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COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVAL SURFACE WARFARE CENTER INDIAN HEAD, MARYLAND

WORK PLAN FOR SITE INSPECTION: PHASE II

Prepared for:

DEPARTMENT OF THE NAVY
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C.

SOUTHDIV CONTRACT NUMBER:
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Release of this document requires the prior notification of the Commanding Officer of the Naval Ordnance Station, Indian Head, Maryland.

FOREWORD

PROJECT TITLE: CONTRACT N62467-89-D-0318, COST PLUS AWARD FEE CONTRACT FOR COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION, NAVY (C.L.E.A.N.) DISTRICT II; SITE INVESTIGATION, NAVAL ORDNANCE STATION (NOS), INDIAN HEAD, MARYLAND.

This Work Plan outlines Phase II of the Site Inspection (SI) to be completed at the Naval Ordinance Station Indian Head, Maryland. Phase II of this Site Inspection involves the assessment of 15 areas at the facility to determine if contamination is present as a result of past uses and practices. These sites were identified during a Preliminary Assessment and were recommended for a SI. The SI will be completed as part of the Installation Restoration Program and will be conducted by EnSafe/Allen & Hoshall through a SOUTHDIV CLEAN contract.

Phase II requires the use of a broad range of sampling techniques and procedures. These include installating shallow soil borings and monitoring wells and collecting soil and groundwater samples, the collecting of surface and subaqueous sediment samples, bulk building material samples and surface water samples. All samples will be submitted for laboratory analysis at an approved laboratory.

This Work Plan includes support documents which outline Phase II of the SI. This Work Plan comprises three sections which include: Section I-Sampling and Analysis Plan (SAP), Section II-Quality Assurance Plan (QAP), and Section III-Health and Safety Plan (HSP). Each of these documents contain the information prescribed in Navy contract N62467-89-D-0318, and the Plan of Action prepared by EnSafe/Allen & Hoshall (August, 1991).

SECTION A — FIELD SAMPLING PLAN

SECTION B — QUALITY ASSURANCE PLAN

SECTION C — HEALTH AND SAFETY PLAN

SECTION A
FIELD SAMPLING PLAN

FOR

SITE INSPECTION

PHASE II

NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

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1.0 INTRODUCTION

The following is a Field Sampling Plan (FSP) for Phase II of the Site Inspection (SI) at the Indian Head Division, Naval Surface Warfare Center (NSWC), Indian Head, Maryland. This FSP is submitted in accordance with the provisions of Southern Division Navy Contract N62467-89-D-0318 and submitted to the Chesapeake Division Engineering Command Facility (CHESDIV). This plan describes the field operations and the analytical requirements to complete the scope of work as defined by the CHESDIV Engineer-in-Charge (EIC) and includes the Project Management Plan with a project schedule.

1.1 Facility Description and Project Background

NSWC is a research and development facility. Operations involve the use and handling of a number of hazardous substances and compounds. Past handling procedures, many of which were accepted at one time, may have resulted in a release of contaminants to site media.

1.2 Previous Studies

An Initial Assessment Study (IAS) was completed at the NSWC facility in 1983 under the former Navy Assessment and Installation Pollutants Program. The focus of the IAS was to assess areas at NSWC for the potential of past releases and to determine if additional study was necessary. The IAS was followed by a Preliminary Assessment (PA).

A PA was completed in 1991 under the current Navy Installation Restoration Program. Fifteen sites were recommended for an SI[1]. Information pertaining to the suspected source of possible contaminants at each site was outlined in the PA. More details are presented in Section 2.0, Site Descriptions.

[1] One site, Olson Road Land Fill (Site 42) was subject to an SI during Phase I; therefore, Site 42 is not included in Phase II of the SI.

1.3 Project Objective

The objective of this project is to determine if contamination exists at any of the subject sites as a result of their former operations. This will be accomplished by completing an SI designed specifically for each site. The FSP describes the approach to studying each site including sampling rationale and analytical rationale.

1.4 Geology and Hydrology

Regional Geology. The Indian Head Peninsula is located in the Atlantic Coastal Plains physiographic province. The peninsula is on the western edge of an eastwardly thickening wedge of interbedded fluvial and marine deposits. This wedge was deposited during the Cretaceous and Quaternary periods and ranges from 650 to 900 feet in thickness. Sedimentary units in the wedge conform to the underlying crystalline basement rock of the Piedmont Plateau. The wedge is composed of the upper Lowland Deposits and the subordinate Potomac Group.

The Lowland Deposits are a Quaternary sequence of fluvial sediments ranging from 0 to 150 feet in thickness. This sequence comprises medium to coarse-grained sands and gravels grading upward to silts and clays. Isolated cobbles and boulders may be found at the base.

The Cretaceous Potomac Group consists of the Patapsco, Arundel, and Patuxen Formations and ranges from 650 to 750 feet in thickness. The Potomac Group is characterized by crossbedding, channel fills, and lateral pinching and thickening of beds (Hiortdahl, 1990). These formations are composed of interbedded gravels, argillaceous sands, and multicolored silts and clays (U.S. Department of the Navy, P-059, 1990).

Regional Hydrology. The main aquifer system used in the Indian Head region is the Potomac Group. The Potomac Group comprises a series of water-bearing units and confining units topped by the Patapsco confining unit. The Potomac Group aquifer system produces water of

good quality and is used as a regional potable water source. There are numerous localized aquifer systems in the Lowlands Deposits; however, it is believed that none of these systems are used for potable water sources due to poor water quality (i.e. elevated metals and alkaline concentrations) (Hiortdahl, 1990).

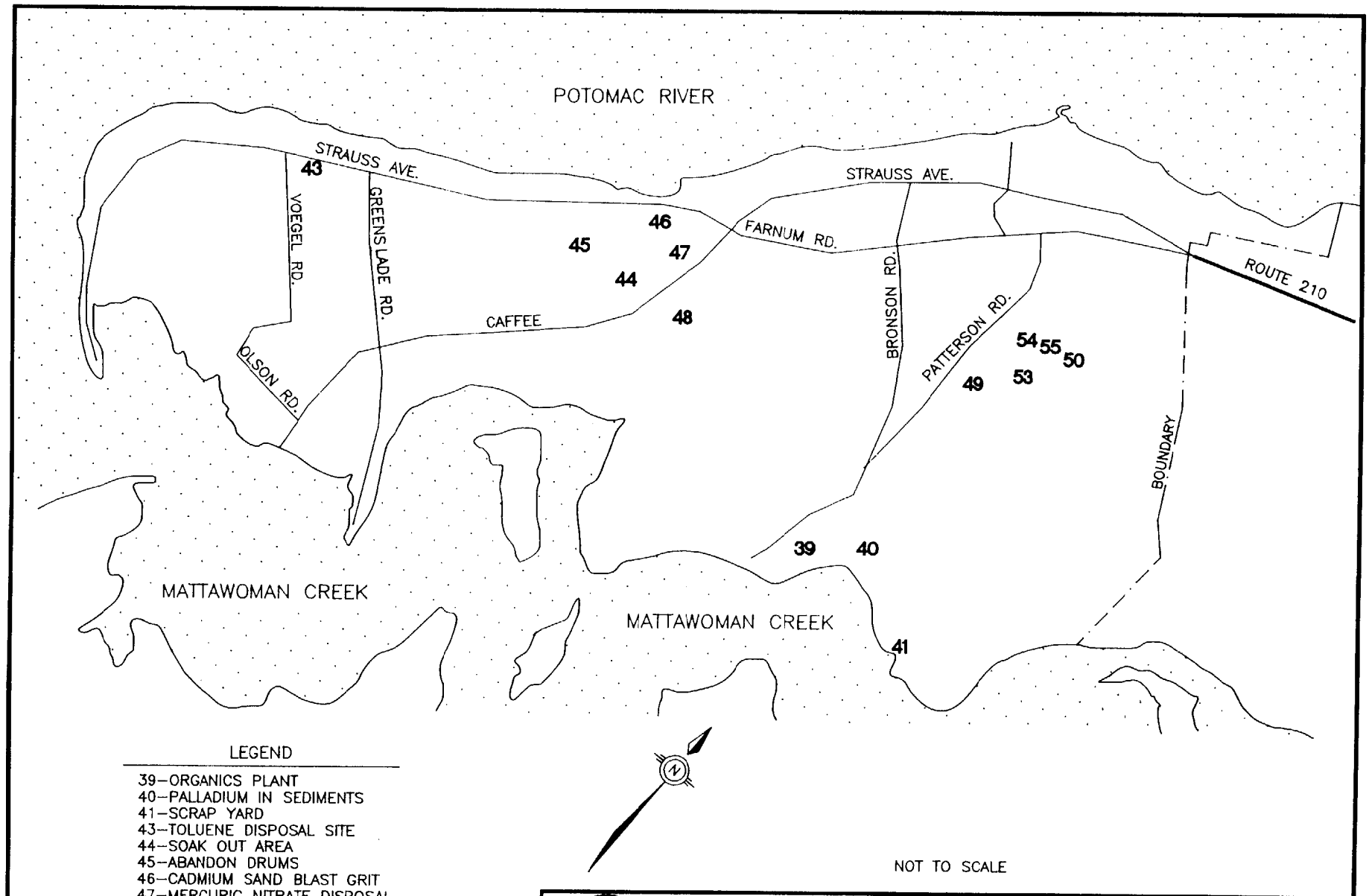
2.0 SITE DESCRIPTIONS

Fourteen sites have been identified for study under the SI at NSWC Indian Head, Maryland. Because information available to E/A&H was limited, the site descriptions rely heavily on information presented in the PA and data collected during site visits conducted by E/A&H. Figure 2-1 indicates the approximate location of each site at the NSWC facility.

Each site description includes brief details of the site layout, the suspected contaminants and the possible sources of contamination. Site processes and/or history are discussed when applicable. Also included is a brief discussion on the approach and sampling rationale for characterizing the nature of contamination, if any. A wide range of analytical parameters and methods will be employed for the completion of the SI. For purposes of clarity, analytical parameter groups are indicated in Table 2-1. The proposed number and type of samples to be collected at each site are outlined with each site description.

Table 2-1
Acronyms for Analytical Groups
Required for This SI

TCL =	Target Compound List
TAL =	Target Analyte List
VOC =	Volatile Organic Compounds
BNA =	Base/Neutrals, Acids (Semi-volatile Organic Compounds)
TPH =	Total Petroleum Hydrocarbons
PNC =	Plastisol Nitro Cellulose
UDMH =	Unsymmetrical Dimethylhydrazine
HBMQ =	High Bulk Nitroguanidine

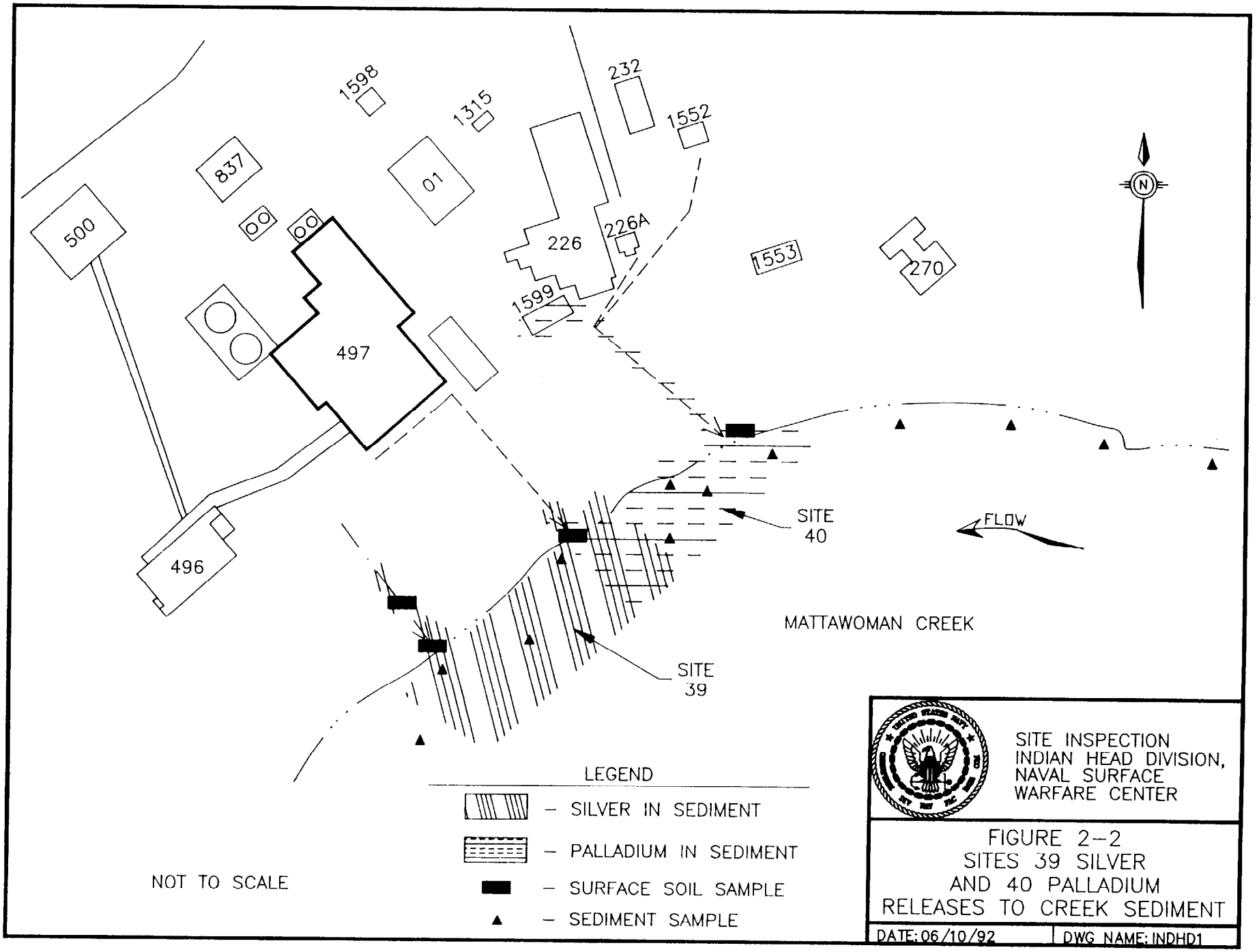

POTOMAC RIVER
STRAUSS AVE.
STRAUSS AVE.
VOEGEL RD.
GREENSLADE RD.
FARNUM RD.
CAFFEE
OLSON RD.
BRONSON RD.
PATTERSON RD.
ROUTE 210
BOUNDARY
MATTAWOMAN CREEK
MATTAWOMAN CREEK
43
46
45
47
44
48
54
55
50
49
53
39
40
41
LEGEND
39–ORGANICS PLANT
40–PALLADIUM IN SEDIMENTS
41–SCRAP YARD
43–TOLUENE DISPOSAL SITE
44–SOAK OUT AREA
45–ABANDON DRUMS
46–CADMIUM SAND BLAST GRIT
47–MERCURIC NITRATE DISPOSAL
48–DUMP SITE
49–CHEMICAL DISPOSAL PIT
50–BUILDING 103
53–GENERAL LABORATORY AREA
54–BUILDING 101
55–BUILDING 102
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–1
FACILITY MAP AND
SITE LOCATIONS
DATE: 06/10/92
DWG NAME: INDHD15

Field sampling techniques to be utilized during the completion of the SI range from shallow soil and groundwater samples to wipe samples. A detailed description of each sampling technique employed for this SI is provided in Section 3.0. All samples will be collected in accordance with the outlined procedures unless unforseen site conditions warrant otherwise. Any variation will be properly noted by the Site Manager in a dedicated field logbook.

Site 39 — Organics Plant-Silver Contamination in Sediments. The organics plant area, Building 497 is identified as Site 39 (Figure 2-2). It is located in the southeastern portion of the NSWC, on a steep slope adjacent to Mattawoman Creek. This site is subject to an SI based on the reported accidental releases of elemental silver and other compounds to Mattawoman Creek.

Former operations (1961 to 1965) included the formulation of bis-2,2 dinitropropanol acetal/formal (acetal/formal), which is a plasticizer (propellent binder). Silver nitrate was used as a catalyst in the production of acetal/formal where, at one stage of the process, silver was in the elemental form.

A discharge pipe extends from Building 497 to an outfall at Mattawoman Creek. Reportedly, several accidental releases occurred via the outfall resulting from an improperly closed valve. Compounds suspected of having been released include: acetal/formal, silver, dinitropropanol (DNPOH), ethylene dichloride, methylene chloride and formaldehyde. Also, as was indicated in the PA, site personnel reported that acetal/formal and silver were visible at times on the surface of Mattawoman Creek near the outfall of the organics plant.


1598
1315
232
1552
837
01
500
226
226A
1553
270
1599
497
496
SITE 40
FLOW
MATTAWOMAN CREEK
SITE 39
LEGEND
– SILVER IN SEDIMENT
– PALLADIUM IN SEDIMENT
– SURFACE SOIL SAMPLE
– SEDIMENT SAMPLE
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2-2
SITES 39 SILVER
AND 40 PALLADIUM
RELEASES TO CREEK SEDIMENT
DATE: 06/10/92
DWG NAME: INDHD1

A study will be completed to determine if silver and/or acetal/formal is present in the sediments near the outfall to Mattawoman Creek. The study will consist of the collection of top sediments from Mattawoman Creek and sediment samples at the outfall.

SITE 39					
	Sample Media:	Surface sediments (at outfall) Sediments (Mattawoman Creek)			
	Sample Procedures:	Type	Number	Sam/Loc	Total
		Surface sediments	2	1	2
		Sediment samples	4	1	4
	Analytical Requirements:	Media	Analyses		
		Surface sediments	TAL, VOC, BNA, Acetal/formal, PNC, UDMH, HBNQ		
		Sediment	TAL, VOC, BNA, Acetal/formal, PNC, UDMH, HBNQ		

Site 40 — Palladium Catalyst in Sediments. Site 40 is defined as the area downgradient of the former hydrogenation facility. The hydrogenation facility includes buildings 232, 1552 and 1559, and is adjacent to Site 39 (Figure 2-2). Site processes included the formulation of unsymmetrical dimethylhydrazine (UDMH), a production process that hydrogenated dimethylnitrosamine (DMNA) using a palladium catalyst on carbon black. Production of UDMH was conducted at the hydrogenation facility from 1974 to 1975.

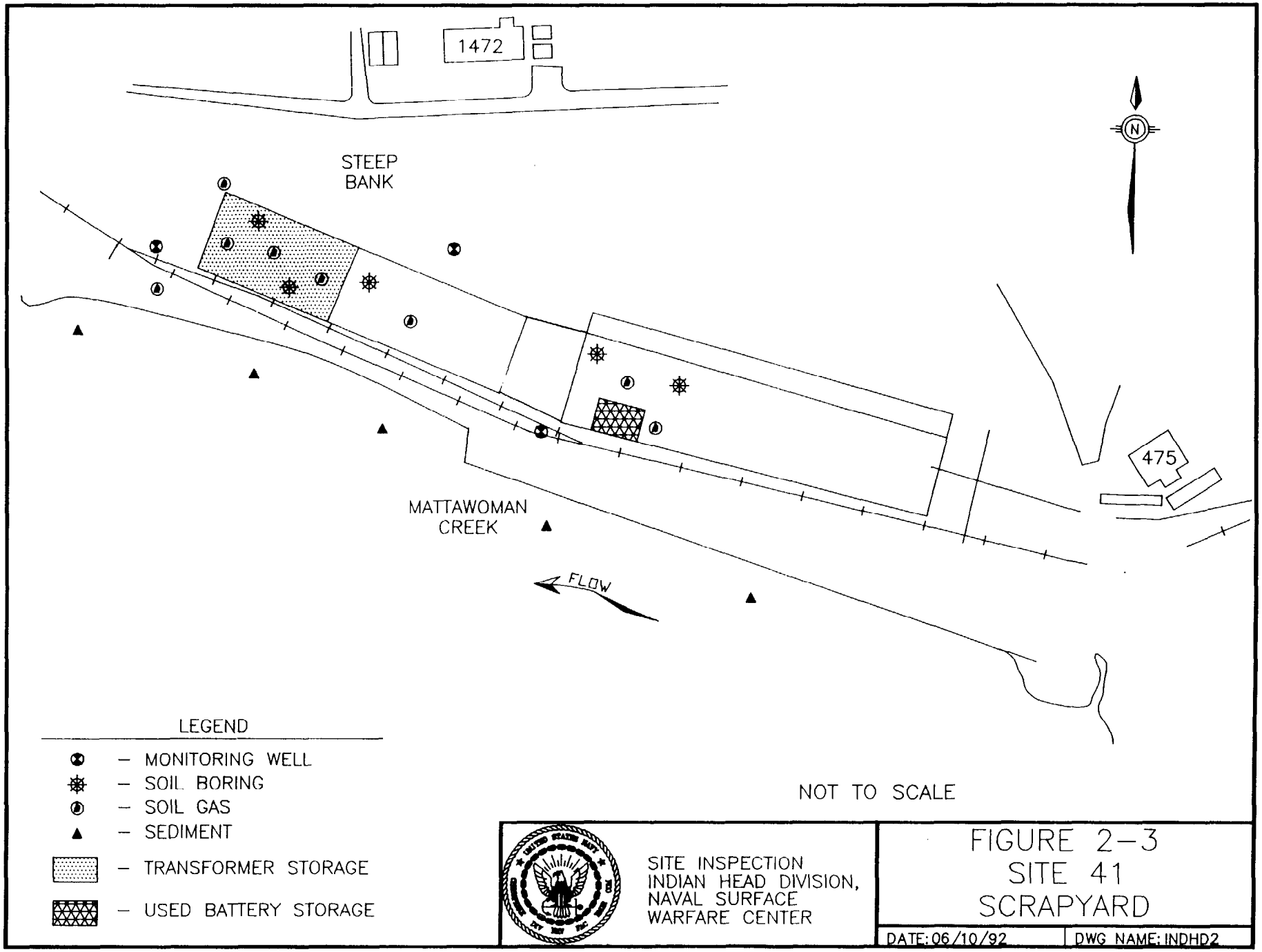
One release to Mattawoman Creek was reported as a result of a faulty valve. The estimated volume of this release was approximately 2000 gallons. Information from personnel interviews conducted during the PA indicated a plume of palladium on carbon black was visible on Mattawoman Creek in association with this spill.

Spills were also reported during the startup of production; however, the nature and quantities of these releases are unknown. Any uncontained spills would potentially migrate down the slope toward Mattawoman Creek and/or discharge through the hydrogenation outfall. Difficulty with the corrosive nature of the compounds was believed to be the cause of numerous releases. Ultimately, production of UDMH stopped at the hydrogenation facility and was continued by an offsite contractor until DMNA was identified as a suspect carcinogen.

Site 40 was not recommended for an SI; however, it has been included at the request of the Maryland Department of the Environment (MDE). Study of this area will include the collection of top sediment from Mattawoman Creek and sediment samples at the outfall.

SITE 40					
	Sample Media:	Surface sediments (at outfall) Sediments (Mattawoman Creek)			
	Sample Procedures:	Type	Number	Sam/Loc	Total
		Surface sediments	2	1	2
		Sediment samples	4	1	4
	Analytical Requirements:	Media	Analyses		
		Surface sediments	Palladium		
		Sediment	Palladium		

Site 41 — Scrap Yard. The scrap yard is located in the southeastern section of the NSWC facility near the shore of Mattawoman Creek (Figure 2-3). The area is relatively flat and surface runoff is to the south toward the Mattawoman Creek. The creek is located less than 100 feet away. The scrap yard is secured by a fence and a locked gate.


1472
STEEP BANK
N
475
MATTAWOMAN CREEK
FLOW
LEGEND
– MONITORING WELL
– SOIL BORING
– SOIL GAS
– SEDIMENT
– TRANSFORMER STORAGE
– USED BATTERY STORAGE
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–3
SITE 41
SCRAPYARD
DATE: 06/10/92
DWG NAME: INDHD2

Polychlorinated biphenlys (PCB) contaminated and PCB containing electrical transformers were stored in the scrap yard from the 1960s to 1988 prior to disposal. Data from the Waste Analysis Plan conducted in 1981 indicated a total of 27 transformers (NEESA, 1983). Nine of the transformers were identified as PCB containing (> 500 ppm PCB oils) and eight were identified as PCB contaminated (50 to 500 ppm PCB oil). Lead batteries also stored in the scrap yard may have resulted in a release of lead to the surface soils.

This site was recommended for an SI to determine if PCB contamination is present. This will be accomplished by the installation of a series of soil and soil gas borings, monitoring wells and the collection of top sediment samples from Mattawoman Creek.

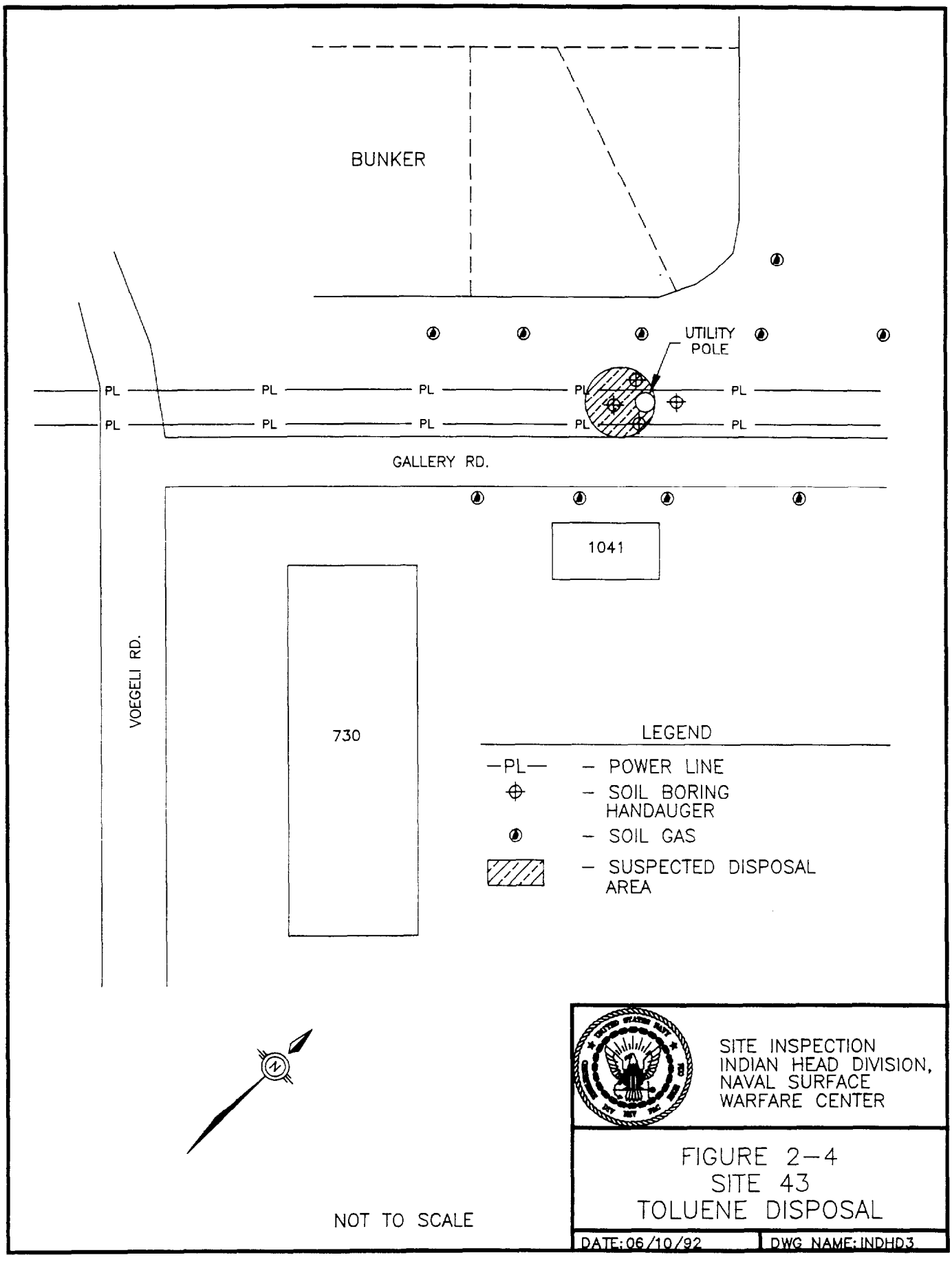
SITE 41

Sample Media:	Shallow soil profile (0-20 feet) Shallow aquifer (water table aquifer) Soil Gas (Vadose Zone) Sediments (Mattawoman Creek)			
Sample Procedures:	Type	Number	Sam/Loc	Total
	Shallow soil borings[A]	8	3	24
	Monitoring wells	3	2	6
	Soil gas borings	8	1	8
	Sediment samples (Mattawoman Creek)	11	1	11
Analytical Requirements:	Media	Analyses		
	Soil	TCL, TAL, TPH		
	Groundwater	TCL, TAL, TPH		
	Soil Gas	Total organic vapor-field analysis with PID[B]		
	Sediment	TCL, TAL, TPH		
	[A] Includes soil boring samples collected during the completion of soil borings and monitoring well borings. [B] PID = photoionization vapor detector.			

Site 43 — Toluene Disposal Site Casting Plant. The casting plant includes Building 1041 which is located in the western portion of the NSWC facility. Solvents such as toluene and xylene were regularly used to degrease metal parts during the casting process. Data collected during the PA indicated that improper dumping of the solvent occurred at the utility pole across the road from Building 1041 (Figure 2-4). The area surrounding the base of the utility pole is defined as Site 43.

Site 43 was recommended for an SI based on information that an unknown quantity of toluene was disposed at the base of the referenced utility pole. Study of this area will incorporate the collection of a series of surface soil samples for submission for laboratory analyses and the completion of a limited soil gas survey.

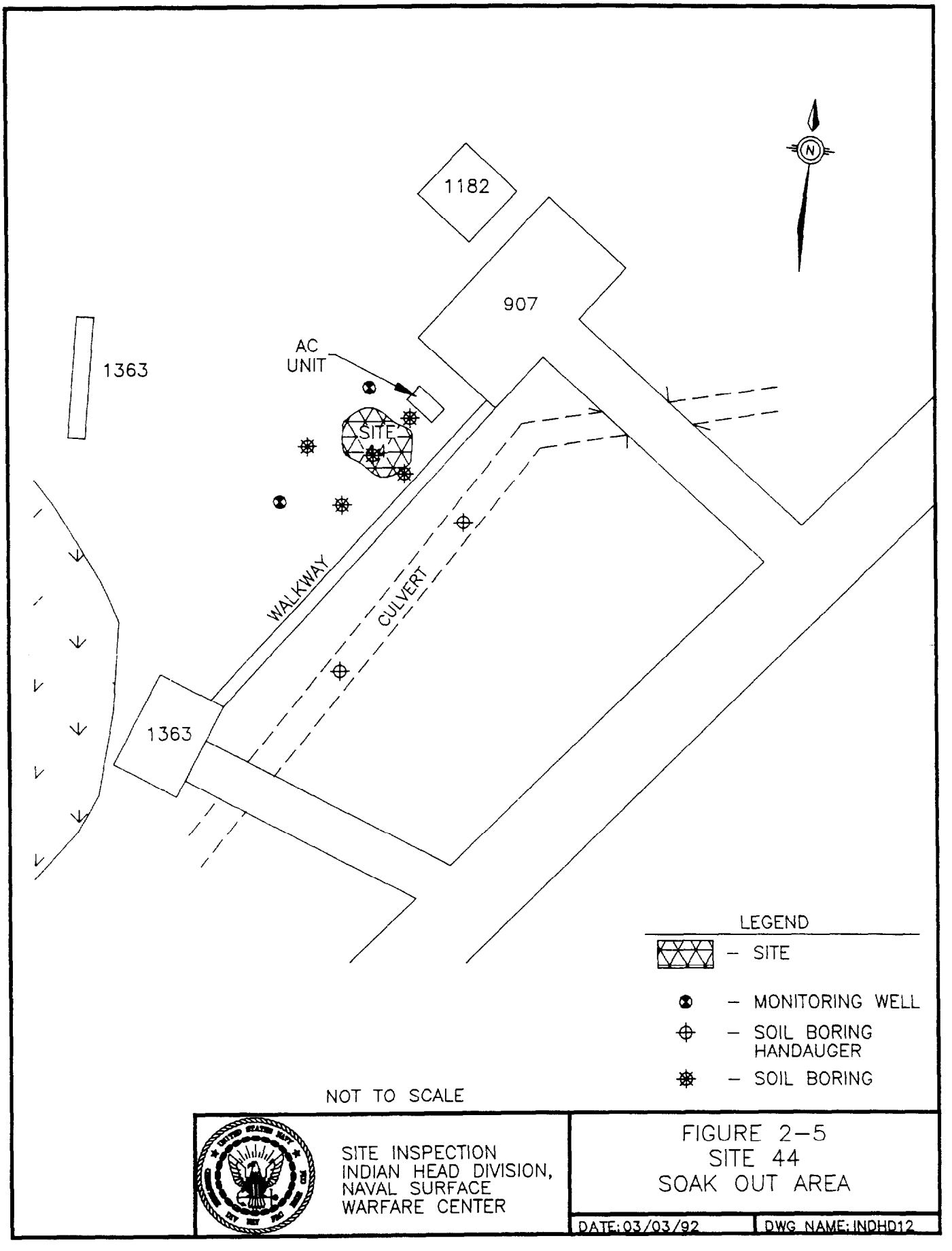
SITE 43					
	Sample Media:	Shallow soil profile (0 to 10) Soil Gas (Vadose Zone)			
	Sample Procedures:	Type	Number	Sam/Loc	Total
		Soil boring-hand auger	4	1	4
		Soil gas borings	10	1	10
	Analytical Requirements:	Media	Analyses		
		Soil (hand auger)	VOC, BNA		
		Soil Gas	GC, FID Volatile Organic Compounds		


BUNKER
UTILITY POLE
PL
GALLERY RD.
1041
VOEGELI RD.
730
LEGEND
—PL— – POWER LINE
– SOIL BORING HANDAUGER
– SOIL GAS
– SUSPECTED DISPOSAL AREA
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–4
SITE 43
TOLUENE DISPOSAL
DATE: 06/10/92
DWG NAME: INDHD3

Site 44 — Soak Out Area. This area is located between Buildings 907 and 1363 (Figure 2-5). Site 44 is the former location where the solvent Pennchem 9018 was used to remove propellant from rocket catapult tubes. Pennchem is a polysulfide solvent containing mercaptan. Data collected in the PA indicated that an unknown volume of the solvent was spilled due to the design of the soak out process and leaks in the holding tanks (two 55-gallon drums welded together end-to-end). The topography consists of a gentle grade to the southwest. A drainage ditch extends along the eastern edge of the area and discharges to the storm sewer system. The area was reported to be void of vegetation for several years subsequent to the close of the soak out process.

Site 44 was recommended for an SI based on the reported spills and apparent stressed vegetation. The SI will include installing a series of soil borings and monitoring wells, a limited soil gas survey, and collecting surface soil samples. Soil samples will be collected from the soil borings and during well installation. Groundwater samples will be collected from the completed monitoring wells.

SITE 44					
	Sample Media:	Shallow soil profile (0-20 feet) Shallow aquifer (water table aquifer) Soil Gas (Vadose Zone)			
	Sample Procedures:	Type	Number	Sam/Loc	Total
		Shallow soil borings[A]	5	3	15
		Monitoring wells	2	2	4
		Soil boring-hand auger	2	1	2
		Soil gas borings	15	1	15
	Analytical Requirements:	Media	Analyses		
		Soil	VOC, BNA, TPH		
		Groundwater	VOC, BNA, TPH		
		Soil (hand auger)	VOC, BNA, TPH		
		Soil Gas	GC, FID Volatile Organic Compounds		
		[A] Include soil boring samples collected during the completion of soil borings and monitoring well borings.			


1182
907
1363
AC
UNIT
SITE
WALKWAY
CULVERT
1363
N
LEGEND
– SITE
– MONITORING WELL
– SOIL BORING
HANDAUGER
– SOIL BORING
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–5
SITE 44
SOAK OUT AREA
DATE: 03/03/92
DWG NAME: INDHD12

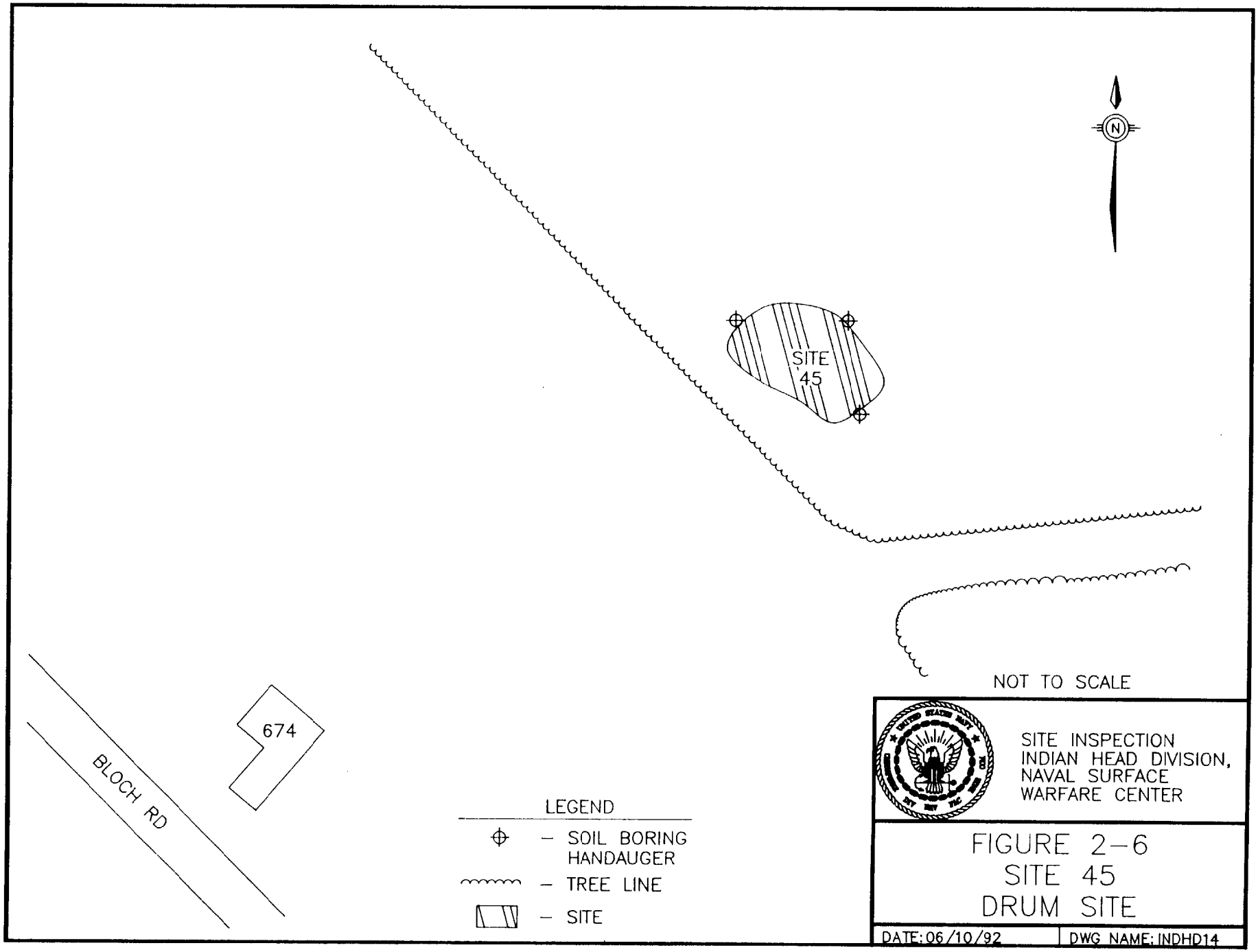
Site 45 — Abandoned Drums. This site is located in the woods approximately 200 feet northeast of Building 674 (Figure 2-6). Information gathered in the PA indicated that the drums have been in this area for 15 to 20 years. The origin of the drums and their prior contents are unknown. Data from the PA indicated that the origin of the drums may be spent solvent drums from the Soak Out Area. Site 45 is in a wooded area with a relatively flat topography. Because the drums are structurally unsound and/or ruptured, the potential for an uncontrolled release of substances to the surface soils is high.

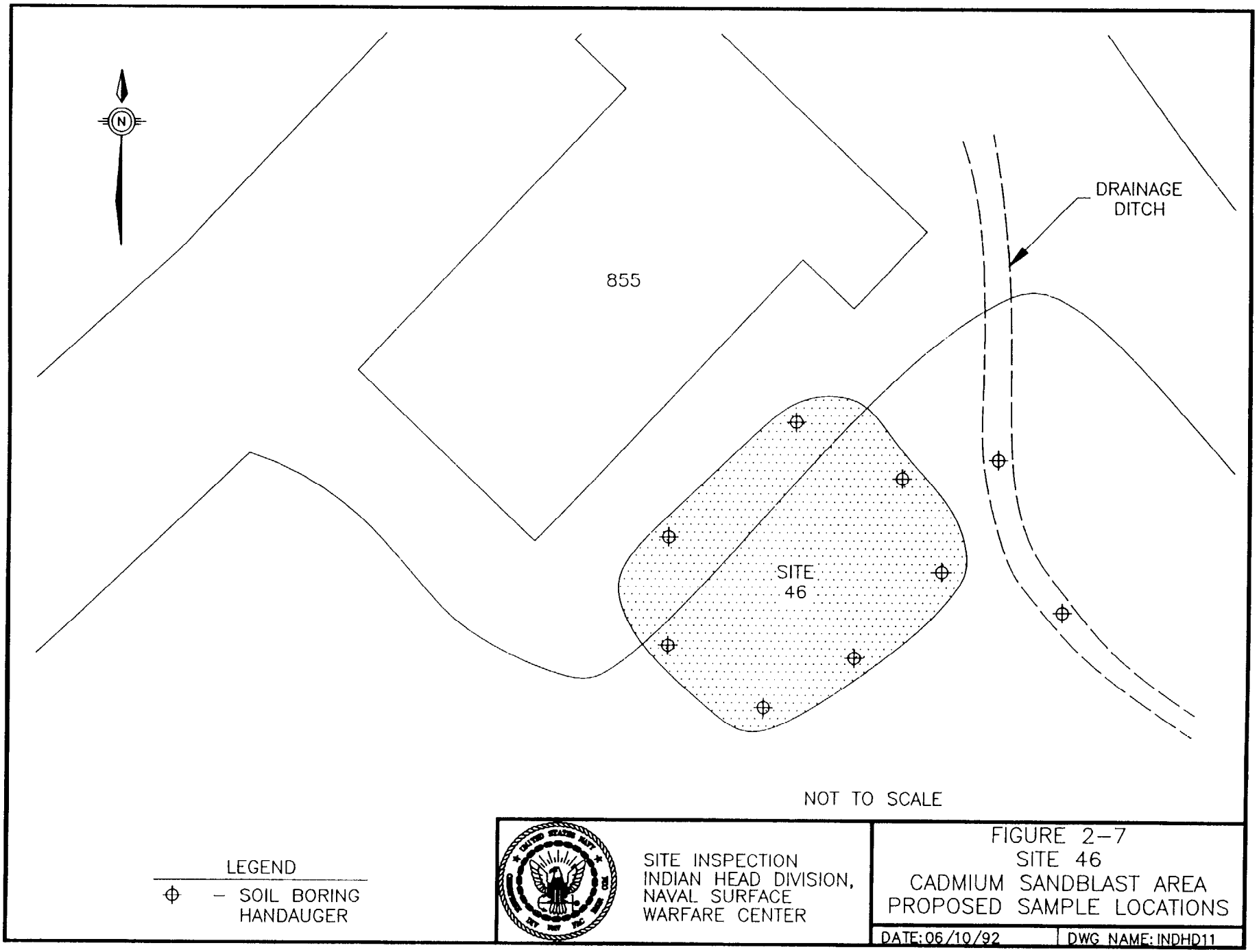
This site was recommended for an SI due to the unknown origin, and prior contents of the drums and the apparent potential for contamination of the surrounding surface soils. The SI of this area will involve collecting a series of surface soil samples for laboratory analyses.

SITE 45					
	Sample Media:	Shallow soil zone (0-3 feet)			
	Sample Procedures:	Type	Number	No/Loc	Total
		Shallow soil zone	3	1	3
	Analytical Requirements:	Media	Analyses		
		Soil	TAL, VOC, BNA		

Site 46 — Cadmium Sandblast Grit Area. The area behind Building 855 was identified in the PA as the disposal location of sandblast grit containing cadmium (Figure 2-7). The topography of the area is relatively flat, with the exception of the surface runoff to the drainage ditch bisecting the northern section of the site.

Cadmium was introduced into the sandblasting grit during resurfacing of rocket catapult tubes. The grit was disposed in the gravel and the ditch behind Building 855. The PA indicated that the disposal was occasional from the mid 1970s to the early 1980s. The total volume of grit disposed of cannot be determined.


SITE 45
674
BLOCH RD
LEGEND
– SOIL BORING HANDAUGER
– TREE LINE
– SITE
N
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–6
SITE 45
DRUM SITE
DATE: 06/10/92
DWG NAME: INDHD14

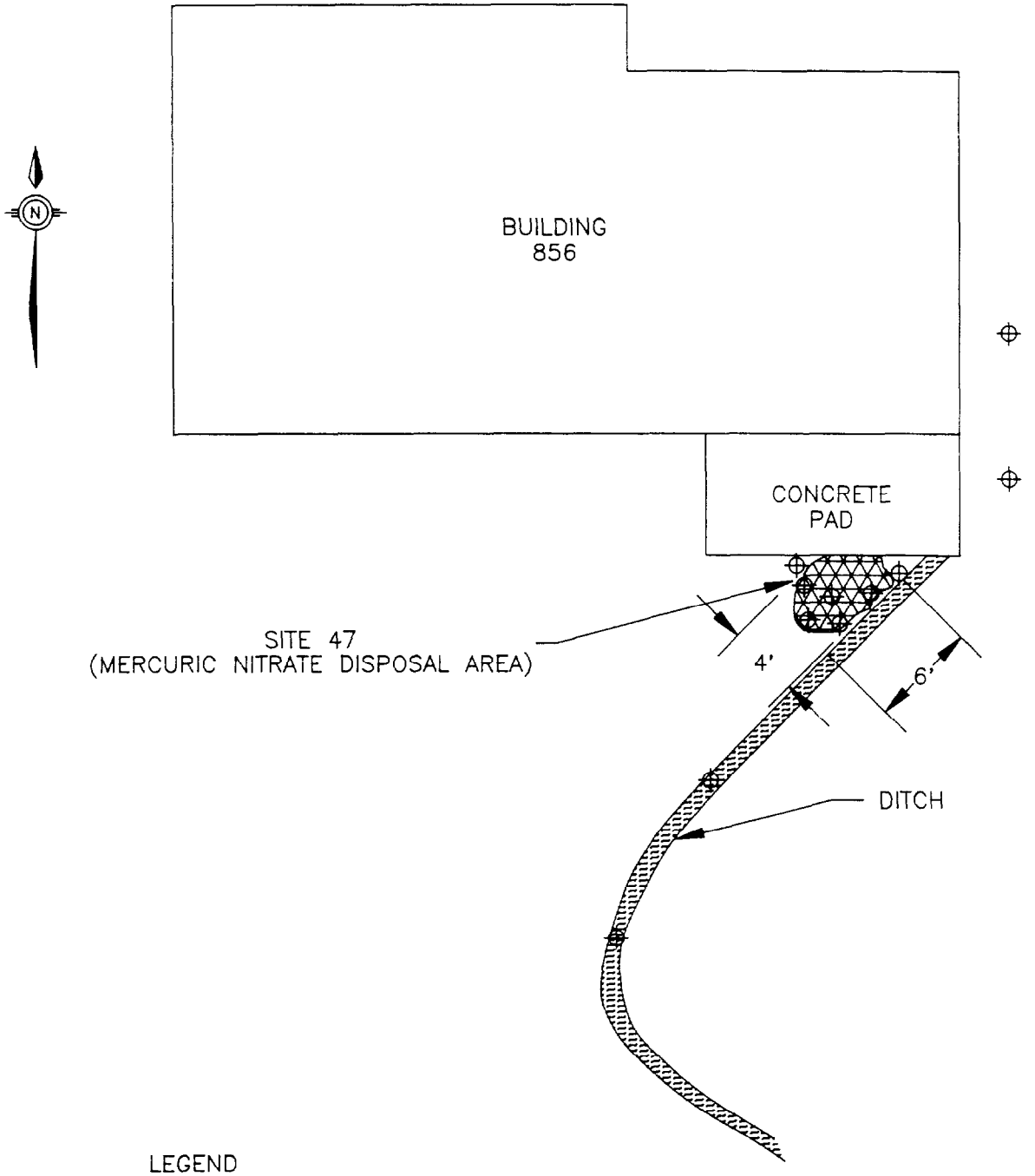

N
855
DRAINAGE DITCH
SITE 46
NOT TO SCALE
LEGEND
– SOIL BORING HANDAUGER
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–7
SITE 46
CADMIUM SANDBLAST AREA
PROPOSED SAMPLE LOCATIONS
DATE: 06/10/92
DWG NAME: INDHD11

This area was recommended for an SI due to the implications of sandblast grit containing cadmium in the area behind Building 855. This study will involve collecting a series of surface soil samples from the gravel area and the drainage ditch behind Building 855. Soil samples will be submitted for laboratory analyses.

SITE 46					
	Sample Media:	Surface soil (0-1 feet)			
	Sample Procedures:	Type	Number	No/Loc	Total
		Soil boring-hand auger	9	1	9
	Analytical Requirements:	Media	Analyses		
		Soil	TAL		

Site 47 — Mercuric Nitrate Disposal Area. Site 47 is located behind Building 856 and was the disposal site for the mercuric nitrate catalyst used in the production of a missile propellant, hydrazinium nitroformate. The mercuric nitrate was disposed of in a 4 x 6 foot pit filled with limestone chips (Figure 2-8). The PA indicated that disposal occurred from 1957 until 1965 and that an estimated 150 to 200 pounds of mercuric nitrate were placed in the pit. A drainage ditch adjacent to the pit drains southward towards Mattawoman Creek. Data collected during the PA and data presented in a study of the hydrology of the Indian Head Peninsula (Hiortdahl, 1990) indicate that the dominant surface runoff from the surrounding area would be southward toward Mattawoman Creek.

