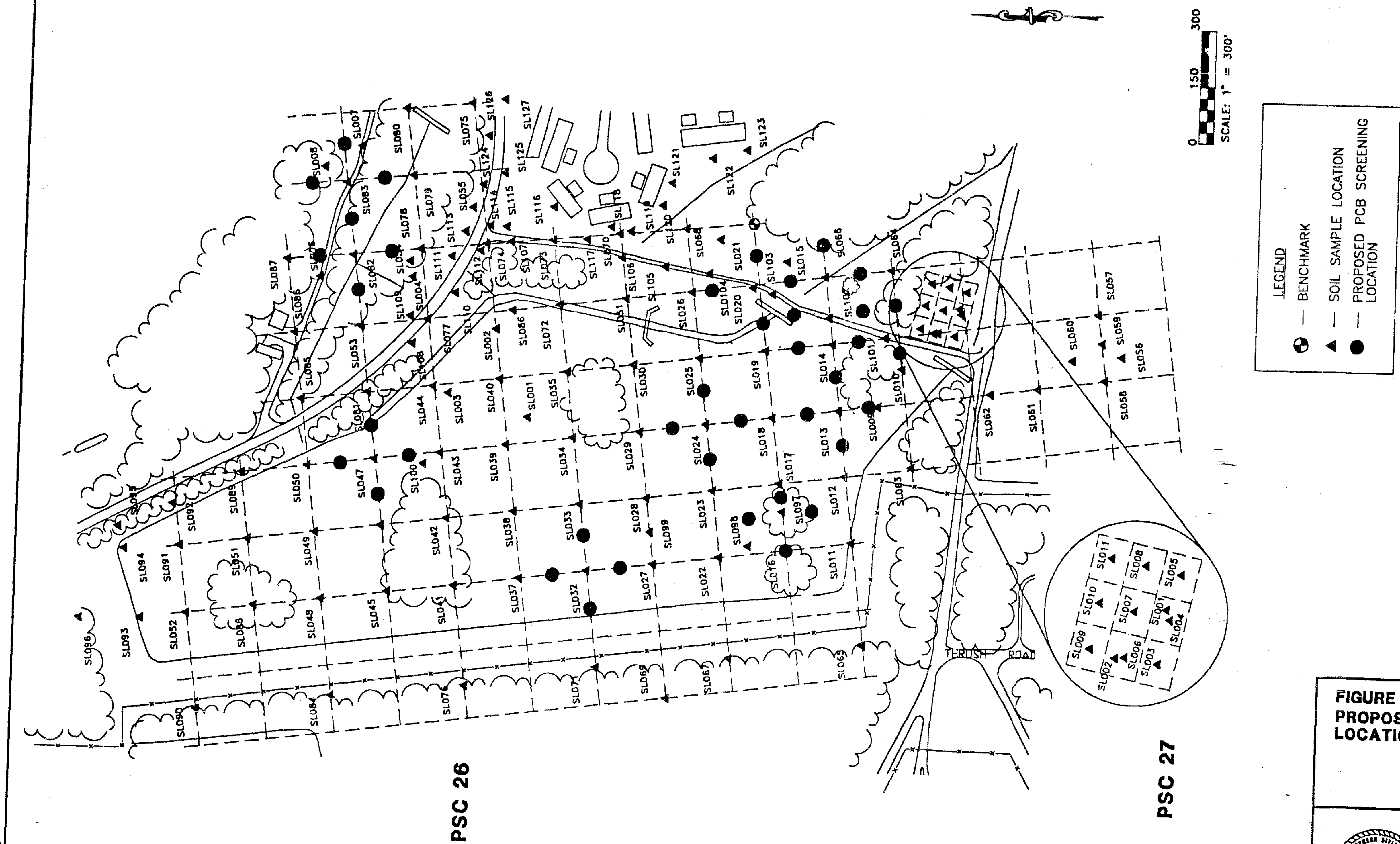
Table 3-1
Selected Constituents, Methods of Analysis, and Number of Ground Water Field Screening Samples OU1, NAS Jacksonville, FL

Parameter	Methods[1]	Direct-Push Technology Shallow Surficial	Direct-Push Technology Deep Surficial	Laboratory Analysis Level II
Total Petroleum Hydrocarbon	9073			20
Volatile Organic Compounds [2]	624 CLP			20
Semi-volatile Organic Compounds [3]	625 CLP			20
Polychlorinated Biphenyls [4]	608 CLP			20
Metals	SW846, TAL			20
Cyanide	SW846, TAL			20
Radiological Parameters				
Gross Alpha	9310 (water) 3050/9310 (soil/ sediment)			20
Gross Beta	9310 (water) 3050/9310 (soil/ sediment)			20
Radium-226	9315 (water) 3050/9315 (soil/ sediment)			20
Radium-228	9320 (water) 3050/9320 (soil/ sediment)			20
Field GC (Volatile Organics)[5]		100	100	480

Notes:
[1] EPA Contract Laboratory Program (CLP) methods – sample preparation will be in accordance with procedures specified in the CLP statement of work (most current version).
[2] Volatile Organic Compounds (VOC) to be analyzed are the Target Compound List (TCL) presented in Table 3-2 of Volume 5, Book 1.
[3] Semi-volatile Organic Compounds to be analyzed are presented in Table 3-2 of Volume 5, Book 1.
[4] PCB's to be analyzed are presented in Table 3-2 of Volume 5, Book 1.
[5] Field GCs Flame Ionization and Election Caputre Detector, 10% Duplicate of Field Screening, 10% Select high or medium volume for confirmation.
Neesa Level D applies to all lab work.
Neesa Level B applies to soil and water field screening.

Table 3–2
Ground Water Field Screening Quality Control Samples
OU1 NAS Jacksonville, FL.

	Equipment Blanks	Field Blanks	Trip Blanks	Field Replicates	Matrix Spike	Matrix Spike Duplicate	Total Samples
Ground Water – Driect–Push							
Volatile Organic Compounds	10	10	10	2	2	2	36
Base, Neutral and Acid Extractable Compounds	10	10		2	2	2	26
Total Metals	10	10		2	2	2	26
Polychlorinated Biphenyls	10	10		2	2	2	26
Radiochemistry	10	10		2	2	2	26
Dioxin							



SOIL17CO

FIGURE 3-2
PROPOSED PCB SCREENING LOCATIONS

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attached to the tubes is released. After a period of approximately 20 minutes, the sample is removed from the tube and a color-change reagent is added to the tube. A color reaction occurs based on the proportion of sites occupied by PCBs and the enzyme conjugate. The concentration of PCBs in the sample are determined using a comparative photometer to compare the coloration of standards of known concentration versus the coloration of the sample.

Ten percent of the screeing samples collected will be submitted for laboratory analysis by USEPA Method 608 and for total petroleum hydrocarbons by USEPA Method 9073 and validated using NEESA Level E. Data validation is discussed in Section 11.2. Samples will be sent under proper chain of custody to the laboratory each sample day by overnight delivery services. Tables 3-3 and 3-4 summarize the PCB screening and QC programs to be completed during the proposed investigation.

Table 3–3
Selected Constituents, Methods of Analysis, and Numbers of PCB Screening of Soil Samples
OU1, NAS Jacksonville, FL

Parameter	Methods[1]	Soil Samples
ENSYS™ Field Screening[2]		550
Total Petroleum Hydrocarbon	9073	250
Polychlorinated Biphenyls[3]	608 CLP	75

Notes:
[1] EPA Contract Laboratory Program (CLP) methods – sample preparation will be in accordance with procedures specified in the CLP statement of work (most current version).
[2] PCB hits above 5 ppm, PSC 26 and 27.
[3] PCB's to be analyzed are presented in Table 3–2 of Volume 5, Book 1.
NEESA Level D applies to all lab work.
NEESA Level B applies to soil and water field screening.

Table 3-4
Field Quality Control Samples
PCB Screening
OU1 NAS Jacksonville

	Equipment Blanks	Field Blanks	Trip Blanks	Field Replicates	Matrix Spike	Matrix Spike Duplicate	Total Samples
Soil							
Volatile Organic Compounds							
Base, Neutral and Acid Extractable Compounds							
Total Metals							
Polychlorinated Biphenyls	8			2	2	2	14
Radiochemistry							
Dioxin							
Total Petroleum Hydrocarbon	25			50			75

[1] 49 screening locations, 20 of those locations selected for laboratory chemical analysis (10 during first phase screening, 10 for conformation).

4.0 MONITORING WELL DRILLING AND INSTALLATION

During the 1992 field program, several monitoring wells were installed on and around Operable Unit 1 (OU1) to characterize potential water quality impacts resulting from former waste-disposal activities. Detailed discussion of the geologic and stratigraphic information generated during the drilling and installation of these wells is presented in the Preliminary Characterization Summary Report (PCSR) for OU1. Because of the level of detail provided in the PCSR regarding the presentation of this information, only the appropriate PCSR section references are provided in this TM. They are:

- Section 2.2.5, *Regional Geology*
- Section 2.2.6, *Regional Hydrology*
- Section 3.2.6, *Piezometer and Monitoring Well Installation*
- Section 3.2.8, *Hydrogeologic Investigations*
- Section 4.1, *Remedial Investigation (RI) Findings: Geology*
- Section 4.2, *RI Findings: Hydrogeologic Conditions*
- Section 5.1, *Conclusions and Recommendations: Geophysical Survey*
- Appendix A, *Boring/Well Logs*
- Appendix B, *Geologic Cross Sections/Potentiometric Surface Maps*

Geological and stratigraphic information developed during the monitoring well drilling and installation has been plotted on several figures in the PCSR. A listing of the appropriate PCSR figure references is provided below. They are:

- Figure 2-4, *Geologic Cross Sections Showing Geologic Formations in Duval and Nassau Counties, Florida*
- Figure 2-5, *Generalized Geologic Column*
- Figure 3-8, *Piezometer and Monitoring Well Locations*
- Figure 3-9, *Typical Piezometer Construction Diagram*
- Figure 3-10, *Typical Monitor Well Construction Diagram, Shallow Zone Surficial Aquifer*
- Figure 3-11, *Typical Monitor Well Construction Diagram, Deep Zone Surficial Aquifer*
- Figure 3-12, *Typical Monitor Well Construction Diagram, Intermediate Zone Hawthorn Formation*

Based on the results of information gathered during the 1992 field program, several target areas needing further clarification have been identified. Additional characterization of these areas is required to fulfill the objectives of the RI/FS Work Plan for OU1. All monitoring wells will be installed in accordance with the following volumes and sections of the NAS Jacksonville NIRP Plan.

- Volume 1, Organization and Planning, Section 2.5, *Data Reduction and Presentation*
- Volume 1, Appendix 1.5, *Site Health and Safety Plan*
- Volume 5, Work Plan, Section 2.1.4, *Hydrogeology*
- Volume 5, Section 4.6, *Geologic and Hydrogeologic Investigation*
- Volume 5, Appendix 5.4.1, Section 8.0, *Internal Quality Control Checks*
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*

Figure 4-1 shows the locations of all wells sampled during the 1992 field program which had reported detections of target compounds and analytes exceeding preliminary ARARs and those containing free product. Figures 4-2 and 4-3 present specific data for shallow and deep surficial aquifer wells with reported ARARs exceedences. Based on the results of the 1992 field program and the results of preliminary groundwater flow modelling, being completed by the USGS, an expanded monitoring well/piezometer installation program has been proposed to fulfill the original objectives of the RI/FS Work Plan.

Discussion of the proposed program is divided into three subsections. Section 4.1 presents expanded well/piezometer installation program planned to support on-going water quality assessment and USGS groundwater flow modelling efforts. Section 4.2 discusses the monitoring well installation program designed to augment the development of a facility-wide background groundwater monitoring network for naturally occurring inorganic parameters. Section 4.3 outlines monitoring well installation to confirm the direct-push technology screening data discussed in Section 3.1.

4.1 OU1 WATER QUALITY ASSESSMENT AND FLOW MODELLING. Prior to developing a calibrated model to simulate surface water and groundwater flow at OU1, it is necessary to establish a more complete hydrogeologic profile. Additional monitoring wells will provide the site-specific data necessary for accurate model simulation. Specifically, the additional data derived will provide information on groundwater flow direction and hydraulic gradients in various portions of OU1, communication between the surficial aquifer and the OU1 ditch system and infiltration rates of surface water through ditch sediments. As more hydrogeologic data is made available, the accuracy of the groundwater flow model will increase.

In addition, groundwater monitoring wells will be installed to further define the nature and extent of groundwater contamination resulting from former waste-

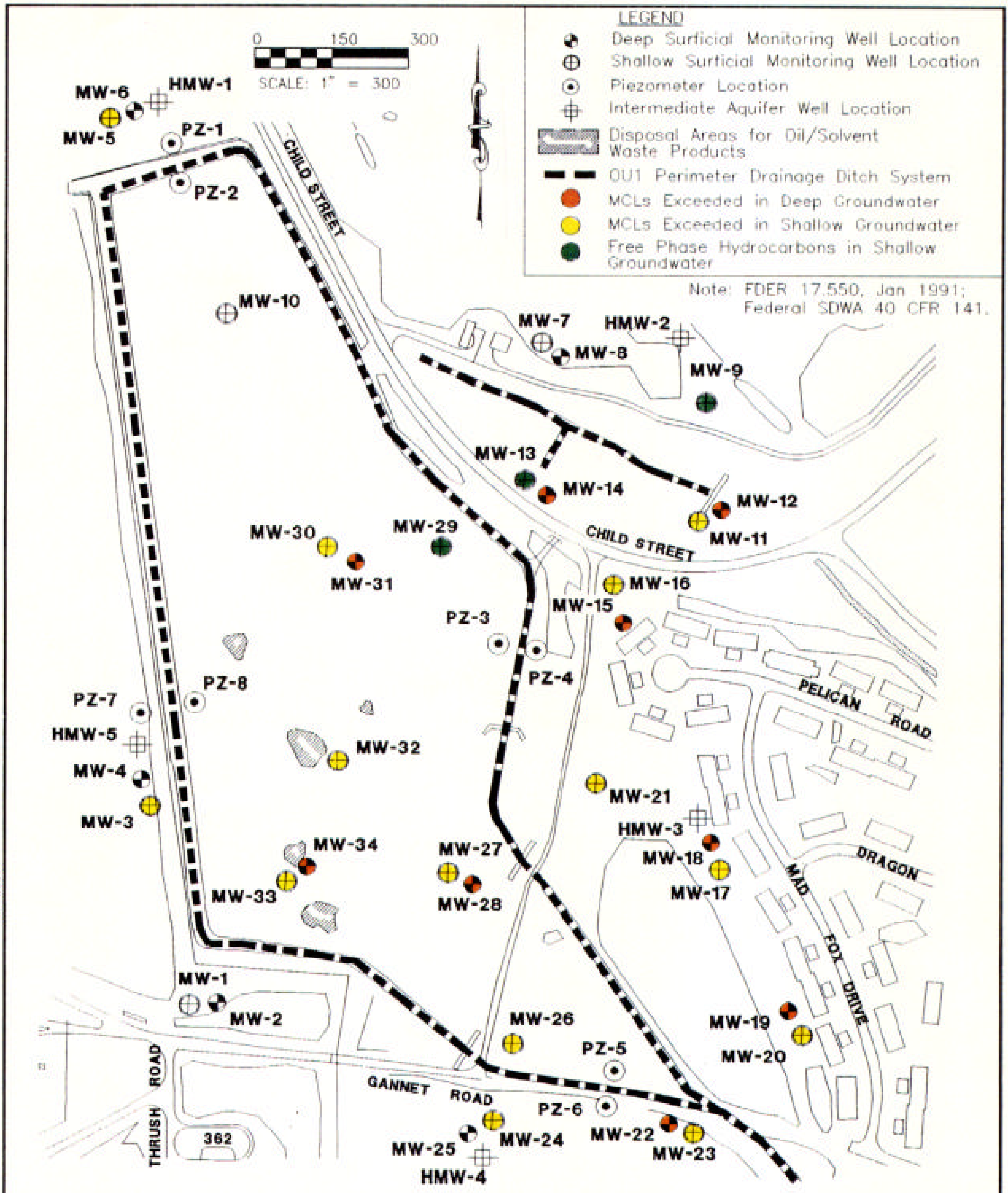

FIGURE 4-1

LOCATION OF WELLS WITH GROUNDWATER WHICH EXCEED PRELIMINARY ARARS

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1

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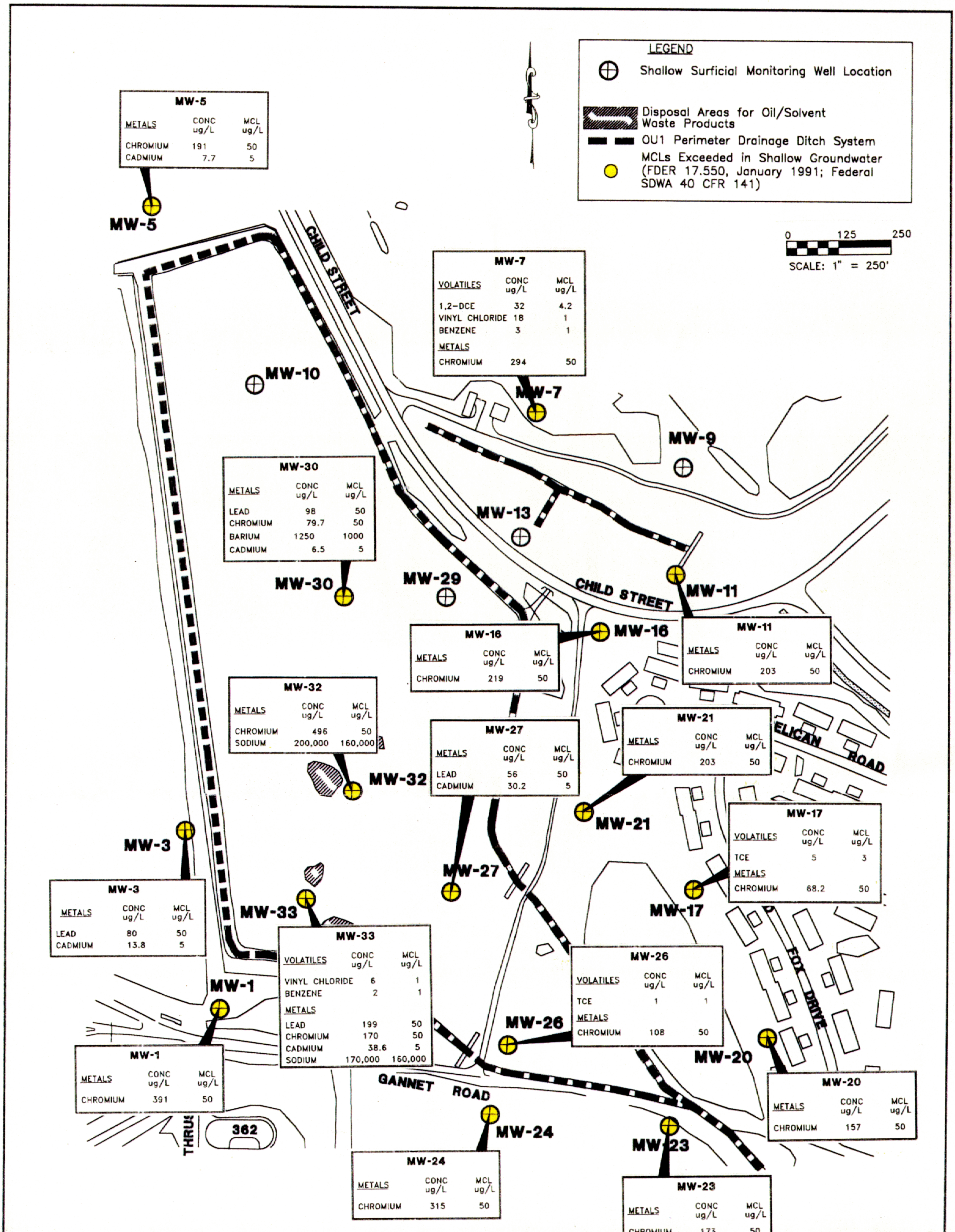

FIGURE 4-2
SHALLOW SURFICIAL MONITORING WELLS CONSTITUENT CONCENTRATIONS EXCEEDING PRELIMINARY ARAR's

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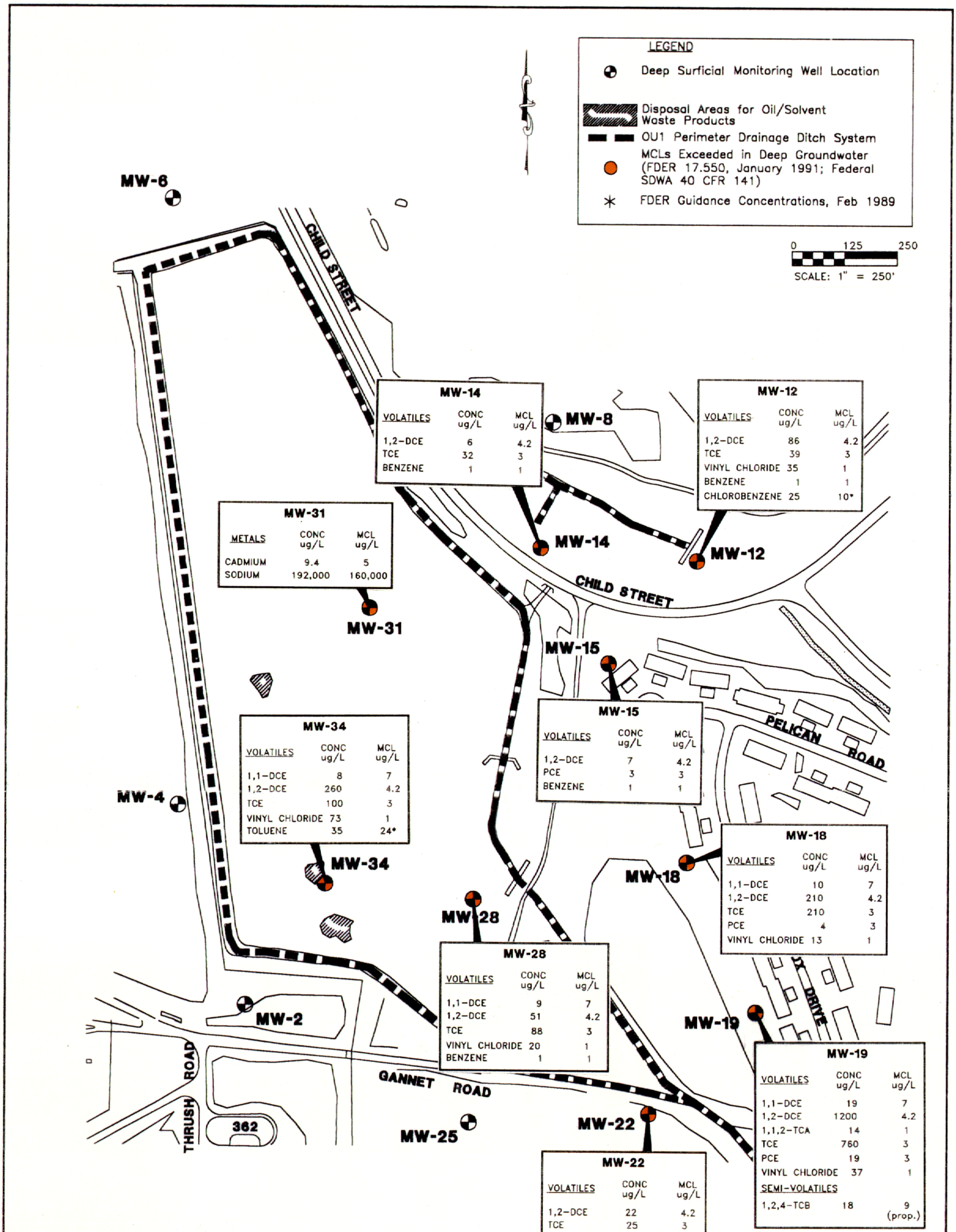

FIGURE 4-3
DEEP SURFICIAL MONITORING WELLS
CONSTITUENT CONCENTRATIONS
EXCEEDING PRELIMINARY ARAR's

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disposal activities at OU1. Because both the dissolved and free-phase product contamination extend, in general, to the limits of the existing explorations, the proposed monitoring wells will be primarily beyond the existing site boundaries. The proposed locations will be based on the existing data, as presented in Figures 4-2 and 4-3 and the groundwater flow patters as presented in PCSR.

Figure 4-4 presents the locations at which groundwater monitoring wells will be installed to support the water quality assessement for OU1 and groundwater flow modelling efforts. Some of the wells shown on Figure 4-4 will be used solely as piezometers to support flow modelling; they are, however, being installed as monitoring well to permit their future use, if necessary, in water quality determinations. Table 4-1 presents a summary of the wells to be installed during the present investigation and the aquifer in which they will be completed. Wells installed to support both the water quality assessment/flow modelling and the background groundwater monitoring network (discussed below in Section 4.2) are summarized in the table.

A description of monitoring well construction techniques to be used is presented below. Both deep surficial and Intermediate Hawthorn monitoring wells will be constructed to prevent potential cross contamination between the hydraulic units identified at the site.

<u>Shallow Surficial Aquifer Monitoring Well Installation</u>. Shallow monitoring wells will be constructed to intercept the upper portion of the water table, in order to capture low-density constituents that may possibly be floating on the water table. As a general rule, a 10-foot well screen will be placed 5 feet below the water table to allow for seasonal and possible tidal fluctuations.

