FINAL

■■■■■■ REMEDIAL INVESTIGATION

WORK PLAN

STRATFORD ARMY ENGINE PLANT

STRATFORD, CONNECTICUT

U. S. Army Aviation Systems Command

Prepared for

US Army Corps of Engineers
Omaha District

U. S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska
January 1992

Woodward-Clyde

One Old Mill Building
101 South 108th Avenue
Omaha, NE 68154

WCC Project No. 89C114CC

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201 Willowbrook Boulevard
P O Box 290
Wayne, NJ 07470
201 785-0700
212 926-2878
Fax 201-785-0023

Woodward-Clyde Consultants

January 31, 1992
89C114CC-1

U.S. Department of the Army
Corps of Engineers Omaha District
CEMRO-ED-EA (Mr. John Barrett)
215 North 17th Street
Omaha, Nebraska 68102-4978

RE: Final - Remedial Investigation Work Plan
Stratford Army Engine Plant

Dear Mr. Barrett:

Attached to this letter, please find five copies of the final Remedial Investigation Work Plan for the Stratford Army Engine Plant (SAEP) in Stratford, Connecticut. Copies of this report have also been sent by Federal Express to those recipients listed below. This plan has been completed under Woodward-Clyde Consultants' Indefinite Delivery Contract No. DACW45-90-D-0008.

We appreciate the opportunity to provide services for this project. If you have any questions regarding this plan, please call.

Very truly yours,

Marion Craig

Marion Craig, P.G.
Project Manager

MC:cd

cc:
R. Matteuzzi/AVSCOM, AMSAV-EMC(1)
H. Moglia/AVSCOM, SAVAI-F(1)
D. Persett/DRPO, TLS-RTAC(1)
J. Sherman/TLS, Business Strategies(6)
A. McDermott/AMC ISA, AMXEN-C(1)
B. Byrnes/HQAMC, AMCCE-PB(2)
P. Szymanski/TACOM, AMSTA-XEM(1)
L. Lypeckyj/TACOM, AMCPM-GMC-CP(1)
Williams/USACE, CEMRD-EP-C(8)
J. Willis/TACOM, AMSTA-ICC(1)
D. McKie/USEPA, HEE-CAN6(1)
M.Powers/CDEP, SRCD(1)

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Consulting Engineers, Geologists
and Environmental Scientists
Offices in Other Principal Cities

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

ADC	Average Daily Concentrations
AVSCOM	U.S. Army Aviation Systems Command
CDAP	Chemical Data Acquisition Plan
CDEP	Connecticut Department of Environmental Protection
CPDWC	Connecticut Public Drinking Water Code
CWTP	chemical waste treatment plant
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
MCL	Maximum Contaminant Level
nd	not detected
NPDES	National Pollution Discharge Elimination System
OATP	Oil Abatement Treatment Plant
PAS	Preliminary Assessment Screening
PCB	polychlorinated biphenyl
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SAEP	Stratford Army Engine Plant
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
semi-VO	semi-volatile organic compound
SSHP	Site Safety and Health Plan
TLS	Textron Lycoming, Stratford Operations
TOC	total organic carbon
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of the Army
USGS	United States Geological Survey
VO	volatile organic compound
WCC	Woodward-Clyde Consultants

1.0
INTRODUCTION

1.1 AUTHORITY

The Stratford Army Engine Plant (SAEP) is a government-owned, contractor-operated facility located in Stratford, Connecticut. The U.S. Department of the Army (USDA) owns the land, the buildings, and some of the production equipment at SAEP. The U.S. Army Aviation Systems Command (AVSCOM) has responsibility for the jurisdiction, control, and accountability of SAEP. Textron Lycoming, an operating division of Textron Corporation, operates SAEP under a facilities contract with AVSCOM. Textron Lycoming (Textron) manufactures and tests turbine engines at SAEP, primarily for the Department of the Army. Textron also produces turbine engines for the U.S. Navy, for foreign military sale, and for commercial use.

The USDA has adopted the position that it may sell a government-owned facility on the basis that it is "excess to ownership". A facility may be considered excess to ownership if it is not necessary for the government to own the facility, although the production capacity of the facility may be required. USDA is currently considering the lease or sale of government-owned property at SAEP to Textron. U.S. Army Regulation 200-1 (AR 200-1) requires that a Preliminary Assessment Screening (PAS) be completed for any real property for which a transaction is being proposed. In March, 1991 the U.S. Army Corps of Engineers (USACE), on behalf of AVSCOM, contracted Woodward-Clyde Consultants (WCC) to complete a PAS for SAEP. Based on the results of the PAS it has been recommended to complete a Remedial Investigation as described in Chapter 9 of AR 200-1 Environmental Protection and Enhancement.

USACE has been tasked by AVSCOM to prepare a Remedial Investigation Work Plan for SAEP. The USACE has contracted the preparation of this plan to WCC under Indefinite Delivery Contract No. DACW45-90-D-0008.

1.2 WORK PLAN ORGANIZATION

Section 1.0 of this Work Plan provides background information on the circumstances and regulations which have precipitated the upcoming investigation. Sections 2.0 and 3.0 provide background information on the site and conceptual models which form the basis of the rationale used to develop the Work Plan. Both of these sections are largely derived from the PAS, and more details can be found in that document. Section 4.0 describes the rationale that was used to develop the sampling and analysis scheme. Section 5.0 broadly outlines each of the tasks to be completed under the Remedial Investigation. Section 6.0 contains an estimated schedule of the time needed to complete the remedial investigation tasks. Section 7.0 provides references cited in the Work Plan. Appendix A is the Sampling and Analysis Plan (SAP). The SAP is comprised of a Field Sampling Plan (FSP) and Chemical Data Acquisition Plan (CDAP). The FSP contains specific details on how and where samples will be collected, for what parameters they will be analyzed, and how and where field testing and monitoring will be done. The CDAP describes the procedures to be used to assure that high quality, defensible data are acquired. Appendix B contains a site specific Site Safety and Health Plan which establishes guidelines and requirements for the safety of personnel performing field activities during this investigation. Appendix C contains a Community Relations Plan which outlines a program to inform the community regarding the remedial investigation activities. Appendix D lists comments regarding the Draft Work Plan and actions taken in response to the comments.

2.0
SITE BACKGROUND AND PHYSICAL SETTING

2.1 SITE DESCRIPTION

SAEP is an industrial facility which is mostly paved or covered by buildings. Surrounding land uses are mainly light industrial, commercial, and residential.

2.1.1 SITE LOCATION

SAEP is located in Stratford, Connecticut, on the Stratford Point peninsula in the southeast corner of Fairfield County. The plant lies on the borders of the Bridgeport and Milford United States Geological Survey (USGS) Quadrangles (Figure 2-1). Latitudinal and longitudinal coordinates of SAEP are approximately 41°10' North and 73°07' West. The property consists of about 126 acres including about 49 acres of riparian rights along the Housatonic River. Existing property features are shown in Figure 2-2.

2.1.2 SITE OWNERSHIP AND OPERATIONS HISTORY

The SAEP property was used for agriculture until 1929 when the first manufacturing facility was built on about 26 acres. The property has been used for development, manufacture, and assembly of aircraft or engines since 1929, and the plant history has been categorized into the following periods:

- 1929 to 1939: Sikorsky Aero Engineering Corporation developed and manufactured sea planes at the Stratford plant from 1929 to 1939.

- 1939 to 1948: Chance Vought Aircraft located its operations at the Stratford plant in 1939, and the company became known as the Vought-Sikorsky Aircraft Division. Sikorsky developed the first helicopter, but left the plant in 1943 because of overcrowding. Chance Vought developed the

"Corsair" for U.S. Navy, and mass produced Corsairs during World War II. Chance Vought vacated the Stratford plant in 1948.

- 1948 to 1951: The Stratford plant was idle.

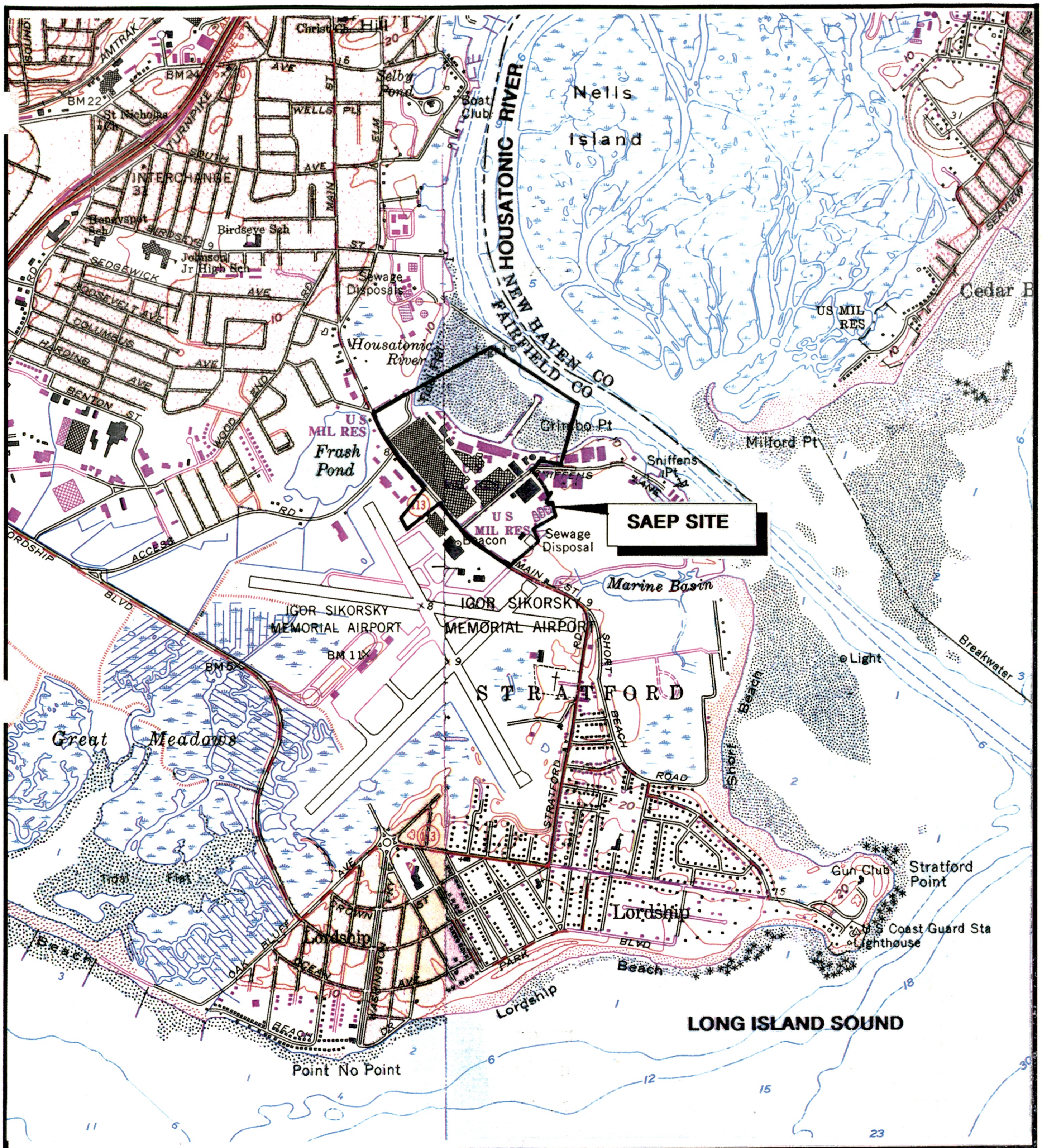
- 1951 to 1976: The U.S. Air Force procured the plant in 1951 and named it Air Force Plant No. 43. The Bridgeport Lycoming Division of the Avco Corporation was contracted by the Air Force to operate the plant. Avco developed and manufactured radial engines in the 1950s, and turbine engines in the 1960s and 1970s.

- 1976 to Present: The plant was transferred from the U.S. Air Force to the Army in 1976; at that time the plant was renamed the Stratford Army Engine Plant (SAEP). Avco was contracted by the Army to develop the AGT-1500 engine to power the Abrams tank. Avco also developed and manufactured marine and industrial engines. Avco Lycoming merged with Textron in December 1985 and formed Textron Lycoming (Textron). Today, turbine engines for military and commercial aircraft as well as land vehicles, continue to be developed, manufactured, and tested at SAEP. Figure 2-2 shows the layout of the site, including building locations.

2.1.3 Physical Setting

2.1.3.1 Topography

The SAEP facility is located on the Stratford Point Peninsula, which is at the mouth of the Housatonic River and extends into Long Island Sound. The topography of the peninsula is relatively flat with a gentle slope towards the south. The ground elevations in the site area do not exceed 10 feet above mean sea level. A dike, approximately ten feet high, was constructed along the edge of the Housatonic River at the eastern edge of the site for flood protection.



MAP SOURCE:
FROM BRIDGEPORT & MILFORD, CT. USGS QUADRANGLE MAP, 1970 & 1960, PHOTOREVISED 1984.

0 1000 2000 FT

SCALE

N

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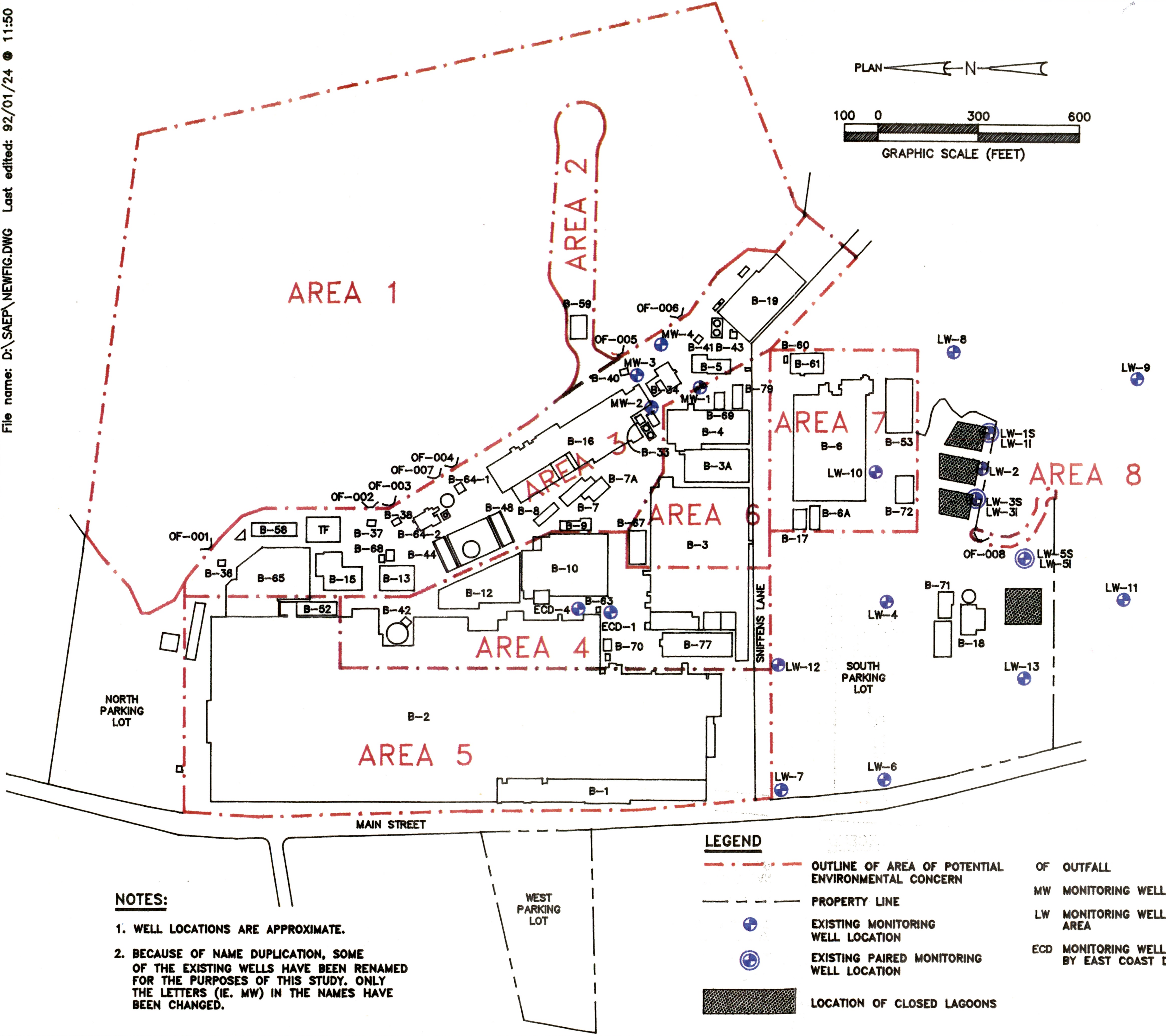
VICINITY MAP
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DR. BY: FWD	DATE: JAN 1992	PROJ. NO:	FIGURE NO.:
CK'D BY: MEC	DATE: JAN 1992	89C114CC	2-1

File name: D:\SAEP\NEWFIG.DWG Last edited: 92/01/24 @ 11:50



BUILDING NUMBER	BUILDING NAME
B-1	MAIN ADMINISTRATIVE & GOVERNMENT OFFICES
B-2	MANUFACTURING OPERATIONS
B-3	RESEARCH & DEVELOPMENT ENGINEERING
B-3A	ENGINEERING LABORATORIES
B-4	STORES AND AGT-1500 REPAIR
B-5	FUEL SYSTEM TEST
B-6	ENGINE ENVIRONMENTAL & COMPONENT TEST
B-6A	ENGINE MECHANICAL COMPONENT TEST
B-7	ENGINE FUEL SYSTEM TEST
B-7A	ENGINE FUEL SYSTEM TEST
B-8	VOLATILE STORAGE
B-9	AUTOMOTIVE MAINTENANCE
B-10	RECUPERATOR MANUFACTURE
B-12	MAINTENANCE DEPARTMENT
B-13	SCRAP & MATERIAL RECLAMATION
B-15	LUBRICATION STORAGE & FIRE HOUSE
B-16	PRODUCTION & DEVELOPMENTAL TEST CELLS
B-17	ENGINEERING TEST FACILITY
B-18	CHEMICAL WASTE TREATMENT PLANT (CWTP)
B-19	COMPONENT TEST FACILITY
B-33	COOLING TOWER PUMP STATION
B-34	FUEL PUMPING STATION
B-36	STORM DRAIN PUMPING STATION (OF-001)
B-37	STORM DRAIN PUMPING STATION (OF-002)
B-38	STORM DRAIN PUMPING STATION (OF-003)
B-40	STORM DRAIN PUMPING STATION (OF-004)
B-41	STORM DRAIN PUMPING STATION (OF-005)
B-42	SPRINKLER BOOST PUMP STATION (400K GAL.)
B-43	FUEL PUMPING STATION
B-44	STORES & CARPENTER SHOP
B-48	ENGINE CONTAINER REBUILD
B-52	STORES & ADJUNCT TO B-2
B-53	SURPLUS EQUIPMENT STORAGE
B-58	QUALITY & TESTING FACILITY
B-59	ENGINEERING STORAGE
B-60	HI-PRESSURE NATURAL GAS PUMPING STATION
B-61	REFRIGERATION PLANT
B-63	CWTP PUMPING STATION
B-64-1	OIL ABATEMENT PLANT PUMP HOUSE
B-64-2	OIL ABATEMENT TREATMENT PLANT (OATP)
B-65	STORAGE FACILITY
B-67	GENERAL STORES
B-68	EMERGENCY GENERATOR
B-69	USACE RESIDENT ENGINEER
B-70	CYANIDE DESTRUCTION FACILITY (CDF)
B-71	CWTP SOLIDS HANDLING
B-72	FUEL PUMPING STATION
B-77	OFFICE
B-79	SSE BUILDING

LEGEND

‒ · ‒	OUTLINE OF AREA OF POTENTIAL ENVIRONMENTAL CONCERN
— — —	PROPERTY LINE
●	EXISTING MONITORING WELL LOCATION
◉	EXISTING PAIRED MONITORING WELL LOCATION
▨	LOCATION OF CLOSED LAGOONS
OF	OUTFALL
MW	MONITORING WELL
LW	MONITORING WELL IN LAGOON AREA
ECD	MONITORING WELL INSTALLED BY EAST COAST DRILLING

NOTES:

1. WELL LOCATIONS ARE APPROXIMATE.
2. BECAUSE OF NAME DUPLICATION, SOME OF THE EXISTING WELLS HAVE BEEN RENAMED FOR THE PURPOSES OF THIS STUDY. ONLY THE LETTERS (IE. MW) IN THE NAMES HAVE BEEN CHANGED.

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BUILDINGS, EXISTING MONITORING WELLS, AND
AREAS OF POTENTIAL ENVIRONMENTAL CONCERN
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY MG/EAB	DATE 10/16/91	PROJECT NO. 89C114CC	FIG. NO. 2-2
CHK'D BY MEC	DATE 10/16/91		

2.1.3.2 Surface Hydrology

Several surface water bodies are in the site vicinity: Long Island Sound, the Housatonic River, Frash Pond, Marine Basin and an associated drainage ditch, and scattered wetland areas (Figure 2-1). Each of these surface water bodies is described more fully in this section.

Long Island Sound is less than a mile south of the site. Water level differences between high tide and low tide are typically about seven feet. Because of the numerous fresh water rivers that empty into the sound, the salinity of Long Island Sound water ranges from about 2.4 to 2.8 percent, which is less than the 3.5 to 3.7 percent salinity of oceanic water (Thomson, et al., 1978).

The Housatonic River is the dominant drainage system in the area. The river is east of the site, flowing southward into Long Island Sound. In the vicinity of the site, the river is an estuary, with low and high tides that range from about 0.0 feet to 7.0 feet above mean sea level (National Oceanic and Atmospheric Administration, 1991). The salinity of the river decreases rapidly upstream, but in the site area the salinity ranges from about 1.7 to 2.2 percent (Connecticut Department of Environmental Protection, 1990).

Frash Pond, located just northwest of the site, drains southward via a ditch into the Great Meadow Marsh. Tidal gates were constructed in the ditch to keep the flow unidirectional into the marsh. The gates, however, are reportedly leaking considerable amounts of brackish water back into the pond during high tide (Stratford, Connecticut, 1982). Consequently, the pond is subject to substantial tidal activity and is, therefore, classified as brackish (transitional between fresh water and sea water).

Marine Basin a nearly enclosed water body connected to the Housatonic River, and is located about 1,000 feet southeast of the site. A drainage system extends from the north into the basin, and one drainage ditch abuts the southeastern edge of the site. Marine Basin and associated drainage ditch are subject to tidal activity.

Wetland areas are mainly associated with the Housatonic River in the form of tidal marshes and intertidal flats, although a brackish to freshwater wetland area is found around Frash Pond. Intertidal flats, devoid of vegetation, occur along the shoreline of the Housatonic River and the coast of Long Island Sound, while tidal marshes (Great Meadow Salt Marsh) occur south of Sikorsky Airport. The riparian rights area of the site, estimated to cover about 51 acres, is intertidal flats.

2.1.3.3 Regional Geology

SAEP is located in a geological province known as the Connecticut Valley Synclinorium that consists primarily of early and middle Paleozoic age (about 300-500 million years ago) metamorphic and volcanic rocks (Rogers, 1985). Rock exposures do not occur in the site vicinity, but it is inferred that schists and granofelses of the Ordovician (500 million years ago) Oronoque Schist Formation underlie the area (Fritts, 1965). On the basis of geologic correlations with surrounding areas, bedrock is estimated to occur about 100 to 150 feet below grade.

Pleistocene glaciation, ending about 10,000 years ago, affected the southern Connecticut area. Glaciers advanced southward as far as Long Island, scoured the underlying bedrock, and left till and stratified sand and gravel deposits of variable thickness as they retreated. As the glaciers receded further, meltwater from the ice was locally impounded, creating a freshwater lake in what is today Long Island Sound. Glacial streams entering the lake left deltaic sand deposits along coastal Connecticut, including the site vicinity (Stone et al., 1985). Locally, the deltaic sand deposits are referred to as the Stratford Outwash sediments (Flint, 1968).

Currently, the glacial deposits are being dissected and locally affected by recent erosional and depositional processes. The Housatonic River has eroded much of the glacial sands from its channel while depositing recent alluvium and estuarine and tidal flat sediments. Marsh and beach sediments are also being locally deposited over the glacial sediments.

2.1.3.4 Site Geology

Based on the subsurface data collected during previous investigations (ESE, 1991; Haley and Aldrich, 1987; Metcalf and Eddy, 1987; and Zecco, Inc., 1990), at least four distinct stratigraphic units can be identified at the site. These units, from shallow to deep, are artificial fill, peat and silt alluvium, estuarine silt, and glacial deposits. The glacial deposits can be divided into three sediment groups: relatively well-sorted (same grain size) sands, gravelly sands, and occasionally-varved silts. Two geologic cross-sections of the site are shown in Figures 2-3 and 2-4. The stratigraphic units are described below.

Fill

Fill material is found throughout the site. Fill was used for road construction, site grading, and as foundation material for buildings. The thickness of the fill is generally about five feet, although it may reach a thickness of up to 19 feet. The composition of the fill is variable, but most of it is described as a granular material that was placed to promote drainage.

Peat and Silt Alluvium

Brown and black peat with some silt is found mainly in the southern portion of the site in the area of the former lagoons (Metcalf and Eddy, Inc., 1987). The peat unit extends northwest to the area of B-3 and terminates. The peat reaches a thickness of up to 15 feet, but has an average thickness of about 5 feet. Older USGS quadrangle maps show that this area was formerly a tidal marsh that was subsequently filled. The peat deposits probably originated in this former marsh.

Estuarine Silt

Thick silt deposits occur on the eastern edge of the facility along the Housatonic River. These deposits consist of black silt and sandy silt that contains organic material and occasional shells. This material is a river sediment deposited by the Housatonic River which was subsequently topped with fill during enlargement of the facility property.

Glacial Sediments

Glacial deposits are the dominant sediments at the site. These deposits are reportedly up to 150 feet thick. They consist of well sorted sands, sands with varying amounts of gravel and boulders, and varved silt. The glacial silt unit has been reported to occur only locally in the vicinity of B-65 (Haley and Aldrich, 1987).

The glacial sands are fine- to coarse-grained and range in color from gray and yellow to light brown. The glacial silt is distinguished from the estuarine silt by its lighter color and presence of thin laminations of sand or clay (varves).

2.1.3.5 Hydrogeology

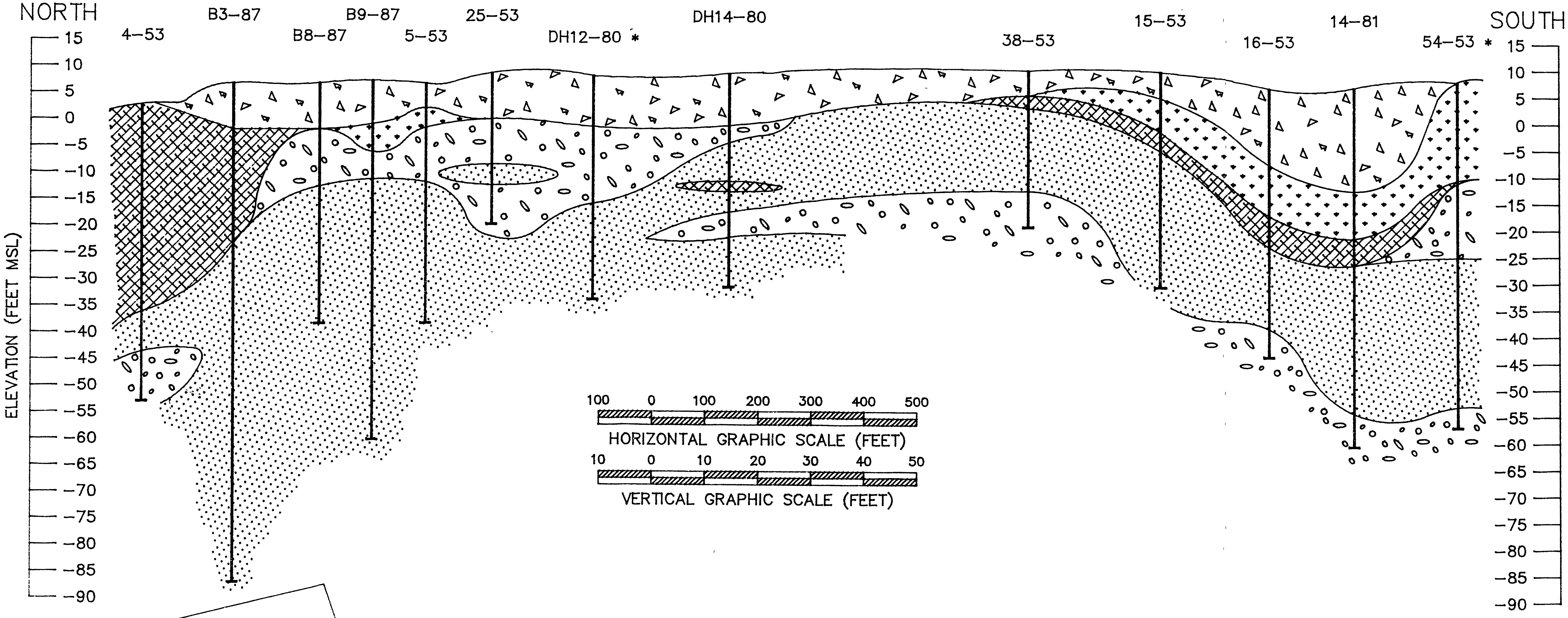
The groundwater regime at the site has not been fully characterized. It is likely to be complex due to tidal influences of Long Island Sound and the Housatonic River, the possible existence of a salt water/fresh water interface beneath the site, and discontinuous confining or semi-confining layers in portions of the site (Figures 2-3 and 2-4).

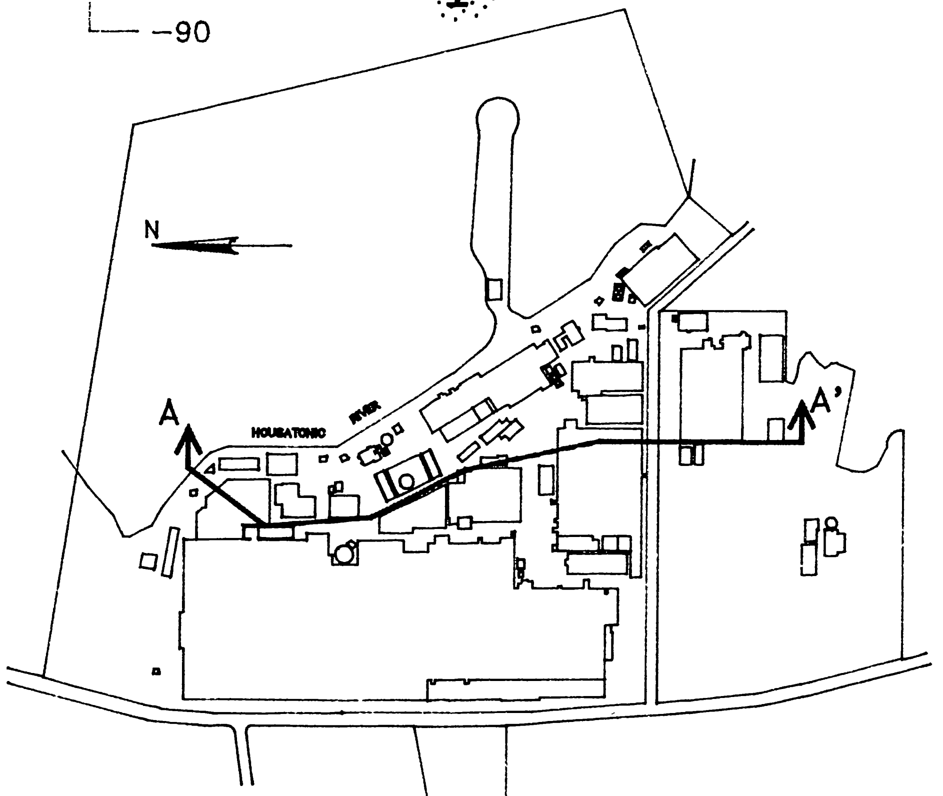
Two areas of the facility have clusters of monitoring wells, for which water level data have been collected.

- Several wells were installed around former sludge storage and equalization lagoons in the southwestern portion of the facility (Figure 2-5). Water levels in these wells have been monitored periodically since installation.

- In the southeast portion of the site, water levels have been measured in a group of wells installed in the vicinity of a former underground storage tank.

Based on information from existing monitoring wells, groundwater at the site is shallow (less than 15 feet below grade). Although the groundwater dynamics are not known for





SITE PLAN
SCALE: NONE

LEGEND

- △ FILL
- ⁘ PEAT
- ▩ SILT
- ⠿ SAND
- ○ SAND AND GRAVEL
- 1-53 BORING IDENTIFICATION
- I BORING BOTTOM
- * ESTIMATED SURFACE ELEVATION

NOTE:
THE GENERALIZED SOIL PROFILE REPRESENTS A WOODWARD-CLYDE CONSULTANTS INTERPRETATION OF BORINGS DONE BY OTHERS. ACTUAL SUB-SURFACE CONDITIONS MAY VARY.

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GEOLOGIC CROSS SECTION A-A'
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY MG/EAB	DATE 10/16/91	PROJECT NO.	FIG. NO.
CHK'D BY MEC	DATE 10/16/91	89C114CC	2-3

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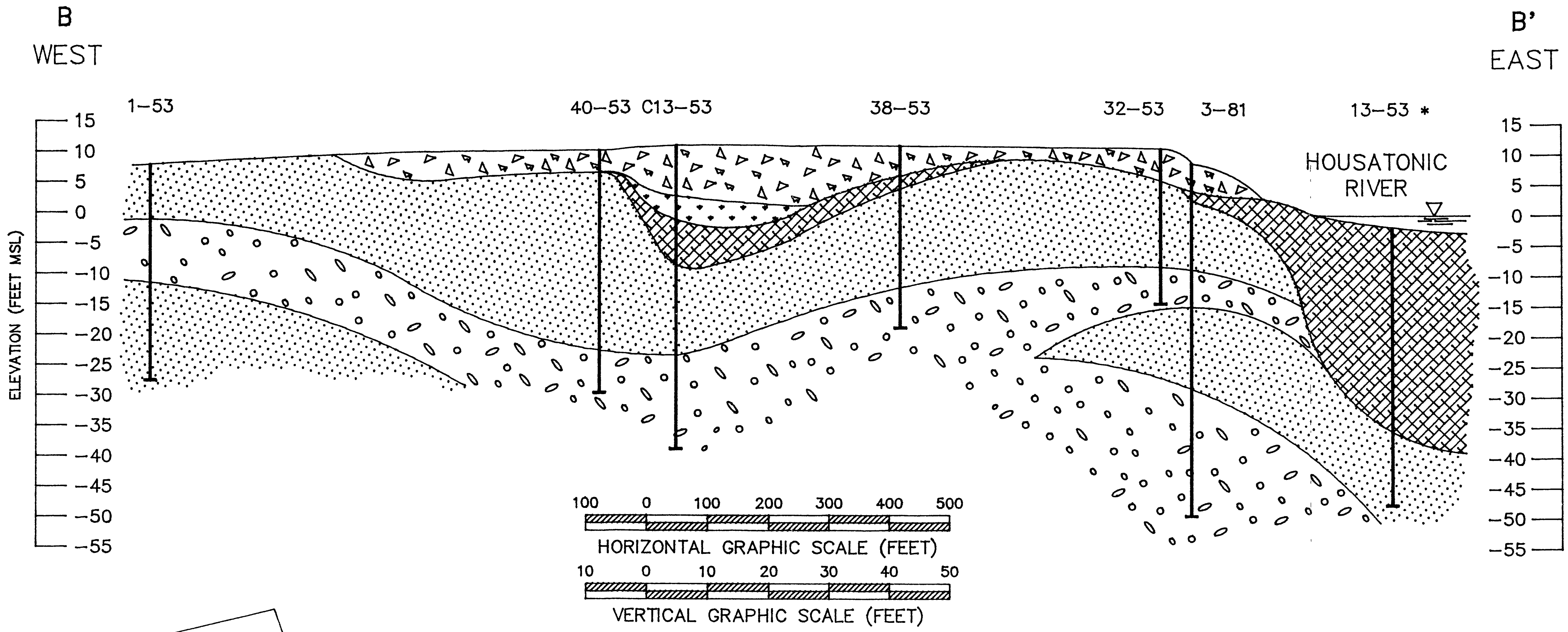

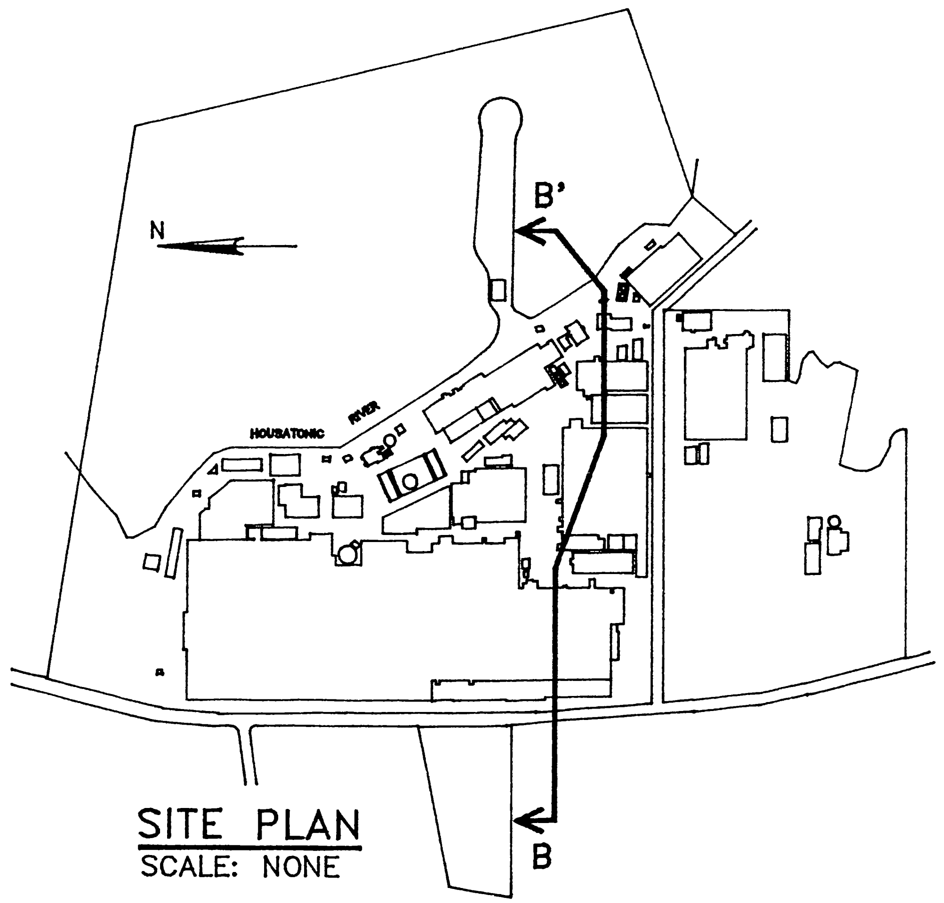

SITE PLAN
SCALE: NONE

LEGEND

△ FILL

∴ PEAT

▩ SILT

⁘ SAND

○ SAND AND GRAVEL

1-53 BORING IDENTIFICATION

I BORING BOTTOM

* ESTIMATED SURFACE ELEVATION

NOTE:
THE GENERALIZED SOIL PROFILE REPRESENTS A WOODWARD-CLYDE CONSULTANTS INTERPRETATION OF BORINGS DONE BY OTHERS. ACTUAL SUB-SURFACE CONDITIONS MAY VARY.

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GEOLOGIC CROSS SECTION B-B'
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY MG/EAB	DATE 10/16/91	PROJECT NO.	FIG. NO.
CHK'D BY MEC	DATE 10/16/91	89C114CC	2-4

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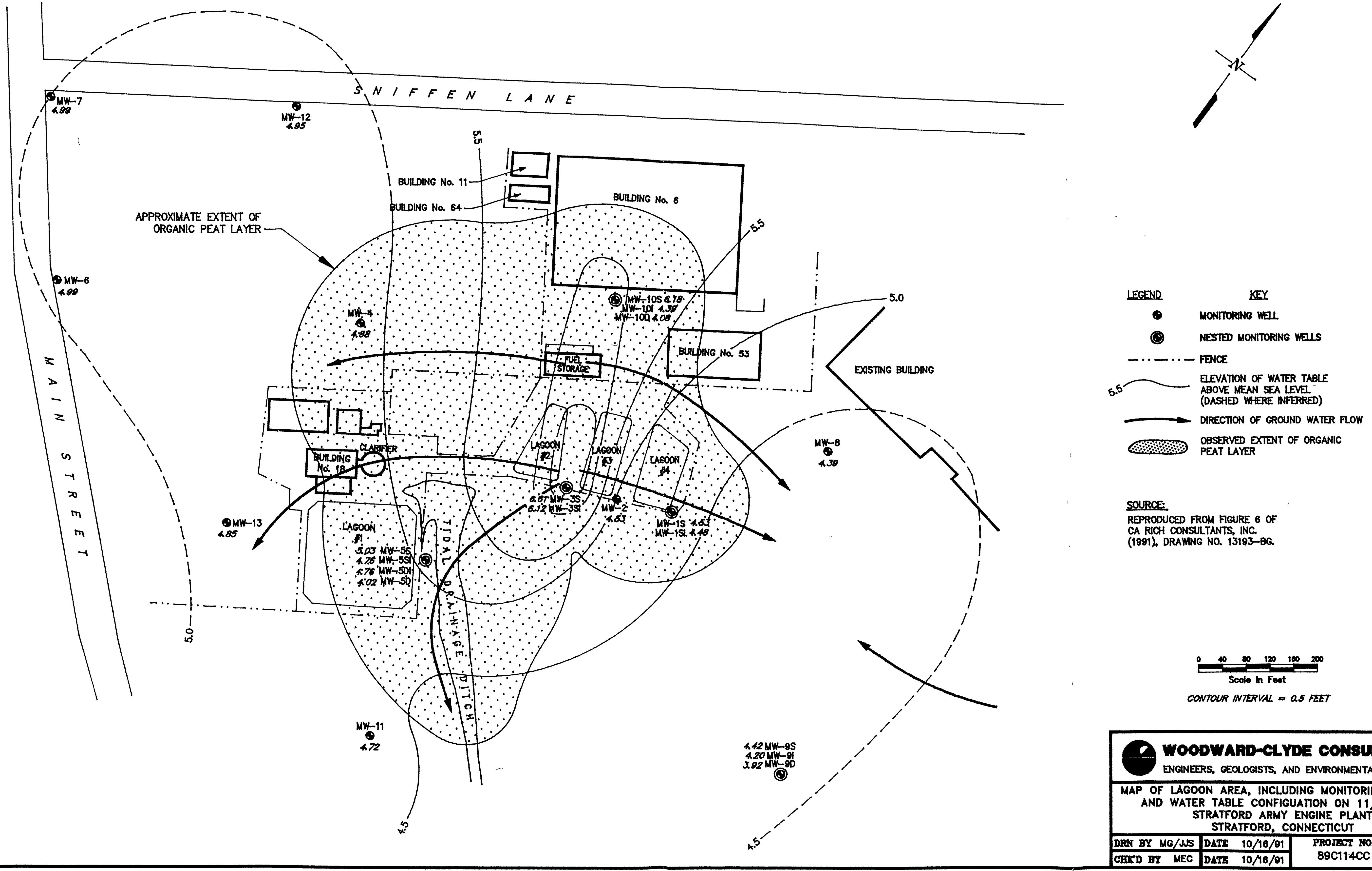

SOURCE:
REPRODUCED FROM FIGURE 6 OF CA RICH CONSULTANTS, INC. (1991), DRAWING NO. 13193-BG.

CONTOUR INTERVAL = 0.5 FEET

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MAP OF LAGOON AREA, INCLUDING MONITORING WELLS
AND WATER TABLE CONFIGUATION ON 11/19/91
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY MG/JJS	DATE 10/16/91	PROJECT NO. 89C114CC	FIG. NO. 2-5
CHK'D BY MEC	DATE 10/16/91		

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the entire site, it is assumed that ground water flow is predominantly east-northeast, towards the Housatonic River.

A groundwater mound was identified in the area of the former lagoons (Metcalf and Eddy, Inc. 1987; Environmental Science and Engineering, Inc., 1991, and CA Rich Consultants, Inc., 1991). The mound is depicted in Figure 2-5 which is from the CA Rich Consultants Study. The cause of the mound may be localized perching of groundwater on the underlying peat layer (Metcalf and Eddy, 1987; C.A. Rich Consultants, Inc., 1991). Although the mound complicates interpretation of the direction of groundwater flow, the general flow direction in the southwestern portion of the site has been inferred to be southward towards Marine Basin (Metcalf and Eddy, Inc., 1987). This inference was confirmed by the data of CA Rich Consultants on wells screened in the aquifer below the peat layer.

CA Rich Consultants, Inc., 1991, evaluated monitoring wells in the lagoon area for water level changes due to tidal forces. In their study, monitoring wells within 600 ft of the drainage ditch (Figure 2-5) showed effects of the tide, with water level fluctuations ranging from 0.48 to 0.02 ft; however, their analysis of the data indicated that the ground water flow gradient would reverse only under the rare conditions of storm and spring tides. Therefore, they concluded that tidal changes probably do not greatly affect groundwater flow in the area.

In the southeast site area, a group of four monitoring wells (MW-1, MW-2, MW-3, and MW-4) were installed near B-5, in the vicinity of a former underground storage tank (Zecco, 1990). Depth to ground water in these wells ranged from four to eleven feet below grade. Groundwater in this area flows to the north-northeast towards the Housatonic River. The horizontal ground water gradient in this area is about 0.002 feet per foot based on the Zecco (1990) contour map. Tidal influences on these wells, if any, have not been studied.

2.2 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Several previous investigations at SAEP have involved sampling and chemical analysis of environmental media. In addition, analytical data collected in compliance with permits are available. This section of the report briefly summarizes the results of the previous investigations and other analytical work.

2.2.1 National Pollution Discharge Elimination System Permit Monitoring

Water samples collected at Outfalls 007 and 008 (see Figure 2-2) have been analyzed in compliance with the facility National Pollution Discharge Elimination System (NPDES) permit. Water discharging from the OATP goes to Outfall 007, and Outfall 008 receives discharges from the CWTP. The permitted average daily concentrations (ADC) of certain analytes were exceeded at different times between 1980 and 1984. For Outfall 007, phenols, total suspended solids, and oil and grease occasionally exceeded ADC limits of 0.1, 20, and 10 parts per million (ppm), respectively. At Outfall 008, the following analytes occasionally exceeded the indicated ADC limits: hexavalent chromium (0.1 ppm), total chromium (1.0 ppm), nickel (1.0 ppm), cadmium (0.1 ppm), total suspended solids (10 ppm), and pH (maximum of 8.75).

The NPDES permit issued in 1985 added outfalls 001, 002, 003, 004, 005, and 006, which discharge intermittent storm water. In addition, permit requirements included maximum daily and average monthly concentrations for various analytes. Textron followed the 1985 NPDES permit conditions while the draft 1990 NPDES permit was reviewed by CDEP. During calendar year 1990, several permit violations were noted (WCC, 1991): average daily flow limitations were exceeded at both outfalls, maximum daily concentration limitations were exceeded for nickel and cyanide, and the limitation for total toxic organics was exceeded.

The 1990 NPDES permit was approved July 10, 1991, and it added toxicity testing to the monitoring program. The first Aquatic Toxicity Monitoring Report (dated November 7, 1991) documented toxicity and analytical results which were within permitted limits.

2.2.2 Buildings B-10 and B-70

Greenish-blue groundwater was observed during construction activities at the cyanide destruction facility (B-70, mid-1980s) and the recuperator manufacturing building (B-10, late-1970s). A subsurface investigation was completed in 1986 to evaluate the soils in the area. East Coast Drilling, Inc. drilled ten test borings and collected soil samples for analysis by Environmental Monitoring Laboratory, Inc. Soil samples were collected above and below the water table, and were analyzed for the EP Toxicity metals. No metals were detected in five of the test borings. In the remaining borings, the following metals were detected in the indicated concentration ranges: total chromium (not detected (nd) to 0.64 ppm), hexavalent chromium (nd to 0.42 ppm), copper (nd to 0.34 ppm), and nickel (nd to 0.48 ppm). The maximum concentrations for total and hexavalent chromium were found at 18 to 20 feet below land surface. The highest concentrations of copper and nickel were found at a depth of 8 to 10 feet below land surface. All of the detectable metals occurred at or below the ground water table. Two of these borings were converted to monitoring wells (ECD-1 and ECD-4 on Figure 2-2). These wells were reportedly sampled, but results are not available at this time.

2.2.3 Discharge Toxicity Evaluation

IPC Corporation performed a discharge toxicity evaluation of Outfalls 007 and 008 in 1988. The complete evaluation involved acute toxicity tests towards freshwater and marine organisms, chemical analysis of the effluents, and a dye dispersion study. Effluent samples were collected on three dates.

IPC's report states that the following analytes were detected in effluent samples from Outfall 007: copper (nd to 0.09 ppm), zinc (0.18 to 0.27 ppm), oil and grease (2 to 5 ppm), phenols (nd to 0.08 ppm), ammonia (nd to 1.17 ppm), and 1,1,1-trichloroethane (0.058 to 2.4 ppm). Toxicity testing was conducted with 100% effluent, using Daphnia pulex and the fathead minnow as the test organisms (D. pulex is a type of crustacean commonly referred to as "water flea"). One of the three samples showed toxicity to D. pulex, and also contained the maximum observed concentration of 1,1,1-trichloroethane. No effects were observed in the test using the fathead minnow.

The following analytes were reported by IPC to be present in effluent samples from Outfall 008: ammonia (nd to 1.7 ppm), total chromium (nd to 0.40 ppm), hexavalent chromium (nd to 0.05 ppm), copper (0.12 to 2.14 ppm), nickel (nd to 0.13 ppm), zinc (nd to 0.01 ppm), chloroform (0.007 ppm) and 1,1,1-trichloroethane (0.019 ppm). Toxicity was evaluated using mysid shrimp and the sheepshead minnow. Some degree of toxicity was observed for both of the organisms. The IPC report suggested that the toxic effects may have been associated with copper concentrations in the effluent. Since the time of the IPC Corporation report, toxicity testing has been added to Textron's NPDES permit monitoring requirements. The first Aquatic Toxicity Monitoring Report (dated November, 1991) documented toxicity and analytical results which were within permitted limits.

2.2.4 Tank Farm Near B-34

Soil and groundwater conditions in the area near the tank farm at B-34 (Figure 2-2) were evaluated in a subsurface investigation by Zecco, Inc. (1990). Seven test borings were drilled and soil samples were collected at 5-foot intervals. One soil sample from each boring was composited from all the depths sampled, and was analyzed for total petroleum hydrocarbons (TPH). Four of the borings were converted to monitoring wells, which were sampled and analyzed for volatile organic compounds and TPH.

Analytical results for the composite soil samples show that six of the seven borings contain measurable levels of TPH, ranging from 43 to 5500 ppm. The highest concentrations were in the borings adjacent to B-16 (MW-2 and MW-3 on Figure 2-2). Groundwater from MW-1 contained no detectable TPH or volatile organic compounds. The remaining three wells contained the indicated ranges of the following analytes: TPH (2.9 to 15.0 ppm), benzene (0.017 to 0.620 ppm), ethylbenzene (0.017 to 0.077 ppm), and xylenes (0.009 to 0.086 ppm). The overall highest concentrations of these analytes were in MW-2.

2.2.5 Groundwater Assessment Monitoring Program

Prior to 1989, four lagoons (one equalization lagoon and three sludge storage lagoons) existed on site (Figure 2-5) and were regulated under the Resource Conservation and Recovery Act (RCRA). Spent plating baths were discharged to the equalization lagoon. Wastewater from this lagoon was pumped to a chemical waste treatment plant, converted to a metal hydroxide sludge, and finally pumped to the sludge storage lagoons. Groundwater monitoring wells were installed and sampled beginning in 1981, although changes in the requested analytical parameters resulted in the consideration of the 1983-1984 data as the "first year" of record. Metcalf and Eddy, Inc. (1987) reported the monitoring results. The lagoons were closed in 1989, but the monitoring program continued as required under RCRA closure. ESE completed the most recent monitoring report, the "seventh year" annual summary for 1990. This section summarizes the conclusions of the two groundwater assessment monitoring reports: Metcalf and Eddy, Inc, 1987, and ESE, Inc, 1991.

Metcalf and Eddy, Inc. (1987) reported that five monitoring wells were installed in 1981, two were installed in 1983, and six were installed in 1985, for a total of thirteen monitoring wells in the lagoon area. The Connecticut Department of Environmental Protection (CDEP) specified the following analytical parameters for the monitoring program: cadmium, hexavalent chromium, total chromium, copper, mercury, nickel, zinc, amenable cyanide, total cyanide, pH, halogenated volatile organics, aromatic volatile organics, specific conductivity, total organic carbon, and total organic halogens. The "first year" results (1983-1984) indicated that Connecticut Public Drinking Water Code (CPDWC) standards were exceeded in samples from MW-1 through MW-5 for total chromium, hexavalent chromium, total cyanide, trichloroethylene, and tetrachloroethylene. In "second year" samples (1984-1985), the CPDWC standards at these five wells were exceeded for total chromium and total cyanide. Metcalf and Eddy, Inc. installed six additional monitoring wells in 1985. The "third year" analytical results (1985-1986) showed that CPDWC standards were exceeded for total chromium, hexavalent chromium, total cyanide, trichloroethylene, and tetrachloroethylene at MW-1, MW-2, MW-3, and MW-5.

Lagoon closure was completed in 1989, and ESE (1991) presented results for the "seventh year" of monitoring (1989-1990). In 1990, an upgradient well (MW-10 on Figure 2-5) contained cadmium in exceedance of CPDWC standards. The following analytes were above CPDWC standards in at least one of several wells (MW-1 through MW-5, MW-7, MW-9 through MW-10, and MW-12) in 1990, and have varied over the indicated concentrations over the entire period of record: cadmium (4-70 ppb), vinyl chloride, 1,1-dichloroethene, 1,2-trans-dichloroethene (2-6500 ppb), and trichloroethene (2-150 ppb). (Concentration ranges for vinyl chloride and 1,1-dichloroethene were not reported.) ESE's statistical analysis of the data indicated that the following analytes showed a statistically significant increase in the downgradient wells (MW-1 through MW-5, and MW-13) as compared to the upgradient well (MW-10): 1,2 trans-dichloroethene, tetrachloroethene, trichloroethene, total organic carbon (TOC), specific conductance, and pH. Note that these results assume that the source of contamination is the closed lagoons; and no further conclusions regarding alternative sources of contamination were made in either of the assessment monitoring reports.

3.0
CONCEPTUAL SITE MODELS

Information obtained during the record search conducted for the PAS was used to identify eight areas of potential environmental concern at SAEP (Figure 2-2). The areas were selected based on: SAEPs environmental setting; historical development of the site; plant operations within the area; chemicals used or stored in the area; evidence of impact based on former investigations and/or remedial measures; reports of releases; and compliance history. A conceptual model was developed for each of the eight areas of potential environmental concern based on information currently available. The conceptual models were developed to identify the types of information that will be needed for a baseline risk assessment.

The conceptual models for the eight areas of environmental concern from the PAS are summarized below. Diagrams of the conceptual models for each area are in Figures 3-1 through 3-8. Background information used to develop the models is presented in the PAS.

3.1 AREA 1 - INTERTIDAL FLATS

The Intertidal Flats is an area that may have received hazardous compounds from past discharges and/or runoff from SAEP, as well as from upstream areas of the Housatonic River. Contaminants which may have been deposited in this area include heavy metals, cyanide, polychlorinated biphenyls (PCBs), semi-volatile organic compounds (semi-VOs) and volatile organic compounds (VOs). These contaminants may be present in sediments and surface water.

There is a potential pathway from the intertidal sediments to human and/or biota receptors (Figure 3-1). When the flats are exposed during low tides there is a possibility that volatiles (if present) could be released to the atmosphere. Also, dermal contact with the sediment by humans and biota is possible. Another primary pathway is the ingestion of sediment and surface water by biota and the subsequent consumption of contaminated organisms. Other potential pathways include direct contact with effluent air emissions from SAEPs discharges to the flats.

3.2 AREA 2 - CAUSEWAY

The causeway was used for a fire training area and a landfill area. Contaminants of concern include asbestos and polynuclear aromatic hydrocarbons. Contaminated media would be limited to soils within the causeway. Potential pathways include contamination of surface water due to runoff and air releases of asbestos fibers and/or contaminated dust particles.

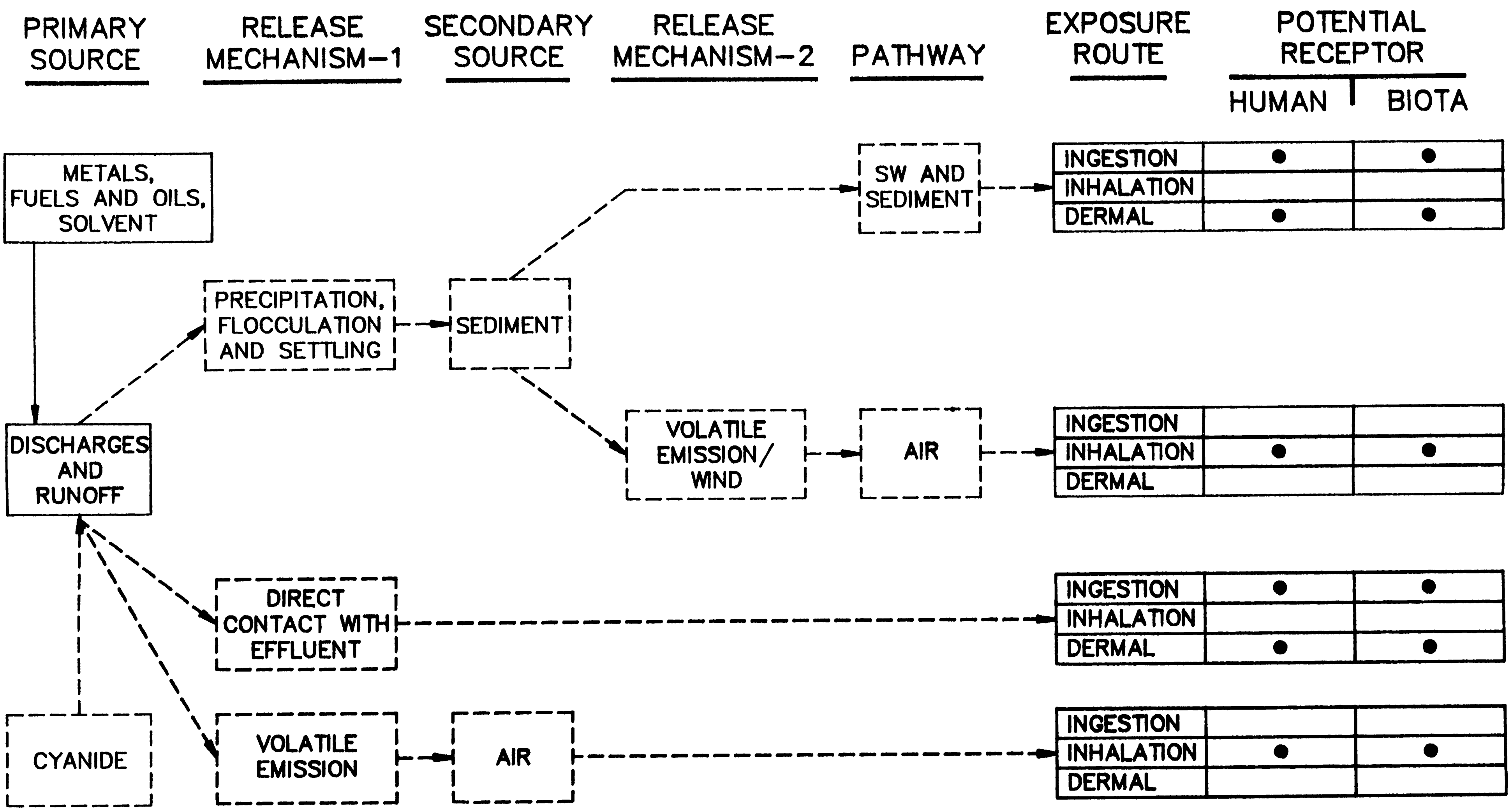
Exposure routes to humans and biota would include ingestion, inhalation and dermal contact (Figure 3-2). Biota receptors would be limited to terrestrial animals and birds.

3.3 AREA 3 - HYDRAULIC FILL AREA

The hydraulic fill area has been used to store, treat, and dispose of materials used at SAEP including metals, fuels, oils and solvents. Contaminants of concern include heavy metals, PCBs, semi-VOs and VOs. Contaminated media would include soil and groundwater.

Because most of this area is paved or covered by buildings, potential pathways to human and/or biota receptors are limited. Groundwater may become a pathway if contaminants migrated into the groundwater which then discharged to sediments and surface water in the intertidal flats.

Potential human receptors would be limited to those involved in intrusive activities (eg. construction) in contaminated soil areas (Figure 3-3). Potential exposure routes would include inhalation, ingestion, and dermal contact. Potential biota receptors and exposure pathways associated with groundwater discharges would be the same as those described for Area 1 - Intertidal Flats.



SW AND SEDIMENT:

EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION	●	●
INHALATION		
DERMAL	●	●

AIR (from VOLATILE EMISSION/WIND):

EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION		
INHALATION	●	●
DERMAL		

DIRECT CONTACT WITH EFFLUENT:

EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION	●	●
INHALATION		
DERMAL	●	●

AIR (from VOLATILE EMISSION):

EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION		
INHALATION	●	●
DERMAL		

NOTE:

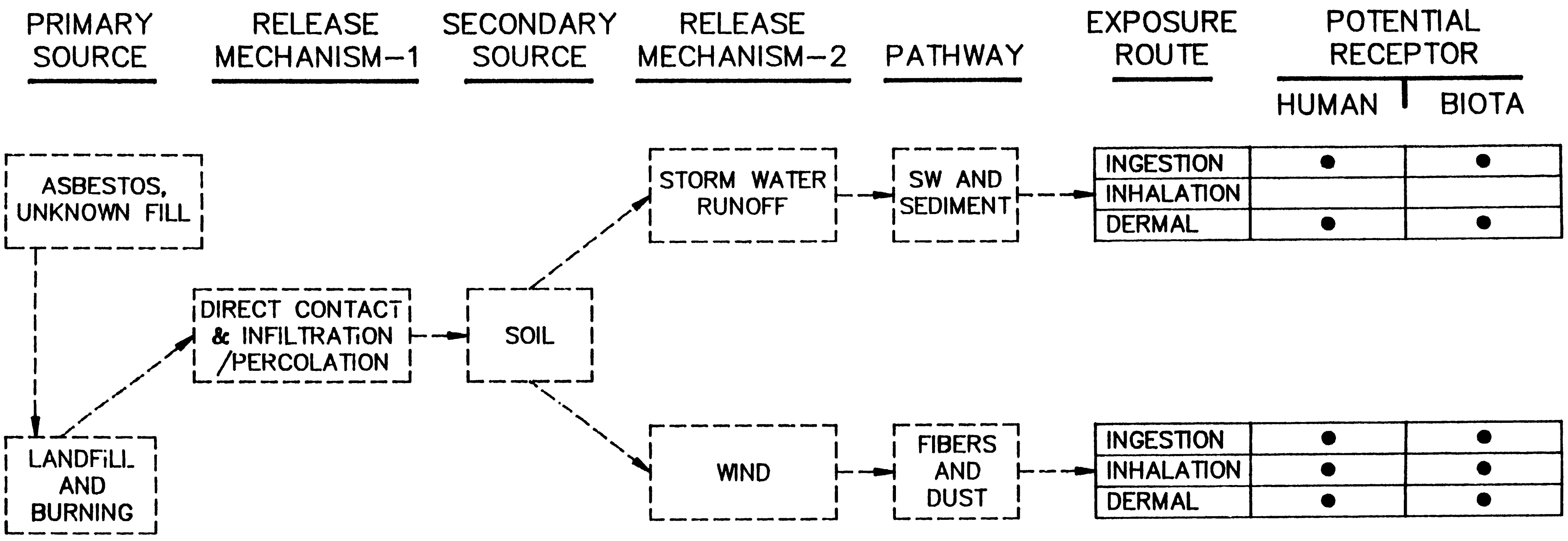
DASHED LINES REPRESENT POTENTIAL (UNVERIFIED) PATHWAYS FROM SOURCE TO POTENTIAL RECEPTORS.

SOLID LINES REPRESENT KNOWN PARTS OF PATHWAYS (BASED ON SI DATA) FROM SOURCE TO POTENTIAL RECEPTORS.

Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

CONCEPTUAL MODEL – AREA 1
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY EAB	DATE APRIL 1991	PROJECT NO. 89MC114M	FIG. NO. 3-1
CHK'D BY JJH	DATE APRIL 1991		



EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION	●	●
INHALATION		
DERMAL	●	●

EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION	●	●
INHALATION	●	●
DERMAL	●	●

NOTE:

DASHED LINES REPRESENT POTENTIAL (UNVERIFIED) PATHWAYS FROM SOURCE TO POTENTIAL RECEPTORS.

SOLID LINES REPRESENT KNOWN PARTS OF PATHWAYS (BASED ON SI DATA) FROM SOURCE TO POTENTIAL RECEPTORS.

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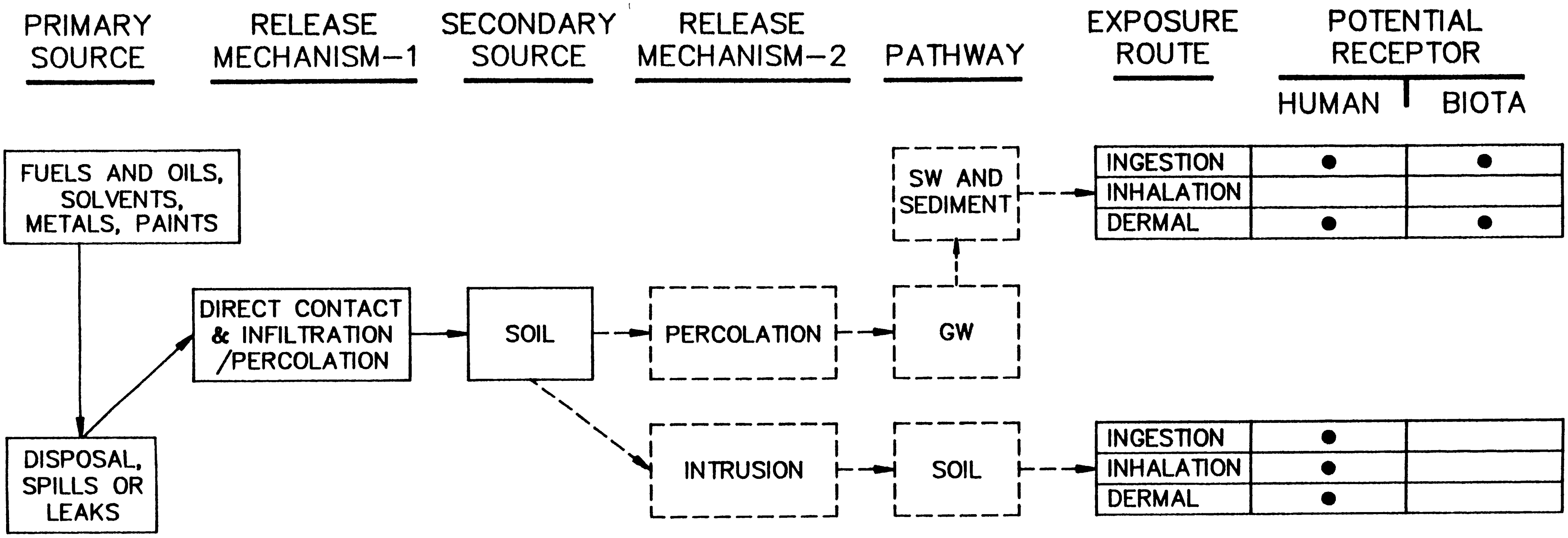
CONCEPTUAL MODEL – AREA 2
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY EAB	DATE APRIL 1991	PROJECT NO. 89MC114M	FIG. NO. 3-2
CHK'D BY JJH	DATE APRIL 1991		



Exposure Route	Human	Biota
INGESTION	●	●
INHALATION		
DERMAL	●	●

Exposure Route	Human	Biota
INGESTION	●	
INHALATION	●	
DERMAL	●	

NOTE:

DASHED LINES REPRESENT POTENTIAL (UNVERIFIED) PATHWAYS FROM SOURCE TO POTENTIAL RECEPTORS.

SOLID LINES REPRESENT KNOWN PARTS OF PATHWAYS (BASED ON SI DATA) FROM SOURCE TO POTENTIAL RECEPTORS.

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CONCEPTUAL MODEL – AREA 3
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY EAB	DATE APRIL 1991	PROJECT NO. 89MC114M	FIG. NO. 3–3
CHK'D BY JJH	DATE APRIL 1991		

3.4 AREA 4 - PLATING AND MANUFACTURING AREA

Area 4 has been used for plating, engine cleaning and manufacturing, and for storage of fuels, solvents and paints. Past disposal and/or uncontrolled releases are known to have contaminated soils and groundwater within this area. Contaminants of concern include heavy metals, cyanide, semi-VOs and VOs.

Because most of this area is paved or covered by buildings, potential pathways to humans and/or biota receptors are limited (Figure 3-4). Exposure pathways and potential receptors for Area 4 are the same as those described for Area 3.

3.5 AREA 5 - BUILDING 2

This area includes most of B-2 (excluding the plating and heat treatment shops) which has been used for assembling aircraft and is presently used for manufacturing gas turbine engines. Past disposal practices and/or uncontrolled releases may have resulted in soil and groundwater contamination. Contaminants of concern include heavy metals, semi-VOs and VOs.

Because most of this area is paved or covered by buildings, potential pathways to humans and/or biota receptors are limited (Figure 3-5). Exposure pathways and potential receptors for Area 5 are the same as those described for Area 3.

3.6 AREA 6 - RESEARCH AND DEVELOPMENT AREA

This area has been used for research and development for over 50 years. Metals, fuels, oils and solvents have been handled in the area. Contaminants of concern include heavy metals, semi-VOs, and VOs.

Because most of this area is paved or covered by buildings, potential pathways to human and/or biota receptors are limited (Figure 3-6). Exposure pathways and potential receptors for Area 6 are the same as those described for Area 3.

3.7 AREA 7 - TESTING AREA

This area contains the steam generating plant and has been used for experimental engine testing and for the storage of fuels. During excavation for lagoon closures, petroleum-contaminated soils were reportedly observed within the southern portion of this area. Contaminants of concern include heavy metals, semi-VOs, and VOs.

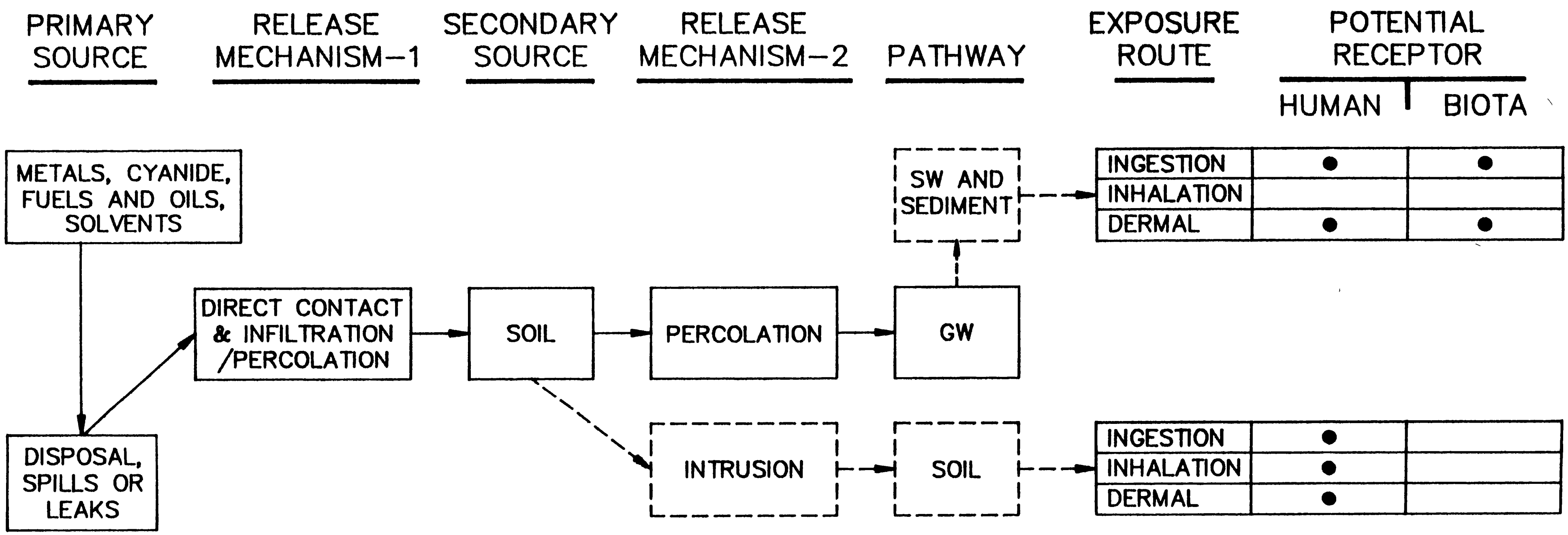
Because most of this area is paved or covered by buildings, potential pathways to human and/or biota receptors are limited (Figure 3-7). Exposure pathways and potential receptors for Area 7 are the same as those described for Area 3.

3.8 AREA 8 - DRAINAGE DITCH

This area includes a drainage ditch that originates at SAEP and flows into Marine Basin. No hazardous materials are handled or generated within this area, but it represents a potential depositional area for runoff and effluent from SAEP. Effluent from the chemical waste treatment plant (CWTP) discharges to the ditch under the facility NPDES permit, and this release has occurred since 1958. Contaminants of concern would primarily include compounds in the CWTP waste stream and, to a lesser extent, chemicals that would be associated with site runoff. These chemicals include heavy metals, cyanide, PCBs, semi-VOs, and VOs.

Potential exposure pathways are direct contact with effluent, air emissions from effluent and/or contaminated sediment (during low tide) and surface water, and direct contact with contaminated sediment and surface water (Figure 3-8).

Potential human receptors include people who may come in contact with effluent, sediment, or surface water in the drainage ditch. Potential biota receptors include organisms that live and/or feed within the ditch and associated riparian areas.



NOTE:

DASHED LINES REPRESENT POTENTIAL (UNVERIFIED) PATHWAYS FROM SOURCE TO POTENTIAL RECEPTORS.

SOLID LINES REPRESENT KNOWN PARTS OF PATHWAYS (BASED ON SI DATA) FROM SOURCE TO POTENTIAL RECEPTORS.

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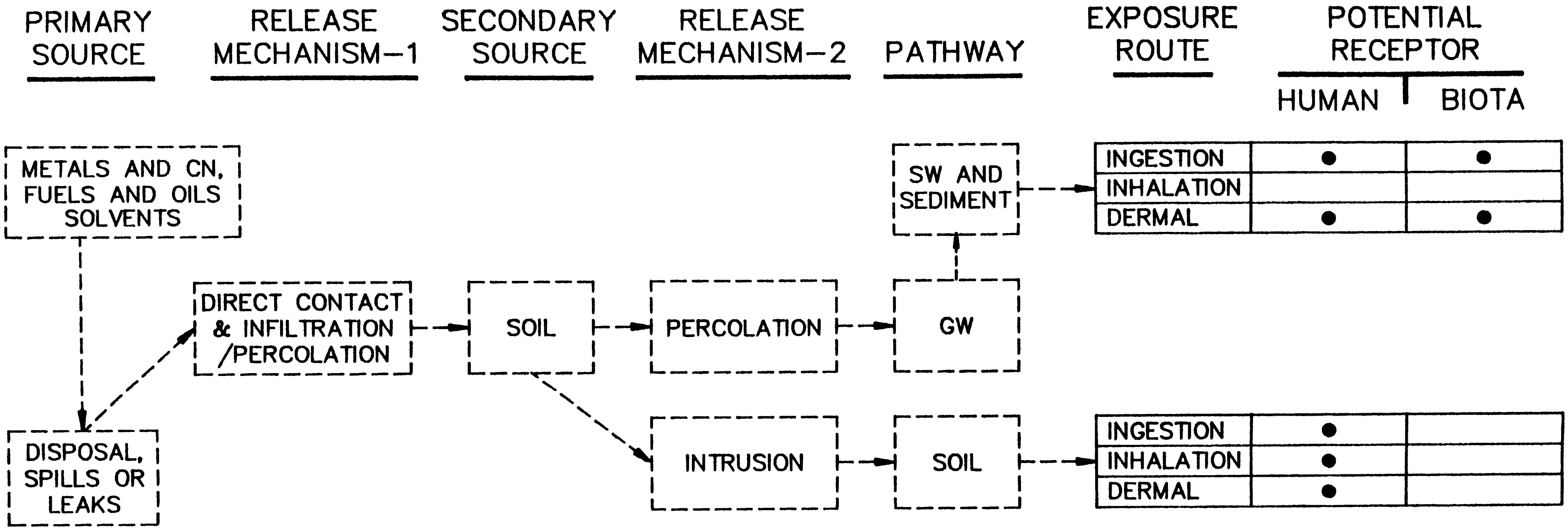
CONCEPTUAL MODEL – AREA 4
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY EAB	DATE APRIL 1991	PROJECT NO. 89MC114M	FIG. NO. 3-4
CHK'D BY JJH	DATE APRIL 1991		



NOTE:

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SOLID LINES REPRESENT KNOWN PARTS OF PATHWAYS (BASED ON SI DATA) FROM SOURCE TO POTENTIAL RECEPTORS.

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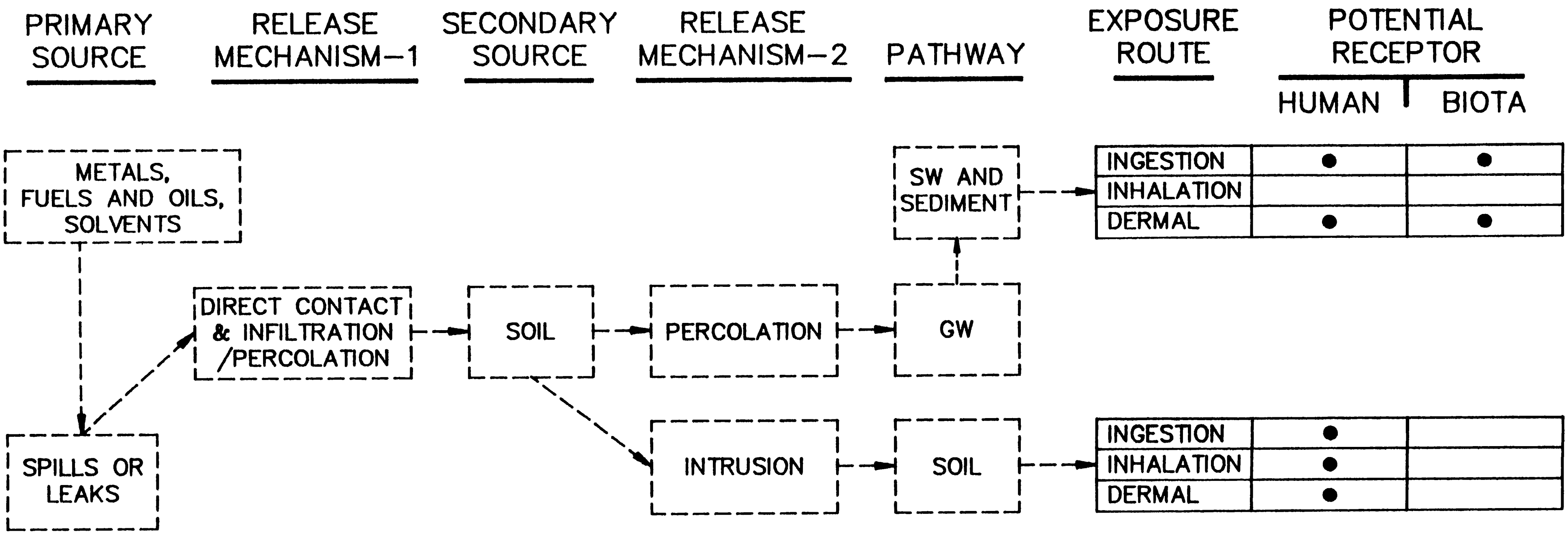
CONCEPTUAL MODEL – AREA 5
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DWN BY	EAB	DATE APRIL 1991	PROJECT NO.	FIG. NO.
CHK'D BY	JJH	DATE APRIL 1991	89MC114M	3–5



	HUMAN	BIOTA
INGESTION	●	●
INHALATION		
DERMAL	●	●

	HUMAN	BIOTA
INGESTION	●	
INHALATION	●	
DERMAL	●	

NOTE:

DASHED LINES REPRESENT POTENTIAL (UNVERIFIED) PATHWAYS FROM SOURCE TO POTENTIAL RECEPTORS.

SOLID LINES REPRESENT KNOWN PARTS OF PATHWAYS (BASED ON SI DATA) FROM SOURCE TO POTENTIAL RECEPTORS.

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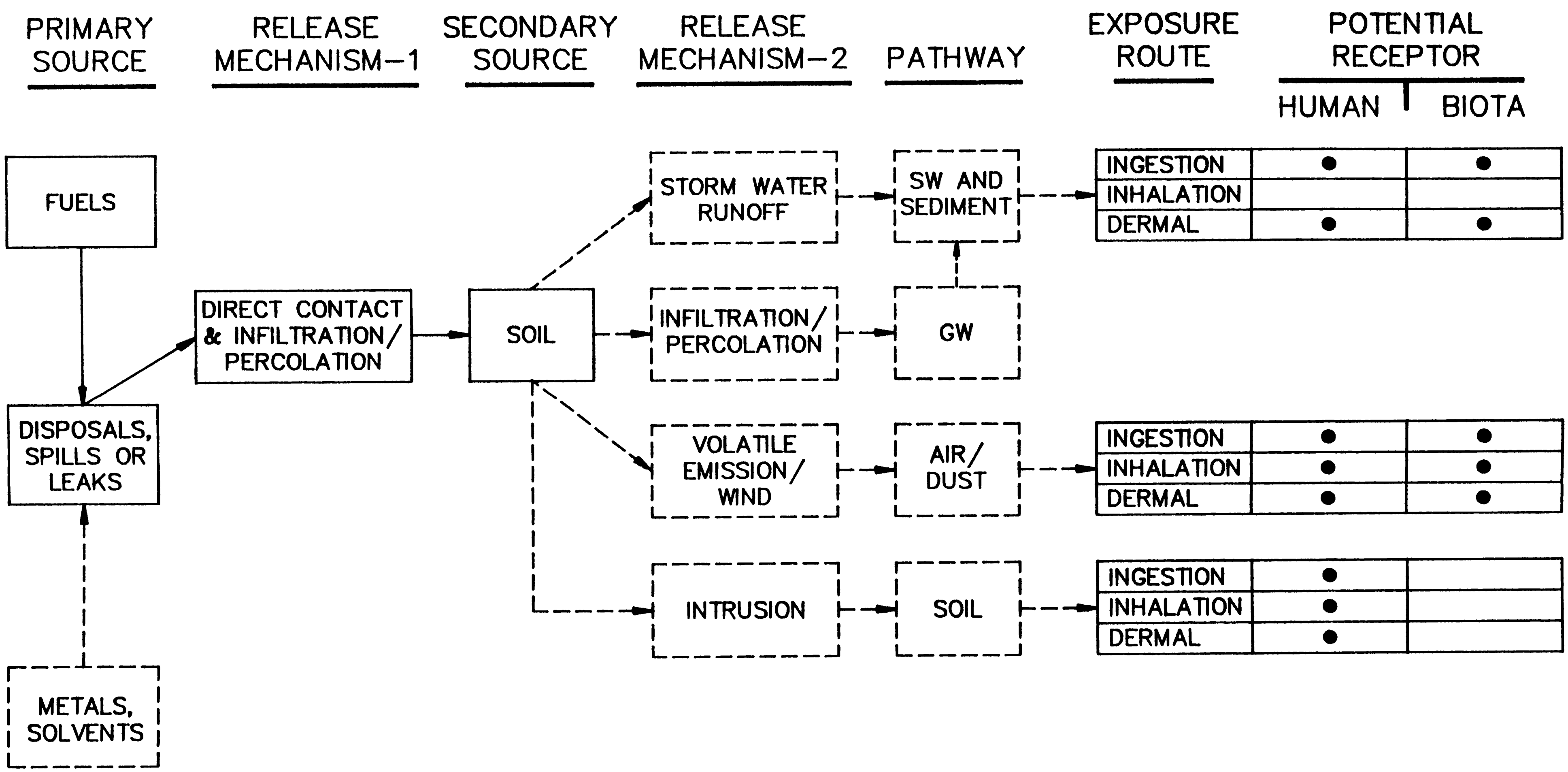
CONCEPTUAL MODEL – AREA 6
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY EAB	DATE APRIL 1991	PROJECT NO. 89MC114M	FIG. NO. 3-6
CHK'D BY JJH	DATE APRIL 1991		



EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION	●	●
INHALATION		
DERMAL	●	●

EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION	●	●
INHALATION	●	●
DERMAL	●	●

EXPOSURE ROUTE	HUMAN	BIOTA
INGESTION	●	
INHALATION	●	
DERMAL	●	

NOTE:

DASHED LINES REPRESENT POTENTIAL (UNVERIFIED) PATHWAYS FROM SOURCE TO POTENTIAL RECEPTORS.

SOLID LINES REPRESENT KNOWN PARTS OF PATHWAYS (BASED ON SI DATA) FROM SOURCE TO POTENTIAL RECEPTORS.