Site 47 was recommended for an SI to determine if mercury compounds impacted the soils beneath the disposal pit and if these compounds migrated via the drainage ditch to Mattawoman Creek. This study will be completed by the collection of a series of surface and shallow soil samples from the drainage ditch. The remaining 10 borings will be completed at the suspected location of the former disposal pit. A hand auger will be used to probe the surface



LEGEND

⊕ – SOIL BORING
HANDAUGER

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2–8
SITE 47
MERCURIC NITRATE
DISPOSAL AREA

DATE: 03/03/92 | DWG NAME: INDHD5

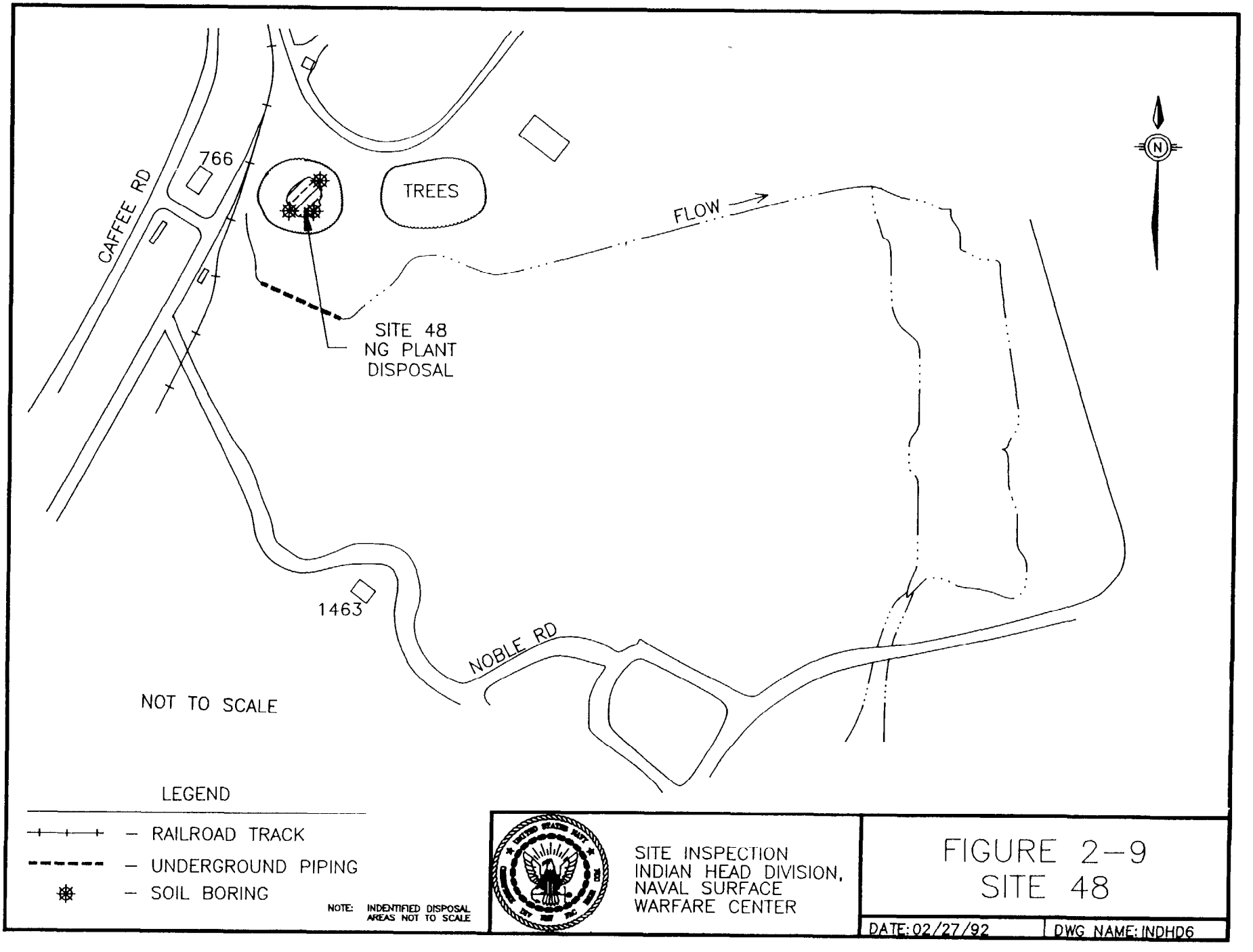
in an attempt to locate the former pit. Soil samples will be submitted for laboratory analyses.

SITE 47					
	Sample Media:	Shallow soil zone (0-1 feet)			
	Sample Procedures:	Type	Number	No/Loc	Total
		Soil boring-hand auger	12	1	12
	Analytical Requirements:	Media	Analyses		
		Soil	VOC, BNA, TAL		

Site 48 — Dump Site (Nitroglycerine Plant Disposal Area). The PA notes that Site 48 consists of several containers located in the woods near Building 766 (Figure 2-9). The origin of these containers is suspected to be the nitroglycerine plant, Building 766; however, no information confirming their origin was available. The containers appear empty and are dispersed about a small area in the woods. Vegetation does not appear stressed.

The possibility exists that these containers may have once contained hazardous substances. Therefore, an SI was recommended and will involve installating a series of soil borings in and around the dump site to determine if contamination is present.

SITE 48					
	Sample Media:	Shallow soil zone (0-15 feet)			
	Sample Procedures:	Type	Number	No/Loc	Total
		Soil boring	3	3	9
	Analytical Requirements:	Media	Analyses		
		Soil	VOC, BNA, TAL		

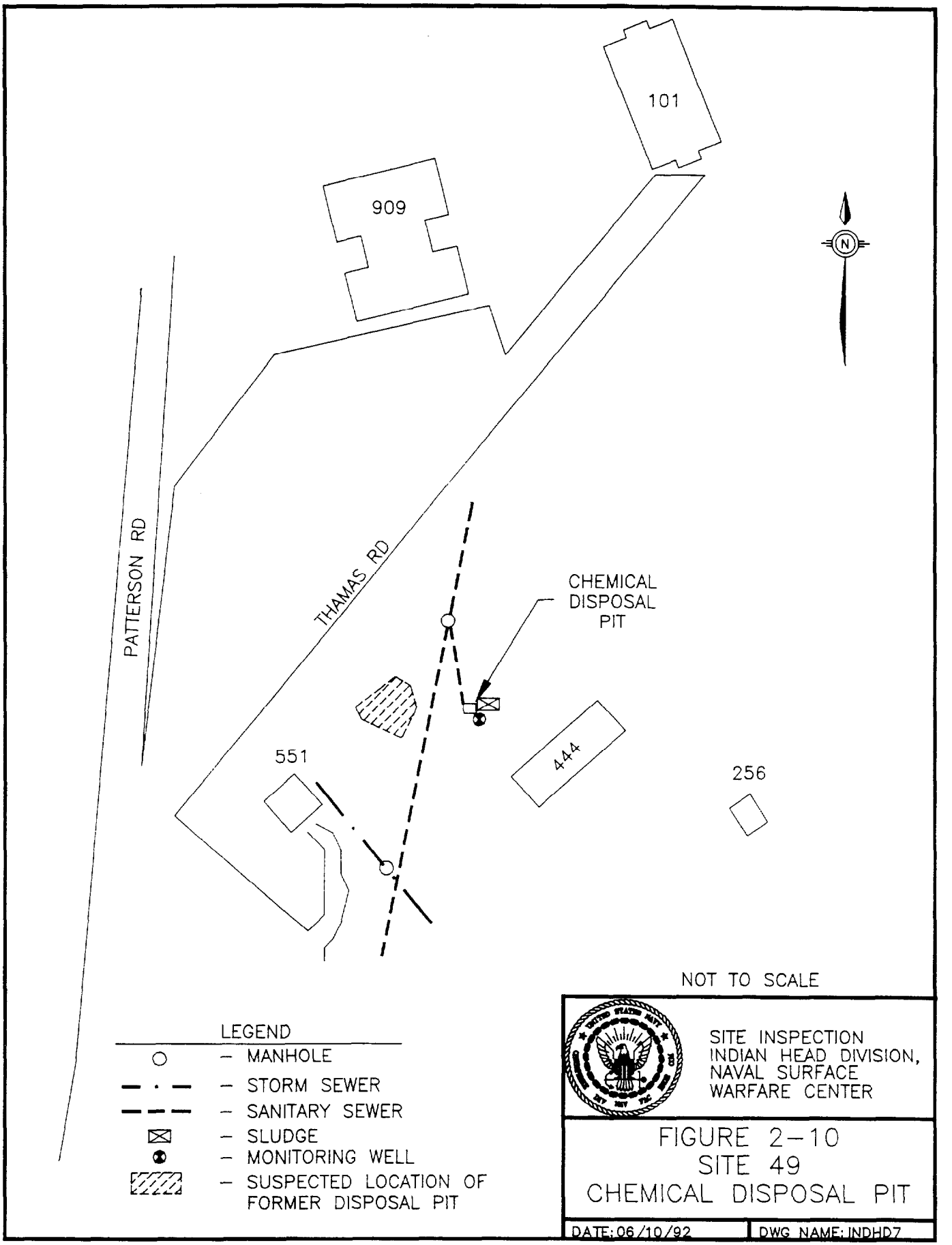

CAFFEE RD
766
TREES
FLOW
SITE 48
NG PLANT
DISPOSAL
1463
NOBLE RD
N
NOT TO SCALE
LEGEND
– RAILROAD TRACK
– UNDERGROUND PIPING
– SOIL BORING
NOTE: INDENTIFIED DISPOSAL AREAS NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–9
SITE 48
DATE: 02/27/92
DWG NAME: INDHD6

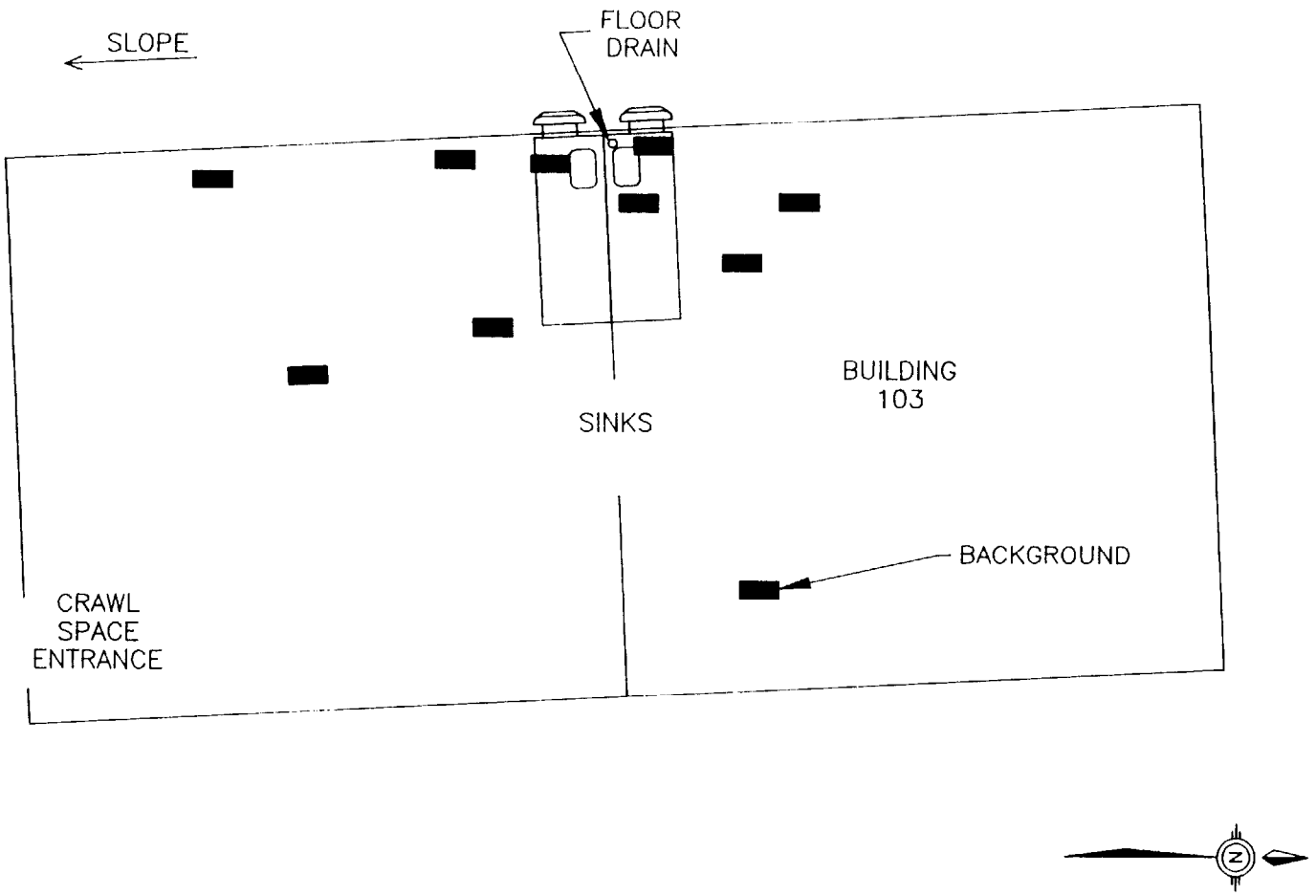
Site 49 — Chemical Disposal Pit. This site is located near Building 444 (Figure 2-10). Information from the PA report indicated the pit had limited use in the early 1970s. Disposal reportedly consisted of spent solvents and acid. Data also indicated that this pit connected to a storm sewer and not the sanitary sewer where chemicals could be treated and/or diluted.

Site 49 was not recommended for an SI in the PA; however, at the request of the MDE, this site was included in the scope of work and will be included in the SI. A study will be completed in this area consisting of the installation of one soil boring and the collection of a sediment sample from within the pit. The boring installed at this site may be completed as a shallow monitoring well as part of the scope of work at Site 53.

SITE 49					
	Sample Media:	Shallow soil zone (0-20 feet) Sediment in pit			
	Sample Procedures:	Type	Number	Sam/Loc	Total
		Soil boring	1	3	3
		Soil boring-hand auger	1	2	2
	Analytical Requirements:	Media	Analyses		
		Soil	VOC, BNA, TAL, Nitrate Esters		
		Sediment	VOC, BNA, TAL, Nitrate Esters		

Site 50 — Building 103 Crawl Space. Site 50 consists of the crawl space underneath Building 103 (Figure 2-11). The building is a small single story wood frame structure on a raised concrete block foundation. During the replacement of two sinks in the building, workers discovered that the drain pipes discharged directly beneath the building and not to the sanitary sewer. Evidently, the open drainage pipes had been discharging underneath the building since the date of construction, 1902, until the sinks were replaced in 1988.


101
909
PATTERSON RD
THAMAS RD
CHEMICAL
DISPOSAL
PIT
551
444
256
N
NOT TO SCALE
LEGEND
– MANHOLE
– STORM SEWER
– SANITARY SEWER
– SLUDGE
– MONITORING WELL
– SUSPECTED LOCATION OF FORMER DISPOSAL PIT
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–10
SITE 49
CHEMICAL DISPOSAL PIT
DATE: 06/10/92
DWG NAME: INDHD7



LEGEND

■ – SURFACE SAMPLE

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2–11
SITE 50
BUILDING 103
FLOOR PLAN

DATE: 06/10/92 | DWG NAME: INDHD9

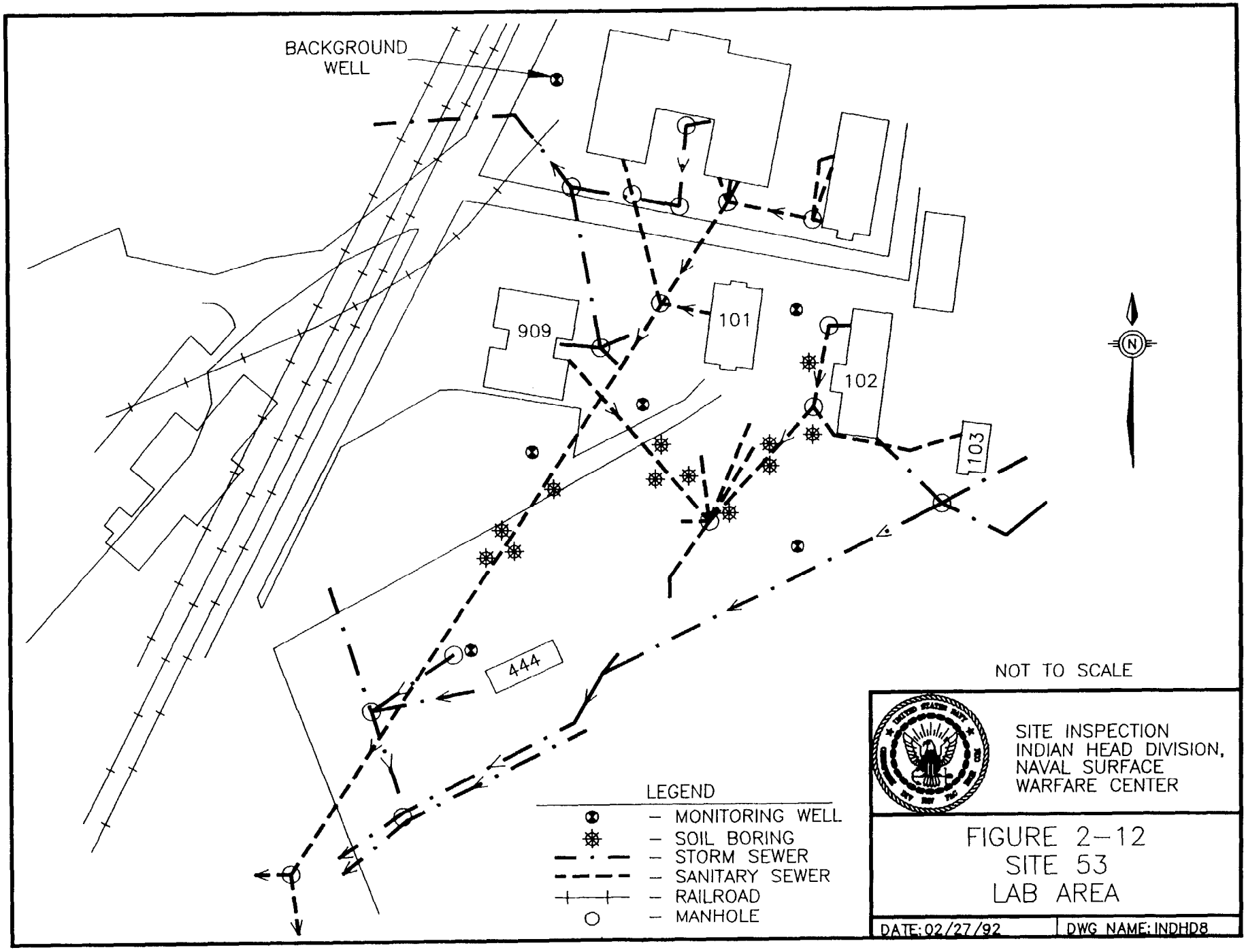
The possibility exists that a number of solvents, including mercury containing compounds and nitrate ester compounds, were introduced to the soil underneath the building via open drain pipes. The amount of mercury and solvents released in the soil beneath the building is unknown. Study of this site will include the collection of a series of surface soil samples from beneath the building for laboratory analyses.

SITE 50					
	Sample Media:	Surface soil			
	Sample Procedures:	Type	Number	Sam/Loc	Total
		Surface soil	10	1	10
	Analytical Requirements:	Media	Analyses		
		Soil	VOC, BNA, TAL, Nitrate Esters		

Site 53 — Mercury Contamination in Laboratory Area. The sewer lines in the general laboratory area are defined as Site 53 (Figure 2-12). Information collected during the PA estimated that 28,000 pounds of mercury may have been released to the soils surrounding these sanitary sewer lines. A survey conducted by NSWC Indian Head personnel found these lines to be in poor condition.

A study will be conducted in this area to determine if mercury contamination originating from the sewer system has impacted surrounding soils. Shallow soil borings will be completed adjacent to the sewer lines to a depth below the bottom grade of the line (estimated at 8 to 10 feet). Two soil samples per boring and 12 sediment samples from man holes will be collected. All samples will be submitted to the laboratory for analysis.

In addition to the soil borings, six groundwater monitoring wells will be installed in the laboratory area. One well will be installed as a background or upgradient well. The boring installed at Site 49 may be completed as one of the six wells. Soil samples will be collected during the installation of the monitoring wells and groundwater samples will be collected from the completed wells.


BACKGROUND WELL
909
101
102
103
444
N
NOT TO SCALE
LEGEND
– MONITORING WELL
– SOIL BORING
– STORM SEWER
– SANITARY SEWER
– RAILROAD
– MANHOLE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–12
SITE 53
LAB AREA
DATE: 02/27/92
DWG NAME: INDHD8

SITE 53					
	Sample Media:	Shallow soil profile (0-10 feet) Shallow aquifer (water table aquifer) Sediment (sewer lines)			
	Sample Procedures:	Type	Number	Sam/Loc	Total
		Shallow soil borings (adjacent to sewer lines)	12	2	24
		Shallow soil borings (monitoring wells)[a]	6	3	18
		Monitoring wells[b]	6	2	12
		Sediment (from sewer manholes)	12	1	12
	Analytical Requirements:	Media	Analyses		
		Soil (adjacent to sewer lines)	Mercury, Nitrate Esters		
		Soil (monitoring wells borings)	VOC, BNA, TAL, TPH[b]		
		Groundwater	VOC, BNA, TAL, TPH		
		Sediment (sewer manhole)	Mercury, Nitrate Esters		
		[a] Monitoring well include one background well and the well installed at Site 49. [b] Soil samples for the wells installed at Site 49 will be analyzed for the parameters defined for that site.			

Site 54 — Building 101 Mercury Contamination. Building 101 is a two-story brick building where mercury compounds were used in research and development. Droplets of mercury were detected on the insulation of a steam pipes in the southeast corner room of the first floor. This first floor room is defined as the study area. During the PA it was discovered that laboratory equipment containing mercury had been located in the southeast corner room of the second floor, directly above the study area. The conclusion of the PA was that the source of the mercury droplets may be due to leaks and spills associated with the laboratory equipment on the floor above.

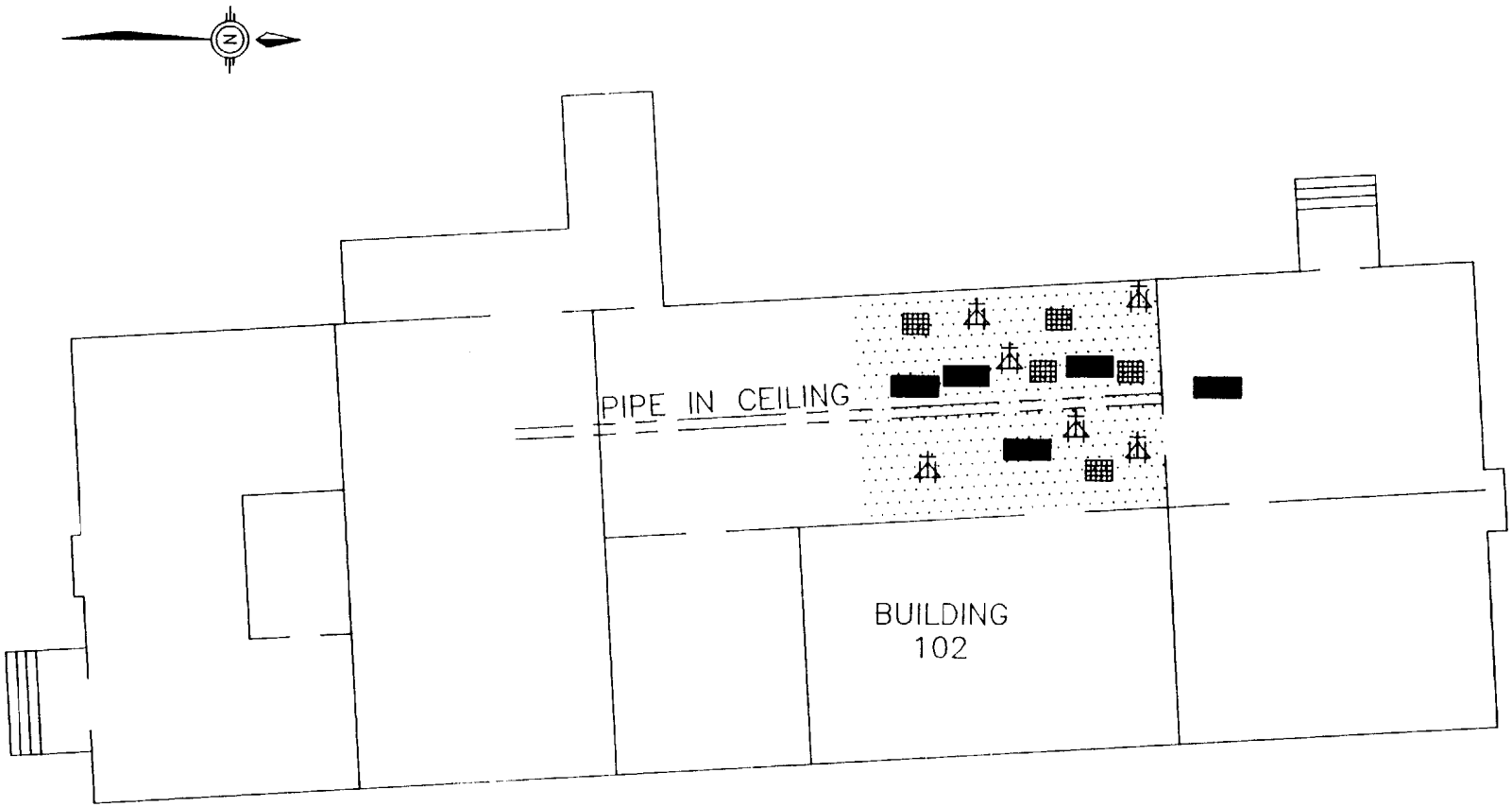
Site 54 was recommended for an SI based on the discovery of the mercury on the pipes and mercury vapors detected in the room by NSWC safety personnel. The SI will involve the collection of wipe samples from the surfaces of selected building materials, the collection of

media samples (bulk building materials) from selected building materials, and the collection of concrete samples from the basement floor.

SITE 54					
	Sample Media:	Horizontal surfaces Building Materials Concrete Floor			
	Sample Procedures:	Type	Number	No/Loc	Total
		Wipe (horizontal surfaces)	5	1	5
		Bulk building materials	5	1	5
		Concrete	5	1	5
	Analytical Requirements:	Media	Analyses		
		Wipe	Mercury		
		Bulk building materials	Mercury		
		Concrete	Mercury, Nitrate Esters		

Site 55 — Building 102 Mercury Contamination. In 1987 mercury was discovered dripping from the ceiling onto the coffee mess located in the basement of Building 102 (see Figure 2-13). Reportedly, a spill of mercury occurred on the upper floor in the early 1960s and was identified in the PA as the probable source of the mercury. The PA outlines a brief site history which indicates the building was used for a number of processes involving mercury for nearly 80 years.

Building 102 was recommended for an SI due to the discovery of mercury permeating through the floor and entering into the basement. The SI will include the collection of wipe samples from the surfaces of selected building materials, and the collection of media samples (bulk building materials) from selected building materials. Soil samples from underneath the concrete basement floor may also be collected and submitted for laboratory analyses. This building contains friable and nonfriable asbestos-containing materials throughout the structure.



LEGEND

- WIPE SAMPLE
- MEDIA SAMPLE
- CONCRETE SAMPLE
- AREA OF SUPECTED MERCURY CONTAMINATION

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2-13
SITE 55
BUILDING 102
BASEMENT FLOOR PLAN

DATE: 06/10/92 | DWG NAME: INDHD10

SITE 55					
	Sample Media:	Horizontal surfaces Building Materials Concrete Floor			
	Sample Procedures:	Type	Number	No/Loc	Total
		Wipe (horizontal surfaces)	5	1	5
		Bulk building materials	5	1	5
		Concrete	5	1	5
	Analytical Requirements:	Media	Analyses		
		Wipe	Mercury		
		Bulk building materials	Mercury		
		Concrete	Mercury, Nitrate Esters		

Industrial Wells Onsite. In addition to those sites discussed above, groundwater samples will be collected from five industrial wells on the NSWC facility. The samples will be submitted for laboratory analyses.

INDUSTRIAL WELLS					
	Sample Media:	Groundwater (deep aquifer)			
	Sample Procedures:	Type	Number	No/Loc	Total
		Existing Well	10	1	10
	Analytical Requirements:	Media	Analyses		
		Groundwater	TCL, TAL		

3.0 SAMPLING PROCEDURES

3.1 Soil Boring Installation and Soil Sampling Procedures

All soil borings will be completed as described in this section unless site conditions warrant a modification. The soil boring procedures described below include borings to be completed as shallow monitoring wells.

3.1.1 Soil Borings

The procedures for the installation of soil borings and the collection of soil samples are:

- Borings will be completed to a maximum depth of 25 feet or to groundwater using standard 4.25-inch internal diameter (ID) augers. Standard penetration tests and split spoon soil samples will be collected at 5-foot intervals to depth, or as directed by the site geologist.

- The soil sampler will be a standard 24 inch, 2-inch outside diameter (OD) split spoon. The augers will be advanced to the desired sampling depth. The split-spoon sampler will be attached to the end of drilling rods, inserted into the annulus of the augers and lowered to the sampling depth. The sampler will be driven 24 inches, in advance of the auger bit, with a 140 pound hammer dropped 30 inches, in accordance with NEESA 20.2-031A.

- After the split spoon sampler is retrieved, the sampler will be opened and a portion of the soil sample will be immediately collected for the volatile constituents when applicable. The soil will be placed in the appropriate container and labeled. The filled sample container will be placed in a cooler on ice.

- The remaining portion of the soil sample will be split where one part will be prepared for laboratory analysis and the second part will be prepared for headspace analysis in the field.

- The headspace screening process involves placing a subsample in a glass jar, (approximately 3/4 full) and covering it with aluminum foil, securing the lid, and allowing the sample to reach ambient temperature. Headspace will be measured by inserting the probe under the foil and measuring the total organic vapor in the headspace of the sample container. All headspace data will be recorded on the boring log. When sample quantity is insufficient for headspace techniques to be applied, direct measurements will be made from the sample immediately after the split spoon is opened (or after the volatile fraction sample has been collected).

- The sample will then be classified by an experienced geologist. Following classification, the sample may be placed in a stainless steel bowl and mixed to form a homogenized sample. The soil will then be placed in the appropriate container, labeled and placed in a cooler on ice.

- Select soil samples will be submitted to PACE, Inc. of Wappinger Falls, NY., (NEESA approved) under strict chain-of-custody, for analysis. Soil samples submitted for laboratory analysis will be selected based on the results of organic vapor screening as outlined above. Samples with the highest indicated level of organic vapors will be submitted to the laboratory. If no organic vapors are detected, the Project Geologist will select the laboratory sample based on sample conditions and/or his past experience.

- All borings will be abandoned by pressure grouting to the surface to prevent the infiltration of surface runoff from entering the boring.

- All drilling equipment will be decontaminated between borings to prevent cross contamination. Decontamination will consist of high pressure hot water wash followed by a potable water rinse. Decontamination will be completed before, between, and after each boring is drilled for this project. Split-spoon samplers will be decontaminated before, between and after each use by an Alconox wash followed by a potable water rinse.

3.1.2 Hand Auger Borings

Shallow soil samples will be collected using a stainless steel hand auger. Soil samples will be collected at 1-foot intervals. The sample intervals will be from 0-1 foot, 1-2 feet and 2-3 feet. The total depth of boring completion will be determined by the scope of study at each site.
The hand auger will be turned to the desired sampling depth. The sample will be retrieved from the boring and placed into a clean stainless steel bowl or cleaned pan. The appropriate container will be filled immediately for the volatile fraction analysis. The remaining soil will be mixed to homogenize the sample. The sample will then be placed into the appropriate, pre-cleaned sample container. A label will be placed on each sample container and given a unique identification number. Each sample will be placed in a cooler on ice.

3.1.3 Surface Soil Samples

Surface soil samples may be collected with a hand auger as described above or with a disposable scoop. The appropriate quantity of soil is scooped and placed in a stainless steel bowl. The volatile fraction is promptly collected by filling the appropriate container, affixing the sample label and placing the container in a cooler on ice. The remaining sample is mixed to form a homogeneous sample. The appropriate sample containers are filled, a sample label is affixed, and the sample is placed in a cooler on ice.

3.2 Monitoring Well

All shallow groundwater monitoring wells will be constructed to comply with the State of Maryland Well Construction Regulations, COMAR 26.04.04 and all applicable USEPA criteria. Figure 3-1 is a typical well construction configuration and is consistent with the COMAR 26.04.04. All well drilling and installations will be logged and supervised by a qualified geologist.

3.2.1 Monitoring Well Installation

The procedures for installing wells for this project are as follows:

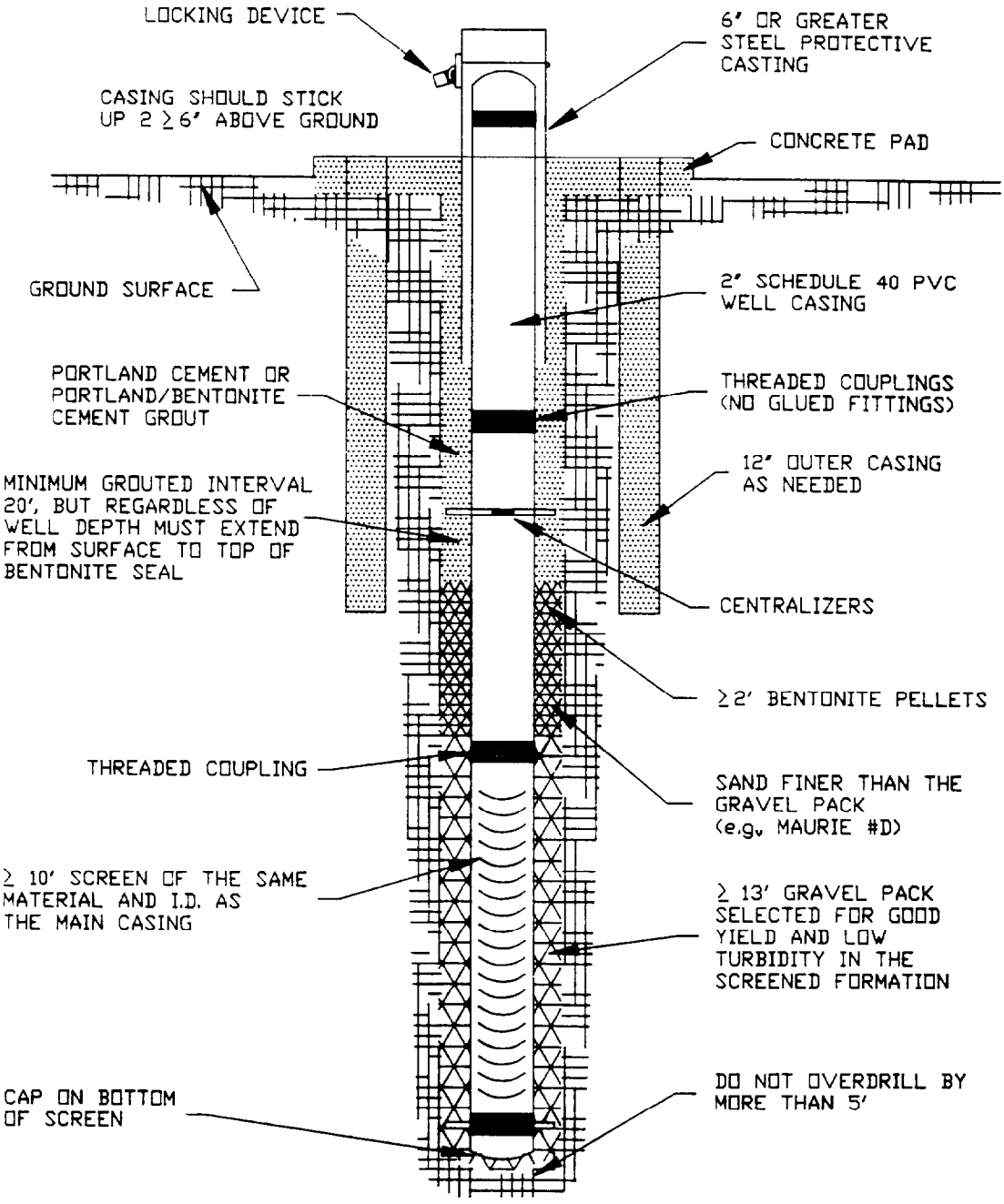
- Shallow monitoring wells will be initiated with 4.25-inch ID augers. Standard penetration tests and split-spoon samples will be performed at 5-foot intervals, or as directed by the site geologist throughout the drilling process.

- Soil samples will be collected by the procedure outlined in section 3.1.1.

- After the drilling is advanced to the target depth, the well boring will be over drilled with 8.25-inch ID augers to the desired depth.

- After over drilling is complete, a section of 4-inch diameter flush threaded, schedule 40 PVC riser and a 10-foot section of 0.010 slot, 4-inch diameter, schedule 40 PVC well screen will be installed. The well screen will be installed at an estimated depth of 7 feet below the water table with a minimum of 2.5 feet above grade stick-up.

TYPICAL ILLUSTRATION OF MINIMUM SPECIFICATIONS
FOR MONITORING WELL CONSTRUCTION



Environmental and Safety Designs, Inc.

EN SAFE®

5724 SUMMER TREE DR. MEMPHIS, TN. 38134 ☎(901)372-7962

FIGURE 3-1
TYPE III
MONITORING WELL DESIGN

DATE: 10/9/91 | DWG NAME: MDWEL10C

- A minimum of three centralizers will be installed to center the well casing in the annular space. One will be placed in the screen section and the other two spaced evenly along the remaining casing.

- The annular space will be packed with a primary filter pack of 20-40 silica sand (U.S.C.S. Standard) to prevent clogging of the slots. The sand will be tremied to a depth of at least 3 feet above the slotted screen. A secondary filter pack of finer sand will be placed above the primary filter pack, at a minimum thickness of 2 feet, to prevent the infiltration of grout and bentonite into the primary filter pack.

- A bentonite seal will be installed to a minimum thickness of 2 feet above the secondary filter pack and charged with deionized water. The bentonite will be allowed to hydrate a minimum of eight hours to allow complete swelling of the seal. The remaining annulus of the borehole will then be filled with a Type I Portland cement with a 5 percent bentonite slurry to the surface.

- An outwardly sloping 3' x 3' x 6" concrete platform will be constructed at the ground surface around each well casing. A security casing with a locking cap will be installed around the well casing to preserve the integrity of the well.

- A permanent measuring point will be established at the top of each "true" well casing. This point will be marked and surveyed to establish the elevation relative to a permanent USGS NAD '27 benchmark or a permanent benchmark to the nearest 0.01 foot.

3.2.2 Monitoring Well Development

Following the completed installation, each well will be properly developed to ensure that the well is functioning properly. Well developing may be completed by bailing or pumping.

Bailing is done with a Teflon-coated single check valve bailer which is manually lowered into the well, filled with water, and then retrieved. Pumping may be completed with a hand pump or an electrical submersible pump. Selected water quality measurements will be completed to ensure proper well development. These field procedures are discussed in Section 3.7.1.

3.2.3 Monitoring Well Abandonment

All monitoring wells installed during this SI will be abandoned in compliance with the State of Maryland Regulation for Monitoring Well Installation, COMAR 26.04.04. The decision to abandon the well will be made by the EIC and/or the activity.

There are two basic approved methods for monitoring well abandonment in the State of Maryland. One requires internally grouting the well in place to the surface with a Type I/II Portland cement with a 5-percent bentonite slurry. The second method requires over drilling the monitoring well and removing the well. The remaining hole is grouted to the surface with a Type I/II Portland cement with a 5-percent bentonite slurry.

3.3 Monitoring Well Sampling Procedures

Sampling of the monitoring wells will involve reading the static water level to calculate well casing volume, purging the well casing of stagnated water, retrieving the sample and placing it into properly labeled sample container(s). These procedures are described below.

3.3.1 Static Water Level Measurement

Static water level measurements will be performed on all monitoring wells prior to purging and in accordance with NEESA 20.2-031A, and the Southern Division *Specifications for Groundwater Monitoring Well Installation and Sampling*. The procedure is as follows:

- The water level meter will be tested prior to use to ensure proper operation.

- The probe will be decontaminated prior to each measurement with a deionized water rinse.
- The probe will be lowered into the annulus of the monitoring well until the buzzer indicates the probe has intersected the groundwater surface.
- The depth to water will be measured to the nearest 0.01 foot relative to the permanent mark established at the wellhead. The depth to water will be recorded in a bound field notebook and the date and time will be noted.

3.3.2 Monitoring Well Purging

Each well will be purged of stagnant water immediately before sampling. The purging process ensures that the well is functioning properly and that representative groundwater samples are obtained. During well purging, select water quality measurements will be collected, including: pH, temperature, specific conductivity, oxidation reduction potential (ORP) and turbidity. These procedures are outlined in Section 3.7.1.

Well Purging Procedures:

- A minimum of three casing volumes will be purged from each well. The water volume in the well casing will be calculated before purging by subtracting the depth to water from the total depth of the casing and multiplying by the appropriate factor (0.661 gallons per foot for a standard 4-inch PVC well casing).

- Well purging may be completed by bailing or pumping. Bailing is done with a Teflon-coated single check valve bailer which is manually lowered into the well, filled with water and then retrieved. Pumping may be completed with a hand pump or an electrical submersible pump.

- If a well bails to dryness before an adequate purge volume is removed, the volume removed will be noted and an explanation will be given. A minimum of 24 hours will be allowed to pass between well purging and well sampling for wells that bail dry.

3.3.3 Groundwater Sample Collection

All groundwater samples will be collected in accordance with NEESA 20.2-031A, Chapter 7 Ground-Water Sampling and Southern Division *Specifications for Groundwater Monitoring Well Installation and Sampling*. Groundwater samples will be collected using a dedicated Teflon-coated single check valve bailer and nylon bailing rope.

Sampling Procedures:

- A sheet of clean visquine will be placed on the concrete platform and around the security casing to prevent possible contact between the bailer and bailer rope with the ground surface.
- The bailer will be slowly lowered into the water column to minimize water column disturbance and possible loss of volatile parameters.
- After the bailer has filled with water, it will be manually retrieved and the samples will be immediately transferred to appropriate sample containers. Sample containers for volatile analysis will be filled first.
- While in the field and during transport to the laboratory, all samples will be retained in a field cooler with ice packs.

3.3.4 Groundwater Sampling Equipment Decontamination

All equipment used in measuring and sampling groundwater monitoring wells will be decontaminated in accordance with NEESA 20.2-031A. Decontamination will consist of a potable water wash, followed by a potable water rinse, an isopropanol rinse, and a final deionized water rinse. This will be completed before initial use and between samples. This

procedure will minimize the potential for cross-contamination between sampling locations. Disposable gloves will be worn during all measurements and sampling activities. A new pair of disposable gloves will be donned for each water sample and/or measurement.

3.4 Wipe Samples

Wipe samples will be collected at Sites 54 and 55 to determine the presence of mercury. Hexane will be used as the solvent to collect these samples. Each sample site to be sampled will be prepared in the following manner:

- Mark the exact sample site with a template or a ruler. (The template or ruler must be thoroughly cleaned between samples to prevent cross contamination.)
- Write a detailed description of the area sampled and include a sketch of the sampling area (as close to scale as possible).
- Prepare all necessary forms, sampling logs and chain-of-custody forms with sampling time, date, location, and other useful information.
- Prepare all sampling equipment for the sampling event.

After site preparation, a trained person will perform the tasks as follows:

- Remove the cap from the sampling vial with gloved hands.
- Remove the solvent- (hexane) soaked gauze or swab from the sampling vial with forceps, tongs or gloves.
- Immediately begin wiping the entire marked area twice, from left to right and then from top to bottom.
- Return the gauze or swab to the sample vial. (If using a gauze, fold the sample side inward.)
- Cap the sample vial to prevent evaporation of the solvent.

- Label the vial and record the sampling details on the sampling forms. Complete the chain-of-custody forms and prepare the vial for storage and shipment. Wipe samples will follow soil requirements for preservation and holding times.

Quality control measures for wipe samples will include field blanks, duplicate samples, and spike samples. In addition to the quality control measures and documentation, descriptions and activities will be included such as: the sampler's identification, a step-by-step description of how samples were obtained, the location and the purpose.

3.5 Media Samples (Bulk Building Materials)

Building materials sampled as media samples will be treated as suspect asbestos-containing materials with the exception of concrete samples. Samples will be collected by first wetting the material with soapy water. A sample will be collected by cutting, breaking or coring the material (as required). Care will be taken not to cause a release of excessive fibers. The sample will be placed in the appropriate container. A label will be affixed and the container will be placed in a cooler on ice.

3.6 Top Sediment Samples

Top sediment samples will be collected from Mattawoman Creek at Sites 39, 40 and 41 with a petite Ponar sampler. The Ponar sampler is a clamshell type scoop activated by a counter lever system. The shell is opened and latched in place and slowly lowered to the stream bottom. When tension is released on the cable, the latch releases. The sampler is then retrieved. The lifting action of the cable on the lever system closes the clamshell.

Sediment Sampling Procedures:

- Attach the precleaned Ponar to the necessary length of sample line.
- Measure and mark the distance to bottom on the sample line. A secondary mark, one meter shallower, will indicate proximity so that lowering rate can be reduced, thus preventing unnecessary bottom disturbance.
- Open sampler jaws until latched. From this point on, support the sampler by its lift line or the sampler will be tripped and the jaws will close.
- Tie free end of sample line to fixed support to prevent accidental loss of sampler.
- Begin lowering the sampler until the proximity mark is reached.
- Slow rate of descent through last meter until contact is felt.
- Allow the sample line to slack several centimeters. In strong currents, more slack may be necessary to release mechanism.
- Slowly raise dredge clear of surface.
- Place the Ponar into a stainless steel bowl and open, then remove sample.
- Immediately fill the sample container for the volatile fraction. Mix the remaining sample until the sample is homogenous. Fill the remaining sample containers, affix the proper sample tags, and labels and place the sample in a cooler on ice.
- Decontaminate the sampler with an Alconox wash and an alcohol rinse, followed by a deionized water rinse.

3.7 Analytical Procedures

Analytical procedures selected for this SI vary from site to site. Specific analytical parameters are indicated in Section 2.0 under the description of each site. For more information regarding detection limits, holding times, etc. please refer to the Quality Assurance Plan (QAP), Section B of this Work Plan.

3.7.1 Field Analytical Procedures

Temperature (EPA 170.1), pH (EPA 150.1), specific conductance (EPA 120.1) and turbidity will be measured during well development and the purging process. These field measurements will be completed by filling the instrument sample chamber with water from the particular well being purged. After a minimum of one minute, the instrument should stabilize and the pH, temperature, specific conductance, time, and date will be entered in the field logbook.

3.7.2 Field and Laboratory Quality Control Checks

Internal laboratory control checks will be conducted in the laboratory by laboratory personnel. E/A&H will conduct internal quality control checks of sampling procedures and laboratory analyses. These checks will include preparation and submittal of sampler rinsate blanks, trip blanks, field blanks, and field duplicates for analysis and an evaluation of the laboratory analytical package.

The types and frequency of blanks and other control check samples are dictated by NEESA level C QC criteria selected for this project by the NEESA Contract Representative (NCR). The required control check sample frequencies are outlined in NEESA 20.2-047B. Level C QC measures for sampling and analysis are discussed below.

3.7.3 Field Data Quality

All field work will be conducted and/or supervised by the E/A&H Project Geologist to ensure proper procedures are followed. Field records will be kept of all field activities. These records will be maintained at the E/A&H office in Memphis, Tennessee. Such records will include any obstacles encountered during the field work and all variations required due to field conditions.

Field samples will be collected per the procedures previously outlined in this section. Precision will be assessed by evaluating the results of duplicate samples, and accuracy will be assessed by

evaluating the analyses of field blanks, trip blanks, and laboratory matrix and surrogate spikes. The collection frequencies for quality control sample collection are discussed in the QAP. The rationale of the quality control samples is discussed below

Duplicate Samples. A duplicate is an identical sample collected from the same location (i.e. well) at the same time under identical conditions. Duplicate samples are analyzed along with the original sample to obtain sample procedure precision and inherent sample source variability. Duplicate samples will be collected from 10 percent of all soil boring samples, and one per monitoring well sample set.

Field Blank. A field blank consists of the source water used in decontamination and pressure washing. The sample container is filled with the source water in the field and is prepared, preserved and stored in the same manner as the other field samples. The field blanks are analyzed along with the field samples for the constituents of interest to check for contamination imparted to the samples by the sample containers or other exogenous sources. One field blank per sampling event will be prepared.

Rinsate Sample. Rinsate (or equipment) blanks are collected by retaining rinsate from sampling equipment. The equipment is rinsed with deionized water after full decontamination procedures have been performed. Rinsate samples are collected in the same type of sample containers as the field samples. Rinsate samples will be collected daily. Initially, samples from every other day will be submitted for analysis. If analytes pertinent to the project are detected, the remaining rinsate sample must be submitted for analysis. The results of the rinsate blanks will be used to flag or assess the levels of the analytes in the samples. This comparison is made during data validation. The rinsate blanks are analyzed along with the field samples for the constituents of interest.

Trip Blank. A trip blank is a sample container prepared by the laboratory and filled with organic-free water that is transported unopened with the sample bottles. It is opened in the laboratory and analyzed along with the field samples for water matrix volatile organic analysis analytes only. Trip blanks will be submitted to the laboratory in all sample shipping containers holding field samples for volatile analyses at a frequency of one per sample shipping cooler.

3.8 Sample Identification, Containers, Preservation and Labeling

All samples will be properly identified upon collection with the time and date of collection, the sample number and the analytical request indicated on each label. Sample documentation and identification will be completed in compliance with the protocols outlined in the QAP, Section B of this Work Plan.

4.0 PROJECT MANAGEMENT PLAN

The following is a Project Management Plan for Phase II of the Site Inspection to be completed at the NSWC Indian Head, Maryland by E/A&H. The project management structure for E/A&H is discussed, the points of contact are listed and the requirements to be fulfilled by NEESA and the project schedule are discussed.

4.1 EnSafe/Allen Hoshall

Project Management structure for contract N62467-89-D-0318, Cost Plus Award includes the Task Order Manager, Project-Geologist (Site Manager), Project-Health and Safety Officer and Site Health and Safety Officer. Complete résumés are presented in Appendix A of this plan. The responsibilities of each are as follows:

Task Order Manager

Paul V. Stoddard, Manager of Geological Services

Responsibilities

The Task Order Manager is responsible for the proper maintenance of project budgets, schedules and deliverables, and is designated as the E/A&H point of contact.

Project-Geologist

Joseph R. Matthews, Professional Geologist

Responsibilities

The Project-Geologist will direct all field operations and is responsible for proper sample collection, identification, preservation and documentation, and documentation of all field activities as outlined in this Work Plan. The Project-Geologist will prepare all draft and final reports.

Project-Health and Safety Officer(s)

Richard C. Barlow, Chemical Engineer

John Borowski, Certified Industrial Hygienist

Responsibilities

The Project-Health and Safety Officer has the primary responsibility of ensuring that all field personnel have read and signed the Health and Safety Plan (HSP), Section C of this Work Plan. The Project-Health and Safety Officer must ensure that all employees have been properly trained (OSHA 40 hour course) and that all employees are covered by a medical surveillance program as required by 29 CFR 1910.120(f).

Additional responsibilities include, but are not limited to, making all field personnel aware of site hazards and naming personnel and alternates responsible for site safety and health. More details on the responsibilities of the Project-Health and Safety Officer are outlined in the HSP.

Project-Site Health and Safety Officer

Joseph R. Matthews

Responsibilities

The Project-Site Health and Safety Officer has the primary responsibility of: maintaining a copy of the Health and Safety Plan onsite during all field activities; advising field personnel on all health and safety related matters involved at the site; directing and ensuring that the safety program is being correctly followed in the field, including the proper use of personal protective and site monitoring equipment; ensuring that the field personnel observe the appropriate work zones and decontamination procedures; reporting any safety violations to the Project-Health and Safety Officer; and, conducting safety briefings during field activities.

4.2 Navy Energy and Environmental Support Activity

Overall responsibility for projects conducted in accordance with NEESA guidelines will be vested in NEESA (or its approved representatives). Therefore, project coordination responsibilities lie with CHESDIV, Naval Facilities Engineering Command (NAVFAC), Engineering Field Division (EFD). The following sections describe the components of the project chain-of-command as established in NEESA 20.2-047B.

4.2.1 Oversight

NEESA is responsible for ensuring that the quality of laboratory analyses performed during the various phases of the IR Program is acceptable. NEESA is also responsible for managing the NCR.

4.2.2 Engineering Field Division

The Engineer in Charge (EIC) at the EFD provides the site information and history, provides logistical assistance, specifies the sites requiring investigation and reviews results and recommendations. Mr. Paul Berkman, CHESDIV, Naval Facilities Engineering Command, Washington, D.C., serves as the EIC for this project.

4.2.3 Engineer in Charge

The EIC is responsible for: (1) coordinating procurement, finance, and reporting, (2) for ensuring that all documents are reviewed by the NCR, (3) for communicating comments from the NCR and other technical reviewers to the subcontractors, (4) and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

4.2.4 NEESA Contract Representative

The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans and work plans, submits performance sample data, provides field

and laboratory audits, and reviews data from the site. The questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR. The NCR also provides evaluation of referee samples. The NCR for this project is Martin Marietta Energy Systems, Inc.

