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Project Workplans

Remedial Investigation/ Feasibility Study for Sites 15 and 16 Naval Station Roosevelt Roads Puerto Rico

Prepared for

Atlantic Division,
Naval Facilities Engineering Command
Norfolk, Virginia

Prepared by

Versar INC.

April 9, 1991

Versar INC.

WORK PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY OF SUBSTATION NO. 2 - BLDG. 90 (SITE 15) AND OLD POWER PLANT - BLDG. 38 (SITE 16) NAVAL STATION ROOSEVELT ROADS PUERTO RICO, U.S.A.

Prepared for:

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1.0 INTRODUCTION

Versar, Inc. has been contracted by the U.S. Navy Facilities Engineering Command (NAVFACENGCOM), Atlantic Division (LANTDIV), to perform a follow-up Remedial Investigation and Feasibility Study (RI/FS) in order to complete the RI/FS efforts for two sites identified in the Initial Assessment Study (Sites 15 and 16) at Naval Station (NAVSTA) Roosevelt Roads (RR), Puerto Rico. This Work Plan, Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HSP) describe the available environmental information concerning the site, the detailed tasks required to complete the RI/FS efforts, and the manner in which they will be accomplished and managed.

NAVSTA Roosevelt Roads is located on the east coast of Puerto Rico and encompasses over 30,000 acres of land. It is approximately 33 miles southeast of San Juan (Figure 1). The town of Ceiba is located near the station's western boundary. It has the largest population in the vicinity of the station, with 15,000 people in an area of approximately 27.5 square miles.

This Work Plan has been developed for Substation 2, (Site 15) and The Old Power Plant, (Site 16) on the base (Figure 2). A Preliminary Assessment and Site Investigation, PA/SI (IAS under the Navy's older NACIP terminology) has been completed for NAVSTA Roosevelt Roads, including Substation No. 2 and the Old Power Plant. A site investigation (called a confirmation study under the NACIP terminology) was conducted for each of these sites. The PA/SIs indicated PCBs present in soil at concentrations exceeding ARARs, and partially delineated the extent of soil contamination.

This work plan and its companion documents (FSP, QAPP, and HSP) have been developed based on the findings of the previous PA/SI. Previous site documents have been used for scoping purposes. The data generated during the follow-up RI/FS at these two sites are intended to field check previous data, further define the vertical and horizontal extent of soil contamination, examine exposure pathways (sediment) that were not previously evaluated, provide a data set suitable for full validation for use in the risk assessment, and select a remedy for these sites.

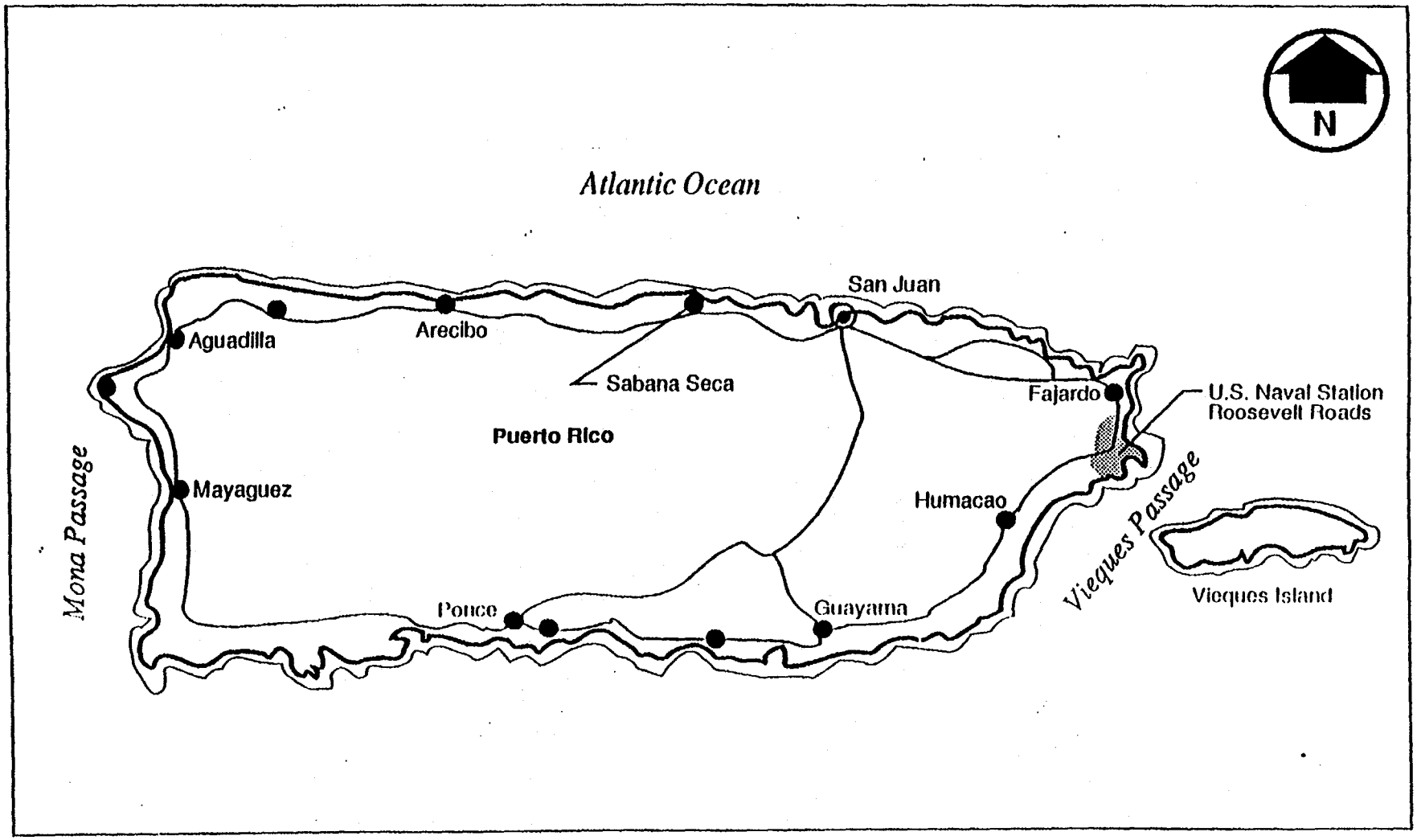

FIGURE 1
LOCATION OF NAVSTA ROOSEVELT ROADS, PUERTO RICO

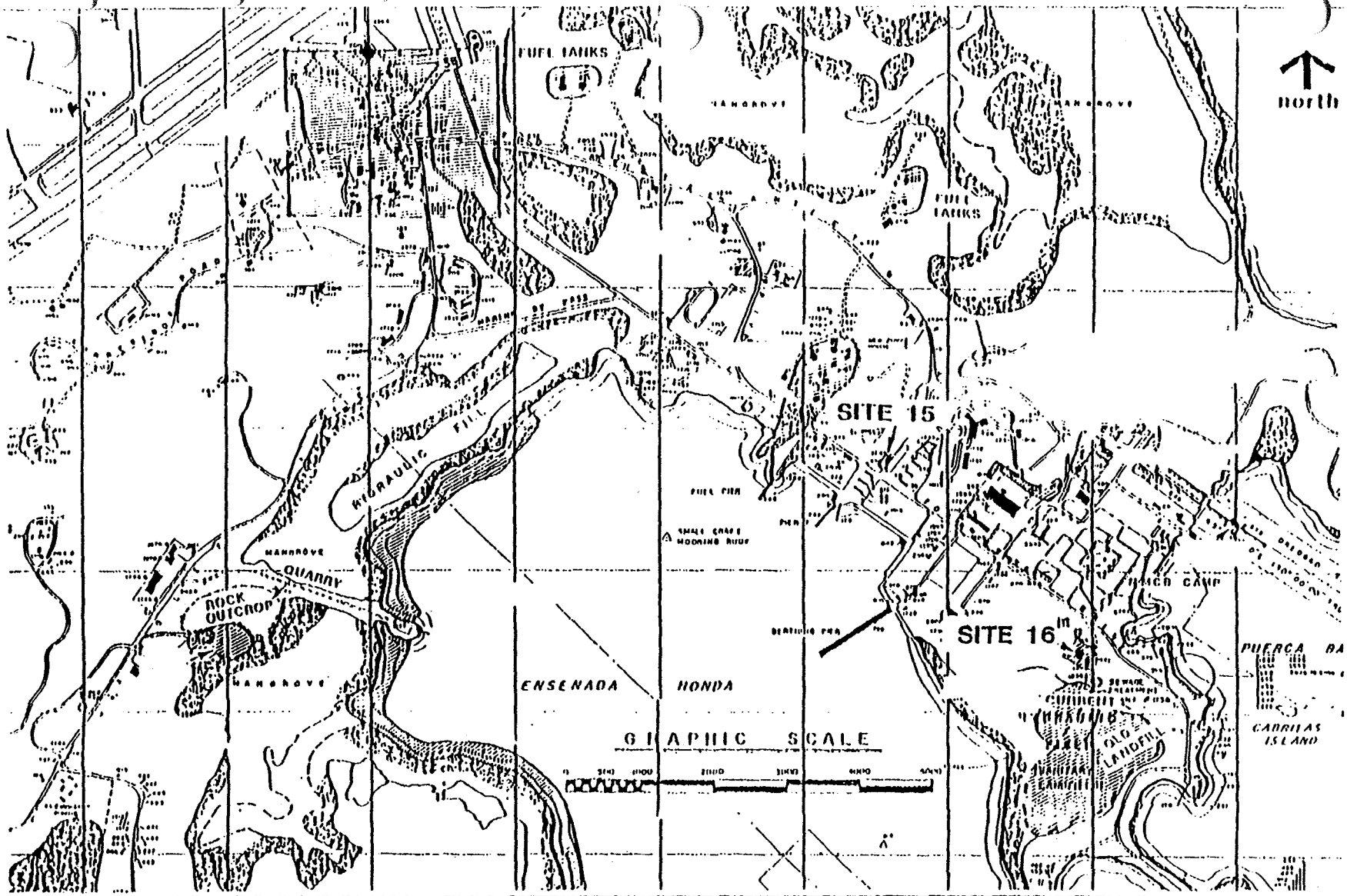

FIGURE 2 LOCATIONS OF SITES 15 AND 16, NAVSTA ROOSEVELT ROADS

U.S. NAVAL COMPLEX
PUERTO RICO

1.1 Description of the Navy IR Program

The Navy Installation Restoration (IR) program is a comprehensive program to identify and evaluate past hazardous material disposal sites on Navy installations, and to control the migration of hazardous environmental contamination resulting from such sites. The IR program is also applicable to facilities or lands that are excess to mission needs and, therefore, might be made available for other public or private use.

Past hazardous waste disposal methods, although acceptable at the time, have often caused unexpected long-term problems through the release of hazardous pollutants into the soil and ground water. In response to increasing national concern regarding these problems, Congress directed the United States Environmental Protection Agency (EPA) to develop a comprehensive national program to manage past disposal sites. The program is outlined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of December 1980. Department of Defense (DOD) efforts in this area preceded the nationwide CERCLA program.

In 1975, the U.S. Army developed for DOD a pilot program to investigate past disposal sites at the military installations. DOD defined the program as the Installation Restoration Program in 1980, and instructed the services to comply with program guidelines. The Navy managed its environmental investigations under a program called the Navy Assessment and Control of Installation Pollutants (NACIP). The NACIP Program had three phases: Phase One, The Initial Assessment Study (IAS), identifies potential threats to human health or to the environment caused by past hazardous substance storage, handling. or disposal practices at Naval activities. Phase Two, the Confirmation Study, analyzes contaminants present at sites of concern and determines their migration paths. Phase Three, Remedial Action, provides the required corrective measures to mitigate or eliminate confirmed problems.

Previous investigations of Sites 15 and 16 at NAVSTA Roosevelt roads have been conducted under a Confirmation Study, Phase Two of the Navy Assessment and Control of Installation Pollutants (NACIP) program. As a result of the Superfund Amendments and Reauthorization Act of October 1986 (SARA), the Navy has changed its program to follow rules, regulations, guidelines, and criteria established by EPA for the Superfund program. SARA also mandated that DOD reports be reviewed by a Technical Review committee (TRC) composed of representatives from EPA, state and local governments, and the local community. The names used to describe documents, field activities, and types of

investigatory activities are now consistent with the terminology used by EPA in most Superfund Investigations. A comparison of NACIP and EPA Superfund terminology is given in Table 1.

As a result of the previous IR investigation programs, Site 15 and 16 current status is: PA/SI completed, and follow up RI/FS pending.

1.2 PA/SI Activities at Substation No. 2 (Site 15)

Substation No. 2, Site 15, has been used by the Public Works Department - Power Distribution Shop for the repair of pole-mounted distribution electrical transformers (Figure 3). From 1964 to 1979, the oil from these transformers was drained or subsequently poured onto the ground. The drained oil in whole or in part was contaminated with polychlorinated biphenyls (PCBs). This site was the subject of an Initial Assessment Study. The IAS began with a records search at various government agencies, including base and NAVFACENGCOM, national and regional archives and records centers, and U.S. Geological Survey offices. In this initial step, study team members reviewed records to assimilate information about the activity's mission, industrial processes, waste disposal records, and known environmental contamination. Typical examples of records include activity master plans and histories, environmental impact statements, historical records, and aerial photographs.

After the records search, the study team conducted an on-site survey to complete documentation of past operations and disposal practices and to identify potentially contaminated areas. With the assistance of an activity point of contact, the team inspected the activity during ground and aerial tours,and interviewed long-term employees and retirees.

The on-site survey for NAVSTA Roosevelt Roads was conducted from January 15 to February 10, 1984. Based on the information provided in the IAS Report, a Confirmation Study was performed for Substation 2, Site 15 and the Old Power Plant, Site 16. A Confirmation Study is typically divided into verification and characterization phases and is recommended only for sites at which (1) sufficient evidence exists to indicate the presence of contamination, and (2) the contamination poses a potential threat to human health or to the environment.

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TABLE 1

NACIP VERSUS EPA-SUPERFUND
INVESTIGATION AND TERMINOLOGY

FORMER	NEW
- Initial Assessment Study	- Preliminary Assessment (PA) - Site Investigation (SI)
-Confirmation Study -- Verification -- Characterization -- Feasibility	- Emergency Removal Action (if necessary) - Remedial Investigation/Feasibility Study (RI/FS-Community Relations Program) - Record of Decision (ROD) - Remedial Action Plan (RAP)
- Remedial Measures	- Remedial Action

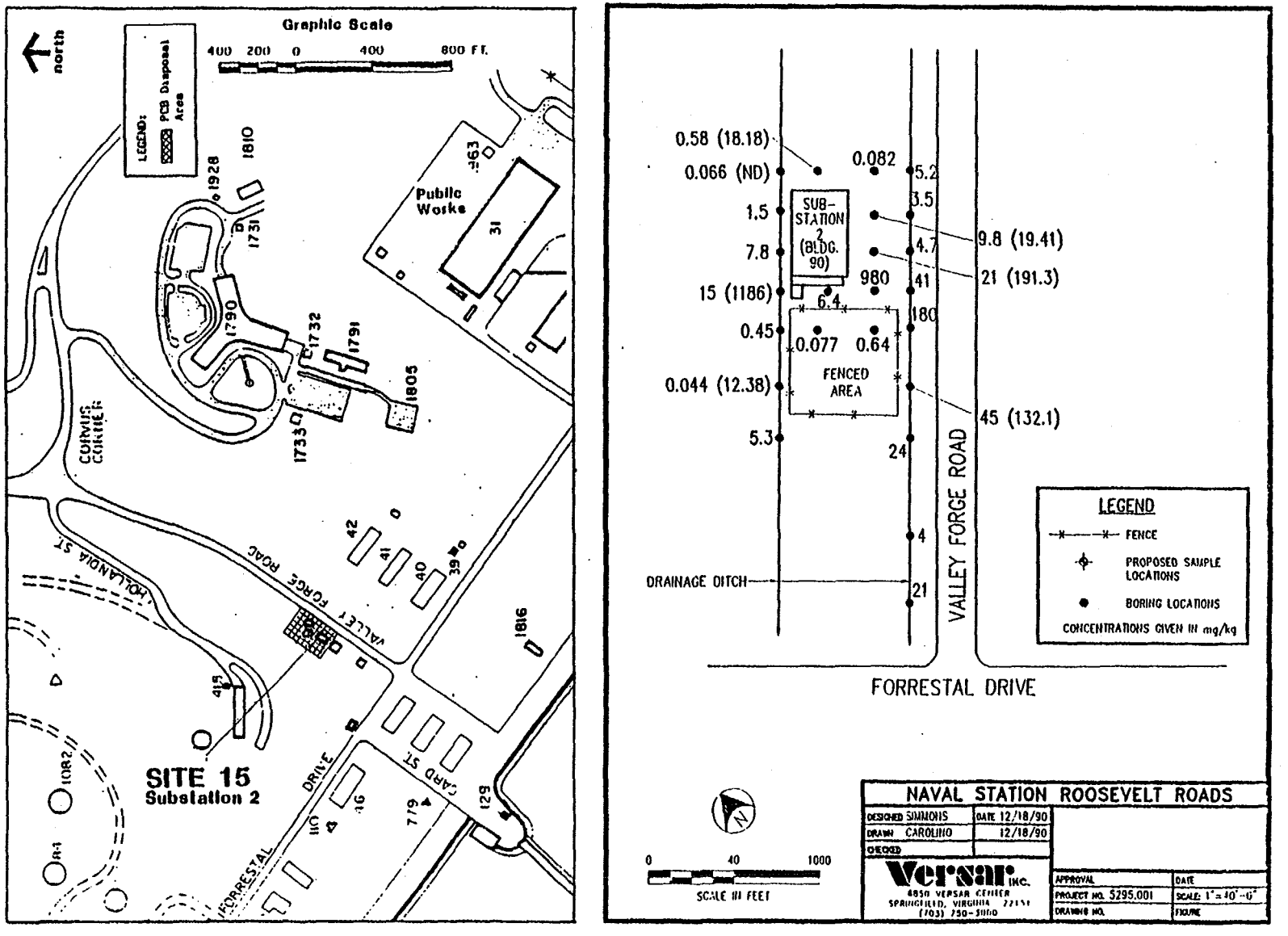

FIGURE 3
LOCATION AND CONFIRMATION STUDY SAMPLING LOCATIONS FOR
SITE 15: SUBSTATION NO. 2, BUILDING 90,
NAVSTA ROOSEVELT ROADS, PUERTO RICO

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As part of the Confirmation Study, thirty-six soil samples were collected from 33 hand augered soil borings at Site 15. Soil samples were collected from the surface to a depth of one foot below land surface (BLS) in all but two of the borings which were extended deeper. The soil samples were analyzed for PCBs. Concentrations of PCBs ranged from ND (not detected) to 1,186 ppm. The sample locations and results are shown on Figure 3. PCB levels above 50 ppm were found at four sampling locations. The highest concentrations were found around Building 90 and in the drainage ditch along Valley Forge Road. Two samples from the fenced-in storage yard were <1 ppm. The sample results and locations were presented in a report entitled Remedial Action Alternatives Analysis for Substation 2, Site 15, USNAVSTA Roosevelt Roads, Environmental Science and Engineering, Inc., February 1988. No remedial actions have been performed at Site 15 to date.

1.3 PA/SI Activities at the Old Power Plant (Site 16)

The Old Power Plant, Building 38, at the Naval Station (NAVSTA) Roosevelt Roads (Figure 4), was a 60 megawatt steam turbine facility that generated power from the early 1940s through 1949. The plant used Bunker "C" fuel, which was stored in two 50,000-gallon reinforced concrete tanks located directly northwest of the building. During heavy rainfalls in the 1970s, C fuel was observed in manholes near the building and discharged to an adjacent beach (i.e., Enlisted Beach) via the old cooling water outlet for the Power Plant. A cleanup contractor was hired twice to drain the underground fuel tanks and cleanup the spill. This area, where the underground storage tanks are located, is now paved over with concrete.

From 1956 to 1964, transformer maintenance was performed at Building 38 by the Public Works Power Distribution Shop. The majority of transformer repair work was conducted just outside of the building at its northeast corner. As part of the maintenance of the transformers, the transformer oil was drained to facilitate repair of the inner cores and coils. Interviewees reported draining the transformers to the soil in the immediate vicinity of the building. The only exception to this practice was with Askarel (a type of PCB) transformers. Power Distribution Shop employees drained transformers containing Askarel directly to 55-gallon drums which were disposed of at the station landfill. The exact quantity of Askarel disposed of in this manner is unknown. The Power Distribution Shop ordered 200 gallons of replacement transformer fluid per year. Assuming the total 200 gallons were used each year, it is possible that over the eight years during which

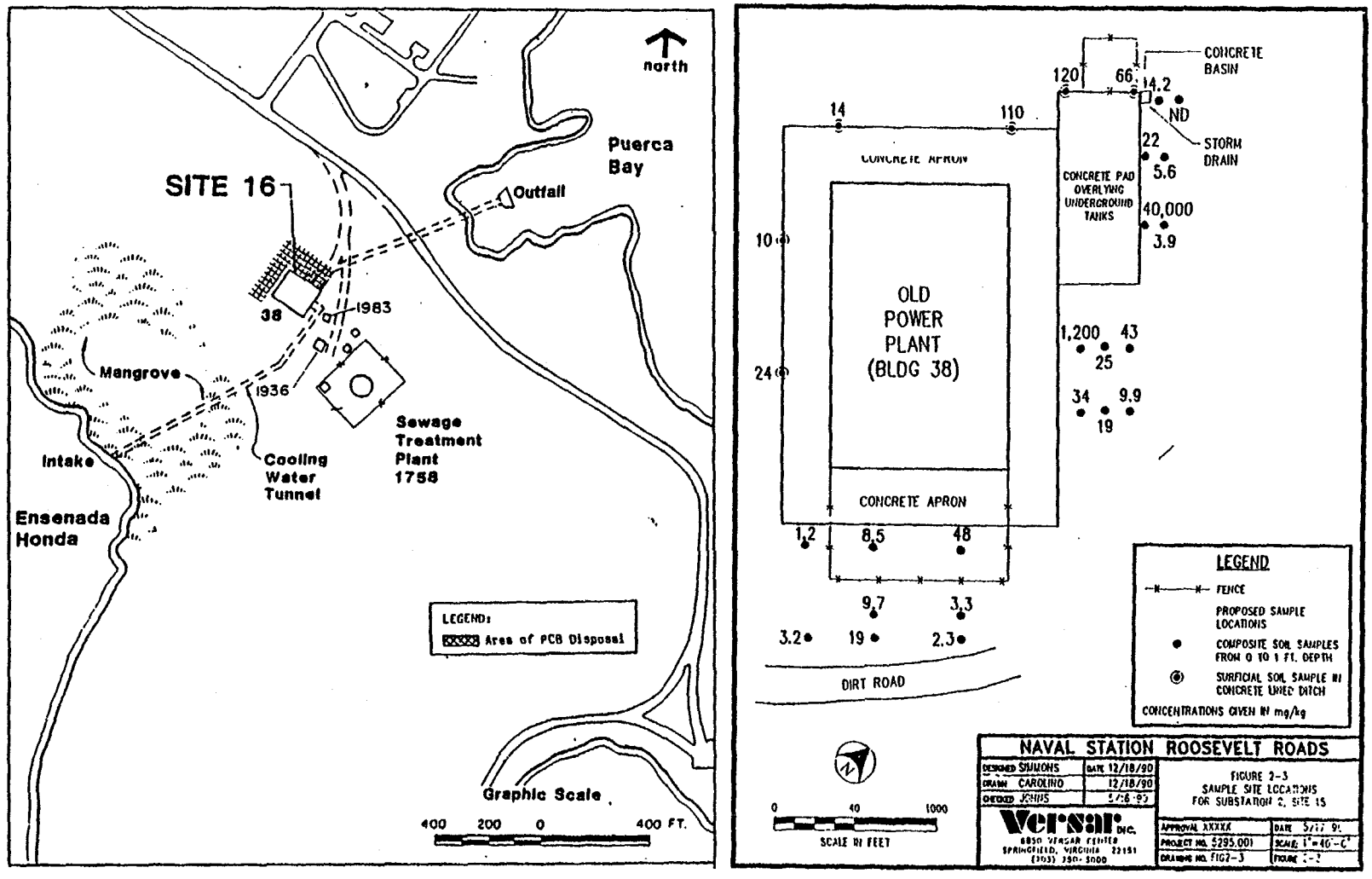

FIGURE 4
LOCATION AND CONFIRMATION STUDY SAMPLING
LOCATIONS, SITE 16: OLD POWER PLANT, BUILDING 90
NAVSTA ROOSEVELT ROADS, PUERTO RICO

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Building 38 was used, approximately 1,600 gallons of transformer oil were drained to the soil in the vicinity of the building, with some portion going to the landfill. The transformer oil commonly used in this time frame was either "pure" PCBs or oil containing PCBs at a 300-ppm concentration (ESE 1988b).

For the Confirmation Study, thirty-eight soil samples were collected from the site (9 in Round 1 and 29 in Round 2). These samples were analyzed for PCBs, oil and grease, volatile organic compounds (VOC), ethylene dibromide (EDB), xylenes, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK). In Round 2, an EP toxicity test for lead was completed. The analytical results indicated the presence of PCB and lead contamination at the site. Lead concentrations were less than the EP toxicity standard for lead. Other constituents detected (but not at levels of concern) were MEK as well as oil and grease. The site plan on Figure 4 shows the PCB concentrations of samples collected for the Confirmation Study. The sample results and locations were presented in the report entitled Remedial Action Alternatives Analysis for The Old Power Plant, Site 16, USNAVSTA Roosevelt Roads Environmental Science and Engineering, Inc., May 1988. No Remedial Actions directed toward PCB contamination have been performed at Site 16 to date.

1.4 Activity Mission Relating to Waste Disposal at Sites 15, and 16

The primary mission of NAVSTA Roosevelt Roads is to provide full support for Atlantic Fleet weapons training and development activities. Sites 15 and 16 are under the jurisdiction of the Power Distribution Shop. The Power Distribution Shop maintains and repairs the electrical distribution system for NAVSTA Roosevelt Roads. This department is responsible for maintenance and servicing of electrical transformers of over 600 volt rating and maintains 13 main transformers in eight substations located at the airfield, industrial area, bundy area, and the Capehart Housing area.

1.4.1 Site 15: Substation No. 2, Building 90

From 1964 to the present, the Power Distribution Shop has maintained and repaired transformers at Substation No. 2, Building 90. As part of maintenance of the transformers, the transformer oil was drained to facilitate repair to the inner cores and coils. During 1964 to 1979, it was routine practice to drain or pour the transformer oil onto the ground at the work location. It is estimated that a maximum of 3,000 gallons of PCB-

contaminated transformer oil was disposed of on the ground at the site during that period of time.

1.4.2 Site 16: Old Power Plant, Building 38

The Old Power Plant is no longer in use for power distribution to the station nor, for the repair and storage of electrical transformers. From 1956 to 1964 building 38, Site 16 was used for the repair and storage of electrical transformers. During this period, used oil drained from transformers was poured onto the ground in the vicinity of Building 38. It is estimated that a maximum of 1,600 gallons of transformer fluid containing PCB's were disposed of in the area.

1.5 Description of Current Study

The current study is a continuation of the assessment work previously performed at Substation 2, Building 90 (Site 15), and the Old Power Plant, Building 38 (Site 16) under the IAS and Confirmation Study. The goal of the current investigation is to 1) complete the RI/FS; 2) define the areas of contamination by additional sampling and analysis; and (3) perform a risk assessment of each site and evaluate potential remedial actions and target cleanup levels.

1.5.1 Scoping Documents

Scoping documents prepared for the RI/FS of Sites 15 and 16 at NAVSTA Roosevelt Roads include this Work Plan, a Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and a Health and Safety Plan (HSP). A Community Relations Plan (CRP) is also being prepared for submittal at a later date. In accordance with Data Quality Objectives for Remedial Response Activities (EPA, 1987a), Versar has identified data users and tailored these documents to specific users of the information. The information contained in the QAPP contains some information also contained in the work plan and FSP so that the QAPP may be more easily used by laboratory personnel that do not need the detailed information contained in other scoping documents.

Scoping documents have been prepared in accordance with Guidance for Conducting RI/FSs Under CERCLA (EPA, 1988), and Preliminary Assessment Guidance (EPA, 1988b), according to the format provided in the Handbook to Support the Installation Restoration Program Statements of Work for RI/FSs (AFOEHL/MITRE, 1989). Technical approach

and sampling procedures have been reviewed for conformance to the substantive aspects of the Compendium of Superfund Field Operations Methods (EPA, 1987b), the Region II CERCLA Quality Assurance Manual (EPA, 1988c), Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA, 1983a), and other guidance as necessary. Each of the above plans (except the CRP) is attached as an appendix to this work plan. A brief description of each plan and its objectives is given below.

Field Sampling Plan (FSP). The overall objectives of the FSP are: (1) to document specific objectives, procedures, and rationales for field work and sample analytical work; (2) to provide a mechanism for planning and approving site and sampling activities; (3) to ensure that sampling and analysis activities are necessary and sufficient to meet project objectives; and (4) to provide a common point of reference for all parties to ensure the comparability and compatibility of all objectives and sampling and analysis activities. The plan documents how tasks will be performed related to all field sampling, analyses, data quality objectives, and procedures or protocols for field sampling and analysis set forth by the RI/FS Work Plan and the Quality Assurance Project Plan (QAPP).

The FSP will be the framework of all anticipated field activities (e.g., sampling objectives, evaluation of existing data, standard operating procedures) and contain specific information on the field work (e.g., sampling locations and rationale, sample numbers and rationale, analyses of samples).

Quality Assurance Project Plan (QAPP). Versar has prepared a QAPP for NAVSTA Roosevelt Roads Substation 2 (Site 15), and The Old Power Plant (Site 16) in accordance with the guidance provided in "Interim Guidelines and Specific Actions for Preparing Quality Assurance Project Plans" (EPA, 1983a). The emphasis of the QAPP will be on the activities which generate analytical data. In this context, analytical chemistry includes those aspects of field sampling that may affect the chemical integrity of samples, as well as the laboratory activities.

The QAPP presents a project description and the project organization and specify the Quality Assurance (QA) objectives, the technical approach, the sampling procedures, the analytical procedures, the data evaluation procedures, the quality control procedures, and the corrective action procedures that will be implemented by Versar during the RI/FS. Versar's implementation of these procedures will help to ensure the validity of data and provide a reliable foundation on which to base decisions. In implementing these procedures, Versar will continue its internal QA/QC policies which are consistent with U.S.

EPA guidelines. QA is defined as an integrated program with associated procedures that is designed to assure that monitoring of quality-related activities has occurred. Quality control (QC) are the procedures used to measure the performance of analytical methods and associated activities. Proper documentation of the results of these procedures is an essential part in providing the basis for the QA program and include concern for the traceability, completeness, and security of documents. QA includes the specific actions of review, evaluation, and control activities that are necessary to ensure that prescribed standards of performance are met. It is these actions which ensure the recision and accuracy of the results.

Health and Safety Plan (HSP). The objective of the Versar site-specific HSP is to establish the procedures, personnel responsibilities, and training necessary to protect the health and safety of all on-site personnel during the RI/FS. The plan provides for routine, but hazardous, field activities and for unexpected site emergencies. The plan addresses chemical and local environmental (biota) aspects of conducting the RI/FS in a manner that is protective of on-site personnel, the public, and the environment.

The site-specific health and safety requirements and procedures in the HSP are updated based on an on-going assessment of site condition, including the most current information on each medium.

The HSP describes the on-site person responsible for implementing the HSP. The measures contained in the HSP are developed and implemented to ensure compliance with all applicable state and federal occupational health and safety regulations. The HSP will be consistent with the objectives and contents of all other plans submitted by Versar. It will be updated at the request of LANTDIV during the course of the RI/FS and as deemed necessary by the Versar staff.

Community Relations Plan (CRP). Following community interviews, Versar will prepare a CRP in conjunction with the Public Works Department, IR Program Manager, who will coordinate with the Public Affairs officer for the activity. The primary elements of community relations support will consist of the following:

- Assistance to the NAVSTA Roosevelt Roads Public Affairs Office on RI/FS issues.
- Preparation of agenda for Technical Review Committee.
- Participation and presentations in public meetings/interviews.

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All Versar staff will be schooled in the importance of the CRP and their responsibilities regarding direct contact with the general public or news media. The Versar staff will refer interested parties to the base Public Affairs Officer and EIC.

2.0 SUMMARY OF EXISTING INFORMATION

Available site information from NAVFACENGCOM files and results of the Initial Assessment Study (PA) and Confirmation Studies (SIs) at Sites 15 and 16 were reviewed in scoping the RI/FS. This information has been summarized and used to develop a sampling rationale for each site, identify preliminary remedial alternatives and ARARs, and assess data needs.

2.1 Installation/Site Environmental Setting

NAVSTA Roosevelt roads is located on the east coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of the capital city of San Juan. It is bordered on all side, but the West by the Caribbean Sea. Located to the southwest is agricultural land use and Bosque Estatal de Ceiba, a mangrove forest adjacent to the station's western border. Immediately to the west of the station and adjacent to its western border is the town of Ceiba (Figures 1 and 2). The nearest major town is Fajardo located 10 miles north of the station.

Elevations on the base range from sea level to 1,050 feet above sea level, with the tallest peak located within two kilometers of the station's boundary. The station is located over an area with hills and valleys of the coastal plain extending from the Sierra de Luquillo range. In the low-lying shore area, seawater flooding results from storms, wind, and abnormally high tides. The region has a humid, tropical climate, moderate temperatures, dense vegetation, and high rainfall.

Contamination migration from Site 15 can potentially occur by surface runoff and soil erosion through two drainage ditches. Surface runoff would occur from the series of drainage ditches which empty into the Rio Daguao watershed to the Vieques Passage, or into the mangroves that fringe Ensenada Honda and Puerca Bay (Figures 1, 2, and 3).

Ground water movement near Site 16 flows generally in either a north to northeast direction (direction dictated by local topography) into the mangrove swamps and Puerca Bay or to the south and southeast into Ensenada Honda (Figure 4). However, PCBs are relatively immobile in aqueous media. Further description of the geology, soils, hydrology, biology, climate, and demography will be described below.

Contaminant migration from Site 16 could occur by subsurface flow in the old cooling water discharge tunnel. The site is at a high point on hydraulic fill with a gentle (3%) slope to the northeast toward Puerca Bay and southwest toward Ensenada Honda, both within 250 meters (Figure 4).

2.2 Contaminant Source Areas

NAVSTA Roosevelt Roads Substation 2 (Site 15), and Old Power Plant (Site 16) were areas used to repair pole-mounted electrical transformers. The PCB-contaminated dielectric fluid was drained onto the ground. Several types of fluids were used and these included pyranol, inerteen, and askeral. Short summaries of previous sampling and analytical results at each site are provided below.

Site 15, Substation No. 2, Building 90

Soil samples were taken from this site during the Confirmation Study, first to verify that PCBs were present at the site, and to begin defining the extent of contamination. The analytical data for these soil samples show that PCB contamination exists in the area surrounding Substation No. 2. However, no PCB contamination was detected in the soil in the storage yard. This PCB contamination might pose an imminent health or environmental threat on or off the Naval Facility. A preliminary site-specific risk assessment and remedial action alternatives analysis were completed based on the characterization data.

Thirty-six soil samples were collected from 33 hand augered soil borings at Site 15. Soil samples were collected from the surface to a depth of one foot below land surface (BLS) in all but two of the borings which were extended deeper. The soil samples were analyzed for PCBs. Concentrations of PCBs ranged from ND (not detected) to 1,186 ppm (Figure 3). PCB levels above the 50 ppm PCB clean-up requirements set forth by EPA in the TSCA policy were found at four sampling locations.

The preliminary risk assessment found that the worst case scenario involves dermal absorption, incidental ingestion, and inhalation of dust. The calculated Pathway Preliminary Pollutant Limit Value (PPLV) for PCBs is 20 mg/kg. Therefore, based on the (ESE, 1988a) site-specific risk assessment, the calculated PCB clean-up level is 20 mg/kg or ppm. However, the more conservative TSCA clean-up standard of 10 ppm was used in the development of preliminary remedial alternatives to provide an added degree of protection of human health. These alternatives are discussed in Section 2.3.

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Site 16, Old Power Plant, Building 38

Thirty-eight soil samples were collected from the site (9 in Round 1 and 29 in Round 2). These samples were analyzed for PCBs, oil and grease, volatile organic compounds (VOC), ethylene dibromide (EDB), xylenes, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK). In Round 2, an EP toxicity test for lead was completed. The analytical results indicated the presence of PCB and lead contamination at the site. Lead concentrations were less than the EP toxicity standard for lead. Other constituents detected (but not at levels of concern) were MEK as well as oil and grease. Maximum levels for the constituents of concerns detected in the soil samples in Rounds 1 and 2 versus comparative values are presented below:

Parameter	Round 1 Concentration	Round 2 Concentration	Comparative Value	
Lead (EP Tox) 40 CFR 264.94 (ug/L)	--	45.9	5000	
Lead (mg/kg) range	15700	1070	<10-700	Common in soils
PCB 1016 (mg/kg)	4.78	--	50	TSCA
PCB 1260 (mg/kg)	404	40,000	50	TSCA
Oil and Grease (mg/kg)	6350	(not sampled)	--	--
Methyl Ethyl Ketone (mg/kg)	1	(not sampled)	--	--

From the preliminary risk assessment, the worst case scenario involved dermal adsorption, incidental ingestion, and inhalation of dust. The calculated Pathway Preliminary Pollutant Limit Value (PPLV) for PCBs is 16 mg/kg. Therefore, based on the site-specific risk assessment, the calculated PCB clean-up level is 16 mg/kg or ppm. However, the more conservative TSCA clean-up standard or 10 ppm was used in the development of the

site preliminary remedial alternatives to provide an added degree of protection of human health.

To determine if the PCB target level results in an acceptable risk level relative to the lead concentrations detected in the soil at Site 16, a chronic hazard risk index (HI) of 2.4×10^{-4} was calculated for lead to determine the associated health risk. This HI indicates a very low degree of risk posed by the observed concentrations of lead in the soil. Therefore, lead has been screened from further investigation.

2.2.1 Geology and Soils

Within the area comprising NAVSTA Roosevelt Roads, there are major variations in the topographic features. The regional area of the Naval Station consists of an interrupted narrow coastal plain with small valleys extending from the Sierra de Luquillo range, which has been deeply eroded by streams into valleys several hundreds of feet deep. Slopes of 30 to 45 degrees are common.

In the immediate area of the station, elevations range from sea level to approximately 295 feet. Immediately to the north of the station boundary, the hills rise abruptly to heights of 800 to 1,050 feet above sea level. There are a series of three hilly areas on the station, two of which separate the southern airfield area from the Port/Industrial, Housing, and Personnel Support areas. The third set of hills is called the Bundy area. Along the shoreline, lagoons and swamps are common.

The underlying geology of the station area is predominantly volcanic rock composed of lava and tuft, as well as sedimentary rocks derived from discontinuous beds of limestone. These rocks range in age from early Cretaceous to middle Eocene. The volcanic rocks and interbedded limestones have been complexly faulted, folded, metamorphosed, and intruded by dioritic rocks. This complex geological restructuring occurred sometime after the deposition of the limestone during the middle Tertiary age.

In addition to the predominate volcanic and sedimentary rock, the northwestern and western sectors of the base are underlain by unconsolidated alluvial deposits deposited during the Quaternary period (Figure 5).

The primary geologic formations on and near NAVSTA Roosevelt Roads are various beach deposits, alluvium, quartz diorite and granodiorite, quartz kerotophyre, the Daguao Formation, and Figuera lava (See Appendix D).

There are six soil associations found on NAVSTA Roosevelt Roads, four of which are found primarily on the station, while the other two are limited to the western boundary of the station in the vicinity of the airfield. Two of the soil associations cover more than one-half of the stations's surface area and are equally distributed. They are the Swamps-Marshes and Maki-Rio-Arriba-Cayagua Associations. The Swamps-Marshes Association is deep, poorly drained sandy or clayey, contains organic material from decaying mangrove trees, and is found slightly above sea level, on level or slightly level areas, and during high tide is covered or affected by salt or brackish water. The soil is underlain by coral, shells, and marl at varying depths. The Maki-Rio-Arriba-Cayagua Association is generally deep, poorly to moderately well-drained, clayey, or nearly level to moderately steep soils found on foot and side slopes, terraces, and alluvial fans.

The Descalabrada-Guayama and Caguabo-Mucara-Naranjito Associations cover most of the remaining surface area of the station. They are shallow to moderately deep, well drained, and are strongly sloping to steep soils on volcanic uplands. The Descalabrado-Guayama Association soils are found primarily in the hilly areas directly inland and adjacent to the Swamp-Marshes Association.

The remaining two soil associations are the Coloso-Toa-Bajura and Jacana-Amelia-Fraternidad Associations. The Coloso-Toa-Bajura Association consists of deep, moderately well-drained to poorly drained, nearly level soils found in flood plains. While the Jacena-Amelia Fraternidd Association consists of moderately well-drained, nearly level to strong sloping soils on foot slopes, terraces and alluvial fans.

Substation 2 (Site 15) and the Old Power Plant, Building 38, (Site 16) are located on the southern side of the base on the northeastern side of Enseneda Honda with shallow, well-drained soil underlain by coral. The bedrock in this area is the Daguao Formation.

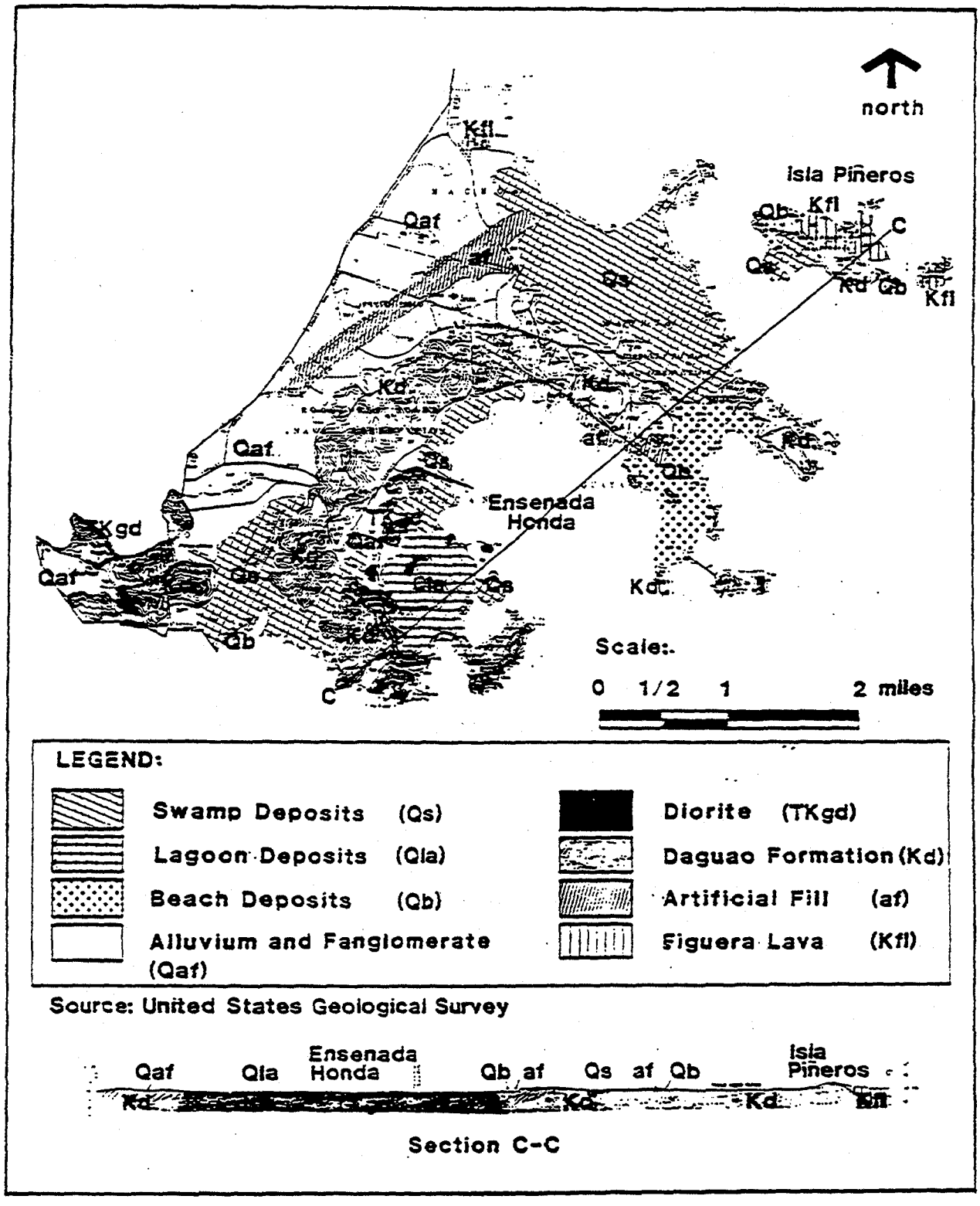


FIGURE 5
GEOLOGIC MAP OF NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

The Daguao Formation consists of interbedded volcanic breccia, lava, and occasionally volcanic sandstone. The thickness of the coral is not known.