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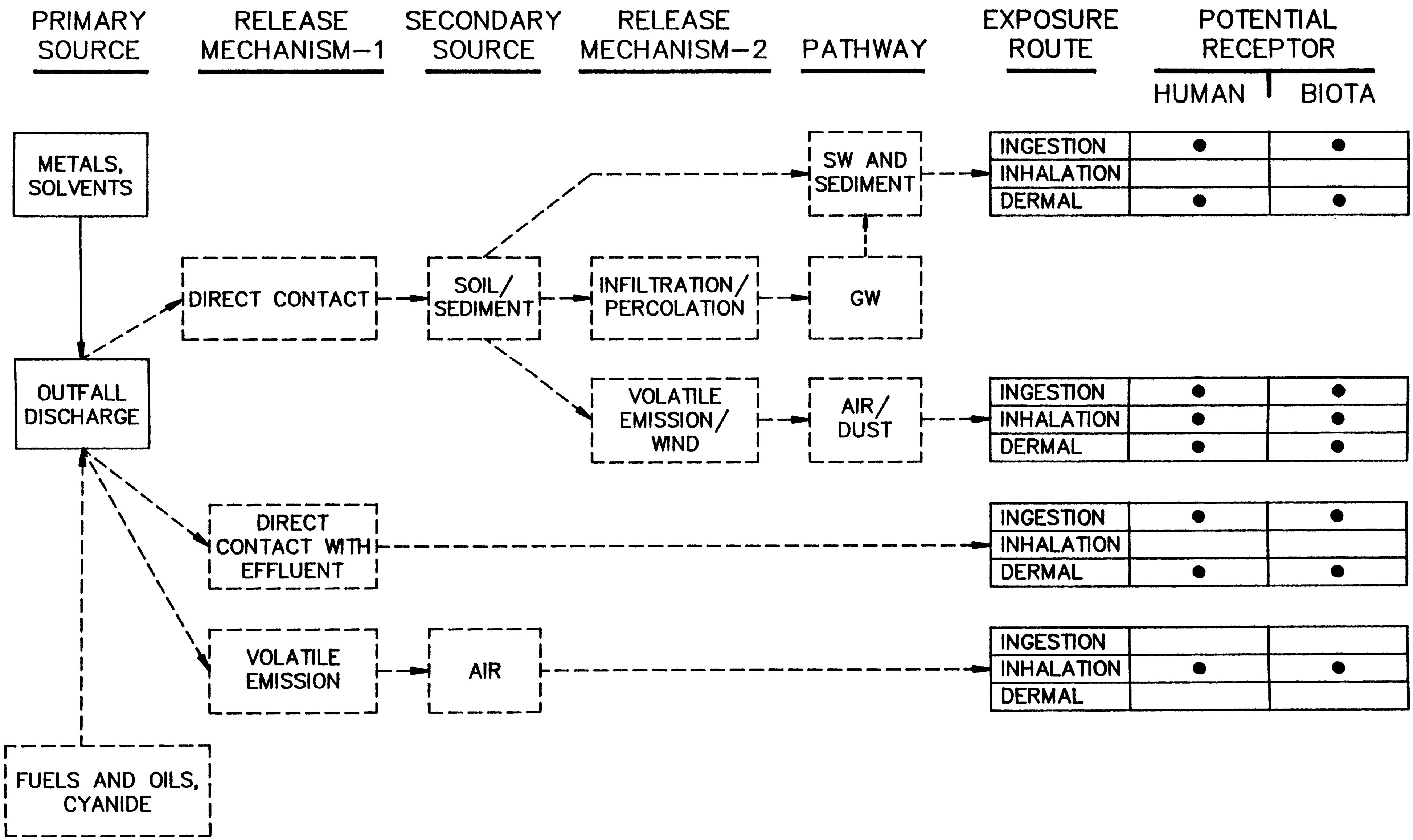
CONCEPTUAL MODEL – AREA 7
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DSN BY EAB	DATE APRIL 1991	PROJECT NO. 89MC114M	FIG. NO. 3-7
CHK'D BY JJH	DATE APRIL 1991		



NOTE:

DASHED LINES REPRESENT POTENTIAL (UNVERIFIED) PATHWAYS FROM SOURCE TO POTENTIAL RECEPTORS.

SOLID LINES REPRESENT KNOWN PARTS OF PATHWAYS (BASED ON SI DATA) FROM SOURCE TO POTENTIAL RECEPTORS.

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CONCEPTUAL MODEL – AREA 8
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY EAB	DATE APRIL 1991	PROJECT NO. 89MC114M	FIG. NO. 3–8
CHK'D BY JJH	DATE APRIL 1991		

4.0
WORK PLAN RATIONALE

4.1 FEDERAL, STATE, AND LOCAL ENVIRONMENTAL CRITERIA AND PERMITS

Federal, state, and local laws and statutes were reviewed for two purposes: 1) to determine if permits are required for the remedial investigation activities, and 2) to evaluate the environmental criteria against which analytical results will be compared. The review included documented telephone conversations with Connecticut Department of Environmental Protection (CDEP) employees and Town of Stratford employees. These conversations confirmed the contents of existing laws and statutes, and further clarified non-statutory policy pertaining to environmental criteria.

Permits are not required for three site investigation activities: 1.) borings (based on a telephone conversation with T. Bobowicz, CDEP, 15 October 1991); 2.) monitoring well installation (based on same telephone conversation); and 3.) sediment and surface water sampling in the intertidal flat area (based on a telephone conversation with J. Shamas, Stratford Conservation Officer, 18 October 1991). Because other investigation activities (sampling and testing) will take place within the property boundaries of SAEP, they will not require a permit.

Connecticut water quality standards and drinking water regulations were reviewed to determine if state environmental criteria are directly applicable to this investigation. Connecticut has promulgated a water quality classification system for ground water and surface waters. Groundwater beneath SAEP is classified as GB (phone conversation with CDEP and CDEP map of water quality classification): groundwater within highly urbanized areas or areas of intense industrial activity and where a public water supply is available; this water may not be suitable for human consumption. Based on this classification, it may become necessary to compare groundwater analytical results to federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs).

As reported in the PAS, the coastal and marine surface waters in the vicinity of the facility are classified as SC/SB (Long Island Sound, Housatonic River, Marine Basin and the drainage ditch). The SC/SB classification signifies that surface water quality is impaired, and that a goal of SB classification (wildlife habitat, suitable for recreation and industrial uses) exists. Frash Pond is unclassified and therefore defaults to an SA classification (wildlife habitat, suitable for shellfish harvesting and recreation). EPA water quality criteria for acute and chronic effects on freshwater and saltwater aquatic life were published pursuant to the Clean Water Act, and CDEP refers to these criteria. However, these criteria are guidelines and are not enforceable (phone conversation with T. Bobowicz, CDEP, 17 October 1991).

There are no regulatory criteria for contaminated soils in Connecticut, and CDEP personnel have stated that criteria are developed on a "case-by-case" basis. However, CDEP has developed guidelines for the removal and disposal of soils contaminated with metals and cyanide which are related to the groundwater classification system. For metals in areas with a groundwater classification GB, soils are to be tested with the Toxicity Characteristic Leaching Procedure (TCLP). The soil guidelines for metals and cyanide are multiples of criteria from CPDWC (Table 4-1). For hydrocarbons and cyanide, soils are to be tested using the appropriate analytical method in EPA-SW-846. Again, these are guidelines, and criteria for remedial activities are determined on a case-by-case basis by CDEP.

Regulatory criteria for sediments do not exist at the federal and state levels at the present time (based on a telephone conversation with Amy Leaberry, USEPA, 30 January 1992).

4.2 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are established to ensure that the data collected are sufficient and of adequate quality for their intended uses. At SAEP the data from the initial remedial investigation sampling described herein will be used to determine the presence or absence of contamination at the various areas of potential environmental concern identified in the PAS report. Presence or absence could be determined using

TABLE 4-1. REGULATORY GUIDELINES FOR SOIL STATE OF CONNECTICUT

Analyte	Connecticut Drinking Water Criteria	Soil Guidelines Using TCLP Results		
		Noncontaminated (Concentration = one to ten times drinking water criteria)	Contaminated (Concentration = ten to thirty times drinking water criteria)	Hazardous (Concentration > thirty times drinking water criteria)
Arsenic	0.05	0.05-0.50	0.50-1.5	>1.5
Barium	1	1.0-10	10.0-30.0	>30.0
Cadmium	0.01	0.01-0.10	0.1-0.3	>0.3
Chromium	0.05	0.05-0.50	0.50-1.5	>1.5
Cyanide	0.2	0.2-2.0	2.0-6	>6
Lead	0.02	0.02-0.20	0.20-0.6	>0.6
Mercury	0.002	0.002-0.02	0.02-0.06	>0.06
Selenium	0.01	0.01-0.10	0.10-0.30	>0.30
Silver	0.05	0.05-0.50	0.50-1.5	>1.5
Total Petroleum Hydrocarbons		See (3)	See (3)	See (3)

NOTE:

1) All concentrations in parts per million (ppm)

2) CTDEP determines cleanup levels for soil on a case-by-case basis. These guidelines are based on a groundwater classification of GB. The concentration ranges for each category above (noncontaminated, contaminated, and hazardous soil) are general guidelines only Soils are to be tested using the Toxicity Characteristic Leaching Procedure (TCLP).

3) In areas with groundwater classification GB, soils with TPH greater than background must be excavated. If TPH is greater than 50 ppm, the soil is considered to be hazardous waste. Representative background samples must be approved by CTDEP.

field screening or field analytical techniques (EPA Analytical Support Levels I and II). However, in order for data to be defensible and confirmational, a higher level of precision and accuracy is needed. This higher level will allow the data to be used to augment any future investigations which may be needed for additional delineation; therefore, sample analysis will be conducted by an off-site laboratory using EPA-approved methodologies (EPA Analytical Support Level III). The methodologies used will be those presented in EPA-SW-846.

Based on the history of compounds used at the site, nearly all samples will be analyzed for the presence of Target Compounds List (TCL) semi-VOs and metals. In some areas samples will also be analyzed for the presence of VOs, PCBs, cyanide, and/or asbestos.

Detection levels need to be sufficiently low to allow comparison of results to regulatory standards or guidance. Groundwater beneath the site is classified as potentially non-potable according to CDEPs classification system; however, it may be necessary to compare analytical results to SDWA MCLs. Laboratory detection limits for compounds with MCLs are lower than the MCLs, except for PCB Arochlors 1254 and 1260 (1.0 ppb versus 0.5 ppb).

CDEP determines cleanup levels for soil on a case-by-case basis. However, multiples of CPDWC criteria for inorganics are used as general guidelines for various excavation and disposal options (Table 4-1). In order to use these guidelines for comparison, detection limits for soil samples should be as low as the lower end of the ranges for the "Contaminated" ranking. For example, the detection limit for arsenic should be 0.50 ppm or less and that for barium should be 10 ppm or less. These guidelines are based on TCLP results. Therefore, soil samples will be analyzed for metals and cyanide using TCLP (SW-846 method 1311).

4.3 WORK PLAN APPROACH

4.3.1 Overall Approach

The primary objective of this phase of the investigation is to evaluate the presence or absence of contamination at the site. Evaluation of the extent of contamination is beyond the scope of this phase of the investigation. Because the sampling in this phase is not intended to provide a comprehensive characterization of site conditions, further sampling will likely be required in subsequent phases.

The data from this investigative phase will form part of the data set to be used in the Defense Priority Model and Baseline Risk Assessments. Recommendations for further sampling will be made, if warranted, on the basis of sampling results.

The overall approach is to sample areas which, on the basis of information reported primarily in the PAS, have, or potentially have experienced historical releases or disposal activities. Areas of environmental concern identified in the PAS will be addressed. Sampling will focus on the two major exposure pathways identified in the PAS:

- releases to soil and sediment potentially resulting from discharge from outfalls in Areas 1 and 8 and landfill and burning in Area 2 (see Figure 2-2).
- releases to surface or subsurface soils from disposal, spills, or leaks in Areas 3, 4, 5, 6 and 7, with potential for leaching to groundwater and subsequent migration to sediment in the Housatonic River (see Figure 2-2).

The environmental media of concern to be sampled are:

- sediment and surface water in the intertidal flats of the Housatonic River and connected waterways adjacent to the site

- surface and subsurface soils in on-shore areas, and

- groundwater beneath the site.

Depending on the environmental medium, sampling will focus on: 1) the immediate vicinities of individual areas of concern within the eight areas, or 2) the site as a whole. In general, soil will be sampled in or immediately adjacent to potential source areas (e.g. spills). Sediment and surface water will also be sampled at potential sources (mainly river outfalls) with some additional sampling upgradient and downgradient. Groundwater sampling locations, however, are designed to assess both individual potential sources and contamination from the site as a whole.

4.3.1.1 Soil Sampling

Soil sampling will be restricted to the immediate vicinities of potential areas of concern (e.g. area of surface spill) because contamination tends to travel downward rather than laterally in the unsaturated zone. Soil samples will generally be obtained from two depths: 1) 0 to 6 inches above the water table to evaluate if contamination has migrated downward and is a source of groundwater contamination, and 2) from an obviously contaminated interval based on field observations, or, if there is no obvious contamination, from a depth halfway between the ground surface and the water table.

Most soil samples will be obtained from split spoon samplers in borings advanced by a truck mounted drilling rig. In Area 2, where much coarse, heterogenous debris is known to have been deposited, borings are probably not feasible; and only surface samples will be collected. Surface soil samples will be collected using hand tools.

Soil samples will be analyzed for chemical parameters identified in Table 4-2. These parameters were selected on the basis of the types of materials or wastes used or generated from operations or other potential sources in the areas.

4.3.1.2 Sediment and Surface Water Sampling

Sediment and surface water samples will be collected from the immediate vicinity of potential sources of contamination (i.e. outfalls). Because of potential for sediment movement from tidal action, sediment samples will also be collected upstream and downstream of the potential source. Sediment samples will be collected from 0" to 12" below ground surface. Sediment contaminated in the past may be present below the surface: therefore, a second, deeper sample (from 12-24") will also be collected at each location. Because most of the outfalls are only active during storm events surface water samples will be collected during such an event. This assumes that during the 23 week field work program at least one such event will occur with sufficient warning to allow for mobilization and sampling. The contingency plan will be to collect samples as soon as possible <u>after</u> a storm event. Sediment and surface water samples will be analyzed for chemical parameters identified in Table 4-2. These parameters were selected on the basis of the type of materials or wastes used or generated from operations or other potential sources in the areas.

4.3.1.3 Groundwater Sampling

Chemicals that have entered groundwater tend to travel horizontally away from the source in a downgradient direction. During this phase of the investigation, groundwater monitoring wells will be positioned downgradient of a number of potential sources to evaluate the effect of these individual sources on groundwater quality. Upgradient wells will be monitored to provide information on the quality of groundwater entering the area (background conditions).

Shallow groundwater is the most likely to be affected by contaminant releases at the ground surface. The water table is reported to be 4 to 11 feet below ground surface, depending on distance from the river. The majority of proposed monitoring wells are in the shallow groundwater bearing zone. Samples from all monitoring wells will be analyzed for TCL VOs, semi-VOs, and total and dissolved metals, plus a 30 compound library search. The library search is used to tentatively identify the 30 highest

TABLE 4-2
SAMPLING MEDIA AND CONTAMINANTS OF CONCERN FOR THE EIGHT IDENTIFIED AREAS OF POTENTIAL ENVIRONMENTAL CONCERN AT SAEP(1)

AREA	SAMPLE MEDIA	CONTAMINANTS OF CONCERN(2)
1 - Intertidal Flats	Sediment and Surface Water	Metals, Cyanide, PCBs, Semi-VOs, and VOs
2 - Causeway	Soil	Asbestos
3 - Hydraulic Fill	Soil and Groundwater	Metals, PCBs, Semi-VOs, and VOs
4 - Plating and Manufacturing	Soil and Groundwater	Metals, Cyanide, Semi-VOs, and VOs
5 - Building 2	Soil and Groundwater	Metals, Semi-VOs, and VOs
6 - Research and Development	Soil and Groundwater	Metals, Semi-VOs, and VOs
Testing	Soil and Groundwater	Metals, Semi-VOs, and VOs
8 - Drainage Ditch	Sediment, and Surface Water	Metals, Cyanide, PCBs, Semi-VOs, and VOs

(1) The eight areas are described in Section 3.0 and shown on Figure 2-2.

(2) Semi-VOs = Semivolatile organic compounds
VOs = Volatile organic compounds
PCBs = Polychlorinated biphenyls

chromatogram peaks, other than those peaks for TCL compounds. The computer library used for the search contains 50,000 compounds.

As discussed in Section 2.1.3, the stratigraphy and the hydrogeology are expected to be complex. Shallow groundwater is expected to flow generally eastward across the site towards the river, but local variations caused by irregularities in permeabilities associated with complex stratigraphy may occur. Areas of perched groundwater and preferential flow pathways in higher permeability soils may exist. The brackish water/fresh water interface near the river and the impact of tidal variations in the Housatonic River on the shallow groundwater zone will add further complexity to flow directions in the shallow groundwater regime.

Hydraulic information on deeper groundwater flow is needed to evaluate potential vertical contaminant transport routes. Both shallow (water table) and deeper ground water monitoring points will be installed. Deeper piezometers will be installed at selected locations at depths of 25 to 35 feet, to provide information on vertical gradients, hydraulic conductivities, and horizontal flow at depth. During this phase of the investigation, the deep piezometers will be used to obtain hydraulic information only (e.g., water levels, insitu permeability tests). Ground water quality analyses from deep piezometers is not planned at this time; however, based on the results of this phase, such sampling and testing may be required in the future.

All new monitoring wells and piezometers will be surveyed for location and elevation. Existing wells to be used in this study will also be surveyed. Slug testing and/or single-well pumping tests will be completed on selected monitoring wells and piezometers to estimate aquifer characteristics. Soil samples from the screened intervals of wells will be submitted for geotechnical analysis (grain size, and if appropriate, Atterberg limits) to provide a further evaluation of permeability. Because the river is tidal, water levels will be measured in all wells through one or more complete tidal cycles to evaluate the relationship between tidal variations and groundwater levels in the shallow and deep zones. This information will be used to evaluate the potential for groundwater flow reversals which might affect contaminant movement. Surface water levels in the intertidal flats and the drainage ditch will also be measured through tidal cycles.

4.3.2 Sampling in Areas of Potential Environmental Concern

A brief discussion of the planned sampling and analytical program at each of the identified areas of potential environmental concern is provided in this section. A more detailed discussion, with maps and tables, is given in the Field Sampling Plan in Appendix A. A summary of the sampling and analytical program is given in Table 4-2.

4.3.2.1 Area 1 - Intertidal Flats

Seven outfalls (001 through 007) discharge into the intertidal flats. Before construction of the OATP, any material or waste dumped or spilled into storm drains was released to the intertidal flats through one or more of these outfalls. Some releases of potentially hazardous materials to the intertidal flats have been documented.

Sediment and surface water samples will be collected near each outfall in the intertidal flats area. Because of the potential for sediment transport by tidal action, samples are also proposed at three locations farther out (east) into the flats. Sediment and surface water samples will be collected on the upstream side of the jetty which extends into the flats. Sediment and surface water from this location is likely to be isolated from any influence of site activities and should be representative of background conditions. A stilling well (STW-1) will be installed in the intertidal flats so that surface water levels can be monitored and variations of surface water levels caused by tides can be compared to variations in groundwater levels measured in monitoring wells.

4.3.2.2 Area 2 - Causeway

The causeway was constructed in the 1930's using an unknown source of fill. Some of the fill is reported to consist of asbestos-containing materials. The causeway was also reportedly used as a training area for the plant's fire department.

Drilling into and through rubble and debris is likely to be difficult. Also, disruptive activities might cause unnecessary releases of asbestos-containing materials into the air. Therefore, only surface soil samples will be collected on the causeway. Ten samples of surface soil will be collected from the causeway. The surface material along the causeway will also be visually surveyed for asbestos-containing materials.

4.3.2.3 Area 3 - Hydraulic Fill Area

The hydraulic fill area has been used to store raw stock, fuels and oils, scrap metals, waste fuels, oils and solvents. Six monitoring wells, eight soil borings, and one shallow sample are proposed in this area. This area is large, and is therefore divided into subareas: B-19, B-34 Tank Farm, B-16, and a northern section which includes B-13, B-15, B-58 and B-65.

<u>B-19</u>

A sample (DW-1) will be collected from the material in a dry well inside Building B-19. This dry well is not currently used but is reported to have been used for disposal of waste fuels, oils and solvents.

Proposed monitoring well WC-1S is located in a drum storage area, east of B-19 where contaminated soils from a drainage system had recently been excavated. Soil samples will be collected from the boring for WC-1S. Soil sampling from one boring (BR-1) is planned in the area north of B-19 where fuel storage tanks were occasionally overfilled. If contamination in soil at the water table is observed during drilling, a Hydropunch sampler will be used to collect a water sample. Results from analysis of this sample will be used to evaluate the need for a monitoring well at this location. (An additional well is not included in the Scope of Work described herein).

<u>B-34 Tank Farm</u>

Monitoring wells WC-2D will be installed in the presumed downgradient direction from the area between B-5 and B-16 where fuel tanks had apparently leaked and petroleum contaminated soil had been discovered. Four monitoring wells, recently installed by Metcalf & Eddy, will be sampled. Since these four existing wells are apparently screened in the shallow ground water zone and the contamination has been identified in these shallow wells, monitoring well WC-2D will be screened at a deeper zone and will be used to evaluate if contamination has migrated downward. Soil samples will be collected from above the water table in the boring for WC-2D to evaluate residual soil contamination in this area.

B-16

Building B-16 contains a system of drains which conveyed waste solvents, oils and fuels, and may have conveyed mercury from manometers. These drains are believed to be in poor condition. To investigate the potential effect on groundwater, two shallow monitoring wells (WC-3S and WC-4S) will be installed and sampled. Deeper piezometer PZ-4D will provide information on deeper horizontal gradients, permeabilities, and vertical gradients in this area. The two shallow monitoring wells may also detect groundwater contaminants resulting from spills that reportedly occurred on the east side of B-16, where waste solvents have been contained in drums or carts and collected on small docks. Analysis of unsaturated (above water table) soil samples collected from borings for WC-3S and WC-4S will be used to evaluate residual soil contamination from these spills.

B-13, B-15, B-58 and B-65

Three shallow monitoring wells, two deep piezometers and seven soil borings are proposed in the northernmost section of Area 3 near B-13, B-15, B-58, B-65, and the tank farm. Five soil borings (BR-2 through BR-6) will be installed outside of B-13, B-15, B-58, and the tank farm where numerous small spills and minor overfills of tanks at the tank farm reportedly occurred. Two soil borings (BR-7 and BR-8) will be advanced adjacent to building B-65 where paint and petroleum-contaminated soils were encountered during recent excavations. Soil samples from the borings for monitoring wells WC-5S, WC-6S, and WC-7S will supplement information from borings BR-2 through BR-8.

Monitoring wells WC-5S, WC-6S, and WC-7S will provide information on groundwater quality in the presumed downgradient direction from these potential areas of concern.

Deep piezometers PZ-5D and PZ-7D will provide information on horizontal and vertical gradients, and hydraulic conductivity of underlying soils (with additional aquifer testing).

The total of six proposed and four existing monitoring wells and five deep piezometers, all situated roughly on the site perimeter, comprise the set of groundwater monitoring points in the presumed downgradient direction from the site. The wells will provide information on quality of shallow groundwater flow leaving the site.

4.3.2.4 Area 4 - Plating and Manufacturing Area

Greenish-blue groundwater was observed during construction of B-10 and B-70, both of which are in the vicinity of the plating shop in B-2. One shallow monitoring well (WC-8S) will be installed in the presumed downgradient (east) direction of B-10 to investigate the potential for groundwater contamination from the B-2 plating shop. One shallow monitoring well (WC-10S) will be installed downgradient of the northern section of the plating area in B-2 and one (WC-12S) will be installed downgradient of the central section. These wells along with existing wells ECD-1 and ECD-4 which are in the vicinity of the south end of the plating shop in B-2, will be sampled.

Soil samples from above the water table in the borings for WC-8S and WC-10S will be analyzed to evaluate residual soil contamination. Proposed deep piezometer PZ-8D will provide information on deep permeabilities and horizontal and vertical flow gradients in this area of the site.

4.3.2.5 Area 5 - Building 2

Building 2 was originally constructed in 1929. Operations include aircraft assembly and engine manufacturing. Cinders and ash, apparently from a former on-site incinerator, were reported during foundation excavations for B-2. Potential effects on shallow groundwater may be apparent in downgradient monitoring wells WC-5S, -6S, and -7S. These wells are in the presumed downgradient direction from the northern end of B-2.

Wells in the presumed upgradient direction of the site will be installed along Main Street (WC-9S and -11S). These wells will provide information on quality of shallow groundwater flowing onto the site. Soil samples from these borings will provide information on background soil conditions. Deep piezometers PZ-9D, PZ-11D and PZ-17D will provide information on deeper permeabilities and horizontal and vertical gradients. One existing shallow well (LW-7) along the southern boundary of Area 5 will also be sampled. This well is in a presumed upgradient direction from Area 5 and the site as a whole.

4.3.2.6 Area 6 - Research and Development Area

Past disposal practices or releases may have impacted soil and groundwater in this area. One shallow well (WC-13S) will be installed in the presumed downgradient (east) direction of B-3 to investigate the potential of groundwater contamination from activities in B-3. Proposed deep piezometer PZ-13D will provide information on deep permeabilities and horizontal and vertical gradients in this area of the site. Aquifer testing will provide limited information on aquifer characteristis of the shallow and deep zones. Existing wells (MW-1, -2, -3 and -4) will be used to assess groundwater quality in the east end of this area.

4.3.2.7 Area 7 - Testing Area

This area includes B-6, which is an engine testing facility. A number of sludge lagoons used as settling ponds for effluent from the CWTP were located just south of this area. These lagoons were closed in 1988. During the lagoon closure oil- stained soils were discovered in an excavation near B-72, which is a fuel storage facility.

Two borings (BR-9 and BR-10), will be installed in the vicinity of B-72 to investigate possible releases of fuel. Two shallow wells (WC-14S and WC-15S) will be installed north and east of B-6, in the presumed downgradient direction of B-6. Both the new wells and existing well LW-10 located just south of B-6 will also be sampled.

4.3.2.8 Area 8 - Drainage Ditch

Outfall 008 discharges into the drainage ditch. This ditch has received treated effluent from the chemical waste treatment plant since 1958 and monitoring has occasionally shown heavy metals in the effluent.

Sediment and surface water samples will be collected at two locations in this area. One sample location is proposed at the outfall and one upgradient sampling location will be used to evaluate background sediment conditions. Because flow in this ditch is tidally influenced, a stilling well (STW-2) will be installed so that surface water levels can be monitored and tidal variations of surface water levels compared and related to variations of groundwater levels in monitoring wells.

5.0
REMEDIAL INVESTIGATION TASKS

5.1 COMMUNITY RELATIONS

This task incorporates all the efforts related to the implementation of the community relations plan for the site (Appendix C). This task begins when the Work Plan is approved and ends when the RI report is submitted. Elements of this task are outlined below and described in detail in Appendix C.

- preparing fact sheets
- providing public meeting support
- providing technical support for community relations
- implementing community relations

5.2 FIELD INVESTIGATION

This task involves all efforts related to fieldwork required to implement this Work Plan. This task will begin when the Work Plan is approved and end when field activities are completed. Elements of this task are outlined below and described in detail in Appendix A.

- procurement of subcontracts
- mobilization
- media sampling
- hydrogeological investigation
- monitoring well and sampling location survey (vertical and horizontal)

5.3 SAMPLE ANALYSIS AND VALIDATION

This task includes all efforts related to laboratory analysis of samples. Analysis begins when the samples are received by the laboratory and ends when the laboratory reports have been reviewed and found to be acceptable. Elements of this task are outlined below and described in detail in the CDAP (Appendix A).

- procurement of subcontracts
- laboratory analysis
- laboratory data validation

5.4 DATA EVALUATION

This task incudes all efforts related to the analysis of the validated data. This task begins when the data validation is complete and ends during the preparation of the RI report. Elements of this task are outlined below.

- data reduction and tabulation
- data evaluation
- evaluation of data gaps

5.5 REMEDIAL INVESTIGATION REPORT

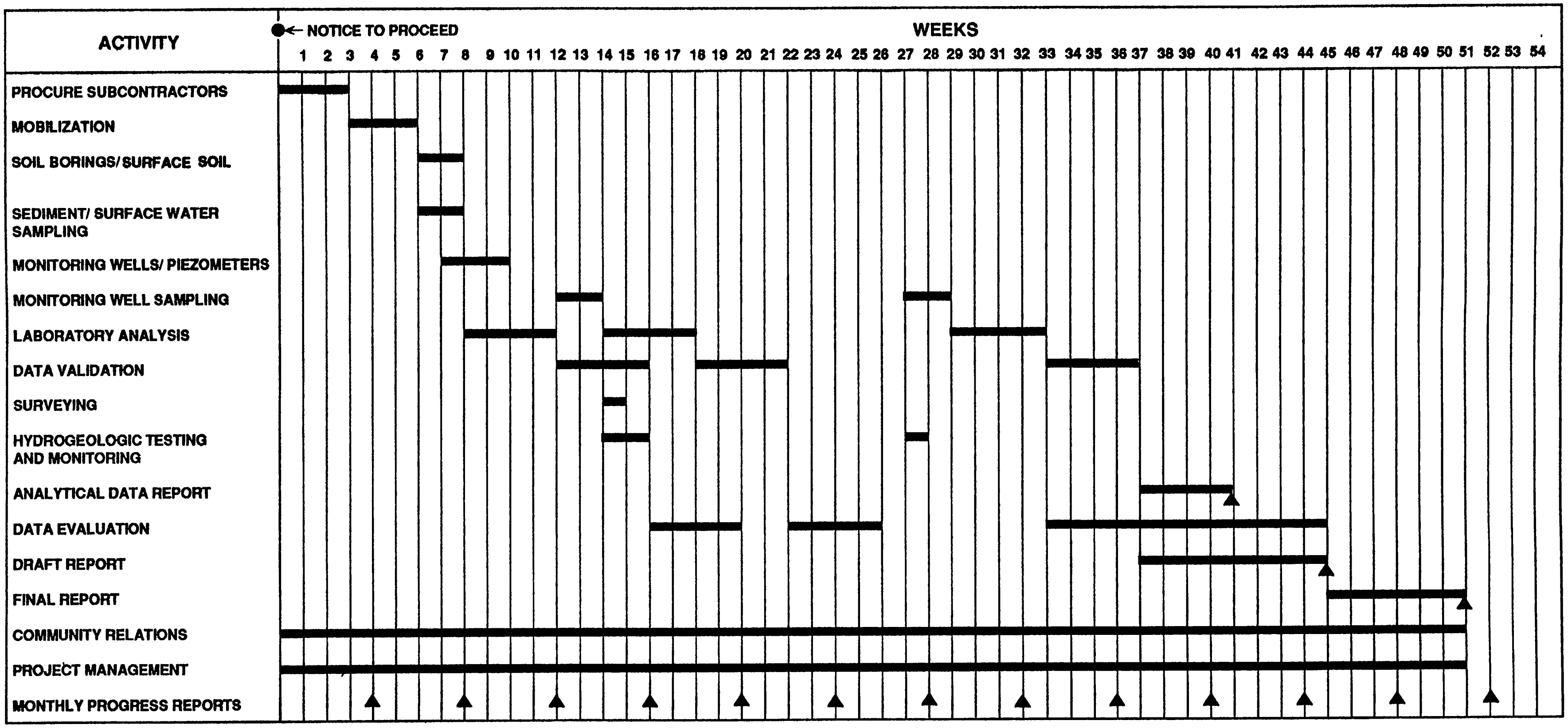
This task includes all efforts related to the presentation of findings once the data has been evaluated. Preliminary work on this task will begin when the field effort is completed. The task will end when the report is submitted to the concerned parties as defined in the USACEs Document Submittal List. Elements of the task are outlined below.

- data presentation
- draft report preparation
- internal WCC peer review
- draft report distribution

- review meeting
- report revisions
- final report distribution

6.0
SCHEDULE

It is estimated that it will take approximately one year to complete all of the Remedial Investigation tasks. A detailed graphical schedule is provided in Figure 6-1.



PROJECT SCHEDULE

REMEDIAL INVESTIGATION–STRATFORD ARMY ENGINE PLANT

STRATFORD, CONNECTICUT

FIGURE 6–1

7.0
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FINAL

APPENDIX A
SAMPLING AND ANALYSIS PLAN

Part 1– Field Sampling Plan

REMEDIAL INVESTIGATION

WORK PLAN

STRATFORD ARMY ENGINE PLANT

STRATFORD, CONNECTICUT

U. S. Army Aviation Systems Command

Prepared for

US Army Corps
of Engineers
Omaha District

U. S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska
January 1992

Woodward-Clyde

One Old Mill Building
101 South 108th Avenue
Omaha, NE 68154

WCC Project No. 89C114CC

TABLE OF CONTENTS

Following
Page

LIST OF TABLES

LIST OF FIGURES

1.0

SITE BACKGROUND

A description of the SAEP site and the purpose of this investigation are contained in Sections 1 and 2 of the RI Work Plan.

2.0
SAMPLING OBJECTIVES

The sampling described herein is designed to determine the presence or absence of contamination at the eight areas of environmental concern identified in the Preliminary Assessment screening. In addition to investigating contamination, the investigation will include a study of the site hydrogeology.

3.0
SAMPLE LOCATION AND FREQUENCY

This section describes the contamination assessment sampling to be conducted in each of the eight areas of potential environmental concern and, in the last subsection, the hydrogeologic investigation plan. Because of name duplication, some of the existing wells have been renamed for the purposes of this study. Wells which were installed for lagoon monitoring are identified with the letters LW (Lagoon Well) followed by the number originally assigned to them. Two wells which were installed in the area of B-70 are identified with the letters ECD (East Coast Drilling) followed by their original numbers.

3.1 AREA 1 - INTERTIDAL FLATS

Sediment and surface water will be sampled at eleven locations in the intertidal flats area as shown on Figure A-1. One of these locations (IBG) is on the east side of the stone jetty which generally separates the intertidal flats from the main course of the Housatonic River. This location was chosen to represent background sediment and surface water conditions. Three of the locations are low-tide stations on the intertidal flats (LT1, LT2, and LT3). The remaining locations are adjacent to the outfalls (OF-001 through OF-007).

Two sediment samples will be collected at each location using a push core sampler. One sediment sample will be collected from 0 to 12 inches below the sediment surface and the other at a depth of 12 to 24 inches. Surface water samples will be collected from the eleven locations during a rainstorm event. This assumes that during the 23 week field work program at least one such event will occur with sufficient warning to allow for mobilization and sampling. The contingency plan will be to collect samples as soon as possible <u>after</u> a storm event.

All of the sediment and surface water samples will be analyzed for the presence of Target Compound List (TCL) volatile (VO) and semi-volatile organic compounds (semi-

VO), metals, cyanide and polychlorinated biphenyls (PCBs) (Table A-1). VO and semi-VO analyses will include a 30 compound library search (+30). Sampling techniques and analytical methods will be as described in the Chemical Data Acquisition Plan (CDAP) (SOPs 6, 7, 10, and 11).

3.2 AREA 2 - CAUSEWAY

Ten surface soil samples (0 to 6 inches) will be collected from the Causeway at the locations shown on Figure A-1 (SF-1 through SF-10). These samples will be analyzed for the presence of asbestos.

Surface soil sampling techniques and laboratory analytical methods will be as described in the CDAP (SOPs 1, 6, and 7).

3.3 AREA 3 - HYDRAULIC FILL AREA

Seven groundwater monitoring wells will be installed in Area 3 at the locations shown in Figure A-1. Six wells (WC-1S, -3S, -4S, -5S, -6S, and -7S) will be installed so that their screens intersect the water table in order to detect floating product if present. Where tidal influences are anticipated, screens will be placed so that they intersect the estimated high tide level. One well (WCC-2D) will be screened below the water table (approximately 25 to 35 ft) in an attempt to vertically delineate shallow groundwater contamination previously detected in this area.

Two rounds of groundwater samples will be collected from each of the new wells described above, and from the four existing wells in this area (MW -1, -2, -3 and -4). The rounds of sampling will be conducted at least three months apart to monitor for seasonal variations. Groundwater samples will be analyzed for the presence of TCL VOs (+15), semi-VOs (+15), total and dissolved metals and PCBs (Table A-1). Well installation, sampling techniques, and analytical methods will be as described in the CDAP (SOPs 2, 3, 6, and 7).

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LEGEND

- ▨ HAZARDOUS WASTE
- ▥ HAZARDOUS WASTE (TO BE PROCESSED)
- ⊖ OIL STORAGE
- ⊖ CHEMICAL STORAGE
- ▨ FUEL STORAGE
- ▩ COMPRESSED GASES
- ○ TANK LOCATIONS
- ⊕ PROPOSED MONITORING WELL LOCATION
- ◐ PROPOSED PIEZOMETER LOCATION
- ● PROPOSED BORING LOCATION
- ◎ PROPOSED STILLING WELL LOCATION
- ◉ EXISTING PAIRED MONITORING WELL LOCATION
- ◕ EXISTING MONITORING WELL LOCATION
- ☐ PROPOSED SEDIMENT AND SURFACE WATER SAMPLING LOCATIONS

NOTE:

LOCATIONS OF EXISTING WELLS ARE APPROXIMATE.

WOODWARD-CLYDE CONSULTANTS
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

SAMPLING LOCATION PLAN
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY MG/EAB	DATE 1/21/92	PROJECT NO.	FIG. NO.
CHK'D BY MEC	DATE 1/21/92	89C114CC	A-1

Table A-1

Contaminant Study
Sampling Locations and Analyses
Stratford Army Engine Plant, Stratford, Connecticut

Area	Subarea	Location *	Media to be Sampled	Sampling Method	Sample Depth	Sample ID	Analytical Parameters
1-Intertidal Flats		Outfall 001	sediment	push core	0-12"	001-0-12	VO, Semi-VO, Met., CN, PCB
		Outfall 001	sediment	push core	12-24"	001-12-24	VO, Semi-VO, Met., CN, PCB
		Outfall 001	surface water	dipper		001-SW	VO, Semi-VO, Met., CN, PCB
		Outfall 002	sediment	push core	0-12"	002-0-12	VO, Semi-VO, Met., CN, PCB
		Outfall 002	sediment	push core	12-24"	002-12-24	VO, Semi-VO, Met., CN, PCB
		Outfall 002	surface water	dipper		002-SW	VO, Semi-VO, Met., CN, PCB
		Outfall 003	sediment	push core	0-12"	003-0-12	VO, Semi-VO, Met., CN, PCB
		Outfall 003	sediment	push core	12-24"	003-12-24	VO, Semi-VO, Met., CN, PCB
		Outfall 003	surface water	dipper		003-SW	VO, Semi-VO, Met., CN, PCB
		Outfall 004	sediment	push core	0-12"	004-0-12	VO, Semi-VO, Met., CN, PCB
		Outfall 004	sediment	push core	12-24"	004-12-24	VO, Semi-VO, Met., CN, PCB
		Outfall 004	surface water	dipper		004-SW	VO, Semi-VO, Met., CN, PCB
		Outfall 005	sediment	push core	0-12"	005-0-12	VO, Semi-VO, Met., CN, PCB
		Outfall 005	sediment	push core	12-24"	005-12-24	VO, Semi-VO, Met., CN, PCB
		Outfall 005	surface water	dipper		005-SW	VO, Semi-VO, Met., CN, PCB
		Outfall 006	sediment	push core	0-12"	006-0-12	VO, Semi-VO, Met., CN, PCB
		Outfall 006	sediment	push core	12-24"	006-12-24	VO, Semi-VO, Met., CN, PCB
		Outfall 006	surface water	dipper		006-SW	VO, Semi-VO, Met., CN, PCB
		Outfall 007	sediment	push core	0-12"	007-0-12	VO, Semi-VO, Met., CN, PCB
		Outfall 007	sediment	push core	12-24"	007-12-24	VO, Semi-VO, Met., CN, PCB
		Outfall 007	surface water	dipper		007-SW	VO, Semi-VO, Met., CN, PCB
		Low tide station 1	sediment	push core	0-12"	LT1-0-12	VO, Semi-VO, Met., CN, PCB
		Low tide station 1	sediment	push core	12-24"	LT1-12-24	VO, Semi-VO, Met., CN, PCB
		Low tide station 1	surface water	dipper		LT1-SW	VO, Semi-VO, Met., CN, PCB
		Low tide station 2	sediment	push core	0-12"	LT2-0-12	VO, Semi-VO, Met., CN, PCB
		Low tide station 2	sediment	push core	12-24"	LT2-12-24	VO, Semi-VO, Met., CN, PCB
		Low tide station 2	surface water	dipper		LT2-SW	VO, Semi-VO, Met., CN, PCB
		Low tide station 3	sediment	push core	0-12"	LT3-0-12	VO, Semi-VO, Met., CN, PCB
		Low tide station 3	sediment	push core	12-24"	LT3-12-24	VO, Semi-VO, Met., CN, PCB
		Low tide station 3	surface water	dipper		LT3-SW	VO, Semi-VO, Met., CN, PCB
		Intertidal backgrnd.	sediment	push core	0-12"	IBG-0-12	VO, Semi-VO, Met., CN, PCB
		Intertidal backgrnd.	sediment	push core	12-24"	IBG-12-24	VO, Semi-VO, Met., CN, PCB
		Intertidal backgrnd.	surface water	dipper		IBG-SW	VO, Semi-VO, Met., CN, PCB
2-Causeway		SF-1	soil	trowel	0-6"	SF-1	Asbestos
		SF-2	soil	trowel	0-6"	SF-2	Asbestos
		SF-3	soil	trowel	0-6"	SF-3	Asbestos
		SF-4	soil	trowel	0-6"	SF-4	Asbestos
		SF-5	soil	trowel	0-6"	SF-5	Asbestos
		SF-6	soil	trowel	0-6"	SF-6	Asbestos
		SF-7	soil	trowel	0-6"	SF-7	Asbestos
		SF-8	soil	trowel	0-6"	SF-8	Asbestos
		SF-9	soil	trowel	0-6"	SF-9	Asbestos
		SF-10	soil	trowel	0-6"	SF-10	Asbestos
3-Hydraulic Fill Area	B-19	WC-1S	groundwater	bailer	screened interval	WC-1S	VO, Semi-VO, Met., PCB
		WC-1S	soil	split-spoon	TBD	WC-1S-a-b	VO, Semi-VO, Met., PCB
		WC-1S	soil	split-spoon	TBD	WC-1S-c-d	VO, Semi-VO, Met., PCB
		Dry well	sediment?	hand auger	6-12"	DW-6-12"	VO, Semi-VO, Met.
		BR-1	soil	split-spon	TBD	BR-1-a-b	VO, Semi-VO, Met., PCB
		BR-1	soil	split-spon	TBD	BR-1-c-d	VO, Semi-VO, Met., PCB
	B-34 tank farm	WC-2D	groundwater	bailer	screened interval	WC-2D	VO, Semi-VO, Met., PCB
		WC-2D	soil	split-spoon	TBD	WC-2D-a-b	VO, Semi-VO, Met., PCB
		WC-2D	soil	split-spoon	TBD	WC-2D-c-d	VO, Semi-VO, Met., PCB
		MW-1	groundwater	bailer	screened interval		VO, Semi-VO, Met., PCB
		MW-2	groundwater	bailer	screened interval		VO, Semi-VO, Met., PCB
		MW-3	groundwater	bailer	screened interval		VO, Semi-VO, Met., PCB
		MW-4	groundwater	bailer	screened interval		VO, Semi-VO, Met., PCB
	B-16	WC-3S	groundwater	bailer	screened interval	WC-3S	VO, Semi-VO, Met., PCB
		WC-3S	soil	split-spoon	TBD	WC-3S-a-b	VO, Semi-VO, Met., PCB
		WC-3S	soil	split-spoon	TBD	WC-3S-c-d	VO, Semi-VO, Met., PCB
		WC-4S	groundwater	bailer	screened interval	WC-4S	VO, Semi-VO, Met., PCB
		WC-4S	soil	split-spoon	TBD	WC-4S-a-b	VO, Semi-VO, Met., PCB
		WC-4S	soil	split-spoon	TBD	WC-4S-c-d	VO, Semi-VO, Met., PCB
	B-13, -15, -58, -65	WC-5S	groundwater	bailer	screened interval	WC-5S	VO, Semi-VO, Met., PCB
		WC-5S	soil	split-spoon	TBD	WC-5S-a-b	VO, Semi-VO, Met., PCB
		WC-5S	soil	split-spoon	TBD	WC-5S-c-d	VO, Semi-VO, Met., PCB

Area	Subarea	Location *	Media to be Sampled	Sampling Method	Sample Depth	Sample ID	Analytical Parameters
		WC-6S	groundwater	bailer	screened interval	WC-6S	VO, Semi-VO, Met., PCB
		WC-6S	soil	split-spoon	TBD	WC-6S-a-b	VO, Semi-VO, Met., PCB
		WC-6S	soil	split-spoon	TBD	WC-6S-c-d	VO, Semi-VO, Met., PCB
		WC-7S	groundwater	bailer	screened interval	WC-7S	VO, Semi-VO, Met., PCB
		WC-7S	soil	split-spoon	TBD	WC-7S-a-b	VO, Semi-VO, Met., PCB
		WC-7S	soil	split-spoon	TBD	WC-7S-c-d	VO, Semi-VO, Met., PCB
		BR-2	soil	split-spoon	TBD	BR-2-a-b	VO, Semi-VO, Met.
		BR-2	soil	split-spoon	TBD	BR-2-c-d	VO, Semi-VO, Met.
		BR-3	soil	split-spoon	TBD	BR-3-a-b	VO, Semi-VO, Met.
		BR-3	soil	split-spoon	TBD	BR-3-c-d	VO, Semi-VO, Met.
		BR-4	soil	split-spoon	TBD	BR-4-a-b	VO, Semi-VO, Met.
		BR-4	soil	split-spoon	TBD	BR-4-c-d	VO, Semi-VO, Met.
		BR-5	soil	split-spoon	TBD	BR-5-a-b	VO, Semi-VO, Met.
		BR-5	soil	split-spoon	TBD	BR-5-c-d	VO, Semi-VO, Met.
		BR-6	soil	split-spoon	TBD	BR-6-a-b	VO, Semi-VO, Met.
		BR-6	soil	split-spoon	TBD	BR-6-c-d	VO, Semi-VO, Met.
		BR-7	soil	split-spoon	TBD	BR-7-a-b	VO, Semi-VO, Met.
		BR-7	soil	split-spoon	TBD	BR-7-c-d	VO, Semi-VO, Met.
		BR-8	soil	split-spoon	TBD	BR-8-a-b	VO, Semi-VO, Met.
		BR-8	soil	split-spoon	TBD	BR-8-c-d	VO, Semi-VO, Met.
4-Plating and	B-10 and -70	WC-8S	groundwater	bailer	screened interval	WC-8S	VO, Semi-VO, Met., CN
Manufacturing		WC-8S	soil	split-spoon	TBD	WC-8S-a-b	VO, Semi-VO, Met., CN
		WC-8S	soil	split-spoon	TBD	WC-8S-c-d	VO, Semi-VO, Met., CN
		ECD-1	groundwater	bailer	screened interval		VO, Semi-VO, Met., CN
		ECD-4	groundwater	bailer	screened interval		VO, Semi-VO, Met., CN
		WC-10S	groundwater	bailer	screened interval	WC-10S	VO, Semi-VO, Met., CN
		WC-10S	soil	split-spoon	TBD	WC-10S-a-b	VO, Semi-VO, Met., CN
		WC-10S	soil	split-spoon	TBD	WC-10S-c-d	VO, Semi-VO, Met., CN
		WC-12S	groundwater	bailer	screened interval	WC-12S	VO, Semi-VO, Met., CN
		WC-12S	soil	split-spoon	TBD	WC-12S-a-b	VO, Semi-VO, Met., CN
		WC-12S	soil	split-spoon	TBD	WC-12S-c-d	VO, Semi-VO, Met., CN
5-Building 2		WC-9S	groundwater	bailer	screened interval	WC-9S	VO, Semi-VO, Met.
		WC-9S	soil	split-spoon	TBD	WC-9S-a-b	VO, Semi-VO, Met.
		WC-9S	soil	split-spoon	TBD	WC-9S-c-d	VO, Semi-VO, Met.
		WC-11S	groundwater	bailer	screened interval	WC-11S	VO, Semi-VO, Met.
		WC-11S	soil	split-spoon	TBD	WC-11S-a-b	VO, Semi-VO, Met.
		WC-11S	soil	split-spoon	TBD	WC-11S-c-d	VO, Semi-VO, Met.
		LW-7	groundwater	bailer	screened interval	WC-12S	VO, Semi-VO, Met.
6-Resrch. & Develop.	B-3	WC-13S	groundwater	bailer	screened interval	WC-13S	VO, Semi-VO, Met.
7-Testing Area	B-6	WC-14S	groundwater	bailer	screened interval	WC-14S	VO, Semi-VO, Met.
		WC-15S	groundwater	bailer	screened interval	WC-15S	VO, Semi-VO, Met.
		BR-9	soil	split-spoon	TBD	BR-9-a-b	VO, Semi-VO, Met.
		BR-9	soil	split-spoon	TBD	BR-9-c-d	VO, Semi-VO, Met.
		BR-10	soil	split-spoon	TBD	BR-10-a-b	VO, Semi-VO, Met.
		BR-10	soil	split-spoon	TBD	BR-10-c-d	VO, Semi-VO, Met.
		LW-10	groundwater	bailer	screened interval	WC-15S	VO, Semi-VO, Met.
8-Drainage Ditch		Outfall 008	sediment	push core	0-12"	008-0-6	VO, Semi-VO. Met., CN, PCB
		Outfall 008	sediment	push core	12-24"	008-12-24	VO, Semi-VO. Met., CN, PCB
		Outfall 008	surface water	dipper		008-SW	VO, Semi-VO. Met., CN, PCB
		Upgradient	sediment	push core	0-12"	008-BG-0-6	VO, Semi-VO. Met., CN, PCB
		Upgradient	sediment	push core	12-24"	008-BG-12-24	VO, Semi-VO. Met., CN, PCB
		Upgradient	surface water	dipper		008-BG-SW	VO, Semi-VO. Met., CN, PCB

Note:

TBD = to be determined

* - see Figure A-1 for locations

VO = target compound list volatile organic compounds

Semi-VO = target compound list semi-volatile organic compounds

Met. = target compound list metals

CN = cyanide

PCB = polychlorinated biphenyls

a-b,c-d = depth intervals to be determined in the field

Two soil samples will be collected from each of the pilot borings to be used for the installation of monitoring wells. One sample from each boring will be collected from 0 to 6 inches above the water table. A second sample will be selected based on field screening observations. Field screening will consist of monitoring for organic vapors using a flame-ionization or photoionization detector and visual inspection for obvious signs of contamination. The soil samples will be analyzed for the presence of TCL VOs (+15), semi-VOs (+15), metals and PCBs (Table A-1). Soil sampling techniques and laboratory analytical methods will be as described in the CDAP (SOPs 1, 6, and 7).

Eight soil borings (BR-1 through BR-8) will be installed at the locations shown in Figure A-1. One sample will be collected from each boring from 0 to 6 inches above the water table. A second sample will be selected based on field screening observations. These samples will be analyzed for the presence of the same compounds as those collected from the monitoring well pilot borings. Soil sampling techniques and laboratory analytical methods will be as described in the CDAP (SOPs 1, 6, 7, and 8).

For boring BR-1 if soil at the water table is obviously contaminated, a Hydropunch sampler will be used to collect a water sample.

One sample will be collected from the material at the bottom of the dry well in Building 19. The sample will be collected from a depth of 6 to 12 inches below the surface and analyzed for the presence of TCL VOs (+15), semi-VOs (+15) and metals (Table A-1). Sampling technique and laboratory analytical methods will be as described in the CDAP (SOPs 6, 7, and 11).

3.4 AREA 4 - PLATING AND MANUFACTURING

Three groundwater monitoring wells (WC-8S, WC-10S and WC-12S) will be installed in Area 4 at the locations shown in Figure A-1. The wells will be installed so that their screens intersect the water table in order to detect floating product, if present.

Two rounds of groundwater samples will be collected from the newly installed well described above and from two existing wells in this area (ECD-1 and ECD-4). Groundwater samples will be analyzed for the presence of TCL VOs (+15), semi-VOs (+15), total and dissolved metals and cyanide (Table A-1). Well installation, sampling techniques and analytical methods will be as described in the CDAP (SOPs 2, 3, 6, and 7).

Two soil samples will be collected from each of the pilot boring to be used for the installation of monitoring wells WC-8S, WC-10S and WC-12S. One sample will be collected from 0 to 6 inches above the water table. A second sample will be selected based on field observations. The soil samples will be analyzed for the presence of TCL VOs (+15), semi-VOs (+15), metals and cyanide (Table A-1). Soil sampling techniques and laboratory analytical methods will be as described in the CDAP (SOPs 1,6, and 7).

3.5 AREA 5 - BUILDING 2

Two groundwater monitoring wells (WC-9S and -11S) will be installed west of Building 2 to monitor the quality of groundwater entering the site from the presumed upgradient direction (Figure A-1). The wells will be installed so that their screens intersect the water table in order to detect floating product, if present.

Two rounds of groundwater samples will be collected from each of the newly installed wells described above. Existing well LW-7 will also be sampled to provide background groundwater quality data. The rounds of sampling will be conducted at least three months apart to monitor for seasonal variations. Groundwater samples from these wells will be analyzed for the presence of TCL VOs (+15), semi-VOs (+15), and total and dissolved metals (Table A-1). If PCBs and/or cyanide are detected in first-round samples from other wells on the site, then the upgradient wells will be analyzed for the presence of PCBs and/or cyanide in the second round. Well installation, sampling techniques and analytical methods will be as described in the CDAP (SOPs 2, 3, 6, and 7).

Two soil samples will be collected from each of the pilot boring to be used for the installation of monitoring wells WC-9S and WC-11S. One sample will be collected from 0 to 6 inches above the water table. A second sample will be selected based on field observations. The soil samples will be analyzed for the presence of TCL VOs (+15), semi-VOs (+15), and metals (Table A-1). Soil sampling techniques and laboratory analytical methods will be as described in the CDAP (SOPs 1, 6, and 7).

3.6 AREA 6 - RESEARCH AND DEVELOPMENT

One groundwater monitoring well (WC-13S) will be installed in Area 6 at the location shown in Figure A-1. The well will be installed so that its screen intersects the water table in order to detect floating product, if present.

Two rounds of groundwater samples will be collected from this well. The rounds of sampling will be conducted at least three months apart to monitor for seasonal variations. Groundwater samples will be analyzed for TCL VOs (+15), semi-VOs (+15), and total and dissolved metals (Table A-1). Well installation, sampling techniques, and analytical methods will be as described in the CDAP (SOPs 2, 3, 6, and 7).

3.7 AREA 7 - TESTING AREA

Two groundwater monitoring wells (WC-14S and -15S) will be installed in Area 7 at the location shown in Figure A-1. The wells will be installed so that their screens intersect the water table in order to detect floating product, if present.

Two groundwater samples will be collected from these newly installed wells and from existing well LW-10. The rounds of sampling will be conducted at least three months apart to monitor for seasonal variations. Groundwater samples will be analyzed for TCL VOs (+15), semi-VOs (+15), and total and dissolved metals (Table A-1). Well installation, sampling techniques and analytical methods will be as described in the CDAP.

Two soil borings (BR-9 and BR-10) will be installed at the locations shown in Figure A-1. One sample from each boring will be collected from 0 to 6 inches above the water table. A second sample will be selected based on field observations. The soil samples will be analyzed for the presence of TCL VOs (+15), semi-VOs (+15), and metals (Table A-1). Soil sampling techniques and laboratory methods will be as described in the CDAP.

3.8 AREA 8 - DRAINAGE DITCH

Sediment and surface water will be sampled at two locations in the drainage ditch. One location will be directly beneath effluent outfall 008. The second location will be as far upgradient as possible (north of the outfall) within the ditch.

Two sediment samples will be collected at each location using a push core sampler. One sample will be collected from 0 to 12 inches below the sediment surface and the other at a depth of 12 to 24 inches. Surface water samples will be collected from the same two locations.

All of the samples will be analyzed for the presence of TCL VOs (+15), semi-VOs (+15), metals (total and dissolved, for surface waters), cyanide and PCBs (Table A-1).

3.9 HYDROGEOLOGIC STUDY

Groundwater level monitoring and aquifer testing will be used to assess the hydrogeologic conditions beneath the plant. All of the existing wells and all of the new monitoring wells will be used in this study. In addition, ten piezometers (Area 3: PZ-1D, -4D, -5D, -7D; Area 4: PZ-8D, -16D; Area 5: PZ-9D, -11D, -17D; Area 6: PZ-13D) and two stilling wells (SW-1 and SW-2) will be installed for the hydrogeologic study at the locations shown on Figure A-1.

Two rounds of water level monitoring will be conducted at least three months apart. Each round will consist of two complete sets of measurements; one during high tide and one during the following low tide. Salinity and conductivity will also be measured in each well. Wells and piezometers to be used for this investigation are listed in Table A-2. This list includes two stilling wells which will be installed to monitor surface water elevations in the tidal flats (Area 1) and the drainage ditch (Area 8).

Groundwater levels will be monitored in selected wells and piezometers for one 24-hour period in order to evaluate tidal influences. Approximately six locations will be monitored. Representative locations will be selected after the first complete round of water level monitoring has been performed and the data reduced. Automatic water level data recorders will be installed at each selected location. These devices will record either continuously (if manual) or at fifteen minute interval (if electronic).

Aquifer permeability testing will be performed in 14 wells and piezometers (Table A-2). Depending on the anticipated permeabilities, the wells and piezometers will either be slug tested and/or subjected to single-well pumping tests. In order to minimize the amount of potentially contaminated water requiring disposal, the single-well tests will be run on new wells during development. Permeability data derived from these tests combined with the hydraulic gradient and porosities will be used to estimate the rates of groundwater flow in the facility area. Testing and data reduction will be performed as described in the CDAP.

Porosities will be determined using geotechnical testing methods. Fine grained components will be analyzed using the Atterberg Limits test. Coarse grained components will be subjected to sieve analysis. Samples for geotechnical analysis will be collected from pilot boreholes for selected wells and piezometers. Samples will be collected from the interval to be screened.

Table A-2

Hydrogeological Study
Sampling Locations and Testing
Stratford Army Engine Plant, Stratford, Connecticut

Area	Well or Piezometer Number	Screened Interval**	Testing *
1-Intertidal Flats	STW-1		synoptic level measurements
2-Causeway			
3-Hydraulic Fill Area	WC-1S	5-15'	synoptic level measurements;permeability;geotech. analysis
	PZ-1D	25-35'	synoptic level measurements;permeability;geotech. analysis
	MW-1	2-15'	synoptic level measurements
	MW-2	2-15'	synoptic level measurements
	WC-2D	25-35'	synoptic level measurements
	MW-3	2-15'	synoptic level measurements
	MW-4	5-15'	synoptic level measurements
	WC-3S	2-12'	synoptic level measurements
	WC-4S	2-12'	synoptic level measurements;permeability;geotech. analysis
	PZ-4D	25-35'	synoptic level measurements;permeability;geotech. analysis
	WC-5S	2-12'	synoptic level measurements;permeability;geotech. analysis
	PZ-5D	25-35'	synoptic level measurements;permeability;geotech. analysis
	WC-6S	2-12'	synoptic level measurements
	WC-7S	2-12'	synoptic level measurements; geotech. analysis
	PZ-7D	35-45'	synoptic level measurements;permeability;geotech. analysis
4-Plating and Manufacturing	WC-8S	4-14'	synoptic level measurements;permeability;geotech. analysis
	PZ-8D	25-35'	synoptic level measurements;permeability;geotech. analysis
	ECD-1	8-18'	synoptic level measurements
	ECD-4	8-18'	synoptic level measurements
	PZ-16D	25-35'	synoptic level measurements;permeability;geotech. analysis
	WC-10S	4-14'	synoptic level measurements
	WC-12S	4-14'	synoptic level measurements
5-Building 2	WC-9S	4-14'	synoptic level measurements;permeability;geotech. analysis
	PZ-9D	25-35'	synoptic level measurements;permeability;geotech. analysis
	WC-11S	4-14'	synoptic level measurements;permeability;geotech. analysis
	PZ-11D	25-35'	synoptic level measurements;permeability;geotech. analysis
	PZ-17D	25-35'	synoptic level measurements;permeability;geotech. analysis
6-Resrch. & Develop.	WC-13S	2-12'	synoptic level measurements
	PZ-13D	25-35'	synoptic level measurements;permeability;geotech. analysis
7-Testing Area	WC-14S	2-12'	synoptic level measurements
	WC-15S	2-12'	synoptic level measurements
	LW-10	5-15'	synoptic level measurements
8-Drainage Ditch	STW-2		synoptic level measurements
Lagoon Area	LW-1S	?	synoptic level measurements
	LW-1I	15-25'	synoptic level measurements
	LW-2	15-25'	synoptic level measurements
	LW-3S	?	synoptic level measurements
	LW-3I	15-25'	synoptic level measurements
	LW-4	25-35'	synoptic level measurements
	LW-5S	?	synoptic level measurements
	LW-5I	20-30'	synoptic level measurements
	LW-6	19-29'	synoptic level measurements
	LW-7	20-30'	synoptic level measurements
	LW-8	5-15'	synoptic level measurements
	LW-9	5-15'	synoptic level measurements
	LW-11	5-15'	synoptic level measurements
	LW-12	5-15'	synoptic level measurements
	LW-13	5-15'	synoptic level measurements

*Two rounds of synoptic water level, salinity, and conductivity measurements will be conducted.
Each round will consist of 2 sets of measurements: one during high tide, and one during low tide.
The type of permeability testing to be performed will be based on the nature of the materials in the screened interval.

**Screened intervals for new wells and piezometers are estimated and will be determined based on groundwater depths and stratigraphy

4.0
SAMPLE DESIGNATION

Sample designations (ID's) have been pre-assigned and are listed in Table A-1. The ID's were developed to allow logical correlation with sampling locations. The sample designation scheme is explained in SOP 6 of the CDAP.

5.0
SAMPLING EQUIPMENT AND PROCEDURES

General descriptions of sampling equipment and procedures are given below; details of the same are provided in the CDAP.

Boring Installation Soil Sampling

Soil borings will be drilled by auger methods. Drilling equipment which enters the boreholes will be steam cleaned between holes. Soil samples will be collected from boreholes using stainless steel split-spoon samplers. Samples for laboratory analysis will be transferred to laboratory-cleaned jars using decontaminated stainless-steel spoons. Where sampling depth intervals have not been assigned samples will be selected based on field screening for organic vapors using a flame-ionization or photo-ionization detector or obvious signs of contamination. Borings which are not to be used for well or piezometer installation will be terminated at the top of the water table. All borings will be tremie grouted upon completion.

Shallow Soil and Sediment Sampling

Shallow soil and sediment will be sampled using decontaminated hand tools. Stainless steel trowels will be used to sample shallow soil. Push cores or hand augers will be used to sample sediment.

Surface Water Sampling

Surface water samples will be collected by sample container immersion or by using a transfer device such as a dedicated beaker or dipper.

Monitoring Well Installation and Groundwater Sampling

Pilot boreholes for monitoring wells will be drilled using the technique described above for soil borings with some modification. Where deep piezometers or wells are to be installed, a working casing will be installed to prevent cross-contamination during drilling. The casing will be installed to two feet below the water table. The remainder of the boring will then be drilled with clean, decontaminated augers. Six inch boreholes will be used for the installation of monitoring wells. Well risers and screens will be constructed of flush threaded 2 inch Schedule 40 PVC. Well screens will be 10 ft long and factory-slotted with 0.01 inch openings. Morie sand No. 1 or equivalent will be used as gravel pack around the screens. The pack will extend 2 ft above the screen whenever possible. The top of the gravel pack will be sealed using a 3 ft thickness of bentonite pellets. The remainder of the annulus will be sealed with cement grout. (Note that the thickness of bentonite seals and filter packs may need to be reduced in areas of the plant where the depth to groundwater is shallow.) This well construction conforms to USACE requirements and, based on a conversation with John Feathers of CDEP, will be acceptable for Connecticut. However, it should be noted the EPA usually requires 4 inch stainless steel wells for long-term monitoring; and that if monitoring is required, PVC wells may not be adequate. Also, if chlorinated solvents are present in the groundwater in high concentrations (greater than 1 ppm) they may degrade the PVC. At this time we have no reason to expect to find high levels of these compounds.

Wells will be developed by pumping, surging or bailing as appropriate. The procedures described above will also be used for the installation of piezometers.

Monitoring wells (not piezometers) will be sampled no sooner than two weeks after development. Before sampling, each well will be purged of 5 casing volumes or pumped dry if recharge is slow. Samples will be collected with laboratory decontaminated, well-dedicated stainless steel bailers.

General Procedures

Groundwater generated during well development and purging, and drill cuttings generated during boring installation will be stored in appropriate drums on site. The disposition of the drums will be determined based on analytical results. Composite samples will be collected from drums of like material (i.e. water or soil) within each area of concern. These samples will be analyzed for waste classification using Toxicity Characteristic Leaching Procedure (TCLP). WCC will be responsible for all aspects of the disposal of contaminated materials, except for signing manifests.

Wells, piezometers and boring locations will be located vertically and horizontally by a licensed surveyor. Ground elevations will be measured to the nearest 0.1 ft and well casings to the nearest of 0.01 ft. The locations and elevations will be plotted on existing site plans at a scale of 1 inch represents 100 ft.

6.0
SAMPLE HANDLING AND ANALYSIS

A sample numbering system will provide a tracking mechanism to allow retrieval of each sample, and information concerning the sample location and description. A unique sample identification number will be assigned to each sample. Chain-of-custody (COC) forms will be used to document the possession of the samples from collection by the field sampling team through shipping, storage and analysis, to data reporting by the laboratory.

Appropriate procedures and safeguards shall be used for all sample packaging and shipping activities. Sample analyses will be performed by a certified laboratory approved by the USACE and the State of Connecticut. The laboratory will comply with all appropriate quality assurance/quality control requirements of the USACE. Laboratory procedural details will be submitted and samples will be analyzed using the EPA SW-846 methodologies.

FINAL

APPENDIX A
SAMPLING AND ANALYSIS PLAN

Part 2– Chemical Data Acquistion Plan

REMEDIAL INVESTIGATION

WORK PLAN

STRATFORD ARMY ENGINE PLANT

STRATFORD, CONNECTICUT

U. S. Army Aviation Systems Command

Prepared for

US Army Corps
of Engineers
Omaha District

U. S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska
January 1992

Woodward-Clyde

One Old Mill Building
101 South 108th Avenue
Omaha, NE 68154

WCC Project No. 89C114CC

TABLE OF CONTENTS

Section Page

TABLE OF CONTENTS

Section Page

Section Page

LIST OF TABLES

Following Text Page

Following

LIST OF FIGURES Text Page

LIST OF ATTACHMENTS

PROJECT ACRONYMS AND DEFINITIONS

The following acronyms and definitions apply to terms commonly used in the text of this document:

Accuracy	Nearness of a measurement or the mean ($\bar{x}$) of a set of measurements to the true value. Accuracy is evaluated by the percent recovery of sample spikes, analysis of laboratory control samples, and reference materials.
ACM	Asbestos-containing material
Analytical Batch	The basic unit for analytical quality control is the analytical batch. The analytical batch is defined as samples which are analyzed together with the same method sequence, the same lots of reagents, and with the manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch should be of similar matrix (e.g., groundwater, surface water, soil, sediment, etc.).
ARAR	Applicable or Relevant and Appropriate Requirement
AVSCOM	U.S. Army Aviation Systems Command

Batch	Synonymous with Sample Delivery Group.
Calibration Blank	Usually an organic or aqueous solution that is as free of analyte as possible and prepared with the same volume of chemical reagents used in the preparation of the calibration standards, and diluted to the appropriate volume with the same solvent (water or organic) used in the preparation of the calibration standard. The calibration blank is used to give the null reading for the instrument response versus the concentration calibration curve.
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	U.S. Environmental Protection Agency Contract Laboratory Program.
Co-located Samples	Two or more separate samples taken from the same location, but not homogenized.
Comparability	A measure of the confidence with which one data set can be compared with another.

Completeness	A measure of the amount of valid sample data obtained from the measurement system compared to the amount of sample data that are analyzed. Valid results are those results which meet or exceed quality control criteria and satisfy quality assurance objectives.
Duplicate	Duplicate samples are two samples taken and analyzed independently. In cases where aliquoting is impossible, as in the case of volatiles, co-located samples must be taken for the duplicate analysis.
Environmental Samples	An environmental sample or field sample is a representative sample of any material (aqueous, nonaqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required.
Field Rinsate Sample	Reagent water or other equivalent analyte-free material is transported to the site, opened in the field, and poured over or through the sample collection device, collected in a sample container, and returned to the laboratory. This serves as a check on sampling device cleanliness and potential cross-contamination.
Matrix Spike (MS)	A matrix spike is employed to provide a measure of accuracy for the method used in a given matrix. A matrix spike analysis consists of adding a predetermined quantity of stock solutions of certain analytes to a sample matrix prior to sample extraction/digestion and analysis. The concentration of the spike should be at

	the regulatory standard level, or the reporting limit for the method if the sample is free of the analyte.
Matrix Spike Duplicate	A second matrix spike sample prepared identically to the matrix spike on a duplicate sample of the matrix.
MDL	The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method Blank	A sample matrix that is as free of analyte as possible, and contains all the reagents in the same volume as used in the processing of the samples. The method blank must be carried throughout the complete sample preparation procedure, and contain the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to monitor for possible contamination resulting from the preparation or processing of the sample.
Opportunity Samples	Samples taken for appropriate chemical analysis at locations determined in the field as important in the fulfillment of site objectives.
PCBs	Polychlorinated biphenyls

Performance Evaluation Sample	A material of known composition that is analyzed concurrently with test samples during a measurement process. It is used to verify the performance of the analytical system. These samples are provided by the USACE during the laboratory validation process.
Precision	Precision is the agreement between a set of replicate measurements without assumption or knowledge of the true value. Precision is evaluated as the relative percent difference or relative standard deviation for replicate or split samples.
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
Replicate Samples	Replicate samples are two or more samples collected separately at the same location.
Reporting Limit	The reporting limit is the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions as defined by laboratory QA procedures.

Representativeness	The degree to which a single measurement is indicative of the characteristics of a larger sample or area, or the degree to which data represents field conditions.
RPD	Relative Percent Difference, calculated as $RPD\ (\%) = \frac{\lvert S-D \rvert}{(S+D)/2} \times 100$ where S = first sample value (original) D = second sample value (duplicate)
SAEP	Stratford Army Engine Plant
SAS	CLP Special Analytical Services
Semi-VO	Semi-volatile organic compounds
SOP	Standard operating procedure
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TLS	Textron Lycoming, Stratford Operations
Trip Blank	A sample of reagent water that is as free of organic analyte as possible and is transported to the sampling site and returned to the laboratory without being opened. This serves as a check on sample contamination originating from the container or sample transport.

USACE	US Army Corps of Engineers
USDA	US Department of the Army
USEPA	US Environmental Protection Agency
VO	Volatile organic compounds
WCC	Woodward-Clyde Consultants

1.0
INTRODUCTION

1.1 PROJECT BACKGROUND

Project background information for SAEP and the Remedial Investigation (RI) is contained in Sections 1 and 2 of the RI Work Plan.

1.2 CHEMICAL DATA ACQUISITION PLAN (CDAP) DESCRIPTION

This CDAP has been prepared based on the requirements presented in the Scope of Work July 1991 and the USDA guidance document entitled Engineering and Design-Chemical Data Quality Management for Hazardous Waste Remedial Activities, October 1, 1990 ER-1110-1-263.

Many of the procedures for conducting the field activities for the RI are described in the Standard Operating Procedures (SOPs) presented in Attachment A of this CDAP.

The proposed laboratory for conducting chemical analyses is Nytest Environmental, Inc. (NEI), Port Washington, New York. Omega Laboratories, Inc., of Hackensack, New Jersey will perform asbestos analysis. Laboratory QA/QC manuals will be sent to USACE and MRD for laboratory validation.

1.3 SITE DESCRIPTION AND HISTORY

A description of the site conditions and a history of activities and investigations at the site is presented in the Work Plan.

1.4 WORK PLAN SCHEDULE

The proposed schedule for the Remedial Investigation (RI) activities is presented in Figure 6-1 of the Work Plan. This schedule is based on the date of authorization by

USACE to proceed with the RI activities. Anticipated milestones in the schedule such as deliverables, documents, and the initiation or completion of major project activities are identified.

Mobilization for site investigation activities should commence upon receipt of authorization to proceed by the USACE. Investigation and analysis activities are expected to extend for 9 months. The entire RI is estimated to be completed in one year.

The proposed schedule represents an aggressive approach to meet overall project objectives. Attainment of the project schedule goals is partially dependent upon expedited regulatory review and USACE review.

2.1 REMEDIAL INVESTIGATION OBJECTIVES

The primary objective of this Remedial Investigation (RI) is to determine the presence or absence of contamination at the eight areas of potential environmental concern identified in the Preliminary Assessment Screening (PAS) for SAEP.

Specific objectives of this Remedial Investigation include the following:

- Determine pertinent parameters of any contamination found (type, concentration, location).
- Characterize the physical properties of the soil and sediment material.
- Study the hydrogeological conditions at SAEP and the immediate surrounding area.

2.2 DEVELOPMENT OF DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are defined as qualitative and quantitative statements which specify the quality of the data required to support decisions regarding remedial investigation activities. DQOs are determined based on the end uses of the data to be collected and, therefore, vary with each intended use.

Data will be generated and collected to provide information concerning the soil, sediment, geological, and groundwater characteristics at the facility. The following data needs are identified for this RI:

- evaluate characteristics of soil and sediment, including chemical and physical properties, and contaminant concentrations, if any;

- determine the near surface stratigraphic units; and,
- identify depth to groundwater, selected aquifer characteristics, groundwater flow direction, and chemical contamination of groundwater, if any.

2.2.1 General Data Quality Needs

Factors involved in assessing the level of chemical data quality include appropriate analytical levels, contaminants of concern, and concentrations expected or appropriate detection limits, and samples designated as critical. The following sections describe the intended level of data quality determined as appropriate for the SAEP RI.

2.2.1.1 Analytical Level

The following are the general analytical levels, as defined by the EPA, with respect to data quality.

- Level I - Samples are field screened or analyzed using portable instruments. Results are often not compound specific and not quantitative, but are available in real-time, and provide initial screening information. These results are also used in modifying health and safety procedures. Field screening is the least costly of the analytical options.
- Level II - Samples are analyzed in the field using more sophisticated portable analytical instruments; in some cases, the instruments may be set up in a mobile laboratory on site. There is a wide range in the quality of data that can be generated. The quality of the data depends on the use of suitable calibration standards, reference materials, sample preparation equipment, detection limits, interference factors, and training of the operator. Results are available in real-time or within several hours.

- Level III - Samples are analyzed in an off-site analytical laboratory. Level III analyses may or may not use Contract Laboratory Program (CLP) procedures; but, although QA/QC may be rigorous, Level III analyses do not usually use the validation or documentation procedures required of Level IV (CLP) analysis. Generally, USEPA SW-846 methodologies with specified QA/QC protocols fall into this level.

- Level IV - CLP Routine Analytical Services (RAS). All samples are analyzed in an off-site CLP analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation.

- Level V - Analysis by nonstandard methods. Samples are analyzed in an off-site analytical laboratory which may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP Special Analytical Services (SAS) are Level V.

Table 2-1 presents a typical characterization of these levels. In general, for SAEP RI, Level I is to be used for field screening of samples, and for health and safety purposes. Level II is appropriate for some field geotechnical analyses and some field screening procedures. Level III is appropriate for all samples sent off site for chemical analysis. Levels IV and V will not be used for the activities proposed in this Work Plan for the RI. Further details of the analytical levels selected for site investigations are discussed in Section 4.0.

2.2.1.2 Detection Limit Requirements

The primary data for this RI will be from Level III analysis. The detection limits required for Level III analysis are determined on a site-specific basis dependent upon the contaminants of concern, and the applicable or relevant and appropriate requirements (ARARs). Details of method and site-specific detection limits are addressed in Section 6.0.

2.3. QUALITY ASSURANCE OBJECTIVES

The overall QA objective for the RI at SAEP is to develop and implement procedures for sampling, laboratory analyses, field measurements, and reporting that provide data to a degree of quality consistent with their intended use. The sample set, chemical analysis results, and interpretations must be based on data that meet or exceed quality assurance objectives established for the project. Quality assurance objectives for field measurement systems are also an important aspect of these investigations. These objectives for non-chemical data are discussed in the appropriate SOPs. The following sections discuss field and laboratory analytical measurements.

Quality assurance objectives are usually expressed in terms of accuracy, precision, completeness, representativeness, and comparability. Target ranges for these objectives are presented for analytical testing and field measurements. Variances from the quality assurance objectives result in the implementation of appropriate corrective measures and an assessment of the impact of corrective measures on the usability of the data in the decision-making process.

2.3.1 Level of Effort

2.3.1.1 QC Effort

Field duplicates and field blank samples will be collected and submitted to the analytical laboratory to provide a means to assess the quality of the data resulting from the field sampling program. Field duplicate samples will be analyzed to check for sampling and

TABLE 2-1
SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES

DATA USES	ANALYTICAL LEVEL	TYPE OF ANALYSIS	LIMITATIONS	DATA QUALITY
Site Characterization, Monitoring during Implementation	Level I	- Total organic/inorganic vapor detection using portable instruments	- Instruments respond to naturally-occurring compounds	- If instruments calibrated and data interpreted correctly, can provide indication of contamination
Site Characterization, Evaluation of Alternatives, Engineering Design, Monitoring during Implementation	Level II	- Variety of organics by GC; inorganics by AA; XRF - Tentative ID; analyte-specific - Detection limits vary from low ppm to low ppb	- Tentative ID - Techniques/instruments limited mostly to volatiles, metals	- Dependent on QA/QC steps employed - Data typically reported in concentration ranges
Risk Assessment, PRP Determination, Site Characterization, Evaluation of Alternatives, Engineering Design, Monitoring during Implementation	Level III	- Organics/inorganics using EPA procedures other than CLP can be analyte-specific - RCRA characteristic tests	- Tentative ID in some cases - Can provide data of same quality as Levels IV, V	- Similar detection limits to CLP - Less-rigorous QA/QC
Risk Assessment, PRP Determination, Evaluation of Alternatives, Engineering Design	Level IV	- HSL organics/inorganics by GC/MS; AA; ICP - Low ppb detection limit	- Tentative identification of non-HSL parameters - Some time may be required for validation of packages	- Goal is data of known quality - Rigorous QA/QC
Risk Assessment, PRP Determination	Level V	- Nonconventional parameters - Method-specific detection limits - Modification of existing methods - Appendix 8 parameters	- May require method development/modifications - Mechanism to obtain services requires special lead time	- Method-specific

Source: EPA Data Quality Objectives for Remedial Response Activities 540/G-87/003 laboratory reproducibility. Field blank samples will be analyzed to check for procedural contamination and cross-contamination. Matrix spike (MS), matrix spike duplicate (MSD), and laboratory control samples will be analyzed to assess whether recoveries falling outside acceptance criteria are attributable to sample matrix interferences and not to laboratory analytical errors, as well as to measure the precision of the analysis. The general level of this QC effort for the SAEP RI will be a minimum of one field duplicate collected for every 20 investigative soil, sediment, surface water and groundwater samples collected and analyzed for chemical parameters. The actual frequency may be higher and will be determined in accordance with site-specific objectives. One field blank sample per day will be collected for each media sampled. One matrix spike and one matrix spike duplicate sample will be analyzed for each matrix per analytical batch, which is usually set at a maximum of 20 samples per batch.

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort specified in USEPA SW-846, Third Edition. The level of laboratory QC effort required for specific analytical parameters is summarized in Table 2-2.

The QC level of effort for the field measurement of pH consists of premeasurement calibration and postmeasurement verification using a standard reference solution at least once per day or one in 20 samples. The QC effort for field conductivity and salinity measurements will include daily calibration of the instrument, using standard solutions of known conductivity and salinity as specified in SOP No. 3.

2.3.1.2 QA Effort

Field duplicates and replicates may be collected for specific parameters and submitted to an independent government quality assurance laboratory. The USACE has chosen the Missouri River Division (MRD) Laboratory for this project. QA samples shall be collected and submitted as directed by the USACE MRD project manager.

2.3.2 Measurement of Data Quality Objectives

2.3.2.1 Accuracy

Accuracy is the degree of agreement of a measurement to an accepted reference or true value. An evaluation of the accuracy of a measurement system provides an estimate of bias. The accuracy of an analytical method is evaluated by analyzing known reference standards. The percent recovery achieved by analysis of known reference standards, laboratory control, or spiking compounds will be used to define the accuracy for the compounds of interest. One known reference standard is also analyzed for every batch of 20 samples.

The estimated ranges of accuracy for each measurement parameter are defined within the analytical test methods. Acceptable accuracy measures are also dependent on the sample matrix. Accuracy criteria (percent recovery) for the parameters to be analyzed by the analytical laboratory will be provided under separate cover with the NEI Laboratory QA/QC Manual.

The accuracy of field measurements such as pH will be assessed through premeasurement calibrations and postmeasurement verifications, using at least two standard buffer solutions. The two measurements must each be within 0.1 standard unit of buffer solution values.

2.3.2.2. Precision

Precision is the measure of variability between individual sample measurements under prescribed conditions. Precision can be assessed by replicate measurements of known standards and analysis of duplicate environmental samples. Replicate samples are compared by calculating the sample standard deviation, while the precision of duplicate samples is expressed as relative percent difference (RPD).

TABLE 2-2
QC LEVEL OF EFFORT FOR ANALYTICAL TESTING

PARAMETERS	QC MEASURE	FREQUENCY
Metals	Calibration Blank (ICP and AA)	Each Calibration, beginning and end of each run, 10% frequency
	Initial Calibration Verification (ICP and AA)	Daily for each instrument setup
	Continuing Calibration Verification (ICP and AA)	Beginning and end of each run; 10% frequency or every 2 hours
	Preparation Blank (ICP and AA)	One per analytical batch[1]
	Matrix Spike Analysis (ICP and AA)	One per matrix
	Matrix Spike Duplicate	One per matrix
	Duplicate Sample Analysis (ICP and AA)	One per 20 samples
	Laboratory Control Sample Analysis (ICP and AA)	One per analytical batch[1]
	Analytical Spike (AA-Furnace)	Each sample (at least a single analytical spike will be performed to determine if the method of standard addition is required for quantitation)
	Interference Check Sample (ICP)	Beginning and end of each day
Volatile Organic Compounds and Semivolatile Organic Compounds[2]	Laboratory Blank	One per analytical batch
	Continuing Calibration	Daily and each instrument setup
	Laboratory Control Sample	One per analytical batch
	Second Column Confirmation	Gas chromatography methods, where appropriate (i.e., pesticides)
	Matrix Spike Analysis	One per matrix per batch
	Matrix Spike Duplicate Analysis	One per matrix per batch
	Surrogate Spike	Each sample, where appropriate (e.g., semivolatiles)
Cyanide	Laboratory Blank	One per batch or one per 20 samples received
	Initial and Continuing Calibration	Daily for each instrument setup
	Duplicate Spike	One per 20 samples

[1] An analytical batch consists of 20 samples or less, prepared or analyzed together with a common QC sample.

[2] Includes PCBs

Replicate measurements of known standards (laboratory control samples) are routinely monitored by the laboratory by comparing the RPD with control limits established at plus three standard deviations from the mean RPD of historical data. Duplicate environmental samples will be submitted from the field at a rate of one duplicate for every 20 environmental samples or per set collected.

Precision of field measurements such as pH will be assessed through replicate measurements. The electrode will be withdrawn, rinsed with deionized water, and reimmersed between each replicate measurement. The instrument used will be capable of providing measurement to 0.1 standard unit, however, a pH change of up to 0.5 pH units between replicates is possible due to potentially rapid equilibration of the sample with atmospheric carbon dioxide. A replicate measurement will be taken at least once per day or one in 20 samples.

2.3.2.3 Completeness

Completeness is a measure of the amount of data from a given measurement system that is considered valid based on the prescribed data quality objectives. The completeness goal is to generate a sufficient amount of valid data to support the RI objectives.

The data set must contain all QC analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to assess the sufficiency of the data base. The goal for all measurement systems is 100% completeness, that is, all the data should be valid. This is not always the case. The acceptability of less than 100% complete data will be reviewed on a case-by-case basis. The acceptability will be based largely on the significance of a particular measurement system to the project goals.

2.3.2.4 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program. The representativeness criteria may also be satisfied by making certain the sampling locations are selected properly and that a sufficient number of samples are collected. The rationale used to select sampling locations is described in the Field Sampling Plan.

Duplicate or co-located samples will be collected and used as a means to assess field representativeness. By definition, duplicate samples are representative of a given point in space and time. Representativeness will also be maintained during the sampling effort by sampling in compliance with the procedures described in the Field Sampling Plan and SOPs in Attachment A to this CDAP. A summary of the duplicate samples to be collected is provided in Tables 4-2, 4-3, 4-4, and 4-5.

2.3.2.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Comparability can be related to accuracy and precision as these quantities are measures of data reliability. Data are comparable if siting considerations, collection techniques, and measurement procedures, methods, and reporting are equivalent for the samples within a sample set. A qualitative assessment of data comparability will be made of applicable data sets.

3.0
PROJECT ORGANIZATION AND RESPONSIBILITY

The project organization identifies the responsibilities of individuals involved in this Remedial Investigation project. The project organizational structure and personnel responsibilities are designed to provide adequate project coordination and control and proper quality assurance for the Remedial Investigation activities at SAEP. The responsibilities of key personnel are described below. The organizational structure is shown on Figure 3-1. Individual personnel assignments to the project organization may be changed at the discretion of the Program Manager and Project Manager. Resumes of key personnel will be submitted to USACE for review and approval by USACE. The analytical laboratory internal organizational structure will be provided in the NEI Laboratory QA/QC Manual submitted under separate cover.

3.1 RESPONSIBILITIES OF KEY PERSONNEL

3.1.1 Program Manager/Responsible Professional

The Program Manager has overall responsibility for all activities on the project. The Program Manager monitors progress of the project work and provides supervision and support to the Project Manager. The Program Manager has overall responsibility for the development of the Work Plan, for monitoring the quality of the technical and managerial aspects of the project, and, where necessary, for implementing corrective measures.

3.1.2 Project Manager

The Project Manager (PM) has primary responsibility for the coordination, implementation, and completion of the scope of work and all activities on the project. The Project Manager is responsible to the Program Manager and the USACE for day-to-day control of planning, scheduling, cost control, and implementation of the project. The Project Manager also supervises the timely development and delivery of the technical reports, and other project documents. The Project Manager assigns and monitors all project personnel in planning, coordinating, and controlling all technical aspects of the tasks, and is responsible for maintaining the quality of the work product, schedule and budget control, and communications with USACE and other key staff personnel.

3.1.3 Project QA/QC Officer

The Project QA/QC Officer reports to the Program Manager and works directly with the Project Manager and other project personnel. Overall responsibility of the QA/QC Officer is to implement the quality assurance program, and monitor and verify that the work is done in accordance with the Field Sampling Plan, the CDAP, the Standard Operating Procedures, and other applicable procedures. The QA/QC Officer also has the following responsibilities: to assess the effectiveness of the QA/QC program; to recommend modifications to the program when applicable; for verifying that personnel assigned to the project are trained and indoctrinated relative to the requirements of the QA/QC Program; for reviewing and verifying the disposition of nonconformance and corrective action reports; and for periodic quality assurance audits. The Project Manager is advised by the QA/QC Officer on implementation of the QA/QC program, but the QA/QC functions of the QA/QC Officer are independent of the Project Manager. The QA/QC Officer is responsible for coordination of QA sample collection and delivery and data submittal to the Government Quality Assurance Laboratory (USACE Missouri River Division Laboratory). The QA/AC Officer will also designate and oversee the activities of the QA/QC Coordinator.