4.2.5 Activity Oversight

Shawn Jorgensen, Environmental Engineer (NSWC), will serve in an oversight capacity for this investigation.

4.3 Investigation Performance

4.3.1 Engineering Subcontractor

EnSafe/Allen & Hoshall will serve as the Engineering Subcontractor for this project. The subcontractor is responsible for designing and implementing the SI as outlined in this Work Plan.

4.3.2 Analytical Laboratory

The analytical laboratory employed by EnSafe/Allen Hoshall for this project is PACE, Inc. Minneapolis, MN. PACE will adhere to the laboratory requirements in NEESA 20.2-047B (or other QA and method requirements as specified). The laboratory is required to prepare and submit a laboratory QA plan, to analyze and submit the results of proficiency testing, submit to an onsite inspection, and to correct any deficiencies cited during the inspection by the NCR. The laboratories are required to identify a Laboratory QA Coordinator (LQAC) responsible for overall QA. The LQAC must not be responsible for schedule, costs, or personnel other than QA assistants. It is preferred that the LQAC report to the laboratory director. The LQAC must have the authority to stop work on projects if QC problems arise which affect the quality of the data produced.

In addition to conforming to all NEESA regulations, all work shall be performed in a manner consistent with: the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended; the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR), Part 300, as amended, and other appropriate federal, state, and local guidelines, rules, regulations, and criteria (where applicable).

4.4 Points of Contact

The following list will be contact points for the agencies and contractors involved in this project.

4.4.1 Chesapeake Bay Division

Engineer-in-Charge

Commanding Officer, Chesapeake Division
Naval Facilities Engineering Command
Washington Navy Yard, Bldg. 212
Washington, D.C. 20374-2121

POC: Mr. Paul Berkman
(202) 433-3760

4.4.2 Site Contact

Building D-28
Naval Ordnance Station
Indian Head, Maryland 20640-5000
Code: 0965C

POC: Mr. Shawn Jorgensen
(301) 743-6745

4.4.3 EnSafe/Allen Hoshall Contact

Task Order Manager

EnSafe/Allen Hoshall

5724 Summer Trees Road

Memphis, TN. 38134

POC: Mr. Paul V. Stoddard

(901) 372-7962

4.5 Deliverables

The following are project deliverables to be submitted to the EIC and the activity point of contact as indicated in Section 3.4.

Draft & Final Site Inspection Report

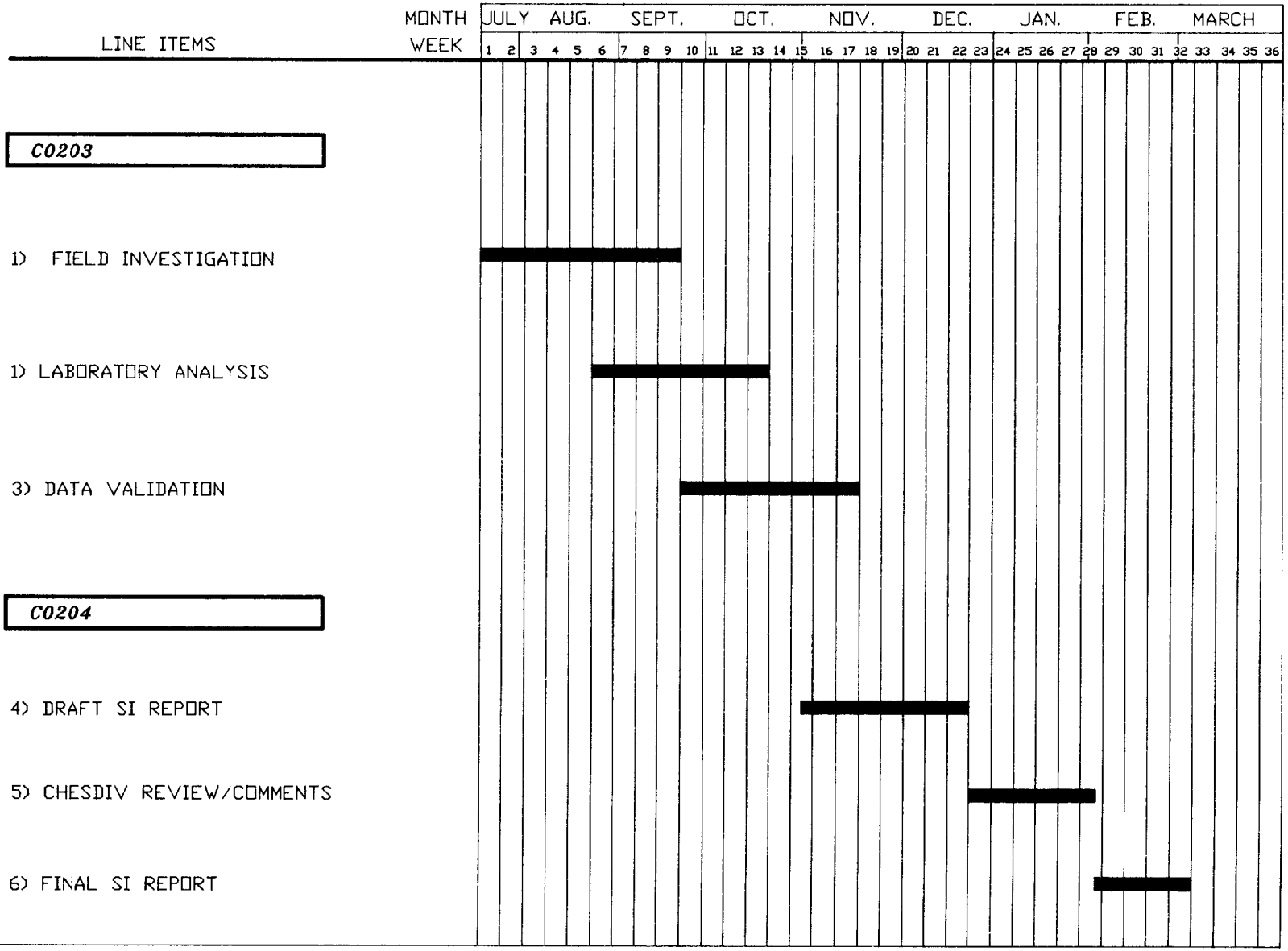
An SI Report (SIR) will be prepared after the completion of all field work, review of analytical and data validation.

This report may also include, but is not limited to:

- Presentation and interpretation of analytical, hydrologic and geologic data collected during the field operations.
- Groundwater gradient maps (where possible) as well as tables of the groundwater level measurements and field analytical data.

4.6 Project Schedule

This project schedule is prepared with the assumption that analytical data will be received within 30 days of receipt by the laboratory, data validation will be completed within 50 days of the completion of field operations, and the draft report will be submitted to the EIC within 35 days after the completion of data validation. The time-line on the following page outlines key events in the project scope.



NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

ACTIVITY SCHEDULE PHASE II

DATE: 06/12/92

DWG NAME: 9CLNCHS1

APPENDIX A

RESUMES

PAUL V. STODDARD, P.G., VICE PRESIDENT, GEOLOGICAL SERVICES

EDUCATION: M.S., Geology, Memphis State University/1983
B.S., Geology, Memphis State University/1982
B.S., Biology, Memphis State University/1980

CERTIFICATION: Professional Geologist, TN, AR
Pending Certification, IN

EXPERIENCE:

- Generated stratigraphic correlations of upper Cretaceous and Tertiary trends of South Texas with concentration in the Wilcox and Frio formations. Responsible for regional correlations of E-logs, preparation of stratigraphic cross sections, development and updating of structure maps, and well spotting and digitizing.

- Conducted remedial site investigations at facilities for sites with potential soil and/or groundwater contamination involving chlorinated hydrocarbons and petroleum products. Field assessments included in-situ monitoring of organic vapors utilizing an organic vapor detector and/or a scanning infrared spectrophotometer.

- Responsible for the design and implementation of "preconveyance" investigations to determine potential soil contamination at various sites being considered for commercial development.

- Field supervision and implementation of closure plans for hazardous waste facilities at Charleston, SC Naval Shipyard. Tasks included removal of hazardous waste inventories, decontamination of tanks, confirmation sampling of decontamination solutions and soil sampling at container storage compounds operated by the Shipyard and Defense Reutilization and Marketing Office.

- Sampled groundwater monitoring wells for hazardous substance contamination and supervised well drillers at Shelby County, TN state Superfund site.

- Conducted a study of pesticide contamination in groundwater at an industrial facility in Missouri. Field Investigation included soil boring, monitoring well installation, determination of hydraulic gradients, data reduction and analyses, and report generation.

- Implemented groundwater investigation for photosensitive hazardous substance contamination at NPL site.

- Field supervision and implementation of closure plans for removal of underground waste oil storage tanks and investigation of potential contamination in soils and groundwater from tank releases.

- Field supervision and implementation of sampling plan for hazardous waste facilities at NAS Memphis. Task included Level B inspection of former waste plating treatment storm sewer, and the sampling of soils associated with defective joints. The task also included the sampling of a former salvage yard for petroleum hydrocarbons and lead.

- Field supervision and implementation of underground storage tank removal investigations. Field assessments include soil sampling and/or monitoring well installation with groundwater sampling and assessment of hydrogeologic conditions.

- Project geologist for interior survey of 120 acre underground room and pillar mine. Additional tasks included surface investigation of karst features, monitoring well installation, interpretation of borehole geophysics, and subsequent groundwater sampling and data reduction.

- Project geologist for hydrogeologic assessment of RCRA facilities. Tasks include site selection and installation of groundwater monitoring networks, slug tests, and subsequent data evaluation.

- Project geologist for MCAS Cherry Point, RFI. Tasks included design and implementation of Field Sampling Plan, including soil borings, monitoring well installation, groundwater sampling, slug tests, hydrogeologic characterization -- including diurnal and tidal influences on the shallow aquifer and subsequent data reduction and report generation.

- Project geologist for hydrogeologic assessment of a proposed TN state Superfund site. Investigation included step drawdown and constant rate aquifer pump test for design and installation of a groundwater treatment system.

- Project manager for CERCLA Remedial Investigation/Feasibility Study for a former pesticide manufacturing facility. Tasks included the design and implementation of geologic/hydrogeologic assessment for volatile organic and pesticide contamination, subsequent data reduction, and report generation. Project management included cost tracking, scheduling, and continued regulatory compliance (i.e. Administrative Order).

- Project manager for CERCLA RI/FS for an industrial manufacturing facility. Related tasks included the design and implementation of geologic/hydrogeologic assessments for chlorinated solvent contamination in soils and groundwater. Investigation included monitor well installations, soil vapor extraction, borehole and surface geophysics, and a constant rate aquifer pump test, with subsequent data reduction and interpretation and RI report generation. Project management duties included community relations, maintaining data quality objectives, scheduling, waste disposal, and meeting Administrative Order Requirements.

- Supervised and directed remedial investigations (RI) per CERCLA requirements at multiple NPL sites, Region 3, Region 4, Region 5 and Region 6. Investigations included, but were not limited to, soil analyses, monitor and recovery well installation, sampling and analyses of groundwater, aquifer tests, borehole geophysics, surface geophysics and data interpretation, including preparation and presentation of assessment reports.

JOSEPH R. MATTHEWS, GEOLOGIST

EDUCATION: M.S., Geology, Memphis State University/1989
B.S., Geology, University of Tennessee at Chattanooga/1985

CERTIFICATION: Registered Professional Geologist TN1112

EXPERIENCE:

- **Project Manager/Geologist** developed RCRA Facility Investigations and directed field operations at Naval facilities. Investigated shallow subsurface and shallow aquifer systems to define contaminant migratory pathways and evaluate health risks. Data used to determine the proper worker protection for the demolition of a pesticide-contaminated storage facility.

- **Project Manager** developed and implemented UST closures in compliance with local, state and federal (RCRA) laws and regulations. Conducted assessments of leaking UST sites and completed corrective actions for petroleum hydrocarbon contaminated soil and groundwater systems. Completed UST- related projects in Tennessee, Mississippi, Missouri, Alabama, Indiana, Texas, and Kentucky.

- **Project Geologist** designed and directed field activities of a Site Inspection of a land disposal facility for the US Navy. Prepared a Site Inspection report under CERCLA protocol for the preparation of a Hazard Ranking Score of the facility.

- **Project Geologist** conducted state and private industry site investigations: assessing geohydrologic conditions, determined nature and extent of site contamination, dealt with organo-pesticides, chlorinated hydrocarbons, non-halogenated hydrocarbons, chlorides, cyanides and PCB's.

- **Project Coordinator** overseeing the emergency remedial response action at a PCB spill site in Akron, Ohio. Activities included removal of PCB-contaminated soils, oil-cooled capacitors containing PCB dielectric fluids and decontamination of PCB contaminated concrete floors and walls. Designed and implemented sampling scheme for verification of cleanup of PCB contaminated areas.

- **Geologist** supervised drilling operations, installed monitoring wells, monitored health and safety compliance, and collected soil and groundwater samples following CLP protocol.

- **Geologist** investigating a proposed hazardous waste incinerator site: characterized stratigraphy, geologic structure and geohydrologic conditions.

- **Assistant Geologist** for a long-term groundwater monitoring program at a Tennessee State Superfund site: quarterly groundwater sampling under CLP protocol, collected and reduced groundwater data and prepared piezometric maps and geologic cross-section delineating the distribution of a chlorinated hydrocarbon plume in a multiple aquifer system.

- **Investigator** conducting Phase I environmental site assessments and environmental compliance audits consistent with the "due diligence" clause of CERCLA. Reviewed facility operation for compliance with local, state and federal environmental laws and regulations. Identified potential environmental compliance problems and estimated cost for corrective action. Conducted audits in close cooperation with investors, legal counsel, and lending institutions and their attorneys. Designed and conducted Phase II audit investigations where subsurface and groundwater contamination was indicated.

- **Field Coordinator** on hazardous materials abatement sites: monitoring health and safety compliance and consulting.

RICHARD C. BARLOW,
CHEMICAL ENGINEER/INDUSTRIAL HYGIENIST

EDUCATION: M.S. Chemical Engineering, University of Maryland/1979
B.S. Engineering, U.S. Coast Guard Academy/1969

EXPERIENCE:

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed underground storage area's emergency remedial action plan, remediation investigation, and feasibility study .

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed pesticide facility's remediation investigation and feasibility study.

- Developed a health and safety plan, as prescribed by 29 CFR 1910.120, for an EPA National Priorities Listed landfill's remediation investigation and feasibility study.

- Developed numerous additional health and safety plans for underground tank removals, pesticide facility investigations, landfill studies, and plating shop remedial actions for both private industry and the U.S. Navy.

- Developed a respiratory protection program for a small company that meets the requirements of 29 CFR 1910.134.

- Experienced in developing personal protection programs for all phases of hazardous waste cleanup activities.

- Developed Oil and Hazardous Substance Spill Contingency plans for the Navy.

- Experienced in confined space entry techniques. Has received training as a "Competent Person" for gathering and evaluating data for confined space entry.

- Trained personnel in confined space entry techniques and exposure hazard recognition.

- Administered an inspection program which involved evaluation of exposure personnel to atmospheres that were toxic, oxygen deficient and/or flammable.

JOHN H. BOROWSKI, C.I.H.
INDUSTRIAL HYGIENIST

EDUCATION:

B.S. Biochemistry, Northern Michigan University/1984

CERTIFICATIONS:

Certified Industrial Hygienist, American Board of Industrial Hygiene, Certification # 5098.
EPA/California Certified Asbestos Building Inspector/Management Planner,1991
EPA/California Certified Asbestos Practices and Procedures, 1991

EXPERIENCE:

- Mr. Borowski is experienced in the development and implementation of Health and Safety Plans for NPL Superfund sites and hazardous waste sites at military/industrial complex sites. He is proficient in the preparation of hazardous substance and oil spill contingency plans and in the performance of industrial hygiene and indoor air quality studies.

- Development and implementation of the health and safety plan for NAS New Orleans UST site investigation project.

- Development of health and safety plan for an EPA NPL Superfund Site in Rhode Island.

- Development of oil and hazardous substance spill contingency plan for NAS Cecil Field, Jacksonville, FL.

- Completion of health and safety audits at NPL site in KY.

- Development of the health and safety plan for site investigations at NWIRP McGregor in McGregor, TX.

- Developed procedures for the sampling, handling, and disposal of PCB contaminated dielectric fluid from non-operating capacitors and transformers for military and private concerns.

- Developed and enforced respiratory protection programs for clients and contractors performing asbestos and lead remediation to ensure compliance with the requirements of 29 CFR 1910.134.

- Assisted in development of personal protection programs for all phases of hazardous waste cleanup activities.

- Performed perimeter high volume air monitoring for VOC, PM10, Metals, and PBB emissions generated by installation of a slurry wall and capping of a hazardous waste landfill.

- Performed personal and area industrial hygiene sampling to determine worker exposure to toxins including; asbestos, lead, metal dusts, CO, CO_2, PBB,
  PCB, formaldehyde, bioaerosols, and various organic and inorganic acids.

- Performed source sampling of power plant and paint spray booth air emissions.

SECTION B
QUALITY ASSURANCE PLAN

FOR

SITE INSPECTION

PHASE II

NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

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1.0 INTRODUCTION

This document presents the Quality Assurance/Quality Control measures for Naval Surface Warfare Center (NSWC), Indian Head, Maryland Site Inspection (SI). EnSafe/Allen & Hoshall (E/A&H) will be conducting this SI at NSWC. Measures outlined in this plan include policies, project organization and objectives, functional activities, and quality assurance and quality control measures intended to achieve data quality goals. The SI is being conducted under the Southern Division CLEAN Contract (N62477-91-D-0043) for the Chesapeake Division (CHESDIV).

This document is intended to fulfill requirements for ensuring that all work is conducted in accordance with quality assurance/quality control protocols and field procedural protocols for environmental monitoring and data measurement as established in:

- *Ground-Water Monitoring Guide*, NEESA 20.2-031A, Naval Energy and Environmental Support Activity, Port Hueneme, Calif., February 1985 (NEESA 20.2-031A)

- *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program*, NEESA 20.2-047B, Naval Energy and Environmental Support Activity, Port Hueneme, Calif., June 1988 (NEESA 20.2-047B)

Where specific NEESA guidelines do not exist, applicable EPA and/or Maryland Department of the Environment (MDE) methods will be applied. These regulations are referenced in specific sections of this document (where applicable).

2.0 PROJECT DESCRIPTION

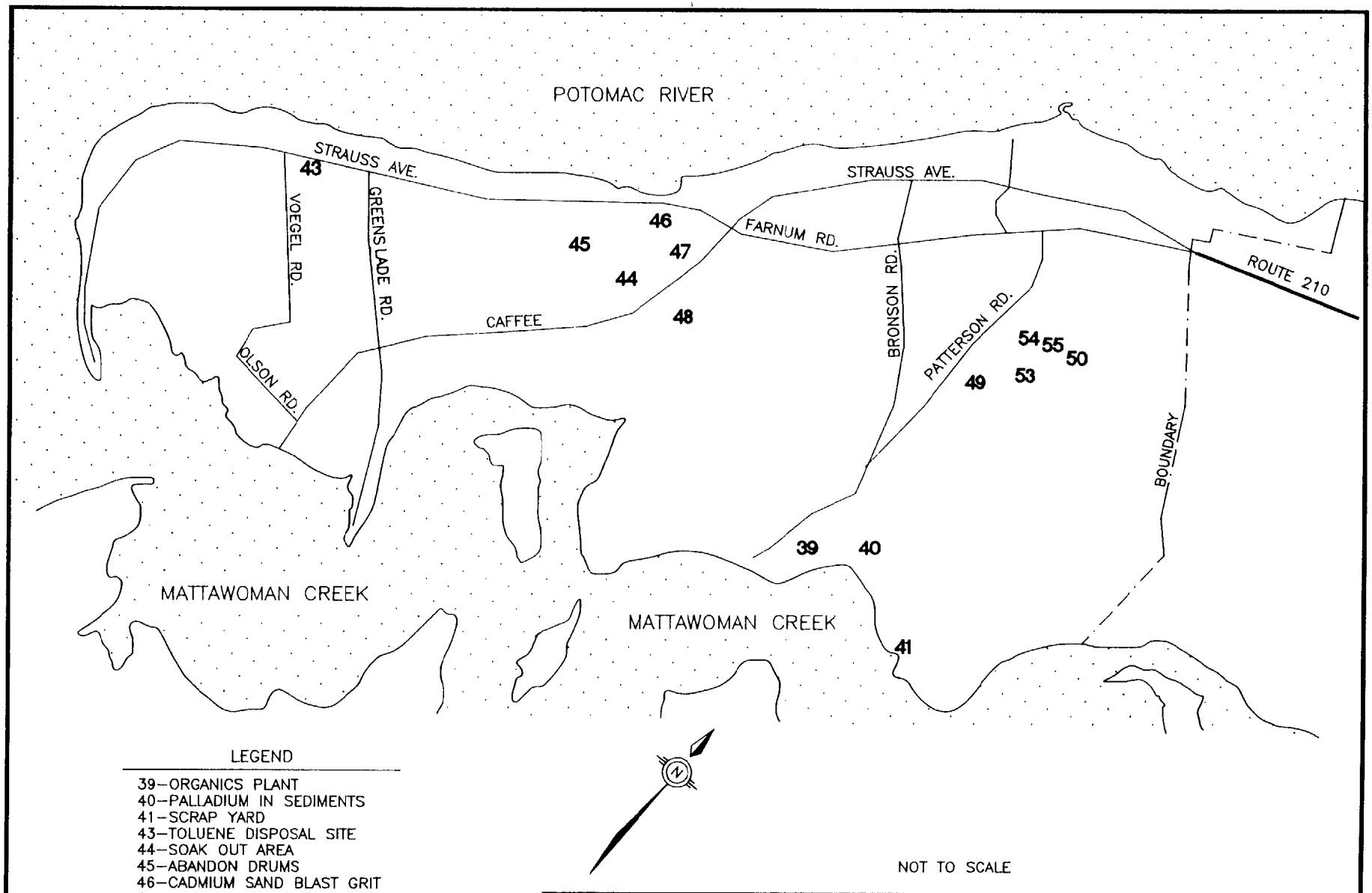
The objective of this SI is to determine if contamination exists at any of the sites discussed in Section 2.1. These particular sites were identified in the Draft Preliminary Assessment Report, (NEESA 13-021A, June 1991), as areas where contaminants may have been released. This will be accomplished by the completion of a study designed specifically for each site. The Field Sampling Plan (FSP) describes the approach to studying each site including sampling and analytical rationale.

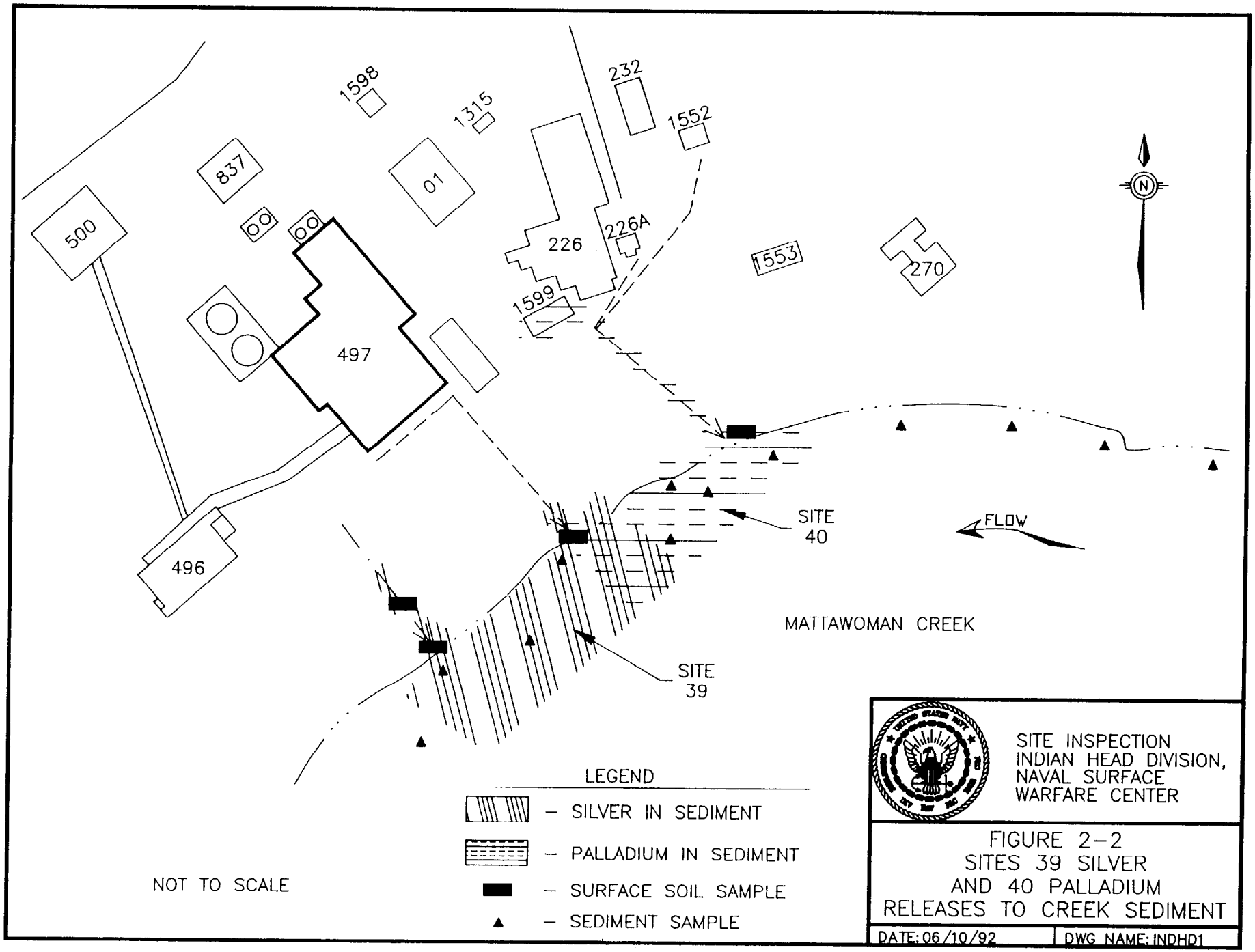
2.1 Site Descriptions

Fourteen sites have been identified for study under the SI at NSWC Indian Head. Because information available to E/A&H was limited, the site descriptions rely heavily on information presented in the PA and data collected during site visits conducted by E/A&H. Figure 2-1 indicates the approximate location of each site at the NSWC facility.

Each site description includes brief details of the site layout, the suspected contaminants and the possible sources of contamination. Site processes and/or history are discussed when applicable. Also included is a brief discussion on the approach for completing the inspection at each site. The proposed number and type of samples are discussed in the FSP.

Site 39 — Organics Plant-Silver Contamination in Sediments. The organics plant area, Building 497 is identified as Site 39 (Figure 2-2). It is located in the southeastern portion of the NSWC facility, on a steep slope adjacent to Mattawoman Creek. This site is subject to an SI based on the reported accidental releases of elemental silver and other compounds to Mattawoman Creek.


POTOMAC RIVER
STRAUSS AVE.
STRAUSS AVE.
VOEGEL RD.
GREENSLADE RD.
FARNUM RD.
BRONSON RD.
PATTERSON RD.
ROUTE 210
CAFFEE
OLSON RD.
BOUNDARY
MATTAWOMAN CREEK
MATTAWOMAN CREEK
43
46
45
47
44
48
54
55
50
49
53
39
40
41
LEGEND
39–ORGANICS PLANT
40–PALLADIUM IN SEDIMENTS
41–SCRAP YARD
43–TOLUENE DISPOSAL SITE
44–SOAK OUT AREA
45–ABANDON DRUMS
46–CADMIUM SAND BLAST GRIT
47–MERCURIC NITRATE DISPOSAL
48–DUMP SITE
49–CHEMICAL DISPOSAL PIT
50–BUILDING 103
53–GENERAL LABORATORY AREA
54–BUILDING 101
55–BUILDING 102
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–1
FACILITY MAP AND
SITE LOCATIONS
DATE: 06/10/92
DWG NAME: INDHD15


1598
1315
232
1552
837
01
500
226
226A
1553
270
1599
497
496
SITE 40
FLOW
MATTAWOMAN CREEK
SITE 39
LEGEND
– SILVER IN SEDIMENT
– PALLADIUM IN SEDIMENT
– SURFACE SOIL SAMPLE
– SEDIMENT SAMPLE
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–2
SITES 39 SILVER
AND 40 PALLADIUM
RELEASES TO CREEK SEDIMENT
DATE: 06/10/92
DWG NAME: INDHD1

Former operations (1961 to 1965) included the formulation of bis-2,2 dinitropropanol acetal/formal (acetal/formal), which is a plasticizer (propellent binder). Silver nitrate was used as a catalyst in the production of acetal/formal where, at one stage of the process, silver was in the elemental form.

A discharge pipe extends from Building 497 to an outfall at Mattawoman Creek. Reportedly, several accidental releases occurred via the outfall resulting from an improperly closed valve. Compounds suspected of having been released include: acetal/formal, silver, dinitropropanol (DNPOH), ethylene dichloride, methylene chloride and formaldehyde. Also, as was indicated in the PA, site personnel reported that acetal/formal and silver were visible at times on the surface of Mattawoman Creek near the outfall of the organics plant.

A study will be completed to determine if silver and/or acetal/formal is present in the sediments near the outfall to Mattawoman Creek. The study consists of the collection of top sediments from Mattawoman Creek and sediment samples at the outfall.

Site 40 — Palladium Catalyst in Sediments. Site 40 is defined as the area downgradient of the former hydrogenation facility. The hydrogenation facility includes buildings 232, 1552 and 1559, and is adjacent to Site 39 (Figure 2-2). Site processes included the formulation of unsymmetrical dimethylhydrazine (UDMH), a production process that hydrogenated dimethylnitrosamine (DMNA) using a palladium catalyst on carbon black. Production of UDMH was conducted at the hydrogenation facility from 1974 to 1975.

One release to Mattawoman Creek was reported as a result of a faulty valve. The estimated volume of this release was approximately 2000 gallons. Information from personnel interviews conducted during the PA indicated a plume of palladium on carbon black was visible on Mattawoman Creek in association with this spill.

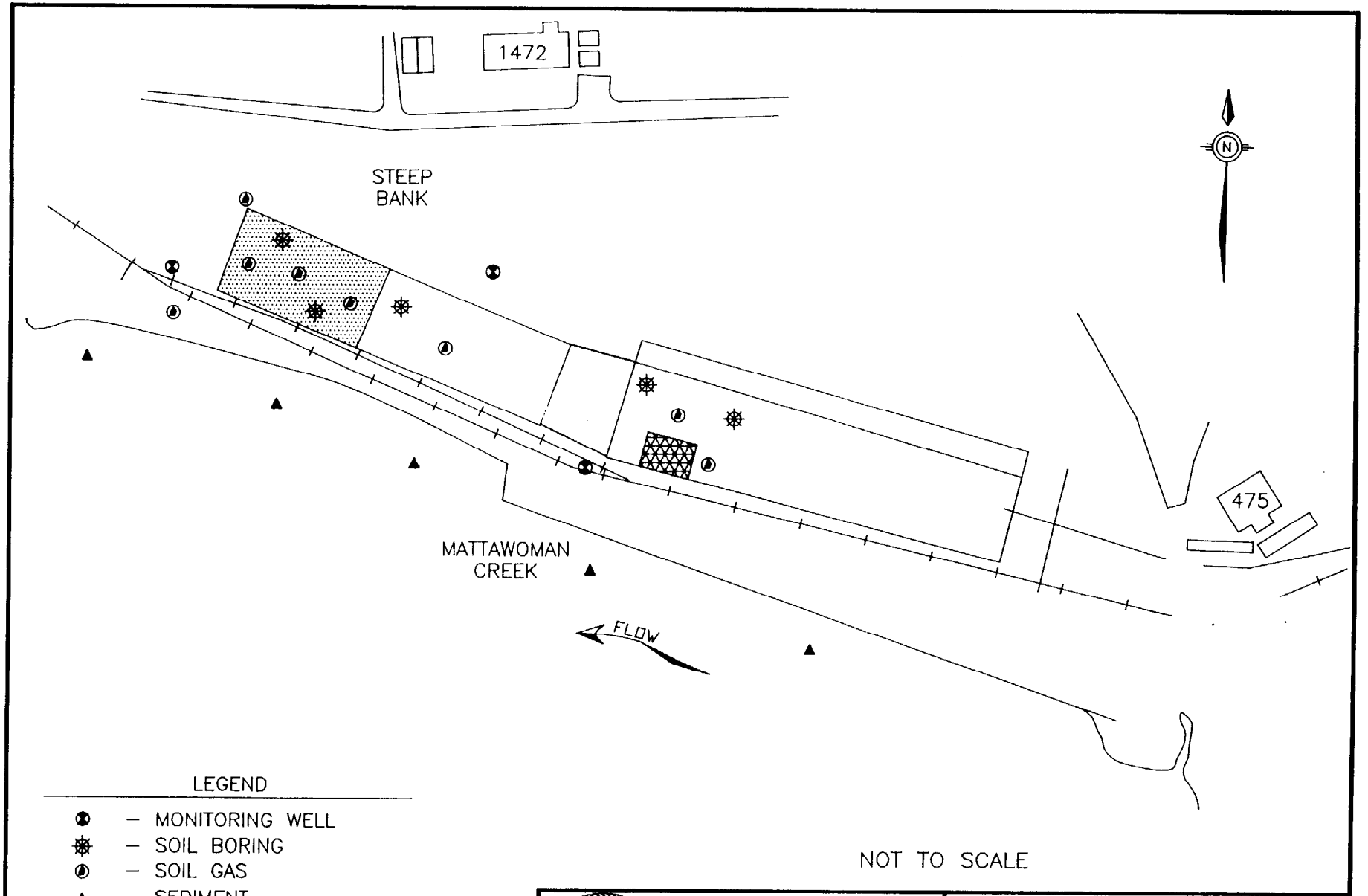
Spills were also reported during the startup of production; however, the nature and quantities of these releases are unknown. Any uncontained spills would potentially migrate down the slope toward Mattawoman Creek and/or discharge through the hydrogenation outfall. Difficulty with the corrosive nature of the compounds was believed to be the cause of numerous releases. Ultimately, production of UDMH stopped at the hydrogenation facility and was continued by an offsite contractor until DMNA was identified as a suspect carcinogen.

Site 40 was not recommended for an SI; however, it has been included at the request of the Maryland Department of the Environment (MDE). Study of this area will include the collection of top sediments from Mattawoman Creek and sediments samples at the outfall.

Site 41 — Scrap Yard. The scrap yard is located in the southeastern section of the NSWC facility near the shore of Mattawoman Creek (Figure 2-3). The area is relatively flat and surface runoff is to the southeast toward the Mattawoman Creek. The creek is located less than 100 feet away. The scrap yard is secured by a fence and a locked gate.

Polychlorinated biphenlys (PCB) contaminated and PCB containing electrical transformers were stored in the scrap yard from the 1960s to 1988 before disposal. Data from the Waste Analysis Plan conducted in 1981 indicated a total of 27 transformers (NEESA, 1983). Nine of the transformers were identified as PCB containing (> 500 ppm PCB oils) and eight were identified as PCB contaminated (50 to 500 ppm PCB oil). Lead batteries were stored in the scrap yard which may have resulted in a release of lead to the surface soils.

This site was recommended for an SI to determine if PCB contamination is present. This will be accomplished by the installation of a series of soil and soil gas borings, monitoring wells and the collection of top sediment samples from Mattawoman Creek.



SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2–3
SITE 41
SCRAPYARD

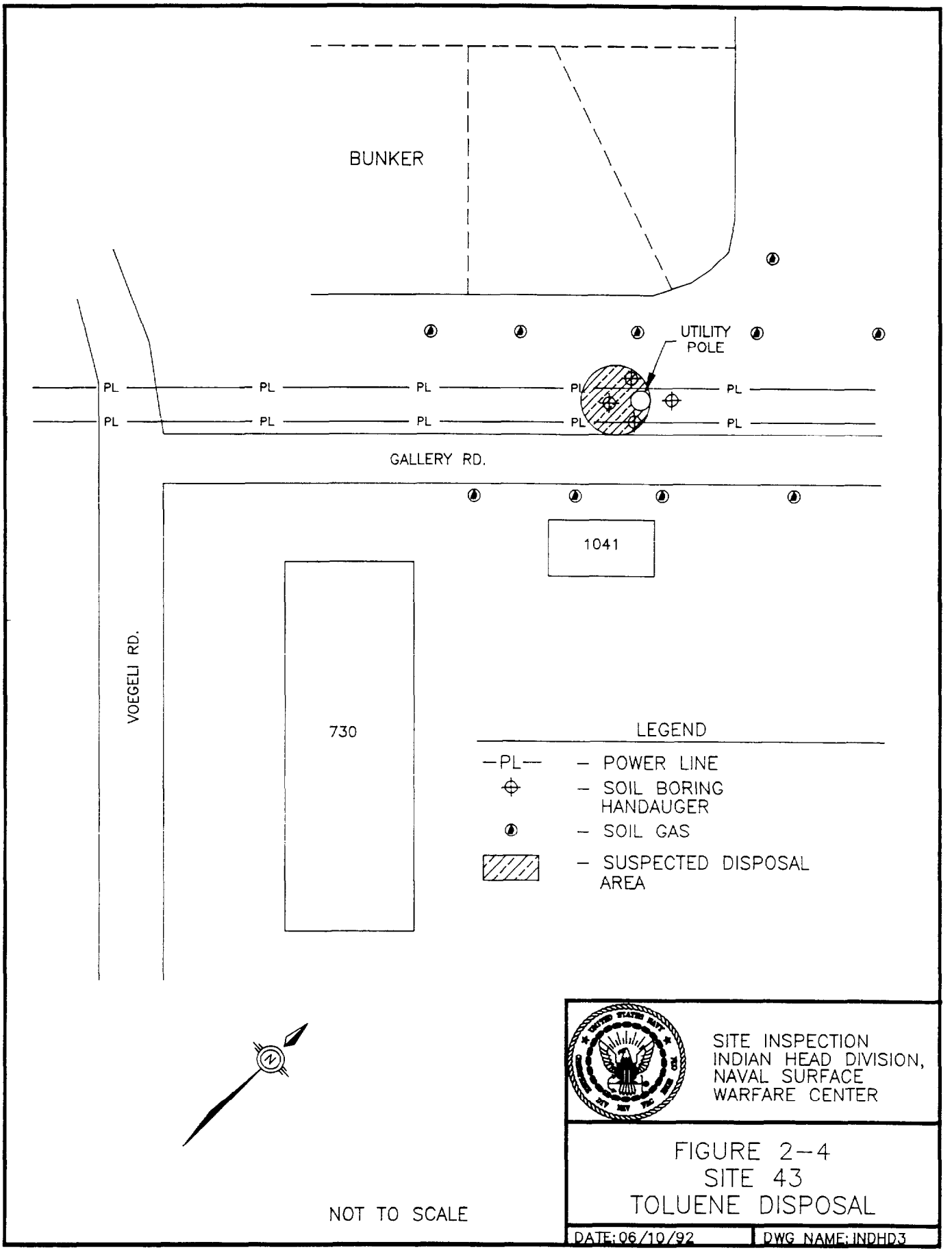
DATE: 06/10/92 | DWG NAME: INDHD2

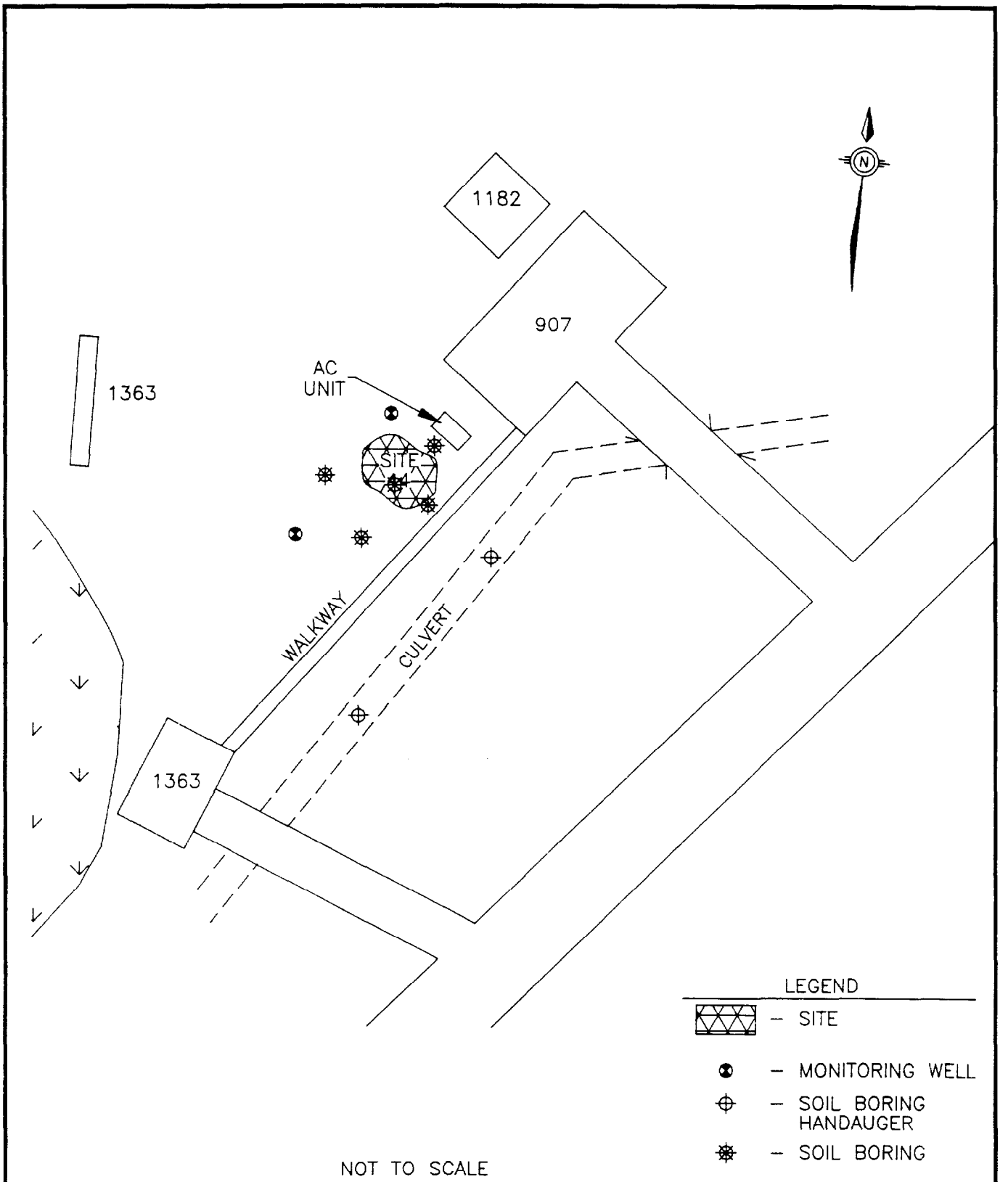
Site 43 — Toluene Disposal Site Casting Plant. The casting plant includes Building 1041 which is located in the western portion of the NSWC facility. Solvents such as toluene and xylene were regularly used to degrease metal parts during the casting process. Data collected during the PA indicated that improper dumping of the solvent occurred at the utility pole across the road from Building 1041 (Figure 2-4). The area surrounding the base of the utility pole is defined as Site 43.

Site 43 was recommended for an SI based on information that an unknown quantity of toluene was disposed at the base of the referenced utility pole. Study of this area will incorporate the collection of a series of surface soil samples for submission for laboratory analyses and the completion of a soil gas survey.

Site 44 — Soak Out Area. This area is located between Buildings 907 and 1363 (Figure 2-5). Site 44 is the former location where the solvent Pennchem 9018 was used to remove propellant from rocket catapult tubes. Pennchem is a polysulfide solvent containing mercaptan. Data collected in the PA indicated that an unknown volume of the solvent was spilled due to the design of the soak out process and leaks in the holding tanks (two 55-gallon drums welded together end-to-end). The topography consists of a gentle grade to the southwest. A drainage ditch extends along the eastern edge of the area and discharges to the storm sewer system. The area was reported to be void of vegetation for several years subsequent to the close of the soak out process.

Site 44 was recommended for an SI based on the reported spills and apparent stressed vegetation. The SI will include installing a series of soil borings and three monitoring wells, limited soil gas survey, and collecting surface soil samples. Soil samples will be collected from


BUNKER
UTILITY POLE
PL
GALLERY RD.
1041
VOEGELI RD.
730
LEGEND
—PL— – POWER LINE
– SOIL BORING HANDAUGER
– SOIL GAS
– SUSPECTED DISPOSAL AREA
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–4
SITE 43
TOLUENE DISPOSAL
DATE: 06/10/92
DWG NAME: INDHD3



NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2–5
SITE 44
SOAK OUT AREA

DATE: 03/03/92 | DWG NAME: INDHD12

the soil borings and during well installation. Groundwater samples will be collected from the completed monitoring wells.

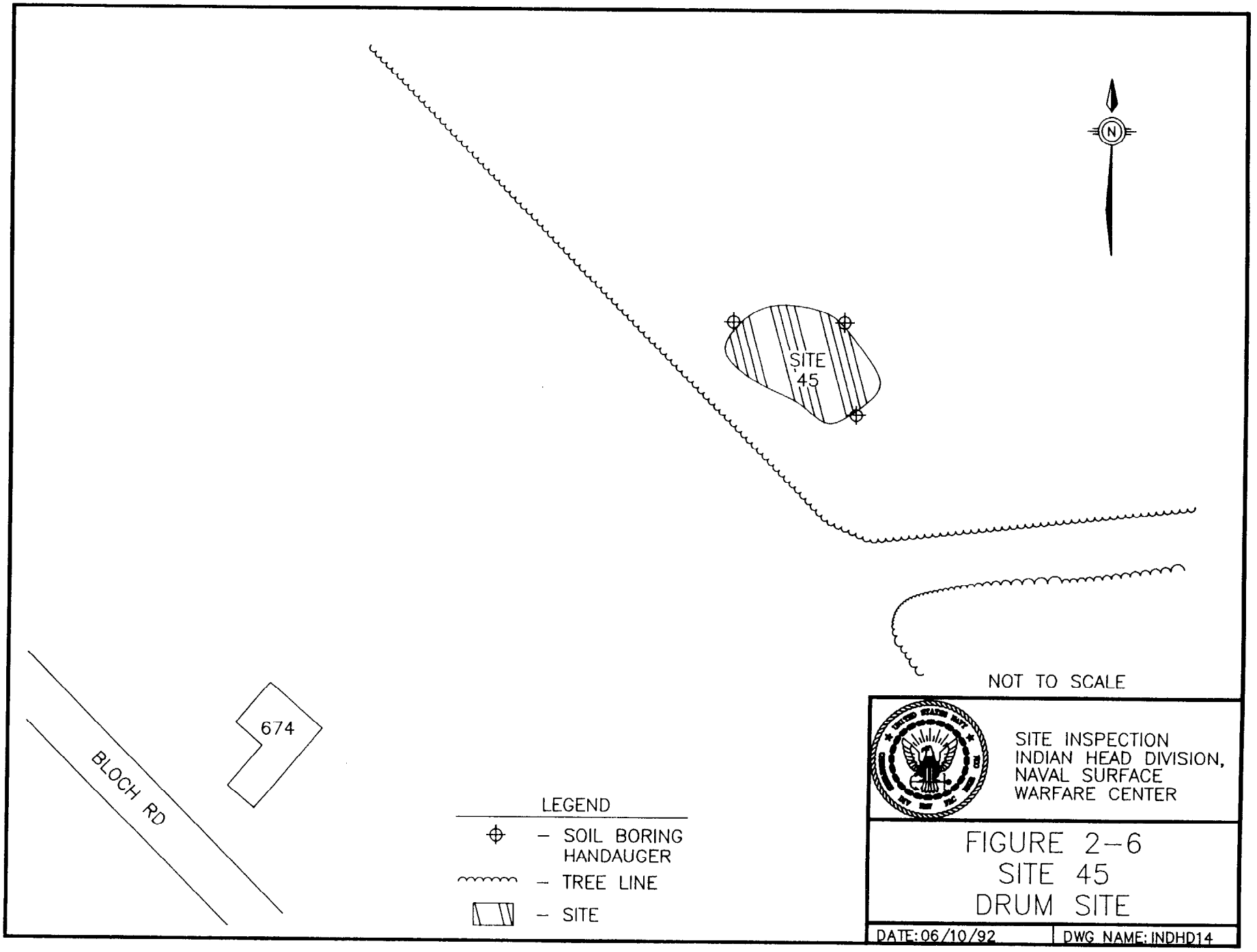
Site 45 — Abandoned Drums. This site is located in the woods approximately 200 feet northwest of Building 674 (Figure 2-6). Information gathered in the PA indicated that the drums have been in this area for 15 to 20 years. The origin of the drums and their prior contents are unknown. Data from the PA indicated that the origin of the drums may be spent solvent drums from the Soak Out Area. The topography of Site 45 is a relatively flat and wooded area. Because the drums are structurally unsound and/or ruptured, the potential for an uncontrolled release of substances to the surface soils is high.

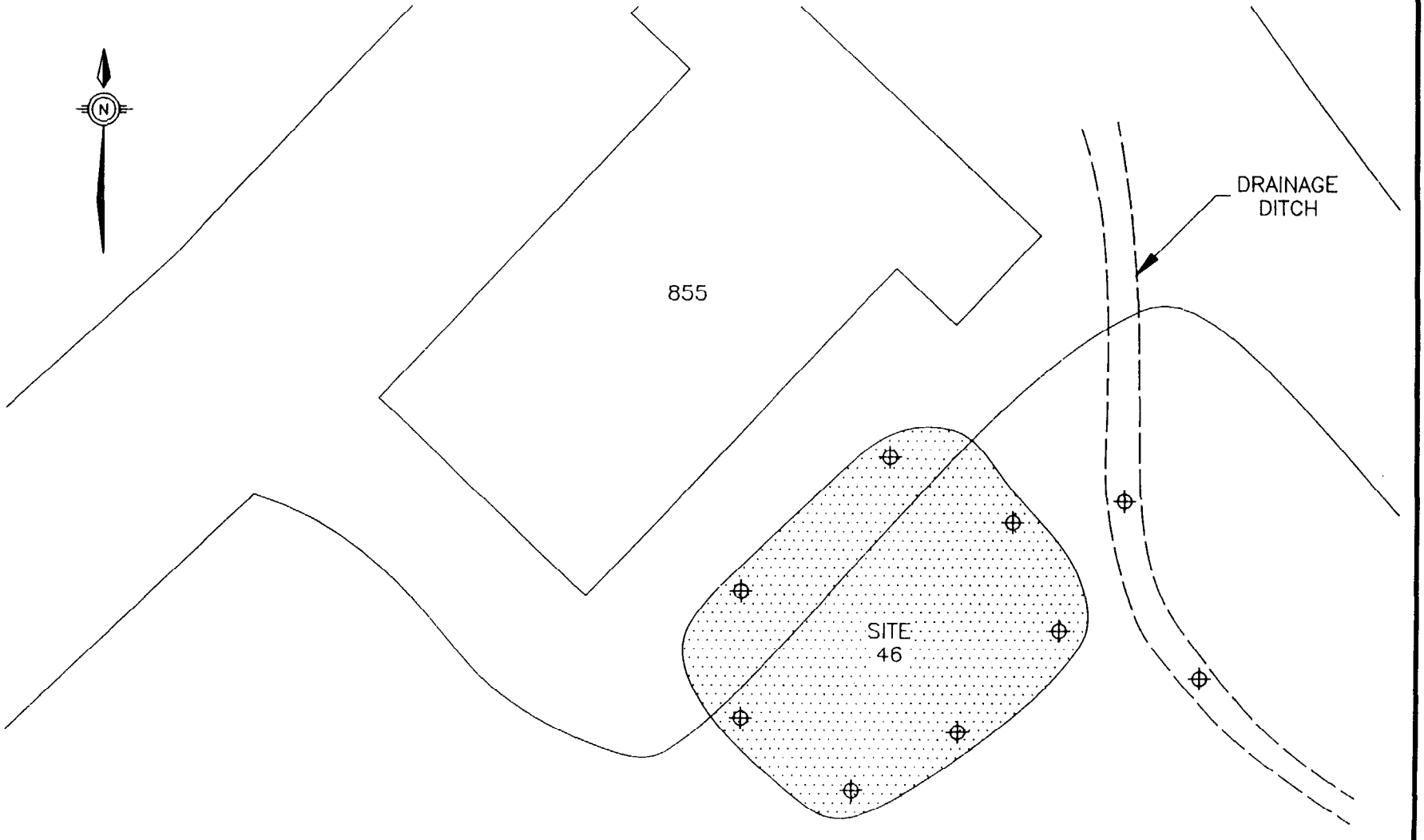
This site was recommended for an SI due to the unknown origin and prior contents of the drums and the apparent potential for contamination of the surrounding surface soils. The SI of this area will involve the collection of a series of surface soil samples for laboratory analyses.