2.2.2 Ground Water

Water from alluvial aquifers along the coast of the Naval Station is of a calcium bicarbonate type, and has high concentrations of iron and manganese. The source of these minerals is unknown, but they may be derived from buried swamp or lagoon deposits.

A seawater-freshwater interface is present in the aquifers throughout the coastal areas of Puerto Rico, usually within a short distance inland of the coastline. Based on their proximity to the sea, ground water at Sites 15 and 16 is probably saline. NAVSTA Roosevelt roads has no ground-water wells used for drinking water supplies.

Little information exists concerning the geohydrology of NAVSTA Roosevelt Roads. The only known possible sources of ground water are lenticular beds of clay, sand gravel, and rock fragments which occur at a depth of less than 30 meters. No wells have been developed on base from these formations. Some wells were developed further inland, upgradient of the station, in the nearby town of Ceiba, some three kilometers from base headquarters. However, they were abandoned due to high levels of salinity.

2.2.3 Surface and Subsurface Water

The surface waters that flow across the northeastern plain of Puerto Rico, where the Naval Station is located, originate on the eastern slopes of the Sierra de Luquillo mountains. Surface runoff is channeled into various rivers and streams which eventually flow into the Caribbean Sea. In the low-lying shore areas, seawater flooding results from storms, wind, and abnormally high tides. The tidal ranges in the Roosevelt Roads area are rather small, with a maximum spring range of less than three feet.

Surface water drainage from Site 15 generally flows either north to northeast into the mangrove swamps and Puerca Bay or to the south and southeast into Ensenada Honda (Figures 2 and 3. Subsurface water drainage from Site 16 generally flows either southeast, into the cooling water tunnel or, southwest or northeast along the trench (Figures 2 and 4).

2.2.4 Biology

The NAVSTA Roosevelt roads has four distinct ecosystems. They are: The upland forest, mangrove, marine, and freshwater ecosystems. The upland forest area includes trees with compound or simple leaves that are succulent or leathery with broad expansive crowns. The trees rarely get higher than 45 feet, and function as an erosion inhibitor, are the habitat used primarily by avian species.

There are three recognized mangrove associations at Roosevelt Roads: the riverine, fringe, and basin. The mangrove ecosystems are perhaps the most important habitat type encompassed by the station. They provide cover, food, and nursery areas for the varied marine sport and commercial fish species, and marine organisms. They also provide nesting and roosting areas for a variety of birds. The marine ecosystems can be generally characterized as coral reef and seagrass associations. The coral reefs are made up of stony and soft coral. Many of the coral reefs are pristine in more remote areas of NAVSTA Roosevelt Roads. The seagrass beds consist of turtlegrass and manatee grass are common in the clean, shallow embayments of the station. Their extent in Ensenada Honda alone is approximately 600 acres. The vegetation allows sediments to settle out of the water, and serves as food and cover for the myriads of marine vertebrates and invertebrates.

The fresh water ecosystem at Roosevelt Roads consists of two small ponds near the airport and Officers' Club. The ponds tend to dry seasonally, due to lack of rain.

2.2.5 Climate

The climate is classified as tropical-maritime, with uniform temperatures ranging from 64 degrees to 88.2 degrees F. The coolest months are January and February, with average temperature of 82.0 degrees F. The warmest months are August and September with an average temperature of 88.2 degrees F. The average annual precipitation at NAVSTA Roosevelt Roads is 60 inches and the rainy season extends from May through October.

The prevailing wind direction reflects the easterly trade winds. However, the differential heating of the land and sea during the day tends to give a more northerly component to the flow on the northern side of the island and a more southerly component on the southern side. During the night, a land breeze causes a prevailing southeasterly flow in the north and a prevailing northeasterly flow over the southern coast. The mean annual wind velocity is 5.5 knots, with a minimum in November and a maximum in

August. Gales associated with westward moving disturbances in the trade winds or hurricanes passing either north or south of the area have the highest probability of occurrence from June through October.

The Hurricane season is from mid-June through mid-September; maximum winds exceed 95 knots during severe hurricanes. An average of two tropical storm per year occur in the area, one of which usually reaches hurricane intensity.

2.2.6 Demographics

NAVSTA Roosevelt Roads is located on the southeastern coast of Puerto Rico in the municipality of Ceiba. The nearest major town is Fajardo, 10 miles to the north. Immediately to the west of the station and adjacent to its western boundary is the town of Ceiba which has a population of 15,000. Naval Station personnel commute on a daily basis from the city of San Juan approximately 33 miles northwest of the station.

2.3 Preliminary Remedial Action Alternatives

ESE (1989a,b) proposed four preliminary remedial alternatives for Site 15 and 16. The four alternatives vary in degree of addressing the PCB contamination at the respective sites. The remedial action alternatives for each site will be discussed in this section. The sampling proposed in the RI/FS is designed to supplement ESE, data base, and aid in determining volume requirements to meet the objectives of Alternative 4 (excavation and disposal).

Remedial Action Alternatives for Site 15 are as follows:

Alternative 1) - The "no action alternative" A 6-foot high galvanized chain link fence would be installed surrounding all areas of the site confirmed to have PCB concentrations above 10ppm.

Alternative 2) - a single-layered asphalt cap would be installed over the site. The cap would consist of 4 inches of base material and 1 inch of bituminous paving. The cap would cover those areas of the site confirmed to have PCB concentrations of 10 ppm or more.

Alternative 3) - Both partial capping and excavation would occur. All areas of the site confirmed to have PCB concentrations above 25 ppm would be excavated. This would be removed to a depth of 1 foot. The excavated areas would then be backfilled with clean soil. Clean soil is defined by EPA as

containing less than 1 ppm PCB's. Site areas confirmed to have PCB concentrations of 10 to 25 ppm would be capped with a single-layer asphalt cap. The cap would meet the same specifications as in Alternative 2. Excavated material would be disposed of by incineration in an incinerator permitted for PCB incineration.

Alternative 4) - The most stringent of the 4 in meeting PCB cleanup criteria. All site areas confirmed to have PCB concentrations exceeding 10 ppm would be excavated. The excavated area would then be backfilled with clean soil. Excavated material would be disposed of by incineration.

Remedial Action Alternatives for Site 16 did not include any action relative to the fenced in areas because the fence was thought to restrict public access into those areas. The alternatives for Site 16 are as follows:

Alternative 1)- The "no action"alternative is a 6-foot high galvanized steel chain link fence installed around the site to restrict public access. This fence would encompass all areas of the site confirmed to have PCB contamination above 10 ppm.

Alternative 2) -The concrete-lined ditch running along the southwest and northwest of Building 38, and along the southeast side of the fenced transformer station would be scraped to remove the soil in the ditch. This soil would be spread out over areas of the site which would be covered by a single-layered asphalt cap, these areas are confirmed to have PCB concentrations above 10 ppm. The cap would consist of 4 inches of base material and 1 inch of bituminous paving. The capped areas do not include the area between building 38 and the rock outcropping because this area mainly consists of rock and weathered rock with little soil.

Alternative 3) - This consists of both partial excavation and capping. The concrete-lined ditch would be scraped to remove the soil, the areas having PCB concentrations above 25 ppm would be excavated to a depth of 1 foot. After the PCB-contaminated soil is removed from these areas they would be backfilled with clean soil. The site areas having PCB concentrations between 10 and 25 ppm would be capped with a single-layered asphalt cap would meet the same specifications as mentioned for Site 15 alternatives 2 and 3. The removed material would be disposed of by incineration.

Alternative 4) - The most stringent of the alternatives. All areas of the site including the concrete-lined ditch exceeding PCB concentrations of 10ppm would be removed by scraping the affected material or, by excavation. Areas which would be excavated would be backfilled with clean soil and the removed material would be disposed of by incineration.

The remedial response will be designed to minimize or eliminate the potential health hazard presented by the site contaminants through control of contaminant dispersal by wind, water, flora, fauna, or human vectors. Each remedial action may include several possible applicable combinations of remedial alternatives.

2.4 Applicable or Relevant and Appropriate Requirements (ARARs)

The 1986 Superfund Amendments and Re-authorization Act (SARA) mandates in Section 121(d) that site remediation under CERCLA comply with the requirements of all applicable or relevant and appropriate Federal, Commonwealth, environmental, and public health laws. These are known as the ARARs for the site. Applicable requirements are specific to the conditions present on the site for which all jurisdictional prerequisites of the law or requirements are satisfied. Relevant and appropriate requirements are those that do not have jurisdictional authority over the particular circumstances on the site, but that are meant to address similar situations and are, therefore, suitable for use at the site. The determination of applicability or relevance and appropriateness is made by the EPA and the responsible commonwealth authority, on a case-by-case basis.

Versar will identify all probably Federal ARARs, commonwealth ARARs, and any local requirements in the FS. Versar will also make preliminary determinations on the extent that other criteria, advisories, and guidance are pertinent to the hazardous substances, location of the site, and remedial actions. Versar's primary role in this regard is to assist the Navy in identifying the action-specific ARARs. However, all location-specific and chemical specific ARARs will also be identified.

Action-specific ARARs are usually technology- or activity-based directions or limitations which control actions taken at CERCLA sites. Action-specific ARARs, as the name implies, govern the remedial actions. The RCRA 40 CFR, Part 264, Subpart G Closure Regulations, the RCRA 40 CFR, Part 264, Subpart O Incineration Regulations, and the land disposal restrictions set forth by the Hazardous and Solid Waste amendments Act of 1984 are a few examples of action-specific ARARs.

A partial list of potential ARARs is presented in the preamble to the NCP as amended in November 1985. Additional ARARs will be sought during a thorough search of Federal and State environmental statutes. Chemical- and location-specific ARARs will be identified after the site characterization, and action-specific ARARs have been identified

after the initial screening of the remedial alternatives. The following paragraphs partially list potential ARARs for the Roosevelt Roads sites.

2.4.1 Toxic Substances Control Act

Disposal of PCBs (40 CFR 761): If the remedy involves excavation of soils that contain PCBs, the requirements of this section must be satisfied.

TSCA clean-up criteria levels for PCB contaminated sites are presented below:

Location of Spill	PCB Clean-up Criteria
1. Spills at outdoor electrical with restricted access	25-50 ppm
2. Spills at other restricted access locations other than electrical substations	25 ppm
3. Spills at non-restricted access areas	10 ppm

2.4.2 Resource Conservation and Recovery Act

In general, the applicable solid waste requirements will be action-specific, applying to the remedial activities undertaken. The following are some examples of RCRA requirements (40 CFR 264) that may be applicable or relevant and appropriate:

General Waste Treatment (40 CFR 263 Subpart O): Although standards do not yet exist for general waste treatment in new facilities, standards do exist for interim status facilities (40 CFR 264 Subpart O) and include specific requirements for ignitable and reactive wastes. The interim status requirements are probably not applicable if the treatment is performed on site, but they may be relevant and appropriate.

Incineration (40 CFR 264 Subpart O): This subpart includes performance standards for incinerators and monitoring, inspection, and operating requirements. Storage (40 CFR 264 Subparts I and J): Two subparts include standards for storage of hazardous waste in containers (Subpart I) and tanks (Subpart J).

Site Closure with Waste in Place (40 CFR 264 and 265 Subpart G): Certain sections of both 40 CFR 164 and 265 may be applicable or relevant and appropriate if the waste is to be left in place. This could include capping, installation of slurry walls, grading and covering with vegetation, or consolidation of substances in one location. Subpart G of both 264 and 265 provides technical requirements for closure and post-closure activities.

Ground-water Monitoring (40 CFR Subpart F): This subpart provides RCRA ground-water corrective action requirements that may be applicable or relevant or appropriate at the site. These requirements include ground-water monitoring and ground water protection standards.

2.4.3 Other ARARs

Other potential ARARS are:

- Safe Drinking Water Act (40 CFR 141, 143)
- Clean Water Act (40 CFR 125, 129)
- Ground-water classification for aquifers underlying the site (EPA, 1986),
- OSHA requirements for hazardous waste workers,
- Department of Transportation rules for transportation of hazardous materials (49 CFR 107 and 171),
- Regulations pertaining to activities that affect the navigation of waters of the United States (33 CFR 320-329),
- Endangered Species Act (50 CFR 81, 225, 402)
- Fish and Wildlife Conservation Act (50 CFR 83), and
- Wild and Scenic Rivers Act (36 CFR 297).

3.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

In general terms, the following will describe the work to be accomplished at NAVSTA Roosevelt Roads Sites 15, and 16. Specific procedural details regarding each field task will be described in the appended Field Sampling Plan (FSP).

3.1 Site Objectives

The remedial investigation at both sites will emphasize the compilation, validation, and evaluation of existing data; collection of additional information to fill any gaps in the ESE (1988a,b) data needed to fully characterize contamination on and off site; determination of the extent of contamination, migration pathways, and the potential receptors.

The work associated with the RI/FS will be conducted in conjunction with an effective community relations plan that assures appropriate distribution of project information in an effort to involve the concerned public and avoid misunderstandings. The RI is the data collection mechanism for the Feasibility Study (FS).

The primary goals of the RI are as follows:

- To define the nature and extent of PCB contamination from the pollutant sources identified using previous (ESE, 1988a,b) and newly collected data.
- To identify and evaluate contaminant migration pathways and potential routes of exposure.
- To evaluate risks to potential receptors.
- To identify and define parameters affecting the feasibility of potential remedial alternatives.

The FS will identify the most technically effective and cost-effective remedial alternatives that will mitigate the human health and environmental impacts resulting from site contamination.

The primary goals of the FS are as follows:

- To identify and develop candidate remedial alternatives (RAs).

- To screen candidate RAs and identify those that are most appropriate on the basis of cost, effectiveness, and implementability.
- To perform detailed analysis of RAs to allow selection of a remedy.

3.2 Literature Search

Versar has photocopied all NAVSTA Roosevelt Roads file information available from LANTDIV NAVFACENGCOM files. Information at a regional level was obtained from other sources such as the U.S. Geological Survey, Soil Conservation Service, Fish and Wildlife Service, National Oceanic and Atmospheric Administration, and Commonwealth and local planning agencies. Versar will consult with Puerto Rico EQB personnel and obtain subsurface information on other sites nearby and will collect any information from local agencies if there is reason to believe the information is not yet within LANTDIV files. All files are treated with great care during duplication. Individual files were disassembled, reproduced, and reassembled to their original condition and paper clips, "post-it" book marks, or other page markings, were attached. Versar is aware of the extreme value and irreplaceability of the files and maintains complete control of the files during duplication.

3.3 Field Investigation

Sites 15, and 16 have been identified as areas of concern regarding PCB contamination. The RI/FS includes field activities to assess the extent of this contamination. These activities will include confirmatory sampling and sampling from areas not previously evaluated, and will be conducted in order to provide thorough and representative analytical results. The analytical results will be used to perform a risk assessment, and delineate the horizontal and vertical extent of contamination for future remedial activities. An excavating permit, photography permit, and site clearance must be arranged with the IR Program Manager at Roosevelt Roads approximately 1 month before sampling.

3.3.1 Field Tasks for sites 15 and 16

The sampling rationale for the RI/FS at Sites 15 and 16 is to use the ESE (1988a, b) data to the greatest degree possible in project scoping and remedial design, while supplementing this information with fully validated data that can be used for tasks that require the highest level of data quality, such as risk assessments. As unvalidated data, the

highest level of use for the ESE (1988a, b) data is screening and engineering purposes. At the time this sampling plan was prepared, analytical data packages necessary for validation of the ESE data were incomplete. Duplicates from their laboratory have been requested. Only validated data will be used in the risk assessment.

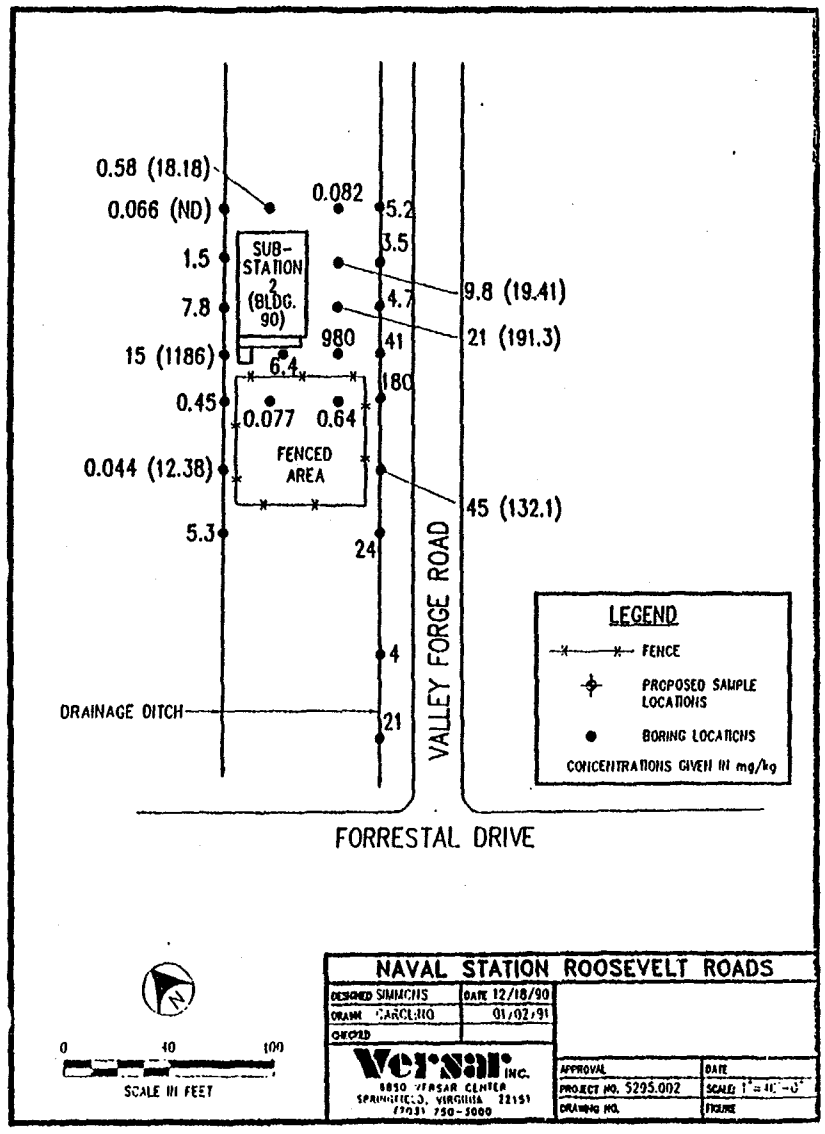
This sampling program is designed to validate and to expand on the data presented in the Confirmation Studies for each site. A major thrust of the soil sampling program is to attempt to identify deeper areas where PCB-bearing fluids may have percolated to coral that is only a foot or less deep at the sites. The soil sampling program recognizes the potential for contaminated soil to be transported short distances form the actual spill area. If a positive detection is encountered in the shallow soil (0-3"), the deeper soil sample (8-12") collected and extracted at the same time, will be analyzed. This technique will identify spill areas (and potential for bedrock contamination of the porous coral) and target these areas for possible bulk sampling following an initial soil removal action. Additional exposure pathways, such as the cooling water tunnel of Site 16, will be evaluated.

Concrete bulk and wipe samples are intended to identify decontamination needs for concrete surface areas. The number of these types of samples was based on the estimated square footage of concrete surface at each site.

Site 15, Substation No. 2:

A total of 47 soil samples will be collected to confirm previous analyses for PCB contamination and to delineate the contaminated area. Proposed sampling locations are shown on Figure 6. These samples will be collected from shallow (0-3") and deep (8-12") soil.

Twenty shallow samples will be extracted and analyzed immediately. The 20 deeper soil samples will be extracted immediately but held for analyses pending the results of analyses of the shallow soil samples. Coral outcrops are visible at the site indicating that the soil is less than a foot thick in parts of the site. Seven sediment samples will be collected from the two ditches running southwest of Substation 2. Deeper soil (8-12") will also be collected from below the 7 drainage ditch sediment sample locations, extracted immediately but held for analyses pending results from the shallower sediments. Two concrete chip samples and three wipe samples will be collected from the concrete pad at



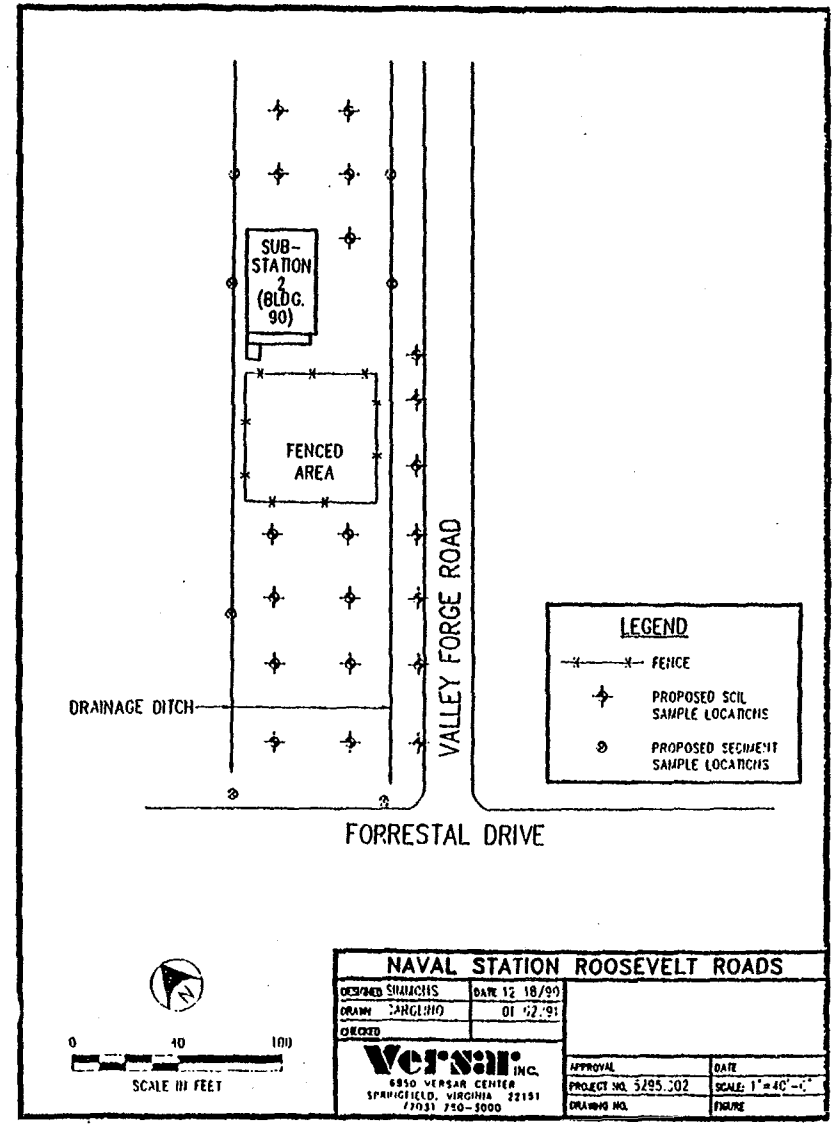


FIGURE 6
PROPOSED SAMPLING LOCATIONS FOR SITE 15:
SUBSTATION NO. 2, BUILDING 90
NAVSTA ROOSEVELT ROADS

the entrance to Substation 2, to confirm previous analyses for PCB contamination and to delineate the area of contamination for remediation. Wipe samples will be used to characterize the unstained concrete surfaces to determine potential needs for remediation of these remediation of these structures.

Site 16, Old Power Plant:

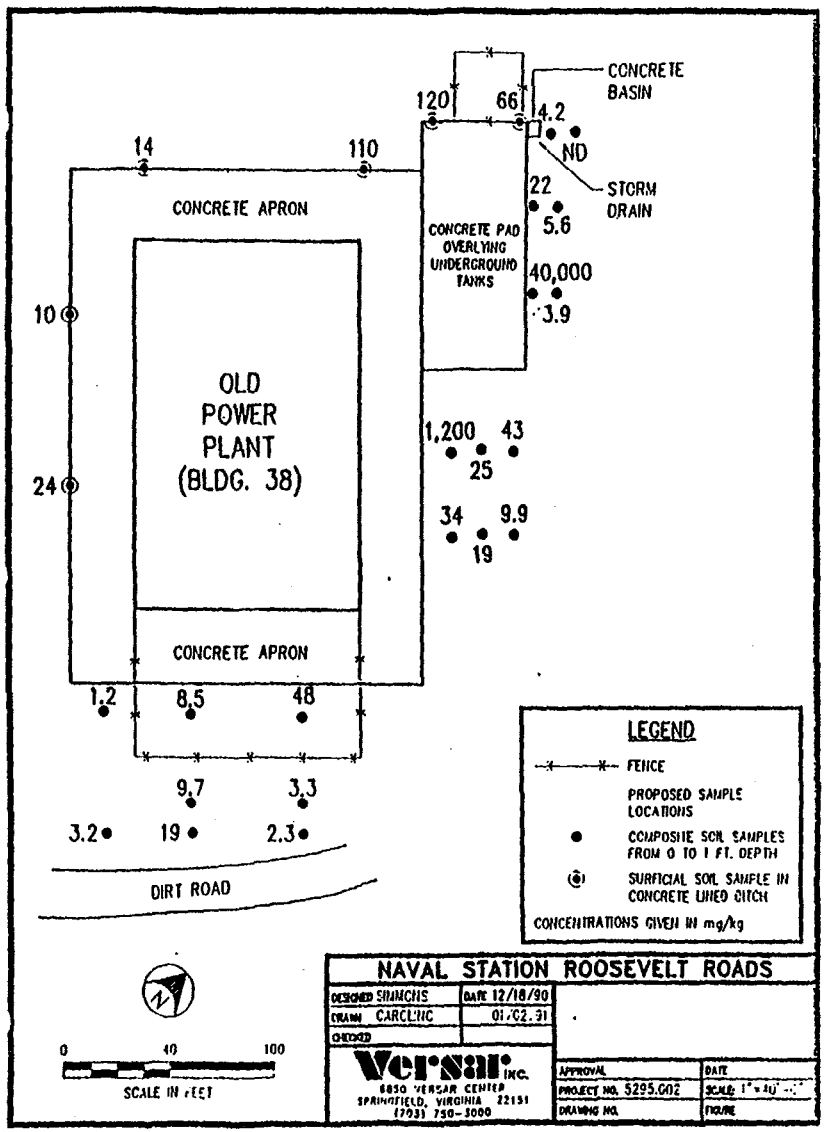
A total of 48 soil samples (grab samples) will be collected to confirm previous analyses for PCB contamination and to delineate the areas of contamination. Proposed sample locations are shown on Figure 7. These samples will be collected from shallow (0-3") and deep (8-12") soil. The shallow samples will be extracted and analyzed immediately. The deep samples will be extracted immediately but held for analyses pending the results of analyses for shallow soil samples.

To define the horizontal extent of contamination, 24 surficial soil grab samples will be collected (0-3"). These locations (Figure 6) were selected to bound previous data, and to fill data gaps remaining from the previous round of sampling.

A total of 8 surficial soil composite samples (0-3") will be collected along the concrete-lined ditch located along the southwest to northwest of Building 38. These will collected and consist of 10 aliquots per sample at 6 foot intervals along the ditch.

Twelve sediment samples will be collected from the tunnel running southwest to northwest of the Old Power Plant. Sample locations will include available access ports and tunnel outfalls.

Six chip samples will be collected from the stained concrete surfaces at Site 16. A total of 53 PCB wipe samples will be collected from the concrete apron surrounding Building 38, the concrete base of the transformer station, the concrete-lined ditch and concrete basin and the concrete pad overlying the underground storage tanks. These samples are intended to characterize unstained concrete areas. Sample locations will be selected based on best engineering judgement.



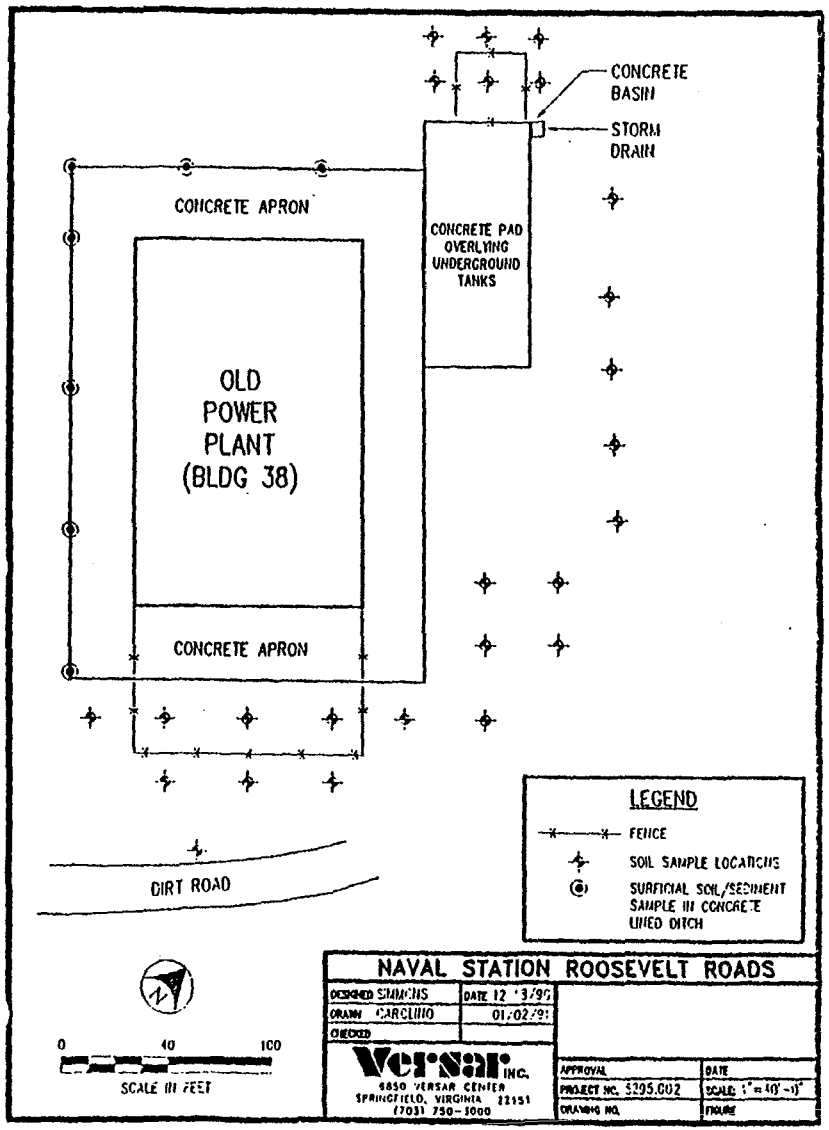


FIGURE 7
PROPOSED SAMPLING LOCATIONS FOR SITE 16:
OLD POWER PLANT, BUILDING 38
NAVSTA ROOSEVELT ROADS

RR-00034-03.05-04/09/91

3.3.2 Sample Analysis Activities

All soil, sediment, concrete chip, and wipe samples will be analyzed for PCBs only. The analytical requirements are provided in the QAPP.

3.4 Field Record Keeping

Versar will maintain permanent records of all field data, analytical data, field notebooks correspondence, and the generation, reduction, and QA/QC of project deliverables. The field logbook(s) is an official record and may be subject to review during any internal or external audit. Most importantly, field logbooks form the basis from which reports are prepared in the office.

Field team members will keep a record of events in dedicated field notebooks. The field notebook(s) will be bound and kept in a secure location at all times when not in possession of the field team leader. The field notebook will include:

- A chronological listing of significant site events and sampling team activities.
- The first page and cover will include the full name of the field team leader, site address, and local phone number. Each page of the notebook will be numbered and dated.
- The names of the note takers along with all other team members and pertinent officials.
- Site conditions, weather, sketches of sampling locations, and sample medial descriptions.
- Record of field decontamination of equipment, including time and method.
- Time of sample filtration and/or preservation.
- Record of all calculations (e.g., calculations of purge volume, volume of stratified liquids in tanks).
- Record of all measurements (e.g., field analytical parameters).
- Photograph documentation.
- If photographs are obtained, record the time of facility personnel or representative granting or denying permission to take photographs. If facility

requests that photographs be processed by facility, obtain receipt and record the date and time of transaction.

3.5 Data Reduction

Data reduction is an integral step in any RI/FS. Data reduction refers to methods used to summarize technical data through various calculations or statistical means, and the transmittal of data to other forms, including reports and data storage systems. Errors commonly occur in using these various data reduction methods.

All reduced data will undergo a peer review whereby data sets will be examined for consistency, and calculations spot-checked for accuracy. The project manager will establish the level of detail (percentage of calculations checked, etc.) to be employed. Any errors uncovered by the reviewer will be brought to the attention of the project manager who will initiate corrective action and identify the source of the error. Data will then be reviewed to determine that the errors have been corrected.

Data entry into computer storage systems will be 100 percent checked through peer review. Data entry checks should consider, if applicable, agreement with:

- total number of data points,
- units reported,
- decimal placement,
- significant figures, and
- outliers.

3.6 Data Assessment

Versar will validate all data collected during RI field activities according to EPA Functional Guidelines (EPA, 1988e and 1988f). Project data will be assessed and analyzed to identify accurate and valid data and to refine site models by the Navy's Quality Assurance Program, NEESA. NEESA will validate the laboratory analytical data by examining the accuracy of not less than 10 percent of the data. For more detailed information regarding data validation procedures, refer to the QAPP.

3.7 Risk Assessment

Data gathered during the RI/FS will be used to establish presence and extent of or absence of contamination in the potentially affected media of each site. This information,

along with data concerning potential contaminant migration routes, will aid in determining the potential for further migration. Information gathered concerning chemical-specific properties of the contaminants will be used along with site data to determine the environmental fate of those contaminants. All of these determinations will be used to determine potentially significant exposure pathways. An exposure pathway is said to be complete if all of the following conditions are met:

1. A source of contamination with a release mechanism exists,

2. A migratory pathway exists for contaminants to move from source to an exposure point,

3. An exposure mechanism exists for receptors to contact contaminants at the exposure point, and

4. Receptors are identified who may contact contaminants at the exposure point.

An evaluation will be performed to identify all potentially complete exposure pathways for each site where possible.

An exposure analysis will be performed to determine possible human intakes of contaminants. Depending upon the predicted environmental fate and transport of contaminants and the completeness of data concerning potential exposure points, either sample data or computer modeled data will be used to determine intakes.

An evaluation of toxicity of site contaminants will be performed to determine possible human health effects of exposure to site contaminants. This evaluation will include, where possible, determination of acceptable levels of exposure based on U.S. EPA recommendations.

Potential risks to humans exposed to chemicals from each site will be calculated based on the exposure assessments and toxicity evaluations. Both carcinogenic and noncarcinogenic risk will be quantified for each site.

For the follow-up RI/FS at Sites 15, and 16, Versar will conduct a Baseline Risk Assessment (RA) to establish the extent to which contaminants present at the site and off site may present a danger to public health, welfare, or the environment. This RA shall evaluate present conditions in the absence of any further remedial action, that is, it will constitute an assessment of the no action remedial alternative. The baseline risk assessment

in the RI shall be developed in accordance with the structure and methodologies outlined in EPA's Human Health Evaluation Manual (EPA, 1989a), as well as new guidance as it becomes available. Risk Assessment results will be used to establish remedial action (cleanup) levels and will be presented in the FS Report.

Data requirements for risk assessment are representative samples and analyses of all contaminated media which constitute a potential exposure pathway including soil, surface water, subsurface water, and ground water. Analyses will determine presence and concentrations of contaminants at detection limits at or below the contaminant specific ARAR, often an applicable health-based standard where one exists, or at detection limits appropriate for assessing exposure to receptor populations at a level of dose where a response could be expected. Analyses of soils will allow quantitative exposure assessment for likely exposure scenarios such as inhalation of airborne dust or ingestion.

The data quality objectives for this project are discussed in detail in the QAPP. Generally, methods of analysis proposed are U.S. EPA Contract Laboratory Program (CLP) methods modified for CLP from Methods for Chemical Analysis of Polychlorinated Biphynels (EPA, 1986) with current updates. The practical quantitation limits of these methods will achieve data of suitable quality for risk assessment.

Other information needed for risk assessment includes direction and speed of ground-water flow, prevailing wind speed, and other information to predict possible or future contaminant concentrations or exposure pathways. The risk assessment will include Hazard Identification, Dose-Response Assessment, Exposure Assessment, and Risk Characterization as described below.

3.7.1 Hazard Identification

The hazard identification process will include identification and concentration PCBs which may cause adverse health effects to the exposed population or environment. This judgment will be based on information derived from monitoring data, disposal practices, and potential routes of exposure found at the site.

The data collected by analyses of each environmental medium shall be summarized to be included in the RI report. The summary table shall delineate frequency of detection, the detection limits employed considering both human health and environmental data needs, the range, and the mean value and totals of the concentrations detected.

Toxicity profiles will be developed for PCB to provide the following information: acute toxicity, chronic toxicity, including system toxic effects, carcinogenicity, mutagenicity, teratogenicity, and reproductive and other effects. Acute and chronic toxic effects of this contaminant on non-human terrestrial populations, aquatic life, and vegetation shall also be discussed. A brief summary of toxicity shall be included in the text; a more detailed profile will be included in the appendix.

3.7.2 Dose-Response Assessment

EPA regulatory standards and guidelines will be determined for each contaminant of concern according to its appropriate chemical-specific ARARs. Dose-response assessments shall be made for both human and non-human animal populations. Under the National Contingency Plan (NCP), effective February 18, 1986, CERCLA remedial actions must attain or exceed the ARARs determined for each site with some limited exceptions.

3.7.3 Exposure Assessment

Versar will conduct an exposure assessment using the methods described in the EPA guidance documents identified above. The exposure assessment will identify exposure pathways, including non-human exposure pathways such as food web, aquatic contact, bioconcentration, etc.; characterize the human and non-human receptors (or potential receptors); and whenever possible, quantify the exposure of affected populations.

The environmental fate and transport of all compounds will be evaluated to determine the pathways that are significant at each site. This evaluation will be based on field monitoring data and on mathematical modeling of relevant fate and transport processes. The Superfund Exposure Assessment Manual (EPA, 1986b) is recommended as guidance for this type of evaluation. Potentially exposed populations will then be characterized, including: characterization estimates of the numbers and ages of people potentially exposed at each exposure point; identification of sensitive groups; and identification of human activity patterns which may influence exposure.

Exposure scenarios will be constructed to quantify the known or potential human exposure levels based on exposure pathways analyses and population characterization. Once exposure scenarios are developed, the "dose" to the affected populations will be

calculated using monitoring data and modeling techniques. Exposure scenarios will be developed for the average and plausible maximum conditions of exposure.

All exposure assessment models will be conservative in order to prevent underestimates of exposure. Any use of non-referenced or non-conservative models will be accompanied by a statement of scientific justification. Literature values used will be referenced and all assumptions will be clearly stated and justified.

3.7.4 Risk Characterization

Based on results of the hazard identification, the dose-response assessment, and the exposure assessment, Versar will estimate the risk to public health and the environment at each site. Exposure point concentrations determined for each exposure pathway at the site will be compared to each chemical-specific ARAR identified. Results of this comparison will be fully discussed and illustrated.

For each receptor exposed via a specific exposure pathway or potential pathway, Versar will describe and evaluate the risk from exposure to individual contaminants and/or concurrent exposure to a chemical mixture. Both carcinogenic and non-carcinogenic effects will be evaluated. Whenever possible, risks will be quantified by using methods discussed in the Human Health Evaluation Manual (EPA, 1989). The risks posed to non-human receptors, including the environmental resources, will be qualitatively evaluated.

3.7.5 Ecological Assessment

An Ecological Assessment will be made as part of the Baseline Risk Assessment to evaluate the probable impact of contaminants at each site or project activities on the environment. The nature, extent, and level of detail of the Ecological Assessment will be determined according to the characteristics of the site and contaminants. The Ecological Assessment will also consider ARARs and To Be Considered (TBC) information in its development. At a minimum, the Ecological Assessment shall address the location of any threatened, endangered, or rare species, sensitive environmental areas, or critical habitats on or near each of the sites.

3.8 Development and Screening of Alternative Remedial Actions

In assessing remedial alternatives for Sites 15 and 16, the primary focus will be on refining the alternatives developed by ESE (1988a,b). These four alternatives (see Section 2.3) will be revised to include updated unit costs and areal extent of contamination based on the RI findings. Additionally, if other alternatives that were not considered by ESE are identified, these too will be evaluated according to the criteria listed in Section 3.10.

Once the universe of potential remedial alternatives has been identified, the next task will be screening all of the options to reduce the number for detailed analysis. The screening will be conducted on a general basis to determine their effectiveness, implementability, and cost.

Individual identified remedial alternatives or technologies will be researched through available literature from similar remedial investigations, feasibility studies, and remedial action projects. Technologies which have proved cost-effective and implementable on other similar projects, or those that have been demonstrated or appear to be reliable, will be retained for treatability investigations. Technologies determined to be too costly or too difficult to implement, that will not achieve the remedial objective within a reasonable time period, or that appear unreliable or not fully demonstrated will be eliminated from consideration.

It is expected that many options will be identified which meet several, but not all, of the necessary criteria. That is, a technology may be very effective and implementable but too costly, while another may be economical to implement but not sufficiently effective. Further, it is to be expected that some remedial options may be identified which have merit, but cannot be effectively screened until site-specific bench or pilot treatability tests are conducted. Where a particular option clearly fails one of the criteria (i.e., effectiveness, implementability, or cost), it will be screened out. Identified alternatives which appear to have merit, but cannot be adequately evaluated without treatability studies, as well as those which can be sufficiently evaluated without treatability studies, will be retained for further consideration.

3.9 Bench Scale/Treatability Studies

Initial remedial alternative development and screening activities are expected to identify hazardous substance treatment and/or destruction technologies which may have merit for mitigating the health and environmental hazards related to each site. Contaminant treatment/destruction options applicable to the substances on site will be identified. Selected technologies will be appropriate for dealing with the media of concern, including soil or building and equipment surface contamination.

Treatment technologies will generally be categorized by virtue of the target contaminants related to the ARARs identified for the project.

There are several treatment technologies that have previously been demonstrated to be effective for the contaminants of concern within matrices similar to those at the sites. However, questions will remain as to site-specific costs, implementability, and effectiveness--even for those technologies found useful in similar applications at other sites, particularly since the Roosevelt Roads sites are relatively small compared with other Superfund sites. Therefore, most treatment options may be eliminated based on large capital or start-up costs. These applicability questions will generally stem from site and waste-specific parameters, both technical and non-technical. Examples of technical considerations include contaminant chemical form, matrix chemical and physical make-up, and remedial technology-specific considerations include numbers and locations of risk receptors, future land use planning, and public concerns and expectations for the site.

As information regarding treatability for selected technologies evolves adequate evaluation may require bench or pilot studies to determine site-specific technology suitability. In all cases, treatability investigations will be pursued to the point where appropriate information is compiled to warrant rejection of the technology or retention of the technology for inclusion in the detailed analysis of remedial alternatives.