3.1.4 Project Safety and Health Officer

The Project Safety and Health Officer (PSHO) reports to the Program Manager and works directly with the Project Manager and other project personnel. The PSHO has the responsibility to monitor and verify, by conducting periodic audits and reports from the Site Safety and Health Officer (SSHO), that the field activities are conducted in accordance with the Site Safety and Health Plan (SSHP) written for this remedial investigation. The PSHO will advise the Project Manager regarding health and safety

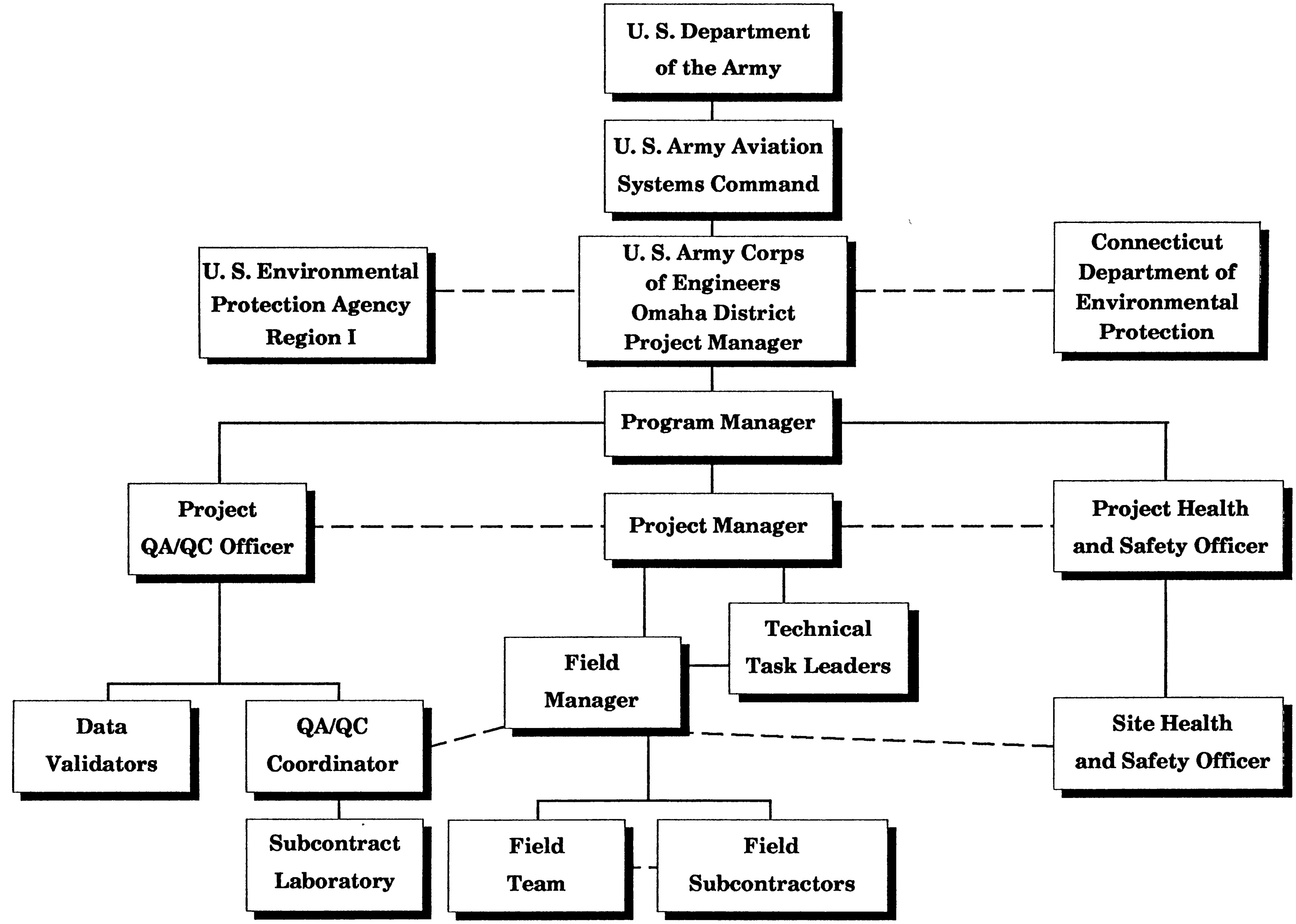


FIGURE 3–1

PROJECT ORGANIZATION CHART
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

issues, but will function independently of the Project Manager. The PSHO will also designate and oversee the activities of the SSHO.

3.1.5 QA/QC Coordinator

A QA/QC Coordinator will be appointed by the QA/QC Officer, with approval by the Program Manager, to review, monitor, and report on the conformance to QA/QC program requirements for specific project activities or tasks. A QA/QC Coordinator may audit activities and will report audit findings to the QA/QC Officer. As QA/QC Coordinator, the designated staff member may also do project-related work, but may not do quality-monitoring on his or her own work. As a QA/QC Coordinator, the designated staff member may also advise the field personnel on QA/QC methods and practices, and conduct field audits of project activities. The QA/QC Coordinator will maintain a record of quality-monitoring activities and will inform the QA/QC Officer of these monitoring activities.

3.1.6 Site Safety and Health Officer

The Site Safety and Health Officer (SSHO) monitors all site activities and is responsible for the implementation of the Site Safety and Health Plan (SSHP). The SSHO reports directly to the Project Health and Safety Officer (PHSO), and works with the Project Manager and Task Leaders to ensure overall compliance with the SSHP. A detailed description of the PSHO and SSHO responsibilities is presented in the SSHP.

3.1.7 Technical Task Leaders

Technical Task Leaders will be chosen by the Project Manager with approval by the Program Manager and will be assigned to work on various tasks as deemed necessary by the Project Manager. Each Task Leader is responsible to the Project Manager for planning, scheduling, cost control, and completion of assigned project tasks. The Task Leader is responsible for implementing the QA/QC program as it relates to assigned tasks for the SAEP RI.

3.1.8 Field Manager

The Field Manager (FM) will be appointed by the Project Manager with approval by the Program Manager, and will be responsible for coordinating all field activities. The Field Manager will work with the Technical Task Leaders, and will schedule field activities with the project staff assigned by the Project Manager. The Field Manager will also work with the Site Safety and Health Officer and the QA/QC Coordinator to accomplish the objectives of all aspects of the work plan, including this CDAP, as they pertain to field activities.

3.1.9 Project Staff

Project staff members are chosen by the Project Manager. Each member of the project staff is responsible to the Field Manager or Project Manager for completion of assigned project activities. Members of the project staff are responsible for understanding and implementing the QA/QC program as it applies to their project activities.

3.2 DATA VALIDATORS

Data Validators are chosen by the Project Manager and the Project QA/QC Officer and report directly to the Project QA/QC Officer. Responsibilities of the Data Validators include, but are not necessarily limited to:

- verifying measurement system calibration;
- auditing quality control activities;
- screening data sets for outliers;
- auditing field sample data records and chain-of-custody forms; and
- checking calculations.

The primary task of the Data Validators is to quantitatively and qualitatively assess chemical data reported by the laboratory.

3.3 SUBCONTRACTORS

Implementation of the Work Plan will require subcontractors for providing additional project support for services such as:

- Laboratory chemical analysis of soil, sediment, surface water, and groundwater samples;
- Classification of soil samples;
- Drilling borings and monitoring well installation and development; and,
- Surveying of sample and monitoring well locations and elevations.

Training and qualifications of subcontractor personnel is assumed through certifications and licenses which are issued by regulatory agencies. Equipment, including related health and safety items, required for field activities performed by subcontractors, will be supplied by the subcontractors.

3.4 QUALIFICATIONS OF PERSONNEL

All personnel assigned to the project, including subcontractors, will be qualified for the task to which they are assigned. Appraisal of the qualification of technical personnel assigned to the project will be made by the Project Manager. The appraisal will include comparison of the requirements of the task assignment with the relevant experience and training of the prospective personnel. All documents concerning qualification appraisal will be stored in the project administrative files.

4.0
FIELD ACTIVITIES

4.1 SAMPLING OBJECTIVES

The sampling activities described in this section are designed to determine the presence or absence of contamination at the eight areas of environmental concern identified in the Preliminary Assessment Study. In addition to determining contamination, the investigation will include a study of the site hydrogeology. Details on the sampling activities are provided in the Field Sampling Plan (FSP). If unforeseen circumstances necessitate major deviations from the procedures described below and in the FSP, the USACE PM will be notified. Changes and modifications will be subject to USACE approval and documented in writing.

The USACE PM and MRD laboratory will be notified one week in advance of all sample collection activities.

All field personnel conducting sample collection activities are required to conform to the health and safety procedures and requirements described in the Site Safety and Health Plan (SSHP).

Specifications and detailed procedures for sampling and associated field activities are described in the Standard Operating Procedures (SOPs) that are presented in Attachment A. Analytical requirements are presented in Section 6.0 of this CDAP.

4.2 SAMPLE LOCATION AND FREQUENCY

The Remedial Investigation sampling to be conducted in each of the eight areas of potential environmental concern and the hydrogeologic investigation are presented in Section 3 of the FSP. All sample locations are presented on Figure A-1 of the FSP. A sample collection summary, including the media, locations, and depths of all proposed samples to be collected during this RI is presented in Table 4-1. The projected numbers of samples (for chemical analyses) to be collected for each media, including QC samples, are presented in Tables 4-2, 4-3, 4-4, and 4-5. A summary of samples for geotechnical analyses is presented on Table 4-6.

4.3 SAMPLING EQUIPMENT AND PROCEDURES

General descriptions of sampling equipment and procedures for collecting samples are described in Section 5 of the FSP; details of the same are provided in the SOPs in Attachment A to this CDAP.

4.4 SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

It is expected that the laboratory will supply sample containers precleaned and packaged according to EPA specifications. Precautions will be taken to avoid sample container contamination.

The general requirements for sampling containers, preservation and holding times, along with site-specific requirements, are shown in Table 4-7 and are detailed in Appendix D of ER 1110-1-263. Specifications will be submitted to USACE in conjunction with the laboratory QA Plan.

4.5 DECONTAMINATION

All sampling equipment will be decontaminated to prevent cross-contamination of samples. The equipment will be decontaminated before entering the sampling location, between intrusive activities, and before equipment is removed from the site. All decontaminated equipment will be inspected prior to use by WCC personnel. Decontamination of personnel and equipment will be performed at specified decontamination areas as determined by the Field Manager and Site Safety and Health Officer. Specific procedures for decontamination are provided in SOP No. 7. Personnel decontamination procedures are outlined in the Site Safety and Health Plan (SSHP). Personnel decontamination will occur to comply with the SSHP and to prevent cross-contamination of samples.

TABLE 4-1
SUMMARY OF SAMPLE COLLECTION FOR CHEMICAL ANALYSES
REMEDIAL INVESTIGATION - SAEP

AREA OF CONCERN	MEDIA	Location	Number	SAMPLE DEPTHS	TOTAL
1	Sediment	Outfalls	7	0-12", 12-24"	14
	Surface Water	Outfalls	7	Surface	7
	Sediment	Low Tide Stations	3	0-12", 12-24"	6
	Surface Water	Low Tide Stations	3	Surface	3
	Sediment	Background	1	0-12", 12-24"	2
	Surface Water	Background	1	Surface	1
2	Soil	Surface	10	0-6"	10
3	Soil	Borings	15	TBD at 2 depths	30
	Groundwater	Monitoring Wells	11	Screened Interval	11
	Sediment	Dry Well	1	6-12"	1
4	Soil	Boring	3	TBD at 2 depths	6
	Groundwater	Monitoring Wells	5	Screened Interval	5
5	Soil	Borings	2	TBD at 2 depths	4
	Groundwater	Monitoring Wells	3	Screened Interval	3
6	Groundwater	Monitoring Well	1	Screened Interval	1
7	Soil	Borings	2	TBD at 2 depths	4
	Groundwater	Monitoring Wells	3	Screened Interval	3
8	Sediment	Outfall	1	0-12", 12-24"	2
	Sediment	Upgradient	1	0-12", 12-24"	2
	Surface Water	Outfall	1	Surface	1
	Surface Water	Upgradient	1	Surface	1
				TOTAL SOIL	**54**
				TOTAL SEDIMENT	**27**
				TOTAL GROUNDWATER	**23***
				TOTAL SURFACE WATER	**13**

Notes

TBD = to be determined in the field based on split spoon observations.

Areas are identified in PAS and the Work Plan.

* Total groundwater represents one round of sampling. Two rounds are planned for this investigation.

TABLE 4-2

PROJECTED TOTAL NUMBER OF GROUNDWATER SAMPLES BY PARAMETER
SAEP - REMEDIAL INVESTIGATION

SW846 Method	Parameter	QUALITY CONTROL					Total Number of Samples
		No. of Field Samples	No. of Field Duplicates	No. of Trip Blanks	No. of Field Blanks	No. of MS/MSD[1] Samples	
8240	Volatile Organics	22	2	10	10	2/2	**48**
3510, 8270	Semi-Volatile Organics	22	2	N/A	10	2/2	**38**
3510, 3520, 8080	PCBs	10	1	N/A	5	1/1	**18**
6010[2]	Metals[3]	22	2	N/A	10	2/2	**38**
9010, 9012	Cyanide	5	1	N/A	2	1/1	**10**

This projected total is for one sampling event; 2 rounds of groundwater sampling are planned for the RI.

[1] MS = Matrix Spike
MSD = Matrix Spike Duplicate

[62] Also includes 7060 (arsenic), 7421 (lead), 7470 (mercury), and 7740 (selenium).

[3] Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

N/A = Not Applicable

TABLE 4-3

PROJECTED TOTAL NUMBER OF SURFACE WATER SAMPLES BY PARAMETER
SAEP - REMEDIAL INVESTIGATION

SW846 Method	**Parameter**	**QUALITY CONTROL**					**Total Number of Samples**
		No. of Field Samples	**No. of Field Duplicates**	**No. of Trip Blanks**	**No. of Field Blanks**	**No. of MS/MSD[1] Samples**	
8240	Volatile Organics	13	1	5	5	1/1	**26**
3510, 8270	Semi-Volatile Organics	13	1	N/A	5	1/1	**21**
3510, 3520, 8080	PCBs	13	1	N/A	5	1/1	**21**
6010[2]	Metals[3]	13	1	N/A	5	1/1	**21**
9010, 9012	Cyanide	13	1	N/A	5	1/1	**21**

[1] MS = Matrix Spike
MSD = Matrix Spike Duplicate

[2] Also includes 7060 (arsenic), 7421 (lead), 7470 (mercury) and 7740 (selenium).

[3] Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

NA = Not Applicable

TABLE 4-4

PROJECTED TOTAL NUMBER OF SOIL SAMPLES BY PARAMETER
SAEP - REMEDIAL INVESTIGATION

SW846 Method	Parameter	QUALITY CONTROL					Total Number of Samples
		No. of Field Samples	No. of Field Duplicates	No. of Trip Blanks	No. of Field Blanks	No. of MS/MSD[1] Samples	
8240	Volatile Organics	38	2	20	20	2/2	**84**
3540, 8270	Semi-Volatile Organics	38	2	N/A	20	2/2	**64**
3540, 3550, 8080	PCBs	14	1	N/A	10	1/1	**27**
6010[2]	Metals[3]	38	2	N/A	20	2/2	**84**
9010, 9012	Cyanide	6	1	N/A	5	1/1	**14**
1311	TCLP[4]	44	2	N/A	N/A	2/2	**50**
EPA-600/M4-82-020	Asbestos	10	1	N/A	N/A	0/0	**11**

Total does not include soil samples selected from borings for geotechnical analysis.

[1] MS = Matrix Spike
MSD = Matrix Spike Duplicate

[2] Also includes 7060 (arsenic), 7421 (lead), 7470 (mercury), and 7740 (selenium).

[3] Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

[4] TCLP is for extraction of soil samples for metals analyses only.

NA = Not Applicable

TABLE 4-5

PROJECTED TOTAL NUMBER OF SEDIMENT SAMPLES BY PARAMETER
SAEP - REMEDIAL INVESTIGATION

SW846 Method	**Parameter**	**QUALITY CONTROL**					**Total Number of Samples**
		No. of Field Samples	**No. of Field Duplicates**	**No. of Trip Blanks**	**No. of Field Blanks**	**No. of MS/MSD[1] Samples**	
8240	Volatile Organics	27	2	5	5	2/2	**43**
3540, 8270	Semi-Volatile Organics	27	2	N/A	5	2/2	**38**
3540, 3550, 8080	PCBs	26	2	N/A	5	2/2	**37**
6010[2]	Metals[3]	27	2	N/A	5	2/2	**38**
9010, 9012	Cyanide	26	2	N/A	5	2/2	**37**

[1] MS = Matrix Spike
MSD = Matrix Spike Duplicate

[2] Also includes 7060 (arsenic), 7421 (lead), 7470 (mercury), and 7740 (selenium).

[3] Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

NA = Not Applicable

TABLE 4-6

SUMMARY OF SAMPLE COLLECTION FOR GEOTECHNICAL ANALYSES REMEDIAL INVESTIGATION SAEP

AREA OF ENVIRONMENTAL CONCERN	NUMBER OF SAMPLES FOR GEOTECHNICAL ANALYSES
1. Intertidal Flats	0
2. Causeway	0
3. Hydraulic Fill	8
4. Plating and Manufacturing	3
5. Building 2	5
6. Research & Development	1
7. Testing	0
8. Drainage Ditch	0
TOTAL:	17

NOTES: Specific locations and depths for geotechnical sample collection are presented on Table A-2 of the FSP.

Each sample will be tested using Atterberg Limits Test on fine-grained components and sieve analysis on coarse-grained components.

Procedures for analysis and associated ASTM methods are presented in SOP No. 12, in Attachment A to the CDAP.

TABLE 4-7

SAMPLE CONTAINERS - PRESERVATION AND HOLDING TIMES FOR CHEMICAL ANALYSES

Parameter	Media/Matrix	SW846 Method	Number, Volume, and Type of Containers per Sample	Preservation	MAXIMUM HOLDING TIME	
					Extraction	Analysis
Volatile Organics	GW, SW	8240	2-40 ml glass vials with Teflon-lined septa	4°C and 4 drops HCI to ph <2	--	40 days
	S, D	8240	2-125 ml glass bottles with Teflon-lined lid			
Semi-Volatile Organics	GW, SW	3510, 8270	2-1L amber glass bottles with Teflon-lined lid	4°C	7 days	40 days
PCBs	GW, SW	3510, 3520, 8080	2-1L amber glass bottles with Teflon-lined lid	4°C	7 days	40 days
Semi-Volatile Organics and PCBs	S, D	3540, 8270, 3550, 8080	1-8 oz. wide-mouth glass bottle with Teflon-lined lid	4°C	14 days	40 days
Metals[1]	GW, SW	6010 (7060, 7421, 7470, 7740)[2]	1-1L plastic[4]	HNO_3 to ph <2	--	6 months[3]
	S, D	1311[5], 6010 (7060, 7421, 7471, 7740)[2]	1-8 oz. glass bottle with Teflon-lined lid	4°C	7 days (TCLP)	6 months[3]
Cyanide	GW, SW	9010, 9012	1-1L plastic[4]	4°C and NaOH to ph>12	--	14 days
	S, D	9010, 9012	1-8 oz. glass bottle with Teflon-lined lid	4°C		6 months
Asbestos	S	EPA-600/M4-82-020	1-8 oz. glass bottle with Teflon-lined lid	(none)	(none)	

TABLE 4-7, Continued

SAMPLE CONTAINERS - PRESERVATION AND HOLDING TIMES FOR CHEMICAL ANALYSES

NOTES:

[1] Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

[2] 7060 (arsenic), 7421 (lead), 7470, 7471 (mercury), 7740 (selenium).

[3] Holding time for mercury (Hg) is 28 days.

[4] Plastic indicates high density polyethylene.

[5] TCLP Method 1311 is for extraction of metals soil samples only.

GW = groundwater
SW = surface water
S = soil
D = sediment
ml = milliliters
L = liters
°C = degrees Celsius
oz. = ounce

4.6 FIELD DOCUMENTATION

Various types of documentation will be produced during the RI, with a majority being field documentation from field activities. The primary documentation is described in the following sections. Other documentation may be produced as necessary during the RI and will be consistent with the standards and requirements presented within this CDAP and associated SOPs.

4.6.1 Field Logbook

Details of field documentation are provided in SOP No. 6. Bound hardcover field logbooks will be used to record all pertinent field data and observations made during the field activities. The pages of the notebook will be consecutively numbered and will not be removed. Documentation in the field logbook will be of sufficient detail to reconstruct pertinent sampling activities of a later date. Entries into the field logbook will include, but are not necessarily limited to, the following information:

- Project name and number
- Task or activity description
- Date and time
- Sample location
- Sample identification number
- Sample depth
- Number of aliquots
- Media type
- Sampling personnel present
- Field measurement data
- Type of health and safety clothing/equipment used
- Analyses requested
- Time of sample collection

- Sample preservation, field observations, to include soil description (if relative)
- Weather conditions
- Photographic information
- Other project-specific information

In addition, field sketches will be made in the field logbooks, when appropriate, and will be referenced to existing permanent structures in the area (i.e., trees, fence posts, buildings).

All entries will be made in blue or black ink and no erasures will be allowed. If an incorrect or unreadable entry is made, the information will be crossed out with a single strike mark and the change initialed and dated by the team member performing the change.

Each page in the field logbook will be signed and dated in the top margin by all persons making entries on that page.

Field logbooks will be identified by a project-specific number (i.e., Logbook No. 1 for Project Number 89C114C, etc.), and will be stored in the field project files when not in use. At the completion of the field activities, the logbooks will be maintained in the permanent project file. A photocopy of all field notebooks, logs, etc., will be provided to the USACE upon request.

4.6.2 Boring Logs

Boring logs will be completed for each boring by qualified personnel. An example boring log and the information to be included on each boring log is located in SOP No. 1, in Attachment A. An alternative boring log will be used if supplied by USACE.

4.6.3 Monitoring Well Construction Log

A log documenting well construction will be completed for each monitoring well installed on the site. An example log and a summary of the information to be included on each log can be found in SOP No. 2, in Attachment A.

4.6.4 Well Development Log

A well development log will be completed to document the well development procedures followed for each monitoring well installed. An example well development log and a list of information to be included on these logs can be found in SOP No. 2, in Attachment A.

4.6.5 Water Level Data Sheet

All water level measurements will be recorded on a water level data sheet. These sheets will include all pertinent information concerning water levels, field measurements, and monitoring wells. An example data sheet can be found in SOP No. 9.

4.6.6 Photographic Documentation

Pertinent field activities and sample locations will be documented with representative photographs. The picture number and roll number will be logged in the field logbook to identify the area and activity depicted in the photograph. A separate photographic documentation logbook will be maintained by the Field Manager in charge of the site investigation. The film roll number will be identified by taking a photograph on an information sign as the first frame of the roll. The project and film roll numbers and date will be shown on this sign. The picture number, roll number, and a description of the picture will be logged in the photographic documentation logbook as well as the Daily Quality Control Report (DQCR), if appropriate. All photographs will be stored in the project file.

Videotape recording cameras may also be used during some field activities to provide an additional type of documentation. Videotapes will be labelled with pertinent project information and stored in the project file.

The use of all photographic equipment will be subject to approval by TLS.

4.7 FIELD SURVEY

An elevational and horizontal control survey will be extended to all sample locations, including surface samples, borings, hand auger holes, and monitoring wells. Permanent survey points will be established at the site for future reference. The accuracies established for the surveys will be ±0.1 foot (vertical control) and ±1.0 foot (horizontal control) for all sample locations and ground surface measurements at monitoring wells. The well casings will be surveyed with an accuracy of 0.01 foot (vertical control). Vertical and horizontal locations will be referenced to permanent survey points.

4.8 FIELD INSTRUMENT PREVENTATIVE MAINTENANCE AND CALIBRATION

All field instrumentation, equipment, and accessories will be maintained in accordance with the manufacturer's recommendations and specifications, and established field practice. Table 4-8 summarizes field equipment calibration procedures.

The calibration and general maintenance of field instrumentation will be the responsibility of the field team member, under the direction of the Field Manager and Site Safety and Health Officer. All documentation pertinent to the calibration and/or maintenance of field equipment will be maintained in a field logbook. Entries made into the logbook regarding the status of any field equipment will contain, but are not necessarily limited to, the following information:

- Date and time of calibration
- Name of person doing calibration; type of equipment being serviced, and identification number (such as serial number)

TABLE 4-8
FIELD EQUIPMENT
CALIBRATION AND MAINTENANCE REQUIREMENTS

EQUIPMENT		TASK	FREQUENCY[1]	MAINTENANCE
OVA	1.	Make sure hydrogen tank is full and allow instrument to warm up for 15 min. after turning on.	Before each day's use	Charge battery daily
	2.	Perform calibration check by introducing a known methane standard and adjusting instrument to correspond to calibration standard.	Before each day's use	
HNu	1.	Perform internal calibration.	Weekly	Charge battery daily
	2.	Introduce a known isobutylene standard and adjust instrument to correspond to calibration standard.	Before each day's use	
	3.	Zero instrument.	Periodically during the day	
Salinity - Specific Conductivity - Temperature/Meter	1.	Obtain correction factor by checking observed reading against 3-point known standard solutions.	Prior to each sampling event	Check batteries daily
	2.	Zero check.		
pH Meter	1.	Immerse electrodes in buffer solution at pH 7 and adjust meter to proper reading. Rinse electrodes and immerse in buffer solution at pH 4 and pH 10 and adjust meter to proper reading.	Before each day's use	Check batteries daily
	2.	Repeat above procedures until readings are within 0.05 pH units of the buffer solution values. All buffer solutions and rinses should be at the same temperature.	Before each day's use	

[1] Site specific conditions may warrant a higher frequency

NOTE: Additional equipment may be required during field activities. Calibration and maintenance will be performed as specified in manufacturer's manual or in guidance documents.

- Reference standard used for calibration (such as pH of buffer solutions);
- Calibration and/or maintenance procedure used
- Other pertinent information

Equipment that fails calibration and/or becomes otherwise inoperable during the field investigation will be removed from service and segregated to prevent use. Such equipment will be properly tagged to indicate that it should not be used until the nature of the problem can be determined. Failed equipment will be repaired or recalibrated and may be used after approved for use by the Field Manager or Site Safety and Health Officer prior to placement back into service. Equipment that cannot be repaired or recalibrated with minimum delay will be replaced.

5.0
SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

5.1 SAMPLE IDENTIFICATION AND LABELING

A sample numbering system will provide a tracking mechanism to allow retrieval of each sample, and information concerning the sample location and description. A unique sample identification number will be assigned to each sample, and this number will be recorded on the sample label and all documentation associated with the sample. Procedures for this sample numbering system are provided in SOP No. 6.

5.2 SAMPLE CHAIN-OF-CUSTODY PROTOCOL

5.2.1 Field

The primary purpose of the chain-of-custody (COC) procedures is to document the possession of the samples from collection by the field sampling team through shipping storage and analysis. COC forms will become the permanent records of all sample handling and shipment. The Field Manager or designee will be responsible to the Project Manager for monitoring compliance with COC procedures. These procedures are described in detail in SOP No. 6.

5.2.2 Laboratory

Procedures for laboratory chain-of-custody, sample storage, and dispersement for analysis and associated documentation to be performed by laboratory personnel will be provided in the NEI Laboratory QA/QC Manual.

5.3 PACKAGING AND SHIPPING

Appropriate procedures and safeguards shall be used for all sample packaging and shipping activities. These procedures, described in SOP No. 6, shall be followed to ensure the integrity of all samples shipped for laboratory analysis.

6.1 LABORATORY ANALYTICAL PROCEDURES

The general laboratory procedures anticipated for the remedial investigation at SAEP are summarized in Table 6-1. The specific analyses for sampling locations are defined in Section 4.0 and in the FSP. Included in these procedures are method-specific data quality objectives that would be applicable whenever a particular method is specified in Section 4.0. Specific laboratory practices for the methods listed below, including sample preparation, sample tracking, and documentation will be provided in the NEI Laboratory QA/QC Manual.

6.1.1 Volatile Organics

Volatile organics include compounds among varying classes such as halogenated organics, nonhalogenated organics, and aromatic organics. The first two classes generally contain contaminants associated with solvents, such as TCE, MEK, acetone, etc. The third class includes compounds associated with fuels, such as benzene, ethylbenzene, toluene, and xylene (BETX). The volatile organic method listed in Table 6-1 (SW846-8240) employs mass spectrometry (MS) for detection. This method is indicated where the volatile contaminants are not known. The GC/MS has the capacity for positive identification at relatively low detection limits. This methodology is also indicated where its capability for tentative identification of nonlisted compounds is desired. Compounds generally analyzed by GC/MS are presented with associated reporting limits in the NEI Laboratory QA/QC Manual.

6.1.2 Semivolatile Organics

Method 8270 (SW846) is a GC/MS method for determining extractable base/neutral and acid compounds in sample extracts that have been extracted by Methods SW846-3510-3520 for aqueous or by Methods SW846-3540/3550 for solid samples. This procedure will include the general classes of compounds, such as phenols, nitrosamines, polynuclear aromatic hydrocarbons (PAHs), phthalate esters, nitrotoluenes, etc. These compounds are generally less volatile, with Method 8270 applicable for detection. The list of analytes and reporting limits are presented with the NEI Laboratory QA/QC Manual.

6.1.3 PCBs

The highly chlorinated arochlors (PCBs) are persistent in the environment and, therefore, more available for exposure or bioaccumulation. SW846 Method 8080, with the associated sample extraction (SW846-3510/3520 for aqueous samples and SW846-3540/3550 for solid samples) is indicated for potential areas contaminated with PCBs.

Method 8080 is a gas chromatographic method employing an electron capture detector or an electrolytic conductivity detector. The general analyte list and associated reporting limits for soil and water are provided in the NEI Laboratory QA/QC Manual.

6.1.4 Metals

The metals analyses for the RI at SAEP shall include the Target Compound List (TCL) specified in Table 6-1. Interpretation of metals data can be complex, particularly when background and/or naturally occurring levels complicate the analysis.

Based on Connecticut requirements, soil samples for metals analysis will be extracted using the Toxicity Characteristic Leaching Procedure (Method 1311 of SW-846). The leachate will subsequently be analyzed for metals using the appropriate SW-846 method for water samples.

The methodology for metals analyses is provided in Table 6-1. Factors which influence the use of particular methods are detection limits, interference, and stability.

Most metals, with a few exceptions (see Table 6-1), are detected at levels appropriate for DQOs by inductively coupled plasma emission spectroscopy (ICP). Method 6010 (SW846) is indicated for water and soil (after appropriate sample digestion, see Table 6-1) for ICP analysis. Atomic absorption (AA) methods for arsenic, selenium, mercury and lead are indicated to achieve the lower detection limits. The reporting

TABLE 6-1
ANALYTICAL METHODS FOR CHEMICAL ANALYSES - REMEDIAL INVESTIGATION SAEP

		Extraction and Analysis Method[2]	
Parameter	**Technique[1]**	**Water**	**Soil/Sediment**
Volatile Organics	GC/MS	8240	8240
Semivolatile Organics	GC/MS	3510 8270	3540 8270
PCBs	GC	3510 8080 3520	3540 8080 3550
Metals[3]	ICP	6010	3050/6010
Arsenic	GFAA	7060	3050/7060
Lead	GFAA	3020/7421	3050/7421
Mercury	CV	7470	7471
Selenium	GFAA	7740	3050/7740
TCLP[4]	Leaching Extraction	NA	1311
Asbestos	PLM	NA	EPA-600/M4-82-020
Cyanide	Digestion	9010, 9012	9010, 9012

[1] GC = Gas chromatography, GC/MS = gas chromatography, mass spectrometry, ICP = inductively coupled plasma, GFAA = graphite furnace atomic absorption, cv = cold vapor, PLM = Polarized Light Microscopy

[2] Methods are from the Third Edition, USEPA SW-846; Asbestos, Interim Method for the Determination of Asbestos in Bulk Insulation Samples, December 1982

[3] Includes the following metals: aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, thallium, vanadium, and zinc

[4] Toxicity Characteristic Leaching Procedure, for extraction of metals in soil samples only.

NA = Not Applicable

limits for the various ICP and AA methods are presented in the NEI Laboratory QA/QC Manual.

The methods of choice for arsenic and selenium are non-ICP due to inherent analytical interferences which, consequently, elevate instrument detection limits. Non-ICP methods for lead, arsenic and selenium are indicated for regulatory purposes, particularly in groundwater.

The measurement of cations (magnesium, sodium, potassium, calcium) may yield important water quality characteristics or aid in the prediction of oxidation-reduction or contaminant transport potential.

6.1.5 Cyanide

EPA methods 9010 and 9012 are manual and automated methods used to determine the concentration of inorganic cyanide in an aqueous waste or leachate. The cyanide in the sample is converted to HCN through an acidic distillation, collected in a basic solution and measured by colorimetric means.

6.1.6 Asbestos

The method to be used for determining the presence of asbestos in soil samples or if a material is asbestos-containing material (ACM) is EPA Interim Method for the Determination of Asbestos in Bulk Insulation Samples as presented in the document EPA-600/M4-82-020, December 1982. This method uses the technique of Polarized Light Microscopy (PLM) with dispersion staining. This permits identification of asbestos fiber bundles in a sample. The limit of detection for this method is 1% asbestos.

7.0
DATA MANAGEMENT, REDUCTION, VALIDATION, AND REPORTING

7.1 DATA MANAGEMENT

During the Remedial Investigation (RI), large amounts of various types of data will be generated. At a minimum, data gathered as a part of the RI will consist of field observations, field data sheets, field log books, boring logs, results of geotechnical soil testing, chemical data from analysis of soil, sediment, surface water and groundwater, field parameter measurements, maps, drawings, and documents. Procedures that will be used to physically manage and present project related data and information are described below.

7.1.1 Sampling Data Management

The intent of these sampling data management procedures is to maintain accurate records of all samples taken and to follow the disposition of the samples and analytical results, while minimizing the duplication of record keeping activities and the possibilities for errors.

The tabulation and flow of all sample data management information can be broken down into the following activities:

- assignment of sample numbers, sample label preparation, and initiation of permanent record keeping;
- labeling of sample bottles;
- sampling and in-the-field record keeping;
- sample receiving and preparation for shipping; and
- completion of sample record book.

7.1.2 Record Keeping During Sampling

Prior to collecting samples, the Task Leader or Field Manager will assign a sample number and a description to all samples to be collected. Sample numbers will be assigned according to the procedures presented in SOP No. 6. The sample number and corresponding description will be entered into a permanent sample record book. The information in the record book will then be written onto the appropriate sample label.

The labels for samples and a copy of the record book pages that include these numbers will be given to the sampler. This individual is responsible for completing all labels on the appropriate types of bottles. A copy of the record book pages that include information about the samples will also be given to the person collecting the samples in order to provide a list of samples to check off during the sampling activity.

The individual(s) performing the sampling is (are) responsible for verifying that each sample is put in the appropriate sample bottle. At the time of sampling this person must complete the sample label. By the end of the sampling day, the sampler must return all samples to the Task Leader or Field Manager, who will oversee preparation of the samples for shipment (i.e., review chain-of-custody (COC) forms, inspect packaging, etc.).

The person responsible for shipping the full sample bottles will compare the sample bottles with the appropriate sample record book pages. This person will then prepare the samples for shipping. All samples sent to laboratories will be recorded on a COC form; the originals must accompany the samples, and copies will be sent to the Field Manager to include in the appropriate project files.

When the samples are ready to be shipped to the laboratory, the Field Manager or Task Leader will examine the samples and note their condition. Information including the date sampled, time sampled, and method of preservation, for each sample will be entered in the sample record book.

At the time the samples are shipped, the Task Leader will have a copy of the pages in the sample record book that include information on the sample numbers and the corresponding information on the date sampled, time sampled, and the date shipped. Detailed procedures for sample handling and shipping are presented in SOP No. 6.

7.1.3 Document Control

The project file will be maintained in the office and will contain the following types of items:

- hard copies of original data;
- computer diskette copies of data;
- engineering calculations;
- data summaries;
- reports;
- original figures and maps;
- memoranda;
- telephone conversation records;
- correspondence; and
- supporting documents, when appropriate.

If a document is removed from the project file, a sign-out card will be inserted in its place. The card will identify the item removed, person removing it, and date of removal.

Original documents and correspondence will be date stamped upon arrival and will be stored in the appropriate dedicated document file. Those materials will be circulated to the appropriate personnel as determined by the Project Manager.

In all cases, the original paper copies of documents, analytical reports, and other information generated during the RI will be stored in the project files. Original, unaltered copies will be maintained independent of any working copies or later generations of the data.

Results of previous investigations and background information or documents that will be used to support the RI will also be stored in the project file.

All graphics generated through use of computer software will be accompanied by a tabular representation of the data which may or may not be included in its entirety in the reports. However, all file copies of graphics will be accompanied by a complete table of data.

All data files stored on electronic media will be backed up periodically and copies of original or master files will be stored in separate locations in the office.

Oversight of data management activities will be carried out by Project Manager.

7.2 DATA REDUCTION

Data will be reported according to accepted practices of quality assurance and data validation. However, replicate measurements, outlier values and results below the method detection limit will require explanations beyond what is presented in the table, graph or map. Non-reduced data will be available for inspection by the USACE.

The reduction of field-generated data may require adjustments because of baseline or background conditions. Adjustments will not be made on raw data tables or field documents.

7.3 DATA VALIDATION

The data validation process for this project will consist of data generation, reduction, and four possible levels of review.

The first level of review, which may contain multiple sublevels, will be made by the analytical laboratory data reviewer who has the initial responsibility for the correctness and completeness of the data. All data are generated and reduced following protocols specified in the NEI Laboratory QA/QC Manual. The laboratory data reviewer will evaluate the quality of the work based on an established set of laboratory guidelines. This person will review the data package to verify the following items:

- Sample preparation information is correct and complete
- Analysis information is correct and complete
- The appropriate SOPs have been followed
- Analytical results are correct and complete
- QC samples are within established control limits
- Blank anomalies have been identified
- Special sample preparation and analytical requirements have been met

- Documentation is complete (all anomalies in the preparation and analysis have been documented; Non-conformance forms, if required, are complete; holding times are documented)

The laboratory will perform the in-house analytical data reduction and QA review under the direction of the laboratory QA Director. The laboratory QA Director is responsible for assessing data quality and advising the Project Manager of any data which were rated "preliminary" or "unacceptable", or other notations which would caution the data user of possible unreliability. Data reduction, QA review, and reporting by the laboratory will proceed as follows:

- Raw data produced by the analyst is processed and reviewed for attainment of quality control criteria as outlined in the laboratory QA/QC Manual and/or established EPA methods and for overall reasonableness.

- After entry into a laboratory management system, a computerized report is generated and sent to the laboratory data reviewer.

- The data reviewer will verify that corrective measures such as sample re-extraction or reanalysis have been performed.

- Upon acceptance of the preliminary reports by the data reviewer, final reports will be generated. This documentation will be retained as hard (paper) copy on file for 3 years. In addition, GC/MS files will be retained on magnetic tape (computerized) for 5 years.

Data reduction procedures will be based on those specified in EPA SW-846, 3rd Edition.

The laboratory will prepare and retain full analytical and QC documentation. As needed, the laboratory will supply hard copies of the retained information.

The laboratory will report the data, as a delivery group of 20 samples or less, in the order of assigned laboratory identification number, along with QC supporting data. The laboratory will provide the hard copy information, listed below, in each analytical data package:

- Cover sheet listing the samples included in the report and narrative comments describing problems encountered in analysis

- Tabulated results of compounds identified and quantified

- Analytical results for QC sample spikes, sample duplicates, method blanks, and laboratory control samples

- Tabulation of reporting limits related to the sample

The data reduction and validation steps are documented, signed, and dated by the analyst.

The second level of review will be performed by a program administrator at the laboratory to verify that the project data quality objectives were met. This review does not include review of calibration data, qualitative identifications, or quantitative results. These items are reviewed by the data reviewer in the laboratory, who provides an independent review of all calculations and QC relevant to the report. An independent audit is performed on 5% of all projects analyzed by the laboratory by the laboratory QA director or his staff.

The project also requires that the analytical laboratory submit additional data to the USACE QA laboratory (MRD) as the third level of review for data validation and comparison purposes. Each data submittal will include all sample, blank, and internal quality control results such as spike and surrogate recoveries and agreement between replicate analyses. Interim data reports may be requested if the project warrants. The following are minimum data reporting requirements:

1) Sample IDs: The laboratory, in conjunction with the Project Manager, will prepare a tabular presentation which matches laboratory sample Ids to QA laboratory sample Ids. This table will identify all field duplicates and field blanks as such and match with their corresponding field samples where applicable.

2) Sample Receipt: The laboratory will verify that the samples were received in good condition. Problems such as broken sample containers, broken custody seals,

improper sample preservation (including temperature), and incomplete sample documentation will be immediately communicated with the Field Manager or QA/QC Coordinator.

3) General Organic and Inorganic Reporting: For each analytical method run, the laboratory will report all analytes for each sample as a detected concentration or as less than the specific limits of quantitation. Generally, all samples with out-of-control spike recoveries resulting from matrix interferences shall be designated as such. All soil samples shall be reported on a dry-weight basis with percent moisture also reported. The laboratory shall also report the date of extraction (if applicable) and date of analysis for each sample.

4) Internal Quality Control Reporting: At a minimum, internal quality control samples shall be analyzed at rates specified in the specific methods or higher rates if required to meet project specific Data Quality Objectives:

a) Laboratory Blanks (Method Blanks and Instrument Blanks): All analytes shall be reported for each laboratory blank. All non-blank sample results shall be designated as corresponding to a particular laboratory blank in terms of analytical batch processing.

b) Surrogate Spikes: Surrogate spike percent recoveries shall be reported with all organic surrogate spikes.

c) Matrix Spikes: Matrix spike recoveries (including Matrix Spike Duplicates) shall be reported for all organic and inorganic analyses. All general sample results shall be designated as corresponding to a particular matrix spike sample. The report shall indicate what field sample was spiked. The report shall also indicate the amount of analyte spiked for each matrix spike, the percent recovered, and relative percent difference.

d) Laboratory Duplicates and/or Matrix Spike Duplicate Pairs: Relative percent difference shall be reported for all duplicate pairs as well as analyte/matrix specific control limits.

The fourth level of review will be provided by the Project Data Validator, whose function is to independently review the data package. The review is intended to verify that:

- Calibration data is appropriate to the method, documented, and meets established calibration criteria.
- QC samples are within established guidelines
- Qualitative identification of sample components is correct
- Quantitative results are correct
- Documentation is complete and correct (all anomalies in the preparation and analysis have been documented; Out-of-Control forms, if required, are complete; holding times are documented)
- The data is ready for incorporation into the final report
- The data package is complete and ready for submittal to USACE MRD.

The reviewer will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analysis may be made by the Project Manager based on the extent of the deficiencies and their importance in the overall context of the project. This data review will also be documented and the signature of the reviewer and the date of the review recorded.

7.4 DATA REPORTING

Data generated during the RI will be presented in a clear and logical format. Tabular, graphical and other appropriate visual aids such as site plans, isopleth plots and groundwater contour maps will be used to organize and display data generated from the investigation. The overall data presentation format described herein will be designed to not only present data but aid and support conclusions drawn from the review of the data.

7.4.1 Tabular Presentation of Data

Tabular presentations of both raw and sorted data will be used as a means of data presentation. Descriptions are provided in the following sections.

Raw Data

Presentation of raw data will be used as a means of introducing other presentation formats. At a minimum, these lists provide sample validation and verify that the proper sample handling and QA/QC protocol were followed. Each data record will provide the following information:

- unique sample identification;
- sample date, location and sample type;
- laboratory analytical identification number;
- parameter measured;
- analytical results and reporting units;
- detection limits for parameters not detected; and
- standard analytical data qualifiers

In addition to the analytical data, tabulated field logs describing pertinent information gathered during the investigation, such as water level measurements, will be included. Information contained in the logs may include the following:

- name of sampler;
- date, time and purpose of sampling;
- sample media;
- sample volume or weight;
- sampling method;
- sample location and identification number;
- sample depth;
- number of samples;

- strata sampled;
- readings from field instruments;
- amount of purged groundwater;
- climatic conditions; and
- signature of person responsible for observations.

Significant events of unexpected conditions which result in a deviation from the Remedial Investigation Work Plan will be detailed.

Sorted Data

Data sorted according to specific categories provide a simple means of displaying trends, comparing sample results to one another and to regulatory guidelines and standards. Examples of categories depend upon the purpose of the table; however, they may include the following:

- sample identification number;
- sample type;
- parameter measured and concentration;
- sampling date;
- sampling location;
- depth to groundwater;
- elevation of groundwater;
- time of measurements;
- regulatory concentration guidelines and standards;
- data reductions for statistical analyses;
- summary data;
- sorted data by strata; and
- results for each constituent in each medium.

Statistical Presentations

There are a wide variety of available statistical data analysis techniques, each having a specific application and particular underlying assumptions. The selection of an appropriate statistical test is based on the specific information desired (i.e., what is the question being asked) and the statistical characteristics exhibited by the parameter being analyzed. The types of important statistical characteristics are type of frequency distribution (normal versus non-normal), presence of seasonality in data, presence of autocorrelation in data (this refers to the degree an observation collected at time t is related to the previous observation collected at t-1), and presence of data measured below the analytical detection limit (non-detected data). These characteristics determine whether a particular statistical test is applicable based on the test's underlying assumptions.

7.4.2 Graphical Presentations of Data

Graphical presentations of data will be used to help visualize trends, ranges and patterns. The following information will be presented in graphical formats:

- sampling locations and sample grids;
- boundaries of sampling areas and areas where more data is required;
- geographical position of contamination; and
- constituent concentrations at each sampling location.

Graphical formats may include bar graphs, line graphs, areal maps and contour maps. Descriptions of these graphical methods of data presentation are provided in the following sections.

Bar Graphs and Line Graphs

Bar graphs and line graphs can be used to display changes in groundwater contaminant concentrations with respect to time. Line graphs are typically more practical when there is a large volume of data points to be displayed. This will allow a more accurate and continuous line to be drawn. Different symbols, colors and textures will be used to distinguish each line or bar.

Areal Maps

The presence and distribution of contamination will be represented by superimposing contaminant concentrations over a plan of the site. Depending upon the distribution, individual measurements or contour plots will be presented.

Areal maps displaying individual measurements are practical when a small number of sampling locations are shown or the concentrations of only one parameter are being displayed. Conversely, contaminant contour maps generally require a large number of sampling locations, spaced across the study area. Contaminant contour maps can be drawn in order to display the configuration of a contamination plume.

Vertical Profiles or Cross-Sections

Vertical profiles can be used to display the distribution of a contaminant release throughout the various substrata. Cross-section diagrams will be drawn based upon stratigraphic observations made during the installation of monitoring wells, soil borings, and background or reference data.

8.1 FIELD QC CHECKS

Field quality control checks will include the review and approval of all field documentation by the Field Manager or designee. Signature or initial approval will indicate that the provisions outlined in the CDAP and Site Safety and Health Plan (SSHP) have been appropriately implemented. In addition, the Field Manager will perform random spot checks on the field team daily. Documentation and procedures will be checked. Nonconformances and field corrective action will be documented as required in Section 10.0.

Field quality control activities will also include the use of calibration standards and blanks for various equipment or parameters such as pH, temperature, salinity, specific conductance, and organic vapor measurements.

8.1.1 Field Blank Samples

Field blank samples will be collected as field QC checks. Field blanks are check samples which monitor contamination associated with the collection of the sample. Field blank samples will also be collected to verify that materials used during the investigation will not result in the introduction of contamination to the samples. The field blank samples will consist of analyte-free deionized water and potable water used for decontamination. The field blank samples will be analyzed for the same parameters as the samples being collected at the time of field blank collection. One field blank sample per day will be collected for each media sampled.

If contaminants in field blanks are reported above the method detection limit for any analytical procedure, the possible source of contamination will be investigated. If a problem is found, it will be corrected and samples rerun, if necessary. If no analytical problems are identified, the data will be flagged accordingly. Decontamination techniques for subsequent sampling events shall also be adjusted in the field prior to collection of additional samples.

8.1.2 Trip Blanks

Trip blanks will be analyzed at the rate of one trip blank per shipment of samples sent to the laboratory for volatile organics analysis. Trip banks will be analyzed for the same volatile organic compounds as the samples which they accompany. Trip banks will consist of two 40 ml glass vials with septum-lined lids which are filled with analyte-free laboratory water in the laboratory. The filled vials will be packed and shipped with the empty sample containers and subsequently returned to the laboratory with the filled sample containers. Results from trip blank analyses will be used to determine whether contaminants may have been introduced during sample shipment, from sample containers, or from laboratory water. The total number of trip blanks submitted and analyzed is dependent upon the type of samples and associated analytical parameters collected on a daily basis.

8.1.3 Duplicates

Field duplicate samples will be made by splitting an individual sample between two sets of sample containers. Duplicates will be analyzed for the same parameters as the samples which they represent. Results of the analysis of duplicates will provide an independent evaluation of laboratory performance by comparing analytical results of two samples from the same location. Duplicate samples will be collected and submitted for analysis at the rate of one duplicate for every 20 environmental samples collected.

8.2 LABORATORY QC CHECKS

Two types of quality assurance checks will be used to assess the production of analytical data of known and documented quality. These include:

- Program quality assurance; and
- Analytical method quality control.

8.2.1 Program Quality Assurance

The stated objectives of the laboratory QA/QC Program are to:

- Verify that all procedures are documented, including any changes in administrative and/or technical procedures.

- Document that all procedures comply with applicable analytical protocol.

- Monitor the performance of the laboratory by a systematic inspection program and provide for corrective action as necessary.

- Verify that all data are properly recorded and archived.

All laboratory procedures are documented in writing as either Standard Operating Procedures (SOPs) or Method Procedures (MPs), which are edited and controlled. Internal quality control procedures for analytical services will comply with the laboratory QA Plan and SOPs. These specifications include the types of audits required (sample spikes, method spikes, reference samples, controls, blanks, MDL studies), the frequency of each audit, the compounds to be used for sample spikes, and the quality control acceptance criteria for these audits.

The laboratory will document, in each data package provided, that analytical QC functions have been met. Any samples analyzed that are in nonconformance with the QC criteria will be reanalyzed by the laboratory, if the laboratory procedures were not in control as assessed by laboratory controls samples and other data specific to the analysis. Reanalysis will also be dependent on availability of sufficient sample volume. QC check samples (method blank, field blank, etc.) will be analyzed concurrently with the sample batch (maximum of 20 environmental samples) to which they are assigned. The method blanks will be analyzed at a rate of 1 in 20.

8.2.2 Analytical Method Quality Control

8.2.2.1 Method Blank

A method blank consists of analyte-free deionized reagant water or equivalent neutral reference material. The method blank is carried through each step of the analytical method and the results are used to evaluate the possible influence of analytical methods on sample analytical results. Method blanks will be analyzed at a rate of one per batch of 20 environmental samples analyzed.

8.2.2.2 Matrix Spike/Matrix Spike Duplicate

A matrix spike (MS) is an environmental sample to which known concentrations of analytes have been added. The matrix spike is taken through the entire analytical procedure and the percentage of recovery of the analytes is calculated. Results are expressed as percent recovery of the known amount spiked. The matrix spike is used to evaluate the effect of the sample matrix on the accuracy of the analysis.

A matrix spike duplicate (MSD) is an environmental sample which is divided into two separate aliquots, each of which is spiked with known concentrations of analytes. The two spiked aliquots are processed separately and the results compared to evaluate the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as relative percent differences (RPD) between the duplicate samples analyzed and as percent recovery. Matrix spike and matrix spike duplicates will be analyzed at a rate of one per matrix per analytical batch, and will be designated on the chain-of-custody by field sampling personnel. The laboratory may request that extra sample volume be collected for matrix spike duplicate samples.

8.3 QUALITY REVIEW OF REPORTS

Quality control during preparation of reports relies on documentation of data and peer review of conclusions drawn from the assembled database. Peer reviews will be conducted to provide assurance that the quality of services is in accordance with the standards of the profession, the objectives of the services, and the terms of the SOW. Peer reviews will be completed prior to submission of the results of work or technical recommendations to USACE. Upon completion of a peer review, the Peer Reviewer will discuss his/her comments with the author/originator and any significant issues concerning the quality of the work reviewed will be resolved. Peer reviews are documented by the reviewer by completing a Peer Review Documentation Form (see Figure 8-1) that is retained in the project file.

Woodward-Clyde Consultants

PROJECT NUMBER AND NAME ____________________

____

PEER REVIEW DOCUMENTATION

SUBJECT ____________________

A. A PEER REVIEW IS NOT REQUIRED FOR THE FOLLOWING REASON:

____ Construction Observations ____ Site Inspection ____ Boring Logs

____ Expert Testimony ____ Laboratory Tests ____ ____________

Responsible Principal/Associate ____________________ Date ____________

B. SCOPE OF PEER REVIEW

____ Letter

____ Complete Report

____ ____________

____ ____________

Following section of the report:

____ Geotechnical ____ Environmental

____ Earth Science ____ ____________

____ Waste Management ____ pages ____ to ____

C. PEER REVIEWER'S STATEMENT

REVIEWER'S CHECKLIST

	SATISFACTORY	NOT APPLICABLE	NUMBER (over)
1. Conformation to required scope and definition of service.			
2. Basic field and laboratory data.			
3. References, documents and correspondence in files.			
4. Assumptions, technical approaches and solutions.			
5. Checking of calculations, drawings, graphs and tables.			
6. Organization, clarity and completeness of report			
7. Applicability and completeness of stated limitations of the technical work.			
8. Specifications, opinions, judgments, conclusions, and recommendations.			

I have reviewed the subject project document dated ____________________, prepared by ____________________, in accordance with the noted scope and applicable checklist items. In my opinion, the material reviewed is professionally adequate and satisfies the agreement between WCC and the client. Further, my comments have been discussed with the author(s) and all significant issues have been resolved, except numbers ____________

PEER REVIEWER ____________________ DATE ____________

D. RESOLUTION OF COMMENTS Significant issues not resolved between the reviewer and author(s) have been resolved by me.

RESPONSIBLE PRINCIPAL/ASSOCIATE ____________________ DATE ____________

FIGURE 8-1
PEER REVIEW DOCUMENTATION FORM
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

GF89-333

9.0
PERFORMANCE AND SYSTEMS AUDITS

Internal performance and system audits will be performed as appropriate throughout the duration of the remedial investigation. The objectives of the performance and system audits are:

- to ensure that the quality assurance program developed for this project is being implemented according to the specified requirements;
- to assess the effectiveness of the quality assurance program;
- to identify nonconformances; and
- to verify correction of identified deficiencies or nonconformances.

If any significant deviations from the CDAP are documented, corrective action measures will be implemented and documented as detailed in Section 10.0. Reports to be prepared at the completion of an audit are described in Section 11.0.

The QA/QC Officer will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation. The QA/QC Officer will also report to the Project Manager the results of audits, and corrective action measures taken, if any.

9.1 PERFORMANCE AUDITS

Performance audits are usually conducted after data management systems are operational and data is being collected. Performance audits are used to quantitatively assess the accuracy of the data. Performance audits consist of two types: internal and external.

9.1.1 Internal

Internal performance audit check samples will be submitted to the subcontracted laboratory. These samples will consist of field blanks and duplicates as described in Section 8.0. Some duplicate samples may be used by the laboratory for matrix spike analysis. Analytical results from these internal performance audit samples will be used throughout the project to assess data from environmental samples for accuracy and precision.

9.1.2 External

External performance audit check samples are samples submitted by external regulatory agencies to assess whether a contracted laboratory is generating data within acceptable control limits. If external performance audit check samples are provided by USACE, the subcontracted laboratory will analyze these samples and provide analytical results along with results of the investigation samples.

Requirements for the performance audit check samples may be fulfilled as part of the contract laboratory validation procedures for USACE as outlined in Appendix C of ER1110-1-263.

In addition, USACE may request that QA samples, usually in form of splits or replicates of field samples, be submitted to the USACE QA laboratory as described in Appendices B and E of ER1110-1-263.

9.2. SYSTEMS AUDITS

Systems audits are conducted during the RI activities in order to verify that quality control measures/procedures specified in the CDAP are being used, documentation and project records are being completed and maintained, and that reviews of documents and reports are being conducted.

9.2.1 Field System Audit

A field system audit will be conducted by the QA/QC Officer or qualified designee during the initial sampling activities. The audit will include an on-site review of field operations, facilities, and activities, including sampling and equipment use and calibration. Documentation such as field notes, chain-of-custody forms, and equipment calibration forms will be checked for completeness and conformance to the CDAP requirements.

The auditor will provide an oral report summarizing the results of the audit to the Project Manager within five working days of the audit. A written report documenting all activities associated with the field system audit will be provided to the Project Manager within ten working days after completion of the audit. The report will document audit findings, on-site meetings, and program revisions, if necessary. A follow-up or second audit will be conducted if the Project Manager deems it necessary.

9.2.2 Laboratory System Audit

A laboratory systems audit may be conducted by the QA/QC Officer or qualified designee during analysis of initial sample shipments sent to the laboratory. If a laboratory systems audit is conducted, the QA/QC Officer, in conjunction with the project manager representing the subcontracted laboratory, will review documentation used to verify that instrumentation required by the analytical program is being operated and that the instruments are functioning properly. This initial audit will also include a review of the analytical methods proposed for use and the laboratory SOPs prepared from these methods. The laboratory project manager, or designee, will make changes as necessary following the initial laboratory systems audits and confirm orally within five working days and in writing within ten working days to the Project Manager and/or QA/QC Officer or designee that the laboratory meets all requirements of the measurement system.

9.2.3 Office System Audit

Office system audits will be conducted as part of the overall Quality Assurance Program. The office audit consists of reviewing the project file and verifying that data collected is being presented, reviewed, and filed in accordance with this CDAP and an established QA Program. The QA/QC Officer or designee, will be responsible for conducting office system audits of this project. The QA/QC Officer will prepare a written audit report within ten working days of the audit. The QA/QC Officer will present the findings to the Project Manager if further action is required.

In addition, the QA/QC Officer will conduct a limited office audit immediately prior to the start of field activities. The audit will focus on review of the established project filing system and procedures and requirements for documentation. This audit will help ensure that the project file and documentation system are set-up in a manner which will facilitate information and data storage and retrieval during the RI.

9.3 AUDIT RECORDS

Original records generated for all audits shall be retained within project files. Records shall include audit reports, the record of the implementation and completion of corrective actions, and documents associated with the audits which support audit findings and corrective actions as appropriate.

10.0
NONCONFORMANCE AND CORRECTIVE ACTION

The ultimate responsibility for maintaining quality throughout the project rests with the Program Manager and the QA/QC Officer. The routine operation of the quality assurance program, however, falls upon the Project Manager, the QA/QC Coordinator, the technical staff, and the subcontracted laboratory's quality assurance officer and project manager.

Any member of the project staff who identifies a condition adversely affecting quality can initiate corrective action by notifying the Project Manager or QA/QC Officer verbally or in writing. A written communication identifying the condition and an explanation of how it may affect data quality or quantity is preferable for initiating the corrective action process.

10.1 NONCONFORMANCE

A nonconformance is an unauthorized deviation from documented procedures, practices or standards, or a defect in an item that is sufficient to render the quality of the item unacceptable or indeterminate, or any event which is beyond the expected conditions and limits such as those presented in this CDAP. Nonconformances may include (but are not limited to) the following:

- failure of an instrument to work properly;
- sample documentation not correct;
- improper sample collection method;
- sample holding time exceeded;
- sample storage conditions outside criteria;
- incorrect sample preparation/analysis procedures used;

- Quality Control sample data (replicate, duplicate, blind duplicate, etc.) outside limits;
- calibration requirements not met;
- documentation errors in data recording or transcription;
- data validation errors;
- a recovery or RPD result that is out of control limits (e.g., more than three standard deviations from the weighted mean);
- relative standard deviation for response factors greater than accepted limits; and/or
- any situation or result which might affect the quality of data.

Any identified nonconformances with the established quality control procedures will be expeditiously controlled or corrected. Additional work which is dependent on the nonconforming activity will not be performed until the identified nonconformance is corrected.

10.2 CORRECTIVE ACTION

A corrective action is an appropriate measure applied to correct a nonconformance and minimize the possibility of recurrence.

Corrective action may be necessary in the event that data is determined to be suspect following performance or system audits or when existing or potential conditions are identified which may have an adverse impact on data quality.

10.2.1 Field Corrective Action

The Project Manager will periodically review the procedures being implemented in the field and audit findings for verifying consistency with the established procedures and protocols. Documentation will be checked for completeness. Where procedures are not strictly in compliance with the established protocol, deviations will be documented and reported. Corrective actions will be defined by the Project Manager and QA/QC Officer and documented as appropriate. Upon implementation of the corrective action, the Project Manager will provide the Program Manager and QA/QC Officer with a written memo documenting field implementation. The memo will become part of the project file.

10.2.2 Laboratory Corrective Action

The laboratory's quality assurance officer and the project Data Validator(s) will review the analytical data generated to ensure that all quality control samples have been analyzed as specified in the protocol. Recoveries of spike samples will be checked for consistency with method accuracy and duplicate samples will be checked with method precision. Where sample results fall outside of the acceptable ranges, deficiencies will be reported to the Project Manager and QA/QC Officer. Corrective actions will be defined by the Project Manager in coordination with the laboratory project manager and documented as appropriate.

Laboratory personnel will be alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy as established for matrix spikes and matrix spike duplicates in the analytical protocols.

- Blanks contain contaminants at concentrations above the required quantitation limit of any target compound.

- Undesirable trends are detected in matrix spike recoveries or coefficients of variation (CV) between matrix spike duplicates.

- There are unusual changes in detection limits.
- Deficiencies are detected during internal or external audits, or from the results of performance evaluation samples.

11.0
CHEMICAL DATA QUALITY MANAGEMENT (CDQM) DELIVERABLES

Various reports and documents will be prepared during the RI for presenting information about the Chemical Data Quality Management (CDQM) program. These reports are described in this section.

11.1 DAILY QUALITY CONTROL REPORTS (DQCR)

During the field investigation, the Field Manager will prepare Daily Quality Control Reports (DQCR) for the USACE. These reports will include the information presented in the USACE ER-1110-1-263. These reports will be compiled and sent to the USACE Project Manager once every week (along with the weekly confirmation notice package) in the event that no problems or deviations from the schedule arise. Should problems arise, the Field Manager or Project Manager will notify the USACE Project Manager immediately and send the DQCR by express mail or fax.

11.2 QUALITY CONTROL SUMMARY REPORT (QCSR)

A summary report of quality control activities will be submitted at the conclusion of the site investigation. The QCSR will contain, but not be limited to, the following information:

1) Project Description: This will include project organization and site description.

2) Laboratory QC Activities: This will include a summary of laboratory QC activities, a summary of any deviations from planned activities and a summary of the evaluation of the data quality for each analysis and matrix.

3) Field QC Activities: This will include a summary of field QC activities, a summary of any deviations from planned activities, and a summary of the evaluation of the quality of the sampling.

4) Data Presentation and Evaluation: This will include an assessment of sampling and analysis techniques, an evaluation of data quality of each matrix and parameter, and an evaluation of the usability of the data.

5) Lessons Learned: This will summarize any suggested changes to field or analytical procedures that could be made to better characterize chemical contamination in future work efforts.

6) DQCR Consolidation: All DQCR's will be consolidated and summarized.

7) Conclusions and recommendations.

11.3 NON-ROUTINE OCCURRENCES REPORT

A written report will be prepared and sent to the USACE Project Manager for all significant problems or non-routine occurrences which may arise. These reports will identify the nonconformance or problem and present the corrective action implemented. These reports will be sent to the USACE Project Manager within 48 hours after the corrective action is implemented.

11.4 ANALYTICAL DATA REPORTS

Analytical data will be presented in report format and will be transmitted to USACE for review. All laboratory analytical reports will follow the same format. Analyses will typically be grouped, for reporting purposes, by the date the sample was received by the laboratory and the batch it was analyzed with. In general, a typical analytical report will include:

1) General Discussion: This will include a description of sample types, tests performed, any problems encountered, and any general comments.

2) Analytical Data: Data are reported by sample or by test. All pertinent dates, information and reporting limits are also included.

3) QC Information: All pertinent QC information, including laboratory control samples, method blanks, matrix spikes, matrix spike duplicates, and duplicates will be included.

4) Methodology: Reference for analytical methodology used is cited.

5) Custom Services: Any requested special services are included.

11.5 SITE INVESTIGATION REPORT

A draft report summarizing the activities, data and findings which occurred or collected during the RI at the site will be prepared. The outline of information and elements to be included in this report will be determined at the end of field activities. At a minimum, the report will include the following elements:

- Information related to the implementation of the investigation;
- A description of field activities;
- Chemical analytical results for the media sampled;
- A discussion of the data and information collected during the RI and from previous investigations; and,
- Conclusions and recommendations.

Upon receipt of USACE comments, it is anticipated that a review meeting will be scheduled to discuss the comments and potential resolutions to any deficiencies identified. Following the review meeting, the resolved comments will be incorporated into the draft report and a final report prepared. This document will be transmitted to the appropriate federal, state, and local agencies.

ATTACHMENT A
STANDARD OPERATING PROCEDURES (SOP)

SOP Nos.	TITLE
SOP No. 1	SOIL SAMPLING
SOP No. 2	MONITORING WELL INSTALLATION
SOP No. 3	GROUNDWATER SAMPLING
SOP No. 4	SLUG TESTING
SOP No. 5	SINGLE WELL PUMPING TESTS
SOP No. 6	SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION
SOP No. 7	DECONTAMINATION
SOP No. 8	BORING ABANDONMENT
SOP No. 9	WATER LEVEL MEASUREMENT
SOP No. 10	SURFACE WATER SAMPLING
SOP No. 11	SEDIMENT SAMPLING
SOP No. 12	PHYSICAL PROPERTY TESTING

STANDARD OPERATING PROCEDURE NUMBER 1

SOIL SAMPLING

TABLE OF CONTENTS

LIST OF FIGURES

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for collecting soil samples. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP). This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect soil samples. The sample locations and frequency of collection are specified in the FSP.

This SOP is intended to be used together with the CDAP and several other SOPs. Sample identification, handling, and documentation procedures are described in SOP No. 6. SOP No. 7 describes decontamination procedures which are also applicable to this SOP. Health and safety procedures and equipment that will be required during the investigation are detailed in the Site Safety and Health Plan (SSHP).

2.0
PROCEDURES FOR SOIL SAMPLING

Both surface analytical soil samples and subsurface soil samples will be collected using either a stainless steel 2-inch O.D. or 3-inch O.D. split-spoon sampler, a stainless steel hand auger apparatus, or a stainless steel trowel.

2.1 EQUIPMENT LIST

The following list of equipment will be needed to collect soil samples:

Surface Soil Sampling Equipment

- Stainless steel hand augering apparatus with appropriate stainless steel hand sampling and mixing tools, or stainless steel 2-inch O.D. or 3-inch O.D. split spoon sampler or stainless steel spade and trowel (for analytical sampling)
- Galvanized 3-inch O.D. drive tube, drive head, hammer, and shovel (for geotechnical sampling)
- Measuring tape - 100 feet
- Ruler marked in 1/10 feet divisions
- Field books/field sheets
- Stainless steel knife
- Sample bottles provided by the laboratory
- Sample bottle labels
- Cooler with ice
- Label tape (clear)
- Paper towels
- Camera and film
- Waterproof and permanent marking pens
- Plastic sheeting
- Plastic bags
- Appropriate health and safety equipment, as specified in the SSHP

- Appropriate decontamination supplies
- Organic free deionized water

Subsurface Soil Sampling Equipment

- Stainless steel hand auger apparatus with appropriate stainless steel hand sampling and mixing tools, or stainless steel spade and trowel, or drill rig with appropriate drilling and stainless steel 2-inch O.D. or 3-inch O.D. split spoon sampler (for analytical sampling)
- Drill rig with appropriate drilling tools and 3-inch-diameter Shelby tubes (for geotechnical sampling)
- Measuring tape - 100 feet
- Surveyor's stakes
- Surveyor's flags
- Aluminum foil
- Field books/field sheets
- Stainless steel knife
- Sample bottles provided by the laboratory
- Sample bottle labels
- Label tape (clear)
- Paper towels
- Camera and film
- Waterproof and permanent marking pens
- Plastic sheeting
- Plastic bags
- Appropriate health and safety equipment, as specified in the HSP
- Appropriate decontamination supplies
- Organic free deionized water

2.2 DECONTAMINATION

Before drilling or sampling begins, the drilling and sampling equipment will be decontaminated according to the procedures contained in SOP No. 7. Drilling and sampling equipment will be decontaminated between boring and sampling locations. Sampling equipment will also be decontaminated between collection of samples from different depths at the same location.

2.3 ANALYTICAL SOIL SAMPLING

The procedures for collecting surface and subsurface analytical soil samples are provided in the following sections.

2.3.1 Surface Analytical Soil Sampling

- Decontaminate sampling equipment according to SOP No. 7.
- Record the sample location on a site map and in the field log book.
- Select the appropriate sampler (stainless steel split spoon, stainless steel hand auger, or stainless steel trowel) and collect the soil samples using the drilling rig, trowel, or hand auger at the intervals stated in the Field Sampling Plan (FSP).
- Don a clean pair of rubber or surgical gloves.
- Clear and remove vegetation and any surface debris such as rocks, as necessary.
- If using a trowel, first use a stainless steel spade to dig a 4 to 6 inch diameter excavation at the sampling point.
- Collect the surface sample with the selected method.
- If using a trowel, scrape the side wall of the excavation with the trowel and transfer sample to the appropriate containers.

- Open the split-spoon or hand auger and measure the recovery, scrape off any soil smear zone from the recovered sample with a stainless steel knife, and homogenize the retained sample from the depth interval to be sampled.

- Determine and identify the use of the recovered sample. This will always be for soil classification and stratigraphic logging and may be for chemical or geotechnical analysis.

- Individual bottles will be filled in the following order:

    - Volatile organic compounds (VOs) - fill prior to sample homogenization
    - Semi-volatile organic compounds (semi-VOs)
    - Pesticides and PCBs
    - Metals
    - Other analysis

- Label, store and document sample according to SOP No. 6.

- Record applicable information on the Sample Collection Field Sheet (Figure 1) and Chain-of-Custody (COC).

- Complete the lithologic description of the recovered sample according to the Unified Soil Classification System.

- Identify the location for future reference.

2.3.2 Subsurface Analytical Soil Sampling

Subsurface analytical soil sampling will occur in borings. Borings will be advanced by auger drilling a boring, using machine driven hollow-stem augers (HSA) with a 4-1/4 inch minimum inside diameter to accommodate a 2-inch or 3-inch outside diameter stainless steel split-spoon sampler. Auger borings will be performed in accordance with ASTM D1452 and standard penetration tests will be made according to ASTM D1586-84. A HSA steel finger plug installed in the bit will be used to prevent soil material coming into the interior of the hollow stem augers.

The coupling head for the split-spoon sampler will be provided with a ball check valve and will have open vents. Where necessary for sample recovery, the sampler will also be equipped with a spring-type sample retainer or an equivalent retainer.

In areas that are inaccessible to a drill rig, a stainless steel hand auger apparatus will be used. Soil samples will be obtained between the required depths from the auger bucket. If refusal is encountered before reaching the required depth, the boring will be relocated approximately 2 feet from the original boring. A second attempt will be made to obtain the remaining sample(s) before drilling operations are stopped at that location. In test pits, subsurface soil samples may be collected with hand auger or with a trowel.

The procedure for collecting, labeling, storing, and transporting subsurface soil samples is described below:

- Decontaminate the drilling and sampling equipment according to SOP No. 7.
- Record the boring location on a site map and in the field log book.
- Select the appropriate sampler for boring (stainless steel split spoon or stainless steel hand auger) and collect the soil samples using the drilling rig or hand auger at the intervals stated in the FSP. In the case of a test pit, select a hand auger or a trowel and collect samples following the protocol stated in the FSP.
- Don a clean pair of rubber or surgical gloves.
- Collect the sample using the appropriate sampler.

- Open the split-spoon or hand auger and measure the recovery, scrape off any soil smear zone from the recovered sample with a stainless steel knife, and homogenize the retained sample from the depth interval to be sampled. Samples to be collected for VOC analysis should be collected prior to homogenizing the retained sample.

- Determine and identify the use of the recovered sample. This will always be for visual soil classification and stratigraphic logging and may be for chemical or geotechnical analysis.

- Individual bottles will be filled in the following order:

    - Volatile organic compounds (VOCs) - fill prior to sample homogenization
    - Semi-volatile organic compounds (SVOCs)
    - Pesticides and PCBs
    - Metals
    - Other analysis

The required analyses are stated in the FSP. The number of additional samples retained for chemical analysis that will be submitted to the analytical laboratory will be a field decision made by the project staff and the Field Manager.

- Label, store, transport and document the samples (depending on the use of the sample) according to SOP No. 6.

- Record applicable information on the sample collection Field Sheet (Figure 1) and Chain-of-Custody (COC).

- Complete the lithologic description of the recovered sample according to the Unified Soil Classification System.

- Identify the location for future reference.

Any boring not used for a well will be abandoned with a cement bentonite mixture according to SOP No. 8.

2.3.3 Soil Geotechnical Sampling

Soil sampling for permeability, soil density, and soil classification will be obtained using the Drive Cylinder Method described in ASTM D2937-83. Samples will be collected with standard 3-inch outside diameter hand-driven, galvanized cylinders and from disturbed materials around the driven tube as necessary to obtain the volume of sample required for classification tests. Soil samples for permeability testing will be collected with 3-inch O.D. thin-walled samplers (galvanized Shelby tubes) as described in ASTM D1587-83.

The procedure for collecting, labeling, storing and transporting surface samples will follow the standard protocols (ASTM D4220-89) described in SOP No. 11 - Physical Property Testing. Sampling equipment will be decontaminated according to SOP No. 7.

2.4 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field Quality Assurance/Quality Control (QA/QC) samples are designed to help identify and minimize potential sources of sample contamination due to field procedures and to evaluate potential error introduced by sample collection and handling. All field QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses. The frequency of QA/QC samples is specified in the CDAP.

2.4.1. Field Blank Samples

A field blank sample of sampling equipment is intended to check if decontamination procedures have been effective. A field blank will be collected from the decontaminated sampling equipment before it is used to obtain the sample. Organic-free deionized water will be rinsed over the decontaminated sampling apparatus and transferred to the sample bottles. The same parameters that are being analyzed in the samples will be analyzed in the field blank. The field blank is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

2.4.2 Duplicate Samples

Duplicate samples are samples collected as close as possible to each other in time and space to check for the natural sample variance and the consistency of field techniques and laboratory analysis. The duplicate samples will be collected at the same time as the primary samples. For example, primary sample bottles for the volatile analysis will be filled first, then the duplicate sample bottles for volatiles, and so on until all necessary sample bottles for both the primary sample and the duplicate sample have been filled. The duplicate sample will be handled in the same manner as the primary sample. The duplicate sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

2.4.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spikes are used to determine the long-term precision and accuracy of the laboratory analytical method on various matrices. For this procedure duplicate samples are collected with the field samples and spiking is done by the lab. Samples are labeled as matrix spikes for the lab. It is useful to collect enough additional sample for both the matrix spike and duplicate samples from the same location.

2.4.4 Blind Spikes and/or Blanks

The USACE may provide blind spikes and/or blanks for laboratory analysis to determine the accuracy of the laboratory analytical method. The samples will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day received.

2.5 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled and recorded as described in this SOP and SOP No. 6. The parameters for analysis and preservation are specified in the CDAP.

2.6 DOCUMENTATION

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field (see SOP No. 6). Sample collection field sheets will be completed for all soil samples submitted for chemical analysis (Figure 1).

2.6.1 Field Logbook

The most important aspect of documentation is thorough, organized, and accurate record keeping. All information pertinent to the investigation and not documented on the boring log will be recorded in a bound logbook with consecutively numbered pages. All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions that are initialed and dated. Entries in the logbook will include the following, as applicable:

- Project name and number
- Sampler's name
- Date and time of sample collection
- Sample number, location, and depth
- Sampling method
- Sampling media
- Sample type (grab or composite)
- Sample preservation
- Observations at the sampling site
- Unusual conditions
- Information concerning drilling decisions
- Decontamination observations

- Weather conditions
- Names and addresses of field contacts
- Names and responsibilities of field crew members
- Names and titles of any site visitors
- Location, description, and log of photographs (if taken)
- References for all maps and photographs
- Information concerning sampling changes, scheduling modifications, and change orders
- Summary of daily tasks and documentation on any cost or scope of work changes required by field conditions
- Signature and date by personnel responsible for observations

Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook for a particular site. A site-specific logging procedure will be developed to include sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel. The logbooks will be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become a part of the final project file.

2.6.2 Boring Logs

Boring logs will be completed for each boring by qualified personnel (geologist, geological engineer, or geotechnical engineer). The boring log form is shown on Figure 2.

SAMPLE COLLECTION FIELD SHEET

SITE NAME ______________________ PROJECT NO. ______________________

SAMPLE NO. ______________________ PERSONNEL ______________________

____

LOCATION DESCRIPTION ______________________

SAMPLE MEDIA (CIRCLE 1): Soil Sediment Groundwater Surface Water
Other ______________________

SAMPLE SPLIT (CIRCLE 1): Yes No SPLIT SAMPLE NUMBER ______________________

SAMPLE DEPTH/WATER LEVEL ______________________

WATER LEVEL MEASUREMENT FROM TOP OF: ________ Riser Pipe ________ Protective Casing

COLLECTION: Year ________ Month ________ Day ________ Method ________

Sample Container / Volume	Preseervative	Analysis Requested

FIELD ANALYSIS

Temperature, ^{0}C ______________________ Date ______________________

Sample, pH ______________________ Time ______________________

Salinity, parts per thou. ______________________ Appearance ______________________

Conductivity, umhos/cm ______________________ Odor ______________________

Comments: ______________________

FIGURE 1
SAMPLE COLLECTION FIELD SHEET
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CCONNETICUT

LOG OF BORING________________ SHEET __1__ OF_____

PROJECT AND LOCATION	ELEVATION AND DATUM	PROJECT NO.
DRILLING AGENCY / FOREMAN	DATE STARTED	DATE FINISHED
DRILLING EQUIPMENT	COMPLETION DEPTH	ROCK DEPTH
SIZE AND TYPE OF BIT / SIZE AND TYPE CORE BARREL	NO. SAMPLES: DIST / UNDIST / CORE	
CASING	WATER LEVEL: FIRST / COMPL. / 24 HR	
CASING HAMMER / WEIGHT / DROP	BORING ANGLE AND DIRECTION	
SAMPLER		
SAMPLER HAMMER / WEIGHT / DROP	INSPECTOR	

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES				HNU/PID READINGS (PPM)			REMARKS
			TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	SAMPLE	AMBIENT AIR	TIME	
		1								
		2								
		3								
		4								
		5								
		6								
		7								
		8								
		9								
		10								
		11								
		12								
		13								
		14								
		15								
		16								
		17								
		18								
		19								

FIGURE–2
BORING LOG FORM
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

STANDARD OPERATING PROCEDURE NUMBER 2

MONITORING WELL INSTALLATION

TABLE OF CONTENTS

LIST OF FIGURES

1.0
PURPOSE AND SCOPE

The purpose of this document is to define the standard operation procedures (SOP) for installation and development of ground water wells. The procedures are sufficiently detailed to allow field personnel to properly install and develop wells. The well locations are defined in the Chemical Data Aquisition Plan (CDAP).

This SOP serves as a supplement to the CDAP and is intended to be used together with the CDAP and several other SOPs. SOP No. 7 describes the decontamination procedures applicable to well installation and development.

2.0
PROCEDURES FOR DRILLING AND MONITORING WELL INSTALLATION

2.1 DRILLING AND WELL INSTALLATION PROCEDURES

This section will describe the standard operating procedures for the installation of both shallow wells (total depth of approximately 15 ft) and deep wells (total depth of approximately 35 feet), the data recorded during the drilling of the well and the well installation procedures. These procedures are defined in keeping with the requirements of the Army Corps of Engineers, as defined in Attachment A of the Scope of Work for Work Plan for Remedial Investigation at the Stratford Army Engine Plant, and the standard operating procedures of the A-E.

2.1.1 Shallow Wells: Total Depth Approximately Fifteen Feet

The borings for shallow wells, i.e. wells screened from five to fifteen feet below ground surface (bgs), will be advanced using a truck mounted hollow stem auger drill rig. The drill rig, augers and other drilling tools that will be used down the hole will be steam cleaned before beginning a new boring and before leaving the site. Borings which cannot be completed by the end of a working day will be covered to prevent contaminated material from entering the borehole and will be secured using available equipment.

During the advancement of the well boring, soil samples will be collected using a two inch outer diameter (OD) split spoon sampler advanced 24 inches using a 140 lb hammer dropped approximately 30 inches (ASTM D1586-84). The split spoons will be decontaminated according to methods outlined in Section 2.2.2 of SOP 7. Blow counts will be recorded by the A-E inspecting the boring.

2.1.1.1 Variable Site Conditions

In areas where the subsurface stratigraphy is principally sand, with some to trace silt, it is not uncommon to experience "running" sands during the advancing of the well boring below the water table. Running sands are sands that advance up the annulus of the auger when the big plug is removed so that a split spoon sample can be collected. In the event of running sands the A-E reserves the right to use standard industry techniques to stabilize the boring. The most common technique is to fill the boring with potable water. The weight of the water may stabilize the running sands, thus allowing the sampling and/or installation to continue. In the event the introduction of a head of potable water does not stabilize the well boring, the A-E reserves the right to investigate alternative methodologies of stabilizing or, if necessary, advancing the well boring. The A-E also reserves the right to address other changing or non-standard site conditions that affect the advancement and installation of the aforementioned well using industry standard procedures and professional judgement.

2.1.2 Deep Well Borings: Total Depth Approximately Twenty Five Feet

Deep well borings will be advanced using a truck mounted hollow stem auger drill rig. The drill rig, augers and other drilling tools that will be used down the hole will be steam cleaned before beginning a new boring and before leaving the site. Borings which cannot be completed by the end of a working day will be covered to prevent contaminated material from entering the borehole and will be secured using available equipment.

During the advancement of the well boring, soil samples will be collected using a two inch outer diameter (OD) split spoon sampler advanced 24 inches using a 140 lb hammer dropped approximately 30 inches (ASTM D1586-84). The split spoons will be decontaminated according to methods outlined in Section 2.2.2 of the SOP 7. Blow counts will be recorded by the A-E inspecting the boring.

Deep well borings will be advanced to the depth of the shallow water table or to a maximum of ten feet below ground surface. At that point the augers will be removed and a six inch inner diameter (ID) steel casing, a "working casing" will be driven to the maximum advancement depth of the augers. The augers will then be steam cleaned or replaced by clean augers in order to prevent the augers from carrying potentially contaminated soil from above the water table to the screened interval of the deep wells. The working casing will be removed during the installation of the well (Section 2.2.5).

2.1.2.1 Variable Site Conditions

In the event of "running sands" the A-E reserves the right to use standard industry techniques such as those described in Section 2.1.1.1. The A-E also reserves the right to address other changing or non-standard site conditions that affect the advancement and installation of the aforementioned well using industry standard procedures and professional judgement.

2.2 STRATIGRAPHIC LOGGING

Soil samples will be collected using 2-inch OD split spoon samplers. Continuous samples well be collected from the ground surface to the top of the water table. From that point samples will be collected at five foot intervals at sample depths that are a multiple of the integer five.

Soils will be classified according to the Unified Soil Classification System (ASTM-D-2487 and ASTM-D-2488). Soil descriptions will be based on visual/manual observations of the soil in the split spoon samples, augmented by observations of soil cuttings from the auger flights. The typical sequence of describing a soil sample is as follows:

- Unified Soil Classification Symbol.
- Condition of soil, i.e. compactness (coarse-grained soils) or consistency (fine grained soils).

- Color.
- Descriptive adjective for main soil component (e.g. silty,sandy,etc.)
- Main Soil component.
- Descriptive adjective for minor soil component.
- Minor soil component (identified by adjective "some" (12-30%) or "trace" (<12%) depending on concentration).
- Description of moisture content (eg. moist, saturated).
- Miscellaneous descriptions.

A legible, concise record of all significant information pertaining to drilling and sampling operations for each boring will be maintained concurrent with the advancement of the hole. That information will be recorded by the A-E on the boring log. A sample boring log is shown in Figure 1. Required information on the boring log is as follows:

- classification and description of all soil samples;
- depth or elevation of strata changes;
- depth or elevation of water table;
- number of blows per 6 inches of penetration of the split-spoon sampler during the standard penetration test;
- location and identification number of samples;
- depth and type of casing;
- sample recovery;
- characteristics of soil cuttings;
- real-time ambient air and sample organic vapor readings as measured on a flame or photoionization detector; and
- difficulties, if any, associated with drilling.

Boring logs will also include the following information:

- Boring Location;
- Drilling Company;
- Drilling company foreman or licensed driller;
- Type of drill rig used;

- Type and number of samples collected;
- Type of sampling equipment;
- Boring angle;
- Completion depth of boring;
- Date and time boring started;
- Date and time boring completed;
- Surface elevation (if available); and,
- Name of drilling inspector(s).

2.3 WELL INSTALLATION PROCEDURES

All materials used for the construction of the wells shall be inert with respect to the contaminants of concern. The well screen and riser will be 2 inch OD, flush joint, schedule 40 PVC. Both the well screen and riser will be steam cleaned before installation to insure that remnant machine oils and greases have been removed.Typical well construction is as follows (Figure 2):

- Ten feet of 2 inch OD factory slotted PVC installed in a 6 inch nominal borehole. Based on our current understanding of the site it is anticipated that 0.010 inch (No. 10) slot will be used. A bottom cap will be installed at the base of the screen. The A-E reserves the right to use another slot size depending on site conditions.

- A filter pack of graded sand will be tremied down the annulus of the borehole to an elevation of approximately 2 ft above the top of the screened interval.

- A three foot thick bentonite seal will be placed above the sand pack using bentonite pellets.

- The remaining annular space shall be tremie grouted with a cement-bentonite grout to within three feet of the ground surface. The grout will be compose of approximately 7 gallons of water per 94 lb bag of cement with 3-5% bentonite (by weight) added if local regulations allow.

- A steel protective casing will be cemented into place in the remaining annular space and the well will be finished with a 4 inch thick, 3 foot square, sloping concrete apron.

- Three 2 inch diameter or larger steel pipes will be equally spaced around the well and securely imbedded in the concrete pad, except in cases where a flush mount protective casing is installed.