Site 46 — Cadmium Sandblast Grit Area. The area behind Building 855 was identified in the PA as the disposal location of sandblast grit containing cadmium (Figure 2-7). The topography of the area is relatively flat, with the exception of the surface runoff to the drainage ditch bisecting the northern section.

Cadmium was introduced into the sandblasting grit during resurfacing of rocket catapult tubes. The grit was disposed in the gravel and the ditch behind Building 855. Information in the PA indicated that the disposal was occasional from the mid 1970s to the early 1980s. The total volume of grit disposed of can not be determined.

This area was recommended for an SI due to the implications of sandblast grit containing cadmium in the area behind Building 855. This study will involve collecting a series of


SITE 45
674
BLOCH RD
LEGEND
– SOIL BORING HANDAUGER
– TREE LINE
– SITE
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–6
SITE 45
DRUM SITE
DATE: 06/10/92
DWG NAME: INDHD14



NOT TO SCALE

LEGEND

⊕ – SOIL BORING HANDAUGER

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2–7
SITE 46
CADMIUM SANDBLAST AREA
PROPOSED SAMPLE LOCATIONS

DATE: 06/10/92 | DWG NAME: INDHD11

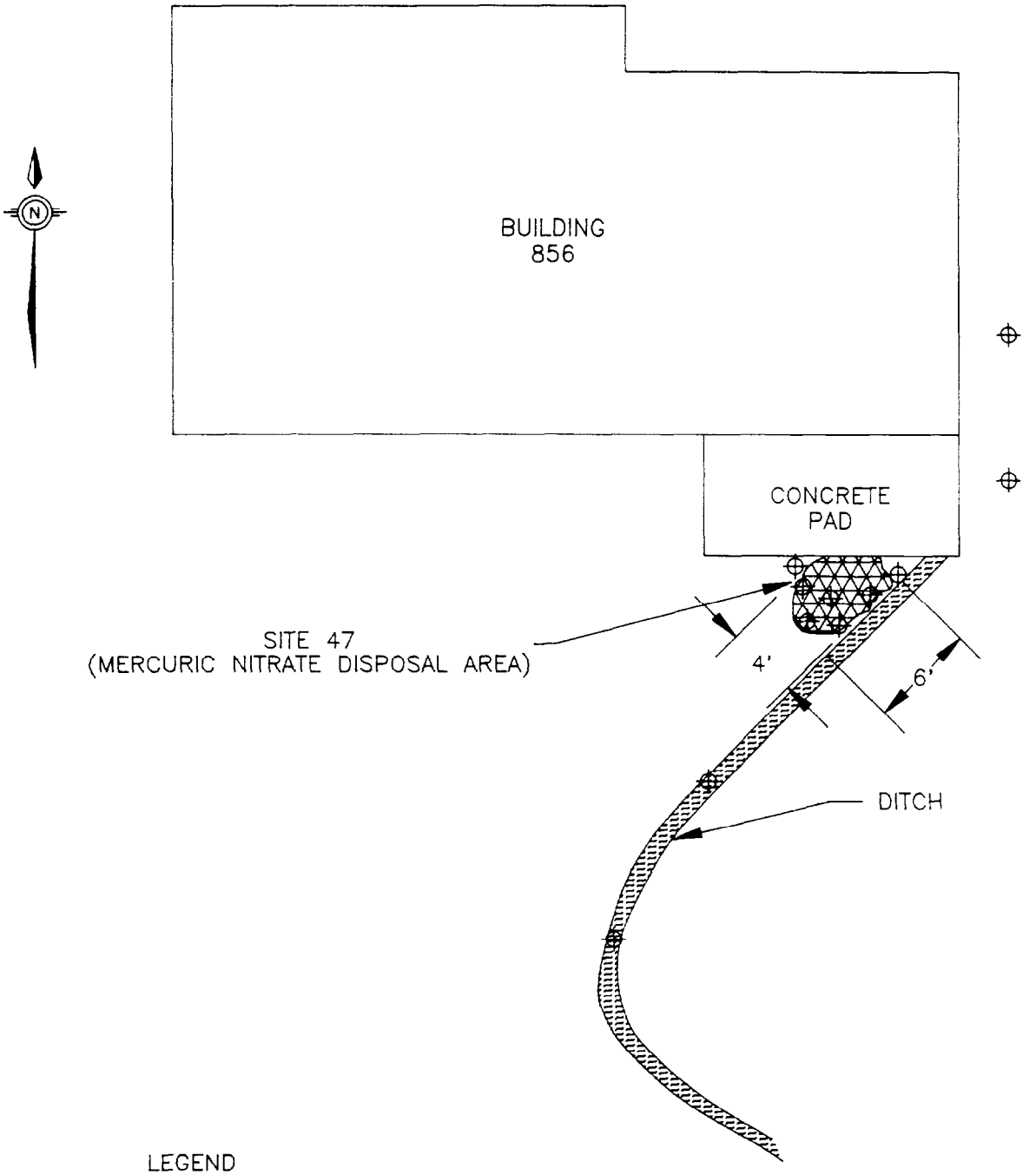
surface soil samples from the gravel area and the drainage ditch behind Building 855. Soil samples will be submitted for laboratory analyses.

Site 47 — Mercuric Nitrate Disposal Area. Site 47 is located behind Building 856 and was the disposal site for the mercuric nitrate catalyst used in the production of a missile propellant, hydrazinium nitroformate. The mercuric nitrate was disposed of in a 4 x 6 foot pit filled with limestone chips (Figure 2-8). The PA indicated that disposal occurred from 1957 until 1965 and that an estimated 150 to 200 pounds of mercuric nitrate were placed in the pit. A drainage ditch adjacent to the pit drains southward toward the Mattawoman Creek. Data collected during the PA and data presented in a study of the hydrology of the Indian Head peninsula (Hiortdahl, 1990) indicate that the dominant surface runoff from the surrounding area would be toward Mattawoman Creek.

Site 47 was recommended for an SI to determine if mercury compounds impacted the soils beneath the disposal pit and if these compounds migrated via the drainage ditch toward Mattawoman Creek. This study will be completed by the collection of a series of surface and shallow soil samples from the drainage ditch and at the suspected location of the former disposal pit. A hand auger will be used to probe the surface in an attempt to locate the former pit. Soil samples will be submitted for laboratory analyses.

Site 48 — Dump Site (Nitroglycerine Plant Disposal Area). The PA notes that Site 48 consists of several containers located in the woods near Building 766 (Figure 2-9). The origin of these containers is suspected to be a nitroglycerine plant, Building 766; however, no information confirming their origin was available. The containers appear empty and are dispersed about a small area in the woods. Vegetation does not appear stressed.

The possibility exists that these containers may have once contained hazardous substances. Therefore, an SI was recommended and will involve installing a series of soil borings in and around the dump site to determine if contamination is present.



LEGEND

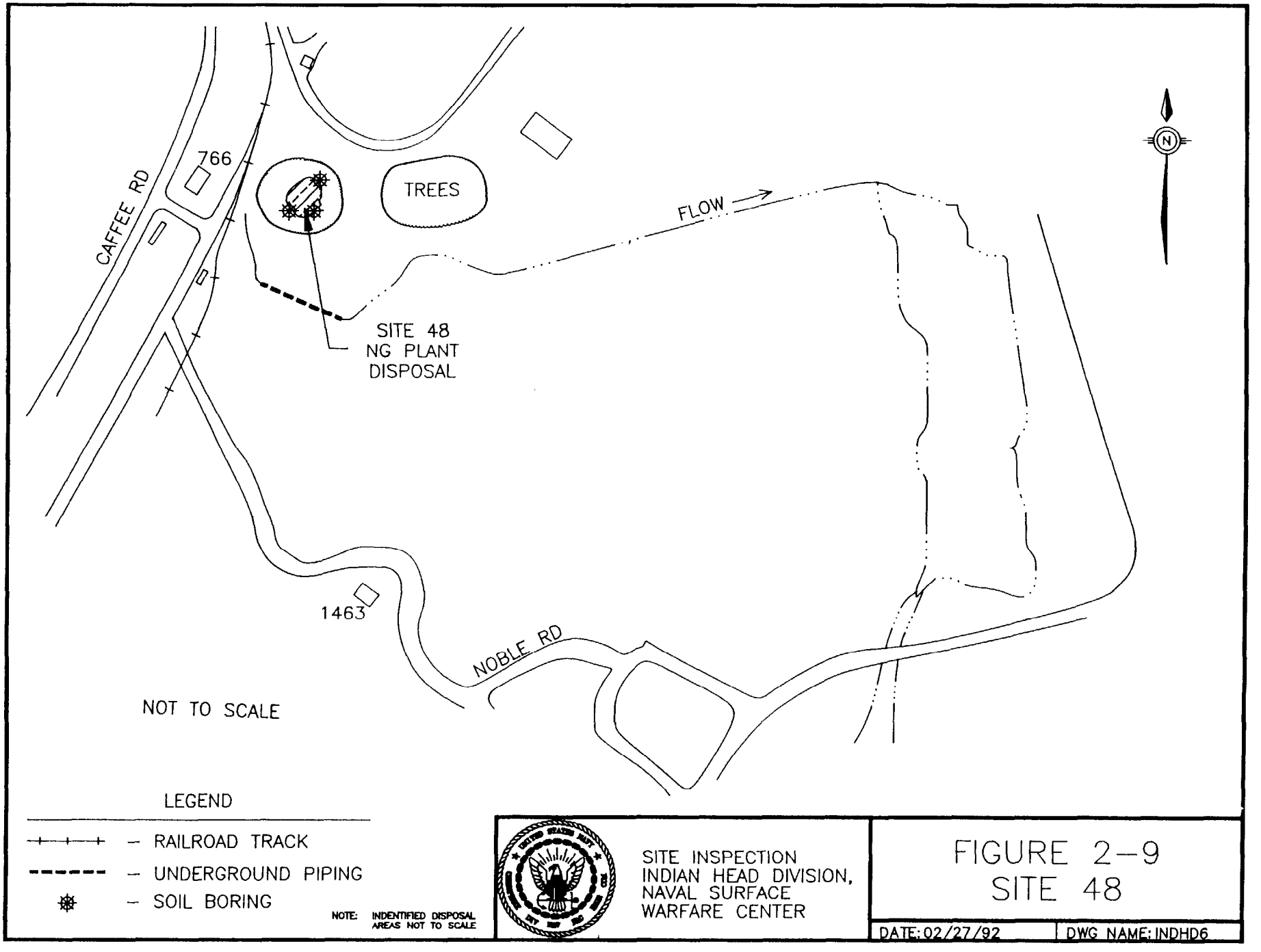
⊕ – SOIL BORING
HANDAUGER

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2–8
SITE 47
MERCURIC NITRATE
DISPOSAL AREA

DATE: 03/03/92 | DWG NAME: INDHD5


766
CAFFEE RD
TREES
FLOW
SITE 48
NG PLANT
DISPOSAL
1463
NOBLE RD
NOT TO SCALE
LEGEND
– RAILROAD TRACK
– UNDERGROUND PIPING
– SOIL BORING
NOTE: INDENTIFIED DISPOSAL AREAS NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–9
SITE 48
DATE: 02/27/92
DWG NAME: INDHD6

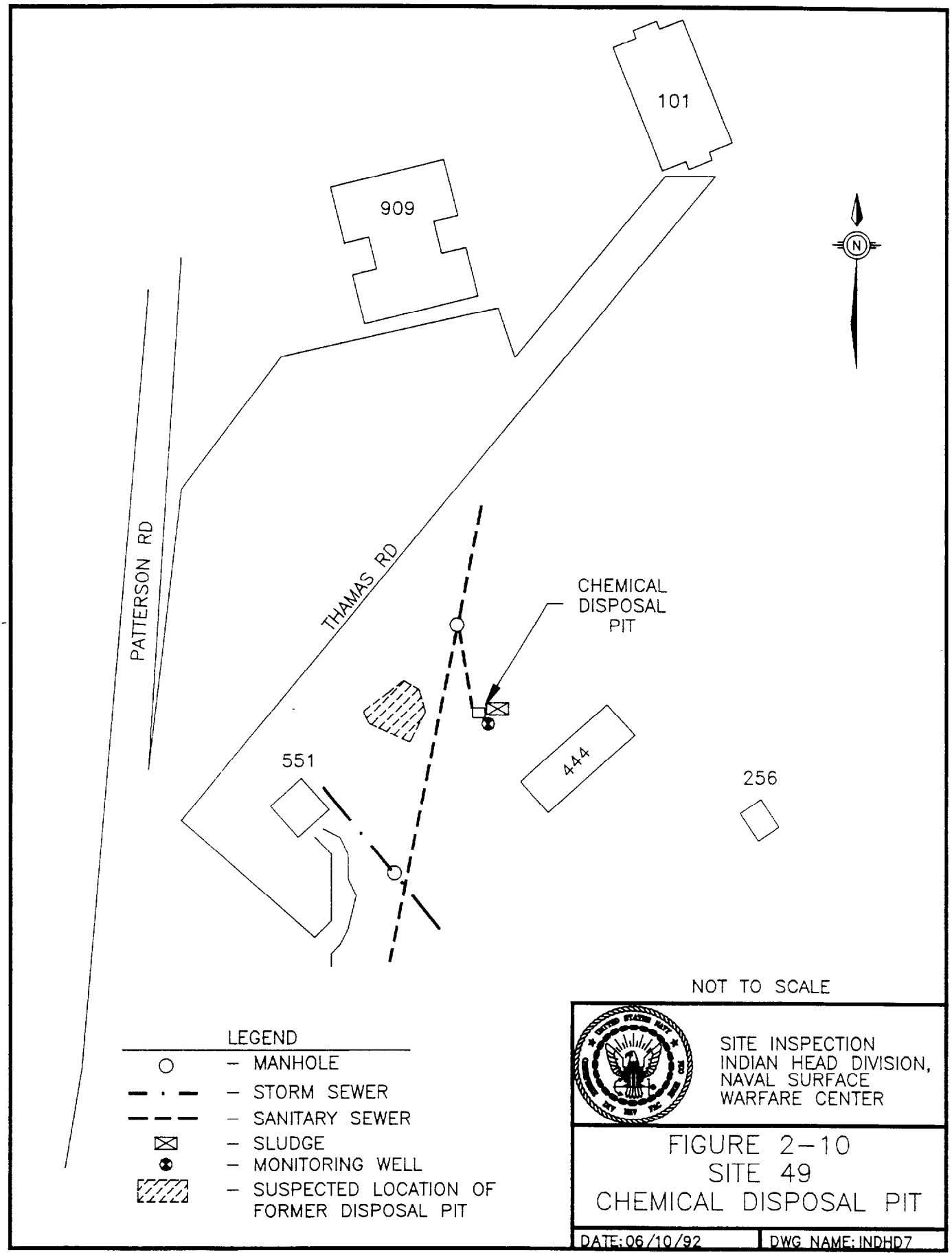
Site 49 — Chemical Disposal Pit. This site is located near Building 444 (Figure 2-10). Information from the PA report indicated the pit had limited use in the early 1970s. Disposal reportedly consisted of spent solvents and acid. Data also indicated that this pit connected to a storm sewer and not the sanitary sewer where chemicals could be treated and/or diluted.

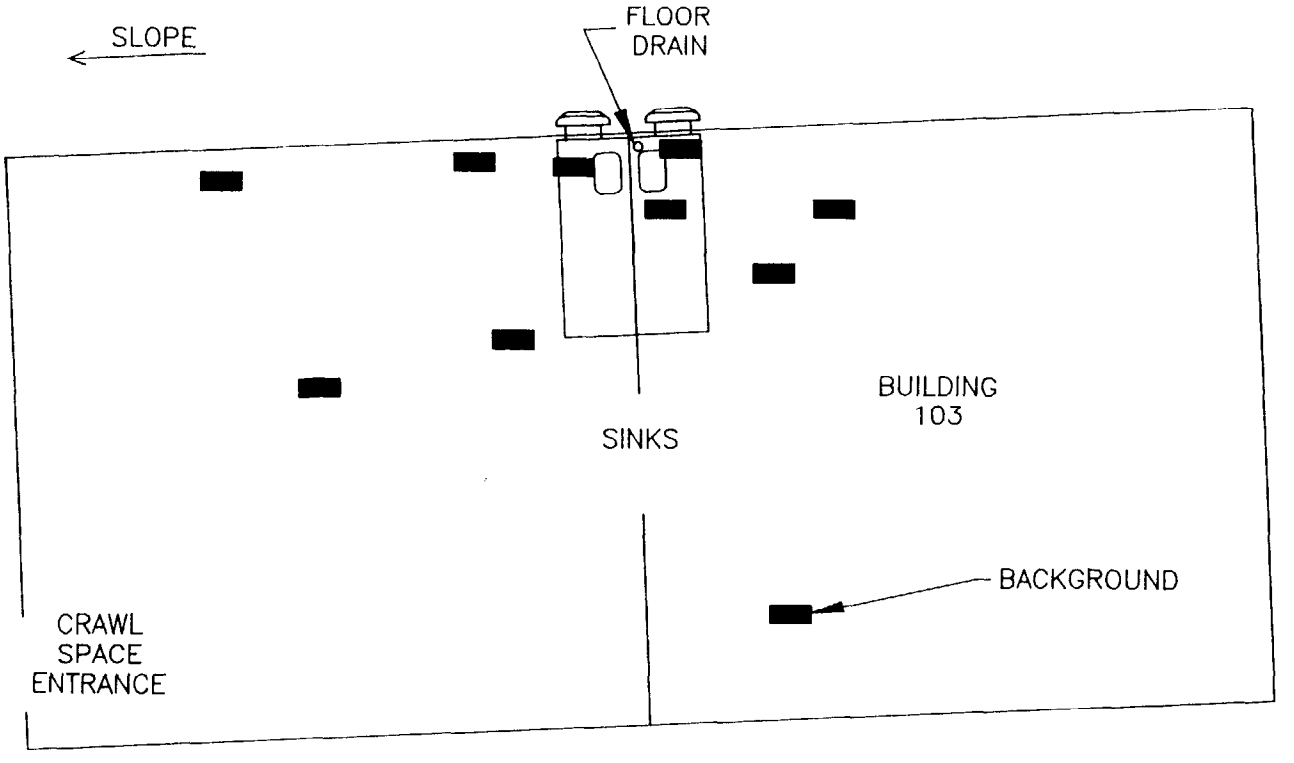
Site 49 was not recommended for an SI in the PA; however, at the request of the MDE, this site is included in the Scope of Work (SOW) and will be included in the SI. A study will be completed in this area consisting of the installation of one soil boring and the collection of a sediment sample from within the pit. The boring installed at this site may be completed as a shallow monitoring well as part of the scope of work at Site 53.

Site 50 — Building 103 Crawl Space. Site 50 consists of the crawl space underneath Building 103 (Figure 2-11). The building is a small single story wood frame structure on a raised concrete block foundation. During the replacement of two sinks in the building, workers discovered that the drain pipes discharged directly beneath the building and not to the sanitary sewer. Evidently, the open drainage pipes had been discharging underneath the building since the date of construction, 1902, until the sinks were replaced in 1988.

The possibility exists that a number of solvents, including mercury containing compounds and nitrate ester compounds, were introduced to the soil underneath the building via open drain pipes. The amount of mercury and solvents released in the soil beneath the building is unknown. Study of this site will include the collection of a series of surface soil samples from beneath the building for laboratory analyses.

Site 53 — Mercury Contamination in Laboratory Area. The sewer lines in the general laboratory area are defined as Site 53 (Figure 2-12). Information collected during the PA estimated that 28,000 pounds of mercury may have been released to the soils surrounding these


101
909
N
PATTERSON RD
THAMAS RD
CHEMICAL
DISPOSAL
PIT
551
444
256
NOT TO SCALE
LEGEND
– MANHOLE
– STORM SEWER
– SANITARY SEWER
– SLUDGE
– MONITORING WELL
– SUSPECTED LOCATION OF FORMER DISPOSAL PIT
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–10
SITE 49
CHEMICAL DISPOSAL PIT
DATE: 06/10/92
DWG NAME: INDHD7



LEGEND

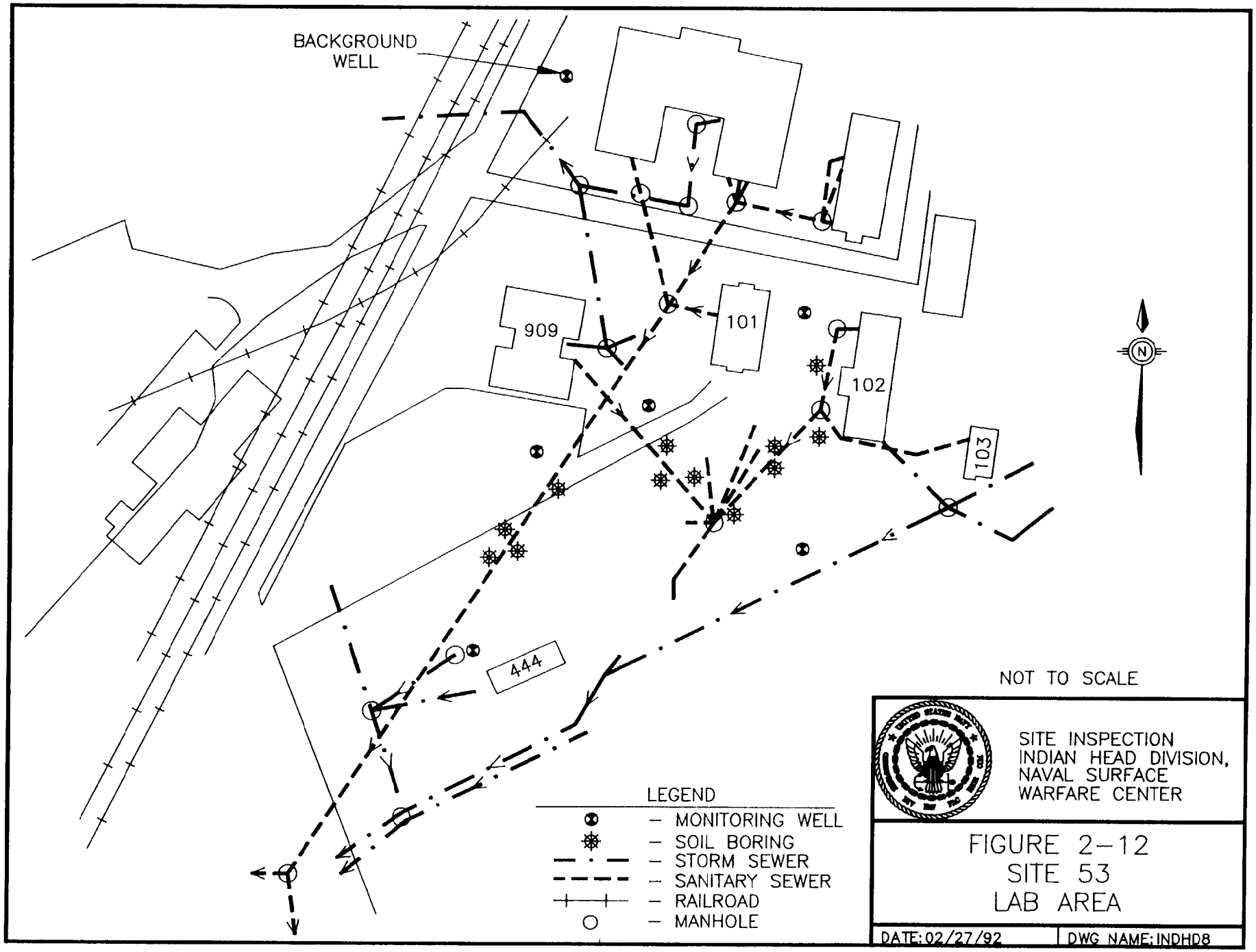
■ – SURFACE SAMPLE

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2–11
SITE 50
BUILDING 103
FLOOR PLAN

DATE: 06/10/92 | DWG NAME: INDHD9


BACKGROUND WELL
909
101
102
103
444
N
NOT TO SCALE
LEGEND
– MONITORING WELL
– SOIL BORING
– STORM SEWER
– SANITARY SEWER
– RAILROAD
– MANHOLE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 2–12
SITE 53
LAB AREA
DATE: 02/27/92
DWG NAME: INDHD8

sanitary sewer lines. A survey conducted by NSWC Indian Head personnel found these sewer lines to be in poor condition.

A study will be conducted in this area to determine if mercury contamination originating from the sewer system has impacted surrounding soils. Shallow soil borings will be completed adjacent to the sewer lines to a depth below the bottom grade of the line (estimated 8-10 feet). Two soil samples per boring and twelve sediment samples from man holes will be collected. All samples will be submitted to the laboratory for analysis.

In addition to the soil borings, six groundwater monitoring wells will be installed in the laboratory area. One well will be installed as a background or upgradient well. The boring installed at Site 49 may be completed as one of the six monitoring wells. Soil samples will be collected during the installation of the monitoring wells and groundwater samples will be collected from the completed wells.

Site 54 — Building 101 Mercury Contamination. Building 101 is a two-story brick building where mercury compounds were used in research and development. Droplets of mercury were detected on the insulation of a steam pipe in the first floor, southeast corner room. This first floor room is defined as the study area. During the PA it was discovered that laboratory equipment containing mercury had been located in the southeast corner room of the second floor, directly above the study area. It was noted in the PA that the source of the mercury droplets may be due to leaks and spills associated with the laboratory equipment on the floor above.

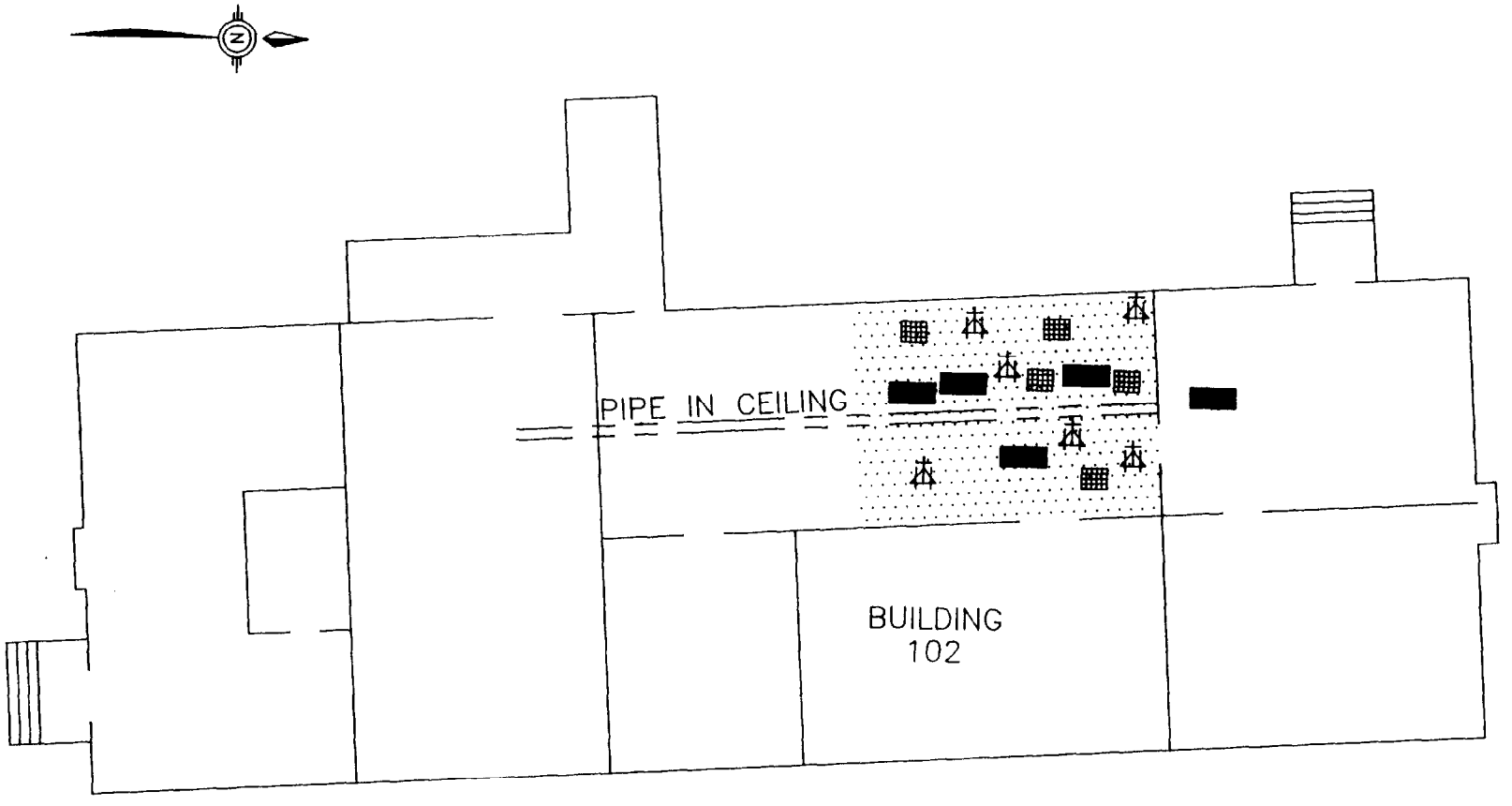
Site 54 was recommended for an SI based on discovery of the mercury on the pipes and mercury vapors detected in the room by NSWC safety personnel. The SI will involve the collection of wipe samples from the surface of selected building materials, the collection of media samples

(i.e. wood, bulk building materials, concrete, etc.) from selected building materials, and the collection of concrete samples from the basement floor.

Site 55 — Building 102 Mercury Contamination. In 1987, mercury was discovered dropping from the ceiling onto the coffee mess located in the basement of Building 102 (Figure 2-13). Reportedly, a spill of mercury occurred on the upper floor of the building in the early 1960s. This was identified in the PA as the probable source of the mercury. The PA outlines a brief site history which indicates the building was used for a number of processes involving mercury for nearly 80 years.

Building 102 was recommended for an SI due to the discovery of mercury permeating through the floor and entering into the basement. The SI will include the collection of wipe samples from the selected surface of the building materials, and the collection of media samples (i.e. wood, concrete, etc.) from selected building materials. Soil samples from underneath the concrete basement floor may also be collected and submitted for laboratory analyses. This building contains friable and nonfriable asbestos containing materials throughout the structure.

Industrial Wells Onsite. In addition to these sites discussed above, groundwater samples will be collected from five industrial wells on the NSWC facility. These samples will be submitted for laboratory analyses.



LEGEND

- WIPE SAMPLE
- MEDIA SAMPLE
- CONCRETE SAMPLE
- AREA OF SUPECTED MERCURY CONTAMINATION

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 2-13
SITE 55
BUILDING 102
BASEMENT FLOOR PLAN

DATE: 06/10/92 | DWG NAME: INDHD10

3.0 PROJECT QUALITY ASSURANCE OBJECTIVES

In general, the quality assurance goals of E/A&H projects are to assess and document all sampling and analysis according to the following criteria: (1) accuracy, (2) precision, (3) completeness, (4) representativeness and (5) comparability. Quality criteria are set herein to assure suitability for intended use of data obtained during projects, and to meet goals established by NEESA. The NEESA Contract Representative (NCR) has stipulated that Level C QC criteria are to be applied to all laboratory analyses required for this investigation as outlined in NEESA 20.2-047B.

3.1 Field Measurements

QA objectives for parameters and instruments to be measured in the field by E/A&H personnel are presented in Tables 3-1 and 3-2. Field measurements will include pH, temperature, specific conductance, turbidity, static groundwater level, and headspace analysis on split-soil samples, boring cuttings, and wellheads.

3.2 Sampling and Analysis for Contamination Level

Project QA objectives of analytical parameters for soil and groundwater will be as stipulated in the respective analytical methods, and as determined by the analytical laboratories historical data quality evaluation for these methods. The NEESA laboratory approval process will ensure that laboratory method QA/QC standards are appropriate to meet goals for intended data uses. Anticipated QA goals for these methods are presented in Table 3-3. PACE Laboratories has been selected as the contract laboratory for this activity. PACE's NEESA-approved QAP will be submitted for inclusion as Appendix A.

TABLE 3-1
FIELD MEASUREMENTS

Measurements Parameter	Reference	Matrix	Precision (%)	Accuracy % Recovery	Completeness (%)
pH	EPA 150.1[1]	Water	± 0.05 pH	± 0.2 pH	90
Temperature	EPA 170.1[1]	Water	± 0.1° C	± 0.2° C	90
Specific Conductivity	EPA 120.1[1]	Water	± 10%	± 10umhos/cm (<1000umhos/cm) ± 100umhos/cm (>1000umhos/cm)	90
Turbidity	EPA 180.1	Water	± 1%	± 1 NTU	90
Static Water Level	SOP[2]	Water	± 0.01 in.	± 0.005 in.	90
Photoionization Detector	SOP[3]	Air	± 10 ppm	± 20 ppm	90
Well Survey Points	SOP	Spatial	± 5%	± 0.1 feet	90
	SOP	Vertical	± 0.05 feet	± 0.01 feet	90

Notes:

[1] - Methods for Chemical Analysis of Water and Wastes, EPA-600/4/79-020, Revised March 1983.
[2] - Manufacturer's SOP for static water level measurement.
[3] - Manufacturer's SOP for operation of Photovac TIP II or HNu.

TABLE 3-2
FIELD TESTING EQUIPMENT

Item	Manufacturer	Model Number	Serial Number	Maintenance[1]
pH Meter	Fisher	Accumet 956	3218	Manufacturer's Operating Manual
Thermometer	—	Platinum RTD	—	Manufacturer's Operating Manual
Turbidity Meter	HF Scientific	DRT 15C	024823	Manufacturer's Operating Manual
Conductivity/pH/ Temperature Meter	YSI	3500	—	Manufacturer's Operating Manual
Photoionization Detector	HNu	HW-101	—	Manufacturer's Operating Manual

Notes:

[1] - Also, refer to Table 14-1 for preventive maintenance.

TABLE 3-3
LABORATORY MEASUREMENTS

Measurement Parameter	References	Matrix	Precision[1] (%)	Accuracy[1] % Recovery	Completeness (%)
TCL	CLP	Soil	±35	±40	90
		Water	±25	±40	90
TAL	CLP	Soil	±35	±45	90
		Water	±35	±55	90
Volatile Organic Compounds	CLP	Water	±25	±40	90
		Soil	±35	±40	90
Semi-Volatile Organic Compounds	CLP	Water	±35	±55	90
		Soil	±35	±45	90
Total Petroleum Hydrocarbons	EPA Method 418.1	Water	±35	±55	90
		Soil	±35	±55	90
Mercury (Cold Vapor)	EPA Method 7470/7471	Water	±25	±25	90
		Soil	±25	±25	90
Nitrate	EPA Method 9200/353.2	Water	±35	±55	90
		Soil	±35	±55	90
Palladium	EPA Method 7000 series	Soil	±25	±25	90
		Water	±25	±25	90
Products Classified under USATHAMA					
Acetal/Formal	USATHAMA LW-32	Soil	±25	±25	90
	USATHAMA UW-35	Water	±25	±25	90
PNC	USATHAMA LW-32	Soil	±25	±25	90
	USATHAMA UW-35	Water	±25	±25	90
UDMH	USATHAMA LW-32	Soil	±25	±25	90
	USATHAMA UW-35	Water	±25	±25	90
HBNQ	USATHAMA LW-32	Soil	±25	±25	90
	USATHAMA UW-35	Water	±25	±25	90

Notes:

[1] - Precision and accuracy goals are subject to change based upon specific method data quality history for the analytical laboratory chosen.

[2] - Precision and accuracy goals will be applied as advisory limits only.

3.3 Precision and Accuracy

Methods of assessing precision and accuracy of the field measurements are discussed in Section 15.0 of this document and summarized in Table 3-1. Precision and accuracy goals for laboratory analytical procedures (NEESA Level C) are provided in Table 3-3. Specific method precision and accuracy goals for required QC samples are discussed in subsequent sections.

3.4 Representativeness

The goal of this SI is to identify the presence of soil and groundwater contamination, if any. By properly collecting soil and groundwater samples and measuring well parameters in accordance with NEESA protocol (and any others by references), a representation can be achieved of any onsite contamination.

3.5 Completeness

Completeness goals for field measurements reflect the ability to re-sample all existing and planned wells, as well as subsequent sample collection for groundwater quality criteria defined in the QA Plan (QAP). The completeness goals do not take into consideration unavoidable non-attainment of QA goals which may occur over the course of the study. Efforts will be made, however, to maintain soil and groundwater data completeness levels above the 90 percent level, when possible.

3.6 Comparability

Comparability is assured through established sampling and analysis methods, such as specified in NEESA 20.2-031A and NEESA 20.2-047B, and where applicable, USATHAMA methods. Other sampling and analysis methods and the EPA SOP/QAM will be applied, as stipulated.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Overall responsibility for projects conducted in accordance with NEESA regulations will be vested in NEESA (or its approved representatives). Therefore, project coordination responsibilities lie with the NEESA, Engineering Field Division (EFD). The following section describes the components of the project chain-of-command as established in NEESA 20.2-047B.

4.1 Oversight

Project oversight is organized along the following lines of authority.

4.1.1 Navy Energy and Environmental Support Activity

NEESA is responsible for ensuring that the quality of laboratory analysis performed during the SI is acceptable. NEESA is also responsible for managing the NEESA Contract Representative (NCR).

4.1.2 Engineering Field Division

The Engineer-in-Charge at the EFD provides the site information and history, logistical assistance, specifies the sites requiring inspection, and reviews results and recommendations. Mr. Paul Berkman, CHESDIV, Naval Facilities Engineering Command, Washington, D.C., serves as the EIC for this project.

The EIC is responsible for coordinating procurement, finance, and reporting; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

4.1.3 NEESA Contract Representative

The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans and work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. The questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR. The NCR also evaluates referee samples. The NCR for this project is Martin Marietta Energy Systems, Inc.

4.1.4 State or Local Oversight

In accordance with verbal agreement, the Task Order Manager will coordinate all field activities with the EIC, Paul Berkman. All correspondence will carbon copy the activity file. Currently, no correspondence with MDE is anticipated. However, all well installations and field sampling protocol will be in accordance with Maryland Well Construction Regulations, COMAR 26.04.04.

4.2 Inspection Performance

The following individual or companies will be responsible for the implementation of all work plan activities.

4.2.1 Engineering Subcontractor

E/A&H will serve as the engineering subcontractor for this project. As the engineering subcontractor, E/A&H will design and implement the SI as outlined in this Work Plan.

4.2.2 Analytical Laboratory

The contracted analytical laboratory for this activity will be PACE Laboratories, Minneapolis, MN. PACE laboratories will be employed by E/A&H and will adhere to the laboratory requirements in NEESA 20.2-047B (or other QA and method requirements as specified).

PACE Laboratories will be required to accomplish the following for this activities: (1) prepare and submit a laboratory QA plan, (2) analyze and submit the results of proficiency testing, (3) submit to an onsite inspection, and (4) correct any deficiencies cited during the inspection by the NCR. PACE Laboratories is required to identify a Laboratory QA Coordinator (LQAC) prior to initiation of this activity, who will be responsible for overall QA. The LQAC must not be responsible for schedule, costs, or personnel other than the laboratory's QA members. It is preferred that the LQAC report directly to PACE Laboratories. The LQAC must have the authority to stop work on projects if QC problems arise which affect the quality of the data produced.

In addition to conforming to all NEESA regulations, all work shall be performed in a manner consistent with:

- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended

- National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR), Part 300, as amended

- Other appropriate federal, state, and local guidelines, rules, regulations, and criteria (where applicable).

5.0 SOIL BORINGS AND SAMPLING

This section is intended to satisfy the basic requirements for drilling and soil sampling as outlined in NEESA 20.2-031A, Chapter 4 — Monitor Well Drilling. Specific information regarding soil sample collection methods is provided in the FSP.

During the SI, soil samples will be collected for chemical analysis from multiple sites at NSWC, Indian Head. Samples will be collected by a variety of methods including soil gas borings, handauger borings, soil borings, and wipe samples. The following sections describe methods to be used for each type of solid media. Variations in the protocol may become necessary due to unknown site conditions.

5.1 Soil Gas Testings

Soil gas samples will be obtained at Sites 41, 43 and 44. Soil gas samples are collected from the vadose zone to assist in locating and characterizing the extent of subsurface contamination. Subsurface soil gas is analyzed for VOCs present in the soil. The main advantage of this method is that large areas can be studied at a lower cost than drilling or trenching.

5.2 Soil Sampling Procedures

All soil samples will be collected in accordance with NEESA 20.2-031A, Chapter 4 — Monitor Well Drilling. The soil sampling process is discussed below.

Soil borings will be placed in areas of suspected or potential contamination as described in the FSP of this SI work plan. Soil borings will be used to collect subsurface soil samples below a depth of 3 to 5 feet. Soil borings may also be used to collect samples where conditions prevent the use of a hand auger. Borings will be installed employing hollow stem auger techniques (4.25-inch internal diameter). Soil samples will be collected ahead of the augers by the use of a pre-cleaned split spoon sampler, at 5-foot intervals. The split spoon sampler will be a standard

2-inch outside diameter and 24-inch long sampling tool. The sampler will be driven into the soil with a 140 pound hammer dropped 30 inches in accordance with NEESA 20.2-031A, Chapter 4 — Monitor Well Drilling specifications.

During drilling operations, a photoionization detector (PID) will be used to monitor organic vapors in the breathing zone and near the auger cuttings. Individual soil samples will also be monitored, using the headspace techniques to assist in locating contaminated zones or areas. Each soil sample (from each interval) will be split into two portions. The first portion will be immediately collected and placed in the appropriate container for subsequent volatile organic analysis. The second remaining portion will be split into two parts. One part will be prepared for subsequent laboratory analysis and the other part will be placed in a clean jar with sufficient headspace to allow contaminant volatilization. After allowing enough time for volatilization of headspace samples, readings will be made with a PID. Each sample will be visually examined and logged by the project geologist. An example of the boring log to be used is provided in Figure 5-1.

The headspace screening process will involve the placement of a representative subsample in a glass jar, (approximately 3/4 full). The glass jar will be covered with aluminum foil, the lid secured, and subsequently allowed to reach ambient temperature. The tip of the instrument probe will be utilized to pierce the aluminum foil and the resultant meter reading will be noted in the field logbook. When sample quantity is insufficient for headspace techniques to be applied, direct HNu measurements will be made to the sample. All HNu measurements will be recorded on the boring log.

All soil borings not completed as monitoring wells will be abandoned by a pressure grouting procedure. The procedure will be accomplished by pumping a cement-bentonite mixture through a tremie pipe starting at the bottom of the boring. Grouting will proceed from the bottom of the boring to the surface in one continuous operation.

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION

DRILLING METHOD:	BORING NO.
	SHEET
SAMPLING METHOD:	OF
	DRILLING
	START / FINISH
WATER LEVEL	TIME / TIME
TIME	
DATE	DATE / DATE
CASING DEPTH	

DATUM ELEVATION

DRILLING CONTR _____

BY _____ CHK BY _____

DATE _____

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

SITE INSPECTION
NAVAL ORDANCE STATION
INDIAN HEAD, MARYLAND

FIGURE 5-1
BORING LOG
DIAGRAM

DATE: 02/20/92 | DWG NAME: CLENBORE

Sample selection criteria is outlined specifically in the FSP. The selected samples will then be preserved in a cool ice chest and shipped under strict chain-of-custody via overnight courier to PACE Laboratories for analysis (as discussed in Section 4.2.2). Additional information about the sampling process is discussed in further detail in the FSP and in the appropriate EPA guidance documents.

Sediment samples will be collected using a Ponar dredge sampler or with a disposable scoop and/or stainless steel bucket hand auger. Surface soil samples will be collected using a stainless steel hand auger. These samples will be handled and documented in the same manner as other soil samples collected onsite.

Media samples will also be collected at NSWC Indian Head at site 54 (Bldg. 101) and at site 55 (Bldg. 102). Media samples will be comprised of building materials such as ceiling tiles, portions of wooden floors and pieces of concrete.

Media samples from sites 54 and 55 are suspected to contain asbestos. Proper precaution will be utilized when handling samples from these areas. Samplers will dampen the surface segment to be sampled with deionized water prior to sampling, to decrease the omission of asbestos particles into the atmosphere.

5.3 Wipe Sampling

Wipe sampling has been historically and universally used as one of the most reasonable, quickest and inexpensive ways to sample surfaces. However, precision and accuracy is difficult to determine. Variations in results can occur due to sampling equipment, porosity of the surfaces sampled and details of the sampling procedure. Sampling can be further complicated by absorption and bonding characteristics of the surface materials.

Site Preparation Procedures:

1. Mark the exact sample site with a template or a ruler. (The template or ruler must be thoroughly cleaned between samples to prevent cross contamination.)
2. Write a detailed description of the area sampled and include a sketch of the sampling area (as close to scale as possible).
3. Prepare all necessary forms, sampling logs and Chain-of-Custody(C-O-C) for entry of sampling time, date, location, and other useful information.
4. Prepare all sampling equipment for the sampling event.

Wipe Sampling Procedures:

1. Remove the cap from the sampling vial with gloved hands.
2. Remove the solvent- (hexane) soaked gauze or swab from the sampling vial with forceps, tongs or gloves.
3. Immediately begin wiping the entire marked area twice, from left to right and then from top to bottom.
4. Return the gauze or swab to the sample vial. (If using a gauze, fold the sample side inward.)
5. Cap the sample vial to prevent evaporation of the solvent.
6. Label the vial and record the sampling details on the sampling forms. Complete the chain-of-custody forms and prepare the vial for storage and shipment. Wipe samples will follow soil requirements for preservation and holding times.

Quality control measures for wipe samples will include field blanks, duplicate samples, and spike samples. In addition to the quality control measures and documentation, descriptions and activities will be included such as the samplers identification, a step-by-step description on how samples were obtained, the location and the purpose.

5.4 Soil Sample Analyses

All soil sample analyses will be performed in accordance with NEESA 20.2-047B, Chapter 7 — Analytical Methods. Soil analytical requirements specific for each site inspection are provided in Tables 3-3 and 5-1.

In addition, due to the nature of specific compounds, U.S. Army & Hazardous Materials Agency (USATHAMA) methodologies will be utilized for specific site constituents nitrate esters, UDMH, Plastisol Nitro Cellulose (PNC), and High Bulk Nitroguanidine (HBNQ). These USATHAMA methodologies will be applicable to only those sites specified in Table 5-1.

5.5 Soil Sample Documentation

All soil samples will be documented in accordance with NEESA 202.-031A, Chapter 6 — Monitoring Well Data Record Requirements, and Chapter 8.0., Sample Identification, Containers, and Labelling. E/A&H personnel will use bound logbooks to maintain all field records pertaining to the SI. These records will document visual observations, calculations, and equipment calibrations. Every entry will be dated and the time for each entry noted. The logbooks are accountable documents that will be properly maintained and retained as part of the project files.

In addition, soil boring logs will be produced for all soil borings advanced beyond 5 feet. Information to be included on boring logs will include (but is not limited to): (1) total depth of boring, (2) lithologic descriptions of each stratigraphic unit encountered, (3) blow counts for split spoon sampler penetration, (4) water bearing zones, and (5) any subsurface obstructions encountered during boring advancement (with explanations if available).

TABLE 5-1
Soil & Sediment Analytical Requirements

Site Locations	Number of Samples	Analytical Requirements
Site 39	6	TAL, VOC, SVOC, Acetal/Formal, PNC, UDMH, HBNQ
Site 40	6	Palladium
Site 41	29	TCL, TAL, TPH
Site 43	10	VOC, SVOC
Site 44	17	VOC, SVOC, TPH
Site 45	3	VOC, SVOC, TAL
Site 46	9	TAL
Site 47	12	VOC, SVOC, TAL
Site 48	9	VOC, SVOC, TAL
Site 49	5	VOC, SVOC, TAL, Nitrate Esters
Site 50	10	VOC, SVOC, TAL, Nitrate Esters
Site 53	15	TAL, VOC, BNA, TPH
	36	Mercury, Nitrate Esters
Site 54	5	Mercury (Media Samples)
	5	Nitrate Esters
Site 55	5	Mercury (Media Samples)
	5	Nitrate Esters
Background Area	3	VOC, SVOC, TAL, TPH
	190	TOTAL SOIL SAMPLES

Note:

PNC - Plastisol Nitro Cellulose
TCL - Target Compound List as specified in CLP
TAL - Target Analyte List as specified in CLP
TPH - Total Petroleum Hydrocarbons
VOC - Volatile Organic Compounds
UDMH - Unsymmetrical Dimethylhydrazine
SVOC - Semi-Volatile Organic Compounds
HBNQ - High Bulk Nitroguanidine

This table does not include wipe samples.

All field logs will be retained in their original condition in the E/A&H project file. For presentation purposes, all logs will be recreated using computer-aided design methods for inclusion in the site inspection report.

5.6 Soil Sampling Equipment Decontamination

All equipment used in collection of soil sampling (i.e. split spoon samplers, sampling rods, augers, etc.) will be cleaned as follows prior to initiation of onsite activities:

Decontamination Procedures Before Sampling

1. Decontamination will begin with a high pressure steam cleaning (with a technician using a brush to remove any particulate matter or surface film).
2. A detergent wash will follow.
3. Equipment will next be rinsed with potable water.
4. After air drying, the equipment will be placed on plastic sheeting.

Decontamination Procedures During Sampling. Decontamination of all augers and downhole equipment (i.e. auger, sampling rods, etc.) will be performed between each boring by steam cleaning and a potable water rinse. All split spoons, hand augers, and the Ponar dredge will be decontaminated between samples using a detergent wash and a potable water rinse. This procedure will be followed to minimize the potential for cross-contamination of soil samples. Disposable gloves will be worn during all sampling and decontamination phases which require handling of samples. Caution must be taken at all times so that samples are not contaminated by the latex gloves. A new pair of latex gloves will be donned prior to handling each sample.

6.0 MONITORING WELL INSTALLATION

Several permanent monitoring wells are proposed for installation at NSWC. The proposed locations are identified in the FSP of this work plan. As previously outlined, the wells will be installed pursuant to Maryland Well Construction Regulations, COMAR 26.04.04, NEESA 20.2-031A, and all applicable EPA requirements.

7.0 GROUNDWATER SAMPLING

Groundwater sampling for the NSWC SI will be performed as outlined in the FSP and in the following sections.

7.1 Developing, Static Water Levels & Purging

Groundwater samples collected from monitoring wells will be collected in accordance with NEESA 20.2-031A, Chapter 7 — Ground-Water Sampling. Groundwater samples will be collected from the monitoring wells within one week after well construction. Disposable latex gloves will be worn while sampling at all types of sites, provided that new, unused gloves are worn for each separate sampling point. Care will be taken by the field sampling team to avoid contacting the samples. Static water level measurements will be performed on all monitoring wells before the sampling procedures begin, as discussed in the FSP. Static water level measurements will be used to determine groundwater flow direction and to construct a potentiometric surface diagram of individual study areas, where possible.