The shallow monitoring wells will be drilled to an approximate depth of 15 feet below land surface (bls) using the hollow stem auger method. A nominal 8 inch borehole will be advanced using a 7 1/4 inch O.D., 4 1/4 inch I.D. auger. Split spoon samples will be collected at 2 ft intervals during drilling of the borehole and physical characteristics will be described in detail using the United Soil Classification System (USCS). Organic vapor concentrations of each sample will be measured by the Head Space Method using an organic vapor analyzer (OVA) equipped with a flame ionization detector (FID).

Ten feet of 2 inch diameter .010 slot well screen, with threaded joints, attached to approximately 8 feet (including 3 feet of riser) of 2 inch Schedule 40 PVC well casing will be lowered into the auger. The annular space between the well screen and the auger will be filled with 20/30 silica sand filter pack from the bottom of the borehole to 2 feet above the top of the well screen using the tremie method. As the filter pack sand is introduced into the borehole, the augers will be pulled from the bottom of the borehole at a pace to allow proper deposition of the sand pack within the borehole.

A 2-foot thick bentonite seal will be placed above the sand pack to prevent downward migration of cement grout. The hydration time for the bentonite will be those recommended by the pellet manufacturer. Water may be added to faciliate hydration. After allowing sufficient time for bentonite hydration, the remaining annular space above the bentonite will be filled with cement grout to land

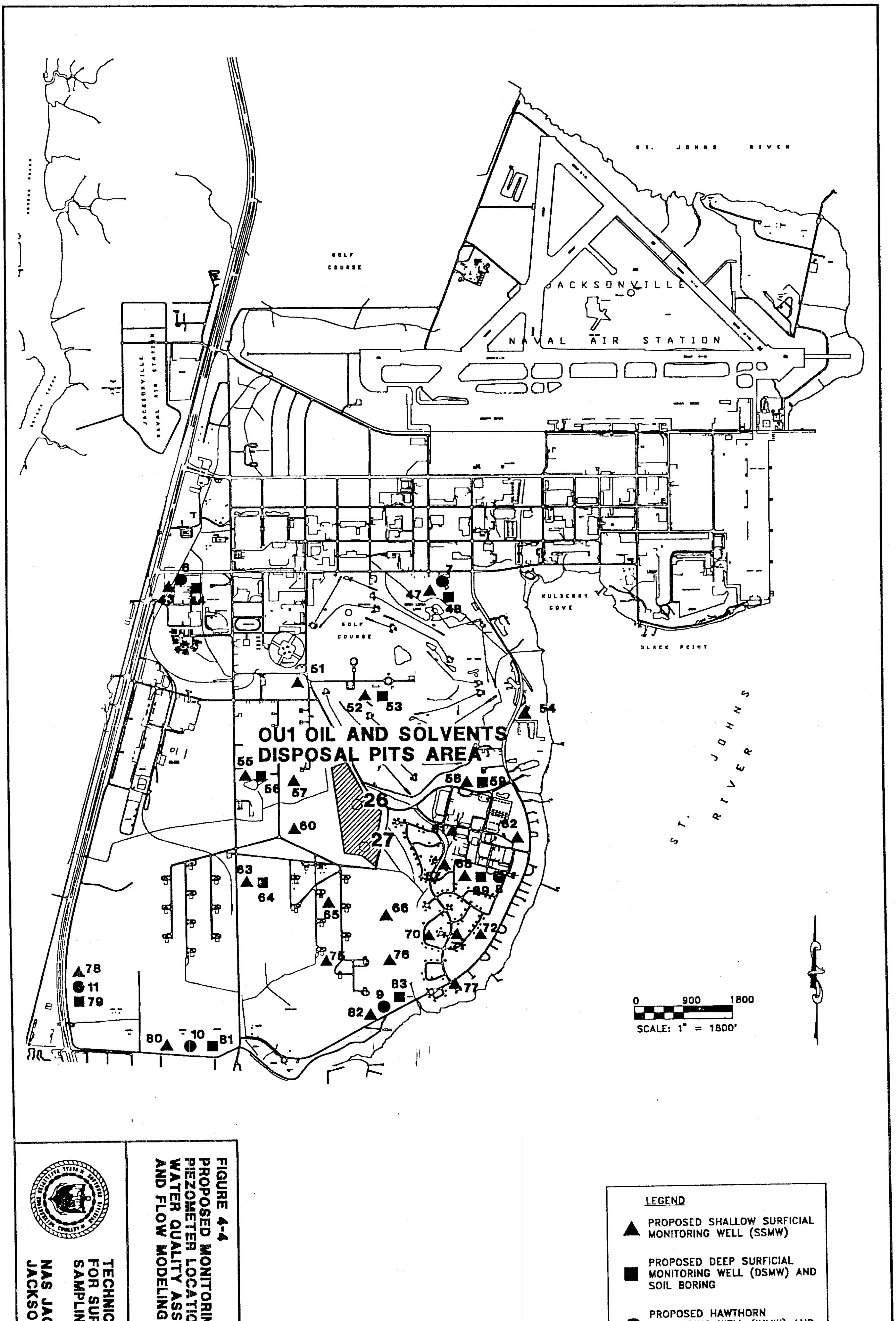

FIGURE 4-4
PROPOSED MONITORING WELL/ PIEZOMETER LOCATIONS FOR WATER QUALITY ASSESSMENT AND FLOW MODELING

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1

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FIG1-2

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Table 4-1
Monitoring Well Installation Summary

Operable Unit 1
NAS Jacksonville
Jacksonville, Florida

Monitoring Well No.	Aquifer	Rationale/Intended Use
IHMW-6	Intermediate Hawthorne	As part of the OU1 characterization, well is located to provide for water quality data and hydraulic head information for the Intermediate Hawthorne aquifer
IHMW-7	Intermediate Hawthorne	As part of the OU1 characterization, well is located to provide for water quality data and hydraulic head information for the Intermediate Hawthorne aquifer
IHMW-8	Intermediate Hawthorne	As part of the OU1 characterization, well is located to provide for water quality data and hydraulic head information for the Intermediate Hawthorne aquifer
IHMW-9	Intermediate Hawthorne	As part of the OU1 characterization, well is located to provide for water quality data and hydraulic head information for the Intermediate Hawthorne aquifer
IHMW-10	Intermediate Hawthorne	As part of the OU1 characterization, well is located to provide for water quality data and hydraulic head information for the Intermediate Hawthorne aquifer
IHMW-11	Intermediate Hawthorne	As part of the OU1 characterization, well is located to provide for water quality data and hydraulic head information for the Intermediate Hawthorne aquifer
SSMW-35	Shallow Surficial	Background groundwater monitoring well network to characterize upper surficial aquifer
DSMW-36	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer
SSMW-37	Shallow Surficial	Background groundwater monitoring well network to characterize upper surficial aquifer
DSMW-38	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer
SSMW-39	Shallow Surficial	Background groundwater monitoring well network to characterize upper surficial aquifer - Original location adjacent to OU2 changed, well will be moved to somewhere in Ortega Hills
DSMW-40	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer - Original location adjacent to OU2 changed, well will be moved to somewhere in Ortega Hills
SSMW-41	Shallow Surficial	Background groundwater monitoring well network to characterized upper surficial aquifer
DSMW-42	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer
SSMW-43	Shallow Surficial	Located north of OU1, the well will provide input for USGS modelling and can also be sampled for characterization of the groundwater quality associated with OU1

Table 4-1 (continued)
Monitoring Well Installation Summary

Operable Unit 1
NAS Jacksonville
Jacksonville, Florida

Monitoring Well No.	Aquifer	Rationale/Intended Use
DSMW-44	Deep Surficial	Located north of OU1, the well will provide input for USGS modelling and can also be sampled for characterization of the groundwater quality associated with OU1
SSMW-45	Shallow Surficial	Background groundwater monitoring well network to characterized upper surficial aquifer
DSMW-46	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer
SSMW-47	Shallow Surficial	Located north of OU1, the well will provide input for USGS modelling and can also be sampled for characterization of the groundwater quality associated with OU1
DSMW-48	Deep Surficial	Located north of OU1, the well will provide input for USGS modelling and can also be sampled for characterization of the groundwater quality associated with OU1
SSMW-49	Shallow Surficial	Background groundwater monitoring well network to characterized upper surficial aquifer
DSMW-50	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer
SSMW-51	Shallow Surficial	Located north of OU1, the well will provide input for USGS modelling and can also be sampled for characterization of the groundwater quality associated with OU1
SSMW-52	Shallow Surficial	Located north of OU1, the well will provide input for USGS modelling and can also be sampled for characterization of the groundwater quality associated with OU1
DSMW-53	Deep Surficial	Located north of OU1, the well will provide input for USGS modelling and can also be sampled for characterization of the groundwater quality associated with OU1
SSMW-54	Shallow Surficial	Located north of OU1, the well will provide input for USGS modelling and can also be sampled for characterization of the groundwater quality associated with OU1
SSMW-55	Shallow Surficial	Background groundwater monitoring well network to characterized upper surficial aquifer - Location can also be used for OU1 characterization and OU1 groundwater flow modelling
DSMW-56	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer - Location can also be used for OU1 characterization and OU1 groundwater flow modelling
SSMW-57	Shallow Surficial	Located immediately west of OU1, the well will be used for the OU1 water quality characterization and for the USGS groundwater flow modelling
SSMW-58	Shallow Surficial	Located east of OU1, location will be use for OU1 water quality characterization and for USGS groundwater flow modelling

Table 4-1 (continued)
Monitoring Well Installation Summary

Operable Unit 1
NAS Jacksonville
Jacksonville, Florida

Monitoring Well No.	Aquifer	Rationale/Intended Use
DSMW-59	Deep Surficial	Located east of OU1, location will be use for OU1 water quality characterization and USGS groundwater flow modelling
SSMW-60	Shallow Surficial	Located immediately west of OU1, the well will be used for the OU1 water quality characterization and for the USGS groundwater flow modelling
SSMW-61	Shallow Surficial	Located east of OU1, location will be use for OU1 water quality characterization and USGS groundwater flow modelling
SSMW-62	Shallow Surficial	Located east of OU1, location will be use for OU1 water quality characterization and USGS groundwater flow modelling
SSMW-63	Shallow Surficial	Background groundwater monitoring well network to characterized upper surficial aquifer - Location can also be used for OU1 characterization and OU1 groundwater flow modelling
DSMW-64	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial - Location can also be used for OU1 characterization and OU1 groundwater flow modelling
SSMW-65	Shallow Surficial	Located south of OU1, location will provide water quality data for the OU1 characterization and will be used for the USGS groundwater flow modelling
SSMW-66	Shallow Surficial	Located south of OU1, location will provide water quality data for the OU1 characterization and will be used for the USGS groundwater flow modelling
SSMW-67	Shallow Surficial	Located east of OU1, location will be use for OU1 water quality characterization and USGS groundwater flow modelling
SSMW-68	Shallow Surficial	Located east of OU1, location will be use for OU1 water quality characterization and USGS groundwater flow modelling
DSMW-69	Deep Surficial	Located east of OU1, location will be use for OU1 water quality characterization and USGS groundwater flow modelling
SSMW-70	Shallow Surficial	Located southeast of the OU1, location will be used for OU1 groundwater characterization and USGS groundwater flow modelling
SSMW-71	Shallow Surficial	Located southeast of the OU1, location will be used for OU1 groundwater characterization and USGS groundwater flow modelling
SSMW-72	Shallow Surficial	Located southeast of the OU1, location will be used for OU1 groundwater characterization and USGS groundwater flow modelling
SSMW-73	Shallow Surficial	Background groundwater monitoring well network to characterized upper surficial aquifer
DSMW-74	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer
SSMW-75	Shallow Surficial	Located south of OU1, location will provide water quality data for the OU1 characterization and will be used for the USGS groundwater flow modelling

Table 4-1 (continued)
Monitoring Well Installation Summary

Operable Unit 1
NAS Jacksonville
Jacksonville, Florida

Monitoring Well No.	Aquifer	Rationale/Intended Use
SSMW-76	Shallow Surficial	Located south of OU1, location will provide water quality data for the OU1 characterization and will be used for the USGS groundwater flow modelling
SSMW-77	Shallow Surficial	Located southeast of the OU1, location will be used for OU1 groundwater characterization and USGS groundwater flow modelling
SSMW-78	Shallow Surficial	Located southwest of OU1, location to be used OU1 groundwater modelling and can be sampled for OU1 water quality characterization
DSMW-79	Deep Surficial	Located southwest of OU1, location to be used OU1 groundwater modelling and can be sampled for OU1 water quality characterization
SSMW-80	Shallow Surficial	Located southwest of OU1, location to be used OU1 groundwater modelling and can be sampled for OU1 water quality characterization
DSMW-81	Deep Surficial	Located southwest of OU1, location to be used OU1 groundwater modelling and can be sampled for OU1 water quality characterization
SSMW-82	Shallow Surficial	Background groundwater monitoring well network to characterized upper surficial aquifer - Location can also be used for OU1 characterization and OU1 groundwater flow modelling
DSMW-83	Deep Surficial	Background groundwater monitoring well network to characterized deep surficial aquifer - Location can also be used for OU1 characterization and OU1 groundwater flow modelling

surface by the tremie method. The cement grout mixture will consist of Portland Type I cement (ASTM-150) and clean potable water in a proportion not to exceed seven gallons of water per 94 pound bag of cement. Five to ten percent bentonite by weight will be added to the grout to prevent shrinking and control the heat of hydration which can cause PVC well casing to warp. Grout will be pumped to a minimum of 3 feet above the top of the bentonite pellets to prevent disrupting the annular seal.

If the water table is very shallow (approximately 1-4 feet bls), it may be necessary to place the well screen less than 5 feet above the water table. Where conditions prevent the previously described procedure, the well screen will be a minimum of 2 feet above the water table. The filter pack maybe reduced to a maximum of 1 foot above the well screen with a bentonite seal of 6 inches to 1 foot.

Each shallow monitoring well will be developed no sooner than 48 hours after completion of the installation. Well development will consist of pumping the piezometer well using a clean centrifugal pump and decontaminated flexible PVC tubing. Each well should be pumped/swabbed until groundwater appears clear, sand and silt free, and until three consecutive readings of pH, conductivity and temperature fall within 5 percent at stabilization, or until further development will not improve turbidity.

Development water will be transferred from 55 gallon drums into a 10,000 gallon dedicated tank truck stored on-site. Drill cuttings and drilling fluids derived during construction of the wells will be transported from the drill site by backhoe and vacuum truck respectively and transferred into the designated on-site disposal pit.

Well construction logs and development forms will be completed in the field and placed in the field file at the end of each day. Log books will be maintained as per the QAPP (Appendix 4.4.1,section 5.0) and reviewed by the field operations leader.

<u>Deep Surficial and Intermediate Hawthorn Well Installation</u>. Deep surficial and intermediate Hawthorn monitoring wells will be paired with several of the shallow surficial monitoring wells as shown in Figure 4-4. Deep surficial monitoring wells will be drilled to the base of the surficial aquifer using the mud rotary method of drilling and cased-off. Intermediate Hawthorn wells will be drilled into the top of the Hawthorn Formation using mud rotary and cased-off. Permanent 6 inch PVC surface casing, with grout plug, will then be installed to seal the overlying hydraulic units from the underlying materials.

The depth at which the surface casing is set will depend on information gathered from the geologic boring to be drilled at each monitoring well location. The geologic boring will ensure the proper placement of well screens in all wells, particularly those beyond the boundaries of the OU1, where the stratigraphy is not well know. Additionally, the completion of geologic borings will enhance the water quality assessment and groundwater flow modelling efforts by increasing current understanding of subsurface conditions in the vicinity of OU1 and NAS Jacksonville. Details of the geologic boring are presented below.

A surface casing completion depth of approximately 16-20 feet bls) is anticipated for deep surficial wells (actual depth will be dictated by the geologic boring and degree of contamiantion). Surface casings for Intermediate Hawthorn wells will be completed approximately 5 to 10 feet into the Hawthorn Formation; depth will be determined by the geologic boring.

Surface casing boreholes will be advanced with a 11 7/8" drill bit using the mud rotary method of drilling. The annular space between the 6 inch surface casing and the nominal 12 inch borehole will be pressure grouted from the bottom of the hole to land surface, using Portland Type I cement (ASTM-C 150) and water to meet the equivalent density of 14 lbs. per gallon. Boring advancement in a cased-off well will commence no sooner than 24 hours following the grouting of the surface casing.

Split spoon samples will be collected at 2 ft intervals during drilling of the surface casing/well borehole. Physical characteristics of the soil and geologic materials will be described in detail using the USCS. Organic vapor concentrations for each sample will be measured using the Headspace method with an organic vapor detector.

After allowing the surface casing grout to seal for at least 24 hours, a 5 7/8 inch mud rotary drill bit will used to drill through the surface casing cement plug and advance the total depth of the well.

A five foot section of 2 inch diameter .010 slot, PVC schedule 40 well screen will be lowered into the wellbore threaded to 2 inch diameter, Schedule 40, PVC well casing.

The annular space between the nominal 6 inch borehole and the 2 inch diameter casing will be filled with 20/30 silica sand filter pack to approximately 2 feet above the top of the screen using clean tremie pipe and an appropriate amount of potable water to allow for proper settling of filter pack sand.

A 1 foot fine sand seal followed by 2 feet of bentonite will be placed above the filter pack to prevent downward migration of cement grout. The bentonite seal will consist of a bentonite slurry or tamped bentonite pellets. Hydration times for either the bentonite slurry or bentonite pellets should be those recommended by the specific pellet manufacturer. The remaining annular space between the nominal 6 inch borehole and the 2 inch diameter well casing will be grouted to land surface using the tremie method of grouting. The cement grout mixture will consist of Portland Type I cement (ASTM-150) and clean potable water in a proportion not to exceed seven gallons of water per 94 pound bag of cement. Five to ten percent bentonite by weight will be added to the grout to prevent shrinking and control the heat of hydration which can cause PVC well casing to warp. Grout will be pumped to a minimum of 3 feet above the top of the bentonite pellets to prevent disrupting the annular seal. Where well bore conditions permit (the borehole does not cave in or appear to be compromised) the Hawthorn monitoring well will be air or pump developed prior to grouting using decontaminated tubing inside clean PVC pipe. Groundwater will be air lifted (not blown into the formation) or pumped until clear, sand free and three consecutive readings of Ph, conductivity and temperature within 5% are observed.

Development prior to grouting allows for uniform settling of filter pack around the screen and prompt removal of drilling fluids and silts that can cause a well screen to become clogged. If borehole conditions will not permit well development prior to grouting, then development will take place no sooner than 48 hours after the well has been constructed and no later than 4 days after the well has been constructed.

Development water will be transferred from 55 gallon drums into a 10,000 gallon dedicated tank truck stored on-site. Drill cuttings and drilling fluids derived during construction of the wells will be transported from the drill site by backhoe and vacuum truck respectively and transferred into the designated on-site disposal pit.

Well construction logs and development forms will be completed in the field and placed in the field file at the end of each day. Log books will be maintained as per the QAPP (Appendix 4.4.1,section 5.0) and reviewed by the field operations leader.

Geologic Borings. Geologic borings will be drilled to characterize the stratigraphy and identify the presence or absence of potential confining or semi-confining units at each of the well locations. This information will permit the correct placement of monitoring well screens and add to the current understanding of subsurface conditions at NAS Jacksonville. These borings will be completed as described below.

Temporary 4 inch, HW steel casing will be installed to the base of the shallow surficial aquifer (at an approximate depth of 16-20 feet bls) or to the top of the Hawthorn Formation. The boring will be completed by advancing the hole with a 3 7/8 inch drill bit with split spoon sampling ahead in 2 foot intervals. Physical soil characteristics will be described using the Unified Classification System (USGS). The temporary casing is intended to prevent vertical cross contamination from the upper surficial aquifer to the lower surficial aquifer during drilling and sampling activities.

Organic vapor concentrations for each split spoon sample will be measured with the Headspace Method (using an organic vapor detector as per the Work Plan) and recorded in the field book and on field forms. Potential confining layers and water bearing zones will be evaluated. Once the soil boring has reached the completion depth the borehole will be grouted from the bottom to ground surface using tremie pipe prior to removal of the casing.

Drill cuttings and drilling fluids will be transported from the drill site to the designated onsite investigation derived waste disposal pit. Section 5.0 discusses groundwater sampling to be completed for the newly installed monitoring wells.

4.2 BACKGROUND MONITORING PROGRAM. As discussed above, a background groundwater monitoring well network will be installed and sampled during the present investigation. The primary purpose of the network is to provide additional information for water quality assessement. Water level and lithologic information will, however, support USGS groundwater flow modelling efforts currently underway.

Several of the target analytes being monitored at OU1 are naturally occurring inorganic parameters. These include all of the metals on the target analyte list (TAL) and all of the radionuclides which have been considered to date. In order to determine the nature and extent of contamination associated with OU1, especially with respect to these naturally occurring inorganic parameters, a background comparison is necessary. The background comparison provides a numerically supportable method of identifying anomalously high concentrations of inorganic parameters (which can then be evaluated as potential site contaminants) by establishing the range of concentrations over which these parameters naturally fluctuate.

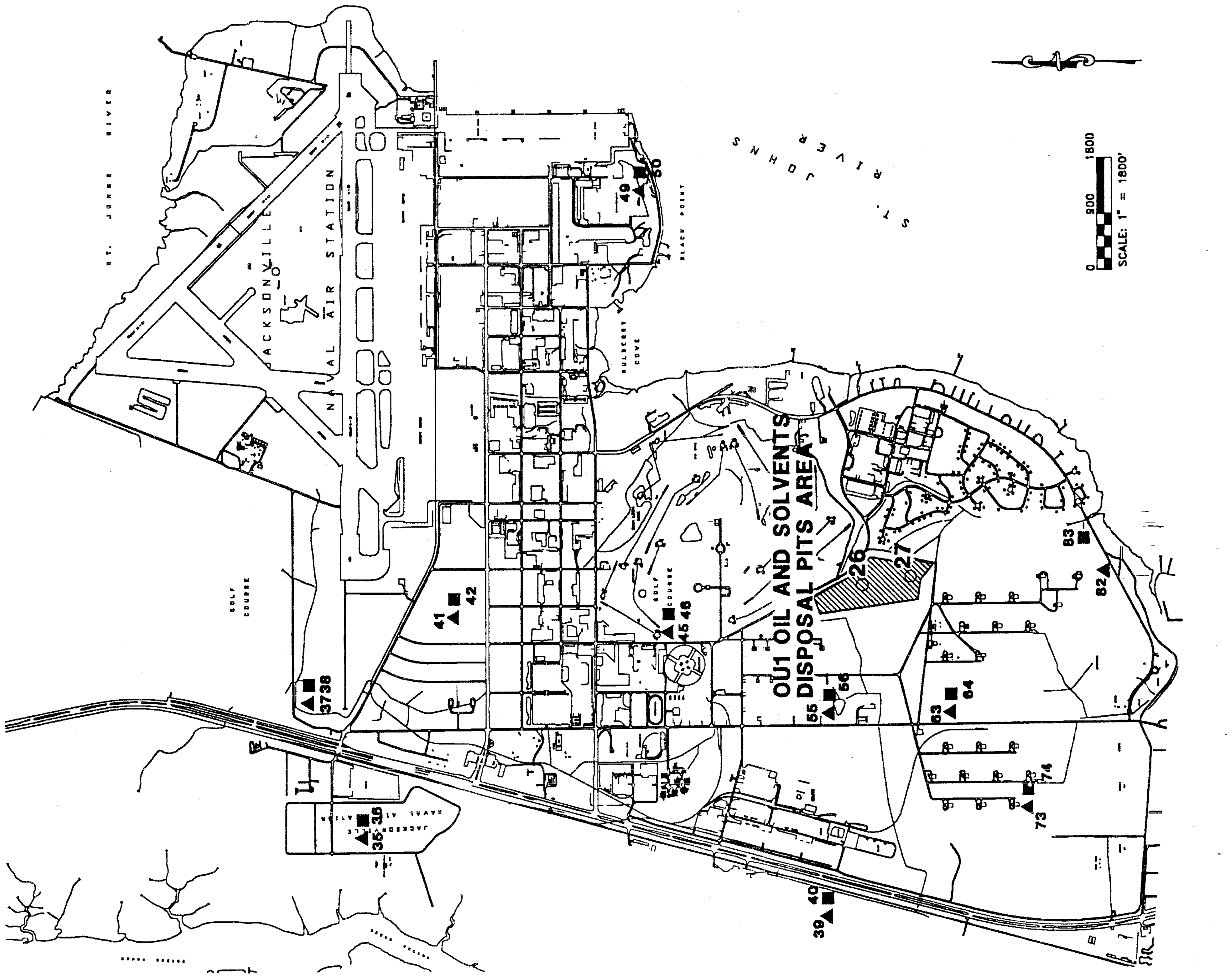
Figure 4-5 presents the monitoring well locations selected for the development of this background groundwater monitoring network. Section 5.0 discusses groundwater sampling to completed for newly installed monitoring wells.

4.3 SCREENING PROGRAM CONFIRMATION. The installation of additional monitoring wells is planned to serve as confirmation of the groundwater screening to be completed during the present investigation. As discussed in Section 3.1, groundwater screening will be used to define the limits of contaminant migration associated with former waste-diposal practices at OU1.

The primary objectives of the well installation program are to confirm the findings of the groundwater screening program, to establish permanent locations for the long-term monitoring of water quality, and to provide data to support the Feasibility Study. The groundwater analytical data will be used to verify both elevated and low- to non-detectable findings from the screening program, as both are important in the assessment of contaminant migration to be completed in the RI report. The placement of monitoring wells beyond the detectable presence of contaminants which have migrated from OU1 will provide a cost-effective method of developing a long-term monitoring network to assess future contaminant migration and the effectiveness of remedial measures to be implemented.