The finished well casing will extend approximately 2 ft above the ground surface and will be identified with a corrosion resistant tag identifying the well, the depth, the date of installation, the top of casing elevation and the U.S. Army Corps of Engineers Omaha District. The riser will be fitted with a vented cap, and the casing fitted with a locking cap. In the event a well must be fitted with a flush mount cap (Figure 3), the well will be fitted with an internal expandable locking cap and bolted flushmount cover.

2.2.1 Variations on Standard Well Installation Procedures

The A-E recognizes that a field conditions and/or slight differences between shallow and deep well construction methods may cause variations on the well construction procedures outlined above. For example, it is anticipated that the deep wells will have the working casings removed before the well is tremie grouted to within three feet of ground surface. However, if the shallow portion of the well boring is unstable, the A-E reserves the right to leave the working casing in place.

The A-E reserves the right to vary well installation procedures, within industry accepted standards, to address differing site conditions such as flowing sands during well installation. Commonly used techniques for installing wells under these conditions include but are not limited to overboring the well to roughly account for the amount of material flowing into the annulus, and/or introducing potable water into the well to stabilize the sands at the bottom of the borehole.

The A-E reserves the right to install wells without using centralizers on the well screen and riser. Centralizers are not compatible with well installation using hollow stem augers and/or in areas where borehole stability is in question. If the hollow stem augers were removed before well installation the borehole may collapse at any elevation, thereby not allowing the well to be installed at the appropriate depth. To avoid this situation the wells will be installed through the annular space of the augers, removing the augers in a stepped fashion. If this method is used, centralizers cannot be used because they will not fit down the annular space of the augers.

2.4 WELL INSTALLATION DOCUMENTATION

A well installation form will be completed for every completed well (Figures 4 and 5). The information included on the well installation form is:

- Well designation;
- Date and time well started;
- Date and time well completed;
- Surface elevation (to the nearest 0.1 ft);
- Casing elevation (to the nearest 0.01 ft);
- Elevation of top of grout in annular space;
- Elevation of top of bentonite seal;
- Elevation of top of sand/gravel pack;
- Elevation of top of screen;
- Elevation of bottom of screen;and,
- Elevation of bottom of borehole.

A summary of the well installation procedures including the volume of each material used will be included in the "Remarks" section of the well installation summary form.

3.0
WELL DEVELOPMENT PROCEDURE

Wells will be developed to improve the hydraulic communication between the formation and monitoring wells and to help assure that representative ground water samples will be collected. During the drilling process, the sides of the borehole may become smeared (commonly referred to as the "skin effect") which substantially retards the movement of water into the well. In addition, soil may enter the filter pack, or temporarily clog the well screen slots during the installation of the well materials.

Well development is the process of flushing the interface between the aquifer and the well. In addition, the filter pack and screen slots are cleaned, allowing ground water to flow into the well with a minimum of retardation. Development is required to (1) restore the natural permeability of the formation immediately adjacent to the borehole, (2) remove clay, silt and other fines from the filter pack and well screen, and (3) remove remnant drilling fluids and contaminants potentially introduced during drilling activities.

3.1 PROCEDURES

The development of a newly installed monitoring well will proceed only after the grout has been allowed to set for a minimum of 28 hours. Before development begins, the development equipment will be decontaminated according to the procedures defined in SOP 7.

Initial development of each well will be accomplished using a surge block. A surge block is a round plunger with pliable edges that will not catch on the well screen. The surge block is moved forcefully up and down inside the well screen, causing the water to surge in and out of the well screen. The surge procedure will continue for approximately 2 hours. Temperature, pH and specific conductivity readings will be taken at the start and finish of the surge block procedure.

Following surging, a mininum of five well volumes of water will be evacuated by pumping and/or bailing. The choice of methodology is dependent upon the well depth and/or recharge rate. Temperature, pH, and specific conductivity will be measured periodically during the pumping/bailing. The pumping/bailing will continue until four consecutive sets of readings are within 10% of each other and the water is clear and free of fines.

3.1.1 Variations from Army Corps Procedures

The pumping phase of well development for wells shall continue for a maximum of three hours if (1) a mechanical pump is used at an average pumping rate of two or more gallons per minute, and (2) temperature, pH and specific conductivity have all stabilized. This will produce approximately 360 gallons of water. This volume is, in the estimation of the A-E, equal to or more than the amount of water that would be produced by bailing the well for a maximum of 8 hours as required in the well development field procedures defined in Appendix B of the Work Plan for Remedial Investigation at the Stratford Army Engine Plant. Mechanical development in excess of three hours does not increase the validity of ground water samples from the well in question.

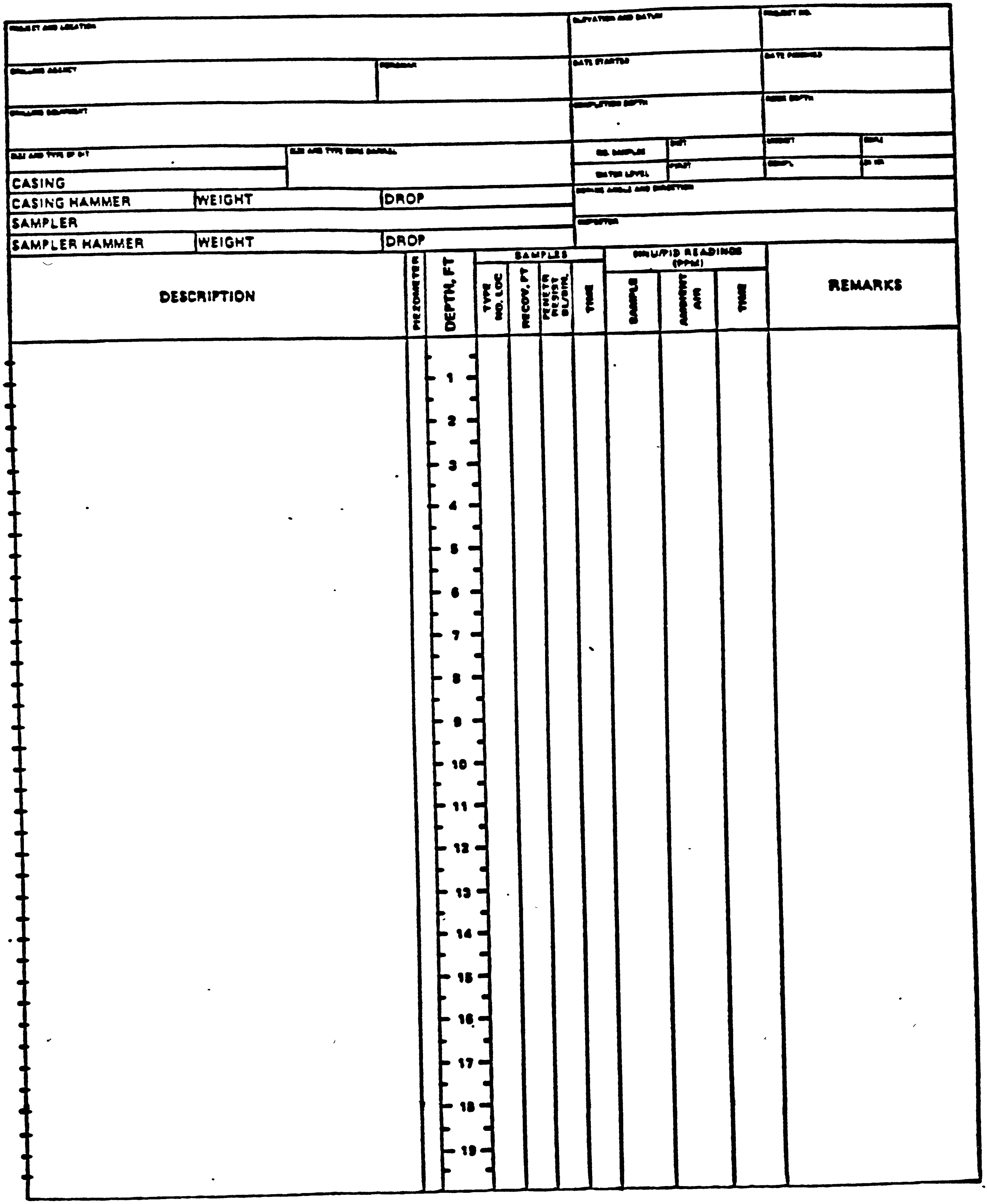
If the well cannot sustain flows of three gpm or greater, the well will be pumped/bailed until the temperature, Ph, and specific conductivity have stabilized, and the water is as clear of sediment as is practical. Regardless of the clarity of the water, the well will be developed until a minimum of five well volumes is removed.

3.2 DOCUMENTATION

The documentation of the observation and data acquired in the field will be recorded in a bound weatherproof field book. As part of the development process the following information will be recorded in the field book:

- Well designation;
- date(s) and time of well development;
- static water level from top of casing before and after development;
- volume of water in well before development;
- volume of water removed and time of removal;
- depth from top of well casing to bottom of well;
- screen length;
- depth from top of well casing to top of sediment inside well, if present, before and after development;
- field measurements of pH, specific conductance and temperature taken during and after development;
- physical character of removed water throughout development (color, odor, turbidity)
- method used;
- rate of recovery of ground water after pumping/bailing is completed (if practical); and,
- description of development technique.

The field books will be maintained in the project files.



PROJECT AND LOCATION
ELEVATION AND DATUM
PROJECT NO.
DRILLING AGENCY
FOREMAN
DATE STARTED
DATE FINISHED
DRILLING EQUIPMENT
COMPLETION DEPTH
ROCK DEPTH
SIZE AND TYPE OF BIT
SIZE AND TYPE CORE BARREL
NO. SAMPLES: DIST. UNDIST. CORE
WATER LEVEL: FIRST COMPL. 24 HR.
CASING
CASING HAMMER WEIGHT DROP
BORING ANGLE AND DIRECTION
SAMPLER
INSPECTOR
SAMPLER HAMMER WEIGHT DROP

DESCRIPTION	PIEZOMETER	DEPTH, FT	SAMPLES				HNU/PID READINGS (PPM)			REMARKS
			TYPE NO. LOC	RECOV, FT	PENETR RESIST BL/6IN.	TIME	SAMPLE	AMBIENT AIR	TIME	
		1								
		2								
		3								
		4								
		5								
		6								
		7								
		8								
		9								
		10								
		11								
		12								
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		16								
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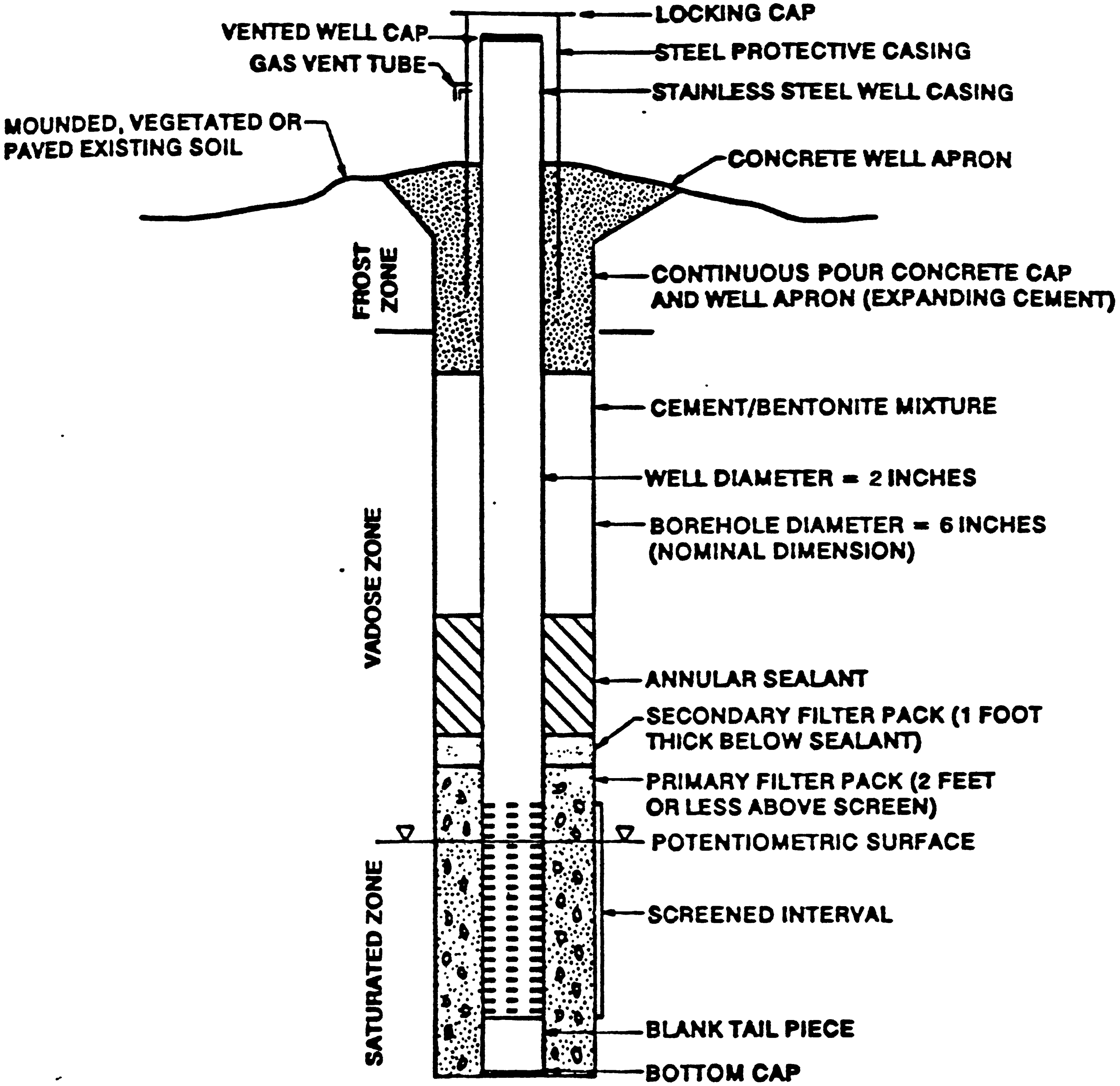
		18								
		19								

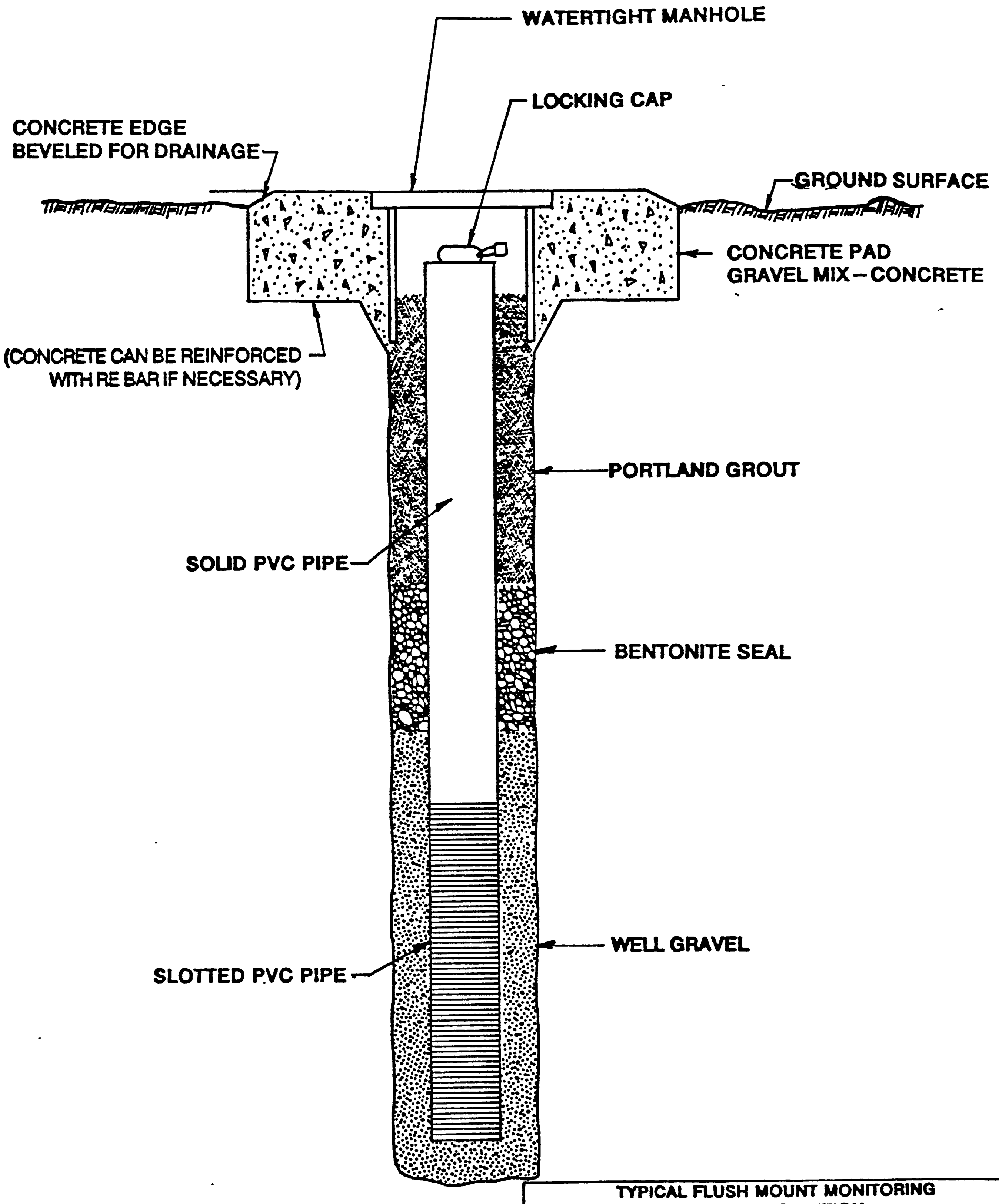
FIGURE – 1
BORING LOG FORM
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT



TYPICAL MONITORING WELL CONSTRUCTION IN UNCONSOLIDATED MATERIALS
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

WOODWARD – CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	FWD	SCALE:	NONE	PROJ. NO:	89C114CC
CK'D BY:	MEJ	DATE:	17 OCT 1991	FIGURE NO.:	2



TYPICAL FLUSH MOUNT MONITORING
WELL CONSTRUTION
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNETICUT

WOODWARD - CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR BY	BAS	SCALE	NOT TO SCALE	PROJ NO	89C4828		
CK'D BY	MJ	DATE	21 SEPT 1989	FIG NO	3		

Remedial Investigation Work Plan - SOP 2
Stratford Army Engine Plant
Stratford, CT
amb\89c114cc\d006sp2.w51

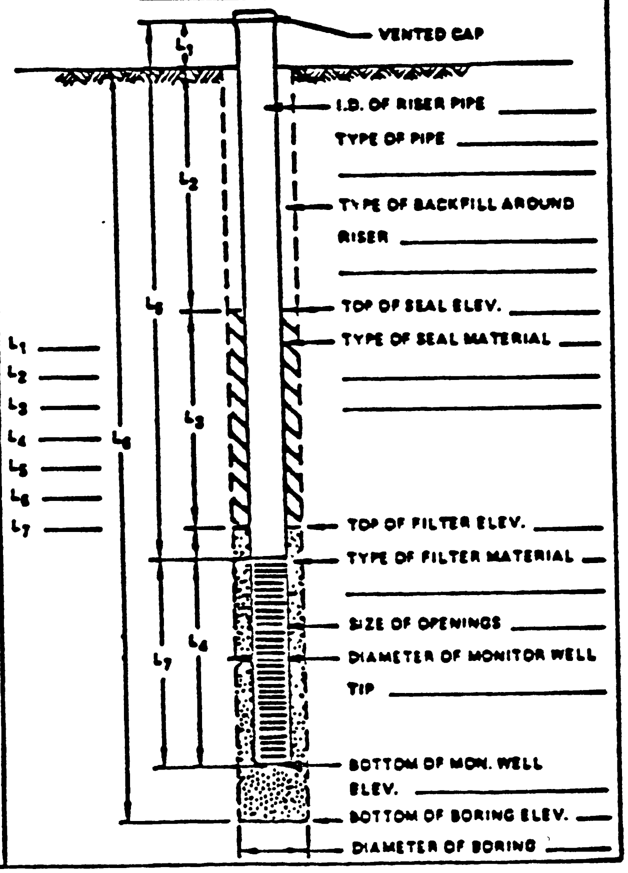
INSTALLATION REPORT

PROJECT AND LOCATION	WELL NO.	ELEVATION DATUM	PROJECT NO.
DRILLING AGENCY	FOREMAN	DATE INSTALLATION STARTED	DATE INSTALLATION FINISHED
DEVELOPMENT EQUIPMENT	GALLONS REMOVED	TIME DEVELOPMENT STARTED	TIME DEVELOPMENT COMPLETED

LOG OF MONITORING WELL

BORING		MONITORING WELL
DEPTH IN FEET	DESCRIPTION	TYPE OF MONITORING WELL ____________

GROUND ELEV. ________ TOP OF RISER ELEV. ________



REMARKS ____________

INSPECTED BY ____________

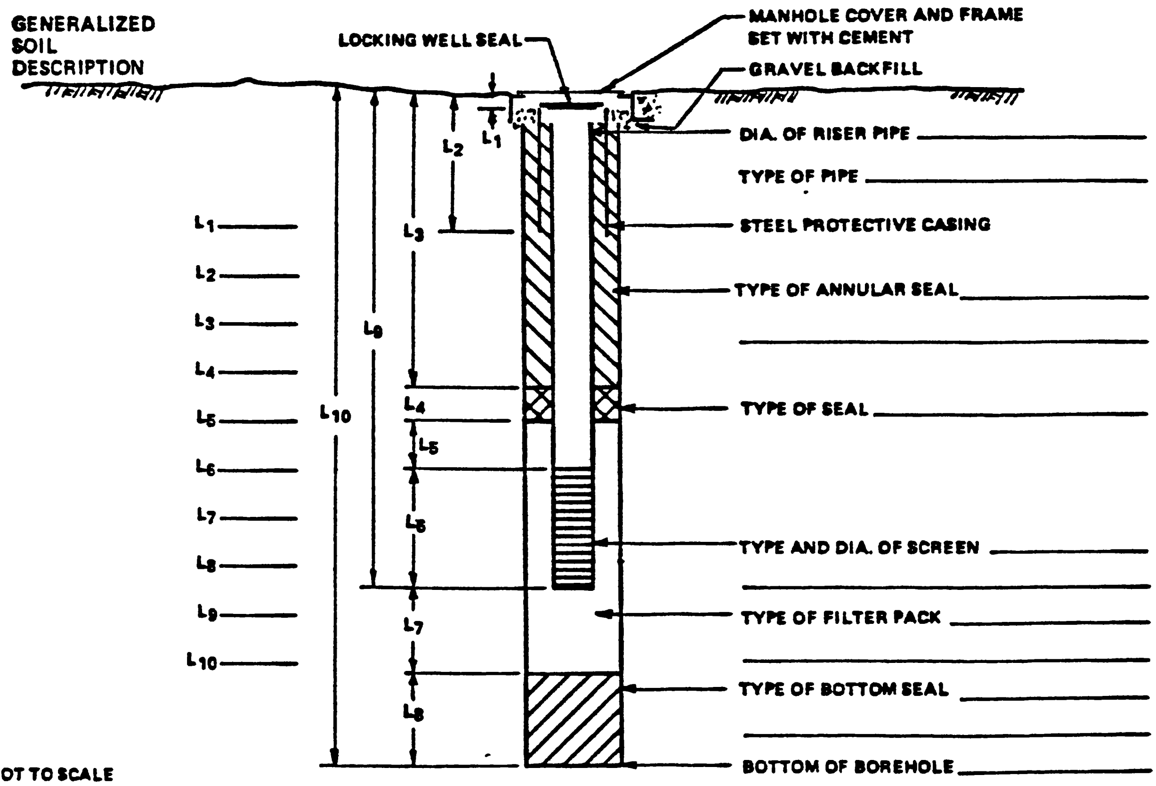
FIGURE–4
MONITORING WELL INSTALLATION REPORT
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

CONSTRUCTION OF FLUSHMOUNT MONITORING WELL NO. ________

PROJECT AND LOCATION	GROUND ELEV. AND DATUM	PROJECT NO.
DRILLING AGENCY	TOP OF RISER ELEV.	DATE FINISHED
METHOD OF DRILLING ____________ DIA. OF BOREHOLE ____________ DEPTH OF BOREHOLE ____________	TOP OF PROTECTIVE CASING ELEV.	INSPECTOR:
	GROUND WATER ELEV.	CHECKED BY:



NOT TO SCALE
(VALUES REPORTED IN FT)

REMARKS: ____

____

____

____

____

____

FIGURE–5
FLUSHMOUNT MONITORING WELL CONSTRUCTION LOG
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

STANDARD OPERATING PROCEDURE NUMBER 3

GROUNDWATER SAMPLING

TABLE OF CONTENTS

LIST OF FIGURES

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for collecting groundwater samples. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP). This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect groundwater samples. The sample locations and frequency of collection are specified in the CDAP.

This SOP is intended to be used together with the CDAP and several other SOPs. Sample identification, handling, and documentation procedures are described in SOP No. 6. SOP No. 7 describes decontamination procedures which are also applicable to this SOP. Health and safety procedures and equipment that will be required during the investigation are detailed in the Site Safety and Health Plan (SSHP).

2.0
GROUNDWATER SAMPLING PROCEDURES

2.1 EQUIPMENT LIST

Equipment used during well purging:

- Well keys
- Electronic water level probe
- Assorted tools (knife, screwdriver, etc.)
- Teflon or stainless steel bailer (bottom filling)
- Nylon rope or twine
- Discharge hose
- Thermometer
- pH meter (with automatic temperature compensation)
- Conductivity meter
- Plastic squeeze bottle filled with deionized water
- Polyethylene or glass container (for field parameter measurements)
- Paper towels
- Calculator
- Field notebook
- Waterproof and permanent marker
- 55-gallon drum or holding tank for storing purged water (if necessary)
- Appropriate health and safety equipment
- Well completion information sheet
- Organic free deionized water
- Appropriate decontamination equipment
- HNu
- Appropriate Pump(s)

Equipment used during well sampling:

- Electronic water level measurement probe
- Stainless steel bailers
- Nylon rope
- Thermometer
- pH meter (with automatic temperature compensation)
- Conductivity meter
- Plastic squeeze bottle filled with organic free deionized water
- Cooler with ice
- Polyethylene or glass jar for measurement of field parameters
- Sample jars and labels. Sample bottles with preservatives added will be obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage or other problems.
- Paper Towels
- Field notebook
- Water sample collection form
- Waterproof and permanent marker
- Well completion information sheet
- Appropriate decontamination equipment
- Appropriate health and safety equipment

2.2 SAMPLING PROCEDURE

This section gives the step-by-step procedures for collecting groundwater samples in the field. Observations made during sample collection should be recorded in the field notebook and field data sheet as specified in Section 2.4 of this SOP.

2.2.1 Equipment Decontamination

Before any purging or sampling begins, all well probes, bailers, and other sampling devices shall be decontaminated. If dedicated equipment is used, it should be rinsed with distilled water. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. Each piece of purging or sampling equipment shall be decontaminated before sampling operations and between each well. The decontamination solutions shall be replaced with clean solutions between each well. Used solutions will be discharged to the ground surface away from each well. The procedures presented in SOP No. 7, Decontamination, will be followed for decontamination of field equipment and for personnel decontamination.

2.2.2 Instrument Calibration

Electronic equipment used during sampling includes a pH meter with temperature scale and automatic temperature compensation, a conductivity meter, and a water level measurement probe. Before going into the field, the sampler shall verify that these instruments are operating properly. The pH and conductivity meters require calibration prior to use every day and must be recalibrated if they have been turned off. Calibration times and readings will be recorded in a notebook to be kept by the field sampler. Specific instructions for calibrating the instruments are given in Section 3.0 of this SOP.

2.2.3 Well Purging

The purpose of well purging is to remove stagnant water from the well and obtain representative water from the geologic formation being sampled while minimizing disturbance to the collected samples. Before a sample is taken, the well will be purged until a minimum of five well casing volumes have been removed and field parameters have stabilized or until the well is pumped or bailed dry. All wells will be sampled on the day they are purged.

Before well purging begins, the following procedures will be performed at each well:

- The condition of the outer well casing, concrete well pad, protective posts and any unusual conditions of the area around the well will be noted in the field logbook.

- The well will be opened.

- The condition of the inner well cap and casing will be noted.

- HNu reading will be taken at well head.

- The depth of static water level will be measured to nearest 0.01 foot and recorded from the measuring point on the well casing.

- The total depth of well from the same measuring point on the casing will be measured and recorded.

- The volume of water in the well casing will be calculated in gallons based on feet of water and casing diameter. (See Section 2.4.3 for calculation of volumes.)

- From the above calculation, the five casing volumes to be evacuated will be calculated.

- When evacuating a well using a hand pump, the pump intake should be placed:

  - for low recovery wells (wells which can be pumped dry), the pump intake will be placed at the bottom of the screened interval

  - for high recovery wells (little drawdown with pumping) the pump will be placed at the top of the screened interval

- If the well is bailed or pumped dry during evacuation, it can and will be assumed that the purpose of removing five well volumes of water has been accomplished, that is, removing all stagnant water which had prolonged contact with the well casing or air. If recovery is very slow, samples may be obtained as soon as sufficient water is available.

2.2.4 Sample Collection

Samples for chemical analysis will be collected within eight hours after purging is completed. For slow recovering wells, the sample shall be collected after a sufficient volume is available. The samples shall be taken from within the well screen interval. The following sampling procedure is to be used at each well:

1. Decontaminated sampling equipment will be assembled. New nylon rope and dedicated stainless steel bailers will be used for each well for each sampling event.

2. Identification labels for sample bottles will be filled out for each well.

3. The bottom filling bailer will be lowered slowly and <u>gently</u> into contact with the water in the well. The bailer will be lowered to the same depth in the well each time, within the screened interval.

4. The bailer will be retrieved smoothly and the water will be slowly poured into the sample containers.

5. The individual sample bottles should be filled in the order given below:
   - Volatile organic compounds (VOs)
   - Semivolatile organic compounds
   - Pesticides and PCBs
   - Metals
   - Others
   - Field test parameters (pH, specific conductance and temperature)

   VO sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles in the vial which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.

Care should be taken to not overfill sample vials. Measure pH in "dummy" sample containers to verify that appropriate amounts of preservatives have been added to the containers. Do not collect samples for laboratory analysis into containers used for preservative level testing.

6. Time of sampling will be recorded.

7. The well cap will be replaced and locked.

8. Field documentation will be completed, including the chain-of-custody.

2.2.5 Field Quality Assurance/Quality Control Procedures and Samples

The well sampling order will be dependent on expected levels of contamination in each well, if known, and will be determined prior to sampling. Sampling will progress from the least contaminated well to the most contaminated. Quality assurance/quality control (QA/QC) samples will be collected during groundwater sampling.

Field QA/QC samples are designed to help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

Field Rinsate Samples

An equipment rinsate sample of sampling equipment is intended to check if decontamination procedures have been effective. For the well sampling operation, a rinsate sample will be collected from the decontaminated sampling equipment (bailer) before it is used to obtain the sample. Organic free deionized water will be rinsed over the decontaminated sampling apparatus and transferred to the sample bottles. The same parameters that are being analyzed in the groundwater samples will be analyzed in the rinsate samples. The rinsate sample is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

Duplicate Samples

Duplicate samples are samples collected side-by-side to check for the natural sample variance and the consistency of field techniques and laboratory analysis. For the groundwater sampling a duplicate sample will be collected at the same time as the initial sample. The initial sample bottle for a particular parameter or set of parameters will be filled first, then the duplicate sample bottle for the same parameter(s), and so on until all necessary sample bottles for both the initial sample and the duplicate sample have been filled. The duplicate groundwater sample will be handled in the same manner as the primary sample. The duplicate sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected.

Matrix Spikes and Matrix Spike Duplicates

Matrix spikes are used to determine long-term precision and accuracy of the laboratory analytical method on various matrices. For this procedure duplicate samples are collected at the well and spiking is done by the lab. Samples are labelled as matrix spikes for the lab. The matrix spike and duplicate will be collected at the same well.

2.3 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled, and recorded as described in this SOP and in SOP No. 6.

2.4 DOCUMENTATION

2.4.1 Field Sampling Data Sheet

A sample collection field sheet for groundwater samples (Figure 1) will be completed at each sampling location. The data sheet will be completely filled in. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA). Well purging information will be recorded on the well purging and sampling form (Figure 2). The information on the data sheet includes the following:

- Well number
- Method of purging
- Type of pump and pumping rate (if applicable)
- Date and time of sampling
- Depth of sample collected
- Person performing sampling
- Type of sampling equipment
- Volume of water purged before sampling
- Conductivity, temperature, and pH during evacuation (note number of well volumes)
- Number of samples taken
- Sample identification number
- Preservation of samples
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sampling quality

2.4.2 Field Notes

Field notes shall be kept in a bound field book. The following information will be recorded using waterproof ink:

- Names of personnel
- Weather conditions
- Location and well number
- Date and time of sampling
- Condition of the well
- Decontamination information
- Initial static water level and total well depth
- Calculations (e.g., calculation of purged volume)
- Analyses that will be performed by the laboratory
- Equipment calibration information

2.4.3 Well Volume Calculations

The following equation shall be used to calculate the volume of water to be removed during well evacuation:

For 2-inch well:

$$\text{Vwc (gal)} = [\text{WCH (ft)}]\ [0.1632\ \text{(gal)/ft)}]$$

where: Vwc = well casing volume

WCH = water column height (total well depth - water level depth)

and

$$\text{Ve (gal)} = (\text{Vwc})(5)$$

where: Ve = minimum water volume to be evacuated

3.0
CALIBRATION

3.1 pH METER

The pH meter must be calibrated each day before taking any readings of samples and must be recalibrated during the day if it has been turned off after the initial calibration. Calibration and operation of the pH meter will follow the manufacturer's specific instructions. In general, calibration is done by adjusting the meter with standard buffers that bracket the expected pH of the field water. Calibration will consist of the following general procedures:

1. Adjust the reading of the pH meter, by using the calibration knob with the electrode placed in the pH 7 buffer. Rinse the electrodes with distilled water between buffer adjustments.

2. With the electrode placed in the pH 4 buffer, adjust the reading of the meter with the slope knob. Adjust using the temperature knob if the meter has no slope knob.

3. Repeat steps 1 and 2 until the meter gives acceptable readings (±0.1 pH unit) for all the buffers used for calibration.

Note: Always use the same electrode for measurements that was used in the calibration. Recalibrate the meter if the electrode is replaced. Although the temperature setting on the pH meter often does not match the sample temperature after calibration, the pH readings will still be accurate in these cases provided that the response to the buffers is correct.

Record the time of analysis and temperature of the buffer in the field notebook whenever the pH meter is calibrated.

3.2 CONDUCTIVITY METER

The conductivity meter must be calibrated each day before taking field measurements. Record time, temperature, and instrument response in the meter notebook. Calibration is done by noting the response of the meter to several standard conductivity solutions which bracket the values expected to be measured in the field. Standards of 100, 1000, and 10,000 umhos/cm should be adequate for the samples expected. If the instrument has a calibration adjustment, set the response to match the standards. Otherwise, simply record in the field notebook the instrument response to each standard.

SAMPLE COLLECTION FIELD SHEET

SITE NAME ____________________ PROJECT NO. ____________________

SAMPLE NO. ____________________ PERSONNEL ____________________

____

LOCATION DESCRIPTION ____________________

SAMPLE MEDIA (CIRCLE 1): Soil Sediment Groundwater Surface Water

Other ____________________

SAMPLE SPLIT (CIRCLE 1): Yes No SPLIT SAMPLE NUMBER ____________________

SAMPLE DEPTH/WATER LEVEL ____________________

WATER LEVEL MEASUREMENT FROM TOP OF: __________ Riser Pipe __________ Protective Casing

COLLECTION: Year __________ Month __________ Day __________ Method __________

Sample Container / Volume	Preseervative	Analysis Requested

FIELD ANALYSIS

Temperature, ^{0}C ____________________ Date ____________________

Sample, pH ____________________ Time ____________________

Salinity, parts per thou. ____________________ Appearance ____________________

Conductivity, umhos/cm ____________________ Odor ____________________

Comments: ____________________

____

____

____

____

FIGURE 1
SAMPLE COLLECTION FIELD SHEET
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CCONNETICUT

WELL SAMPLING LOG

Meters/Instruments

Date: ____________________ Temperature: ____________________

Inspector(s): ____________________ pH: ____________________

Project No.: ____________________ Conductivity: ____________________

Project Name: ____________________ HNu/OVA ____________________

Site Location: ____________________ Dissolved Oxygen ____________________

Weather Obs.: ____________________

- -

Well Information

Well ID No:

Well Condition:

Casing Ht./Lock No:

Well Type:

Screened Interval:

Reference Pt:

Well Diameter

Well Depth/Diameter:

Installed

Measured

Purging

Depth to Water [DTW]:

Water Column; Ht/Vol:

Minimum Purge Volume:

Purged Volume:

Purge Date/Time(s):

Purge Method:

Purge Depth(s):

Purge Rates (gpm):

DTW After Purging:

Purge Observations:

Sampling

DTW Before Sampling:

Sample Date/Time(s):

Sampling Method:

Sampling Depth(s):

Sample Analysis:

Analytical Lab:

Sampling Observations:

Sample Chemistry

Temperature:

pH:

Conductivity:

Dissolved Oxygen

Air Quality Data

Background:

Well Head:

Purge Water:

Sample Water:

Comments:

FIGURE – 2
WELL PURGING AND SAMPLING FORM
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

STANDARD OPERATING PROCEDURE NUMBER 4

SLUG TESTING

TABLE OF CONTENTS

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for slug testing monitoring wells. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP). This SOP gives descriptions of equipment and field procedures used to estimate the hydraulic conductivity of the aquifer. Hydraulic conductivity will be determined by a positive displacement test and/or a negative displacement test.

2.0
SLUG TESTING PROCEDURES

2.1 EQUIPMENT LIST

Field equipment to be used for the slug testing activities includes:

- Electronic water level indicator
- Field books
- Slug of known volume for 2-inch diameter wells
- Pressure transducer (10-50 psig)
- Data logger (Hermit) and Operation Manual (Hermit)
- Weighted Measuring tape (100 feet)
- Nylon rope
- Keys to well locks
- Paper towels (organic and lint free)
- Stainless steel knife
- Camera and film
- Waterproof and permanent marking pens
- Clock
- Appropriate health and safety equipment

2.2 PRE-TEST DATA RECORDING

Pre-test data will be collected in accordance with the following procedures:

A. The well casing will be approached from upwind.

B. The well cap will be unlocked and removed.

C. Before beginning the slug test, the following information will be recorded:

- Monitoring well identification number or letter
- Location and elevation of the reference point from which water depth measurements are made (top of PVC well casing)
- Elevation of groundwater with respect to the reference point
- Date and time of test
- Well depth, screen length, riser pipe radius, well screen radius, and radius of gravel pack plus the well screen depth and radius (from the installation record)
- Aquifer or ground water zone (lithology) being tested (from the installation record)
- Volume of solid cylinder (slug)
- Type of measuring device used
- Names of personnel conducting test

2.3 TESTING PROCEDURES

Slug testing will be conducted in accordance with the following procedures.

A. The static water level in the well and total depth of the well will be determined to the nearest 0.01 foot. The appropriate pressure transducer will be inserted and the Hermit Data Logger activated. The water level recording interval will be programmed on the data logger to the logarithmic mode.

B. The slug of known volume will be instantaneously introduced to (or removed from) the well, taking care to fully submerge (or withdraw) the slug. It is important to remove or add the volume as quickly as possible because the analysis assumes an "instantaneous" change in volume in the well. Falling head tests are not valid for wells where the water level is below the top of the screen. Only rising head test data should be recorded from such wells.

C. With the moment (time) of volume addition or removal assigned time zero, the depth of water will be measured and recorded. The pressure transducer will monitor water level change. Care must be taken to ensure that the transducer is submerged throughout the test. Once the test has started, the transducer elevation must not be changed.

D. The test will continue until the water level has stabilized or 90 percent of the excess head has dissipated.

E. The slug testing equipment will be removed and wrapped for decontamination.

F. The well will be locked upon completion.

G. Gloves, aluminum foil/visquene will be disposed of as appropriate.

H. The slug will be decontaminated before the next slug test, in accordance with the procedures discussed in Section 3.0 and SOP No. 7 - Decontamination.

I. The slug test data will be downloaded from the data logger to a field printer to confirm the successful completion of the test prior to departing the site.

3.0
DECONTAMINATION

All slug testing equipment will be decontaminated prior to use. The slug will be decontaminated with:

- Soap (Alconox) and potable water wash with scrub brush
- Potable water rinse
- Distilled water rinse
- Air drying of the equipment

All decontaminated equipment will be stored on clean aluminum foil sheeting or visquene, and the equipment will not be allowed to touch the ground adjacent to the well.

4.0
SLUG TEST DATA ANALYSIS

Slug test data will be evaluated using the method of Bouwer and Rice (1976) and Bouwer (1989). The Bouwer and Rice method is applicable to unconfined and confined aquifers and considers the effect of partial penetration, the radius of the filter pack, and the effective radius of influence of the test.

STANDARD OPERATING PROCEDURE NUMBER 5

SINGLE-WELL PUMPING TESTS

TABLE OF CONTENTS

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for pump-testing a single monitoring well. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP). This SOP gives descriptions of equipment and field procedures used to estimate the hydraulic conductivity of an aquifer. Hydraulic conductivity will be determined by measuring drawdown and recovery during and after pumping a single well at a constant rate.

2.0
SINGLE-WELL PUMPING TEST PROCEDURES

2.1 EQUIPMENT LIST

Field equipment to be used for the single-well pumping test activities includes:

- Electronic water level indicator
- Field books
- Centrifugal or submersible pump
- Pump hosing
- Generator
- Flow control valve
- Pressure transducer (10-50 psig)
- Data logger (Hermit) and Operation Manual (Hermit)
- Weighted Measuring tape (100 feet)
- Nylon rope
- Keys to well locks
- Paper towels (organic and lint free)
- Stainless steel knife
- Camera and film
- Waterproof and permanent marking pens
- Clock
- Appropriate health and safety equipment
- Drums for discharge water storage

2.2 PRE-TEST DATA RECORDING

Pre-test data will be collected in accordance with the following procedures:

A. The well casing will be approached from upwind.

B. The well cap will be unlocked and removed.

C. Before beginning the test, the following information will be recorded:

- Monitoring well identification number or letter
- Location and elevation of the reference point from which water depth measurements are made (top of PVC well casing)
- Elevation of groundwater with respect to the reference point
- Date and time of test
- Well depth, screen length, riser pipe radius, well screen radius, and radius of gravel pack plus the well screen depth and radius (from the installation record)
- Aquifer or ground water zone (lithology) being tested (from the installation record)
- Type of measuring device used
- Names of personnel conducting test

2.3 TESTING PROCEDURES

Single-well pumping tests will be conducted in accordance with the following procedures.

A. The static water level in the well and total depth of the well will be determined to the nearest 0.01 ft. The appropriate pressure transducer will be inserted. The appropriate pump or hosing will be inserted into the well. The pump discharge will be equipped with a flow regulating valve. An appropriate flow rate will be selected based on the anticipated hydraulic capabilities of the geologic materials encountered.

B. The water level recording interval will be programmed on the Hermit data logger to the logarithmic mode. The reading schedule will be as follows:

- 30 second intervals for 5 minutes,
- 1 minute intervals for 10 minutes,
- 2 minute intervals for 20 minutes, and
- 5 minute intervals for remainder.

The pressure transducer will measure and record water level change. Care must be taken to ensure that the transducer is submerged throughout the test. Once the test has started, the transducer elevation must not be changed.

C. The data logger will be activated. The pump will be activated.

D. Pumping will continue until development is complete. When pumping is stopped the data logger will be restarted immediately to record recovery in logarithmic mode until recovery is 90 percent complete. Falling head tests are not valid for wells where the water level is below the top of the screen. Only rising head test data should be recorded from such wells.

E. The testing equipment will be removed and wrapped for decontamination.

F. The well will be locked upon completion.

G. Gloves, aluminum foil/visquene and centrifugal pump hosing will be disposed of as appropriate.

H. The submersible pumps and transducers will be decontaminated before the next test, in accordance with the procedures discussed in Section 3.0.

I. The test data will be downloaded from the data logger to a field printer to confirm the successful completion of the test prior to departing the site.

3.0
DECONTAMINATION

All testing equipment will be decontaminated prior to use. The submersible pump and transducers will be decontaminated with:

- Soap (Alconox) and potable water wash with scrub brush
- Potable water rinse
- Distilled water rinse
- Air drying of the equipment

All decontaminated equipment will be stored on clean aluminum foil sheeting or visquene, and the equipment will not be allowed to touch the ground adjacent to the well.

4.0

SINGLE-WELL PUMPING TEST DATA ANALYSIS

Single-well pumping test data will be evaluated using one of several methods. The appropriate method will be selected based on specific well and aquifer characteristics (eg. penetration, confined vs. unconfined). The selected method will be applied using the AQTESOLV computer program).

STANDARD OPERATING PROCEDURE NUMBER 6

SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

TABLE OF CONTENTS

LIST OF FIGURES

1.0
PURPOSE AND SCOPE

This document defines the standard protocols for sample identification, handling, and documentation. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP). This procedure is intended to be used in conjunction with the CDAP and other SOPs.

2.0
PROCEDURES FOR SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

2.1 SAMPLE IDENTIFICATION

Samples collected during site activities will be assigned unique sample identification numbers. These numbers are necessary to identify and track each of the samples collected for analysis during the duration of this project. In addition, the sample identification numbers will be used in documentation to identify and retrieve the analytical results received from the laboratory as well as other data.

Each sample will be identified by a unique alpha-numeric code which indicates the particular sample type and location information.

The sample identification code developed for this remedial investigation is based on an identifier for the location of the sample as the first set of characters or digits and a second set of characters or digits designating the depth of the sample.

The following codes are designated for the corresponding information on sample types:

BR = Boring
SF = Surface Soil
SW = Surface Water
LT = Low Tide
DW = Dry Well
IBG = Intertidal Background
WC = Monitoring Well (proposed)
MW = Monitoring Well (existing)
LW = Monitoring Well (existing) Lagoon Area
S = Shallow (monitoring well screened interval)
D = Deep (monitoring well screened interval)

- site name
- sample identification code
- date and time of sample collection
- analyses requested
- sample preservation
- sample matrix

2.3 SAMPLE HANDLING

This section discusses proper sample containers, preservatives, and packaging and shipping procedures. The CDAP summarizes the information contained in this section and also includes the sample holding times for each analyte.

2.3.1 Sample Containers

Certified, commercially clean (to EPA standards) sample containers shall be obtained from the contract analytical laboratory. The bottles shall be labeled by the lab to indicate the type of analyte to be collected in the container.

The CDAP lists appropriate sample containers for the specific analyses required for this project.

2.3.2 Sample Preservation

Sample preservation efforts shall commence with container preparation at the laboratory and will continue until analyses are performed. Required preservatives shall be prepared and placed in the bottles at the laboratory prior to shipment to the site. Samples will be stored with ice or cold packs in coolers immediately following collection to maintain sample temperature of approximately 4°C. Additional sample preservation requirements based on analytical methodology are presented in the CDAP. Freezing samples to extend holding times will not be permitted.

- Fill the cooler with cushioning material.

- Close large plastic bag in cooler and tape or secure shut.

- Place chain-of-custody form and other paperwork in a clear plastic bag and tape the bag to the inside lid of the cooler.

- Place address label on inside lid of the cooler.

- Wrap the cooler completely around with strapping tape at two locations. Do not cover any labels.

- Place address label on top of cooler.

- Attach "THIS SIDE UP" labels on all four sides and "FRAGILE" labels on at least two sides and the top of the cooler. ("FRAGILE" labels are optional for coolers not containing glass bottles).

- Affix signed custody seals on the cooler. Cover the seals with wide, clear tape.

- Make a copy of the airbill for the project file and place the original in a clear envelope secured to the cooler lid.

2.4 HOLDING TIMES AND ANALYSES

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest and stability factors, and preservative (if any) used. Holding times are listed in the CDAP. Samples should be sent to the laboratory as soon as possible after collection by overnight express courier service.

- Sampling methods or reference to the appropriate SOP
- Sample handling, including filtration and preservation, as appropriate for separate sample aliquots
- Analytes of interest
- Field observations
- Results of any field measurements, such as depth to water, pH, temperature, and conductivity
- Personnel present
- Level of PPE used during sampling

Changes or deletions in the field book should be lined out with a single strike mark and initialed and dated by the person making the change or deletion. Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the sampler's memory.

Each page in the field books will be signed by any persons making entries on that page. Anyone making entries in another person's field book will sign and date those entries.

2.5.2 Sample Chain-Of-Custody

During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. Initial information concerning collection of the samples will be recorded in the field log book. Information on the custody, transfer, handling, and shipping of all samples will be recorded on a Chain-of-Custody (COC) form. An example COC form is shown on Figure 2.

The sampler will be responsible for initiating and filling out the Chain-of-Custody form. The field team members are responsible for the care and custody of the samples collected until the samples are transferred to another individual or shipped to the laboratory. The field team, under the direction of the Field Manager, is responsible for enforcing COC procedures during fieldwork. The COC will be signed, with date and time, by the sampler and when the sampler relinquishes the samples to anyone else. Chain-of-Custody forms will accompany the samples at all times. All individuals who

- A shipping bill is completed and the shipping bill number recorded in the COC record prior to enclosing the COC record, placing inside a clear plastic bag and attaching it to the inside of the cooler lid.

When transferring custody of the samples, the individual relinquishing custody of the samples will verify sample numbers and condition and will document the sample acquisition and transfer by signing, with date and time, the COC. Samples are packaged for shipment and dispatched to the analytical laboratory with a separate COC form accompanying each cooler.

A copy of each chain-of-custody form is retained by the sampling team for the project file and the original is sent with the samples. Bills of lading will also be retained as part of the documentation for the chain-of-custody records.

In conjunction with data reporting, the analytical laboratory will return the original or a photocopy of the original COC to the Project Manager for inclusion into the central project file.

Project/Site Name ______________________________

Project No. ____________________________________

Sample No. ____________________________________

Collection Date/Time ___________________________

Sample Type/Depth/Description ___________________

______________________Preservative______________

Analyze for ____________________________________

Bottle _____ of _____ _____ Filtered _______ Nonfiltered

FIGURE 1

Typical Sample Label
Remedial Investigation
Stratford Army Engine Plant
Stratford, Connecticut

CHAIN-OF-CUSTODY FORM

PROJECT NUMBER:	PROJECT / SITE NAME:	PROJECT / SITE LOCATION:	TEAM LEADER: ____________ SAMPLERS: (SIGNATURES): ____________

Sample I.D. Number	Sample Location	Sample Collection		Sample Matrix	Container Description (Size / Type)	Quantity	Requested Analysis	Comments
		Date	Time					

CHAIN - OF - CUSTODY CHRONICLE					
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received at Laboratory by:	Date	Time
Method of Shipment:			Airbill (Shipping Number):		

FIGURE – 2
CHAIN OF CUSTODY FORM
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

STANDARD OPERATING PROCEDURE NUMBER 7

DECONTAMINATION

TABLE OF CONTENTS

1.0
INTRODUCTION AND TYPES OF CONTAMINATION

This document defines the standard procedure for decontamination. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP) and the Site Safety and Health Plan (SSHP). The procedure is intended to be used together with the CDAP and the other SOPs.

Site and/or Sample Cross-Contamination

The overall objective of multimedia sampling programs is to obtain samples which accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminant materials can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g., by bailing or pumping of ground water with equipment previously contaminated at another sampling site). Trace quantities of these contaminant materials can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., bailers, pumps, tubing, soil and sediment sampling equipment) and field support equipment (e.g., drill rigs, vehicles) is therefore required prior to, during and after use at SAEP to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

If contaminants detected in field blanks are reported above the method detection limit for any analytical procedure, the possible source of contamination will be investigated. If a problem is found, it will be corrected and samples rerun, if necessary. If no analytical problems are identified, the data will be flagged accordingly. Decontamination techniques will also be adjusted in the field prior to collection of additional samples.

2.0
PROCEDURE

2.1 EQUIPMENT LIST

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot water - high-pressure sprayer
- Disposal drums (55-gallon with secure lids)
- Sponges or paper towels
- Alconox detergent (or equivalent)
- Potable tap water
- Organic free deionized water
- Garden-type water sprayers

2.2 DECONTAMINATION

Sampling order will be selected to minimize cross contamination. The first locations sampled at each site will be those expected to have the lower concentrations of contaminants and the sampling order will proceed to the expected higher contaminated areas. Present chemical data, visual site inspection, and logical contamination movement will be used to select sampling order.

If PPE is upgraded to Level C, then work zones shall be required. Three work zones will be established: the exclusion zone, the contamination reduction zone, and the support zone. An exclusion zone is an area where contamination could or does occur. The exclusion zone will be demarcated using orange cones and/or flagging. All WCC

5. Wash hands and face with water and soap prior to eating or drinking.

All decontamination water, decontamination refuse, and used protective gear for Level C work will be drummed and stored on site. Drums will be sealed and labelled with an identification number, content, dates of generation, and date sealed, using paint or other permanent marker.

2.2.2 Sampling Equipment

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the Site Safety and Health Plan.

- Gross contamination on equipment will be scraped off at the sampling or construction site.

- Equipment that will not be damaged by water will be placed in a wash tub containing Alconox or low-sudsing detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by an acetone rinse. The equipment will be allowed to air dry and then rinsed with deionized water. Equipment used for metals sampling will be rinsed with a dilute nitric acid solution.

- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with deionized water. Care will be taken to prevent any equipment damage.

- Rinse and detergent water will be replaced with new solutions between borings or sample locations.

2.2.5 Wastewater

Wash and rinse solutions obtained from decontamination operations will be containerized for proper disposal.

2.2.6 Other Wastes

Solid wastes such as used personal protective equipment will be collected in drums. When drums are full they will be sealed. Each drum will be labelled with its contents and the date, using enamel paint or other permanent marker. Drums will be stored on site in a secure area for later handling or disposal.

2.3 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions

3.0
QUALITY ASSURANCE REQUIREMENTS

FIeld blank samples will be taken using decontaminated sampling equipment to verify the effectiveness of the decontamination procedures. The procedure will include rinsing organic free deionized water through or over a decontaminated sampling tool (such as a split spoon sampler or bailer) and collecting the rinsate water into the sample bottles, which will be sent to the laboratory for analysis. The procedure, including the sample number, will be recorded in the field notebook. Water used to make field blanks will be supplied by the analytical laboratory.

If contaminants detected in field blanks are reported above the method detection limit for any analytical procedure, the possible source of contamination will be investigated. If a problem is found, it will be corrected and samples rerun, if necessary. If no analytical problems are identified, the data will be flagged accordingly. Decontamination techniques will also be adjusted in the field prior to collection of additional samples.

STANDARD OPERATING PROCEDURE NUMBER 8

BORING ABANDONMENT

TABLE OF CONTENTS

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for abandoning borings. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP) and gives descriptions of equipment and field procedures necessary to abandon borings.

2.0
BORING ABANDONMENT PROCEDURES

2.1 EQUIPMENT LIST

The following is an equipment list for boring abandonment:

- Portland cement (type I or II) and powdered bentonite for grouting
- Drill rig
- Log book
- Boring log sheets
- Waterproof and permanent marking pens
- Tremie pipe
- Appropriate health and safety equipment

2.2 ABANDONMENT PROCEDURES

Upon completion of drilling, each boring, will be abandoned with a grout mixture of cement, bentonite and water. The grout mixture will consist of approximately ten parts cement (Portland cement) to one part bentonite (equivalent to one 94-pound bag of cement to about 10 pounds of bentonite powder). The grout mixture will be prepared in an above-ground rigid container by first thoroughly mixing the bentonite with water and then mixing in the cement. The grout will be mixed until it is free of excessive cement/bentonite clumps.

Grout will be placed in the boring with a tremie pipe before the augers are pulled from the hole. The tremie pipe will initially be located about 10 feet above the bottom of the boring. The grout will be pumped through the tremie pipe and the tremie pipe pulled up incrementally with the augers until the boring is grouted to ground surface.

After the grout sets for 24 hours it will be checked for settlement. Additional grout will be added to top off the void, if necessary.

STANDARD OPERATING PROCEDURE NUMBER 9

WATER LEVEL MEASUREMENT

TABLE OF CONTENTS

FIGURES

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for measuring water levels in wells. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP). This procedure describes equipment and field procedures necessary to collect water level measurements. The well locations and frequency of measurement are specified in the CDAP. This procedure is intended to be used together with the CDAP and other SOPs. SOP No. 7 describes decontamination procedures which are applicable to this SOP.

2.0
WATER LEVEL MEASUREMENT PROCEDURE

2.1 EQUIPMENT LIST

The equipment necessary to measure water levels includes:

- Solinst Model 101 water level meter or equivalent
- Two 5-gal buckets (with lids) or equivalent for decontamination
- Decontamination brushes
- Alconox soap
- Deionized or distilled water
- Potable water
- Spray bottle
- Field data sheets
- Field notebook
- Appropriate health and safety equipment

2.2 MEASUREMENT PROCEDURE

This section gives the sequence of events to follow when measuring water levels. Appropriate health and safety equipment, as described in the Health and Safety Plan (HSP) should be worn during well opening, well measurement, and decontamination.

- The water level probe shall be decontaminated prior to use in each monitoring well. Decontamination procedures are discussed in SOP No. 7.

- The well will be approached from upwind, the well cap unlocked and removed.

- After any measurement is taken, the water level probe shall be decontaminated as described in Section 2.3.

2.3 DECONTAMINATION

The water level indicator and the salinity-conductivity-temperature meter must be decontaminated before use, and at the conclusion of measurements. The probes will be decontaminated according to the procedure for decontamination of sampling equipment described in SOP No. 7.

Probe decontamination will be completed at the wells and wash and rinse water will be discharged on the ground surface, at least 20 feet downgradient from the well.

2.4 DOCUMENTATION

This section describes the documentation necessary for water level measurement.

The water level data sheet, shown as Figure 1, shall be completed during each measuring event. Field data sheets will include date, time, well number, total well depth, water level, static water elevation, salinity, specific conductance, temperature, and comments. A field notebook will also be kept during water level measurement activities describing decontamination procedures, calibration procedures, monitoring procedures, and other observations during water level measurement. Both the data sheets and notebook shall be neat and legible, and shall be signed and dated by the person completing the page.

The depth to water, in feet below the measuring point, will be subtracted from the measuring point elevation to determine the elevation of the static water level. The resulting elevation shall be checked in the field to see that it is reasonable and that the subtraction was performed correctly. If there is a discrepancy, the well shall be measured again.

3.0
CALIBRATION

The length of the water level measurement probe cord should be calibrated at least once per month or more often as needed to ensure the desired accuracy. The calibration check consists of laying out 100 feet of steel tape next to 100 feet of the probe cord. Note any measurement discrepancies between the two at 2-foot intervals. The probe cord shall be rechecked if there is a possibility it could have been stretched or damaged during water level measurements.

The procedures followed during any calibration and verification of equipment shall be documented in the field notebook along with any calculations. If a correction is required, the probe will be tagged to indicate the correction.

PROJECT NAME ____________________ PROJECT NUMBER __________
PROJECT LOCATION ____________________
GEOLOGIST ____________________ DATE __________
METHOD OF OBSERVATION ____________________ TIME __________

BORING NUMBER	SURFACE ELEVATION	DEPTH TO WATER	ELEVATION OF WATER	REMARKS

FIGURE-1
WATER LEVEL DATA FORM
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

STANDARD OPERATING PROCEDURE NUMBER 10

SURFACE WATER SAMPLING

TABLE OF CONTENTS

1.0
PURPOSE AND SCOPE

This document defines the Standard Operating Procedure (SOP) that will be used in collecting surface water samples. A goal of surface water sampling is to obtain water chemistry data that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. Details are provided in this procedure so that all sampling personnel following these procedures will collect samples in a consistent and documented manner, resulting in acceptable water chemistry data.

This SOP describes equipment and field procedures that will be used to collect surface water samples.

2.0
PROCEDURES

2.1 OVERVIEW

Surface water samples will be collected as grab samples. Grab samples characterize a medium at a particular point in space and time. Surface water grab samples are collected by sample container immersion or by using a transfer device, such as a beaker or dipper.

Grab water samples are often collected by holding a container just beneath the water surface and filling it. If an open bottle is lowered to the bottom and raised to the surface at a uniform rate, and at such a rate as to have the bottle filled when reaching the surface, the resulting sample will roughly approach the collection of what is known as a depth-integrated sample. This approach may be used for grab samples that will be collected or collected and transferred when the depth of water exceeds 1.0 foot. If depth is less than 1.0 foot, the bottle will be held just beneath the surface of the water and filled.

2.2 EQUIPMENT FOR COLLECTING SAMPLES

Equipment that may be used for collecting surface water samples:

- Laboratory-provided clean sample containers
- Teflon, stainless steel, or glass beakers and dippers
- pH meter (including temperature probe)
- Specific conductivity meter
- Photoionization detector (PID) and/or flame ionization detector (FID)
- Cooler with ice

Equipment used during sample filtration:

2.3 METHOD

2.3.1 Samples Collected by Container Immersion

- Submerge the sample container below the water surface.
- Allow container to fill to desired volume.
- Remove the container.
- Preserve the sample, if necessary, and place the cap on the container and tighten.
- Decontaminate the container's outside surface.
- Label sample containers.
- Using a decontaminated container, collect a water sample, then measure and record field parameters such as pH, specific conductance, salinity, and temperature.
- Record time of sampling.
- Store samples with ice in coolers.

3.0
DECONTAMINATION PROCEDURES

Decontamination shall be performed on all used sampling equipment.

Mobile decontamination supplies will be provided so that equipment can be decontaminated at the sampling site. Each piece of sampling equipment shall be decontaminated before and after sampling operations at each site. The decontamination procedure shall be as follows:

- Wash with an Alconox and potable water wash solution.
- Intermediate rinse with potable water.
- Final rinse with distilled water.
- Air dry the equipment.
- Wrap in aluminum foil or plastic bags for storage.

In addition to the above procedures, the decontamination solutions shall be replaced with clean solutions between each decontamination operation (i.e., between each site).

4.0
SAMPLES

4.1 CONTAINERS, PRESERVATION, AND HOLDING TIMES

Certified clean sample containers shall be obtained from the contract analytical laboratory. The bottles shall be labeled by the sampler to indicate the type of sample to be taken.

The sampling containers, preservation, and holding times for the various types of analyses are presented in the CDAP.

Thorough documentation in the field is required to ensure proper labeling and tracking of samples, identify potential sources of error, and maintain accountability among field personnel.

5.1 FIELD NOTES

Field notes shall be kept in a bound field book assigned to individuals each day. The following information should be written, as noted, in indelible ink.

General Information:

- Project name and number
- Names of personnel
- Weather conditions
- Date and time of sampling
- Location
- Site condition
- Times that procedures and measurements are completed
- Decontamination times
- PID or FID readings

Sampling Information:

- Conductivity, water temperature, and pH during sampling (note times)
- Any deviation from the SOP and reasons for the deviation
- Time samples are obtained
- Number of samples taken
- Color, odor, turbidity
- Order that sample bottles were filled

STANDARD OPERATING PROCEDURE NUMBER 11

SEDIMENT SAMPLING

TABLE OF CONTENTS

LIST OF FIGURES

1.0
PURPOSE AND SCOPE

This document defines the standard procedure for collecting sediment samples. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP). This procedure gives descriptions of equipment, field procedures, and QA/QC procedures necessary to collect sediment samples. The sample locations and frequency of collection are specified in the FSP.

This SOP is intended to be used together with the CDAP and several other SOPs. Sample identification, handling, and documentation procedures are described in SOP No. 6. SOP No. 7 describes decontamination procedures which are also applicable to this SOP. Health and safety procedures and equipment that will be required during the investigation are detailed in the Site Safety and Health Plan (SSHP).

2.0
PROCEDURES FOR SEDIMENT SAMPLING

Both surface and subsurface sediment will be collected using either a stainless steel hand corer or gravity corer apparatus, or a stainless steel trowel.

2.1 EQUIPMENT LIST

The following list of equipment will be needed to collect sediment samples:

Sediment Sampling Equipment

- Stainless steel hand or gravity corer apparatus with appropriate stainless steel hand sampling (trowel) and mixing tools
- Ruler marked in 1/10 feet divisions
- Field books/field sheets
- Stainless steel knife
- Sample bottles provided by the laboratory
- Sample bottle labels
- Cooler with ice
- Label tape (clear)
- Paper towels
- Camera and film
- Waterproof and permanent marking pens
- Plastic sheeting
- Plastic bags
- Appropriate health and safety equipment, as specified in the SSHP
- Appropriate decontamination supplies
- Organic free deionized water

- Withdraw the corer in a single smooth motion. Do not jerk or bump corer because this may result in sample loss.

- Remove the nosepiece and transfer sediment to a clean aluminum tray with a clean stainless steel trowel.

- Measure the sediment and determine depth penetration and recovery.

- Transfer (using the trowel) the appropriate section (depth interval) of sediment into a stainless steel bowl if sample requires homogenizing. Samples to be collected for VO analysis should be collected prior to homogenizing.

- After homogenizing, transfer the sediment into appropriate sample containers using the same trowel.

- Repeat with second depth interval, using a clean, decontaminated trowel.

- Return unused sediment to the collection location.

- Individual bottles will be filled in the following order:

    - Volatile organic compounds (VOs) - fill prior to sample homogenization
    - Semi-volatile organic compounds (semi-VOs)
    - PCBs
    - Metals
    - Other analysis

- Label, store and document sample according to SOP No. 6.

- Record applicable information on the Sample Collection Field Sheet (Figure 1) and Chain-of-Custody (COC).

2.4.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spikes are used to determine the long-term precision and accuracy of the laboratory analytical method on various matrices. For this procedure duplicate samples are collected with the field samples and spiking is done by the lab. Samples are labeled as matrix spikes for the lab. It is useful to collect enough additional sample for both the matrix spike and duplicate samples from the same location.

2.4.4 Blind Spikes and/or Blanks

The USACE may provide blind spikes and/or blanks for laboratory analysis to determine the accuracy of the laboratory analytical method. The samples will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day received.

2.5 SAMPLE IDENTIFICATION, HANDLING, AND DOCUMENTATION

Samples will be identified, handled and recorded as described in this SOP and SOP No. 6. The parameters for analysis and preservation are specified in the CDAP.

2.6 DOCUMENTATION

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field (see SOP No. 6). Sample collection field sheets will be completed for all sediment samples submitted for chemical analysis (Figure 1).

2.6.1 Field Logbook

The most important aspect of documentation is thorough, organized, and accurate record keeping. All information pertinent to the investigation and not documented on the boring log will be recorded in a bound logbook with consecutively numbered pages. All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions that are initialed and dated. Entries in the logbook will include the following, as applicable:

2.6.2 Sample Collection Field Sheet

Sample Collection Field Sheets will be completed for each sample by the sampling personnel (geologist, geological engineer, or geotechnical engineer). The form is shown on Figure 1. Most of the information required on the field sheet will have been completed at the conclusion of the sediment sampling task.

STANDARD OPERATING PROCEDURE NUMBER 12

PHYSICAL PROPERTY TESTING

TABLE OF CONTENTS

1.0
PURPOSE AND SCOPE

This document defines the standard procedures to be used for physical property testing of soil samples. It is anticipated that these procedures will be performed in an off-site laboratory. This Standard Operating Procedure (SOP) serves as a supplement to the Chemical Data Acquisition Plan (CDAP). The ASTM standard practices to be used are referenced in this SOP, and they include complete descriptions of procedures necessary to perform physical property testing. Actual laboratory methods may be modifications of these ASTM standard practices or based on other regulatory guidance standards. The laboratory will prepare a QA plan presenting analytical standard practices and methodologies, and laboratory techniques and procedures.

The following ASTM standard practices will be used:

D1452-80	STANDARD PRACTICE FOR SOIL INVESTIGATION AND SAMPLING BY AUGER BORINGS
D1586-84	STANDARD METHOD FOR PENETRATION TEST AND SPLIT-BARREL SAMPLING OF SOILS
D1587-83	STANDARD PRACTICE FOR THIN-WALLED TUBE SAMPLING OF SOILS
D2937-83	STANDARD TEST METHOD FOR DENSITY OF SOIL IN PLACE BY THE DRIVE-CYLINDER METHOD
D4220-89	STANDARD PRACTICES FOR PRESERVING AND TRANSPORTING SOIL SAMPLES
D2487-85	STANDARD TEST METHOD FOR CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

FINAL

APPENDIX B
SITE SAFETY AND HEALTH PLAN

■■■■■■ REMEDIAL INVESTIGATION

WORK PLAN

STRATFORD ARMY ENGINE PLANT

STRATFORD, CONNECTICUT

U. S. Army Aviation Systems Command

Prepared for

US Army Corps
of Engineers
Omaha District

U. S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska
January 1992

Woodward-Clyde

One Old Mill Building
101 South 108th Avenue
Omaha, NE 68154

WCC Project No. 89C114CC

TABLE OF CONTENTS

Section Page

LIST OF TABLES Following Page

LIST OF FIGURES

LIST OF ATTACHMENTS

INTRODUCTION

This Site Safety and Health Plan (SSHP) establishes guidelines and requirements for safety of personnel during the performance of field activities associated with pre-design investigations at the Stratford Army Engine Plant (SAEP). All employees and subcontractors of Woodward-Clyde Consultants (WCC) involved in field activities for this project are required to abide by the provisions of this SSHP. They are required to read the SSHP and sign the attached Health and Safety Plan Compliance Agreement. This SSHP is prepared in accordance with OSHA Regulations 29 CFR Part 1910.120 (Hazardous Waste Operations and Emergency Response, Final Rule - March 6, 1989).

The health and safety guidelines and requirements presented herein are based on a review of available information and an evaluation of potential hazards. Because of the variety of possible work activities and site conditions which may be encountered and the uncertainties associated with potential health effects from exposures to various constituents which may be present, no guarantees can be made regarding the potential for health effects associated with field activities at the SAEP. This SSHP describes the health and safety procedures and equipment required for activities at the SAEP to reduce the potential for exposure of field personnel.

WCC has been retained by the Department of the Army, Corps of Engineers, Omaha District (USACE) to conduct soil sampling activities at the SAEP. This SSHP is only for activities defined in the Field Sampling Plan.

Regulations applying to the proposed field activities during the pre-design investigations are listed below. These regulations will be enforced during all activities described in this SSHP.

Government Regulations	Subject
FAR Clause 52.236-13	Accident Prevention
USACE EM 385-1-1	Safety and Health Requirements Manual
OSHA 29 CFR 1926	Construction Industry Standards
OSHA 29 CFR 1910	General Industry Standards
OSHA 29 CFR 1910.120	Hazardous Waste Site Operations and Emergency Response
OSHA 29 CFR 1910.20	Recordkeeping/Recording
OSHA 29 CFR 1904	Recordkeeping/Recording
OSHA 29 CFR 1910.1000	OSHA Permissible Exposure Limits
OSHA 29 CFR 1910.134	Respiratory Protection
NIOSH/OSHA/USCG/EPA	Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

1.0
PROJECT IDENTIFICATION

CLIENT:	Department of the Army Corps of Engineers, Omaha District
SITE:	Stratford Army Engine Plant Stratford, Connecticut
PROJECT NO:	89C114CC
BUSINESS UNIT:	New York Metro
PROJECT MANAGER:	Marion E. Craig
DATE OF SSHP:	January 31, 1992
MANDATORY REVIEW DATE OF SSHP:	September 1, 1992

2.1 SITE DESCRIPTION

SAEP is an industrial facility which is mostly paved or covered by buildings. Surrounding land uses are mainly light industrial, commercial, and residential.

2.1.1 SITE LOCATION

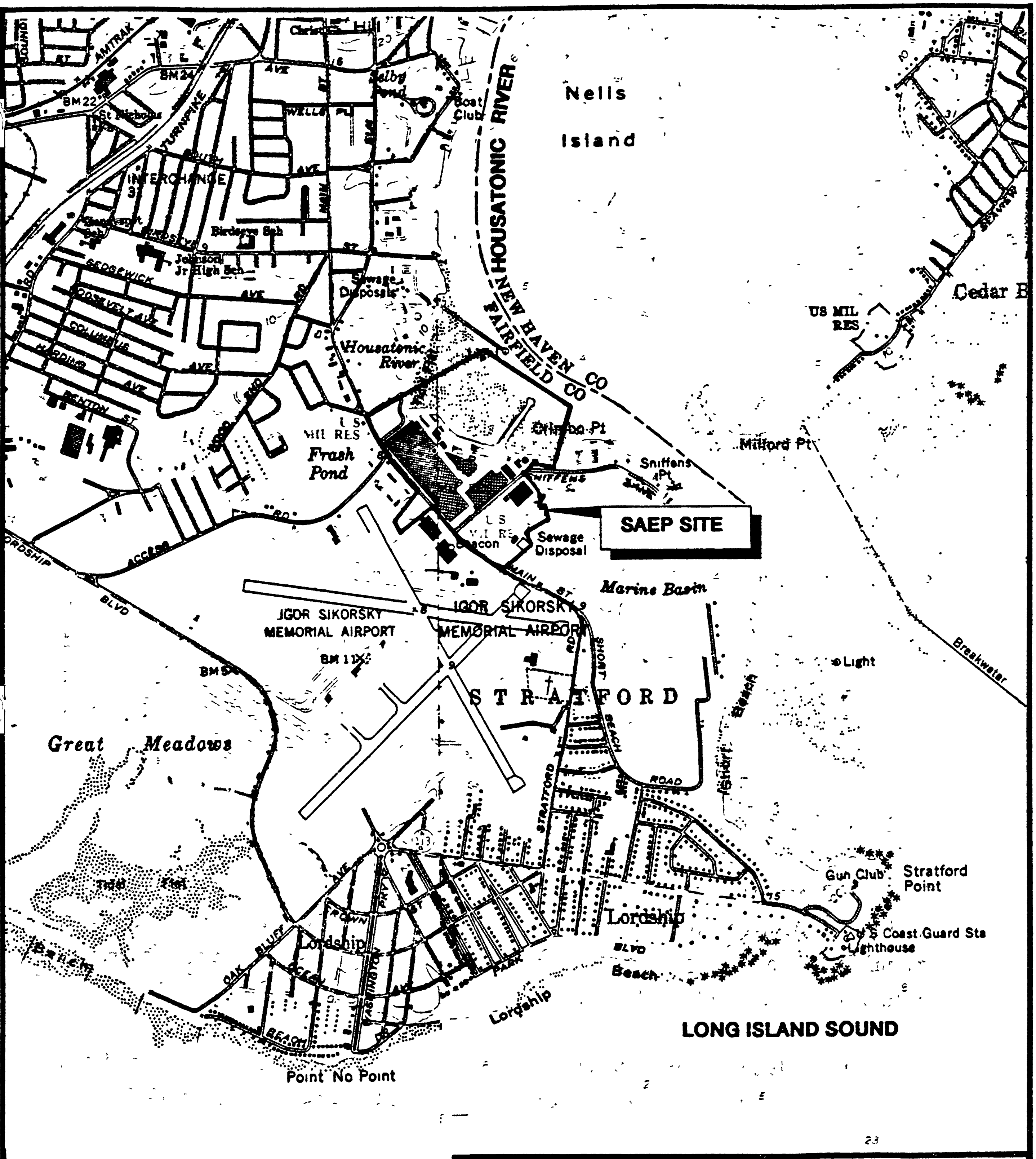
SAEP is located in Stratford, Connecticut, on the Stratford Point peninsula in the southeast corner of Fairfield County. The plant lies on the borders of the Bridgeport and Milford United States Geological Survey (USGS) Quadrangles (Figure 2-1). Latitudinal and longitudinal coordinates of SAEP are approximately 41°10' North and 73°07' West. The property consists of about 126 acres including about 49 acres of riparian rights along the Housatonic River. Existing property features are shown in Figure 2-2.

2.1.2 SITE OWNERSHIP AND OPERATIONS HISTORY

The SAEP property was used for agriculture until 1929 when the first manufacturing facility was built on about 26 acres. The property has been used for development, manufacture, and assembly of aircraft or engines since 1929, and the plant history has been categorized into the following periods:

- 1929 to 1939: Sikorsky Aero Engineering Corporation developed and manufactured sea planes at the Stratford plant from 1929 to 1939.

- 1939 to 1948: Chance Vought Aircraft located its operations at the Stratford plant in 1939, and the company became known as the Vought-Sikorsky Aircraft Division. Sikorsky developed the first helicopter, but left the plant in 1943 because of overcrowding. Chance Vought developed the



MAP SOURCE:
FROM BRIDGEPORT & MILFORD, CT. USGS QUADRANGLE MAP, 1970 & 1960, TOPHOREVISED 1984.

0 1000 2000 FT
SCALE

WOODWARD – CLYDE CONSULTANTS
ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

VICINITY MAP
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DR. BY: FWD	DATE: 15 OCT 1991	PROJ. NO:	FIGURE NO.:
CK'D BY: MEC	DATE: 15 OCT 1991	89C114CC	2-1

LEGEND

- ▨ HAZARDOUS WASTE
- ▥ HAZARDOUS WASTE (TO BE PROCESSED)
- ▤ OIL STORAGE
- ▤ CHEMICAL STORAGE
- ▨ FUEL STORAGE
- ▩ COMPRESSED GASES
- ○ TANK LOCATIONS
- ⊕ PROPOSED MONITORING WELL LOCATION
- ◑ PROPOSED PIEZOMETER LOCATION
- ● PROPOSED BORING LOCATION
- ◎ PROPOSED STILLING WELL LOCATION
- ◉ EXISTING PAIRED MONITORING WELL LOCATION
- ◕ EXISTING MONITORING WELL LOCATION
- ☐ PROPOSED SEDIMENT AND SURFACE WATER SAMPLING LOCATIONS

NOTE:

LOCATIONS OF EXISTING WELLS ARE APPROXIMATE.

WOODWARD-CLYDE CONSULTANTS
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

SAMPLING LOCATION PLAN
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DRN BY MG/EAB	DATE 1/21/92	PROJECT NO.	FIG. NO.
CHK'D BY MEC	DATE 1/21/92	89C114CC	2-2

"Corsair" for U.S. Navy, and mass produced Corsairs during World War II. Chance Vought vacated the Stratford plant in 1948.

- 1948 to 1951: The Stratford plant was idle.
- 1951 to 1976: The U.S. Air Force procured the plant in 1951 and named it Air Force Plant No. 43. The Bridgeport Lycoming Division of the Avco Corporation was contracted by the Air Force to operate the plant. Avco developed and manufactured radial engines in the 1950s, and turbine engines in the 1960s and 1970s.
- 1976 to Present: The plant was transferred from the U.S. Air Force to the Army in 1976; at that time the plant was renamed the Stratford Army Engine Plant (SAEP). Avco was contracted by the Army to develop the AGT-1500 engine to power the Abrams tank. Avco also developed and manufactured marine and industrial engines. Avco Lycoming merged with Textron in December 1985 and formed Textron Lycoming (Textron). Today, turbine engines for military and commercial aircraft as well as land vehicles, continue to be developed, manufactured, and tested at SAEP. Figure 2-2 shows the layout of the site, including building locations.

2.2 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Several previous investigations at SAEP have involved sampling and chemical analysis of environmental media. In addition, analytical data collected in compliance with permits are available. This section of the report briefly summarizes the results of the previous investigations and other analytical work.

2.2.1 National Pollution Discharge Elimination System Permit Monitoring

Water samples collected at Outfalls 007 and 008 (see Figure 2-2) have been analyzed in compliance with the facility National Pollution Discharge Elimination System (NPDES) permit. Water discharging from the OATP goes to Outfall 007, and Outfall 008 receives discharges from the CWTP. The permitted average daily concentrations (ADC) of certain analytes were exceeded at different times between 1980 and 1984. For Outfall 007, phenols, total suspended solids, and oil and grease occasionally exceeded ADC limits of 0.1, 20, and 10 parts per million (ppm), respectively. At Outfall 008, the following analytes occasionally exceeded the indicated ADC limits: hexavalent chromium (0.1 ppm), total chromium (1.0 ppm), nickel (1.0 ppm), cadmium (0.1 ppm), total suspended solids (10 ppm), and pH (maximum of 8.75).

The NPDES permit issued in 1985 added outfalls 001, 002, 003, 004, 005, and 006, which discharge intermittent storm water. In addition, permit requirements included maximum daily and average monthly concentrations for various analytes. Textron followed the 1985 NPDES permit conditions while the draft 1990 NPDES permit was reviewed by CDEP. During calendar year 1990, several permit violations were noted (WCC, 1991): average daily flow limitations were exceeded at both outfalls, maximum daily concentration limitations were exceeded for nickel and cyanide, and the limitation for total toxic organics was exceeded.

The 1990 NPDES permit was approved July 10, 1991, and it added toxicity testing to the monitoring program. The first Aquatic Toxicity Monitoring Report (dated November 7, 1991) documented toxicity and analytical results which were within permitted limits.

2.2.2 Buildings B-10 and B-70

Greenish-blue groundwater was observed during construction activities at the cyanide destruction facility (B-70, mid-1980s) and the recuperator manufacturing building (B-10, late-1970s). A subsurface investigation was completed in 1986 to evaluate the soils in the area. East Coast Drilling, Inc. drilled ten test borings and collected soil samples for analysis by Environmental Monitoring Laboratory, Inc. Soil samples were collected above and below the water table, and were analyzed for the EP Toxicity metals. No metals were detected in five of the test borings. In the remaining borings, the following metals were detected in the indicated concentration ranges: total chromium (not detected (nd) to 0.64 ppm), hexavalent chromium (nd to 0.42 ppm), copper (nd to 0.34 ppm), and nickel (nd to 0.48 ppm). The maximum concentrations for total and hexavalent chromium were found at 18 to 20 feet below land surface. The highest concentrations of copper and nickel were found at a depth of 8 to 10 feet below land surface. All of the detectable metals occurred at or below the ground water table. Two of these borings were converted to monitoring wells (ECD-1 and ECD-4 on Figure 2-2). These wells were reportedly sampled, but results are not available at this time.

2.2.3 Discharge Toxicity Evaluation

IPC Corporation performed a discharge toxicity evaluation of Outfalls 007 and 008 in 1988. The complete evaluation involved acute toxicity tests towards freshwater and marine organisms, chemical analysis of the effluents, and a dye dispersion study. Effluent samples were collected on three dates.

IPC's report states that the following analytes were detected in effluent samples from Outfall 007: copper (nd to 0.09 ppm), zinc (0.18 to 0.27 ppm), oil and grease (2 to 5 ppm), phenols (nd to 0.08 ppm), ammonia (nd to 1.17 ppm), and 1,1,1-trichloroethane (0.058 to 2.4 ppm). Toxicity testing was conducted with 100% effluent, using Daphnia pulex and the fathead minnow as the test organisms (D. pulex is a type of crustacean commonly referred to as "water flea"). One of the three samples showed toxicity to D. pulex, and also contained the maximum observed concentration of 1,1,1-trichloroethane. No effects were observed in the test using the fathead minnow.

The following analytes were reported by IPC to be present in effluent samples from Outfall 008: ammonia (nd to 1.7 ppm), total chromium (nd to 0.40 ppm), hexavalent chromium (nd to 0.05 ppm), copper (0.12 to 2.14 ppm), nickel (nd to 0.13 ppm), zinc (nd to 0.01 ppm), chloroform (0.007 ppm) and 1,1,1-trichloroethane (0.019 ppm). Toxicity was evaluated using mysid shrimp and the sheepshead minnow. Some degree of toxicity was observed for both of the organisms. The IPC report suggested that the toxic effects may have been associated with copper concentrations in the effluent. Since the time of the IPC Corporation report, toxicity testing has been added to Textron's NPDES permit monitoring requirements. The first Aquatic Toxicity Monitoring Report (dated November, 1991) documented toxicity and analytical results which were within permitted limits.

2.2.4 Tank Farm Near B-34

Soil and groundwater conditions in the area near the tank farm at B-34 (Figure 2-2) were evaluated in a subsurface investigation by Zecco, Inc. (1990). Seven test borings were drilled and soil samples were collected at 5-foot intervals. One soil sample from each boring was composited from all the depths sampled, and was analyzed for total petroleum hydrocarbons (TPH). Four of the borings were converted to monitoring wells, which were sampled and analyzed for volatile organic compounds and TPH.

Analytical results for the composite soil samples show that six of the seven borings contain measurable levels of TPH, ranging from 43 to 5500 ppm. The highest concentrations were in the borings adjacent to B-16 (MW-2 and MW-3 on Figure 2-2). Groundwater from MW-1 contained no detectable TPH or volatile organic compounds. The remaining three wells contained the indicated ranges of the following analytes: TPH (2.9 to 15.0 ppm), benzene (0.017 to 0.620 ppm), ethylbenzene (0.017 to 0.077 ppm), and xylenes (0.009 to 0.086 ppm). The overall highest concentrations of these analytes were in MW-2.

2.2.5 Groundwater Assessment Monitoring Program

Prior to 1989, four lagoons (one equalization lagoon and three sludge storage lagoons) existed on site (Figure 2-5) and were regulated under the Resource Conservation and Recovery Act (RCRA). Spent plating baths were discharged to the equalization lagoon. Wastewater from this lagoon was pumped to a chemical waste treatment plant, converted to a metal hydroxide sludge, and finally pumped to the sludge storage lagoons. Groundwater monitoring wells were installed and sampled beginning in 1981, although changes in the requested analytical parameters resulted in the consideration of the 1983-1984 data as the "first year" of record. Metcalf and Eddy, Inc. (1987) reported the monitoring results. The lagoons were closed in 1989, but the monitoring program continued as required under RCRA closure. ESE completed the most recent monitoring report, the "seventh year" annual summary for 1990. This section summarizes the conclusions of the two groundwater assessment monitoring reports: Metcalf and Eddy, Inc, 1987, and ESE, Inc, 1991.

Metcalf and Eddy, Inc. (1987) reported that five monitoring wells were installed in 1981, two were installed in 1983, and six were installed in 1985, for a total of thirteen monitoring wells in the lagoon area. The Connecticut Department of Environmental Protection (CDEP) specified the following analytical parameters for the monitoring program: cadmium, hexavalent chromium, total chromium, copper, mercury, nickel, zinc, amenable cyanide, total cyanide, pH, halogenated volatile organics, aromatic volatile organics, specific conductivity, total organic carbon, and total organic halogens. The "first year" results (1983-1984) indicated that Connecticut Public Drinking Water Code (CPDWC) standards were exceeded in samples from MW-1 through MW-5 for total chromium, hexavalent chromium, total cyanide, trichloroethylene, and tetrachloroethylene. In "second year" samples (1984-1985), the CPDWC standards at these five wells were exceeded for total chromium and total cyanide. Metcalf and Eddy, Inc. installed six additional monitoring wells in 1985. The "third year" analytical results (1985-1986) showed that CPDWC standards were exceeded for total chromium, hexavalent chromium, total cyanide, trichloroethylene, and tetrachloroethylene at MW-1, MW-2, MW-3, and MW-5.