3.10 Detailed Analyses of Alternatives

Prior to detailed analysis of alternatives, further definition of alternatives may be necessary based on generation of additional data from site characterization and/or treatability testing. Detailed analysis of alternatives will be performed to provide decision-makers sufficient information for selecting the optimum alternative for each site. The analysis will involve assessment of each alternative with respect to the nine evaluation

criteria listed below and developed to address the CERCLA requirements as well as other regulatory, technical, cost, and institutional considerations.

- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Implementability
- Cost
- Compliance with ARARs
- Overall protection of human health and the environment
- Support agency acceptance
- Community acceptance

Short-term Effectiveness. This criterion addresses the effects of the alternatives during the construction and implementation phase until remedial response objectives are met. The factors to be considered during evaluation of alternatives with respect to this criterion will include protection of the community and workers during remedial actions, environmental impacts, and remediation time. For example, if excavation of soil is considered as part of remediation (e.g., prior to treatment), then the effects of exposure to soil contaminants by the workers will be assessed and appropriate protection measures will be considered. Environmental impacts of a remedial alternative (e.g., construction of a structure) will be addressed. Alternatives which produce quick remediation will be preferred over those which take many years to achieve the remedial response objectives.

Long-Term Effectiveness and Permanence. This criterion addresses the results of a remedial action in terms of the risk remaining at the site after response options have been met. The factors to be considered during evaluation of alternatives with respect to this criterion will include magnitude of remaining risk, and adequacy and reliability of controls. Remedial alternatives that leave in place residual contaminants in soil (e.g., cap or slurry wall) are likely to have longer term effects than alternatives such as destruction of constituents by incineration..

Reduction of Toxicity, Mobility and Volume. This criterion addresses the statutory preference for selecting remedial options that employ treatment technologies that permanently reduce toxicity, mobility or volume of the hazardous substances. Alternatives which will be preferred will be those that remedy major threats at the site; are effective in reducing or destroying large amounts of contaminants or reducing toxicity, mobility, volume of contaminants; are irreversible; and generate no, or small, amounts of non-toxic

residuals. For example, paving over the contaminated soil prevents the PCBs from migrating by surface water movement.

Implementability. This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation.

Cost. The economic viability of each remedial alternative will be determined via a cost analysis. This includes estimation of capital and annual costs, present work analysis, and sensitivity analysis. For each remedial alternative, capital and annual costs will be estimated from vendor estimates, estimates used in similar projects, and standard costing guidance such as R.S. Means. The accuracy of these estimates will be -30 to +45 percent.

Capital costs will include direct capital costs (construction costs, equipment costs, land and site development costs, building and services costs, relocation expenses, and transportation and disposal costs) and indirect capital costs (engineering expenses, legal fees, and license or permit costs, start-up and shakedown costs, and contingency allowances). Annual costs are post-construction costs, necessary to ensure the continued effectiveness of a remedial action. Annual costs include operating labor costs, maintenance materials and labor costs, auxiliary materials and energy, disposal costs form treatment operations, purchased services, administrative costs, insurance, taxes and licensing costs, maintenance reserve and contingency funds, rehabilitation costs, and costs of periodic site reviews. Additionally, costs of future remedial actions will be addressed.

A present worth analysis will be used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year. After the present worth of each remedial alternative is calculated, a sensitivity analysis will be performed to assess the effect of variations in specific assumptions on estimated cost of the alternative. Potential factors that will be considered for sensitivity analysis include life of the remediation action, annual costs, duration of cleanup, volume of contaminated material, and discount rate.

Compliance with ARARs. This evaluation criterion will be used to determine how each alternative complies with Federal and State ARARs, as defined in CERCLA Section 121. The following will be addressed for each alternative during the detailed analysis with ARARs: compliance with chemical-specific ARARs (e.g., MCLs); compliance with action-specific ARARs (e.g., RCRA minimum technology standards);

compliance with location-specific ARARs (e.g., preservation of historic sites); and compliance with appropriate criteria, advisories, and guidance. When ARAR is not met, the six waivers allowed under CERCLA will be considered.

Overall Protection of Human Health and the Environment. This criterion assesses whether each alternative meets the requirement that is protective of human health and the environment. The assessment is based on a composite of factors assessed under other evaluation criteria such as short-term and long-term effectiveness and compliance with ARARs. The assessment focuses on how risks associated with each alternative are reduced over time. For example, risks associated with a successful excavation of soil for remediating soil at the site are expected to be lower than the capping over the soil with concrete.

Support Agency Acceptance. Technical and administrative issues and concerns the support agency may have regarding each of the alternatives will be addressed. The analysis will be limited to formal comments made during previous phases of the RI/FS.

Community Acceptance. Public comments on the RI report or screening of alternatives will be incorporated into the analysis of alternatives. The detailed analysis will address features of technologies that the community supports, has reservations about, or opposes.

Individual analysis of each alternative will be presented in narrative form as well as in tabular form. The narrative discussion for each alternative will include a description of the alternative and a discussion of the individual criteria assessment. The alternative description will provide data on the technology components, quantities of hazardous materials handled, time required for implementation, process sizing, implementation requirements, and assumptions. The narrative discussion of the analysis will present the assessment for each alternative with respect to each of the nine criteria. The FS report will also include a table summarizing these analyses.

Next, a comparative analysis of alternatives will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. The comparative analysis will be presented in narrative form and will describe advantages and disadvantages of each alternative relative to one another. The results of the comparative analysis will serve as the rationale for selecting a preferred alternative and preparing the proposed plan.

4.0 REPORTING REQUIREMENTS

Scoping documents prepared for RI/FS activities at NAVSTA Roosevelt Roads include this work plan and the appended Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HSP). These documents have been prepared based on recommendations in the confirmation study (ESE 1988a,b), file review at NAVFACENGCOM, and interviews with on-site personnel during the site visit. RI/FS scoping documents were prepared according to the detailed format provided in Handbook to Support the Installation Restoration Program Statement of Work for RI/FS (AFOEHL/MITRE, 1989). This handbook was developed to meet DOD and EPA requirements and reflects the recognition of the differing data needs of field, laboratory, and management personnel involved in the project.

Complete RI/FS documentation will be provided for Sites 15, and 16. RI and FS Reports will be prepared in conformance with EPA Guidance on Conducting RI/FSs under CERCLA (EPA, 1988a) or the most currently available version of this document available at the time of report preparation. The follow up RI Report will discuss the overall program history and include a brief site description and history, location and site maps showing sample locations, a summary of the sampling plan for the site, analytical data in tabular form (for all compounds exceeding detection limits), a comparison of this date to relevant standards and criteria, and a concise series of recommendations. The RI Report will also contain the baseline site assessment (no-action alternative). EPA guidance on conducting risk assessments is extensive; primary guidance will be obtained from the Superfund Public Health Evaluation Manual (EPA, 1986a) and the Human Health Evaluation Manual (EPA, 1989a).

Two additional Superfund decision documents are required under the Federal Facilities Agreement between the Navy and EPA. There are the Proposed Remedial Action Plan (PRAP) and the Record of Decision (ROD). The PRAP and ROD will be prepared according to Guidance on Preparing Superfund Decision Documents (EPA, 1989a).

All documents prepared during these investigations (with the exception of these work plans) will be submitted in three versions: initial draft, final draft, and final. Initial drafts are submittals to LANTDIV NAVFACENGCOM, NAVSTA Roosevelt Roads, and the NEESA QA contractor, Martin Marietta Energy systems. Final Drafts will be circulated to U.S. EPA and Puerto Rico EQB. Final documents are publicly released.

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Versar will furnish LANTDIV NAVFACENGCOM with brief monthly progress reports by the fifteenth day of each month for the duration of the project. The monthly progress will be prepared as a letter report and shall include at least the following elements.

- Work accomplished during the reporting period including results of quantitative chemical analysis.
- Special problems encountered requiring resolution.
- Percentage of work completed.
- Confirmation of any clarifications or technical guidance reached as a result of technical meetings.

Monthly QA/QC progress reports will also be submitted to Martin Marietta Energy Systems and to the Public Works, IR Program Manager, at Roosevelt Roads. The final QA/QC Report will be included as an attachment to the RI Report.

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5.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Versar's technical project management responsibility for all Navy programs resides with Mr. James Spatarella, Navy Programs Manager, and Mr. Bruno Maestri, Senior Vice President, Eastern Regional Operations, Technical Services Group. They are responsible for assigning senior project staff, meeting Naval Energy and Environmental Support Activity (NEESA) requirements on a corporate basis, and assuring consistency in technical approach and product deliverables across project lines.

On a project-specific basis, Mr. Spatarella is responsible for ensuring that the quality of the data and reports are suitable for the project objectives. Mr. Spatarella reports directly to the LANTDIV Project Manager and Engineer in Charge on an as-needed basis. This organizational structure assures that the Versar Project Manager and his team are responsive to LANTDIV; and provide LANTDIV with a direct line of communication to senior management.

Versar's technical project management responsibility for the RI/FS at NAVSTA Roosevelt Roads resides with Mr. Noel Simmons. He is responsible for assigning and managing the Versar personnel who will provide their technical expertise for the required field activities. These technical personnel will organize the field team support staff, which are necessary to perform the investigations, sample collection, and chemical analysis. The project organization chart is presented in Figure 8. The Versar project personnel and their responsibilities are indicated below.

- Project Manager (Noel Simmons) - The project manager will ensure that the overall project objectives are met and that the QA/QC Plan is followed throughout all phases of the RI/FS. He will also perform technical review of all reports to ensure that they are technically sound and complete and function as primary interface with the EIC.

- Technical Operations Quality Assurance Coordinator (John Maier) - The TOQAC will be responsible for ensuring that the quality of the data and the reports are suitable for the project objectives. His primary QA responsibilities will be for the sampling and data management activities. The technical QAC will work closely with the laboratory QAC, the project manager, and the task managers to ensure that the QA/QC Plan is being implemented. He will also prepare the QA/QC Plan in conjunction with the laboratory QAC.

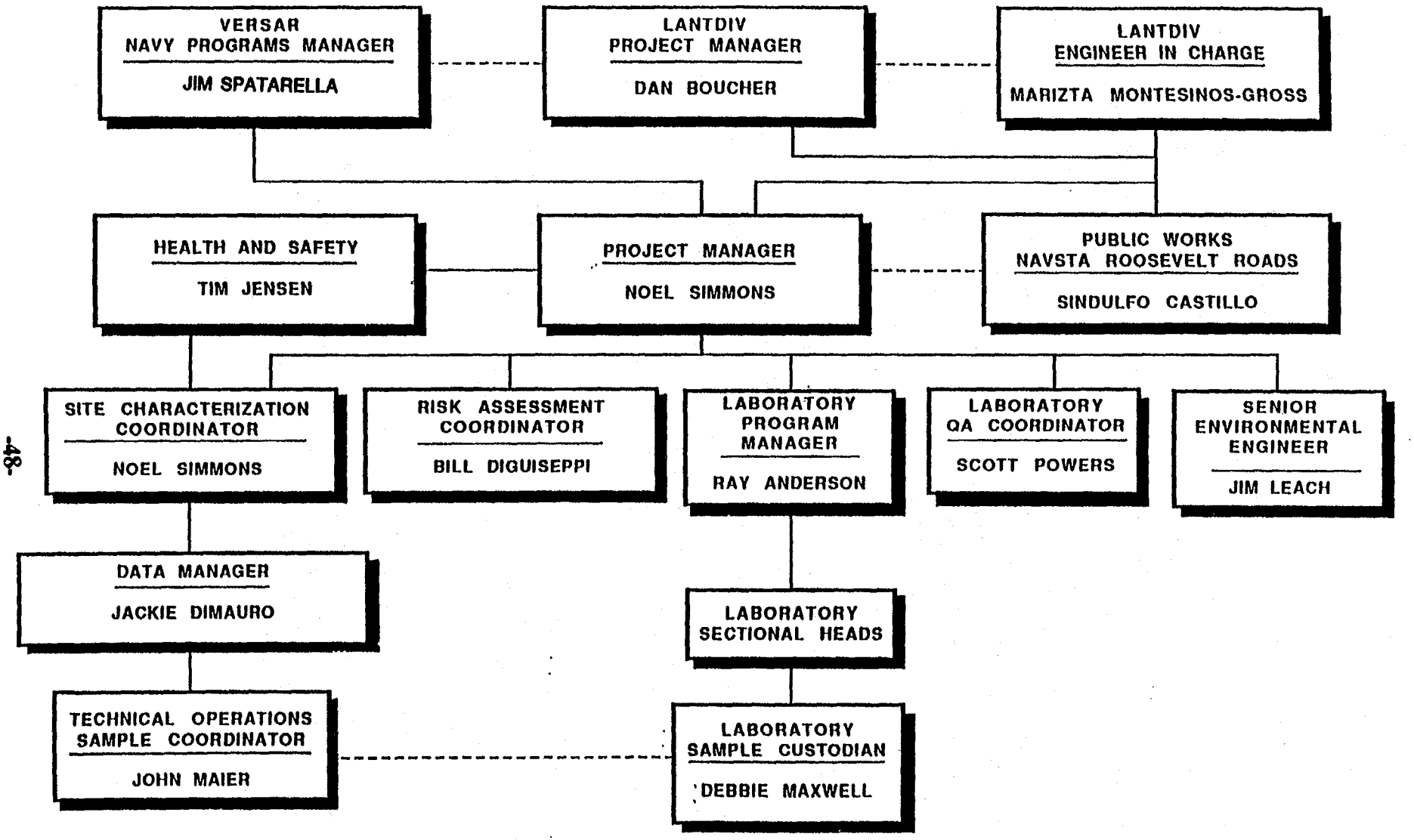

FIGURE 8
ORGANIZATIONAL STRUCTURE - RI/FS FOR SITES 15 AND 16,
NAVSTA ROOSEVELT ROADS

- Laboratory Quality Assurance Coordinator (Scott Powers) - The laboratory QAC will be responsible for ensuring the quality of the analytical data by overseeing the quality of purchased laboratory reagents; ensuring that sampling handling and preparation activities are adequate for the sample types received; ensuring that all records, logs, standard procedures, and analytical results are maintained in a retrievable fashion; establishing with the analyst the correct QC samples to be included in each lot and the correct procedures for evaluating acceptable, in-control analytical performance; ensuring that analysts are preparing QC samples, maintaining control charts, and implementing and documenting corrective action when necessary; and reviewing calibration data, control charts, and other performance indicators to verify that the data was collected under conditions of analytical systems control. The laboratory QAC will also prepare the QA/QC Plan in conjunction with the technical QAC and will prepare corrective action reports, monthly laboratory progress reports, and a final analytical report.

- Health and Safety Coordinator (Tim Jensen) - The health and safety coordinator will be responsible for preparing the site safety/contingency plan that conforms to applicable health and safety regulations and for ensuring that health and safety requirements are not compromised during on-site activities. This safety/contingency plan provides task-specific health and safety requirements that are to be followed during investigation and sampling to ensure that the workers are properly protected while meeting the QA objectives of this QA/QC Plan.

- Laboratory Program Manager (Ray Anderson) - The laboratory program manager will work with the laboratory sectional heads to ensure that adequate staffing is provided to complete chemical analyses within prescribed holding times. He will also review the analytical data for quality and work with the laboratory QAC to ensure that QA/QC procedures are being implemented.

- Laboratory Sectional Heads - The laboratory sectional heads will be responsible for ensuring that the analytical results being generated by their respective sections (e.g., metals, GC/MS, etc.) meet the QA/QC objectives of this QA/QC Plan. The sectional heads will ensure that the analysts are properly trained and that they are following the appropriate QA/QC procedures, including the construction and maintenance of control charts. The sectional heads will also review all analytical data from their respective section prior to submitting the results to the laboratory manager or laboratory QAC.

- Laboratory Sample Custodian (Debbie Maxwell) - The laboratory sample custodian will be responsible for receiving, logging, and storing of the samples as they arrive at the laboratory. She will work closely with the technical operations sample manager to complete log-in information sheets, which contain specific information such as analysis parameters, holding times, and analysis priority. She will also ensure that prescribed sample holding times are not exceeded and that sample custody is maintained.

- Data Manager (Jackie DiMauro) - The data manager will be responsible for developing the database, for entering information into the database, and for performing sorts, summaries, and "what-if" analyses. He will also be responsible for ensuring that the information is entered into the database correctly and accurately.

- Senior Environmental Engineer (Jim Leach) - The senior environmental engineer will be responsible for providing technical expertise and will review all plans and reports for technical accuracy. He will also be ultimately responsible for the review of all analytical data and calculations.

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6.0 SCHEDULE

A detailed project schedule for all significant tasks is included in Figure 9. This schedule assumes a three-week review time for initial draft reports, and two-week review time for final draft documents. Under the current schedule, the RI/FS process for NAVSTA Roosevelt Roads will require approximately 10 to 12 months from approval of work plans to release of a ROD for public comment.

Versar plans to accomplish the work in accordance with the 10 to 12-month schedule shown within the limitations of components we control. The primary components which are not controlled by Versar and could adversely affect the project schedule are: 1) inclement weather (such as hurricanes); 2) timely review of project deliverables; and 3) encountering unexpected or unknown site contaminants or conditions. In the event revision of the project schedule becomes necessary, Versar will work in concert with the LANTDIV NAVFACENGCOM to assure that reasonable adjustments are made.

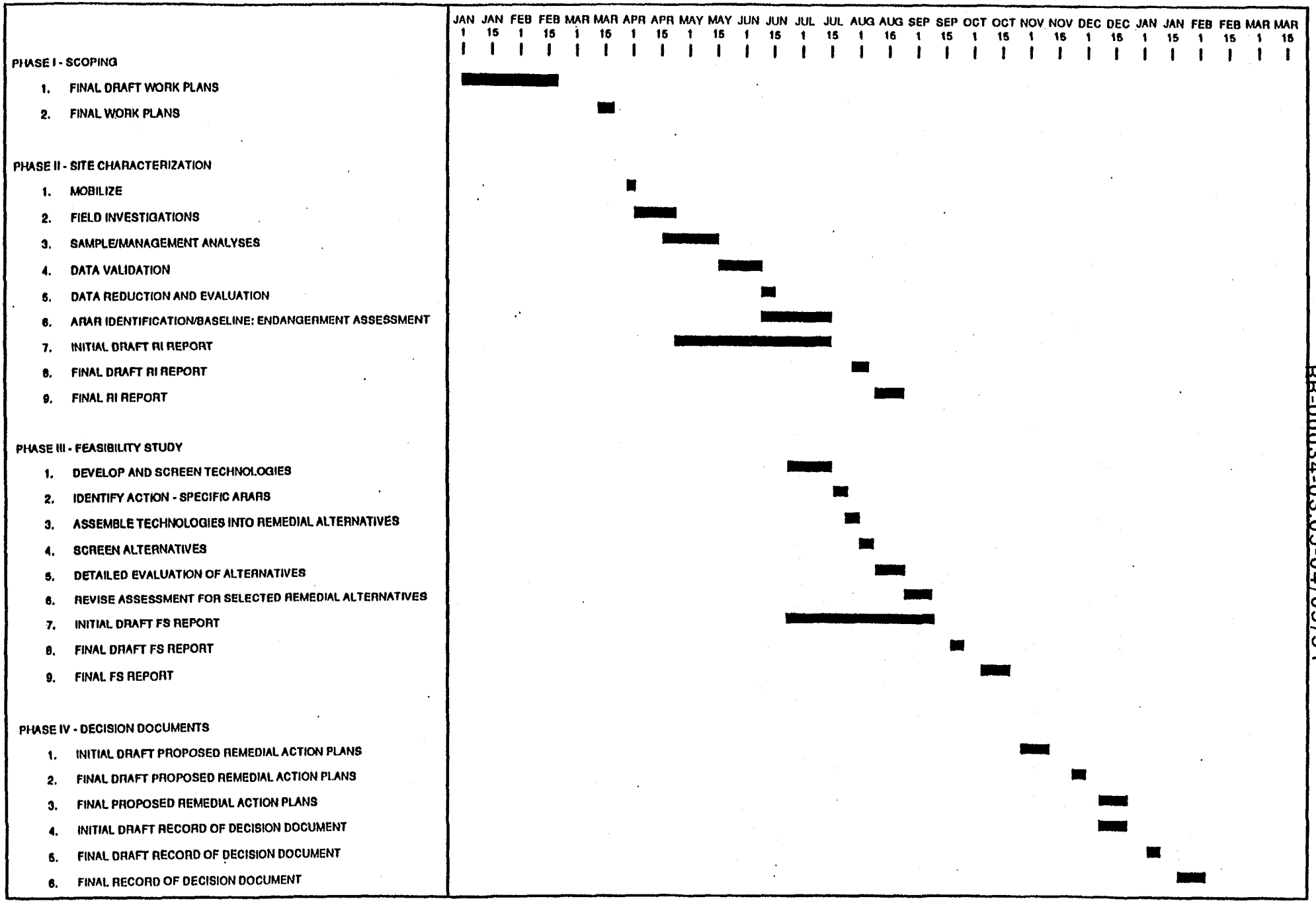

FIGURE 9
PROJECT SCHEDULE

RR-00034-03.05-04/09/91

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APPENDIX A

FIELD SAMPLING PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY OF SUBSTATION NO. 2 - BLDG. 90 (SITE 15) AND OLD POWER PLANT - BLDG. 38 (SITE 16) NAVAL STATION ROOSEVELT ROADS PUERTO RICO, U.S.A.

Prepared for:

Atlantic Division
Naval Facilities Engineering Command
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Prepared by:

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APRIL 9, 1991

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1.0 INTRODUCTION

The U.S. Navy Facilities Engineering Command (NAVFACENGCOM), Atlantic Division (LANTDIV) has contracted Versar, Inc., to perform a Remedial Investigation/Feasibility Study (RI/FS) at two sites at the Naval Station (NAVSTA) Roosevelt Roads, Puerto Rico. The location of Roosevelt Roads is shown on Figure 1. These sites were identified for further characterization during a Preliminary Assessment/Site Investigation. They are Substation 2, Building 90 (Site 15) and the Old Power Plant, Building 38 (Site 16). This Field Sampling Plan (FSP), the Quality Assurance Project Plan (QAPP), and the accompanying Work Plan, and Health and Safety Plan (HSP) describe available environmental information concerning the site, the detailed tasks required to accomplish the RI/FS, and the manner in which they will be accomplished and managed.

NAVSTA Roosevelt Roads Substation No. 2 (Site 15), and Old Power Plant (Site 16) were areas used to repair electrical transformers. The dielectric fluid was drained onto the ground, and it is believed that some of the oil contained polychlorinated biphenyls (PCB)s. Several types of PCB fluids have been identified including pyranol, inerteen, and askeral. Short summaries of previous sampling and analytical results at each site are provided below.

This FSP has been organized in accordance with Data Quality Objectives for Remedial Response Activities (EPA, 1987). Versar has identified data users and tailored these documents to specific users of the information. The FSP has been designed so that it may be detached from other documents for use by field personnel that do not need the detailed information contained the QAPP or Work Plan. Detailed sample collection methodologies are contained in the FSP and cross-referenced within the QAPP.

Site 15: Substation 2 Background Information

Substation 2, Building 90, at the Naval Station Roosevelt Roads, Puerto Rico, has been used for the repair of electrical transformers since 1964 by the Public Works Department Power Distribution Shop. As part of the maintenance of pole-mounted distribution transformers, the oil was drained to facilitate in the repair to the inner core and coils. The oil from the transformers was drained onto the ground in the vicinity of Substation 2, Building 90, from 1964 through 1979. The amount of possible PCB

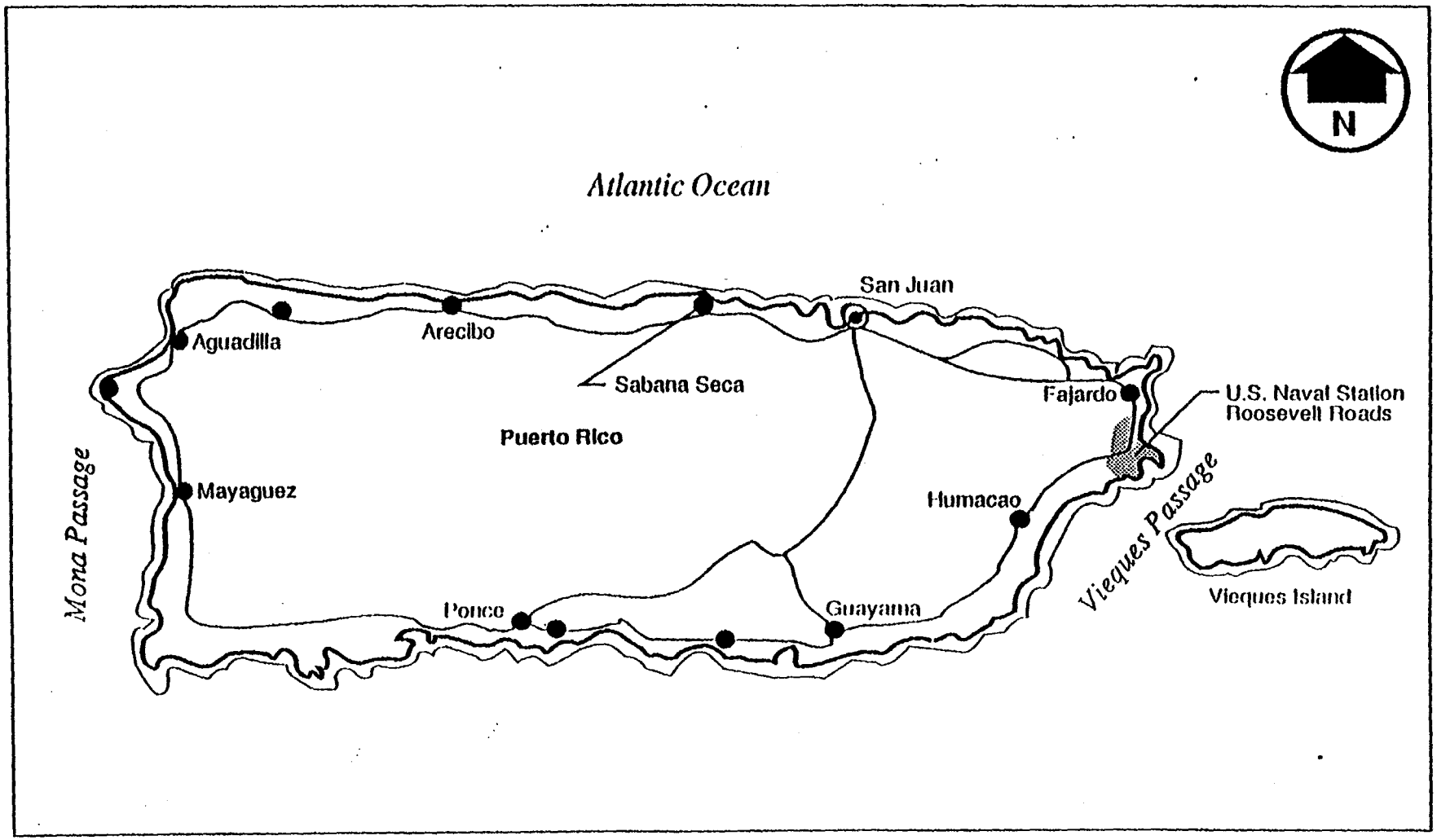


FIGURE 1
LOCATION OF NAVSTA ROOSEVELT ROADS, PUERTO RICO

contaminated oil deposited onto the ground has been estimated at a maximum of 3,000 gallons. Figure 2 shows the general location of Site 15 at Roosevelt Roads, and Figure 3 contains the specific location and a site plan.

As part of the Navy Assessment and Control Installation Pollutants (NACIP) program, an Initial Assessment Study (IAS) was performed in 1984. The results of the IAS indicated the potential presence of PCBs in the soil, and the site was recommended for a Confirmation Study which was performed by Environmental Science and Engineering, Inc. and completed in February 1988 (ESE, 1988). The Confirmation Study included a characterization of the site, a preliminary risk assessment and an analysis of several remedial action alternatives.

As part of the Confirmation Study, thirty-six soil samples were collected from 33 hand augered soil borings at Site 15. Soil samples were collected from the surface to a depth of one foot below land surface (BLS) in all but two of the borings which were extended deeper. The soil samples were analyzed for PCBs. Concentrations of PCBs ranged from ND (not detected) to 1,186 ppm. The sample locations and results are shown on Figure 3. PCB levels above 50 ppm were found at four sampling locations. The highest concentrations were found around Building 90 and in the drainage ditch along Valley Forge Road. Two samples from the fenced-in storage yard were <1 ppm.

Site 16: Old Power Plant Background Information

The Old Power Plant, Building 38, at the NAVSTA Roosevelt Roads, was a 60 megawatt steam turbine facility that generated power from the early 1940s through 1949. The plant used Bunker "C" fuel, which was stored in two 50,000-gallon reinforced concrete tanks located directly northwest of the building. During heavy rainfalls in the 1970s, fuel was observed in the manholes near the building and was also discharged to the Enlisted Beach via the old cooling water outlet for the Power Plant. A cleanup contractor was hired twice to drain the underground fuel tanks and cleanup the spill. This area, where the underground storage tanks are located, is now paved over with concrete.

From 1956 to 1964, transformer maintenance was performed at Building 38 by the Public Works Power Distribution Shop. The majority of transformer repair work was conducted just outside of the building at its northeast corner. As part of the maintenance

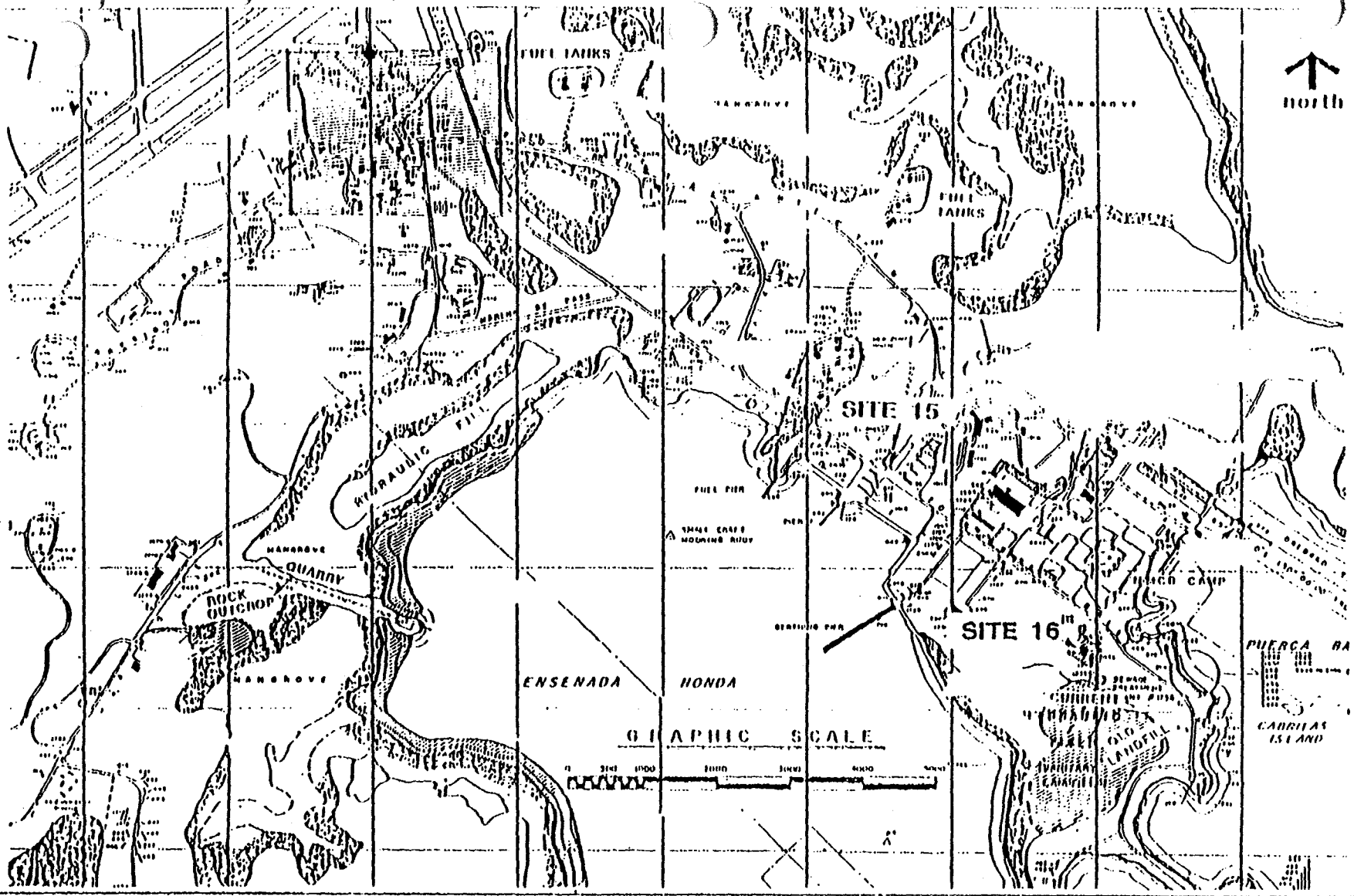


FIGURE 2

LOCATIONS OF SITES 15 AND 16,
NAVSTA ROOSEVELT ROADS

U.S. NAVAL COMPLEX
PUERTO RICO

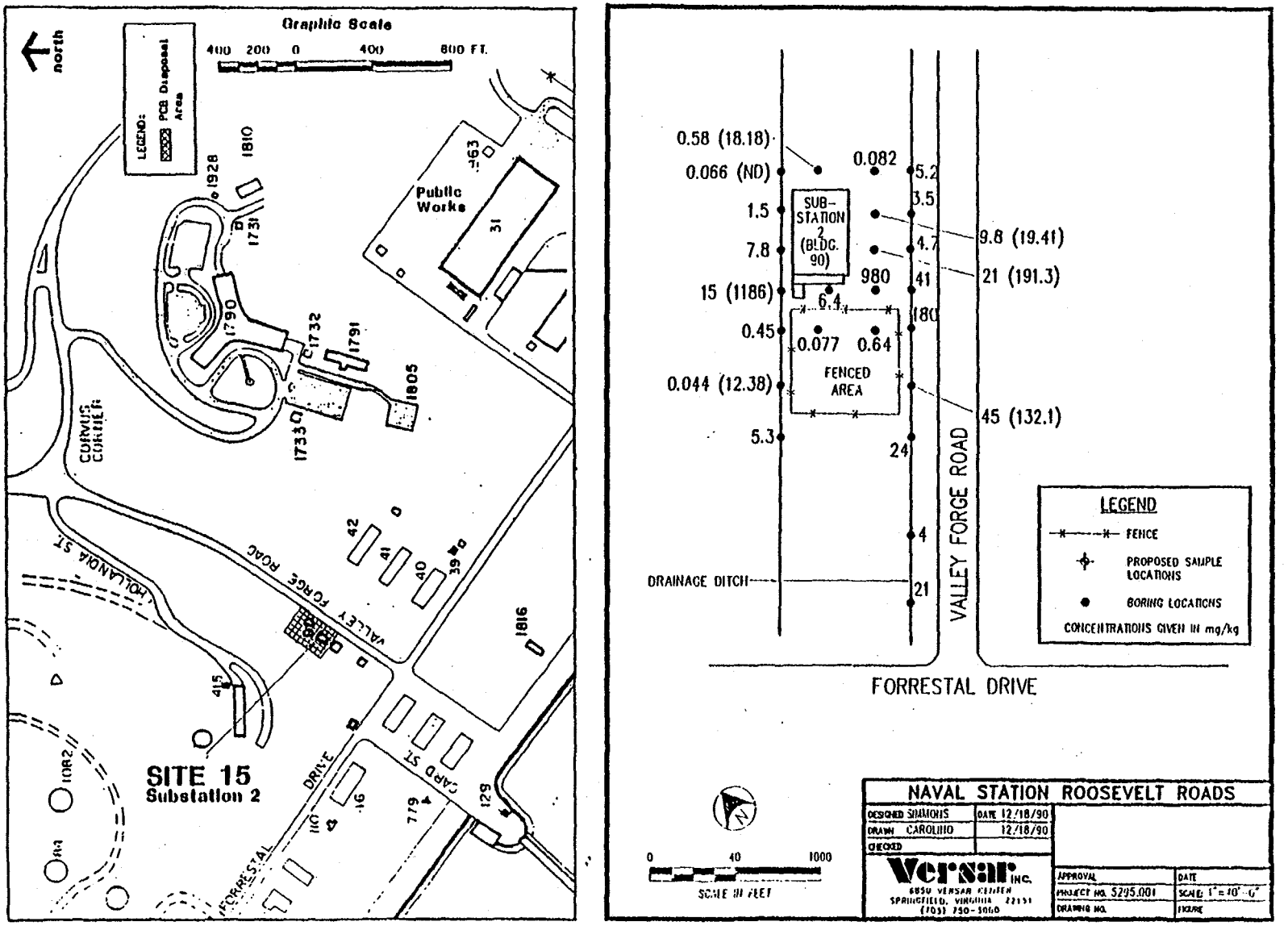


FIGURE 3
LOCATION AND CONFIRMATION STUDY SAMPLING LOCATIONS FOR
SITE 15: SUBSTATION NO. 2, BUILDING 90,
NAVSTA ROOSEVELT ROADS, PUERTO RICO

RR-00034-03.05-04/09/91

of the transformers, the transformer oil was drained to facilitate repair of the inner cores and coils. Reportedly, oil was drained from the transformers to the soil in the immediate vicinity of the building. The only exception to this practice was with Askarel transformers. Power Distribution Shop employees drained transformers containing Askarel directly to 55-gallon drums which were disposed of at the station landfill. The exact quantity of Askarel disposed of in this manner is unknown. The Power Distribution Shop ordered 200 gallons of replacement transformer fluid per year. Assuming the total 200 gallons were used each year, it is possible that over the eight years during which Building 38 was used, approximately 1,600 gallons of transformer oil were drained to the soil in the vicinity of the building, with some portion going to the landfill. The transformer oil commonly used in this time frame was either "pure" PCBs or oil containing PCBs at a 300-ppm concentration (ESE 1988b).

An Initial Assessment Study was performed at Site 16 in 1984. The site was recommended for a confirmation study due to potential presence of PCBs and fuel-related contamination in the soil. This study was completed by Environmental Science and Engineering, Inc. in May 1988 (ESE 1988b). From the Confirmation Study, it was determined that PCB contamination exists in the vicinity of the Old Power Plant, Building 38, and that remedial measures are warranted..

For the Confirmation Study, thirty-eight soil samples were collected from the site (9 in Round 1 and 29 in Round 2). These samples were analyzed for PCBs, oil and grease, volatile organic compounds (VOC), ethylene dibromide (EDB), xylenes, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK). In Round 2, an EP toxicity test for lead was also performed. The analytical results indicated the presence of PCB and lead contamination at the site. Lead concentrations were less than the EP toxicity standard for lead. Other constituents detected (but not at levels of concern) were MEK as well as oil and grease. The site plan on Figure 4 shows the PCB concentrations of samples collected for the Confirmation Study.

1.1 Field Operations

This section describes the methods to be used for conducting the on-site field operations at NAVSTA Roosevelt Roads. Soil boring and sampling operations and associated activities such as decontamination procedures are described below. As presented earlier, Figures 2, 3, and 4 show the locations of the sites to be investigated. Operations

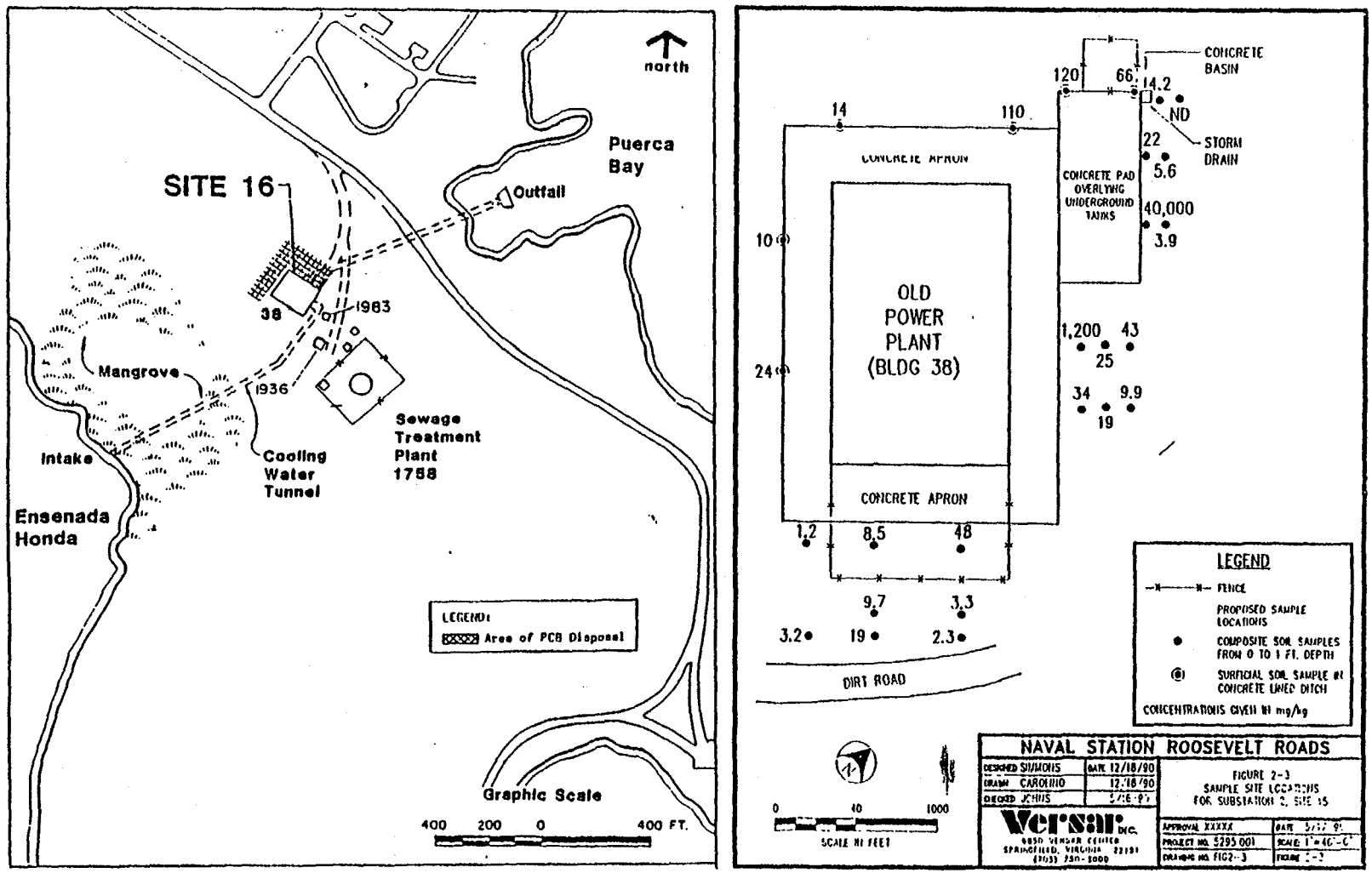


FIGURE 4
LOCATION AND CONFIRMATION STUDY SAMPLING
LOCATIONS, SITE 16: OLD POWER PLANT, BUILDING 90
NAVSTA ROOSEVELT ROADS, PUERTO RICO

RR-00034-03.05-04/09/91

described will include site-specific activities as well as activities that are standard Versar operating procedures (e.g., decontamination procedures).

Site preparation will include establishing a local staging/decontamination area, the marking of soil sampling locations, and coordinating operations with the appropriate base personnel. The location of the staging/decontamination area will be determined in conjunction with the base Public Works Officer, and will preferably be located in an area central to both sites. This area will also include a secured area for storage of equipment and materials such as sampling tools, sample jars, and wash water. Further information about site specific decontamination procedures is also contained in the Health and Safety Plan.

Versar field personnel will be provided with site maps at a scale of one inch equals 16 feet. In this manner, sample sites can be very accurately located on the map with respect to permanent features using an ordinary ruler for scale and translated to the actual site. Each sample site will be located with a steel tape measure. Restoration of areas after sampling is expected to be minimal. Soil sampling areas will be filled with soil from the same hole so that no open holes remain.