Figure 4-6 presents idealized locations for confirmatory monitoring well placement. The actual locations chosen and the completion depths selected will depend on the findings of the screening program and existing monitoring well data. It is prossible that in some ares of the site, particularly to the southeast and east, the monitoring wells installations, as discussed in Sections 4.1 and 4.2, may serve the objectives of the confirmation program. Section 5.0 discusses monitoring well sampling to be completed for the newly installed monitoring wells.

Upon completion of the screening program and prior to the installation of confirmation monitoring wells, a letter will be sent to the appropriate state and federal agencies informing them of the locations selected. The installation of the wells will commence approximately one week after the submission of this letter.



LEGEND

▲ PROPOSED SHALLOW SURFICIAL MONITORING WELL (SSMW) AND SOIL SAMPLE

■ PROPOSED DEEP SURFICIAL MONITORING WELL (DSMW) AND SOIL BORING

FIGURE 4-5
PROPOSED BACKGROUND SAMPLE LOCATIONS (SOIL AND GROUNDWATER)

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1

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JACKSONVILLE, FLORIDA

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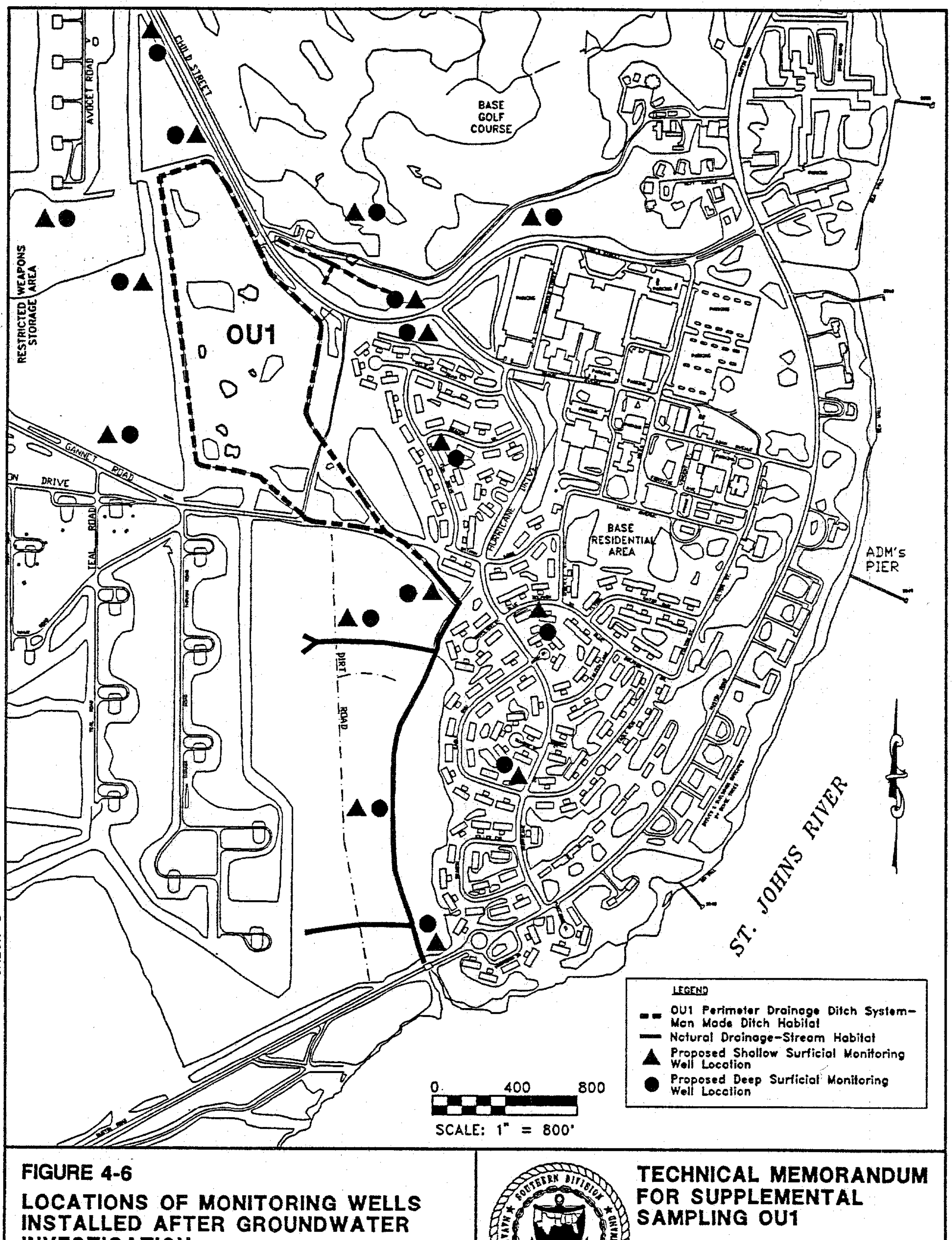


FIGURE 4-6

LOCATIONS OF MONITORING WELLS INSTALLED AFTER GROUNDWATER INVESTIGATION

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1

NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

5.0 GROUNDWATER SAMPLING

Proposed additional groundwater sampling is intended to permit further delineation of the horizontal and vertical extent of contamination on and around OU1.

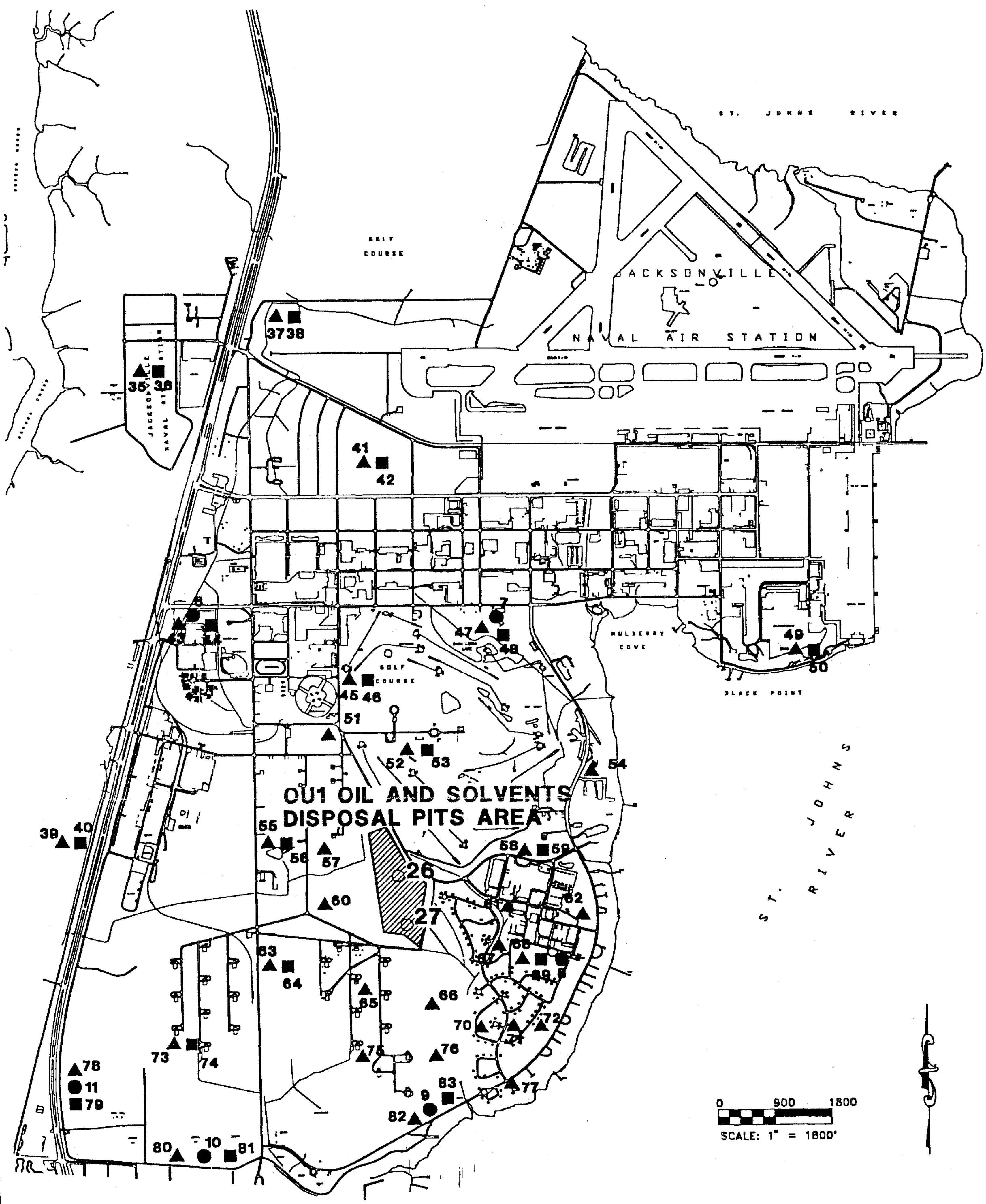
5.1 RESULTS FROM ROUND 1 SAMPLING AT OU1. The groundwater sampling event and analytical results from the Spring 1992 activities are discussed in detail in the PCSR. Relevant sections, appendices, and figures include:

- Section 3.2.7, *Groundwater Sampling*
- Section 4.3.5, *RI Findings: Groundwater Sample Results*
- Section 5.6, *Conclusions and Recommendations: Groundwater Sampling*
- Appendix E, *Groundwater Sample Analytical Results*
- Figures 4-22 through 4-27

The analytical results indicated that twenty-five wells (sixteen shallow surficial, nine deep surficial) had constituents which exceeded preliminary ARARs (see Figure 4-1). Based on these findings, ABB-ES is proposing additional groundwater sampling. The intention of this sampling is to accomplish several objectives.

- more fully defined the extent of contamination by constituents which exceeded preliminary ARARs;
- delineate the orientation and the magnitude of the free-phase plume around MW-9 and MW-13;
- information obtained from background wells will be used to assess the level of naturally occurring radionuclide and inorganic constituents in the vicinity of NAS Jacksonville. This will permit meaningful comparison of analytical results from the OU1 investigation with existing background levels for naturally occurring constituents on and around OU1;
- verify contamination found in the site screening process;
- support solute transport modelling efforts being completed by the USGS;
- support the feasibility study's evaluation of remedial technologies; and
- resample existing wells which had low level detections, and/or no detectable concentration to support the baseline risk assessment.

Table 4-1 summarizes the proposed new wells to be installed, their depths, and a rationale for their installation and location. Figure 5-1 shows the proposed locations for all of the newly installed monitoring wells, with the exception of those wells which will be sited after completion of the groundwater screening program. Locations were chosen based on the type and amount of contamination detected in the soil and groundwater of the first round of field work at OU1. Also, Figure 4-6 shows tentative locations for wells that ABB-ES anticipates installing after the Round 2 site screening investigation has taken place. Overall, a total of 48 shallow surficial, 33 deep surficial, and 6 intermediate Hawthorn wells are being proposed for installation and sampling. Tables 3-1, 3-2, 5-1 and 5-2 summarize the intended groundwater sampling and QC programs, respectively, for both the groundwater field screening program and the regular groundwater sampling program for the proposed investigation. For the purposes of this TM, it is assumed that all new wells will be sampled.



LEGEND

▲ PROPOSED SHALLOW SURFICIAL MONITORING WELL (SSMW)

■ PROPOSED DEEP SURFICIAL MONITORING WELL (DSMW) AND SOIL BORING

● PROPOSED HAWTHORN MONITORING WELL (IHMW) AND SOIL BORING

FIGURE 5-1
PROPOSED MONITORING WELL AND BACKGROUND SAMPLE LOCATIONS

TECHNICAL MEMORANDUM
FOR SUPPLEMENTAL
SAMPLING OU1
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

FIG1-2

Table 5–1
Selected Constituents, Methods of Analysis, and Numbers of Ground–Water Samples
OU1, NAS Jacksonville

Parameter	Methods[1]	Groundwater Samples
Free–Phase Product		10
Total Petroleum Hydrocarbon	418.1	87
Volatile Organic Compounds	524.2	10
Volatile Organic Compounds [2]	624 CLP	87
Semi–volatile Organic Compounds [3]	625 CLP	87
Polychlorinated Biphenyls [4]	608 CLP	87
Metals	SW846, TAL	87
Cyanide	SW846, TAL	87
Radiological Parameters		
Gross Alpha	9310 (water) 3050/9310 (soil/ sediment)	87
Gross Beta	9310 (water) 3050/9310 (soil/ sediment)	87
Radium–226	9315 (water) 3050/9315 (soil/ sediment)	87
Radium–228	9320 (water) 3050/9320 (soil/ sediment)	87

Notes:
[1] EPA Contract Laboratory Program (CLP) methods – sample preparation will be in accordance with procedures specified in the CLP statement of work (most current version).
[2] Volatile Organic Compounds (VOC) to be analyzed are the Target Compound List (TCL) presented in Talbe 3–2 of Volume 5, Book 1.
[3] Semi–volatile Organic Compounds to be analyzed are presented in Table 3–2 of Volume 5, Book 1.
[4] PCB's to be analyzed are presented in Table 3–2 of Volume 5, Book 1.
NEESA Level D applies to all lab work.
NEESA Level B applies to soil and water field screening.

Table 5–2
Ground Water Quality Control Samples
OU1 NAS Jacksonville, FL.

	Equipment Blanks	Field Blanks	Trip Blanks	Field Replicates	Matrix Spike	Matrix Spike Duplicate	Total Samples
Ground Water							
Volatile Organic Compounds	15	15	22	5	10	10	77
Base, Neutral and Acid Extractable Compounds	15	15	22	5	10	10	77
Total Metals	15	15	22	5	10	10	77
Dissolved Metals	15	15	22	5	10	10	77
Polychlorinated Biphenyls	15	15	22	5	10	10	77
Uranium scan/Radiological	15	15	22	5	10	10	77
Total Petroleum Hydrocarbon	15	15	22	5	10	10	77

6.0 HYDRAULIC TESTING AND WATER LEVEL MEASUREMENTS

During the 1992 field program, hydraulic testing and water level measurements were completed for all of the monitoring wells installed by ABB-ES on and around OU1. Detailed analysis of this information is presented in the PCSR. Because of the level of detail provided in the PCSR regarding the hydraulic data, only the appropriate PCSR section references are provided here. They are:

- Section 3.2.8.2, *Well Location and Elevation Survey*
- Section 3.2.8.3, *Potentiometric Water Surface Measurements*
- Section 3.2.8.5, *Aquifer Slug Testing*
- Section 4.2, *RI Findings: Hydrogeologic Conditions*
- Appendix B, *Geologic Cross Sections/Potentiometric Surface Maps*

All hydraulic testing and water level measurements completed during the proposed investigation will be accomplished in accordance with the field procedures and protocols described in the following volumes and sections of the NIRP Plan for NAS Jacksonville. They are:

- Volume 1, Organization and Planning, Section 2.5, *Data Reduction and Presentation*
- Volume 1, Appendix 1.5, *Site Health and Safety Plan*
- Volume 4, Section 3.2.4.5(b) *Specific Capacity Testing*
- Volume 5, Work Plan, Section 4.6, *Geologic and Hydrogeologic Investigation*
- Volume 5, Section 5.13, *Water Level Measurements*
- Volume 5, Section 5.12, *Slug Testing*
- Volume 5, Appendix 5.4.1, Section 3.0, *Quality Assurance Objectives*
- Volume 5, Appendix 5.4.2, Section 4.8, *Sampling Procedures: Water Levels*

The hydraulic testing and water level measurements data generated during the 1992 field program have also been incorporated, where appropriate, into USGS groundwater flow modelling efforts which are on-going. Hydraulic data generated during the proposed investigation will provide essential information to these modelling efforts (as discussed in Section 4.1) and to the assessment of contaminant migration.

Three types of hydraulic data will be gathered during the proposed investigation. These are water level elevation measurements (including groundwater and surface water), slug test data, and specific capacity testing (referred to as recovery test) data. This suite of hydraulic data is the same as that collected during the 1992 field program.

Water level measurements will be collected in rounds, with water levels from all wells and staff gauges being collected in the shortest possible time. One round of water level measurements per month will be collected through the duration of the field program.

Three additional staff gauges will be installed in the drainage area south of OU1. The staff gauges will provide surface water level elevations and information regarding surface water flow directions as well as groundwater/surface water hydraulic relationships.

Slug tests will be performed in all newly installed monitoring wells that are completed in either the shallow or deep surficial aquifer. Recovery tests will be performed on all newly installed monitoring wells completed in the Intermediate Hawthorn aquifer. All aquifer testing will be completed following the collection of groundwater samples.

The methodology for data acquisition and data reduction to be employed for during hydraulic testing are presented in the Work Plan (see section references above). All waste fluids disposed of as described in Section 4.3.

7.0 SOIL SAMPLING

During the 1992 field program, an extensive sampling program was completed for surface and subsurface soil on and around OU1. Figure 7-1 presents the surface soil sampling locations from the 1992 field program. Detailed analysis of the analytical results for the surface soil sampling program is presented in the PCSR. Because of the level of detail provided in the PCSR regarding the analysis and presentation of soil sampling data, only the appropriate PCSR section references are provided here. They are:

- Section 2.2.4, *Background Information: Soils*
- Section 3.2.5, *Soil Sample Collection*
- Section 4.3.4, *RI Findings: Soil Sample Results*
- Section 5.5, *Conclusions and Recommendations: Soil Sampling*
- Appendix D, *Soil Sample Analytical Results*

Results from the soil sampling analytical program have been plotted on several figures in the PCSR. A listing of the appropriate PCSR figure references is provided. They are:

- Figure 2-2, *Soil Series Associations Near OU1*
- Figure 3-6, *Initial Soil Sampling Locations*
- Figure 3-7, *Soil Sample Locations*
- Figure 4-17, *Volatile Organic Compounds in Soil Samples*
- Figure 4-18, *Semivolatile Organic Compounds in Soil Samples*
- Figure 4-19, *Pesticides in Soil Samples*
- Figure 4-20, *PCBs in Soil Samples*
- Figure 4-21, *Inorganic Compounds in Soil Samples*
- Table 4-6, *Soil Samples with PCBs Exceeding USEPA PRG of 83 μg/kg*

All soil sampling will be accomplished in accordance with the field procedures and protocols described in the NIRP Plan for NAS Jacksonville. The volumes and sections applicable to soil sampling are:

- Volume 1, Organization and Planning, Section 2.5, *Data Reduction and Presentation*;

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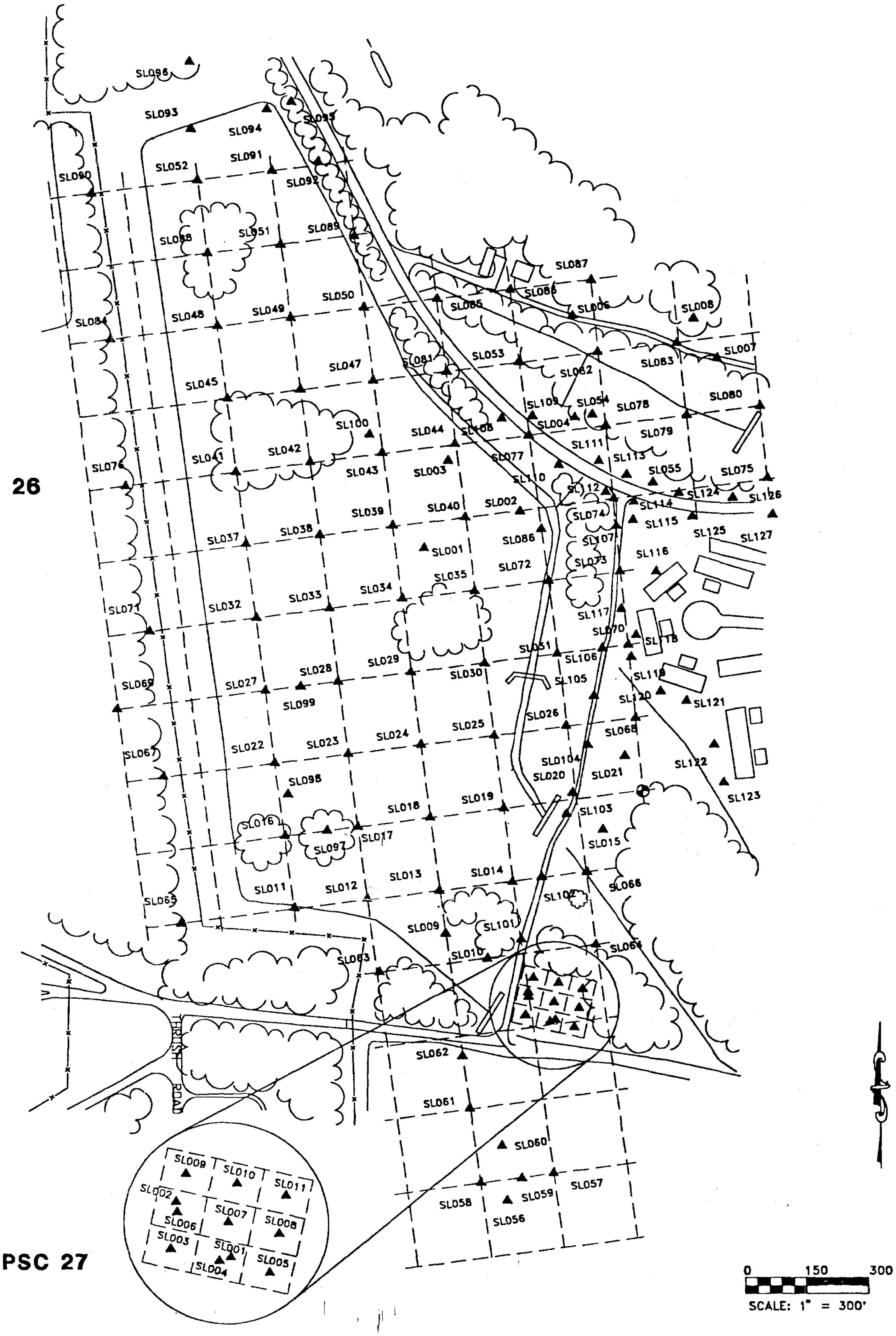

LEGEND

- BENCHMARK
- SOIL SAMPLE LOCATION

NOTE:
PSC 26 SAMPLES DESIGNATED JSLXXX.
PSC 27 SAMPLES DESIGNATED JSL27XXX.

FIGURE 7-1
SOIL SAMPLING LOCATIONS

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

- Volume 5, Work Plan, Section 5.6, *Soil Sampling*;
- Volume 5, Appendix 5.4.1, Table 1-1, *Selected Constituents, Methods of Analysis, and Numbers of Surface-water, Sediment, Ground-water, and Soil Samples to be Analyzed During the RI at OU1, NAS Jacksonville*;
- Volume 5, Appendix 5.4.1, Table 1-3, *Field Quality Control Samples to be Collected During the RI at OU1, NAS Jacksonville*;
- Volume 5, Appendix 5.4.1, Section 3.0, *Quality Assurance Objectives*;
- Volume 5, Appendix 5.4.1, Table 8-1, *Field QC Samples Required for Each Matrix per Sampling Event*;
- Volume 5, Appendix 5.4.2, Section 2.4, *Soil Sampling*;
- Volume 5, Appendix 5.4.2, Section 4.7, *Collection of Field Quality Control Samples*;
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*.

Soil sampling during the proposed investigation will be completed to fulfill the objectives of the RI/FS Work Plan for OU1, NAS Jacksonville. The specific focus of the soil sampling will be to provide further characterization of the nature and extent of contamination in site soils with regard to (1) confirmation of the PCB screening program (detailed in Section 3.0), (2) development of representative background levels for naturally occurring inorganic constituents and (3) enhancement of the representativeness of the surface soil analytical data for human health and ecological risk assessment purposes. Sampling pursuant to each of the areas requiring additional or further characterization is discussed in a separate section below.

7.1 PCB SCREENING PROGRAM CONFIRMATION. The PCB screening program is discussed in Section 3.0. A PCB screening test kit will be used for the in-field screening of soil samples. In addition to this screening, a limited laboratory analytical program for the confirmation of screening results will be completed as part of the proposed investigation.

Ten percent of the screening samples collected and for field analysis will be submitted for confirmatory laboratory analysis. The contract chemical laboratory will preform the PCB analyses using USEPA Method 8080. The samples submitted for confirmatory analysis will also be analyzed for total petroleum hydrocarbons using USEPA Method 9073. Tables 3-3 and 3-4 summarize the sampling and associated QC programs for the PCB screening confirmatory samples. Sections 11.1 and 11.2 discuss sample analysis and data validation for the PCB confirmatory soil sampling program.

As suggested by the manufacturer of the screening kit, the ten percent of screening samples sent for confirmatory laboratory analysis will be divided as follows. Eighty percent of the samples sent for confirmatory analysis will be selected from the screening results for which the screening kit reported detections of 5 ppm (see Section 3.2) or less. The remaining 20 percent of the samples will be selected for locations where the screening kit reported PCB concentrations greater than 5 ppm.

Figure 3-2 shows the locations initially selected for the in-field PCB screening. This screening will be an iterative process, starting at the locations selected in Figure 3-2, with the completion of the screening program dictated by the results generated. Therefore, the locations from which confirmatory samples will be collected has not been presented in a figure.