Lagoon closure was completed in 1989, and ESE (1991) presented results for the "seventh year" of monitoring (1989-1990). In 1990, an upgradient well (MW-10 on Figure 2-5) contained cadmium in exceedance of CPDWC standards. The following analytes were above CPDWC standards in at least one of several wells (MW-1 through MW-5, MW-7, MW-9 through MW-10, and MW-12) in 1990, and have varied over the indicated concentrations over the entire period of record: cadmium (4-70 ppb), vinyl chloride, 1,1-dichloroethene, 1,2-trans-dichloroethene (2-6500 ppb), and trichloroethene (2-150 ppb). (Concentration ranges for vinyl chloride and 1,1-dichloroethene were not reported.) ESE's statistical analysis of the data indicated that the following analytes showed a statistically significant increase in the downgradient wells (MW-1 through MW-5, and MW-13) as compared to the upgradient well (MW-10): 1,2 trans-dichloroethene, tetrachloroethene, trichloroethene, total organic carbon (TOC), specific conductance, and pH. Note that these results assume that the source of contamination is the closed lagoons; and no further conclusions regarding alternative sources of contamination were made in either of the assessment monitoring reports.

3.1 SAMPLING PROGRAM

The SAEP is a government-owned contractor-operated facility located in Stratford, Connecticut. The USDA owns the land, the buildings, and much of the production equipment at the SAEP. The U.S. Army Aviation Systems Command (AVSCOM) has responsibility for the jurisdiction, control, and accountability of the SAEP. Textron Lycoming, an operating division of Textron Corporation, operates the SAEP under a facilities contract with AVSCOM. Textron Lycoming manufactures and tests turbine engines at the SAEP, primarily for the USDA. They also produce turbine engines for the U.S. Navy, for foreign military sale, and for commercial use.

The USDA is currently considering the lease or sale of government-owned property at the SAEP to Textron. USDA regulations require that an environmental investigation of the property be performed.

USACE has been tasked by AVSCOM to prepare a Remedial Investigation Work Plan for the SAEP. The USACE has contracted the preparation of this Work Plan to WCC under Indefinite Delivery Contract No. DACW45-90-D-0008.

3.2 SAMPLING OBJECTIVES

The sampling described herein is designed to determine the presence or absence of contamination at the eight areas of Environmental Concern identified in the Preliminary Assessment Report. In addition to investigating contamination, the investigation will include a study of the site hydrogeology.

3.3 SAMPLING IN AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

A brief discussion of the planned sampling and analytical program at each of the identified areas of potential environmental concern is provided in this section. A more detailed discussion, with maps and tables, is given in the Field Sampling Plan. Sampling locations are shown in Figure 2-2. Figure 3-1 presents the Project Schedule for the Remedial Investigation at the SAEP.

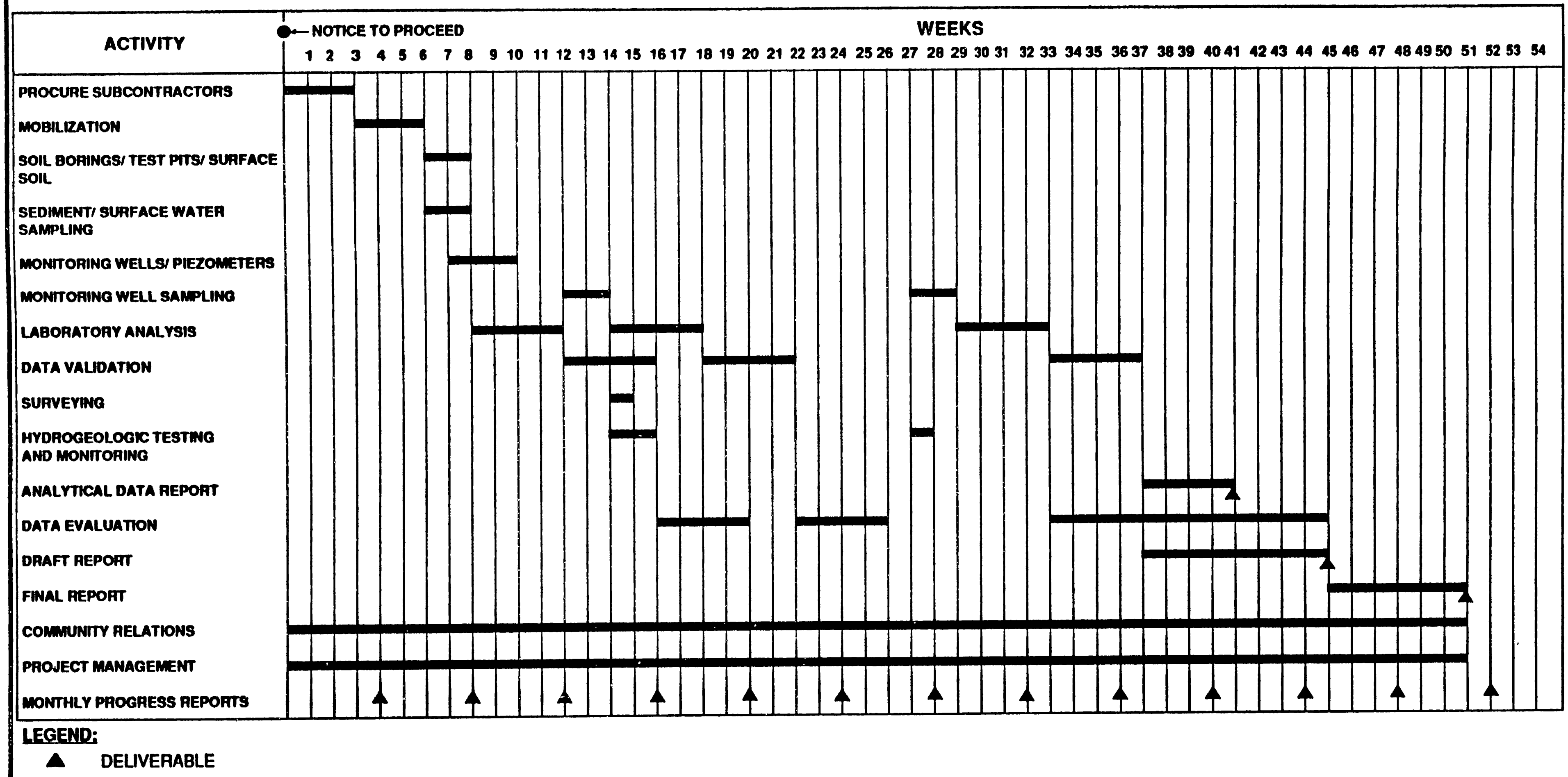
3.3.1 Area 1 - Intertidal Flats

Seven outfalls (001 through 007)discharge into the intertidal flats. Before construction of the OATP, any material or waste dumped or spilled into storm drains was released to the intertidal flats through one or more of these outfalls. These releases of potentially hazardous materials to the intertidal flats have been documented.

Sediment and surface water samples will be collected near each outfall in the intertidal flats area. Because of the potential for sediment transport by tidal action, samples are also proposed at three locations farther out (east) into the flats. Sediment and surface water samples will be collected on the upstream side of the jetty which extends into the flats. Sediment and surface water from this location is likely to be isolated from any influence of site activities and should be representative of background conditions. A stilling well (STW-1) will be installed in the intertidal flats so that surface water levels can be monitored and variations of surface water levels caused by tides can be compared to variations in groundwater levels measured in monitoring wells.

3.3.2 Area 2 - Causeway

The causeway was constructed in the 1930's using an unknown source of fill. Some of the fill is reported to consist of asbestos-containing materials. The causeway was also reportedly used as a training area for the plant's fire department.



PROJECT SCHEDULE

STRATFORD ARMY ENGINE PLANT

STRATFORD, CONNECTICUT

FIGURE 3–1

Prior to any ground disruptive activities a detailed visual survey of the causeway will be performed with the objective of determining the presence of asbestos containing materials. Surface soil samples will be collected for polarized light microscopy/phase contrast microscopy (PLM/PCM) or transmission electron microscopy (TEM) analysis for asbestos. Identification and counting as described in NIOSH Method 9002 EPA STD Bulk Sample and AHERA Methodology, 40 CFR 763.86.

Sampling will not be performed at any location where;

- The concentration of asbestos is determined to pose a health hazard to the personnel, and,
- Proper engineering controls can not be implemented to reduce fugitive dust emissions to acceptable levels, and,
- PPE and contaminant reduction controls can not be used to reduce exposure to personnel to acceptable levels, and,
- Sampling is to be performed during adverse atmospheric/weather conditions such as high winds, or low humidity (extremely dry days), which could hinder efforts to control dust emission.

Ten surficial soil samples will be collected from the causeway. If significant quantities of asbestos-containing materials are discovered, additional air monitoring and sampling for asbestos may be required. If the presence of significant quantities of asbestos-containing materials is confirmed, all work in these areas must be performed in accordance with OSHA Regulation 29 CFR 1926.58, EPA Regulations 40 CFR 61.140-156, DOT Regulations 49 CFR 172.101, 172.200-204, 173.1090, Textron Lycoming's Asbestos Policy and all state and local regulations applicable to safety and health, emission control, transportation and disposal requirements for asbestos.

3.3.3 Area 3 - Shoreline Fill Area

The shoreline fill area has been used to store raw stock, fuels and oils, scrap metals, waste fuels, oils and solvents. Four monitoring wells, one soil boring, and one shallow sample are proposed in this area.

A sample (DW-1) will be collected from the material in a dry well inside Building B-19. This dry well is not currently used but is reported to have been used for disposal of waste fuels, oils and solvents.

Proposed monitoring well WC-1S is located in a drum storage area, east of B-19 where contaminated soils from a drainage system had recently been excavated. Soil samples will be collected from the boring for WC-1S. Soil sampling from one boring (BR-1) is planned in the area north of B-19 where fuel storage tanks were occasionally overfilled.

Monitoring well WC-2D will be installed in the presumed downgradient direction from the area between B-5 and B-16 where fuel tanks had apparently leaked and petroleum contaminated soil had been discovered. Four monitoring wells, recently installed by Metcalf & Eddy will be sampled. Since these four existing wells are apparently screened in the shallow ground water zone and contamination has been identified in these shallow wells, monitoring well WC-2D will be screened at a deeper zone and will be used to evaluate if contamination has migrated downward. Soil samples will be collected from above the water table in the boring for WC-2D to evaluate residual soil contamination in this area.

Building B-16 contains a system of drains which conveyed waste solvents, oils and fuels, and may have conveyed mercury from manometers. These drains are believed to be in poor condition. To investigate the potential effect on groundwater, two shallow monitoring wells (WC-3S and WC-4S) will be installed and sampled. Deeper piezometer PZ-4D will provide information on deeper horizontal gradients, permeabilities, and vertical gradients in this area. The two shallow monitoring wells may also detect groundwater contaminants resulting from spills that reportedly occurred on the east side of B-16, where waste solvents have been contained in drums or carts and collected on small docks. Analysis of soil samples collected from borings for WC-3S and WC-4S will be used to evaluate residual soil contamination from these spills.

Three shallow monitoring wells, two deep piezometers and seven soil borings are proposed in the northernmost section of Area 3 near B-13, B-15, B-58, B-65, and the tank farm. Five soil borings (BR-2 through BR-6) will be installed outside of B-13, B-15, B-58, and the tank farm where numerous small spills and minor overfills of tanks at the tank farm reportedly occurred. Two soil borings (BR-7 and BR-8) will be advanced outside of B-65 where paint and petroleum-contaminated soils were encountered during recent excavations. Soil samples from the boring for monitoring wells WC-5S, WC-6S, and WC-7S will supplement information from borings BR-2 through BR-8.

Monitoring wells WC-5S, WC-6S, and WC-7S will provide information on groundwater quality in the presumed downgradient direction from these potential areas of concern. Deep piezometers PZ-5D and PZ-7D will provide information on deeper permeabilities and on horizontal and vertical gradients.

The total of seven proposed and four existing monitoring wells and five deep piezometers, all situated roughly on the site perimeter, comprise the set of groundwater monitoring points in the presumed downgradient direction from the site, as a whole. These wells will provide information on quality of shallow groundwater flow leaving the site.

3.3.4 Area 4 - Plating and Manufacturing Area

Greenish-blue groundwater was observed during construction of B-10 and B-70, both of which are in the vicinity of the plating shop in B-2. One shallow monitoring well (WC-8S) will be installed in the presumed downgradient (east) direction of B-10 to investigate the potential for groundwater contamination from the B-2 plating shop. One shallow monitoring well (WC-10S) will be installed downgradient of the northern section of the plating area in B-2 and one (WC-12S) will be installed downgradient of the central section. These wells along with existing wells ECD-1 and ECD-4 which are in the vicinity of the south end of the plating shop in B-2, will be sampled.

Soil samples from above the water table in the borings for WC-8S and WC-10S will be analyzed to evaluate residual soil contamination. Proposed deep piezometer PZ-8D will provide information on deep permeabilities and horizontal and vertical flow gradients in this area of the site.

3.3.5 Area 5 - Building 2

Building 2 was originally constructed in 1929. Operations include aircraft assembly and engine manufacturing. Cinders and ash, apparently from a former on-site incinerator, were reported during foundation excavations for B-2. Potential effects on shallow groundwater may be apparent in downgradient monitoring wells WC-5S, -6S, and -7S. These wells are in the presumed downgradient direction from the northern end of B-2.

Wells in the presumed upgradient direction of the site will be installed along Main Street (WC-9S and -11S). These wells will provide information on quality of shallow groundwater flowing onto the site. Soil samples from these borings will provide information on background soil conditions. Deep piezometers PZ-9D, PZ-11D and PZ-17D will provide information on deeper permeabilities and horizontal and vertical gradients. One existing shallow well (LW-7) along the southern boundary of Area 5 will also be sampled. This well is in a presumed upgradient direction from Area 5 and the site as a whole.

3.3.6 Area 6 - Research and Development Area

Past disposal practices or releases may have impacted soil and groundwater in this area. One shallow well (WC-13S) will be installed in the presumed downgradient (east) direction of B-3 to investigate the potential of groundwater contamination from activities in B-3 Proposed deep piezometer PZ-13D will provide information on deep permeabilities and horizontal and vertical gradients in this area of the site. Existing wells (MW-1, -2, -3 and -4) will be used to assess groundwater quality in the east end of this area.

3.3.7 Area 7 - Testing Area

This area includes B-6, which is an engine testing facility. A number of sludge lagoons used as settling ponds for effluent from the CWTP are located just south of this area. These lagoons were closed in 1988. During the lagoon closure oil- stained soils were discovered in an excavation near B-72, which is a fuel storage facility.

Two borings (BR-9 and BR-10), will be installed in the vicinity of B-72 to investigate possible releases of fuel. Two shallow wells (WC-14S and WC-15S) will be installed north and east of B-6, in the presumed downgradient direction of B-6. Existing well LW-10 located just south of B-6 will also be sampled.

3.3.8 Area 8 - Drainage Ditch

Outfall 008 discharges into the drainage ditch. This ditch has received treated effluent 2from the chemical waste treatment plant since 1958 and monitoring has occasionally shown chlorinated hydrocarbons and heavy metals in the effluent.

Sediment and surface water samples will be collected at two locations in this area. One sample location is proposed at the outfall and one upgradient sampling location will be used to evaluate background sediment conditions. Because flow in this ditch is tidally influenced, a stilling well (STW-2) will be installed so that surface water levels can be monitored and tidal variations of surface water levels compared and related to variations of groundwater levels in monitoring wells.

This SSHP does not cover any site activities other than those listed above. Other possible work activities not described in this section may only be conducted after approval of an appropriate addendum to this SSHP by the Project Manager, Corporate Health and Safety Administrator/Eastern Operating Group Health and Safety Officer, and the New York Metro Business Unit Health and Safety Officer.

This SSHP must be reviewed and reauthorized by September 1, 1992. Use of this SSHP after this date to perform the work activities described herein, or other activities in addition to those described herein, is not permitted and constitutes a violation of WCC's health and safety protocols. If work is to be performed after this date, the SSHP must be reviewed and modified, if necessary, by the New York Metro Business Unit Health and Safety Officer.

4.0
ON-SITE HAZARDS

4.1 HAZARD ASSESSMENT

An assessment of the hazards has been made for the sampling activities to be conducted under the SSHP by reviewing the SAEP's historical and current operations and data compiled in the Environmental Baseline Study. The hazards which were assessed include:

- Biological hazards: poison ivy, mosquitoes, ticks, mice/rats, and snakes
- Chemical hazards: inhalation, ingestion and contact with the contaminants of concern
- Physical hazards: use of excavating, drilling, sampling and support equipment
- Radiological hazards

4.1.1 Biological Hazards

The surface debris, particularly the standing water and general industrial waste, and the presence of natural marshes, provides a breeding ground for numerous types of pest organisms, including mosquitoes. The use of insect repellents before donning personal protective equipment (PPE) will be encouraged. To avoid bites from rodents and snakes, personnel will check carefully for these animals before walking through grassy or debris strewn areas. A first aid kit, snake bite kit and insect repellent will be available for use in the field. In many parts of the northeast United States, tick-borne diseases pose a significant health risk during warm months. Attachment 1 presents a discussion of Ticks and Tick-Borne Diseases. Lyme disease, a bacterial (Borrelia

Burgdorferi) infection carried by the deer tick and some species of mosquitoes, is of particular concern. Tick repellant will be available at the field office.

Poison ivy may be present at site. Appropriate clothing should be worn to prevent exposure to poison ivy and a protective barrier lotion should be worn on exposed skin. Tubes of the barrier lotion will be available at the field office.

4.1.2 Chemical Hazards

All areas at which soil sampling, drilling, and well installation will be performed are suspected of containing petroleum based materials; halogenated solvents, organic solvents, aromatic compounds, fuels, lubricating oils, cutting oils and greases. These contaminants may be released either by volatilization from their liquid form or by volatilization from contaminated soil, cement and asphalt. These organic compounds and mixtures have generally low boiling points and high vapor pressures, thus evaporation/volatilization of these compounds and mixtures may occur readily. Moreover, the air concentration of these compounds may increase during hot and dry days. The sampling activities described in Section 3.0 may increase the exposure of workers to these chemicals since ground disrupting activities may facilitate the volatilization of these compounds.

Other chemicals of concern are inorganic compounds and metals that could be found in the pavement, asphalt, soil, sediment in tidal marshes and flats, and water. These compounds include cyanides, asbestos, thorium[1], nickel, chromium, bromine, and lead.

A summary of personal exposure information for the chemicals of concern is contained in Table 4-1. Table 4-2 presents a summary of chemical and physical properties of the chemicals of concern.

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[1] Thorium is also considered a radiological hazard; see Section 4.1.4.

TABLE 4-1
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	OSHA			ACGIH		Acute Symptoms	Target Organs	Carcinogen
	TWA (ppm)	STEL (ppm)	Ceiling (ppm)	TLV-TWA (ppm)	TLV-STEL (ppm)			
VOLATILE ORGANIC COMPOUNDS								
Vinyl chloride	1	5	5	5	--	Weakness, abdominal pain	Liver, blood, CNS[7]	Confirmed
Methylene chloride	500	2000[6]	1000	50	--	Nausea, eye & skin irritation, fatigue, weakness, sleeplessness, limbs numb	Skin, eyes, CNS, cardiovascular system	Suspected
Trans-1,2-Dichloroethene	200	--	--	200	--	Skin irritation, CNS depressant, eye irritation	Liver, kidneys, heart, eyes	Suspected
Chloroform	2	--	--	10	--	Dizziness, skin & eye irritation, nausea, disorientation, heat fatigue	Liver, kidneys, heart, eyes, skin	Suspected
1,1,1-Trichloroethane	350	--	1000[8]	350	450	Irritation, CNS depressant	CNS, eyes, nose, kidneys	
Trichloroethene	50	200[6]	200	50	200	Irritation, CNS depressant	CNS, eyes, nose, kidneys	Suspected
Benzene	1	5	25	10	--	Eye & nose Irritation, nausea	Blood, CNS, respiratory system	Suspected

TABLE 4-1, Continued
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	OSHA			ACGIH		Acute Symptoms	Target Organs	Carcinogen
	TWA (ppm)	STEL (ppm)	Ceiling (ppm)	TLV-TWA (ppm)	TLV-STEL (ppm)			
VOLATILE ORGANIC COMPOUNDS, continued								
4-methyl 2-Pentanone	50	75	3000[8]	50	75	Eye irritation, dermatitis,drowsiness	Skin, eyes, CNS, respiratory system	
2-Butanone	200	300	3000[8]	200	300	Eye & nose irritation, dizziness, vomiting	CNS, lungs	
Tetrachloroethene	25	300[9]	--	50	200	Eye, nose, & throat irritation	Liver, kidneys, CNS, respiratory system	Suspected
Ethyl benzene	100	125	2000[8]	100	125	Eye and mucous membrane irritation, dermatitis	Eyes, skin, CNS, respiratory system	
Phenol	5	15.6	15.6	5	--	Eye, nose, & throat irritation, dermatitis	Liver, kidneys, skin	
1,2-Dichlorobenzene	50	--	50	50	--	Eye & nose irritation, skin blisters	Liver, kidneys, skin, eyes	
1,2,4-Trichlorobenzene	5	--	5	5	--	Eye & skin irritation	Liver, kidneys, skin, eyes	
1,1-dichloroethane	100	--	4000[8]	200	250	CNS depressant, skin irritation	Kidneys, liver, skin	

TABLE 4-1, Continued
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	OSHA			ACGIH		Acute Symptoms	Target Organs	Carcinogen
	TWA (ppm)	STEL (ppm)	Ceiling (ppm)	TLV-TWA (ppm)	TLV-STEL (ppm)			
VOLATILE ORGANIC COMPOUNDS, Continued								
1,2 Dichloroethane	1	2	4000[8]	10	--	CNS depressant, skin & eye irritation, nausea, vomiting, irritation	Kidneys, liver, skin, eyes, CNS	Suspected
2-Methylphenol	5	--	250[8]	5	--	Confusion, rapid respiration, eye and skin burns	CNS, respiratory system, kidneys, liver, skin, eyes	
4-Methylphenol	5	--	250[8]	5	--	Confusion, rapid respiration, eye and skin burns	CNS, respiratory system, liver, skin, eyes	
Naphthalene	10	15	500[8]	10	15	Eye irritant, excitement, vomiting, nausea	Eyes, blood, liver, kidneys, skin, RBC(10), CNS	

TABLE 4-1, Continued
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	OSHA			ACGIH		Acute Symptoms	Target Organs	Carcinogen
	TWA (ppm)	STEL (ppm)	Ceiling (ppm)	TLV-TWA (ppm)	TLV-STEL (ppm)			
SEMI-VOLATILE COMPOUNDS Bis (2-Ethylhexyl) phthalate	5	--	--	--	10	Eye irritation	Eyes, upper respiratory system, GI[11]	
Di-n-Butyl phthalate	5	--	9300[2]	--		Upper respiratory irritation, stomach irritation/discomfort	Respiratory system, GI	
Coal Tar Pitch Volatiles	0.2 mg/m^3 0.1 mg/m^3 (cyclohexane extractibles)	--	700[2] mg/m^3	0.2 (as Benzene Solubles)	--	Dermatitis,bronchitis	Respiratory system, bladder, kidneys, skin	Confirmed
Bromoform	0.5 ppm	--	Unknown[8]	.5	--	Eye and respiratory system irritation, CNS depressant	Liver, CNS,kidneys, skin, respiratory system	Suspected
Chlorodiphenyl (PCB) 48% Chlorine	1 mg/m^3 skin	--	10[8]mg/m^3	1 mg/m^3 skin	--	Eye irritation Chloracne Derm.	Liver, skin, eyes	Confirmed
Chlorodiphenyl (PCB) 54% Chlorine	0.5 mg/m^3 skin	--	5[8]mg/m^3	0.5 mg/m^3 skin		Eye irritation Chloracne	Liver, skin, eyes	Confirmed

TABLE 4-1, Continued
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	OSHA			ACGIH		Acute Symptoms	Target Organs	Carcinogen
	TWA (ppm)	STEL (ppm)	Ceiling (ppm)	TLV-TWA (ppm)	TLV-STEL (ppm)			
METALS								
Lead	0.05 mg/m^3	--	700^2 mg/m^3	0.15 mg/m^3	--	Weakness, eye irritation, trembling	GI, CNS, kidneys, blood, gingival tissue	Suspected
Mercury	0.01 mg/m^3 Alkyl Compounds (organic mercury)	.03 mg/m^3	10 mgm$^{3(8)}$	0.01 mg/m^3 Alkyl Compounds (organic mercury)	0.03	Irritation, cough, chest pain, weakness, dizziness, vomit, skin burns, bronchial pneumonia, impaired vision, diarrhea, insomnia, emotional disturbance	CNS, respiratory system, eyes, kidneys, skin	
	0.05 mg/m^3 vapor/skin (inorganic compounds)		28 mg/m$^{3(8)}$	0.05 mg/m^3 vapors (inorganic compounds)	--			
				0.1 mg/m^3 skin Alkyl and inorganic compounds	--			
Nickel	1 mg/m^3 (metal dust) 0.1 mg/m^3 (soluble compounds)	--	N/A	--	--	Allergic asthma, eye and respiratory system irritation, vertigo, nausea, vomiting	Lungs, skin, nasal cavities, CNS	Suspected

TABLE 4-1, Continued
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	**OSHA**			**ACGIH**		**Acute Symptoms**	**Target Organs**	**Carcinogen**
	TWA (ppm)	**STEL (ppm)**	**Ceiling (ppm)**	**TLV-TWA (ppm)**	**TLV-STEL (ppm)**			
METALS, Continued								
Chromium	1 mg/m^3 (metal dust)	--	N/A	0.5 mg/m^3 (metal dust)	--	Irritation, dermatitis	Lungs, skin	Suspected
	0.05 mg/m^3 Hexavalent Cr(VI)	--	--	0.05 mg/m^3 Hexavalent Cr(VI)	--	Irritation, dermatitis	Lungs, skin	Suspected
Bromine	0.1 (metallic dust)	0.3	10	0.1	0.3	Irritation, headaches, dizziness, pneumonia, diarrhea, eye burns, skin burns	Lungs, CNS, eyes	
Thorium	N/A (metallic dust)		N/A		N/A		Liver, kidneys, blood, bone marrow, respiratory system	Suspected

TABLE 4-1, Continued
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	OSHA			ACGIH		Acute Symptoms	Target Organs	Carcinogen
	TWA (ppm)	STEL (ppm)	Ceiling (ppm)	TLV-TWA (ppm)	TLV-STEL (ppm)			
INORGANIC COMPOUNDS Cyanides	5 mg/m^3		50 mg/m^3		5 mg/m^3	Asphyxia, weakness, headache, confusion, nausea, incoherence, eye & skin irritation	Liver, kidneys, skin, lungs, cardio-vascular system, CNS	
Asbestos	0.2 $fiber/cm^3$ 0.1 $fiber/cm^3$ (action level)	--	--	0.2 $fiber/cm^3$	--	Restricted pulmonary function, finger clubbing	Lungs	Confirmed
Arsenic trioxide	0.010 mg/m^3	0.002[4] mg/m^3	0.002[4] mg/m^3	--	--	Ulceration of nasal septum, dermatitis, GI(11) disturbances, respiratory irritation, peripheral neuropathy, hyper-pigmentation of skin	Liver, kidneys, skin, lungs, lymphatic system	Confirmed

ACTION LEVELS WILL BE A MAXIMUM OF ONE-HALF OF THE OSHA AND/OR ACGIH. IN THE EVENT THAT THE OSHA PELs DIFFER FROM ACGIH TLVs, THE MORE RESTRICTIVE SHALL PREVAIL.

REFERENCES:

Threshold Limit Values and Biological Exposure Indices for 1991-1992 American Conference of Governmental Industrial Hygienists (ACGIH).
Air Contaminants - Permissible Exposure Limits (Title 29 CFR Part 1910.1000) Occupational Safety and Health Administration (OSHA), 1989.

TABLE 4-1, Continued
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

NOTES:

(1)OSHA TWA - Occupational Safety and Health Administration Time-Weighted Average: the employee's average airborne exposure in any 8-hour work shift of a 40-hour work week which shall not be exceeded, as established by OSHA.

(2)OSHA STEL - Occupational Safety and Health Administration Short-Term Exposure Limit: the employee's 15-minute time-weighted average exposure which shall not be exceeded at any time during a work day unless another time limit is specified in a parenthetical notation below the limit. If another time period is specified, the time-weighted average exposure over that time limit shall not be exceeded at any time during the working day. These limits are established by OSHA.

(3)OSHA Ceiling - Occupational Safety and Health Administration Ceiling: the employee's exposure which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time over a working day.

(4)TLV-TWA - Threshold Limit Value - Time-Weighted Average: the time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect (ACGIH). These values are updated annually by the ACGIH and represent guidelines based on the latest toxicological data.

(5)TLV-STEL - Threshold Limit Value - Short Term Exposure Limit: the concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. It is not a separate independent exposure limit; rather, it supplements the time-weighted average (TWA) limit where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals. A STEL is defined as a 15-minute TWA exposure which should not be exceeded at any time during a workday even if the 8-hour TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range. An averaging period other than 15 minutes may be recommended when this is warranted by observed biological effects (ACGIH). These values are updated annually by the ACGIH and represent guidelines based on the latest toxicological data.

(6) - Maximum peak duration of 5 minutes in any 2 hours

(7)CNS - Central Nervous System

(8) - IDLH - Immediately Dangerous to Life or Health

TABLE 4-1, Continued
PERSONAL EXPOSURE INFORMATION
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

NOTES, Continued

(9) - Maximum peak duration of 5 minutes in any 3 hours

(10)RBC - Red Blood Cell Count

(11)GI - Gastrointestinal

TABLE 4-2
CHEMICAL AND PHYSICAL PROPERTIES
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	CAS #	Boiling Pt. (°C) (760 mm Hg)	Vapor Pressure (mm Hg)	Flash Pt. (°C)	Vapor Density (air=1.0)	Solubility	Spec Gravity d^{20}_4	Reactivity
Volatile Organic Compounds								
Vinyl Chloride	75-01-4	-13.37	2530 (20°C)	-78°		Slight	0.9106	
Methylene Chloride	75-09-2	39.75				2%	1.3255	
Trans-1, 2- Dichloroethene		47.2	180-264^N			Insoluble	~1.28	Oxidizes in air
Chloroform	67-66-3	61-62				1 ml/250 ml $H_2$0	1.484	Light sensitive
1,1,1-Trichloroethane		74.1		Non-Flammable		Insoluble	1.3376	
Trichloroethene	79-01-6	86.7		Non-Flammable	4.53	Very Low	1.4649	
Benzene	71-43-2	80.1		-11 (12°F)		0.188%	0.8787	
4-methyl 2-Pentanone		117		73°F		1.91%	0.801	
2-Butanone	78-93-3	79.6		21°F		27.5%	.805	
Tetrachloroethene	127-18-4	121		Non-Flammable			1.623	
Ethyl benzene	100-41-4	136.25		64°F		Insoluble	0.866	
Phenol	108-95-2	182		175°F		1 g/15 ml $H_2$0	1.071	
1,2 Dichlorobenzene	95-50-1	180.5		151°F		Insoluble	1.3059	
1,2,4-Trichlorobenzene		213		230°F		Insoluble	1.4634	
1,1-Dichloroethane	75-34-3	57.3				.5%	1.1757	
1,2-Dichloroethane		83		56°F		1 part/120 parts	1.2569	

TABLE [illegible] Continued
CHEMICAL AND PHYSICAL PROPERTIES
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	CAS #	Boiling Pt. (°C) (760 mm Hg)	Vapor Pressure (mm Hg)	Flash Pt. (°C)	Vapor Density (air=1.0)	Solubility	Spec Gravity d^{20}_4	Reactivity
2-Methyl-phenol		191		81-83°		1 part/40 parts	1.047	
4-Methyl-phenol		201.8				2.5 g/100 cc @ 50°	1.0341	
Napthalene	91-20-3	217.9		174°F		Insoluble	1.162	
Bis (2-ethylhexyl) phthalate								
Di-n-Butylpthalate (dibutylphthalate)		340°		170°C		1:2500	1.0459	Incompatible with Nitrates, Strong Oxidizers and Acids
Bromoform	75-25-2	149-150°				1:800	d^{15}_4 2.9035	Chemically Active Metals Sodium Potassium, Calcium Powdered Aluminum Zinc, Magnesium, Strong Caustics
Metals Lead	7439-92-1	1740°					11.34	Strong Oxidizers Hydrogen Peroxide Active Metals, Sodium, Potassium
Thorium								
Mercury			at 25° 2x10^{-3}mm				d^{25} 13.534	Strong Oxidizers such as Chlorine
Nickel	7440-02-0	2837°						Strong Acids, Sulfur
Chromium	7440-47-3	2642°					7.14	Strong Oxidizers

TABLE 4-2, Continued
CHEMICAL AND PHYSICAL PROPERTIES
CHEMICALS OF CONCERN
STRATFORD ARMY ENGINE PLANT

Chemical	CAS #	Boiling Pt. (°C) (760 mm Hg)	Vapor Pressure (mm Hg)	Flash Pt. (°C)	Vapor Density (air=1.0)	Solubility	Spec Gravity d^{20}_4	Reactivity
Bromine	7726-95-6	59.47°						Compostible Organics, Oxidizable Material Aqueous Ammonia. Anhydrous Br_2 reacts with Aluminum Titanium Mercury Potassium, Wet Br_2 reacts with other metals
Inorganics Cyanide								Strong Oxidizers such as Nitrates, Chlorates, Acids, Acid Salts
Asbestos	1332-21-4							
Arsenic Trioxide	7740-38-2	465°				1:15 Hot H_20		

The primary exposure pathways of concern for these contaminants are inhalation and skin absorption (particularly for some of the chromium and bromine compounds).

4.1.2.1 Inhalation

Volatile organic compounds (VOs) and other organic compounds that have high vapor pressures and low boiling points may vaporize readily upon exposure to air during excavation and drilling through asphalt pavement and concrete slabs, floors and subfloors since these structures may have acted as shields or caps, preventing volatilization. The extent and rate of volatilization will increase with increasing temperature and decreasing soil moisture levels. As a result, on-site workers will be exposed to the highest levels of organic vapors during dry, hot periods and when the air exchange or wind speed is low.

Particulate solids containing inorganic crystals, arsenic-based compounds, asbestos, cyanides and metallic compounds such as nickel, chromium and thorium may be generated during intrusive operations. The majority of the sampling activities have the potential for generating dust since they will involve breaking through concrete, asphalt and compact soil and rock (as found at the dike).

Most of the VOs can cause irritation of the mucous membrane at the nasal cavities, trachea and lungs. Dust-containing inorganic compounds may cause inflammation and irritation of the mucous membrane at the nasal cavities, trachea and lungs and may become permanently deposited in the lung cavities (especially asbestos and silica-based compounds).

4.1.2.2 Ingestion

Since exposure may occur at any time when the field personnel are near or within the SAEP, a constant response to risk must be enforced. Ingestion of the contaminants of concern will be controlled by prohibiting eating and smoking during any field activity within the SAEP property and by requiring all field personnel to decontaminate themselves upon leaving the sampling areas.

4.1.2.3 Dermal Contact

Skin and eye contact with most of the volatile contaminants can cause skin or mucous membrane irritation and inflammation. Many of these contaminants can be absorbed into the bloodstream through the skin or eyes.

Many of the inorganic contaminants and metals can cause allergic reactions to the skin and eye, thus causing irritation, inflammation, and ulcers. They may also permeate through the skin and eyes and be absorbed into the bloodstream affecting the liver, kidneys, digestive system, as well as the nervous system.

4.1.3 Physical Hazards

Possible physical hazards during sampling activities include flying debris during concrete and asphalt breaking operations. Physical hazards associated with drilling are identified and safety procedures presented in Attachment 2, Safety Guidelines for Drilling.

In addition, high noise levels are expected during the ground breaking operations. Field workers should be aware of the slippery conditions existing at the tidal flats and tidal conditions since they can hinder sampling activities and create loose footing conditions, thus increasing the risk of falling.

A summary of the physical hazards which may be encountered while working at the SAEP is provided in Table 4-3.

4.1.4 Radiological Hazards

The historical presence of small amounts of radioactive materials and the current presence of thorium-based alloys at the SAEP, may present a radiological hazard to field personnel during sampling activities. Potential routes of exposure include inhalation of or dermal contact with radioactively contaminated dust or debris.

TABLE 4-3

PHYSICAL HAZARDS
STRATFORD ARMY ENGINE PLANT

Hazard	Description	Location	Procedure Used to Monitor/Reduce Hazard
Heavy Equipment	Construction Machinery	Throughout Site	Personnel maintain eye contact with operators; hard hats, safety shoes, and eye protection worn (as appropriate) during equipment operation. Avoid interfering with SAEP operations.
Refuse and Materials	Construction refuse and construction materials	Throughout Site	Maintain clean work areas; dispose of refuse immediately; do not block access routes with materials.
Heat Producing/Electrical Equipment	Generators/Construction Equipment	Throughout Site	Operate equipment away from vegetation and other materials that may ignite. Maintain fire-fighting equipment in the vicinity of operating equipment.
Heat Stress(1)/Cold Exposure(2)	Personnel working under extreme temperature are subject to adverse temperature-related effects.	Throughout Site	Employ buddy system. Each worker is responsible for visually monitoring his/her partner for signs of heat stress/cold exposure. Site safety personnel will also monitor worker's conditions and establish work/rest regimens.

<u>NOTES</u>:

(1) Heat stress monitoring protocols shall be implemented, as appropriate. Work/rest schedules shall be determined based upon ambient temperature, humidity, wind speed, solar radiation intensity, duration and intensity of work, and protective equipment ensembles. In cases where impervious clothing is worn (full-body), the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" protocol for prevention of heat stress shall be followed, and heat stress monitoring shall commence at temperatures of 70 degrees Fahrenheit and above. Where impervious clothing is not worn, the most current published ACGIH heat stress standard shall be used. Both of these guidance documents are contained in Attachment 3.

(2) Cold stress monitoring protocols shall be implemented, as appropriate. Work/rest schedules shall be determined based upon ambient temperature, humidity, wind speed (wind chill), solar radiation intensity, duration and intensity of work, and protective equipment ensembles. For cold stress monitoring to help prevent frostbite and hypothermia, the ACGIH cold stress standard contained in Attachment 4 must be followed.

4.1.5 Asbestos Hazard Evaluation

The effects of asbestos on human health are well-documented. The major effects of inhaling asbestos fibers are asbestosis (a thickening of lung tissues), cancer of the lung, and cancer of the peritoneal and pleural mesothelia. There is evidence that ingestion of asbestos fibers can cause cancer of the gastrointestinal tract. Dermal exposure to asbestos can cause skin irritation. Asbestosis and cancer usually do not appear until 10 to 30 years post-exposure.

Asbestos fibers are usually very thin and fragile. When physically disturbed, they readily break into small pieces and can become airborne in the presence of very slight air turbulence. The most dangerous fibers are believed to be those that are less than 5 microns long. 5-micron fibers are barely visible under a light microscope. The above indicates that there is a high probability of asbestos becoming airborne when sampled and that the person collecting the sample will usually be unaware of the presence of asbestos fibers in the air.

During sampling operations, exposure to asbestos can be reduced by wearing appropriate protective apparel and respirators and be wetting the material or area to be sampled.

5.0
ENVIRONMENTAL MONITORING, PERSONAL MONITORING, PERIMETER MONITORING, AND HAZARD MITIGATION

5.1 ENVIRONMENTAL MONITORING

During field activities at the SAEP, environmental monitoring will be performed by the SSHO and other appropriately trained WCC personnel and recorded in the Inspectors' Field Inspection Reports and summarized in the Daily Health and Safety Reports. Several instruments, as discussed below, will be utilized to monitor the environment in the work zones.

5.1.1 Organic Vapor Monitoring

An organic vapor monitor will be used to detect concentrations of certain vapors in the air. Specifically, an HNu Model PI 101 photoionization detector (HNu PID) with an 11.7 eV probe or OVA flame ionization detector (OVA FID) will be used to monitor organic vapors. Readings will be taken in the employee breathing zone during all work activities. It should be kept in mind that the organic vapor monitor detects mixtures of compounds simultaneously and readings do not indicate concentrations of any individual compound when a mixture of compounds are present.

Organic vapors will be monitored a minimum of every 15 minutes in the breathing zone of workers deemed to be subjected to the greatest exposure.

If more than one work zone is active at the same time, additional air quality monitoring will be performed by qualified personnel assigned to each operation.

Air purifying respirators are not effective in environments containing vinyl chloride, methylene chloride, and chloroform. These compounds exhibit poor absorption qualities or poor warning properties. It will be necessary to monitor the concentrations of these chemicals individually. Draeger colorimetric tubes will be used to analyze the presence of these chemicals as well as for benzene, during periods of HNu PID or OVA FID readings above 1 ppm.

5.1.2 Combustible Gas Monitoring

A Combustible Gas Indicator (CGI) will be used to monitor the release of explosive gases and vapors. A Gas Tech Triple Range Monitor, or similar instrument, will be used.

5.1.3 Airborne Dust Monitoring

Because there is concern for contaminated dusts being generated by vehicular travel on the access roads and other areas within the SAEP, work areas will be initially monitored for total airborne dusts with a MIE, Inc. MINIRAM.

5.1.4 Asbestos

Airborne concentrations of asbestos must be measured at least weekly during asbestos-sampling operations, except when sampling intact insulation in occupied buildings that are not being or have not been used to manufacture asbestos products. Concentrations to which sampling personnel are being exposed shall be determined by collecting samples of airborne asbestos in the breathing zone of at least one representative worker engaged in each distinctly different work task. The sampling regimen must be designed to obtain an 8-hour time-weighed average.

Airborne asbestos concentrations must be monitored upwind and downwind of the area being sampled for all operations that may generate dust when the presence of asbestos is suspected.

Sampling of airborne asbestos will be performed using sampling pumps with flow rates ranging from 500 to 2,500 cc/min, particulate filters (0.8 Mpore size), and filter cassettes. Sampling procedures and analytical methods described in 29 CFR 1910.1001, NIOSH

7400 Methods for Airborne Asbestos shall be used. Galson Laboratories of East Syracuse, New York will be performing analytical testing for asbestos for this project.

Copies of all sample test results will be submitted to the SAEP Safety Office.

5.1.5 Noise Level Monitoring

Noise levels around drilling operations will be monitored and logged. A sound level meter will be used to determine levels of noise to which personnel are exposed.

5.1.6 Radiation Monitoring

Personal Dosimeters will be worn by all field personnel during intrusive field work. In addition, a radiation meter designed for measuring Alpha, Beta, Gamma and X-ray particles/waves will be used to compile additional information.

5.1.7 Instrument Calibration

The OVA FID, HNu PID and CGI monitors will be calibrated twice daily (before the start of any activities and at the end of the work day) in accordance with the manufacturers' specifications for calibration. Calibration procedures are described in Attachment 6. Daily instrument calibrations will be documented in an instrument calibration log book which will be kept at the SAEP. The radiation meter and MINIRAM will be calibrated in accordance with manufacturers' instructions. All equipment calibrations will be performed by the SSHO and other appropriately trained WCC personnel.

5.2 PERSONAL EXPOSURE MONITORING

Personal exposure monitoring for selected chemicals of concern will be performed to confirm actual employee exposures. Chemicals of concern previously found in high concentrations will be targeted (eg. tetrachloroethene, 1,1 dichloroethane, trichloroethene, 1,1,1-trichloroethane, asbestos and lead) as well as contaminants with low PELs (benzene, chloroform, carbon tetrachloride, and vinyl chloride).

Attachment 5 presents a summary of Personal Exposure Sampling Methods and applicable National Institute for Occupational Safety and Health (NIOSH) analytical methods. Personal exposure monitoring samples will be analyzed only by laboratories successfully participating in and meeting the requirements of the American Industrial Hygiene Association's (AIHA) Proficiency Analytical Testing (PAT) or Laboratory Accreditation programs. Galson Laboratories of East Syracuse, New York will be performing analytical testing for the personal exposure monitoring program. The results of these analyses will be used to indicate the relative response of the HNu PID and/or OVA FID and evaluate the efficacy of the environmental monitoring program.

Copies of all sample test results will be submitted to the SAEP Safety Office.

Personal exposure monitoring will be performed during the first two weeks of field work for employees of highest expected exposure. Sampling will be performed by the Site Safety and Health Officer (SSHO) under the direction of a Certified Industrial Hygienist. (CIH) The need for additional personal exposure monitoring will be evaluated by the SSHO and a CIH.

5.3 PERIMETER MONITORING

The SSHO and other appropriately trained WCC personnel will conduct periodic perimeter air monitoring at frequencies no longer than 1 hour if air quality measurements 20 ft downwind of any work area or in any work area accessible to non-project personnel (whichever is closer) exceed 50% of the maximum levels permissible under Level D PPE to document that personnel in the Support Zone, off-site populations, and the environment are not adversely exposed as a result of field activities. If the perimeter monitoring reveals sustained levels greater than 25% of these action levels, work will be stopped in the work area causing these elevated readings and corrective measures will be implemented on-site. The location and type of monitoring will be determined in the field by the SSHO based on the nature of the work being performed on-site, the results of the air quality monitoring program, and the type of exposure being experienced at the perimeter of the work area. Meteorological monitoring shall be performed on-site as needed and used as an adjunct in determining perimeter and any off-site monitoring or air sampling locations.

5.4 HAZARD MITIGATION

5.4.1 Mitigation of Organic Vapors

Any wash water used in drilling and decontamination should be collected into chemical resistant containers that can be readily sealed.

An explosion-proof fan or blower may be used to dissipate fumes emanating from the soil and/or water surface in areas where the air exchange is inadequate, where the sampling area falls below the surface grade, or if the area is surrounded by buildings or structures high enough to prevent any air circulation.

Engineering controls, such as the use of vapor suppressant foams, wetting of the ground surface and plastic sheeting, should be used, if possible, to reduce the volatilization of organic vapors.

5.4.2 Mitigation of Airborne Dust

Water mists and sprays may be used during ground disrupting activities to reduce the emission of any contaminated fugitive dust and asbestos fibers.

5.4.3 Mitigation of Airborne Asbestos

The formation of dust must be minimized using water when drilling or digging with engine-driven equipment in dry soil containing asbestos, when driving vehicles over dry soil containing asbestos on the surface, and when collecting dry samples of asbestos-containing material.

Dry ground known or suspected of containing asbestos at the surface must be thoroughly wetted before vehicles are allowed to run over it. If the water is sprayed from a moving tank truck, the sprayer end of the truck must lead the way so that the wheels of the truck pass over wet ground.

Asbestos-containing insulation, intact or damaged, must be wetted before being sampled. Wetting a small area around the point to be sampled using a bottle of water equipped with a hand-operated spray pump is a recommended technique.

5.4.4 Mitigation of Noise

Hearing protection will be worn when noise levels maintain an intensity of over 85 dBA.

6.0
ACTION LEVELS BY TASK

The action levels presented herein are based on the chemicals of concern (Table 4-1), their respective exposure limits (OSHA PELs and ACGIH TLVs), and the relative response of the instruments to the contaminants. The PELs for the compounds with the highest concentrations (chlorinated solvents and aromatics) are in the range of 50 to 350 ppm. However, some contaminants found at the SAEP at lower concentrations have PELs of 1 ppm.

The selected action level of 5 ppm total volatile organics is based on the expected composition of the airborne contaminants. It is expected that the highest airborne concentrations will be tetrachloroethene and 1,1,1-trichloroethane, which have PELs of 25 ppm and 350 ppm, respectively, with 1,1,1-trichloroethane expected in higher concentrations than tetrachloroethene.

ACTION LEVELS WILL BE A MAXIMUM OF ONE-HALF OF THE OSHA PELS AND/OR ACGIH TLVS. IN THE EVENT THAT OSHA PELs DIFFER FROM ACGIH TLVS, THE MORE RESTRICTIVE SHALL PREVAIL.

In the event that work must be stopped, personnel will vacate the work area and proceed to a predetermined location, as selected by the SAEP's Manager of Health, Safety and Loss Control and the SSHO. This location will be chosen and discussed each morning, and will not have concentrations of airborne contaminants above the SAEP background levels. The maximum working levels are 500 ppm for total volatile organic compounds and 25 percent LEL for combustible gases. If either of these levels are measured, the work area will be vacated, allowed to vent, and be monitored for organic compounds and combustible gases every 15 minutes by the SSHO.

The following action levels will be used for sampling activities conducted at the SAEP.

Soil Boring, Sampling and Monitoring Well Installation

Asbestos	Level of Protection
Background level to 0.1 fibers/cm^3	Level D
0.1 to 2 fibers/cm^3	Level C (half-face air purifying respirator with GMC-H cartridges may be worn)
2 fibers/cm^3 to 10 fibers/cm^3	Level C
>10 fibers/cm^3	Evacuate work area and allow area to ventilate. Return only after asbestos levels are less than 10 fibers/cm^3

Total VOCs	Level of Protection
Background level to 5 ppm	Level D
5 ppm to 50 ppm	Level C
>50 ppm	Evacuate work area and allow area to ventilate. Return only after total VOC levels are less than 50 ppm

Vinyl Chloride	Level of Protection
< 1 ppm	Level D
>1 ppm	Evacuate work area and allow area to ventilate. Return only after vinyl chloride levels are less than 1 ppm

Chloroform	Level of Protection
< 2 ppm	Level D
>2 ppm	Evacuate work area and allow area to ventilate. Return only after chloroform levels are less than 2 ppm

Benzene	Level of Protection
< 0.5 ppm	Level D
0.5 ppm to 10 ppm	Level C
>10 ppm	Evacuate work area and allow area to ventilate. Return only after benzene levels are less than 10 ppm.

Combustible Gases	Action
< 25 Percent LEL	Perform work
> 25 Percent LEL	Stop work, remove ignition sources, evacuate work area and allow area to ventilate. Return only after gases return to less than 25 percent LEL

Drilling Through Paved Areas and Excavating
(in addition to previously discussed action levels)

Total Dust Concentration	Level of Protection
< 5 mg/m^3	Level D
5 mg/m^3 to 10 mg/m^3	Level C
> 10 mg/m^3	Stop work, evacuate work area, return only after dust concentrations return to less than 10 mg/m^3

RADIATION ACTION LEVEL

Radiation levels are not to exceed the lesser of three times the off-site background level or 0.1 milli Rems/hour. If at any time any worker's exposure to radiation exceeds the lesser of these levels, all workers in that work area must leave the area immediately and notify the SSHO as soon as possible. The appropriate course of action will be decided by the Corporate Health and Safety Administrator, the SAEP Manager of Health, Safety and Loss Control, the SAEP Radiation Safety Officer, the USACE Health and Safety Officer, and the Project Manager.

7.0
KEY HEALTH AND SAFETY PERSONNEL

WCC's health and safety responsibilities lie in a chain of command headed by the Corporate Health and Safety Administrator (CHSA) and the Eastern Operating Group Corporate Health and Safety Officer (EOG CHSO). Consultation, internal review, and approval of SSHPs are provided by the CHSA, EOG CHSO and the New York Metro Business Unit Health and Safety Officer (New York Metro BUHSO). The New York Metro BUHSO assists the Project Manager in matters of health and safety but does not have everyday on-site responsibilities. Site safety is maintained in the field by the Site Safety and Health Officer (SSHO). The SSHO reports to the Project Manager. The Project Manager coordinates all operations and reports to the Program Director.

The health and safety chain of command is shown in Figure 7-1. Resumes of key health and safety personnel are presented in Attachment 7.

7.1 PROJECT MANAGER: MARION E. CRAIG

The Project Manager has the following responsibilities:

- To see that the project is performed in a manner consistent with WCC's Health and Safety Program
- To have a SSHP prepared and approved
- To provide the New York Metro BUHSO with project information related to health and safety matters and development of the SSHP
- To implement the SSHP
- To monitor the compliance with the SSHP by WCC personnel

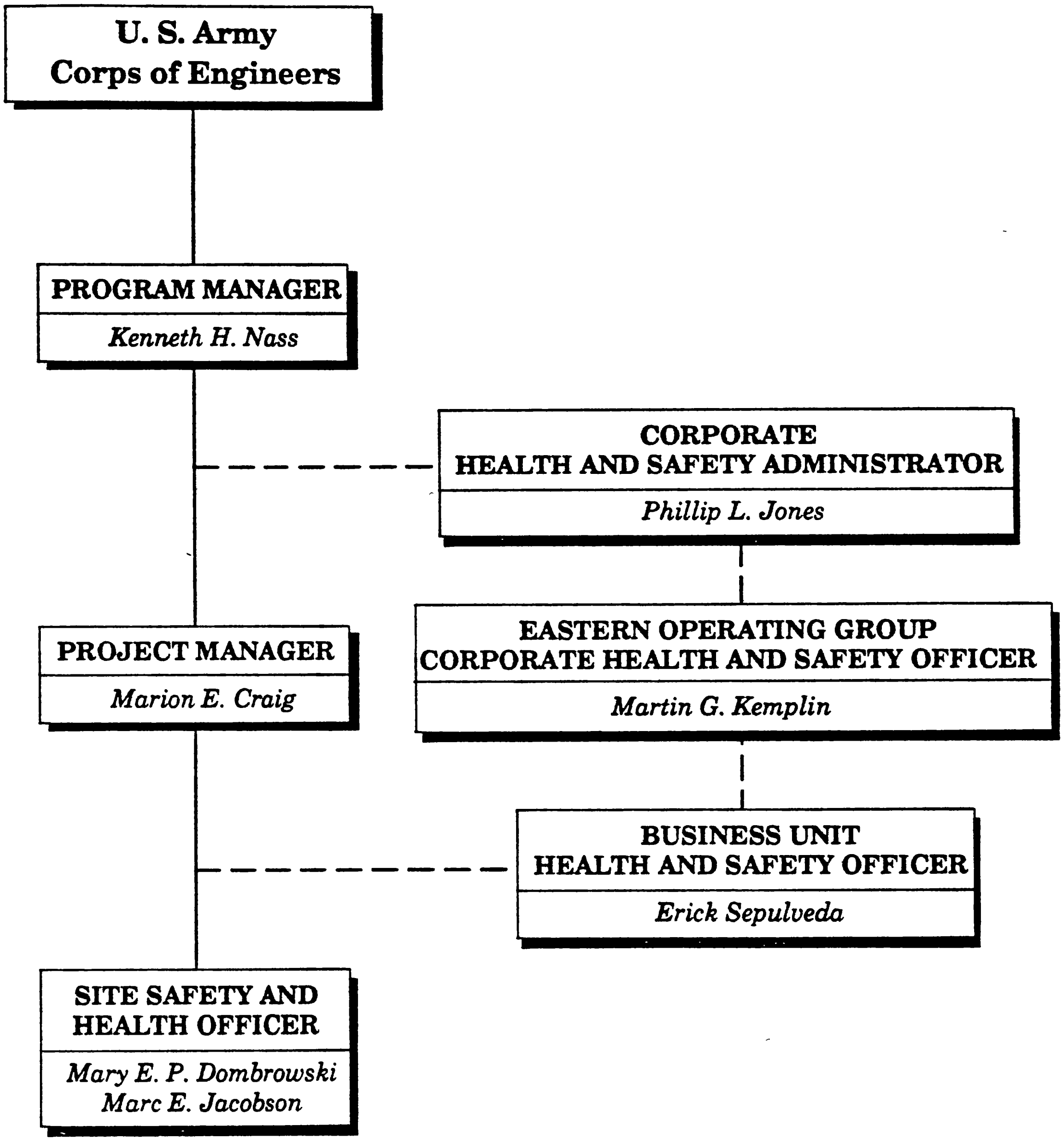
The Project Manager has the authority to take the following actions:

- To determine personnel assignments on this project
- To temporarily suspend field activities if the health and safety of personnel are endangered, pending further consideration by the New York Metro BUHSO.
- To temporarily suspend an individual from field activities for infractions of the SSHP pending further consideration by the New York Metro BUHSO.

7.2 CORPORATE HEALTH AND SAFETY ADMINISTRATOR: PHILLIP L. JONES, CIH EASTERN OPERATING GROUP HEALTH AND SAFETY OFFICER: MARTIN G. KEMPLIN, CIH

The Corporate Health and Safety Administrator/Eastern Operating Group Health and Safety Officer have the following responsibilities:

- To develop, implement and oversee WCC's Health and Safety Program and provide recommendations for improvement of the program
- To coordinate health and safety activities of the business units
- To develop, implement and oversee SSHPs
- To investigate reports of incidents or accidents
- To determine whether an accidental exposure or injury merits a change in the affected individual's work assignments and whether changes in work practices are required.
- To perform site audits.



CHAIN OF COMMAND STRUCTURE
FOR HEALTH AND SAFETY
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

FIGURE 7–1

The CHSA and the EOG CHSO have the authority to take the following actions:

- To approve or disapprove SSHPs
- To access project files
- To direct changes in personnel work practices to improve health and safety of employees involved in hazardous waste management projects
- To remove individuals from projects, if their conduct jeopardizes their health and safety or that of co-workers
- To suspend work on any project which jeopardizes the health and safety of personnel involved.

7.3 NEW YORK METRO BUSINESS UNIT HEALTH AND SAFETY OFFICER: ERICK SEPULVEDA

The New York Metro Business Unit Health and Safety Officer has the following responsibilities:

- To interface with the Project Manager in matters of health and safety
- To develop a SSHP for the project and to submit it to the CHSA and/or EOG CHSO for approval
- To monitor compliance with the approved SSHP
- To assist the Project Manager in seeing that proper health and safety equipment is available for the project
- To approve personnel to work on this site with regard to medical examination and health and safety training

- To report safety-related incidents or accidents to the CHSA and/or EOG CHSO

- The New York Metro BUHSO will not have everyday on-site responsibilities

The New York Metro BUHSO has the authority to take the following actions:

- To suspend work or otherwise limit exposures to personnel if the SSHP appears to be unsuitable or inadequate.

- To direct workers to change work practices if they are deemed to be hazardous to the health and safety of personnel.

- To remove personnel from the project if their actions or conditions endanger their health and safety or the health and safety of co-workers.

7.4 SITE SAFETY AND HEALTH OFFICER: MARC E. JACOBSON

The Site Safety and Health Officer has the following responsibilities:

- To implement and continually enforce WCC's Health and Safety Program

- To report safety-related incidents or accidents to the Project Manager and New York Metro BUHSO

- To implement and continually enforce the SSHP

- To maintain health and safety equipment on-site, as specified in the SSHP

- To inspect health and safety activities on-site, as specified in the SSHP, and report results to the Project Manager and the New York Metro BUHSO

The SSHO has the authority to take the following actions:

- To temporarily suspend field activities, if health and safety of personnel are endangered, pending further consideration by the New York Metro BUHSO.
- To temporarily suspend an individual from field activities for infractions of the SSHP, pending further consideration by the New York Metro BUHSO.
- To designate an alternate SSHO in his absence.

7.5 ALTERNATE SITE SAFETY AND HEALTH OFFICER: MARY E.P. DOMBROWSKI

The Alternate Site Safety Officer assumes the responsibilities and authorities of the SSHO in the absence of the assigned SSHO.

8.0

ANTICIPATED PERSONAL PROTECTIVE EQUIPMENT LEVELS FOR SITE ACTIVITIES

The initial level of protection assigned to each work task, except where noted below, covered by this SSHP is Level D. Level D represents WCC's best estimate of the PPE necessary to reduce the potential for exposure of field personnel to potential hazards to acceptable levels. This level of protection may be upgraded based on visual observations or the results of air monitoring.

8.1 PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment specified in this SSHP will be provided for all field personnel. The following requirements are in accordance with OSHA regulations:

- Facial hair that interferes with proper fit of respirators must not be worn
- Contact lenses must not be worn
- Eyeglasses that interfere with proper fit to full-face respirators must not be worn

The following descriptions of personal protective equipment ensembles shall constitute the cited Levels of Protection as used in this SSHP for the sampling activities at the SAEP:

Level D Personal Protective Equipment

- Hard hat using the SAEP recommended colors
- Safety glasses, goggles, or face shield(1)
- Chemical-resistant steel-toed and steel shank work boots
- Overboots or disposable "booties" (dark color preferred)(2)
- Outer gloves(3)
- Latex surgical gloves (to be worn underneath outer gloves)(2)
- Gray or dark blue Tyvek coveralls

(1) if splash or dust hazard exists

(2) personnel should wear neoprene overboots or "booties" in Areas 1, 3 and 8 as identified on Figure 2-2 of the Work Plan as these areas may contain PCBs; rubber overboots or "booties" may be worn, as required, in other areas of the facility.

(3) personnel should wear neoprene outer gloves in Areas 1, 3 and 8 as identified on Figure 2-2 of the Work Plan as these areas may contain PCBs; nitrile rubber outer gloves may be worn, as required, in other areas of the facility.

Level C Personal Protective Equipment

- Hard hat using the SAEP's recommended colors
- Full-face air purifying respirator with GMC-H combination cartridges
- Chemical-resistant steel-toed and steel shank work boots
- Nitrile rubber outer gloves or a material compatible with the suspected chemicals
- Latex surgical gloves (to be worn underneath outer gloves)
- Rubber overboots or disposable "booties" (dark color preferred)
- Gray or dark blue hooded Saranex impregnated or polycoated Tyvek coveralls (taped at cuffs)

Level B Personal Protective Equipment

- Positive pressure-demand full-facepiece self-contained breathing apparatus (SCBA), or positive pressure-demand supplied air respirator with escape SCBA
- Gray or dark blue hooded Saranex impregnated or polycoated Tyvek coveralls (taped at cuffs, seams and facepiece)
- Nitrile rubber outer gloves or a material compatible with the expected chemicals
- Latex surgical gloves (to be worn underneath outer gloves)
- Chemical-resistant steel-toed and steel shank work boots
- Rubber overboots or disposable "booties" (dark color preferred)

In addition to this equipment, a first aid kit, snakebite kit, emergency eyewash in accordance with ANSI Z-358.1, and multi-purpose dry chemical UL Class 10A-10B-C fire extinguisher must be maintained at each work site.

A list of required personal protective equipment is provided in Attachment 8.

9.0
GENERAL HEALTH AND SAFETY REQUIREMENTS

9.1 MEDICAL EXAMINATION

Before commencing any of the activities on-site, all WCC and subcontractor personnel must take a medical examination as part of a medical surveillance program. WCC's medical surveillance program is specified in Section 3 of WCC's Hazardous Waste Management Practice Health and Safety Manual, dated November 1990, and meets the requirements of OSHA Regulations 29 CFR 1910.120(f)and ANSI Z-88.2. A description of this program is provided in Attachment 9 of this SSHP.

Before working on-site, written certification for each WCC and subcontractor employee expected to enter either the Contamination Reduction Zone or Exclusion Zone of participation in a Medical Surveillance Program, ability to wear a respirator and the date of last medical examination will be compiled by the SSHO. These documents will be provided to the SAEP Manager of Health, Safety and Loss Control prior to that individual engaging in field work. Additional copies of this documentation will be kept on-site by the SSHO. The written medical opinion from the reviewing physician concerning fitness to work on-site and ability to wear a respirator required by OSHA Regulations 29 CFR 1910.120 (f)(7) shall be made available upon request to the Contracting Officer's Representative for all WCC and subcontractor site personnel.

9.2 TRAINING

All WCC personnel and subcontractor exposed to hazardous substances, health hazards or safety hazards must be thoroughly trained as specified in OSHA Regulations 29 CFR 1910.120(e). Training includes attendance at an initial 40-hr basic health and safety training course, annual health and safety refresher courses, a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor, and on-site, site-specific training. On-site supervisors must have completed the Management and Supervisor Training course as specified in OSHA Regulations 29

CFR 1910.120(e)(4). At least one First Aid and CPR trained and currently certified person must be present on-site at all times when fieldwork is being performed. Documentation concerning the type, duration and dates of training, including fit-test certificates, for all WCC and subcontractor on-site personnel will be provided to the SAEP Manager of Health, Safety and Loss Control prior to that individual engaging in fieldwork. Additional copies of this documentation will be kept at the site by the SSHO. The SSHO shall conduct site-specific training covering site hazards, procedures, and all contents of the SSHP for WCC and subcontractor on-site personnel and visitors to the site prior to commencement of work or entering the SAEP. Documentation of appropriate training for all WCC and subcontractor site personnel and site visitors shall be maintained on-site and submitted to the Contracting Officer's Representative at the conclusion of the site work.

9.3 INCIDENT REPORTING

In the event of fire, explosion, illness, and/or injuries occurring on site at SAEP, SAEP Security Headquarters, (Extension 2767 (2SOS)) will be notified at the time of occurrence.

Any incident or accident involving WCC field personnel or WCC subcontractors will require that a Hazardous Waste Incident Report be filed. Situations covered by this policy include, but are not limited to, fires, explosions, illnesses injuries, and automobile accidents. Those reports must be sent to the New York Metro BUHSO within 24-hours of the incident/accident. Worker's Compensation Insurance reports should be filed with the individual's employer within 48-hours of each accident or illness which results from work related activities and requires medical attention. See Attachment 10 for a copy of the Hazardous Waste Incident Report Form. The SSHO will complete this form in case of an accident or incident.

The USACE requires the following to be reported on ENG Form 3394 in cases of an incident or accident:

1) Notify USACE within 24 hours of the event

2) Report within two working days sufficient information to allow completion of ENG 3394 in accordance with AR 385-40 and USACE Supplement 1 to that regulation

   a) First aid
   b) Lost-time
   c) Property damage: $1,000 or more to government or contractor property
   d) $50,000 or more damage to government or contractor property, requires immediate board of investigation
   e) Questionable property damage
   f) Fatalities; 5 or more people sent to a hospital

The SSHO will be responsible for completing ENG Form 3394.

Incidents or accidents requiring immediate reporting required by OSHA Regulation 29 CFR 1904):

1) Fatalities or catastrophe (5 or more people sent to a hospital)

All other personal injuries requiring first aid or resulting in lost time must be recorded on OSHA Form 200. OSHA does not require this to be sent in, but WCC is required to keep this Form for the purpose of inspections by OSHA.

Accidents will be investigated in-depth to identify all causes and to recommend hazardous control measures. Except for rescue and emergency measures, the accident scene shall not be disturbed until it has been released by the investigating official. The consequences requiring an in-depth investigation are:

- Fatal Injury
- Five or more persons admitted to a hospital
- Property damage in an amount specified by the designated authority

The Project Manager must be notified as soon as possible of all accidents or incidents which require either a ENG Form 3394 or OSHA Form 200 to be completed.

9.4 ILLUMINATION AND SANITATION

If practical, all major work tasks will occur during daylight hours. The illumination requirements set forth in OSHA Regulation 29 CFR 1910.120(m) will be met when these tasks are performed. Needs for artificial illumination are primarily expected to be limited to work inside buildings. An electric lamp will be used in these areas. In compliance with OSHA Regulation 29 CFR 1926.56, the minimum intensity of lighting in work areas will be 5 foot candles.

The sanitation requirements regarding potable and non-potable waters, toilet facilities and washing facilities will be followed as set forth in OSHA Regulation 29 CFR 1910.120(n). Food handling areas and temporary sleeping quarters requirements are not applicable to the work covered by this SSHP.

Attachment 15 contains OSHA Regulations on Illumination and Sanitation at Temporary Work Places.

9.5 COMPLIANCE AGREEMENT

The Site Manager and/or the SSHO will hold meetings with WCC and subcontractor field personnel before work commences. During the meetings, all personnel will be provided with a copy of this SSHP; the SSHP will be reviewed and discussed and questions answered; fit testing and care of respirators will be reviewed. Signed Compliance Agreement Forms will be collected by the Site Manager and filed. Individuals refusing to sign the Compliance Agreement will not be allowed to work at the SAEP. A copy of the Compliance Agreement Form is contained in Attachment 11.

9.6 RESPIRATOR MAINTENANCE

Each person is responsible for their own respirator. Respirators, if used, will be cleaned daily according to procedures prescribed by the manufacturer. GMC-H combination cartridges will be used and replaced either daily or if breakthrough is detected at any time while is use. Use of other cartridges must be approved by the New York Metro BUHSO. The following checks will be performed on a daily basis on each individual respirator in use:

- Exhalation valve - pull off plastic cover and check valve for debris or tears in the neoprene valve which could cause leakage.
- Inhalation valves (two) - screw off cartridges and visually inspect neoprene valves for tears. Make sure that the inhalation valves and cartridge receptacle gaskets are in place.
- Make sure a protective lens cover is attached to the lens. Lenses are expensive to replace and must be protected at all times.
- Make sure you have the right cartridge (use GMC-H).
- Make sure that the face piece harness is not damaged. The serrated portion of the harness can fragment which will prevent proper face seal adjustment.
- Make sure the speaking diaphragm retainer ring is hand tight.

Additional information on respirator inspection, care, maintenance and storage is provided in Attachment 12.

9.7 PROJECT MANAGER NOTIFICATION

All field personnel must inform the Project Manager or designated representative before entering the SAEP.

> IF ANY UNEXPECTED POTENTIAL HAZARDS ARE DISCOVERED DURING FIELD WORK, LEAVE THE AREA OF CONCERN IMMEDIATELY AND CALL THE SITE SAFETY AND HEALTH OFFICER FOR FURTHER INSTRUCTIONS.

The SAEP Manager of Health, Safety and Loss Control, extension 3278, and the Contracting Officer's Representative will be notified as soon as possible by the SSHO if unexpected potential hazards which were not addressed in this SSHP are discovered during field work. Field activities in such areas shall be halted until the SSHP has been modified to reflect these changed conditions and reviewed/approved by the SAEP Manager of Health, Safety and Loss Control and the Contracting Officer's Representative.

9.8 DAILY HEALTH AND SAFETY SUMMARY REPORT

A Daily Health and Safety Summary Report will be used to record entry and exit times of all WCC and subcontractor personnel and work area visitors; accidents, injuries, and illnesses; incidences of safety infractions by field personnel; air quality and personal exposure monitoring data; and other information related to safety matters. Daily health and safety inspections shall be conducted by the SSHO to determine if operations are being performed in accordance with the SSHP; results of these inspections will be documented in the Daily Health and Safety Summary Report. All accidents, illnesses, or other incidents will be reported to the Project Manager, the New York Metro BUHSO, and SAEP Manager of Health, Safety and Loss Control. A copy of the form for the Daily Health and Safety Summary Report for this project is presented in Attachment 13. The Daily Health and Safety Summary Reports, including personnel/visitor logs and results of environmental and personal exposure monitoring/sampling shall be completed and maintained on-site by the SSHO and submitted to the Contracting Officer's Representative at the conclusion of the site work.

9.9 OSHA JOB SAFETY AND HEALTH PROTECTION POSTER

In accordance with the Occupation Safety and Health Act of 1970, a copy of the OSHA Job Safety and Health Protection poster must be present on all sites. This poster is appended as Attachment 14. It should be posted at its full size (11 inches x 17 inches) on-site.

9.10 PROHIBITIONS

- Smoking, eating, drinking, chewing tobacco or toothpicks, application of cosmetics, storing food or food containers, or having open fires will not be permitted in the Exclusion Zone and the Contamination Reduction Zone and any manufacturing and/or storage areas. Good personal hygiene will be practiced by field personnel to avoid ingestion of contaminants. Washing the face and hands will be performed after personal decontamination.

- Approach or entry into areas or confined spaces where toxic or explosive concentrations of gases or dusts may exist is prohibited.

9.11 WORK PROCEDURES

Whenever possible, field personnel will work from a position upwind of work activities.

All operations conducted on the intertidal flats including collection of surface water and sediment samples, must be performed with a dedicated "watcher" on-shore. If working from a boat, all personnel on the boat must wear U.S. Coast Guard approved flotation jackets while on the boat and suitable slip resistant footwear.

9.12 UNDERGROUND STRUCTURES

Extreme caution will be exercised whenever possibility of encountering buried utilities, (i.e., tanks) exists. Prior to commencement of intrusive activities, all available sources of information such as site utility drawings, public utility drawings, and construction drawings will be reviewed. If underground obstructions are unexpectedly encountered, the area will be manually excavated until the nature of the obstruction is discerned.

9.13 SITE SAFETY MEETINGS

During field operations, an initial size orientation meeting and daily safety meetings will be held by the SSHO to review and plan specific health and safety aspects of scheduled work. Potential subjects to be discussed are presented here:

1. Preliminary

    - Medical clearances for all on-site personnel
    - Written SSHP availability (copies provided to all participants)
    - Personal protective equipment availability, demonstration and fit testing (if necessary)
    - General construction protocols.

2. Training Topics

    - Delineation of responsibilities of on-site personnel.

- Review of SSHP including:
  - types of hazards;
  - pathways of exposure;
  - levels of protection;
  - contamination avoidance;
  - physical hazards;
  - decontamination;
  - emergency procedures; and,
  - specific on-site area/work tasks of concern

- Decontamination review including:
  - delineation of work zones; and
  - set-up and dry run of decontamination equipment.

- Personnel protective clothing - use and dress out procedures

- Monitoring equipment review

- Questions and answers

- Completion of SSHP Compliance Agreement

9.14 WORK ZONES

To minimize the movement of contaminants from contaminated areas of the SAEP to uncontaminated areas, work zones will be set up. The work zones will include, at a minimum, the following:

Zone 1: Exclusion Zone
Zone 2: Contamination Reduction Zone

Zone 3: Support Zone

The Exclusion Zone is the zone where contamination does or could occur. All persons entering this zone must wear the Level of Protection set forth in Section 8. These levels of protection guidelines are based on the different types of field activities.

Because work at several areas may be performed concurrently, an Exclusion Zone and Contamination Reduction Zone will be established at each area of work. These Contamination Reduction Zones will be in addition to the Contamination Reduction Zone located near the support trailers. All personnel must decontaminate after leaving Exclusion Zones.

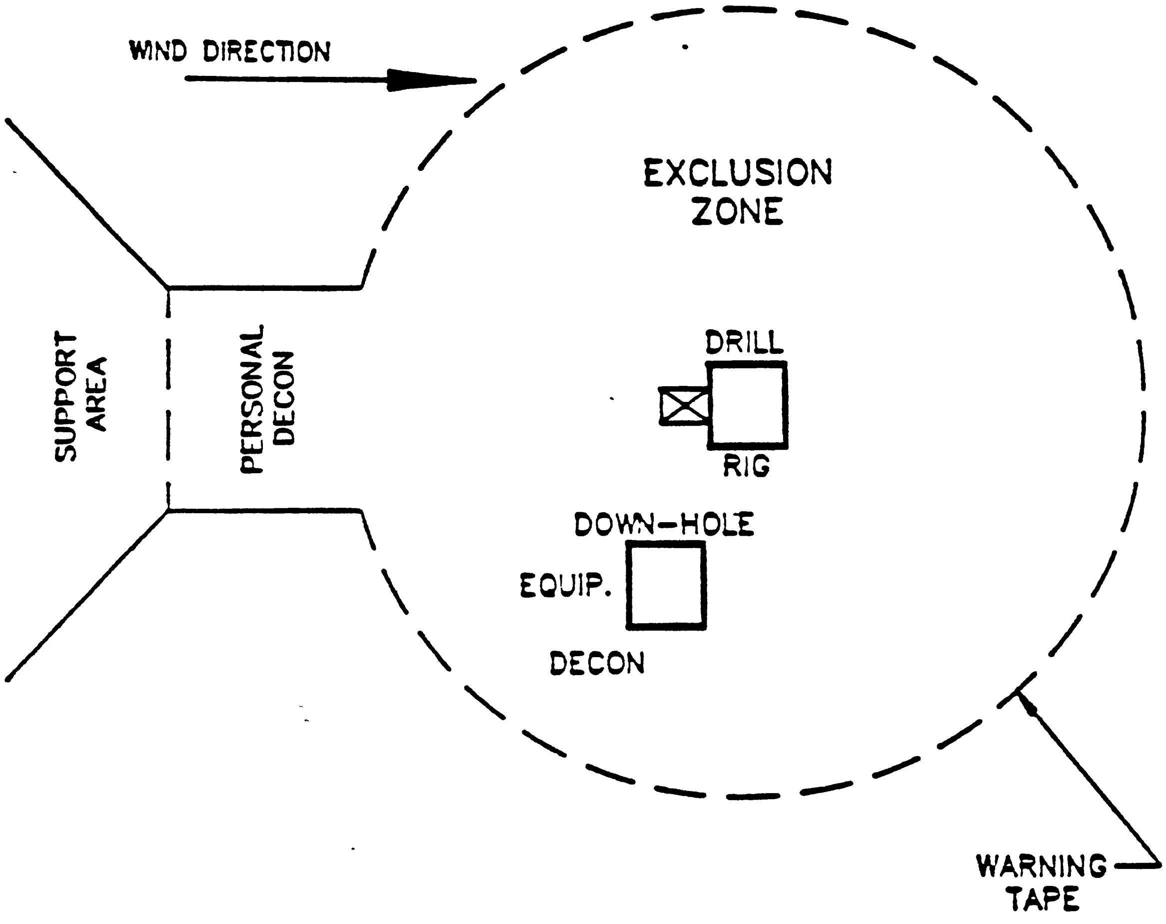
All work zone entrances and exits will be clearly marked or displayed in accordance with the SAEP Requirements and Standard Operating Procedures. Yellow and black striped caution tape will be used to demark the zones. Exclusion Zones will be established using the back of the drilling rig as the center of the zone by delineating a circle (see Figure 9-1). The radius can vary, depending on wind direction and speed, physical obstructions, and the minimum space requirements for safe and effective work. Monitoring equipment will be used to aid in delineating these zones. A wind direction indicator (i.e. wind sock) will be deployed at each work site.

9.15 WORKING FROM BOATS OR NEAR WATER

The following precautions should be taken when working from boats or near water:

- All work in a boat or near the water shall be performed by at least a two-person team. Flotation devices, such as life vests, shall be worn at all times.

- If the work requires reaching, stretching, etc., from the boat or bank, the worker shall be equipped with a harness and lifeline. The lifeline shall be attached to the boat (if boat work) or a sturdy object on the bank (if bank work).



TYPICAL WORK ZONES
AROUND DRILLING OPERATIONS
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

FIGURE 9–1

- The sampling area of the boat shall be lined with plastic to reduce contamination of the boat.

10.0
SITE ACCESS AND SITE CONTROL

10.1 SITE ACCESS

All access to the SAEP must be cleared through the SAEP security and administrative personnel and the USDA.

Access to the SAEP will be limited to authorized personnel. Such personnel may include WCC employees, subcontractors, and designated client, state and federal agencies.

10.2 SITE CONTROL

Certain procedures must be followed to ensure suitable site control and limitation of access so that those persons who may be unaware of site conditions are not exposed to inherent hazards.

All machinery and equipment shall be stored in an on-site area designated by Textron Lycoming's personnel upon completion of daily activities. All potentially contaminated materials, such as bottles, containers and soil will be stored in an on-site area to prevent unauthorized tampering.

Anyone from the general public, Textron Lycoming personnel and/or media requesting information about site activities should be referred to the Site Manager or the SAEP Manager of Communications. Do not give your opinion or information to anyone asking questions about this project.

Communications will be maintained at the SAEP with two-way radios operating on a designated channel whenever work groups are not within a reasonable proximity of each other. The buddy system will be used when working in any Exclusion Zone.

A telephone at the SAEP will be used to communicate with others off-site. All emergency services will be addressed by SAEP's Security Headquarters, Extension 2767. Cellular telephones are not permitted at the SAEP.

10.3 SITE SECURITY

Areas within the SAEP will be provided for the office trailers, parking of drilling equipment and storage of supplies. These areas are surrounded by a chain link fence. Access to these areas is controlled by security guards 24 hours per day.

Controlled access to the site will be established. This controlled access will be through the main access road and the SAEP gates.

Only authorized personnel (Textron Lycoming personnel, USDA personnel and ID visitors (by SAEP security)) shall be permitted to enter the SAEP. No one shall enter the SAEP without appropriate authorization from SAEP's security personnel. All individuals entering the site will sign the daily log and be given SAEP identification (visitors) badges.

All persons entering the sampling areas at the SAEP shall be equipped with appropriate personal protective equipment. Documentation of ability to work on hazardous waste sites, wear respiratory protection, and training must be provided to the SSHO.

All persons entering the sampling areas at the site must be familiar with and abide by the SSHP and the SAEP's HAZCOM Program, Emergency Response Plan and Standard Operating Procedures.

11.0
DECONTAMINATION

11.1 GENERAL INFORMATION

Personnel involved with hazardous substances may be exposed to contaminants in a number of ways, despite the most stringent protective procedures. Personnel may come in contact with vapors, gases, mists, or particulates in the air. Use of monitoring instruments and construction equipment can also result in exposure to hazardous substances. This contamination must be removed before leaving any contaminated area.

In general, decontamination involves scrubbing or spraying with a non-phosphate soap/water solution followed by clean water rinses. All disposable items will be disposed of in a dry container. Certain parts of contaminated respirators, such as harness assemblies, are difficult to decontaminate. These components can be soaked in soap and water and scrubbed with a brush. In addition to being decontaminated, all respirators, non-disposable protective clothing, and other personal articles must be sanitized before they can be used again. The manufacturer's instructions should be followed in sanitizing the respirators. The SSHO will be responsible for ensuring that personal protective equipment is used properly.

It must be understood that the decontamination process is flexible. Changes occur on-site which can easily be overlooked during planning stages. The SSHO should always be prepared to alter (add or delete a step or process) the decontamination sequence or equipment. Extra decontamination equipment (spares) as well as a local supplier should be readily available for items such as brushes, rags, soap, buckets, hoses, etc.

The main thing to remember concerning modification of the decontamination sequence is to <u>thoroughly and safely decontaminate regardless of the changes. Actions must be taken to minimize the contamination in the decontamination zone and eliminate any contamination in the support zone and off-site areas</u>. At all times, minimize contact between potentially contaminated material and clean material (e.g., do not touch yourself without thoroughly washing).

11.2 DECONTAMINATION AREA

A decontamination pad will be set up near the support trailers. This pad will be for decontaminating heavy equipment leaving the SAEP.

Each work zone will also have decontamination facilities. A high-pressure hot water "steam-type" cleaner for cleaning tires and undercarriages of drilling rigs and other vehicles and down-hole equipment will be kept on-site. Personal decontamination equipment will be near each work zone. All field personnel will thoroughly decontaminate before leaving the Contamination Reduction Zone and entering the Support Zone.

All decontamination water will be collected in drums for analysis and appropriate disposal. All used disposable PPE will be placed in heavy gauge plastic bags for proper disposal.

11.3 PERSONAL DECONTAMINATION PROCEDURES

The following steps must be taken for personnel decontamination when leaving Exclusion Zones (subject to modification by SSHO):

- Deposit equipment that needs to be decontaminated on plastic drop cloths.
- Wash boots and outer gloves with long handled brushes in wash tub containing detergent and water.
- Rinse boots and outer gloves with long handled brush in a wash tub containing clean water or use a sprayer to rinse off boots and gloves.
- Rinse suit with portable spray bottle if it is water resistant
- Remove tape and place in plastic bag
- Remove outer gloves and place in plastic bag
- Remove coveralls and place in plastic bag

- When applicable, remove respirator and place in a separate area to be decontaminated
- Remove inner gloves and place in plastic bag
- Wash hands and face

Decontamination procedures to be used in case of an emergency are described in Section 12.

11.4 EQUIPMENT DECONTAMINATION PROCEDURES

11.4.1 Small Sampling Equipment Decontamination

The following steps must be taken for decontaminating small sampling equipment when removing such equipment from the Exclusion Zone (subject to modification by the SSHO):

- After use, small equipment such as that associated with sampling (split tube samplers, trowels, shovels, picks, chisels, hammers, other specific samplers, etc.) will be transported from the Exclusion Zone to the decontamination pad in the adjacent Contamination Reduction Zone.

- Equipment will first be washed with a hot water high-pressure hot water "steam-type" cleaner.

- Equipment will then be scrubbed down with soapy water using brushes and a phosphate-free soap.

- Equipment will then be rinsed, by hose, with water.

- Equipment will then be placed on the plastic sheet covered area on the decontamination pad to air dry.

11.4.2 Large Sampling Equipment Decontamination

The following steps must be taken for decontaminating large sampling equipment when such equipment leaves the Exclusion Zone (subject to modification by the SSHO):

- Large sampling equipment such as drill rigs, hollow-stem augers, etc., shall be driven or carted from the Exclusion Zone to the decontamination pad.
- Equipment will first be washed with a high-pressure hot water "steam-type" cleaner.
- Equipment will then be scrubbed down with soapy water using brushes and a phosphate-free soap.
- Equipment will then be rinsed, by hose, with water.
- Equipment will then be placed on the plastic sheet covered area on the decontamination pad to air dry.

11.4.3 Respirator Care, Maintenance and Storage

Respirator care, maintenance and storage are discussed in Attachment 12.

12.0
EMERGENCY PROCEDURES

12.1 GENERAL

The purpose of this section of SSHP is to address how site personnel will respond to emergencies. The types of potential emergencies that are addressed by this SSHP include:

- Fire and explosion
- Medical (chemical exposures and physical injuries)
- Chemical spills

It is policy at the SAEP that:

- Industrial Security and Loss Control Department Personnel will respond to all emergency situations.

- Qualified professional medical personnel will be on duty in the Medical Department from 0700 to 2330 hours, Monday through Friday. Medical Department personnel will respond to an accident scene involving injury or illness to personnel upon notification from Security Headquarters.

- In instances when the Medical Department is closed, the Security Department will assume the First Aid responsibility for the affected personnel.

- Plant Engineering, Maintenance and Environmental Personnel will respond to accident scenes, and/or chemical spill/release scenes when notified by Security Headquarters.

- Emergency Medical Technicians (EMTs) will respond to an accident scene involving personnel injury or illness when notified by Security Headquarters.

12.2 EMERGENCY RECOGNITION AND PREVENTION

12.2.1 Fires and Explosion

Fires and explosions are possible whenever flammable gases, vapors, or contaminants are present in proper concentrations and an ignition source is present. While flammable gases or vapors are not expected to be a concern during the activities covered by this SSHP, there is need to protect against potential explosive situations. A CGI will be on-site for monitoring any activity that may lead to the release of explosive gases or vapors. This is especially relevant when drilling.

12.2.2 Medical

12.2.2.1 Chemical Exposure

Work will be performed in such a manner that exposure to contaminants through skin or eye contact, inhalation or ingestion is minimized. Work practices that will be followed to reduce chemical exposures include:

- PPE, as specified in Section 8, for the appropriate work activities and areas as defined by the SSHO, will be used by all personnel. A formal revision to the SSHP must be made by the New York Metro BUHSO in order to modify the PPE requirements.
- Keep hands away from face during work activities.
- Minimize all skin and eye contact with contaminants.