Each well will be fully developed by using bailing, surging, or pumping techniques. During the development process, pH, temperature, conductivity and turbidity will be measured. Each well will be considered developed when the pH, temperature, conductivity and turbidity have adequately stabilized and the water is visually free of silt. (Field measurements and instruments were previously outlined in Tables 3-1 and 3-2).

The water level measurement is recorded in the project field logbook. Water level measurements will be taken from the same point each time they are measured. The description of any free-floating product observed will also be noted in the field notebook. Wells with free products will not be sampled for trace contaminants. Water level measurements will be collected to the nearest one-hundredth of a foot.

The volume of water in the well casing will be calculated as follows:

V = (height of the water column) x 0.661 gal./foot

V = the well volume in gallons

Wells will be purged to ensure that the collected groundwater samples are representative of the aquifer under inspection. Well water will be purged using a clean dedicated bailers. Wells will be purged of at least three well volumes to ensure that the sample retrieved is representative of aquifer water quality. The wells will be considered purged and ready for sampling when pH, temperature, conductivity and turbidity readings of the well water have stabilized (values within 10 percent of the mean). If stabilization has not occurred, then additional water will be purged until readings stabilize or a minimum of three volumes have been evacuated. The minimum allowable time between purging and sampling is eight hours or within 24 hours for wells which have been bailed to dryness. If a well has not recovered sufficiently after this time, the well will not be sampled. Purged waters will be retained onsite in 55-gallon drums until laboratory analytical results indicate the regulatory status of the water. Once the regulatory status of the waste has been determined, NSWC Indian Head will be responsible for the disposal of all wastes.

7.2 Groundwater Sampling Procedures

E/A&H will begin well sampling with the placement of a clean dedicated plastic sheeting around the wellhead before purging and sampling to provide an area where equipment can be temporarily placed without risk of contamination. A PID measurement will be taken at each wellhead immediately after the removal of the well cap.

Groundwater samples will be collected using a clean dedicated Teflon-coated single-check valve bailer and nylon-coated bailing rope. The bailer will be slowly lowered into the water column to minimize water column disturbance and possible loss of volatile parameters. The bailer will be manually retrieved and the samples will be immediately transferred to appropriate sample containers. Samples to be collected for volatile organics analyses will be contained first in the appropriate containers. The sampling process is discussed in further detail in the project FSP, and outlined in EPA SOP/QAM.

All dedicated equipment, except equipment that is never removed from the well, even during sampling, will be cleaned between sampling events and will be secured at the end of each sampling day by the project geologist.

If groundwater is encountered during soil boring activities, an in-situ sample may be collected from selected locations for analysis. Grab (in-situ) groundwater samples will be collected randomly at locations where flow is sufficient from acquiring the full sample quantity or where directed by the project geologist.

7.3 Groundwater Sample Analyses

All groundwater sample analyses will be performed according to NEESA 20.2-047B, Chapter 7 — Analytical Methods. The EIC has established that all groundwater samples will be analyzed under NEESA Level C QC methods. Additionally, pH, temperature, conductance and turbidity for each sample collected will be measured in the field for each sample collected. Groundwater analytical requirements specific for each site inspection are provided in Table 7-1.

TABLE 7-1
Groundwater Analytical Requirements

Site Locations	Number of Samples	Analytical Requirements
Site 41	6	TCL, TAL, TPH
Site 43	4	VOC, SVOC
Site 44	4	VOC, SVOC, TPH
Site 49	2	TAL, VOC, SVOC, TPH
Site 53	10	VOC, SVOC, TAL, TPH
Background Monitoring Wells	2	TAL, VOC, SVOC, TPH
Drinking/Industrial Wells	5	TCL, TAL
Total Groundwater Samples	33	

Notes:

TCL — Target Compound List as specified in CLP
TAL — Target Analyte List as Specified in CLP
VOC — Volatile Organic Compounds
SVOC — Semi-Volatile Organic Compounds
TPH — Total Petroleum Hydrocarbons

7.4 Groundwater Sample Documentation

All groundwater samples will be documented according to NEESA 20.2-047B, Chapter 3 — Site-Specific QC Requirements, and NEESA 20.2-031A, Chapter 6 — Monitoring Well Data Record Requirements. E/A&H personnel will use bound logbooks to maintain all field records pertaining to the SI. Every entry will be dated and the time for each entry noted.

7.5 Groundwater Sampling Equipment Decontamination

All equipment used in measuring and sampling groundwater monitoring wells will be decontaminated in accordance with NEESA 20.2-031A, Chapter 3.3 — Aquifer Protection requirements. Before site activities begin, it will be necessary to decontaminate all bailers and the water level indicator using a potable water/detergent wash, followed by a potable water rinse, isopropanol rinse and a final deionized water rinse.

8.0 SAMPLE IDENTIFICATION, CONTAINERS, PRESERVATION AND LABELING

Clean sample containers will be provided by the laboratory. E/A&H will receive the containers from PACE Laboratories. Sample containers will be cleaned in accordance with NEESA 20.2-047B, Chapter 3.5 — Sample Container Cleaning Procedures (and/or other applicable protocol). The containers will remain in the custody of field project manager.

Labels will be affixed to each container immediately upon sampling. Labels will include the following information: site and sample designation, sampling time and date, sample preservation, sampler identification and analytical methods. Figure 8-1 is an example of the sample label to be used in this inspection. When sample containers are filled at a site, all forms will be completed, and the samples prepared and shipped to the laboratory. Sample preservation methods, holding times, container requirements and quantities are summarized in Tables 8-1 and 8-2.

8.1 Sample Designation

All samples collected in the field will be labeled with an alphanumeric code that identifies the site, sample type, sample location and sample depth (for soil boring samples). Where applicable QA sample type or background samples will be indicated.

The labeling format will be as follows:

IHD-AB-CD-EFG-HIJ-KL

Each set of two or three letters separated by a hyphen is an information group. The prefix IHD is the identifier for NSWC.

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE
SAMPLE IDENTIFICATION	
PROJECT NUMBER	

SITE INSPECTION
NAVAL ORDANCE STATION
INDIAN HEAD, MARYLAND

FIGURE 8-1
SAMPLE BOTTLE LABEL

DATE: 02/20/92 | DWG NAME: CLENSMPL

TABLE 8-1
SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

Analytical Method	Sample Matrix	Container Size/ Material	Sample Preservation	Holding Time
Total Petroleum Hydrocarbon EPA Method 418.1	Soil	8 oz. Glass Jar	Chill, 4°C	28 days until analysis
	Water	One Liter Glass Jar	Chill, 4°C pH<2, H2SO4	28 days until analysis
CLP-TCL Volatile Organic Compounds	Soil	8 oz. Glass Jar with Teflon-lined septa	Chill, 4°C	10 days until analysis
	Water	(3) 40 ml. vials with Teflon-lined septa	Chill, 4°C pH<2, HCl	10 days until analysis
CLP-TCL Semivolatile Organic Compounds	Soil	8 oz. Glass Jar with Teflon-lined septa	Chill, 4°C	Extract within 10 days, Analyze within 40 days
	Water	(2) One Liter Amber Glass Jars	Chill, 4°C	Extract within 5 days, Analyze within 40 days
CLP-TCL-Pesticides/PCBs	Soil	8 oz. Glass Jar	Chill, 4°C	Extract within 10 days, Analyze within 40 days
	Water	2.5 Liter Amber Glass Jar (1 liter for CLP)	Chill, 4°C, pH between 5 & 9	Extract within 5 days, Analyze within 40 days

TABLE 8-1
SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

Analytical Method	Sample Matrix	Container Size/ Material	Sample Preservation	Holding Time
CLP-TAL Metals	Soil	8 oz. Glass Jar	Chill, 4°C	180 days until analysis, Hg-26 days until analysis
	Water	1 liter Plastic Container + 16 oz. Plastic Container for Cyanide (Unpreserved)	pH <2 HNO_3, Chill 4°C	180 days until analysis, Hg-26 days until analysis
CLP - Volatile Organic Compounds	Soil	8 oz. Glass Jar with Teflon-lined septa	Chill 4°C	Analyze within 10 days
	Water	(3)40 ml VOA Vials with Teflon-lined septa	Chill 4°C	Analyze within 10 days
CLP - Semi-Volatile Compounds	Soil	8 oz. Glass Jar	Chill, 4°C	Extract within 10 days, Analyze within 40 days
	Water	(2) One liter Amber Glass Jars	Chill, 4°C	Extract within 5 days, Analyze withing 40 days
Nitrate EPA Method 9200/353.2	Soil	8 oz. Glass Jar	Chill, 4°C	48 Hours until analysis
	Water	100 ml Glass Vial	Chill, 4°C	48 Hours until analysis
Mercury EPA Method 7470/7471	Soil	8 oz. Glass Jar	Chill, 4°C	28 days until analysis
	Water	250 ml HDPE Bottle	pH<2, HNO_3	28 days until analysis
Palladium EPA Method 7000 series	Soil	8 oz. Glass Jar with Teflon-lined septa	Chill, 4C°	Analyze within 180 days
	Water	500 ml HDPE Bottle	pH<2, HNO_3	Analyze within 180 days

Note: For soil matrices, samples required for multiple analyses may be obtained from multiple 8 ounce jars or a single 32 ounce jar. CLP analysis holding times begin at verified time of sample receipt (VTSR) by the laboratory. Non-CLP analyses holding times begin from the time of collection.

Table 8-2
SAMPLE CONTAINERS, PRESERVATION & HOLDING TIMES BY USATHAMA

Analytical Method	Sample Matrix	Container Size/Material	Sample Preservation	Holding Times
Acetal/Formal	Soil	8 oz. Glass Jar with Teflon-lined septa	Chill, 4°C	Extract within 56 days, Analyze within 40 days
	Water	1 Liter Glass Amber Bottle with Teflon-lined septa	Chill, 4°C	Extract within 56 days, Analyze within 40 days
PNC	Soil	8 oz. Glass Jar with Teflon-lined septa	Chill, 4°C	Extract within 56 days, Analyze within 40 days
	Water	1 Liter Glass Amber Bottle with Teflon-lined septa	Chill, 4°C	Extract within 56 days, Analyze within 40 days
UDMH	Soil	8 oz. Glass Jar with Teflon-lined septa	Chill, 4°C	Extract within 56 days, Analyze within 40 days
	Water	1 Liter Glass Amber Bottle with Teflon-lined septa	Chill, 4°C	Extract within 56 days, Analyze within 40 days
HBNQ	Soil	8 oz. Glass Jar with Teflon-lined septa	Chill, 4°C	Extract within 56 days, Analyze within 40 days
	Water	1 Liter Glass Amber Bottle with Teflon-lined septa	Chill, 4°C	Extract within 56 days, Analyze within 40 days

Notes:

PNC - Plastisol Nitor Cellulose
UDMH - Unsymmetrical Dimethylhydrazine
HBNQ - High Bulk Nitroguanidine

Holding times specified above are the maximum allowed time as defined in Appendix H of the USATHAMA QAPP (January 1990). Every effort shall be made to have samples analyzed as soon as possible upon reciept by the laboratory.

Other Sampler Identifiers:

Site Location (AB) These two-character codes will be used in identifying the site location numbers. For example site location number 39 will have 39 in place of the AB.

Sample Type (CD) These two-character codes will be used in identifying the sampling type taken using the following letters:

MW — monitoring well (may include soil boring)
SB — soil boring
SC — surface composite
SD — sediment
SG — soil gas
SH — soil borings by hand augering
SS — surface soil
GW — ground water
SL — sludge sample
SW — surface water
WP — wipe samples

Sample Locations (EFG-HIJ) These six-character codes identify the sampling location according to horizontal and vertical components. The first three characters reflect a predetermined number sequence assigned to specific monitoring wells or locations as located on each site sampling map. The last three characters (HIJ) distinguish samples taken at different depths. Numbers may be used here to represent the depth below land surface where the sample was taken, in inches.

QA Sample Type (KL) When appropriate, the two character code KL can be used to identify the QA sample type or a background sample as follows:

RB — rinsate blank
FB — field blank
TB — trip blank
DP — duplicate sample
BG — background sample

8.2 Sample Chain-of-Custody

E/A&H will follow strict chain-of-custody procedures in accordance with NEESA 20.2-047B, Chapter 3.8, and corporate Standard Operating Procedures for chain-of-custody. E/A&H will generally use chain-of-custody forms, such as illustrated in Figure 8-2 for transferring sample shipments to the laboratory. Documentation of all samples will also be kept in a project field logbook.

Upon transfer of custody, the chain-of-custody form will be signed by E/A&H field personnel, including the date and time the samples were relinquished. Because common carriers will not sign chain-of-custody forms, the chain-of-custody records will be sealed within each shipping container. All chain-of-custody forms received by the laboratory must be signed and dated by the laboratory sample custodian and returned to E/A&H following receipt, or as part of the data reporting package.

FIGURE 8-2
CHAIN OF CUSTODY RECORD

LABORATORY: _____

ATTENTION: _____

PROJECT NO.: _____

PAGE___ of____

SITE INSPECTION
NAVAL ORDANCE STATION
INDIAN HEAD, MARYLAND

CLIENT NAME

COLLECTED BY

SAMPLE ID	DATE	TIME	comp	grab	well	SAMPLE LOCATION	#of containers	MEDIA (X)				SAMPLE ANALYSIS (X)									REMARKS
								SOIL	WATER	SEDIMENT	GROUNDWATER										

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:
RELINQUISHED BY:	DATE	TIME	RECEIVED AT LAB BY:	DATE	TIME	REMARKS	

CLENCUS1

9.0 CALIBRATION PROCEDURES AND FREQUENCY

PACE Laboratories will perform analytical instrument calibration in accordance with NEESA 20.2-47B (and specific instrument methods by reference). Adherence to proper calibration procedures will be determined by the NCR during any onsite laboratory inspection. All laboratory calibration procedures will be outlined in the laboratory's NEESA-approved QAP manual.

E/A&H plans to calibrate field equipment such as pH meter, temperature meter, turbidity meter and PID according to manufacturer's standard operating procedures. Field equipment for which SOPs are not in force will be calibrated and operated in accordance with the manufacturer's recommendations.

All field instruments will be calibrated at the beginning and end of each work day. The pH meter will be calibrated prior to each set of measurements.

10.0 ANALYTICAL PROCEDURES

The SI will involve the collection of soil, sediment, and surface water samples for laboratory analysis. Groundwater samples will be collected for field (in-situ parameters) and laboratory analysis. The analytical procedures selected by the NCR are discussed below.

10.1 Field Analyses

The boreholes for soil borings and monitoring wells will be monitored during drilling with a PID to measure total VOCs. Static water level measurements will be taken on all monitoring wells before and after the well development, allowing adequate time for well recharge. The wells will also be checked with a PID prior to sampling to measure for total VOCs. All field measurements will be recorded in a dedicated field logbook and/or appropriate E/A&H field activity log (i.e. boring log, well construction log, etc.).

Monitoring well casing (heads) will be surveyed (spatial and horizontal orientation) by a State of Maryland registered land surveyor. The survey measurements will be recorded relative to the USGS NAD '27.

10.2 Laboratory Analyses

Selected soil and water samples collected during the course of the SI will be analyzed by the EPA methods listed in Table 8-1. The detection limits for each of the EPA analytical methods are provided in Appendix B. Standard soil and water analyses were chosen to assess the presence of contaminants in these media to meet the requirements of the SI scope of work.

11.0 DATA REDUCTION, VALIDATION, AND REPORTING

Laboratory procedures for data reduction, validation, and reporting will be conducted according to the standard operating procedures as dictated by the requirements of NEESA 20.2-047B, Chapter 7 — Analytical Methods and in Chapter 8 — Maintaining Laboratory Approval. The specific procedures for data reduction, validation and reporting will be those outlined for Level C QC data in NEESA 20.2-047B, and the NCR approved laboratory QA plan.

12.0 FIELD AND LABORATORY QUALITY CONTROL CHECKS

Internal laboratory quality control checks used by the laboratory will be conducted in the laboratory by the laboratory staff. E/A&H will conduct internal quality control checks of sampling procedures and laboratory analyses. These checks will consist of preparation and submittal of sampler rinsate blanks, trip blanks, field blanks, and field duplicates for analysis, and subsequent evaluation of the laboratory analytical package. The data validation checklists, included as Appendix C of this QA plan, will be used as a guide in evaluating reported data, field records and analytical performance.

The types and frequency of blanks and other quality control check samples will be dictated by the NEESA Level C QC selected by the NCR. The required control check sample frequencies are outlined in NEESA 20.2-047B, Chapter 3 — Site-Specific QA Requirements and Chapter 7 — Analytical Methods. For Level C QC, quality control measures for sampling and analysis are described below.

12.1 Field Data Quality

All field work will be conducted and/or supervised by the project geologist to ensure that proper procedures are followed. Field records will be kept of all activities that take place during the SI and these records will be maintained at the E/A&H office in Memphis, Tennessee. These records will include documentation of any problems that have been encountered during the SI.

Field samples will be collected per the procedures outlined in Sections 5, 6 and 7 of this QA plan. Precision will be assessed by evaluating the results of duplicate samples, and accuracy will be assessed by evaluating the analyses of field blanks, trip blanks rinsate blanks and laboratory matrix and surrogate spikes.

Duplicates are identical samples collected from the same locations (i.e. wells) at the same time under identical conditions. Duplicate samples are analyzed along with the original sample to obtain sample procedure precision and inherent sample source variability. For this project, every other field duplicate will be used to prepare of the laboratory matrix spike/matrix spike duplicate samples. Soil duplicate samples will be collected to assess the heterogeneity of contaminant concentrations in the soil, at a specific location. Due to the potential of loss for volatile parameters during the preparation of soil samples, soils which are to be analyzed for TCL or VOCs will not be homogenized in the field. Duplicate samples will be collected from 10 percent of all soil and groundwater samples.

Field blanks are sample containers filled with the source water used in the decontamination of equipment in the field. The field blanks are prepared, preserved and stored in the same manner as the other field samples. The field blanks are analyzed along with the field samples for the same constituents of interest to check for contamination imparted to the samples by the sample containers or other exogenous sources. One field blank per sampling event will be prepared.

Rinsate (or equipment) blanks are collected by retaining rinsate from sampling equipment. The equipment is rinsed with deionized water after full decontamination procedures have been performed. Rinsate samples are collected in the same type of sample containers as the field samples. Rinsate samples will be collected daily. Initially, samples from every other day will be submitted for analysis. If analytes pertinent to the project are detected, the remaining rinsate samples must be submitted for analysis. The results of the rinsate blanks will be used to flag or assess the levels of the analytes in the samples. This comparison is made during data validation. The rinsate blanks are analyzed along with the field samples for the constituents of interest.

Trip blanks are prepared by the laboratory and filled with organic-free water that is transported unopened with the sample bottles. It is opened in the laboratory and analyzed along with the field samples for VOCs constituents of interest. Trip blanks will be submitted to the laboratory in all sample shipping containers holding field samples for VOC analyses at a frequency of one per sample shipping cooler. The collection frequencies for quality control sample collection are summarized in Table 12-1.

TABLE 12-1
QUALITY CONTROL SAMPLE COLLECTION FREQUENCIES

Quality Control Sample	Frequency of Collection	Additional Sample Volumes Required
Trip Blank (volatiles only)	One per sample shipping cooler containing samples to be analyzed for volatiles	(3) 40 ml. glass vials with Teflon-lined septa
Rinsate Blank	One per day per media (to be analyzed every other day unless contaminants are identified)	A
Field Blank	Two per groundwater sampling event/source	A
Duplicates	One per 10 water and/or soil samples collected	A,B
Matrix Spike/Matrix Spike Duplicate Samples	One per 20 water and/or soil samples collected; matrix is to be the same sample used for duplicate analysis	A

Notes:

A - Adequate sample volumes should be collected to perform all aqueous analytical methods described for the area of investigation (Tables 8-1 & 8-2).

B - An identical set of containers should be provided for each soil duplicate dependent upon the area of investigation (Tables 8-1 & 8-2).

12.2 Analytical Data Quality

Analytical data quality is assured through the use of NEESA guidelines for QA/QC as set forth in NEESA 20.2-047B. The guidelines include analysis and evaluation of matrix spikes.

Matrix spike samples prepared by the laboratory are useful in assessing the accuracy of the analytical method and can detect matrix effects, in which other sample components interfere with the analysis of the contaminant of concern. The method of measuring analytical accuracy is percent recovery. Analysis of matrix spike duplicates will provide a basis for determining method precision specific to the matrix under study. Precision is measured as relative percent difference between duplicate analyses. Analytical matrix spikes and matrix spike duplicates will be performed at a rate of one per sample batch (20 samples maximum) per matrix in accordance with NEESA 20.2-047B.

Surrogate spikes are also used to determine the accuracy of the analytical method with respect to the matrix under inspection. Surrogate spike compounds are compounds similar in chemical nature to the target compounds, but would not be expected in the affected media (i.e. radioisotopically labelled compounds, etc.). These compounds are introduced into each sample before analysis. By comparing the reported results for these compounds with the pre-determined quantities introduced, a percent recovery can be determined. This percent recovery data is subsequently used to assess the accuracy of results for the target compounds within each specific sample. Surrogate spike analysis will be performed on each sample analyzed for organic parameters. The choice of compounds to be used for matrix and surrogate spike purposes is generally stipulated by the analytical method employed. Tables 12-2 and 12-3 present compounds commonly used for this purpose in performing contract laboratory protocol (CLP) level analyses, along with QA limits.

12.3 Field Data Package

The field data package will include all field records and measurements obtained at a site by E/A&H personnel in accordance with NEESA 20.2-047B, Chapter 7.2 — Deliverables and NEESA 20.2-031A, Chapter 6 — Monitoring Well Data Record Requirements. The package, including all field records and measurements obtained at the activity by E/A&H sampling personnel, is validated as outlined below.

- Review field data noted on water and soil sampling logs for completeness. Failure in this area may result in the data being invalidated for litigation or regulatory purposes.
- Verify that field blanks, sampler rinsate blanks, and trip blanks were properly prepared, identified, and analyzed. Failure in this area may compromise the analytical data package and result in some data being considered qualitative or invalid.
- Check field analyses for equipment calibration and condition. Failure in this area may result in the field measurements being invalidated.
- Review chain-of-custody forms for proper completion, signatures of field personnel and the laboratory sample custodian, and dates. Failure may result in the data being invalidated for litigation or regulatory purposes.

The field data package will be reviewed by the E/A&H project QA officer. For completeness and accuracy, the E/A&H QA officer will use the guidance of the checklist provided in Appendix C.

12.4 Analytical Data Package

Validation of the analytical data package will be performed by the E/A&H project QA officer prior to submittal to the NCR (not before completion of field data validation). E/A&H will perform data validation independent of the laboratory's data review and will be consistent with the level of effort specified in NEESA 20.2-047B (and specific to the laboratory's QC level

TABLE 12-2 METALS ANALYSES DATA QA OBJECTIVES
MATRIX SPIKES/DUPLICATE ANALYSES

Compound (Metal)	Medium/High Sample Precision[A] (%RPD)	Low Sample Precision[B] (%RPD)	Accuracy (% Spike Recovery)
Aluminum	± 20	± CRDL	75-125
Antimony	± 20	± CRDL	75-125
Arsenic	± 20	± CRDL	75-125
Barium	± 20	± CRDL	75-125
Beryllium	± 20	± CRDL	75-125
Cadmium	± 20	± CRDL	75-125
Calcium	± 20	± CRDL	75-125
Chromium	± 20	± CRDL	75-125
Cobalt	± 20	± CRDL	75-125
Copper	± 20	± CRDL	75-125
Iron	± 20	± CRDL	75-125
Lead	± 20	± CRDL	75-125
Magnesium	± 20	± CRDL	75-125
Manganese	± 20	± CRDL	75-125
Mercury	± 20	± CRDL	75-125
Nickel	± 20	± CRDL	75-125
Potassium	± 20	± CRDL	75-125
Selenium	± 20	± CRDL	75-125
Silver	± 20	± CRDL	75-125
Sodium	± 20	± CRDL	75-125
Thallium	± 20	± CRDL	75-125
Tin	± 20	± CRDL	75-125
Vanadium	± 20	± CRDL	75-125
Zinc	± 20	± CRDL	75-125
Cyanide	± 20	± CRDL	75-125
Palladium	± 20	± CRDL	75-125

Notes: QA/QC Requirements excerpted from CLP SOW ILMO 1.0

[a] - Medium/High Samples = compound or metal present at 5 times (or more) the contract required detection limit (CRDL)

[b] - Low Samples = compound or metal present at less than 5 times the CRDL

TABLE 12-3
DATA QUALITY OBJECTIVES
MATRIX SPIKES/MATRIX SPIKE DUPLICATES/SURROGATE SPIKES

Fraction	Compound	Soil Precision (%RPD)	Soil Accuracy (%Recovery)	Water Precision (%RPD)	Water Accuracy (%Recovery)
VOA	Matrix Spikes				
	1,1-Dichloroethene	22	59-172	14	61-145
	Trichloroethene	24	62-137	14	71-120
	Chlorobenzene	21	60-133	13	75-130
	Toluene	21	59-139	13	76-125
	Benzene	21	66-142	11	76-127
VOA	Surrogate Spikes				
	Toluene-d_8	---	50-160	---	86-119
	4-Bromofluorobenzene	---	50-160	---	85-121
	1,2-Dichloroethane-d_4	---	50-160	---	77-120
BNA	Matrix Spikes				
BN	1,2,4-Trichlorobenzene	23	38-107	28	39-98
	Acenaphthene	19	31-137	31	46-118
	2,4-Dinitrotoluene	47	28-89	38	24-96
	Di-n-butyl Phthalate	47	29-135	40	11-117
	Pyrene	36	35-142	31	26-127

TABLE 12-3
DATA QUALITY OBJECTIVES
MATRIX SPIKES/MATRIX SPIKE DUPLICATES/SURROGATE SPIKES

Fraction	Compound	Soil Precision (%RPD)	Soil Accuracy (%Recovery)	Water Precision (%RPD)	Water Accuracy (%Recovery)
	N-Nitroso-Di-n-Propylamine	36	41-126	38	41-116
	1,4-Dichlorobenzene	27	26-104	26	36-97
A	Pentachlorophenol	47	17-109	50	9-103
	Phenol	35	26-90	42	12-89
	2-Chlorophenol	50	25-102	40	27-123
	4-Chloro-3-Methylphenol	33	26-103	42	23-97
	4-Nitrophenol	50	11-114	50	10-80
BNA	Surrogate Spikes				
	Nitrobenzene-d_5	---	20-140	---	41-120
	2-Fluorobiphenyl	---	20-140	---	44-119
	p-Terphenyl-d_{14}	---	20-140	---	33-128
	Phenol-d_5	---	20-140	---	15-103
	2-Fluorophenol	---	20-140	---	23-121
	2,4,6-Tribromophenol	---	10-140	---	10-130
Pesticides	Matrix Spikes				
	Lindane	50	46-127	15	56-123
	Heptachlor	31	35-130	20	40-131

TABLE 12-3
DATA QUALITY OBJECTIVES
MATRIX SPIKES/MATRIX SPIKE DUPLICATES/SURROGATE SPIKES

Fraction	Compound	Soil Precision (%RPD)	Soil Accuracy (%Recovery)	Water Precision (%RPD)	Water Accuracy (%Recovery)
	Aldrin	43	34-132	22	40-120
	Dieldrin	38	31-134	18	52-126
	Endrin	45	42-139	21	56-121
	4,4'-DDT	50	23-134	27	38-127
Pesticides	Surrogate Spikes				
	Dibutylchlorendate	---	48-136*	---	20-150*

Notes: QA/QC Requirements for CLP analyses excerpted from CLP SOW 3/90 (OLM01.0-OLM01.7); Other QA/QC requirements were derived from the analytical method references (USEPA, SW-846).

VOA = Volatile Organics
BN = Base/Neutral Extractable
A = Acid Extractable
* = Advisory Limits
--- = Not Applicable

applied). The validation steps will be performed by applying, where applicable, the *EPA Laboratory Data Validation Functional Guidelines for Evaluating Organics and Inorganics Analyses*, Technical Directive Document No. HQ-8410-01, and EPA precision and accuracy statements for the analytical methods employed. NEESA 20.2-047B, Chapter 7.3.1, Level C Data Validation Guidelines, will be applied to all Level C data validation procedures. For analyses for which NEESA has not established validation guidelines, the QA assessment parameters outlined in Table 12-3 will be applied. An analytical data validation checklist (Appendix C) will be used for this purpose.

The analytical data package validation procedure includes, but is not limited to, review of the following:

- Comparison of the data package to the reporting level requirements designated for the project, to confirm completeness.
- Comparison of sampling dates, sample extraction dates, and analysis dates to check that samples were extracted and/or analyzed within the proper holding times. Failure in this area may render the data unusable.
- Review of analytical methods and required detection limits to verify that they agree with the QAP and the laboratory contract. Failure may render the data unusable.
- Analysis of field and laboratory blanks to evaluate possible contamination sources. The preparation techniques and frequencies, and the analytical results (if appropriate) will be considered.
- Evaluation of blanks must confirm freedom from contamination at the specified detection limit. All blank contaminants must be explained or the data applicable to those blanks labelled suspect and sufficient only for qualitative purposes.

12.5 Data Classification

NEESA Level C data will be classified by the E/A&H QA officer based upon the level of reportables and the result of evaluating the field and analytical data packages. The useability of collected data will be evaluated using the guidelines outlined above. Should data validation identify usable data or data of questionable reliability, data qualifiers will be assigned to each affected datum using USEPA CLP qualifiers (Appendix C). Subsequent use of qualified data will be restricted and when used, the uncertainty associated with the data will be documented.

As with the laboratory data validation, the classification of data is based on specifically defined criteria. Samples are evaluated by matrix against the specific class criteria and judged as acceptable, provisional, or unacceptable. The explanation of the judging criteria is as follows:

Data Classes:

Unusable data: Data that may not be used for any purpose;

Class A data: Data that meets only the Class A screening criteria contained in Appendix B but not the Level B criteria. This class of data may be used for qualitative purposes only, (i.e., to help develop or refine study plans), evaluate different sampling or analytical techniques, or identify gaps in the database. For this inspection, data will be classified Class A if all documentation identified by checklists in Appendix B and the QAPP have been properly prepared and are available.

Class B data: Data that meets both the Class A and Class B screening criteria. In addition to qualitative uses, the data submitted also may be used for quantitative purposes such as evaluating conditions such as risks or potential remedial solutions. For this SI, data will be classified Class B if all analytical and field QC samples (rinsates, blanks, and spikes) are within acceptable control limits.

A - Acceptable: All criteria have been successfully met for all samples.

P - Provisional: Some samples have not fully met the criteria but the information is obtainable.

U - Unacceptable: Criteria has not been met with any samples and is not obtainable. This data may not be classified for use unless sufficient other data criteria have been met and scientific judgement indicate the data may be useful if classified.

N - Not Applicable.

Data will be classified using the Data Classification Summary Checklist included in Appendix C. A report of the results of the data validation for both previously collected and planned data will be submitted to the project geologist or the task order manager (Section 17.1).

13.0 PERFORMANCE AND SYSTEM AUDITS

Audits will be performed before and during the work to evaluate the capability and performance of the entire system of measurement and reporting. The following are parameters included in the system: experimental design, sampling (or data collection), analyses, and quality control activities.

13.1 Field System Audits

The site project geologist is responsible for evaluating the performance of field personnel and general field operations and progress. The project geologist will observe the performance of the field operations personnel during each kind of activity such as water-level readings and sampling rounds. A formal systems audit of field operations personnel by the E/A&H QA officer will be performed on a biannual basis (for all projects) and a field audit report of each sampling team member will be maintained on file by E/A&H. Where applicable, these audits will ensure that field operations are being conducted in accordance with NEESA 20.2-031A guidelines.

13.2 Laboratory Systems Audit

A laboratory systems audit is routinely conducted (at least annually) by E/A&H QA members. These audits test methodology and assure that systems and operational capability are maintained. Audits also verify that quality control measures are being followed as specified in the laboratory written SOP and QAP. The systems audit checklist used by the EPA CLP forms the procedural basis for conducting these audits.

Laboratory initiated audits will be conducted in accordance with guidelines set forth in NEESA 20.2-047B, and the laboratory QA Plan as approved by the NCR. Under NEESA 20.2-047B guidelines, the project NCR is also responsible for laboratory inspections to ensure compliance with NEESA laboratory requirements.

13.3 Performance Evaluation Audits

A performance evaluation (PE) audit is performed to evaluate a laboratory's ability to obtain an accurate and precise answer in the analysis of known check samples by a specific analytical method. Following the analytical data validation described in Section 11.0, E/A&H will perform an evaluation audit of the laboratory if it is determined that the quality assurance data provided are outside acceptance criteria control limits. PE audits may include a review of all raw data developed by the laboratory and not reported (laboratory non-reportables) and the submission of blind spiked check samples for the analysis of the parameters in question. These check samples may be disguised as field samples. In this case, the laboratory will not know the purpose of the samples. The samples may be obvious check samples (EPA or National Bureau of Standards traceable).

PE audits may also be conducted by reviewing the laboratory's results from "round-robin" certification testing and/or EPA Contract Laboratory Program (CLP) evaluation samples. An additional component of PE audits includes the review and evaluation of raw data generated from the analysis of PE samples and actual field samples that may be in question.

13.4 Regulatory Audits

It is understood that E/A&H field personnel and subcontract laboratories are also subject to quality assurance audits by the EPA, MDE, and the NCR. The NCR (under NEESA guidelines) will conduct laboratory inspections prior to approval for participation in any NEESA project and will provide performance samples to the laboratory for approval purposes.

14.0 PREVENTIVE MAINTENANCE

The sampling equipment employed by E/A&H during an SI that may require preventive maintenance will be checked for proper operation before and after each use on a daily basis. These checks will be conducted at the beginning and end of each day. Any replacements or repairs will be made as needed in accordance with manufacturer's instructions. Preventive maintenance requirements are listed in Table 14-1.

Preventive maintenance to be performed by the analytical laboratory will in accordance with laboratory SOPs as established in an NCR approved QA Plan.

TABLE 14-1
PREVENTIVE MAINTENANCE FOR FIELD EQUIPMENT

Conductivity Meters	**Each Use**	**Quarterly**
	Meter probes are cleaned before and after each use with distilled or deionized water. Before and after each use (daily) the instruments are checked with a commercial conductivity standard for proper calibration. The battery is checked for proper charge.	The instrument is inspected on a quarterly basis, whether used during the quarter or not. The inspection consists of a general examination of the electrical system (including batteries) and a calibration check. Instruments not functioning properly are shipped to the manufacturer for repair and calibration.
pH Meters	**Each Use**	**Quarterly**
	Before each use (daily), the probe should be checked for cracks in the electrode bulb and complete filling with electrolyte solution. At the beginning and end of any sampling day, the pH meter must be calibrated using two standard pH buffers. The battery is checked for proper charge. Following each use, the probe is rinsed with deionized water. The probe cap is filled with electrolyte solution and placed on the probe tip. Excess electrolyte is rinsed off and the probe dried with a paper towel. The instrument is then placed in its carrying case.	The instrument is inspected on a quarterly basis whether or not it has been used. The inspection consists of a general examination of the probe, wire, electrical system (battery check) and a calibration check. Any malfunctioning equipment is returned to the manufacturer for repair and recalibration.
Thermometers	**Each Use**	**Monthly**
	Before each use, thermometers are visually checked for cracks and mercury separation. After use, thermometers are rinsed with deionized or distilled water and placed in their protective case to prevent breakage.	Thermometers are visually inspected as described above, whether used or not. They are checked against an NBS certified thermometer for accuracy.
Turbidity Meters	**Each Use**	**Quarterly**
	The battery is checked for proper charge. The turbidity meter must be calibrated at the beginning and the end of each sampling day. Following each use the sampling cuvettes and caps are cleaned and rinsed with deionized water. Sample cuvettes are also checked for surface scratches and finger smudges, such interferences will cause analysis errors.	The instrument is inspected on a quarterly basis, whether used during the quarter or not. The inspection consists of a general examination of the electrical system (including batteries) and a calibration check. Instruments not functioning properly are shipped to the manufacturer for repair and calibration.

15.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Precision is an estimate of the reproducibility of a method, and it is estimated by several statistical tests: the standard deviation of the error distribution, the coefficient of variation and the relative percent difference between replicate (duplicate) samples. E/A&H will determine the precision of a method by analyzing replicate data.

Precision is then defined by the coefficient of variation (CV), which expresses the standard deviation as a percentage of the mean. An indicator of CV, relative percent difference will serve as quality criterion for classification of data resulting from this SI.

Specific statistical comparison of duplicate samples (field and laboratory), as a measure of precision evaluating both sample collection procedures and laboratory instrument performance, may be accomplished by first comparing the obtained duplicate results with the published EPA criteria for method precision (relative percent difference).

Accuracy. The accuracy of a method is an estimate of the difference between the true value and the determined mean value. Specific statistical comparison of percent recovery values reported by the laboratory as a measure of method accuracy will be compared with the published EPA (or other appropriate regulatory entity) criteria for the accuracy of an individual method. Another technique for evaluating the accuracy of a method is to use Student's t-test. This test identifies whether or not a significant bias is present.

Data completeness will be expressed both as the percentage of total tests conducted and required in the scope of work that are deemed valid. Methods for assessing data precision, accuracy, and completeness by the laboratory will be outlined in the approved laboratory QA Plan.

16.0 CORRECTIVE ACTION

During the course of any field study, field personnel are responsible for seeing that field instruments and equipment are functioning properly and that work progresses satisfactorily. The field personnel are also responsible for ensuring performance of routine preventive maintenance and quality control procedures, thereby ensuring collection of valid field data. If a problem is detected by the field personnel, the project geologist shall be notified immediately, at which time problem correction will begin. Similarly, if a problem is identified during a routine audit by the project QA officer or the regulatory QA officer (or NCR), an immediate inspection will be undertaken and corrective action deemed necessary will be taken as early as possible.

Examples of potentially out-of-control situations include field instrument breakdown, mislabeling or loss of samples, inadvertent contamination of samples, or circumstances which preclude performance of field activities in accordance with the QAP (or other work plan documents). If an out-of-control event occurs, field sampling personnel shall make appropriate contacts (as outlined above), and document any and all corrective measures taken to bring field activities under control. All variances or changes from QAP guidance are subject to approval by the E/A&H site project geologist and/or the task order manager (or his/her designated representative). If circumstances arise which will necessitate substantive changes in the protocols, methods, or techniques outlined in the work plan (and QAP), the EIC will be contacted and all alterations will be documented and implemented with the EIC's written consent. A detailed description of the out-of-control event and remedial actions will be entered into the field logbook along with justification for the corrective actions.

In the event that corrective action is required by the analytical laboratory, it should be conducted in accordance with the laboratory's NCR approved QA Plan following guidelines provided in NEESA 20.2 -047B, Chapter 4.5 — Out-of-Control Events.

17.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

QA reports will be submitted to E/A&H management in accordance with the following schedule.

17.1 Internal Reports

The E/A&H QA officer will provide status reports to the project geologist and/or the task order manager.

The reports address the following, as applicable during the course of the project:

- Quality assurance activities and quality of collected data
- Equipment and calibration and preventive maintenance activities
- Results of data precision and accuracy calculations
- Evaluation of data completeness
- QA problems and recommended and/or implemented corrective actions. Results of corrective action taken.
- QA performance and system audit findings

The laboratory is required to submit a monthly QC progress report to the NCR. The contents of the monthly report will be as outlined in NEESA 20.2-047B, Chapter 8 — Maintaining Laboratory Approval, and the NEESA-approved laboratory QAP.

17.2 Reports to NEESA

E/A&H will provide a data quality assurance summary within the Site Inspection report for submittal to the NCR. A draft must be submitted to the CHESDIV EIC no later than 90 days after completion of field activities.

APPENDIX A

LABORATORY QUALITY ASSURANCE PLAN

LABORATORY
QUALITY ASSURANCE
PLAN

PACE, Inc.

Submitted by:

_____

Approved by:

Roger C. Splinter, Ph.D.
Vice President

Rev. #0 - DATE: November 1, 1989
Rev. #1 - DATE: May 17, 1990

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III. INTRODUCTION, PROGRAM OBJECTIVES, AND STATEMENT OF POLICY

This Generic Quality Assurance (QA) Plan is written in compliance with the elements required in the U.S. EPA, "Guidelines and Specifications for Preparing Quality Assurance Program Plans." (QAMS-004 80, September 20, 1980). This document contains the required elements of a Quality Assurance Plan and is prepared in such a way that entire sections can be referenced in subsequent specific project plans. This Laboratory QA Manual defines the systems of quality control and quality assessment that constitute the comprehensive Quality Assurance Program at PACE, Inc. Quality Control consists of specific procedures applied to all phases of analysis from sample receipt through the final reporting of results. The purpose of quality control is to insure that quality goals are met under routine operating procedures. Quality assessment involves the continuous evaluation of data and monitoring of analytical processes for the purpose of insuring that the quality control systems are performing effectively.

PROGRAM OBJECTIVES

The major elements of the overall Quality Assurance Program are summarized below:

- Use of appropriate methodologies by technically competent, well-trained personnel with state-of-the-art instrumentation and equipment.
- Adherence to well-defined standard operating procedures with emphasis on good laboratory and measurement practices.
- Analysis and assessment of quality control samples including (but not limited to) matrix spike samples, duplicate samples, surrogate spikes, blanks, and independent laboratory control standards.
- Participation in external quality evaluation programs such as the EPA Water Pollution and Water Supply (WP & WS) Study Programs.
- Maintainance of accreditation by State, Federal, and other applicable agencies for work performed.
- Monitor internal and external compliance to procedures and to assess the performance of the analytical methods.

STATEMENT OF POLICY:

PACE, Inc. is committed to the policy of providing the highest quality product to its client. The validity and reliability of the information generated is maximized by the adherence to documented quality control procedures and quality assurance protocols. PACE emphasizes the application of sound quality assurance/quality control principles beginning with the initial planning of the project, through all the field and laboratory activities and ultimately to the generation of the final report. The principles of data quality objectives, representativeness, completeness, comparability, precision and accuracy are applied.

PACE is committed to providing the resources, including facilities, equipment and personnel, to ensure the adherence to rigorous QA/AC protocols. Individual Quality Assurance Project Plans are developed for monitoring analytical projects to conform with the established QA/QC protocols.

IV. LABORATORY ORGANIZATION AND RESPONSIBILITY

The organizational structures for PACE, Inc. are provided in Exhibits 1, 2, and 3.

Exhibit #1	Illustrates the PACE, Inc. Organizational Structure
Exhibit #2	Illustrates the PACE Corporate Structure with Regional Designation
Exhibit #3	Illustrates a Typical Regional Structure Showing the Quality Responsibilities

Job descriptions are provided within Quality Assurance Project Plans, as they are designed and developed to address specific projects.

PACE Organizational Sructure

1.

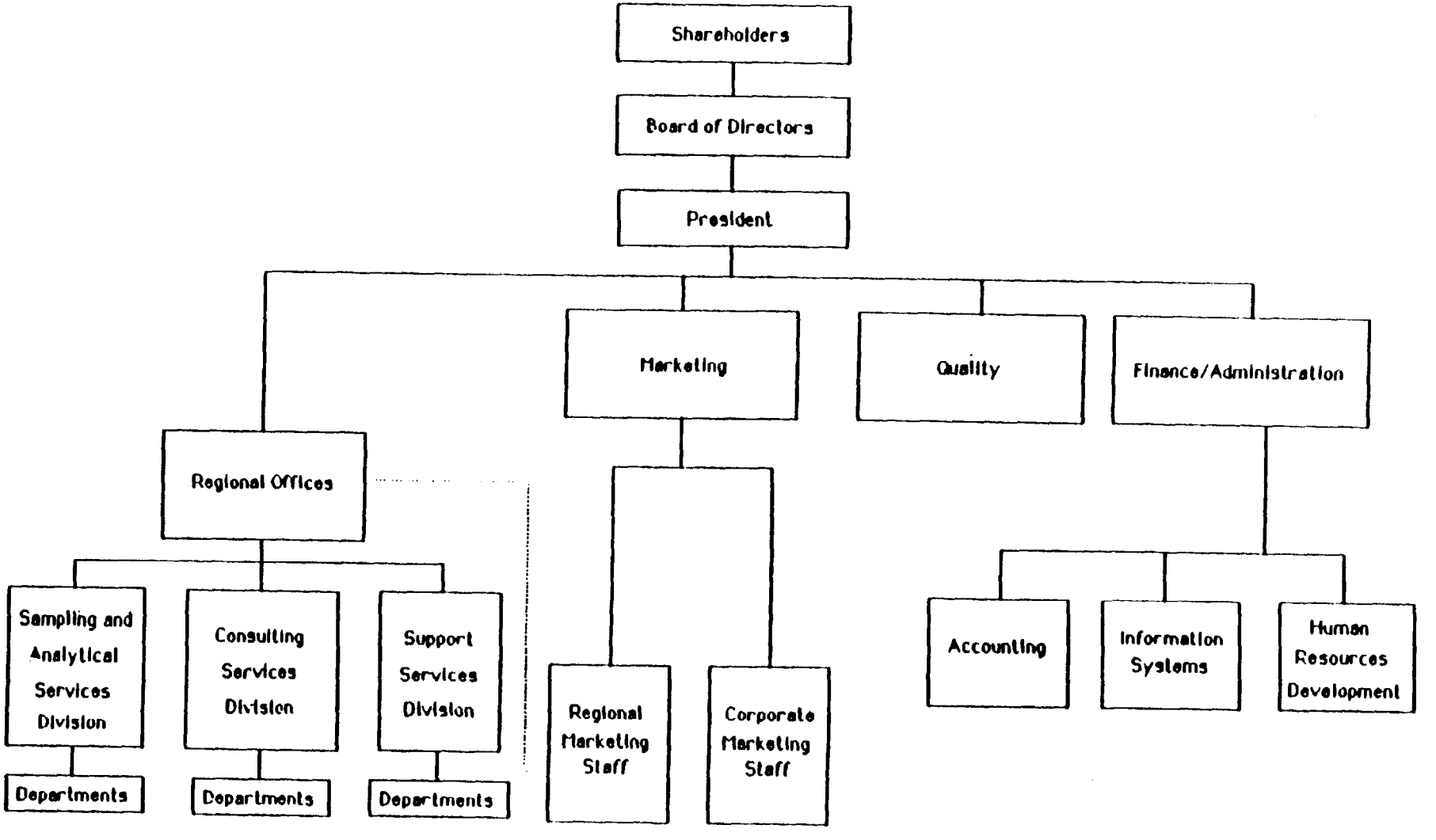

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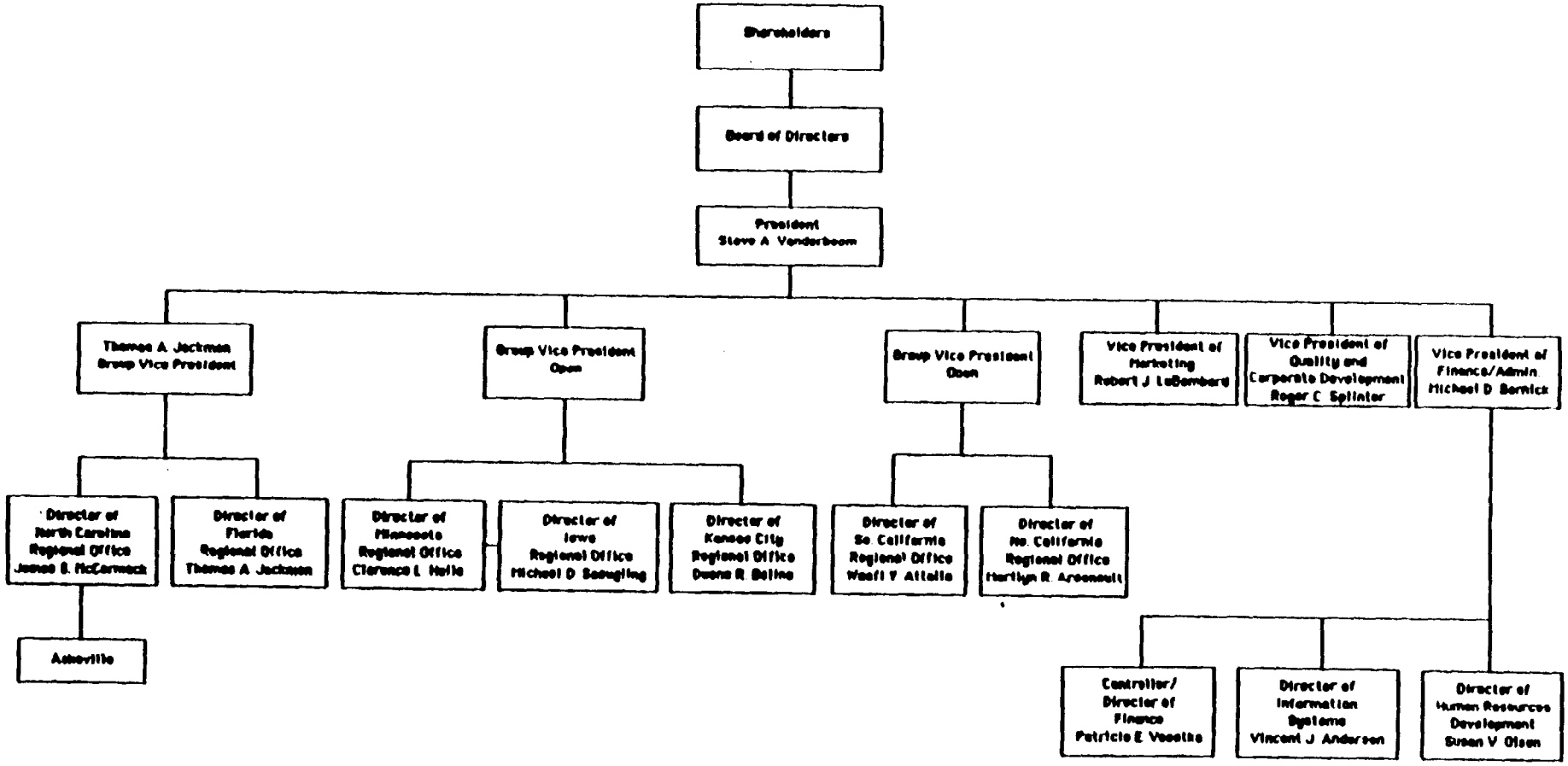
EXHIBIT 2

Corporate Management Personnel
&
Regional Directors

1.1



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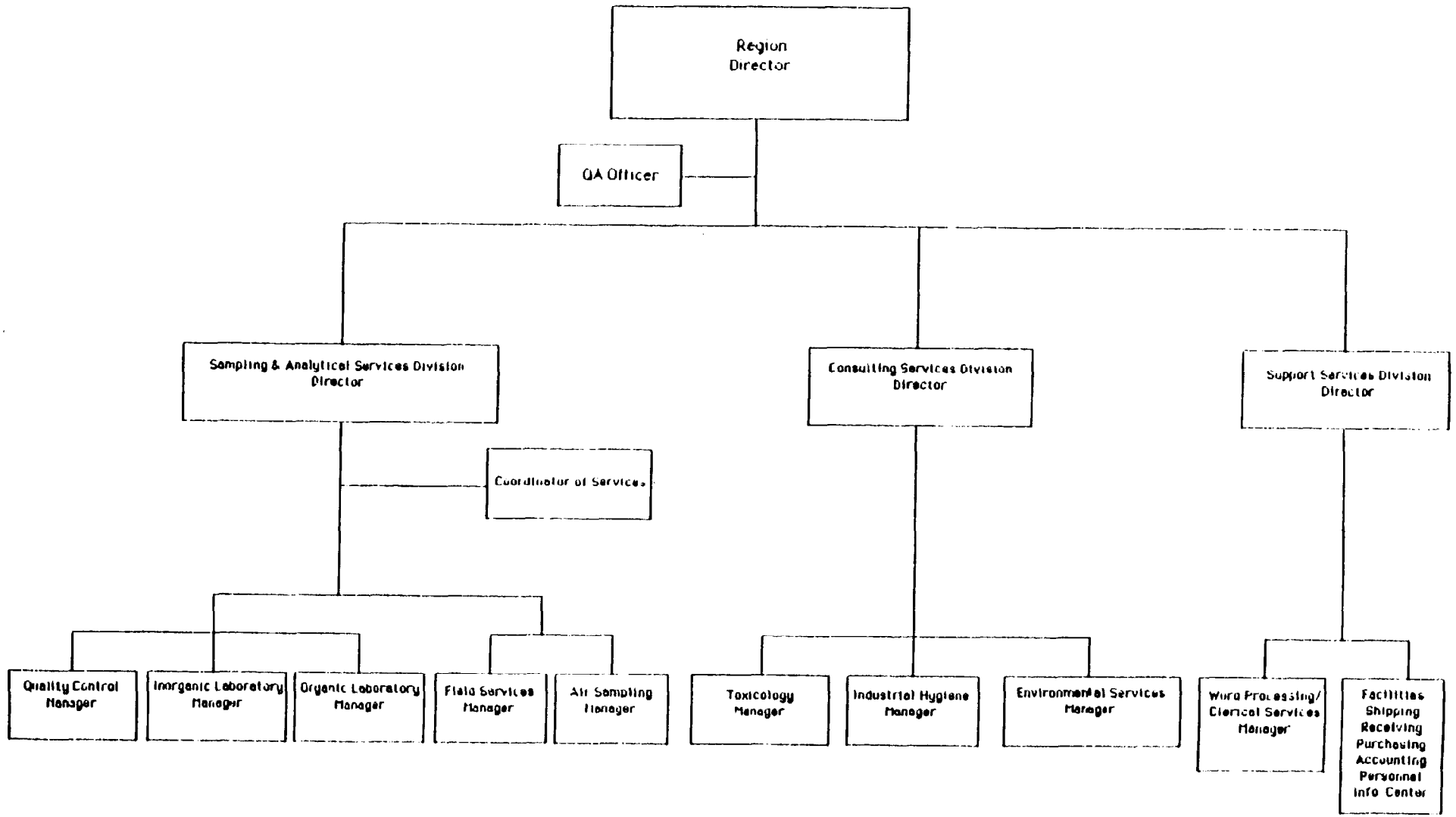
Region


Region Director
QA Officer
Sampling & Analytical Services Division Director
Consulting Services Division Director
Support Services Division Director
Coordinator of Services
Quality Control Manager
Inorganic Laboratory Manager
Organic Laboratory Manager
Field Services Manager
Air Sampling Manager
Toxicology Manager
Industrial Hygiene Manager
Environmental Services Manager
Word Processing/ Clerical Services Manager
Facilities
Shipping
Receiving
Purchasing
Accounting
Personnel
Info Center

V. QUALITY ASSURANCE/OBJECTIVES

A. INTRODUCTION

The purpose of the plan is to define procedures for the documentation, evaluation, validation, and reporting of data. The objective is to provide a uniform basis for sampling, sample handling, instrument maintenance and calibration, methods control, performance evaluation and analytical data generation and reporting. Specific procedures to be used for sampling, chain of custody, calibration of field instruments (pH, conductivity meters, etc.), laboratory analysis, reporting, internal quality control, audits, preventive maintenance, and corrective actions are described in specific sections of this plan. This section addresses the objectives of accuracy, precision, completeness, representative, and comparability.