7.2 BACKGROUND SOIL SAMPLING. As discussed in Section 4.2, several analytical samples will be collected during the proposed investigation to develop background levels for naturally occurring inorganic parameters. The establishment of a background database is essential to fulfilling the objectives of the RI/FS Work Plan. The database will facilitate the comparison of analytical data gathered during remedial activities at OU1 with ambient background conditions for NAS Jacksonville. Additionally, the background information thus compiled will be available for other remedial activities, future and on-going, at NAS Jacksonville.

Figure 4-5 presents the locations where background groundwater monitoring well clusters will be installed. At each of these ten cluster locations, a surface soil sample, a sample for lithological characterization, and two split-spoon samples will be collected.

The precise surface soil sampling location at each cluster will be determined in the field by the Field Operations Leader (FOL). The location chosen will be as "undisturbed" as possible, given the conditions present at each location. As musch as possible the location will be away from roads, fences, and other man-made structures to ensure that the analytical results generated will be representative of existing background conditions. If a suitable location cannot be found at the well cluster, the surface soil sampling location will be moved to the nearest possible undisturbed area.

Prior to monitoring well installation at each cluster location, an exploratory soil boring will be completed. The objective of the exploratory boring is to characterize the lithology present and to determine screen elevations in the shallow and deep surficial aquifer. During the subsequent installation of monitoring wells, one sample from each lithologic unit will be collect. These samples will provide an analytical characterization of the various lithologic units present in the NAS Jacksonville vicinity.

During the installation of each well cluster, two additional split-spoon samples will be collected. The elevations from which these samples will be taken are 1-3 and 3-5 feet bls. This combination of a surface soil sample and two split-spoon samples will provide analytical information from 0-5 feet bls at each background monitoring well cluster location.

Tables 7-1 and 7-2 summarize the background soil sampling and associated QC programs to be implemented during the proposed investigation. Sections 11.1 and 11.2 discuss selected laboratory analyses and data validation.

Table 7-1
Selected Constituents, Methods of Analysis,
and Number of Soil Samples (Background and During Well Installation)
OU1, NAS Jacksonville, FL

Parameter	Methods[1]	Soil Boring Samples for New Monitoring Wells
Total Petroleum Hydrocarbon	9073	20
Volatile Organic Compounds [2]	624 CLP	40
Semi-volatile Organic Compounds [3]	625 CLP	40
Polychlorinated Biphenyls [4]	608 CLP	40
Metals	SW846, TAL	40
Cyanide	SW846, TAL	40
Radiological Parameters		
Gross Alpha	9310 (water) 3050/9310 (soil/ sediment)	40
Gross Beta	9310 (water) 3050/9310 (soil/ sediment)	40
Radium-226	9315 (water) 3050/9315 (soil/ sediment)	40
Radium-228	9320 (water) 3050/9320 (soil/ sediment)	40
Dioxin[5]	8280 (SW-846)	20

Notes:
[1] EPA Contract Laboratory Program (CLP) methods – sample preparation will be in accordance with procedures specified in the CLP statement of work (most current version).
[2] Volatile Organic Compounds (VOC) to be analyzed are the Target Compound List (TCL) presented in Table 3-2 of Volume 5, Book 1.
[3] Semi-volatile Organic Compounds to be analyzed are presented in Table 3-2 of Volume 5, Book 1.
[4] PCB's to be analyzed are presented in Table 3-2 of Volume 5, Book 1.
[5] The Dioxin constituent list is presented in Table 3-2 of Volume 5, Book 1.
NEESA Level D applies to all lab work.
NEESA Level B applies to soil and water field screening.

Table 7–2
Soil Sample Background Field Quality Control Samples
OU1 NAS Jacksonville, FL.

	Equipment Blanks	Field Blanks	Trip Blanks	Field Replicates	Matrix Spike	Matrix Spike Duplicate	Total Samples
Soil							
Volatile Organic Compounds	20	20	20	2	20	20	102
Base, Neutral and Acid Extractable Compounds	20	20	20	2	20	20	102
Total Metals	20	20	20	2	20	20	102
Polychlorinated Biphenyls	20	20	20	2	20	20	102
Radiochemistry	20	20	20	2	20	20	102
Dioxin	20	20	20	2	20	20	102
Total Petroleum Hydrocarbon	20	20	20	2	20	20	102

7.3 SOIL SAMPLING AT 0-1 FEET BLS. The results of the soil sampling from the 1992 field program are detailed fully in the PCSR (see listing of appropriate references above). During the 1992 field program soil samples were collected at depths of 0-3 inches bls and 2-4 bls, as outlined in the RI/FS Work Plan for OU1. As a result of sample collection from only these depths, the interval between 3 inches bls to 2 feet bls was not characterized.

In order to fulfill the human health and ecological risk assessment objectives put forth in the RI/FS Work Plan for OU1, additional soil sampling will be completed during the proposed investigation. Analytical sampling data from the 0-1 foot interval has (since the finalization of the RI/FS Work Plan) been determined to provide a better representation of existing site conditions. Therefore, to fulfill the objectives of the Work Plan and enhance the representativeness of the soil analytical database developed, the expanded soil sampling program outlined below will be completed.

A total of 120 locations were sampled during the 1992 field program. Of these locations, 50% will be resampled with the interval of collection being 0-1 foot bls. Figure 7-2 shows the locations proposed for resampling. The locations were selected based on three criteria. They are:

- Soil sampling locations were selected such that adequate areal coverage of the area of OU1 would be maintained;

- Twenty of the locations were selected from areas with a reported detection of at least one target compound or analyte at an elevated level; and

- Forty of the locations were selected from areas with reported concentrations of target compounds or analytes at low or non-detectable levels.

Tables 7-3 and 7-4 summarize the 0-1 foot confirmatory soil sampling and associated QC programs to be implemented during the proposed investigation. Sections 11.1 and 11.2 discuss selected laboratory analyses and data validation.

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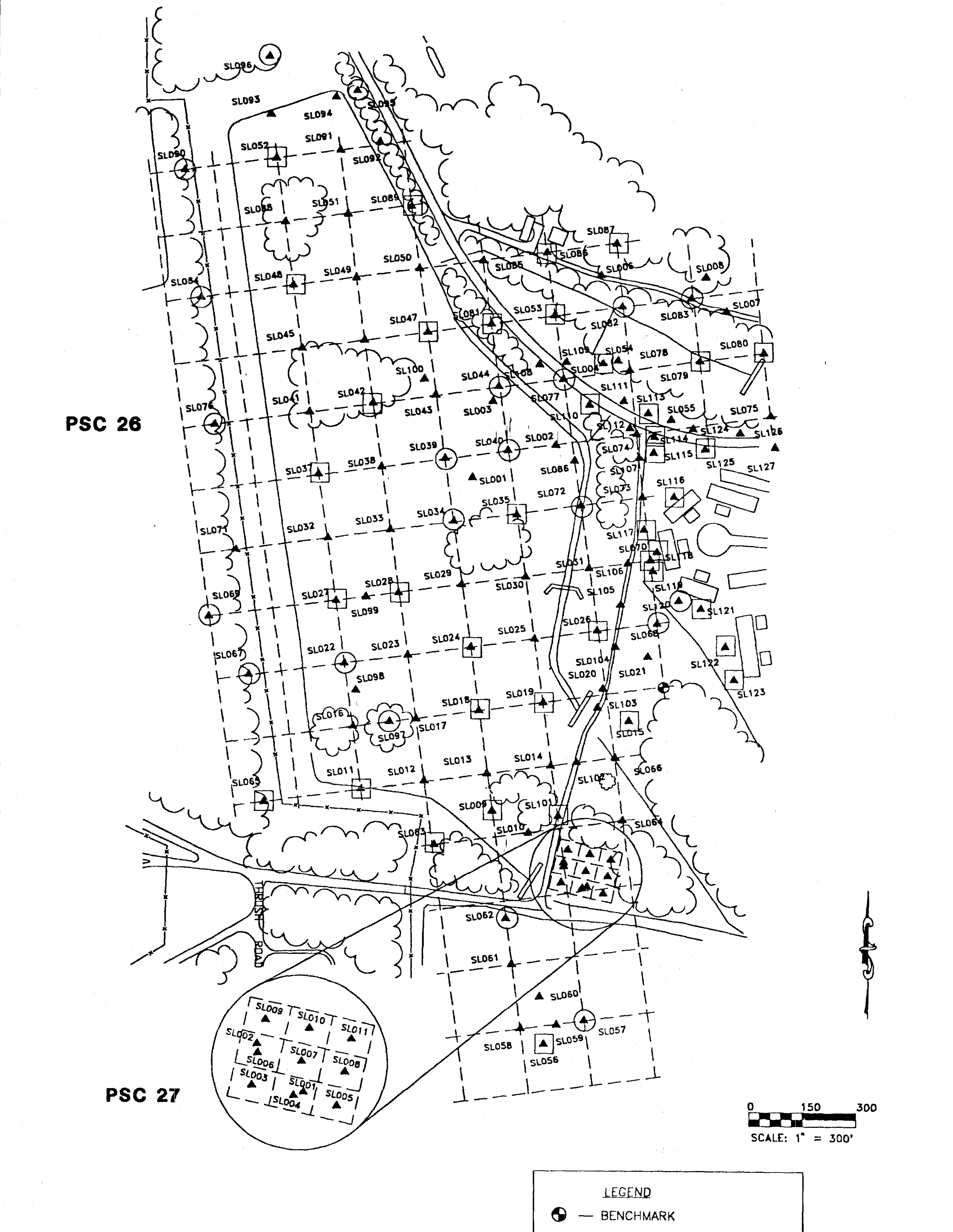


FIGURE 7-2
CONFIRMATORY 0"-1' SOIL SAMPLING LOCATIONS

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

Table 7–3
Selected Constituents, Methods of Analysis, and Numbers of Confirmatory Soil Samples at 0 – 1 feet bls.
OU1, NAS Jacksonville, FL

Parameter	Methods[1]	Total Samples
Total Petroleum Hydrocarbon	9073	60
Volatile Organic Compounds [2]	624 CLP	60
Semi–volatile Organic Compounds [3]	625 CLP	60
Polychlorinated Biphenyls [4]	608 CLP	70
Metals	SW846, TAL	60
Cyanide	SW846, TAL	60
Radiological Parameters		
Gross Alpha	9310 (water) 3050/9310 (soil/sediment)	60
Gross Beta	9310 (water) 3050/9310 (soil/sediment)	60
Radium–226	9315 (water) 3050/9315 (soil/sediment)	60
Radium–228	9320 (water) 3050/9320 (soil/sediment)	60

Notes:
[1] EPA Contract Laboratory Program (CLP) methods – sample preparation will be in accor procedures specified in the CLP statement of work (most current version).
[2] Volatile Organic Compounds (VOC) to be analyzed are the Target Compound List (TCL) in Table 3–2 of Volume 5, Book 1.
[3] Semi–volatile Organic Compounds to be analyzed are presented in Table 3–2 of Volum
[4] PCB's to be analyzed are presented in Table 3–2 of Volume 5, Book 1.
NEESA Level D applies to all lab work.
NEESA Level B applies to soil and water field screening.

Table 7–4
0 – 1' Soil Sampling Field Quality Control Samples
OU1, NAS Jacksonville, FL.

	Equipment Blanks	Field Blanks	Trip Blanks	Field Replicates	Matrix Spike	Matrix Spike Duplicate	Total Samples
Soil							
Volatile Organic Compounds	5	5	5	6	6	6	33
Base, Neutral and Acid Extractable Compounds	5	5		6	6	6	28
Total Metals	5	5		6	6	6	28
Polychlorinated Biphenyls	5	5		6	6	6	28
Uranium scan/Radiological	5	5		6	6	6	28
Total Petroleum Hydrocarbon	5	5		6	6	6	28

8.0 AIR SAMPLING

During the 1991-92 field effort at OU1, air samples were taken at four different locations in four consecutive days on OU1 in order to gather information on ambient air quality and to monitor it. The air samples were analyzed for total suspended particulates (TSP), volatile orgranic compounds (VOCs), semivolatile organic compounds (SVOCs), and PCBs. The PCSR outlines the techniques and equipment used for air sampling, along with the analytical results obtained from the initial air sampling event. Relevant sections in the PCSR include the following:

- Section 3.2.3, *Ambient Air Sample Collection*
- Section 4.3.2, *RI Findings: Ambient Air Sample Results*
- Section 5.3, *Conclusions and Recommendations: Ambient Air Sampling*

Sampling locations and results have also been plotted on figures and tables in the PCSR. Those which are relevant are the following:

- Figure 2-1, *Windrose Diagram, Jacksonville, Florida*
- Figure 3-3, *Air Sampling Locations RUN1, RUN2, and RUN3*
- Figure 3-4, *Air Sampling Location RUN4*
- Table 4-2, *RUN1 Air Quality Analytical Results*
- Table 4-3, *RUN2 Air Quality Analytical Results*
- Table 4-4, *RUN3 Air Quality Analytical Results*
- Table 4-5, *RUN4 Air Quality Analytical Results*

Air sampling for the proposed investigation will be accomplished in accordance with the field procedures and protocols described in the NIRP Plan for NAS Jacksonville. The applicable volumes and sections are listed below:

- Volume 1, Organization and Planning, Section 2.5, *Data Reduction and Presentation*
- Volume 1, Appendix 1.5, *Site Health and Safety Plan*
- Volume 5, Work Plan, Section 2.1.5, *Meteorology*
- Volume 5, Section 4.1, *Ambient Air Quality*
- Volume 5, Appendix 5.4.1, Section 3.0, *Quality Assurance Objectives*
- Volume 5, Appendix 5.4.1, Section 8.0, *Internal Quality Control Checks*

- Volume 5, Appendix 5.4.2, Section 4.1, *Air Sampling*
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*

Based on the results from the air sampling from the first field effort at OU1, it is proposed that air sampling be performed again during the Round 2 field investigation. Samples will be taken from the same locations as they were during the first field effort. Figures 8-1 and 8-2 show these locations.

Resampling the ambient air will accomplish two objectives. First, there is a need to obtain clear results on ambient conditions for VOCs because problems with VOCs sampling and analysis were encountered during the initial sampling event. Carbo Trap filters were used instead of the TENAX sorbant proposed originally because the latter would not collect some of the target VOC constituents. However, the sample volume and air flow rates were not adjusted from those in the original proposal. As a result, the Carbo Trap filter collected large amounts of carbon dioxide which condensed into the instrumentation. Subsequently, the cryogenic focusing apparatus froze the gas released by the filter. The freezing action blocked effective desorption from the sample tubes; therefore the response of the analytical instrumentation (gas chromatograph/mass spectrometer) was masked by the desorption and freezing of the carbon dioxide.

Second, it is necessary to have on-site air monitoring capability. This is required for two reasons:

- High concentrations of organic vapors (3,000 to 5,000 ppm detected by OVA) were detected during the drilling of the monitoring wells, and
- Strong odors were noticed during the construction of the disposal pits for the investigation-derived waste.

Monitoring the air quality will allow ABB-ES to assess health and safety issues and exposure risk during Round 2 field activities such as drilling of soil borings, installation of monitoring wells, and excavation of additional pits for investigation-derived waste.

Air samples will be collected and analyzed for the same constituents that were tested during the initial field investigation. Table 8-1 summarizes the air sampling program to be completed during the current field investigation. Sample collection for TSP, SVOCs, and PCBs will be done with the same equipment and in the manner described in the PCSR, Section 3.2.3 (see above). However, collection of air samples for VOCs will be done with SUMMA® canisters and EPA-approved method TO-14 will be used for volatile analysis. Details on air sampling procedures and equipment can be found in Section 11.1.5.

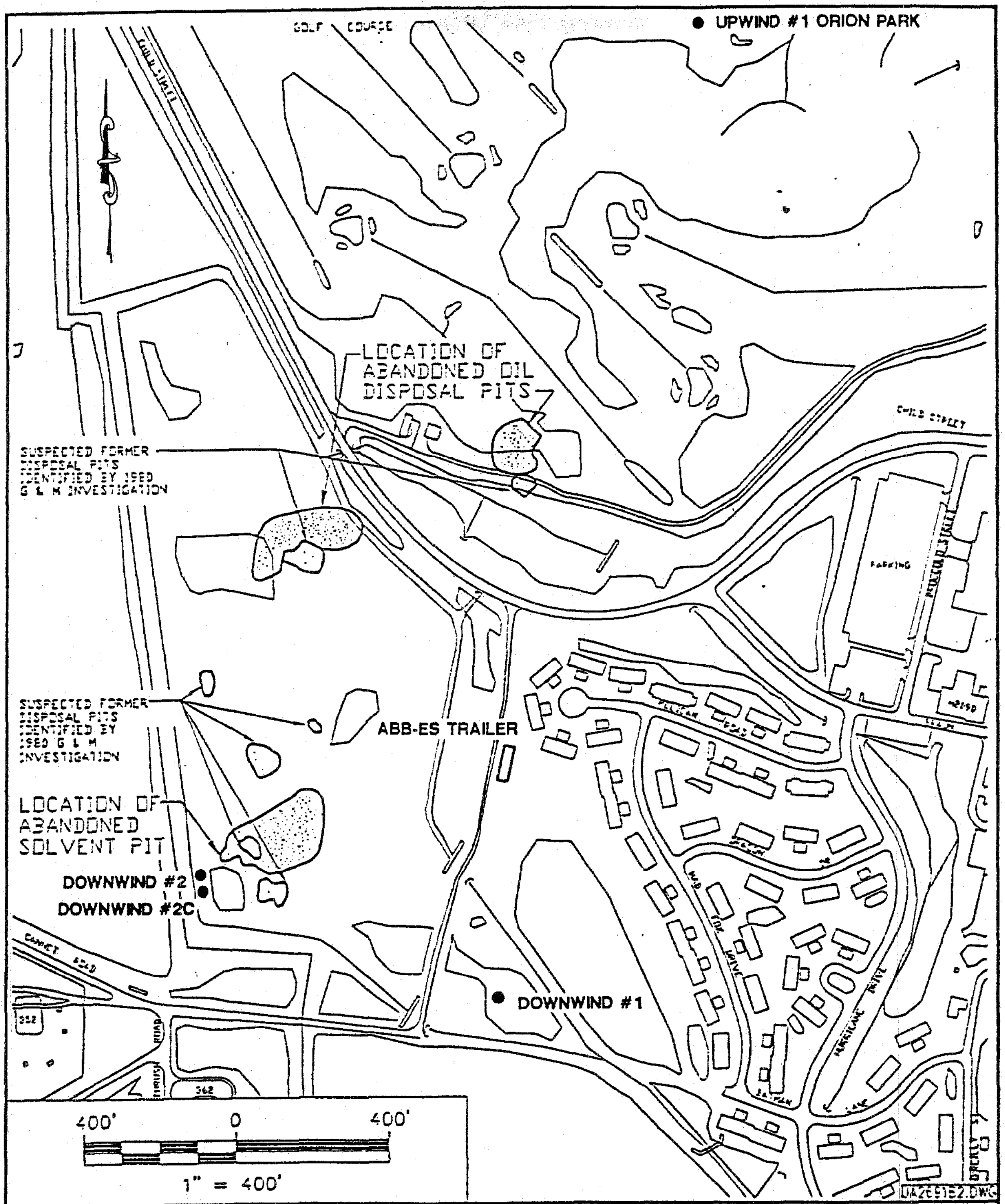


FIGURE 8-1

AIR SAMPLING LOCATIONS RUN1, RUN2, RUN3

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1

NAS JACKSONVILLE JACKSONVILLE, FLORIDA

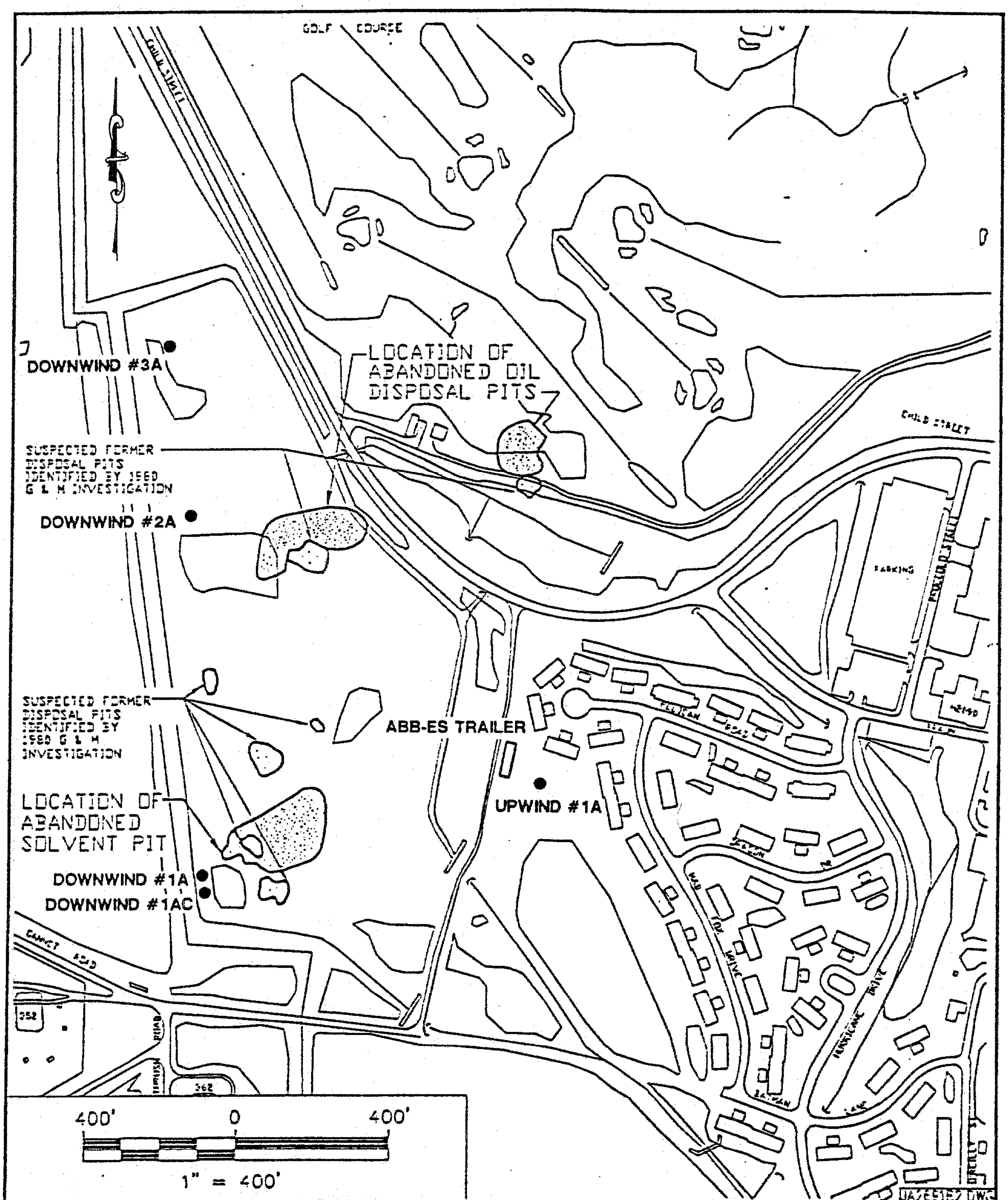


FIGURE 8-2

AIR SAMPLING LOCATIONS RUN4

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1

NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

TABLE 8–1
Selected Constituents and Methods of Analysis for Air Quality Samples OU1, NAS Jacksonville, FL

EVENT	VOCs	TSPs	BNAs	PCBs
Ambient Air Sampling Event	12	12	12	12
On–Site Air Monitoring*				
Day 1**	6	6	6	6
Day 2**	6	6	6	6
Day 3**	6	6	6	6
Grass Cutting Sampling Event**	6	6	6	6
Totals	36	36	36	36

* Includes second event when decon pits for IDW are expanded, includes QC samples.
** 1 up wind, 3 down wind, 1 co–located, and 1 QC.

9.0 GEOPHYSICAL INVESTIGATION

During the 1992 field program, limited geophysical surveying was completed on and around OU1. The geophysical survey consisted of seismic velocity profiling. Detailed analysis of this information is presented in the PCSR. Because of the level of detail provided in the PCSR regarding these results, only the appropriate PCSR section references are provided here. They are:

- Section 3.2.1, *Geophysical Survey*
- Section 4.1.1, *RI Findings: Geophysical Survey*
- Section 5.1, *Conclusions and Recommendations: Geophysical Survey*
- Appendix B, *Geologic Cross Sections/Potentiometric Surface Maps*

Graphical results from the seismic profiling completed during the 1992 field program have been plotted on several figures in the PCSR. A listing of the appropriate PCSR figure references is provided. They are:

- Figure 3-1, *Seismic Survey*
- Figure 4-1, *Seismic Refraction Survey, Line 1*
- Figure 4-2, *Seismic Refraction Survey, Line 2*
- Figure 4-3, *Seismic Refraction Survey, Line 3*
- Figure 4-4, *Seismic Refraction Survey, Line 4*
- Figure 4-5, *Seismic Refraction Survey, Line 5*

All geophysical investigations proposed for the proposed investigation will be accomplished in accordance with the field procedures and protocols described in the NIRP Plan for NAS Jacksonville. The applicable volumes and sections are listed below:

- Volume 1, Organization and Planning, Section 2.5, *Data Reduction and Presentation*
- Volume 1, Appendix 1.5, *Site Health and Safety Plan*
- Volume 5, Work Plan, Section 2.1.1, *Physiography*
- Volume 5, Section 2.1.2, *Geology*
- Volume 5, Section 4.6, *Geologic and Hydrogeologic Investigation*
- Volume 5, Appendix 5.4.1, Section 3.0, *Quality Assurance Objectives*

As fully discussed in the PCSR, the objective of the geophysical surveying conducted during the 1992 field program, was to verify the presence and areal continuity of a unit previously described (before and during the development of the RI/FS Work Plan for OU1) as a clay/shale layer. This layer is of importance to the investigation because of its potential effects on the migration of water-borne OU1 contaminants. The interval in questions has since been redefined, by direct observation from soil borings, as a dolomite or dolosilt and, because of its physical similarities with the underlying Hawthorn Formation, could not be resolved with seismic profiling.