Early recognition of chemical exposure symptoms is essential to the prevention of serious chemical exposure incidents. Symptoms of exposure to the type of compounds potentially present at the SAEP include the following: fatigue, weakness; eye, nose, throat irritation; headache; dizziness; nausea; vomiting; malaise; tremors; aggressive confusion; cyanosis (blue color to skin); anemia; and muscle spasms.

If a person experiences any of these symptoms, or others recognize any of the symptoms in a fellow worker, the person experiencing the symptoms will stop work and report his or her symptoms to the SSHO. All work shall stop. The SSHO shall increase monitoring and make a decision whether upgrading will be necessary. If the symptoms persist or appear to be damaging in any way, the SSHO will make arrangements to take the individual to a hospital for medical treatment. If symptoms are serious, work activities in the area where the person was exposed will be discontinued until more is known about the incident. Incident reporting procedures as specified in Section 9.3 will be initiated.

12.2.2.2 Physical Injury

Site personnel should constantly look for potential safety hazards such as holes or ditches; precariously positioned objects, such as drums, on-site tires, or equipment that may fall; sharp objects, such as nails, metal shards, and broken glass; protruding objects at eye or head level; slippery surfaces; steep grades; uneven terrain or unstable surfaces. Site personnel should inform the SSHO of any potential hazards identified so that mitigative action can be taken.

12.3 EMERGENCY ALERTING PROCEDURES

The SSHO will alert the appropriate work groups when and if an emergency occurs relating to the site investigation activities through the use of radios or by directly contacting the work group. The SSHO and any isolated work group will carry radios if reasonable contact cannot be maintained. If radios fail, repeated short blasts from an alarm horn will be used to signal workers to stop work and assemble in the Contamination Reduction Zone. Workers will become familiar with emergency hand signals during the site briefing.

12.4 EMERGENCY NOTIFICATION PROCEDURES

All Emergency Calls will be directed to Security Headquarters, Extension 2SOS (2767). Upon receipt of an emergency notification call, the Security Officer will request the following information:

1. Type of Accident/Illness/Emergency.
2. Specific Location of the Patient/Incident, (By Column Number, Floor, Building Number and Telephone Extension).
3. Description of the emergency and circumstances of illness/injury.
4. Name of the Caller.

Upon receipt of an Alarm Signal, the Security Officer will dispatch/notify the appropriate personnel to respond to the incident as indicated.

Written record (documentation) of all incidents shall be prepared by Security Headquarters and copies distributed to the Loss Control and other departments as applicable.

Table 12-1 presents a Summary of Emergency Telephone Numbers.

12.5 EMERGENCY RESPONSE PROCEDURES

The following procedures will be followed in the notification of accidents, illnesses, fire conditions, chemical spills, natural disasters, etc., which occur at the SAEP.

12.5.1 Medical

- Security Headquarters will contact the Medical Department by direct phone and will contact the EMT Captain for that Zone via radio. Information will include the nature of the incident and location.

TABLE 12-1

EMERGENCY TELEPHONE NUMBERS
STRATFORD ARMY ENGINE PLANT

SAEP Security Headquarters	2SOS
Barnert Memorial Hospital Center (Dr. Cronin/Dr. Wilkenfeld)	(201) 977-6764
Poison Control Center	(800) 962-1253
WCC Wayne Office	(201) 785-0700
WCC Plymouth Meeting Office	(215) 825-3000

- Based upon the Medical Department's or EMT's evaluation of the injured, the Emergency Medical Service (EMS) will be contacted by phone (911) by Security Headquarters.

- Medical Department personnel may request/require transportation to the injury scene. If transportation is required, a Security Officer will respond with vehicle.

- Security, Fire, Safety and Medical personnel will be notified, according to need, and will form the Response Team.

- The Duty Lieutenant will remain in the Security Control Center to act as coordinator and maintain a level of continuity. A Security or Safety Supervisor will act as "Incident Commander" at the scene during normal duty hours. After hours, the Duty Lieutenant will perform "Incident Commander" responsibilities while a fellow Security Officer remains in the Security Control Center to coordinate communications, etc.

- At the scene, the "Incident Commander" will assume responsibility for the direction and coordination of all necessary actions and support personnel. The Incident Commander will then notify Security Headquarters of the actual situation (via radio). If EMS is required, the Duty Officer will initiate the phone call, and give EMS all of the necessary information, i.e., which gate to respond to, nature of the injury/illness, etc.

- Should EMS be required, the Duty Lieutenant will be responsible to dispatch Security Officers to meet the EMS at the gate and direct them to the scene.

- Should the on-scene situation be of sufficient magnitude (multiple injuries/illnesses), with the concurrence of on-scene medical personnel, additional Textron EMT Personnel would be called from adjacent zones to assist.

- EMS will assume Medical Control for the injured upon arrival. The Incident Commander/Duty Lieutenant/Medical Representative (as applicable) will advise the EMS representative of the circumstances and the nature of illness/injury along with current medical status.

- The Incident Commander or Medical Representative will secure the injured's identification badge prior to transportation with EMS. A report shall be forwarded to the Medical Department on the appropriate form (AL734).

- All information pertaining to the emergency will be recorded in the Daily Health and Safety Summary Report and the Incident Report.

12.5.2 Fire

- The Duty Lieutenant upon receipt of a Fire Alarm notification call or alarm will immediately dispatch a Security Officer to the scene. A Security or Safety Supervisor will also be notified for the purpose of performing as Incident Commander if required.

- Fire Protection Specialists will be directed to the fire location via radio communications.

- Fire Squad members for the Emergency Zone where the fire alarm was reported will also be notified via the EMT radio system to report to the location.

- Based on on-scene situation reports received from the Security Officer or Fire Protection Specialist sent to the reported location - the Duty Lieutenant will determine whether the fire is in the incipient stage or larger.

- Incipient stage fires will be controlled and extinguished by in-plant resources.

- In the event the incipient stage fire intensifies or the actual fire is of greater intensity than can be handled internally - the Duty Lieutenant will immediately notify the Stratford Fire Department.

- The Duty Lieutenant will advise the Stratford Fire Department of the location, intensity and point of entry to the plant, etc.

- A Security Officer will be dispatched to the plant perimeter entrance that the responding equipment will use to direct them to the fire location.

- The Duty Lieutenant will activate the Fire Alarm in the affected Emergency Zone where the fire is located, and also provide voice evacuation directions to the employees working in the Zone.

- Security Officers and Fire Squad members will provide area control and evacuation duties as required.

- The Duty Lieutenant will notify Plant Engineering and Plant Maintenance representatives to remove electrical power, provide ventilation fans, other equipment or cleanup as required.

- When the Duty Lieutenant/Incident Commander have determined that the danger is no longer present and the fire has been extinguished, will direct employees to return to work and will notify senior management of the details.

- An Incident Report will be prepared which summarizes the event and the actions taken to neutralize the fire.

12.5.3 Chemical Spill

- The Duty Lieutenant, when notified that a chemical spill has occurred on plant property, will request the following information:

(1) Description of the emergency.
(2) Extent of injuries/exposure.
(3) Name of chemical involved and quantity spilled.
(4) Location of the spill.
(5) Name of the Caller.

- Upon receipt of the above information, the Duty Lieutenant will dispatch a Security Officer, Fire Prevention Specialist, Safety Specialist and Environmental Engineer to the scene.

- The Duty Lieutenant will immediately contact the Primary and Alternate Emergency Coordinator for Chemical Spills.

- All visitors or workers not engaged in cleanup of the chemical spill will be evacuated immediately.

- The Emergency Coordinator will identify the severity of the incident and determine if the Emergency Response Plant and emergency evacuation procedures need to be implemented.

- The Emergency Coordinator will identify the chemicals or hazardous wastes involved, the origin of the problem, the amount of materials involved, and the proximity of other material or wastes. He or she should assess possible hazards to human health or the environment that may occur.

- The Emergency Coordinator will indicate the appropriate protective clothing and breathing apparatus, the use of materials and equipment which are appropriate for the characteristics of the hazardous release.

- If the chemical spill can be handled by in-plant resources then routine clean-up procedures will be followed.

- The Duty Lieutenant will provide support to the Emergency Coordinator as requested.

- Plant Maintenance and Engineering representatives will be notified to provide logistics support, clean-up and repair (if required) to the spill scene.

12.6 EMERGENCY RESPONSE PERSONNEL

The SSHO will have the primary role in responding to all WCC on-site emergencies. All site personnel will contact the SSHO in case of emergency. The SSHO, or designee, must be present on-site during all site work. If reasonable contact cannot be maintained, the SSHO will carry a two-way radio and the work group will also have a two-way radio. If any emergency such as a fire, chemical exposure, or physical injury occurs, the SSHO will be immediately contacted. The SSHO and any designees performing in this capacity will have current certification in First Aid and Cardiopulmonary Resuscitation (CPR). All WCC site personnel will take direction from the SSHO and all SAEP emergency response personnel in cases of emergency response. If the SSHO or designee is not present, the Site Manager will respond to emergencies. Coordination with the SAEP Manager of Health, Safety and Loss Control will be made before work recommences.

12.7 EMERGENCY DECONTAMINATION PROCEDURES

Decontamination of an injured or exposed worker will be performed only if decontamination does not interfere with essential treatment.

If decontamination can be done: wash, rinse, and/or cut off protective clothing and equipment.

If decontamination cannot be done:

- Wrap the victim in blankets, plastic or rubber to reduce contamination of other personnel

- Alert emergency and off-site medical personnel to potential contamination
- The SSHO or other personnel familiar with the incident and site contaminants will accompany the victim to the hospital

12.8 PHYSICAL INJURIES

On-site First Aid or CPR may be administered by the SSHO and/or other personnel who have been appropriately certified. General medical treatment procedures include:

- Remove the injured or exposed person(s) from immediate danger.
- Render First Aid, if necessary, and decontaminate affected personnel, if necessary.
- Evacuate other personnel in the work area on-site to a safe place until the Site Manager (assisted by the SSHO) determines that it is safe for work to resume.

Additional information on Emergency First Aid Procedures is presented in Attachment 15. Charts providing information on medical procedures for artificial respiration, choking and emergency first aid are presented in Attachment 16.

13.1 PROJECT PERSONNEL

WCC personnel authorized to enter the site and work on this project subject to compliance with provisions of the SSHP are:

Project Manager	Marion E. Craig
Site Safety and Health Officer	Marc E. Jacobson
Alternate Site Safety and Health Officer	Mary E.P. Dombrowski
New York Metro Business Unit Health and Safety Officer	Erick Sepulveda
Corporate Health and Safety Administrator	Phillip L. Jones
Eastern Operating Group Corporate Health and Safety Officer	Martin G. Kemplin

13.2 PROJECT SAFETY PERSONNEL

Personnel responsible for implementing this SSHP are the Project Manager and the SSHO. Their specific responsibilities and authority are described in WCC's Health and Safety Manual (November, 1990).

14.0
SITE SAFETY AND HEALTH PLAN APPROVALS

Marion Craig

Marion E. Craig
Project Manager

1/31/92
Date

Erick

Erick Sepulveda
New York Metro Business Unit
Health and Safety Officer

1/31/92
Date

Phillip L Jones

Phillip L. Jones
WCC Corporate Health and Safety Administrator

1/30/92
Date

ATTACHMENTS

ATTACHMENT 1
TICKS AND TICK-BORNE DISEASES

ATTACHMENT 1
TICKS AND TICK-BORNE DISEASES

Field personnel should be aware of an increased occurrence of tick-borne disease in the United States. In the northeast, the most likely carriers are the white-footed mouse and the white-tailed deer. These animals are most prevalent in areas where suburban environments abut open fields or woodlands. Although exposure is increased in these areas, other carriers, such as dogs and horses, can be found in a variety of environments.

All field personnel should take proper precautions to limit exposure to ticks and tick-borne diseases. These include:

Cinching and taping clothing at the ankles and wrists, especially the ankles. Ticks lie low on grass blades and shrubs. They encounter your feet, ankles or lower legs and then crawl upward. When checking for ticks, pay special attention to the neck, groin, arm pits and scalp.

Wear light-colored clothing to facilitate spotting the ticks, and check your clothing periodically. Be especially careful in terrain with tall grass, bushes or woods.

Use a tick repellant on skin or clothing. Always read the labels before using. Clothing repellents should never be used on the skin.

Recognize the signs of a bite or an infection. It takes several hours for a tick to attach and feed; removing it promptly lessens the chance of being infected.

Seal field clothes in plastic bags until cleaned. Do not take them into the house as a tick may be attached.

Pregnant women should be particularly careful since the effects of the most common tick-borne disease in the northeast, Lyme disease, upon the fetus is unknown.

If a tick is discovered on the skin, it is important to remove the entire insect as soon as possible. The most effective method is to grasp the tick as close as possible to the mouth with tweezers or thin, curved forceps. Then, without jerking, pull it upward steadily (a small amount of skin may be removed in the process).

After removing the tick, disinfect the bite with rubbing alcohol or povidone iodine (Betadine). Don't handle the tick; spirochetes could enter the body through breaks in the skin. Dispose of it in alcohol or flush it down the drain. And check the bite occasionally for at least two weeks to see if a rash forms. If it does, you've been infected and should seek treatment promptly.

The rash appears at the bite location from two days to a few weeks after the bite. It usually starts as a small red spot that expands as the spirochetes spread beyond the bite. Most commonly, the rash develops into a reddish circle or oval about two to three inches in diameter. It fades with or without treatment after a few weeks.

Much larger rashes - anywhere from 6 to 20 inches in diameters - may also occur, especially on the back. Despite their size, large rashes may be easy to miss because they're often very faint.

Other variants include a rash with a red perimeter and a clear center and the so-called bull's-eye rash, which consists of several concentric red rings. Rashes may vary in shape, depending on where they occur on the body. Frequent sites are the thigh, groin, and armpits. People often develop a rash in more than one place.

Early symptoms may include profound fatigue, a stiff neck, and flu-like symptoms such as headache, chills, fever, and muscle aches. Since tick bites don't always produce a rash, those symptoms alone may warrant a medical check for possible Lyme infection - especially if they occur in summer and you live in an area that is endemic for Lyme disease.

Without treatment, the spirochetes usually multiply and the disease progressively worsens. The second stage, occurring within weeks to months of the bite, may affect the heart and nervous system. Third is the chronic arthritic stage, which begins up to a year or more after the bite.

ATTACHMENT 2

SAFETY GUIDELINES FOR DRILLING

SAFETY GUIDELINES FOR DRILLING

Drill rig maintenance and safety is the responsibility of the drill rig operator. The following is provided as a general guideline for safe drilling practices on-site.

OFF-ROAD MOVEMENT OF DRILL RIGS

The following safety guidelines related to off-road movement:

- Before moving a drill rig, first walk the route of travel, inspecting for depressions, slumps, gulleys, ruts and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven or hilly ground.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4x4, 6x6, etc., vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill.
- Attempt to cross obstacles such as small logs and small erosion channel or ditches squarely, not at an angle.
- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.
- After the drill rig has been moved to a new drilling site, set all brakes and/or locks. When grades are steep, block the wheels.

- Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.

- Tie down loads on the drill rig and support trucks during transport.

OVERHEAD AND BURIED UTILITIES

The use of a drill rig near electrical power lines and other utilities requires that special precautions be taken by both supervisors and members of the exploration crew. electricity can shock, it can burn, and it can cause death.

Overhead and buried utilities should be located, noted and emphasized on all boring location plans and boring assignment sheets.

Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest power line will be when the mast is raised and/or being raised. Do not raise the mast or operate the drill rig if this distance is less than 20 feet. In general, the distance between the overhead power line and the boom should be no less than the height of the boom.

Keep in mind that both hoist and overhead power lines can be moved toward each other by the wind.

Drilling personnel should double-check any side underground electrical and piping drawings prior to initiating drilling. If an obstruction is encountered during drilling, proceed with extreme caution until the possibility of an exposed electrical line or combustible product pipeline is excluded.

CLEARING THE WORK AREA

Prior to drilling, adequate site cleaning and leveling should be performed to accommodate the drill rig and supplies and provide a safe working area. Drilling should not be commenced when tree limbs, protruding objects, unstable ground or site obstructions or debris cause unsafe tool handling conditions and/or limited, awkward work spaces. An area clear of obstructions or debris should be maintained 180 degrees around the drilling or sampling activities, where practical.

NOTE: In coordination with the Drilling Crew, the Site Safety Officer will review the precautions taken to insure that the drill rig is leveled and stabilized.

HOUSEKEEPING ON AND AROUND THE DRILL RIG

The first requirement for safe field operations is that the drilling crew safety supervisor understands and fulfills the responsibility for maintenance and "housekeeping" on and the drill rig.

Suitable storage locations should be provided for all tools, materials and supplies so that they can be conveniently and safety handled without hitting or falling on a member of the drill crew or a visitor, without creating tripping hazards, and without protruding at eye or head level.

Avoid storing or transporting tools, materials or supplies within or on the mast (derrick) of the drill rig.

Pipe, drill rods, bit casings, augers and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling or sliding.

Penetration of other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.

Work areas, platforms, walkways, scaffolding and other accessways should be kept free of materials, obstructions and substances such as ice, excess grease or oil that could cause a surface to become slick or otherwise hazardous.

Keep all controls, control linkages, warning and operation lights and lenses free of oil, grease and/or ice.

Do not store gasoline in any portable container other than a non-sparking, red container with a flame arrester in the fill spout and having the word "gasoline" easily visible.

Welding gas cylinders should be stored in an upright position to avoid gas leaks.

SAFE USE OF HAND TOOLS

There are almost an infinite number of hand tools that can be used on or around a drill rig. "Use the tool for its intended purpose" is the most important rule. The following are a few specific and some general suggestions which apply to safe use of several hand tools that are often used on and around drill rigs.

- When a tool becomes damaged, either repair it before using it again or get rid of it.
- When using a hammer, any kind of hammer, for any purpose, wear safety glasses and require all others near you to wear safety glasses.
- When using a chisel, any kind of chisel, for any purpose, wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and orderly stored when not in use.
- Replace hook and heel jaws when they become visibly worn.

- When breaking tool joints on the ground or on a drilling platform, position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

SAFE USE OF WIRE LINE HOISTS, WIRE ROPE AND HOISTING HARDWARE

The use of wire line hoists, wire rope and hoisting hardware should be as stipulated by the American Iron and Steel Institute's Wire Rope Users Manual.

All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for: abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper weaving, jamming, crushing, bird caging, kinking, core protrusion and damage to lifting hardware and any other feature that would lead to failure. Wire ropes should be replaced when inspection indicates excessive damage according to the wire rope users manual.

If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to assure that the swivel freely rotates under load.

If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1-foot (0.3 m) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints and do not make up, tighten or loosen tool joints while the rod column is being supported by a slipping device. If drill rods should slip back into the borehole, do not attempt to brake the fall of the rods with your hands.

Most sheaves on drill rigs are stationary with a single part line. The number of parts of line should not ever be increased without first consulting with the manufacturer of the drill rig. Wire ropes must be properly matched with each sheave.

The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware.

Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool handling hoists to pull on objects away from the drill rig; however, drills may be moved using the main hoist as the wire rope is pulled through proper sheaves according to the manufacturer's recommendations.

When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanisms of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanisms of the drill.

When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch or the front or rear of the vehicle or drill rig carrier and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.

Minimize shock loading of a wire rope - apply loads smoothly and steadily.

- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.
- Replace worn sheaves or worn sheave bearings.
- Replace damaged safety latches on safety hooks before using.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Clutches and brakes of hoists should be periodically inspected and tested.

- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles and other lifting aids.

- Always wear gloves when handling wire ropes.

- Do not guide wire ropes or hoist drums with your hands.

- Follow the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.

- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or property are created.

- Never leave a load suspended in the air when the hoist is unattended.

- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up and when the load is being hoisted.

- Safety rules described in OSHA Regulations 29 CFR 1926.552 and guidelines contained in the Wire Rope User's Manual published by the American Iron and Steel Institute shall be used whenever wire line hoists, wire rope, or hoisting hardware are used.

- Never hoist loads over anyone's head.

- The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must insure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.

- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench or any other tool during rotation.

- Whenever possible, use tool hoists to handle auger sections.

- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.

- Never allow feet to get under the auger section that is being hoisted.

- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatsoever.

- Never place your hands between the drill rig and an auger, even when attempting to free a damaged or bound Shelby tube from the auger.

- Never use your hands or feet to move cuttings away from the auger.

- Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

SAFETY DURING ROTARY AND CORE DRILLING

Rotary drilling tools should be safety checked prior to drilling:

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.

- Drill rod chuck jaws should be checked periodically and replaced when necessary.

- The capacities of hoists and sheaves should be checked against the anticipated weight of the drill rod string plus other expected hoisting loads. All cables should be inspected daily.

Special precautions that should be taken for safety rotary or core drilling involve chucking, joint break, hoisting and lowering of drill rods:

- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws.
- Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- In the event of a plugged bit or other circulations blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.
- If work must progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with a rough surface, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

- All hydraulic lines should be periodically inspected for integrity and replaced as needed.

START UP

All drill rig personnel and visitors should be instructed to "stand clear" of the drill rig immediately prior to and during starting of an engine.

Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct non-actuating positions and the cathead rope is not on the cathead before starting a drill rig engine.

GENERAL SAFETY DURING DRILLING OPERATIONS

Safety requires the attention and cooperation of every worker and site visitor.

Do not drive the drill rig from hole to hole with the mast (derrick) in the raised position.

Before raising the mast (derrick) look up to check for overhead obstructions. (Refer to previous Section on overhead and buried utilities).

Before raising the mast (derrick), all drill rig personnel and visitors (with exception of the operator) should be cleared from the areas immediately to the rear and the sides of the mast. All drill rig personnel and visitors should be informed that the mast is being raised prior to raising it.

Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig must be first leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be re-leveled if it settles after initial set up. Lower the mast (derrick) only when leveling jacks are down and do not raise the leveling jack pads until the mast (derrick) is lowered completely.

Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.

The operator of a drill rig should only operate a drill rig from the position of the controls. The operator should shut down the drill engine before leaving the vicinity of the drill rig.

Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.

Watch for slippery ground when mounting and dismounting from the platform.

All unattended boreholes must be adequately covered or otherwise protected to prevent drill rig personnel, site visitors or animals from stepping or falling into the hole. All open boreholes should be covered, protected or backfilled adequately and according to local or state regulations on completion of the drilling project.

"Horsing around" within the vicinity of the drill rig and tool and supply storage areas should never be allowed, even when the drill rig is shut down.

Be careful when lifting heavy objects. Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not the muscles in your lower back.

Drilling operations should be terminated during an electrical storm.

The minimum number of personnel necessary to achieve the objectives shall be within 25 feet of the drilling or sampling activity. Back-up personnel should remain at least 25 feet from the drilling or sampling activity, where practical.

Hardhats and steel boots are to be worn by all personnel in the vicinity of the drilling activities. Drilling personnel should not wear loose-fitting or baggy clothing which may be awkward or get caught on equipment. Jewelry, including rings and necklaces, should not be worn around electrical wires or rotating equipment.

ATTACHMENT 3
HEAT STRESS

HEAT STRESS PLAN
(IF NOT WEARING IMPERVIOUS FULL-BODY CLOTHING)

HEAT STRESS

Note: Materials on the Notice of Intended Changes have been incorporated into the text and are indicated by a † preceding the revision/addition and by a vertical rule in the margin.

The heat stress TLVs specified in Table 1 and Figure 1 refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. These TLVs are based on the assumption that nearly all acclimatized, fully clothed (e.g , lightweight pants and shirt) workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C (100.4°F).

Since measurement of deep body temperature is impractical for monitoring the workers' heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological responses to heat. At the present time, the Wet Bulb Globe Temperature Index (WBGT) is the simplest and most suitable technique to measure the environmental factors. WBGT values are calculated by the following equations.

1. Outdoors with solar load:
   WBGT = 0.7 NWB + 0.2 GT + 0.1 DB
2. Indoors or Outdoors with no solar load:
   WBGT = 0.7 NWB + 0.3 GT

where.

WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer.

Higher heat exposures than those shown in Table 1 and Figure 1 are permissible if the workers have been undergoing medical surveillance and it has been established that they are more tolerant to work in heat than the average worker. Workers should not be permitted to continue their work when their deep body temperature exceeds 38°C (100.4°F).

Evaluation and Control

I. *Measurement of the Environment*

The instruments required are a dry-bulb, a natural wet-bulb, a globe thermometer, and a stand The measurement of the environmental factors should be performed as follows:

A. The range of the dry and the natural wet bulb thermometer should be -5°C to +50°C (23°F to 122°F) with an accuracy of ± 0.5°C. The dry bulb thermometer must be shielded from the sun and the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet-bulb thermometer should be kept wet with distilled water for at least 1/2 hour before the temperature reading is made. It is not enough to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillarity. The wick should be wetted by direct application of water from a syringe 1/2 hour before each reading The wick should extend over the bulb of the thermometer, covering the stem about one additional bulb length. The wick should always be clean and new wicks should be washed before using.

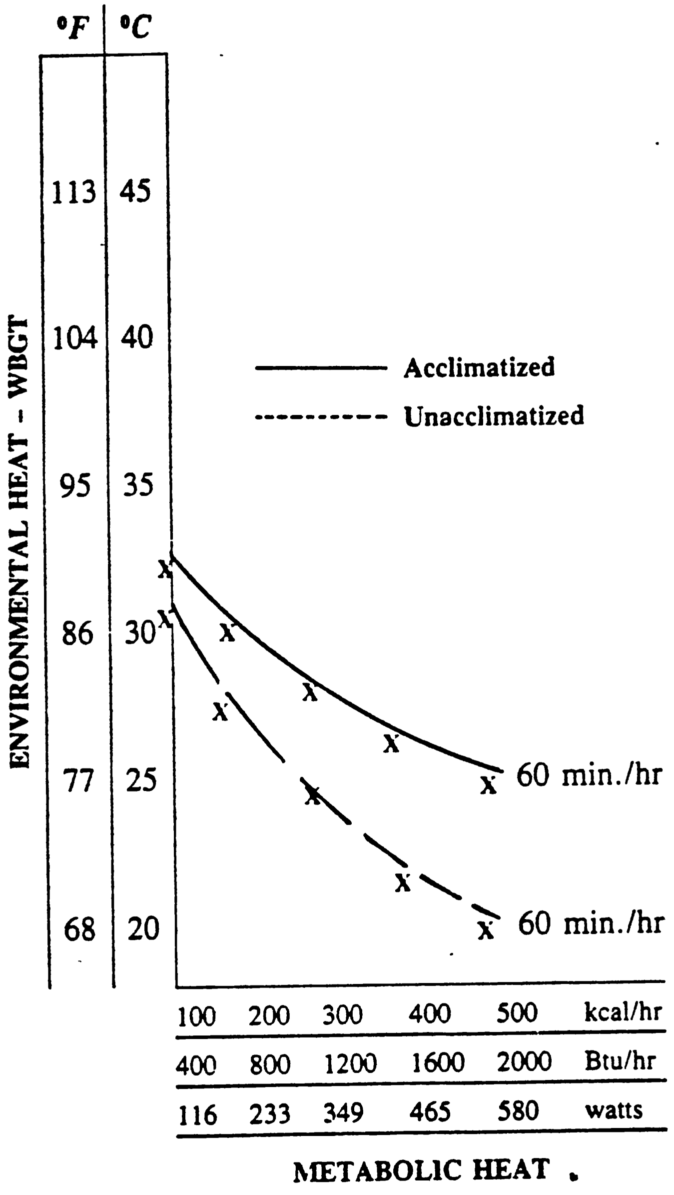
B. A globe thermometer, consisting of a 15-cm (6-inch) diameter hollow copper sphere painted on the outside with a matte black finish or equivalent, should be used The bulb or sensor of a thermometer (range -5°C to +100°C [23°F to 212°F] with an accuracy of ± 0.5°C) must be fixed in the center of the sphere. The globe thermometer should be exposed at least 25 minutes before it is read.

C. A stand should be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs, and the wet-bulb and globe thermometer are not shaded.

D. It is permissible to use any other type of temperature sensor that gives a reading identical to that of a mercury thermometer under the same conditions

TABLE 1. Permissible Heat Exposure Threshold Limit Values [Values are given in °C and (°F) WBGT]

	Work Load		
Work—Rest Regimen	Light	Moderate	Heavy
Continuous work	30.0 (86)	26.7 (80)	25.0 (77)
75% Work — 25% Rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% Work — 50% Rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% Work — 75% Rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)



†Figure 1—Permissible heat exposure Threshold Limit Values for heat acclimatized and unacclimatized workers.

E. The thermometers must be placed so that the readings are representative of the conditions under which the employees work or rest, respectively.

II. *Work Load Categories*

Heat produced by the body and the environmental heat together determine the total heat load Therefore, if work is to be performed under hot environmental conditions, the workload category of each job should be established and the heat exposure limit pertinent to the workload evaluated against the applicable standard in order to protect the worker exposure beyond the permissible limit.

A. The work load category may be established by ranking each job into light, medium, or heavy categories on the basis of type of operation:

(1) light work (up to 200 kcal/hr or 800 Btu/hr). e.g., sitting or standing to control machines, performing light hand or arm work,

(2) moderate work (200–350 kcal/hr or 800–1400 Btu/hr): e.g., walking about with moderate lifting and pushing, or

(3) heavy work (350–500 kcal/hr or 1400–2000 Btu/hr): e.g., pick and shovel work.

Where the work load is ranked into one of said three categories, the permissible heat exposure TLV for each workload can be estimated from Table 1 or calculated using Tables 2 and 3.

B. The ranking of the job may be performed either by measuring the worker's metabolic rate while performing a job or by estimating the worker's metabolic rate with the use of Tables 2 and 3. Additional tables available in the literature(1–4) may be utilized also. When this method is used, the permissible heat exposure TLV can be determined by Figure 1.

III. *Work-Rest Regimen*

The TLVs specified in Table 1 and Figure 1 are based on the assumption that the WBGT value of the resting place is the same or very close to that of the workplace. Where the WBGT of the work area is different from that of the rest area, a time-weighted average value should be used for both environmental and metabolic heat.

The time-weighted average metabolic rate (M) should be determined by the equation:

$$\text{Av. M} = \frac{M_1 \times t_1 + M_2 \times t_2 + \ldots + M_n \times t_n}{t_1 + t_2 + \ldots + t_n}$$

where M_1, M_2...and M_n are estimated or measured metabolic rates for the various activities and rest periods of the worker during the time periods t_1, t_2...and t_n (in minutes) as determined by

TABLE 2. Assessment of Work Load

Average values of metabolic rate during different activities.

A. Body position and movement	**kcal/min**
Sitting	0.3
Standing	0.6
Walking	2.0-3.0
Walking up hill	add 0.8 per meter (yard) rise

B. Type of Work		**Average kcal/min**	**Range kcal/min**
Hand work	*light*	0.4	0.2-1.2
	heavy	0.9	
Work with one arm	*light*	1.0	0.7-2.5
	heavy	1.7	
Work with both arms	*light*	1.5	1.0-3.5
	heavy	2.5	
Work with body	*light*	3.5	2.5-15.0
	moderate	5.0	
	heavy	7.0	
	very heavy	9.0	

TABLE 3. Activity Examples

- Light hand work: writing, hand knitting
- Heavy hand work: typewriting
- Heavy work with one arm: hammering in nails (shoemaker, upholsterer)
- Light work with two arms: filing metal, planing wood, raking of a garden
- Moderate work with the body: cleaning a floor, beating a carpet
- Heavy work with the body: railroad track laying, digging, barking trees

Sample Calculation

Assembly line work using a heavy hand tool.

A.	Walking along	2.0 kcal/min
B.	Intermediate value between heavy work with two arms and light work with the body	3.0 kcal/min
	Subtotal:	5.0 kcal/min
C.	Add for basal metabolism	1.0 kcal/min
	Total:	6.0 kcal/min

a time study

The time-weighted average WBGT should be determined by the equation

$$\text{Av. WGBT} = \frac{\text{WBGT}_1 \times t_1 + \text{WBGT}_2 \times t_2 + \ldots + \text{WBGT}_n \times t_n}{t_1 + t_2 + \ldots + t_n}$$

where WBGT_1, WBGT_2 ... and WBGT_n are calculated values of WBGT for the various work and rest areas occupied during total time periods; t_1, t_2 ... and t_n are the elapsed times in minutes spent in the corresponding areas which are determined by a time study Where exposure to hot environmental conditions is continuous for several hours or the entire work day, the time-weighted averages should be calculated as an hourly time-weighted average, i.e., $t_1 + t_2 + \ldots t_n = 60$ minutes Where the exposure is intermittent, the time-weighted averages should be calculated as two-hour time-weighted averages, i.e., $t_1 + t_2 + \ldots + t_n = 120$ minutes.

The TLVs for continuous work are applicable where there is a work–rest regimen of a 5-day work week and an 8-hour work day with a short morning and afternoon break (approximately 15 minutes) and a longer lunch break (approximately 30 minutes) Higher exposure values are permitted if additional resting time is allowed. All breaks, including unscheduled pauses and administrative or operational waiting periods during work, may be counted as rest time when additional rest allowance must be given because of high environmental temperatures.

IV. *Water and Salt Supplementation*

During the hot season or when the worker is exposed to artificially generated heat, drinking water should be made available to the workers in such a way that they are stimulated to frequently drink small amounts, i.e., one cup every 15–20 minutes (about 150 ml or 1/4 pint).

The water should be kept reasonably cool, 10°C to 15°C (50°F to 60°F) and should be placed close to the workplace so that the worker can reach it without abandoning the work area.

The workers should be encouraged to salt their food abundantly during the hot season and particularly during hot spells. If the workers are unacclimatized, salted drinking water should be made available in a concentration of 0.1% (1 g NaCl to 1.0 liter or 1 level tablespoon of salt to 15 quarts of water). The added salt should be completely dissolved before the water is distributed, and the water should be kept reasonably cool.

V. *Other Considerations*

A. *Clothing:* The permissible heat exposure TLVs are valid for light summer clothing as customarily worn by workers when working under hot environmental conditions. If special clothing is required for performing a particular job and this clothing is heavier or it impedes sweat evaporation or has higher insulation value, the worker's heat tolerance is reduced, and the permissible heat exposure TLVs indicated in Table 1 and Figure 1 are not applicable. For each job category where special clothing is required, the permissible heat exposure TLV should be established by an expert.

†Table 4 identifies TLV WBGT correction factors for representative types of clothing.

B. *Acclimatization and Fitness:* Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during the first week of exposure to hot environmental conditions. The recommended heat stress TLVs are valid for acclimated workers who are physically fit. Extra caution must be employed when unacclimated or physically unfit workers must be exposed to heat stress conditions.

†TABLE 4. TLV WBGT Correction Factors for Clothing

Clothing Type	Clo Value*	WBGT Correction
Summer work uniform	0.6	0
Cotton coveralls	1.0	-2
Winter work uniform	1.4	-4
Gortex® (water barrier)	1.2	-6
Tyvek® (vapor barrier) (fully encapsulating suit, gloves, boots & hood)	1.2	-10

*Clo. Insulation value of clothing One clo unit = 5.55 kcal/m²/hr of heat exchange by radiation and convection for each °C of temperature difference between the skin and adjusted dry bulb temperature.

†C. *Adverse Health Effects:* The most serious of heat-induced illnesses is heat stroke because of its potential to be life threatening or result in irreversible damage Other heat-induced illnesses include heat exhaustion which in its most serious form leads to prostration and can cause serious injuries as well. Heat cramps, while debilitating, are easily reversible if properly and promptly treated. Heat disorders due to excessive heat exposure include electrolyte imbalance, dehydration, skin rashes, heat edema, and loss of physical and mental work capacity.

If during the first trimester of pregnancy, a female worker's core temperature exceeds 39°C (102.2°F) for extended periods, there is an increased risk of malformation to the unborn fetus. Additionally, core temperatures above 38°C (100.4°F) may be associated with temporary infertility in both females and males.

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HEAT STRESS PLAN
(IF WEARING IMPERVIOUS FULL-BODY CLOTHING)

Heat Stress and Other Physiological Factors

Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventive precautions are vital.

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.

Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount and type of PPE worn. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the:

- Anticipated work rate.
- Ambient temperature and other environmental factors.
- Type of protective ensemble.
- Individual worker characteristics and fitness.

Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

- For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress [11]. If the actual clothing worn differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly [12].
- For workers wearing semipermeable or impermeable[1] encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C) [6].

To monitor the worker, measure:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

  If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third [12].
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).

  If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.

  If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third [12].

  Do *not* permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C)[12].
- Body water loss, if possible. Measure weight on a scale accurate to ±0.25 lb at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, is nude. *The body water loss should not exceed 1.5 percent total body weight loss in a work day* [12].

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 8-10). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Prevention

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, management should take the following steps:

- Adjust work schedules:

  Modify work/rest schedules according to monitoring requirements.

  Mandate work slowdowns as needed.

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[1] Although no protective ensemble is "completely" impermeable, for practical purposes an outfit may be considered impermeable when calculating heat stress risk.

  - Rotate personnel: alternate job functions to minimize overstress or overexertion at one task.
  - Add additional personnel to work teams.
  - Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain workers' body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, *i.e.*, 8 fluid ounces (0.23 liters) of water must be ingested for approximately every 8 ounces (0.23 kg) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat [14]. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:
  - Maintain water temperature at 50° to 60°F (10° to 15.6°C).
  - Provide small disposable cups that hold about 4 ounces (0.1 liter).
  - Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.
  - Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
  - Weigh workers before and after work to determine if fluid replacement is adequate.
- Encourage workers to maintain an optimal level of physical fitness:
  - Where indicated, acclimatize workers to site work conditions: temperature, protective clothing, and workload (see *Level of Acclimatization* at the end of this chapter).
  - Urge workers to maintain normal weight levels.
- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:
  - Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.
  - Cooling jackets, vests, or suits (see Table 8-5 for details).
- Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress (see Table 8-11).

Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This section discusses the demonstrated physiological responses to PPE, the individual human characteristics that play a factor in these responses, and some of the precautionary and training measures that need to be taken to avoid PPE-induced injury.

The physiological factors may affect worker ability to function using PPE include:

- Physical condition.
- Level of acclimatization.
- Age.
- Gender.
- Weight.

Physical Condition

Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work, a fit person, relative to an unfit person, will have [5,8,15,16]:

- Less physiological strain.
- A lower heart rate.
- A lower body temperature, which indicates less retained body heat (a rise in internal temperature precipitates heat injury).
- A more efficient sweating mechanism.
- Slightly lower oxygen consumption.
- Slightly lower carbon dioxide production.

Level of Acclimatization

The degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions affects his or her ability to do work. Acclimatized individuals generally have lower heart rates and body temperatures than unacclimatized individuals [17], and sweat sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work loads than unacclimatized workers [18]. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss [8].

Acclimatization can occur after just a few days of exposure to a hot environment [15,16]. NIOSH recommends a progressive 6-day acclimatization period for the unacclimatized worker before allowing him/her to do full work on a hot job [16]. Under this regimen, the first day of work on site is begun using only 50 percent of the anticipated workload and exposure time, and 10 percent is added each day through day 6 [16]. With fit or trained individuals, the acclimatization period may be shortened 2 or 3 days. However, workers can lose acclimitization in a matter of days, and work regimens should be adjusted to account for this.

When enclosed in an impermeable suit, fit acclimatized individuals sweat more profusely than unfit or unacclimatized individuals and may therefore actually face a greater danger of heat exhaustion due to rapid dehydration. This can be prevented by consuming adequate quantities of water. See previous section on *Prevention* for additional information.

Table 8-10. Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]

ADJUSTED TEMPERATURE[b]	NORMAL WORK ENSEMBLE[c]	IMPERMEABLE ENSEMBLE
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F (28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Source. Reference [13].

[a] For work levels of 250 kilocalories/hour.

[b] Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 × % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[c] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Table 8-11. Signs and Symptoms of Heat Stress[a]

- **Heat rash** may result from continuous exposure to heat or humid air.
- **Heat cramps** are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms
  - pain in the hands, feet, and abdomen
- **Heat exhaustion** occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting
- **Heat stroke** is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels Immediate action must be taken to cool the body before serious injury and death occur Competent medical help must be obtained. Signs and symptoms are:
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - dizziness and confusion
  - strong, rapid pulse
  - coma

[a] Source: Reference [6].

Age

Generally, maximum work capacity declines with increasing age, but this is not always the case. Active, well-conditioned seniors often have performance capabilities equal to or greater than young sedentary individuals. However, there is some evidence, indicated by lower sweat rates and higher body core temperatures, that older individuals are less effective in compensating for a given level of environmental heat and work loads [19]. At moderate thermal loads, however, the physiological responses of "young" and "old" are similar and performance is not affected [19].

Age should not be the sole criterion for judging whether or not an individual should be subjected to moderate heat stress. Fitness level is a more important factor.

Gender

The literature indicates that females tolerate heat stress at least as well as their male counterparts [20]. Generally, a female's work capacity averages 10 to 30 percent less than that of a male [8]. The primary reasons for this are the greater oxygen-carrying capacity and the stronger heart in the male [15]. However, a similar situation exists as with aging: not all males have greater work capacities than all females.

Weight

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). Heat loss (dissipation) is a function of surface area and heat production is dependent on mass. Therefore, heat balance is described by the ratio of the two.

Since overweight individuals (those with a low ratio) produce more heat per unit of surface area than thin individuals (those with a high ratio), overweight individuals should be given special consideration in heat stress situations. However, when wearing impermeable clothing, the weight of an individual is not a critical factor in determining the ability to dissipate excess heat.

ATTACHMENT 4
COLD EXPOSURE

COLD STRESS

The cold stress TLVs are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body temperature from falling below 36°C (96.8°F) and to prevent cold injury to body extremities (deep body temperature is the core temperature of the body determined by conventional methods for rectal temperature measurements) For a single, occasional exposure to a cold environment, a drop in core temperature to no lower that 35°C (95°F) should be permitted. In addition to provisions for total body protection, the TLV objective is to protect all parts of the body with emphasis on hands, feet, and head from cold injury.

Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body The clinical presentations of victims of hypothermia are shown in Table 1 Workers should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96 8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F) This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs

Since prolonged exposure to cold air, or to immersion in cold water, at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating dry clothing to maintain core temperatures above 36°C (96.8°F) must be provided to workers if work is performed in air temperatures below 4°C (40°F) Wind chill cooling rate and the cooling power of air are critical factors. [Wind chill cooling rate is defined as heat loss from a body expressed in watts per meter squared which is a function of the air temperature and wind velocity upon the exposed body.] The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required An equivalent chill temperature chart relating the actual dry bulb air temperature and the wind ve-

TABLE 1. Progressive Clinical Presentations of Hypothermia*

Core Temperature		
°C	°F	Clinical Signs
37.6	99.6	"Normal" rectal temperature
37	98.6	"Normal" oral temperature
36	96.8	Metabolic rate increases in an attempt to compensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with normal blood pressure
33	91.4	Severe hypothermia below this temperature
32	89.6	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
31	87.8	
30	86.0	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases
29	84.2	
28	82.4	Ventricular fibrillation possible with myocardial irritability
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent
26	78.8	Victim seldom conscious
25	77.0	Ventricular fibrillation may occur spontaneously
24	75.2	Pulmonary edema
22	71.6	Maximum risk of ventricular fibrilation
21	69.8	
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to recover
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patient to recover

* Presentations approximately related to core temperature. Reprinted from the January 1982 issue of *American Family Physician*, published by the American Academy of Family Physicians.

locity is presented in Table 2 The equivalent chill temperature should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

2. Unless there are unusual or extenuating circumstances, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Evaluation and Control

For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of -32°C (25 6°F) Superficial or deep local tissue freezing will occur only at temperatures below -1°C (30.2°F) regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 3.

Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10-20 minutes in an environment below 16°C (60.8°F), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below -1°C (30.2°F).
2. If the air temperature falls below 16°C (60.8°F) for sedentary, 4°C (39 2°F) for light, -7°C (19.4°F) for moderate work and fine manual dexterity is not required, then gloves should be used by the workers.

To prevent contact frostbite, the workers should wear anticontact gloves.

1. When cold surfaces below -7°C (19.4°F) are within reach, a warning should be given to each worker by the supervisor to prevent inadvertent contact by bare skin.

TABLE 2. Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* In < hr with dry skin. Maximum danger of false sense of security				*INCREASING DANGER* Danger from freezing of exposed flesh within one minute.				*GREAT DANGER* Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

TABLE 3. Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift*

Air Temperature—Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm. Breaks)	1	(Norm. Breaks)	1	75 min	2	55 min	3	40 min	4
-29° to -31°	-20° to -24°	(Norm. Breaks)	1	75min	2	55 min	3	40 min	4	30 min	5
-32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-emergency work should cease					
-40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease		↓		↓		↓		↓	

Notes for Table 3:

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -35°C (-30°F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:
   5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/m^2; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m^2. In general the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for workers in dry clothing.

---

* Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labour.

2. If the air temperature is −17.5°C (0°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (39.2°F). The workers should wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.
2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments should include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the employee should make sure that clothing is not wet as a consequence of sweating If clothing is wet, the employee should change into dry clothes before entering the cold area. The workers should change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change should be determined empirically and will vary individually and according to the type of shoe worn and how much the individual's feet sweat.
3. If exposed areas of the body cannot be protected sufficiently to prevent sensation of excessive cold or frostbite, protective items should be supplied in auxiliary heated versions.
4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.
5. Workers handling evaporative liquid (gasoline, alcohol or cleaning fluids) at air temperatures below 4°C (39.2°F) should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point that is just above ambient temperature.

Work-Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below −7°C (19.4°F), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing should be provided as necessary to prevent workers from returning to work with wet clothing Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of the diuretic and circulatory effects.

For work practices at or below −12°C (10 4°F) ECT, the following should apply:

1. The worker should be under constant protective observation (buddy system or supervision).
2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing, if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing should be provided.
3. New employees should not be required to work fulltime in the cold during the first days of employment until they become accustomed to the working conditions and required protective clothing.
4. The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
5. The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.
6. The workers should be instructed in safety and health procedures. The training program should include as a minimum instruction in:
    a. Proper rewarming procedures and appropriate first aid treatment.
    b. Proper clothing practices.
    c. Proper eating and drinking habits.
    d. Recognition of impending frostbite.
    e. Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
    f. Safe work practices.

Special Workplace Recommendations

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.
2. Special wind protective clothing should be provided based upon existing air velocities to which workers are exposed.

Special caution should be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain should be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60.8°F) so that overall compliance with the requirements of the TLV can be maintained
2. Whenever the air temperature at a workplace falls below −1°C (30 2°F), the dry bulb temperature should be measured and recorded at least every 4 hours.
3. In indoor workplaces, the wind speed should also be recorded at least every 4 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).
4. In outdoor work situations, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below −1°C (30.2°F).
5. The equivalent chill temperature should be obtained from Table 2 in all cases where air movement measurements are required, it should be recorded with the other data whenever the equivalent chill temperature is below −7°C (19.4°F).

Employees should be excluded from work in cold at −1°C (30.2°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below −24°C (11.2°F) with wind speeds less than five miles per hour, or air temperatures below −18°C (0°F) with wind speeds above five miles per hour, should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissues in addition to providing for first aid treatment.

ATTACHMENT 5
PERSONAL EXPOSURE SAMPLING METHODS AND NIOSH ANALYTICAL METHODS

PERSONAL EXPOSURE SAMPLING METHODS

1.0 APPLICABILITY

This document applies to monitoring programs employing low volume air sampling devices including those manufactured by Gilian and SKC and the Dawson air sampling pump. Procedures are provided for routine operations, calibration and maintenance of these systems.

2.0 REFERENCES AND SUPPORTING DOCUMENTS

- Operating Manual for the HFS 513 Air Sampling System - Gilian
- Operating Manual for SKC Sample Pump Model 224-PCXR3
- Operating Manual for Dawson Sampling Pump

3.0 EQUIPMENT REQUIRED

3.1 System Components

- Gilian Sampling Pump, Model # HFS 513A
- SKC Sampling Pump, Model # 224-PCXR3
- Dawson Air Sampling Pump (AC power)
- Rotameter Calibrator Cases Model IHCP-HL-300
  Rotameters include 10-70 ml, 20-200 ml, 50-800 ml, and 500-5000 ml ranges
- Gilian Battery Chargers
- SKC 224 Battery Chargers

3.2 Accessory Items

- Multiple flow controller manifolds with 1,2,3,4&5 sampling points
- "Small" sorbent tube holders (THH-S-225)
- "Large" sorbent tube holders (THH-L-247)
- "Large" sorbent tube holder modifiers (ie, # 800138)
- Connectors for joining tube holders in series end nozzles
- Screw driver (phillips and slots) for flow adjustment
- Sampling Tripods
- Glass impingers - liquid media sampling
- Cartridge adapters

4.0 FORMS REQUIRED

- Form AQ-500.1: Personal Air Sample Data Sheet
- Form AQ-500.2: Low Volume Ambient Sample Data Sheet

5.0 DISPOSITION OF DOCUMENTATION

All calibration documents called for in this SOP will be distributed as follows:

- One copy remains with the instrument and is placed in the instrument's Calibration and Maintenance File at the field site

- One copy is submitted to the Program Manager at the Wayne, NJ office

- One copy is submitted to the Data Processing and Validation Department at the Wayne, NJ office

6.0 PERSONAL SAMPLING OPERATION

The low volume pumps are designed to sample a broad category of contaminants at a range of flow rates utilizing a variety of sorbent and collection media. The setup and monitoring procedures for personal sampling are provided in the following sections.

6.1 Charging the Sampling Pumps

Before use, it is necessary to properly charge the Gilian and SKC pump's internal battery. Pumps require 16 hours to recharge from a completely discharged state. It is not advisable to charge the pumps at the high (standard) rate for more than 24 hours. If the batteries are to charge for more than 24 hours, the charger should be switched to low (trickle) rate. When charging pumps, check the charger to make sure it is the correct charger for the pumps to be charged. This is VERY IMPORTANT before departing for the field or sending pumps to other offices. When preparing a pump for sampling check battery charge by pressing the "bat ck" switch.

After the pumps are charged, test each pump for correct operation using the following procedures:

1) Remove the pump from the charger and using the slot screwdriver supplied with the unit, turn the pump on by flipping the switch located near the bottom right of the pump's face. The pump should begin running immediately. If it does not, repeat the step.

   If the pump will not run, it may require further charging. If a red light appears at the center of the face of the pump, then a problem exists with the flow stream within the pump. Do not use this pump. Turn it off, and call the Wayne office.

2) The flow controller adjustment screw is located just to the right of the on/off switch. Use the screwdriver to adjust the flow up and down several times. You should hear the pump volume and speed change with the movement, and see the flowmeter located on the right of the pump react.

   If the pump will not react to flow adjustment, do not use this pump. Turn it off and contact the Wayne office.

3) Return the pump flowrate to approximately 2 to 3 liters/min using the unit's flowmeter. Using the screwdriver press lightly the small blue button located at the bottom of the unit's face, between the on/off switch and the adjustment screw. As you hold this button down the LCD clock face located in the center of the pump will light up. The amount of time (in minutes) that has passed since you first turned the pump on will appear, along with a blinking dot representing seconds.

   If the clock does not appear, do not use the pump.

4) If the pump passes all the above tests, it is ready for use.

6.2 Adjusting the Flowrate

After testing the pumps, begin to set them up for sampling. The first step is to perform a rough flow rate adjustment using the following procedures. Note: Personal sampling for Health and Safety requires higher accuracy, hence a gilibrator or a bubblemeter should be used in place of a rotameter to adjust the flowrate.

1) Place the calibration case onto a flat and level surface. Open the case and pull the top fully into its upright position. To adjust the pump to the proper flowrate for arsenic sampling use the rotameter marked High Flow, FM 1. The second rotameter and the vacuum gauge will not be require

for this application. The rotameter should be calibrated against an NBS traceable device (bubblemeter), at 5-points within the last 3 months.

2) Various lengths of tygon tubing have been supplied with the unit, remove the one that is 2 feet long, and has no nozzles or clips attached to it. Attach one end of this tube to the inlet nozzle on the pump (the pump should not be running at this time). The inlet is the clear plastic attachment located on the right side of the pump. Attach the other end onto the calibration case nozzle marked B1, Pump Suction.

3) Place the pump down next to the case and turn it on using the screwdriver. Make sure the pump outlet (at the top of the pump) and the calibration case nozzle marked B2 are not covered or blocked in any way.

4) The high flow rotameter should immediately react to the suction being applied. Give the pump several seconds to produce a steady flowrate, then using the screwdriver, adjust the flowrate to 2-3 liters/minute on the rotameter. Hold the pump still on the level surface during adjustment. Do not pick it up and hold it in the air!

The rotameter should not be fluctuating more than plus or minus 0.1 after the adjustment. If the rotameter is showing a wide fluctuation in readings, then check the tygon tube connections. If the connections are tight, be sure the case B2 nozzle and the pump's outlet are clear. If the rotameter continued to fluctuate, do not use the pump.

5) After adjustment, turn the pump off and remove it from the calibration case. Repeat the steps for the other pumps.

6.3 Preparation for Sampling

The next procedure is to install the sample filter and make the final adjustments for sampling using the following procedures. Note: Personal sampling for Health and Safety requires higher accuracy, hence a gilibrator or bubblemeter should be used in place of a rotameter to make the final adjustments to flow rates.

1) First complete the Personal Sample Data Sheet (Form AQ-500.1) with the following information.

    1. Date
    2. Name of the person to be sampled.
    3. Name of the person's company.
    4. The person's job description.
    5. The filter number.

2) Remove one of the preassembled sample filter cassettes and place a label on it containing the same information.

3) Remove one of the supplied tubes (tygon or teflon) which have a nozzle and metal clip attached. Connect this tube to the pump. Remove the short tygon tube that has only a nozzle, and attach it to the calibration case B 1 nozzle.

4) Remove the two protective plugs from the filter cassette. Do not throw these away or lose them. They will be needed again. Connect the end of the cassette nearest to the sample filter to the tubing from the pump by pushing it onto the nozzle with a slight twisting action. Do not force it on too tightly. Use wide masking or cellophane tape to secure the cassette onto the tube.

5) Next place the pump next to the calibration case and connect the other end of the filter cassette to the tubing from the case's nozzle B 1.

6) You are now ready to make the final adjustment to the pump flow rate. As before, turn the pump on as it sits on a level surface. While reading the rotameter adjust the flow rate until you achieve 2.0 liters/minute. If a steady flow rate cannot be achieved, check all connections for tightness.

7) Once you have the proper flow, turn the pump off, wait a moment and then turn it back on. You should again have a reading of 2.0 on the rotameter. If it is off by 0.2 liters/minute or more, readjust the flowrate, and repeat this step. Record your initial flowrate on Form AQ-500.1.

8) It is the preferred method to leave the pump running, disconnect it from the calibration case, and immediately place it on the person to be sampled. If this is not possible, then turn the pump off, disconnect it from the case, and seal the end of the filter cassette with one of the plugs.

9) Once you are ready to sample, attach the pump to the person's belt or place in a pocket if they are wearing overalls. Make sure that the outlet is not blocked, or covered by his clothing. Bring the filter cassette over the person's shoulder and clip it as near the person's face as is convenient. Have the open end of the cassette facing downwards, to limit the amount of dirt falling in, rather than being drawn in with air. Remove the plug from the cassette, and turn the pump on. Record the start time of the sampling in Form AQ-500.1

6.4 Sample Collection

During the monitoring, check the pump as often as possible for correct operation. Check the following items:

1. Is the filter cassette secured?
2. Is the pump running?
3. Is the red light showing on the pump face?
4. Does the running time show when the button is pressed?

Also check the condition of the cassette itself, how much dust has entered, have mud or chemicals been splashed on it, etc.

If the pump has stopped during the run and the red light is showing then the outlet or inlet has been blocked. Change the pump's position to prevent this, record the elapsed time, turn the pump off to reset, and begin sampling again.

Once sampling has begun it should never be stopped, even if the person is to leave the site temporarily. Average running times should be between 6 and 8 hours. A second sample filter should be used to replace the first filter after 2 or 3 hours if very heavy dust conditions exist and the pump flow rate is difficult to maintain.

6.5 Sample Removal

When monitoring is complete, the person wearing the unit should return to the area with the calibration case. Without turning off the pump, remove the unit and cassette from the person. Immediately connect the filter cassette to the rotameter. Record the final flow rate and the time on the sample data sheet. Note: Personal sampling for Health and Safety requires higher accuracy, hence a gilibrator or bubblemeter should be used in place of a rotameter to check the final flow rates.

Turn the pump off, and remove the cassette from the calibration case. Remove the cassette from the pump tubing, and immediately seal the open ends of the cassette with the plugs. Use tape to secure the plugs, and place the cassette into a clean zip lock bag for storage. Record any problems or unusual events that occurred during sampling in the Remarks section of Form AQ-500.1. Record the average temperature and barometric pressure during the run. This can be taken from the closest meteorological or NWS station.

Clean off any dirt from the pump and tubing, and connect it to the charger for reuse later.

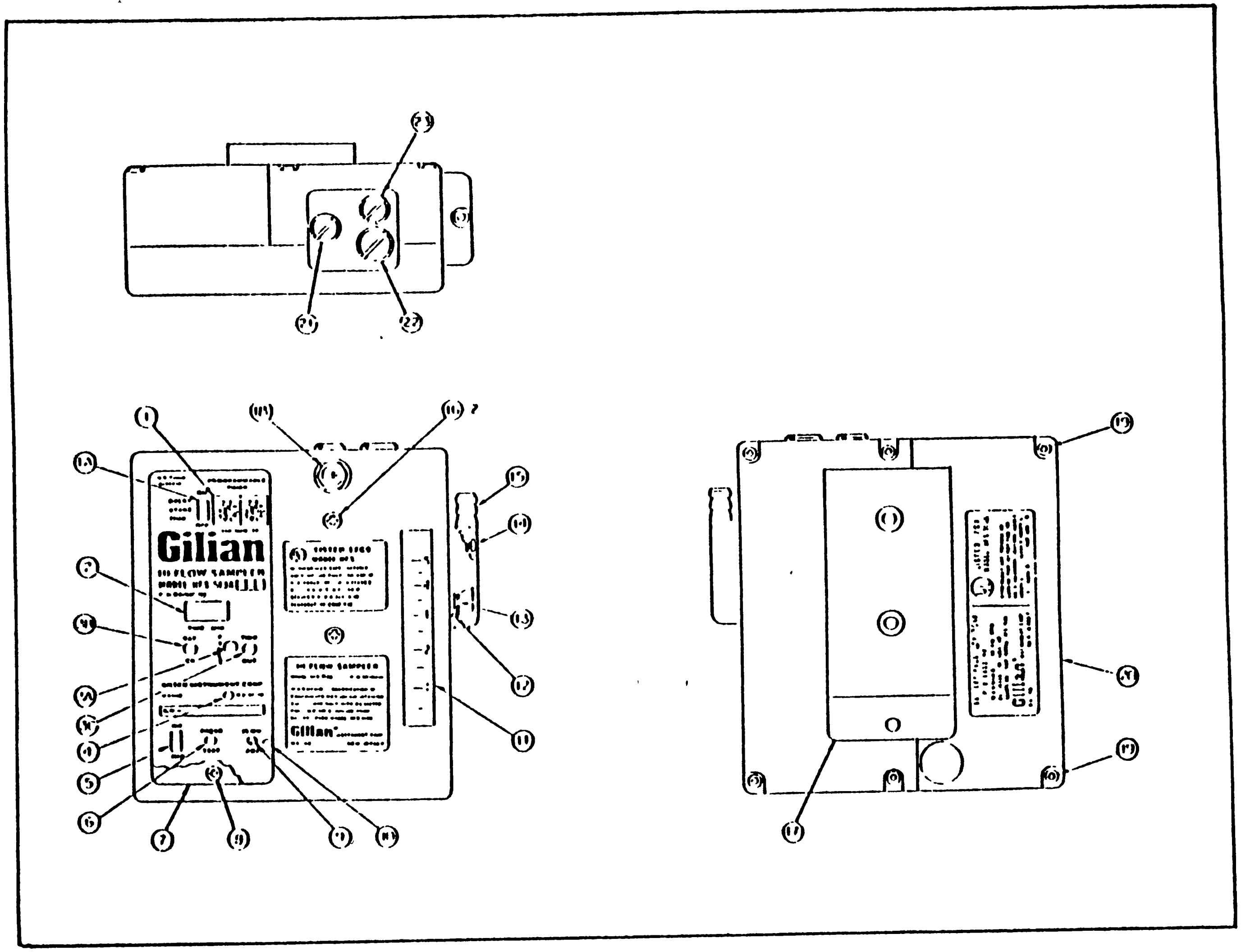

FIGURE 500-1 AIR SAMPLING PUMP

FORM AQ500-1

PERSONAL AIR SAMPLE DATA SHEET

FILTER SAMPLE NUMBER	PERSON SAMPLED	COMPANY	JOB DESCRIPTION	DATE SAMPLED	START TIME	INTIAL FLOWRATE	STOP TIME	FINAL FLOWRATE
AVERAGE AIR TEMPERATURE				BAROMETRIC PRESSURE				
AVERAGE AIR TEMPERATURE				BAROMETRIC PRESSURE				
AVERAGE AIR TEMPERATURE				BAROMETRIC PRESSURE				
AVERAGE AIR TEMPERATURE				BAROMETRIC PRESSURE				
AVERAGE AIR TEMPERATURE				BAROMETRIC PRESSURE				

REMARKS; ____

____

FORM AQ-500.2
LOVOLUME AMBIENT SAMPLE DATA SHEET

DATE ______________________

WOODWARD - CLYDE CONSULTANTS
WAYNE, NEW JERSEY
Page 1 of 2

OPERATOR'S NAME ______________________

GILIAN / DAWSON MULTI - SAMPLE DATA SHEET

PROJECT NAME ; ______________________

PROJECT NO. ______________________

SAMPLER LOCATION ID ______________________

ROTOMETERS SERIAL NOS. __________ / __________ **CALIBRATION DATE** ______________________

SAMPLER WCC SERIAL NO. ______________________

SAMPLE IDENTIFICATION NUMBERS

VO - CHARCOAL ______________________

AMMONIA - SILICA GEL ______________________

HCN - IMPINGER/FILTER ______________________

HS - IMPINGER ______________________

WEATHER CONDITIONS DURING RUN

TEMPERATURE RANGE ______________________ **C** **RH** __________

WINDS ______________________

VISIBILITY ______________________

SKY CONDITION ______________________

PRECIP. ______________________

SOIL CONDITION ______________________

MISC ______________________

SAMPLER LOCATION AND ACTIVITY DESCRIPTION

____

____

____

____

____

____

____

____

____

aq500-1.xls

FORM AQ-500.2
LOVOLUME AMBIENT SAMPLE DATA SHEET

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Page 2 of 2

FLOWRATE AND ENVIRONMENTAL DATA

SAMPLING START TIME ____________________ SAMPLING STOP TIME ____________________

TIME	FLOWRATES FOR SAMPLE NO.					AIR TEMP
	1	2	3	4		
________						
________						
________						
________						
________						
________						
________						
________						
AVER FLOW						

TOTAL RUN TIME ____________________ AVERAGE TEMPERATURE ____________________

OPERATIONAL CHECKLIST

	YES	NO
1. WERE SAMPLES AND GILIAN CORRECTLY IMPLACED?	________	________
2. WERE FLOWRATES WITHIN 10% OF ESTABLISHED RATE ? (200 ML / MIN)	________	________
3. ALL CONNECTIONS SECURED ?	________	________
4. GILIANS OPERATED CORRECTLY?	________	________
5. ROTOMETER OPERATED CORRECTLY ?	________	________
6. SAMPLES INTACT AND NON - CONTAMINATED?	________	________

(IF ANY ANSWER IS "NO",OR ANY VARIATION IN NORMAL OPERATION IS FOUND, DESCRIBE IT IN THE REMARKS SECTION)

REMARKS;

____
____
____

SAMPLES WAS COLLECTED IN ACCORDANCE WITH QUALITY ASSURANCE GUIDELINES ? YES ______ NO ______

SIGNATURE ____
REVIEWD BY: ____

NIOSH ANALYTICAL METHODS

FORMULA: various organic-soluble compounds [1,2,3]
M.W.: various

COAL TAR PITCH VOLATILES

METHOD: 5023
ISSUED: 5/15/85

OSHA: 0.2 mg/m³ (benzene-solubles)
NIOSH: 0.1 mg/m³/10 hr (cyclohexane-solubles) [2,3]
ACGIH: 0.2 mg/m³ (benzene solubles) [4]

PROPERTIES: liquid; d ~1.06 g/mL @ 38 °C; 60 to 85% distills @ ≤355 °C [5]; creosote distills @ 270 to 395 °C [2]

SYNONYMS: benzene-solubles, cyclohexane-solubles, coal tar pitch volatiles (CAS #8007-45-2), creosote from coal tar.

SAMPLING

SAMPLER: FILTER (2-µm, 37-mm PTFE membrane)

FLOW RATE: 1 to 4 L/min

VOL-MIN: 500 L @ 0.2 mg/m³
-MAX: 2400 L

SHIPMENT: routine

SAMPLE STABILITY: unknown

FIELD BLANKS: 10% (≥2) of samplers

ACCURACY

RANGE STUDIED: not studied

BIAS: unknown

OVERALL PRECISION (s_r): not determined

MEASUREMENT

TECHNIQUE: GRAVIMETRIC

ANALYTE: organic-solubles (includes anthracene, benzanthracene, benzo(a)pyrene, carbazole, chrysene, phenanthrene, pyrene and others [1,2,3,4])

EXTRACTION: benzene, cyclohexane or other appropriate solvent; ultrasonic 20 min

CALIBRATION: National Bureau of Standards Class M weights

RANGE: 0.1 to 2 mg per sample

ESTIMATED LOD: 0.05 mg per sample [6]

PRECISION (s_r): 0.02 at 1.35 mg [6]; 0.23 for blanks [6]

APPLICABILITY: The working range is 0.1 to 2 mg/m³ for a 1000-L air sample. The method is useful for air monitoring of coke oven emissions, petroleum combustion products such as diesel emissions, and petroleum asphalt fumes. The method may be applied to bulk samples. The method is non-specific and measures all substances in the sample which are soluble in the solvent selected and which can be desorbed from particulate matter present on the filter.

INTERFERENCES: Changes in temperature or humidity during pre- and post-collection weighing affect accuracy. Losses may occur due to volatilization of collected aerosol during or after sampling.

OTHER METHODS: This method modifies and combines P&CAM 217 [7] and the criteria document method [2].

REAGENTS:

1. Solvent: Benzene,* cyclohexane or other solvent, reagent grade.
2. Dichromic acid cleaning solution.
3. Acetone, reagent grade.
4. Hexane.

*See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: PTFE laminated membrane filter, 2-µm pore size, 37-mm diameter (Zeflour, Membrana Inc., Pleasanton, CA or equivalent) backed by a gasket (37 mm OD, 32 mm ID) cut from a cellulose support pad in plastic filter holder.
2. Personal sampling pump, 1 to 4 L/min, with flexible connecting tubing.
3. Ultrasonic bath.
4. Microbalance, readable to 1 µg, with NBS Class M weights.
5. Environmental chamber for balance, e.g., 20 °C ±0.3 °C and 50% ±5% relative humidity.
6. Weighing cups, PTFE, 2-mL, approximate tare weight 60 mg, in metal rack.
7. Vacuum oven.
   NOTE: Keep the interior of the vacuum oven dust-free for maximum sensitivity, reproducibility, and accuracy.
8. Forceps.
9. Test tubes, PTFE-lined, screw cap, 13 mm x 100 mm.*
10. Filter, 0.5-µm (Millex-SR, Millipore Corp., Bedford, MA or equivalent).
11. Pipets, 1- and 5-mL.*

*Rinse with distilled water, acetone, and hexane; dry.

SPECIAL PRECAUTIONS: Benzene and coal tar pitch volatiles are suspect carcinogens [1,2,3,4].

SAMPLING:

1. Calibrate each sampling pump with a representative sampler in line.
2. Sample at an accurately known flow rate between 1 and 4 L/min for a total sample volume of 500 to 2400 L. Do not exceed a filter loading of ca. 2 mg total particulate.
3. Replace caps in cassette and ship to laboratory.

SAMPLE PREPARATION:

4. Transfer filter carefully using forceps to test tube. Add 5.0 mL solvent via pipet. Cap the tube.
   NOTE 1: Cyclohexane is recommended as solvent because of the carcinogenic potential of benzene [2].
   NOTE 2: This extraction is also applicable to bulk samples (ground and sieved to ca. 250 µm). Extract 250 mg bulk sample with 5.0 mL solvent.
5. Place tube upright in beaker containing water to the same level as the liquid in the tube. Place beaker and tube in ultrasonic bath. Sonicate for 20 min.
6. Filter solution through a 0.5-µm filter into a clean, preweighed weighing cup. Discard the filter.
   NOTE: An aliquot of the solution may be taken at this step if other analyses (e.g., polynuclear aromatic hydrocarbons) are to be performed on the sample. Apply the appropriate aliquot factor in calculations.

FORMULA: Pb

LEAD

M.W.: 207.19 (Pb); 223.19 (PbO)

METHOD: 7082
ISSUED: 2/15/84

OSHA: 0.05 mg/m³
NIOSH: 0.05 mg/m³ [1]
ACGIH: 0.15 mg/m³; STEL 0.45 mg/m³

PROPERTIES: soft metal;
d 11.3 g/cm³; MP 327.5 °C;
valences +2, +4 in salts

SYNONYMS: vary depending upon the chemical form (elemental lead and lead compounds except alkyl lead); CAS #1317-36-8 (PbO); CAS #7439-92-1 (Pb).

SAMPLING

SAMPLER: FILTER
(0.8-µm cellulose ester membrane)

FLOW RATE: 1 to 4 L/min

VOL-MIN: 200 L @ 0.05 mg/m³
-MAX: 1200 L

SHIPMENT: routine

SAMPLE STABILITY: stable

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: 0.13 to 0.4 mg/m³ [2];
0.15 to 1.7 mg/m³ (fume) [3]

BIAS: not significant [2]

OVERALL PRECISION (s_r): 0.072 [2];
0.068 (fume) [3]

MEASUREMENT

TECHNIQUE: ATOMIC ABSORPTION, FLAME

ANALYTE: lead

ASHING: conc. HNO_3, 6 mL; 140 °C

FINAL SOLUTION: 10% HNO_3, 10 mL

FLAME: air-acetylene, oxidizing

WAVELENGTH: 283.3 nm

BACKGROUND CORRECTION: D_2 or H_2 lamp

CALIBRATION: Pb^{++} in 10% HNO_3

RANGE: 10 to 200 µg per sample [3,8]

ESTIMATED LOD: 2.6 µg per sample [9]

PRECISION (s_r): 0.03 [2]

APPLICABILITY: The working range is 0.025 to 0.5 mg/m³ for a 400-L air sample. The method is applicable to elemental lead, including Pb fume, and all other aerosols containing lead. This is an elemental analysis, not compound specific. Aliquots of the samples can be analyzed separately for additional elements.

INTERFERENCES: Use D_2 or H_2 continuum background correction to control flame or molecular absorption. High concentrations of calcium, sulfate, carbonate, phosphate, iodide, fluoride, or acetate can be corrected.

OTHER METHODS: This method combines and replaces P&CAM 173 [8] and S341 [7,9] for lead. Method 7300 (ICP-AES) is an alternate analytical method.Method 7505 is specific for lead sulfide. The following have not been revised: the dithizone method, which appears in P&CAM 102 [4] and the lead criteria document [1]; P&CAM 191 (ASV) [5]; and P&CAM 214 (graphite furnace-AAS) [6].

REAGENTS:

1. Nitric acid, conc.
2. Nitric acid, 10% (w/v). Add 100 mL conc. HNO_3 to 500 mL water; dilute to 1 L.
3. Hydrogen peroxide, 30% H_2O_2 (w/w), reagent grade.
4. Calibration stock solution, 1000 µg Pb/mL. Commercial standard or dissolve 1.00 g Pb metal in minimum volume of (1+1) HCl and dilute to 1 L with 1% (v/v) HCl. Store in a polyethylene bottle. Stable ≥ one year.
5. Air, compressed, filtered.
6. Acetylene.
7. Distilled or deionized water.

EQUIPMENT:

1. Sampler: Cellulose ester filter, 0.8-µm pore size, 37-mm diameter; in cassette filter holder.
2. Personal sampling pump, 1 to 4 L/min, with flexible connecting tubing.
3. Atomic Absorption Spectrophotometer with an air-acetylene burner head.
4. Lead hollow cathode lamp or electrode dischargeless lamp.
5. Regulators, two-stage, for air and acetylene.
6. Beakers, Phillips, 125 mL, or Griffin, 50 mL with watchglass covers.*
7. Volumetric flasks, 10- and 100-mL.*
8. Assorted volumetric pipets as needed.*
9. Hotplate, surface temperature 140° C.
10. Bottles, polyethylene, 100-mL.

*Clean all glassware with conc. nitric acid and rinse thoroughly with distilled or deionized water before use.

SPECIAL PRECAUTIONS: Perform all acid digestions in a fume hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Sample at an accurately known flow rate between 1 and 4 L/min for up to 8 hrs for TWA measurements. Do not exceed a filter loading of ca. 2 mg total dust.

SAMPLE PREPARATION:

NOTE: The following sample preparation gave quantitative recovery (see EVALUATION OF METHOD) [9]. Steps 4 through 9 of Method 7300 or other quantitative ashing techniques may be substituted, especially if several metals are to be determined on a single filter.

3. Open the cassette filter holders and transfer the samples and blanks to clean beakers.
4. Add 3 mL conc. HNO_3, and 1 mL 30% H_2O_2 and cover with a watchglass. Start reagent blanks at this step.
   NOTE: If PbO_2 is not present in the sample, the 30% H_2O_2 need not be added [3,9].
5. Heat on hotplate (140 °C) until most of the acid has evaporated.
6. Repeat two more times using 2 mL conc. HNO_3 and 1 mL 30% H_2O_2 each time.
7. Heat on 140 °C hotplate until a white ash appears.
8. When sample is dry, rinse the watchglass and walls of the beaker with 3 to 5 mL 10% HNO_3. Allow the solution to evaporate to dryness.
9. Cool each beaker and dissolve the residues in 1 mL conc. HNO_3.
10. Transfer the solution quantitatively to a 10-mL volumetric flask and dilute to volume with distilled water.
    NOTE: If the concentration ($\underline{M}$) of any of the following is expected to exceed the lead concentration ($\underline{M}$) by 10-fold or more, add 1 mL 1 $\underline{M}$ Na_2EDTA to each flask before dilution to volume: $CO_3^=$, PO_4^{-3}, I^-, F^-, CH_3COO^-. If Ca^{++} or $SO_4^=$ are present in 10-fold excess, make all standards and samples 1% (w/w) in La^{++} [8].

FORMULA: $CH_2{=}CHCl$; C_2H_3Cl

M.W.: 62.50

VINYL CHLORIDE

METHOD: 1007
ISSUED: 2/15/84

OSHA: 1 ppm; C 5 ppm
NIOSH: minimum measurable
ACGIH: 5 ppm (human carcinogen) [1]
(1 ppm = 2.56 mg/m³ @ NTP)

PROPERTIES: BP -14 °C; vapor density 2.2 (air = 1)

SYNONYMS: chloroethylene; chloroethene; CAS #75-01-4.

SAMPLING

SAMPLER: SOLID SORBENT TUBE
(2 tandem tubes, each with 150 mg activated coconut charcoal)

FLOW RATE: 0.05 L/min

VOL-MIN: 0.7 L
-MAX: 5 L

SHIPMENT: separate primary and backup tubes and cap each

SAMPLE STABILITY: 10 days @ 25 °C

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: 1 to 64 mg/m³ [2]

BIAS: -6% of calculated concentration [2]

OVERALL PRECISION (s_r): 0.06 [2]

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTE: vinyl chloride

DESORPTION: 1 mL carbon disulfide; 30 min

INJECTION ALIQUOT: 5 µL

COLUMN: stainless steel, 6.1 m x 3.2 mm, 10% SE-30 on 80/100 mesh Chromosorb W (AW-DMCS)

CARRIER GAS: He, 40 mL/min

TEMPERATURE-INJECTOR: 230 °C
-DETECTOR: 230 °C
-COLUMN: 60 °C

CALIBRATION: solutions of vinyl chloride in CS_2

RANGE: 0.002 to 0.2 mg per sample [2]

ESTIMATED LOD: 0.00004 mg per sample [2]

PRECISION (s_r): not determined

APPLICABILITY: The working range is 0.4 to 40 mg/m³ (0.16 to 16 ppm) for a 5-L air sample. The method is applicable to 15-min samples at concentrations of 1 ppm or higher.

INTERFERENCES: Other than the possibility of loss of sample upon storage of two weeks or more at room temperature, none have been noted.

OTHER METHODS: This is a revision of P&CAM 178 [3].

REAGENTS:

1. Carbon disulfide,* chromatographic quality.
2. Vinyl chloride,*, 99.9%, in lecture bottle fitted with valve and septum.
3. Calibration stock solution, 0.26 mg/mL.
   a. Insert the tip of a gas syringe containing 1 mL vinyl chloride gas under the surface of 5 mL CS_2 in a 10-mL volumetric flask.
   b. Open the valve of the syringe and withdraw the plunger to pull CS_2 into the barrel. (As vinyl chloride dissolves, a vacuum will be created, pulling CS_2 into the syringe.)
   c. Push the solution from the syringe into the flask. Rinse the syringe twice with 1-mL portions of CS_2 and add the washings to the flask.
   d. Dilute to the mark with CS_2.
4. Helium, purified.
5. Hydrogen, purified.
6. Air, filtered.

*See Special Precautions.

EQUIPMENT:

1. Sampler: two tandem glass tubes, 7 cm long, 6 mm OD, 4 mm ID, flame-sealed ends, each containing 150 mg of 20/40 mesh activated (600 °C) coconut shell charcoal. A silylated glass wool plug precedes the charcoal beds and a 3-mm urethane foam plug follows the charcoal beds. Plastic caps are included for sealing after use. Pressure drop across each tube at 1 L/min airflow must be less than 3.4 kPa.
   NOTE: A pair of two-section (100 mg/50 mg) tubes may be used.
2. Personal sampling pump, 0.05 L/min, with flexible connecting tubing.
3. Gas chromatograph, flame ionization detector, integrator and column (page 1007-1).
4. File.
5. Bent wire for removing plugs from sampling tube.
6. Vials, 2-mL, glass with PTFE-lined septa and crimp-on seals.
7. Volumetric flasks, 10-mL, with polyethylene stoppers.
8. Pipettes, delivery, 1.0-mL, graduated in 0.1-mL increments, 2- and 5-mL, with pipet bulb.
9. Air sampling bags, Tedlar, 10-L.
10. Gas syringe, with gas-tight valve, 0.1- and 1-mL.
11. Syringe, 10-µL, with 0.1-µL graduations.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and an acute fire and explosion hazard (flash point = -30 °C); work with it only in a hood.

Vinyl chloride is a human carcinogen [1].

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the tubes immediately before sampling. Attach two tubes, with ends touching, with a short piece of tubing. Label one tube as the back tube and insert the back tube into the flexible tubing attached to the personal sampling pump.
3. Sample at 0.05 L/min for 15 to 100 min. Do not sample more than 5 L of air.
4. Separate the primary and backup tubes and cap each tube for shipment.

SAMPLE PREPARATION:

5. Add 1.0 mL CS_2 to an empty vial. Loosely cap the vial.
6. Score each sampler tube with a file in front of the glass wool plug. Break the tube at the score line.

FORMULA: mixture: $C_{12}H_{10-x}Cl_x$
[where x = 1 to 10]
M.W.: ca. 258 (42% Cl ; $C_{12}H_7Cl_3$);
ca. 326 (54% Cl ; $C_{12}H_5Cl_5$)

POLYCHLOROBIPHENYLS

METHOD: 5503
ISSUED: 2/15/84
REVISION #1: 8/15/87

OSHA: 1 mg/m³ (42% Cl);
0.5 mg/m³ (54% Cl)
NIOSH: 0.001 mg/m³ [1,2]
ACGIH: 1 mg/m³ (42% Cl); STEL 2 mg/m³
0.5 mg/m³ (54% Cl); STEL 1 mg/m³
(skin)

PROPERTIES:
42% Cl: BP 325 to 366 °C; MP -19 °C;
d 1.38 g/mL @ 25 °C;
VP 0.01 Pa (8×10^{-5} mm Hg;
1 mg/m³) @ 20 °C [3]
54% Cl: BP 365 to 390 °C; MP 10 °C;
d 1.54 g/mL @ 25 °C;
VP 0.0004 Pa (3×10^{-6} mm Hg;
0.05 mg/m³) @ 20 °C [3,4]

SYNONYMS: PCB; CAS #1336-36-3; 1,1'-biphenyl chloro (CAS #27323-18-8); chlorodiphenyl, 42% Cl (Aroclor 1242; CAS #53469-21-9), and 54% Cl (Aroclor 1254; CAS #11097-69-1)

SAMPLING

SAMPLER: FILTER + SOLID SORBENT
(13-mm glass fiber + Florisil,
100 mg/50 mg)

FLOW RATE: 0.05 to 0.2 L/min or less

VOL-MIN: 1 L @ 0.5 mg/m³
-MAX: 50 L

SHIPMENT: transfer filters to
glass vials after sampling

SAMPLE STABILITY: unknown for filters;
2 months for Florisil
tubes [5]

BLANKS: 10% of samples

ACCURACY

RANGE STUDIED: not studied

BIAS: none identified

OVERALL PRECISION (s_r): not evaluated

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, ECD (^{63}Ni)

ANALYTE: polychlorobiphenyls

DESORPTION: filter + front section, 5 mL hexane;
back section, 2 mL hexane

INJECTION VOLUME: 4 µL with 1-µL backflush

TEMPERATURE-INJECTION: 250 - 300 °C
-DETECTOR: 300 - 325 °C
-COLUMN: 180 °C

CARRIER GAS: N_2, 40 mL/min

COLUMN: glass, 1.8 m x 2 mm ID, 1.5% OV-17/1.95%
QF-1 on 80/100 mesh Chromosorb WHP

CALIBRATION: standard PCB mixture in hexane

RANGE: 0.4 to 4 µg per sample [6]

ESTIMATED LOD: 0.03 µg per sample [6]

PRECISION (s_r): 0.044 [5]

APPLICABILITY: The working range is 0.01 to 10 mg/m³ for a 40-L air sample [5]. With modifications, surface wipe samples may be analyzed [7,8].

INTERFERENCES: Chlorinated pesticides, such as DDT and DDE, may interfere with quantitation of PCB. Sulfur-containing compounds in petroleum products also interfere [9].

OTHER METHODS: This method revises Methods S120 [10], 5503 (dated 2/15/84), and P&CAM 244 [5]. Methods S121 [11] and P&CAM 253 [12] for PCB have not been revised.

REAGENTS:

1. Hexane, pesticide quality.
2. Florisil, 30/48 mesh sieved from 30/60 mesh. After sieving, dry at 105 °C for 45 min. Mix the cooled Florisil with 3% (w/w) distilled water.
3. Nitrogen, purified.
4. Stock standard solution of the PCB in methanol or isooctane (commercially available).*

*See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: 13-mm glass fiber filter without binders in a Swinnex cassette (Cat. No. SX 0001300, Millipore Corp.) followed by a glass tube, 7 cm long, 6 mm OD, 4 mm ID containing two sections of 30/48 mesh deactivated Florisil. The front section is preceded by glass wool and contains 100 mg and the backup section contains 50 mg; urethane foam between sections and behind the backup section. Join the cassette and Florisil tube with PVC tubing, 3/8" L x 9/32" OD x 5/32" ID, on the outlet of the cassette and with another piece of PVC tubing, 3/4" L x 5/16" OD x 3/16" ID, complete the union.
2. Personal sampling pump, 0.05 to 0.2 L/min, with flexible connecting tubing.
3. Tweezers.
4. Vials, glass, 4- and 7-mL, with aluminum or PTFE-lined caps.
5. Gas chromatograph, electron capture detection (^{63}Ni), integrator and column (page 5503-1).
6. Volumetric flasks, 10-mL and other convenient sizes for preparing standards.
7. Syringe, 10-µL.

SPECIAL PRECAUTIONS: Avoid prolonged or repeated contact of skin with PCB and prolonged or repeated breathing of the vapor [1,2,13].

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the Florisil tube immediately before sampling. Connect Florisil tube to Swinnex cassette and attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.05 and 0.2 L/min for a total sample size of 1 to 50 L.

   NOTE: At low PCB concentrations, the sampler was found to be efficient when operated at flow rates up to 1 L/min, for 24 hours [8]. Under these conditions, the limit of detection was 0.02 µg/m^3.
4. Transfer the glass fiber filters to 7-mL vials. Cap the Florisil tubes with plastic (not rubber) caps and pack securely for shipment.

SAMPLE PREPARATION:

5. Place the glass wool and 100-ml Florisil bed in the same 7-mL vial in which the filter was stored. Add 5.0 mL hexane.

   NOTE: For surface wipe samples, extract each gauze pad with 25 mL hexane [7].
6. In a 4 mL vial, place the 50-mg Florisil bed including the two urethane plugs. Add 2.0 mL hexane.
7. Allow to stand 20 min with occasional agitation.

FORMULA: Table 1

HYDROCARBONS, BP 36 – 126 °C

M.W.: Table 1

METHOD: 1500
ISSUED: 2/15/84

OSHA, NIOSH, ACGIH: Table 2

PROPERTIES: Table 1

COMPOUNDS:
(Synonyms
in Table 1)

benzene
cyclohexane
cyclohexene
n-heptane
n-hexane
methylcyclohexane
n-octane
n-pentane
toluene

SAMPLING

SAMPLER: SOLID SORBENT TUBE
(coconut shell charcoal,
100 mg/50 mg)

FLOW RATE, VOLUME: Table 3

SHIPMENT: no special precautions

SAMPLE STABILITY: at least 2 weeks

BLANKS: 2 to 10 field blanks per set

BULK SAMPLE: desirable, 1 to 10 mL; ship in separate containers from samples

ACCURACY

RANGE STUDIED,
BIAS and OVERALL PRECISION (s_r): Table 3

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTES: hydrocarbons listed above

DESORPTION: 1 mL CS_2; stand 30 min

INJECTION VOLUME: 5 µL

TEMPERATURE-INJECTION: 250 °C
-DETECTOR: 250 °C
-COLUMN: see step 11

CARRIER GAS: N_2 or He, 25 mL/min

COLUMN: glass, 3.0 m x 2 mm, 20% SP-2100 on 80/100 mesh Supelcoport

CALIBRATION: analytes in CS_2

RANGE AND PRECISION (s_r): Table 4

ESTIMATED LOD: 0.001 to 0.01 mg per sample with capillary column [1]

APPLICABILITY: This method is intended for determining the OSHA-regulated hydrocarbons included within the boiling point range of n-pentane through n-octane. It may be used for simultaneous measurements; however, interactions between analytes may reduce breakthrough volumes and change desorption efficiencies.

INTERFERENCES: At high humidity, breakthrough volumes may be reduced by as much as 50%. Other volatile organic solvents, e.g., alcohols, ketones, ethers, and halogenated hydrocarbons, are likely interferences. If interference is suspected, use a more polar column or change column temperature.