The QA objectives for precision and accuracy are to achieve the QC acceptance criteria specified in the proposed analytical procedures. For the organic and inorganic procedures, the precision and accuracy guideline requirements are specified in the individual methods.

Field Blanks and duplicates are collected and analyzed to assess field sampling activities. The results check procedural contamination and/or ambient conditions at the site.

Due to the extensive number of organic parameters and potential matrices, the development of precision and accuracy objectives and control limits for every matrix is difficult. This is typically done with (1) matrix spike and matrix spike duplicate compounds which are added to selected samples before extraction and analysis, and/or (2) surrogate spike compounds which are added to every sample, before extraction and analysis. Although the surrogate and matrix spike analyses do not provide statistically valid statements about precision and accuracy for every compound in a sample, they do give the data reviewer enough information to make judgements about precision and accuracy on a sample-by-sample basis.

Inorganic precision and accuracy data are determined by using duplicate samples (precision), matrix spike and laboratory control samples (accuracy). The following procedure is used:

For a duplicate sample analysis, at least one duplicate sample is analyzed per sample matrix type (e.g. water, soil) and concentration (e.g. low, medium) per batch of samples or for each 20 samples received, whichever is more frequent, or as specified by state/project requirements. Samples identified as field blanks can NOT be used for duplicate samples analyses. If two analytical methods are used to obtain the reported values for the same element for a batch of samples (i.e., ICP, GFAA), duplicate samples will be run by each method. The relative percent difference (RPD) for each component is calculated for later use during data assessment.

Completeness is a measure of all information necessary for a valid scientific study. For completeness, it is expected that the methodology proposed for chemical characterization of the samples collected will provide data meeting QC acceptance criteria for at least 90% of all samples collected. Completeness may also be defined as a comparison of the number of tests successfully completed (with acceptable QC) to the number of tests requested.

Representativeness is a qualitative element that is related to the ability to collect a sample that reflects the characteristics of that part of the environment that is to be assessed. Sample representativeness is dependent on the sampling techniques used and is considered individually for each project. It is specifically addressed in each work plan.

Comparability is also considered during preparation of the work plan. The objective of comparability is to ensure that results of similar activities conducted by different parties are comparable. For example, the use of EPA-approved or other methods and procedures ensures comparability with data from previous or following studies.

VI. SAMPLING PROCEDURES

PACE, Inc. receives samples collected by clients and also has the capability to perform sampling for clients. PACE prepares sample containers in accordance with EPA-issued guidelines for container and preservative requirements. Technical assistance from all supervisory and management staff is available to clients if needed.

A. BOTTLE PREPARATION PROCEDURES

The following is the procedure used for Sample Container Preparation:

1. Purpose

The purpose of this Standard Operating Procedure (SOP) is to provide clear, consistent methods for preparing containers for sample collection. Following this procedure will facilitate accurate and consistent analytical results.

2. Application

The policies and procedures contained in this SOP are applicable to the personnel in the container preparation area.

3. General Policies

a. Always use new bottles when preparing containers for sampling (exception: One gallon, amber glass bottles used for transporting deionized water can be re-used after proper cleaning). These may be commercially-obtained precleaned bottles.

b. Always wear disposable latex gloves when handling sample containers.

c. Several preparation procedures require the use of acids as a preservative or cleaning agent.

   1. Be extremely careful when working with acids.

   2. Always wear safety glasses and a laboratory coat.

d. Bottle labels will list the preservatives added and the analysis to be performed, minimizing the probability for error.

e. When shipping pre-preserved bottles containing corrosives or oxidizers, consult proper DOT regulations.

1. **Procedures: Containers for Aqueous Samples**

   a. **Volatile Organic (VOA) Sample Container Preparation**

      1. Vial cleaning procedures.

         a. Wash an entire package of vials in one washing session. Never store open packages of vials.

         b. Soak the vials in cleaning solution (one capful of Acationox detergent, American Scientific, per sink of hot tape water) for 5 minutes.

         c. After soaking, thrice rinse each vial thorougnly with hot tap water.

         d. Thrice rinse each vial thoroughly with carbon filtered, deionized water (CFDI).

         e. Stack rinsed vials in a drying tray (metal tray lined with aluminum foil, dull side exposed).

         f. Bake the vials at 103°C for a minimum of four hours.

         g. Cover baked vials with aluminum foil such that the dull side of the foil is in contact with the vials and set trays on a lab bench to cool.

      2. Septum and cap cleaning procedures.

         a. Clean entire packages of caps and septums. Do not store open bags.

         b. Clean caps and septums separately.

         c. The same procedures used for vial cleaning are used for cap and septum cleaning. Follow B through D in Section 1.

         d. Spread evenly and thinly in drying trays to facilitate drying.

         e. Dry for one hour at 103°C. Extended periods of heat can damage caps and septums.

         f. Place clean caps and septums into a 1500 mL glass container which has been cleaned.

3. Assembling VOA vials.

   a. Place ten clean vials upright in a vial box with dividers. Recover drying trays with foil after vials have been removed.

   b. Add 4 drops of concentrated hydrochloric acid (HCL).

   c. Add (10 mg/40 ml) 0.008% sodium thiosulfate if chlorine is present (e.g. drinking water).

   d. Assemble a cap by inserting a septum in the cap such that the Teflon (white) side is exposed to the interior of the vial.

   e. Cap each vial tightly.

   f. Repeat assembly procedures until all vials are capped.

b. **Semi-Volatile Container Preparation**

1. Glass, amber jars (250, 500, and 1000 mL) with Teflon lined caps are used to hold samples for semi-volatile analysis.

2. Bottles and cap liners are rinsed with reagent grade acetone. (Acetone is a target compound for EPA 8240 and an HSL compound. If acetone interferes with the analyses, use of hexane and/or methanol may be an alternative, as specified in the method.)

   a. Acetone is highly flammable and acetone vapors are toxic.

   b. When using acetone, wear latex gloves, safety glasses and work in a vented hood.

   c. Pour a small amount of reagent grade acetone in the bottle to be rinsed.

   d. Cap the bottle with a Teflon lined cap.

   e. Shake the bottle making sure the acetone comes in contact with all sides of the bottle and the cap liner.

   f. Empty the bottle, invert it on a drying rack and allow it to air dry.

   g. Cap the bottle with a rinsed cap.

   h. Attach a blue dot to the top of the cap indicating the container has been acetone rinsed.

c. **Preparation of Containers for Metals Analysis**

1. Polyethylene bottles (125, 250, 500, and 1000 mL) with plastic caps are used to hold water samples to be analyzed for metals.

2. Add a small amount of 1:1 nitric acid to a bottle.

3. Cap the bottle and shake vigorously, being certain the acid comes in contact with all interior surfaces.

4. Empty the container.

5. Rinse the bottle and cap thrice with deionized water.

6. Add the appropriate amount of 1:1 nitric acid, cap, and place a pink or red dot on the cap to indicate the container contains nitric acid preservative.

Container Size	Quantity 1:1 Nitric Acid
125 mL	1/4 mL
250 mL	3/8 mL
500 mL	3/4 mL
1000 mL	1 1/2 mL

d. **Nutrient Container Preparation**

1. Polyethylene bottles (250, 500, and 1000 mL) with plastic caps are used to hold water samples for nutrient analysis.

2. Add the appropriate amount of sulfuric acid, diluted 1:1 from concentrate with carbon filtered deionized water, to each container.

Container Size	Quantity 1:1 Sulfuric Acid
250 mL	3/8 mL
500 mL	3/4 mL
1000 mL	1 1/2 mL

3. Attach an orange dot sticker to the cap of each prepared container.

e. **Cyanide Container Preparation**

1. Polyethylene containers (1000 mL) with plastic caps are used to hold samples for cyanide analysis.

2. Add one gram (8 to 10 pellets) or concentrated solution of sodium hydroxide and one gram of ascorbic acid to each container. If chlorine is present in the sample, use only ascorbic acid.

3. Attach a green dot sticker to the cap of each prepared container.

4. Cyanide containers have a short shelf life; do not prepare in large quantities. (See #6b)

f. **Phenol Container Preparation**

1. Clear glass, small mouth containers (1000 mL) with "poly seal" caps are used to hold samples for phenol analysis.

2. Add 1 1/2 mL of sulfuric acid, diluted 1:1 from concentrate with carbon-filtered deionized water, to each container.

3. Attach an orange dot sticker to the cap of each prepared container.

g. **Oil and Grease Container Preparation**

1. Clear glass, wide-mouth containers (1500 mL) with foil lined caps are used to hold samples for oil and grease analysis.

2. 1000 mL amber glass containers with Teflon lined caps are acceptable.

3. Add five mL of 1:1 sulfuric acid to each container.

4. Attach an orange dot sticker to the cap of each prepared container.

h. **Sulfide Container Preparation**

1. Polyethylene bottles (250 mL) with plastic caps are used to hold samples for sulfide analysis.

2. Add 0.5 mL of zinc acetate and NaOH (to pH greater than 9) to each container.

3. Attach a white dot sticker to the lid of each prepared container.

i. **Total Organic Carbon (TOC) Container Preparation**

1. Polyethylene bottles (250 mL) with plastic caps are used to hold samples for TOC analyses.

2. Add 0.25 mL of 1:1 sulfuric acid.

3. Attach an orange dot sticker to each prepared container.

j. **Radiological Containers Preparation**

1. Polyethylene bottles (one gallon) with wax coated, paper lined caps are used to hold samples for radiological analysis.

2. Add five mL of 1:1 nitric acid to each other.

3. Attach a pink dot sticker to the cap of each prepared container.

k. **CFDI Water Container Preparation**

1. One gallon, small mouth, amber glass bottles with Teflon lined caps are used to transport CFDI water.

2. These containers can be reused after appropriate cleaning.

3. Wash the bottle in hot tap water and Acationox detergent (American Scientific Products one cap of detergent per sink of water).

4. Thrice rinse the bottle with hot tap water.

5. Thrice rinse with CFDI water.

6. Bake the bottle at 103° until dry (at least four hours).

7. Remove the bottle from the oven, cover the mouth with foil, and let cool.

8. Cap the bottle with a new, Teflon lined cap.

1. **Other Container Preparation**

1. Polyethylene bottles (125, 250, 500, and 1000 mL) with plastic caps are used to hold samples for general chemistry analysis.

2. Clear glass bottles (125, 500, and 1000 mL) with foil lined caps are used to hold samples with high oil content to be analyzed for general chemistry parameters.

3. Amber glass, small neck bottles (500 mL) with Teflon-lined caps are used to hold samples for total organic halide (TOX) analysis.

5. **Procedure: Containers for Soil Samples**

a. **Volatile Organic Analysis Sample Container Preparation for Soil Samples**

1. Wide-mouth, amber glass vials (65 mL) with Teflon-lined caps are used to hold samples for volatile organic analysis.

2. The same preparations procedure is used as is used in preparation of VOA containers for aqueous samples except no preservative is added to the containers. (See #4a)

b. **Semi-Volatile Container Preparation**

1. Wide-mouth, amber glass jars (250, 500, and 1000 mL) with Teflon-lined caps are used to hold samples for semi-volatile analysis.

2. Preparation procedures are identified as those used in preparation of semi-volatile containers for aqueous samples. (See #4b)

c. **Inorganic Container Preparation**

1. Polyethylene bottles (125, 250, 500, and 1000 mL) with plastic caps are used to hold samples for inorganic analysis.

2. If the samples contain a large quantity of oil, clear glass jars (125, 500, and 1000 mL) with foil lined caps are used instead of the polyethylene bottles.

3. Container preparation procedures are identical to those used in preparation of general containers for aqueous samples.

6. **Sample Container Quality Control and Lot Assignment**

a. Bottles of a given type, prepared in one session, constitute a lot.

b. Lot sizes will vary, depending on the demand for a given bottle type.

1. A lot should be large enough to meet one week's demand for the given bottle type. Containers for samples to be analyzed for cyanide and VOA are exceptions.

2. Due to an extremely short shelf life, cyanide containers should be prepared in lot sizes required for approximately 2 days demand and prepared as necessary.

3. Due to spatial limitations, VOA vials should be prepared daily.

c. When a lot is prepared, it is assigned an eight character lot code.

1. The first two characters indicate the bottle type.

GN: General Unpreserved
MU: Metals Unfiltered
NT: Nutrients
CN: Cyanide
PH: Phenol
OG: Oil and Grease
SD: Sulfide
GV: GC VOA Water
GC: GC VOA Solid
GL: GC Q-Amber
GS: GC Sm Amber
GM: GC Misc. Refrigerated
HW: Hazardous Waste
OC: Total Organic Carbon
OX: Total Organic Halides
RA: Radiological

A complete listing of codes can be found in Section I of the LDMS User's Manual

2. The next three digits indicate the bottle size.

125: 125 mL
250: 250 mL
500: 500 mL
000: 1000 mL and one gallon

3. The last three digits are the lot number. They are assigned in sequential order.

4. When the lot code is assigned, it is listed on the Lot Log Sheet (Exhibit 4).

5. The person who prepared the containers initials the Lot Sheet next to the lot code.

One container per lot is used to hold a deionized water blank. This blank is analyzed to determine the level of contamination in the lot.

- The appropriate analyses are performed for the given container type.
- Use carbon-filtered, deionized water for all blanks.
- Fill all containers, except VOA's, up to the neck of the bottle.
- Fill VOA's such that no bubbles are trapped when the vial is capped.
- Label each blank with the following information:

  Client: PACE, QC

  Sample description: (Lot Code)
  Date Collected:
  Collected by: (Initials)
  Time Collected:
  Analysis: (As indicated for the bottle type)
  Preservative: (Check appropriate preparation)

6. Complete a Chain-of-Custody form to accompany the samples. Client, sample description, time sampled, preservative, analysis: as listed on the bottle label.

   Report to: (Name of container preparation person)

   Project Name: Container QA

   Requested Due Date: Priority 2

   Matrix: H_2O

   Route samples and Chain-of-Custody to Sample Check-in.

EXHIBIT 4

LOT LOG SHEET

LOT =	INIT.	LOCATION				LOT =	INIT.	LOCATION			
		OUT	SHELF	TIER 1	TIER 2			OUT	SHELF	TIER 1	TIER 2

7. **Sample Analysis Data Entry Form Tracking for Bottle Prep QC**

Forms will be kept in an Outstanding QC file.

a. When a Report of Laboratory Analysis is received for the project, the Sample Analysis Data Entry Form is moved to the Complete QC file.

b. A copy of the Report of Laboratory Analysis is then routed to QC Data Entry and data are entered into the appropriate data base.

c. The data are reviewed by the supervisor of the Bottle Preparation Area and signed off as being certified "clean" if the following criteria are met. After subtraction of the daily DI water blank, all laboratory contaminants shall be less than 2 times the detection limit. If this criterion is not met, the bottles are re-cleaned and another blank analyzed.

The following are guidelines for the addition of sample preservatives to containers. Check the list of analyses to be performed and determine the types and sizes of containers needed and required.

Add the appropriate preservative to its designated container under a hood. Pack the bottles into a cooler with blue ice for the client.

PREPARING ACID PRESERVATIVES

All acid preservatives are prepared using a concentration of 1:1 acid to water. Reagent grade acids are used when making the 1:1 concentrations.

COMMON ANALYSES PRESERVATIVES

Analysis	Bottle Type	Preservative	pH	Approx. Amount
Metals	1 liter plastic	1:1 HNO_3	2.0	1.5 mL
EPA 602/8020	2 XVOA vials	1:1 HCl	2.0	3 drops
Cyanide	1 liter plastic	NaOH tablets	12.0	4-5 tabs
Sulfide	500 mL plastic	Zn acetate, NaOH	9.0	2 mL Zn acetate 2 tabs NaOH
Ammonia	1 liter plastic/ glass	1:1 H_2SO_4	2.0	1.5 mL
Phenolics	1 liter amber glass	1:1 H_2SO_4	2.0	1.5 mL

Sample containers, preservatives, and holding times for representative analytical groups are listed in Table 1. Refer to 40CFR 136 for complete information and details.

pace laboratories, inc.

Inorganic Analytical Guide

TABLE 1

Common Non-Metals Analysis

Parameter	Typical Method(s)	Comparable SW-846 Method(s), If Applicable	Sample Container/ Preservative*	Preferred Volume (ml)*	EPA Holding Time*
Acidity	EPA 305.1		P, G/4°C	100	14 Days
Alkalinity	EPA 310.1/310.2		P, G/4°C	100	14 Days
Bacteria, Total Coliform	Standard Method 909A	9131/9132	WK/4°C	100	6 Hours
Bacteria, Fecal Coliform	Standard Method 909C		WK/4°C	100	6 Hours
Bacteria, Total Plate	Standard Method 907		WK/4°C	100	48 Hours
BOD 5 Day	EPA 405.1		P, G/4°C	500	48 Hours
BOD 5 Day Carbonaceous	EPA 405.1		P, G/4°C	500	48 Hours
Boron	EPA 212.3		HNO_3 < 2	100	6 Months
Bromide	EPA 320.1		P, G	200	28 Days
COD	EPA 410.1/410.2		P, G/4°C, H_2SO_4	250	28 Days
Color	EPA 110.3		P, G/4°C	250	48 Hours
Chloride	EPA 325.2/325.3	9251/9252	P, G	100	28 Days
Chlorine, Residual	EPA 330.1		P, G	500	immed.
Cyanide, Total	EPA 335.2	9010	P, G/4°C, NaOH pH > 12	500	14 Days
Fluoride, Total	Standard Method 413A		P	500	28 Days
Fluoride, Electrode	EPA 340.2		P	200	28 Days
Fluoride (SPADNS)	EPA 340.1		P	500	28 Days
Grease & Oil	EPA 413.1	9070/9071	G/4°C, H_2SO_4	1000	28 Days
Hardness, Total ($CaCO_3$)	EPA 130.2		P, G/4°C	250	6 Months
Ion Chromatography (Including common anions such as: Br^-, Cl^-, F^-, ClO_3^-, NO_3^-, PO_4^{-3}, SO_4^{-2}, SO_3^{-2}, & others)	EPA 300		P, G/4°C	100	28 Days
Nitrogen, Ammonia	EPA 350.1/350.2		P, G/4°C, H_2SO_4	500	28 Days
Nitrogen, Kjeldahl	EPA 351.2/351.3		P, G/4°C, H_2SO_4	1000	28 Days
Nitrogen, Nitrate	EPA 353.2	9200	P, G/4°C	100	48 Hours
Nitrogen, Nitrite	EPA 353.2		P, G/4°C	100	48 Hours
Nitrogen, Nitrate & Nitrite	EPA 353.2		P, G/4°C, H_2SO_4	100	28 Days
Nitrogen, Organic	EPA 351.3		P, G/4°C, H_2SO_4	100	28 Days
Odor	EPA 140.1		G/4°C	1000	24 Hours
Oxygen, Dissolved	EPA 360.1		G - Bottle & Top	300	immed.
pH	EPA 150.1	9040/9041/9045	P, G/4°C	100	immed.
Phenol	EPA 420.1	9065	G/4°C, H_2SO_4	1000	28 Days
Phosphorus, Total	EPA 365.1/365.2		P, G/4°C, H_2SO_4	100	28 Days
Phosphorus, Ortho	EPA 365.1/365.2		P, G/Filter	100	48 Hours
Silica, Dissolved	EPA 370.1		P/4°C	100	28 Days
Solids, Total	EPA 160.3		P, G/4°C	100	7 Days
Solids, Total Volatile	EPA 160.4		P, G/4°C	100	7 Days
Solids, Total Dissolved	EPA 160.1		P, G/4°C	100	7 Days
Solids, Total Suspended	EPA 160.2		P, G/4°C	100	7 Days
Solids, Suspended Volatile	Standard Method 209A		P, G/4°C	100	7 Days
Solids, Settleable	EPA 160.5		P, G/4°C	1 Gal.	48 Hours
Specific Conductance	EPA 120.1	9050	P, G/4°C	100	28 Days
Sulfate	EPA 375.4	9036/9038	P, G/4°C	100	28 Days
Sulfide, Total	EPA 378.1	9030	P, G/4°C, NaOH pH > 9, Zn acetate	500	7 Days
Sulfite	EPA 377.1		P, G	500	immed.
Surfactants	EPA 425.1		P, G/4°C	250	48 Hours
Total Organic Carbon	EPA 415.1	9060	P, G/4°C HCl pH < 2	100	28 Days
Total Organic Halogen	EPA 450.1	9020/9021	GA/4°C	500	14 Days
Turbidity	EPA 180.1		P, G/4°C	100	48 Hours

Sample Containers
P Plastic, polyethylene bottle with a polypropylene cap
G Glass
WK Whirl-Pak®
GA Glass, amber bottle with a Teflon® lined cap

Preservatives
H_2SO_4 Sulfuric Acid
HNO_3 Nitric Acid
NaOH Sodium Hydroxide

*Sample container, preferred volume and holding time are for water matrix. Consult laboratory for solid matrix sampling recommendations.

NOTE:
The methods shown are most commonly employed in performing environmental analysis. It is not intended to be inclusive of all possible EPA analytical methods or to indicate that any laboratory routinely provides the methods or parameters shown.

TABLE I (CONT.)

Common Metals Analysis

Solid
Sample Container: Plastic or glass
Preservative: 4°C
Preferred Volume: 100 grams
EPA Holding Time: 6 Months

Water
Sample Container: Plastic or glass
Preservative: HNO_3 pH < 2
Preferred Volume: 100 ml
EPA Holding Time: 6 Months

Parameter	FLAME** EPA or Standard Method	FLAME** SW-846 Method	FURNACE EPA or Standard Method	FURNACE SW-846 Method
Aluminum	202.1	7020	202.2	NA
Antimony	204.1	7040	204.2	7041
Arsenic	206.3**	7060	206.2	7061
Barium	208.1	7080	208.2	NA
Beryllium	210.1	7090	210.2	7091
Cadmium	213.1	7130	213.2	7131
Calcium	215.1	7140	NA	NA
Chromium, Total	218.1	7190	218.2	7191
Chromium, Hexavalent	Standard Method 312B	7195-7198	218.5	NA
Cobalt	219.1	7200	219.2	7201
Copper	220.1	7210	220.2	NA
Gold	231.1	NA	231.2	NA
[illegible]n, Total	236.1	7380	236.2	NA
[illegible]d	239.1	7420	239.2	7421
Lithium	Standard Method 317B	NA	NA	NA
Magnesium	242.1	7450	NA	NA
Manganese	243.1	7460	243.2	NA
Mercury (Cold Vapor)	245.1	7470/7471	NA	NA
Molybdenum	246.1	7480	246.2	7481
Nickel	249.1	7520	249.2	NA
Potassium	258.1	7610	NA	NA
Selenium	270.3**	7740	270.2	7741
Silicon	Standard Method 303C	NA	NA	NA
Silver	272.1	7760	272.2	NA
Sodium	273.1	7770	NA	NA
Strontium	Standard Method 303A	NA	NA	NA
Tellurium	Standard Method 303A	NA	Standard Method 304	NA
Thallium	279.1	7840	279.2	7841
Tin	282.1	7870	282.2	NA
Titanium	283.1	NA	283.2	NA
Vanadium	286.1	7910	286.2	7911
Zinc	289.1	7950	289.2	NA

Metals by Inductively Coupled Plasma (ICP): Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Si, Ag, Na, Tl, V, Zn: EPA ICP Method 200.7 or SW-846 Method 6010

**Flame A.A. or Hydride

pace laboratories, inc.

Organic Analytical Guide

TABLE 1 (CONT.)

Water and Wastewater Analysis

EPA Method	Parameter	Technique	Sample Preparation	Sample Container/ Preservative	Preferred Volume (ml)	EPA Holding Time
601	Purgeable Halocarbons	GC-HALL	P&T	VOA/4°C	40	14 Days
602	Purgeable Aromatics	GC-PID	P&T	VOA/4°C	40	14 Days
603	Acrolein and Acrylonitrile	GC-FID	P&T	VOA/4°C, pH Adjusted	40	14 Days
604	Phenols	GC-FID	EXT	GA/4°C	1000	7/40 Days
605	Benzidines	HPLC-Electrochem	EXT	GA/4°C	1000	7/40 Days
606	Phthalate Esters	GC-ECD	EXT	GA/4°C	1000	7/40 Days
607	Nitrosamines	GC-NPD	EXT	GA/4°C	1000	7/40 Days
608	Organochlorine Pesticides and PCB's	GC-ECD	EXT	GA/4°C	1000	7/40 Days
609	Nitroaromatics and Isophorone	GC-FID + ECD	EXT	GA/4°C	1000	7/40 Days
610	Polynuclear Aromatic Hydrocarbons	HPLC-UV/Fluor or GC-FID	EXT	GA/4°C	1000	7/40 Days
611	Haloethers	GC-HALL	EXT	GA/4°C	1000	7/40 Days
612	Chlorinated Hydrocarbons	GC-ECD	EXT	GA/4°C	1000	7/40 Days
613	2,3,7,8-Tetrachlorodibenzo-p-dioxin	GC/MS	EXT	GA/4°C	1000	7/40 Days
614	Organophosphorus Pesticides	GC-FPD or NPD	EXT	GA/4°C	1000	7/40 Days
615	Chlorinated Herbicides	GC-ECD or Hall	EXT	GA/4°C	1000	7/40 Days
624	Purgeables	GCMS	P&T	VOA/4°C	40	14 Days
625	Base/Neutrals, Acids and Pesticides	GC/MS	EXT	GA/4°C	1000	7/40 Days

Solid Waste Analysis

EPA Method	Parameter	Technique	Sample Preparation	Sample Container/ Preservative	Preferred Volume	EPA Holding Time
8010	Purgeables Halogenated Volatile Organics	GC-HALL	5030	VOA/4°C	*	14 Days
8015	Purgeables Non-Halogenated Volatile Organics	GC-FID	5030	VOA/4°C	*	14 Days
8020	Aromatic Volatile Organics	GC-PID	5030	VOA/4°C	*	14 Days
8030	Acrolein, Acrylonitrile, Acetonitrile	GC-FID	5030	VOA/4°C	*	14 Days
8040	Phenols	GC-FID	3550	GA/4°C	*	14 Days or 7/40 Days**
8060	Phthalate Esters	GC-ECD	3550	GA/4°C	*	14 Days or 7/40 Days**
8080	Organochlorine Pesticides and PCB's	GC-ECD	3550	GA/4°C	*	14 Days or 7/40 Days**
8090	Nitroaromatics and Cyclic Ketones	GC-FID or ECD	3550	GA/4°C	*	14 Days or 7/40 Days**
8100	Polynuclear Aromatic Hydrocarbons	GC-FID	3550	GA/4°C	*	14 Days or 7/40 Days**
8120	Chlorinated Hydrocarbons	GC-ECD	3550	GA/4°C	*	14 Days or 7/40 Days**
8140	Organophosphorus Pesticides	GC-FPD or NPD	3550	GA/4°C	*	14 Days or 7/40 Days**
8150	Chlorinated Herbicides	GC-ECD or HALL	3550	GA/4°C	*	14 Days or 7/40 Days**
8240	Volatile Organics	GC/MS	5030	VOA/4°C	*	14 Days
8250	Semi-Volatile Organics	GC/MS	3550	GA/4°C	*	14 Days or 7/40 Days**

Technique

Instruments:
- GC — Gas Chromatograph
- GC/MS — Gas Chromatograph Mass Spectrometer
- HPLC — High Performance Liquid Chromatograph

Detectors:
- ECD — Electron Capture
- Fluor — Fluorescence
- FID — Flame Ionization
- FPD — Flame Photometric
- HALL — Electrolytic Conductivity
- NPD — Nitrogen Phosphorous
- PID — Photoionization
- UV — Ultraviolet

Sample Preparation Method Used:
- EXT — Extraction Methods that could be used include 3510, 3520, 3540 and 3550.
- P&T — Purge and Trap
- 3510 — Separatory Funnel Extraction of Liquid Samples
- 3520 — Continuous Liquid-Liquid Extraction
- 3540 — Soxhlet Extraction of Solid Samples
- 3550 — Sonication Extraction of Solid Samples
- 5030 — Purge and Trap, Direct Injection of Liquid Samples, Solid Samples Mixed then Injected.

Sample Container/Preferred Volume:
- GA — Glass Amber Bottle with Teflon Lined Cap
- VOA — Volatile Organic Analysis: 40 ml Amber Glass Vial with Teflon Septum
- * — Contact Laboratory for recommendation

EPA/Holding Time:
- 7/40 — 7 Days for Extraction and 40 Days for Analysis
- ** — Depends upon Sample Matrix

NOTE:
The methods shown are those commonly employed in performing environmental analyses. It is not intended to be inclusive of all possible EPA analytical methods or to indicate that any laboratory routinely provides the methods or parameters shown.

B. SAMPLING PROCEDURE FOR GROUNDWATER AND SURFACE WATER

Groundwater and surface water sampling techniques employed by PACE are in accordance with the EPA Regional IV Standard Operating Procedures and Quality Assurance Manual, and the PACE Field Services SOP Manual.

Trained field sampling crews are dispatched to the site for sample collection and deliver collected samples to the laboratory.

For groundwater sampling, the water level within the well is determined prior to sampling using an electronic water level meter, then recorded on the field log data sheet with all additional pertinent information (Exhibit 5). The volume of water in the casing is calculated and three to five times that volume is purged from the well. In all cases, the well is purged until the conductivity, temperature, and pH have all stabilized.

Samples from monitoring wells are taken with a precleaned Teflon or stainless steel bailer. Bailers are precleaned by washing first with detergent, then rinsed with tap water, triple rinsed with deionized water, and baked to dryness. Precleaned bailers are used between each sampling point.

All samples collected for metals analysis are preserved with nitric acid. The bailer to be used for sampling is used for purging two inch diameter wells and a gas-driven centrifugal pump is used when larger volumes of water need to be removed (static water levels of less than 25 feet). Wells with static water levels greater than 25 feet and casing diameters greater than 3 inches are purged using a submersible pump.

Quality Control Protocols:

A. All Quality Control (QC) procedures are as specifically required by the method, state, or project requirements.

B. The USEPA requires as a minimum one matrix spike, one duplicate or MSD, one blank, per set of samples of similar matrix with a maximum of 20 samples per set. This is a recommended minimum frequency for QC, unless stated otherwise by method, state or project requirements. A client may also request more frequent QC in which case it will be necessary to collect additional samples.

EXHIBIT 5

FIELD LOG DATA SHEET

PACE, Inc.

WELL SAMPLING

Client:_____ Project:_____ Project #:_____

Sample Site:_____

Well Identification and Description: (Locked_____ Not Locked_____) Key#:_____

ID inches_____PVC:_____Steel:_____Stainless Steel:_____Other:_____Labeled:_____

Total Well Depth (from top of casing)_____meters_____feet Elevation:_____feet

Static Water Level (from top of casing) Before Prepumping:_____meters_____feet

Static Water Level (from top of casing) At Time of Sampling:_____meters _____feet

Static Water Elevation:_____feet Water Column:_____feet One Casing Volume_____gal

Date Prepumped:_____Time Prepumped:_____Volume Prepumped:_____gal

Prepumping Method Used:_____ Pump Rate:_____gpm

Date Sampled:_____Time Sampled:_____Sampling Equipment Used:_____

Sample Temperature:_____°C Sample pH:_____Sample Specific Conductance:_____umho/cm2

Field Measurements Temperature Corrected: Yes___No___Metals Filtered in Field: Yes___No__

Weather Conditions:_____

Observations:_____

_____

Sample Description:_____

Name and Affiliation of Sampler(s)_____

Name and Affiliation of Inspector(s) Present:_____

STABILIZATION TEST

Time	pH	Specific Conductance (umhos/cm2)	Temp. (°C)	Cumulative Volume Removed (gallons)

C. SAMPLING PROCEDURES FOR SOILS AND SEDIMENTS

Soil and sediments are collected according to procedures in the latest edition of Test Methods for Evaluating Solid Waste, EPA-SW-846.

Soil sampling is designed to determine the depth and range of contamination from spillage or the leaching effects of rain on materials stored above ground. If borings are required, the depth and placement of the borings are planned by the project manager/subcontractor and client, using the suspected range of contamination as a guide.

VII. SAMPLE CUSTODY

A. SAMPLE RECEIPT

Sample shipments are received at the sample receiving area. Sample custodians verify the number of shipping containers received against the numbers listed on the shipping manifest/chain-of-custody. Any damage to the shipping containers or other discrepancy observed is noted on the chain-of-custody before signing it. A copy is kept for future reference.

The external chain-of-custody must be signed by the carrier for relinquishment of samples and signed by sample custodian personnel for sample receipt. The actual chain-of-custody may be supplied by PACE, (Exhibit 6), or may be the client's own form. The chain-of-custody remains in the project file at all times.

B. SAMPLE VERIFICATION

Upon arrival of a sample shipment, sample control personnel perform sample inspection. PACE's Sample I.D. and Condition Sheet (Exhibit 7) serves as a check-off list of procedures to follow and as documentation of the following:

1. Presence/absence of custody seals or tapes of the shipping containers and the condition of the seals (i.e., intact, broken).

2. Presence/absence of chain-of-custody; (if present, is it complete?)

3. Presence/absence of sample tags; (if present, are they removable?)

4. Agreement/non-agreement between the sample tags, chain-of-custody, and any client documentation.

5. Condition of the samples when received, including:

   - Cold or ambient
   - Intact, broken/leaking
   - Headspace in VOA vials
   - Sample holding time (has it been exceeded)?
   - Sample pH (less than 2 if acid preserved)

   If discrepancies are found, the PACE project manager is contacted immediately (verbally and by using the Discrepancy Report Form) (Exhibit 8). If the project manager is not available, the QC manager is contacted for further directions. A copy of a Discrepancy Report Form is attached to the project data package.

EXHIBIT

pace laboratories, inc.

11560

CHAIN-OF-CUSTODY RECORD
Analytical Request

lient

ddress

hone

Report To:

Bill To:

P.O. # / Billing Reference

Project Name / No.

Pace Client No.

Pace Project Manager

Pace Project No.

*Requested Due Date

mpled By (PRINT):

mpler Signature

Date Sampled

ITEM NO.	SAMPLE DESCRIPTION	PH	TIME	MATRIX	PACE NO.	NO. OF CONTAINERS	UNPRESERVED	H_2SO_4	HNO_3	VOA			ANALYSES REQUEST	REMARKS
1														
2														
3														
4														
5														
6														
7														
8														

COOLER NOS.	BAILERS	SHIPMENT METHOD OUT DATE	RETURNED DATE	ITEM NUMBER	RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME

30

EXHIBIT 7

SAMPLE I.D. AND CONDITION FORM

Client: _____
Project No.: _____
Date Received: _____

SAMPLE CONDITION UPON RECEIPT CHECKLIST

Complete checklist (A) during sample receipt. If any items are marked "NO," complete section (B) of this form. Otherwise, go to record samples.

			YES	NO
(A)	1.	Are there custody seals or tapes on the shipping container?	___	___
	2.	Are custody seals on the shipping container intact?	___	___
	3.	Is there a completed Chain-Of-Custody (C-O-C)?	___	___
	4.	Do the numbers of samples received and the sample matrices agree with C-O-C?	___	___
	5.	Are there tags attached to each sample?	___	___
	6.	Are sample tags, sample containers and C-O-C all in agreement?	___	___
	7.	Is the C-O-C complete with requested analyses?	___	___
	8.	Are the samples preserved correctly?	___	___
	9.	Is there enough sample to do all analyses?	___	___
	10.	Do the samples have the proper temperature?	___	___
	11.	Are the sample containers intact (e.g., not broken, leaking)?	___	___
	12.	Are VOA vials head-space free?	___	___
	13.	Are all samples within the holding times for requested analyses?	___	___
	14.	Is pH recorded for non-VOA's?	___	___

(B) Explain "NO" item here: _____

_____

_____

Send a copy of this form to Project Manager with Discrepancy Report Form. Copy of both forms remain in the QC file.

Custodian Signature: _____

EXHIBIT 8

PACE, INC.
DISCREPANCY REPORT FORM

Urgency Level: 1(_____) Requires immediate attention
2(_____) Requires attention today
3(_____) Requires attention this week

Initiator: _____ Client: _____
Date: _____
Project # _____

Sample(s) # _____ _____ _____ _____ _____

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____

Discrepancy (if more space needed, use the back of this form): _____

_____

_____

To QC Manager: _____ Date: _____

Client Notified? YES ( ) NO ( ) Date & Time: _____

Project Manager Notified? YES ( ) NO ( ) Date & Time: _____

QC Response: _____

_____

_____

Project Manager Response: _____

_____

_____

Cause and Resolution (proposed or carried out): Completed by: _____

_____

_____

_____

Manager's Initials:

PM Signature: _____ Date: _____

QC Signature: _____ Date: _____

cc: Project File

C. SAMPLE LOG-IN

1. General Policies

a. Upon completing sample receipt/custody procedures, all sample and analysis data must be complete and documented on the chain-of-custody or accompanying forms for input into the Lab Data Management System (LDMS).

Sample and analysis data must include:

1. Client name and contact
2. Client number
3. PACE project number
4. PACE project manager
5. Sample descriptions
6. Due date
7. List of analyses requested

b. Sample and requested analyses data are input into the LDMS.

c. All samples received are logged into the LDMS on the day of receipt.

d. A Sample and Analysis Data Entry Form (SADEF) is generated immediately by the LDMS.

Distribution of SADEF:

- To the PACE Project Manager with a photocopy of the chain-of-custody. (Include a copy of the Discrepancy Report is applicable).
- To the QC project file with the original chain-of-custody.
- Photocopy to the Organic or Inorganic Department Manager as it applies for RUSH samples.
- To the client.

e. SADEF is to be reviewed against the chain-of-custody.

f. Sample containers are labeled with the corresponding sample number and the stamped date of receipt.

g. Samples are ready for storage.

2. **When Samples Are Received With No Paperwork**

a. If delivered by a client: Client is asked if previous arrangements were made for analysis (and with whom). The client completes a chain-of-custody and/or request for analysis, relinquishes samples to sample custodian personnel, and is given a copy of the C-O-C.

b. If received by courier or shipping:

1st: Routine Client File is checked
2nd: Anticipate Sample Alert File is checked
3rd: Sampling Kit Request File is checked
4th: PACE key client contact is consulted
5th: QC department manager is consulted to determine the designated PACE project manager
6th: Information is requested from the PACE project manager.

c. If analysis information can not be determined on the day of sample receipt, sample data entry personnel proceed to assign sample numbers and put samples on hold. Follow-up with project manager occurs until the analyses are determined and samples can be properly logged in.

3. **Responsibilities for Sample Log In**

a. Quality Control Manager/Sample Management Officer

- Has the overall responsibility for ensuring that this procedure is implemented for all samples received into the laboratory.

- Has overall responsibility for ensuring that samples are logged in correctly (given that appropriate information has been supplied).

b. Sample Custodian

- Has the primary responsibility of ensuring that sample information is input into the LDMS as described in the SOP.

- Has the responsibility to make recommendations to the QC manager for revising the SOP.

D. SAMPLE STORAGE

1. General Procedures

Samples for analysis are properly stored in the lab according to container type, preservative, and type of security required by the project.

Samples are stored immediately upon receipt to prevent sample degradation.

2. Refrigerated Storage Area Maintenance

All refrigerated storage areas are maintained at 4°C ± 2°C. The temperature is monitored and recorded daily. If the temperature fails outside the limit of 2° to 6°C, corrective action is to be taken as follows and appropriately documented.

a. Temperature is monitored at 30 minute intervals with the refrigerator door closed.

b. QC Manager is notified if the problem persists longer than one hour.

c. Samples are relocated to a proper storage environment if temperature cannot be maintained after corrective actions are implemented.

3. Routine Sample Storage

a. General Samples

Samples within each project are stored in sample number order. Waters and soils are generally stored on labeled separate shelves.

4. Specific Procedures

a. Volatiles

Samples within a project are stored in numerical order in vial containers. The holders are then stored where space permits in one of the designated volatile organic refrigerated storage areas.

b. Semi-Volatiles

Samples within a project are stored in numerical order in a designated, refrigerated storage area.

c. Hazardous Materials

Pure product or potentially heavily contaminated samples are tagged as "hazardous" and stored within a secured area, separate from other samples. This area is used only for hazardous samples and is labeled per OHSA requirements.

d. Special Projects

- Volatiles

  Samples within a project are stored in sample number order in vial containers. The holders are then stored as space permits in the Special Project VOA refrigerated storage area.

e. Asbestos

No refrigeration required. Samples are taken to asbestos lab for storage.

5. **Responsibilities for Sample Storage**

a. QC Department Manager/Sample Management Officer has direct responsibility for ensuring that the SOP is followed, samples are stored properly upon receipt, and refrigerated storage area temperatures are maintained.

b. Sample custodians are responsible for storing all samples upon receipt into the appropriate storage area, maintaining high level security for those samples under custody, and for keeping a current custody sample inventory.

c. Analytical personnel have the responsibility of daily sample storage area maintenance, disposal of old samples, and providing space for incoming samples in routine storage areas.

d. Assigned individuals are responsible for maintaining and documenting: (a) refrigerated storage area temperatures, and (b) corrective actions.

See temperature log (Exhibit 9).

Exhibit 9

TEMPERATURE LOG FORM

Storage Area No. _____

Date	Temperature	Initials	Corrective Action/Comments

Note: Temperature must be $4^{o}C \pm 2^{o}C$. If temperature is outside the limit of 2° to 6° continue to monitor at 30 minute intervals (door must remain closed). If no correction within one hour, notify the QC Manager.

F. SAMPLE/DATA ACCESS AND INTERNAL CHAIN-OF-CUSTODY

1. General Policies and Procedures

PACE has implemented standard operating procedures to assure the integrity of samples and data so that they are not degraded or disclosed to unauthorized personnel. In order to ensure that this policy is maintained, the laboratory facilities are under controlled access. Only employees are allowed into the laboratory facilities; visitors must register at the front desk.

Samples are removed from their proper location by the analyst and returned to the storage area immediately after the required sample quantity has been taken. This minimizes unnecessary time spent searching for samples and helps prevent matrix degradation from prolonged exposure to room temperature. Most samples are retained in storage in their original locations for approximately two months. Preserved metals samples and hazardous waste samples are stored up to six months. After the final report is sent and clients are allowed adequate time to review the results, the samples are properly discarded or returned to the client.

PACE normally completes the sample analysis within 15 working days after receipt. Holding times may require faster turnaround times.

Upon client request, additional and more rigorous chain-of-custody protocols for samples and data can be implemented. For samples involving a high degree of confidentiality or potential litigation, PACE, Inc. has developed extensive sample and data handling protocols to assure the scientific and legal defensibility of the report submitted. These protocols include those specified by the USEPA Contract Laboratory Program.

Analysts and technicians follow strict internal chain-of-custody procedures to further ensure the validity of all data. All samples are signed out in a sample custody log book when they are removed for analysis. The sample ID, date, time, analyst, and lab of analysis is recorded in the sample custody log (Exhibit 10). Samples are signed back in noting date, time, and storage location, upon return.

Exhibit 10

CHAIN-OF-CUSTODY
LAB CONTROL FORM

Contract/Project No.: _____
Date Received: _____
Received by: _____
Time: _____
Witness: _____
Stored in: _____

Samples No(s). _____
_____
_____
_____
_____
_____

Date & Time Removed	Sample Nos. Removed	Name	Witness	Time Returned	Name	Witness

REMINDER: Samples must be returned at the end of the shift.

2. **Responsibilities for SOP Compliance**

a. The QC manager has the overall responsibility for ensuring that the SOP is implemented and followed.

b. The sample custodian personnel have the responsibility for ensuring that the SOP is properly followed, and to notify the QC manager of problems.

c. All employees checking out samples are required to follow procedures.

G. **EXCESS SAMPLE DISPOSITION**

Samples not totally consumed during the analyses are returned to the client. It is the project manager's responsibility to ensure that proper disposal has taken place. If the sample is water or wastewater and is considered non-hazardous by the project manager, it may then (by request) be properly disposed of at PACE facilities and not returned to the client.

1. **Notification of Sample Return**

The project manager and client receive written notification at the time of project initiation in the following manner:

a. The project proposal states the following paragraph in its Conditions and Terms Statement:

PACE, Inc. Standard Operating Procedures is to return all samples of hazardous materials or wastes to the client at project completion, and PACE, Inc. reserves the right to return or dispose of all samples at our discretion.

This is a standard form used by PACE's Marketing Department.

b. The Sample and Analysis Data Entry Form states the following sentence:

- PACE, Inc. reserves the right to return all samples at our discretion.
- This form is printed out by the LDMS at sample check-in.

c. The Sample and Analysis Data Entry Form cover letter will state the following paragraph:

1. PACE, Inc. Standard Operating Procedure is to return all samples of hazardous materials or wastes to the client at project completion. PACE, Inc. reserves the right to return or dispose of all samples at our discretion. (Exhibit 11)

2. This is a pre-printed cover letter that accompanies the Sample and Analysis Data Entry Form.

d. The Sample and Analysis Data Entry Form and cover letter is sent to the project manager and to the client by the sample custodian personnel.

2. **Sample Return and Disposal**

Upon completion of laboratory analysis and/or the project, the LDMS automatically prints a report, invoice and sample disposition form. This form is part of the report package and is routed to the project manager.

a. The Sample Disposition Form (Exhibit 12) contains the following information:

1. Client name, address, and contact
2. PACE project number
3. Client project identification number
4. PACE sample identification number
5. PACE project manager name

pace® laboratories, inc.
PROFESSIONAL ANALYTICAL CHEMISTRY & ENGINEERING

Offices:
Minneapolis, Minnesota
Tampa, Florida
Coralville, Iowa
Novato, California
Leawood, Kansas
Irvine, California
Asheboro, North Carolina

1710 Douglas Drive North □ Minneapolis, MN 55422 □ Phone (612) 544-5543 □ FAX (612) 544-3974

Exhibit 11

November 1, 1989

Dear Valued Client:

A new policy has been implemented in the Sample Receiving Department of PACE Laboratories, Inc. We hope that this policy will be helpful to you.

Upon receipt of samples into the laboratory, the Sample Custodian completes a Sample and Analysis Data Entry Form. This form is designed to accommodate a short description of the samples received (sample name and/or sample reference), the type of container, and a list of the analyses requested to be performed on each sample. A copy of this form will be sent to the client (submitter).

Enclosed is a copy of the Sample and Analysis Data Entry Form relevant to the samples we recently received from you. Please compare the information on the form to assure that it is consistent with your request. If there is any inconsistency or if you have any questions on your project, please call the PACE Contact indicated on Sample and Analysis Data Entry Form. The PACE Contact has primary responsibility for monitoring the progress of your project through the laboratory.

It is also part of PACE Laboratories, Inc. Standard Operating Procedure to return all samples pertaining to the information attached that are hazardous materials or hazardous wastes to the client at project completion. PACE Laboratories, Inc. reserves the right to return or dispose of all samples at our discretion.

We have implemented this procedure to better serve our clients, and would appreciate any comments you may have.

Sincerely,

Vice President, Corporate Quality

Exhibit 12

SAMPLE DISPOSITION FORM

_____

_____

_____

_____

_____

Date removed: _____
Initials: _____

Date shipped: _____
Initials: _____

RE: Client Project ID: _____

PACE Project No.: _____

Sample ID _____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

Dear_____:

All requested analyses of the samples for the above referenced project have been completed. Enclosed are the remaining portions of the samples which are being returned to you for final disposition.

If you have any questions, please call me.

Sincerely,

_____
Project Manager

3. **Procedure for Use of the Sample Disposition Form**

a. The project manager separates the sample disposition form from the report package, signs the form, and routes it to the sample custodian. If the sample is water or wastewater and non-hazardous, the project manager may wish to properly dispose of the waste.

- If the project requires, the project manager may hold the form for an acceptable amount of time before return or disposal.

- It is important that this form be used and not discarded. It is part of the internal chain-of-custody and is filed with the project report.

- The project manager will use action codes such as:

  1 = Return to client 2 = In house disposal
  C = Clean D = Dirty

  As a general rule, soil samples will be returned and water samples will be disposed of in-house. Water samples which are highly contaminated will be returned. Preserved samples, VOA's, and extracted/tainted samples will not be returned to the client. Therefore, it is necessary to note clean or dirty to facilitate handling. If a sample has an extremely high level of contamination, note the contaminant.