The geophysical survey proposed during the proposed investigation will not attempt to further define the nature of the dolomite/dolosilt unit overlying the Hawthorn. Rather, the geophysical investigation planned will have two primary objectives:

- Assess the horizontal extent of OU1 along the western, northern and eastern site boundaries, and

- Investigate an area in the southern portion of OU1 in which drum were reportedly buried.

Much of the information collected during the 1992 field investigation indicates that the boundaries of OU1, as defined in the RI/FS Work Plan, are not as well understood as formerly thought. Monitoring well MW-3, located on the central portion of the western site boundary, field data (OVA measurements of 3,000 ppm from soil samples) indicate potential OU1 contaminants may exist in this area. Drilling and soil sampling completed west of the OU1 boundary reported the presence of trash and other debris in the subsurface, indicating that areas to the west were used for disposal.

MW-1, completed in the Intermediate Hawthorn, is located beyond the current northern boundary of OU1. OVA measurements of soil samples collected during the installation of MW-1 indicated organic vapor concentrations of 5,000 ppm. Historical aerial photographs (July 1961) revealed the possible presence of a seepage pit near the current location of MW-1. No surface representation of this potential feature is currently visible.

Monitoring well MW-9, located on the east central portion of OU1 site boundary, contains free-phase product. The source of this floating product is not currently known. It is possible that a former disposal pit(s), not currently identified as such, was located in this area.

Additionally, a former employee of NAS Jacksonville has indicated that approximately 200 drums, which potentially contained hazardous materials, were disposed at OU1 in the area between the former horse stables and the western site boundary in the approximate location of monitoring well AW-3.

In each of the instances listed above, the application of surface geophysical methods could be employed to located and delineate areas of disturbed soil or buried material. This effort will also serve to further define the actual boundaries of OU1 and meet the objectives set forth in the RI/FS Work Plan.

Geophysical Surveys. The geophysical survey will be initially conducted with a Geonics, Ltd. EM-31 terrain conductivity meter. The Geonics EM-31 is a portable instrument that permits continuous measurement of terrain conductivity without electrical connection to the ground surface. The instrument can be used to determine conductivity anomalies that may be indicative of buried drums, cylinders, metallic objects, or debris and soils that are impacted by metallic contaminants. Anomalies detected during the survey will be flagged for location by a registered land surveyor. The effective depth is determined by the spacing between the transmitter and the receiver which is about 20 feet for the EM-31. This depth of penetration is well within the maximum range that materials may have been deposited at the OU1 site.

If cultural interferences (e.g. powerlines, metallic fences, buried metal) are encountered and affect the value and interpretation of the electromagnetic survey data, the survey may be terminated and other surface geophysical techniques for surveying the site will be considered. These techniques will include use of a magnetometer and/or ground penetrating radar.

At OU1, the transect lines for the electromagnetic survey will be established using a level and a measuring tape following the grid pattern shown on Figure 9-1. The compass direction of each survey will be obtained with a Brunton (magnetic) compass. The measured distances of the line from landmarks will be documented in the field log book.

The survey procedure will continuously record terrain conductivity measurements along each survey line and place a mark on the record tape at the intersection of each survey line transect. Measurements will be made with the instrument boom parallel to the survey line. Entries will be made into the geophysical survey log book to record the identification of each line so that the integrity of coordinate information is maintained.

Data Review/Interpretation. The data will be reviewed at the end of each day to determine if the survey is producing useful information and assess if another geophysical method would be more appropriate to either confirm the results of the EM-31 survey or replace the EM-31 with another method.

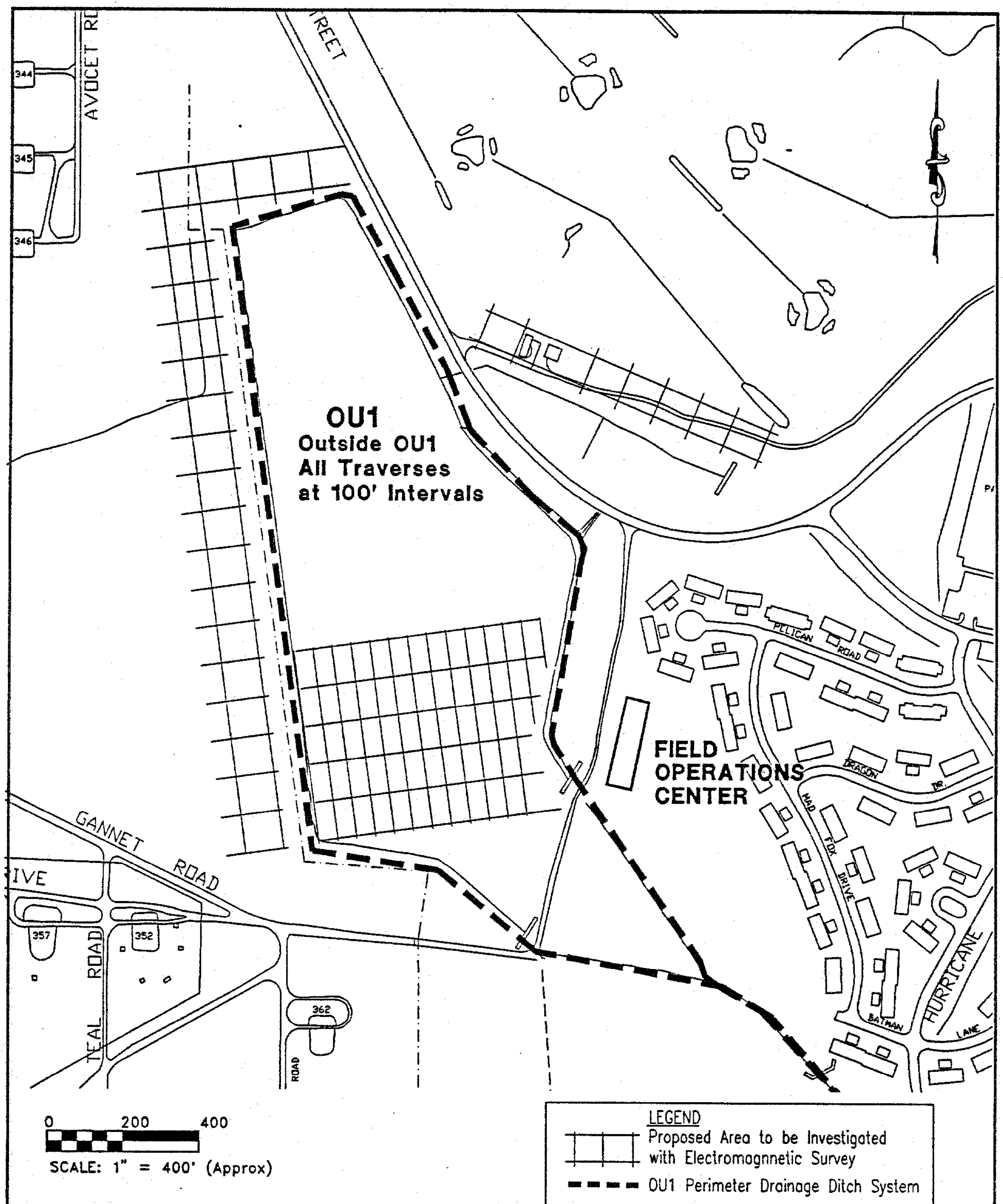


FIGURE 9-1
PROPOSED ELECTROMAGNETIC CONDUCTIVITY SURVEY GRID

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1

NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

10.0 ECOLOGICAL INVESTIGATION

Ecological field activities at OU1 are recommended based on: (1) the expanded definition of the OU1 study area, (2) ecological concerns raised by natural resource trustee personnel, and (3) a preliminary risk screening conducted using Phase I analytical results. Natural resource trustees have expressed concerns about the potential impacts of site-related constituents on St. Johns River biota, as well as organisms that occur at OU1 itself. In addition, the preliminary Baseline Ecological Risk Assessment (BERA) suggests that contaminant concentrations in environmental media (i.e., surface water, sediment, and surface soil) collected from aquatic, wetland, and terrestrial habitats at OU1, are elevated relative to available screening criteria (in some cases by 2-3 orders of magnitude). Moreover, preliminary ecological contaminants of concern include several compounds that are known to bioaccumulate in biological tissues. Because a contaminant migration pathway to critical off-base habitats has been demonstrated and because a number of sensitive ecological receptors are known to occur at OU1 and in the St. Johns River (ABB-ES, 1992), further ecological studies are herein proposed.

Proposed additional ecological assessment activities at OU1 consist of two primary components:

- qualitative inventory of the additional biotic communities identified during Phase I activities at OU1, and
- bioassessment studies to provide site-specific data on actual exposure levels and potential toxicity of site-related constituents to ecological receptors.

10.1 ECOLOGICAL HABITAT CHARACTERIZATION. Based on the detection of site-related contamination in environmental media outside the perimeter of the original study area and on discussions with natural resource trustee personnel, the scope of the RI at OU1 has been expanded. As a result, additional ecological field studies will be necessary to characterize the potential ecological receptors associated with a portion of the Restricted Weapons Area, an additional section of the forested area between Child Street and the golf course, and the portion of the St. Johns River associated with OU1 up to and including Admiral's Pier. These studies will provide supporting information for use in the RI/FS process, including the BERA.

All newly-defined regions at OU1 will be characterized by the type and relative abundance of the flora and fauna identified in each habitat. For certain proposed activities, reference areas representing undisturbed habitats with similar biotic potential will be identified and used for comparison with the identified resources within and adjacent to OU1. All signs of biological stress will be noted and evaluated. In addition, the presence of any state and or federally rare, threatened, or endangered species and/or sensitive communities will be documented.

Data gathered from OU1 during this phase of ecological assessment will provide information regarding the following site-specific ecological characteristics:

- potential terrestrial, semi-aquatic, and aquatic receptors at OU1, including terrestrial and wetland habitats in adjoining areas, and the adjacent segment of the St. Johns River;
- general distribution of flora and fauna in the newly defined regions of OU1;
- major vegetative communities at OU1 and in the immediate surrounding areas, including the submerged macrophyte community in the adjacent segment of the St. Johns River;
- macroinvertebrate community composition associated with the various substrates in the adjacent segment of the St. Johns River;
- occurrence of potentially sensitive and important ecological resources at OU1 and the immediately surrounding areas; and
- identification and characterization of selected aquatic reference areas which are not known to be impacted by OU1 related contaminants or other stressors.

During the ecological assessment, a number of investigative methods will be employed to document field conditions and observations. The majority of the observations will be recorded using a hand-held tape recorder and transcribed after the field work has been completed. However, significant observations will be documented by written notation in a bound field notebook. Photographs documenting conditions at OU1 will be taken throughout the inventory.

<u>10.1.1 Terrestrial Habitats</u> OU1 has been redefined to include an upland portion of the Restricted Weapons Area and an additional segment of the forested terrestrial region between Child Street and the golf course. As a result, additional field work to characterize the flora and fauna associated with these habitats are proposed. Field evaluations at these new locations will be conducted to verify the nature, location, and composition of vegetative communities. Proposed activities will include a qualitative walkover survey to identify ecological habitat types, flora, and fauna in the affected portion of the Restricted Weapons area, as well as in the additional segment of the forested area between Child Street and the golf course. Proposed activities have been designed to provide required information to evaluate the potential for exposures by state- and federal-listed species, to verify exposure model assumptions for evaluated ecological risks, and to reduce risk characterization uncertainties.

Belt and/or line transect surveys of plant types in these areas will be conducted. Observations and identification of plant species within each defined community and an estimate of the general abundance of plant species within each strata will be recorded. Strata will consist of the canopy (i.e., trees) and understory (i.e., saplings, shrubs, herbs). An estimate of the relative size and age distribution of representative trees will be made by either consulting with appropriate NAS JAX personnel or by measuring tree bole diameters using a diameter tape and estimating age by taking small diameter cores using a tree-corer and enumerating the growth rings. The potential use of the newly defined OU1 habitats by wildlife species will be described. This information will be used to evaluate the forage base and other functions (e.g., shelter and nest areas) that these habitats provide to various animal species that may occur within these habitats.

Field observation of animal species (including indirect evidence from nests, tracks, songs, and runways) will be noted and photographed by biologists during the field investigation. Small mammal traps (approximately 75-100 trap nights) will be utilized to evaluate the presence of small mammal receptors at these habitats. Prior to any trapping activities, the existing OU1 scientific trapping permit will be reviewed to ensure compliance with the State of Florida Game and Fresh Water Fish Commission (FGFWFC) regulations. Bird species observed during dawn and dusk surveys, as well as during the course of other phases of the ecological field investigation, will be documented. Based on the recent observations of gopher tortoise activity in the vicinity of PSC 26 (ABB-ES, 1992_), evidence of any active tortoise burrows within these two habitats will be evaluated during the transect walkovers as part of the vegetative characterization. The gopher tortoise is a state listed Species of Special Concern (FGFWFC, 1991).

<u>10.1.2 Aquatic Habitats</u> Based on the revised definition of OU1, as well as on discussions with natural resource trustee personnel, a more detailed characterization of the various wetland and aquatic habitats (ie., shore, submerged aquatic vegetative (SAV) zone, and demersal areas) associated with the St. Johns River is required. OU1 has been redefined to include the portion of the St. Johns River from the Admiral's Pier upriver to the Buckman Bridge (I-295). The proposed ecological characterization will consist of qualitative mapping of the wetland and aquatic habitat associated with this region, including substrate characteristics, depth, nature and coverage of submerged macrophytes, as well as additional survey activities to more fully characterize the macroinvertebrate community associated with each major river habitat.

<u>Mapping of Aquatic Habitats</u>. Five transects will be established at approximately equidistant intervals along the St. Johns River between the Buckman Bridge and the Admiral's Pier. At a number of locations along each transect, a sediment corer or Ponar grab sampler will be used to collect a sediment sample to qualitatively evaluate sediment composition (i.e., grain size fractions, relative amounts of organic matter, sands, and silts). The presence, coverage, and composition of submerged aquatic macrophytes will be assessed at each location either visually from the boat or by using the Ponar grab sampler. Brody (1990) suggests that light penetration probably restricts plant growth to the shallow portions of the river (maximum 1.5 -2.0 meters depth) in the SAV zone. Sampling along each transect will continue beyond the SAV zone to collect two to three sediment samples in the deeper demersal zone. This information will be used to develop a qualitative description of the nature and extent of each significant habitat type within the section of the river under investigation and will be used to establish sampling locations for benthic macroinvertebrate fauna. To the

extent possible, all proposed sampling for the St. Johns River will be conducted from a boat to minimize disturbance to the sediment.

<u>Characterization of Aquatic Macroinvertebrate Fauna</u>. A preliminary characterization of the macroinvertebrate community occurring in this section of the St. Johns River was conducted as part of the initial ecological investigation for Phase I (ABB-ES_, 1992). This investigation consisted of a review of available reports, unpublished literature, discussions with local experts on the fauna of the St. Johns River, as well as quantitative macroinvertebrate sampling from five locations in the SAV zone in the vicinity of the mouth of the unnamed stream that conveys surface water drainage from OU1. Based on discussions with natural resource trustee personnel regarding the expanded scope of the study area in the St. Johns River, additional macroinvertebrate community studies are necessary to provide a more complete characterization of the fauna associated with different substrates and habitats within this section of the river.

Benthic macroinvertebrates associated with each of the major substrate types (e.g., inshore, SAV, and demersal zones) identified during the habitat mapping activity will be sampled at three sampling stations per substrate type in the St. Johns River adjacent to OU1 and at three reference stations on the St. Johns River. Benthic macroinvertebrate sampling locations will be selected to provide a range of physical characteristics (e.g., depth, flow rates) and habitat type (e.g., vegetation, substrate type). Reference stations will be selected based on a review of available literature, consultation with local biologists, and preliminary site inspections. Due to the highly variable nature of the environment in the St. Johns River in the vicinity of NAS JAX and the proximity of OU1, it may not be possible to locate reference sites in close proximity to OU1 sampling stations. If this is the case, regional off-base reference stations will be established.

To the extent possible, the sampling gear and techniques will be chosen to be consistent with ongoing studies, such as the Florida Benthic Invertebrate database (FDER, 1992), to provide data suitable for regional comparisons. A Ponar grab sampler will be used to qualitatively sample benthic macroinvertebrates at the nine selected sampling locations in the St. Johns River. The contents of the pail will be sieved and then placed in sample jars containing 70% ethanol. Sample jars will be labeled to identify location, data and time of collection, and collector and sent to a professional invertebrate taxonomist for identification. Organisms will be identified to the lowest taxonomic level readily possible and the number of each taxonomic group recorded on data sheets (FDER, 1992).

The benthic macroinvertebrate data will be summarized to provide baseline information on the species composition present in the St. Johns River and at selected reference sites. Specifically, species abundance, taxa richness and species composition within each habitat type will be compared among sampling locations. Reduced abundance or taxa richness, or a shift to more pollution-tolerant families may be indicative of impacts and these results will be interpreted in the BERA in conjunction with the toxicological assessment of analytical data. Analysis and presentation of the data derived from identified organisms may include abundance tables, species richness (= number of taxa), a diversity index (Shannon-Weiner), and an evenness index (Heip) (Boesch, 1977, Cairns and Dickson 1971; Kaesler and Herricks, 1977; Schaeffer et al., 1985; Godfrey, 1978).

Concurrently with the benthic macroinvertebrate sample collection activities, selected water quality parameters will be measured at each sampling location. Measured parameters will include dissolved oxygen, temperature, salinity, pH, and specific conductance. These parameters will be measured at the top and bottom of the water column and recorded on data sheets.

<u>10.2 PROPOSED BIOMONITORING ACTIVITIES</u>. Biomonitoring, in general, is the use and analysis of biological organisms to assess soil, water, or sediment quality. Biomonitoring can provide a direct link to the protection of biota and may be a more timely and cost-effective means of assessing:

- the synergistic and/or additive effects of compounds,
- the toxicity of a given discharge or non point source release when its composition is unknown,
- the toxicity of compounds when few water or sediment quality criteria exist, and
- the relative health of a given part of an ecosystem (in this case a comparison with reference areas).

The biomonitoring program at OU1 has been designed to evaluate the potential impacts to resident and migratory biota from contaminants in wetland, aquatic, and terrestrial media. The primary contaminants to be evaluated through this program are those contaminants that exceed various state and federal soil, sediment, and surface water criteria, standards, and guidance values (as determined in the Phase I BERA). In developing the OU1 Biomonitoring Program, guidance from the USEPA "Protocol for Bioassessment of Hazardous Waste Sites" (USEPA, 1983) and various papers from the scientific literature were reviewed (USEPA 1989, Levin et al., 1989); in addition, regional experts were contacted for advice on species availability (Brody, 1992).

The proposed suite of bioassessment studies at OU1 focuses on different aspects of the potentially impacted ecosystem and works to build an overall picture of changes that may occur at the site if remedial activities are required. Ecosystem recovery, not just a reduction in tissue concentrations in a few species, is the ultimate goal of any potential future site remediation at NAS JAX. Biomonitoring to assess the natural recovery of the ecosystem after the source of contamination has been eliminated and the most contaminated areas have been cleaned up can best be addressed by examining changes at several levels of organization throughout the range of effected habitats. The proposed activities serve to establish baseline conditions at OU1, to provide information to risk management decision-makers regarding the need for and extent of any potential future remedial activities at OU1, and to provide a basis for any required trend comparison over time or spatial comparison at other NAS JAX operational units.

Specific objectives of the OU1 biomonitoring program include:

- Establish baseline ecological conditions at OU1, prior to commencement of any remedial or restoration activities
- Determine whether or not environmental contaminants are bioaccumulating in receptor species in OU1 terrestrial, wetland, aquatic habitats
- Determine whether or not exposure to environmental contamination in the various OU1 habitats is resulting in adverse ecological effects in ecological receptors in OU1 terrestrial, wetland, and aquatic habitats
- Establish baseline conditions at a series of non-contaminated reference stations (representing the OU1 habitat types), in order to identify any regional impacts that may be occurring

<u>10.2.1 Terrestrial Biomonitoring Activities</u> Because preliminary ecological risk screening of surface soil contamination at OU1 suggests that elevated levels of several site constituents in surface soil may be impacting terrestrial biota, terrestrial bioassessment tasks are proposed. Subacute toxicity tests are recommended to determine if there are adverse health effects to soil organisms. Biological tissue analyses of primary prey species is also proposed to obtain empirical data concerning actual exposure levels for various higher trophic level species. These data will be used to evaluate the potentially conservative Phase I BERA food web exposure model assumptions relating to contaminant bioavailability and food-web exposures.

The following terrestrial bioassessment studies are proposed. In each case the specific species and life stages selected will be based on initial surveys, literature search, and further consultation with local specialists. The final terrestrial biomonitoring recommendations will depend on the nature or extent of the perceived problem, selected target species or community, and the project schedule.

10.2.1.1 **Earthworm Bioassays** Subacute toxicity tests for earthworms are recommended to determine if OU1 soil invertebrates are suffering adverse health effects from site contamination. Earthworms are the preferred test species because they are ecologically important and an integral part of the food chain (Callahan, 1988); furthermore, they may be exposed to toxic chemicals in the aqueous phase via soil moisture. Subacute toxicity tests are valuable for estimating the relative toxicity of a test chemical and are simpler and more cost effective to perform than chronic tests. Several studies (Diercxsens, et al., 1985; Beyer, et al., 1989) suggest that earthworms are good biomonitoring indicators for PCB, heavy metal, and pesticide contamination.

A soil bioassay using an earthworm species, such as *Eisenia foetida*, is proposed for PSC 26, PSC 27, and the Restricted Weapons area. The general steps involved in the soil bioassay are described below.

1) **Identify Sampling Station.** Sample sites will be selected to encompass the range of terrestrial habitats available and to represent sites with surface

soil and subsurface soil contamination well in excess of state and federal guidance values and criteria, or in excess of ingestion toxicological criteria. Based on the preliminary evaluation of potential surface soil exposures to terrestrial receptors at OU1, PCBs and lead appear to be the most significant contaminants in the surface soil medium. As a result, the proposed soil bioassay will be designed to focus on potential impacts associated with these two contaminants. Soil sampling stations for the proposed bioassays will include: (1) a station with high concentrations of surface soil PCBs and low concentrations of lead; (2) a station with high lead concentrations and low PCB concentrations; (3) a station with low concentrations of both contaminants; and (4) a station in which high concentrations of both contaminants were detected during Phase I sampling activities (Table 10-1). Reference stations will be established off-site to collect control soil samples representative of the substrate at OU1. All stations will be shown on a map indicating the types of terrestrial bioassays being performed at each station.

2) **Collection of Soil Samples**. Approximately two kg of soil will be collected from the top six inches at each sampling location. Soil samples will be taken according to accepted protocols, placed in containers and then be transported on ice (2 - 4 °C) to qualified laboratories for the remainder of the soil bioassay and chemical analysis.

3) **Conduct Laboratory Bioassays**. The laboratory will conduct the soil bioassay according to the methods established in "Protocol for Bioassessment of Hazardous Waste Sites" (1983). Because the purpose of the bioassay is to assess the toxicity of the contaminants present in the soil and to estimate toxicological effect concentrations, soil dilutions will be performed to determine a threshold toxicity value.

   Earthworms will be placed in dilution series mixtures containing artificial soil and site soil from various stations at OU1 and the reference locations for two weeks. For each test, five replicates as well as QA/QC samples will be used. Mortality of the worms be assessed by emptying the worms into a tray and testing their reaction to a mechanical anterior stimulus. The worms will be weighed prior to the commencement of the assay and again at the end of the bioassay period. The worms will be tested in soil stored at 20 °C, at a soil moisture of 20-25%, and with continuous light. At seven days the worms will be assessed for mortality at which time the study will either be terminated (if all the worms are dead) or will be continued for up to 28 days, assaying for mortality every seven days.

4) **Data Summary and Interpretation**. The mortality/dose data should be plotted on log probit paper and the median lethal concentration (LC_{50}) and its confidence limits tested. Bioassay results will be tested for significance using a one way ANOVA followed by Dunnett's Test (Steel and Torrie, 1980) against results from reference and control samples. The results will be discussed and interpreted in conjunction with the analytical results, and any correlations between contaminant concentration and response data determined.

TABLE 10–1
PROPOSED BIOASSESSMENT ACTIVITIES FOR TERRESTRIAL HABITATS
ROUND 2 – OU1
NAS JACKSONVILLE, JACKSONVILLE, FL

SURFACE SOIL CONCENTRATIONS LEAD (mg/kg)	SURFACE SOIL CONCENTRATIONS PCBs (mg/kg)	SOIL INVERTEBRATE BIOASSAY[1]	Food Web Tissue Analysis[2] Invertebrate	Food Web Tissue Analysis[2] Plant
HIGH (376 – 1490)	HIGH (13 – 270)	X	X	X
HIGH (222 – 484)	LOW (< 1.0)	X	X	X
LOW (< 77.0)	HIGH (3 – 47)	X	X	X
LOW (< 77.0)	LOW (< 1.0)	X	X	X

NOTES:
[1]Proposed locations may include one of each of the following groups:
- HIGH LEAD/HIGH PCBs: SL034, SL039, SL044, SL082
- HIGH LEAD/LOW PCBs: SL035, SL057, SL069, SL088, SL096
- LOW LEAD/HIGH PCBs: SL014, SL017, SL024, SL101
- LOW LEAD/LOW PCBs: SL018,SL031,SL045,SL051,SL056

[2]One composite plant and one composite invertebrate sample per station

10.2.1.2 Plant Tissue Analysis PCBs and lead, the two primary contaminants of concern at OU1 surface soils, are bioaccumulated in the tissues of herbaceous plants. Plants, including grasses and composite species, can accumulate toxins within their tissues via absorption from soil and surface water; both contaminants have been shown to accumulate in the leaves and fruits of terrestrial plants (Eisler, 1986; Eisler, 1988).