OTHER METHODS: This method is based on and supercedes Methods P&CAM 127, benzene and toluene [2]; S28, cyclohexane [3]; S82, cyclohexene [3]; S89, heptane [3]; S90, hexane [3]; S94, methylcyclohexane [3]; S311, benzene [4]; S343, toluene [4]; S378, octane [4]; and S379, pentane [4]. For benzene or toluene in complex mixture of alkanes ($\leq C_{10}$), Method 1501 (aromatic hydrocarbons) is more selective.

REAGENTS:

1. Eluent: Carbon disulfide*, chromatographic quality with (optional) suitable internal standard.
2. Analytes, reagent grade.*
3. Nitrogen or helium, purified.
4. Hydrogen, prepurified.
5. Air, filtered.

*See Special Precautions.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6 mm OD, 4 mm ID, flame-sealed ends, containing two sections of activated (600 °C) coconut shell charcoal (front = 100 mg, back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section, and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available.
2. Personal sampling pump, 0.01 to 0.2 L/min, with flexible connecting tubing.
3. Gas chromatograph, FID, integrator and column (page 1500-1).
4. Vials, glass, 1-mL, with PTFE-lined caps.
5. Pipet, 1-mL, with pipet bulb.
6. Syringes, 5-, 10-, 25- and 100-µL.
7. Volumetric flasks, 10-mL

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and extremely flammable (flash point = -30 °C); benzene is a suspect carcinogen. Prepare samples and standards in a well-ventilated hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min (0.01 to 0.05 L/min for n-pentane) for a total sample size as shown in Table 3.
4. Cap the samplers with plastic (not rubber) caps and pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL eluent to each vial. Attach crimp cap to each vial immediately.
7. Allow to stand at least 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least five working standards over the appropriate range (ca. 0.01 to 10 mg analyte per sample; see Table 4).
   a. Add known amounts of analyte to eluent in 10-mL volumetric flasks and dilute to the mark.
   b. Analyze together with samples and blanks (steps 11, 12 and 13).
   c. Prepare calibration graph (peak area of analyte vs. mg analyte).
9. Determine desorption efficiency (DE) at least once for each batch of charcoal used for sampling in the calibration range (step 8). Prepare three tubes at each of five levels plus three media blanks.
   a. Remove and discard back sorbent section of a media blank sampler.
   b. Inject a known amount of analyte directly onto front sorbent section with a microliter syringe.

c. Cap the tube. Allow to stand overnight.
d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11, 12 and 13).
e. Prepare a graph of DE vs. mg analyte recovered.

10. Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control. Check for possible contamination during shipment of field samples by comparing results from field blanks and media blanks.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1500-1. Select appropriate column temperature:

Substance	Approximate Retention Time (min), at Indicated Column Temperature			
	40 °C	70 °C	100 °C	Programmed[a]
n-pentane	2.2	1.2		1.8
solvent (CS_2)	3.0	1.6		2.4
n-hexane	5.1	2.2		3.5
benzene[b]	7.7	3.2		4.5
cyclohexane[b]	8.4	3.4		4.7
cyclohexene	9.5	3.8		4.9
n-heptane	12	4.3		5.4
methylcyclohexane	14	5.2	2.2	5.9
toluene	17	6.5	2.6	6.5
n-octane	19	8.7	3.2	7.1

[a] Temperature program: 50 °C for 2 min, then 15 °C/min to 150 °C, 2-min final hold.
[b] Not completely resolved.

NOTE: Alternatively, column and temperature may be taken from Table 4.

12. Inject sample aliquot manually using solvent flush technique or with autosampler.
NOTE: If peak area is above the linear range of the working standards, dilute with eluent, reanalyze and apply the appropriate dilution factor in calculations.
13. Measure peak area.

CALCULATIONS:

14. Determine the mass, mg (corrected for DE) of analyte found in the sample front (W_f) and back (W_b) sorbent sections, and in the average media blank front (B_f) and back (B_b) sorbent sections.
NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.
15. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3.$$

FORMULA: Table 1

M.W.: Table 1

HYDROCARBONS, HALOGENATED

METHOD: 1003
ISSUED: 2/15/84
REVISION #1: 8/15/87

COMPOUNDS: (synonyms in Table 1)

- benzyl chloride
- bromoform
- carbon tetrachloride
- chlorobenzene
- chlorobromomethane
- chloroform
- o-dichlorobenzene
- p-dichlorobenzene
- 1,1-dichloroethane
- 1,2-dichloroethylene
- ethylene dichloride
- hexachloroethane
- methylchloroform
- tetrachloroethylene
- 1,1,2-trichloroethane
- 1,2,3-trichloropropane

SAMPLING

SAMPLER: SOLID SORBENT TUBE
(coconut shell charcoal, 100 mg/50 mg)

FLOW RATE: 0.01 to 0.2 L/min

VOL-MIN: Table 2
-MAX: Table 2

SHIPMENT: routine

SAMPLE STABILITY: not determined

FIELD BLANKS: 10% of samples

ACCURACY

RANGE STUDIED: see EVALUATION OF METHOD [1]

BIAS: not significant [1]

OVERALL PRECISION (s_r): see EVALUATION OF METHOD [1]

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTE: compounds above

DESORPTION: 1 mL CS_2, stand 30 min

INJECTION VOLUME: 5 µL

TEMPERATURES: Table 3

CARRIER GAS: N_2 or He, 30 mL/min

COLUMN: Table 3; alternates are SP-2100,
SP-2100 with 0.1% Carbowax 1500
or DB-1 fused silica capillary column

CALIBRATION: standard solutions of analyte in CS_2

RANGE: Table 3

ESTIMATED LOD: 0.01 mg per sample [2]

PRECISION (s_r): see EVALUATION OF METHOD [1]

APPLICABILITY: See Table 2 for working ranges. This method can be used for simultaneous determination of two or more substances suspected to be present by changing gas chromatographic conditions (i.e., temperature program). High humidity during sampling will prevent organic vapors from being trapped efficiently on the sorbent and greatly decreases breakthrough volume.

INTERFERENCES: None identified. The chromatographic column or separation conditions may be changed to circumvent interferences.

OTHER METHODS: This method combines and replaces P&CAM 127 [3], S101 [4], S110 [5], S113 [6], S114 [7], S115 [8], S122 [9], S123 [10], S126 [11], S133 [12], S134 [13], S135 [14], S281 [15], S314 [16], S328 [17], S335 [18], S351 [19], and Method 1003 (dated 2/15/84).

REAGENTS:

1. Carbon disulfide, chromatographic quality.*
2. Analyte, reagent grade.
3. Calibration stock solutions:
   a. benzyl chloride, 10 mg/mL in n-heptane.
   b. bromoform, 10 mg/mL in n-hexane.
   c. o-dichlorobenzene, 200 mg/mL in acetone.
   d. p-dichlorobenzene, 300 mg/mL in acetone.
   e. hexachloroethane, 25 mg/mL in toluene.
4. Decane, n-undecane, octane or other internal standards (see step 6).
5. Nitrogen or helium, purified.
6. Hydrogen, prepurified.
7. Air, filtered.

*See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6 mm OD, 4 mm ID, flame-sealed ends with plastic caps, containing two sections of 20/40 mesh activated (600 °C) coconut shell charcoal (front = 100 mg; back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available (e.g., SKC #226-01).
2. Personal sampling pump, 0.01 to 0.2 L/min, with flexible connecting tubing.
3. Gas chromatograph, FID, integrator and column (see Table 3).
4. Vials, 2-mL, glass, PTFE-lined septum crimp caps.
5. Volumetric flasks, 10-mL.
6. Syringes, 10-µL, readable to 0.1 µL.
7. Pipet, TD, 1-mL, with pipet bulb.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and a serious fire and explosion hazard (flash point = -30 °C); work with it only in a hood. Several of the analytes are suspect carcinogens (Table 1). n-Heptane, n-hexane, and acetone are fire hazards.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min for a total sample size between the limits shown in Table 2.
4. Cap the samplers. Pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL CS_2 to each vial. Cap each vial.
   NOTE: A suitable internal standard, such as decane [16], n-undecane [6,19], or octane [9,13,17] at 0.1% (v/v) may be added at this step and at step 8.
7. Allow to stand 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least five working standards over the appropriate range (Table 3).
   a. Add known amounts of neat analyte or calibration stock solution to CS_2 in 10-mL volumetric flasks and dilute to the mark.
   b. Analyze with samples and blanks (steps 11 and 12).
   c. Prepare calibration graph (peak area vs. mg analyte).
9. Determine desorption efficiency (DE) at least once for each lot of charcoal used for sampling in the range of interest. Prepare three tubes at each of five levels plus three media blanks.

a. Remove and discard back sorbent section of a media blank sampler.
b. Inject a known amount (2 to 20 µL) of pure analyte, or calibration stock solution (see REAGENTS, 3.), directly onto front sorbent section with a microliter syringe.
c. Cap the tube. Allow to stand overnight.
d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11 and 12).
e. Prepare a graph of DE vs. mg analyte recovered.

10. Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1003-1 and in Table 3. Inject sample aliquot manually using solvent flush technique or with autosampler.
    NOTE: If peak area is above the linear range of the working standards, dilute with CS_2, reanalyze and apply the appropriate dilution factor in calculations.
12. Measure peak area.

CALCULATIONS:

13. Determine the mass, mg (corrected for DE), of analyte found in the sample front (W_f) and back (W_b) sorbent sections and in the average media blank front (B_f) and back (B_b) sorbent sections.
    NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.
14. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b)\cdot 10^3}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Laboratory testing was performed with spiked samples and generated atmospheres using SKC Lot 105 coconut shell charcoal [1]. Results were:

Compound	Range, mg/m³	Sample Size	Precision (s_r) Overall	Precision (s_r) Measurement	Desorption Efficiency	Ref.
Benzyl chloride	2–8	10 L	0.096	0.031	0.90 @ 0.03–0.1 mg	[8]
Bromoform	3–10	10 L	0.071	0.043	0.80 @ 0.025 mg	[7]
Carbon tetrachloride	65–299	15 L	0.092	0.037	0.96 @ 1.3–4.8 mg	[16]
Chlorobenzene	183–736	10 L	0.056	0.025	0.91 @ 1.8–7.1 mg	[12]
Chlorobromomethane	640–2655	5 L	0.061	0.051	0.94 @ 3.3–13 mg	[6]
Chloroform	100–416	15 L	0.057	0.047	0.97 @ 1.8–7.4 mg	[19]
o-Dichlorobenzene	150–629	3 L	0.068	0.013	0.86 @ 0.5–1.9 mg	[14]
p-Dichlorobenzene	183–777	3 L	0.052	0.022	0.91 @ 0.7–2.7 mg	[15]
1,1-Dichloroethane	212–838	10 L	0.057	0.011	1.01 @ 1.9–8 mg	[10]
1,2-Dichloroethylene*	475–1915	3 L	0.052	0.017	1.00 @ 2.4–9.5 mg	[5]
Ethylene dichloride	195–819	3 L	0.079	0.012	0.96 @ 0.6–2.5 mg	[9]
Hexachloroethane	5–25	10 L	0.121	0.014	0.98 @ 0.05–0.2 mg	[4]
Methyl chloroform	904–3790	3 L	0.054	0.018	0.99 @ 2.9–11 mg	[17]
Tetrachloroethylene	655–2749	3 L	0.052	0.013	0.96 @ 2.1–8 mg	[18]
1,1,2-Trichloroethane	26–111	10 L	0.057	0.010	0.97 @ 0.3–1.2 mg	[13]
1,2,3-Trichloropropane	163–629	10 L	0.068	0.027	0.95 @ 1.5–6 mg	[11]

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*isomer used (i.e., cis- or trans-) in evaluation unknown.

ELEMENTS (ICP)

METHOD: 7300
ISSUED: 2/15/84

M.W.: Table 1

OSHA/NIOSH/ACGIH: Table 1

PROPERTIES: Table 1

ELEMENTS:
aluminum
arsenic
beryllium
cadmium
calcium
chromium
cobalt
copper
iron
lead
lithium
magnesium
manganese
molybdenum
nickel
phosphorus
platinum
selenium
silver
sodium
tellurium
thallium
tin
titanium
tungsten
vanadium
yttrium
zinc
zirconium

SYNONYMS: vary depending upon the compound.

SAMPLING

SAMPLER: FILTER
(0.8-µm, cellulose ester membrane)

FLOW RATE: 1 to 4 L/min

VOL-MIN: Table 1
-MAX: Table 1

SHIPMENT: routine

SAMPLE STABILITY: stable

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: not studied

BIAS: none identified

OVERALL PRECISION (s_r): not evaluated

MEASUREMENT

TECHNIQUE: INDUCTIVELY COUPLED ARGON PLASMA,
ATOMIC EMISSION SPECTROSCOPY

ANALYTE: elements above

ASHING REAGENTS: conc. HNO_3, 4 mL;
and conc. $HClO_4$, 1 mL
CONDITIONS: room temperature, 30 min;
150 °C to near dryness

FINAL SOLUTION: 4% HNO_3, 1% $HClO_4$, 10 mL

WAVELENGTH: depends upon element; Table 2

BACKGROUND CORRECTION: spectral wavelength shift

CALIBRATION: elements in 4% HNO_3, 1% $HClO_4$

RANGE: 2.5 to 1000 µg per sample [1]

ESTIMATED LOD: 1 µg per sample [1]

PRECISION (s_r): Table 2

APPLICABILITY: The working range of this method is 0.005 to 2.0 mg/m³ for each element in a 500-L air sample. This is simultaneous elemental analysis, not compound specific. Verify that the types of compounds in the samples are soluble with this ashing procedure.

INTERFERENCES: Spectral interferences are the primary interferences encountered in ICP-AES analysis. These are minimized by judicious wavelength selection, interelement correction factors and background correction [1,2].

OTHER METHODS: This method replaces P&CAM 351 [2] for trace elements. Atomic absorption spectroscopy (e.g., Methods 70XX) is an alternate analytical technique for many of these elements.

REAGENTS:
1. Nitric acid, conc.
2. Perchloric acid, conc.*
3. Ashing acid: 4:1 (v/v) $HNO_3:HClO_4$. Mix 4 volumes conc. HNO_3 with 1 volume conc. $HClO_4$.
4. Calibration stock solutions, 1000 µg/mL. Commercially available, or prepared per instrument manufacturer's recommendation (see step 12).
5. Dilution acid, 4% HNO_3, 1% $HClO_4$. Add 50 mL ashing acid to 600 mL water; dilute to 1 L.
6. Argon.
7. Distilled,deionized water.

*See Special Precautions.

EQUIPMENT:
1. Sampler: cellulose ester membrane filter, 0.8-mm pore size, 37-mm diameter; in cassette filter holder.
2. Personal sampling pump, 1 to 4 L/min, with flexible connecting tubing.
3. Inductively coupled plasma-atomic emission spectrometer, equipped as specified by the manufacturer for analysis of elements of interest.
4. Regulator, two-stage, for argon.
5. Beakers, Phillips, 125-mL, or Griffin, 50-mL, with watchglass covers.*
6. Volumetric flasks, 10- and 100- mL.*
7. Assorted volumetric pipets as needed.*
8. Hotplate, surface temperature 150 °C.

*Clean all glassware with conc. nitric acid and rinse thoroughly in distilled water before use.

SPECIAL PRECAUTIONS: Perform all perchloric acid digestions in a perchloric acid hood.

SAMPLING:
1. Calibrate each personal sampling pump with a representative sampler in line.
2. Sample at an accurately known flow rate between 1 and 4 L/min for a total sample size of 200 to 2000 L (see Table 1) for TWA measurements. Do not exceed a filter loading of approximately 2 mg total dust.

SAMPLE PREPARATION:
3. Open the cassette filter holders and transfer the samples and blanks to clean beakers.
4. Add 5 mL ashing acid. Cover with a watchglass. Let stand 30 min at room temperature.
   NOTE: Start a reagent blank at this step.
5. Heat on hotplate (120 °C) until ca. 0.5 mL remains.
   NOTE: Some species of Li, Mn, Mo, Sn, W, and Zr will not be completely solubilized by this procedure. Alternative solubilization techniques for most of these elements can be found elsewhere [2,3,4,5,6,7].
6. Add 2 mL ashing acid and repeat step 5. Repeat this step until the solution is clear.
7. Remove watchglass and rinse into the beaker with distilled water.
8. Increase the temperature to 150 °C and take the sample to dryness.
9. Dissolve the residue in 2 to 3 mL dilution acid.
10. Transfer the solutions quantitatively to 10-mL volumetric flasks.
11. Dilute to volume with dilution acid.

CALIBRATION AND QUALITY CONTROL:
12. Calibrate the spectrometer according to the manufacturers recommendations.
    NOTE: Typically, an acid blank and 10 µg/mL multielement working standards are used. The following multielement combinations are chemically compatible in 4% HNO_3/1% $HClO_4$:
    a. Ag, Ca, Co, Mn, Pb, V, Zn;
    b. Al, Be, Cd, La, Li, Ni, Tl;
    c. As, B, Ba, Mg, Mo, P, Sn;

   d. Cu, Fe, Na, Pt, Sr, Te, Y;
   e. Cr, K, Sb, Se, Ti, Zr; and
   f. Si, W (distilled water only)

13. Analyze a standard for every ten samples.
14. Check recoveries with at least two spiked media blanks per ten samples.

MEASUREMENT:

15. Set spectrometer to conditions specified by manufacturer.
16. Analyze standards and samples.
    NOTE: If the values for the samples are above the range of the standards, dilute the solutions with dilution acid, reanalyze and apply the appropriate dilution factor in the calculations.

CALCULATIONS:

17. Obtain the solution concentrations for the sample, C_s (µg/mL), and the average media blank, C_b (µg/mL), from the instrument.
18. Using the solution volumes of sample, V_s (mL), and media blank, V_b (mL), calculate the concentration, C (mg/m³), of each element in the air volume sampled, V (L):

$$C = \frac{C_s V_s - C_b V_b}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Method P&CAM 351 was evaluated in 1981 [1,2]. The precision and recovery data were determined at 2.5 and 1000 µg of each element per sample on spiked filters. The precision and recovery data, instumental detection limits, sensitivity, and analytical wavelengths are listed in Table 2. The values in Table 2 were determined with a Jarrell-Ash Model 1160 ICP operated according to manufacturer's instructions.

REFERENCES:

[1] Hull, R.D. "Multielement Analysis of Industrial Hygiene Samples," NIOSH Internal Report, presented at the American Industrial Hygiene Conference, Portland, Oregon (May 1981).
[2] NIOSH Manual of Analytical Methods, 2nd ed., V. 7, P&CAM 351, U.S. Department of Health and Human Services, Publ. (NIOSH) 82-100 (1981).
[3] Ibid, S341 (Lead).
[4] Ibid, V. 2, S5 (Manganese), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-B (1977).
[5] Ibid, V. 4, P&CAM 271 (Tungsten), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-175 (1978).
[6] Ibid, V. 5, P&CAM 173 (Metals by Atomic Absorption), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 79-141 (1979).
[7] Ibid, V. 3, S183 (Tin), S185 (Zirconium), and S376 (Molybdenum), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).

METHOD REVISED BY: R. DeLon Hull and Mark Millson, NIOSH/DPSE.

Table 1. Properties and sampling volumes.

Element (Symbol)	Properties		Permissible Exposure Limits, mg/m³ TWA	Air Volume @ OSHA, L	
	Atomic Weight	MP, °C	OSHA/NIOSH/ACGIH	MIN	MAX
Silver (Ag)	107.87	961	0.01/ — / 0.1	250	2000
Aluminum (Al)	26.98	660	— / — / 10.	5 (g)	100 (g)
Arsenic (As)	74.92	817*	0.5/C 0.002/ 0.2	5	2000
Beryllium (Be)	9.01	1278	0.002/ 0.0005/ 0.002	1250	2000
Calcium (Ca)	40.08	842	5 (b)/ — / 2 (b)	5	200
Cadmium (Cd)	112.40	321	0.2/ 0.04/ 0.05	13	2000
Cobalt (Co)	58.93	1495	0.1/ — / 0.1	25	2000
Chromium (Cr)	52.00	1890	1.0 (c)/ 0.025/ 0.5 (c)	5	1000
Copper (Cu)	63.54	1083	1.0/ — / 1.0	5	1000
Iron (Fe)	55.85	1535	10 (b)/ — / 5 (b)	5	100
Lithium (Li)	6.94	179	0.025 (d)/ — / 0.025 (d)	100	2000
Magnesium (Mg)	24.31	651	15 (b)/ — / 10 (b)	5	67
Manganese (Mn)	54.94	1244	C 5/ — / C 5	5	200
Molybdenum (Mo)	95.94	651	15 (e)/ — / 10 (e)	5	67
Sodium (Na)	22.99	98	2 (f)/ C 2 (f)/ C 2 (f)	13	2000
Nickel (Ni)	58.71	1453	1/ 0.015/ 1 (c)	5	1000
Phosphorus (P)	30.97	44	— / — / 0.1	25 (g)	2000 (g)
Lead (Pb)	207.19	328	0.05/ 0.1/ 0.15	50	2000
Platinum (Pt)	195.09	1769	0.002 (a)/ — / 1 (c)	1250	2000
Selenium (Se)	78.96	217	0.2/ — / —	13	2000
Tin (Sn)	118.69	232	2/ — / 2 (c)	5	500
Tellurium (Te)	127.60	450	0.1/ — / 0.1	25	2000
Titanium (Ti)	47.90	1675	— / — / 10 (b)	5	100
Thallium (Tl)	204.37	304	0.1 (a)/ — / 0.1 (a)	25	2000
Vanadium (V)	50.94	1890	C 0.5/ 1 (c)/ 0.05 (V_2O_5)	5	2000
Tungsten (W)	183.85	3410	— / 5 (e)/ 5 (e)	5 (g)	200 (g)
Yttrium (Y)	88.91	1495	1/ — / 1	5	1000
Zinc (Zn)	65.37	419	5 (b)/ 5 (b)/ 5 (b)	5	200
Zirconium (Zr)	91.22	1852	5/ — / 5	5	200

(a) soluble
(b) oxide
(c) metal
(d) hydride
(e) insoluble
(f) hydroxide
(g) at the ACGIH TLV

Table 2. Measurement procedures and data (a).

				Recovery (%)		Precision (s_r) (N = 3)	
Element	Wavelength (nm)	Instrumental LOD (ng/mL)	Sensitivity (Intensity/ µg/mL)	@ 2.5 µg/ filter (b)	@ 1000 µg/ filter	@ 2.5 µg/ filter	@ 1000 µg/ filter
Ag	328.3	26	0.65	111	91	0.02	0.075
Al	308.2	14	0.23	93	100	0.092	0.023
As	193.7	13	0.57	103	99	0.062	0.026
Be	313.0	1.5	1.29	107	90	0.040	0.034
Ca	315.9	10	0.49	99	95	0.036	0.014
Cd	226.5	1.6	0.83	107	99	0.032	0.020
Co	231.2	7.4	0.38	101	95	0.040	0.005
Cr	205.6	1.3	0.50	98	106	0.053	0.016
Cu	324.8	2.1	0.72	98	99	0.036	0.022
Fe	259.9	3.9	0.13	94	97	0.068	0.016
Li	670.8	2.8	0.48	89	95	0.171	0.043
Mg	279.6	24	0.22	105	106	0.084	0.027
Mn	257.6	0.4	0.74	84	93	0.062	0.035
Mo	281.6	7.0	0.18	94	88	0.023	0.049
Na	589.0	10	0.76	(c)	101	(c)	0.045
Ni	231.6	3.4	0.41	105	97	0.027	0.020
P	214.9	22	0.17	(c)	91	(c)	0.056
Pb	220.4	17	0.42	105	95	0.060	0.011
Pt	203.7	15	0.69	106	91	0.041	0.075
Se	190.6	21	0.28	105	97	0.068	0.049
Sn	190.0	64	0.43	74	67	0.33	0.16
Te	214.3	29	0.41	102	94	0.050	0.063
Ti	334.9	1.2	0.55	96	108	0.051	0.029
Tl	190.9	17	0.22	103	99	0.043	0.017
V	310.2	3.2	0.88	99	94	0.043	0.014
W	207.9	13	2.58	35	23	0.053	0.60
Y	371.0	0.8	2.35	99	100	0.015	0.013
Zn	213.9	0.6	0.60	101	94	0.013	0.013
Zr	339.2	1.9	0.88	75	98	0.049	0.008

(a) Values reported were obtained with a Jarrell-Ash Model 1160 ICP; performance may vary with instrument and should be independently verified.

(b) 2.5 µg/filter corresponds to 5 µg/m³ for a 500-L air sample.

(c) Blank levels too high to make accurate determinations

FORMULA: various

M.W.: various

FIBERS

METHOD: 7400
ISSUED: 2/15/84
REVISION #3: 5/15/89

PROPERTIES: solid, fibrous

OSHA: 0.2 asbestos fiber (≥5 µm long)/cc;
1 asbestos fiber/cc/30 minute excursion [1]
MSHA: 2 asbestos fibers (>5 µm long)/cc [2]
NIOSH: carcinogen; control to lowest level possible [3]; 3 glass fibers (>10 µm x <3.5 µm)/cc [4]
ACGIH: 0.2 crocidolite; 0.5 amosite; 2 chrysotile and other asbestos, fibers/cc [5]

SYNONYMS: actinolite [CAS #13768-00-8] or ferroactinolite; cummingtonite-grunerite (amosite) [CAS #12172-73-5]; anthophyllite [CAS #17068-78-9]; chrysotile [CAS #12001-29-5] or serpentine; crocidolite [CAS #12001-28-4] or riebeckite; tremolite [CAS #14567-73-8]; amphibole asbestos; fibrous glass.

SAMPLING

SAMPLER: FILTER
(0.45- to 1.2-µm cellulose ester membrane, 25-mm diameter; conductive cowl on cassette)

FLOW RATE*: 0.5 to 16 L/min

VOL-MIN*: 400 L @ 0.1 fiber/cc
-MAX*: (step 4, sampling)
*Adjust to give 100 to 1300 fibers/mm^2

SHIPMENT: routine (pack to reduce shock)

SAMPLE STABILITY: stable

FIELD BLANKS: 10% of samples

ACCURACY

RANGE STUDIED: 80 to 100 fibers counted

BIAS: see EVALUATION OF METHOD

OVERALL PRECISION (s_r): 0.115 to 0.13 [7]

MEASUREMENT

TECHNIQUE: LIGHT MICROSCOPY, PHASE CONTRAST

ANALYTE: fibers (manual count)

SAMPLE PREPARATION: acetone/triacetin "hot block" method [6]

COUNTING RULES: Described in previous version of this method as A rules [1,7]

EQUIPMENT:
1. Positive phase-contrast microscope
2. Walton-Beckett graticule (100-µm field of view) Type G-22
3. phase-shift test slide (HSE/NPL)

CALIBRATION: HSE/NPL test slide

RANGE: 100 to 1300 fibers/mm^2 filter area

ESTIMATED LOD: 7 fibers/mm^2 filter area

PRECISION: 0.10 to 0.12 [7]; see EVALUATION OF METHOD

APPLICABILITY: The quantitative working range is 0.04 to 0.5 fiber/cc for a 1000-L air sample. The LOD depends on sample volume and quantity of interfering dust, and is <0.01 fiber/cc for atmospheres free of interferences. The method gives an index of airborne fibers. It is primarily used for estimating asbestos concentrations, though PCM does not differentiate between asbestos and other fibers. Use this method in conjuction with electron microscopy (e.g., Method 7402) for assistance in identification of fibers. Fiber <ca. 0.25 µm diameter will not be detected by this method [8]. This method may be used for other materials such as fibrous glass by using alternate counting rules (see Appendix C).

INTERFERENCES: Any other airborne fiber may interfere since all particles meeting the counting criteria are counted. Chain-like particles may appear fibrous. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the detection limit.

OTHER METHODS: This method introduces changes for improved sensitivity and reproducibility. It replaces P&CAM 239 [7,9] and NIOSH Method 7400, Revision #2 (dated 8/15/87).

REAGENTS:

1. Acetone.*
2. Triacetin (glycerol triacetate), reagent grade.

*See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: field monitor, 25-mm, three-piece cassette with ca. 50-mm electrically-conductive extension cowl and cellulose ester filter, 0.45- to 1.2-µm pore size, and backup pad.
   NOTE 1: Analyze representative filters for fiber background before use. Discard the filter lot if mean is ≥ 5 fibers per 100 graticule fields. These are defined as laboratory blanks. Manufacturer-provided quality assurance checks on filter blanks are normally adequate as long as field blanks are analyzed as described below.
   NOTE 2: The electrically-conductive extension cowl reduces electrostatic effects. Ground the cowl when possible during sampling [10].
   NOTE 3: Use 0.8-µm pore size filters for personal sampling. The 0.45-µm filters are recommended for sampling when performing TEM analysis on the same samples. However, their higher pressure drop precludes their use with personal sampling pumps.
2. Sampling pump, 0.5 to 16 L/min (see step 4 for flow rate), with flexible connecting tubing.
3. Microscope, positive phase (dark) contrast, with green or blue filter, adjustable field iris, 8 to 10X eye-piece, and 40 to 45X phase objective (total magnification ca. 400X); numerical aperture = 0.65 to 0.75.
4. Slides, glass, frosted-end, pre-cleaned, 25- x 75-mm.
5. Cover slips, 22- x 22-mm, No. 1-1/2, unless otherwise specified by microscope manufacturer.
6. Lacquer or nail polish.
7. Knife, #10 surgical steel, curved blade.
8. Tweezers.
9. Heated aluminum block for clearing filters on glass slides (see ref. [6] for specifications or see manufacturer's instructions for equivalent devices).
10. Micropipets, 5-µL and 100- to 500-µL.
11. Graticule, Walton-Beckett type, 100-µm diameter circular field (area = 0.00785 mm^2) at specimen plane (Type G-22). Available from PTR Optics Ltd., 145 Newton Street, Waltham, MA 02154 [phone (617) 891-6000] and McCrone Accessories and Components, 850 Pasquinelli Drive, Westmont, IL 60559 [phone (312) 887-7100].
    NOTE: The graticule is custom-made for each microscope. (See Appendix A for the custom-ordering procedure).
12. HSE/NPL phase contrast test slide, Mark II. Available from PTR Optics Ltd. (address above).
13. Telescope, ocular phase-ring centering.
14. Stage micrometer (0.01-mm divisions).
15. Wire, multi-stranded, 22-gauge.
16. Tape, shrink- or adhesive-.

SPECIAL PRECAUTIONS: Acetone is extremely flammable. Take precautions not to ignite it. Heating of acetone in volumes greater than 1 mL must be done in a ventilated laboratory fume hood using a flameless, spark-free heat source.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. For personal sampling, fasten sampler to the worker's lapel near the worker's mouth. Remove top cover from cowl extension ("open-face") and orient face down. Wrap joint between cowl and monitor body with tape to help hold the cassette together, keep the joint free of dust, and provide a marking surface to identify the cassette.

   NOTE: If possible, ground the cassette to remove any surface charge, using a wire held in contact (e.g., with a hose clamp) with the conductive cowl and an earth ground such as a cold-water pipe.
3. Submit at least two field blanks (or 10% of the total samples, whichever is greater) for each set of samples. Handle field blanks in the same fashion as other samplers. Open field blank cassettes at the same time as other cassettes just prior to sampling. Store top covers and cassettes in a clean area with the top covers from the sampling cassettes during the sampling period.
4. Sample at 0.5 L/min or greater [11]. Adjust sampling flow rate, Q (L/min), and time, t(min), to produce a fiber density, E, of 100 to 1300 fibers/mm^2 ($3.85 \bullet 10^4$ to $5 \bullet 10^5$ fibers per 25-mm filter with effective collection area $A_c = 385\ mm^2$) for optimum accuracy. These variables are related to the action level (one-half the current standard), L (fibers/cc), of the fibrous aerosol being sampled by:

$$t = \frac{A_c \bullet E}{Q \bullet L \bullet 10^3}, \text{ min.}$$

   NOTE 1: The purpose of adjusting sampling times is to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for 8 hrs is appropriate in atmospheres containing ca. 0.1 fiber/cc in the absense of significant amounts of non-asbestos dust. Dusty atmospheres require smaller sample volumes ($\leq$400 L) to obtain countable samples. In such cases take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high flow rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres, where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3000 to 10000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust. If $\geq$ 50% of the filter surface is covered with particles, the filter may be too overloaded to count and will bias the measured fiber concentration.

   NOTE 2: OSHA regulations specify a maximum sampling rate of 2.5 L/min [1].

   NOTE 3: OSHA regulations specify a minimum sampling volume of 48 L for an excursion measurement [1].
5. At the end of sampling, replace top cover and end plugs.
6. Ship samples with conductive cowl attached in a rigid container with packing material to prevent jostling or damage.

   NOTE: Do not use untreated polystyrene foam in shipping container because electrostatic forces may cause fiber loss from sample filter.

SAMPLE PREPARATION:

NOTE 1: The object is to produce samples with a smooth (non-grainy) background in a medium with refractive index of $\leq$1.46. This method collapses the filter for easier focusing and produces relatively permanent mounts which are useful for quality control and interlaboratory comparison. The aluminum "hot block" or similar flash vaporization techniques may be used outside the laboratory [6]. Other mounting techniques meeting the above criteria may also be used (e.g., the laboratory fume hood procedure for generating acetone vapor as described in Method 7400 - revision of 5/15/85, or the non-permanent field mounting technique used in P&CAM 239 [3,7,9,12]). A videotape of the mounting procedure is available from the NIOSH Publication Office [13].

NOTE 2: Excessive water in the acetone may slow the clearing of the filters, causing material to be washed off the surface of the filter. Also, filters that have been exposed to high humidities prior to clearing may have a grainy background.

7. Ensure that the glass slides and cover slips are free of dust and fibers.
8. Adjust the rheostat to heat the "hot block" to ca. 70 °C [6].

   NOTE: If the "hot block" is not used in a fume hood, it must rest on a ceramic plate and be isolated from any surface susceptible to heat damage.
9. Mount a wedge cut from the sample filter on a clean glass slide.
   a. Cut wedges of ca. 25% of the filter area with a curved-blade knife using a rocking motion to prevent tearing. Place wedge, dust side up, on slide.

      NOTE: Static electricity will usually keep the wedge on the slide.
   b. Insert slide with wedge into the receiving slot at the base of "hot block". Immediately place tip of a micropipet containing ca. 250 µL acetone (use the minimum volume needed to consistently clear the filter sections) into the inlet port of the PTFE cap on top of the "hot block" and inject the acetone into the vaporization chamber with a slow, steady pressure on the plunger button while holding pipet firmly in place. After waiting 3 to 5 sec for the filter to clear, remove pipet and slide from their ports.

      CAUTION: Although the volume of acetone used is small, use safety precautions. Work in a well-ventilated area (e.g., laboratory fume hood). Take care not to ignite the acetone. Continuous, frequent use of this device in an unventilated space may produce explosive acetone vapor concentrations.
   c. Using the 5-µL micropipet, immediately place 3.0 to 3.5 µL triacetin on the wedge. Gently lower a clean cover slip onto the wedge at a slight angle to reduce bubble formation. Avoid excess pressure and movement of the cover glass.

      NOTE: If too many bubbles form or the amount of triacetin is insufficient, the cover slip may become detached within a few hours. If excessive triacetin remains at the edge of the filter under the cover slip, fiber migration may occur.
   d. Glue the edges of the cover slip to the slide using lacquer or nail polish [14] Counting may proceed immediately after clearing and mounting are completed.

      NOTE: If clearing is slow, warm the slide on a hotplate (surface temperature 50 °C) for up to 15 min to hasten clearing. Heat carefully to prevent gas bubble formation.

CALIBRATION AND QUALITY CONTROL:

10. Microscope adjustments. Follow the manufacturer's instructions. At least once daily use the telescope ocular (or Bertrand lens, for some microscopes) supplied by the manufacturer to ensure that the phase rings (annular diaphragm and phase-shifting elements) are concentric. With each microscope, keep a logbook in which to record the dates of calibrations and major servicings.
    a. Each time a sample is examined, do the following:
       (1) Adjust the light source for even illumination across the field of view at the condenser iris. Use Kohler illumination, if available. With some microscopes, the illumination may have to be set up with bright field optics rather than phase contrast optics.
       (2) Focus on the particulate material to be examined.
       (3) Make sure that the field iris is in focus, centered on the sample, and open only enough to fully illuminate the field of view.
    b. Check the phase-shift detection limit of the microscope periodically for each analyst/microscope combination:
       (1) Center the HSE/NPL phase-contrast test slide under the phase objective.
       (2) Bring the blocks of grooved lines into focus in the graticule area.

          NOTE: The slide contains seven blocks of grooves (ca. 20 grooves per block) in descending order of visibility. For asbestos counting the microscope optics must completely resolve the grooved lines in block 3 although they may appear somewhat faint, and the grooved lines in blocks 6 and 7 must be invisible when centered in the graticule area. Blocks 4 or 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope which fails to meet these requirements has resolution either too low or too high for fiber counting.

(3) If image quality deteriorates, clean the microscope optics. If the problem persists, consult the microscope manufacturer.

11. Document the laboratory's precision for each counter for replicate fiber counts.
    a. Maintain as part of the laboratory quality assurance program a set of reference slides to be used on a daily basis [15]. These slides should consist of filter preparations including a range of loadings and background dust levels from a variety of sources including both field and PAT samples. The Quality Assurance Officer should maintain custody of the reference slides and should supply each counter with a minimum of one reference slide per workday. Change the labels on the reference slides periodically so that the counter does not become familiar with the samples.
    b. From blind repeat counts on reference slides, estimate the laboratory intra- and intercounter s_r (step 21). Obtain separate values of relative standard deviation for each sample matrix analyzed in each of the following ranges: 5 to 20 fibers in 100 graticule fields, >20 to 50 fibers in 100 graticule fields, >50 to 100 fibers in 100 graticule fields, and 100 fibers in less than 100 graticule fields. Maintain control charts for each of these data files.

       NOTE: Certain sample matrices (e.g., asbestos cement) have been shown to give poor precision [16]

12. Prepare and count field blanks along with the field samples. Report counts on each field blank.

    NOTE 1: The identity of blank filters should be unknown to the counter until all counts have been completed.

    NOTE 2: If a field blank yields greater than 7 fibers per 100 graticule fields, report possible contamination of the samples.

13. Perform blind recounts by the same counter on 10% of filters counted (slides relabeled by a person other than the counter). Use the following test to determine whether a pair of counts by the same counter on the same filter should be rejected because of possible bias: Discard the sample if the absolute value of the difference between the square roots of the two counts (in fiber/mm^2) exceeds 2.8 (X) s_r, where X = the average of the square roots of the two fiber counts (in fiber/mm^2) and s_r = one-half the intracounter relative standard deviation for the appropriate count range (in fibers) determined from step 11. For more complete discussions see reference [15].

    NOTE 1: Since fiber counting is the measurement of randomly placed fibers which may be described by a Poisson distribution, a square root transformation of the fiber count data will result in approximately normally distributed data [15].

    NOTE 2: If a pair of counts is rejected by this test, recount the remaining samples in the set and test the new counts against the first counts. Discard all rejected paired counts. It is not necessary to use this statistic on blank counts.

14. The analyst is a critical part of this analytical procedure. Care must be taken to provide a non-stressful and comfortable environment for fiber counting. An ergonomically designed chair should be used, with the microscope eyepiece situated at a comfortable height for viewing. External lighting should be set at a level similar to the illumination level in the microscope to reduce eye fatigue. In addition, counters should take 10 to 20 minute breaks from the microscope every one or two hours to limit fatigue [17]. During these breaks, both eye and upper back/neck exercises should be performed to relieve strain.

15. All laboratories engaged in asbestos counting should participate in a proficiency testing program such as the AIHA-NIOSH Proficiency Analytical Testing (PAT) Program or the AIHA Asbestos Analyst Registry and routinely exchange field samples with other laboratories to compare performance of counters.

    NOTE: OSHA requires that each analyst performing this method take the NIOSH direct training course #582 or equivalent [1]. Instructors of equivalent courses should have attended the NIOSH #582 course at NIOSH within three years of presenting an equivalent course.

FORMULA: various

M.W.: various

ASBESTOS (bulk)

METHOD: 9002
ISSUED: 5/15/89

EPA Standard (Bulk): 1%

PROPERTIES: solid, fibrous, crystalline, anisotropic

SYNONYMS: actinolite [CAS #13768-00-8], or ferroactinolite; cummingtonite-grunerite (amosite) [CAS #12172-73-5]; anthophyllite [CAS #17068-78-9]; chrysotile [CAS #12001-29-5] or serpentine; crocidolite [CAS #12001-28-4] or riebeckite; tremolite [CAS #14567-73-8]; amphibole asbestos.

SAMPLING

BULK SAMPLE: 1 to 10 grams

SHIPMENT: seal securely to prevent escape of asbestos

SAMPLE STABILITY: stable

BLANKS: none required

ACCURACY

RANGE STUDIED: <1% to 100% asbestos

BIAS: not determined

PRECISION: not determined

MEASUREMENT

TECHNIQUE: MICROSCOPY, STEREO AND POLARIZED LIGHT, WITH DISPERSION STAINING

ANALYTE: actinolite asbestos, amosite, anthophyllite asbestos, chrysotile, crocidolite, tremolite asbestos

EQUIPMENT: microscope, polarized light: 100-400X dispersion staining objective, stereo microscope: 10-45X

RANGE: 1% to 100% asbestos

ESTIMATED LOD: <1% asbestos [1]

PRECISION: not determined

APPLICABILITY: This method is useful for the qualitative identification of asbestos and the semi-quantitative determination of asbestos content of bulk samples, expressed as a percent of projected area. The method measures percent asbestos as perceived by the analyst in comparison to standard area projections, photos, and drawings, or trained experience. The method is not applicable to samples containing large amounts of fine fibers below the resolution of the light microscope.

INTERFERENCES: Other fibers with optical properties similar to the asbestos minerals may give positive interferences. Optical properties of asbestos may be obscured by coating on the fibers. Fibers finer than the resolving power of the microscope (ca. 0.3 µm) will not be detected. Heat and acid treatment may alter the index of refraction of asbestos and change its color.

OTHER METHODS: This method (originally designated as method 7403) is designed for use with NIOSH Methods 7400 (phase contrast microscopy) and 7402 (electron microscopy/EDS). The method is similar to the EPA bulk asbestos method [1].

REAGENTS:

1. Refractive index (RI) liquids for Dispersion Staining: high-dispersion (HD) series, 1.550, 1.605, 1.620.
2. Refractive index liquids: 1.670, 1.680, and 1.700.
3. Asbestos reference samples such as SRM #1866, available from the National Institute of Standards and Technology.*
4. Distilled Water (optional).
5. Concentrated HCl: ACS reagent grade (optional).

*See SPECIAL PRECAUTIONS

EQUIPMENT:

1. Sample containers: screw-top plastic vials of 10- to 50-mL capacity.
2. Microscope, polarized light, with polarizer, analyzer, port for retardation plate, 360° graduated rotating stage, substage condenser with iris, lamp, lamp iris, and:
   a. Objective lenses: 10X, 20x, and 40X or near equivalent.
   b. Ocular lense: 10X minimum.
   c. Eyepiece reticle: crosshair.
   d. Dispersion staining objective lens or equivalent.
   e. Compensator plate: ca. 550 nm ± 20 nm, retardation: "first order red" compensator.
3. Microscope slides: 75 mm x 25 mm.
4. Cover slips: 22 mm x 22 mm.
5. Ventilated hood or negative pressure glove box.
6. Mortar and pestle: agate or porcelain.
7. Stereomicroscope, ca. 10 to 45X.
8. Light source: incandescent or fluorescent.
9. Tweezers, dissecting needles, spatulas, probes, and scalpels.
10. Glassine paper or clean glass plate.
11. Low-speed hand drill with coarse burr bit (optional).

SPECIAL PRECAUTIONS: Asbestos, a human carcinogen, should be handled only in an exhaust hood (equipped with a HEPA filter). [2] Precautions should be taken when collecting unknown samples, which may be asbestos, to preclude exposure to the person collecting the sample and minimize the disruption to the parent material [3]. Disposal of asbestos-containing materials should follow EPA Guidelines [4].

SAMPLING:

1. Place 1 to 10 g of the material to be analyzed in a sample container.
   NOTE: For large samples (i.e., whole ceiling tiles) that are fairly homogenous, a representative small portion should be submitted for analysis. Sample size should be adjusted to ensure that it is representative of the parent material.
2. Make sure that sample containers are taped so they will not open in transit.
3. Ship the samples in a rigid container with sufficient packing material to prevent damage or sample loss.

SAMPLE PREPARATION:

4. Visually examine samples in the container and with a low-magnification stereomicroscope in a hood. (If necessary, a sample may be carefully removed from the container and placed on glassine transfer paper or clean glass plate for examination). Break off a portion of the sample and examine the edges for emergent fibers. Note the homogeneity of the sample. Some hard tiles can be broken, and the edges examined for emergent fibers. If fibers are found, make an estimate of the amount and type of fibers present, confirm fiber type (steps 6 through 13) and quantify (steps 14 through 16).

5. In a hood, open sample container and with tweezers remove small, representative portions of the sample.
   a. If there are obvious separable layers, sample and analyze each layer separately.
   b. If the sample appears to be slightly inhomogeneous, mix it in the sample container with tweezers or a spatula before taking the portion for analysis. Alternatively, take small representative portions of each type of material and place on a glass slide.
   c. On hard tiles that may have thin, inseparable layers, use a scalpel to cut through all the layers for a representative sample. Then cut it into smaller pieces after placing RI liquid on it before trying to reduce the thickness. Alternatively, use a low-speed hand drill equipped with a burr bit to remove material from hard tiles. Avoid excessive heating of the sample which may alter the optical properties of the material.
      NOTE: This type of sample ofter requires ashing or other specialized preparation.
   d. If the sample has large, hard particles, grind it in a mortar. Do not grind so fine that fiber characteristics are destroyed.
   e. If necessary, treat a portion of the sample in a hood with an appropriate solvent to remove binders, tars, and other interfering materials which may be present in the sample. Make corrections for the non-asbestos material removed by this process.
      NOTE: Other methods of sample preparation such as acid and sodium metaphosphate treatment and ashing are not normally necessary. However, if needed, use as described in Reference [1].
6. After placing a few drops of RI liquid on the slide, put a small portion of sample in the liquid. Tease apart with a needle or smash small clumps with the flat end of a spatula or probe, producing a uniform thickness of particles so that better estimates of projected area percentages can be made. Mix the fibers and particles on the slide so that they are as homogeneous as possible.
   NOTE: An even dispersion of sample should cover the entire area under the cover slip. Some practice will be necessary to judge the right amount of material to place on the slide. Too little sample may not give sufficient information and too much sample cannot be easily analyzed.

CALIBRATION AND QUALITY CONTROL:

7. Check for contamination of microscope slides, cover slips and refractive index liquids once per day of operation. Record results in a separate logbook.
8. Verify the refractive indices of the refractive index liquids used once per week of operation. Record these checks in a separate logbook.
9. Follow the manufacturer's instructions for illumination, condenser alignment and other microscope adjustments. Perform these adjustments prior to each sample set.
10. Determine precent of each identified asbestos species by comparision to standard projections (Figure 1) [1]. If no fibers are detected in a homogeneous sample, examine at least two additional preparations before concluding that no asbestos is present.
11. If it appears that the preparation technique might not be able to produce a homogeneous or representative sample on the slide, prepare a duplicate slide and average the results. Occasionally, when the duplicate results vary greatly, it will be necessary to prepare additional replicate slides and average all the replicate results. Prepare duplicate slides of at least 10% of the samples analyzed. Average the results for reporting.
12. Analyze about 5% blind samples of known asbestos content.
13. Laboratories performing this analytical method should participate in the National Voluntary Labortory Accreditation Program [5] or a similar interlaboratory quality control program. Each analyst should have completed formal training in polarized light microscopy and its application to crystalline materials. In lieu of formal training, laboratory training in asbestos bulk analysis under the direction of a trained asbestos bulk analyst may be substituted. Due to the subjective nature of the method, frequent practice is essential in order to remain proficient in estimating projected area percentages.

QUALITATIVE ASSESSMENT:

14. Scan the slide to identify any asbestos minerals using the optical properties of morphology, refractive indices, color, pleochroism, birefringence, extinction characteristics, sign of elongation, and dispersion staining characteristics.

    NOTE: Identification of asbestos using polarized light microscopy is unlike most other analytical methods. The quality of the results is dependent on the skill and judgment of the analyst. This method does not lend itself easily to a step-wise approach. Various procedures devised by different analysts may yield equivalent results. The following step-wise procedure repeatedly utilizes the sample preparation procedure previously outlined.

    a. Prepare a slide using 1.550 HD RI liquid. Adjust the polarizing filter such that the polars are partially crossed, with ca. 15° offset. Scan the preparation, examining the morphology for the presence of fibers. If no fibers are found, scan the additional preparations. If no fibers are found in any of the preparations, report that the sample does not contain asbestos, and stop the analysis at this point.
    b. If fibers are found, adjust the polarizing filter such that the polars are fully crossed. If all of the fibers are isotropic (disappear at all angles of rotation) then those fibers are not asbestos. Fibrous glass and mineral wool, which are common components of suspect samples, are isotropic. If only isotropic fibers are found in the additional preparations, report no asbestos fibers detected, and stop the analysis.
    c. If anisotropic fibers are found, rotate the stage to determine the angle of extinction. Except for tremolite-actinolite asbestos which has oblique extinction at 10-20°, the other forms of asbestos exhibit parallel extinction. Tremolite may show both parallel and oblique extinction.
    d. Insert the first-order red compensator plate in the microscope and determine the sign of elongation. All forms of asbestos have a postive sign of elongation except for crocidolite. If the sign of elongation observed is negative, go to step "g".

       NOTE: To determine the direction of the sign of elongation on a particular microscope configuration, examine a known chrysotile sample and note the direction (NE-SW or NW-SE) of the blue coloration. Chrysotile has a positive sign of elongation.
    e. Remove the first-order red compensator and uncross the polarizer. Examine under plane polarized light for blue and gold-brown Becke colors at the fiber-oil interface (i.e., index of refraction match). Becke colors are not always evident. Examine fiber morphology for twisted, wavy bundles of fibers which are characteristic of chrysotile. Twisted, ribbon-like morphology with cellular internal features may indicate cellulose fibers. It may be necessary to cross the polars partially in order to see the fibers if the index of refraction is an exact match at 1.550. If the fibers appear to have higher index of refraction, go to step "h", otherwise continue.
    f. Identification of chrysotile. Insert the dispersion staining objective. Observing dispersion staining colors of blue and blue-magenta confirms chrysotile. Cellulose, which is a common interfering fiber at the 1.550 index of refraction, will not exhibit these dispersion staining colors. If chrysotile is found, go to step 15 for quantitative estimation.
    g. Identification of crocidolite. Prepare a slide in 1.700 RI liquid. Examine under plane-polarized light (uncrossed polars); check for morphology of crocidolite. Fibers will be straight, with rigid appearance, and may appear blue or purple-blue. Crocidolite is pleochroic, i.e., it will appear to change its color (blue or gray) as it is rotated through plane polarized light. Insert the dispersion staining objective. The central stop dispersion staining colors are red magenta and blue magenta, however these colors are sometimes difficult to impossible to see because of the opacity of the dark blue fibers. If observations above indicate crocidolite, go to step 15 for quantitative estimation.

h. Identification of amosite. Prepare a slide in 1.680 RI liquid. Observe the fiber morphology for amosite characteristics: straight fibers and fiber bundles with broom-like or splayed ends. If the morphology matches amosite, examine the fibers using the dispersion staining objective. Blue and pale blue colors indicate the cummingtonite form of amosite, and gold and blue colors indicate the grunerite form of amosite. If amosite is confirmed by this test, go to step 15 for quantitative estimation, otherwise continue.

i. Identification of anthophyllite-tremolite-actinolite. Prepare a slide in 1.605 HD RI liquid. Examine morphology for comparision to anthophyllite-tremolite-actinolite asbestos. The refractive indices for these forms of asbestos vary naturally within the species. Anthophyllite can be distinguished from actinolite and tremolite by its nearly parallel extinction. Actinolite has a light to dark green color under plane-polarized light and exhibits some pleochroism. For all three, fibers will be straight, single fibers possibly with some larger composite fibers. Cleavage fragments may also be present. Examine using the central stop dispersion staining objective. Anthophyllite will exhibit central stop colors of blue and gold/gold-magenta; tremolite will exhibit pale blue and yellow; and actinolite will exhibit magenta and golden-yellow colors.

NOTE: In this refractive index range, wollastonite is a common interfering mineral with similiar morphology including the presence of cleavage fragments. It has both positive and negative sign of elongation, parallel extinction, and central stop dispersion staining colors of pale yellow and pale yellow to magenta. If further confirmation of wollastonite versus anthophyllite is needed, go to step "j". If any of the above forms of asbestos was confirmed above, go to step 15 for quantitative estimation. If none of the tests above confirmed asbestos fibers, examine the additional preparations and if the same result occurs, report the absence of asbestos in this sample.

j. Wash a small portion of the sample in a drop of concentrated hydrochloric acid on a slide. Place the slide, with cover slip in place, on a warm hot plate until dry. By capillary action, place 1.620 RI liquid under the cover slip and examine the slide. Wollastonite fibers will have a "cross-hatched" appearance across the length of the fibers and will not show central stop dispersion colors. Anthophyllite and tremolite will still show their original dispersion colors.

NOTE: There are alternative analysis procedures to the step-wise approach outlined above which will yield equivalent results. Some of these alternatives are:

i. Perform the initial scan for the presence of asbestos using crossed polars as well as the first-order red compensator. This allows for simultaneous viewing of birefringent and amorphous materials as well as determining their sign of elongation. Some fibers which are covered with mortar may best be observed using this configuration.

ii. Some analysts prefer to mount their first preparation in a RI liquid different than any asbestos materials and conduct their initial examination under plane-polarized light.

iii. If alternative RI liquids are used from those specified, dispersion staining colors observed will also change. Refer to an appropriate reference for the specific colors associated with asbestos in the RI liquids actually used.

QUANTITATIVE ASSESSMENT:

15. Estimate the content of the asbestos type present in the sample using the 1.550 RI preparation. Express the estimate as an area percent of all material present, taking into account the loading and distribution of all sample material on the slide. Use Figure 1 as an aid in arriving at your estimate. If additional unidentified fibers are present in the sample, continue with the qualitative measurement (step 14).

NOTE: Point-counting techniques to determine percentages of the asbestos minerals are not generally recommended. The point-counting method only produces accurate quantitative data when the material on the slide is homogeneous and has a uniform thickness, which is difficult to obtain [6]. The point-counting technique is, recommended by the EPA to determine the amount of asbestos in bulk [1]; however in the more recent Asbestos Hazard Emergency Response Act (AHERA) regulations, asbestos quantification may be performed by a point-counting or equivalent estimation method [7].

16. Make a quantitative estimate of the asbestos content of the sample from the appropriate combination of the estimates from both the gross and microscopic examinations. If asbestos fibers are identified, report the material as "asbestos-containing". Asbestos content should be reported as a range of percent content. The range reported should be indicative of the analyst's precision in estimating asbestos content. For greater quantities use Figure 1 in arriving at your estimate.

EVALUATION OF METHOD:

The method is compiled from standard techniques used in mineralogy [8-13], and from standard laboratory procedures for bulk asbestos analysis which have been utilized for several years. These techniques have been successfully applied to the analysis of EPA Bulk Sample Analysis Quality Assurance Program samples for more than 8 years [1,5]. However, no formal evaluation of this method, as written, has been performed.

REFERENCES:

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METHOD WRITTEN BY: Patricia A. Klinger, CIHT, and Keith R. Nicholson, CIH, DataChem, Inc., Salt Lake City, Utah, under NIOSH Contract 200-84-2608, and Frank J. Hearl, PE and John T. Jankovic, CIH, NIOSH/DRDS.

Table 1. Optical Properties of Asbestos Fibers

		Refractive Index (Approximate Values)		
Mineral	Morphology and Color	⊥ to Elongation	‖ to Elongation	Birefringence
Chrysotile	Wavy fibers with kinks. Splayed ends on larger bundles. Colorless to light brown upon being heated. Nonpleochroic. Aspect ratio typically >10:1.	1.54	1.55	0.002 - 0.014
Cummingtonite-Grunerite (Amosite)	Straight fibers and fiber bundles. Bundle ends appear broom-like or splayed. Colorless to brown upon heating. May be weakly pleochroic. Aspect ratio typically >10:1.	1.67	1.70	0.02 - 0.03
Crocidolite (Riebeckite)	Straight fibers and fiber bundles. Longer fibers show curvature. Splayed ends on bundles. Characteristic blue color. Pleochroic. Aspect ratio typically >10:1.	1.71	1.70	0.014 - 0.016 Interference colors may be masked by blue color.
Anthophyllite	Straight fibers and fiber bundles. Cleavage fragments may be present. Colorless to light brown. Nonpleochroic to weakly pleochroic. Aspect ratio generally <10:1.	1.61	1.63	.019 - .024
Tremolite-Actinolite	Straight and curved fibers. Cleavage fragments common. Large fiber bundles show splayed ends. Tremolite is colorless. Actinolite is green and weakly to moderately pleochroic.. Aspect ratio generally <10:1.	1.60 - 1.62 (tremolite) 1.62 - 1.67 (actinolite)	1.62 - 1.64 (tremolite) 1.64 - 1.68 (actinolite)	0.02 - 0.03

Table 1. Optical Properties of Asbestos Fibers (Continued)

			Central Stop Dispersion Staining Colors		
Mineral	Extinction	Sign of Elongation	RI Liquid	⊥ to Vibration	∥ to Vibration
Chrysotile	Parallel to fiber length	+ (length slow)	1.550 ^{HD}	Blue	Blue-magenta
Cummingtonite-Grunerite (Amosite)	Parallel to fiber length	+ (length slow)	1.670	Red magenta to blue	Yellow
			Fibers subjected to high temperatures will not dispersion-stain.		
Cummingtonite			1.680	pale blue	blue
Grunerite			1.680	blue	gold
Crocidolite (Riebeckite)	Parallel to fiber length	- (length fast)	1.700	Red magenta	Blue-magenta
			1.680	yellow	pale yellow
Anthophyllite	Parallel to fiber length	+ (length slow)	1.605 ^{HD}	Blue	Gold to gold-magenta
			1.620 ^{HD}	Blue-green	Golden-yellow
Tremolite-Actinolite	Oblique — 10 to 20° for fragments. Some composite fibers show ∥ extinction.	+ (length slow)	1.605 ^{HD}	Pale blue (tremolite) Yellow (actinolite)	Yellow (tremolite) Pale yellow (actinolite)

HD = high-dispersion RI liquid series.

ATTACHMENT 6
CALIBRATION OF MONITORING INSTRUMENTS FOR HEALTH AND SAFETY

CALIBRATION OF MONITORING INSTRUMENTS FOR HEALTH AND SAFETY

It is essential that each piece of air quality monitoring equipment be calibrated on a routine basis. This assures that a given monitoring instrument is both working and working with a reasonable degree of accuracy. This operating procedure outlines required calibration frequencies and techniques. The manufacturer's instructions for calibration should be kept at the site and consulted when calibrating monitoring instruments.

FREQUENCY OF CALIBRATION

The following instruments must be calibrated daily before use:

- Combustible Gas Indicator (CGI)
- Oxygen Meter
- HNu Photoionization Detector, Model PI101 (HNu PID)
  (As well as other photoionization detectors such as the Photovac TIP, AID OVM, etc.)
- Foxboro Organic Vapor Analyzer Flame Ionization Detector (OVA FID)
- Air Sampling Pumps

The following instruments require an annual factory calibration:

- Radiation Survey Meter

CALIBRATION TECHNIQUES

Combustible Gas Indicator

CGI's are both separate instruments or multi-purpose instruments (CGI/0_2, CGI/0_2/H_2S, etc.). CGI's are calibrated using a variety of different organic compounds. The most common of these are methane, hexane, and pentane. Allow a few minutes for instrument warmup prior to calibration. The calibration for a CGI is normally performed by attaching a cylinder of "factory" calibration gas to the CGI inlet or blanketing the CGI detector element (element) with an atmosphere from a calibration gas cylinder. The CGI readout is then set to that value using whatever device (set-screw, etc.) the CGI possesses to adjust the instrument to the calibration value.

Depending on which calibration gas is used for a particular CGI, the instrument manufacturer normally provides data on the relative response of other organic solvents relative to the "factory" calibration. For example, a CGI calibrated for methane could be used to measure benzene, if the manufacturer supplies a relative response curve for that compound. Of course, most solvent measurements are of mixtures and it is often difficult to accurately assess these mixtures. This is one reason that CGI's are normally set to alarm at conservative levels (usually 20 percent of the Lower Exposure Limit (LEL) of the organic compound chosen as the calibration standard).

Oxygen Meter

The meter should be allowed to warm up for a few minutes prior to calibration. A cylinder of calibration gas (typically containing 17 percent oxygen and 25,000 parts per million (ppm) methane) is attached to the meter inlet. (In the case of passive air flow instruments, a hood or cover is placed over the detectors and this in turn is connected to the calibration gas.) Calibration to 21 percent of 0_2 may also be performed using ambient air.

The calibration gas is turned on and is allowed to stabilize for 15 to 30 seconds. The meters are then adjusted (following manufacturer's instructions) to proper calibration. This usually involves adjusting a set screw at the base of the meter. The instrument should then be rechecked for proper return to zero.

HNu Photoionization Detector, Model PI 101 (HNu PID)

The instrument is turned to the battery check position first. Assuming proper charge, the main control switch is set to the standby position using the zero knob. The instrument is then allowed to warm up for about five minutes in the standby mode. The calibration gas (usually isobutylene from the HNu factory) is attached to the probe by a flexible hose. The proper range setting is selected (usually 0 to 200 ppm) and the calibration gas turned on.

The gas flows through an orifice which reduces its flow rate to the proper rate for calibration purposes. The normal factory calibration of this instrument is for benzene in air. Isobutylene is used for normal calibration because it is less toxic. The relative response of isobutylene as compared to benzene is about 70 percent with the 10.2 eV and 11.7 eV lamps (there is a slight difference between the relative response of the two different energy probes, but it is not considered significant for most field calibration purposes). Accordingly, a bottle of isobutylene calibration gas that contains 100 ppm isobutylene will read out at about 70 ppm on a factory calibrated instrument. A bottle of factory calibration gas will state the proper readout on the instrument "as benzene."

If the instrument does not calibrate exactly, the span pot knob is normally adjusted to bring the instrument into calibration. The normal "factory" settings are 9.8 for the 10.2 eV lamp and 5.0 for the 11.7 eV lamp. If the instrument cannot be brought into calibration by using the span pot knob, the lamp may need to be cleaned or other maintenance items performed so that the unit will calibrate accurately.

Foxboro Organic Vapor Analyzer Flame Ionization Detector (OVA FID)

The instrument must first be checked for adequate hydrogen supply and battery charge. It should then be started up and stabilized for about five minutes with the flame lit. The calibration gas (usually 100 ppm methane) is then attached to the probe inlet. The span pot is adjusted to bring the instrument into proper calibration (using the X10 scale).

Periodic Instrument Response Checks

It is important that each piece of monitoring equipment be checked occasionally during its use to determine that it is responding to contaminants. For the CGI/0_2 meter, this can be done by exhaling on the 0_2 sensor (exhaled air has less than 18 percent oxygen) periodically to check for proper alarming. A butane lighter or "Zippo" lighter can be used as a source to check for proper alarming of the CGI element.

The HNu PID should periodically be exposed to a magic marker or Zippo lighter to check response.

A butane lighter or magic marker works well to demonstrate that the OVA FID is responding.

These "response checks" are key to providing confidence to the user that the instrument is at least functioning and responding to contaminants.

The same type of response check can be performed with the radiation meter using low level test sources with the appropriate type of probe (alpha, beta, or gamma).

ATTACHMENT 7
RESUMES OF SAFETY PERSONNEL

PHILLIP L. JONES

health & safety administration
industrial hygiene
health & safety training

EDUCATION

Temple University: M.S., Industrial Hygiene, 1977
Houghton College: B.A., Chemistry, 1974

REGISTRATION

Certified Industrial Hygienist (CIH) in Comprehensive Practice by the American Board of Industrial Hygiene, 1981, Certificate #2116

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Associate, 1989-present; Corporate Health & Safety Administrator, 1985-1989
Johnson Matthey, Inc., Manager, Safety and Health, 1979-1985
PMA Insurance Company, Industrial Hygienist, 1977-1979
City of Philadelphia, Water Quality Chemist, 1975-1976

REPRESENTATIVE EXPERIENCE

Mr. Jones' twelve years of experience in occupational health/ industrial hygiene includes safety and health management at chemical process plants (Johnson Matthey, Inc.), industrial hygiene assistance to manufacturing facilities (PMA Insurance Company), as well as extensive experience in hazardous waste health and safety. Air sampling, noise monitoring, radiation monitoring, asbestos sampling, and related hazard evaluation techniques have been utilized by Mr. Jones for a broad range of work environments. In addition to the technical aspects of industrial hygiene, expertise in training, regulatory compliance, and health and safety administration is noted.

Mr. Jones' most extensive experience is in health and safety training. Training experience at Johnson Matthey, Inc. included RCRA hazardous waste safety training, management seminars on safety and health, worker training on specific hazards (lead, drum handling, platinum allergy, asbestos, etc.), hazard communication classes, and seminars for industrial hygiene graduate students. Over 100 training courses for workers at hazardous material sites have been organized and conducted by Mr. Jones since joining Woodward-Clyde Consultants. These 40-hour courses (mandated by OSHA 1910.120) include a combination of lecture and hands-on workshops with course locations including Anchorage, Baton Rouge, Chicago, Denver, Houston, Kansas City, Las Vegas, Los Angeles, New Mexico, Philadelphia, San Diego, and San Francisco.

Project experience in hazardous waste includes preparation of health and safety plans for remedial cleanup projects and remedial investigations. Sites have included the Rocky Mountain Arsenal (Colorado), Nike Missile sites (Pennsylvania, Maryland, Virginia), waste incineration site (Louisiana), construction operations at hazardous waste sites (New York), and a solvent cleanup site (New York). As Corporate Health and Safety Administrator, Mr. Jones has reviewed and approved over two hundred site-specific safety and health plans. Site audits are conducted to evaluate health and safety plan implementation.

As administrator of Woodward-Clyde Consultants health and safety program, the responsibilities include coordination of the medical surveillance and training programs for twenty-six offices, regular updating of the Health and Safety Manual, investigation of incidents, routine regulatory review, health and safety policy development, health and safety plan approval, and program record keeping.

Mr. Jones' industrial hygiene experience includes extensive studies in secondary metals refining (platinum group metals, lead, silver, gold), specialty chemicals, pharmaceutical manufacturing, and catalyst manufacturing. Additional experience is noted in oil refineries, pigment manufacturing, semiconductor production, textile manufacturing, electroplating, foundries, and asbestos abatement.

Regulatory experience includes preparation of contingency plans for compliance with the Resource Conservation and Recovery Act (RCRA) and preparation of a product application under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). Over twenty separate OSHA inspections were handled while at Johnson Matthey, Inc. including five contested citations. Hazardous waste health and safety regulatory experience includes work with EPA and the Corps of Engineers on site-specific health and safety plans.

RECENT PRESENTATIONS

Construction Health and Safety at Hazardous Waste Sites. American Industrial Hygiene Conference, June 1, 1987.

Interpreting OSHA's Hazardous Waste Workers Standard. American Public Health Association Meeting (Occupational Health and Safety Section), April 24, 1987.

Hazardous Waste Health and Safety Training for Blue Collar Workers. American Industrial Hygiene Conference, May 17, 1988.

Hazardous Waste Health and Safety for Consulting Firms. Hazardous Waste Action Coalition Meeting, November, 1987.

AFFILIATIONS

American Industrial Hygiene Association
American Society of Safety Engineers
American Academy of Industrial Hygiene
Hazardous Waste Action Coalition, Health and Safety Committee
National Environmental Training Association

MARTIN G. KEMPLIN

industrial hygiene
environmental compliance
risk assessment
health & safety training
health & safety administration
hazardous waste site
investigations & clean up

EDUCATION

Temple University, M.S., Industrial Hygiene, 1977
Oklahoma Christian College, B.S., Pre-Med, 1973

CERTIFICATION

Certified Industrial Hygienist (CIH), American Board of Industrial Hygiene, Comprehensive Practice (Certificate #2119)
EPA AHERA Asbestos Inspector and Management Planner

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Corporate Health and Safety Officer, Eastern Operating Group, 1985-Present
American Cyanamid Company, Manager, Industrial Hygiene and Environmental Affairs, Agricultural Group, 1980-1985
Glidden Coatings & Resins Division, SCM Corporation, Manager, Industrial Hygiene, 1978-1980
Nicolet, Inc., Manager, Safety and Industrial Hygiene, 1977-1978

REPRESENTATIVE EXPERIENCE

Mr. Kemplin has twelve years of professional experience as an industrial hygienist. He has been responsible for supervising environmental compliance and safety programs for numerous manufacturing facilities. His most recent areas of activity have involved hazardous waste site investigations and cleanups with particular emphasis on employee health and safety training and site safety planning.

Mr. Kemplin is currently responsible for hazardous waste site health and safety for eight Woodward-Clyde offices in the Eastern half of the United States. He is responsible for employee training, review of site safety plans, hazardous waste site auditing, and program coordination. In addition, he has worked on a wide variety of projects including a number of site health and safety reviews for the Corps of Engineers and the Department of Defense. He has participated in several asbestos sampling and exposure control programs. He has been actively involved in a number of waste removal and remediation projects including lead sludge, drummed wastes, and a wide variety of toxic materials.

Mr. Kemplin is certified to EPA Level B for hazardous waste site work. He has participated in Level B (supplied-air) projects which have included dioxin sampling in a confined space and trenching through buried drums, among other projects. He has worked on a variety of Superfund projects, including the Stringfellow Site in California.

Mr. Kemplin is an AHERA Certified Asbestos Building Inspector and Management Planner. He has participated in numerous asbestos inspection and management projects.

Mr. Kemplin has had safety, industrial hygiene, and environmental responsibility for two large American Cyanamid pesticide and fertilizer plants in North America as well as one underground limestone mine, two open-pit phosphate mines, and one pharmaceutical manufacturing plant (in Puerto Rico).

While at American Cyanamid, he performed detailed safety, industrial hygiene, and environmental audits at these facilities. He was particularly involved in the RCRA compliance program and in the inspection of off-site hazardous waste disposal facilities. He participated in employee training in Health and Safety, RCRA, and emergency response procedures.

Also while at American Cyanamid, he supervised the development of permissible exposure limits (PELs) and sampling and analytical methods for a variety of pesticide and herbicide compounds. He provided professional assistance to numerous contract formulators and specialty contract manufacturers associated with the pesticide and herbicide production processes.

Mr. Kemplin participated in numerous hazards and operability reviews (HAZOPS) of pesticide and herbicide manufacturing processes while at American Cyanamid. These reviews included step-by-step analyses of complex chemical manufacturing operations.

Mr. Kemplin was intimately involved in the development and implementation of the OSHA Hazard Communication Standard (29 CFR 1910.1200). Also while at American Cyanamid, he was an active member of the Public Risk Analysis Special Committee of the Chemical Manufacturer's Association. This committee developed numerous risk/benefit/cost scenarios to provide more disciplined techniques for risk analysis in the regulatory decision making framework.

While with SCM/Glidden, Mr. Kemplin had audit responsibility for 12 paint and coatings manufacturing plants in North America and five in Central and South America. Many of these operations included "Resin House" departments involved primarily in polymer manufacture. He developed industrial hygiene sampling programs at these facilities and performed numerous exposure and contaminant control evaluations. He assisted in the development of innovative ventilation designs for dust and solvent controls.

As part of the Occupational Health Committee of the National Paint and Coatings Association, Mr. Kemplin was instrumental in the development of the Hazardous Materials Information System (HMIS). This system is extensively used in the paint and coatings industry (as well as a variety of other industries) for hazard communication (Right-To-Know) purposes.

At Nicolet, Inc., Mr. Kemplin was responsible for safety and industrial hygiene for three manufacturing facilities involved in the manufacture of asbestos-containing products (lab table tops, asbestos paper, etc.). He instituted dust control measures including the use of ventilation systems, wet work practices, and the use of high efficiency vacuum cleaners, as well as enforcing the proper use of respirators, where required.

PROFESSIONAL AFFILIATIONS

American Industrial Hygiene Association
American Academy of Industrial Hygiene
British Occupational Hygiene Society

TRADE ASSOCIATION SERVICE

Public Risk Analysis Special Committee, Chemical Manufacturer's Association, Washington, D.C.

Occupational Safety and Health Subcommittee, National Agricultural Chemicals Association, Washington, D.C.

Occupational Health Committee, National Paint and Coatings Association, Washington, D.C.

PRESENTATIONS AND PAPERS

Hazardous waste site health and safety procedures and practices, International Conference on Ergonomics, Occupational Safety and Health and the Environment, Beijing, China, October 1988.

Managing risk factors in the selection and use of personal protective equipment (PPE) on hazardous waste sites. HMCRI Conference on Hazardous Wastes and Hazardous Materials, Las Vegas, NV, April 1988.

Meeting the new OSHA hazardous waste training requirements. HMCRI Superfund '87, Washington, D.C., November 1987.

Development of permissible exposure limits. Animal Health Institute Mid-Year Meeting, Wesley Chapel, Florida, October 1984.

ERICK SEPULVEDA

health and safety
risk assessment

EDUCATION

State University of New York at Stony Brook; B.S., Chemistry, Minor Biology, 1984

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Senior Staff Scientist, 1991-present
James C. Anderson Associates, Inc., Health and Safety, Assistant Project Manager, 1990-1991
Pall Corporation, Sr. Test Engineer, New Market Development, R&D Staff, 1984-1990

TRAINING

Hazardous Waste Management, 1986
Industrial Hydraulics and Pneumatic Systems, 1986
Advance Hazardous Waste Management (Level A/B), 1986
FT-1R Instrumentation and Analytical Evaluation, 1987
Basic Health and Safety Training, 1989
Site Supervisor Training, 1990
Air/Stack Sampling, Monitoring and Assessment, 1991
EPA/AHERA/NYState Building Inspector/Restricted III, 1991

REPRESENTATIVE EXPERIENCE

Health and Safety:

Mr. Sepulveda is the Health and Safety Officer for the New York Metropolitan Business Units. As such, he is responsible for the development of Health and Safety Plans which are site specific and meet all the compliance requirements established by WCC internal policies as well as the regulations stipulated under local, state and federal regulations. Mr. Sepulveda also supports WCC internal programs, OSHA and medical monitoring. He has received Level A, B, C and D training and has extensive experience in confined space entry work including above and below ground storage tanks, sewers and water supply tunnels.

Mr. Sepulveda is involved in Health and Safety activities involving sanitary landfills as well as hazardous waste sites, drum sampling, classification, bulking and final disposal.

In addition to landfills and hazardous waste sites, he has been involved in a number of road and rail projects where extensive monitoring of the ambient air, water and soil is demanded due to the presence of toxic materials.

Mr. Sepulveda has extensive experience in the sample collection, analysis and remediation for microorganisms (pathogenic and non-pathogenic), for indoor as well as outdoor environments. He has conducted studies on medical waste found on landfills where tubercular, legionella, coliform and hepatitis etiological agents are present. In addition he has also conducted studies in enclosed structures, such as buildings, factories, warehouses, sewage treatment plants and discharge mains.

He also has extensive experience in field sampling and inspection activities of structures insulated, built or shielded with asbestos containing materials (ACMs). Moreover, Mr. Sepulveda was heavily involved with the lab analysis of field samples, through the use of Polarized Light Microscopy (PLM), Scanning Electron Microscopy (SEM) and, gravimetric particle/fiber size and type distribution.

Filtration:

Mr. Sepulveda has extensive experience in the field of filtration and purification. He has worked on water and solid waste separation and purification systems such as reverse osmosis systems for the U. S. Navy, ultrafine filtration for water filtration and fecal separation for NASA's space shuttle and space station. He has also worked with the U.S. Armed Forces in the Nuclear, Biological and Chemical (NBC) program, gas mask air purification systems and etiological agents removal.

In addition, he was involved in the research and development and implementation of air filtering systems, industrial food and beverage filtration, industrial hydraulics and residential water filtration.

PROFESSIONAL AFFILIATIONS

American Chemical Society

MARC E. JACOBSON

hazardous waste management
site investigation
risk assessment
laboratory and analytical services

EDUCATION

Pennsylvania State University: B.S., Earth Sciences. Concentration in Geosciences, 1983

TRAINING

Hazardous Materials Health & Safety Training (OSHA); 40 hours, 1987
Advanced Health and Safety Training, Level B, 1989
Red Cross Basic First Aid Training, 1991
Red Cross CPR Training, 1991
Site Health and Safety Supervisory Training (OSHA), 1991

PROFESSIONAL HISTORY

Woodward-Clyde Consultants; Wayne, New Jersey; Senior Staff Scientist to Assistant Project Scientist, 1989 - date
Woodward-Clyde Consultants; Overland Park, Kansas; Staff Scientist, 1986 - 1989
Environmental Testing and Certification Corporation (ETC), Edison, New Jersey; Sample Manager and Production Control Supervisor, 1984 to 1986

REPRESENTATIVE EXPERIENCE

Mr. Jacobson has over seven years of experience in hazardous waste management, site investigations, risk assessment, laboratory testing and analytical services. He has participated in projects located in 11 states focused on site investigation assessment, and characterization, research, endangerment evaluation, work plan, sampling plan, QA plan development, and field activities including drilling, trenching, multi-media sampling, and groundwater remediation. His previous involvement at ETC with various aspects of sample testing and associated analytical services familiarized him with laboratory function and operation. He has served as Site Safety Officer on many sites and has extensive experience using HNu Photoionization Detectors, OVA Flame Ionization Detectors, Combustible Gas Indicators, Personal Samplers and Draeger Colorimetric Detector Tubes. He has also been responsible for preparing documentation of Health and Safety air quality monitoring on these sites. Representative examples of Mr. Jacobson's project experiences are summarized below.

Field Manager, Site Safety Officer, and sampling supervisor for a multi-phased remedial investigation at an abandoned PCB site in upstate New York. As Site Safety Officer, Mr. Jacobson was responsible for performing real-time measurements of air quality during intrusive investigatory and remedial operations.

Team member for field investigation activities at the Rocky Mountain Arsenal in Denver, Colorado. Responsibilities included preparation and peer review of field standard operating procedures (SOPs) and participated in Level C and B field activities.

Prepared the QA/QC Plan for the RI/FS project at the Pelham Bay Landfill in Bronx, New York.

Team member for field investigation activities at the Rocky Mountain Arsenal in Denver, Colorado.

Supervised installation and startup operation of a groundwater monitoring and product recovery system for an UST investigation at a trucking terminal in Carlstadt, New Jersey.

Field activities coordinator and Site Health and Safety Officer for a groundwater and soil investigation at a New Jersey ECRA site.

Prepared the Community Relations Plan and the Quality Assurance Plan for a US Army Corps of Engineers RI/FS at a former ammunitions depot in Nebraska.

Designed and implemented field sampling activities for site investigation at an abandoned metal smelting and structural steel facility in Kansas City, Kansas. Activities included soil borings, monitoring well installation, surface soil, and storm water surface runoff sampling.

Records and Sample Custodian for a remedial investigation in a pesticide-contaminated rural Illinois town. Responsible for review and approval of field documentation, coordination of packing and shipping samples to the laboratory and tracking of all samples collected. Assistant to the Field Manager in coordinating daily operations and direction of the sampling team activities. Coordinated community relations including visits to residents and integrated access locations with the planned sampling points.

Researched and developed a Level 3 Endangerment Assessment Report for a former waste disposal site at a U.S. Air Force facility in Tennessee. Concentrated on exposure assessment, chemical fate, transport integration and risk characterization as part of the Endangerment Study.

Conducted a comprehensive QA/QC audit at an environmental analytical laboratory in compliance with a site-specific QA plan.

REM II - Superfund staff member responsible for various duties and assignments pertaining to the management and enforcement support services of 23 USEPA - Region VII hazardous waste Superfund sites.

- Developed and wrote Work Plans and amendments, Project Operations and Quality Assurance Plans (POP/QAPP) and Health and Safety Plans, for presenting scope of work activities during RI/FS and enforcement support services at Superfund sites. Also responsible for QA review of Work Plan budgets.

- Performed REM II oversight of PRP field activities including soil sampling at a former pesticide plant and boring and trenching operations at a former landfill. Also responsible for split sample collection at sites for the USEPA Region VII laboratory.

Production Control Group Scheduler at an environmental testing laboratory in New Jersey. Coordinated client lab work, monitored shift production and computer status of samples for extractions and sample preparation departments. Insured accurate and proper laboratory application of USEPA, CLP and state protocols and methodologies.

Sample Manager for national testing laboratory. Duties focused on sample receipt, identification and cataloging of samples, processing documentation, client services and special handling of high hazard and complex matrix samples. Also responsible for development, review and revision of standard operating procedures and staff training.

AFFILIATIONS

Air & Waste Management Association

MARY E. P. DOMBROWSKI

geology
hydrogeology
geochemistry
water quality

EDUCATION

Indiana University: M.S., Geology, 1991
Wellesley College: B.A., Geology, 1979

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Senior Staff Hydrogeologist, 1989 to present
Hendricks and Associates, Consulting Geologist, 1984-1986
Reservoirs, Inc., Senior Geologist, 1982-1983
Gulf Oil Company, Geologist, 1980-1981

REPRESENTATIVE EXPERIENCE

Ms. Dombrowski joined Woodward-Clyde Consultants after working as a consultant in the oil industry for several years. The depositional and diagenetic models she devised for various sandstone and carbonate reservoirs were used to better understand the distribution of hydrocarbons and the hydrodynamics of oil/gas production. This work led to Ms. Dombrowski's interest in groundwater flow and mass transport.

Ms. Dombrowski's graduate studies concentrated on hydrogeology. Her thesis research on a brackish coastal lagoon documented the magnitude of the groundwater and sea water inputs to an extremely dynamic system, using a simple chemical model.

Since joining Woodward-Clyde Consultants, Ms. Dombrowski has performed field and office assignments on projects under various regulatory programs. She is experienced in groundwater and soil sampling. Specific project experience includes:

- For a major trucking facility under regulation by NJDEP's Bureau of Underground Storage Tanks, Ms. Dombrowski operated a pump-and-treat system for recovering diesel-contaminated groundwater. The ground water response to pumping was also monitored. Ms. Dombrowski prepared the DICAR (Discharge Investigation and Corrective Action Report) and the NJPDES (New Jersey Pollutant Discharge Elimination System) permit for this site.

- Ms. Dombrowski prepared the Sampling Results and Cleanup Plan report for a synthetic natural gas plant site under regulation by ECRA. The cleanup plan was accepted by NJDEP.

- Ms. Dombrowski is currently involved with a RCRA Facility Investigation at a former pharmaceutical facility. Specifically, she is task leader for the hydrological investigation involving a river flowing through the site. Ms. Dombrowski was responsible for preparing the geology, hydrogeology, and hydrology sections of the Phase I report for this site.

TRAINING

40-Hour Basic Health and Safety Training under OSHA 1910.120 for Hazardous Waste Workers, September 1989

AFFILIATIONS

Association of Groundwater Scientists and Engineers - National Water Well Association (AGWSE-NWWA)

PUBLICATIONS

Salinity variations and tidal flushing in a coastal lagoon, Edgartown Great Pond, Edgartown, Massachusetts, unpublished Master's thesis, Indiana University, Bloomington, Indiana.

ATTACHMENT 8
REQUIRED PERSONAL PROTECTIVE EQUIPMENT

REQUIRED PERSONAL PROTECTIVE EQUIPMENT

LEVEL D PERSONAL PROTECTIVE EQUIPMENT

- Hard hat using the SAEP recommended colors
- Safety glasses, goggles, or face shield(1)
- Chemical-resistant steel-toed and steel shank work boots (PVC) or rubber
- Overboots or disposable "booties" (dark color preferred)(2)
- Outer gloves(3)
- Latex surgical gloves (to be worn underneath outer gloves)
- Gray or dark blue Tyvek coveralls

(1) if splash or dust hazard exists

(2) personnel should wear neoprene overboots or "booties" in Areas 1, 3 and 8 as identified on Figure 2-2 of the Work Plan as these areas may contain PCBs; rubber overboots or "booties" should be worn, as required, in other areas of the facility.

(3) personnel should wear neoprene outer gloves in Areas 1, 3 and 8 as identified in Figure 2-2 of the Work Plan as these areas may contain PCBs; nitrile rubber outer gloves should be worn, as required, in other areas of the facility.

LEVEL C PERSONAL PROTECTIVE EQUIPMENT

- Hard hat using the SAEP's recommended colors
- Full-face air purifying respirator with GMC-H combination cartridges
- Chemical-resistant steel-toed and steel shank work boots
- Nitrile rubber or neoprene outer gloves(1)
- Latex surgical gloves (to be worn underneath outer gloves)
- Rubber or neoprene overboots or disposable "booties" (dark color preferred)(1)
- Gray or dark blue hooded Saranex impregnated or polycoated Tyvek coveralls (taped at cuffs)

(1) choice at discretion of SSHO

LEVEL B PERSONAL PROTECTIVE EQUIPMENT

- Positive pressure-demand full-facepiece self-contained breathing apparatus (SCBA), or positive pressure-demand supplied air respirator with escape SCBA
- Gray or dark blue hooded Saranex impregnated or polycoated Tyvek coveralls (taped at cuffs, seams and facepiece)
- Nitrile rubber or neoprene outer gloves (1)
- Latex surgical gloves (to be worn underneath outer gloves)
- Chemical-resistant steel-toed and steel shank work boots
- Rubber or neoprene overboots or disposable "booties" (dark color preferred)(1)

(1) choice at discretion of SSHO

ATTACHMENT 9
MEDICAL SURVEILLANCE PROGRAM

MEDICAL SURVEILLANCE PROGRAM

Medical surveillance is a major component of the WCC health and safety program. It was established to monitor and promote the health of employees engaged in projects which have the potential for exposure to hazardous substances.

Medical surveillance provides a clinical base of information useful in evaluating employee's fitness to work at hazardous waste sites, to identify anomalies in a person's medical history that may be related to potential impaired health, to evaluate a person's capability to use respiratory protection equipment, and to identify illnesses that may be related to chemical exposure while on the job. This base of medical information includes personnel health history, exposure history, physical examination results, laboratory analyses, and results of screening and special tests. Medical examinations include:

- **Past Medical History** - on entry to the program, information concerning past occupational exposures and personal as well as family history of disease.
- **Present Medical Profile** - all pertinent medical information regarding present state of health and during each year of field work in hazardous material projects.
- **Exposure History** - information concerning the cumulative duration of time spent on potentially hazardous sites, the primary toxic substances, and the levels of protection employed by each site.
- **Laboratory Analyses** - hematology, liver and kidney function tests, and urinalysis.
- **Hearing test.**
- **Vision test.**
- **Pulmonary function test.**
- **Electrocardiogram.**

- **X-ray.**

- **Physical examination.**

- **Special Tests** - medical information concerning the effects of exposure to specific contaminants.