1.2 Field Investigation

Sites 15, and 16 have been identified as areas of concern regarding PCB contamination. The RI/FS includes field activities to assess the extent of this contamination. These activities will include confirmatory sampling and sampling from areas not previously evaluated, and will be conducted in order to provide thorough and representative analytical results. The analytical results will be used to perform a risk assessment, and delineate the horizontal and vertical extent of contamination for future remedial activities.

The sampling rationale for the RI/FS at Sites 15 and 16 is to utilize the ESE data (ESE 1988a,b) to the greatest degree possible in project scoping and remedial design, while supplementing this information with fully validated data that can be used for tasks that require the highest level of data quality, such as risk assessments. As unvalidated data, the highest level of use for the ESE data is screening and engineering purposes. At the time this sampling plan was prepared, analytical data packages necessary for validation of the ESE data were incomplete. Duplicates from their laboratory have been requested. Only validated data will be used in the risk assessment.

A major thrust of the soil sampling program is to attempt to identify deeper areas where PCB-bearing fluids may have percolated to coral that is only a foot or less deep at the sites. The soil sampling program recognizes the potential for contaminated soil to be transported short distances form the actual spill area. If a positive detection is encountered in the shallow soil (0-3"), the deeper soil sample (8-12") collected and extracted at the same time, will be analyzed. This technique will identify spill areas (and potential for bedrock contamination of the porous coral) and target these areas for possible bulk sampling following an initial soil removal action. Also, additional exposure pathways, such as the cooling water tunnel of Site 16, will be evaluated. Concrete bulk and wipe samples are intended to identify decontamination needs for concrete surface areas.

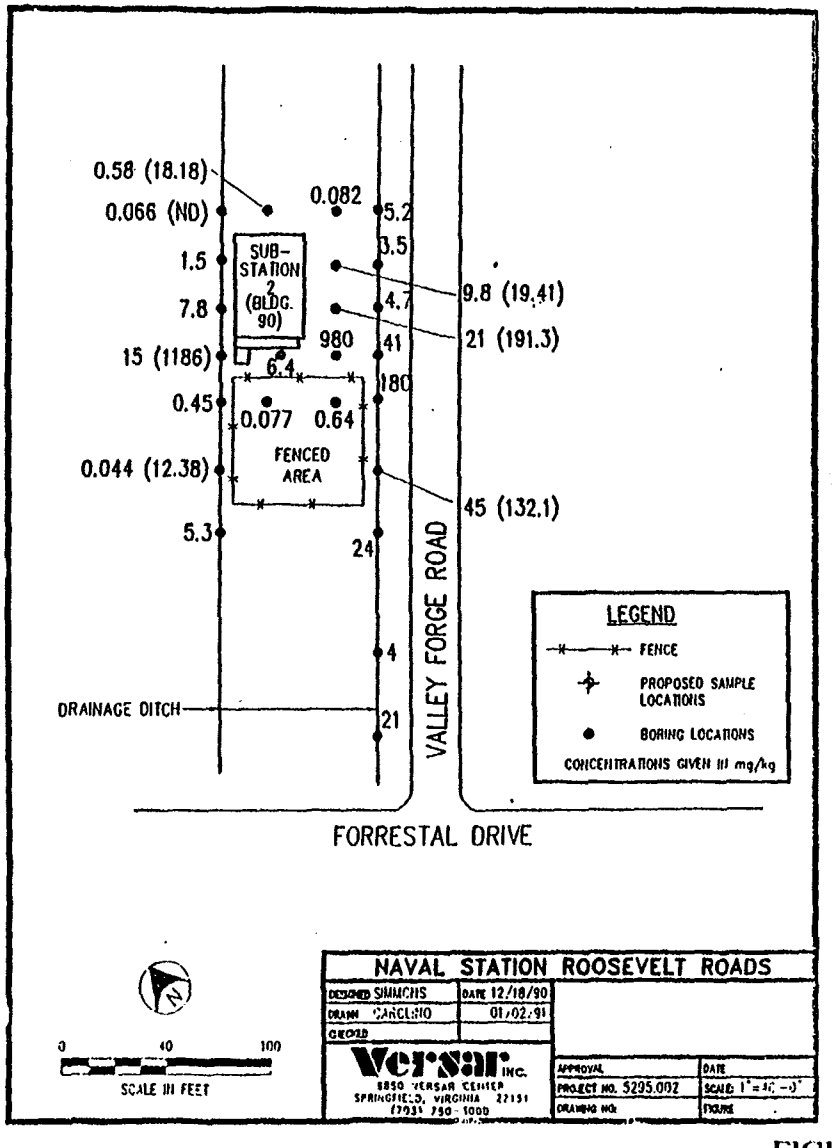
Site 15, Substation No. 2:

A total of 47 soil samples will be collected to confirm previous analyses for PCB contamination and to delineate the contaminated area. The proposed sample locations are shown on Figure 5. These samples will be collected from shallow (0-3") and deep (8-12") soil. Twenty shallow samples will be extracted and analyzed immediately. The 20 deeper soil samples will be extracted immediately but held for analysis pending the results of analysis of the shallow soil samples. Coral outcrops are visible at the site indicating that the soil is less than a foot thick in parts of the site. Seven sediment samples will be collected from the two ditches running southwest of Substation 2. Deeper soil (8-12") will also be collected from below the 7 drainage ditch sediment sample locations, extracted immediately, but held for analysis pending the results of the shallow sediments.

Two concrete chip samples and three wipe samples will be collected from the concrete pad at the entrance to Substation 2 to confirm previous analyses for PCB contamination. Wipe samples will be used to characterize the unstained concrete surfaces to determine potential needs for remediation of these structures.

Site 16, Old Power Plant:

A total of 48 soil samples (grab samples) will be collected to confirm previous analyses for PCB contamination and to delineate the areas of contamination. The proposed sample locations for Site 16 are shown on Figure 6. Twenty-four samples will be collected from shallow (0-3") and 24 from deep (8-12") soil. The shallow samples will be extracted immediately but analyzed immediately. The deep samples will be extracted and held for analyses pending the results of analyses for shallow soil samples.



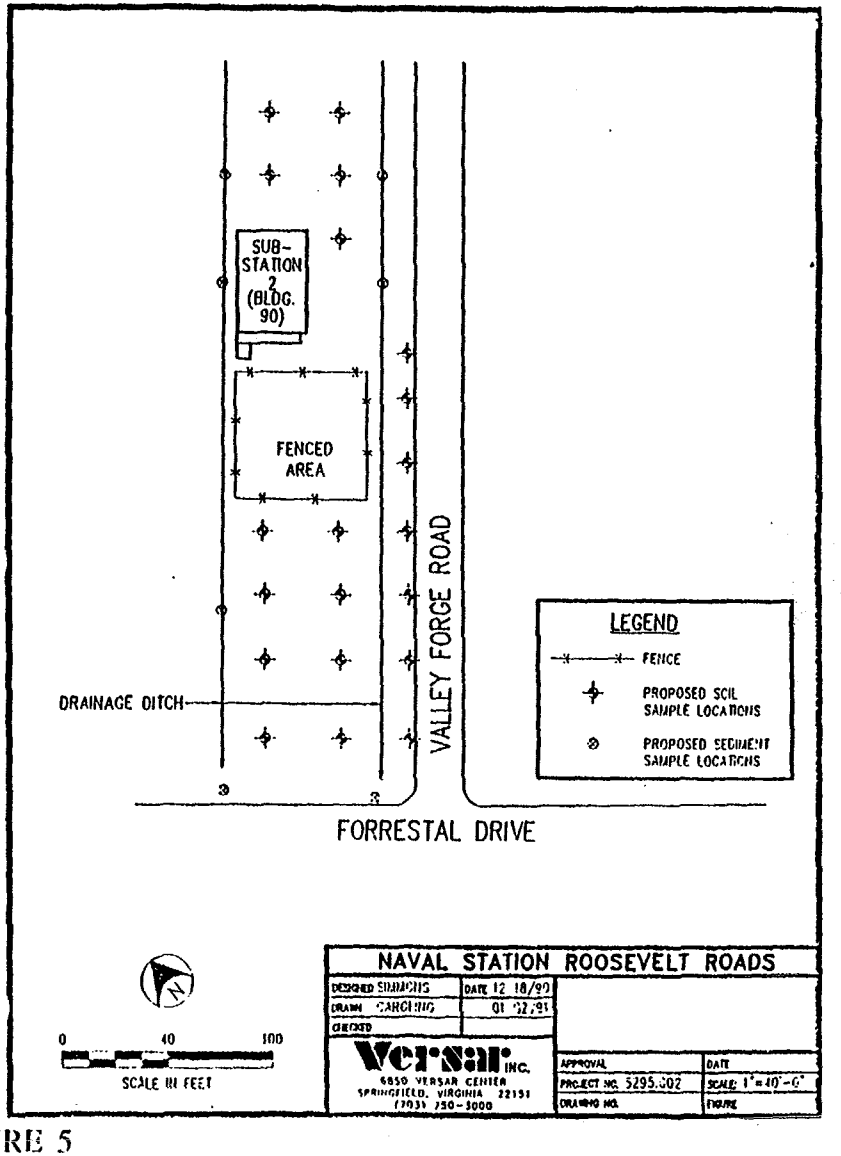


FIGURE 5
PROPOSED SAMPLING LOCATIONS FOR SITE 15:
SUBSTATION NO. 2, BUILDING 90
NAVSTA ROOSEVELT ROADS

To define the horizontal extent of contamination, 24 surficial soil grab samples will be collected (0-3"). These locations were selected to bound previous data, and to fill data gaps remaining from the previous round of sampling done for the Confirmation Study.

A total of 8 surficial soil composite samples (0-3") will be collected along the concrete-lined ditch located along the southwest to northwest of Building 38. These will consist of 10 aliquots per sample at 6 foot intervals along the ditch.

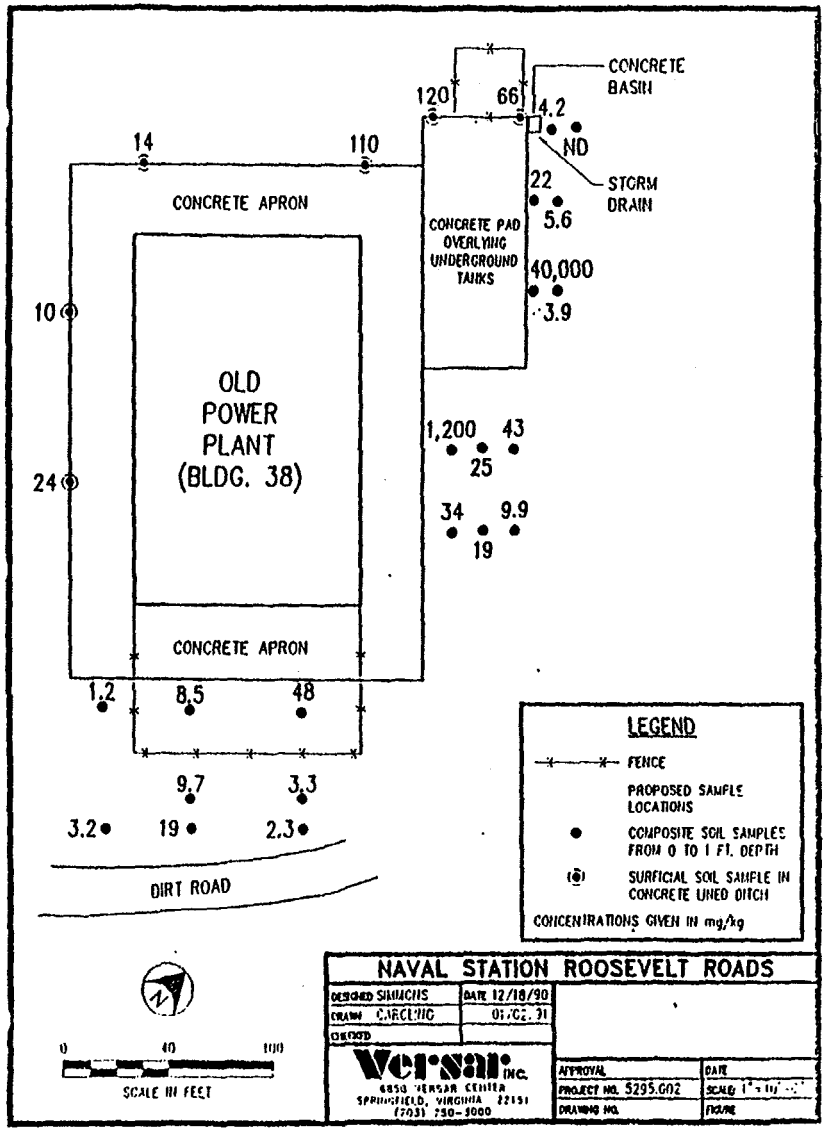
Twelve sediment samples will be collected from the tunnel running southwest to northwest of the Old Power Plant. Sample locations will include available access ports and tunnel outfalls.

Six chip samples will be collected from the stained concrete surfaces at Site 16. A total of 53 PCB wipe samples will be collected from the concrete apron surrounding Building 38, the concrete base of the transformer station, the concrete-lined ditch and concrete basin, and the concrete pad overlying the underground storage tanks. These samples are intended to characterize unstained concrete areas. Sample locations will be selected on site using best engineering judgement.

1.3 Equipment Decontamination

All equipment that may directly or indirectly contact samples will be initially precleaned and decontaminated at Versar's staging area/warehouse in Springfield, Virginia. This includes sample scoops, drill bits, bucket augers, bush hammers, and instruments such as pH meters. Unless prewrapped, all sampling equipment, either new or previously used, will undergo the level of decontamination appropriate to its intended use and construction. The following sections detail various decontamination procedures to be used. The procedures outlined under Level 1, Level 2, and Level 3 decontamination are intended to be performed in the staging area in Springfield, Virginia. Field decontamination procedures are discussed at the end of this section.

There are several levels of decontamination presented below, and each level is designed according to the type of equipment being decontaminated. Once all sampling and safety equipment has been decontaminated and allowed to dry, the equipment will be packaged to protect it from dust.



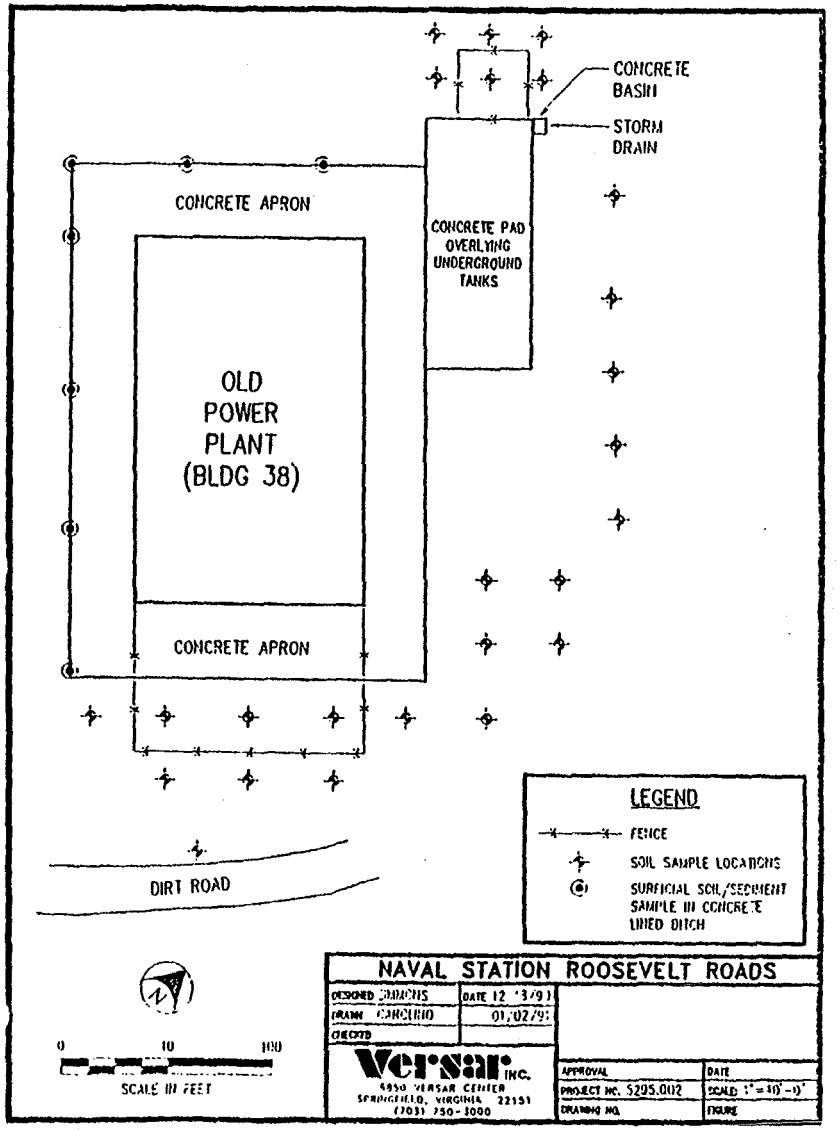


FIGURE 6
PROPOSED SAMPLING LOCATIONS FOR SITE 16:
OLD POWER PLANT, BUILDING 38,
NAVSTA ROOSEVELT ROADS

Versar INC.

Level 1 Decontamination. Items such as glassware and stainless steel equipment that will be used in the collection and containerization of organic samples, and whose construction will tolerate the high temperature of the muffle furnace should undergo Level 1 decontamination. The following procedures are recommended:

- Thoroughly wash with nonphosphate detergent in hot water.
- Rinse several times with tap water.
- Rinse several times with deionized water.
- Rinse once with acetone.
- Rinse once with pesticide grade methanol and hexane.
- Place in muffle furnace at 450°C for 15 to 30 minutes.
- Allow to cool, protect from dust and other contaminants by sealing or covering with aluminum foil.

Level 2 Decontamination. All Teflon equipment and stainless steel equipment with components which may be damaged by the high temperature of a muffle furnace, should undergo Level 2 decontamination. This level of decontamination is used on items used in the collection of organic samples. The following procedures are recommended:

- Thorough wash with nonphosphate detergent in hot water.
- Rinse several times with tap water.
- Rinse several times with deionized water.
- Rinse once with acetone.
- Rinse once with pesticide grade methanol and hexane.
- Air dry in hood.
- Cap or cover after drying; Teflon bailers and other applicable equipment should be wrapped in aluminum foil and sealed in plastic bags.

NOTE: Chromic acid can be used to remove persistent organic deposits.

Level 3 Decontamination. This level of decontamination is recommended for items used in the collection of metal samples. For Sites 15 and 16, metal samples will not be collected. Therefore, this level of decontamination will not be used unless field modifications dictate collection of such samples. The procedures are as follows:

- Wash thoroughly with nonphosphate detergent in hot water.
- Rinse once with 1:1 nitric acid.
- Rinse several times with tap water.
- Rinse once with 1:1 hydraulic acid.
- Rinse several times with tap water.
- Rinse several times with deionized water.
- Invert and air dry in dust free environment.
- Wrap in aluminum foil (shiny side out) after drying.

NOTE: If chromic acid is used as cleaning agent, rinsing must be increased. Note the use of chromic acid on bottle box seal.

Field Decontamination. All sampling equipment used during the RI will be precleaned at Versar prior to the start of site activities. Sufficient equipment will be available to minimize reuse during the course of the RI; therefore, extensive field decontamination of sampling equipment is not anticipated. But, when equipment must be reused, it will be field decontaminated according to the procedures as summarized below:

- Brush off loose dirt with a soft bristle brush or cloth.
- Rinse thoroughly with tap water.
- Wash with nonphosphate detergent in warm water.
- Rinse thoroughly with tap water.
- Rinse with pesticide grade methanol, then hexane (spent hexane will be collected for proper disposal).
- Rinse thoroughly with deionized water.

- Air dry in clean environment.
- Wrap in aluminum foil (shiny side out).

1.4 Waste Handling

Waste materials generated at the site will include excavated soils from soil sampling operations, waste water from decontamination activities, and waste materials such as Tyvek suits and gloves. Attempts will be made to screen materials generated and separate uncontaminated materials from those that are potentially contaminated. Contaminated soils, waters, and material generated from investigations at Site 15 and 16 will be contained in sealed drums.

1.5 Table of Field Activities for Each Site

A summary of sediment, soil, concrete chip, and PCB wipe sampling proposed for NAVSTA Roosevelt Roads is provided in Table 1.

TABLE 1
SITE SPECIFIC SAMPLE AND ANALYSIS SUMMARY

Site	Number of Sediment Samples	Number of Sediment Samples in Tunnel	Number of Surficial Soil Samples (0-3" depth)	Number of Surficial Soil Samples (0-3" composite)	Number of Surficial Soil Samples (8-12" depth)	Number of Concrete Chip Samples	Number of Wipe Samples
Site 15 Building 90 Substation 2	7	-	20	-	27*	2	3
Site 16 Building 38 Old Power Plant		12	24	8*	24**	6	53

*Includes surficial soil and ditch sediment sample locations. Versar will extract and hold.

**Includes surficial soil (0-3" grab) sample locations. Versar will extract and hold.

*10 aliquots per sample at 6 foot intervals.

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2.0 ENVIRONMENTAL SAMPLING: PROTOCOL AND PROCEDURES

This section provides information on procedures, sample handling, sample custody, QA/QC samples, and a summary of analytical requirements for the RI/FS and SI activities at NAVSTA Roosevelt Roads.

2.1 Procedures

Prior to initiating soil, concrete chip, and wipe sampling activities, the on-site coordinator will ensure that all sample locations have been clearly identified, and all field equipment has been properly cleaned, inspected, and found to be in good working condition. In addition, arrangements will have been made concerning sample shipment and timely laboratory analyses.

Field Sampling Equipment

- Stainless steel scoops, augers, or trowels
- Chemically cleaned sample bottle (I-Chem 300 series, 30 ml teflon lined, 4-8 oz.)
- 8 ft. x 10 ft. plastic sheeting
- Disposable Nitrile sampling gloves
- Methanol
- Hexane pesticide grade
- 3 inch x 3 inch sterile gauge pads individually wrapped
- Metal tape measure
- Ink marker and masking tape
- Stainless steel bowl
- Aluminum foil
- Stainless steel spatula
- Diamond-tip core borer
- Chisel and hammer
- Bush hammer
- Stainless steel bucket
- Dispenser bottle
- Templates (art board or galvanized sheet metal)-0.25 m^2 surface area

2.1.1 Soil and Sediment Sampling

Stainless-steel bucket augers, scoops, or trowels will be used to transfer the sampled soil into sampling jars. The following points will be followed during soil sampling.

1. The equipment used at each sampling location will be precleaned and wrapped in aluminum foil (shiny side out). Each sampling location will have dedicated sampling equipment.

2. The sample will be collected and placed in a stainless-steel bowl lined with aluminum foil.

3. When a sufficient volume of soil has been collected, the soil will be mixed and then transferred to precleaned containers using a stainless-steel spatula. If sufficient volume is collected in one aliquot, then it may be transferred directly to the sample container.

4. All sampling equipment will be kept on clean plastic sheeting until needed.

2.1.2 Concrete Bulk Samples

For this sample program, concrete samples will be collected from the top ¼ to ½ inch of the concrete. These samples will be collected with a bush hammer or chisel, whichever is most suitable for the sample location. If it is determined that samples from deeper into the concrete are required, they would be collected using a diamond-tip core borer or a jackhammer.

The diamond chip borer, chisel, or jackhammer bit will be cleaned between each sample with nonphosphate soap, methanol and hexane rinses, and a distilled water rinse. NITRILE gloves will be used to pick up or handle the concrete cores or chips. All samples will be placed in precleaned sample jars and the exact location of each sample will be recorded on a sample data sheet.

2.1.3 Wipe Samples

The procedure for collecting a PCB surface wipe sample is as follows:

- Select the area meeting the test plan requirements.
- Hold the template in place, or measure and mark an area .25 m^2 in surface area.
- Put on a new pair of gloves.
- Soak a 12 ply gauze pad with 8 ml of hexane.
- Apply even and steady pressure to the pad while drawing it in straight strokes, moving from left to right in the area designated in slightly overlapping, adjacent

strokes. Upon completion of wiping left to right, repeat the procedures from top to bottom of the wipe area.

After completion of the sampling, the gauze pad will be folded onto itself twice and placed into a sampling container. The exact location of each sample will be recorded on the site map and in the field notebook.

2.2 Sample Handling

The objective of this section is to establish sample identification procedures, assure compliance with appropriate packaging and shipping requirements, and specify the materials and procedures needed to insure sample integrity.

Sample Identification. Each sample container will be labelled with a unique field sample number. As a standard, Versar uses the upper portion of a three-part label that is marked with a unique serialized number and allows for parameter identification. For an example of the Versar three-part label, see Figure 7. Clear tape will be placed over the label on the container. The lower portion of the label will be completed and entered into a bound field logbook. These unique numbers will then be used to fill out a chain-of-custody form. For more information concerning chain-of-custody procedures, refer to Section 2.2.3 Sample Custody.

Sample Packaging and Shipping. There are three major concerns confronting field teams in preparing samples for transport to the laboratory: (1) preventing deterioration of the sample, (2) protecting the samples from incidental breakage during shipment, and (3) abiding by applicable transportation regulations. In most instances, packaging to prevent breakage is achieved by following common sense, and allowing sufficient time to complete the packaging tasks. There are some general considerations that must be made when packaging environmental (nonhazardous) or hazardous samples.

First, significant time and expense has gone into sample collection. In addition, the holding times for samples will be restrictive. Therefore, expedient and coordinated shipment and receipt of the samples is essential. Field personnel should predict the amount of time that will be required at the end of the sample collection period to properly package (and document) samples. It is imperative that this time allotment be given the same priority as the sample collection time. Sample packaging should be coordinated and supervised to ensure at least two cross checks on completeness of packaging.

Versar INC.

VERSAR, INC.
73701 PARAMETER

AFFIXED TO SAMPLE CONTAINER

73701
DUPLICATE

AFFIXED TO DUPLICATE SAMPLE
(eg., VOA SAMPLES)

VERSAR, INC.
73701 PARAMETER

TASK

PLANT

SAMPLE LOCATION

MATRIX

SAMPLING COMMENTS

SIGNATURE TIME/DATE

ENTERED IN FIELD NOTEBOOK AS
PERMANENT SAMPLE IDENTIFICATION

FIGURE 7
3-PART LABEL

Sample containers belonging to a sample set will be packaged together. This will minimize delays and errors when the samples are logged in at the laboratory. If there is ample room in the cooler or package for packing two or more sample sets, each sample set will be contained in a separate sealed plastic bag.

All samples will be packed in such a way that they cannot move freely about in the cooler or packing container. Glass will be kept away from glass and each individual sample bottle will be cushioned with bubble wrap (preferred), styrofoam, or other non-reactive cushioning material. Ice is not used as a cushioning material. The sample and ice bags (if needed) will be tightly closed with tape to prevent leakage of material from the bag. Commercial carriers will not transport packages if they are wet, so precautions will be taken to prevent leakage and excessive condensation.

Samples transported off site must be packaged for shipment in compliance with current Department of Transportation (DOT) or International Air Transporters Association (IATA) and commercial carrier regulations. All required government and commercial carrier shipping papers must be filled out and shipment classifications made according to current DOT or IATA regulations. The samples will be packaged and shipped via overnight freight to Versar's laboratory.

A decision must be made concerning whether the samples should be declared hazardous. Generally, if there is no evidence or data that defines a given set of samples as being hazardous, they can be shipped by non-restricted procedures as described above. If there is evidence that the samples are a hazardous substance as defined by IATA (Section 3) or DOT (49 CFR 101-177), then they must be shipped as hazardous environmental samples.

Chain-of-custody records and other shipping/sample documentation accompanying the shipment will be enclosed in a waterproof plastic bag and taped to the underside of the cooler lid. If more than one cooler or package is being sent, these records are always placed in the cooler which has the original airbill attached to it. This is the first cooler that the laboratory sample receiving teams open, and these procedures aid in lessening the amount of time it takes to log samples into the laboratory.

Sample Integrity Requirements. Table 2 provides information concerning the sample parameters and their requisite analytical methods, preservation techniques, holding times and containers.

TABLE 2
SAMPLING REQUIREMENTS, CONTAINERS, PRESERVATION AND HOLDING TIMES

Parameter	Matrix	Analytical Method	Same Preservation	Holding Time	Container
TCL PCBs	Soil/Sediment	CLP[1]	Cool, 4°C	8 days until extractions 40 days for analysis	8-ounce wide-mouth glass bottles
TCL PCBs	Concrete Chips	CLP	Cool, 4°C	8 days until extractions 40 days for analysis	1L wide-mouth amber glass bottles
TCL PCBs	Wipes	CLP	Cool, 4°C	8 days until extractions 40 days for analysis	40-ounce wide-mouth glass bottles

Notes:

1. U.S. EPA Contract Laboratory Program Statement of Work, February 1988.

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2.3 Sample Custody

Sample chain-of-custody is the tracking of samples that begins when the sample is collected, continues through laboratory analysis, and ends with final disposal of the sample. Chain-of-custody fixes sample accountability to the individual in possession of the sample and ensures sample traceability. This minimizes the possibility of any tampering with the sample.

When a sample is collected, containerized and labeled, Versar personnel will enter the appropriate information on a Versar standard field chain-of-custody form (see Figure 8). This custody record will provide the necessary information to cross reference the sample number to the specific sampling location and will provide the date and time of collection as well as documentation of custody.

The team leader will maintain custody of the samples until shipment. Containers will be kept in a secure cooler within visual contact of sampling personnel, or in a locked vehicle or room. Only the team leader or team members will have access to the samples. Chain-of-custody records and any other shipping/sample documentation accompanying the shipment will be enclosed in a waterproof bag and taped to the underside of the cooler lid. Before shipment, a signed custody seal will be affixed to each edge of the cooler (see Figure 9).

Upon receipt of the samples in custody, the laboratory shall inspect the shipping container and sample containers and shall document receiving information. The sample custodian or a designated representative shall sign and date all appropriate receiving documents at the time of receipt. The laboratory will contact the field team leader if any documents are absent, if information on receiving documents does not correspond to the contents of the shipping container, if custody seals are not intact, or the sample is not in good condition. The laboratory will document resolution of any discrepancies and this documentation will become a part of the permanent case file.

Versar will maintain all originals of field chain-of-custody forms and laboratory analytical reports in a designated secured area in the laboratory. Copies of these forms and reports will also be maintained in the Versar project file.

All field documentation developed during the site investigation will be maintained in the on-site office until field activities have been completed. As required for the remedial

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CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME						PARAMETERS	INDUSTRIAL HYGIENE SAMPLE	Y / N
SAMPLERS: *(Signature)*					(Printed)				
FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS			REMARKS

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
(Printed)		(Printed)	(Printed)		(Printed)

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

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

FIGURE 8
CHAIN-OF-CUSTODY FORM

Versar INC
RR-00034-03.05-04/09/91

CUSTODY SEAL

Date

Signature

Versar INC.

FIGURE 9
CUSTODY SEAL

investigation data evaluation, copies of the field documentation will be submitted to technical staff in Springfield. Upon completion of the on-site activities, all field documentation will be shipped to Springfield and maintained in the project files.

2.4 QA/QC Samples

Throughout the course of this sampling program, specific Quality Assurance/Quality Control (QA/QC) samples will be collected. All of these samples typically fall into one of the following categories: trip blank, field blank, equipment blank, or duplicate/replicate sample. Only duplicate soil samples and laboratory spike samples will be used for QA/QC samples during this RI/FS. A brief discussion of the reasons for omitting trip blanks, field blanks, and equipment blanks is presented below. QA/QC samples will be collected at a frequency of one in ten (10%) for each analyte in each media (where applicable).

Trip blanks are typically prepared using analyte-free water prior to the sampling trip and accompanying field sample containers as a check for contamination emigration between sample containers during shipment and handling. Problems due to cross-contamination of samples between sample containers is generally only an issue with volatile organic chemicals. Because PCBs are non-volatile, no trip blanks are planned.

Normally, field blanks are collected in the field at a location where samples are containerized. The purpose of a field blank is to detect contamination resulting from the water used for decontamination purposes. The purpose of an equipment blank is to detect contamination originating from the sampling device. Precleaned and dedicated equipment will be used at virtually every sample location. Because dedicated equipment will be used, only one equipment blank will be collected to ensure that laboratory decontamination procedures were adequate. Therefore, equipment blanks will not be collected. As an equipment blank for PCB wipe samples, a glove blank will be collected. This blank is prepared by pouring hexane onto the wipe pad and wiping the pad over the gloved hand, then placing the wipe pad in the sampling container. As an equipment blank for PCB wipe samples, a glove blank will be collected. This blank is prepared by pouring hexane onto the wipe pad and wiping the pad over the gloved hand, then placing the wipe pad in the sampling container.

Field replicates are two or more sets of samples collected from the same location. The samples will be analyzed to measure the sampling and analysis variability and the potential heterogeneity of the sample matrix. Replicate soil samples will be collected. All

replicate samples will be collected simultaneously with non-QC samples. By definition, duplicate wipe samples cannot be collected. Soil samples will be homogenized in a stainless steel bowl before the replicate samples are taken. All replicate sample jars will be given Versar 3-part labels and will be identified on the chain-of-custody form by the collection location only.

2.5 Sample Analyses Summary

Table 3 identifies the number of samples, matrices, analytical methods, and quality control information for this sample program.

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TABLE 3

SAMPLE AND ANALYSIS QC SUMMARY

Site	Matrix	Analyses	Number of Environmental Samples	Number and Type of Quality Control Samples
Site 15 Substation 2	Sediment	PCBs	7	
	Surficial Soil (0-3")	PCBs	20	2 Duplicates
	Soil (8-12" depth)	PCBs	27	3 Duplicates
	Concrete Chip	PCBs	2	
	Wipe	PCBs	3	
Site 16 Old Power Plant	Sediment in Tunnel	PCBs	12	1 Duplicate
	Surficial Soil (0-3" grab)	PCBs	24	3 Duplicates
	Surficial Soil	PCBs	8	1 Duplicate
	Soil (8-12" depth)	PCBs	24	2 Duplicates
	Wipe	PCBs	53	1 Equipment Blank

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Versar INC.

3.0 FIELD MEASUREMENTS

Field measurements will be taken only for organic vapors for health and safety purposes. A Foxboro Organic Vapor Analyzer or HNu will be used to measure the concentration of organic vapors in the air to determine the appropriate level of removal of personnel protection.

Organic Vapor Analyzer. The Organic Vapor Analyzer (OVA) is a flame ionization detector (FID) which is capable of monitoring many organic vapors and gases. It is used to survey the total concentration of these organic gases. The instrument analyses of all of the present organic vapors and gases in a flame, producing a current in proportion to the number of carbon atoms present.

A flame is produced as the instrument burns high purity hydrogen (99.99%). The units operates using an internal rechargeable battery. The OVA will be calibrated at Versar's Equipment Maintenance Warehouse immediately prior to this field investigation. The instrument is calibrated with methane gas at a concentration of 99 ppm.

HNu. The HNu is a photoionization detector (PID) used to monitor many organic gases and vapors. The instrument ionizes molecules using ultraviolet (UV) radiation, resulting in the production of a current which is directly proportional to the number of ions. It then provides a reading of the total concentration of organic gases and vapors.

The instrument operates on a rechargeable battery. The HNu will be performance tested and calibrated immediately prior to the field investigation. The calibration will take place at Versar's Equipment Maintenance Warehouse. The instrument is calibrated with gas containing 48.9 ppm benzene.

3.1 Equipment Calibration

Calibration records are maintained to demonstrate the precision and accuracy of field measurements made with a particular instrument.
Calibration records include:

- A unique identification number assigned to the device, such as the factory serial number.
- The source and traceability of the standard(s) used for calibration.

- The name of the person performing the calibration, the date, and a notation as to whether it was a routine check or one required by malfunction.

3.2 Equipment Maintenance

Preventative maintenance of the OVA is limited to fully discharging the NiCad batteries with each use, and recharging the batteries to full capacity. The hydrogen fuel is replaced as it is consumed. Preventative maintenance of the HNu is limited to daily charging of battery packs and weekly UV lamp cleaning. All equipment will be kept clean and free of dust and dirt.

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4.0 FIELD QA/QC PROGRAM

The objective of the field QA/QC program is to ensure that the field measurements and sampling protocol yield legally defensible results. Standards have been established both to minimize sampling errors and to scrutinize field practices.

All significant site activities will be recorded in the field notebook. Detailed record keeping information is specified in the Work Plan. The notebooks will be kept in a secure area at all times, and reviewed by the field team leader on a regular basis. A notebook of sample numbers and 3-part labels will also be maintained. Chain-of-custody records will be maintained both in a field file and at Versar's laboratory.

As an accountable document, chain-of-custody must be maintained on the field logbook. Each individual is responsible for the transfer of logbooks to individuals assigned to a given project. Individuals will sign the logbook upon receipt and use it to record all pertinent information. Because the actual transfer of the logbook from one person to the next (under chain-of-custody) is sometimes logistically difficult, a secure location (e.g., locking drawer in office) will be designated. If a secure location is not available, the logbook will be placed in an envelope, custody-sealed and left at the front desk (or preferably the safe) of the hotel for pickup by the next person.

Logbook entries will be dated, legible, and contain accurate and inclusive documentation of project field activities. Language will be objective, factual and free of personal feelings or other terminology that might prove inappropriate. If clearly identified as speculation, personal observations may be useful. Any conjectures should, however, include the rationale behind it. Entries or corrections made by individuals other than the person to whom the logbook was assigned should be dated and signed by the individual making the entry or correction.

Upon completion of all field activities, the field team leader is responsible for ensuring that the logbook is complete, accurately filled out and legible. A quick review of logbook entries made in the field may save valuable time and money. The project manager will conduct a quality control review of the logbook and document its technical soundness and acceptability by signing and dating the last page of entries.

After the end of field activities, the logbook will be archived in a central location. Formally entered, the logbook will become an accountable document that may be retrieved

for a re-review or audited at any time. The format of the logbook should be neat, consistent, logical, and provide easy review. Although neatness is sometimes difficult in the field, a logical format that is used consistently facilitates easy review. The following guidelines should be employed in all field logbooks:

- The logbook itself should be permanently bound, but not spiral bound, and all pages (front and back) should be serially numbered.
- All entries should be written in blue or black ballpoint pen. Felt tip pens should be avoided.
- The first page should contain a listing of key personnel and telephone numbers specific to that job.
- Each page of the logbook should be dated and initialed.
- A new page should be started at the beginning of each day.
- Entries into the logbook should be chronological--a time notation should introduce each entry.
- The logbook should be signed at the end of each day. Signatures should be written on a single diagonal line drawn across the blank portion of the page following the day's last entry.
- If an error is made in the field logbook, it should be corrected by simply crossing a single line through the error and entering the correct information. Errors should be corrected by the person who made the entry. All corrections must be dated and initialed.

The logbook should contain information pertaining only to the site to which it is dedicated. Include the following information, where appropriate:

- The inside front cover should be reserved for business cards from key personnel. A "Reward for Return" notice including Versar's address and telephone number and the Project Manager's name should be placed on the inside front cover.
- The first page of the logbook should contain the following information:

  - Project Name
  - Project Number
  - Project Manager
  - LANTDIV EIC, Maritza Montesinos-Gross

- On-site contacts or supervisors
- Telephone numbers for all key personnel

- On-site telephone number and address
- Emergency fire and medical telephone numbers

- The time you enter the site should be the first entry each day.

- The last entry for each day should be the time you leave the site and should include a short summary of the day's activities. Similarly, the last entry for each week should be a summary of the week's activities. These weekly summaries form the basis of the monthly report and should be thorough and descriptive.

- Describe all activities on site. Observations should be objective, factual, and thorough. Speculations and well founded suspicions, if clearly identified as such and fully documented, are acceptable. If the speculation or suspicion is later determined to be incorrect, a single line should be drawn through the appropriate entry and a notation made in the margin. The notation should include the date of the correction and should be initialed.

- Problems, delays, or any unusual occurrences such as wrong equipment, or breakdowns, should be included, as well as the resolutions and recommendations.

- Fully document all deviations from or changes in the work plan or planned procedures. If necessary, obtain an explanation for the changes and include this and Versar's response to the deviation in the logbook.

- Summarize the content and conclusions of all meetings, discussions, and telephone conversations in which you are involved. Include the names and affiliations of all personnel present at meetings and discussions and involved in telephone conversations.

- Record the names and affiliations of all key personnel on site each day.

- Provide a description of the weather and changes in the weather. Weather conditions are particularly important with respect to sampling events and when it adversely affects site activity. Record temperature, wind speed and direction, general conditions (i.e., rain, sunny, overcast, etc.), and, if possible, relative humidity and barometric pressure.

- List all field instruments and equipment used and record field measurements, distances and locations.

- Give factual descriptions and locations of structures and features--wells, units, containment structures, buildings, roads, topography and drainage, soils, road cut geology, surface waters, dimensions, and construction.

- Note signs of contamination--oily discharges, discolored surfaces, unusual odors, dead or distressed vegetation, including types of plants, if possible.

- Sketch or obtain a map of the area and facility. Include sketches of facility layout, structural features and points of interest or contamination. Include north arrow and rough scale. If possible, obtain a site map that can be reduced and/or permanently placed in the logbook.

- Record all information pertaining to sampling events. Include location, time, sample media (soil, concrete, wipes, etc.), analysis, sampling procedure, equipment used, size and type of containers, preservation technique, sample identification numbers including those for split samples, chain-of-custody procedures, packing and shipping procedures (record airbill numbers), and the name, address, telephone number, and contact of the laboratory performing the analysis.

Photographs are an excellent method of recording activities. When slides or photographs are taken of any activity (sampling, removal, well installation, etc.), they will be numbered to correspond to logbook entries. Each roll of film will be assigned a unique number and each photograph on that roll should be numbered sequentially. The Versar 3-part sample label should be used to label and track rolls of film used on a given site because it provides a label that can be placed in the logbook and provides both the necessary information and a unique number for tracking purposes.

Documentation should be entered in the logbook as each photograph is taken. This documentation should include the following:

- Photographer's name
- Date
- Time
- Site location
- Description of photograph, including salient features and aspects

The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. Special lenses (e.g., wide angle, telephoto, zoom), film types, filters, or other image enhancements must be noted in the logbook.

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Photographs should include identifiable objects in either the foreground or background that will provide landmarks for pinpointing, at a later time, the location and direction which the photographer was facing when the photograph was taken. This information should also be recorded in the logbook and/or photographic log. For samples and sampling locations, it is advisable to include a sign with pertinent information in the photograph for identification and scaling purposes. All photographs should have some identifiable feature that can be used for scale.

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5.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Versar's technical project management responsibility for all Navy programs resides with Mr. James Spatarella, Navy Program Managers, and Mr. Bruno Maestri, Senior Vice President, Eastern Regional Operations, Technical Services Group. They are responsible for assigning senior project staff, meeting Naval Energy and Environmental Support Activity (NEESA) requirements on a corporate basis, and assuring consistency in technical approach and product deliverables across project lines.

On a project-specific basis, Mr. Spatarella is responsible for ensuring that the quality of the data and reports are suitable for the project objectives. Mr. Spatarella reports directly to the LANTDIV Project Manager and Engineer-in-Charge on an as-needed basis. This organizational structure assures that the Versar Project Manager and his team are responsive to LANTDIV and provides LANTDIV with a direct line of communication to Versar project management and senior management.

Versar's technical project management responsibility for the RI/FS at NAVSTA Roosevelt Roads resides with Mr. Noel Simmons. He is responsible for assigning and managing the Versar personnel who will provide their technical expertise for the required field activities. These technical personnel will organize the field team support staff which are necessary to perform the investigations, sample collection and chemical analysis. The project organization chart is presented in Figure 10. The Versar project personnel and their responsibilities are indicated below.

- Project Manager (Noel Simmons) - The project manager will ensure that the overall project objectives are met and that the QA/QC Plan is followed throughout all phases of the RI/FS. He will also perform technical review of all reports to ensure that they are technically sound and complete and function as primary interface with the EIC.