In order to determine whether or not these surface soil contaminants have entered the terrestrial food chain at OU1, plant tissue analysis is proposed. This proposed activity is relevant at OU1 because of the presence of several herbivorous species, including the gopher tortoise, a Species of Special Concern in Florida (FGFWFC, 1991). Gopher tortoises have been observed in the western portion of OU1 during the first phase of the ABB-ES ecological field investigation (ABB-ES, 1992_), and contaminants accumulated in plant tissues may be posing a potential risk to these and other ecological receptors foraging at OU1.

Plant tissue samples will be collected from the same sampling locations defined in the soil bioassay study, and plant species known to be preferred by gopher tortoises will be selected for the tissue contaminant analysis. Terrestrial plant samples will be collected at these stations, stored on ice, and shipped to a qualified laboratory for analysis of contaminants known to occur at OU1. The results of this study will be used in the BERA to evaluate the magnitude of exposure concentrations and to estimate the potential for adverse ecological effects to the herbivore fauna that occur at OU1.

<u>10.2.2 Aquatic Biomonitoring Activities</u> Table 10-2 summarizes the site-specific bio-monitoring studies proposed at the various aquatic habitats at OU1. A suite of activities (addressing individual, population, and community level responses in the different wetland and aquatic habitats at OU1) are necessary to provide a reliable and comprehensive picture of the ecological impacts associated with OU1 contamination. These activities are focused on:

- determining the direct toxicity from contaminated material exposure to environmental receptors, and

- evaluating the bioavailability of site-related contaminants and potential ecological exposure to higher trophic level receptors through environmental contamination of prey items.

Sediment bioassays and *in situ* toxicity tests will be used to evaluate the toxicological impacts of direct exposure to contaminated media at the site. Bioaccumulation studies and residue analyses of various biological organisms within the aquatic ecosystem at the site will quantify the magnitude of exposure to environmental receptors, and the extent of contamination in the aquatic food chain.

Prior to initiation of the field component of the bioassessment program, ABB-ES will examine local maps and literature on local conditions to identify candidate reference sites. State agency staff familiar with the area will also be contacted for information regarding the location of suitable reference areas.

TABLE 10-2
PROPOSED BIOMONITORING ACTIVITIES FOR AQUATIC HABITATS
ROUND 2 - OU1
NAS JACKSONVILLE, JACKSONVILLE, FL

AQUATIC HABITAT	STATION[1]	SEDIMENT BIOASSAY[2]	CLAM TOXICITY AND BIOACCUMULATION[3]	FOOD WEB TISSUE ANALYSIS[4]		
				Invertebrate	Minnow	Plant
Manmade Ditch						
	2	X		X	X	X
	12	X		X	X	X
	17	X		X	X	X
	REF	X		X	X	X
Intermittent Stream/ Hydrophytic Swamp						
	20	X			X	
	26a	X			X	
	26b	X			X	
	REF	X			X	
					X	
St. Johns River						
	27	X	X			X
	28	X	X			X
	31	X	X			X
	32 (REF)	X	X			X

NOTES:

[1]Station numbering following Sampling Event Report No. 8 (ABB-ES, 1992)

[2]Five randomly selected replicate samples will be collected in the vicinity of each station

[3]Ten trays of clams per location

[4]Collected invertebrate, minnow, and plant tissues will each be composited per station

10.2.2.1 Sediment Bioassay A sediment bioassay is proposed using sediments collected from the St. Johns River, the unnamed intermittent stream/hydrophytic forested swamp area, and the man-made drainage ditches (see Table 10-2). The objective of the sediment bioassay is to assess the potential toxicity of aquatic sediments to fish and invertebrates species. The general steps involved in the proposed sediment bioassay for OU1 are described below.

1) **Identify Sampling Stations.** Sediment samples for bioassay will be collected from sampling stations co-located with stations sampled during earlier sampling event programs at OU1 (see Sampling Event Report No. 8, ABB-ES, 1992). Sample sites have been selected to encompass the range of wetland and aquatic habitats available and to represent sites with surface water and sediment contamination well in excess of state and federal guidance values and criteria. ABB-ES proposes that nine permanent sample stations be used in the sediment bioassay, distributed as follows: un-named OU1 stream and hydrophytic swamp (three stations); St. Johns River (three stations); and, man-made drainage ditch (three stations). Reference stations will be established off-site to represent the range of conditions found at the experimental stations. Each station will be staked and its location indicated on a base map. Proposed sediment sampling stations are shown on Figure 2-2.

2) **Collect Sediment Samples.** At each sampling station, five pairs of samples will be collected for sediment bioassay, and contaminant analysis. Replicate samples for bioassay and contaminants analysis will be collected randomly from a circular area (five meter radius) around each sample location stake. Sediments will be collected using an Ekman or Ponar grab sampler, and placed in a sieve bucket for removal of large macrophytes, rocks, and other debris, as well as to homogenize and drain the samples. The exact quantity of sample required will be determined based on discussion with the laboratory conducting the analysis. Sediment samples will be stored and shipped on ice (2°C - 4°C) to the bioassay and analytical laboratories.

3) **Conduct Bioassay Analysis.** The sediment samples will be shipped to qualified laboratories for the contaminant analysis and bioassay test. The procedure used will be based on accepted protocols (e.g., LeBlanc and Surprenant, 1985; Dawson et al., 1988). Because the primary objective of the bioassay is to assess the spatial variability and potential toxicity of contaminated sediments associated with OU1, sediment dilutions will not be necessary. Control sediment will consist of potting sand (five replicates).

   The test species used in the sediment bioassay will be determined based on species identified during the preliminary survey (ABB-ES, 1992) and on consultation with the bioassay laboratory. The organisms used will be pollution-sensitive species (not necessarily resident fauna) as recommended in various guidance documents (USEPA, 1978; USEPA, 1988; Green et al., 1988), and will include a fish, a benthic invertebrate, and a free-swimming or floating invertebrate. The duration of the tests will vary depending on the particular species used. Biological endpoints that will be analyzed will include larval fish growth, water flea reproduction, and mortality in all species (Suter et al., 1987).

Sediments will be analyzed for PCBs/pesticides and lead, the primary contaminants of concern in surface soil. In addition, Total Organic Carbon (TOC) and grain size analysis will be conducted, to provide information necessary to evaluate the potential bioavailability of contaminants and physical characteristics of the samples. Analytical chemistry data collected for the sediment bioassay study will also be used to interpret results obtained from the other two aquatic biomonitoring studies proposed at OU1 (Table 10-2).

4) **Data Summary and Interpretation.** Bioassay results will be tested for significance using a one-way ANOVA followed by Dunnett's Test (Steel and Torrie, 1980) against results from reference and control samples. These data will also be used to establish baseline conditions for trend analysis studies, should long-term biomonitoring be required. The results will be discussed and interpreted in conjunction with the analytical results, and any correlations between contaminant concentration and response data quantified (Clark et al., 1987).

10.2.2.2 ***In Situ* Toxicity and Bioaccumulation Monitoring** The objective of this biomonitoring task is to determine the bioavailability and potential toxicity associated with contact with contaminated surface water and suspended sediments in the St. Johns River and at the mouth of the un-named stream that conveys surface water from PSCs 26 and 27. The general approach to this task is to place caged organisms in aquatic habitats at the site and subsequently measure growth rates, mortality, and tissue concentrations over a six month period of time. *In situ* toxicity testing is proposed only at St. Johns River portion of OU1 and at the mouth of the unnamed stream.

The clam, *Rangia cuneata*, is a brackish water organism that has been used in *in situ* toxicity testing (Versar, 1989) and is suitable for bioaccumulation monitoring in the St. Johns River. This bivalve is an appropriate species for monitoring contaminant tissue loading because it is a suspension feeder and serves as a good indicator of the toxic effects associated with exposure to resuspended sediment. *Rangia* occurs naturally in the St. Johns River and was identified by ABB-ES ecologists during the Phase I ecological investigation at OU1 (ABB-ES, 1992).

The following general procedure for this study is proposed. *Rangia* individuals will be collected from an unimpacted area in the region, marked, and measured. Small individuals (15 mm-25 mm) of similar size will be placed in trays (e.g., 30 cm x 25 cm x 10 cm) containing sediments collected from the particular sampling stations which have been coarse-sieved to remove other clams and larger fauna. Clams will be placed in the trays at numbers similar to natural densities (approximately 30 per tray). The trays will be covered with cages (e.g., 6-mm mesh hardware cloth) to exclude predators, and placed in the bottom of the St. Johns River so that the top of the tray will be flush with the sediment surface. Ten trays will be placed in a location at the mouth of the un-named stream; and at two locations situated in the St. Johns River approximately 10-15 meters east of the mouth of the un-named stream (Figure 2-2). Ten additional trays will be placed at the selected reference location.

A sub-set of the ten trays (i.e., five trays) at each station will house clams designated for *in situ* toxicity testing. On a monthly basis, *Rangia* individuals will be removed from these trays and preserved in 70 percent ethanol for subsequent studies in the laboratory. The biological endpoints to be measured in this proposed study include growth rate and mortality.

A second sub-set of trays (i.e., the remaining five trays) at each station will be employed for bioaccumulation studies. *Rangia* individuals from this sub-set of trays will be collected at five one month intervals for bioaccumulation studies. Sufficient organisms will be removed from trays for laboratory analysis of PCBs, pesticides, and lead tissue burdens. The organisms collected will be stored on ice (2°- 4°C) and shipped to a laboratory for whole body (excluding shell) analysis.

10.2.2.3 Aquatic Biota Tissue Analysis This activity will consist of sample collection and tissue analysis from various plant, benthic macroinvertebrate, amphibians, and fish species at OU1. These data will provide information necessary to evaluate whether contaminants have entered the aquatic food chain in the study area, and whether detected concentrations are sufficiently high as to adversely impact specific receptors. Of particular concern is the presence of the West Indian Manatee (*Trichechus manatus latirostris*), a state- and federally endangered herbivorous mammal that is known to occur in this section of the St. Johns River (ABB-ES, 1992_.

Residue analyses will consist of the following steps.

1) **Identify Sampling Stations.** The residue analysis program will include sampling from the man-made drainage ditches, the intermittent stream/hydrophytic swamp region, and the St. Johns River. Biological samples will be collected from stations co-located with stations sampled during earlier sampling event programs at OU1 (ABB-ES, 1992_). Sample sites have been selected to encompass the range of wetland and aquatic habitats available and to represent sites at which contaminant concentrations in surface water and sediment are well in excess of state and federal guidance values and criteria. Each station will be staked and its location indicated on a base map. ABB-ES proposes that nine permanent sample stations be used in the bioaccumulation studies, distributed as follows: un-named OU1 stream and hydrophytic swamp (three stations); St. Johns River (three stations); and, man-made drainage ditch (three stations). Reference stations will be permanently established off-site to represent all sampled habitat types. Each station will be staked and its location indicated on a base map; proposed sampling stations are shown on Figure 2-2.

2) **Collect Tissue Samples.** Biological tissue samples will be collected using a variety of techniques. Large aquatic macroinvertebrates (e.g., dragonfly nymphs, snails), plants, and fish will be collected in the vicinity of each appropriate sample station as to provide sufficient

tissue for tissue burden analysis. Macroinvertebrates will be collected using a combination of dipnet and handpicking techniques. The invertebrate samples will be composited so as to obtain the recommended sample quantity (USEPA, 1981). Plants will be obtained using a shovel, and leaf and root tissue will be collected. Amphibians will be collected using a dip net or baited hook, possibly at night. Fish will be caught using a combination of minnow traps, seine nets, and, if necessary, electrofishing techniques. Samples will also be collected from similar habitats at reference locations. Table 10-2 outlines the numbers of biological samples to be collected at each station. All samples will be washed, packaged, and shipped on ice (2 °C - 4 °C) to the analytical laboratory.

3) **Conduct Tissue Residue Analysis.** The tissue samples will be shipped to a qualified laboratory for contaminant residue analysis. The analytical procedures used will be based on established protocols.

4) **Data Summary and Interpretation.** The analytical results from the samples collected at the site will be compared with similar results from reference areas. These results will be used in the BERA to evaluate the magnitude of exposures to aquatic receptors at OU1 and in the St. Johns River. In addition, the results will establish baseline conditions for comparison to similar studies that may be required following site-remediation.

<u>10.3 SCHEDULE</u> The proposed scheduling of Phase II ecological activities is presented in Table 10-3. If necessary, a detailed sampling and analysis plan (SAP) will be written to further describe proposed bioassessment activities. The SAP will present the biomonitoring activities selected and will provide further details concerning sampling locations, required sample sizes, reference locations, and selected indicator organisms. In addition, analytical protocols for the various tissue analyses and other laboratory analyses, and quality control procedures will be provided. Finally, the SAP will present a schedule for the reports summarizing the interim and final conclusions of this biomonitoring program.

TABLE 10–3
PROPOSED SCHEDULE FOR FIELD ACTIVITIES
ROUND 2 – OU1
NAS JACKSONVILLE, FL

ACTIVITY	STARTING DATE	ESTIMATED DURATION
Ecological Inventory		
Terrestrial inventory	May 1993	2 days
Aquatic mapping	May 1993	2 days
Macroinvertebrate characterization	May 1993	2 days
Biomonitoring Activities		
Terrestrial:		
Soil Invertebrate Bioassay	May 1993	2 days
Food Web Tissue Analysis	May 1993	2 days
Aquatic:		
Sediment Bioassay	May 1993	3 days
In Situ Toxicity Analysis	May 1993	20 weeks
Food Web Tissue Analysis	May 1993	2 days

11.0 FIELD PROGRAM IMPLEMENTATION

This section briefly discusses the sample analytical program to be completed during the proposed investigation and the data validation protocols which will be maintained . Other items, associated with the implementation of the field program proposed, but not involving the collection of either screening or laboratory analytical samples, are also discussed. These items include plans to enlarge the existing investigation-derived waste (IDW) disposal pits located on OU1, location surveying for the sample collection points from all of the media samples discussed above, and scheduling of the proposed field program.

11.1 SAMPLE COLLECTION AND ANALYSIS. In general, the sampling and analysis of the various media will be performed in the same manner as the initial field effort. In addition, the original site health and safety plan from this effort will remain intact (see Volume 1, Organization and Planning, Appendix 1.5, *Site Health and Safety Plan*).

Neither direct-push technology nor PCB screening was an element in the original scope of work in the RI/FS Work Plan for OU1. As such, the sampling and analysis procedures for these technologies were not addressed in the Work Plan. For a discussion of these procedures and techniques, see Section 3.0, *Site Screening*.

Following is a discussion of each medium which will undergo additional sampling under the proposed amendments to the Work Plan.

11.1.1 Surface Water/Sediment Surface water and sediment samples will be collected from the proposed sites shown in Figure 2-2.

Field procedures and protocols for surface water and sediment sampling are detailed in the sampling and analysis plan for OU1, which is appended to Volume 5, the RI/FS Work Plan. The relevant sections are as follows:

- Volume 5, Appendix 5.4.2, Section 4.5, *Surface Water and Sediment Sampling*
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*
- Volume 5, Appendix 5.4.2, Section 4.10, *Sampling Equipment Quality Assurance*

These same procedures will be followed during the Round 2 field effort. As sampling takes place, all relevant information, measurements, locations, times and dates will be recorded in the field log book. All samples will be analyzed for TCL VOCs, SVOCs, pesticides and PCBs, TAL inorganics, cyanide, radiological parameters, and TPH. Table 2-1 lists the analyses to be performed on the samples and the expected number of field samples that will be sent to the laboratory. Table 2-2 outlines the expected number of QC samples to be collected.

11.1.2 Soil Sampling Soil samples will be collected from the proposed sites and at the depths shown in Figure 7-2.

Field procedures and protocols for soil sampling are detail in the sampling and analysis plan for OU1, which is appended to Volume 5, the RI/FS Work Plan. The relevant sections are as follows:

- Volume 5, Appendix 5.4.2, Section 4.3, *Surface and Subsurface Soil Sampling*
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*
- Volume 5, Appendix 5.4.2, Section 4.10, *Sampling Equipment Quality Assurance*

Soil sampling will follow the same procedures outlined in the above sections during the Round 2 field effort. As sampling takes place, all relevant information, measurements, locations, times and dates will be recorded in the field log book. The samples will be analyzed for TCL VOCs, SVOCs, pesticides and PCBs, TAL inorganics, cyanide, radiological parameters, and TPH. Tables 7-1 and 7-3 provide a summary of the analyses performed and the number of field samples expected to be sent to the laboratory. Tables 7-2 and 7-4 list the anticipated number of QC samples to be collected.

11.1.3 Groundwater Sampling Groundwater samples will be collected from all new monitoring wells installed during the proposed Round 2 field operations sampling events (see Figures 4-4, 4-6, 5-1).

Procedures and protocols for well purging and sampling are detailed in the sampling and analysis plan for OU1, which is appended to Volume 5, the RI/FS Work Plan. The relevant sections are as follows:

- Volume 5, Appendix 5.4.2, Section 4.6, *Groundwater Sampling*
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*
- Volume 5, Appendix 5.4.2, Section 4.10, *Sampling Equipment Quality Assurance*

These same procedures will be followed during the Round 2 field investigation. As purging and sampling takes place, all relevant information, measurements, locations, times and dates will be recorded in the field log book. All samples will be analyzed for TCL VOCs, SVOCs, pesticides and PCBs, TAL inorganics (filtered and unfiltered), cyanide, radiological parameters, and TPH. Table 5-1 summarizes the analyses to be performed on the samples, and the expected number of field samples to be collected. Table 5-2 lists the expected number of QC samples to be collected.

11.1.4 Air Sampling Ambient air samples will be collected during two separate sampling events: one lasting for three consecutive days, and one during the semiannual grass-cutting at OU1.

The three consecutive days of ambient air sampling will consist of the following:

- one upwind location for determination of background conditions;
- two downwind locations for evaluation of the air quality impact at the perimeter of the site; and
- one co-located downwind location to provide a duplicate sample for quality control.

The grass-cutting sampling event will consist of the following:

- one upwind location for determination of background conditions;
- three downwind locations for evaluation of air quality impact at the perimeter of the site; and
- one co-located downwind location to provide a duplicate sample for quality control.

The proposed locations where these samples will be taken are shown in Figures 8-1 and 8-2, the acutal location will be modified based on acutal wind directions.

Field procedures and protocols for ambient air sampling are detailed in the sampling and analysis plan for OU1, which is appended to Volume 5, the RI/FS Work Plan. The relevant sections are as follows:

- Volume 5, Appendix 5.4.2, Section 4.1, *Air Sampling*
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*
- Volume 5, Appendix 5.4.2, Section 4.10, *Sampling Equipment Quality Assurance*

In the case of sampling for VOCs, Carbo Trap filters were used instead of the TENAX sorbant proposed originally in the Work Plan. This change is discussed in the PCSR. The relevant section is as follows:

- Section 3.2.3, *Ambient Air Sample Collection*

Samples will be analyzed for TCL VOCs, SVOCs, PCBs, and TSP metals. Table 8-1 summarizes the analyses to be performed and the expected number of field and QC samples to be collected. Collection of air samples for SVOCs, PCBs, and TSP will follow the procedures outlined in the PCSR. Due to problems encountered using the Carbo Trap filters, which is discussed in Section 8.0, ambient air sampling for VOCs will be performed differently during the Round 2 field investigation.

Air samples to be analyzed for VOCs will be collected with SUMMA® passivated steel canisters; the volatile constituents will be analyzed by GC/MS by EPA-approved method TO-14. The canister is designed to collect air samples passively, without the need for power or pumps. A sample of ambient air is drawn through the sampling train comprised of components that regulate the rate and duration of sampling into the pre-evacuated SUMMA® canister. The valve is closed after the sample is collected. Upon arrival at the laboratory, the canister is attached to the analytical system. Water vapor in the gas stream is reduced by a dryer and the VOCs are then concentrated in a cryogenically-cooled trap. The cryogen is removed and the trap temperature is raised, which causes the collected VOCs to revolatilize. The constituents can then be separated on a GC column.

During the air sampling program, meteorological conditions will be monitored with the on-site meteorological station located in the field trailer. The system provides continuous measurements of temperature, wind speed, wind direction, humidity, and barometric pressure. In addition, soil temperature measurements will be made four times per day at the sampling locations. These data will be used to determine on a daily basis the locations for the upwind and downwind sampling.

The Work Plan states that the sample locations should be moved if a "sustained" wind shift is detected. However, it is proposed that if a "sustained" wind shift occurs, the air samplers will be shut off and reactivated when the wind direction has returned to its original location.

As sampling proceeds, all relevant information, measurements, locations, times and dates will be recorded in the field log book.

<u>11.1.5 Sample Handling and Custody</u> All samples will be shipped to a laboratory for analysis under proper chain of custody documentation. Standard labelling, packing, and preservation procedures will be followed. These procedures are discussed in the Quality Assurance Project Plan for OU1, which is appended to Volume 5, the RI/FS Work Plan. The relevant sections are as follows:

- Volume 5, Appendix 5.4.1, Section 4.0, *Sampling Procedures*
- Volume 5, Appendix 5.4.1, Section 5.0, *Sample Custody*
- Volume 5, Appendix 5.4.1, Table 4-1, *Sample Container, Preservative, and Holding Time Specifications*

<u>11.1.6 Equipment Calibration, Maintenance and Decontamination</u> Equipment used in the Round 2 field effort includes, but is not limited to, OVAs, conductivity meters, pH meters, thermometers, portable gas chromatograph, pumps, and bailers. All equipment will be used, calibrated and maintained according to manufacturer's instructions. Frequent checks will be made to assure the proper functioning of such equipment. Decontamination of equipment will occur at proper intervals during sampling.

Calibration and maintenance procedures for the various pieces of equipment used are available in the manufacturer's instruction manual for each piece. There are also summaries of these procedures, along with decontamination procedures, in the Quality Assurance Project Plan and the Sampling and Analysis Plan for OU1, which are appended to Volume 5, the RI/FS Work Plan. The relevant sections are as follows:

- Volume 5, Appendix 5.4.1, Section 6.0, *Calibration Procedures and Frequency*
- Volume 5, Appendix 5.4.1, Section 7.0, *Analytical Procedures*
- Volume 5, Appendix 5.4.1, Section 10.0, *Performance and System Audits*
- Volume 5, Appendix 5.4.1, Section 11.0, *Preventative Maintenance*
- Volume 5, Appendix 5.4.1, Section 13.0, *Corrective Action*
- Volume 5, Appendix 5.4.1, Attachment A, *Preventative Maintenance and Calibration Frequency for Field Equipment*
- Volume 5, Appendix 5.4.2, Section 4.9, *Equipment Cleaning*
- Volume 5, Appendix 5.4.2, Section 4.10, *Sampling Equipment Quality Assurance*

Equipment calibration, maintenance, and decontamination will be performed according to the procedures and recommendations outlined in the above sections.

<u>11.1.7 Quality Control</u> The quality control measures taken in the field will follow those outlined in the original Work Plan for OU1. Field quality assurance and quality control samples will be collected for each medium sampled in order to assess the reproducibility of the field collection techniques, the quality of preservation reagents and the sample bottles, and the adequacy of field decontamination procedures. The following tables list the anticipated number of field QA/QC samples for each medium sampled:

- Surface Water/Sediment: Table 2-2
- Soil: Tables 7-2 and 7-4
- Groundwater: Table 5-2
- Ambient Air: Table 8-1

Procedures and protocols for taking field QA/QC samples, including equipment blanks, field blanks, trip blanks and replicates, are outlined in the Quality Assurance Project Plan for OU1. This is appended to Volume 5, the RI/FS Work Plan. The relevant sections are as follows:

- Volume 5, Appendix 5.4.1, Section 3.0, *Quality Assurance Objectives*
- Volume 5, Appendix 5.4.1, Section 8.0, *Internal Quality Control Checks*

- Volume 5, Appendix 5.4.1, Table 8-1, *Field QC Samples Required for Each Matrix per Sampling Event*

The required number of field QA/QC samples will be collected in the manner outlined in the above sections. For ambient air sampling, the one co-located downwind sampling location will serve as the replicate, field QC sample.

<u>11.2 DATA VALIDATION</u>. Field and laboratory data for all sampled media will be subject to a validation process by an independent organization. Data validation is a two-fold process: field data are evaluated for adherence to the approved Work Plans, and laboratory analytical data are evaluated for completeness of data package deliverables (Contract Compliance Screening) and achievement of project-specific data quality objectives (data usability determination). After reviewing all the available data, the validators can make the following determinations:

1) Identify need for resampling and/or reanalysis;

2) Indicate the usability of data with standard qualifiers;

3) Indicate appropriateness of penalties and reductions in fees on laboratory invoices;

4) Bill the laboratory for direct costs associated with correcting data packages, if necessary; and

5) Allocate responsibility (to lab or Contractor) for paying costs associated with resampling and/or reanalysis.