  For In-House Sample Disposal

  All preserved - Clean - Neutralize/sink
  Dirty - Toxic waste

  Un-preserved water - Clean - Sink
  Dirty - Toxic waste

  Soil/Sludge - Clean - Trash
  Dirty - Toxic waste

  All VOA's - Clean - Neutralize/sink
  Dirty - Toxic waste

All Extracted/Tainted Samples

CAM Extracts - Clean - Neutralize/sink
Dirty - Acid metals waste

Other Extracts - Toxic waste

Liquid/Unknown Misc. - Project manager specify

- Project manager will complete the sample disposition form and route it back to invoicing.

- The invoicing department will put completed sample disposition form in sample control mailbox.

b. Upon receipt of the Sample Disposition Form by the sample custodian personnel, the custodian personnel will remove the samples from storage using the information provided on the form.

- If the Sample Disposition Form indicates "Dump," the sample custodian personnel will remove them from storage and place them at a sample disposal station for proper disposal. The process of disposal is performed by the sample custodian personnel or appropriate laboratory staff. The Sample Disposition Form is signed and dated by the sample custodian personnel, then routed to the file clerk for filing with other project information.

- If the samples are to be returned, the sample custodian removes the sample or samples from storage, initials and dates the Sample Disposition Form. The samples, the Sample Disposition Form, and a copy of the client's chain-of-custody are then delivered to the shipping clerk by the sample custodian for return to the client.

c. Upon receipt of the samples and Sample Disposition Form, the shipping clerk signs and dates the form.

The Sample Disposition Form is copied and the original form with the samples is returned to the client, along with a copy of the client's chain-of-custody. A copy of the Sample Disposition Form and the original chain-of-custody is routed to the file clerk for filing with other project information (QC file).

- The shipping clerk labels the box with an appropriate hazard label and ships the samples back to the client using UPS or any other requested manner for shipment. (Note: It is important for proper packaging to prevent breakage during shipment.)

- All shipping costs will be charged against the appropriate project number.

d. Upon receipt of Sample Disposition Form, the file clerk files it with other project related information.

4. **Hazardous Material/Waste Sample Disposition Option**

The preferred method for disposition of excess hazardous material/waste samples is to return the excess sample to the client. It may not be feasible to return samples in all cases or the client may require PACE to dispose of excess samples. PACE will dispose of excess hazardous samples when required and will charge a disposal fee to recover costs for management and disposal.

Procedure for Disposal Option for Excess Hazardous Material/Waste Samples:

a. The project manager informs the client that excess sample disposal will require an additional charge.

b. When analyses are complete, the project manager indicates disposal as the option on the Sample Disposition Form and completes and attaches Hazardous Material/Waste Disposal Option Form (Exhibit 13). An entry is to be made in all fields of this form as it will determine the basis for lab packing and disposal.

c. The project manager routes the Disposal Option Form to sample check-in.

d. The project manager is responsible for billing the client for disposal.

e. The sample custodian is responsible for maintaining a file of Disposal Option Forms for all samples awaiting disposal. Hazardous material/waste samples are stored in safe manner, segregated by compatibility groups as indicated by the hazardous waste disposal SOP.

EXHIBIT 13

HAZARDOUS MATERIAL/WASTE SAMPLE DISPOSAL OPTION FORM

Client _____ Client Project ID _____

Contact _____ PACE Project # _____

Address _____ Project Manager _____

_____ Report Sent Date _____

Phone # _____ Pull Sample Date _____

_____

Sample #	Matrix	Location	Disposal Method	Charge

Remarks: 1=Return to Client C=Clean
2=In House Disposal D=Dirty

Removed from Refrigerator (initial/date) _____
Returned to Client (initial/date) _____
Disposed of Samples (initial/date) _____

f. The Quality Control Manager is responsible for reviewing accumulated samples awaiting disposal and initiating the disposal process when warranted. The Field Services, Inorganic, Organic, and Environmental Services Departments cooperate and participate in the disposal process. (For compatibility and compositing, see the Hazardous Waste Disposal SOP.)

VIII. CALIBRATION PROCEDURES AND FREQUENCY

Most measurements taken in the laboratory are based upon comparison to reference standards as analyzed by the standard method. The standard results are utilized to generate calibration curves or calibration factors. The results of the sample analysis are then quantified.

All instruments are calibrated using standard solutions of known concentrations. The standards are prepared from certified reference materials and are generally traceable back to NIST. Refer to Section XI for additional information.

Continuous calibration is verified by analysis of calibration standards or laboratory control samples from different sources at regular intervals. Recalibration is performed at specified time intervals or when indicated by the continuous verification procedure or as required by the method. Typical acceptance criteria for some common organic analyses are summarized in Table 2.

Forms to document initial and continuing calibration have been developed (Exhibits 14 and 15).

Refer to Section IX for additional calibration information and frequency as specified in the specific analytical methods.

TABLE 2 CALIBRATION AND QC ACCEPTANCE CRITERIA[a] FOR HALOGENATED VOLATILE ORGANICS

Parameter	Range for Q (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range P, P_s (%)
Bromodichloromethane	15.2-24.8	4.3	10.7-32.0	42-172
Bromoform	14.7-25.3	4.7	5.0-29.3	13-159
Bromomethane	11.7-28.3	7.6	3.4-24.5	D-144
Carbon tetrachloride	13.7-26.3	5.6	11.8-25.3	43-143
Chlorobenzene	14.4-25.6	5.0	10.2-27.4	38-150
Chloroethane	15.4-24.6	4.4	11.3-25.2	46-137
2-Chloroethylvinyl ether	12.0-28.0	8.3	4.5-35.5	14-186
Chloroform	15.0-25.0	4.5	12.4-24.0	49-133
Chloromethane	11.9-28.1	7.4	D-34.9	D-193
Dibromochloromethane	13.1-26.9	6.3	7.9-35.1	24-191
1,2-Dichlorobenzene	14.0-26.0	5.5	1.7-38.9	D-208
1,3-Dichlorobenzene	9.9-30.1	9.1	6.2-32.6	7-187
1,4-Dichlorobenzene	13.9-26.1	5.5	11.5-25.5	42-143
1,1-Dichloroethane	16.8-23.2	3.2	11.2-24.6	47-132
1,2-Dichloroethane	14.3-25.7	5.2	13.0-26.5	51-147
1,1-Dichloroethene	12.6-27.4	6.6	10.2-27.3	28-167
trans-1,2-Dichloroethene	12.8-27.2	6.4	11.4-27.1	38-155
1,2-Dichloropropane	14.8-25.2	5.2	10.1-29.9	44-156
cis-1,3-Dichloropropene	12.8-27.2	7.3	6.2-33.8	22-178
trans-1,3-Dichloropropene	12.8-27.2	7.3	6.2-33.8	22-178
Methylene chloride	15.5-24.5	4.0	7.0-27.6	25-162
1,1,2,2-Tetrachloroethane	9.8-30.2	9.2	6.6-31.8	8-184
Tetrachloroethene	14.0-26.0	5.4	8.1-29.6	26-162
1,1,1-Trichloroethane	14.2-25.8	4.9	10.8-24.8	41-138
1,1,2-Trichloroethane	15.7-24.3	3.9	9.6-25.4	39-136
Trichloroethene	15.4-24.6	4.2	9.2-26.6	35-146
Trichlorofluoromethane	13.3-26.7	6.0	7.4-28.1	21-156
Vinyl chloride	13.7-26.3	5.7	8.2-29.9	28-163

Q = Concentration measured in QC check sample, in ug/L.

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

P, P_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 601 and were calculated assuming a QC check sample concentration of 20 ug/L.

TABLE 2. CALIBRATION AND QC ACCEPTANCE CRITERIA[a] FOR AROMATIC VOLATILE ORGANICS

Parameter	Range for Q (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range P, P_s (%)
Benzene	15.4-24.6	4.1	10.0-27.9	39-150
Chlorobenzene	16.1-23.9	3.5	12.7-25.4	55-135
1,2-Dichlorobenzene	13.6-26.4	5.8	10.6-27.6	37-154
1,3-Dichlorobenzene	14.5-25.5	5.0	12.8-25.5	50-141
1,4-Dichlorobenzene	13.9-26.1	5.5	11.6-25.5	42-143
Ethylbenzene	12.6-27.4	6.7	10.0-28.2	32-160
Toluene	15.5-24.5	4.0	11.2-27.7	46-148

Q = Concentration measured in QC check sample, in ug/L.

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

P, P_s = Percent recovery measured.

[a]Criteria are from 40 CFR Part 136 for Method 602 and were calculated assuming a QC check sample concentration of 20 ug/L. These criteria are based directly upon the method performance data in Table 4. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 1.

TABLE 2. QC ACCEPTANCE CRITERIA[a] FOR ORGANOCHLORINE PESTICIDES & PCB's

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range P, P_s (%)
Aldrin	2.0	0.42	1.08-2.24	42-122
α-BHC	2.0	0.48	.98-2.44	37-134
β-BHC	2.0	0.64	0.78-2.60	17-147
δ-BHC	2.0	0.72	1.01-2.37	19-140
γ-BHC	2.0	0.46	0.86-2.32	32-127
Chlordane	50	10.0	27.6-54.3	45-119
4,4'-DDD	10	2.8	4.8-12.6	31-141
4,4'-DDE	2.0	0.55	1.08-2.60	30-145
4,4'-DDT	10	3.6	4.6-13.7	25-160
Dieldrin	2.0	0.76	1.15-2.49	36-146
Endosulfan I	2.0	0.49	1.14-2.82	45-153
Endosulfan II	10	6.1	2.2-17.1	D-202
Endosulfan Sulfate	10	2.7	3.8-13.2	26-144
Endrin	10	3.7	5.1-12.6	30-147
Heptachlor	2.0	0.40	0.86-2.00	34-111
Heptachlor epoxide	2.0	0.41	1.13-2.63	37-142
Toxaphene	50	12.7	27.8-55.6	41-126
PCB-1016	50	10.0	30.5-51.5	50-114
PCB-1221	50	24.4	22.1-75.2	15-178
PCB-1232	50	17.9	14.0-98.5	10-215
PCB-1242	50	12.2	24.8-69.6	39-150
PCB-1248	50	15.9	29.0-70.2	38-158
PCB-1254	50	13.8	22.2-57.9	29-131
PCB-1260	50	10.4	18.7-54.9	8-127

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

P, P_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 608. These criteria are based directly upon the method performance data in Table 4. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 4.

TABLE 2. CALIBRATION AND QC ACCEPTANCE CRITERIA[a] FOR GC/MS VOLATILE ORGANICS

Parameter	Range for Q (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range p, p_s (%)
Benzene	12.8-27.2	6.9	15.2-26.0	37-151
Bromodichloromethane	13.1-26.9	6.4	10.1-28.0	35-155
Bromoform	14.2-25.8	5.4	11.4-31.1	45-169
Bromomethane	2.8-37.2	17.9	D-41.2	D-242
Carbon tetrachloride	14.6-25.4	5.2	17.2-23.5	70-140
Chlorobenzene	13.2-26.8	6.3	16.4-27.4	37-160
2-Chloroethylvinyl ether	D-44.8	25.9	D-50.4	D-305
Chloroform	13.5-26.5	6.1	13.7-24.2	51-138
Chloromethane	D-40.8	19.8	D-45.9	D-273
Dibromochloromethane	13.5-26.5	6.1	13.8-26.6	53-149
1,2-Dichlorobenzene	12.6-27.4	7.1	11.8-34.7	18-190
1,3-Dichlorobenzene	14.6-25.4	5.5	17.0-28.8	59-156
1,4-Dichlorobenzene	12.6-27.4	7.1	11.8-34.7	18-190
1,1-Dichloroethane	14.5-25.5	5.1	14.2-28.4	59-155
1,2-Dichloroethane	13.6-26.4	6.0	14.3-27.4	49-155
1,1-Dichloroethene	10.1-29.9	9.1	3.7-42.3	D-234
trans-1,2-Dichloroethene	13.9-26.1	5.7	13.6-28.4	54-156
1,2-Dichloropropane	6.8-33.2	13.8	3.8-36.2	D-210
cis-1,3-Dichloropropene	4.8-35.2	15.8	1.0-39.0	D-227
trans-1,3-Dichloropropene	10.0-30.0	10.4	7.6-32.4	17-183
Ethyl benzene	11.8-28.2	7.5	17.4-26.7	37-162
Methylene chloride	12.1-27.9	7.4	D-41.0	D-221
1,1,2,2-Tetrachloroethane	12.1-27.9	7.4	13.5-27.2	46-157
Tetrachloroethene	14.7-25.3	5.0	17.0-26.6	64-148
Toluene	14.9-25.1	4.8	16.6-26.7	47-150
1,1,1-Trichloroethane	15.0-25.0	4.6	13.7-30.1	52-162
1,1,2-Trichloroethane	14.2-25.8	5.5	14.3-27.1	52-150
Trichloroethene	13.3-26.7	6.6	18.5-27.6	71-157
Trichlorofluoromethane	9.6-30.4	10.0	8.9-31.5	17-181
Vinyl chloride	0.8-39.2	20.0	D-43.5	D-251

Q = Concentration measured in QC check sample, in ug/L.
s = Standard deviation of four recovery measurements, in ug/L.
$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.
p, p_s = Percent recovery measured.
D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 624 and were calculated assuming a QC check sample concentration of 20 ug/L. These criteria are based directly upon the method performance data in Table 7. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 7.

TABLE 2. QC ACCEPTANCE CRITERIA[a] FOR GC/MS SEMIVOLATILE ORGANICS

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range p, p_s (%)
Acenaphthene	100	27.6	60.1-132.3	47-145
Acenaphthylene	100	40.2	53.5-126.0	33-145
Aldrin	100	39.0	7.2-152.2	D-166
Anthracene	100	32.0	43.4-118.0	27.133
Benzo(a)anthracene	100	27.6	41.8-133.0	33-143
Benzo(b)fluoranthene	100	38.8	42.0-140.4	24-159
Benzo(k)fluoranthene	100	32.3	25.2-145.7	11-162
Benzo(a)pyrene	100	39.0	31.7-148.0	17-163
Benzo(ghi)perylene	100	58.9	D-195.0	D-219
Benzyl butyl phthalate	100	23.4	D-139.9	D-152
β-BHC	100	31.5	41.5-130.6	24-149
δ-BHC	100	21.6	D-100.0	D-110
Bis(2-chloroethyl)ether	100	55.0	42.9-126.0	12-158
Bis(2-chloroethoxy)methane	100	34.5	49.2-164.7	33-184
Bis(2-chloroisopropyl)ether	100	46.3	62.8-138.6	36-166
Bis(2-ethylhexyl)phthalate	100	41.1	28.9-136.8	8-158
4-Bromophenyl phenyl ether	100	23.0	64.9-114.4	53-127
2-Chloronaphthalene	100	13.0	64.5-113.5	60-118
4-Chlorophenyl phenyl ether	100	33.4	38.4-144.7	25-158
Chrysene	100	48.3	44.1-139.9	17-168
4,4'-DDD	100	31.0	D-134.5	D-145
4,4'-DDE	100	32.0	19.2-119.7	4-136
4,4'-DDT	100	61.6	D-170.6	D-203
Dibenzo(a,h)anthracene	100	70.0	D-199.7	D-227
Di-n-butyl phthalate	100	16.7	8.4-111.0	1-118
1,2-Dichlorobenzene	100	30.9	48.6-112.0	32-129
1,3-Dichlorobenzene	100	41.7	16.7-153.9	D-172
1,4-Dichlorobenzene	100	32.1	37.3-105.7	20-124
3,3'-Dichlorobenzidine	100	71.4	8.2-212.5	D-262
Dieldrin	100	30.7	44.3-119.3	29-136
Diethyl phthalate	100	26.5	D-100.0	D-114
Dimethyl phthalate	100	23.2	D-100.0	D-112
2,4-Dinitrotoluene	100	21.8	47.5-126.9	39-139
2,6-Dinitrotoluene	100	29.6	68.1-136.7	50-158
Di-n-octylphthalate	100	31.4	18.6-131.8	4-146
Endosulfan sulfate	100	16.7	D-103.5	D-107
Endrin aldehyde	100	32.5	D-188.8	D-209
Fluoranthene	100	32.8	42.9-121.3	26-137
Fluorene	100	20.7	71.6-108.4	59-121
Heptachlor	100	37.2	D-172.2	D-192
Heptachlor epoxide	100	54.7	70.9-109.4	26.155
Hexachlorobenzene	100	24.9	7.8-141.5	D-152
Hexachlorobutadiene	100	26.3	37.8-102.2	24-116
Hexachloroethane	100	24.5	55.2-100.0	40-113

TABLE 2. QC ACCEPTANCE CRITERIA[a] FOR GC/MS SEMIVOLATILE ORGANICS (CONT.)

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range p, p_s (%)
Indeno(1,2,3-cd)pyrene	100	44.6	D-150.9	D-171
Isophorone	100	63.3	46.6-180.2	21-196
Naphthalene	100	30.1	35.6-119.6	21-133
Nitrobenzene	100	39.3	54.3-157.6	35-180
N-Nitrosodi-n-propylamine	100	55.4	13.6-197.9	D-230
PCB-1260	100	54.2	19.3-121.0	D-164
Phenanthrene	100	20.6	65.2-108.7	54-120
Pyrene	100	25.2	69.6-100.0	52-115
1,2,4-Trichlorobenzene	100	28.1	57.3-129.2	44-142
4-Chloro-3-methylphenol	100	37.2	40.8-127.9	22-147
2-Chlorophenol	100	28.7	36.2-120.4	23-134
2,4-Chlorophenol	100	26.4	52.5-121.7	39-135
2,4-Dimethylphenol	100	26.1	41.8-109.0	32-119
2,4-Dinitrophenol	100	49.8	D-172.9	D-191
2-Methyl-4,6-dinitrophenol	100	93.2	53.0-100.0	D-181
2-Nitrophenol	100	35.2	45.0-166.7	29-182
4-Nitrophenol	100	47.2	13.0-106.5	D-132
Pentachlorophenol	100	48.9	38.1-151.8	14-176
Phenol	100	22.6	16.6-100.0	5-112
2,4,6-Trichlorophenol	100	31.7	52.4-129.2	37-144

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

p, p_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 625. These criteria are based directly on the method performance data in Table 7. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 7.

INITIAL CALIBRATION DATA
EXTRACTABLE 8080/608 COMPOUNDS
EXHIBIT 14

CALIBRATION DATE: COLUMN ID:

INSTRUMENT ID: DETECTOR ID:

MAXIMUM % RSD IS 20%

Standard ID	#	#	#		
Compound	CF 20	CF 40	CF 60	$\overline{CF}$	%RSD
Alpha-BHC					
Beta- BHC					
Lindane					
Delta- BHC					
Heptachlor					
Aldrin					
Heptachlor Epoxide					
Endosulfan I					
DDE/Dieldrin					
Endrin					
Endosulfan II					
4,4'-DDD					
Endrin Aldehyde					
4,4'-DDT					
Endosulfan Sylfate					

CF=CALIBRATION FACTOR= $\frac{\text{Total ng of Standard}}{\text{Area}}$

$\overline{CF}$ = AVERAGE CALIBRATION FACTOR = CF/n

%RSD = RELATIVE STANDARD DEVIATION = $\frac{\text{(Standard Dev.) (100)}}{\overline{CF}}$

CONTINUING CALIBRATION CHECK
Semi-Volatile Compounds
EXHIBIT 15

CASE NO: _____ CALIBRATION DATE: _____

LABORATORY NAME: PACE LABORATORIES TIME: _____

CONTRACT/PROJECT NO. _____ ANALYST: _____

INSTRUMENT I.D.: _____ INITIAL CALIBRATION DATE: ___

MAXIMUM %D FOR CCC IS 10%

COMPOUND	CF	CF	%D	CCC
Alpha-BHC				
* Beta-BHC				
Lindane				
Delta-BHC				
Heptachlor				
* Aldrin				
Heptachlor Epoxide				
* Endosulfan I				
DDE/Dieldrin				
* Endrinion				
Endosulfan II				
4,4'-DDD				
Endrin Aldehyde				
4,4'-DDT				
Endosulfan Sulfate				
Aroclor 1016				
Aroclor 1221				
Aroclor 1232				
Aroclor 1242				
Aroclor 1248				
Aroclor 1254				
Aroclor 1260e				
Chlordane				
Toxaphene				
Methoxychor				
DBC				

CF -Calibration Factor from daily standard at ug/L
CF-Average Calibration Factor from initial calibration Form VI
%D-Percent Difference
CCC-Calibration Check Compounds

IX. ANALYTICAL PROCEDURES

Analytical methods employed at PACE can be EPA methodologies from the Federal Register and SW 846 (References 2 and 3) or approved equivalent methods. When there is no approved EPA method, industrial methods are used. A list of analytical methods utilized at PACE is as follows:

A. LIST OR ANALYTICAL METHODS

1. Organic Analyses

Parameter	Method	DW	WW Method	SW 846	Spec.
Purgeable Halocarbons	GC	502.1/502.2	601	8010	
Non-Halogenated Volatile Organics	GC			8015	
Purgeable Aromatics and Unsaturated Organics	GC	503.1/502.2	602	8020	
Acrolein & Acrylonitrile	GC		603	8030	
Phenols	GC	515.1	604	8040	
Benzidines	HPLC		605		
Phthalate Esters	GC		606	8060	
Nitrosamines	GC		607		
Organochlorine Pesticides and PCBs	GC	508/505/508A 507/515.1	608/608.1 608.2	8080	CA Mod 8080 MN. 570A
Nitroaromatics and Isophorone	GC		609	8090	
Polynuclear Aromatic Hydrocarbons	HPLC/GC	502.2/503.1	610	8310/ 8100	
Haloethers	GC		611		
Alachlor, Atrazine, Chlordane, Hepatchlor, Heptachlor Epoxide, Lindane, Methoxychlor, Toxaphene, and PCBs (as Aroclors)	GC	505/507	645		MN 570A

Parameter	Method	DW	WW Method	SW 846	Spec.
Chlorinated Hydrocarbons	GC		612	8120	
2, 3, 7, 8 - TCDD	GC/MS		613		
Volatile Organics					(MN)465C
Base/Neutrals & Acids	GC/MS	525 (NCA)	625	8250/8270	
Organophosphorus Pesticides	GC	507	614/622	8140/ 8220	(MN)570A (CA)AB1803
Chlorinated Herbicides	GC	515.1	615/608.1/ 608.2	8150	(MN)574A (CA)509B
EDB and DBCP	GC	504			(CA) DOHS
Volatile Organic Compounds	GC/MS	524.2/524.1	624	8240	
Carbamates & Urea & Pesticides	HPLC	531.1	632		(CA)AB1803 (MN)572A
Fuel Hydrocarbons & BTEX	GC		602	8020	(CA) Mod. 8015
Alachlor, Atrazine	GC	507/505	619/645		(CA)AB1803 (MN)570A
Chlordane, Heptachlor, Heptachlor Expoxide, Lindane; Methoxychlor	GC	508/505	608/617	8080	
Aldicarb; Aldicarb sulfone; Aldicarb sulfoxide; Carbofuran	GC	531.1			(CA)AB1803

2. INORGANIC ANALYSES

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	ASTM	SW 846
A. Non Metals					
Acidity	Potentiometric Titration	402	305.1	D1067-82	
Alkalinity	Potentiometric Titration	403	310.1	D1067-82	
Bacteria,					
Total Coliform	Membrane Filter	909A			9132
Fecal Coliform	Membrane Filter	908C			
Fecal Strept.	Membrane Filter	910A			
Total Plate Count	Agar Medium	907			
Biochemical Oxygen Demand, 5-Day	Winkler Electrode	507 507	405.1		
Boron	Curcumin 405-A	404A	212.3		
	ICP		200.7		6010
Chemical Oxygen Demand	Dichromate Reflux (High)	508A	410.1	D1252-83	
	Dichromate Reflux (Low)	508A	410.2	D1252-83	
Chloride	Mercuric Nitrate	407B	325.3	D512-81	9252
	Auto. Ferricyanide	407D	325.2		9251
	Titration	407A			
Chlorine, Residual	Amperometric Titration	408C	330.1 330.5	D1253-76	
	Colorimetric	408E			
Color	Visual Comparison	204A	110.2		
Cyanide, Total	Pyridine-Barbitutic Acid, Colorimetric	412D	335.2	D2036-82	9010
Amenable	Chlorination-Colorimetric	412F	335.1	D2036-82	9010

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	ASTM	SW 846
Flouride, Total	Distillation-Electrode	413A/B	340.2	D1179-80	
Flouride, Diss.	Electrode	413B	340.2	D1179-80	
Hardness, Total	EDTA Titration Calculation	314B	130.2	D1126-80	
Hardness, Calcium	EDTA Titration	303A	242.1	D511-84	
Nitrogen,					
Ammonia	Distillation Titration	417D	350.2		
	Potentiometric		350.3		
Kjeldahl	Digestion Distillation	420B	351.3	D3590-84	
Nitrate	Automated Cadmium	418F	353.2	D3867-85	9200
	Brucine Sulfate		352.1	D091-71	
Nitrite	Automated Cadmium	418F	353.2	D3867-85	
	Colorimetric	419			
Organic	Kjeldahl-NH_3	420A	351.3	D3590-84	
	Kjeldahl-Potentiometric		351.4		
Oil & Grease	Soxhlet	503C			
	Partition-Gravimetric	503A	413.1		9070/ 9071
Oxygen	Winkler	421B	360.2	D888-81	
Dissolved	Electrode	421F	360.1		
pH (Hydrogen Ion)	Electrode	423	150.1	D1293-84	9040
Phenol	Distillation-Extraction Colorimetric		420.1	D1783-80	9066
Phosphorus,	Persulfate Digestion-	424C/F	365.2	D515-82	
Total	Ascorbic Acid Reduc.				
Ortho	Ascorbic Acid Reduc.	424F	365.2	D515.82	
Silica,	Molybdosilicate	425C	370.1	D859-80	
Dissolved	ICP		200.7		
Solids					
Total	Gravimetric	209A	160.3		
Total Volatile	Gravimetric	209D	160.4		
Suspended	Gravimetric	209C	160.2		
Suspended Volatile	Gravimetric	209D	160.4		
Total Dissolved	Gravimetric	209B	160.1		
Settleable	Gravimetric	209E	160.5		

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	ASTM	SW 846
Specific Conductance	Meter	205	120.1	D1125.82	9040
Sulfate	Ion Chromatography	426C	375.4	D516-82	
	Automated Methyl Thymol Blue		375.2		9036
Sulfide	Colorimetric	427C	376.2		9030
	Titration	427D	376.1		
Sulfite	Titration	428A	377.1	D1339-84	
Surfactants (MBAS)	Methylene Blue	512B	425.1	D2330-82	
Turbidity	Meter	214A	180.1	D1389-18	

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1979	SW 846
B. Metals				
Aluminum	AA-Direct Aspiration	303C	202.1	7020
	AA-Furnace	304	202.2	
	ICP-AES		200.7	6010
Antimony	AA-Direct Aspiration	303A	204.1	7040
	AA-Furnace	304	204.2	7041
	ICP-AES		200.7	6010
Arsenic	AA-Gaseous Hydride	303E	206.3	7061
	AA-Furnace	304	206.2	7060
	ICP-AES		200.7	6010

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	SW 846
Barium	AA-Direct Aspiration	303C	208.1	7080
	AA-Furnace	304	208.2	7081
	ICP-AES		200.7	6010
Beryllium	AA-Direct Aspiration	303C	210.1	7090
	AA-Furnace	304	210.2	7091
	ICP-AES		200.7	6010
Cadmium	AA-Direct Aspiration	303A	213.1	7130
	AA-Furnace	304	213.2	7131
	ICP-AES		200.7	6010
Calcium	AA-Direct Aspiration	303A	215.1	7140
	AA-Furnace	311C	215.2	
	ICP-AES		200.7	6010
Chromium,				
Total	AA-Direct Aspiration	303A	218.1	7190
Hexavalent	AA-Furance	304	218.2	7191
	ICP AES		200.7	6010
	Colorimetric	312B		7196
	MIBK Extraction			7197
Cobalt	AA-Direct Aspiration	303A	219.1	7200
	AA-Furnace	304	219.2	7201
	ICP-AES		200.7	6010
Copper	AA-Direct Aspiration	303A	220.1	7210
	AA-Furnace	304	220.2	7211
	ICP-AES		200.7	6010
Iron	AA-Direct Aspiration	303B	236.1	7380
	AA-Furnace	304	236.2	7381
	ICP-AES		200.7	6010
Lead	AA-Direct Aspiration	303A	239.1	7240
	AA-Furnace	304	239.2	7241
	ICP-AES		200.7	6010

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	SW 846
Lithium	AA-Direct Aspiration	317B		
Magnesium	AA-Direct Aspiration	303A	242.1	7450
	ICP AES		200.7	6010
Manganese	AA-Direct Aspiration	303A	243.1	7460
	AA-Furnace	304	243.2	7461
	ICP AES		200.7	6010
Mercury	AA-Cold Vapor	303F	245.1	7470 or 7471
Molybdenum	AA-Direct Aspiration	303C	246.1	7480
	AA-Furnace	304	246.2	7481
Nickel	AA-Direct Aspiration	303A	249.1	7520
	AA-Furnace	304	249.2	
	ICP AES		200.7	6010
Potassium	AA-Direct Aspiration	303A	258.1	7610
Selenium	AA-Gaseous Hydride	303E	270.3	7740
	AA-Furnace	304	270.2	7741
	ICP AES		200.7	6010
Silver	AA-Direct Aspiration	303A	272.1	7760
	AA-Furnace	304	272.2	7761
	ICP AES		200.7	6010
Sodium	AA-Direct Aspiration	303A	273.1	7770
	ICP AES		200.7	6010
Strontium	AA-Direct Aspiration	303A		7780
Thallium	AA-Direct Aspiration	303A	279.1	7840
	AA-Furnace	304	279.2	7841
	ICP AES		200.7	6010
Tin	AA-Direct Aspiration	303A	282.1	7870
	AA-Furnace	304	282.2	

JUNE 1988

SAMPLING AND CHEMICAL ANALYSIS QUALITY ASSURANCE REQUIREMENTS FOR THE NAVY INSTALLATION RESTORATION PROGRAM

NEESA 20.2-047B

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY

Port Hueneme, California 93043

SAMPLING AND CHEMICAL ANALYSIS QUALITY ASSURANCE REQUIREMENTS FOR THE NAVY INSTALLATION RESTORATION PROGRAM

NEESA 20.2-047B
Project Manager: Anthony R. Sturtzer

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LIST OF ACRONYMS

AA	Atomic Absorption
ASTM	American Society for Testing Materials
BNA	Base Neutral Acids
CCC	Calibration Check Compounds
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Protocol
COC	Chain of Custody
DQO	Data Quality Objective
EFD	Engineering Field Division (U.S. Navy)
EIC	Engineer in Charge (U.S. Navy)
FEL	Field Equipment Log
GC	Gas Chromatography
HSL	Hazardous Substances List
IRP	Installation Restoration Program
ICP	Inductively Coupled Plasma
LQAC	Laboratory Quality Assurance Coordinator
MPR	Monthly Progress Report
MS	Mass Spectrometry
NCR	NEESA Contract Representative (Martin Marietta Energy Systems, Inc.)
NEESA	Naval Energy and Environmental Support Activity
NPL	National Priorities List
PCB	Polychlorinated Biphenyl
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
RRF	Relative Response Factor
RSD	Relative Standard Deviation
SOW	Statement of Work
SPCC	System Performance Check Compounds
TCL	Toxic Contaminant List
VOA	Volatile Organic

1. INTRODUCTION

The Installation Restoration Program (IRP) identifies and evaluates past hazardous material disposal sites in order to control the migration of hazardous contaminants. The program also controls hazards that may result from these past disposal operations. The IRP has the following phases: Preliminary Assessment/Records Search, Site Inspection/Remedial Investigation, Technical Base Development, Feasibility Study, and implementation of selected alternatives for remediation. During any of these phases, analysis of soil, water, and waste samples may be performed. The Navy program for the IRP includes performing field investigations and analysis of samples. The purpose of this document is to specify the requirements for the control of the accuracy, precision, and completeness of the samples, and data from the point of collection through reporting. Because every instance and concern may not be addressed in this document, contractors are encouraged to discuss any questions with the Navy engineer in charge (EIC) or the appropriate Naval Energy and Environmental Support Activity (NEESA) contract representative (NCR).

1.1 SCOPE

Laboratories performing studies in support of the IRP are required to obtain Navy approval prior to beginning field studies or analyses of samples and to maintain that approved status throughout the site characterization. The laboratory approval is specific to a particular study for a given site and Statement of Work (SOW). The Navy Requirements document provides guidance to the laboratories on obtaining and maintaining approval. Should more than one laboratory be involved in the analysis of samples from a single site, each laboratory performing analysis must be approved and must comply with the quality control (QC) requirements. These objectives and requirements conform, in general, with the *U.S. Environmental Protection Agency Federal Register*, November 29, 1983 (p. 53937 or 40 CFR 792), the *Food and Drug Administration Federal Register*, December 22, 1978 (p. 59986 or 21 CFR 58), the *Quality Assurance Program Requirements for Nuclear Facilities*, ANSI/ASME NQA-1, 1986 ed., and the *Interim Guidelines and Preparing Quality Assurance Project Plans* (U.S. EPA, EPA-600/4-83-004, QAMS-005/80).

Each laboratory is required to submit a Laboratory Analysis Quality Assurance (QA) Plan. Each engineering contractor must submit a site work plan as part of the approval process. The laboratory's QA plan and the site work plan are emphasized, since the content of those plans and the laboratory's strict adherence to it are essential for obtaining and maintaining Navy approval. Certain basic requirements are stressed--a laboratory QA coordinator (LQAC), the use of accepted analytical methods, careful documentation of chain of custody (COC), corrective action policy, and use of control charts. The laboratory-approval process and subsequent laboratory reporting requirements provide the mechanism for verifying that a laboratory is adhering to its QA and work plan.

Currently, most IRP studies do not include analysis of air, plant, or tissue samples. Future revisions that will include more discussion as to available methods for biota and air are planned. If questions on these methods arise, the NCR may be consulted at the Martin Marietta Energy Systems, Inc., Analytical Chemistry Department at the Oak Ridge Gaseous Diffusion Plant. Where Environmental Protection Agency (EPA) methods are not available for biota, methods from other agencies and published methods which have undergone method validation by the laboratory requesting approval must be used. On occasion, when methods are required for biota and no EPA method is available, the proposed method must be submitted to the NCR for approval.

1.2 APPROACH

The approach reflected in this document is one of outlining requirements and allowing the laboratories, principally through their QA plans, to detail their approach to meeting these requirements. For example, with the exception of the laboratory control sample program, see Sect. 4.4, the discussion of QC procedures includes a requirement that warning and action limits be set but allows each laboratory to describe its procedures for establishing such limits. The specific organization and presentation of the laboratory plan are left largely to the discretion of the laboratory, although certain areas must be addressed.

In order for the above approach to work, emphasis must be placed on effective communication between the laboratory, the Navy EIC, the NCR, and the engineering subcontractor. All documents must be concise, well organized, and free of jargon that might hinder constructive review and evaluation.

1.3 LEVELS OF QC

Data quality objectives (DQOs) are requirements needed to support decisions relative to the various stages of remedial actions. Throughout the project planning process, DQOs are supplied through qualitative and quantitative statements. They are specified in such documents as sampling plans, work plans and QA plans. Five general levels of analytical options to support data collection are identified by Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The Navy has adopted three of the analytical levels as QC requirements. They are C, D, and E, which correlate with Levels 3, 4, and 5 described in *Data Quality Objectives for Remedial Response Activities Development Process* by the EPA. These levels are based on the type of site to be investigated, the level of accuracy and precision required and the intended use of the data. The level of QC required at the site will be decided by the Navy EIC. Analytical requirements for the remaining two levels have not been defined. Table 1.1 outlines the basic QC requirements at each level. The laboratory method requirements for each level of QC are outlined in Sect. 7.

Table 1.1. Overall plan for QC based on type of site

DQO Levels[1]	Type of Site	QC Requirements						
3	Major Non-NPL Level C	PE sample	Laboratory[2] audit	QA Plan review	Use EPA-approved method[3]	Monthly review	10% field duplicates	Review of final data
4	NPL Level D	PE sample	Laboratory[2] audit	QA Plan review	Use CLP procedures	Monthly review	10% field duplicates	CLP validation
5	Non-NPL Level E	PE sample	Laboratory[2] audit	QA Plan review	Use EPA-approved methods.[3] Non-EPA methods for tissue and explosives.	Monthly review	5% Field duplicates	Review of final data

[1]QC criteria for DQO Levels 1 and 2 has not been defined.
[2]All laboratory audits will be performed by the NCR.
[3]Includes methods from SW 846, Amercian Society for Testing Materials, and Federal Register.

CLP = Contract laboratory protocol
PE = Performance evaluation samples
DQO = Data quality objective

1.3.1 Level C QC

A site requiring Level C QC would be a site near a populated area, not on the NPL, and not likely to be undergoing litigation. The Level C QC includes review and approval of the laboratory QA and the site work plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. The laboratory that performs Level C QC must have passed the performance sample furnished by the Superfund CLP in the past year. The laboratory does not need to be receiving CLP bid lots of samples.

Level C allows the use of non-CLP methods but requires that the methods be accepted EPA methods listed in Tables 7.1 through 7.5. All methods used must be EPA methods or be equivalent to EPA methods. Further discussion about these methods is presented in Sect. 7. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. These audits will be administered and evaluated by the NCR. The Navy audit and performance sample are required in addition to any specified by the EPA Superfund Program.

1.3.2 Level D QC

Level D QC is to be used for sites that are on or about to be on the National Priorities List (NPL). These sites are typically near populated areas and are likely to undergo litigation. Level D QC includes review and approval of the laboratory QA plan, the site work plan, and the field QA plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide monthly progress reports (MPRs) on QA. These activities will be administered and evaluated by the NCR. This audit and the analysis performance sample are in addition to those related to the EPA Superfund Program. The laboratory that performs Level D QC must have passed the performance sample furnished through the Superfund Contract Laboratory Protocol (CLP) and must be able to generate the CLP deliverables. For a Level D site, the CLP methods are used and the CLP data package generated. The Navy audit and performance sample are required in addition to any specified by the EPA Superfund Program.

1.3.3 Level E QC

A site requiring Level E QC will be located away from a populated area, will not be an NPL site, and will have a low probability of litigation. Level E QC includes review and approval of the laboratory QA plan and the site work plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide MPRs on QA. For Level E, the laboratory is not required to have passed a CLP performance sample. Level E allows the use of non-CLP methods but requires that the methods be accepted EPA methods listed in Tables 7.1 through 7.5. All methods used must be EPA or equivalent. Further discussion about these methods is presented in

Sect. 7. Level E QC is also appropriate for analysis of the contents of underground storage tanks where the samples are primarily pure product or waste.

1.4 ROLES AND RESPONSIBILITIES

As indicated in Fig. 1.1, the organizations involved are NEESA, the Navy Engineering Field Division (EFD), and the subcontractors. Each organization has multiple tasks and groups that support the project. Fig. 1.1 includes the structure of the organization related to the IRP process. A brief description of the key roles and responsibilities is listed.

1. Navy Energy and Environmental Support Activity

   NEESA is responsible for ensuring that the quality of laboratory analyses performed during the various phases of the IRP is acceptable. NEESA is also responsible for managing the NCR.

2. Engineering Field Division

   The EIC at the EFD provides the site information and history, provides logistical assistance, specifies the site requires investigation and reviews results and recommendations.

3. Engineer in Charge

   The EIC is responsible for coordinating procurement, finance, and reporting; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors; and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

4. NEESA Contract Representative

   The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans, work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. The questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR. The NCR also provides evaluation of referee samples.

5. Engineering Subcontractor

   Each project has an engineering subcontractor that specializes in setting up the sampling for IRP studies, evaluating the hydrology and geology of a site, assessing risks of contamination, and designing and implementing clean-up techniques. Each engineering firm is required to have a laboratory available to perform sample analysis.

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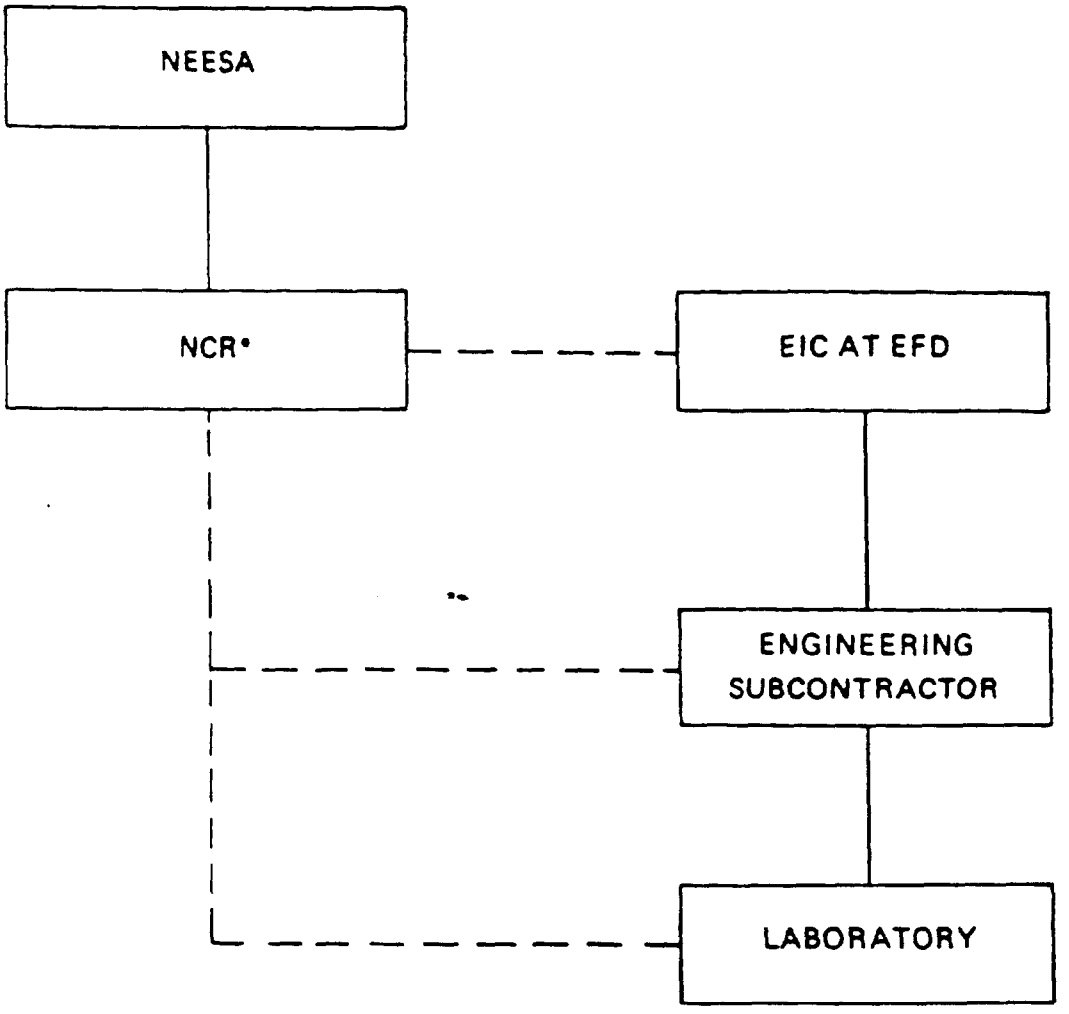

*NCR-MARTIN MARIETTA ENERGY SYSTEMS, INC.

Fig. 1.1. QA Organization

The engineering firm also employs drillers and other personnel to perform IRP tasks. The engineering firm submits a site-specific work plan.

6. Analytical Laboratory

The analytical laboratory is employed by the engineering firm and must adhere to the laboratory requirements in this document. The laboratory is required to prepare and submit a laboratory QA plan, to analyze and submit the results of proficiency testing, to submit to an on-site inspection, and to correct any deficiencies cited during inspection by the NCR. The laboratories are required to identify a LQAC responsible for overall QA. The LQAC must not be responsible for schedule, costs, or personnel other than QA assistants. It is preferred that the LQAC report to the laboratory director. The LQAC must have the authority to stop work on projects if QC problems arise which affect the quality of the data produced.

2. APPROVAL PROCESS

Prior to beginning any field studies or analysis of samples from the field, contract laboratories will be required to receive Navy approval. This section describes the laboratory approval process in terms of the activities and documentation required of participants in the process.

2.1 OVERVIEW

Laboratory approval is necessary to ensure that contract laboratories meet the minimum requirements for a QC program that facilitates the generation of data of defensible accuracy and precision. Specific objectives of the approval process are as follows:

- to communicate Navy's QC requirements to the laboratories,
- to verify that such requirements are being met by each laboratory prior to analysis of Navy field samples,
- to establish plans for maintaining the QC program while work is being done for the Navy, and
- to ensure that proper communication and planning have been done between the engineering subcontractor and the laboratory prior to the laboratory receiving samples.

The above objectives will be met through an approval process that includes the following elements:

- proficiency testing through analysis of performance samples,
- laboratory inspection and audit,
- reviewing laboratory QA plans,
- reviewing site-specific QC plans, and
- reviewing of sampling plans including QC procedures.

The overall process and the above elements are described in detail in the remainder of this section.

2.1.1 The Laboratory Approval Process

The laboratory approval process, as depicted in Fig. 2.1, begins with the engineering subcontractor awarding a contract to the laboratory. The engineering subcontractor is responsible for supplying a site-specific work plan to the NCR. The laboratory and engineering contractors are required to prepare a site-specific work plan and laboratory QA plan.

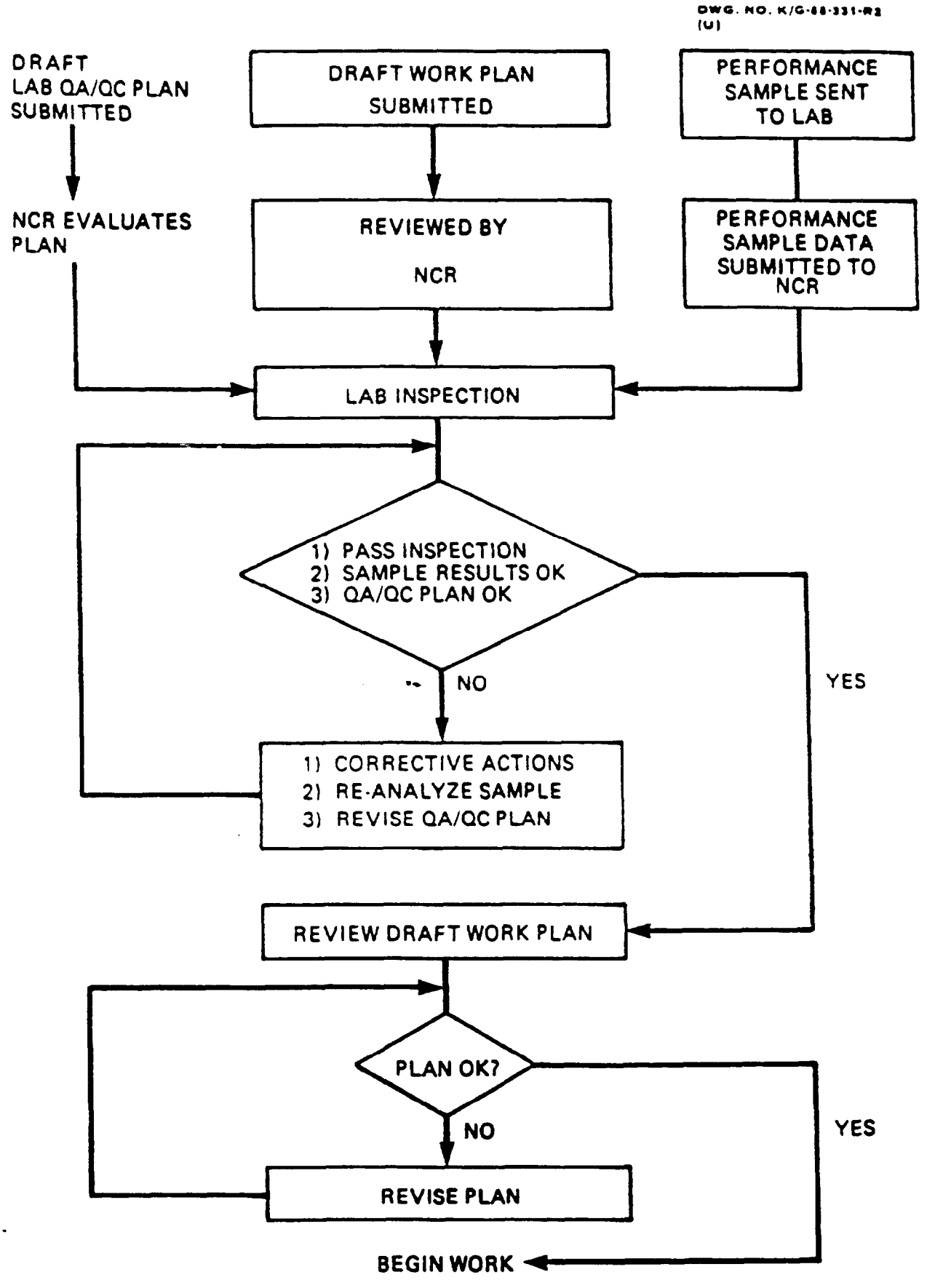

Fig. 2.1. Approval and Review Process

The site-specific work plan shall include a section on QA. This section shall either outline the field and laboratory QA or shall reference documents which outline the QA procedures. The laboratory shall successfully analyze proficiency samples. The site-specific work plan, QA plans, and the results of the proficiency test are submitted to the NCR who will evaluate this information. The QA plans, the proficiency test results, and a draft work plan shall be received and evaluated by the NCR prior to scheduling a laboratory inspection. Based on the results of these evaluations and the inspection, the laboratory and engineering firm may be required to revise their QA plans, to retest a proficiency sample(s), to revise the work plan, or to prepare and implement a corrective action plan addressing deficiencies cited during the inspection.

Approval to begin work on samples is based on a combination of satisfactory QA plans and a site-specific work plan, satisfactory results of proficiency testing, and acceptable laboratory inspection. Approval may be granted to perform all or part of the methods required for a study.

2.1.2 Laboratory Reapproval

If a laboratory is requested to analyze samples from a second site, the NCR will evaluate the similarity between the analysis from the first and the second sites. The past performance of the laboratory and the time elapsed from previous sample analysis determine the steps the laboratory must follow to be reapproved. If a laboratory has performed well in the past, if the methods in the first and second work plan are similar, and if it has been less than a year since the first approval, the engineering contractor may only need to submit the site work plan, and work may proceed. If the laboratory's past performance was satisfactory but it has been longer than a year since a performance sample was analyzed, the laboratory must successfully analyze a new performance sample.

Any changes in personnel or general laboratory QA must be submitted to the NCR prior to receiving approval to begin the next site.

Figure 2.2 shows a flow diagram of the reapproval process.