- Technical Operations Quality Assurance Coordinator (John Maier) - The TOQAC will be responsible for ensuring that the quality of the data and the reports are suitable for the project objectives. His primary QA responsibilities will be for the sampling and data management activities. The TQAC will work closely with the laboratory QAC, the project manager, and the task managers to ensure that the QA/QC Plan is being implemented. He will also prepare the QA/QC Plan with participation by the laboratory QAC.

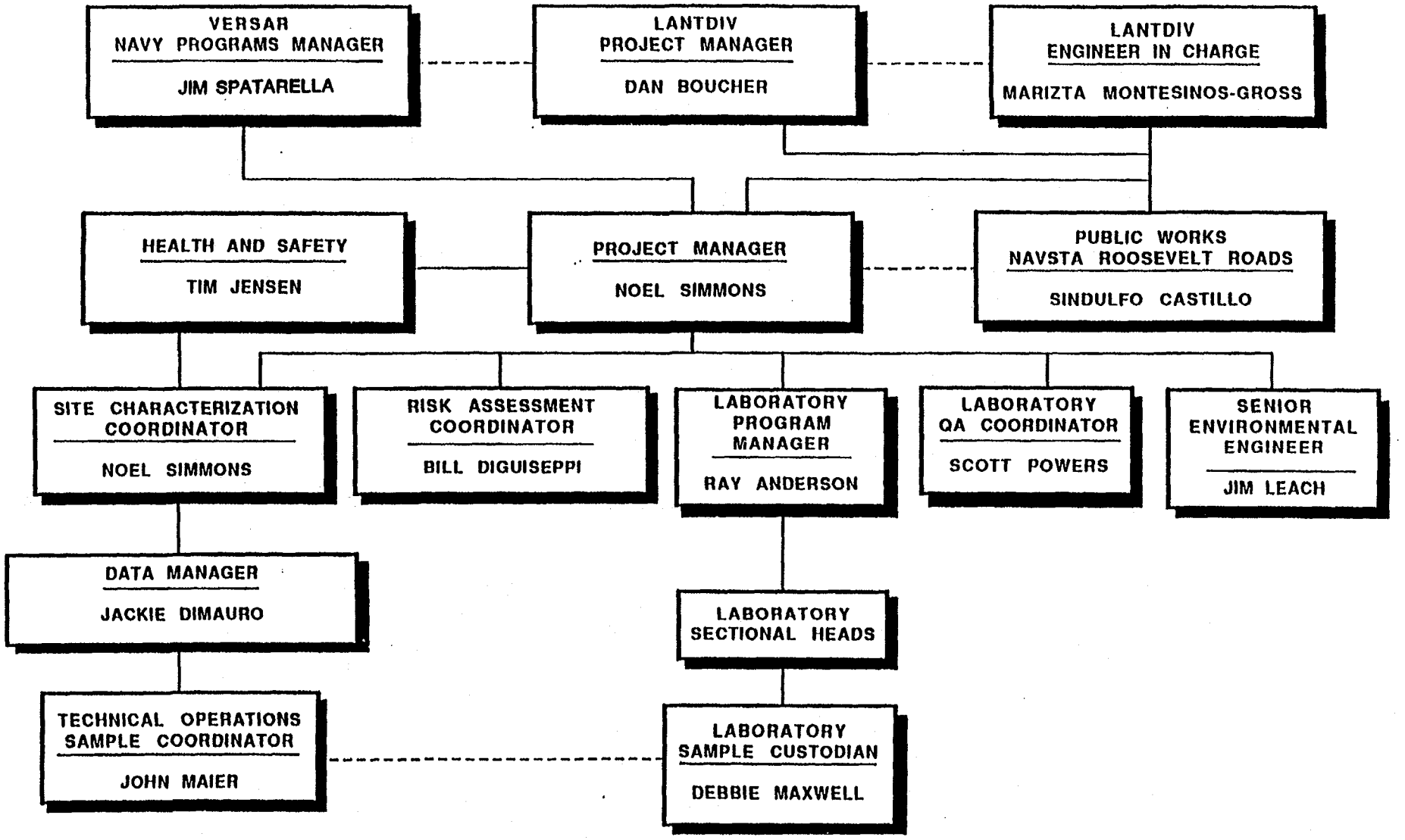

FIGURE 10
PROJECT ORGANIZATION CHART

- Laboratory Quality Assurance Coordinator (Scott Powers) - The laboratory QAC will be responsible for ensuring the quality of the analytical data by overseeing the quality of purchased laboratory reagents; ensuring that sampling handling and preparation activities are adequate for the sample types received; ensuring that all records, logs, standard procedures, and analytical results are maintained in a retrievable fashion; establishing with the analyst the correct QC samples to be included in each lot and the correct procedures for evaluating acceptable, in-control analytical performance; ensuring that analysts are preparing QC samples, maintaining control charts, and implementing and documenting corrective action when necessary; and reviewing calibration data, control charts, and other performance indicators to verify that the data was collected under conditions of analytical systems control. The laboratory QAC will also prepare the QA/QC Plan in conjunction with the technical QAC and will prepare corrective action reports, monthly laboratory progress reports, and a final analytical report.

- Health and Safety Coordinator (Tim Jensen) - The health and safety coordinator will be responsible for preparing the site safety/contingency plan that conforms to applicable health and safety regulations and for ensuring that health and safety requirements are not compromised during on-site activities. This safety/contingency plan provides task-specific health and safety requirements that are to be followed during investigation and sampling to ensure that the workers are properly protected while meeting the QA objectives of this QA/QC Plan.

- Laboratory Program Manager (Ray Anderson) - The laboratory manager will work with the laboratory sectional heads to ensure that adequate staffing is provided to complete chemical analyses within prescribed holding times. He will also review the analytical data for quality and work with the laboratory QAC to ensure that QA/QC procedures are being implemented.

- Laboratory Sectional Heads - The laboratory sectional heads will be responsible for ensuring that the analytical results being generated by their respective sections (e.g., metals, GC/MS, etc.) meet the QA/QC objectives of this QA/QC Plan. The sectional heads will ensure that the analysts are properly trained and that they are following the appropriate QA/QC procedures, including the construction and maintenance of control charts. The sectional heads will also review all analytical data from their respective section prior to submitting the results to the laboratory manager or laboratory QAC.

- Laboratory Sample Custodian (Debbie Maxwell) - The laboratory sample custodian will be responsible for receiving, logging, and storing of the samples as they arrive at the laboratory. She will work closely with the technical operations sample manager to complete log-in information sheets, which contain specific information such as analysis parameters, holding times, and analysis priority. She will also ensure that prescribed sample holding times are not exceeded and that sample custody is maintained.

- Data Manager (Jackie DiMauro) - The data manager will be responsible for developing the database, for entering information into the database, and for performing sorts, summaries, and "what-if" analyses. The data manager will also be responsible for ensuring that the information is entered into the database correctly and accurately.

- Senior Environmental Engineer (James Leach) - The senior environmental engineer will be responsible for providing technical expertise and will review all plans and reports for technical accuracy. He will also be responsible for the review of all analytical data and calculations.

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APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY OF SUBSTATION NO. 2 - BLDG. 90 (SITE 15) AND OLD POWER PLANT - BLDG. 38 (SITE 16) NAVAL STATION ROOSEVELT ROADS PUERTO RICO, U.S.A.

PREPARED FOR:

Atlantic Division
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APRIL 9, 1991

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1.0 INTRODUCTION

The U.S. Navy Facilities Engineering Command (NAVFACENGCOM), Atlantic Division (LANTDIV) has contracted Versar, Inc., to perform a Remedial Investigation/Feasibility Study (RI/FS) at two sites at the Naval Station (NAVSTA) Roosevelt Roads, Puerto Rico, that were identified for further characterization during a Preliminary Assessment/Site Investigation. These sites are Substation 2, Building 90 (Site 15) and the Old Power Plant, Building 38 (Site 16). This Quality Assurance Project Plan (QAPP), the Field Sampling Plan (FSP); and the accompanying Work Plan, and Health and Safety Plan (HSP) describe available environmental information concerning the site, the detailed tasks required to accomplish the RI/FS, and the manner in which they will be accomplished and managed.

This QAPP has been organized in accordance with Data Quality Objectives for Remedial Response Activities (EPA, 1987). Versar has identified data users and tailored these documents to specific users of the information. The information contained in the QAPP covers some of the same material in the Work Plan and FSP so that the QAPP may be detached from other documents for use by laboratory personnel that do not need the detailed information contained in other scoping documents. Generally, only those aspects of field sampling that directly affect the laboratory are included (such as sample numbers, media, and requisite QA/QC samples). Detailed sample collection methodologies are contained in the FSP and cross-referenced within the QAPP.

Site 15: Substation 2 Background Information

Substation 2, Building 90, at the Naval Station (NAVSTA), Roosevelt Roads, Puerto Rico, was used for the repair of electrical transformers since 1964 by the Public Works Department Power Distribution Shop. As part of the maintenance of pole-mounted distribution transformers, the oil was drained to facilitate in the repair to the inner core and coils. The oil from the transformers was drained onto the ground in the vicinity of Substation 2, Building 90, from 1964 through 1979. The amount of possible polychlorinated biphenyl (PCB) contaminated oil deposited onto the ground has been estimated at a maximum of 3,000 gallons.

An Initial Assessment Study was performed at Substation 2, Building 90 (referred to as Site 15). The site was recommended for a confirmation study to determine whether specific toxic or hazardous materials were present in concentrations considered to be hazardous. As a result of this study, verification sampling and analysis was performed and

completed in May 1986. Additional characterization for Site 15 was completed in January, 1988. From these studies, it was determined that PCB contamination exists in the vicinity of Site 15, and that remedial action was warranted.

Site 16: Old Power Plant Background Information

The Old Power Plant, Building 38, at the Naval Station (NAVSTA) Roosevelt Roads, Puerto Rico, was a 60 megawatt steam turbine facility that generated power from the early 1940s through 1949. The plant used Bunker "C" fuel, which was stored in two 50,000-gallon reinforced concrete tanks located directly northwest of the building. During heavy rainfalls in the 1970s, C fuel was observed in manholes near the building and discharged to an adjacent beach (i.e., Enlisted Beach) via the old cooling water outlet for the Power Plant. A cleanup contractor was hired twice to drain the underground fuel tanks and cleanup the spill. This area, where the underground storage tanks are located, is now paved over with concrete.

From 1956 to 1964, transformer maintenance was performed at Building 38 by the Public Works Power Distribution Shop. The majority of transformer repair work was conducted just outside of the building at its northeast corner. As part of the maintenance of the transformers, the transformer oil was drained to facilitate repair of the inner cores and coils. Interviewees reported draining the transformers to the soil in the immediate vicinity of the building. The only exception to this practice was with Askarel (a type of PCB) transformers. Power Distribution Shop employees drained transformers containing Askarel directly to 55-gallon drums which were disposed of at the station landfill. The exact quantity of Askarel disposed of in this manner is unknown. The Power Distribution Shop ordered 200 gallons of replacement transformer fluid per year. Assuming the total 200 gallons were used each year, it is possible that over the eight years during which Building 38 was used, approximately 1,600 gallons of transformer oil were drained to the soil in the vicinity of the building, with some portion going to the landfill.

An Initial Assessment Study was performed at the Old Power Plant, Building 38, Site 16, in 1984. The site was recommended for a confirmation study to determine whether specific toxic or hazardous materials were present in concentrations considered to be hazardous. Verification sampling and analysis was completed in May 1986. Characterization testing was performed and completed in January 1988. From the studies performed, it was determined that PCB contamination exists in the vicinity of the Old Power Plant, Site 16, and that remedial action was warranted.

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1.1 Purpose

The purpose of this Quality Assurance/Quality Control Project Plan (QAPP) is to specify the quality assurance (QA) and quality control (QC) procedures that Versar will follow to ensure that the technical data generated throughout the Installation Restoration Program (IRP) are precise, accurate, and representative of the actual field conditions. More specifically, the purposes of the QA/QC plan are to:

- Establish function-specific responsibilities and authorities for data quality.
- Establish procedures to ensure that non-laboratory activities do not compromise analytical data quality.
- Establish procedures for estimating the quality of the analytical data, including precision, accuracy, and sensitivity.
- Establish procedures to ensure that all data are collected under conditions of analytical system control.
- Establish procedures to identify and implement actions that are necessary to ensure the validity of laboratory data, including procedures for recognizing and correcting out-of-control situations.
- Establish documentation procedures to verify that the quality of the data are commensurate with project data uses.

Quality assurance is defined as an integrated program that is designed to assure that monitoring of quality-related activities has occurred. Frequently, QA is interpreted as a record keeping system to ensure documentation of all activities, including traceability, completeness, and security of documents. QC is defined as the specific actions taken to ensure that prescribed standards of performance are met. It is these actions that ensure the precision and accuracy of the results.

1.2 Application and Scope

The emphasis of this QA/QC Plan is on the activities that generate analytical data. In this context, analytical chemistry includes those aspects of field sampling that may affect the chemical integrity of samples, as well as the laboratory activities. Therefore, specific requirements are provided for the sampling and chemical analysis of all samples.

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This QA/QC Plan presents a project description and the project organization and specifies the QA objectives, the technical approach, the QA/QC procedures for sampling, the analytical procedures, the data evaluation procedures, the quality control procedures, and the corrective action procedures that will be implemented by Versar during the NAVSTA Roosevelt Roads RI/FS activities.

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2.0 PROJECT DESCRIPTION

2.1 Objective

The objective of data collection related to determine the extent of contamination and select a remedy for each site under consideration. Data collected will also be used to compile a health risk assessment and health and safety plan for personnel involved with remediation efforts.

2.2 Approach

Sites 15 and 16 have been identified as areas of concern where previous disposal activities introduced PCB contamination to the soil and where other media (e.g., concrete) may be contaminated. The RI/FS includes field activities to assess contamination levels and to delineate the areas of contamination. These activities will include confirmatory testing and sampling from areas not previously evaluated. These activities will be conducted in order to provide thorough and representative analytical results. The analytical results will be used to perform a risk assessment, and delineate the horizontal and vertical extent of contamination for future remedial measures.

Field Tasks for Sites 15 and 16

The sampling rationale for the RI/FS at Sites 15 and 16 is to utilize the ESE (1988a, b) data to the greatest degree in project scoping and remedial design use, while supplementing this data with fully validated data that can be used for tasks that require the highest level of data quality, such as risk assessment. Data quality objectives (DDQs) are based on the concept that different data uses may require different levels of data quality. Data quality can be defined as the degree of uncertainty in the data with respect to precision, accuracy, representativeness, completeness, and comparability.

As unvalidated data, the ESE (1988a, b) data is limited in usefulness for screening and engineering purposes. At the time the QAPP was prepared, analytical data packages necessary for validation were incomplete. Duplicates from the laboratory have been requested. Only validated data will be used in the risk assessment.

The sampling program design is intended to expand on the previous data set. Additional exposure pathways, such as the cooling water tunnel, will be evaluated. A major thrust of the soil sampling program is to attempt to identify deeper areas where

PCB-bearing fluids may have percolated to the coral bedrock that is only a foot or less deep at the sites. The soil sampling program recognizes the potential for contaminated soil to be transported short distances form the actual spill area. If a positive detection is encountered, the deeper soil sample (8-12"), collected and extracted at the same time, will be analyzed. This technique will identify spill areas (and potential for bedrock contamination of the porous coral) and target these areas for possible diamond core sampling following an initial soil removal action.

Concrete core and wipe samples are intended to identify decontamination needs for concrete surface areas. The number of these types of samples was based on the estimated square footage of concrete surface at each site.

Site 15 (Substation No. 2):

A total of 47 soil samples will be collected to confirm previous analyses for PCB contamination and to delineate the contaminated area. These samples will be collected from shallow (0-3") and deep (8-12") soil. Twenty shallow samples will be extracted and analyzed immediately. The 20 deeper soil samples will be extracted immediately but held for analyses pending the results of analyses of the shallow soil samples. Coral outcrops are visible at the site indicating that the soil is less than a foot thick in parts of the site. Seven sediment samples will be collected from the two ditches running southwest of Substation 2. Deeper soil (8-12") will also be collected from below the 7 drainage ditch sediment sample locations, extracted immediately but held for analyses pending results of the shallower sediments.

Two concrete chip samples and three wipe samples will be collected from the concrete pad at the entrance to Substation 2, to confirm previous analyses for PCB contamination and to delineate the area of contamination for remediation. Wipe samples will be used to characterize the unstained concrete surfaces to determine potential needs for remediation of these structures.

Site 16, Old Power Plant:

A total of 48 soil samples (grab samples) will be collected to confirm previous analyses for PCB contamination and to delineate the areas of contamination. These samples will be collected from shallow (0-3') and deep (8-12") soil. The shallow samples will be extracted and analyzed immediately. The deep samples will be extracted immediately but held for analyses pending the results of analyses for shallow soil samples.

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To define the horizontal extent of contamination, 24 surficial soil grab samples will be collected (0-3"). These locations (Figure 6) were selected to bound previous data, and to fill data gaps remaining from the previous round of sampling.

A total of 8 surficial soil composite samples (0-3") will be collected along the concrete-lined ditch located along the southwest and northwest margins of Building 38. These will consist of 10 aliquots per sample at 6-foot intervals along the ditch.

Twelve sediment samples will be collected from the tunnel running southwest to northwest of the Old Power Plant. Sample locations will include available access ports and tunnel outfalls.

Six chip samples will be collected from the stained concrete surfaces at Site 16. A total of 53 PCB wipe samples will be collected from the concrete apron surrounding Building 38, the concrete base of the transformer station, the concrete-lined ditch and concrete basin and the concrete pad overlying the underground storage tanks. These samples are intended to characterize unstained concrete areas. Sample locations will be selected based on best engineering judgment.

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3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Versar's technical project management responsibility for all Navy programs resides with Mr. James Spatarella, Navy Program Managers, and Mr. Bruno Maestri, Senior Vice President, Eastern Regional Operations, Technical Services Group. They are responsible for assigning senior project staff, meeting Naval Energy and Environmental Support Activity (NEESA) requirements on a corporate basis, and assuring consistency in technical approach and product deliverables across project lines.

On a project-specific basis, Mr. Spatarella is responsible for ensuring that the quality of the data and reports are suitable for the project objectives. Mr. Spatarella reports directly to the LANTDIV Project Manager and Engineer in Charge on an as-needed basis. This organizational structure assures that the Versar Project Manager and his team are responsive to LANTDIV; and that LANTDIV has a direct line of communication to senior management.

Versar's technical project management responsibility for the RI/FS at NAVSTA Roosevelt Roads resides with Mr. Noel Simmons. He is responsible for assigning and managing the Versar personnel, who will provide their technical expertise for the required field activities. These technical personnel will organize the field team support staff, which are necessary to perform the investigations, sample collection, and chemical analysis. The project organization chart is presented in Figure 1. The Versar project personnel and their responsibilities are indicated below.

- Project Manager (Noel Simmons) - The project manager will ensure that the overall project objectives are met and that the QA/QC Plan is followed throughout all phases of the RI/FS. He will also perform technical review of all reports to ensure that they are technically sound and complete and function as primary interface with the EIC.

- Technical Operations Quality Assurance Coordinator (John Maier) - The TOQAC will be responsible for ensuring that the quality of the data and the reports are suitable for the project objectives. His primary QA responsibilities will be for the sampling and data management activities. The technical QAC will work closely with the laboratory QAC, the project manager, and the task managers to ensure that the QA/QC Plan is being implemented. He will also prepare the QA/QC Plan in conjunction with the laboratory QAC.

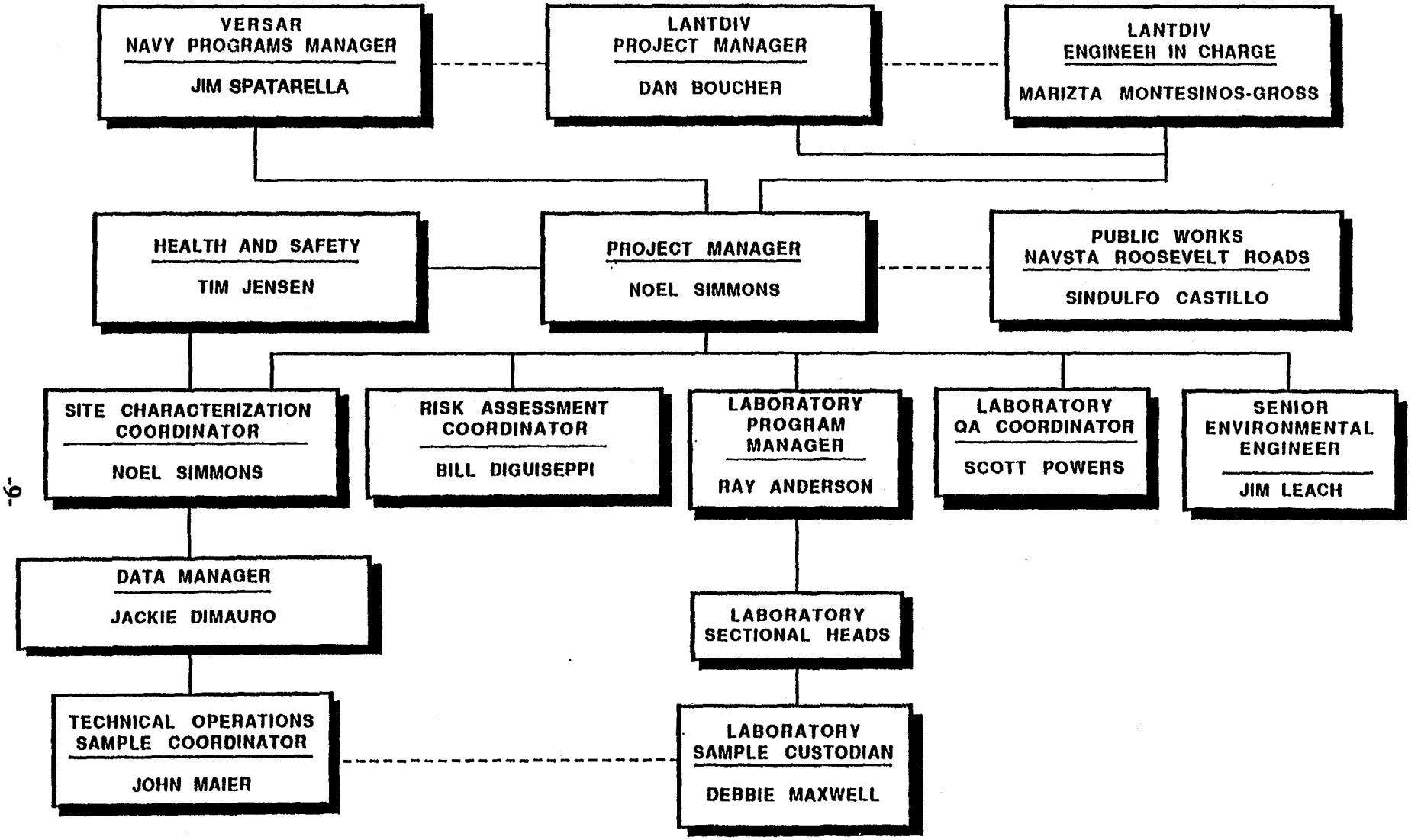

FIGURE 1. PROJECT ORGANIZATION CHART

- Laboratory Quality Assurance Coordinator (Scott Powers) - The laboratory QAC will be responsible for ensuring the quality of the analytical data by overseeing the quality of purchased laboratory reagents; ensuring that sampling handling and preparation activities are adequate for the sample types received; ensuring that all records, logs, standard procedures, and analytical results are maintained in a retrievable fashion; establishing with the analyst the correct QC samples to be included in each lot and the correct procedures for evaluating acceptable, in-control analytical performance; ensuring that analysts are preparing QC samples, maintaining control charts, and implementing and documenting corrective action when necessary; and reviewing calibration data, control charts, and other performance indicators to verify that the data was collected under conditions of analytical systems control. The laboratory QAC will also prepare the QA/QC Plan in conjunction with the technical QAC and will prepare corrective action reports, monthly laboratory progress reports, and a final analytical report.

- Health and Safety Coordinator (Tim Jensen) - The health and safety coordinator will be responsible for preparing the site safety/contingency plan that conforms to applicable health and safety regulations and for ensuring that health and safety requirements are not compromised during on-site activities. This safety/contingency plan provides task-specific health and safety requirements that are to be followed during investigation and sampling to ensure that the workers are properly protected while meeting the QA objectives of this QA/QC Plan.

- Laboratory Program Manager (Ray Anderson) - The laboratory program manager will work with the laboratory sectional heads to ensure that adequate staffing is provided to complete chemical analyses within prescribed holding times. He will also review the analytical data for quality and work with the laboratory QAC to ensure that QA/QC procedures are being implemented.

- Laboratory Sectional Heads - The laboratory sectional heads will be responsible for ensuring that the analytical results being generated by their respective sections (e.g., metals, GC/MS, etc.) meet the QA/QC objectives of this QA/QC Plan. The sectional heads will ensure that the analysts are properly trained and that they are following the appropriate QA/QC procedures, including the construction and maintenance of control charts. The sectional heads will also review all analytical data from their respective section prior to submitting the results to the laboratory manager or laboratory QAC.

- Laboratory Sample Custodian (Debbie Maxwell) - The laboratory sample custodian will be responsible for receiving, logging, and storing of the samples as they arrive at the laboratory. She will work closely with the technical operations sample manager to complete log-in information sheets, which contain specific information such as analysis parameters, holding times, and analysis priority. She will also ensure that sample custody is maintained.

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- Data Manager (Jackie DiMauro) - The data manager will be responsible for developing the database, for entering information into the database, and for performing sorts, summaries, and "what-if" analyses. She will also be responsible for ensuring that the information is entered into the database correctly and accurately.

- Senior Environmental Engineer (Jim Leach) - The senior environmental engineer will be responsible for providing technical expertise and will review all plans and reports for technical accuracy. He will also be ultimately responsible for the review of all analytical data and calculations.

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4.0 QUALITY ASSURANCE OBJECTIVES

The overall objectives of the sampling and analysis activities addressed herein are to provide data that is precise, accurate, comparable, representative, and complete. Data that meets the project objectives will be used to assess the contamination at NAVSTA Roosevelt Roads. The definitions of these objectives and methods for determining conformance with these objectives are described below. Data quality objectives for this investigation are to achieve Level D data under the NEESA program (equivalent to EPA Level V data). Table 1 provides numerical data quality objectives for the RI/FS.

4.1 Data Precision and Accuracy

Precision is defined as the measure of mutual agreement among individual measurements of the same property, usually secured under the same conditions. Field and laboratory precision will be expressed as relative percent differences (RPD).

$$RPD = \frac{X1 - X2}{(X1 + X2)/2} \times 100$$

where:

RPD = Relative percent difference between duplicate results
X1 and X2 = Results of duplicate analyses
X1 - X2 = Absolute difference between duplicates X1 and X2

Accuracy is defined as the degree to which the analytical measurement reflects the true level present. Accuracy will be measured as percent recovery for matrix and surrogate spikes.

$$\% \text{ Recovery} = \frac{X - B}{T} \times 100$$

where:

X = Measured concentration in sample after spiking
B = Background concentration in the sample
T = Concentration of spike added

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TABLE 1

PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES

Measurement	Parameter Reference (method)	Precision (RPD)	Accuracy Matrix (Spike Recovery)	Completeness
Wipe Samples (PCBs)	Modified CLP[1]	40%	100± 40%	95%
Soil Samples (PCBs)	Modified CLP[1]	40%	100± 40%	95%
Concrete Samples (PCBs)	Modified CLP[1]	40%	100± 40%	95%

1. Contract Laboratory Statement of Work, February 1988.

4.2 Data Comparability

Comparability is a measure of the confidence with which one data set can be compared to another. The following measures will be taken to ensure the comparability of the data.

- Standardized written sampling and analysis procedures will be followed for all tasks:
- Standard handling and shipping procedures will be used for all samples collected;
- A uniform supply of sample containers will be used; and
- Results for depths, distances, concentrations, etc. will be reported in consistent units.

The data generated during this IRP will be entered into a database for extrapolation and report generation. Therefore, the results from any given sampling event will have to be comparable, so that extrapolations, sorts, summaries, and "what-if" analyses can be performed correctly.

4.3 Data Representativeness

Representativeness should be considered an objective to be achieved, rather than a characteristic that can be described in quantitative terms. Representativeness is the degree to which the data accurately and precisely represent the characteristics of the site that is being investigated. Therefore, representativeness must be evaluated based upon two separate criteria. First, the analytical results must adequately characterize the sample that was analyzed and, secondly, the collected samples must adequately characterize the site that was being investigated.

4.4 Data Completeness

Completeness is a measure of all information necessary for a valid investigation. Completeness will be evaluated by carefully comparing project objectives with the proposed data acquisition scheme and the resulting potential data gaps in the required information. Generally, it is not useful to try to measure this in quantitative terms.

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In addition, completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data that was collected. The validity of the data is assessed using the quality control criteria presented in the analytical method. Data meeting these criteria are considered valid. The goal for completeness for this project is greater than 95 percent.

Completeness will be assessed for each parameter in the following manner:

$$C = \frac{V}{D} \times 100$$

where:

C = The percentage of valid data for each parameter
V = The number of valid results for each parameter
D = The number of samples collected for each parameter

5.0 SAMPLING PROCEDURES

In order to properly define the areas and amount of contamination at Sites 15 and 16, several different types of samples will be collected.

The following sections describe the sampling procedures for each of the different sample types. Table 2 gives the site-specific sampling requirements for the RI/FS.

5.1 Wipe Samples

Wipe samples will be collected using the following procedures:

1. Equipment

   - 3" x 3" sterile cotton gauze pads, individually wrapped (Johnson & Johnson sterile pad, multiply or similar). Preextract for PCB samples.
   - Disposable gloves (polyethylene food handlers or meat cutter's gloves).
   - Chemically cleaned sample bottles (I-CHEM 300 series), 30-ml and Teflon lined. (Aluminum foil is an approved substitute.)
   - Hexane (pesticide grade).
   - Dispenser bottle (preset to dispense 8 ml).
   - Template (art board or galvanized sheet metal, 0.25 m^2 surface area).
   - Masking tape and indelible marker.

2. Sampling Procedures

   - Select an area for sampling criteria. Write down the exact location of area.
   - Place the template in place, or measure an area corresponding to 0.25 m^2 in surface area.
   - Put on a new pair of gloves.
   - Soak a gauze pad with 8 ml of hexane.

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TABLE 2
SITE-SPECIFIC SAMPLE AND ANALYSIS SUMMARY

Site	Matrix	Analyses	Number of Environmental Samples	Number and Type of Quality Control Samples
Site 15 Substation 2	Sediment	PCBs	7	
	Surficial Soil (0-3")	PCBs	20	2 Duplicates
	Soil (8-12" depth)	PCBs	27	3 Duplicates
	Concrete Chip	PCBs	2	
	Wipe	PCBs	3	
Site 16 Old Power Plant	Sediment in Tunnel	PCBs	12	1 Duplicate
	Surficial Soil (0-3" grab)	PCBs	24	3 Duplicates
	Sediment in concrete ditch	PCBs	8	1 Duplicate
	Soil (8-12" depth)	PCBs	24	2 Duplicates
	Wipe	PCBs	53	1 Equipment Blank
	Concrete Chip	PCBs	6	

*20 surficial soil locations plus the 7 sediment sample locations.

- Apply even and steady pressure to the pad while drawing it in straight strokes, moving from left to right in the area designated in slightly overlapping, adjacent strokes. Upon completion of wiping left to right, repeat the procedure from top to bottom of the wipe area.

- After completion of the sampling, fold the gauze pad at least twice onto itself and place in the sampling container. All data associated with wipe sample collection will be recorded in a bound, field notebook.

5.2 Soil and Sediment Samples

All soil and sediment sampling will be conducted in a manner to ensure minimal sample contamination. Stainless-steel bucket augers, bowls, scoops, or trowels will be used as intermediate containers during the transfer the sampled soil into the sample jars. The following considerations will be applied to the collection of soil samples:

1. The equipment used at each sampling location will be precleaned and wrapped in aluminum foil (shiny side out). Each sampling location will have dedicated sampling equipment.

2. The sample will be collected and placed in a stainless-steel compositing bowl. If excess volume is collected, the material should be thoroughly blended with the stainless steel scoop and an approximate aliquot prepared using the cone and quarter method.

3. When a sufficient volume of soil has been collected, the soil will be mixed and then transferred to the sample container using a stainless-steel spatula. If sufficient volume is collected in one aliquot, then it may be transferred directly to the sample container.

4. All sampling equipment will be kept on clean plastic sheeting until needed and decontaminated before future use.

5.3 Concrete Samples

Concrete samples will be collected for PCB analysis at each site. These samples will be collected with a diamond tip core borer, a chisel and hammer, or a jackhammer to chip the concrete surface if the diamond tip core borer will not perform efficiently.

The diamond bit corer, chisels, hammers, or jackhammer bit will be cleaned between each sample with non-phosphate soap, hexane and methanol rinse, and a distilled water

rinse. clean nitrile gloves will be used to handle the concrete cores or chips. The exact location of each sample will be documented on a data sheet. All samples will be placed in precleaned (I-CHEM) jars for shipment to the analytical laboratory.

5.4 Sample Containers

Sample containers to be used for collecting soil are specified by the analytical methodology. Versar will use EPA-recommended (Test Method for Evaluating Solid Waste - Physical Chemical Methods, SW-846, U.S. EPA, 1986) sample containers which are compatible with analytes of interest. Table 3 gives the holding times and containers, and preservation requirements for each sample matrix.

5.5 Sample Preservation and Holding Times

After a sample is collected, Versar personnel will take the necessary steps to preserve the chemical and physical integrity of the sample during shipment and storage prior to analysis. All samples will be capped immediately after sample collection. Specific chemical or temperature preservation is not required for PCB analysis. The holding time for PCB samples is 10 days until extraction and 40 days for analysis of the extract.

TABLE 3

SAMPLE REQUIREMENTS, CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Matrix	Analytical Method	Same Preservation	Holding Time	Container
TCL PCBs	Soil/Sediment	CLP[1]	Cool, 4°C	10 days until extractions 40 days for analysis	8-ounce wide-mouth glass bottles
TCL PCBs	Concrete Chips	CLP	Cool, 4°C	10 days until extractions 40 days for analysis	1L wide-mouth amber glass bottles
TCL PCBs	Wipes	CLP	Cool, 4°C	10 days until extractions 40 days for analysis	40-ounce wide-mouth glass bottles

Notes:

1. U.S. EPA Contract Laboratory Program Statement of Work, August 1987.

5295TBLL.003_RooseveltRoad_Table2

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6.0 SAMPLE IDENTIFICATION AND CUSTODY

Each sample will be labeled with a unique sample identification number, recorded on a chain-of-custody form, and shipped to the Versar laboratory for analysis. Additionally, the field team members will maintain sampling log data sheets to document sample collection and identification. The documentation on the data sheets will, at a minimum, include:

- Date and time of sampling;
- Names of field team members;
- Rough diagram of sample collection locations;
- Coordinate reference of sample location;
- Sample parameters and identification numbers; and
- Technical data on sample collection.

The following sections describe the procedures for sample identification, custody, and shipping.

6.1 Sample Identification

Versar has developed and currently uses a three-part label to provide an efficient, accurate method for sample identification. A copy of one of these labels is provided as Figure 2. The use of this labeling system has virtually eliminated mislabeling in the field, facilitated rapid sample identification without referencing field notes, and eliminated confusion during laboratory log-in. Both upper portions and the single lower portion have preprinted numbers that become the field sample number. The upper portion (or portions if duplicate samples are collected) will be completed and affixed to the sample container. The lower portion will be completed with the pertinent information and entered into the field logbook as a permanent record of sample collection.

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VERSAR, INC.
73701 PARAMETER

AFFIXED TO SAMPLE CONTAINER

73701
DUPLICATE

AFFIXED TO DUPLICATE SAMPLE
(eg., VOA SAMPLES)

VERSAR, INC.
73701 PARAMETER

TASK

PLANT

SAMPLE LOCATION

MATRIX

SAMPLING COMMENTS

SIGNATURE TIME/DATE

ENTERED IN FIELD NOTEBOOK AS
PERMANENT SAMPLE IDENTIFICATION

FIGURE 2
VERSAR 3-PART LABEL

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6.2 Sample Custody

Sample custody will begin, in all cases, at the time of sample collection by placing the sample into an appropriate container, in the possession of the designated field sample custodian. A line item on the field chain-of-custody form will immediately be completed and initialed by the field sample custodian. The Versar chain-of-custody form is shown in Figure 3. The field sample custodian will complete the sample chain-of-custody form as follows:

1. Enter the complete project number; enter the laboratory subtask number, not the sampling subtask number.
2. Enter the project name as it is listed on the Versar Contract Status Summary Sheet.
3. Enter signature and print name of person or persons who participated in the collection of the samples listed.
4. Enter date of sample collection. If sample is a composite, both start and finish dates will be listed.
5. Enter actual time of sample collection. If sample is a composite, both the start and finish times will be listed.
6. Indicate with a check mark whether the sample is a composite or a grab.
7. Enter a description of the sample location.
8. Enter the actual number of sample bottles to be submitted to the laboratory.
9. List parameters for which the sample is to be analyzed.
10. For each line entry, indicate the last two digest of the sample number. Enter the first three sample number digits in the remarks section.
11. Circle the appropriate box to indicate whether the sample is an industrial hygiene sample.

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CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME						PARAMETERS									INDUSTRIAL HYGIENE SAMPLE	Y / N
SAMPLERS: *(Signature)*					(Printed)												
FIELD SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS										REMARKS	

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
(Printed)		(Printed)	(Printed)		(Printed)

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

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

FIGURE 3
VERSAR CHAIN-OF-CUSTODY FORM

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RR-00034-03.05-04/09/91

Upon completion of all line items, the field sample custodian will sign, date, list time, and confirm completeness of all descriptive information contained on the form. The pink copy of the chain-of-custody form will be removed by the field sample custodian and retained for project files. All samples will be accompanied by a chain-of-custody form. Each individual who subsequently assumes responsibility for the samples will sign, date, and note the time on the chain-of-custody form. The field chain-of-custody terminates upon laboratory receipt of the samples.

Upon receipt of the samples at the laboratory, the laboratory sample custodian and the technical operations sample custodian accept custody of the shipped samples and verify that the information on the sample labels matches that on the chain-of-custody form(s). The sample custodians will also check for any breakage or leakage that may have occurred during shipment. Then, the laboratory sample custodian will accept sample custody and will enter the appropriate data into the laboratory sample tracking system. The laboratory custodian will then assign a unique laboratory number to each sample, and will transfer the samples to the proper analyst or store the samples in the appropriate secure area.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

Calibration is the process of establishing the relationship of a measurement system output to a known stimulus. In essence, calibration is a reproducible reference point to which all sample measurements can be correlated. Before samples are analyzed on an instrument, chemical or physical calibration standards will be analyzed to establish that the instrument is functioning properly with the desired sensitivity. Calibration solutions will be documented with the preparer's initials, date of preparation, concentration of solution, and standard materials used to prepare the solution. All standard materials used in the preparation of calibration solutions will be NBS traceable standards. This section describes the calibration procedures, the calibration frequency, and the calibration standards to be used during NAVSTA Roosevelt Roads RI/FS activities. Generally, calibration procedures are required for both field and laboratory instrumentation. However, because no field analytical information is being generated for assessment purposes, calibration procedures are given for only laboratory instrumentation.

7.1 Calibration Procedures for PCB Analysis

The gas chromatographic system used for PCB analyses must be calibrated using the external standard technique for all packed columns used for quantitation. Calibration standards are prepared at a minimum of three concentration levels for each parameter of interest by adding volumes of one or more stock standards to a volumetric flask and diluting to volume with hexane. One of the external standards should be a concentration near, but above, the CRQL and the other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector. This is done on each quantitation column and each instrument at the time a new column is installed. The data is retained by the laboratory and made available for inspection during on-site evaluations.

Using injections of 2 to 5 ul of each calibration standard, the peak height or area responses are tabulated against the mass injected. The results are then used to prepare a calibration curve for each compound.

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8.0 ANALYTICAL PROCEDURES

Various soil, concrete, and wipe samples will be collected at NAVSTA Roosevelt Roads according to the procedures describe in Section 5.0. These samples will then be analyzed to determine the concentrations of PCBs. The following sections describe the sample preparation and analytical procedures that will be used to generate reliable analytical results.

8.1 Sample Preparation - PCB

The sample extraction procedure for PCBs in soil, concrete, and wipe samples are different. Each procedure will be addressed in the following sections.

8.1.1 Extraction Procedure for PCB Wipe Samples

(1) Set up the appropriate glassware.

(2) Add 40 ml of 15% methylene chloride/85% hexane to the sample jar, make sure that the wipe is covered by the extraction solvent.

(3) QC:
Two reagent blanks (RB) containing 40 ml of extraction solvent.
One method standard (MSTD) containing 40 ml of extraction solvent.
NOTE: use an extracted, clean wipe for each QC check.

(4) Spike the samples and QC with the appropriate surrogate and matrix solutions.

(5) Extract on a wrist shaker for 30 minutes.

(6) Transfer the extracts to a KD, rinse the sample jars with 20 ml of hexane and transfer it to the KD. Repeat two more times.

(7) Concentrate the extracts to 10 ml on a water bath at high heat.

(8) Remove the ampule and concentrate the extracts to 5 ml with nitrogen.

(9) Acid clean the extracts with 5 ml of concentrated sulfuric acid. Shake for 30 seconds with venting.

(10) Micro-florisil clean 2 ml of the extract.
NOTE: refer to the florisil cleanup procedure.

(11) Vial the remaining 3 ml in a dram vial and dispose of the acid waste. Record the storage location on the extraction log.

(12) Clean up the work area.

8.1.2 Extraction Procedure for PCB in Soil or Concrete Samples

(1) Set up the appropriate glassware.

(2) Homogenize the sample.
Weigh out 10 g of the sample into a 250-ml erlenmeyer flask.
Weigh out 5 g for total solid analysis.
NOTE: For concrete samples see the additional preparation procedure.

(3) QC
Matrix spike (MS) and matrix spike duplicate (MSD).
One reagent blank (RB).
One method standard (MSTD).

(4) Add 20 g of neutral baked sodium sulfate and mix.

(5) Add 40 ml of 1:1 acetone/hexane.

(6) Spike the samples and QC with the appropriate surrogate and matrix solutions.

(7) Extract on a wrist shaker for 30 minutes.

(8) Transfer the extract to a KD through a baked-out granular sodium sulfate drying column rinse the erlenmeyer two times with 10 ml of hexane. Transfer the rinse to the column, rinse the column with 30 ml of hexane.

(9) Concentrate the extracts to 10 ml on a water bath at high heat.

(10) Remove the ampule and concentrate the extract to 10 ml with nitrogen.

(11) Acid clean the extract with 10 ml of concentrated sulfuric acid. Shake for 30 seconds with venting.

(12) Micro-florisil clean 2 ml of the extract.
NOTE: Refer to the florisil clean up procedure.

(13) Place the remaining extract in a 8 ml dram vial and dispose of the acid waste. Record storage location on the extraction log.

(14) Clean up the work area.

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8.1.3 Versar PCB Florisil Clean-up, PCB Extracts, 1 g Florisil Cartridge

(1) Set up the solid phase vacuum chamber, glassware, and solid phase florisil cartridges.

(2) Pre-elute the cartridge with 10 ml 10% Acetone in Hexane. Allow this rinse to drain to waste. Vacuum should be approximately 10 inches of Hg during rinse procedure.

(3) Turn vacuum off. Align florisil cartridge over the appropriate collection tube.

(4) Transfer 2 ml of extract to the appropriate cartridge. Load extract onto columns while vacuum is off.

(5) When all extracts have been loaded, turn the vacuum to 3 inches of Hg. Elute each cartridge with exactly 4 ml 10% Acetone in Hexane. Elute each cartridge twice. Total elution volume should be exactly 10 ml (2 ml of extract and 8 ml of eluate).