The data validation procedures that were followed during the initial field effort are based on three criteria:

1) Functional guidelines set forth by the U.S. Environmental Protection Agency (EPA);

2) Guidelines established in the document entitled "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program," NEESA 20.2-047B, and

3) The accumulated experience of numerous technical persons qualified in data validation procedures.

Procedural guidelines for data validation are outlined in both Volume 4, the Basic Site Work Plan for NAS-Jacksonville, and Volume 5, the RI/FS Work Plan for OU1. The relevant sections are as follows:

- Volume 4, Appendix 4.2, *Data Analysis Plan*

- Volume 4, Appendix 4.2, Attachment A, *Required Deliverables*

- Volume 4, Appendix 4.2, Attachment B, *Laboratory Data Functional Guidelines for Evaluating Organic Analyses, February 1, 1988*

- Volume 4, Appendix 4.2, Attachment C, *Laboratory Data Functional Guidelines for Evaluating Inorganic Analyses, July 1, 1988*
- Volume 4, Appendix 4.2, Attachment E, *FVDC and MSL Forms*
- Volume 4, Appendix 4.2, Attachment F, *Data Validation Report Sheets (DVRS) Forms and Wet Chemistry Checklist*
- Volume 4, Appendix 4.2, Attachment G, *Data Validation Coding Form*
- Volume 4, Appendix 4.2, Attachment H, *Data Usability Classification Form*
- Volume 4, Appendix 4.4.1, Quality Assurance Program Plan (QAPP), Section 9.0, *Data Reduction, Validation, and Reporting*
- Volume 5, Appendix 5.4.1, Section 9.0, *Data Reduction, Validation, and Reporting*

The data validation process will follow the procedures outlined in the above sections. Validated data will be sent to ABB-ES, which will then be presented in the Draft RI report; no sampling event reports will be prepared for the investigation proposed.

NEESA Level D data validation protocol will be followed for all laboratory analyses, except confirmatory sampling for PCB and direct-push screening. Samples sent to the laboratory for screening confirmation will follow NEESA Level C data validation protocol. NEESA data validation protocol are fully explained in "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program," NEESA 20.2-047B.

11.3 ENLARGE DISPOSAL PITS. As part of the original field effort conducted for the RI/FS at OU1, disposal pits were constructed for on-site disposal of non-liquid investigation-derived wastes. Construction of the disposal pits was completed in accordance with Section 5.15 of the RI/FS Work Plan for OU1, Volume 5 of the NIRP Plan for NAS Jacksonville. The location of the on-site disposal pits is shown on Figure 10-1.

The expanded field program proposed herein will necessitate the expansion of the previously constructed pits. The areas into which the pits are to be expanded are shown on Figure 11-1. It is anticipated that at least two of the disposal pits will have to be enlarged and covers made for them. The expansion of the pits will be completed by a subcontractor and supervised by the Field Operations Leader. Expansion of the disposal pits will be completed in accordance with the Section 5.15 of the RI/FS Work Plan for OU1.

The decontamination pad and the dedicated water tanker already on OU1 should be sufficient for use in the Round 2 field program.

11.4 LOCATION SURVEYING. In order to accurately place analytical information and other data gathered during the field investigation proposed in the existing site

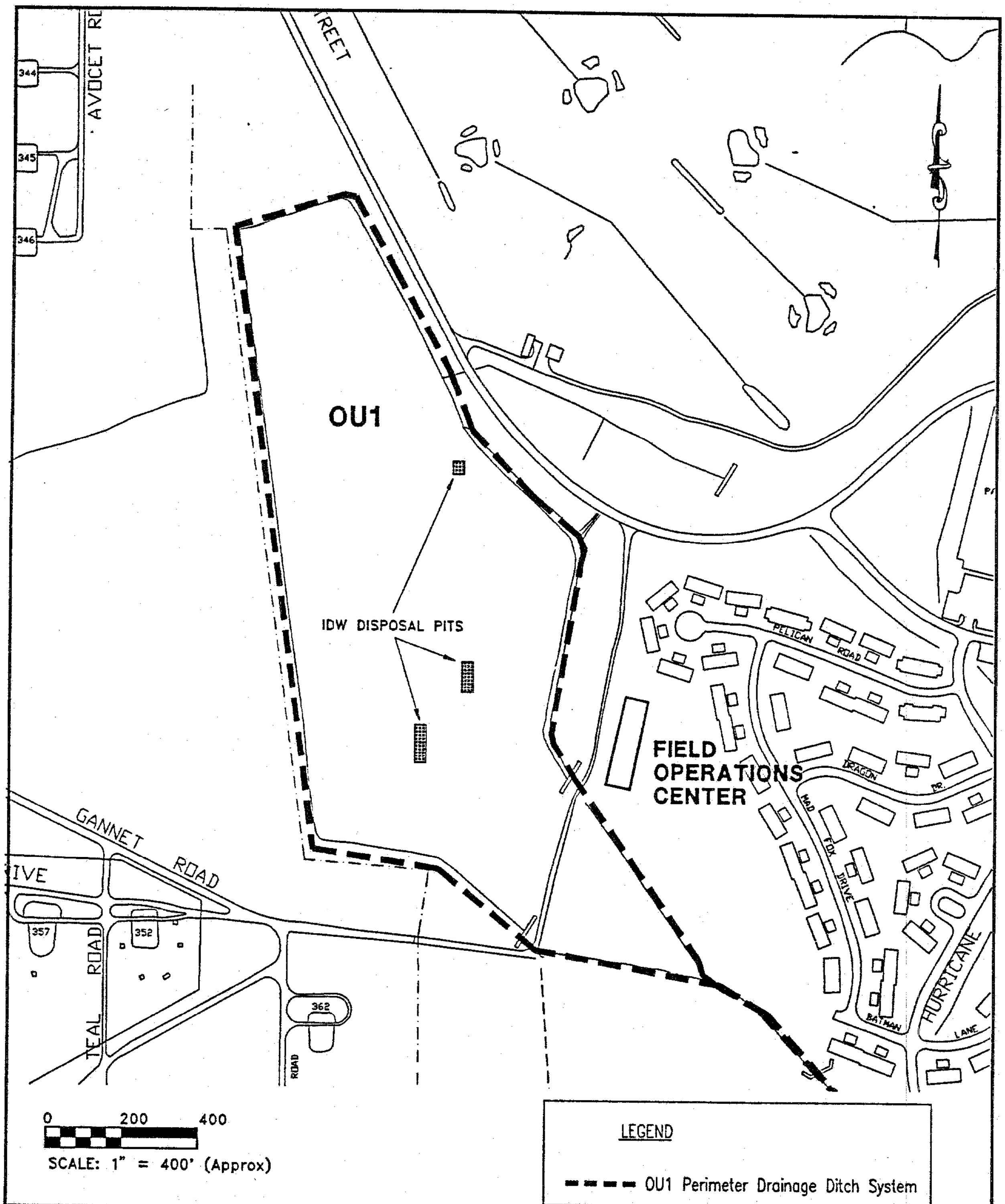


FIGURE 11-1
LOCATION OF IDW DISPOSAL PITS

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1

NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

database and ensure its future usability, location surveying for both horizontal coordinates and elevation is necessary for all sampling locations in all sampled media. Surveying will be conducted in accordance with the procedures and protocols provided in Section 5.14 of the RI/FS Work Plan for OU1, Volume 5 of the NIRP Plan for NAS Jacksonville.

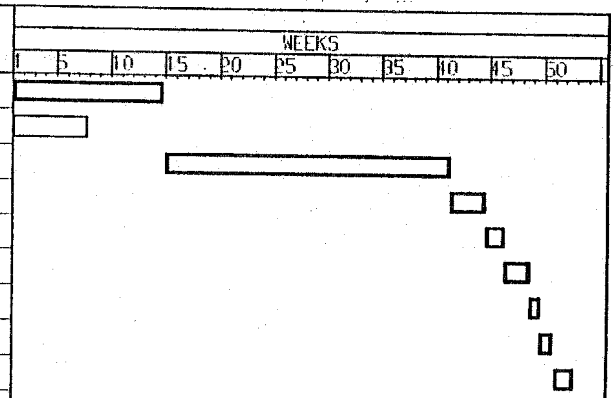
Prior to initiating direct-push screening and PCB screening efforts, surveyors will lay out the grids for the large-scale screening locations identified in Figures 3-1 and 3-2. Results generated during sampling of initial large-scale grids for the PCB and direct-push screening efforts will dictate that smaller, finer grids be sampled. These finer grid locations will be surveyed after the sampling has been completed.

Sampling locations for other media will also be surveyed as part of the field program proposed. All new monitoring well locations, soil boring locations, soil sampling locations, and surface water and sediment sampling locations will be surveyed for horizontal coordinates and elevations by a Florida-certified surveyor. Oversight of the surveying will be maintained by the Field Operations Leader.

<u>11.5 SCHEDULE</u>. A preliminary schedule has been prepared for the execution of the field investigation proposed in this Technical Memorandum. The schedule has been developed assuming that: (1) work weeks will be composed of five eight-hour days, (2) field elements will be completed consecutively with no two elements occurring simultaneously, and (3) that only one drill rig will be used for the drilling and installation of monitoring wells.

As execution of the investigation proposed is not currently under contract, firm start and finish dates have not been supplied to the schedule presented in Figure 11-2. Certain ecological field activities are seasonally constrained; the completed design of that field program may affect the sequencing of field elements as present in Figure 11-2.

ACTIVITY ID	ACTIVITY DESCRIPTION	ORIG DUR
AA0650005	DIRECT-PUSH TECHNOLOGY SCREENING	70
AA0850005	ECOLOGICAL STUDIES	35
AA0820005	MONITORING WELL INSTALLATION	132
AA0665005	PCB SCREENING FOR SOILS	17
AA0830005	SURFACE WATER/SEDIMENT SAMPLING	8
AA0860005	WATER LEVEL MEASUREMENTS	12
AA0820010	SOIL SAMPLING AT 0-1 FT INTERVALS	5
AA0845005	AIR SAMPLING	6
AA0630005	GEOPHYSICS	10



Plot Date 24DEC92
Data Date 14DEC92
Project Start 14DEC92
Project Finish 10DEC93

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

Sheet 1 of 1

NAVY CLEAN
NAS JAX OU1 ROUND II FIELD WORK
BASELINE PROJECT SCHEDULE

Date	Revision	Checked	Approved

FIGURE 11-2
PRELIMINARY SCHEDULE

TECHNICAL MEMORANDUM FOR SUPPLEMENTAL SAMPLING OU1
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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APPENDIX A

DIRECT-PUSH TECHNOLOGY SCREENING DISCUSSION

FIELD PROCEDURES FOR SUBSURFACE SAMPLING
UTILIZING DIRECT-PUSH TECHNOLOGY

1.0 Introduction

The procedures described below will be followed during subsurface sampling/sensing involving the Piezocone, Geocone, and Hydrocone tools. The sampling sensing tools utilize a hydraulic load frame capable of exerting 50,000 pounds to thrust the stainless steel samplers or sensing device into the ground. This technology is based on the standard cone penetrometer (CPT) used for assessing geotechnical properties of soils.

2.0 Piezocone Soundings

The Piezocone system (Figure 1) consists of an electronic dutch cone penetrometer having the capability to measure pore pressure. An electronic cable connects the downhole instrument to a microcomputer stationed on the direct push technology (DPT) hydraulic load frame rig. Within the piezocone are various sensors which take three independent measurements each one-half second. These measurements are relayed to the computer, which in turn presents to the operator a real time graphic display of soil type and strength using well established correlations.

The test proceeds by pushing the Piezocone into the soil in one meter increments at a constant rate of two centimeters per second. This is repeated until the final sounding depth is reached. Data collection is performed during the entire push sequence, including intervals between push segments. During those intervals, the data collected on the time to stabilize the disturbed groundwater pressure and the final equilibrium value provides a measure of soil permeability and of the in-situ piezometric pressure at that depth. Because the instrument is pushed rather than drilled into the soil, no drilling products are produced.

The minimum operating procedures and data quantity and quality for the piezocone exceed the requirements of ASTM D-3441. Data obtained from this methodology are analyzed pursuant to Robertson and Campanella, September 1984, "Guidelines for Use and Interpretation of the Electric Cone Penetrometer Test." The standard operating procedure for the electric Piezocone is as follows:

1. Disassemble all elements within the downhole Piezocone sampler.

2. Clean the elements with organic-free deionized water followed by nano-grade isopropyl alcohol, and allow to air-dry thoroughly.

3. Reassemble the downhole components of the Piezocone and check for response (saturation). Proper response occurs when no air voids occur within the Piezocone element, as verified by a CRT readout based on the software package.

4. Thrust the Piezocone in accordance with ASTM D-3441, and monitor the real

time CRT display. Data obtained during thrusting are recorded on floppy disks and used to generate plots.

5. After penetrating to the target depth the Piezocone rods and instrument are retrieved and decontaminated prior to further use. Because the system is water-tight, decontamination activities are necessary only for the outside of the Piezocone rods and instrument. Decontamination procedures consist of the following:

   a. steam clean all downhole equipment;
   b. wash with alconox/tap water solution using a brush to remove soil particles;
   c. rinse with tap water;
   d. rinse with nano-grade isopropyl alcohol;
   e. rinse twice with <u>organic free</u> deionized water;
   f. cover (wrap) with aluminum foil.

3.0 Geocone Sampling

The Geocone soil sampler (Figure 2) is a modified split-spoon sampler which is hydraulically pushed into soils. The stainless steel sampler contains a pointed, cone-shaped plug which is released at the desired sampling depth. The Geocone is then pushed an additional 18 to 24 inches into the soil. as the sampler is pushed, the plug floats freely up in to the spoon. The spoon is then pulled from the subsurface and opened to permit collection of the soil sample.

The Geocone is pushed into the soil at a rate of two centimeters per second. Sampling and decontamination procedures are listed below.

1. Disassemble all elements within the Geocone sampler.

2. Clean the elements with organic-free deionized water followed by nano-grade isopropyl alcohol, and allow to air-dry thoroughly.

3. Reassemble the sampler and attach the argon gas lines.

4. The assembled sampler operations are checked using the on-board computer system to ensure that the push plug will release properly. This check proceeds by applying argon gas pressure and verifying that the push plug releases.

5. The sampler is hydraulically pushed to the required sampling depth using the hydraulic load frame.

6. When the sampler is at the target sampling depth, argon gas pressure is applied to activate the push plug release mechanism. The sampler is pushed a maximum of 24 inches to collect the soil sample.

7. The sampler is withdrawn to the surface. During withdrawal, the rods are disassembled and decontaminated.

8. The sampler is detached from the rods and opened, and the soil sample collected and placed in labeled sample containers.

9. Decontamination will be performed prior to and between sampling locations. Decontamination procedures will be as follows:

   a. disassemble all components;
   b. steam clean;
   c. alconox soap, brush and tap water scrub to remove soil particles;
   d. rinse with tap water;
   e. rinse with nano-grade isopropyl alcohol;
   f. rinse twice with organic free deionized water;
   g. cover with aluminum foil until used.

4.0 Hydrocone Groundwater Sampler

The Hydrocone HC-1 groundwater sampler (Figure 3) was developed to enable groundwater contamination surveys to be performed rapidly and cost effectively and to assist in initial plume delineation. Water samples obtained with the Hydrocone are subjected to minimum volatilization of contaminants, and are extracted from a precisely known depth. The Hydrocone sampler is operated using the hydraulic load frame developed for the Piezocone and Geocone, with microtransducer information stored within the on-board computer system.

The Hydrocone HC-1 sampler has an outside diameter of about 1.4 inches, an inside diameter of about 0.9 inch, and a length of 2.0 meters. The maximum sample volume is 700 ml. The sampler is constructed of 316 steel and Teflon to ensure high-quality groundwater samples. The sampler is activated by argon gas, and the entire filling process is monitored in real time using the on-board computer CRT. The standard operating procedures for the Hydrocone HC-1 sampler are listed below.

1. The sampler is disassembled and properly cleaned (see step 14, below). Disassembly consists of removing the retractable tip, lower unit valve mechanism, and upper unit sensor package.

2. A new or decontaminated stainless steel filter is placed on the stainless steel mandrel. Filters can be constructed of various materials, and for most studies will be 60 to 400 mesh stainless steel 4.0 to 24.0 inches long.

3. The lower valve unit is assembled, the mandrel and filter unit are assembled, and the lower unit is retracted. In the retracted position, the stainless steel filter is contained within the sampler and is uncontaminated during thrusting to the sampling depth.

4. The downhole sensor package is installed in the upper portion of the sampler.

5. The assembled sampler operations are checked using the on-board computer system to ensure that argon gas pressure in the sampler is monitored

properly. This check proceeds by varying the argon gas pressure and monitoring the response on the CRT.

6. The sampler is checked for leaks and to ensure that the tip opens on pressurization. The sampler tip is retracted inside the sampler.

7. The sampler is hydraulically pushed to the required sampling depth using the hydraulic load frame.

8. When the sampler is at the target sampling depth, the argon gas pressure is activated to greater than the hydrostatic pressure on the water-bearing formation. At this point, the hydraulic load frame pulls upward on the rods to enable exposure of the stainless steel filter. The sampler is now ready for filling.

9. The argon gas pressure within the sampler is lowered to less than the hydrostatic pressure, or a vacuum is applied and water flows into the sampler. Filling of the sampler is monitored in real time on the CRT.

10. When sufficient sampler volume has been obtained, as monitored on the CRT, the sampler is repressurized to greater than hydrostatic pressure and withdrawn to the surface. During withdrawal, the rods are disassembled and decontaminated.

11. The sampler is pulled to the surface and held vertically within the load frame. The tip is removed and disassembled for cleaning. The sampler is now ready for evacuation.

12. The groundwater sampler is removed from the sampler by utilization of a sampler release valve. The sampler release valve enables the flow of water from the sampler into the containers to be regulated and to minimize aeration and volatilization.

13. After evacuation of the sample the Hydrocone sampler is disassembled and the used stainless steel filter removed.

14. Decontamination of the Hydrocone HC-1 will be performed by disassembling the sensor unit and the lower filter tip mandrel. Decontamination will be performed prior to and between sampling locations. Decontamination procedures will be as follows:

    a. disassemble all components;
    b. steam clean;
    c. alconox soap, brush and tap water;
    d. rinse with tap water;
    e. rinse with nano-grade isopropyl alcohol;
    f. rinse twice with organic free deionized water;
    g. cover with aluminum foil until used.