OBJECTIVES

The objectives of the medical surveillance component of the health and safety program are:

- Protect the health of employees assigned to work on hazardous material projects.

- Pre-assignment screening of employee's health to determine present status and to identify existing problems that may be aggravated by chemical exposures or physical stress.

- Monitoring employee health for early signs of work-related illness and employee suitability for further field or laboratory assignments on sites containing potentially hazardous substances.

- Evaluation and care of individuals with work-related illnesses or injuries.

- Satisfy the requirements of OSHA Part 1910.134 regarding respiratory protection and OSHA 1910.120 for hazardous waste workers.

RESPONSIBILITIES OF WCC OPERATING UNITS

Each operating unit, through its HSO, must comply with the medical surveillance provisions of the health and safety program. It is the responsibility of the operating unit manager to assure that the following activities are punctually and thoroughly conducted.

- Arrange for health monitoring services by a qualified local physician or medical organization, preferably with occupational health expertise. The physician must be willing to perform all physician-related tasks described in the WC medical surveillance program.

- Identify personnel within the operating unit required to enter the program.

- Inform participants of the specific arrangements for scheduling and receiving medical examinations.

- Comply with the examining and/or the reviewing physician's recommendations regarding work restrictions and attending to all work-related illnesses.

- Document and report work/exposure histories for all employees engaged in field activities.

REQUIREMENTS

Under Part 1910.120, OSHA requires medical surveillance for personnel involved in hazardous waste operations. OSHA states that persons should not be assigned to tasks unless it has been determined that they are physically able to perform the work and use the equipment.

The OSHA program has two essential components: routine health care and emergency treatment. Routine health care and maintenance shall consist of at least:

1. Pre-employment medical examinations to establish the individual's state of health, baseline physiological data, and ability to wear personal protective equipment. The frequency and type of examination to be conducted thereafter should be determined by medical personnel knowledgeable in the area of occupational medicine.

2. Arrangements to provide special medical examinations, care, and counseling in case of known or suspected exposures to toxic substances. Any special tests

performed depend on the chemical substance in which the individual has been exposed.

The site safety plan must address emergency medical care and treatment of personnel, including possible exposures to toxic substances and injuries due to physical hazards. The following items should be considered in emergency care provisions.

- The name, address, and telephone number of the nearest medical treatment facility should be conspicuously posted. A map and/or directions for locating the facility, plus the travel time, should be readily available.

- The facility's ability to provide care and treatment of personnel exposed or suspected of being exposed to toxic (or otherwise hazardous) substances should be ascertained. If the facility lacks toxicological capability, arrangements should be made for consultant services.

- All administration arrangements for accepting patients should be made in advance with the facility.

- Arrangements should be made to quickly obtain ambulance, emergency, fire, and police services. Telephone numbers and procedures for obtaining these services should be conspicuously posted.

- Emergency showers, eye wash fountains, and first aid equipment should be readily available on-site. Personnel should have first aid and medical emergency training.

- Provisions should be made for rapid identification of the substance to which the worker has been exposed (if this has not previously been done). This information must be provided to medical personnel.

MEDICAL EXAMINATIONS

Initial Baseline Examination

All applicable employees shall be given a baseline examination before being assigned to work at sites containing potentially hazardous substances. The purpose of the baseline examination is pre-assignment screening.

Routine Examinations

All personnel who have taken the initial baseline examination and have received clearance by the examining and/or reviewing physician to participate in field or laboratory activities shall be re-examined on an annual or biennial basis. Generally, employees with less than 100 hours of annual hazardous waste field work will have biennial examinations. Employees with greater than 100 hours hazardous waste field work will have annual examinations. The reviewing physician will have final authority in regard to examination frequency.

Exit Examination

An exit examination shall be given to any employee whose employment with WC has included hazardous materials work and who has been a participant in medical surveillance. The exit examination may be waived if the most recent examination was in the past six months.

Special Testing

Special testing may be required on certain projects due to the potential for exposure to specific substances. This may also be necessary where the potential for heat or cold stress exists. The need for special testing will be assessed on a project-by-project basis. Examples of special testing conditions include sites containing asbestos, arsenic, or lead where specific OSHA medical requirements for these compounds are in effect.

EXAMINATION PROTOCOLS

The protocols presented in Table 1 apply to baseline, annual, and exit examinations. A detailed health/work history questionnaire is provided before baseline and routine examinations. The protocols may be expanded by the reviewing or examining physician after consultation with WCC.

PHYSICIAN'S REPORTS

Examining physicians will use information provided by the employee in the questionnaire, the examination results, and the results of laboratory tests to determine if any work restrictions or occupational health problems appear to be present. The examining physician will provide the results of the examination to the WCC reviewing physician for final evaluation of employee suitability for work at hazardous material sites. The reviewing physician's conclusions shall supercede those of the examining physician. A physician's report on the examination will be sent directly to the employee with a separate letter stating ability to work at hazardous waste sites sent to WCC.

Employer reports received by WCC shall be reviewed by the HSO and kept in the Operating Unit's health and safety file. Physician recommendations regarding limitations must be followed.

EMPLOYEE MEDICAL SURVEILLANCE PROGRAM

The employee medical surveillance program (EMSP) is a computerized database which stores and processes employee medical surveillance information such as medical examination results, exposure history, training and respirator fit testing data. The purpose of EMSP is to facilitate record documentation, the reviewing physician's evaluation of the medical surveillance data, and administration of the WCC Health and Safety Program. Administrative and quality control features include: profile reports on employee eligibility for site work, medical examination scheduling reports, training requirement notices, and listing of qualified staff by operating unit and firmwide.

REVIEWING PHYSICIAN

Dr. Peter Greaney of Anaheim, California has been retained to provide medical oversight to the WCC medical surveillance program. The reviewing physician receives copies of all medical questionnaires, examinations, and laboratory testing results, reviews the opinions of examining physicians, and determines an employee's fitness for work at hazardous material sites. The physician also provides advice and assistance regarding site specific medical monitoring needs and programs.

CONFIDENTIALITY

Employee medical records are confidential and available for review only by the examining and/or reviewing physicians and their medical personnel.

Each employee can obtain information on his/her health by asking the examining physician for the information at the time of, or after, an examination. The employee may also request release of records or information, and/or designate a representative, in a letter to the physician. The request must contain the full name and address of the representative and indicate the records to be released. Medical information about an employee will not be made available to anyone without authorization from the individual concerned.

FINANCIAL RESPONSIBILITY

The costs of baseline, routine, special, and exit examinations will be paid to the examining physician by WCC operating units. The cost of examinations and tests that the employee voluntarily takes on recommendations by the examining or reviewing physician shall be borne by the employee unless the examinations/tests are related to the employee ability to work or to diagnose a work-related illness. The cost of the reviewing physician and the EMSP data base will be paid by Corporate Health and Safety.

TABLE 1

MEDICAL EXAMINATION PROTOCOL

Test		Testing Frequency			Remarks
		Baseline	Routine	Other	
1.	Cardiogram	X		X	Preplacement every 3 years for less than or equal to 40 years old. Every examination for more than 40 years old.
2.	Chest X-Ray	X		X	Preplacement every 3 years for less than or equal to 40 years old. Every 2 years for more than or equal to 40 years old to less than or equal to 55 years old. Every exam for more than 55 years old.
3.	Audiogram	X	X		
4.	Blood Chemistry Panel	X	X		

Required:

Glucose
Sodium
Potassium
Chloride
BUN
Creatinine
Uric Acid
Phosphate
Calcium
Cholesterol
Triglycerides
Total Protein
Albumin
Globulin
Total Bilirubin
Direct Bilirubin

TABLE 1
(continued)

Test	Testing Frequency			Remarks
	Baseline	Routine	Other	
4. Blood Chemistry Panel Required: (continued)				
Alk. Phosphatase				
G-Glutamyl Transpep.				
Transaminase, SGO				
Transaminase, SGP				
LDH				
Iron				
Optional:				
Magnesium				
Albumin/Globulin Ratio				
BUN/Creatinine Ratio				
5. CBC Count (Hemogram)	X	X		
WDC				
RBC				
HGB				
HCT				
MCV				
MCH				
MCHC				
Differential White Count		X		
Seg				
Band				
Lymph				
Mono				
Eosin				
Baso				
Platelets				
Platelets Count				
Reticulocyte Count				

TABLE 1
(continued)

Test	Testing Frequency Baseline	 Routine	Other	Remarks
6. Serum Iron and Total Iron Binding Capacity (TIBC)	X			
7. Urinalysis	X	X		
Appearance Color pH Ketones Direct Bilirubin Total Bilirubin Glucose Blood Urobilinogen L. Esterase WDC RBC Casts Mucus Bacteria Eiptherlial Crystals Yeast MCG/DL				
8. Morphology (Present, Absent, Unknown)	X	X		
Anisocytosid Poikilocytosis Hypochromia Polychromasia Basophilic Stippling				

ATTACHMENT 10
HEALTH AND SAFETY INCIDENT REPORT

WOODWARD-CLYDE CONSULTANTS
HEALTH AND SAFETY INCIDENT REPORT

Project Number ____________________ Date/Time of Incident ____________________________

Project Name ____________________ Project Location __________________________________

DESCRIPTION OF INCIDENT (Describe what happened and possible cause, identify individuals involved, witnesses, and their affiliations, and describe emergency or corrective action taken.)

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Reporter: ____________________ ___________________________ ______________________

Print Name Signature Date

Reporter must deliver this report to the New York Metro BUHSO within one day of the date of incident for medical treatment cases and within five days for other incidents.

Reviewed by: ____________________ ___________________________ ______________________

Print Name Signature Date

New York Metro Business Unit Health and Safety Officer

Distribution:

____________ WCC Corporate Health and Safety Administrator, ____________________
____________ EOG Corporate Health and Safety Officer, ____________________
____________ New York Metro Manager of Health and Safety, ____________________
____________ New York Metro BUHSO, ____________________
____________ Business Unit Manager, ____________________
____________ Responsible Professional, ____________________
____________ Project Manager, ____________________
____________ Site Safety Officer, ____________________
____________ Personnel Manager (Medical Treatment Cases Only), ____________________

ATTACHMENT 11
SITE SAFETY AND HEALTH PLAN COMPLIANCE AGREEMENT

SITE SAFETY AND HEALTH PLAN COMPLIANCE AGREEMENT

I,________________________________(print name), have received a copy of the Site Safety and Health Plan for the Stratford Army Engine Plant (WCC Project No. 89C114CC). I have read the SSHP, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the SSHP.

Signed:

________________________________ __________________________

Signature Date

ATTACHMENT 12
RESPIRATOR INSPECTION, CARE, MAINTENANCE AND STORAGE

RESPIRATOR INSPECTION, CARE, MAINTENANCE, AND STORAGE

The purpose of this Attachment is to provide guidance on the proper care and use of respiratory protective devices, to assist in adequately protecting personnel as well as complying with OSHA Part 1910.134.

APPLICABILITY

This procedure is applicable for use in caring for half-face and full-face respirators of either air-purifying or air supplying type. Proper care of respirators is essential for their satisfactory performance. Of importance are respirator inspection, care, maintenance, and storage.

REQUIREMENTS

OSHA requires, as part of an inspection program, that all respirators be leak checked, a determination that the complete assembly is gas tight. Follow field inspection procedures to examine the freshly cleaned, reassembled respirator.

Cleaning and Disinfecting - OSHA Part 1910.134 states "routinely used respirators shall be collected, cleaned and disinfected as frequently as necessary to ensure that proper protection is provided..." and that emergency use respirators "shall be cleaned and disinfected after each use."

The OSHA standard states that "replacement or repair shall be done by experienced persons with parts designed for the respirators." Besides being contrary to OSHA requirements, substitution of parts from a different brand or type of respirator invalidates approval (i.e., NIOSH, MSHA) of the device.

OSHA requires that respirators be stored to protect against:

- Dust;
- Sunlight;
- Heat;

- Extreme cold;
- Excessive moisture;
- Damaging chemicals; and,
- Mechanical damage.

The OSHA standard suggests that respirators be in their original cartons, however, this may provide only minimal protection from mechanical damage.

INSPECTION

Air-Purifying Respirators

Routinely used air-purifying respirators should be checked as follows before and after each use:

1. Examine the facepiece for:

    - Excessive dirt;
    - Cracks, tears, holes or physical distortion of shape from improper storage;
    - Inflexibility of rubber facepiece (stretch and knead to restore flexibility);
    - Cracked or badly scratched lenses in full facepieces;
    - Incorrectly mounted full facepiece lenses, or broken or missing mounting clips; and,
    - Cracked or broken air-purifying element holder(s), badly worn threads or missing gasket(s), if required.

2. Examine the head straps or head harness for:

    - Breaks;
    - Loss of elasticity;
    - Broken or malfunctioning buckles and attachments; and,
    - Excessively worn serrations on head harness, that might permit slippage (full facepieces only).

3. Examine the exhalation valve for the following after removing its cover:

    - Foreign material, such as detergent residue, dust particles or human hair under the valve seat;
    - Cracks, tears or distortion in the valve material;
    - Improper insertion of the valve body in the facepiece;
    - Cracks, breaks, or chips in the valve body, particularly in the sealing surface;
    - Missing or defective valve cover; and,
    - Improper installation of the valve in the valve body.

4. Examine the air-purifying element for:

    - Incorrect cartridge, canister or filter for the hazard;
    - Incorrect installation, loose connections, missing or worn gasket or cross threading in the holder;
    - Expired shelf-life date on the cartridge or canister; and,
    - Cracks or dents in the outside case of the filter, cartridge or canister, indicated by the absence of sealing material, tape, foil, etc., over the inlet.

5. If the device has a corrugated breathing tube, examine it for:

    - Broken or missing end connectors;
    - Missing or loose hose clamps; and,
    - Deterioration, determined by stretching the tube and looking for cracks.

6. Examine the harness of a front-or back-mounted gas mask for:

    - Damage or wear to the canister holder, that may prevent its being held in place; and,
    - Broken harness straps for fastening.

Atmosphere-Supplying Respirators

For a routinely used atmosphere-supplying device, use the following procedures:

1. If the device is a tight-fitting facepiece, use the procedures outlined under air-purifying respirators, except those pertaining to the air-purifying elements.

2. If the device is a hood, helmet, blouse or full suit, use the following procedures:

   - Examine the hood, blouse or full suit for rips and tears, seam integrity, etc.;

   - Examine the protective headgear, if required, for general condition with emphasis on the suspension inside the headgear;

   - Examine the protective face shield, if any, for cracks or breaks or impaired vision; and,

   - Make sure the protective screen is intact and secured correctly over the face shield.

3. Examine the air supply systems for:

   - Integrity and good condition of air supply lines and hoses, including attachment and end fittings; and,

   - Correct operation and condition of all regulators, or other air flow regulators.

In addition to the above, for self-contained breathing apparatus (SCBA) units also determine that:

1. The high pressure cylinder of compressed air or oxygen is sufficiently charged for the intended use, preferably full charged.

2. On closed circuit SCBA, a fresh canister of CO_2 (carbon dioxide) sorbent is installed.

3. On open circuit SCBA, the cylinder has been recharged if less than 25 percent of the useful service time remains.

All SCBAs are required to have a warning device that indicates when the 25 percent level is reached. However, it is recommended that an open-circuit SCBA be fully charged before use.

Respirator Disassembly

The used respirators should be collected and deposited in a central location. They are taken to an area where the filters, cartridges or canisters are removed and discarded. Canisters should be damaged or marked to prevent accidental reuse. If facepieces are equipped with reusable dust filters, they may be cleaned with compressed air in a hood. This prevents dust from getting into the room and affecting the respirator maintenance personnel. If SCBAs are used, tanks should be removed and taken to an area where the SCBA regulators and low-air warning devices are tested. SCBA facepieces are cleaned like air-purifying respirator facepieces.

Defects Found in Field Inspection

If defects are found during any field inspection, two remedies are possible. If the defect is minor, repair and/or adjustment may be made immediately. If it is major, the device should be removed from service until it can be repaired. (A spare unit should replace the unit removed from service.) Under no circumstances should a device that is known to be defective remain in the field.

Inspection During Cleaning

Because respirator cleaning usually involves some disassembly, it presents a good opportunity to examine each respirator thoroughly. The procedures outlined above for a field inspection should be used. Respirators should be inspected after cleaning operations and reassembly have been accomplished.

Respirator Care

When used routinely, respirators should be exchanged daily for cleaning and inspection. Where respirators are used only occasionally, the exchange period could be weekly or monthly. Workers maintaining their own respirators should be thoroughly briefed on cleaning and disinfecting them. Although workers may not be required to maintain their own respirators, briefing on the cleaning procedure will encourage their acceptance of a respirator by providing knowledge of what is a clean, disinfected, properly maintained device. This is particularly important where respirators are not individually assigned.

Where respirators are individually assigned (a practice to be encouraged), they should be identified to ensure that the worker always receives the same device. Identification markers must not penetrate the facepiece, block the filter, cartridge parts or exhaust valves.

When a relatively small number of respirators are used, or where workers clean their own respirators, the generally accepted procedure is washing with detergent and warm water using a brush, thoroughly rinsing in clean water, and drying in a clean place. Precautions should be taken to prevent damage from rough handling during this procedure.

When large numbers of respirators are used, it is recommended that centralized cleaning and maintenance be performed and that specialized equipment and personnel trained in respirator maintenance be utilized.

Cleaning and Sanitizing

The actual cleaning may be done in a variety of ways. A commercial dishwasher can be used. A standard domestic clothes washer may also be used if a rack is installed around the agitator to hold the facepieces in fixed positions. If the facepieces are placed loose in the washer, the agitator may damage them. A standard domestic dishwasher may be used, but it is not preferred because it does not immerse the facepieces. any good detergent may be used followed by a disinfecting rinse or a combination disinfectant-detergent for a one step operation. Disinfection is not absolutely necessary if the respirator is reused by the same person. However, where individual issue is not practical, disinfection is strongly recommended. Reliable, effective disinfectants may be made from readily available household solutions, including:

1. Hypochlorite solution [50 parts per million (ppm) of chlorine] made by adding approximately two milliliters of bleach (such as Clorox) to one liter of water, or two tablespoons of bleach per gallon of water. A two minute immersion disinfects the respirators.

2. Aqueous solution of iodine (50 ppm of iodine) made by adding approximately 0.8 milliliters of tincture of iodine per liter of water, or one teaspoon of tincture of iodine per gallon of water. A two-minute immersion disinfects the receptors.

If the respirators are washed by hand, a separate disinfecting rinse may be provided. If a washing machine or dishwasher is used, the disinfectant must be added to the rinse cycle; the amount of water in the machine at that time will have to be measured to determine the correct amount of disinfectant.

To prevent damaging the rubber and plastic in the respirator facepieces, the cleaning water should not exceed 140°F (60°C), but it should not be less than 120°F (49°C) to ensure adequate cleaning. In addition, if commercial or domestic dishwashers are used, the drying cycle should be eliminated, since the temperatures reached in these cycles may damage the respirators.

Rinsing

The cleaned and disinfected respirators should be rinsed thoroughly in water [140°F (60°C) maximum] to remove all traces of detergent and disinfectants. This is very important for preventing dermatitis.

Drying

The respirators may be allowed to dry in room air on a clean surface. They may also be hung from a horizontal wire, like drying clothes, but care must be taken not to damage or distort the facepieces. Another method is to equip a standard steel storage cabinet with an electric heater that has a built-in circulating fan, and to replace the solid steel shelves with steel mesh.

Reassembly and Inspection

The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. The inspection procedures have been discussed; special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking.

The respirator should be thoroughly inspected and all defects corrected. New or retested cartridges and canisters should be installed, and the completely reassembled respirator should be tested for leaks.

Maintenance and Repair

Maintenance personnel must be thoroughly trained. They must be aware of the limitations and never try to replace components or make repairs and adjustments beyond the manufacturer's recommendations, unless they have been specially trained by the manufacturer.

These restrictions apply primarily to maintenance of the more complicated devices, especially closed- and open-circuit SCBA, and more specifically, regulator valves and low pressures warning devices. These devices should be returned to the manufacturer or to a trained technician for adjustment or repair. There should be no major problems in repairing and maintaining most respirators, particularly the commonly used air-purifying type.

An important aspect of any maintenance program is having enough spare parts on hand. Only continual surveillance of replacement rates will determine what parts and quantities should be kept in stock. It is desirable to have a recording system to indicate spare parts usage and the inventory on hand.

For SCBA devices, the facepiece should be combined with the tested regulator and the fully charged cylinder, and an operational check performed.

Respirator Storage

Damage and contamination of respirators may take place if they are stored on a workbench, or in a tool cabinet or toolbox, among heavy tools, greases and dirt. Freshly cleaned respirators should be placed in heat-sealed, ziplock, or other reusable plastic bags until reissue. They should be stored in a clean, dry location away from direct sunlight. They should be placed in a single layer with the facepiece and exhalation valve in an undistorted position to prevent rubber or plastic from taking a permanent distorted "set."

Air-purifying respirators kept ready for non-routine or emergency used should be stored in a cabinet with individual compartments. The storage cabinet should be readily accessible, and all workers should be made aware of its location, as is done for fire extinguishers. Preventing serious injury from the inhalation of a toxic substance depends entirely on how quickly workers can get to the emergency respirators.

A chest or wall-mounted storage case may be used for storing SCBAs for use in emergencies. Again, the location of SCBA should be well-known and clearly marked. Unlike fire extinguishers, however, they should be located in an area that will predictably remain uncontaminated. Putting on a SCBA in a highly contaminated atmosphere such as might be created by massive release of a hazardous material may take too long a time to perform safely in that area. Therefore, the first reaction should be to escape to an uncontaminated area, then put on the SCBA that should be located there, and re-enter the hazardous area for whatever task must be done. Exceptions to this rule may be encountered; only a thorough evaluation of the process and escape routes will permit a final decision about the correct storage location for SCBAs. Respirators should be stored in a plastic bag inside a rigid container within an area that is expected to remain uncontaminated.

Workers who are adequately trained should develop a respect for respirators that will be an automatic incentive to protect respirators from damage. Besides providing better assurance of adequate protection, this training will lower maintenance costs by decreasing damage.

Recordkeeping

Records should be maintained to document that proper care and maintenance has been performed on respiratory protection devices. Records should indicate when and what was done to each respirator, and also by whom.

ATTACHMENT 13

DAILY HEALTH AND SAFETY SUMMARY REPORT

WOODWARD-CLYDE CONSULTANTS
DAILY HEALTH AND SAFETY REPORT
STRATFORD ARMY ENGINE PLANT
WCC PROJECT NO. 89C114CC

WCC SSO: ____________________ DATE: ____________________

Weather: ____

WCC Personnel Present:
(include times)

Other Personnel Present
and Affiliation:
(include times)

Work Activities: ____

Level of Protection: ____

Summary of Ambient Measurements*:
_________ ppm (HNu PID)
_______ ppm (Foxboro OVA)
_________ % 0_2 (CGI/0_2)
____ % LEL (CGI/% LEL)
_________________ ppm (CGI/H_2S)
_______ ppm _________ (Draeger)
_______ ppm _________ (Draeger)
____ mR/hr (Ludlum Radiation Meter)

Summary of Environmental Monitoring in Breathing Zone*:
_________ ppm (HNu PID)
_______ ppm (Foxboro OVA)
_________ % 0_2 (CGI/0_2)
____ % LEL (CGI/% LEL)
_________________ ppm (CGI/H_2S)
_______ ppm _________ (Draeger)
_______ ppm _________ (Draeger)
____ mR/hr (Ludlum Radiation Meter)

Notes, Incidents and Comments: ____

* Detailed record of measurements contained in Inspectors' Field Inspection Reports

ATTACHMENT 14
OSHA JOB SAFETY & HEALTH PROTECTION POSTER

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Provisions of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discriminatory action.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

There are also provisions for criminal penalties. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of up to $250,000 (or $500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State Labor or Health department or a State university.

Posting Instructions

Employers in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta	(404) 347-3573
Boston	(617) 565-7164
Chicago	(312) 353-2220
Dallas	(214) 767-4731
Denver	(303) 844-3061
Kansas	(816) 426-5861
New York	(212) 337-2325
Philadelphia	(215) 596-1201
San Francisco	(415) 995-5672
Seattle	(206) 442-5930

Elizabeth Dole

Elizabeth Dole, Secretary of Labor

Washington, D.C.
1989 (Revised)
OSHA 2203

U.S. Department of Labor

Occupational Safety and Health Administration

ATTACHMENT 15

OSHA REGULATIONS ON ILLUMINATION AND SANITATION AT TEMPORARY WORKPLACES

shall be decontaminated or disposed of properly.

(5) *Personal protective clothing and equipment.* (i) Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

(ii) Employees whose non-impermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

(6) *Unauthorized employees.* Unauthorized employees shall not remove protective clothing or equipment from change rooms.

(7) *Commercial laundries or cleaning establishments.* Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures to hazardous substances.

(8) *Showers and change rooms.* Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they shall be provided and meet the requirements of 29 CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing shall be provided and used.

(l) *Emergency response by employees at uncontrolled hazardous waste sites*—(1) *Emergency response plan.* (i) An emergency response plan shall be developed and implemented by all employers within the scope of this section to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.

(ii) Employers who will evacuate their employees from the workplace when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan complying with section 1910.38(a) of this part.

(2) *Elements of an emergency response plan.* The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following:

(i) Pre-emergency planning.

(ii) Personnel roles, lines of authority, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination procedures which are not covered by the site safety and health plan.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(3) *Procedures for handling emergency incidents.* (i) In addition to the elements for the emergency response plan required in paragraph (l)(2) of this section, the following elements shall be included for emergency response plans:

(A) Site topography, layout, and prevailing weather conditions.

(B) Procedures for reporting incidents to local, state, and federal governmental agencies.

(ii) The emergency response plan shall be a separate section of the Site Safety and Health Plan.

(iii) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(iv) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(v) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(vi) An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(vii) Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(m) *Illumination.* Areas accessible to employees shall be lighted to not less than the minimum illumination intensities listed in the following Table H-120.1 while any work is in progress:

TABLE H-120.1—MINIMUM ILLUMINATION INTENSITIES IN FOOT-CANDLES

Foot-candles	Area or operations
5	General site areas.
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: Warehouses, corridors, hallways, and exitways.

TABLE H-120.1—MINIMUM ILLUMINATION INTENSITIES IN FOOT-CANDLES—Continued

Foot-candles	Area or operations
5	Tunnels, shafts, and general underground work areas. (Exception: Minimum of 10 foot-candles is required at tunnel and shaft heading during drilling mucking, and scaling. Mine Safety and Health Administration approved cap lights shall be acceptable for use in the tunnel heading.)
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.)
30	First aid stations, infirmaries, and offices.

(n) *Sanitation at temporary workplaces.*—(1) *Potable water.* (i) An adequate supply of potable water shall be provided on the site.

(ii) Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

(iii) Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

(iv) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

(2) *Nonpotable water.* (i) Outlets for nonpotable water, such as water for firefighting purposes, shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(ii) There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

(3) *Toilet facilities.* (i) Toilets shall be provided for employees according to the following Table H-120.2.

TABLE H-120.2—TOILET FACILITIES

Number of employees	Minimum number of facilities
20 or fewer	One.
More than 20, fewer than 200.	One toilet seat and one urinal per 40 employees.
More than 200	One toilet seat and one urinal per 50 employees.

(ii) Under temporary field conditions, provisions shall be made to assure that at least one toilet facility is available.

(iii) Hazardous waste sites not provided with a sanitary sewer shall be provided with the following toilet facilities unless prohibited by local codes:

(A) Chemical toilets;

(B) Recirculating toilets;

(C) Combustion toilets; or

(D) Flush toilets.

(iv) The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

(v) Doors entering toilet facilities shall be provided with entrance locks controlled from inside the facility.

(4) *Food handling.* All food service facilities and operations for employees shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

(5) *Temporary sleeping quarters.* When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

(6) *Washing facilities.* The employer shall provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be in near proximity to the worksite; in areas where exposures are below permissible exposure limits and published exposure levels and which are under the controls of the employer; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

(7) *Showers and change rooms.* When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require six months or greater time to complete, the employer shall provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations.

(i) Showers shall be provided and shall meet the requirements of 29 CFR 1910.141(d)(3).

(ii) Change rooms shall be provided and shall meet the requirements of 29 CFR 1910.141(e). Change rooms shall consist of two separate change areas separated by the shower area required in paragraph (n)(7)(i) of this section. One change area, with an exit leading off the worksite, shall provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to the worksite, shall provide employees with an area where they can put on, remove and store work clothing and personal protective equipment.

(iii) Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels.

(iv) Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

(o) *New technology programs.* (1) The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(2) New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminates while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations shall be made available to OSHA upon request.

(p) *Certain Operations Conducted Under the Resource Conservation and Recovery Act of 1976 (RCRA).* Employers conducting operations at treatment, storage, and disposal (TSD) facilities specified in paragraph (a)(1)(iv) of this section not exempted by paragraph (a)(2)(iii) of this section shall provide and implement the programs specified in this paragraph.

(1) *Safety and health program.* The employer shall develop and implement a written safety and health program for employees involved in hazardous waste operations that shall be available for inspection by employees, their representatives and OSHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection, to provide for emergency response meeting the requirements of paragraph (p)(8) of this section and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and uses of new technologies.

(2) *Hazard communication program.* The employer shall implement a hazard communication program meeting the requirements of 29 CFR 1910.1200 as part of the employer's safety and program.

NOTE TO 1910.120.—The exemption for hazardous waste provided in § 1910.1200 is applicable to this section.

(3) *Medical surveillance program.* The employer shall develop and implement a medical surveillance program meeting the requirements of paragraph (f) of this section.

(4) *Decontamination program.* The employer shall develop and implement a decontamination procedure meeting the requirements of paragraph (k) of this section.

(5) *New technology program.* The employer shall develop and implement procedures meeting the requirements of paragraph (o) of this section for introducing new and innovative equipment into the workplace.

(6) *Material handling program.* Where employees will be handling drums or containers, the employer shall develop and implement procedures meeting the requirements of paragraphs (j)(1) (ii) through (viii) and (xi) of this section, as well as (j)(3) and (j)(8) of this section prior to starting such work.

(7) *Training program*—(i) *New employees.* The employer shall develop and implement a training program, which is part of the employer's safety and health program, for employees involved with hazardous waste operations to enable employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees. The initial training shall be for 24 hours and refresher training shall be for eight hours annually. Employees who have received the initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

(ii) *Current employees.* Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training requirements of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive eight hours of refresher training annually.

(iii) *Trainers.* Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.

(8) *Emergency response program*—(i) *Emergency response plan.* An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan. The emergency response plan shall be a written portion of the employers safety and health program required in para-

ATTACHMENT 16
EMERGENCY FIRST AID PROCEDURES

EMERGENCY FIRST AID PROCEDURES

If an employee working in a contaminated area is physically injured, Red Cross first aid procedures will be followed. Depending on the severity of the injury, emergency medical response may be sought. If the employee can be moved, they will be taken to the edge of the work area (on a stretcher, if needed) where contaminated clothing will be removed (if possible), emergency first aid administered, and transportation to local emergency medical facility awaited.

If the injury to the worker is chemical in nature (e.g., overexposure), the following first aid procedures are to be instituted as soon as possible:

- Eye Exposure - If contaminated solid or liquid gets into the eyes, wash eyes immediately at the emergency eyewash stations using large amounts of water and lifting the lower and upper lids occasionally. Obtain medical attention immediately. (Contact lenses are not permitted in the Exclusion Areas.)

- Skin Exposure - If contaminated solid or liquid gets on the skin, promptly wash contaminated skin using soap or mild detergent and water. If solids or liquid penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately if symptoms warrant.

- Breathing - If a person breathes in large amounts of organic vapor, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.

- <u>Swallowing</u> - Place victim on side if vomiting. Phone SAEP Security Headquarters at extension 2767 (2S0S); have containers in hand if possible. Follow directions from SAEP Security Headquarters. Contact the Poison Control Center if necessary at (800) 962-1253. Monitor the victim's vital signs (i.e., breathing and pulse). Save containers and any vomit.

GENERAL FIRST AID PROCEDURES

- Remove the injured or exposed person(s) from immediate danger.
- Render first aid if necessary, and decontaminate affected personnel, if necessary.
- Call an ambulance for transport to local hospital immediately. <u>This procedure should be followed even if there is no apparent serious injury</u>.
- Evacuate other personnel on-site to a safe place until the Site Manager (assisted by the WCC SSO) determines that it is safe for work to resume.
- Report the accident to the New York Metro BUHSO immediately.

ATTACHMENT 17

FIRST AID PROCEDURES CHARTS

EMERGENCY FIRST AID INSTRUCTION

EMERGENCY FIRST AID INSTRUCTION

IN CASE OF A SERIOUS ACCIDENT:

MOVE FAST!

1. RESCUE: Remove victim from a dangerous situation.
2. CHECK BREATHING: Give artificial respiration if necessary.
3. CONTROL SEVERE BLEEDING: Use direct pressure and elevation.
4. DILUTE POISONS: Use large quantities of milk or water.
5. CALL FOR HELP (ACTIVATE EMERGENCY MEDICAL SYSTEM)

"Let them hang up first - **YOU HANG UP LAST!**"

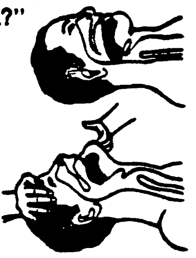
______________ ______________

Give this information:

L location of emergency - phone # you are calling from
I injury (number and type)
F first aid given
E equipment needed or available

STOPPAGE OF BREATHING

Give artificial respiration — Mouth-to-mouth method:



Head-Tilt/Chin-Lift

1. Determine unresponsiveness - "Are you OK?"
2. SHOUT for help.
3. Open airway - use Head-Tilt/Chin-Lift.
4. Check breathing (3-5 seconds).
5. Determine if not breathing.
6. Give two full slow breaths (maintain open airway, pinch nose, inhale, seal mouth).
7. Look, listen, and feel (about 5 seconds).
8. Check PULSE for 5-10 seconds.
9. **CALL 911 or 0 FOR HELP (ACTIVATE EMS SYSTEM)**
10. START rescue breathing.

Breathe for: adults once every 5 seconds.
children once every 4 seconds.
infants once every 3 seconds (gentle puffs).

WOUNDS

1. Control bleeding: Direct pressure on wound with a sterile dressing (if available). Elevate injured area if possible. Apply pressure to supplying blood vessel.
2. Apply dry sterile dressings, if needed add more dressing **OVER** the area. **DO NOT REMOVE THE OLD DRESSINGS!**
3. Cleanse minor injuries thoroughly Use mild hand soap and water (wash your hands first).
4. Treat for shock.
5. If evidence of infection appears, see a doctor.

BURNS

1. Relieve pain and prevent contamination. Small minor burns - cold water (**NOT ICE WATER**). Large extensive burns - dry sterile dressings Bandage to exclude air.
2. Treat for shock.
3. Seek medical assistance.

SHOCK

1. Limit activity. Lay victim down. (If face is red RAISE the HEAD) (If face is pale RAISE the FEET - 8 to 12 inches)
2. Cover victim ONLY enough to keep from losing body heat.
3. Shock may be FATAL - **CALL FOR HELP (ACTIVATE EMS SYSTEM).**

FROSTBITE

1. Cover the frozen part. Separate frozen fingers or toes with dry sterile gauze.
2. Provide extra clothing and blankets.
3. Quickly immerse chilled part in warm water (102° - 105°F).
4. DO NOT RUB frozen part.
5. Give a warm non-alcoholic drink - if victim is conscious and not vomiting.
6. **CALL FOR HELP (ACTIVATE EMS SYSTEM).**

HEART ATTACK

Symptoms: Chest pain, pain radiating down left arm, breathing difficulty, swelling of ankles, chronic cough, bluish color of face, finger nail beds, under eyelids, inside mouth or under tongue. Shock as a rule.

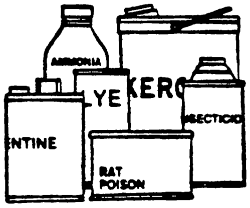
First Aid:

1. Comfortable position - loosen all tight clothing.
2. Raise head and chest if breathing is difficult.
3. If breathing stops, apply artificial respiration or cardiopulmonary resuscitation (CPR), if indicated.
4. **CALL FOR HELP (ACTIVATE EMS SYSTEM)** - equipped with oxygen and contact victim's own doctor.

FRACTURES

1. Maintain open airway and apply artificial respiration if indicated.
2. Do not move victim - unless in case of life threatening danger.
3. **CALL FOR HELP (ACTIVATE EMS SYSTEM)** if indicated.
4. Keep the broken bone ends and adjacent joints quiet.
5. Control bleeding if present and apply splints.

POISONING (conscious victim only)



1. Dilute poison with milk or water (except petroleum product poisoning). Discontinue if victim becomes nauseated.
2. Save the label, container and/or a sample of the vomit for chemical analysis and identification.
3. **CALL FOR HELP (ACTIVATE EMS SYSTEM)** and call the Poison Control Center.
4. If breathing stops, maintain open airway, apply artificial respiration or cardiopulmonary resuscitation (CPR), if indicated.
5. Induce vomiting (except acids, alkali, convulsions, petroleum based, semiconscious or unconscious) **IF MEDICAL ADVICE OR HELP IS DELAYED OR IF THE POISON CONTROL CENTER INDICATES TO DO SO.**

HEAT EXHAUSTION

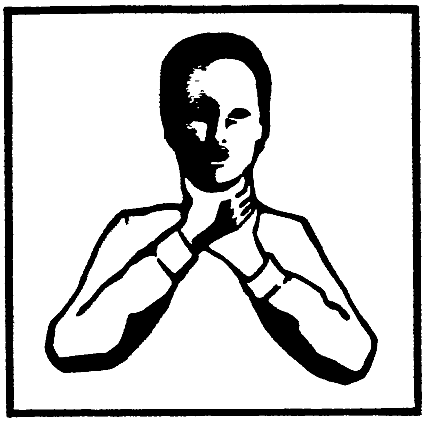
1. Give sips of salt water for 1 hour (one tsp. salt per 1/2 glass every 15 minutes - **STOP** if victim becomes nauseated).
2. Provide rest, loosen clothing and raise feet 8-12 inches.
3. Apply wet, cool cloths and fan victim or remove him to an air conditioned room.
4. Take victim, as soon as possible, to hospital.

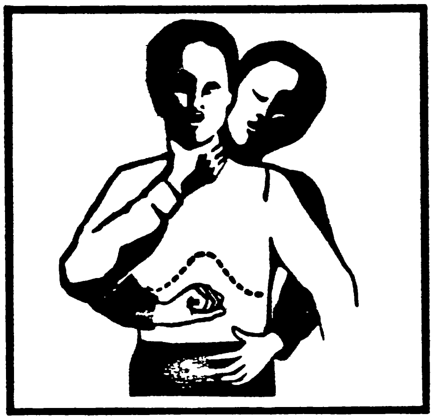
SIMPLE FAINTING

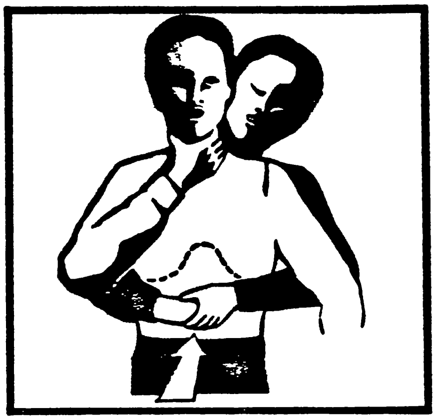
1. Keep victim laying down with feet raised 8-12 inches until recovery is complete.
2. Loosen any tight clothing and keep crowds away. Maintain open airway.
3. Bathe face gently with cool water - DO NOT POUR WATER OVER VICTIM'S FACE.
4. Unless recovery is prompt - **CALL FOR HELP (ACTIVATE EMS SYSTEM).**

FIRST AID FOR CHOKING

FIRST AID FOR CHOKING



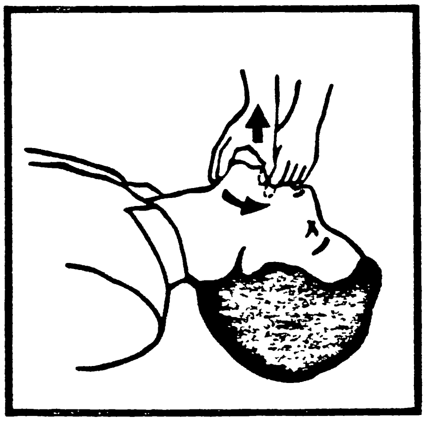


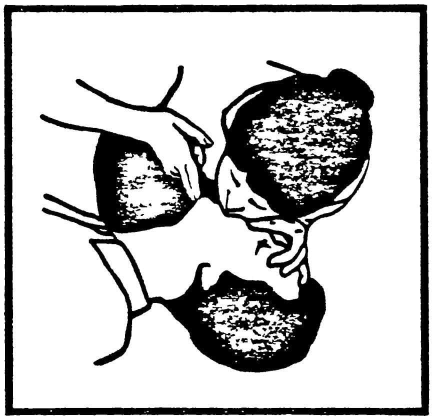


1. **Ask:**
"Are You Choking?"
If victim cannot breathe, cough, or speak . . .
Call (Shout) for HELP!

2. **Give the Heimlich Maneuver.**
Stand behind the victim.
Wrap your arms around the victim's waist.
Make a fist with one hand.
PLACE your FIST (thumbside) against the victim's stomach in the midline just ABOVE THE NAVEL AND WELL BELOW THE RIB MARGIN.
Grasp your fist with your other hand.
PRESS INTO STOMACH WITH A QUICK UPWARD THRUST.

3. **Repeat until object is expelled or until victim becomes unconscious.**





IF A VICTIM HAS BECOME UNCONSCIOUS:
CALL 911 or 0 FOR HELP (ACTIVATE THE EMS SYSTEM)

4. Sweep the mouth.

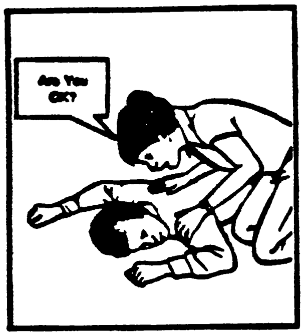
5. Attempt rescue breathing.

6. Give 6-10 abdominal thrusts. Repeat Steps 4, 5 and 6 as necessary.

Everyone should learn how to perform the steps above for choking and how to give rescue breathing and CPR. Call your local American Red Cross chapter for information on these and other first aid techniques. Caution: The Heimlich Maneuver (abdominal thrust) may cause injury. Do not *practice* on people.

FIRST AID FOR ARTIFICIAL RESPIRATION

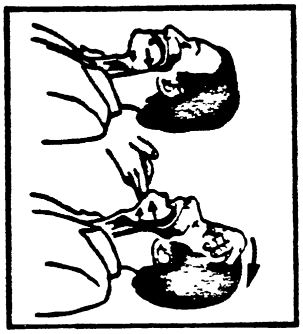
ARTIFICIAL RESPIRATION



MOUTH-TO-MOUTH METHOD

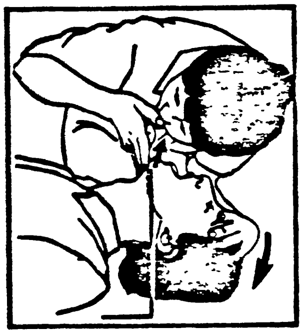
IF A VICTIM APPEARS TO BE UNCONSCIOUS TAP VICTIM ON THE SHOULDER AND SHOUT, "ARE YOU OKAY?"

TO ATTRACT ATTENTION SHOUT FOR "HELP".



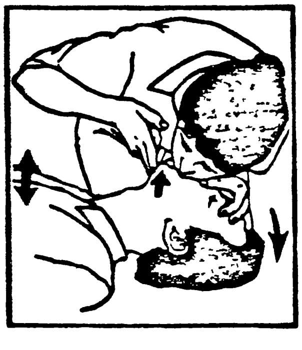
IF THERE IS NO RESPONSE
TILT THE VICTIM'S HEAD. Place the fingers on one hand under the bony part of the lower jaw near the chin and lift to bring the chin forward. At the same time, push with the other hand on the victim's forehead. This will rotate the head and cause the tongue to move away from the back of the throat to open the airway.

IMMEDIATELY LOOK LISTEN AND FEEL FOR AIR While maintaining the backward head tilt position, place your cheek and ear close to the victim's mouth and nose. Look for the chest to rise and fall while you listen and feel for the return of air. Check for 3-5 seconds.



IF THE VICTIM IS NOT BREATHING
GIVE TWO FULL SLOW BREATHS. Maintain the backward head tilt, pinch the victim's nose with the hand that is on the victim's forehead to prevent leakage of air, open your mouth wide, take a deep breath, seal your mouth around the victim's mouth, and blow into the victim's mouth with two full breaths. Adequate time for the two breaths (1 to 1.5 seconds per breath) should be allowed to provide for good chest expansion.

If you do not get an air exchange when you blow the first time, REPOSITION THE HEAD AND TRY AGAIN. If chest rises, check for pulse on the neck. Activate EMS System. If chest fails to rise, give abdominal thrusts.

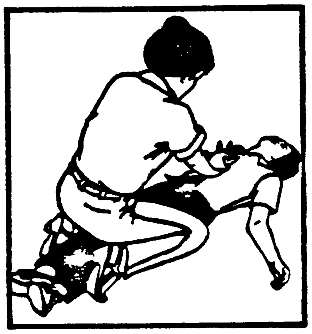


IF THERE IS STILL NO BREATHING
CALL FOR HELP (ACTIVATE EMS SYSTEM) AND BEGIN ARTIFICIAL RESPIRATION.
Change Rate To:
Adults:
  One breath every 5 seconds
Children:
  One breath every 4 seconds
Infants:
  One breath every 3 seconds
Continue until help arrives.

MOUTH-TO-NOSE METHOD

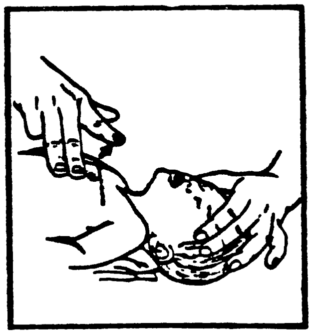
For the mouth-to-nose method, maintain the position by placing the heel of the hand on the forehead and using the other hand to lift the victim's lower jaw (bony part) and close the mouth. Seal your lips around the victim's nose and blow into the nose. On the exhalation phase, open the victim's mouth to allow air to exhale.

RELATED INFORMATION



FOR ADULTS,
HEIMLICH MANEUVER
Straddle victims knees or one leg if victim is large. Place heel of one hand against victim's abdomen in the midline slightly above navel and well below the sternum. Place second hand directly over first hand, keep fingers elevated. Press into the abdomen with quick upward thrusts with the intent of expelling the blockage. Perform 6-10 abdominal thrusts.

FOR CONSCIOUS INFANTS. CLEAR OBSTRUCTION WITH BACK BLOWS Place the infant face down over the rescuer's forearm resting on thigh. Support head and neck with hand and fingers. Keep infant in head down position, and deliver 4 back blows, forcefully, between the shoulder blades with the heel of your hand.



CHEST THRUSTS
While supporting the head and neck, sandwich infant between your hands and forearms and turn onto back, with head lower than trunk. Then, lie infant on firm surface and deliver 4 thrusts in the midsternal region (2-3 fingers on sternum, 1 finger's width below imaginary line between nipples).

CLEAR MOUTH WITH LITTLE FINGER IF OBJECT CAN BE SEEN. DO NOT ATTEMPT TO REMOVE THE OBJECT IF IT IS NOT SEEN! REPEAT UNTIL OBJECT IS EXPELLED.

If child becomes unconscious, yell for HELP - give 2 puffs of air then repeat steps above.

FINAL

APPENDIX C
COMMUNITY RELATIONS PLAN

■■■■■■ REMEDIAL INVESTIGATION

WORK PLAN

STRATFORD ARMY ENGINE PLANT

STRATFORD, CONNECTICUT

U. S. Army Aviation Systems Command

Prepared for

US Army Corps
of Engineers
Omaha District

U. S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska
January 1992

Woodward-Clyde

One Old Mill Building
101 South 108th Avenue
Omaha, NE 68154

WCC Project No. 89C114CC

TABLE OF CONTENTS

Following
Page

LIST OF TABLES

LIST OF APPENDICES

1.0
OVERVIEW: COMMUNITY RELATIONS PLAN

1.1 INTRODUCTION

This document is the Community Relations Plan (CRP) for the remedial investigation (RI) that is to be conducted at the Stratford Army Engine Plant (SAEP) under Contract Number DACW45-90-D-0008. The SAEP is a government-owned contractor-operated facility located in Stratford, Connecticut. The U.S. Department of the Army (USDA) owns the land, the buildings, and some of the production equipment at SAEP. The U.S. Army Aviation Systems Command (AVSCOM) has responsibility for the jurisdiction, control, and accountability of SAEP. Textron Lycoming (Textron) operates SAEP under a facilities contract with AVSCOM. Textron manufactures and tests turbine engines at SAEP, primarily for the Department of the Army. Textron also produces turbine engines for the U.S. Navy, for foreign military sale, and for commercial use.

The USDA has adopted the position that it may sell a government-owned facility on the basis that it is "excess to ownership." A facility may be considered excess to ownership if it is not necessary for the government to own the facility, although the production capacity of the facility may be required. USDA is currently considering the lease or sale of government-owned property at SAEP to Textron. U.S. Army Regulation 200-1 (AR 200-1) requires that a Preliminary Assessment Screening (PAS) be completed for any real property for which such a transaction is being proposed.

This CRP is being developed as a result of AR 200-1 requiring Army Facilities which are conducting environmental studies to develop and implement a plan that involves and informs the surrounding communities about the project. A more detailed discussion of the federal requirements is provided in Section 1.2. A more detailed discussion of the RI process and the work being done at SAEP is provided in the RI Work Plan.

This CRP outlines a program to inform and involve the community regarding RI activities at SAEP. The CRP describes the existing community views of and concerns about SAEP and the proposed project, establishes procedures to enhance public involvement, and identifies a proposed schedule for implementation.

Throughout this plan, public relations activities and community relations activities are described. For this document these two types of activities are **not** synonomous. As described below, they are different types of activities with different purposes.

The intent of public relations is to "promote a favorable relationship with the public" [American Heritage Dictionary]. It is also a "management function which evaluates both public attitudes, identifies the policies and procedures of an individual or an organization with the public interest, and plans and executes a program of action to earn public understanding and acceptance" [Public Relations News].

Given the above definitions, this plan recognizes that SAEP already has some public relations programs in place. Because of these programs, SAEP is generally viewed as an active community member and is well regarded within the community. The overall objective of this plan will be to implement an environmental community relations program that meets AR 200-1 requirements while using the established relationships as a base for its communication purposes.

This CRP is consistent with U.S. Environmental Protection Agency (EPA) guidance for implementing community relations efforts, and will be updated (as needed) throughout the RI and any other remedial processes that may occur.

This CRP is organized as follows:

Section 1.0 - Overview: The Community Relations Plan
Explains the Community Relations Plan as it relates to SAEP.
Section 2.0 - Site Description
This information is presented in detail in the RI Work Plan.

Section 3.0 - Community Background
Summarizes SAEP's surrounding communities, the existing level of community involvement in environmental programs at SAEP, and concerns expressed during the interviews.
Section 4.0 - Highlights of the Community Relations Program
Provides an overview of the community relations plan objectives, techniques, and key activities.
Section 5.0 - Community Relations Activities and Timing
Provides a schedule of tasks described in Section 4 as they relate to technical milestones.
Appendix A - Key Contacts
Lists key contacts and individuals who will potentially receive mailings.
Appendix B - Suggested Locations for Meetings and Information Repositories
This is the list of suggested locations for any public meetings that occur and for the Information Repositories.

This plan is based on information obtained through interviews and meetings with individuals from SAEP, elected officials, public agency officials, and other concerned citizens and community leaders who were identified as having an interest in environmental activities at SAEP.

Additional members of the community can become involved in this process by attending public meetings; reviewing available information; submitting opinions, questions, or ideas to SAEP; and commenting during formal project comment periods. Any interested party who wants information may call or write:

Mr Bill McDaniel
Director, Communications
Textron Lycoming, Stratford Division
550 Main Street
Stratford, CT 06497
(203) 385-1581

This plan relies on the use of advertisements, press releases and/or articles, project update mailers, fact sheets, and public meetings to inform the public about the project. The actual plan which describes these activities is contained in Sections 4 and 5.

1.2 ARMY REGULATION 200-1

In the late 1970's, the Department of Defense (DOD) became aware that its facilities, by nature of their mission, are vulnerable to hazardous waste contamination from past waste management practices. Army Regulation 200-1 is a document describing the Department of the Army's responsibilities, policies, and procedures to preserve, protect, and restore the quality of the environment. It states that environmental programs at Army facilities are to comply with CERCLA guidance. (Army Regulation 200-1; 23 April, 1990).

This Community Relations Plan and the Remedial Investigation are being conducted using requirements and guidelines presented in AR200-1 and the "Commander's Guide to Public Involvement in the Army's Installation Restoration Program," November 1990.

2.0
SITE DESCRIPTION

This section provides a basic description of SAEP and the Remedial Investigation. Details of the site and project description are provided in the Work Plan.

2.1 SITE LOCATION

The site location is described in Section 2.1.1 of the Work Plan.

2.2 SITE USE/OWNERSHIP HISTORY

The site ownership and operations history is described in Section 2.1.2 of the Work Plan.

2.3 REMEDIAL INVESTIGATION PROCESS

The Work Plan describes the remedial investigation study to be conducted at SAEP. A remedial investigation is needed to properly evaluate if contamination exists at SAEP.

The remedial investigation consists of sampling and analyzing the soil, groundwater, sediment, and surface water in areas of potential environmental concern. If contamination is observed, the study may continue into the feasibility study phase. A feasibility study evaluates the extent of existing, known contamination, and the different alternatives that are possible for remediating any environmental disturbance that exists now or could exist in the future.

2.4 HISTORY OF STUDIES & INSPECTIONS

Several previous investigations at SAEP have involved sampling and chemical analysis of environmental media. They are discussed in Section 2.2 of the Work Plan.

2.5 AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

Eight areas of potential environmental concern were defined in the PAS. Conceptual models of each area are presented in Section 3.0 of the Work Plan.

2.6 NATURE OF THREAT TO PUBLIC HEALTH & ENVIRONMENT

Information obtained during the record search conducted for the initial PAS report was not adequate to establish if any complete pathway to human or biota receptors exist. Because most of the site is occupied by buildings or pavement and groundwater in the vicinity of SAEP is not used, the number of potential pathways are reduced. It appears that no immediate threat to the public, workers, or environment exists. However, it appears that workers associated with intrusive activities at SAEP could represent the primary human receptors. Biota within the intertidal flats and the Marine Basin drainage ditch may have the highest potential to be affected by chemicals of concern from SAEP.

2.7 RESPONSIBLE LEAD AGENCY

This RI project at SAEP is under the supervision of the US Army Aviation Systems Commany (AVSCOM).

3.0
COMMUNITY BACKGROUND

This section identifies and describes the economic base of Stratford, Connecticut and the other communities that comprise the Stratford metropolitan area surrounding SAEP. This section also summarizes SAEP's previous community and public relations involvement and attempts to define SAEP's credibility. Environmental and communication comments and concerns that were expressed during the community interviews are also included.

3.1 COMMUNITY PROFILE

SAEP is located in Stratford, Connecticut, on the Stratford Point peninsula in the southeast corner of Fairfield County (see Figure 2-1). The plant lies on the borderline of the Bridgeport and Milford Quadrangles. Latitudinal and longitudinal coordinates of SAEP are approximately 41°-10' North and 73°-07' West.

Area public communication media include one large daily newspaper and approximately 2 smaller weekly newspapers; 9 radio broadcasting stations; and 8 television stations. The smaller local papers (*Stratford Bard and Stratford Star*), and TL newspaper are the main newspapers most likely read by the potentially affected population. The national public television station (Cable TV 12) is the electronic medium which is most likely to be effective in reaching the potentially affected population.

The Greater Bridgeport Regional Planning Agency's population census of Stratford was 49,389 people for 1990. The Connecticut Office of Policy and Management anticipates a slow or declining growth rate for Stratford through the end of the century with a population projection of 48,650 for the year 2000, and 45,800 for the year 2010 (Stratford Planning and Zoning Commission, 1990).

In Stratford, the age of the population is decidedly older than the state average. The town's median age in 1980 was 38.2, compared to 32 for the State of Connecticut. The

Connecticut Office of Policy and Management anticipates the median age of Stratford to be 45.7 by the year 2010. Nearly 23 percent of Stratford's population had reached age 60 by 1980, compared to the state average of 17 percent.

The population of Stratford represents various races and nationalities. Over 8 percent of the 1980 population in Stratford was nonwhite. This compares closely to a nonwhite population of 9.9 percent for the State of Connecticut (Town of Stratford, 1989).

The work force at SAEP currently consists of approximately 3,900 workers of which approximately one-half are "white-collar" and one-half are "blue-collar" (TLS, 1991). Over the past 10 years, the work force population has varied from approximately 5,100 in 1982 to the current 3,900.

The Bridgeport Metropolitan area (which includes Stratford, as well as 7 other cities in the area) is heavily reliant upon manufacturing as a primary source of economic income. The town of Stratford itself contains several manufacturing facilities other than Textron Lycoming.

Recently, the Bridgeport Metropolitan area has had a significant economic decline. The State of Connecticut itself has one of the highest unemployment rates in the nation, and ranks in the top 10 for highest cost of living in the nation. In addition, the city of Bridgeport, one of the largest cities in Connecticut, filed for bankruptcy in late 1990.

3.2 KEY COMMUNITY CONCERNS

Business leaders, environmentally active people, community members, and public officials from Stratford and Bridgeport were interviewed. The interviews, which began October 2, 1991, and concluded October 3, 1991 were conducted to obtain the following information:

1) The extent of SAEP's community relations activities and public relations activities that were in place, and the effectiveness of those activities.

2) a) Public interest and knowledge regarding possible contamination at SAEP and studies that have been completed at SAEP.
   b) How the public obtains such information and how best to get new information disseminated.
   c) Public interaction with government officials regarding environmental issues at SAEP.

The information obtained in the interviews was used to assess the strengths and weaknesses of SAEP's existing public relations programs, evaluate the program's effectiveness in addressing the communities' concerns, and determine whether the existing programs can be used as models for the environmental community relations program to be put in place. The interviewers tried to identify the communications medium and frequency that would work best for these communities, and the overall interest in this project.

SAEP does not currently have an environmental community relations program in place. Historically, there has been very little communication between SAEP and neighboring communities regarding environmental issues at SAEP. However, SAEP has implemented a number of other public relations activities with its surrounding communities (public relations activities as defined in the first section of this document) that have encouraged a favorable attitude toward SAEP. The recommended community relations activities described in this plan are based on SAEP's success with these other activities.

SAEP was generally described by those interviewed as a good neighbor to the surrounding communities. There is an overall feeling among the interviewees that SAEP has been active in and accessible to all communities.

One type of public relations activity SAEP has developed with its communities includes the active role it plays with the local Chambers of Commerce. SAEP has enacted a mentoring program with the local schools, and donates both money as well as time to several school functions. It has recently relandscaped the grounds that border the public access road, significantly improving its image. Several of the interviewees mentioned this as a positive form of public relations.

SAEP has been very involved with various community activities with local mayors and town managers and political representatives (specifically those in Bridgeport and Stratford). Service organizations and charity functions are also a major part of SAEP's public relations effort.

Relatively few comments and concerns regarding potential contamination at SAEP were expressed by those interviewed.

Credibility of SAEP

Those comments and concerns that interviewees expressed concerning the credibility of SAEP are described below.

- Overall, SAEP appears to have high credibility with the interviewees. They expressed a high level of trust that SAEP correctly addresses environmental problems. Some acknowledged that the trust is "blind" in that SAEP, to the interviewees' knowledge, has not demonstrated that it has addressed any environmental problems -- either in a correct or incorrect manner. Many interviewees said they felt SAEP would not do anything considered environmentally wrong. However, they were disappointed that SAEP had not previously informed residents about the environmental activities that have occurred.

- Several times the interviewees stated that Textron Lycoming was a credible source of information. All those interviewed said that they felt information would be viewed "more believable" coming from Textron than it would be coming from the Army.

- It was also stated that although the interviewees do think of SAEP as a good neighbor, the plant is part of big industry. Some interviewees did point out that, in general, there exists a circumstance of "big industry vs. the little guy". This is not directed specifically at SAEP, but at industry in general.

- There is concern that Textron Lycoming may depart the plant, leaving some of the population jobless.

Management of Environmental Issues

The comments and concerns that interviewees expressed concerning the management of environmental issues are described below.

- Generally speaking, interviewees did not express any direct knowledge of environmental problems at SAEP, though many stated they supposed that some contamination did exist, due to the nature of SAEP's manufacturing activities. Although there was no first-hand information, interviewees said it is not a problem that an environmental investigation is planned; however, they would like to be informed about it if significant events are to take place.

- Some interviewees suggested that SAEP capitalize on the "leadership" it will be showing in doing the environmental investigation by publicizing it's activities, and demonstrating positive actions to correct any environmental problems that may appear. It was the consensus that if SAEP took this approach, it would be received favorably within the communities.

Environmental Concerns

The environmental concerns that the interviewees expressed are described below. These concerns also indicate the lack of community awareness regarding SAEP's environmental activities.

- One individual expressed concern about transporting hazardous materials to or from SAEP on public streets. Currently, the individual is not aware of what types of materials (if any) are being transported, or how they are being transported.

- It was suggested that the fire department should know where and what hazardous materials are stored so it can be knowledgeable when called upon to help.

Management of Communication Issues

The commments and concerns the interviewees expressed concerning management of communication issues are described below:

- All interviewees expressed appreciation for the concern SAEP was demonstrating through these interviews and wanted this level of concern to continue.

- The interviewees agreed that SAEP is responsive to the communities' needs.

- Everyone stated that the timeliness of announcements about this project is important. They stressed that communication should occur two or three times a year, based on major project milestones, and more often if environmental issues of public interest are discovered.

- Individuals interviewed agreed that news releases and project update mailing would be effective communications vehicles. They also suggested targeting specific individuals within the community (i.e., the Rotary Club, the Harbor Commission, the Protect Your Environment group, the Save Our Sound group, and representative public officials) to conduct a public meeting. It was also suggested that a representative from SAEP speak about the event at a Chamber of Commerce breakfast and at a Rotary Club meeting.

Communication Concerns

The concerns about communication the interviewees expressed are described below:

- Some interviewees expressed a concern they classified as minor, saying that Textron does not always give out as much information regarding environmental activies as perhaps they should. Interviewees said that communication in this manner is not adequate in terms of quality, quantity, or timing of information that is provided to the community. All interviewees expressed an understanding of the need to protect classified information, but requested that non-classified information be released on a more timely basis.

4.0
HIGHLIGHTS OF COMMUNITY RELATIONS PROGRAM

This section presents an in-depth discussion of the Community Relations Plan and outlines the five objectives on which the plan is based. These objectives, based on EPA guidance, are designed to enhance communication between SAEP and the local community. This section describes how the plan intends to meet these objectives, i.e., by using such resources as newspaper advertisements, news releases, articles, fact sheets, and public comment periods and meetings. An in-depth discussion of how and when each of these resources could be used is also provided.

The RI community relations program is based upon five mutually supportive objectives developed from the findings in Section 3.0 of this document. The objectives are:

1) Expand the existing public relations program.

- This would include informing and involving the public in the environmental activities at SAEP, thus enhancing the two-way communication between the communities and SAEP. Since SAEP's current public relations program has been successful in establishing rapport with the local communities, the RI effort should parallel and enhance the existing plan.

- This objective stems from the interest expressed in increasing community involvement in SAEP's current environmental activities. As noted in Section 3, although environmental community involvement efforts are not currently in place, public relations efforts are in place.

2) Inform the community about previous environmental work done at SAEP.

- This objective stems from the need to explain the project to the public. Since the public is not aware of past environmental activities at SAEP, it would be beneficial to explain, in layman's terms, what has transpired and why. Providing this type of historic information would help the public understand the new project. Improved public awareness should result in support which should reduce conflict and avoid unnecessary delays.

3) Provide for citizen involvement and input for this project.

- EPA guidance recommends this objective for community relations plans. Informing and involving the community in decisions builds a "working" relationship between the public and SAEP. This involvement allows the public to feel as if they have been part of the decision-making process which can help prevent future conflicts.

- If a positive relationship has already been established between SAEP and the local communities, SAEP is in a better position to present newly discovered information without the need to bring the community up to date. This helps avoid project delays because of public conflict or misunderstanding.

4) Respond to community concerns, needs, and potential conflicts that arise during this project.

- EPA guidance recommends this objective for all community relations plans. This strategy builds upon the previous three objectives. If the other three objectives have been implemented and met, SAEP should be able to avoid having conflicts escalate to a high degree of intensity. However, if conflicts arise, SAEP is on much stronger ground if it has been up-front with its communities from the beginning.

- Based on the attainment of the three previous objectives, SAEP will be able to anticipate potential conflicts and respond in a proactive manner, building on the "working relationship" that has already been established.

This relationship should allow the necessary two-way communication to occur in a less hostile environment.

5) Identify a single, well-publicized knowledgeable point of contact for all environmental work being done at SAEP.

- This objective addresses the potential problem of information trickling out that is only half correct, and allows the public to be aware of who is to be contacted if there are questions, problems, or suggestions.

These objectives will be met by implementing a plan which utilizes the communication, activities, techniques, resources, key individuals, and organizations discussed in the remainder of this section. Section 5 presents a schedule relating the tools and resources to technical milestones.

4.1 COMMUNICATION, ACTIVITIES, TECHNIQUES & RESOURCES TO BE USED

Currently, the communities' primary source of information about SAEP is the media. It is suggested that future sources of information continue to use the media, but also expand the use of other resources such as establishing an information repository. Community groups (Rotary Club, Chamber of Commerce, Protect Your Environment, PTAs, etc.) are also recommended as effective tools to be used for informing the community.

The following is an in-depth description of the resources to be used.

At the onset of the project, an **information repository** will be established and maintained by AVSCOM. This is a file that contains site information and documents on site activities. The information repository will be at the Stratford Public Library. Textron Lycoming's Environmental Engineering Office will maintain a **project file** which contains all information used by AVSCOM to make decisions regarding the investigation. The information repository may contain some or all of the information in the project file. Only the information repository will be available for direct public access.

A **mailing list** of persons interested in the project, including public officials, can be developed and maintained by the Textron Lycoming's Communications Director (see Section 1.1). This list will be used to mail information about the project to interested community members. This list should be developed by placing a "reply card" and/or listing the name and address of the Communications Director as a contact person in the various ads, news releases, and mailings that are developed.

It is recommended that fact sheets be developed throughout the project. These intervals include at the onset of this project explaining the RI process, and after completion of the RI Report. These fact sheets should be developed by Textron Lycoming's Communication Director and mailed to interested persons. The main purpose of the fact sheets are to explain technical aspects of the project.

4.2 KEY INDIVIDUALS & ORGANIZATIONS

TLS Communications Department and the Environmental Engineering Department will work with AVSCOM, the project management office, to implement the community relations effort as defined in this CRP. The Communications Director is Mr. Bill McDaniel and the TLS project manager is Jack Sherman. The project manager from AVSCOM is Mr. Ron Matteuzzi.

4.3 AREAS OF SPECIAL SENSITIVITY

The primary issues of special sensitivity for this locale are the economy and the concern about Textron Lycoming vacating the SAEP, which would leave thousands of people unemployed. This issue should be remembered each time a communications item is released to the public.

5.0

COMMUNITY RELATIONS ACTIVITIES & TIMING

Table 5-1 summarizes the project schedule by identifying community relations activities and their relationship to technical milestones.

Table 5-1
SCHEDULE OF ACTIVITIES

Technical Activities	Completion of Work Plan	After Completion of Field-work	During RI Report Preparation	After Completion of RI Report
Community Activities	Winter 1991	Spring 1992	Summer 1992	Winter 1992
Establish Information Repository	X			
Establish Project File	X			
Prepare Fact Sheet	X			X
Create and Update Mailing List	X	X	X	X
Develop Proposed Plan				X
Enter Documents into Administrative Record Project File	X	X	X	X

APPENDIX A
MAILING LIST

FEDERAL GOVERNMENT

United States Congress

Rep. Rosa DeLauro
327 Cannon House Office Bldg.
Washington, D.C. 20515

U.S. Environmental Protection Agency

Jane Anderson
U.S. Environmental Protection Agency
Region I
J.F. Kennedy Federal Building
Boston, MA 02203-2211

AMSAV-EMC-Ronald Matteuzzi
SAIVAI-F A. Gibson
U.S. Army Aviations Systems Command
4300 Goodfellow Blvd.
St. Louis, MO 63120-1789

STATE AND LOCAL GOVERNMENT

Stratford State Legislators

Sen. George L. Gunther
Redacted - Privacy Act

(203)240-8863

Rep. J. Vincent Chase
Whippoorwill Lane
Stratford, CT 06497
(203)375-8922

Rep. Robert F. Frankel
Redacted - Privacy Act

(203)378-3669

Rep. Lawrence G. Miller
Redacted - Privacy Act

(203)240-8779

Connecticut Department of Environmental Protection

Mike Powers
Hazardous Waste Management Bureau
165 Capitol Avenue
Hartford, CT 06106

City of Stratford

David Killeen
Planning Administrator
Planning Department
Stratford, CT

Stratford Fire Department
Robert Wilcox
Fire Marshall of Hazardous Waste
Stratford, CT

TOWN COUNCIL

Stratford, Connecticut 06497

Councilman-At-Large
Rudolf J. Weiss
Redacted - Privacy Act

Laurie M. Baird
Redacted - Privacy Act

Paul S. Corvino
Redacted - Privacy Act

Michael A. Koperwhats
Redacted - Privacy Act

Kent C. Wahlberg
Redacted - Privacy Act

Irena M. Kandybowicz
Redacted - Privacy Act

Michael A. DiZnezo
Redacted - Privacy Act

Maynard W. Doughtery
Redacted - Privacy Act

Joseph A. Kubic
Redacted - Privacy Act

Anthony F. Ross
Redacted - Privacy Act

David E. Lendacky
Redacted - Privacy Act

MEDIA

Bridgeport Post
410 State Street
Bridgeport, CT 06604

New Haven Register
40 Sargent Dr
New Haven, CT 06519

Stratford Bard
2742 Main Street
Stratford, CT 06497

Stratford Star
6515 Main Street
Trumbull, CT

Associated Press
40 Sargent Drive
New Haven, CT 06519

WFSB T.V.3
3 Constitution Plaza
Hartford, CT 06103

WTNH T.V.8
8 Elm Street
New Haven, CT 06510

WVIT T.V.30
1422 New Britain Ave.
West Hartford, CT 06110

Cable T.V.12
Norwalk, CT

WRLI Radio
495 Benham Street
Hamdon, CT 06514

WEZN Radio
10 Middle Street
Bridgeport, CT 06604

WICC Radio
177 State Street
Bridgeport, CT 06604

WAVZ Radio
Quinnipial Ave
North Haven, CT 06473

Waterbury Republican
389 Meadow Street
Waterbury, CT 06722

OTHER INTERESTED PARTIES

Richard Brew
Brew Printing Co.
53 Hamecore St
Stratford, CT

Harry Davis
Oronoque Village President
93A Seminole Lane
Stratford, CT

Jim Tansley
University of Bridgeport
Bridgeport, CT

Ken Feathers
Department of Environmental Protection
Hartford, CT

Robert Sammis
Senior Vice-President also Director,
Union Trust Company Protect Your Environment
Church and Elm Streets
P.O. Box 404 Chairman,
New Haven, CT 06502-0907 Harbor Management Board

OTHER INTERESTED PARTIES

The Honorable Mayor of the
City of Bridgeport
45 Lyon Terrace
Bridgeport, CT 06604

Robert Stone
The Curtain Corner
3625 Main St
Stratford, CT 06497

Kelly Golden
Stratford Chamber of Commerce
10 Middle Street
P.O. Box 999
Bridgeport, CT 06601-0999

APPENDIX B

SUGGESTED LOCATIONS OF MEETINGS AND INFORMATION REPOSITORIES

Information Repositories

Stratford Public Library
2203 Main Street
Stratford, CT
(203) 385-4161

Potential Locations for Meetings

Stratford High School Auditorium
45 North Parade
Stratford, CT
(203) 385-4230

Textron Lycoming Tech Center
550 Main Street
Stratford, CT

FINAL

APPENDIX D
COMMENTS ON DRAFT WORK PLAN

REMEDIAL INVESTIGATION

WORK PLAN

STRATFORD ARMY ENGINE PLANT

STRATFORD, CONNECTICUT

U. S. Army Aviation Systems Command

Prepared for

US Army Corps of Engineers
of Engineers
Omaha District

U. S. Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska
January 1992

Woodward-Clyde

One Old Mill Building
101 South 108th Avenue
Omaha, NE 68154

WCC Project No. 89C114CC

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
GENERAL

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
General	USACE JH	CHG: Document organization is repetitious. Combine Work Plan, Field Sampling Plan, CDAP, and SSHP into one document.	E Repetition has been removed from the Work Plan, Field Sampling Plan and CDAP. At USACE's request, SSHP is a stand-alone document.
General	USACE JH	CHG: Have figures follow the page on which they are first referenced rather than at the end of the section.	A
General	USACE JH	CHG: Sections 4.3.2 of Work Plan and 4.2 of CDAP are repeated in the FSP. Eliminate repetition.	A
General	TLS JS	CHG: Use consistent and sequential page numbering. Tab sections for ease of reference.	E Pages within each main section are numbered sequentially. Figures and tables do not have page numbers.

LEGEND ON PAGE 14.

APPENDIX D

COMMENTS ON DRAFT WORK PLAN
WORK PLAN SECTION

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
General	TLS JS	ADD: Specify location and size of field office, and describe necessary utilities.	A
General	TLS JS	ADD: That contractor will be responsible for disposition of contaminated soil and materials with the concurrence of TLS.	A
General	AVSCOM GM	CHG: Increase number of samples in the riparian rights area.	D Because the action of the tides tends to rework sediments and dilute and disperse water-borne contaminants, we don't believe that there is any benefit in terms of additional data to be gained from additional sampling in the intertidal zone.
General	AVSCOM GM	CHG: Add samples under the main floor of Building 2.	D Any gross contamination which might exist beneath floors should be detected in samples which are to be collected downgradient of buildings. Also, we would like to avoid disrupting plant activities.
General	AVSCOM GM	CHG: Include a boring in Building 2 near the rototumble operation.	D See explanation for previous comment.

<u>LEGEND ON PAGE 14.</u>

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
WORK PLAN SECTION

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION	
2.1.2	USACE JH	CHG: Operations history to bullet format, as in CRP.	A	
2.1.3.2	USACE JH	ADD: Reference to Fig. 2-1, Vicinity Map, where appropriate.	A	
2.1.3.5	USACE JH	ADD: Definition of lagoons, reference to map identifying lagoons, and include groundwater contours to show mounding.	A	
2.1.3.5	USACE JH	ADD: Map showing locations of monitoring well and drainage ditch, and provide well number in text.	E	A more generalized discussion based on the CA Rich study was substituted, and a map is referenced.
2.2.1	USACE JH	ADD: Graphs showing effluent concentrations referenced in text.	E	The reference to specific graphs was deleted.
2.2.3	USACE-JH	ADD: Type of animal for *D. pulex*	A	
2.2.5	USACE JH	ADD: Map showing location of lagoons and associated monitoring wells, specify which wells are M&E, and clarify upgradient vs. downgradient wells.	E	Map was added, discussion of well installation more generalized, references to upgradient and downgradient wells made specific with well numbers.
2.2.5	USACE JH	CHG: Discussion of downgradient contaminant increase to indicate whether increase is sourced in lagoon area or is part of a larger plume.	E	Statement was added that referenced report assumes contaminant source is closed lagoons, and that no further source determination can be made.

LEGEND ON PAGE 14.

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
WORK PLAN SECTION

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
Figures 2-2, 2-5, and 3-1	USACE JH	CHG: Combine information from three figures so one master figure contains building identification and areas of potential environmental concern.	A
3.0	USACE- SG	ADD: Diagrams for conceptual site models.	A
3.5	TLS JS	CHG: "which has been used for assembling aircraft and is presently used for manufacturing gas turbine engine."	A
4.1	USACE SG	ADD: Clarification re: whether or not permits are required for borings.	A
4.2	USACE SG	ADD: Clarification re: CDEP guidelines for soil using TCLP analyses.	A
4.3.1.1	USACE JH	ADD: Clarification re: type of field observations to be used in selecting soil sampling intervals.	A
4.3.1.2	USACE JH	ADD: Clarify how outfalls to be sampled if no precipitation. Carry change over to FSP.	A
4.3.2.2	USACE JH	CHG: Reconsider strategy for test pits. Air monitoring for asbestos should be followed by remediation if necessary. Carry change over to FSP.	A

<u>LEGEND ON PAGE 14.</u>

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
WORK PLAN SECTION

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
4.3.2.3	USACE JH	CHG: Instead of installing WC-2D, install shallow well between WC-3S and MW-3, <u>or</u> evaluate water levels from PZ-1D and PZ-4D to see if WC-2D justified. Carry change over to FSP.	D Dissolved contaminants may travel downward despite upward flow gradient; therefore, a deep well is needed. Comment disapproved with concurrence of T. Zink, USACE.
4.3.2.3	USACE JH	ADD: Provisions for collecting a water sample if contamination at B-19 is discovered. Carry change over to FSP.	A
4.3.2.5	USACE JH	ADD: More downgradient wells for B-2, at expense of upgradient wells. Carry change over to FSP.	A
Table 4-1	USACE JH	CHG: Table 4-1 to follow the page on which it is first referenced.	A

<u>LEGEND ON PAGE 14.</u>

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
FIELD SAMPLING PLAN

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
General	USACE JH	ADD: The compounds which are included in the +15 and +30 library search lists.	E This computer library contains 50,000 compounds and would be impractical to present.
General	USACE SG	ADD: The number of QA/QC samples, and a sample ID number system for same.	A
3.0	USACE JH	ADD: Specific references to applicable SOPs at the end of each section describing sampling in areas of environmental concern.	A
Table A-1	USACE SG	CHG: Make sampling depths consistent with CDAP, e.g., Area 1 inconsistent with CDAP and Area 8 inconsistent within FSP and with CDAP.	A

<u>LEGEND ON PAGE 14.</u>

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
CHEMICAL DATA ACQUISITION PLAN

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
1.2.1	USACE - SG	ADD: Laboratory needs to be identified.	A
2.3.1.1	USACE SG	CHG: Field rinsate and field blank definitions are transposed.	E Field rinsate definition changed to field blank. Field blanks will be collected during sampling activities.
Tables 2-3a and b	USACE SG	CHG: Acceptance criteria from CLP to SW-846.	E Tables 2-3a,b,c,d, 2-4, and 2-5 have been removed from the CDAP. Acceptance criteria are laboratory specific and will be presented with the Laboratory QA/QC Manual.
3.3	TLS JH	ADD: Specific training requirements for and equipment needs of subcontractors.	E Subcontractor training and responsibilities for equipment are clarified.
4.2.9	USACE JH	ADD: Complete description of "mini pump test": number of wells, method and frequency of water level measurement, type of pump, pump rates. Reference SOP 4.	E Description of pump tests is in SOP No. 5.
4.2.9	USACE JH	ADD: Definition of a ground water monitoring event, method of water level measurement, time interval. Identify purpose of evaluating tidal influences.	E This section was moved to the FSP in Section 3.9, and was edited for clarification.

<u>LEGEND ON PAGE 14.</u>

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
CHEMICAL DATA ACQUISITION PLAN

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION	
4.3	USACE SG	CHG: Laboratory decontaminated S.S. bailers to dedicated bailers.	E	Clarification with S. George, laboratory decontaminated stainless steel bailers are acceptable.
Table 4-1	USACE SG	DEL: Sampling depth inconsistencies	A	
Table 4-3	USACE SG	ADD: Justification for Method 7841 for thallium over Method 6010.	E	Thallium will be analyzed using Method 6010.
Table 4-4	USACE SG	ADD: The complete first task for the OVA.	A	
6.1.4	USACE SG	CHG: Clarify if totals and TCLP analyses are to be run, and justify TCLP analyses.	E	TCLP is a CDEP requirement for metals extraction in soil samples. Subsequent analysis of TCLP leachate by Method 6010 is for total metals; however, leachate will be filtered as a required step of extraction procedure.
Table 6-2, 6-3, 6-4, & 6-5	USACE SG	REP: Reporting limits with detection limits.	E	Tables have been removed from the CDAP. Information will be provided with the Laboratory QA/QC Manual.
Page 2-2 of SOP 7	USACE - HM	ADD: Page 2-2 of SOP 7	A	

LEGEND ON PAGE 14.

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
SITE SAFETY AND HEALTH PLAN

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
General	TLS JH	ADD: Provide copies of safety training documentation, first-aid training records, spirometry tests, fit-check documentation to SAEP Safety Office.	A
General	TLS JH	ADD: Statement that medical baseline evaluation of all workers be conducted before investigation.	A
General	TLS JH	ADD: Specific statement of who will take air monitoring readings, who will sample, who will conduct instrument calibration, etc.	A
General	TLS JH	ADD: Identity of laboratory selected for sample analyses. Copies of analytical results should be sent to SAEP Safety Office.	A
General	TLS JS	CHG: Plan provides for more contingencies than a normal prudent contractor would require.	D As discussed during the December 19, 1991 meeting at the SAEP, the Plan has been prepared in accordance with the provisions of OSHA Regulations 29 CFR 1910.120.

<u>LEGEND ON PAGE 14.</u>

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
SITE SAFETY AND HEALTH PLAN

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
General	USACE HM	ADD: Standard Operating Safety Procedures, Engineering Controls, and Work Practices, or justify why they are not included.	E Item Nos. (1), (9), (10) and (11) of paragraph (j) of page D-10 of the scope of work are addressed in the SSHP; Item No. (2) is addressed in the Field Sampling Plan. Items Nos. (3) through (8) are not pertinent to the work activities.
Page 1-1	TLS - JS	CHG: Expiration date of plan.	A
2.3.2	USACE - HM	TYPO: Buidling to Building	A
3.3	USACE HM	ADD: Figure showing areas of environmental concern.	A
3.3.2	USACE HM	CHG: Strategy for Area 2 sampling must address safety hazards of asbestos, & comply with OSHA (29 CFR 1926.58), EPA (40 CFR 61.140-156), DOT (49 CFR 172.101, 172.200-204, 173.1090) and all state and local regs.	A
Fig. 3-1	TLS JH	ADD: Training requirements or time for the training.	All on-site personnel will be trained in accordance with OSHA Regulations 1910.120 prior to beginning of fieldwork.
4.1.2	USACE HM	ADD: Chemical and physical properties of contaminants of concern.	A

LEGEND ON PAGE 14.

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
SITE SAFETY AND HEALTH PLAN

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
4.1.4	TLS JS	CHG: "historical presence of small amounts of radioactive materials."	A
Table 4-1	USACE HM	CHG: a) Include site-specific chemicals of concern only. b) state that if PELs ≠TLVs, the most restrictive shall prevail c) Indicate the form of metals (total dust, soluble compounds, respirable fractions, etc.) d) Include PEL for hexavalent Cr e) Consolidate thorium information f) Include PCBs.	A
6.0	USACE - HM	CHG: Action levels to 1/2 PEL.	A
Page 6-3, Radiation Action Level	TLS JH	ADD: SAEP Radiation Safety Officer in list of people to decide course of action if action level is exceeded.	A
Sect. 7-1	TLS JH	ADD: Exact involvement of WCC BUHSO with respect to the project.	A
8.1	TLS JS	ADD: State clearly that Level D will be used unless/until sampling or monitoring requires upgrading.	A
8.1	USACE - HM	CHG: Specify type of outer glove for SAEP.	A

LEGEND ON PAGE 14.

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
SITE SAFETY AND HEALTH PLAN

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
8.1	AVSCOM GM	CHG: Insure Level D PPE is sufficient for Bldg 16 test cell drain investigation	D The comment is not applicable to this investigation, because it does not include an investigation of Bldg 16 test cell drains
9.3	TLS JH	ADD: Provision that SAEP Security HQ will be notified immediately in the event of fire, explosion, injuries, and illness, at Extension 2767 (2-SOS).	A
9.4	USACE HM	ADD: OSHA requirements (29 CFR 1910.120 (n) re: potable and non-potable waters, toilet and washing facilities.	A
9.7	TLS JH	ADD: Notification to SAEP Safety Office, Extension 3278.	A
Sect. 10.1 through 10.3	TLS JS	CHG: "SAEP" to "Textron Lycoming" when referring to the organization or personnel.	A
10.2	TLS JH	CHG: Calls for emergency services will be directed to SAEP Security HQ (Ext. 2767), NOT directly to outside services.	A
11.3	USACE HM	ADD: Complete decontamination sequences applicable to Level C and Level B PPE.	A

LEGEND ON PAGE 14.

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
SITE SAFETY AND HEALTH PLAN

LOCATION OF TEXT IN DRAFT REPORT	SOURCE	COMMENT	ACTION
11.4.1	USACE HM	CHG: 1st bullet as follows: "After use . . . decontamination pad in the adjacent CRZ."	A
12.4	USACE - HM	CHG: Highlight or underline first sentence.	A
12.5.1, 5th bullet	TLS - JH	DEL: "or Safety"	A
12.8	USACE HM	ADD: Requirement that one person on-site must be first aid/CPR certified.	A
Attachment 2, Overhead and Buried Utilities	USACE HM	TYPO: "Seep in mind" to "Keep in mind".	A
Attachment 2, Overhead and Buried Utilities	USACE HM	CHG: Clarify the meaning of the eighth bullet.	A
Attachment 15, Swallowing	USACE HM	ADD: Red Cross protocols for "Poisoning".	A

<u>LEGEND ON PAGE 14.</u>

APPENDIX D
COMMENTS ON DRAFT WORK PLAN
COMMUNITY RELATIONS PLAN

	SOURCE	COMMENT	ACTION
Table 5-1	TLS JS	CHG: Text to be consistent with Table 5-1.	

LEGEND
USACE = United States Army Corps of Engineers
TLS = Textron Lycoming - Stratford
AVSCOM = United States Army Aviation Systems Command
JH = John Hartley
JS = Jack Sherman
SG = Susan George
JH = John Hammond
HM = Helen Mead
GM = G. Alan McDermott
CHG: = change
ADD: = add
DEL: = delete
REP: = replace
TYPO: = typographical error
A = comment approved and has been incorporated into final report
E = comment approved with exception as noted and incorporated into final report
D = comment is disapproved with the explanation given.