(6) Adjust the cleaned extract volume and vial for analysis.

Cleaned extracts are adjusted to 2 ml in hexane. Vial two 1 ml portions (vortex before vialing). Store the remaining un-cleaned extract in an 8 ml screw cap vial and record the location on the extraction log.

8.1.4 PCB Concrete Preparation Procedure

(1) Cut the core sample in the lengths designated by the project manager or chain of custody. If sample is precut, proceed to step 3.

(2) Cutting the concrete:
- To be done only in a glove box.
- Use a diamond blade circular saw.
- A chain of custody form must be generated for the new samples.
- Use DI water as a lubricant to eliminate dust.
- Before beginning to cut note the top and bottom of the core.
- Cut the core to the appropriate lengths and transfer to new sample containers.
- After completing all cuts from one sample, transfer the used DI water to a labeled container. Rinse the inside and outside of the saw with hexane and collect the rinse in a labelled container.
- Cut the remaining samples following the above procedures.

NOTE: The sample, hexane, and waste water, if contaminated (>49 ppm) with must be disposed of according to federal regulations.

(3) Wrap the cut sample in aluminum foil.

(4) Crush the concrete using a solvent rinsed hammer

NOTE: Procedures must be done with caution, dust from the concrete must be minimized. Cover the extract with solvent rinsed foil to reduce cross contamination.

(5) Transfer 10 g of the sample to a 250 ml erlenmeyer flask.

(6) Between samples, rinse the hammer and work areas with hexane.

(7) Proceed to step number 5 of the PCB soil/sediment procedure.

8.2 PCB Analysis

Samples will be analyzed using CLP methods that have been modified by the Versar laboratory. The following sequences will be used for all PCB analysis:

Aroclor 1242	OR:	Aroclor 1242
Aroclor 1254		Aroclor 1016/1260 low
Aroclor 1260		Aroclor 1016/1260 med
Reagent Blank (RB)		Aroclor 1016/1260 high
Method Standard (MSTD)		Aroclor 1254
Samples		RB
Aroclor 1242		MSTD
Aroclor 1254		Samples
Aroclor 1260		Final standards (mid)

If the list of samples is particularly long, it is recommended that a mid-run standard be run every ten samples to insure minimal deviation in the standard analysis. The minimum requirement for check standards is 12 hours, the time between injections is used to determine the number of analyses performed in 12 hours and integrate check standards into the sequence accordingly. The check standards need not include all PCB configuration, rather the PCB used for spiking the MSTD and any other QC samples would be most appropriate.

Two different modified run sequences are provided for the analysis of PCBs. It is recommended that the sequence which includes AR1016 be utilized. The run sequence was

modified due to the infrequent detection of AR122, AR1232, and AR1248. It is recommended, however, that standard AR1248 be analyzed at least once during the 72-hour sequence.

It should be noted that AR1016, AR1221, AR1232, and AR1248 are not included in this first example analysis, and only 1016 is included additionally in the second. The three aroclors run in this first analytical sequence are representative of the most commonly occurring aroclors in widescale contamination. In the second analytical sequence, the 1016/1260 standard curve serves to establish linearity in both the early and late portions of the chromatogram, thereby establishing linearity over a multiconcentration range. This conclusion has been documented by previous studies done by this laboratory. If a sample is suspected to be one of the aroclors not in the run, recent chromatogram of those aroclors are run monthly and kept on file for such situations so that a positive identification can be made.

In the case of analyses performed under multiconcentration curve, the %Relative Standard Deviation (RSD) for the standard calibration factors must be less than 15 percent.

To insure validity of the samples in the analysis, there is a comparison of the continuing and final standards to the initial standard series. In the case of aroclors, which exhibit a multipeaked patterned response, five peaks indicative to the aroclor, either by retention time or by amplitude in comparison, are selected for calculations. The Percent Difference for the continuing and final standard comparison results should be less than 20 percent, if not, a new sequence is required to complete sample analyses. No samples analyzed prior to an outlying standard need be reanalyzed unless the chromatography yields carry-over, or a poor sample injection.

8.3 Calculations

Calculations are performed by selecting five peaks are selected from the chromatogram. For multicomponent mixtures, such as PCBs, retention times are matched with peaks in the sample. More than 50% of peaks in the standard are matched with peaks in the sample. More than 50% of the total area must be used unless interference with individual peaks persists after lineup. PCB concentrations are then calculated as follows:

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$$\text{Concentration Sample} = \frac{\text{Area Sample*}}{\text{Concentration Factor}} \times \text{Dilution Factor}$$

$$\text{Concentration Factor} = \frac{\text{Area Standard}}{\text{Concentration Standard (ng)}}$$

$$\text{Dilution Factor} = \frac{\text{Volume}_f}{\text{Sample Size}}$$

*Area of the 5 peaks

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9.0 DATA REDUCTION, VALIDATION, AND REPORTING

The data collected during the RI/FS at Sites 15 and 16 will be presented in a technical report. The procedures selected for data analysis will be described in the text of this report. Prior to using the analytical results, the data will be reviewed and validated to ensure that the results are reliable. All of the results will be reported in consistent units to simplify the data analysis procedures. The following sections describe the data reduction scheme, the principal criteria to validate data integrity, and the reporting scheme of validated concentrations.

9.1 Data Reduction

The equations to calculate the concentrations of the measured parameters can be found in the analytical method descriptions. After the data has been validated, the raw concentration data will be entered into a computerized spreadsheet to facilitate data manipulation and to generate graphs and/or tables. The spreadsheet will allow manipulation of the data by all parameters. In cases where data comparison would be meaningful, the data will be grouped together, and graphs and/or tables will be prepared to highlight the significant trends.

9.2 Data Validation

Data validation is a systematic procedure of reviewing data against a set of established criteria to provide a level of assurance of its validity prior to its intended use. Data will be validated in a two-step process by the laboratory quality assurance coordinator and the technical staff. The data will then be coded either valid or invalid, depending on the adherence to the quality control criteria. EPA data validation procedures given in "Laboratory Data Validation: Organic Analyses (EPA, 1988)" will be used as guidance to validate all samples to the fullest extent possible. Because CLP has not adequately defined acceptance criteria for PCBs, the criteria provided in Section 4.0 and 8.0 will be used in evaluating the data.

The laboratory quality assurance coordinator will review the data for adherence to the quality control criteria outlined in Section 4.0. The project manager, task manager, and technical operations quality assurance coordinator will then review the data for consistency and reasonableness based on a knowledge of the site characteristics and the specific locations of individual samples. The review will evaluate the data in terms of adherence to sampling and analysis protocols and to quality control criteria outlined in Section 4.0. The

criteria for data validation includes checks for internal consistency, duplicate sample analysis, spike addition recoveries, instrument calibration, tests for outliers, and transcription errors. The acceptance/rejection of data will be in a uniform and consistent manner based on the established validation criteria provided in Sections 4.0 and 12.0.

9.3 Data Report

Data will be reported in the appropriate unit of concentration depending upon the matrix and type of analysis. Generally, concentrations in solids will be reported in mg/kg. Wipe sample results will be reported in ug/m^2. Soil samples will be reported on a dry weight basis. The data will be reported in concentrations to two significant figures. Premature rounding of intermediate results can significantly affect the final result. Therefore, the reported results will be rounded to the correct number of significant figures only after all calculations and manipulations are completed. As many significant figures as are warranted by the analytical method will be used in prereporting calculations. Only data meeting the validation criteria will be reported. Percent recovery and relative percent difference values will also be reported using two significant figures. Compounds that are not detected will be reported as "ND" with the actual sample detection limit indicated in parentheses.

Data generated by the Versar laboratory will be checked for both internal consistency and transcription errors by the Laboratory Quality Assurance Coordinator. The coordinator will review the data and, if errors are observed, they will be corrected and documented, or the samples will be reanalyzed, accordingly. The analyst performing the task will be notified of the errors to reduce or eliminate errors in the future. The final analytical data reports will be submitted to the Project Manager, the Task Managers, and the Technical Operations Quality Assurance Coordinator for their review and acceptance of the data in terms of completeness with respect to technical requirements of the project.

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10.0 QUALITY CONTROL PROCEDURES AND DOCUMENTATION

The Versar laboratory will provide qualitative and quantitative data for use in determining the presence and extent of contamination at Sites 15 and 16. For the data to be valuable, it must accurately describe the characteristics and concentrations of constituents in the samples being analyzed. Because approximate or incorrect results lead to faulty interpretations, they must be eliminated, or at least minimized. Second column confirmations will be performed on all positive detections as required by the method. Versar's laboratory will analyze QC samples to provide quantitative evidence that the entire analytical system is functioning properly. These controls will be initiated during and maintained throughout the analysis of samples. The following sections describe the specific laboratory QC procedures to be adhered to during this project.

10.1 Use of Quality Control Samples

Quality control samples are those that are introduced into the train of environmental matrix samples to function as monitors on the performance of the analytical method. QC samples will be used to obtain data for evaluating the precision and accuracy of the analytical method. These QC samples will be prepared using standard matrices and environmental matrices, which are processed through the entire analytical method (i.e., preparation and analysis). Stock solutions, which are used to spike QC samples, will be purchased or prepared independently of the stock solutions used for calibration standards (i.e., spike solutions and calibration standards will be prepared from separate master stock solutions).

The types of QC samples used vary for different analyses. Generally, however, the QC samples applied to all organic analyses are the same. The following sections describe the QC samples that will be used and their frequency of use in organic analyses.

10.1.1 Quality Control Samples

The analyses for the Old Power Plant and Substation 2 include PCBs in soil, concrete chips, and wipes. As discussed earlier, not all QC samples are applicable to all analyses. However, Versar will analyze the following QC samples for all analyses to which they are applicable:

- Equipment rinsate blank,
- Duplicate sample,

- Method (preparation or reagent) blank,
- Spiked sample, and
- Laboratory control sample (method or reference standard).

Duplicate samples will be prepared by splitting a sample into two aliquots prior to the preparation steps. Then, each aliquot will be carried through the entire analytical method as an independent sample. The results of the duplicate analyses will be used to assess the analytical precision.

The method blank will be prepared by taking an aliquot of reagent water and subjecting it to all preparation steps received by the samples (e.g., acid digestion). The results from the analyses of method blanks will be used to determine whether the samples are being contaminated by laboratory glassware or impure reagents. The trigger level for potential contamination in a method blank is a level greater than the detection limit for any single analyte. A method blank will be used at a frequency of at least 5 percent (i.e., one method blank per 20 samples) or a minimum of one per analytical lot, whichever is more frequent.

Certain sample matrices or parameters will not require duplicate analyses. By nature, a wipe sample cannot be duplicated. Each wipe sample must be collected from a discrete location. One duplicate sample will be collected for every 10 soil samples.

Spiked samples will be prepared by adding a known amount of the constituent of interest to a sample aliquot prior to sample preparation. The matrix spike sample will be used to evaluate the matrix interferences and the accuracy (i.e., recovery). Spiked samples will be used for soil and concrete samples at a minimum of one per analytical lot.

Laboratory control samples will be prepared from Standard Reference Materials that are obtained from EPA or NBS. The laboratory control samples will be subjected to the same preparation steps received by each sample. The laboratory control spike (blank spike) will be prepared using Aroclor 1260. The acceptance criteria are given in Table 1. The results from the laboratory control samples will be used to check the accuracy of both the sample preparation and instrumental analysis procedures. Laboratory control samples will be used for all the inorganic analyses at a frequency of at least 5 percent, or a minimum of one per analytical lot, whichever is more frequent.

In addition to these quality control samples, several other quality control samples specifically referenced in the analytical method will be required. During analysis, a

continuing calibration verification standard will be analyzed at a frequency of 10 percent or every two hours, whichever is more frequent, to assure calibration accuracy during the analysis run. A calibration blank will be analyzed each time the instrument is calibrated, at the beginning and end of each run, and at a frequency of 10 percent during the run. Additionally, each sample will be spiked (an analytical of post-digest spike) at twice the CLP required detection limit to verify that the method of standard additions is not required. If the recovery of the analytical spike is not between 85 percent and 115 percent, the method of standard additions will be used. Finally, each sample will be injected in duplicate, except during the method of standard additions. The average concentration of the duplicate injections will be reported. Results will be evaluated based on the quality control requirements of the method and the quality assurance objectives detailed in Section 4.0.

10.2 Internal Audits

The Versar laboratory quality assurance coordinator (LQAC) will perform internal audits of critical functions to ensure that the procedure specified in this QA/QC Plan are being implemented. The LQAC will be responsible for: verifying that standards, procedures, records, charts, etc. are properly maintained; verifying that actual practice agrees with written instructions; verifying that QA record are adequately filed and maintained in a retrievable fashion; assessing the results of QC sample analyses; and is required to submit monthly QA reports to LANTDIV's QA contractor, Martin Marietta. The internal audit will consist of observations and notations as to whether approved practices are being followed. Deviations discovered during the audit will be noted and discussed with the staff member(s), appropriate management and, if required, the NEESA Contract Representative.

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11.0 PREVENTATIVE MAINTENANCE

This section establishes procedures for maintaining test and measurement equipment used to conduct analyses in such areas as instrument maintenance, service contracts, and absolute physical or electronic calibration. All equipment will receive routine maintenance checks in order to minimize equipment breakdowns. Any items that are found to be defective or inoperable will be taken out of service or repaired. All equipment requiring absolute calibration will have a label affixed showing: description, manufacturer, model number, serial number, date of last calibration or maintenance, by whom calibrated or maintained, and due date of next servicing. Calibration reports and compensation or correction factors will be maintained with each instrument.

A laboratory can be severely crippled by instrument failure, but preventative maintenance can minimize the down time of a system. Each analyst will be responsible for conducting a daily inspection of critical systems on the instruments he/she is using. Inspections include: vacuum lines and pumps for GC/MS, automatic injection systems, controlled reagent-feed motors, temperature-controlled equipment, GC columns, detectors and support systems, and many others. Wear-dependent items, such as septums on GC injection system, will be replaced as needed. The performance of all instruments will be checked against known standards at the beginning of each working day or shift. Failure to achieve proper performance will indicate that a system problem is present, and the problem will be dealt with by laboratory personnel or by the manufacturer's service representative, as required.

Calibration and maintenance intervals for complex or sensitive laboratory instruments will be those recommended by the respective manufacturer, unless experience dictates a shorter interval. When the manufacturer has not specified a calibration and maintenance interval for the equipment, the interval will be established, and a fixed maintenance schedule will be written for the equipment. The Versar laboratory will adhere to all these maintenance schedules, whether specified by the manufacturer or established by Versar.

The Versar laboratory will be responsible for identifying, monitoring, and controlling preventative maintenance intervals to ensure that checks are made on time. A record of service and repairs, whether accomplished by laboratory personnel or by the manufacturer's service representative, will be maintained in a log book kept with each instrument.

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The Versar laboratory will also perform routine absolute calibration on specific equipment to ensure that it is functioning correctly. Absolute calibration is not the same as chemical calibration, where the relationship between instrument response and concentration is established. Absolute calibration ensures that the perceived instrument response corresponds to the correct physical signal that should produce that response. The equipment that will be absolutely calibrated will be used to measure environmental materials and will include: balances, thermometers, other temperature sensors and controllers, flow controllers, auto-injectors, and recorders.

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12.0 PROCEDURES TO ASSESS DATA FOR PRECISION, ACCURACY, AND COMPLETENESS

RI/FS activities for NAVSTA Roosevelt Roads Substation 2 (Site 15) and the Old Power Plant (Site 16) are intended to fill the gaps in the current site-specific data, thus enabling Versar and the U.S. Navy to determine the nature and extent of contamination present at the site. This site-specific QA/QC Plan provides the necessary formal QA/QC procedure for assurance that site activities are performed properly and that the data generated meet the overall project objectives for precision and accuracy as discussed in Section 4.0. The QA/QC Plan provides the traceable sampling and analysis procedures, the personnel requirements, the chain-of-custody and documentation requirements, and specific criteria for determination of the acceptance of the data generated. The QA/QC Plan also establishes the procedures that Versar will follow to address data deficiencies, data reduction and evaluation, and preparation of all field investigation reports, which will be produced to ensure that outputs are accurate and technically sound.

The data produced during the RI/FS at NAVSTA Roosevelt roads Substation 2 will be validated by comparing it with the QA objectives and criteria for precision, accuracy, and completeness specified in Section 4.0, and data validation according to EPA functional guidelines. The data will also be evaluated with respect to internal consistency between sampling points and to existing data from previous site investigations. The primary goal of these validation procedures is to ensure that the data reported during the investigation are representative of actual site conditions.

This data assessment activity is an ongoing process coordinated with data production and is intended to assure that all data produced in the project are acceptable for use in subsequent evaluations. Both statistical and qualitative evaluations will be used to assess the quality of the data. The primary evaluation of the data will be based upon the three major categories of control samples described in Section 10.0 (i.e., spikes, duplicates, and blanks). The spike sample results will be used to assess data accuracy, while the duplicate sample results will be used to assess the precision of the data. The blank samples will be used to evaluate whether the laboratory represents a possible source of sample contamination.

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13.0 DETERMINING, CORRECTING, AND REPORTING OUT-OF-CONTROL EVENTS

When, as a result of internal audits or QC sample analysis, sampling or analysis systems are shown to be unsatisfactory, a corrective action will be implemented. Failure to meet calibration criteria, improper sampling techniques, improper storage or preservation of samples (e.g., exceeding sample holding times), and QC sample results exceeding control limits are all examples of out-of-control events that affect data quality and require investigation/correction. When an out-of-control event is identified, immediate action will be taken to identify and correct the problem, so that large quantities of data do not have to be discarded, which would necessitate the acquisition, preparation, and analysis of all samples analyzed after the problem was detected. After the out-of-control event has been corrected, the Laboratory Quality Assurance Coordinator will prepare a formal corrective action report documenting the occurrence of the problem, the cause of the problem, the corrective action used, and verification that the problem has been eliminated. This report will be submitted to the Project Manager, the Engineering Field Division's Engineer-in-Charge, and the NEESA Contract Representative.

In general, there are three basic types of problems that result in out-of-control events requiring the initiation of a corrective action: (1) sample problems, (2) QC batch problems, and (3) systematic problems. Improper preservation, violation of holding time requirements, and/or matrix interferences are examples of sample problems that may result in an out-of-control situation. Corrective actions for these out-of-control events will be implemented by the analytical laboratory and may include re-extraction, analysis, cleanup, dilutions, or matrix modifications. The actual corrective actions taken will be those specified in the corresponding analytical method. All actions taken will be documented with the analytical results.

QC batch problems contribute to out-of-control events when the requirements for acceptance (e.g., precision, accuracy, linearity, degradation, retention times, etc.), based on the analysis of duplicates, spikes, check standards, or calibration standards, are not met. Corrective actions for out-of-control situations caused by QC batch problems will also be implemented by the analytical laboratory and may include reanalysis of the affected sample batch or of all samples since the analytical system was last in control. If reanalysis is required, the laboratory quality assurance coordinator will review both sets of data to determine whether the problem has been resolved. As is the case for sample problems, the actual corrective actions taken will be those specified in the corresponding analytical method. All actions taken will be documented with the analytical results.

Systematic problems are those problems of a procedural nature that cause out-of-control events. Two common systematic problems are improper execution of sampling procedures and improper execution of analytical procedures. Out-of-control events caused by systematic problems may require correction by training project team members to properly execute specific technical skills or by modifying the affected sampling or analysis procedure. For any major operational changes, initiation of such will occur only after approval from the Project Manager, the Engineering Field Division's Engineer-in-Charge, and the NEESA Contract Representative.

Corrective actions can be broadly divided into two categories: (1) immediate and (2) long term. Immediate corrective actions will be necessary to correct or repair nonconforming equipment and systems. The need for immediate corrective action will most frequently result from sample or QC batch problems. Long-term corrective actions will be necessary to eliminate causes of nonconformance. The need for long-term corrective action will most frequently result from systematic problems, which are usually identified by internal audits.

For either immediate or long-term corrective actions, the following steps comprise the closed-loop corrective action system:

1. Define the problem.
2. Assign responsibility for investigating the problem.
3. Investigate and determine the cause of the problem.
4. Determine an appropriate corrective action to eliminate the problem.
5. Assign responsibility for implementing the corrective action.
6. Establish the effectiveness of the corrective action and implement the correction.
7. Verify that the corrective action has eliminated the problem(s).
8. Prepare corrective action report.

The Laboratory Quality Assurance Coordinator will be responsible for performing these steps if the corrective action is caused by sample or QC batch problems. If the corrective action is necessary because of systematic problems, the Project Manager, the Technical Operation Quality Assurance Coordinator, and the Laboratory Quality Assurance

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Coordinator will work jointly to perform these steps. Depending on the nature of the problem, the corrective action may be formal or informal. In either case, occurrence of the problem, corrective action used, and verification that the problem has been eliminated will be documented.

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14.0 REPORTING

All QA and QC reports and activities will be included with the final report. Project deliverables for the analytical laboratory will be complete CLP analytical data packages, including a narrative discussion of the results.

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APPENDIX C

HEALTH AND SAFETY PLAN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY OF SUBSTATION NO. 2 - BLDG. 90 AND OLD POWER PLANT - BLDG. 38 NAVAL STATION ROOSEVELT ROADS PUERTO RICO

Prepared for:

U.S. Naval Station
Roosevelt Roads
Substation No.2, Building 90 (Site 15)
The Old Power Plant, Building 38 (Site 16)
Puerto Rico, U.S.A.

Prepared by:

Versar, Inc.
6850 Versar Center
Springfield, VA 22151

APRIL 9, 1991

Versar INC.

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The purpose of this Health and Safety Plan is to facilitate compliance with governmental laws and regulations relating to health, safety, and the environment.

As such, Versar, Inc., has prepared this Health and Safety Plan for use by all personnel onsite to provide the means to achieve safe working conditions through informational programs and persistent review and improvement of facilities and practices that protect the health and safety of all personnel.

In accordance with 29 CFR Part 1910.120, Paragraph (a), Versar, Inc. has prepared this site-specific Health and Safety Plan for the Remedial Investigation/Feasibility Study (RI/FS) at Site Number 15 (Substation No. 2) and Site Number 16 (Old Power Plant, Building 38) for the Naval Station, Roosevelt Roads, Puerto Rico. This plan documents specific requirements and procedures for the protection of Versar field personnel and other personnel who participate under the authority of Versar, Inc., while performing RI/FS activities. Emergency and site contacts are provided in Appendix 1. Versar supervisory personnel involved with this project and their respective titles are listed below:

Versar Health and Safety Officer: Bill DiGuiseppi — 4/9/91 (date)

Versar Activity Supervisor: Noel Simmons — 4-9-91 (date)

Versar Project Manager: Noel Simmons — 4-9-91 (date)

Versar Health and Safety Coordinator: James Leach for J. Timothy Jensen — 4-9-91 (date)

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1.0 INTRODUCTION

This document presents the Health and Safety Plan to be implemented for the field activities at Roosevelt Roads, Puerto Rico. This plan is applicable to all onsite personnel under the authority of Versar, Inc. All onsite activities will be performed in accordance with the Occupational Safety and Health Administration (OSHA) standards (Title 29 CFR 1910 and 1926) and in accordance with other applicable federal, state, and local regulations.

2.0 OBJECTIVE

It is the objective of this Health and Safety Plan to establish a means to provide a safe work environment for site personnel, to provide a uniform and concise policy of action, and to provide all site personnel with the necessary guidance to adhere to the policies. The organization of this program and the procedures contained herein have been based on an evaluation of potential hazards at the site and the recognized standard procedures in response to these hazards.

3.0 ORGANIZATION OF SITE SAFETY

Versar, Inc. has designed and written this Health and Safety Plan. This plan is for the benefit of all personnel who participate under the authority of Versar, Inc. in the field investigation activities. Copies shall be made available to all onsite personnel. As such, all personnel who are involved in this effort are required to adhere to the policies and procedures of this plan. This includes, but is not limited to, subcontractors, inspectors, site visitors, the general public, and Naval Station personnel. Individual Health and Safety Plans from subcontractors or others under direct authority of Versar, Inc., are encouraged and must meet at a minimum the performance standards of this Health and Safety Plan. Copies of individual Health and Safety Plans should be attached to this Health and Safety Plan.

All personnel who participate under the authority of Versar, Inc., shall be in compliance with all training and medical monitoring requirements for hazardous waste operations as established in 29 CFR 1910.120, 1910.1200, and 1910.134. Certification of training and medical monitoring shall be documented in personnel files for Versar employees. All other personnel must submit copies of certifications as part of the contractor-specific Health and Safety Plan.

In addition, all Versar field personnel should be familiar with basic first aid procedures. CPR certified field personnel should be identified.

The Health and Safety Officer will have the authority to implement specific health and safety requirements for specific site activities, and to ensure that all Versar employees and onsite personnel under authority of Versar, Inc., follow the policies and procedures of this program. It is the responsibility of other organizations to ensure compliance of this plan by its onsite employees or representatives.

4.0 SITE CHARACTERIZATION

Roosevelt Roads Naval Station is the location for NAVCOMMSTA Headquarters, whose primary mission is to provide long haul, point-to-point communications for all DOD agencies in Puerto Rico and fleet units operating in the area. As such, the use of hazardous materials and subsequent generation of hazardous waste has historically been limited. Sites 15 and 16 (Substation No. 2 and the Old Power Plant, Building 38, respectively) are locations of suspected PCB (polychlorinated biphenyl) and petroleum hydrocarbon contamination.

A site map which includes the locations and configurations of all known areas of potential contamination, buildings, and other important structures is provided in Figure 1 for Site 15 and Figure 2 for Site 16.

4.1 Site 15: Substation 2 Background Information

Substation 2, Building 90, at the Naval Station Roosevelt Roads, Puerto Rico, has been utilized for the repair of electrical transformers since 1964 by the Public Works Department Power Distribution Shop. As part of the maintenance of pole-mounted distribution transformers, the oil was drained to facilitate in the repair to the inner core and coils. The oil for the transformers was drained onto the ground in the vicinity of Substation 2, Building 90, from 1964 through 1979. The amount of possible polychlorinated biphenyl (PCB) contaminated oil deposited onto the ground has been estimated at a maximum of 3,000 gallons.

As part of the Navy Assessment and Control Installation Pollutants (NACIP) program, an Initial Assessment Study (IAS) was performed in 1984. The results of the IAS indicated the potential presence of PCBs in the soil, and the site was recommended for a Confirmation Study which was performed by Environmental Science and Engineering, Inc. and completed

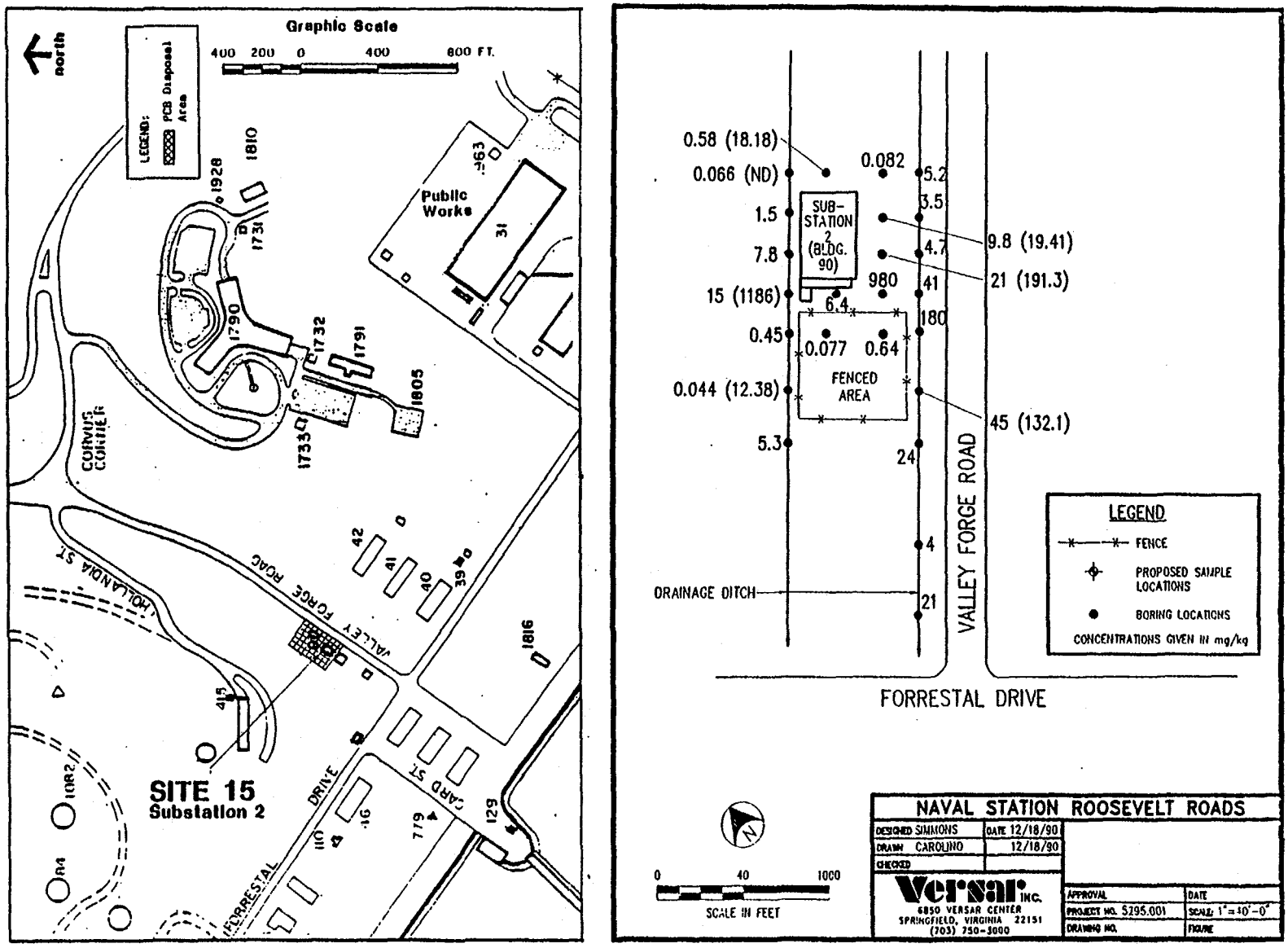

FIGURE 1
SITE 15, SUBSTATION 2

RR-00034-03.05-04/09/91

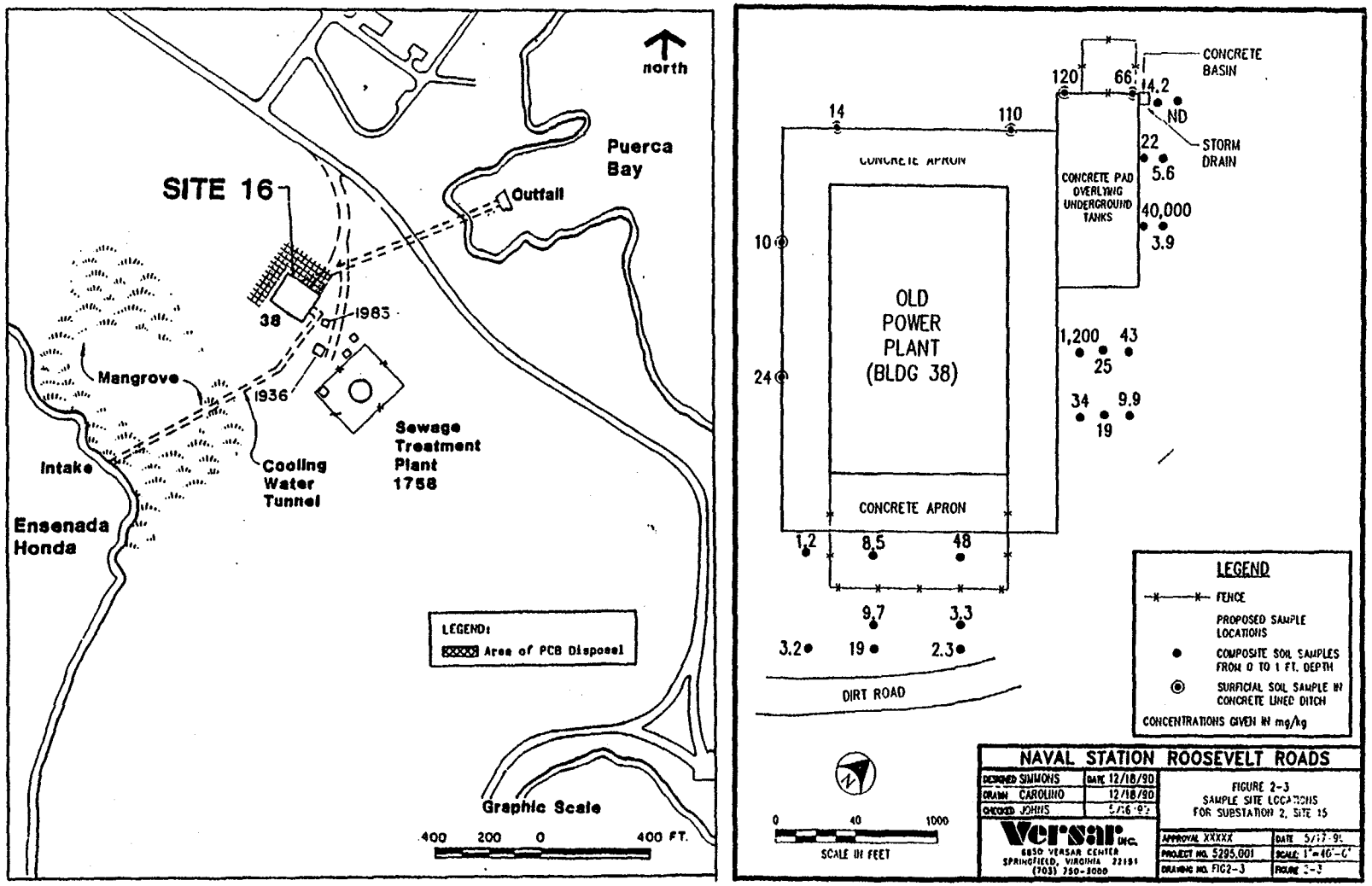

FIGURE 2
SITE 16, OLD POWER PLANT BUILDING 38

RR-00034-03.05-04/09/91

in February 1988 (ESE, 1988a). The Confirmation Study included a characterization of the site, a preliminary risk assessment and an analysis of several remedial action alternatives.

As part of the Confirmation Study, thirty-six soil samples were collected from 33 hand augered soil borings at Site 15. Soil samples were collected from the surface to a depth of one foot below land surface (BLS) in all but two of the borings which were extended deeper. The soil samples were analyzed for PCBs. Concentrations of PCBs ranged from ND (not detected) to 1,186 ppm. PCB levels above 50 ppm were found at four sampling locations. The highest concentrations were found around Building 90 and in the drainage ditch along Valley Forge Road. Two samples from the fenced-in storage yard were <1 ppm.

4.2 Site 16: Old Power Plant Background Information

The Old Power Plant, Building 38, at the NAVSTA Roosevelt Roads, was a 60 megawatt steam turbine facility that generated power from the early 1940s through 1949. The plant used Bunker "C" fuel, which was stored in two 50,000-gallon reinforced concrete tanks located directly northwest of the building. During heavy rainfalls in the 1970s, fuel was observed in the manholes near the building and was also discharged to the Enlisted Beach via the old cooling water outlet for the Power Plant. A cleanup contractor was hired twice to drain the underground fuel tanks and cleanup the spill. This area, where the underground storage tanks are located, is now paved over with concrete.

From 1956 to 1964, transformer maintenance was performed at Building 38 by the Public Works Power Distribution Shop. The majority of transformer repair work was conducted just outside of the building at its northeast corner. As part of the maintenance of the transformers, the transformer oil was drained to facilitate repair of the inner cores and coils. Reportedly, oil was drained from the transformers to the soil in the immediate vicinity of the building. The only exception to this practice was with Askarel (a type of PCB) transformers. Power Distribution Shop employees drained transformers containing Askarel directly to 55-gallon drums which were disposed of at the station landfill. The exact quantity of Askarel disposed of in this manner is unknown. The Power Distribution Shop ordered 200 gallons of replacement transformer fluid per year. Assuming the total 200 gallons were used each year, it is possible that over the eight years during which Building 38 was used, approximately 1,600 gallons of transformer oil were drained to the soil in the vicinity of the building, with some portion going to the landfill. The transformer oil commonly used in this time frame was either "pure" PCBs or oil containing PCBs at a 300-ppm concentration (ESE

1988b).

An Initial Assessment Study was performed at Site 16 in 1984. The site was recommended for a confirmation study due to potential presence of PCBs and fuel-related contamination in the soil. This study was completed by Environmental Science and Engineering, Inc. in May 1988 (ESE 1988b). From the Confirmation Studies, it was determined that PCB contamination exists in the vicinity of the Old Power Plant, Building 38.

For the Confirmation Study, thirty-eight soil samples were collected from the site (9 in Round 1 and 29 in Round 2). These samples were analyzed for PCBs, oil and grease, volatile organic compounds (VOC), ethylene dibromide (EDB), xylenes, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK). In Round 2, an EP toxicity test for lead was completed. The analytical results indicated the presence of PCB and lead contamination at the site. Lead concentrations were less than the EP toxicity standard for lead and risk assessment indicated that lead concentrations posed no health risks to workers. Other constituents detected (but not at levels of concern) were MEK as well as oil and grease.

5.0 SITE CONTROL

Naval Station, Roosevelt Roads is a secured activity with limited access. Activity personnel have been instructed to not enter specific areas of concern without prior approval.

During augering and sampling operations performed by Versar, Inc., a zone of safety shall be established around the operation to keep non-essential persons at a safe distance. This may require visual barricades or tape in occupied and accessible areas or verbal warning in other areas of limited access.

For operations involving heavy equipment, an emergency work stoppage signal will be established and agreed upon by all affected parties. All personnel must be aware of immediate avenues of egress from the work site.

6.0 HAZARD ASSESSMENT

6.1 Chemical Hazards

All suspected site contaminants related to PCB fluids and diesel fuels and their respective

characteristics and symptoms are listed in Table 1. In the event of an emergency situation or injury, an emergency response plan is included in Appendix 1. Additional information for suspected contaminants are presented in Appendix 2.

6.2 Physical Hazards

- General Construction Dangers: Operation of heavy equipment pose a crush, loss of limb potential.
- Slip/Trip: Work on and around tailings piles, abandoned equipment, and other scrap materials.
- Electrical/Shock/Spark: Public Works must be notified prior to use of heavy equipment on base.
- Overhead/Underground Power Lines: All equipment must maintain a minimum of 10 feet of clearance from power lines.
- Crush Potential: Heavy equipment needed to access cooling water tunnel.
- Asbestos: Only if ACM suspect old equipment or pipes are disturbed.
- Noise: Heavy equipment, power sampling equipment.
- Flammable/Explosive: Only near Bunker C fuel storage tanks.

6.3 Environmental Hazards

- Heat Stress (Average Ambient Temperature 76°F): High temperatures and high humidity require careful personnel observation. Appendix 3 contains information on heat stress.
- Flora: Appendix 3 identifies the typical flora associated with two areas: jungle and occupied land.
- Fauna: Appendix 3 identifies indigenous and introduced species. Extreme caution should be displayed when any mammal is encountered due to the increased incidence of rabies. Contact with surface water in Puerto Rico should be avoided.
- Frequent Rain: Average precipitation for February is between 2 and 4 inches per month. Expect rainstorms daily; plan work around these times.

- Bright Sun: Due to Puerto Rico's proximity to the equator, sunburn is a large concern. High protection factor lotion and hats should be standard daily necessities.

6.4 Biohazards

Due to the proximity of swamps and standing water, another potential hazard to be discussed is biological in nature. The swamps tend to be recipients of a wide spectrum of biohazardous materials and wastes. These include human and animal fecal matter, rotting carcasses, and other sources of biowaste.

Routes of exposure include:

1. Skin absorption via contact with infections liquids and soils (not wearing proper PPE).

2. Injection via a puncture wound or open skin lesion (cuts, scrapes).

3. Ingestion via improper personal hygiene (not washing hands, eating while onsite).

4. Potential inhalation (low hazard) of airborne biocontaminants.

Care should be taken when working in and around standing or moving water. Proper PPE should be worn. Gloves, boots, splash suits, and face shields should be used during "messy" operations. Contact with contaminants requires immediate washing and rinsing of affected area.

7.0 MONITORING PROCEDURES

A photoionization detector (PID), such as an HNu PI-101, or a flame ionization detector (FID), such as an OVA 128, will be calibrated and used to monitor ambient air conditions during all initial intrusive activities. The purpose of the periodic air monitoring is to assess potential areas of contamination and detect the presence of volatile organic compounds (VOCs). If VOCs are consistently detected in excess of PEL, PuEL (published exposure levels), or TLVs (known chemicals) or above background levels in the breathing zone (unknown chemicals), the area will be evacuated and the use of appropriate respiratory protection will be determined and implemented. As an added precaution, Versar personnel will make every attempt to remain upwind of and at a safe distance from activities at all times.

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8.0 PERSONAL PROTECTION

8.1 Primary

All Versar field personnel shall perform nonintrusive field activities using at a minimum Level D personal protective equipment. Smoking, eating, or drinking will not be permitted in or near contaminated areas. Level D protection is designed for use when only minor skin and eye protection is needed and airborne contamination is unlikely. Personal equipment requirements for Level D include:

- Hard hat (optional, except around operating well drill rig)
- Splash shield, goggles or safety glasses (optional except when splash potential exists)
- Work gloves (optional)
- Coveralls, long-sleeve (optional)
- Steel-toe safety boots
- Chemical-resistant gloves and boots (optional, except when collecting soil samples and any contact with surface water)
- Ear protection (optional)

Noise from power augers and well drill rigs may be substantial. At the discretion of the field person or under direction from the Health and Safety Officer, ear protection may be recommended or required.

8.2 Contingency

As a contingency, all Versar field personnel shall upgrade to modified Level C personal protection equipment if air monitoring readings exceed PELs, PuELs, or TLVs (known chemicals) or concentrations above ambient levels in the breathing zone (unknown chemicals). Oxygen concentration must be >19.5%. At present, no confined space activities are planned. Modified Level C protection is designed for use when minor skin and eye protection is needed with the addition of respiratory protection. The Health and Safety Officer shall identify the chemical present and its concentration and select the appropriate respiratory protection. The personal protection equipment required for modified Level C includes:

- Hard hat
- Air purifying respirator with appropriate cartridge (organic vapor with HEPA)
- Chemical-resistant gloves
- Coveralls, long-sleeve, chemical resistant (optional)
- Steel-toe safety boots
- Chemical-resistant overboots
- Ear protection (optional)

As a contingency, all field personnel shall upgrade to modified Level B personal protective equipment if the Health and Safety Officer identifies potential contact with any vapor concentrations above PELs, PuELs, or TLVs for carcinogens or if concentrations exceed the capabilities of air purifying respiratory protection. IDLH conditions shall always require modified Level B personal protection. Modified Level B protection is designed for use when there is a primary inhalation hazard. The personal protective equipment required for modified Level B includes:

- Hard hat
- Positive pressure/demand SCBA
- Chemical-resistant gloves
- Coveralls, long-sleeve (chemical resistant)
- Steel-toe safety boots
- Chemical-resistant overboots
- Ear protection (optional)

Levels of protection may be modified under the direction of the Health and Safety Officer so long as it is justified and recorded in this Health and Safety Plan or in the onsite daily log.

9.0 DECONTAMINATION AND DISPOSAL

A proper decontamination layout appropriate to suspected contaminants will be established after further site characterization. At a minimum, reusable equipment and PPE should be washed with a nonphosphate wash solution and rinsed with water. All solutions will be collected and containerized for eventual proper disposal.

The Health and Safety Officer or their designated representative shall periodically assess the effectiveness of the decontamination procedure and has the authority to correct the decontamination procedure to preclude the spread of contamination.

Versar INC.

APPENDIX 1
EMERGENCY RESPONSE PLAN

Versar INC.