FIGURE 1

SKETCH OF PIEZOCONE INSTRUMENT

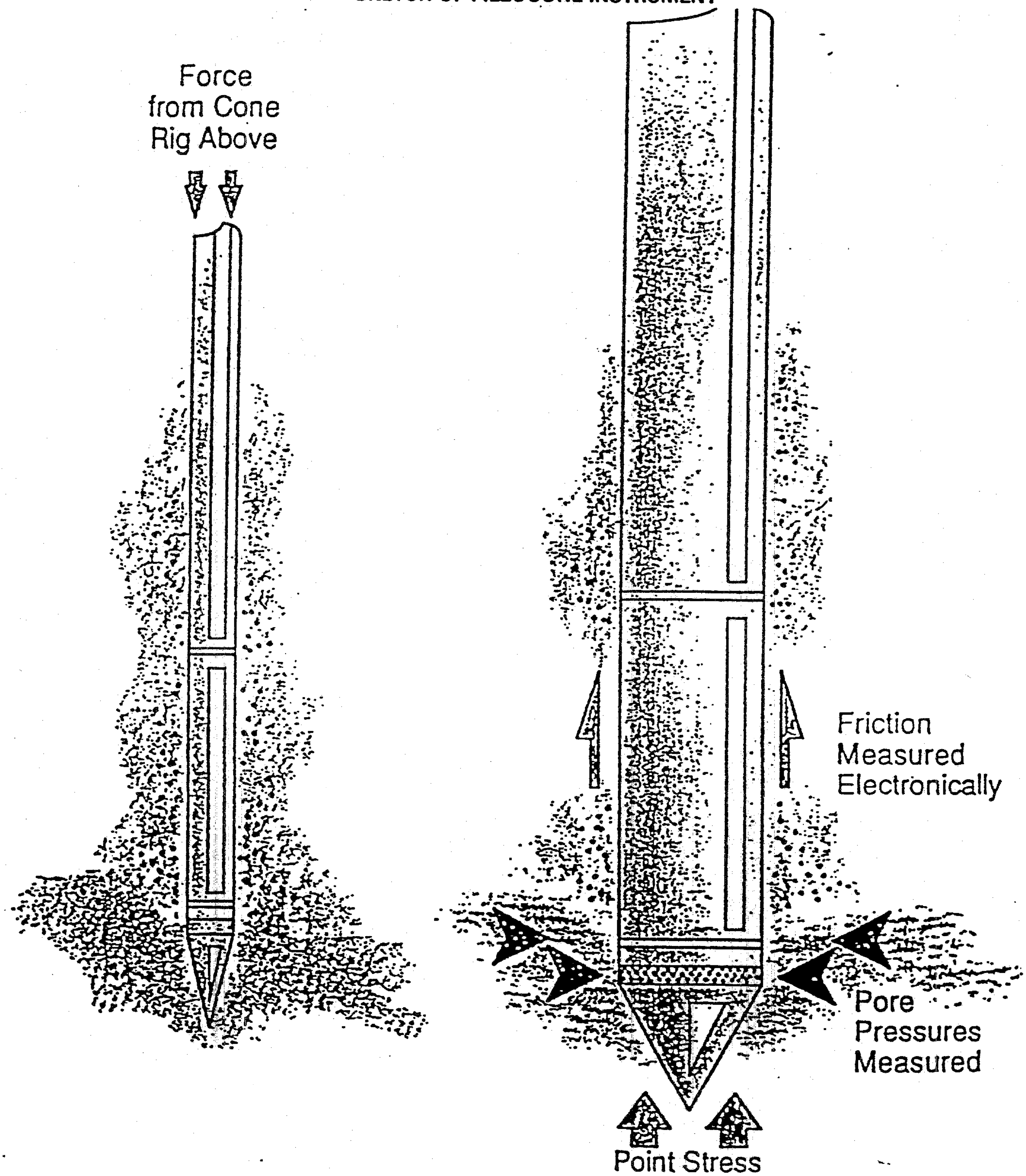


FIGURE 2

SKETCH OF GEOCONE INSTRUMENT

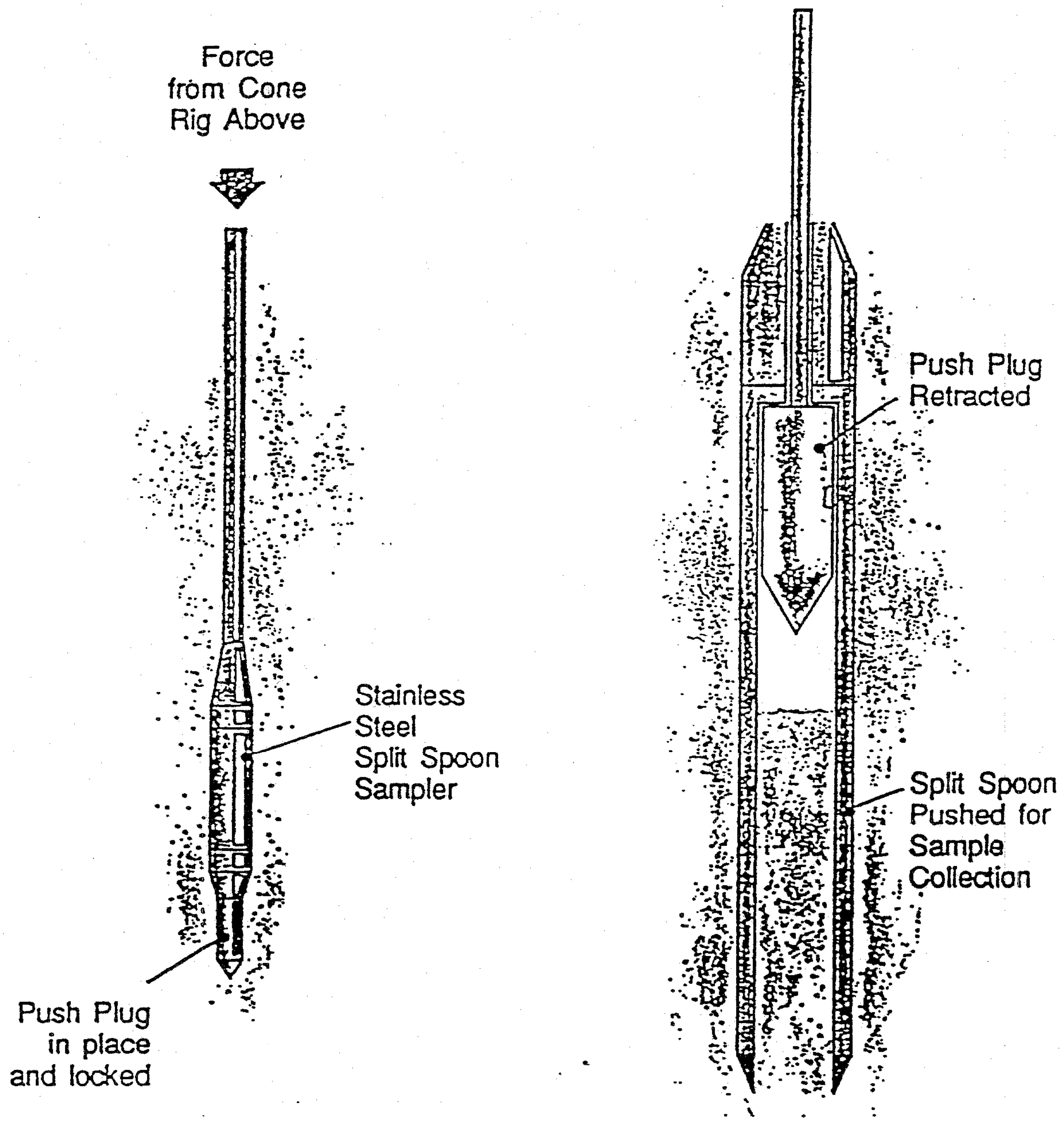
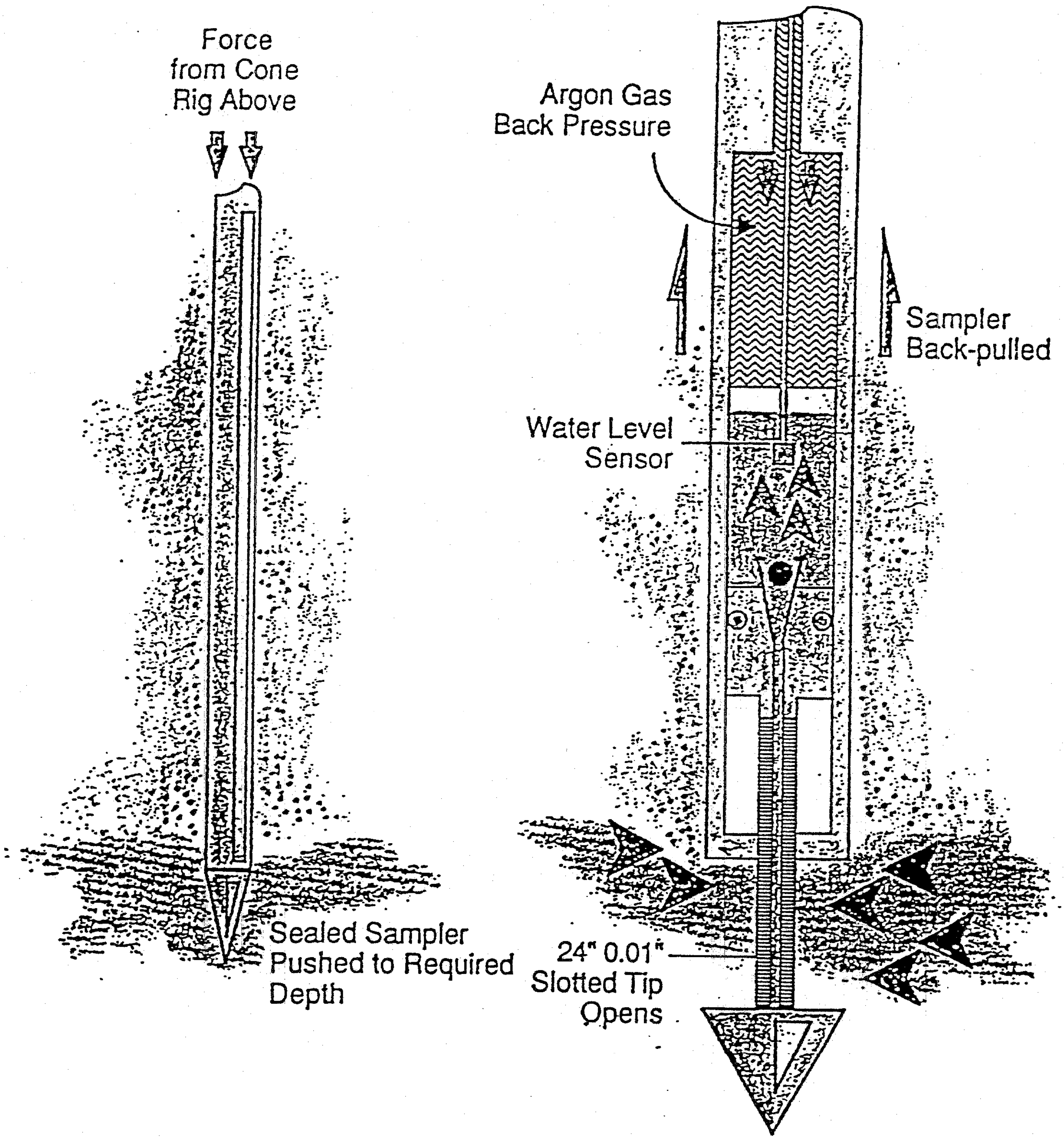


FIGURE 3

SKETCH OF HYDROCONE INSTRUMENT



APPENDIX B

PCB SCREENING METHODOLOGY

APPENDIX B

FIELD PCB TESTING PROCEDURAL GUIDELINES

As mentioned in section 3.0, field testing kits will be used to screen soil samples for PCBs. The designated field test kit is the semi-quantitative PCB RIS©™ Soil Test System manufactured by EnSys, Inc., of Research Triangle Park, North Carolina. This test is in conformance with proposed EPA SW 846 Method 4020 for immunoassay-based field screening for PCBs in soils.

The kit has a minimum detection level of 0.4 ppm and can detect Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260. EnSys will provide kits with the test level adjusted to the action level of 5 ppm for OU1. Five parts per million was chosen as an action level because it falls between the recommended residential soil action level of 1 ppm and the recommended industrial action level of 10-25 ppm.

The field test procedure will be performed according to the standard operating procedure provided with the field kits. In summary, soil samples are weighed, filtered and diluted. The sample and a standard are then placed in antibody-coated tubes. These antibodies are molecules which are developed to have a high degree of affinity for PCBs. After a designated time period, the tubes are washed out and color-developing reagents are added to the tubes. Finally, test results are obtained by comparing the color development in the tube which contained the soil sample to that developed in the standard. A photometer supplied by EnSys will be used for the color comparison. PCB concentration is inversely proportional to color development; the lighter the color development of the sample, the higher the concentration of PCBs.

This immunoassay-based testing method is specific to PCBs and is not based on detecting the presence of chloride ions. Therefore, no interferences due to the presence of other chlorinated compounds at the site is expected.

The PCB RIS©™ Soil Test is divided into four phases. Following is a description of and instructions for each phase, along with the equipment needed during each. Unless otherwise noted, all equipment listed is supplied in the test kit. Items needed for testing that are not supplied with the kit are:

- Permanent marking pen
- Laboratory tissue
- Timer or stopwatch
- Liquid waste container
- Disposable gloves

Phase I: Extraction and Preparation of the Sample

Equipment/Components Needed:

- Weigh boat
- Pan balance
- Wooden spatula

- Sample extraction jar
- Filtration barrel
- Filtration plunger
- Bulb pipette

Procedure:

1. Place the weigh boat on the pan balance.

2. Press ON/MEMORY button on the pan balance. The balance will beep and display 0.0.

3. Weigh out 10 +/- 0.1 grams of soil.

4. Remove the lid from the sample extraction jar and transfer the 10 grams of soil from the weigh boat to the jar.

5. Recap the extraction jar tightly and shake vigorously for one minute.

6. Allow to settle for one minute.

7. Remove lid from extraction jar.

8. Disassemble filtration plunger from filtration barrel.

9. Insert the bulb pipette into the top (liquid) layer in the extraction jar and draw up the sample. Transfer at least 1/2 bulb capacity into the filtration barrel. **Do not use more than one full bulb.**

10. Press the plunger firmly into the barrel until at least 1/2 mL of filtered sample is available (place on table and press if necessary).

The sample is now ready to be tested with the immunoassay.

Phase II: Dilution and Buffering of Sample and Standards

Equipment/Components Needed:

- Filtered sample (from Phase I)
- Permanent marking pen (not included in test kit)
- Foam workstation
- 3 blue buffer tubes
- 3 antibody-coated tubes
- Dilution vial marked "5"
- PCB standard vial marked "PCB Standard"
- Mechanical pipette
- 2 mechanical pipette tips

Notes Before Proceeding With Phase II:

A. Using a permanent marking pen, write **Standard 1** on one blue buffer tube and one antibody-coated tube. Write **Standard 2** on a second blue buffer tube and antibody-coated tube. Place these **Standard** tubes in the workstation provided with the test kit.

B. For each sample to be tested, place one **5 ppm** dilution vial in the work station. Write **5 ppm** on one blue buffer tube and one antibody-coated tube.

C. Assemble the new tip onto the mechanical pipette according to the instructions provided in the kit. Avoid withdrawing air bubbles when pipetting.

D. Do not attempt the test using more than 12 antibody-coated tubes at the same time.

Procedure:

1. Remove cap from the **5 ppm** dilution vial.

2. Withdraw 30 μL of filtered sample from Phase I using the mechanical pipette and dispense below the liquid level in the **5 ppm** dilution vial. Next, withdraw another 30 μL of filtered sample and dispense below the liquid level into the same **5 ppm** dilution vial for a total of 60 μL. Replace the cap and shake the vial gently for 5 seconds.

3. Remove cap from the **5 ppm** blue buffer tube.

4. Withdraw 30 μL of diluted sample from **5 ppm** dilution vial and dispense below the liquid level in the **5 ppm** blue buffer tube. Do not recap the blue buffer tube.

5. Gently shake the **5 ppm** blue buffer tube for 5 seconds.

6. Discard the mechanical pipette tip.

7. Assemble a new tip onto the mechanical pipette according to the instructions included in the test kit.

8. Remove tops from the PCB Standard vial and 2 blue buffer tubes marked **Standard 1** and **Standard 2**.

9. Withdraw 30 μL of PCB Standard and dispense below the liquid level in the **Standard 1** blue buffer tube.

10. Wipe the pipette tip with laboratory tissue.

11. Withdraw 30 μL of PCB Standard and dispense below the liquid level in the **Standard 2** blue buffer tube. Immediately replace the cap on the PCB Standard vial.

12. Discard the mechanical pipette tip.

13. Gently shake **Standard 1** and **Standard 2** blue buffer tubes for 5 seconds.

Folliwing completion of Phase II steps, proceed directly to Phase III.

Phase III: The Immunoassay and Color Development

Equipment/Components Needed:

- Foam workstation
- Blue buffer tube marked "5" (from Phase II)
- Blue buffer tube marked "Standard 1" (from Phase II)
- Blue buffer tube marked "Standard 2" (from Phase II)
- Antibody-coated tube marked "5" (from Phase II)
- Antibody-coated tube marked "Standard 1" (from Phase II)
- Antibody-coated tube marked "Standard 2" (from Phase II)
- Laboratory tissue (not included)
- Enzyme dropper
- Wash bottle
- Liquid waste container (not included)
- Stop watch or timer (not included)
- Substrate A (yellow cap)
- Substrate B (green cap)
- Stop Solution (red cap)

Notes before proceeding with Phase III:

A. This phase of the testing procedure requires critical timing and care in handling the antibody-coated tubes.

B. All washing must be done thoroughly and with force to remove all unbound material. The wash solution is a harmless, dilute detergent solution. Do not hesitate to wash vigorously even if the solution contacts gloved hands.

Procedure:

1. **Start timing** and immediately pour solution from each **Standard** blue buffer tube (1 and 2) into the appropriate Standard antibody-coated tube.

2. Pour the solution from the 5 ppm blue buffer tube into the 5 ppm antibody-coated tube.

3. When pouring is complete, gently shake all 3 tubes for 5 seconds.

4. Let the tubes stand for exactly 10 minutes.

5. Crush the glass ampule contained within the enzyme dropper by pressing the tube against a hard edge. Repeat this step to prepare one enzyme dropper for every 5 antibody-coated tubes.

6. Mix enzyme by turning dropper end-over-end 5 times. Do not shake.

7. Remove seal from enzyme dropper.

8. Dispense first drop from enzyme dropper into liquid waste container. **Note: Before dispensing drops, tap capped tip on hard surface to avioid dispensing air bubbles.**

9. At exactly 10 minutes, **start timing** and immediately dispense 3 drops into each antibody-coated tube (**Standards** and **Sample**) by squeezing the dropper. When complete, **gently shake** the antibody-coated tubes **for 5 seconds**.

10. Let tubes stand exactly 5 minutes.

11. After the 5-minute incubation (a total of 15 minutes), discard the solution from each antibody-coated tube into the liquid waste container.

12. Keeping the nozzle of the wash solution bottle just above the top of the antibody-coated tube, **forcefully** squeeze the wash solution into each tube with a strong, vigorous stream to fill each tube. Empty all 3 washed tubes into the liquid waste container. Repeat wash 3 times.

13. After the final (fourth) wash, tap the antibody-coated tubes upside down on a laboratory tissue.

14. Remove the top from Substrate A (yellow cap). Note: Keep Substrate dropper bottles vertical and direct each drop at the bottom of antibody-coated tubes. **Addition of more or less than the indicated number of drops of Substrate may give inaccurate results.**

15. Add 5 drops of Substrate A to each antibody-coated tube.

16. Remove top from Substrate B (green cap).

17. Start timing and immediately add 5 drops of Substrate B to each antibody-coated tube.

18. Shake all 3 tubes for 3-5 seconds, and let stand for exactly 2 1/2 minutes. Solution will turn blue in some or all antibody-coated tubes.

19. Stop reaction at end of 2 1/2 minutes by adding 5 drops of Stop Solution (red cap). Note: **Blue solution will turn yellow when Stop Solution is added.**

Phase IV: Interpreting Test Results

Equipment/Components Needed:

- Foam workstation
- Antibody-coated tube marked "5" (from Phase III)
- Antibody-coated tube marked "Standard 1" (from Phase III)
- Antibody-coated tube marked "Standard 2" (from Phase III)
- Laboratory tissue (not included)
- Photometer

Notes Before Proceeding With Phase IV:

A. In tis step, the standards are evaluated first in order to identify which is darker. To be conservative, the sample will be measured against the darker of the two standards.

Procedure:

1. Wipe the outside of **Standard 1** and **Standard 2** antibody-coated tubes with laboratory tissue.

2. Place both **Standard** tubes in the photometer.

3. If the photometer readout is negative or zero, the tube in the left well is the darker standard. Remove the tube from the right well and discard it. **However,** if the photometer reading is positive, the tube in the right well is the darker standard. Remove tube from the left well, discard it, and move the tube from the right well to the left well.

4. Wipe the outside of the **5 ppm** antibody-coated tube with laboratory tissue.

5. Place the **5 ppm** tube in the right well of the photometer and record the reading shown on the display.

If the photometer reading is **negative or zero,** PCBs are present in the sample.

If the photometer reading is **positive,** the concentration of PCBs in the sample is less than 5 ppm.

Storage and Handling Precautions

A. Wear protective gloves and eyewear when handling samples and standards.

B. Store kits at room temperature and away from direct sunlight.

C. Keep aluminized pouch (which contains unused antibody-coated tubes) sealed when not in use.

D. If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention. If Stop Solution or liquid from the extraction jar comes into contact with skin or clothing, wash thoroughly with cold water.

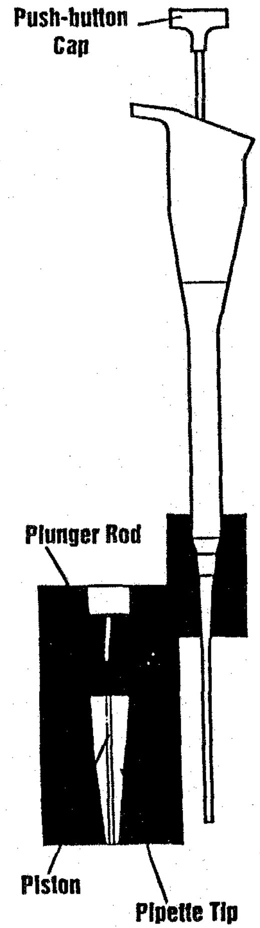
E. The Standard Solution contains PCBs, and test samples may contain PCBs. Handle with care.

Laboratory Confirmation/Quality Control

As suggested by the manufacturer, 10% of the soil samples analyzed by the field test method will be sent to a laboratory for confirmatory analysis. These samples will be analyzed by EPA Method 8080. Of these samples sent, 80% will be samples which tested above 5 ppm, and 20% will be samples which tested below 5 ppm.

EnSys, Inc., maintains that the PCB RIS©™ Soil Test System will give correct results 95% of the time if the system is used, handled and stored according to their instructions, which are summarized above.

HOW TO OPERATE THE MECHANICAL PIPETTE



To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "030". Tighten volume lock screw and replace push-button cap.

To Assemble Pipette Tip

Slide larger mounting end of pipette tip onto end of pipette. Holding tip in place, press push-button until plunger rod enters pipette tip. Ensure no gap exists between piston and plunger rod (see illustration).

To Withdraw Sample

With tip mounted in position on pipette, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipette, please refer to your pipette manual.

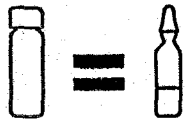
ENSYS INC

PCB RISc™ SOIL TEST SYSTEM

1 ppm

User's Guide

We've Improved!



For ease of use, at many common dilution levels, we have replaced the dilution vial with the dilution ampule.

To Open ampule: Tap on hard surface, then slip plastic safety sleeve over top. Break tip at scored neck.

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

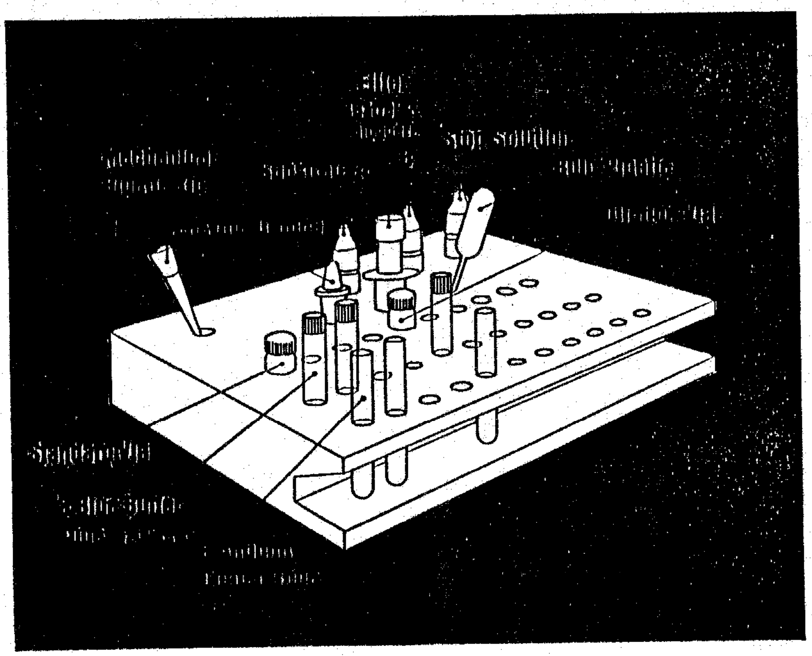
IMPORTANT NOTICE

The Test System performs accurately only when used as directed. This User's Guide is brief. Read it carefully prior to using the Test System. It will increase understanding of test objectives and help ensure a successful test.

WORKSTATION SET-UP

Assemble the following components in the workstation:

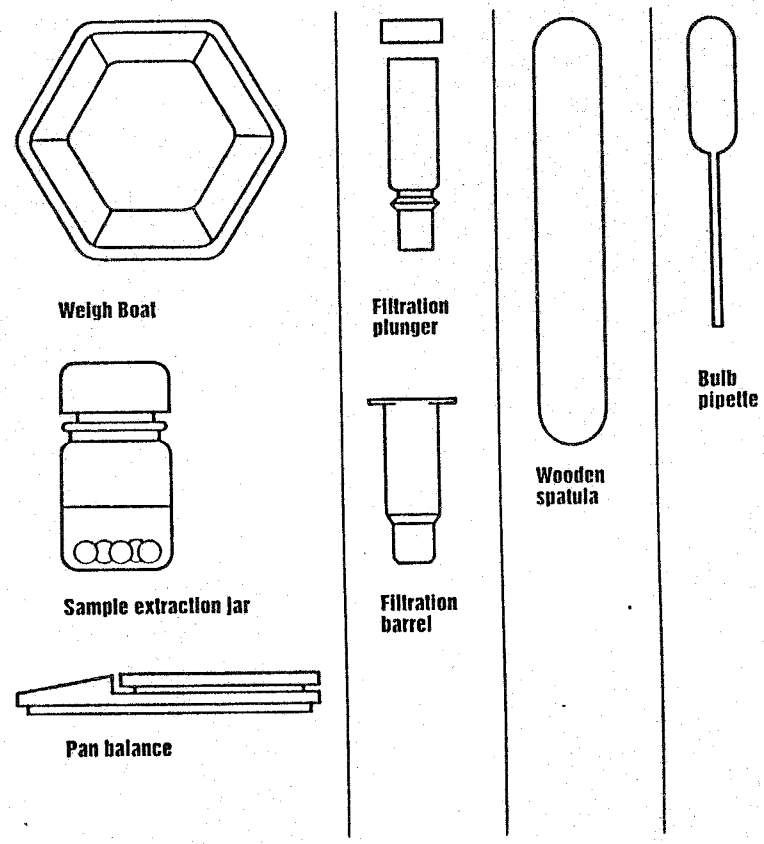
- □ 3 antibody coated tubes
- □ PCB standard vial
- □ Enzyme dropper
- □ Bulb pipette
- □ Substrate A
- □ Stop solution
- □ 3 blue buffer tubes
- □ 1 ppm dilution vial
- □ Filtration barrel & plunger
- □ 2 mechanical pipette tips
- □ Substrate B



PHASE ONE
COMPONENTS FOR EXTRACTION & SAMPLE PREPARATION

Assemble the following components:

- □ Weigh boat
- □ Pan balance
- □ Wooden spatula
- □ Sample extraction jar
- □ Filtration barrel
- □ Filtration plunger
- □ Bulb pipette



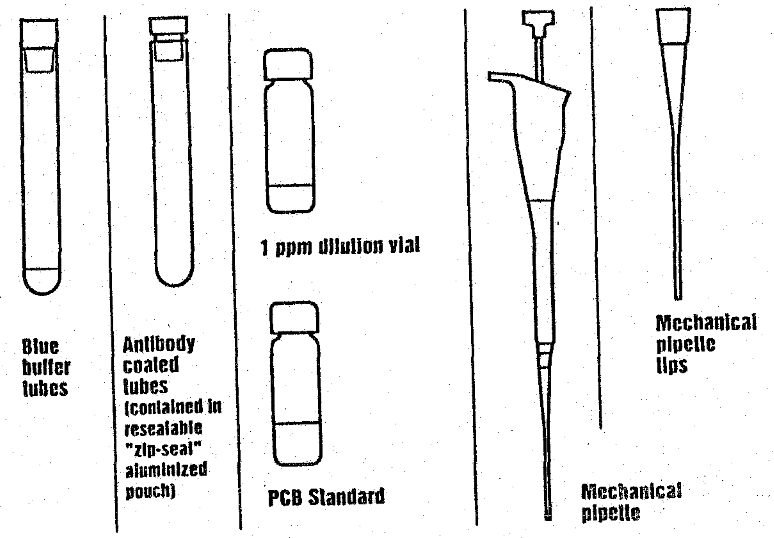
PHASE TWO
COMPONENTS FOR DILUTION OF SAMPLE & STANDARDS

Use the following component from Phase One:

- ☐ **Filtered sample**

Use the following additional components:

- ☐ **Permanent marking pen (not included in test)**
- ☐ **3 blue buffer tubes**
- ☐ **3 antibody coated tubes**
- ☐ **Dilution vial marked "1"**
- ☐ **PCB standard vial marked "PCB Standard"**
- ☐ **Mechanical pipette**
- ☐ **2 mechanical pipette tips**



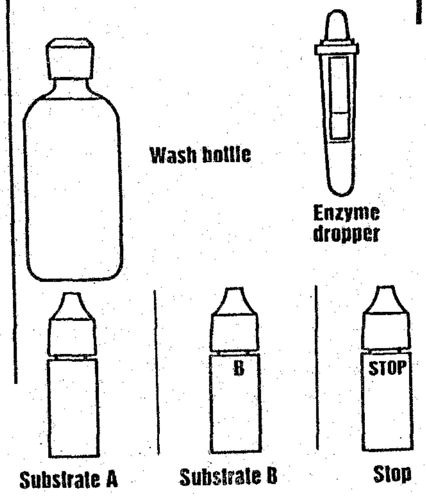
PHASE THREE
COMPONENTS FOR IMMUNOASSAY & COLOR DEVELOPMENT

Use the following components from earlier phases:

- ☐ **Foam workstation**
- ☐ **Blue buffer tube marked "1"**
- ☐ **Blue buffer tube marked "Standard 1"**
- ☐ **Blue buffer tube marked "Standard 2"**
- ☐ **Antibody coated tube marked "1"**
- ☐ **Antibody coated tube marked "Standard 1"**
- ☐ **Antibody coated tube marked "Standard 2"**
- ☐ **Laboratory tissue (not included)**

Use the following additional components:

- ☐ **Enzyme dropper**
- ☐ **Wash bottle**
- ☐ **Liquid waste container (not included)**
- ☐ **Stop watch or timer**
- ☐ **Substrate A (yellow cap)**
- ☐ **Substrate B (green cap)**
- ☐ **Stop Solution (red cap)**



PHASE FOUR
COMPONENTS FOR INTERPRETING TEST RESULTS

Use the following components from earlier phases:

- ☐ **Foam workstation**
- ☐ **Antibody coated tube marked "1"**
- ☐ **Antibody coated tube marked "Standard 1"**
- ☐ **Antibody coated tube marked "Standard 2"**
- ☐ **Laboratory tissue (not included)**

Use the following additional component:

- ☐ **Photometer**