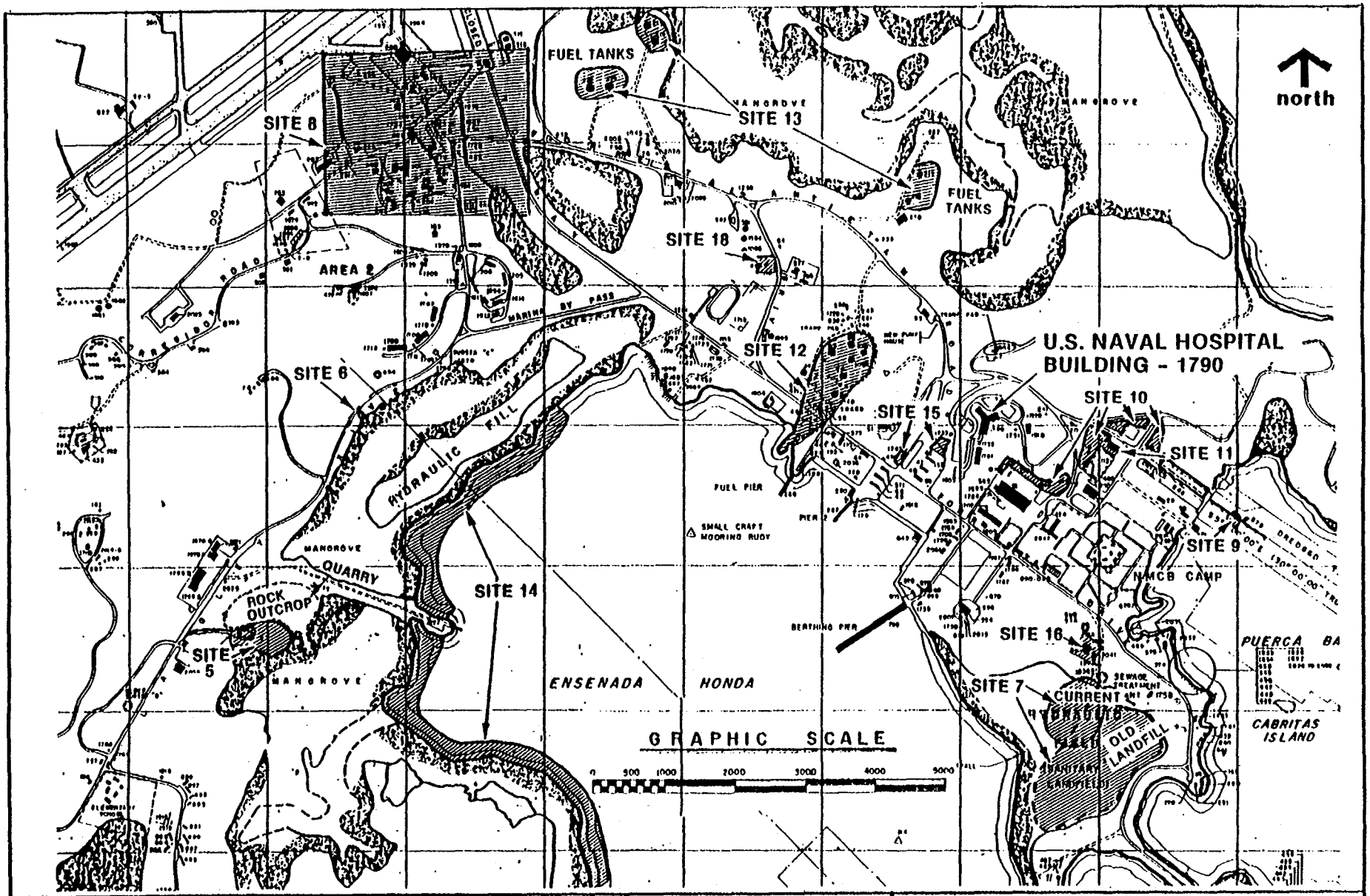
EMERGENCY CONTACTS

- Emergency Communications--In the event of emergency, the appropriate response resources must be contacted. Pertinent emergency activities and telephone numbers are listed below:

NSGA Roosevelt Roads:

Ambulance	Ext. 4144
Hospital	Ext. 4133
Police	Ext. 4123
Fire Department	Ext. 4333
Explosives Unit	Ext. 4333
Safety Manager	Ext. 3010 or 5564
Environmental Coordinator	Ext. 2507

All field team members should acquaint themselves with the location of the nearest telephone to each site prior to initiation of work. This will help minimize response time in the event of an emergency. In the event of a medical emergency, the Roosevelt Roads Naval Hospital will provide medical attention required for stabilizing the injured person prior to transferring to an offpost medical facility. The NAVSTA Roosevelt Roads Naval Hospital is located in Building 1790. First aid kits and emergency eye wash bottles will be kept at the central decontamination station for field use.



SITE MAP SHOWING LOCATION OF EMERGENCY MEDICAL FACILITY (U.S. NAVAL HOSPITAL), NAVSTA ROOSEVELT ROADS

U.S. NAVAL COMPLEX
PUERTO RICO

HOSPITAL LOCATION MAP

RR-00034-03.05-04/09/91

Versar INC.

EMERGENCY RESPONSE GUIDELINES

1. In the event of a life threatening/serious injury emergency, any person has the authority to stop all site work activities.

2. The signal for cessation of work shall be verbal alarm and hand signals. The egress signal shall be verbal alarm.

3. The Naval Station On Scene Commander shall take full responsibility and authority to implement the ER Plan.

4. Access/egress through the decontamination corridor may be modified to expedite the egress of personnel from imminently dangerous situations.

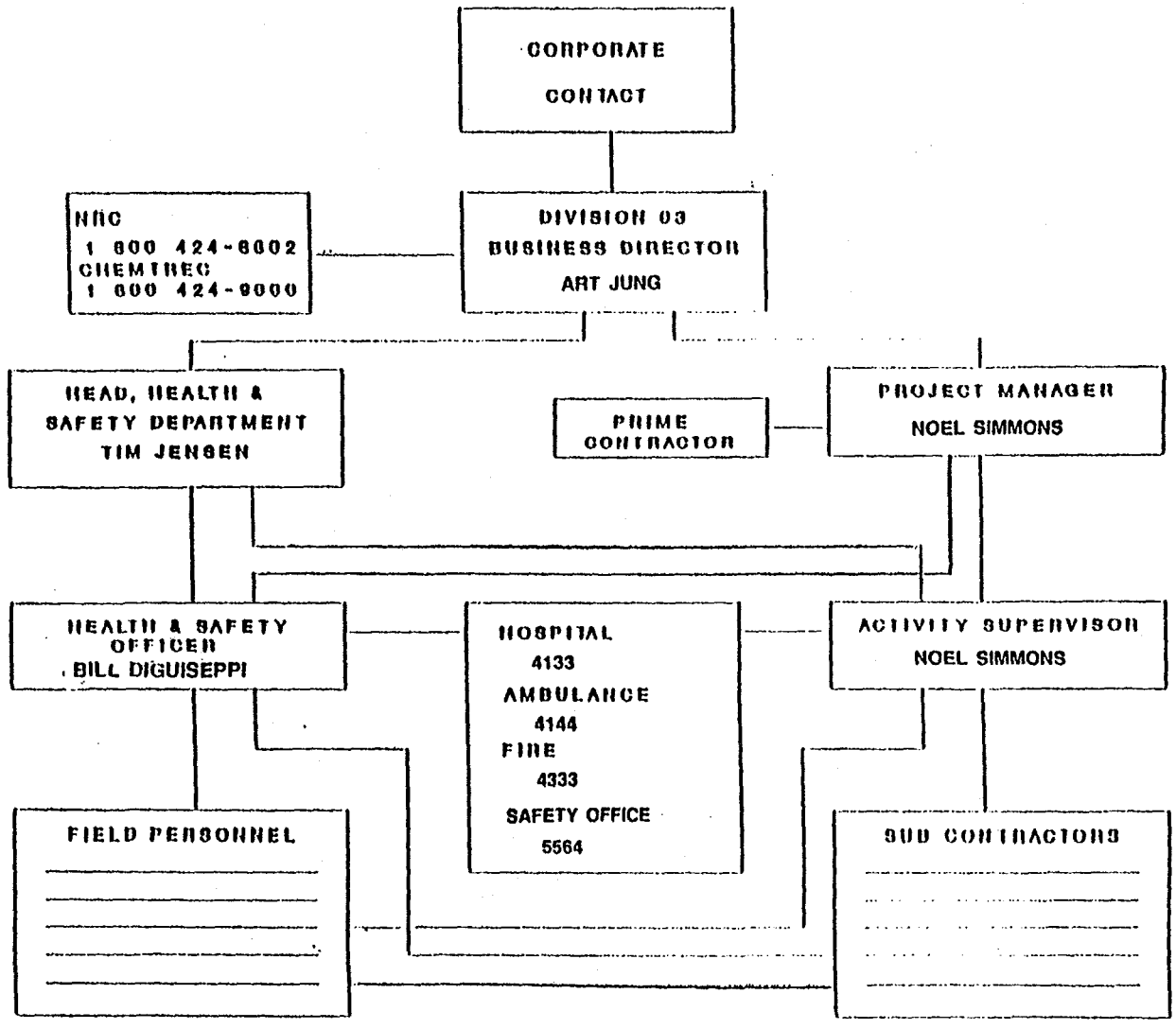
5. No person shall compromise their personal health and safety when attempting to accomplish a task (i.e., containing a leak, saving a life).

6. Decontamination procedures shall be followed unless an injury is life threatening where time is a critical factor. In this case, the contaminated injured person shall be covered or wrapped with uncontaminated material (plastic bags, blanket, etc.) for transport to the medical facility.

7. A person shall accompany the injured individual to the medical facility. That person is instructed to carry a complete copy of the Health and Safety Plan, including MSDS's. That person has the responsibility to answer pertinent questions and give information as to the type and level of exposure and any known acute or chronic health effects of exposure.

8. Appropriate action shall be taken to minimize the spread of contamination to personnel, the public, and the environment in the event of a spill or release.

COMMAND AND COMMUNICATION MATRIX



RR-00034-03.05-04/09/91

SITE HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT FORM

SITE NAME: NAVSTA Roosevelt Roads

By placing my signature below I certify that I have read this Health & Safety Plan, fully understand its requirements, and will follow all safety directives set forth by the Plan or dictated by Versar Inc. as long as I am present at this site.

NAME	DATE	TIME	REPRESENTING	CERTIFICATION					
				MED.	40 HR	24 HR	8 HR	SUPR	APR

Versar INC.

APPENDIX 2
ADDITIONAL CHEMICAL INFORMATION

---------- IDENTIFIERS ----------

CHEMTOX RECORD 518 LAST UPDATE OF THIS RECORD: 12/01/90
NAME: AROMATIC HYDROCARBONS (MIXED)
SYNONYMS: XYLENE(MIXED)
CAS: 1330-20-7 RTECS: ZE2100000
FORMULA: MOL WT: MIXTURE
WLN: 1R X1
CHEMICAL CLASS:

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION:
BOILING POINT:
MELTING POINT:
FLASH POINT:
AUTO IGNITION: NA
VAPOR PRESSURE:
UEL: NA
LEL: NA
VAPOR DENSITY: No data
SPECIFIC GRAVITY:
DENSITY: g/cc or 0 lb/gal
WATER SOLUBILITY:

INCOMPATIBILITIES: STRONG OX

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:MODERATE FIRE HAZARD: IN THE PRESENCE OF HEAT OR FLAME; CAN REACT WITH OXIDIZING MATERIALS Source: SAX 6
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: WHEN HEATED TO DECOMPOSITION IT EMITS ACRID SMOKE AND FUMES
ODOR DETECTED AT (ppm):
ODOR DESCRIPTION:
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT HAZARD CLASS: No class given
DOT GUIDE: 27
DOT ID NUMBER: UN1307
DOT SHIPPING NAME: XYLENE(XYLOL)
STCC NUMBER:

CLEAN AIR ACT: N
EPA WASTE NUMBER: U239
CERCLA REF: N
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.
LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:
HEALTH HAZARD (BLUE): Unspecified
FLAMMABILITY (RED) : Unspecified
REACTIVITY (YELLOW): Unspecified
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS:
SYMPTOMS: DIZZ, EXCITEMENT, DROW, INVO, STAGGERING
GAIT, IRRIT EYES, IRRIT NOSE, THROAT,
CORNEAL VACUOLIZATION, ANOR, NAU, VOMIT,
ABDOM PAIN, DERM Source: NIOSHP

CONC IDLH: 22 ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
434 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN)
868 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: 100 ppm SKIN
ACGIH STEL: 150 ppm

OSHA PEL: Transitional Limits:
PEL = 100ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 150 ppm(655 mg/M3)

CARCINOGEN?: STATUS:

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-man LCLo:10000 ppm/6H BMJOAE 3,442,70

LD50 value: orl-rat LD50:4300 mg/kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

orl-rat LD50:4300 mg/kg
ihl-rat LC50:5000 ppm/4H
ipr-rat LD50:2459 mg/kg
scu-rat LD50:1700 mg/kg
ipr-mus LD50:1548 mg/kg
ivn-rbt LDLo:129 mg/kg
ihl-gpg LCLo:450 ppm
ipr-gpg LDLo:2000 mg/kg
ipr-mam LDLo:2000 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1988)

eye-hmn 200 ppm
skn-rbt 100% MOD
skn-rbt 500 mg/24H MOD
eye-rbt 87 mg MLD
eye-rbt 5 mg/24H SEV

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability hazard.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (AROMATIC HYDROCARBONS (MIXED))
1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
2500 ppm: Any supplied-air respirator operated in a continuous flow mode. * Substance reported to cause eye irritation or damage may require eye protection.
5000 ppm: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece.
10000 ppm: Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.:
Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID (NIOSH):
EYE:
IRR IMMED
SKIN:
SOAP WASH PROMPTLY
INHALATION:
ART RESP
INGESTION:
NO VOMIT

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: XYLENE(XYLOL)
DOT ID NUMBER: UN1307

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
- Flammable/combustible material; may be ignited by heat, sparks or flames.
- Vapors may travel to a source of ignition and flash back.
- Container may explode in heat of fire.
- Vapor explosion hazard indoors, outdoors or in sewers.
- Runoff to sewer may create fire or explosion hazard.

*HEALTH HAZARDS
- May be poisonous if inhaled or absorbed through skin.
- Vapors may cause dizziness or suffocation.
- Contact may irritate or burn skin and eyes.
- Fire may produce irritating or poisonous gases.
- Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

- Keep unnecessary people away; isolate hazard area and deny entry.
- Stay upwind; keep out of low areas.
- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
- Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
- CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE
- Small Fires: Dry chemical, CO_2, water spray or regular foam.
- Large Fires: Water spray, fog or regular foam.
- Move container from fire area if you can do it without risk.
- Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
- For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
- Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK
- Shut off ignition sources; no flares, smoking or flames in hazard area.
- Stop leak if you can do it without risk.
- Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
- Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
- Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID
- Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
- In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
- Remove and isolate contaminated clothing and shoes at the site.

IDENTIFIERS

CHEMTOX RECORD 59 LAST UPDATE OF THIS RECORD: 12/01/90
NAME: BENZENE
SYNONYMS: BENZOL; COAL TAR NAPHTHA; CYCLOHEXATRIENE; PHENYL HYDRIDE; PHENE; COAL NAPHTHA; PYROBENZOL
CAS: 71-43-2 RTECS: CY1400000
FORMULA: C6H6 MOL WT: 78.11
WLN: RH
CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: COLORLESS TO PALE YELLOW WATERY LIQUID WITH A GASOLINE-LIKE ODOR
BOILING POINT: 353.15 K 80 C 176 F
MELTING POINT: 278.71 K 5.5 C 42 F
FLASH POINT: 262 K -11.2 C 11.9 F
AUTO IGNITION: 864.8 K 591.6 C 1096.9 F
VAPOR PRESSURE: 75 mm @ 20 C
UEL: 7.1 %
LEL: 1.3 %
IONIZATION POTENTIAL (eV): 9.25
VAPOR DENSITY: 2.77 air=1
SPECIFIC GRAVITY: 0.86-0.88 20 C
DENSITY: 0.8794 @ 20 C
WATER SOLUBILITY: 0.06%

INCOMPATIBILITIES: STRONG OX,CHLORINE,BROMINE WITH IRON

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:OXIDIZING MATERIALS(Br_2, F_2, CL_2, CrO_3, $NaClO_4$, O_2, O_3), PERCHLORATES ($AlCl_3$ +$NaClO_4$), (H_2SO_4
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: VAPOR IS HEAVIER THAN AIR AND MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
ODOR DETECTED AT (ppm): 4.68
ODOR DESCRIPTION: LIKE BENZENE, TOLUENE, AND XYLENE Source: CHRIS
100 % ODOR DETECTION: No data

REGULATIONS

DOT HAZARD CLASS: Flammable liquid
DOT GUIDE: 27
DOT ID NUMBER: UN1114
DOT SHIPPING NAME: BENZENE
STCC NUMBER: 4908110

CLEAN AIR ACT: Y
EPA WASTE NUMBER: U019,D018
CERCLA REF: Y
RQ DESIGNATION: A 10 pounds (4.54 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.
Chronic toxicity: carcinogen
Acute toxicity: adverse effect to target organs.
LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Not given
Mailability: Nonmailable
Max per parcel: 0

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS: BLOOD, CNS, SKIN, BONE MARROW, EYES, RESP SYS
SYMPTOMS: IRRIT EYES, NOSE, RESP SYS; GIDDY; HEAD, NAU, STAGGERED GAIT; FTG, ANOR, LASS; DERM; BONE MARROW DEPRES; ABDOM PAIN Source: SAX

CONC IDLH: 2000PPM

NIOSH REL: Potential occupational carcinogen
0.1 ppm Time weighted averages for 8-hour exposure
0.32 mg/M3 Time weighted averages for 8-hour exposure
1 ppm Ceiling exposures which shall at no time be exceeded
3.2 mg/M3 Ceiling exposures which shall at no time be exceeded

ACGIH TLV: 10 ppm Suspected human carcinogen (A2)
ACGIH STEL: Not specified

OSHA PEL: Final Rule Limits:
TWA = 1 ppm
STEL = 5 ppm

CARCINOGEN?: Y STATUS: HUMAN POSITIVE
REFERENCES:
HUMAN SUSPECTED IARC** 7,203,74
HUMAN SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 29,93,82
HUMAN POSITIVE IARC** 29,93,82
ANIMAL INDEFINITE IARC** 7,203,74

CARCINOGEN LISTS:
IARC: Carcinogen as defined by IARC as carcinogenic to humans, with sufficient epidemiological evidence.
MAK: Capable of inducing malignant tumors as shown by experience in humans.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as known to be carcinogenic, with evidence from human studies.
ACGIH: Carcinogen defined by ACGIH TLV Committee as a suspected carcinogen, based on either limited epidemological evidence or demonstration of carcinogenicity in experimental animals.
OSHA: Cancer hazard

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
* ihl-hmn LCLo:2 pph/5M TABIA2 3,231,33

* orl-man LDLo:50 mg/kg YAKUD5 22,883,80

* ihl-hmn LCLo:2000 ppm/5M YAKUD5 22,883,80

ihl-man TCLo:150 ppm/1Y-I BLUTA9 28,293,74
BLOOD
Other changes
NUTRITIONAL AND GROSS METABOLIC
Changes in:
Body temperature increase

ihl-hmn TCLo:100 ppm INMEAF 17,199,48

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
- Flammable/combustible material; may be ignited by heat, sparks or flames.
- Vapors may travel to a source of ignition and flash back.
- Container may explode in heat of fire.
- Vapor explosion hazard indoors, outdoors or in sewers.
- Runoff to sewer may create fire or explosion hazard.

*HEALTH HAZARDS
- May be poisonous if inhaled or absorbed through skin.
- Vapors may cause dizziness or suffocation.
- Fire may produce irritating or poisonous gases.
- Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

- Keep unnecessary people away; isolate hazard area and deny entry.
- Stay upwind; keep out of low areas.
- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
- Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire.
- CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE
- Small Fires: Dry chemical, CO_2 or Halon, water spray or alcohol-resistant foam.
- Large Fires: Water spray, fog or alcohol-resistant foam.
- Move container from fire area if you can do it without risk.
- Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
- For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
- Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK
- Shut off ignition sources; no flares, smoking or flames in hazard area.
- Stop leak if you can do it without risk.
- Water spray may reduce vapors; but it may not prevent ignition in closed spaces.
- Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
- Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID
- Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
- In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
- Remove and isolate contaminated clothing and shoes at the site.

---------- IDENTIFIERS ----------

CHEMTOX RECORD 1369 LAST UPDATE OF THIS RECORD: 09/01/90
NAME: GAS OIL
SYNONYMS: DISTALLATE; FUEL OIL; HOME HEATING OIL NO. 2
CAS: RTECS: LS8950000
FORMULA: MOL WT:
WLN:
CHEMICAL CLASS:

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: <1
BOILING POINT:
MELTING POINT:
FLASH POINT: 338.56 K 65.4 C 149.7 F
AUTO IGNITION: 610.78 K 337.6 C 639.7 F
VAPOR PRESSURE:
UEL: NA
LEL: NA
VAPOR DENSITY: No data
SPECIFIC GRAVITY: 0.879 20C
DENSITY: 0.879 g/cc or 8.1747 lb/gal
WATER SOLUBILITY: INSOLUBLE3^U

INCOMPATIBILITIES:

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: No data
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: TOXIC FIR^U^U^USMOKE AND FUMES
ODOR DETECTED AT (ppm):
ODOR DESCRIPTION: LIKE KEROSINE; CHARACTERISTIC Source: CHRIS
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT HAZARD CLASS: Combustible liquid
DOT GUIDE: 27
DOT ID NUMBER: UN1202
DOT SHIPPING NAME: GAS OIL
STCC NUMBER:

CLEAN AIR ACT:
EPA WASTE NUMBER:
CERCLA REF:
RQ DESIGNATION: N Not listed
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Combustible liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 GAL

NFPA CODES:
HEALTH HAZARD (BLUE): (0) No unusual health hazard.
FLAMMABILITY (RED) : (2) This material must be moderately heated before ignition will occur.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

TOXICITY DATA

TARGET ORGANS:
SYMPTOMS: INHALATION CAUSES HEADACHE, SLIGHT GIDDINESS. INGESTION CAUSES NAUSEA, VOMITING, CRAMPING; DEPRESSION OF CENTRAL NERVOUS SYSTEM RANGING FROM MILD HEADACHE TO ANESTHESIA, COMA & DEATH; PULMONARY IRRITATION SECONDARY TO EXHALATION OF SOLVENT; SIGNS OF KIDNEY & LIVER DAMAGE MAY BE DELAYED. ASPIRATION CAUSES SEVERE LUNG IRRITATION WITH COUGHING, GAGGING, DYSPNEA, SUBSTERNAL DISTRESS, & RAPIDLY DEVELOPING PULMONARY EDEMA; LATER, SIGNS OF BRONCHOPNEUMONIA & PNEUMONITIS; ACUTE ONSET OF CENTRAL NERVOUS SYSTEM EXCITEMENT FOLLOWED BY DEPRESSION. Source: CHRIS

CONC IDLH: Unknown ppm

NIOSH REL: Not given

ACGIH TLV: Not listed
ACGIH STEL: Not specified

OSHA PEL: Not in Table Z-1-A

CARCINOGEN?: STATUS:

CARCINOGEN LISTS:
IARC: Listed by IARC, but not assigned an overall evaluation.
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

LD50 value: Not in RTECS 1988

Reproductive toxicity (1988 RTECS):
This chemical has no known mammalian reproductive toxicity.

PROTECTION AND FIRST AID

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

PROTECTIVE GLOVES; GOGGLES OR FACE SHIELD.

FIRST AID (NIOSH):
EYE:
WASH WITH COPIOUS QUANTITY.
SKIN:
REMOVE SOLVENT BY WIPING AND WASH WITH SOAP AND WATER.
INHALATION:
ASPIRATION: ENFORCE BED REST; ADMINISTER OXYGEN; SEEK MEDICAL ATTENTION.
INGESTION:
DO NOT INDUCE VOMITING.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: GAS OIL
DOT ID NUMBER: UN1202

ERG90 GUIDE 27

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

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CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.
*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

BEHAVIORAL
Somnolence(general depressed activity)
GASTROINTESTINAL
Nausea or vomiting
SKIN AND APPENDAGES
Skin - after systemic exposure
Dermatitis,other

ihl-hmn LCLo:65 mg/m3/5Y ARGEAR 44,145,74
BLOOD
Other changes

LD50 value: orl-rat LD50:930 mg/kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

orl-rat LD50:930 mg/kg
ihl-rat LC50:10000 ppm/7H
ipr-rat LD50:2890 ug/kg
orl-mus LD50:3800 mg/kg
ihl-mus LC50:9980 ppm
ipr-mus LD50:340 mg/kg
orl-dog LDLo:2000 mg/kg
ihl-dog LCLo:146000 mg/m3
ihl-cat LCLo:170000 mg/m3
ihl-rbt LCLo:45000 ppm/30M
ivn-rbt LDLo:88 mg/kg
ipr-gpg LDLo:527 mg/kg
scu-frg LDLo:1400 mg/kg
ihl-mam LCLo:20000 ppm/5M
ipr-mam LDLo:1500 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1988)
skn-rbt 15 mg/24H open MLD
skn-rbt 20 mg/24H MOD
eye-rbt 88 mg MOD
eye-rbt 2 mg/24H SEV

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:
HYDROCARBON VAPOR CANISTER, SUPPLIED AIR OR HOSE MASK;
HYDROCARBON-INSOLUBLE RUBBER OR PLASTIC GLOVES; CHEMICAL GOGGLES OR FACE SPLASH SHIELD; HYDROCARBON-INSOLUBLE APRON SUCH AS NEOPRENE.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly wash with soap when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability hazard.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (BENZENE)
Less than or equal to 10 ppm: Half-mask air-purifying respirator with organic vapor cartridge.
Less than or equal to 50 ppm: Full facepiece respirator with organic vapor cartridges. / Full facepiece gas mask with chin style canister.
Less than or equal to 100 ppm: Full facepiece powered air-purifying respirator with organic vapor canister.
Less than or equal to 1000 ppm: Supplied air respirator with full facepiece in positive-pressure mode.
Greater than 1000 ppm or Unknown concentration: (1) Self-contained breathing apparatus with full face-piece in positive pressure mode. (2) Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.
Escape : (1) Any organic vapor gas mask; or (2) Any self-contained breathing apparatus with full facepiece.
Firefighting : Any full facepiece self-contained breathing apparatus operated in positive pressure mode.

FIRST AID (NIOSH):
EYE:
IRR IMMED
SKIN:
SOAP WASH PROMPTLY
INHALATION:
ART RESP
INGESTION:
NO VOMIT
FIRST AID (CHRIS):
EYE:
FLUSH WITH PLENTY OF WATER UNTIL IRRITATION SUBSIDES.
SKIN:
FLUSH WITH WATER FOLLOWED BY SOAP AND WATER; REMOVE CONTAMINATED CLOTHING AND WASH SKIN.
INHALATION:
REMOVE FROM EXPOSURE IMMEDIATELY. CALL PHYSICIAN. IF BREATHING IS IRREGULAR OR STOPPED, START RESUSCITATION, ADMINISTER OXYGEN.
INGESTION:

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: BENZENE
DOT ID NUMBER: UN1114

ERG90 GUIDE 27

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE

Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

---------- IDENTIFIERS ----------

CHEMTOX RECORD 206 LAST UPDATE OF THIS RECORD: 09/01/90
NAME: ETHYL BENZENE
SYNONYMS: AETHYLBENZOL (German); EB; ETHYLBENZEEN (Dutch); ETHYL BENZENE; ETHYL BENZENE (DOT); ETHYLBENZOL; ETILBENZENE (Italian); ETYLOBENZEN (Polish); NCI-C56393; PHENYLETHANE
CAS: 100-41-4 RTECS: DA0700000
FORMULA: C8H10 MOL WT: 106.18
WLN: 2R
CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: COLORLESS LIQUID WITH A SWEET, GASOLINE-LIKE ODOR.
BOILING POINT: 409.2 K 136 C 276.8 F
MELTING POINT: 178.15 K -95 C -139 F
FLASH POINT: 288 K 14.8 C 58.7 F
AUTO IGNITION: 733 K 459.8 C 859.7 F
VAPOR PRESSURE: 10mm @ 25.9 C
UEL: 6.7 %
LEL: 1.0 %
IONIZATION POTENTIAL (eV): 8.76
VAPOR DENSITY: 3.7 air=1
SPECIFIC GRAVITY: 0.867 20C
DENSITY: 0.866 g/mL @ 20 C
WATER SOLUBILITY: 0.015%

INCOMPATIBILITIES: STRONG OXIDIZERS

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:OXIDIZING MATERIALS Source: SAX
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors
ODOR DETECTED AT (ppm): 140
ODOR DESCRIPTION: AROMATIC Source: CHRIS
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT HAZARD CLASS: Flammable liquid
DOT GUIDE: 26
DOT ID NUMBER: UN1175
DOT SHIPPING NAME: ETHYLBENZENE
STCC NUMBER: 4909163

CLEAN AIR ACT: N
EPA WASTE NUMBER:
CERCLA REF: Y
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.
Acute toxicity: adverse effect to target organs.
LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS: EYES, UPPER RESP SYS, SKIN, CNS
SYMPTOMS: INHALATION MAY CAUSE IRRITATION OF NOSE, DIZZINESS, DEPRESSION. MODERATE IRRITATION OF EYE WITH CORNEAL INJURY POSSIBLE. IRRITATES SKIN AND MAY CAUSE BLISTERS, SUBSTERNAL TIGHTNESS, NARCOSIS. Source: THIC, CHRIS

CONC IDLH: 2000PPM

NIOSH REL:

ACGIH TLV: 100 ppm
ACGIH STEL: 125 ppm

OSHA PEL: Transitional Limits:
PEL = 100ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 125 ppm(545 mg/M3)

CARCINOGEN?: N STATUS:

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
ihl-hmn TCLo:100 ppm/8H AIHAAP 31,206,70
SENSE ORGANS
Eye
Other
BEHAVIORAL
Sleep
LUNGS, THORAX, OR RESPIRATION
Other changes

LD50 value: orl-rat LD50:3500 mg/kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

orl-rat LD50:3500 mg/kg
ihl-rat LCLo:4000 ppm/4H
ihl-mus LDLo:50 gm/m3/2H
ipr-mus LD50:2272 mg/kg
skn-rbt LD50:17800 mg/kg
ihl-gpg LCLo:10000 ppm

IRRITATION DATA: (Source: NIOSH RTECS 1988)

skn-rbt 15 mg/24H open MLD
eye-rbt 100 mg

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:
SELF-CONTAINED BREATHING APPARATUS; SAFETY GOGGLES.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability hazard.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (ETHYL BENZENE)
1000 ppm: Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection. / Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection.
2000 ppm: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any supplied-air respirator with a full facepiece. / Any self-contained breathing apparatus with a full facepiece.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID (NIOSH):
EYE:
PROMPTLY FLUSH WITH PLENTY OF WATER FOR 15 MIN. AND GET MEDICAL ATTENTION.
SKIN:
PROMPTLY FLUSH WITH PLENTY OF WATER AND GET MEDICAL ATTENTION. REMOVE AND WASH CONTAMINATED CLOTHING.
INHALATION:
IF ILL EFFECTS OCCUR, REMOVE VICTIM TO FRESH AIR, KEEP WARM & QUIET, & GET MEDICAL HELP PROMPTLY; IF BREATHING STOPS, GIVE ARTIFICIAL RESPIRATION.
INGESTION:
INDUCE VOMITING ONLY UPON PHYSICIAN'S APPROVAL; MATERIAL IN LUNG MAY CAUSE CHEMICAL PENUMONITIS.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: ETHYLBENZENE
DOT ID NUMBER: UN1175

IDENTIFIERS

CHEMTOX RECORD 1513 LAST UPDATE OF THIS RECORD: 09/01/90
NAME: KEROSENE
SYNONYMS: COAL OIL; KEROSINE; ILLUMINATING OIL; RANGE OIL; A FUEL OIL NO. 1; JET FUEL; JP-1
CAS: 8008-20-6 RTECS: OA5500000
FORMULA: CnH2n+2 MOL WT:
WLN:
CHEMICAL CLASS:

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: COLORLESS WATERY LIQUID WITH A FUEL OIL ODOR; PALE YELLOW OR WATER WHITE, MOBILE OILY LIQUID
BOILING POINT:
MELTING POINT: 227.55 K -45.6 C -50.1 F
FLASH POINT: 310.92 K 37.7 C 99.9 F
AUTO IGNITION: 502 K 228.8 C 443.9 F
VAPOR PRESSURE:
UEL: 5.0 %
LEL: 0.7 %
IONIZATION POTENTIAL (eV): 6.79
VAPOR DENSITY: 4.5 air=1
SPECIFIC GRAVITY: 0.80 15C
DENSITY: 0.80 g/mL
WATER SOLUBILITY: INSOLUBLE

INCOMPATIBILITIES:

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:OXIDIZING MATERIALS
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors
ODOR DETECTED AT (ppm): 1ppm
ODOR DESCRIPTION: CHARACTERISTIC; LIKE FUEL OIL; NOT ALTOGETHER DISAGREEABLE Source: HCDB
100 % ODOR DETECTION: No data

REGULATIONS

DOT HAZARD CLASS: Combustible liquid
DOT GUIDE: 27
DOT ID NUMBER: UN1223
DOT SHIPPING NAME: KEROSENE
STCC NUMBER: 4915171

CLEAN AIR ACT:
EPA WASTE NUMBER:
CERCLA REF:
RQ DESIGNATION: N Not listed
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Combustible liquid - Mailable as ORM-D
Mailability: Domestic service and air transportation shipper's declaration required
Max per parcel: 1 GAL

NFPA CODES:
HEALTH HAZARD (BLUE): (0) No unusual health hazard.
FLAMMABILITY (RED) : (2) This material must be moderately heated before ignition will occur.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

TOXICITY DATA

TARGET ORGANS:
SYMPTOMS: VAPOR CAUSES SLIGHT IRRITATION OF EYES AND NOSE. LIQUID IRRITATES STOMACH; IF TAKEN INTO LUNGS, CAUSES COUGHING, DISTRESS, & RAPIDLY DELELOPING PULMONARY EDEMA. INHALATION OF HIGH CONCENTRATIONS - HEADACHE, STUPOR. INGESTION - IRRITATION OF STOMACH AND INTESTINES WITH NAUSEA AND VOMITING. Source: SAX, MI10, CHRIS

CONC IDLH: Unknown ppm

NIOSH REL:
100 mg/M3 Time weighted averages for 8-hour exposure

ACGIH TLV: 200ppm
ACGIH STEL: 2500mg/m3 / 60MIN ppm

OSHA PEL: Transitional Limits:
PEL = 100ppm

CARCINOGEN?: N STATUS:

CARCINOGEN LISTS:
IARC: Listed by IARC, but not assigned an overall evaluation.
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

LD50 value: Not in RTECS 1988

Reproductive toxicity (1988 RTECS):
This chemical has no known mammalian reproductive toxicity.

PROTECTION AND FIRST AID

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

PROTECTIVE GLOVES; GOGGLES OR FACE SHEILD.

FIRST AID (NIOSH):
EYE:
WASH WITH PLENTY OF WATER.
SKIN:
WIPE OFF AND WASH WITH SOAP AND WATER.
INHALATION:

INGESTION:
DO NOT INDUCE VOMITING; CALL A DOCTOR.

INITIAL INCIDENT RESPONSE

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: KEROSENE
DOT ID NUMBER: UN1223

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
- Flammable/combustible material; may be ignited by heat, sparks or flames.
- Vapors may travel to a source of ignition and flash back.
- Container may explode in heat of fire.
- Vapor explosion hazard indoors, outdoors or in sewers.
- Runoff to sewer may create fire or explosion hazard.

*HEALTH HAZARDS
- May be poisonous if inhaled or absorbed through skin.
- Vapors may cause dizziness or suffocation.
- Contact may irritate or burn skin and eyes.
- Fire may produce irritating or poisonous gases.
- Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

- Keep unnecessary people away; isolate hazard area and deny entry.
- Stay upwind; keep out of low areas.
- Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
- Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
- CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE
- Small Fires: Dry chemical, CO_2, water spray or regular foam.
- Large Fires: Water spray, fog or regular foam.
- Move container from fire area if you can do it without risk.
- Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
- For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
- Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK
- Shut off ignition sources; no flares, smoking or flames in hazard area.
- Stop leak if you can do it without risk.
- Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
- Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
- Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID
- Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
- In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
- Remove and isolate contaminated clothing and shoes at the site.

IDENTIFIERS

CHEMTOX RECORD 247 LAST UPDATE OF THIS RECORD: 12/01/90
NAME: LEAD
SYNONYMS: C.I. PIGMENT METAL 4; C.I. 77575; KS-4; LEAD FLAKE; LEAD S2; OLOW (Polish); SI; SO
CAS: 7439-92-1 RTECS: OF7525000
FORMULA: Pb MOL WT: 207.19
WLN: PB
CHEMICAL CLASS:Metal

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: BLUISH-GREY, SOFT METAL; HEAVY DUCTILE, SOFT, GRAY SOLID
BOILING POINT: 2013 K 1739.8 C 3163.7 F
MELTING POINT: 600.6 K 327.4 C 621.4 F
FLASH POINT:
AUTO IGNITION: NA
VAPOR PRESSURE: 1mm @ 973 C
UEL: NA
LEL: NA
VAPOR DENSITY: No data
SPECIFIC GRAVITY: 11.34
DENSITY: 11.34 g/mL @ 20 C
WATER SOLUBILITY: INSOLUBLE; DISSOLVES SLOWLY IN WATER CONTAINING A WEAK ACID

INCOMPATIBILITIES: STRONG OX, HYDROGEN PEROXIDE, ACTIVE METALS, SODIUM, POTASSIUM, CHLORINE TRIFLUORIDE, HYDROGEN PEROXIDE, ZIRCONIUM, DISDIUM ACETYLIDE, OXIDANTS

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:RELATIVELY IMPENETRABLE TO RADIATION
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: WHEN HEATED EMITS HIGHLY TOXIC FUMES; CAN REACT VIGOROUSLY WITH OXIDIZING MATERIALS
ODOR DETECTED AT (ppm):
ODOR DESCRIPTION:
100 % ODOR DETECTION: No data

REGULATIONS

National Primary Ambient Air Quality Standards
1.5 ug/M3 maximum arithmetic mean averaged over a calendar year
National Secondary Ambient Air Quality Standards
same as primary standard

DOT HAZARD CLASS: No class given
DOT GUIDE: 53
DOT ID NUMBER: NA2291
DOT SHIPPING NAME: LEAD
STCC NUMBER:

CLEAN AIR ACT: N
EPA WASTE NUMBER: D008
CERCLA REF: Y
RQ DESIGNATION: X 1 pound (0.454 kg) CERCLA for pieces of solid metal with diameter less than 100 micrometers (0.004 inches).
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Chronic toxicity: carcinogen
Chronic toxicity: adverse effect to target organ after long period of exposure.

LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: ORM-B
Mailability: Domestic service and air transportation; shipper's declaration required
Max per parcel: 25 LBS; 5 LBS

NFPA CODES:
HEALTH HAZARD (BLUE): Unspecified
FLAMMABILITY (RED) : Unspecified
REACTIVITY (YELLOW): Unspecified
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS: GI,CNS,KIDNEYS,BLOOD,GINGIVAL TISSUE
SYMPTOMS: LASS, INSOM, PAL, EYE GROUNDS, ANOR, LOW-WT, MALNUT, CONSTI, ABDOM PAIN, COLIC; HYPOTENSE, ANEMIA, GINGIVAL LEAD LINE; TREM, PARA WRIST. METALLIC TASTE, INCREASED SALIVATION, PYORRHEA (FLOW OF MUCOUS). NEUROMUSCULAR: NUMBNESS AND TINGLING OF EXTREMITIES WITH SENSORY DISTRUBANCE, EXTENSOR WEAKNESS OF WRISTS AND ANKLES, LOSS OF MUSCLE TONE, TREMOR INCREASED DEEP-TENDON REFLEXES, MUSCULAR CRAMPS AND ACHING, MUSCULAR ATROPHY. CNS: VISUAL DISTURBANCES, HEADACHE, NERVOUSNESS OF DEPRESSION, INSOMNIA, MENTAL CONFUSION, DELIRIUM. Source: NIOSHP, THIC

CONC IDLH: NA ppm

NIOSH REL:
<0.1 mg/M3 Air level to be maintained so that worker blood level remains <0.06 mg/100 g of whole blood

ACGIH TLV: 0.15 mg/M3
ACGIH STEL: Not specified

OSHA PEL: Final Rule Limits:
TWA = See 29 CFR 1910.1025
50 ug/M3

CARCINOGEN?: Y-POSSIBLE STATUS: ANIMAL INDEFINITE

CARCINOGEN LISTS:
IARC: Carcinogen defined by IARC to be probably carcinogenic to humans, but having (usually) no human evidence.
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
orl-wmn TDLo:450 mg/kg/6Y JAMAAP 237,2627,77
PERIPHERAL NERVE AND SENSATION
Flaccid paralysis without anesthesia
BEHAVIORAL
Hallucinations, distorted perceptions
BEHAVIORAL
Muscle weakness

LD50 value: Not in RTECS 1988

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

ipr-rat LDLo:1000 mg/kg
orl-pgn LDLo:160 mg/kg

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE

Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.

*SPILL OR LEAK

Do not touch or walk through spilled material; stop leak if you can do it without risk.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Small Dry Spills: With clean shovel place material into clean, dry container and cover; move containers from spill area.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air; call emergency medical care.
In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.
Remove and isolate contaminated clothing and shoes at the site.

IDENTIFIERS

CHEMTOX RECORD 323 LAST UPDATE OF THIS RECORD: 12/01/90
NAME: POLYCHLORINATED BIPHENYL(S) (PCBS)
SYNONYMS: AROCLOR; AROCLOR 1221; AROCLOR 1232; AROCLOR 1242; AROCLOR 1248; AROCLOR 1254; AROCLOR 1260; AROCLOR 1262; AROCLOR 1268; AROCLOR 2565; AROCLOR 4465; BIPHENYL, POLYCHLORO-; CHLOPHEN; CHLOREXTOL; CHLORINATED BIPHENYL; CHLORINATED DIPHENYL; CHLORINATED DIPHENYLENE; CHLORO BIPHENYL; CHLORO 1,1-BIPHENYL; CLOPHEN; DYKANOL; FENCLOR; INERTEEN; KANECHLOR; KANECHLOR 300; KANECHLOR 400; KANECHLOR 500; MONTAR; NOFLAMOL; PCB; PCBs; PHENOCHLOR; PHENOCLOR; POLYCHLORINATED BIPHENYL; POLYCHLOROBIPHENYL; PYRALENE; PYRANOL; SANTOTHERM; SANTOTHERM FR; SOVOL; THERMINOL FR-1
CAS: 1336-36-3 RTECS: TQ1350000
FORMULA: MOL WT:
WLN:
CHEMICAL CLASS:Halogenated h-carbon

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: LIGHT YELLOW OILY LIQUID OR WHITE SOLID POWDER WITH A WEAK ODOR
BOILING POINT:
MELTING POINT:
FLASH POINT:
AUTO IGNITION: NA
VAPOR PRESSURE:
UEL: NA
LEL: NA
VAPOR DENSITY: No data
SPECIFIC GRAVITY: 1.3-1.8 20C
DENSITY:
WATER SOLUBILITY:

INCOMPATIBILITIES:

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: No data
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors
ODOR DETECTED AT (ppm):
ODOR DESCRIPTION: PRACTICALLY ODORLESS Source: CHRIS
100 % ODOR DETECTION: No data

REGULATIONS

DOT HAZARD CLASS: ORM-E
DOT GUIDE: 31
DOT ID NUMBER: UN2315
DOT SHIPPING NAME: POLYCHLORINATED BIPHENYL
STCC NUMBER: 4961666

CLEAN AIR ACT:
EPA WASTE NUMBER:
CERCLA REF:
RQ DESIGNATION: X 1 pound (0.454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Chronic toxicity: carcinogen
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:
HEALTH HAZARD (BLUE): Unspecified
FLAMMABILITY (RED) : Unspecified
REACTIVITY (YELLOW): Unspecified
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS: SKIN, LIVER
SYMPTOMS: CAUSES CHLORACNE (SMALL PIMPLES AND DARK PIGMENTATION AT FIRST, FOLLOWED BY COMEDONES AND PUSTULES), NAUSEA AND VOMITING, LOSS OF WEIGHT, JAUNDICE, EDEMA, ABDOMINAL PAIN. Source: CHRIS,SAX

CONC IDLH: Unknown ppm

NIOSH REL: Not given

ACGIH TLV: Not listed
ACGIH STEL: 2 ppm

OSHA PEL: Transitional Limits:
PEL = 1.0ppm

CARCINOGEN?: Y STATUS: HUMAN SUSPECTED

CARCINOGEN LISTS:
IARC: Carcinogen defined by IARC to be probably carcinogenic to humans with (usually) at least limited human evidence.
MAK: Not listed.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as reasonably anticipated to be carcinogenic, with limited evidence in humans or sufficient evidence in experimental animals.
ACGIH: Not listed.
OSHA: Not listed.

LD50 value: Not in RTECS 1988

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

orl-mus LD50:1900 mg/kg

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: POLYCHLORINATED BIPHENYL
DOT ID NUMBER: UN2315

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS: CNS, LIVER, KIDNEYS, SKIN, EYES
SYMPTOMS: FAINTING, WEAKNESS, CONF, EUPHORIA, DIZZINESS, HEADACHE; DIAL PUPILS, LACRIMATION, NER, MUSCLE FATIGUE, INSOMNIA, PARESTHESIAS, DERM, PHOTO, CNS, PSYCHOTROPIC EFFECTS. Source: NIOSHP

CONC IDLH: 2000ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
375 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN)
750 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: 100 ppm
ACGIH STEL: 150 ppm

OSHA PEL: Final Rule Limits:
TWA = 100 ppm (375 mg/M3)
STEL = 150 ppm(560 mg/M3)

CARCINOGEN?: N STATUS:

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-hmn TCLo:200 ppm JAMAAP 123,1106,43
BRAIN AND COVERINGS
Recordings from specific areas of CNS
BEHAVIORAL
Antipsychotic
BLOOD
Changes in bone marrow not included above

LD50 value: orl-rat LD50:5000 mg/kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

orl-rat LD50:5000 mg/kg
ihl-rat LCLo:4000 ppm/4H
ipr-rat LD50:1332 mg/kg
ivn-rat LD50:1960 mg/kg
unr-rat LD50:6900 mg/kg
ihl-mus LC50:5320 ppm/8H
ipr-mus LD50:640 mg/kg
scu-mus LD50:2250 mg/kg
unr-mus LD50:2000 mg/kg
skn-rbt LD50:12124 mg/kg
ivn-rbt LDLo:130 mg/kg
ihl-gpg LCLo:1600 ppm
scu-frg LDLo:920 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1988)

eye-hmn 300 ppm
skn-rbt 435 mg MLD
skn-rbt 500 mg MOD
skn-rbt 20 mg/24H MOD
eye-rbt 870 ug MLD
eye-rbt 2 mg/24H SEV
eye-rbt 100 mg/30S rinse MLD

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------
PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes wet.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability hazard.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (TOLUENE)
1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
2000 ppm: Any supplied-air respirator operated in a continuous flow mode. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece. / Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.:
Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID (NIOSH):
EYE:
IRR IMMED
SKIN:
SOAP WASH PROMPTLY
INHALATION:
ART RESP
INGESTION:
NO VOMIT

ERG90 GUIDE 31

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.
*HEALTH HAZARDS
Contact may cause burns to skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will privide limited protection.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Do not scatter spilled material with high-pressure water streams.
Dike fire-control water for later disposal.
*SPILL OR LEAK
Stop leak if you can do it without risk.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
Cover powder spill with plastic sheet or tarp to minimize spreading.
*FIRST AID
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

---------- IDENTIFIERS ----------

CHEMTOX RECORD 398 LAST UPDATE OF THIS RECORD: 09/01/90
NAME: TOLUENE
SYNONYMS: TOLUOL; PHENYL METHANE; METHYL BENZENE; BENZENE, METHYL-
CAS: 108-88-3 RTECS: XS5250000
FORMULA: C7H8 MOL WT: 92
WLN: 1R
CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: COLORLESS WATERY LIQUID WITH A PLEASANT ODOR
BOILING POINT: 383.6 K 110.4 C 230.8 F
MELTING POINT: 178.00 K -95.2 C -139.3 F
FLASH POINT: 277.6 K 4.4 C 40 F
AUTO IGNITION: 809 K 535.8 C 996.5 F
VAPOR PRESSURE: 36.7 mm @ 30 C
UEL: 7.1 %
LEL: 1.3 %
IONIZATION POTENTIAL (eV): 8.82
VAPOR DENSITY: 3.14 air=1
SPECIFIC GRAVITY: 0.867 @ 20 C
DENSITY: 0.867 g/cc or 8.0631 lb/gal
WATER SOLUBILITY: 0.05%

INCOMPATIBILITIES: STRONG OX

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: No data
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors
ODOR DETECTED AT (ppm): 0.17
ODOR DESCRIPTION: PUNGENT; AROMATIC, BENZENE-LIKE; DISTINCT, PLEASANT Source: CHRIS
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT HAZARD CLASS: Flammable liquid
DOT GUIDE: 27
DOT ID NUMBER: UN1294
DOT SHIPPING NAME: TOLUENE
STCC NUMBER: 4909305

CLEAN AIR ACT:
EPA WASTE NUMBER: U220
CERCLA REF:
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: TOLUENE
DOT ID NUMBER: UN1294

ERG90 GUIDE 27

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.
*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

IDENTIFIERS

CHEMTOX RECORD 3254 LAST UPDATE OF THIS RECORD: 09/01/90
NAME: m-XYLENE
SYNONYMS: m-DIMETHYLBENZENE; 1,3-XYLENE; 1,3-DIMETHYLBENZENE; m-XYLOL
CAS: 108-38-3 RTECS: ZE2275000
FORMULA: C8H10 MOL WT: 106.18
WLN: 1R C1
CHEMICAL CLASS:Aromatic amine

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: .8684g/mL @ 15 C
BOILING POINT: 411.15 K 138 C 280.4 F
MELTING POINT: 320.55 K 47.4 C 117.3 F
FLASH POINT: 300 K 26.8 C 80.3 F
AUTO IGNITION: 803 K 529.8 C 985.7 F
VAPOR PRESSURE: 10mm @ 28.3 C
UEL: 7.0 %
LEL: 1.1 %
VAPOR DENSITY: 3.66 air=1
SPECIFIC GRAVITY: .9
DENSITY: .9 g/cc or 8.37 lb/gal
WATER SOLUBILITY: INSOLUBLE

INCOMPATIBILITIES:

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:OXIDIZING MATERIALS. Source: SAX
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: ACRID SMOKE
ODOR DETECTED AT (ppm):
ODOR DESCRIPTION: LIKE BENZENE, CHARACTERISTIC AROMATIC
100 % ODOR DETECTION: No data

REGULATIONS

DOT HAZARD CLASS: Flammable liquid
DOT GUIDE: 27
DOT ID NUMBER: UN1307
DOT SHIPPING NAME: XYLENE
STCC NUMBER:

CLEAN AIR ACT:
EPA WASTE NUMBER: U239
CERCLA REF:
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS: EYES, NERVOUS SYSTEM, LINER, KIDNEY
SYMPTOMS: INFLAMMATION OF SKIN AND MUCOUS MEMBRANE; RESPIRATORY TRACT IRRITATION; HARD TO BREATH, LACK OF APPETITE, NAUSEA, VOMITING, FATIGUE, HEADACHE, DIZZINESS, INCOORDINATION, IRRITABILITY NARCOSES, ANEMIS; PARTIAL PARALYSIS PARESTHESIAS OF HANDS AND FEET Source: MI

CONC IDLH: Unknown ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
434 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN)
868 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: 100 ppm
ACGIH STEL: 150 ppm

OSHA PEL: Transitional Limits:
PEL = 100ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 150 ppm(655 mg/M3)

CARCINOGEN?: STATUS:

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
ihl-man TCLo:424 mg/m3/6H/6D TOLED5 1000(Sp lss 1),74,80
BEHAVIORAL
Changes in motor activity(specific assay)

LD50 value: orl-rat LD50:5 gm/kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

orl-rat LD50:5 gm/kg
ihl-rat LCLo:8000 ppm/4H
ihl-mus LCLo:2010 ppm/24H
ipr-mus LD50:1739 mg/kg
skn-rbt LD50:14100 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1988)

skn-rbt 10 ug/24H open SEV
skn-rbt 20 mg/24H MOD
eye-rbt 5 mg/24H SEV

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: XYLENE
DOT ID NUMBER: UN1307

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* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.

*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE
Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

IDENTIFIERS

CHEMTOX RECORD 3555 LAST UPDATE OF THIS RECORD: 09/01/90
NAME: P-XYLENE
SYNONYMS: 1,4-DIMETHYLBENZENE; p-DIMETHYLBENZENE; p-METHYLTOLUENE; p-XYLOL; 1,4-XYLENE
CAS: 106-42-3 RTECS: ZE2625000
FORMULA: C8H10 MOL WT: 106.18
WLN: 1R D1
CHEMICAL CLASS:Aromatic amine

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: COLORLESS LIQUID; MOBILE FLAMMABLE LIQUID; CLEAR PLATES OR PRISMS
BOILING POINT: 411.45 K 138.3 C 280.9 F
MELTING POINT: 286.45 K 13.3 C 55.9 F
FLASH POINT: 300 K 26.8 C 80.3 F
AUTO IGNITION: 797.85 K 524.7 C 976.4 F
VAPOR PRESSURE: 10mm @ 27.3 C
UEL: 7.0 %
LEL: 1.1 %
VAPOR DENSITY: 3.66 air=1
SPECIFIC GRAVITY: 0.8611 @ 20 C
DENSITY: 0.8611 g/mL @ 20 C
WATER SOLUBILITY: INSOLUBLE

INCOMPATIBILITIES: MAY REACT WITH OXIDIZING MATERIALS; ACETIC ACID AND AIR; NITRIC ACID 1,3-DICHLORO-5, 5-DIMETHYL-2, 4-IMID-AZOLIDINDIONE SAX

REACTIVITY WITH WATER: INSOLUBLE Source: SAX, MI
REACTIVITY WITH COMMON MATERIALS:SOLUBLE IN ALCOHOL, ETHER, ORGANIC SOLVENTS Source: SAX, MI
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: ACRID SMOKE AND FUMES SAX
ODOR DETECTED AT (ppm): 0.4 mg/m3
ODOR DESCRIPTION: Source: HED2
100 % ODOR DETECTION: No data

REGULATIONS

DOT HAZARD CLASS: Flammable liquid
DOT GUIDE: 27
DOT ID NUMBER: UN1307
DOT SHIPPING NAME: XYLENE
STCC NUMBER:

CLEAN AIR ACT:
EPA WASTE NUMBER: U239
CERCLA REF:
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS: CNS, EYES, GIT, BLOOD, LIVER, KIDNEYS, SKIN.
SYMPTOMS: HEADACHE, DIZZINESS, SKIN AND EYE IRRITATION; IN LUNGS, CAUSES SEVERE COUGHING DISTRESS AND PULMONARY EDEMA, WHEN INGESTED, SYMPTOMS ARE NAUSEA, VOMITING, CRAMPS, AND COMA; MAY CAUSE KIDNEY AND LIVER DAMAGE. MAY BE NARCOTIC IN HIGH CONCENTRATIONS. Source: CSDS, SAX, MI

CONC IDLH: 200ppm/10min

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
434 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN)
868 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: 100 ppm
ACGIH STEL: 150 ppm

OSHA PEL: Transitional Limits:
PEL = 100ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 150 ppm(655 mg/M3)

CARCINOGEN?: STATUS:

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

LD50 value: orl-rat LD50:5 gm/kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

orl-rat LD50:5 gm/kg
ihl-rat LC50:4550 ppm/4H
ipr-rat LD50:3810 mg/kg
ihl-mus LCLo:15 gm/m3
ipr-mus LD50:2110 mg/kg

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: XYLENE
DOT ID NUMBER: UN1307

ERG90 GUIDE 27

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.

*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.

*FIRE
Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.
Remove and isolate contaminated clothing and shoes at the site.

---------- IDENTIFIERS ----------

CHEMTOX RECORD 512 LAST UPDATE OF THIS RECORD: 09/01/90
NAME: o-XYLENE
SYNONYMS: o-DIMETHYLBENZENE; 1,2-DIMETHYLBENZENE; o-METHYLTOLUENE; 1,2-XYLENE; o-XYLOL; 1,2-DIMETHYLBENZENE,XYLOL; O-XYLENE
CAS: 95-47-6 RTECS: ZE2450000
FORMULA: C8H10 MOL WT: 106.18
WLN: 1R B1
CHEMICAL CLASS:Aromatic amine

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: COLORLESS WATERY LIQUID WITH A SWEET ODOR
BOILING POINT: 417.40 K 144.2 C 291.6 F
MELTING POINT: 247.8 K -25.4 C -13.7 F
FLASH POINT: 305 K 31.8 C 89.3 F
AUTO IGNITION: 738 K 464.8 C 868.7 F
VAPOR PRESSURE: 10mm @ 32.1 C
UEL: 6%
LEL: 1%
IONIZATION POTENTIAL (eV): 7.5
VAPOR DENSITY: No data
SPECIFIC GRAVITY: 0.880 20C
DENSITY: 0.880g/mL @ 20 C
WATER SOLUBILITY: VERY SL SOL

INCOMPATIBILITIES: STRONG OX

REACTIVITY WITH WATER: INSOLUBLE Source: SAX
REACTIVITY WITH COMMON MATERIALS:MISCIBLE IN ABSOLUTE ALCOHOL, ETHER Source: SAX
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: ACRID SMOKE AND FUMES
ODOR DETECTED AT (ppm): 0.05
ODOR DESCRIPTION: BENZENE-LIKE; CHARACTERISTIC AROMATIC Source: CHRIS
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT HAZARD CLASS: Flammable liquid
DOT GUIDE: 27
DOT ID NUMBER: UN1307
DOT SHIPPING NAME: XYLENE(XYLOL)
STCC NUMBER:

CLEAN AIR ACT: N
EPA WASTE NUMBER: U239
CERCLA REF: Y
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect. 313: Yes

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- TOXICITY DATA ----------

TARGET ORGANS: CNS,EYES,GI TRACT,BLOOD,LIVER,KIDNEYS,SKIN
SYMPTOMS: HEADACHE, DIZZINESS, SKIN AND EYE IRRITATION; IN LUNGS CAUSING SEVERE CAUGHING, DISTRESS AND PULMONARY EDEMA; WHEN INGESTED, SYMPTOMS ARE NAUSEA, VOMITING, CRAMPS, AND COMA; MAY CAUSE KIDNEY AND LIVER DAMAGE. MAY BE NARCOTIC IN HIGH CONCENTRATIONS. Source: CSDS; MI

CONC IDLH: 10000[22] ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
434 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN)
868 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: 100 ppm
ACGIH STEL: 150 ppm

OSHA PEL: Transitional Limits:
PEL = 100ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 150 ppm(655 mg/M3)

CARCINOGEN?: NO STATUS:

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed.
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed.
OSHA: Not listed.

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
* ihl-hmn LCLo:6125 ppm/12H YAKUD5 22,883,80

LD50 value: orl-rat LDLo:5 gm/kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1988)

orl-rat LDLo:5 gm/kg
ihl-rat LCLo:6125 ppm/12H
ihl-mus LCLo:30 gm/m3
ipr-mus LD50:1364 mg/kg

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

FIRST AID (NIOSH):
EYE:
REMOVE CONTACT LENSES. FLUSH EYES WITH WATER OR NORMAL SALINE SOLUTION FOR AT LEAST 20-30 MINUTES. SEEK MEDICAL ATTENTION AT ONCE.
SKIN:
FLOOD ALL AFFECTED AREAS OF THE BODY WITH WATER. REMOVE CONTAMINATED CLOTHING IMMEDIATELY UNDER WATER STREAM. USE SOAP. ISOLATE CONTAMINATED CLOTHING TO PREVENT CONTACT BY OTHERS.
INHALATION:
REMOVE VICTIM TO FRESH AIR IMMEDIATELY . PROPER RESPIRATORY PROTECTION MUST BE PROVIDED TO ANY RESCUER. IF COUGHING, DIFFICULTY WITH BREATHING OR OTHER SYMPTOMS DEVELOP. SEEK MEDICAL ATTENTION AT ONCE.
INGESTION:
IF NO CONVULSIONS, GIVE WATER OR MILK TO DILUTE SUBSTANCE. ASSURE THAT VICTIM'S AIRWAY IS UNOBSTRUCTED AND CONTACT PHYSICIAN IMMEDIATELY FOR ADVICE ON WHETHER OR NOT TO INDUCE VOMITING.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: XYLENE(XYLOL)
DOT ID NUMBER: UN1307

ERG90 GUIDE 27

* POTENTIAL HAZARDS *

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Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
Isolate for 1/2 mile in all direction if tank, rail car or tank truck is involved in fire.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.
*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.

In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.

Remove and isolate contaminated clothing and shoes at the site.

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APPENDIX 3
ENVIRONMENTAL HAZARDS

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INTRODUCTION/SPECIAL CONCERNS

Working in hot, humid sub-tropical conditions creates a great deal of heat stress on personnel that are not wearing chemical protective equipment. Additional layering of PPE creates a vapor barrier, entrapping body heat and (otherwise) evaporated sweat. All personnel should carefully monitor their own physical condition while working. Work levels can increase as each individual becomes acclimatized. Work/rest regimens should be established and adhered to. All physical and behavioral deviations from baseline must be reported to the Health and Safety Officer.

In addition, all personnel must take the responsibility to monitor their intake of alcoholic beverages during off-work hours. Quantities of alcohol in the bloodstream further inhibit the body's thermoregulatory mechanism; and increased level of stress results. Any personnel exhibiting characteristic symptoms has the potential to be removed from the job.

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Hazardous Flora

Incidence of contact by sensitized individuals to indigenous plants is a real threat. Bare skin should be covered as must as practical when working in densely forested areas. All rashes should be reported to the Health and Safety Officer.

While attempting to cut into dense underbrush, hazards exist from the obvious (sharp machete) to more subtle (contact with saps and resins).

Hazardous Fauna

All animal life must be treated with respect. Without proper training, personnel may not be able to differentiate between dangerous and non-dangerous varieties. Feral dogs and cats have been observed. There are no poisonous snakes indigenous to Puerto Rico.

Mongoose, rats, and mice have been documented to (potentially) carry rabies. There is some evidence that mongooses can be infected with the rabies virus in an attenuated form, allowing them to carry and spread the virus for considerable time before succumbing to the disease. Any observed unusual behavior by mongooses and other mammals must be reported. Signs of rabies can be characterized in two forms. Furious Rabies exhibits agitation and viciousness followed by paralysis and death. Dumb Rabies exhibits lethargy and paralytic symptoms followed by death. Behavioral indicators for both include fearlessness, and change in nocturnal/diurnal rhythms.

Working in wet or swampy areas unprotected shall not be allowed. Contact with surface water must be avoided. There have been several incidents of infection by schistosomes (blood flukes) from contact with surface water. The aquatic snail vector, Australorbis Glabratus, transmits the schistosomes into surface waters, predominantly drainage ditches. Event momentary contact with contaminated surface water is sufficient to acquire an infection. Accidental contact requires thorough washing with isopropyl alcohol. Symptoms of infestation are fever, diarrhea, itchy skin, and CNS damage. Schistosomiasis is hard to treat and once establish in its host, may remain for several years.

Mosquitoes and sand flies pose a nuisance and physical hazard to field personnel. As a nuisance, they distract workers, leading to accidents. Mosquitoes also pose a physical threat by injecting live microorganisms into their victim. Sand fly bites that are repeatedly scratched have caused several secondary infections. Repellants containing DEET, and Avon Skin So Soft, (a moisturizing lotion that also works as a mosquito repellant) for example, are

necessary. Perfumes and deodorants should be avoided. Light colored clothing is preferable, as mosquitoes are not attracted to lighter colors. There is potential to come in contact with other dangerous insects. These include centipedes, ants, chiggers, bees, wasps, hornets, mites, fleas, black widow spiders, and tarantulas. All personnel should perform "checks" on each other periodically and at the end of the work shift. All insect bites must be reported to the Health and Safety Officer.

Prior to final selection of personnel, each individual should be questioned about known sensitivities to any organism or agent.

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WORKING IN HOT CONDITIONS

Hot Conditions

Overexposure to heat from work stress, ambient temperature, and radiant heat can cause a variety of ill-effects on humans, ranging from cramps to fainting, to possible death. Employees need to assess the exposure and recognize the signs and symptoms of heat stress so they can take preventative measures. Drinking water, electrolyte fluids, protective clothing, and regular rest breaks in a cool area need to be available and used to prevent serious effects of overexposure. Heat stress can be serious. The major effects are described briefly in the next four paragraphs, and described in detail later in this section, including symptoms and treatment.

Heat cramps are muscle spasms, caused by depletion of salt from excessive sweating, without replacement of the lost salt. Under extreme exposures, salt loss may be as much as 6 to 8 teaspoonsful in 1 day.

Fainting, due to heat exposure, occurs when a person adapts by dilating blood vessels in the skin and superficial muscles in order to deliver warm blood to the surface of the body, where the excess energy can be delivered back to the environment. The expansion of the superficial blood vessels allows a greater-than-normal proportion of the circulating blood volume to be away from the central circulation (which supplies, among other organs, the brain). This lack of sufficient central pressure is worsened when a person is on his feet for a prolonged period of time, as gravity allows a significant blood volume to collect in the lower extremities. Combined with fatigue and mild dehydration, the diversion of blood leads to a fainting episode, as not enough blood (with oxygen and glucose) is pumped to the brain.

Heat exhaustion can result from excess loss of water and salt, and affected persons may collapse from dehydration or inadequate circulation. There is heavy sweating, little or not increase in body temperature, and a rapid pulse, up to 150 per minute.

Heat stroke is an extreme failure of the body thermoregulatory system, with hot, dry skin, flushed face, rapid breathing, pounding pulse, and high body temperature greater than 105°F. Continuous exposure to extreme heat for as little as 3 hours can produce heat stroke. Brain disorders may range from headache to delirium to unconsciousness. Rapid cooling is urgent to prevent death.

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Working at hazardous materials/waste sites can be heavy work, can generate considerable metabolic heat. Heat stress, as discussed in this section, is not likely to occur unless there is medium or heavy work.

Other factors that may magnify harmful effects of heat exposure are chemical exposures, altitude, inadequate acclimatization, fatigue, lack of sleep, consumption of alcohol, inadequate nutrition, cardiac and respiratory conditions, and taking certain medications. Toxic substances such as carbon monoxide have a synergistic effect, so that heat stress effects will occur at lower temperatures than expected if there are toxic exposures at the same time as heat exposures.

In order to assess the heat stress presented at sites by ambient conditions, it is recommended that a Wet Bulb Globe Temperature (WBGT) Thermometer or Botsball Thermometer be used to determine potential heat stress situations. If the WBGT is above 80°F, or the Botsball temperature is above 75°F, there is going to be sufficient heat stress to require monitoring of body temperatures and weight loss, and to take steps to reduce the effects of heat stress.

Some of the methods of reducing heat stress are rest periods in cool areas, providing block and tackle or hoisting, providing cooling fans or reflective clothing, or scheduling set-up work during a cooler period of the day. Methods of reducing heat transfer to working personnel include the following:

- Reduce solar load (if sampling is done outdoors)
  - Wear light-colored clothing and headcovering (e.g., hard hat)
  - Cover as much exposed skin as possible
  - Provide shade if possible

- Reduce conductive and radiant heat load from machinery and equipment
  - Provide insulating material on hot surfaces
  - Provide reflective surface to shield personnel

- Improve corrective heat load factors
  - Wear loose-fitting or limited clothing and promote evaporation if ambient temperatures are below 100°F (37.8°C)
  - Cover the body as much as possible if the ambient air temperatures are higher than 100°F (37.8°C)

At sites where the heat stress may be severe, it is advisable to equip teams with an oral medical thermometer. It may be necessary to kept the thermometer in the ice chest or other cool areas to keep the thermometer from reaching temperatures above 100°F.

If personnel begin to have symptoms or show signs of heat stress, the thermometer will be very useful in assessing the problem. Oral temperature information and the signs and symptoms will help identify the degree of heat stress before the problem becomes so severe that the affected person cannot be removed from the worksite. Recovery of a seriously affected person is directed related to the severity of the symptoms when removed from the heat stress and the availability and vigorousness of the first aid treatment. Recovery of a person showing signs of extreme heat stress may also depend on whether the affected person promptly receives the needed medical aid.

If the oral temperature exceeds 100°F as a result of heat stress, the exposed person should definitely be removed from further heat and work stress for at least 24 hours.

Core body temperatures are a more accurate measure of the effects of heat stress and are usually at least 1.0°F higher than oral temperatures. Definitive first aid and medical treatment will use rectal thermometers to measure core body temperatures. If a team is going to work at a site remote from medical assistance (infirmary, clinic, or hospital) it is necessary that one or more persons on the team be trained in first aid. (It is desirable for all personnel to have had first aid training.)

Preventative Measures

If an employee is not exposed to a hot environment on a daily basis, the employee will not become acclimated to the hot environment, and sweating will be more profuse and will contain a higher percentage of salts than is common with acclimated workers. Thirst cannot be relied upon to assure sufficient fluid intake.

In hot environments where heat stress may be severe, the following recommendations should be considered for the protection of personnel:

1. A minimum of 2 gallons of special fluid is recommended per person. The fluid can be iced drinking water, commercial electrolyte replenishment products, or special formulas.

2. Work/rest regiment should be adjusted in accordance with the temperature (see Table 1).

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TABLE 1
PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES

Work Rest Regimen	Work Load (°F WBGT) Light	Moderate	Heavy
Continuous Work	86	80.6	77
75% Work, 25% Rest (each hour)	87	82.4	78.6
50% Work, 50% Rest (each hour)	88.5	84.42	82.2
25% Work, 75% Rest (each hour)	89.9	97.9	86
Botsball Equivalent			
Continuous Work	80.4	75.8	73.2
75% Work, 25% Rest (each hour)	81.2	77.6	74.6
50% Work, 50% Rest (each hour)	82.3	79.6	77.5
25% Work, 75% Rest (each hour)	83.3	81.9	80.4

*For personnel working in impermeable clothing, 5 degrees should be subtracted from the above values to allow for the additional heat stress placed upon the body.

3. Breaks to an air-conditioned or cool area will reduce the heart rate and allow for a greater margin of safety in preventing heat stress conditions.

4. Weighing each exposed person before and after working in the hot environment is recommended; weight loss will indicate dehydration and the urgent need to drink more water or special fluids.

5. Employees should be trained in the recognition of the signs and symptoms of heat stress.

6. It is imperative that treatment begin immediately if symptoms and signs of severe heat stress are present.

7. Wear head covering and loose-fitting, absorbent clothing, preferably cotton, to assist evaporation.

8. If possible, schedule strenuous work and hot work in cooler part of the day.

TEMPERATURE EXTREMES

Heat Cramps

Heat Cramps are caused by working in a hot environment and not replacing the electrolytes being lost by sweating. Electrolyte replacement is as important as liquid replacement.

Symptoms

Spasms (cramps) of the skeletal muscles.

Treatment

1. Drink water and electrolyte solutions. With proper fluid and electrolyte replacement, salt tablets (which irritate the stomach lining) are unnecessary.

2. General motion, stretching, and massage of the affected muscles should relieve the cramps.

3. If symptoms are not relieved or if spasms are severe and multiple, transport to the nearest doctor for possible saline I.V.

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Fainting

A victim who has suffered a fainting episode in the heat should be examined for any head or neck injuries, as well as other possible breaks or cuts. Other causes of fainting must be considered (low blood sugar, abnormal heat rhythm, etc.). If the faint is due to the heat, the victim will reawaken shortly, as the horizontal position returns blood to the brain and solves the major problem. In general, body temperature is not elevated.

Symptoms

Warning signs of a fainting spell include dizziness, lightheadedness, nausea, weakness, sweating, blurred vision, or seeing flashing lights.

Treatment

1. At the onset of symptoms, immediately assume a horizontal position or sit and lower the head between the knees.

2. If fainting has occurred, the victim should be rested in a horizontal position for 15-30 minutes.

3. Drink water and electrolyte solution (1 or 2 pints).

Heat Exhaustion

Recovery is assured within 1 to 5 days if treated. If untreated, heat exhaustion will usually progress into heat stroke.

Symptoms

May appear during work or during rest periods.

1. Skin - clammy and moist, pale, muddy, or flushed.

2. Body core temperature 99.5 - 101°F, oral temperature can be below the normal 98.6°F.

3. Heart - the pulse may be weak with the blood pressure low, causing fainting, especially upon standing after sitting.

4. Brain - will be rational, but may have headache.

5. General Symptoms - extreme fatigue, weakness, giddiness, and nausea. Any one or all may be present.

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Treatment

1. Protect from sum and other heat sources.

2. Electrolyte solution to replenish both the salt and fluids lost from sweating, or

3. Cold water to drink and pour over face and head.

4. Evacuate to cool, preferably air-conditioned room.

5. Electrolytes and water must be replaced. Drink water or an electrolyte solution.

6. Transport to definitive medical care.

Heat Stroke (Sunstroke)

Serious medical emergency of major magnitude: Is uniformly fatal unless treated promptly and adequately (vigorously).

Symptoms

1. Skin is hot and dry, red, mottled, or cyanotic (gray to blue)..

2. Body core temperature 106°F and rising, oral temperatures of 105°F and rising.

3. Heart pounding and rapid.

4. The worker may become confused, delirious, unconscious, or comatose, either slowly or rapidly.

Treatment

IT IS ESSENTIAL THAT TREATMENT BEGIN IMMEDIATELY. RAPID COOLING OF THE BODY IS IMPERATIVE.

1. Saturate the worker's clothes with ice water. Do not protect the worker from any wind available. Shade from sun and any other heat source.

2. Evacuate to a safe area, or if evacuation is delayed, initiate additional treatment before reaching a safe area.

3. Immerse in chilled water and massage the body vigorously, or

4. If immersion is impossible, wrap the unclothed body in wet sheets and fan vigorously with cool, dry air.

5. If immersion or wrapping in sheets is not feasible, then soak the worker's clothing with ice water and fan vigorously (use an electric fan if available).

6. Monitor body temperature to prevent the oral temperature from dropping below 100°F. Continue to monitor body temperature to detect either a continued drop or rise.

7. Treat for shock if present by elevating feet, legs, lower torso, or by placing on a plank with the foot end of the plank or Stokes Stretcher elevated approximately 12-24 inches.

8. Transport to nearest hospital preferably by ambulance, van, or accompanied in back of pickup truck in Stokes Stretcher with feet elevated at least 6 inches.

Complications may include: kidney failure, liver failure, blood disorders, impairment of the muscles of the heart, and permanent brain damage. The complications are, in part, consequences of prolonged high body core temperature and, in part, the result of oxygen starvation of the tissues if shock is severe or prolonged.

Loss of consciousness accompanied by cyanotic (gray-blue) skin will appear to be shock, but if the body temperature is elevated, the symptoms are from the heat stroke. If the body temperature is elevated (105°F or above, orally), but sweating is occurring, the condition is probably the stage before heat stroke, and the person should be treated as vigorously as if he/she were suffering a heat stroke.

Wet Bulb Globe Temperature

The following equations are used for WBGT determination:

(indoors - no solar load) WBGT = 0.7 WB + 0.3 GT
(outdoors - solar load) WBGT = 0.7 WB + 0.2 GT + 0.1 DB

where:

WB = natural wet bulb temperature, used for assessing humidity
GT = globe temperature, used for assessing radiant heat load
DB = dry bulb temperature

Note that wind velocity does not have to be measured to calculate the WBGT.

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The WBGT index is widely used because of its simplicity, and has been adopted for use as the index for a threshold limit value (TLV) by the American Conference of Governmental Industrial Hygienists, as illustrated in Table 1.

The work-rest regiments in Table 1 may be altered if workers are well acclimated. Personnel should discontinue work performed in hot environments if their core body temperature exceed 100.4°F.

To monitor the worker, measure:

- Heart Rate. Count the radial pulse during a 30 second period immediately following the end of a work period.
  - If the heart rate exceeds 140 beats per minute at the end of a work period and 100 beats per minute at the end of a rest period, shorten the next work cycle by one-third or lengthen the rest period by one-third.
- Oral Temperature. Use a clinical thermometer (3 minutes under the tongue) or a similar device.
  - If oral temperature exceeds 99.6°F, shorten the next work cycle by one-third or lengthen the rest period by one-third.
  - **Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F.**
- Body Weight, if possible. Measure at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Do not allow more than a 1.5 percent body weight loss in a work day.

Body Weight	-1.5%	Body Weight	-1.5%
230	226.5	155	152.6
220	216.7	150	147.7
210	206.8	145	142.2
200	197.0	140	137.9
195	192.0	135	132.9
190	187.1	130	128.0
185	182.2	125	123.1
180	177.3	120	118.2
175	172.3	115	113.2
170	167.5	110	108.3
165	162.5	105	103.4
160	157.6	100	98.5

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include:

- Lack of physical fitness
- Lack of acclimatization
- Age
- Dehydration
- Obesity
- Alcohol and drug use
- Infection
- Sunburn
- Diarrhea
- Chronic disease
- Energy expenditure increases by about 1.2 percent for every kilogram of added weight. (A bulky suit can increase by two to four times the energy ordinarily needed to perform a task.)

Reproductive toxicity (1988 RTECS):
This chemical is a mammalian reproductive toxin.

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED:
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
At the end of each work shift.

** REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes contaminated.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (LEAD)
Not in excess of 0.5 mg/M3: Half-mask, air-purifying respirator equipped with high efficiency filters.
Not in excess of 2.5 mg/M3: Full facepiece air-purifying respirator equipped with high-efficiency filters.
Not in excess of 50 mg/M3: (1) Any powered, air-purifying respirator with high efficiency filters; or (2) Half-mask supplied-air respirator operated in positive-pressure mode.
Not in excess of 100 mg/M3: Supplied air respirator with full facepiece hood, or helmet or suit and operated in positive pressure mode.
Unknown concentration or Firefighting: Full facepiece, self-contained breathing apparatus operated in postive-pressure mode.

FIRST AID (NIOSH):
EYE:
IRR IMMED
SKIN:
SOAP FLUSH PROMPTLY
INHALATION:
ART RESP
INGESTION:
WATER, VOMIT

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: LEAD
DOT ID NUMBER: NA2291

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* POTENTIAL HAZARDS *

*HEALTH HAZARDS
Poisonous if swallowed.
Inhalation of dust poisonous.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.
*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.

Versar INC.

APPENDIX D

GEOLOGIC FORMATIONS AT NAVAL STATION ROOSEVELT ROADS

Versar INC.

GEOLOGIC FORMATIONS AT NAVAL STATION ROOSEVELT ROADS

BEACH DEPOSITS OF PEBBLES AND COBBLES (HOLOCENE)

- Moderately sorted, generally well-rounded local pebble and cobble deposits. Composed mainly of volcanic rock fragments from lavas and dikes, coral fragments, and calcareous sand. Gradational into sandy beach deposits. Thickness ranges from two to four meters or more.

LAGOON DEPOSITS (HOLOCENE)

- Mud and calcareous sand deposits periodically inundated by very shallow marine waters. Gradational into swamp deposits. Found on western side of Ensenada Honda. Thickness uncertain.

SWAMP DEPOSITS (HOLOCENE)

- Black to dark brown organic-rich soil and muck in poorly drained part of alluvial plains. In large part covered with mangroves. Thickness probably as much as five meters locally.

BEACH DEPOSITS (HOLOCENE AND PLEISTOCENE)

- Unconsolidated fine-to coarse-grained sand and pebble deposits. South of Ensenada Honda these desposits are composed of quartz and feldspar grains and plutonic and volcanic rock fragments, with considerable amounts of shell, algal, and coral fragments locally. From Ensenada Honda northward, quartz grains are rare and plutonic rock fragments uncommon; deposits are principally of calcium carbonate grains with local admixtures of volcanic rock fragments and pebble clasts. Gradational into, and partly overlain by, alluvial and swamp deposits. Thickness is probably more than 20 meters locally.

ALLUVIUM AND FANGLOMERATE (HOLOCENE AND PLEISTOCENE)

- Unconsolidated to poorly consolidated, poorly to well-sorted, clay to boulder-sized material in fans and in stratified alluvial valley fill deposits. Locally terraced; includes slope wash, small landslides, and channel fill deposits. Gradational into units mapped as predominantly alluvium, alluvial plain, and terraced deposits. Thickness locally more than 25 meters.

QUARTZ DIORITE AND GRAND DIORITE (TERTIARY AND UPPER CRETACEOUS)

- Light gray to light olive gray stocks of medium- to fine-grained unfoliated rock with hypodiomorphic-granular texture. Composition ranges from quartz diorite

to grandodiorite. Hornblende is the predominant mafic mineral; only minor amounts of biotite are present. Rounded metavolcanic xenoliths are locally present. A sample from the stock at the head of the Rio Daguao exhibits a peculiar fine-grained allotrimorphic-granular quarts and feldspar groundmass for the otherwise normally developed medium-grained minerals in the quartz diorite.

QUARTZ KEROTOPHYRE (TERTIARY AND UPPER CRETACEOUS)

- Stocks of medium-dark-gray to medium-bluish-gray porphyritic rock with an aphanitic matrix in north-central part of mapped area. Contains oliogoclasse and bipyramidal quartz phenocrysts. Weathers to grayish yellow, dusky yellow, and light brown. The quartz phenocrysts and the light colors are distinctive, interior parts of the intrusive are massive in aspect, although the rock is commonly much jointed and locally shattered. Borders of the intrusive are often irregular, with numerous apophyses and dikes extending into the county rock. Groundmass is an intricate intergrowth of quartz albite and oligoclase. X-ray diffraction indicates that somewhat more than 10% of the rock is potassium feldspar, but this could not be confirmed optically. Phenocrysts of plagioiclase are albite and aligoclase in crystals about one to four millimeters in length. The three-millimeter-long quartz phenocrysts appear to be resorbed and rounded, although a bipyramidal shape is plainly evident in many of them. Epidote is common as patches and stringers throughout the rock.

FIGUERA LAVA (LOWER CRETACEOUS)

- Andesitic lava sequence with intercalations of volcaniclastic breccia and tuft. Exposures generally confined to artificial cuts; most slopes show only float of lava fragments in soil. Medium-dark-gray to dark-gray, reddish-brown weathering lavas are generally fine-grained, medium-bedded to massive, and locally autobrecciated. The lava contains small, scattered andesine phenocrysts and sparese pyroxene pheoncrysts. Quart is fairly common in inlets, stringers, and blebs ranging from three to nine centimeters in length. The original composition of the groundmass appears to have been largely andesine and clinopyroxene with minor magnetite, but in most places the groundmass is altered to epidote, chlorite, tremolite-actinolite, quartz, and clay. Local amygdaloidal lavas have quartz, epidote, and calcite as vesice fillings. Some lenticular zones of pillow lava are scattered through the section; the pillows range from one to two meters in diameter, and generally a light-colored, aphanitic, silicified material occupies the interstices between the pillows. One thin, light gray tuft bed crossed by Highway 975 along the ridge crest west of Ceiba appears in thin section to contain devitrified pumice fragments and glass shards in a brown cryptocrystalline groundmass containing scattered broken plagioclase and pyroxene crystals. A planar texture is readily discernible in the rock, and it is interpreted as a nonwelded andesitic ash flow tuft, relatively rich in crystal fragments. Volcaniclastic rocks occur in units a few meters thick as interbeds within the main lava sequence. These rocks include some graded tufts

in layers two to eight centimeters thick, but are mainly medium- to thick-bedded coarse tuft to lapilli tuft and tuft breccia. Clasts include some cherty-looking material that may be a silicified tuft as well as minor pumaceous fragments, but are generally fine-grained lava and amygdaloidal lava, like that of the main part of the figuera. An especially thick massive breccia underlying pillow lavas can be found along route 972 on the ridge in the northwest part of the Naquabo quadrangle. The breccia is made up of angular to rounded pebble-sized clasts of pumice, amygdaloidal fine-grained lavas, and locally, silicified tuft in calcareous clinopyroxene-bearing tuft matrix. As much as 2,000 meters of Figuera Lava may be exposed in the area.

MIXED ZONE (LOWER CRETACEOUS)

- Interstratified Figuera Lava and Daguao Formation.

DAQUAO FORMATION (LOWER CRETACEOUS)

- Interbedded volcanic breccia, lava, and subordinate volcanic sandstone and crystal tuft. The volcanic breccia is medium gray, massive, and is composed of clasts of dark-gray irregularly shaped subangular to subrounded granule-to cobble-size porphyritic andesite lava in a medium gray coarse-grained plagioclase and clinopyroxene crystal tuft matrix. The breccia units are commonly cut by fine-grained and prophyritic lava dikes. Breccia beds are generally exposed only in artificial excavations, and float on natural slopes consists largely of lava clasts. Lavas are principally medium-dark gray andesites with a pilo-taxitic texture and andesine and clinopyroxene phenocrysts; they are locally amygdaloidal. Some of these lavas are flow breccias, with porphyritic andesite clasts commonly more than five centimeters in diameter, either welded together or in a matrix of speared andesite. Some dark-greenish-gray, very fine-grained flows are also autobrecciated. Typical massive tuft breccia can be seen in housing excavations just northwest of Daquao; good breccia and lava exposures can be found along the coast southeast of Hucares. Coarse autoclastic lavas may be found throughout the section in the ridge directly west of Ensenada Honda and Langley Drive, on the Roosevelt Roads Naval Reservation. Dark- to medium-gray volcanic sandstones and tufts are usually laminated to thin-bedded and graded, and are locally crossbedded. A few crystals tufts are hornblende-rich; most sand stones and tufts are composed of plagioclase and clinopyroxene grains like the matrix of the massive volcanic breccias, and calcareous are fairly common. The sandstones and tufts generally form units only a few meters thick in the western part of the mapped area. Notably thicker sequences in the east are shown by diagonal lines. Thick sequences of thin-bedded to laminated tuft are well exposed along the coast from Punta Algodones to Punta Cascajo, on the roosevelt roads Naval Reservation. Rocks of the Daguao Formation are commonly epidotized and chloritized in varying degrees. Volcaniclastic hornfels occurs in a few places near the diorite and granodiorite stocks, and small exposures of phyllitic to schistone rocks (s) occur in one area

north of Daquao, south of the keratophyre stocks. The formation interfingers with the overlying Figuera Lava in a few places; its base is not exposed. The thickness of the Daguao is estimated to be on the order of 1,000 to 1,500 meters.

DAGUAO INTRUSIVE BRECCIA (LOWER CRETACEOUS)

- Hypabyssal intrusive rock medium-dark-gray brecciated andesite. Contains subangular clasts of dark-gray andesite with large plagioclase and clinopyroxene phenocrysts in a brecciated matrix of the same composition. The clasts seem to be lithologically identical to andesite clasts in the tuft breccias and autoclastic lavas of the Daguao Formation. The clasts of the two intrusive bodies in the Naguabo quadrangle east of Daguao range from three to 15 centimeters in length; on Isla Pineros in the Punta Puerca quadrange blocks as large as 90 centimeters in length are found in an intrusive body making up a small hill on the northwest corner of the island. The intrusive rocks are locally much epidotized and silicified; the epidote and quartz occur in veins and in irregular patches. In a quarry in the intrusive body that is south of the Roosevelt Roads airfield some podshaped zones several meters long have been largely replaced by epidote and quartz, yet the original texture of the porphyritic andesite breccia is discernible. An exposure of massive andesite lava about 100 meters wide and 200 meters long on the crest of the ridge to the northwest of Naquabo may also be an intrusive body. The lave is lithogically similar to the other intrusive breccias; although it is only partly brecciated, it does show some near vertical banding (flow lines).