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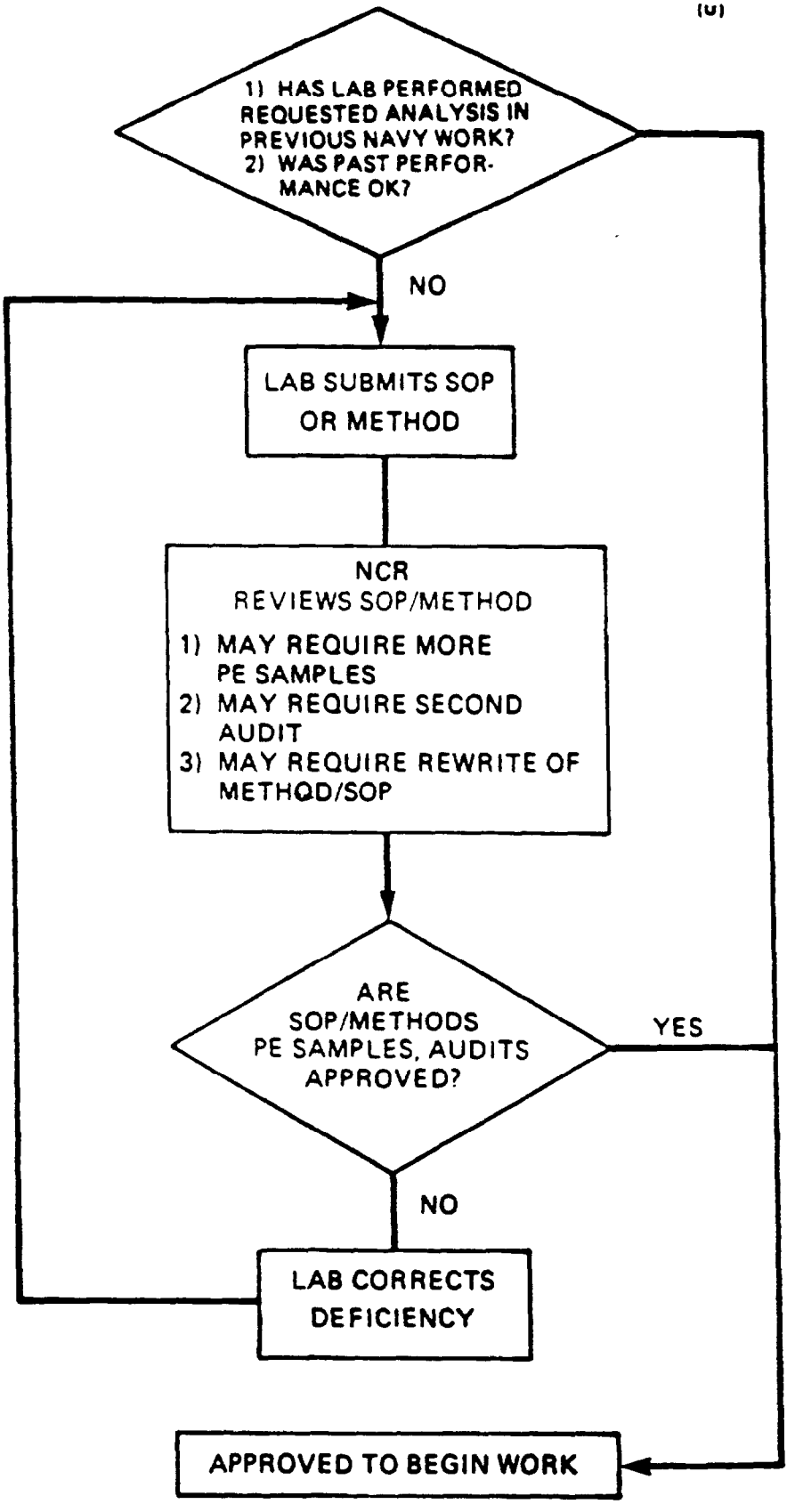


Fig. 2.2. Laboratory Reapproval Process

3. SITE-SPECIFIC QC REQUIREMENTS

The following are the requirements for the site-specific QC section to be included in the site-specific work plan or to be presented as a separate QC document.

3.1 CONTENTS OF SITE-SPECIFIC QC SECTION

1. The laboratory must be identified along with all other subcontractors.

2. Any pertinent state environmental or EPA federal/regional requirements shall be presented. This includes specific procedures or clean-up levels.

3. References must be made to the appropriate corporate or laboratory QA plans which contain pertinent information.

4. A discussion of COC and shipping practices must be provided.

5. Tables of the following shall be included.

   - Analytical methods and numbers of samples of each matrix to be collected at each site.

   - List of analytes to be identified and quantitated.

   - List of holding times, preservatives, amount of sample required, and container requirements.

   - List of the number, type, and matrix of field and laboratory QC samples by site. This includes trip blanks, equipment rinsates, field blanks, field duplicates, laboratory method blanks, laboratory matrix spikes and duplicates.

   - List of sample volume and bottles vs method.

6. All site-specific field sampling procedures which are not included in any corporate QA plan shall be presented.

7. Decontamination procedures for both drilling and sampling equipment shall be described.

8. Data quality objectives shall be discussed. This shall include precision, accuracy, and completeness required for acceptable data.

3.2 STATE AND REGION REQUIREMENTS FOR SITE QC PLAN

In addition to, or in place of, the requirements in this document, those requirements specific to the state or EPA region applicable to the

site shall be considered. Any state- or region-specific requests must be addressed in the site work plan.

3.3 SAMPLING DESIGN

Every site is unique in its own way. To this end, a sampling rationale shall be included with the work plan. The rationale should define and explain thoroughly the sampling statistics, the equipment involved, and anticipating data to be gained by this proposed methodology.

3.4 PRESERVATIVES

After samples have been taken, they shall be sent to the laboratory for analysis within 24 h after collection to ensure that the most reliable and accurate answers will be obtained as a result of the analysis. The holding time begins from the date of collection in the field. Preservatives shall be added in the field. Tables 3.1, 3.2, and 3.3 present the holding times, type of containers, and preservatives to be used. A table corresponding to each of the three different methods such as those from the *Federal Register; SW-846* 3rd ed.; and CLP is presented. The site-specific plan shall outline which preservatives will be used, and it shall be based on these tables. Freezing of samples shall not be permitted.

3.5 SAMPLE CONTAINER CLEANING PROCEDURES

In general, glass bottles with Teflon lids are used for organic samples, while polypropylene is used for metals and other inorganics. The following specifies the bottle cleaning required. If precleaned bottles are purchased, this must be noted in the work or field QA plan and approved by the NCR. If precleaned bottles are used, a certificate indicating that the bottles are analyte free must be provided.

3.5.1 Cleaning Procedure for Glass Bottles

1. Wash glass bottles, Teflon liners, and caps in hot tap water with laboratory-grade nonphosphate detergent.

2. Rinse three times with tap water.

3. Rinse with 1:1 nitric acid (metals-grade), American Society for Testing Materials (ASTM) Type I deionized water.

4. Rinse three times with ASTM Type I deionized water.

5. Rinse with pesticide-grade methylene chloride using 20 mL for 1/2-gal container and 5 mL for 4- and 8-oz containers.

6. Oven dry at 125°C. Allow to cool to room temperature in an enclosed contaminant-free environment.

Table 3.1 Required containers, preservation techniques, and holding times (40 CFR, Part 136, July 1, 1987)

Parameter No./name	Container[1]	Preservation[2,3]	Maximum holding time[4]
Table IA—Bacterial Tests			
1-4 Coliform, fecal and total	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	6 hours
5 Fecal streptococci	P, G	do	24 hours
Table IB—Inorganic Tests			
1 Acidity	P, G	Cool, 4°C	14 days
2 Alkalinity	P, G	do	14 days
4 Ammonia	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
9 Biochemical oxygen demand	P, G	Cool, 4°C	48 hours
11 Bromide	P, G	None required	28 days
14 Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours
15 Chemical oxygen demand	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
16 Chloride	P, G	None required	28 days
17 Chlorine, total residual	P, G	do	Analyze immediately
21 Color	P, G	Cool, 4°C	48 hours
23-24 Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH > 12, 0.6g ascorbic acid[6]	14 days[7]
25 Fluoride	P	None required	28 days
27 Hardness	P, G	HNO_3 to pH < 2, H_2SO_4 to pH < 2	6 months
28 Hydrogen ion (pH)	P, G	None required	Analyze immediately
31, 43 Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
Metals[8]			
18 Chromium VI	P, G	Cool, 4°C	24 hours
35 Mercury	P, G	HNO_3 to pH < 2	28 days
2, 3-6, 10, 12, 13, 19, 20, 22, 26, 29, 30, 32-34, 36, 37, 45, 47, 51, 52, 58-60, 62, 63, 70-72, 74, 75 Metals, except chromium VI and mercury	P, G	do	6 months
38 Nitrate	P, G	Cool, 4°C	48 hours
39 Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days[9]
40 Nitrite	P, G	Cool, 4°C	48 hours[9]
41 Oil and grease	G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
42 Organic carbon	P, G	Cool, 4°C, HCl or H_2SO_4 to pH < 2	28 days
44 Orthophosphate	P, G	Filter immediately. Cool, 4°C	48 hours
46 Oxygen, Dissolved Probe	G Bottle and top	None required	Analyze immediately
47 Winkler	do	Fix on site and store in dark	8 hours
48 Phenols	G only	Cool, 4°C, H_2SO_4 to pH < 2	28 days
49 Phosphorus (elemental)	G	Cool, 4°C	48 hours[9]
50 Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to pH < 2	28 days
53 Residue, total	P, G	Cool, 4°C	7 days
54 Residue, Filterable	P, G	do	48 hours
55 Residue, Nonfilterable (TSS)	P, G	do	7 days
56 Residue, Settleable	P, G	do	48 hours
57 Residue, volatile	P, G	do	7 days
61 Silica	P	do	28 days
64 Specific conductance	P, G	do	28 days
66 Sulfate	P, G	do	28 days
68 Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to pH > 9	7 days
67 Sulfite	P, G	None required	Analyze immediately
69 Surfactants	P, G	Cool, 4°C	48 hours
69 Temperature	P, G	None required	Analyze
73 Turbidity	P, G	Cool, 4°C	48 hours
Table IC—Organic Tests[10]			
13, 18-20, 22, 24-26, 34-37, 38-43, 45-47, 56, 66, 68, 69, 82-85, 97 Purgeable Halocarbons	G Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	14 days
8, 57, 60 Purgeable aromatic hydrocarbons	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], HCl[11] to pH 2[12]	28 days
3, 4 Acrolein and acrylonitrile	do	Cool, 4°C, 0.008% $Na_2S_2O_3$[5], Adjust pH to 4-5[13]	28 days
23, 30, 44, 49, 53, 67, 70, 71, 83, 85, 86 Phenols[14]	G Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
7, 38 Benzidines[14]	do	do	7 days until extraction[15]
14, 17, 48, 50-52 Phthalate esters[14]	do	Cool, 4°C	7 days until extraction, 40 days after extraction
72-74 Nitrosamines[14,16]	do	Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$	28 days
75-82 PCBs[14] acrylonitrile	do	Cool, 4°C	28 days
54, 55, 65, 68 Nitrobenzenes and isophorone	do	Cool, 4°C, 0.008% $Na_2S_2O_3$, store in dark	28 days
1, 2, 5, 8-12, 32, 33, 58, 59, 64, 68, 84, 86 Polynuclear aromatic hydrocarbons[14]	do	do	28 days
15, 16, 21, 31, 75 Haloethers[14]	do	Cool, 4°C, 0.008% $Na_2S_2O_3$	28 days
79, 35-37, 60-63, 91 Chlorinated hydrocarbons[14]	do	Cool, 4°C	28 days
87 TCDD[14]	do	Cool, 4°C, 0.008%, $Na_2S_2O_3$	28 days
Table ID—Pesticides Tests			
1-70 Pesticides[14]	do	Cool, 4°C, pH 5-9[17]	28 days
Table IE—Radiological Tests			
1-5 Alpha, beta and radium	P, G	HNO_3 to pH < 2	6 months

[1] Polyethylene (P) or Glass (G).

[2] Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of automatic sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

[3] When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). This portion deals with material for transportation is responsible for ensuring both compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.82 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details.

[5] Should only be used in the presence of residual chlorine.

[6] Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

[7] Samples should be filtered immediately on-site before adding preservatives for dissolved metals.

[8] Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[9] Samples receiving no pH adjustment must be analyzed within seven days of sampling.

[10] The pH adjustment is not required if acrolein and not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

[11] When the extractable analysis of samples fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analysis of samples fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, filling to the brim, and adjusting the pH to 5-9. Samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to the general preservation and holding time procedure are noted in footnotes 5 (for the requirement for immediate reduction of residual chlorine), and footnotes 12, 13 (for the analysis of benzidine).

[12] If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

[13] Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (nitrogen) atmosphere.

[14] For the analysis of diphenylhydrazine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

[15] The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of diuron, add 0.008% $Na_2S_2O_3$.

Table 3.2 Preservative and holding times for the contract laboratory protocol

Parameter	Container	Preservative	Holding Time Soil	Holding Time Water
Volatiles by gas chromatography/mass spectroscopy (GC/MS)	Water - 40-mL glass vial with Teflon-lined septa	Cool, 4°C	10 days	10 days
	Soil-glass with Teflon-lined septa			
PCB/ pesticides	G, Teflon-lined-lid	Cool, 4°C	Extract within 10 days, analyze 40 days	Extract within 5 days, analyze 40 days
Extractable organics	G, Teflon lined-lid	Cool, 4°C	Extract within 10 days, analyze 40 days	Extract within 5 days, analyze 40 days
Metals	P, G	HNO_3 to pH<2	6 months	6 months
Mercury	P, G	HNO_3 to pH<2	26 days	26 days
Cyanide	P, G	NaOH to pH>12 Cool 4°C add 0.6 g ascorbic acid if residual chlorine present	14 days	14 days
Chromium VI	P, G	HNO_3 to pH<2	24 h	24 h

7. Place liners in lids and cap containers.

8. Store in contaminant-free area. (Amber glass containers shall not be exposed to sunlight).

Table 3.3 Preservatives and holding times for EPA-document SW-846 (3rd ed.)

Parameter	Container	Preservative	Holding Time Soil	Holding Time Water
Volatiles by GC/MS, and GC	Water - 40-mL glass vial with Teflon-lined septa Soil-glass with Teflon-lined septa	Cool, 4°C	14 days	14 days
PCB/ pesticides	G, Teflon-lined lid	Cool, 4°C	Extract within 7 days, analyze 40 days	Extract within 7 days, analyze 40 days
Extractable organics	G, Teflon-lined lid	Cool, 4°C	Extract within 7 days, analyze 40 days	Extract within 7 days, analyze 40 days
Metals	P, G	HNO_3 to pH<2	6 months	6 months
Mercury	P, G	HNO_3 to pH<2	28 days	28 days
Cyanide	P, G	NaOH to pH>12 Cool 4°C add 0.6 g ascorbic acid if residual chlorine present	14 days	14 days
Chromium	P, G	HNO_3 to pH<2	24 h	24 h

3.5.2. Cleaning Procedure for Bottles Used for Volatile Organics (40-mL Glass)

1. Wash glass vials, Teflon-backed septa, Teflon liners, and caps in hot tap water using laboratory-grade nonphosphate detergent.

2. Rinse three times with tap water.

3. Rinse three times with ASTM Type I deionized water.

4. Oven dry vials, septa, and liners at 125°C.

5. Allow vials, septa, and liners to cool to room temperature in an enclosed contaminant-free environment.

6. Seal 40-mL vials with septa (Teflon side down) and cap.

7. Store in contaminant-free area.

3.5.3. Cleaning Procedure for Polyethylene Bottles

1. Wash polyethylene bottles and caps in hot tap water with laboratory-grad nonphosphate detergent.

2. Rinse with 1:1 nitric acid (metals-grade), ASTM deionized water).

3. Rinse three times with ASTM Type I deionized water.

4. Invert and air dry in contaminant-free environment.

3.5.4. All Bottles Should Be

1. Capped and labeled with sample numbers and packed in cooler or box.

2. Stored in contaminant-free area.

3.6 ORGANIZATION AND PERSONNEL

All management personnel responsible for performing field sampling or analytical work shall be listed along with their job assignment and years of experience in performing this type of work. Any education and training related to the tasks performed for this project shall also be listed.

3.7 FIELD QC SAMPLES

Although the number of QC samples changes, the types of field QC samples remain the same regardless of the level of QC implemented. Table 3.4 lists the percentage of field QC samples per level per sample matrix. A sampling event is considered to be from the time the sampling personnel arrive at the site until these personnel leave for more than a day. An example of two events would occur if sampling personnel went to a site for three weeks, drilled borings, and put groundwater wells in place. During this visit, soil and water samples were collected. The sampling crew left the site for two months, thus concluding the first sampling event. The crew later returned to collect another set of groundwater samples over a three-day period. The second visit would constitute the second sampling event.

Table 3.4. Field QC samples per sampling event

Type of Sample	Level C		Level D		Level E	
	Metal	Organic	Metal	Organic	Metal	Organic
Trip blank (for volatiles only)	NA[1]	1/cooler	NA[1]	1/cooler	NA[1]	1/cooler
Equipment rinsate[2]	1/day	1/day	1/day	1/day	1/day	1/day
Field blank	1/source/event for all levels and all analytes					
Field duplicates[3]	10%	10%	10%	10%	5%	5%
Referee duplicate[3]						

[1]NA - Not applicable.

[2]Samples are collected daily; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contamination exists.

[3]The duplicate must be taken from the same sample which will become the laboratory matrix/spike duplicate for organics or for the sample used as a duplicate in inorganic analysis.

The following information defines and explains the blanks, duplicates, and referee samples.

1. Trip Blanks

Trip blanks are defined as samples which originate from analyte-free water taken from the laboratory to the sampling site and returned to the laboratory with the volatile organic (VOA) samples. One trip blank should accompany each cooler containing VOAs, should be stored at the laboratory with the samples, and analyzed by the laboratory. Trip blanks are only analyzed for VOAs.

2. Equipment Rinsates

Equipment rinsates are the final analyte-free water rinse from equipment cleaning collected daily during a sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining samples must be analyzed. The results from the blanks will be used to flag or assess the levels of analytes in the samples. This comparison is made during data validation. The rinsates are analyzed for the same parameters as the related samples.

3. Field Blanks

Field blanks consist of the source water used in decontamination and steam cleaning. At a minimum, one field blank from each event and each source of water must be collected and analyzed for the same parameters as the related samples.

4. Field Duplicates/Splits

Duplicates or splits for soil samples are collected, homogenized, and split. All samples except VOAs are homogenized and split. Volatiles are not mixed, but select segments of soil are taken from the length of the core and placed in 40-mL glass vials. Cores may be sealed and shipped to the laboratory for subsampling if the project deems this appropriate. The duplicates for water samples should be collected simultaneously. Field duplicates should be collected at a frequency of 10% per sample matrix for Levels D and C. For Level E, the duplicates should be analyzed at a frequency of 5%. All the duplicates should be sent to the primary laboratory responsible for analysis. The same samples used for field duplicates shall be split by the laboratory and be used as the laboratory duplicate or matrix spike. This means that for the duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

5. Referee Duplicates

Duplicates/splits shall be sent to the referee QA laboratory if regulators (state or region) collect split samples or if a special problem occurs in sample analysis or collection. These duplicates/splits are collected and analyzed in addition to the field duplicates mentioned in the previous paragraph.

3.8 CHAIN OF CUSTODY

Samples, other than those collected for *in situ* field measurements or analyses, are identified by using a standard sample label which is attached to the sample container. The sample labels are sequentially numbered and are accountable. The following information shall be included on the sample label.

1. Site name.
2. Field identification or sample station number.
3. Date and time of sample collection.
4. Designation of the sample as a grab or composite.
5. Type of sample (matrix) and a brief description of the sampling location.
6. The signature of the sampler.
7. Sample preservation and preservative used.
8. The general types of analyses to be conducted.

If a sample is split with another party, sample labels with identical information shall be attached to each of the sample containers.

The COC record is used to record the custody of samples and shall accompany samples at all times. The following information shall be supplied to complete the COC record.

1. Project name.
2. Signature of samplers.
3. Sampling station number or sample number, date and time of collection, grab or composite sample designation, and a brief description of the type of sample and sampling location.
4. Signatures of individuals involved in sample transfer (i.e., relinquishing and accepting samples). Individuals receiving the samples shall sign, date, and note the time that they received the samples on the form.
5. Matrix.

Sample analysis request sheets serve as official communication to the laboratory of the particular analyses required for each sample and provide further evidence that the COC is complete.

COC records initiated in the field shall be placed in a plastic cover and taped to the inside of the shipping container used for sample transport from the field to the laboratory.

3.9 SHIPPING REQUIREMENTS

Shipping containers shall be secured using nylon strapping tape and custody seals to ensure that samples have not been disturbed during transport. The custody seals shall be placed on the containers so they cannot be opened without breaking the seal.

Samples which must be kept at 4°C shall be shipped in insulated containers with either freezer forms or ice. If ice is used, it shall be placed in a container so that the water will not fill the cooler as the ice melts. The samples shall be shipped within 24 h of collection to allow the laboratory to meet holding times. The Department of Transportation regulations shall be used for packaging, quantities of shipment, and the way samples are sent. Each subcontractor responsible for sampling shall become familiar with the regulations.

Copies of the signed COC forms shall be delivered with the data packages. The originals shall remain on file with the contractor or with the laboratory.

3.10 SAMPLE RECEIPT

Upon receipt, the laboratory shall sign and keep copies of the air bill. The COC shall be signed. The temperature of the cooler shall be

measured and documented. The condition of the samples shall be documented. If any breakage or discrepancy arises between COC, sample labels, and requested analysis, the sample custodian will notify the engineering subcontractor. The pH of incoming samples shall be checked and documented upon receipt. Any discrepancy or improper preservation shall be noted by the laboratory as an out-of-control event and shall be documented on an out-of-control form with the corrective action taken. The out-of-control form shall be signed and dated by the custodian and any other person responsible for corrective action.

4. LABORATORY QA PLAN REQUIREMENTS

An essential step in the sequence of events leading to Navy approval of contract laboratories is the preparation and acceptance of a QA plan for each laboratory.

The contents and format of an acceptable plan are described below. If the laboratory has a general QA plan in place, this should be sent for review. In this case, a site-specific QA plan may not be needed. Any deviations or additions to the normal laboratory QA should be documented in the site-specific work plan.

4.1 PURPOSE AND SCOPE

The QA plan is a statement of the laboratory's approach to ensuring that quality data are generated from the analysis of Navy samples. In the context of laboratory approval, the plan provides a basis for evaluating a laboratory's QC procedures. This evaluation includes a critical review of the plan and verification of the laboratory's adherence to the plan through inspection.

4.2 ORGANIZATION AND CONTENTS OF PLAN

The items listed below may be presented in any order that the laboratory desires; however, the list includes the items that are required in the QA plan.

1. Title Page with Provision for Signatures
2. Table of Contents
3. Organization and Personnel
4. Personnel Training
5. Sample-Handling Practices and COC
6. Material Procurement and Control
7. Facilities and Equipment
8. Equipment Maintenance
9. Analytical Procedures
10. Calibration
11. Limits of Detection
12. Analysis of QC Samples and Documentation
13. Out-of-Control Events and Corrective Action
14. Data Evaluation and Data Reduction
15. Holding Times and Preservatives
16. Internal Laboratory Audits and Approvals from Other Agencies
17. Document Control
18. QA Reports to Management
19. Accuracy, Precision, and Completness

1. Title Page with Provisions for Signature

   A title page with provision of approval signatures and date of revision shall be provided.

2. Table of Contents

   A table of contents shall be provided.

3. Laboratory Organization and Personnel

   This section provides an overview of the laboratory organization as it relates to implementation of the QC program. The roles, responsibilities, and authority of key laboratory personnel are described with emphasis on the authority given the LQAC with regard to QC monitoring, reporting, and corrective action.

   An appendix shall contain a list of all the personnel, their assignments and responsibilities, degrees of education, and the years of applicable experience.

4. Personnel Training

   The plan shall address how personnel are trained in laboratory methods, in QC, and in safety policies.

5. Sample-Handling Practices and COC

   This section shall include tracking of samples through the laboratory, receipt of samples, verification of preservation, login of samples, and COC. Sample storage and disposal shall also be included. Preparation of bottles and glassware washing shall also be included.

6. Material Procurement and Control

   This section shall include a description of procedures for purchasing materials, quality inspection prior to use in sample analysis, chemical and standard inventory, solvent storage policies, and laboratory waste disposal.

7. Facilities and Equipment

   A list of basic types of equipment, year of purchase, and general description of the facility assures that the laboratory is large enough to handle the sample load expected and that the equipment is capable of performing the analysis.

8. Equipment Maintenance

   This section shall include general information as to who performs both major, preventive, and day-to-day maintenance and how it is documented.

9. Analytical Procedures

This section shall contain a list of all procedures that the laboratory offers (by method number and matrix) in the event that future work may require analyses not specified in the SOW.

Any method variances must be reported, and any documentation from EPA for approvals-of-method variances shall be presented to assure that they are known prior to sample analysis.

The laboratory policy and implementation procedures shall emphasize that methods are available to the analyst.

10. Calibration

This section shall include calibration procedures by instrument type, calibration frequency, reference standards used, calibration acceptance criteria, and calibration documentations procedures. Calibration applies to both instruments such as gas and liquid chromatography, GC/MS, inductively coupled plasma (ICP), atomic absorption (AA), infrared and ultraviolet spectroscopy, and wet chemical methods.

The method for assuring that balances, refrigerators, and ovens are accurate and how these pieces of equipment are checked must be outlined. Balances and ovens must be checked prior to use. Balances must also be checked by an outside company annually.

11. Limits of Detection

The laboratory shall indicate what the typical method-detection limits are for water, soil, and any other matrix commonly analyzed by the laboratory, with the understanding that this varies with the sample matrix. The procedures for determining the limits of detection for each type of method and the frequency of detection limit verification shall be outlined.

12. Analysis of QC Samples and Documentation

This section shall summarize the QC procedures and documentation to be used in the day-to-day operation of the laboratory. The discussion shall emphasize the following:

- analysis of field, method, and reagent blanks;
- analysis of duplicates, spiked samples, spiked laboratory blanks, and reference or control standards such as EPA check standards;
- the criteria used to establish warning and action limits for the above types of QC samples;

- documentation and examples of control data and control charts (see Sect. 4.4) for explanation of control charts and their usage;
- the frequency of blanks and other QC samples and controls;
- how the data from the QC samples are reported and reviewed;
- who reviews and makes decisions from the QC data;
- details of how requirements of minimum control program in Sect. 8.2 will be met; and
- verification of calibration.

13. Out-of-Control Events and Corrective Action

This section shall contain a definition as to the types of out-of-control occurrences, how these occurrences are documented, and who is responsible for correction and documentation. It is recognized that several out-of-control events occur. Four examples are given.

- Observations Corrected at the Bench - If the calibration of an instrument is not linear, the analyst may find this and correct it prior to continuing to analyze samples. The laboratory may document this and note that the corrective action was to recalibrate and that no samples were affected, as none were analyzed prior to calibration.
- Corrective Actions Taken by Supervisor - A matrix spike recovery is out of control and the laboratory supervisor finds this after the samples for the day have been analyzed. The supervisor shall document that the laboratory blank spiked with surrogates or standards was in control and that other sample spikes were in control; therefore, no reanalysis of the sample is required.
- Corrective Actions at the Receiving Level - If the sample is broken, the analyst may note this and document whether or not more sample is available. If no more sample is available, the customer shall be notified and the decision documented.
- Statistical Out-of-Control Events - If a control chart is being monitored and the measured parameter exceeds the 99% confidence limit then explanation shall be documented as to when the parameter exceeded statistical limits.
    - Procedures shall be outlined as to what corrective action is taken if an out-of-control event occurs and how it is documented and used to improve laboratory performance. The documentation shall be easily used by all personnel and shall be part of routine laboratory procedure.

- Procedures for assuring that results for samples processed during out-of-control conditions are not reported shall be outlined.

- The conditions necessary to reestablish control and criteria for assuring the system is operating properly.

14. Data Evaluation and Data Reduction

A discussion of data evolution procedures for each analytical method as well as for an entire data set shall be included. The process of certification of reviewed data shall be outlined with an explanation of how suspect data are flagged if they are suspect but still reported.

15. Holding Times and Preservatives

The document shall include laboratory policy for meeting holding times for sample analysis and how it is assured that these are met. The sample storage requirements, holding times, and preservatives specified in Tables 3.1, 3.2 and 3.3 are minimal criteria for Navy approval.

16. Internal Laboratory Audits and Approvals from Other Agencies

A listing of approvals from other agencies and states gives an indication of the general quality and type of laboratory experience the organization has. If the laboratory performs self-audits, the frequency and method of documentation shall be outlined.

17. Document Control

The QA plan shall outline the flow of documents containing COC and data. The plan shall explain how documents are checked, signed, and filed.

18. QA Reports to Management

The plan shall include the frequency and information of management QA reports.

19. Accuracy, Precision, and Completeness

The plan shall include the laboratory's definition and method of evaluating the precision, accuracy, and completeness of measurement parameters and of evaluating data sets.

4.3 CONTROL SAMPLES

Control samples are those samples containing known concentrations of analytes that are introduced into a run of environmental samples to

monitor the performance of the analytical system. Control samples involving duplicates, blanks, analytical standards, reference materials, and spikes can be used in different phases of the overall analysis from sampling through storage, transportation, and preparation to the analytical method itself. The choice of types of controls relates to the analysis phase(s) to be controlled and the information (e.g., precision, accuracy, interferences, recovery) to be developed.

The QA plan describes generally how and where such control mechanisms are used by the laboratory. Control materials may be purchased from commercial sources, the National Bureau of Standards, or the EPA. A brief description of each control sample (or set of samples) used shall be provided in the MPR, subsequent to its introduction, and shall cover the following items.

1. Where the control samples are made.

2. How they are made.

3. How many are made and with what frequency.

4. How they are used.

   - Physically (e.g., placed in the sample tray along with 14 environmental samples just before the samples enter the processing stream).

   - Analytically (e.g., used to determine the recovery factor of the procedures; used to check for interferences).

5. Frequency of analysis of control sample.

4.4 CONTROL CHARTS

Control charts provide a useful tool in assessing QC efforts and improving processes through graphic displays of a parameter(s) and its variability over time. The parameter plotted on the chart is usually related to control sample testing--either directly in terms of concentrations or indirectly in terms of derived information such as means of concentrations, ranges of concentrations, percent recovery of spikes, relative percent differences based on duplicate results, or slopes of least-squares data fits.

The laboratory should include in its QA plan, as required in Sect. 4.2, a brief description of the basic methodology used in control charting, covering such considerations as the following.

1. Verification that the methods are valid and working properly prior to beginning control charts.

2. Number of control samples per run.

3. Number of runs analyzed.

4. Parameters to be plotted against time and the general formulae for developing these parameters.

5. Statistical/mathematical basis for assigning warning and rejection limits on the charts in terms of, for example, standard deviation.

6. Types of shifts, trends, or biases that may typically be revealed by these charts.

4.4.1 Method Blank/Spike Control Program

Controls are required for only the methods and analytes pertinent to the program. The laboratory shall employ a measurement-control program which, as a minimum, consists of monitoring the results of laboratory preparation and analysis of control samples using statistical control charts. The basis of this program is to demonstrate that the laboratory method for sample preparation and analysis is working properly. This minimum program consists of using the laboratory's distilled and/or deionized water and spiking it with known compounds or elements. By plotting the results of the method blank spike on control charts, a true picture of the actual process of sample analysis is obtained with fewer problems from matrix effects and sample nonhomogeneity. This information, used in conjunction with matrix spike recoveries, can aid in determining whether an out-of-control condition is due to laboratory problems or matrix problems. Therefore, one batch of control material is the spiked laboratory blank water. The second batch of control material is a soil or sand. This soil can be pulverized and homogenized. If the soil used is known to contain some of the analytes of interest, then no spiking may be required. Additional spiking may be done to an aliquot of control soil just prior to sample preparation. The method blank/spike water (laboratory water) should be analyzed when water samples are analyzed and the method blank/spike soil analyzed alongside soil or waste samples.

The analytes selected for spiking should be representative of the compound class for the organics. It is suggested that the surrogates used for volatiles and base/neutral/acids (BNAs) analyses be used as control analytes for the GC/MS methods. At least two pesticides should be used when pesticide methods are performed and one polychlorinated biphenyl (PCB) when PCBs are analyzed. For wet chemical methods, a single spike of an appropriate control for each method may be used. As an example for cyanide, a control of sodium cyanide from a source other than that used for calibration may be spiked into water and analyzed alongside the water samples. For the metals, it is suggested that at least three of the metals typically analyzed by ICP be monitored and that each element analyzed by furnace or flame atomic absorption be monitored.

4.4.2 Control Sample Quality

The laboratory QA plan shall describe the steps which will be taken to ensure and verify the quality of the two types of control samples of Sect. 4.4.1. The QA plan shall address the following concerns pertaining to the control batches.

1. How the batch will be selected.
2. Shelf life of control batch.
3. Under what conditions the batch will be stored.
4. How the batch will be homogenized.
5. How and when the individual samples will be taken.
6. How and when the sample will be spiked.
7. How the batch will be replaced as it is depleted.
8. How the control charts will be affected by changes in batches.

The QA plan shall address the following concerns pertaining to the spikes.

1. What compound/element will be used to spike.
2. How the spike material will be selected.
3. Target concentration of spiking compound/element.
4. How long the spike is expected to last.
5. Under what conditions the spike will be stored.
6. How the spike will be homogenized.
7. How and when the individual samples will be taken.
8. How the spike will be replaced as it is depleted.
9. How the control charts will be affected by changes in spikes.

4.4.3 Minimum Statistical Control Charting

As a minimum, the laboratory shall run two control charts for each analyte listed in Table 4.1. These charts shall monitor the laboratory measurements obtained from individually spiked water samples and individually spiked soil samples.

Each control chart shall consist of a center line, two warning limits, and two control limits. The control chart parameters should be calculated according to the formulae provided in Table 4.2. A minimum of 20 points/chart shall be obtained prior to the initial attempt to establish the control chart parameters.

If the laboratory does not have 20 points to use in setting control chart limits, the recommended EPA recoveries for the method will be used until such time as 20 points are attained.

4.4.4 Minimum Criteria for an Out-of-Control Condition

A laboratory process for a particular analyte should be considered out of statistical control whenever, as a minimum, any one of the following conditions is demonstrated by a control chart monitoring that analyte.

1. Any one point is outside of the control limits.
2. Any three consecutive points are outside the warning limits.
3. Any eight consecutive points are on the same side of the centerline.
4. Any six consecutive points are such that each point is larger (smaller) than its immediate predecessor.
5. Any obvious cyclic pattern is seen in the points.

Table 4.1. Typical number of analyses to be monitored through measurement control program

Number	Analyses
10	Metals by AA and ICP
1	Mercury
3	Volatiles
1	Wet chemicals
1	PCB
2	Pesticides
3	Base neutrals
3	Acids

4.4.5 Reactions to Out-of-Statistical-Control Conditions on Control Samples

The laboratory QA plan shall describe the steps which will be taken in the occurrence of an out-of-statistical-control condition from the control charts of Sect. 4.2.3. The steps should be similar to those requested in Sect. 4.6 but shall include those actions related to the quality and stability of the control batches, sampling, spiking, and handling of the control samples.

4.4.6 Administration of the Control Charts

The laboratory QA plan shall address the following aspects of administering the control charts of Sect. 4.4.2.

1. What types of laboratory activities the control charts will monitor.
2. How often control samples will be run.
3. How soon after results are obtained will charts be monitored.
4. Who is responsible for reading the charts.
5. How will changes in people, equipment, processes affect the charts.
6. How often and under what circumstances will limits be updated.

4.4.7 Statistical Quality of the Control Charts

The formulae for the control chart parameters given by Table 4.2 are those commonly accepted and used. They are based on normally distributed measurements and short-term variation. If these bases are inappropriate, the charts will not perform as desired. The charts will either falsely signal out-of-control warnings more frequently than usual, fail to detect existing out-of-control conditions as often as they ordinarily would, or both (for different types of out-of-control states). In order to correct any problems due to improperly fitting control charts, the laboratory may propose alternate methods for setting the control chart parameters for those analytes of Table 4.2. All such proposals

Table 4.2. Control chart formula for Water and Soil Control Batch Program

Definitions

Let X_1, X_2, X_3, ..., X_n ($n \geq 20$) represent the first n time-ordered determinations for an analyte of Table 4.2 from either the water or soil control batch program.

Then, define the following:

$\bar{X}$ = average = $(1/n)(X_1 + X_2 + \ldots + X_n)$,
$Ri = |X_i - X_{(i-1)}|$ $i = 2,3,\ldots,n$
R_2 = average moving range of two successive points,

$$= [1/(n-1)][\,|X_2 - X_1| + |X_3 - X_2| + \ldots + |X_n - X_{(n-1)}|\,] .$$

Control Chart Parameter Estimation

Parameter	Symbol	Formula
Centerline	CL	X
Upper control limit	UCL	$\bar{X} + 3R_2/d_2$
Lower control limit	LCL	$\bar{X} - 3R_2/d_2$
Upper warning limit	UWL	$\bar{X} + 2R_2/d_2$
Lower Warning limit	LWL	$\bar{X} - 2R_2/d_2$

(d_2 = 1.128, factor from tables for control charting within n = 2, see American Society for Quality Control)

should include data and supportive statistical evidence. Possible alternate statistical approaches can include using nonparametric techniques, medians instead of averages for the centerlines, identifying sources of variation, using long-term variation instead of short-term variation in setting limits, and transformations of the data.

4.4.8 Example of Setting Control Limits

As an example of setting control chart parameters and a very brief introduction to interpretation of the chart, consider the following:

A sample is obtained from the batch of control soil which has been thoroughly mixed and is stored in a special atmospherically controlled location. It is carefully spiked with known amounts of the constituents of Table 4.2 and sent to sample preparation to be processed with a customer's solid waste samples. It is analyzed along with the other samples. It is subjected to the same types of treatment as the other samples in the batch. This scenario is repeated until 20 control samples have been analyzed.

The data are listed in Table 4.3. Also shown are calculations according to the formulae in Table 4.2. Figure 4.1 displays the results of the initial attempt at sizing the data to the control chart parameters. The point falling above the upper control limit was investigated. It was determined that the sample had received a double spiking and, thus, was deleted from the second iteration calculation of the chart parameters. Figure 4.2 shows the second fitting. This fit appears adequate, and the chart is approved by the LQAC authority. Had no explanation for the high result been found, the first calculations would have been used. The chart would have been placed under a probationary condition and its performance monitored with guarded caution.

4.5 OUT-OF-CONTROL EVENTS

The interpretation of control charts can reveal shifts, trends, biases, and conditions where parts of the analytical system are out-of-control. The contract laboratory should specify in the QA plan its criteria of defining an out-of-control condition related to the different zones on a control chart [e.g., data beyond the rejection limits, data in the zone(s) between the rejection and warning limits, and data inside the warning limits] and different patterns within these zones [e.g., number of consecutive data points on one side of the mean, number of consecutive data points in the middle zone number of monotically changing data points, obviously repetitive patterns (Garfield, 1984)].

The laboratory shall identify what actions will be taken when the warning and/or control limits are exceeded. Warning conditions may only require more frequent observations of a piece of equipment, while rejection conditions require shutting down an instrument.

Any incident that delays sample processing for a period of time, affects holding times, or delays work by more than two days should immediately be reported by phone to the NCR. The NCR should be informed as soon as the problem is solved and an explanation given as to the corrective action taken. An example of this type of event would be the breakdown of a GC/MS system used for VOAs which could not be repaired for several days. If the laboratory could not use another instrument in its laboratory, then provisions for another approved laboratory to analyze the samples would need to be made.

Table 4.3. Data and calculations for control chart example

Order I	Result X	Moving range $\lvert X_I - X_{I-1} \rvert$
1	12.25	
2	7.52	4.73
3	12.29	4.78
4	10.04	2.25
5	8.48	1.56
6	10.89	2.40
7	9.57	1.32
8	11.40	1.83
9	9.28	2.12
10	11.66	2.39
11	12.06	0.40
12	8.52	3.54
13	11.14	2.62
14	19.56	8.42
15	10.48	9.08
16	9.12	1.35
17	12.79	3.66
18	10.30	2.49
19	5.54	4.76
20	8.93	3.39
Sum	211.82	63.0

First calculations (Fig. 4.1)

Average = 211.82/20 = 10.591
Average moving range = 63.09/19 = 3.321

Centerline = 10.591
Upper control limit = 10.591 + 3 x 3.321/1.128 = 19.423
Lower control limit = 10.591 - 3 x 3.321/1.128 = 1.758
Upper warning limit = 10.591 + 2 x 3.321/1.128 = 16.479
Lower warning limit = 10.591 - 2 x 3.321/1.128 = 4.703

Second Iteration after Removing Point #14 (Fig. 4.2)

Average = 192.26/19 = 10.119
Average moving range = 46.26/18 = 2.570

Centerline = 10.119
Upper control limit = 10.119 + 3 x 2.570/1.128 = 16.954
Lower control limit = 10.119 - 3 x 2.570/1.128 = 3.284
Upper warning limit = 10.119 + 2 x 2.570/1.128 = 14.676
Lower warning limit = 10.119 - 2 x 2.570/1.128 = 5.562

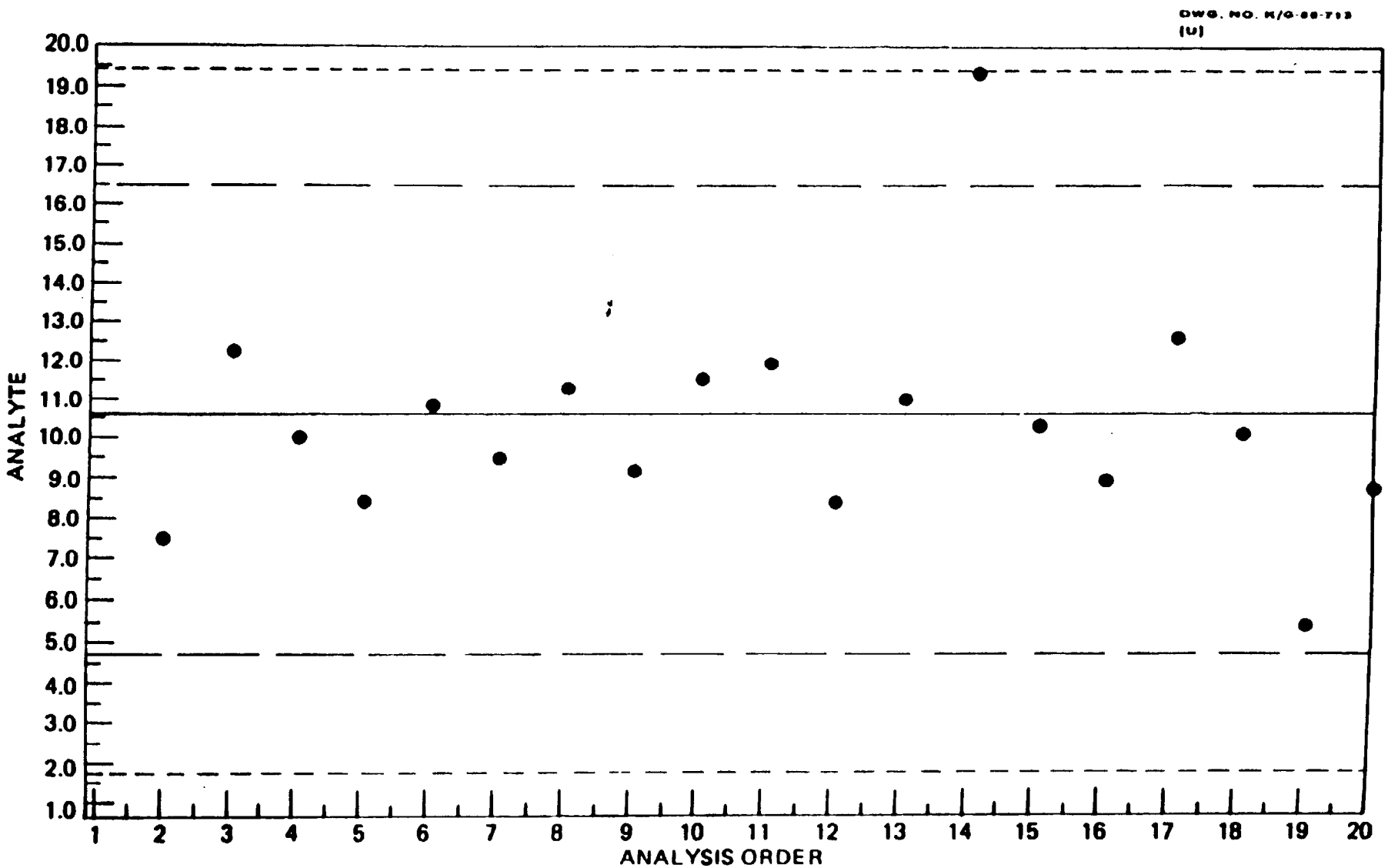


Fig. 4.1. Control Chart Example Data and Control Values of Table 4.3

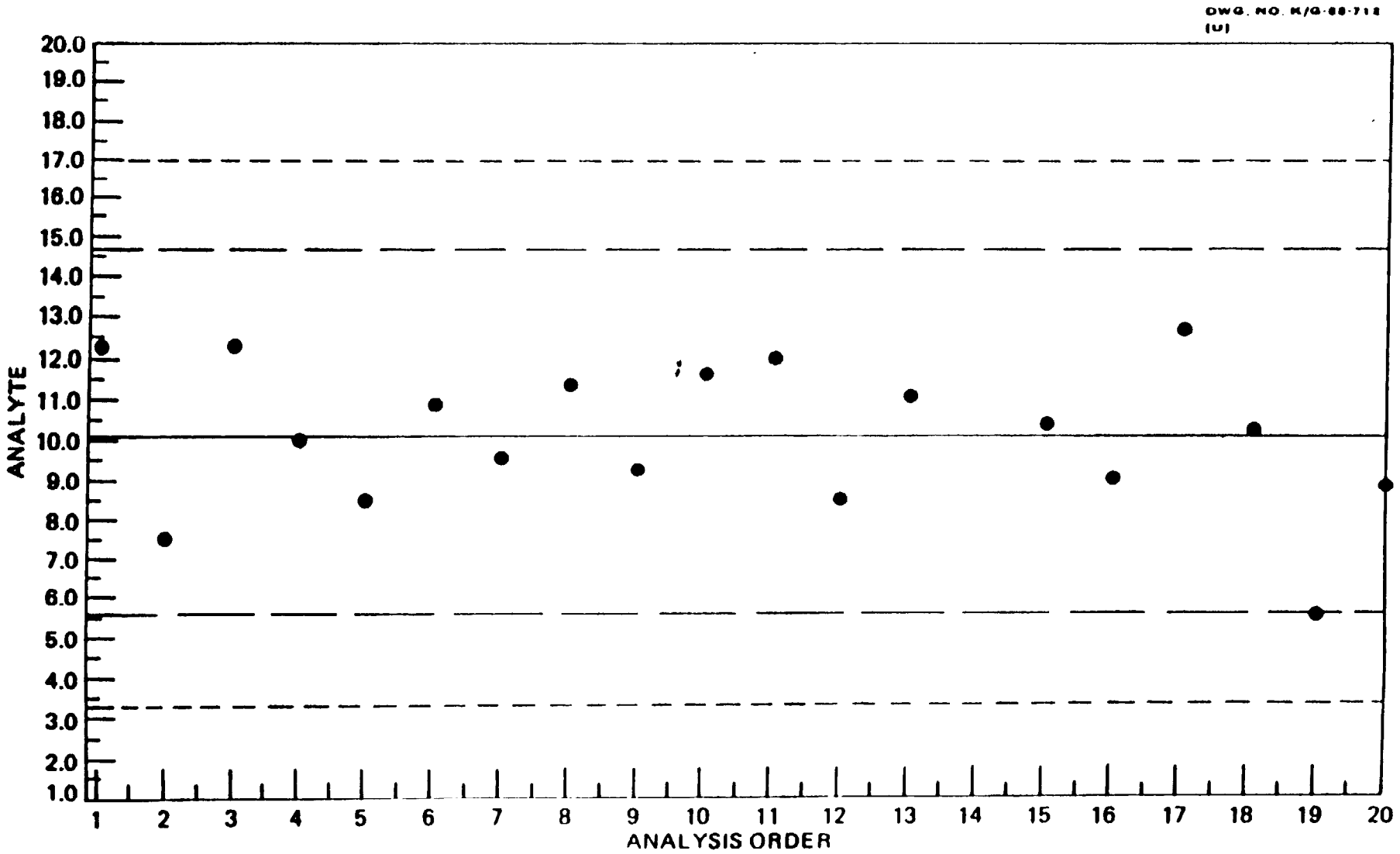


Fig. 4.2. Control Chart Example Data and Second Iteration Control Values of Table 4.3

Many laboratories use forms to aid in rapidly reporting out-of-control events and corrective actions. One way to expedite the more routine out-of-control occurrences, which are frequently corrected by the analyst prior to running samples, is to list these on a form. For instance, a form for the GC/MS laboratory might list events such as continuing check standard outside limits, tune not met, and peak areas for the internal standard outside criteria. The analyst would check the occurrence, note that the item was corrected prior to sample analysis, initial, and date the form. If forms for out-of-control events are made specific to the group using these, time can be saved in documenting events and corrective actions (see Sect. 4.2 for examples of out-of-control events).

4.6 CORRECTIVE ACTION REPORT

For out-of-control incidents, it is essential to document the nature of the incident and the corrective actions taken to set the system back "in control." A corrective action report, to be signed by the laboratory director and the LQAC, should be reported in the MPR to the NCR and discuss the following topics.

1. Where - did the out-of-control incident occur (laboratory name, address, telephone number, section name)?

2. When - did the incident occur?

   - was it corrected?

3. Who - discovered the out-of-control incident?

   - verified the incident?

   - corrected the problem?

4. What - was the name of the test?

   - was the disposition of the test or control and/or instrument?

   - was the nature of the corrective action?

   - will be done to prevent the reoccurrence of the problem?

5. Why - did the incident happen (if scientific explanation is available)?

A copy of the subject control charts and other data describing the out-of-control conditions should be included in the corrective action report.

All out-of-control incident documentation and copies of the corrective action reports sent to the NCR should be

1. placed in the laboratory archive record for the sample(s) in question,
2. placed in the LQAC's file of incidents documentation, and
3. referenced and briefly described in the MPR.

5. PROFICIENCY TESTING

Prior to beginning analysis of field samples, each laboratory must analyze proficiency samples for chemical substances representative of those anticipated in environmental samples. The purpose of proficiency testing is to gage each laboratory's proficiency with samples which are designed to mimic field samples. A second benefit of performance samples is to provide a known material from a source outside the laboratory which can be used to evaluate the laboratory's performance.

5.1 SUBMITTING THE PROFICIENCY SAMPLES

Proficiency samples will be provided to the LQAC within ten working days of receipt of the site work plan. The samples may be soil or water samples or vials of concentrate. The laboratory will be directed as to any required sample reconstitution and the analytes to be determined. If analyses are to be subcontracted to a second laboratory, appropriate proficiency samples must be sent by the NCR to that laboratory as well.

5.2 RESULTS OF PROFICIENCY SAMPLES

Results of proficiency sample analyses are to be received by the NCR within 20 working days after receipt of the samples. The NCR must have the data at least five working days prior to inspection in order to properly evaluate the data. If performance samples are to be subcontracted to a second laboratory, the data report should be sent directly to the primary laboratory by the subcontract laboratory. The entire performance data package is then submitted to the NCR. QC data such as blanks, spikes, EPA controls, daily calibration check standards, sample chromatograms, mass spectra of identified compounds and raw absorbance data for metals shall be provided.

5.3 EVALUATION OF PROFICIENCY SAMPLE RESULTS

The NCR will compare the laboratory's evaluation of proficiency sample results to peer group proficiency sample results.

Performance will always be acceptable if the laboratory results are not statistically different from the peer group results, at 95% confidence, and no procedural problems are found during the laboratory inspection. For nonacceptable results, the records will be reviewed to determine the cause for the nonconformance. The actual limits for a batch of performance samples will be provided only after the batch is discontinued.

6. LABORATORY INSPECTION

The laboratory inspection will occur within 45 days after the laboratory(s) have provided the first edition of the QA plan, the site-specific work plan, and the performance sample data. The inspection will be performed by an experienced chemist from the NCR. The chemist may be accompanied by the EIC.

6.1 PURPOSE OF INSPECTION

The purpose of laboratory inspection is to verify that the Navy QC requirements are being met as reflected by the laboratory's daily operations in adherence to the QC plan received by the NCR.

6.2 INSPECTION PROCEDURE

The laboratory inspection involves four phases.

1. Overview and Orientation

   The inspector meets with the laboratory management, including the laboratory director, the LQAC, and others as the director deems appropriate. The objectives of the visit are reviewed and a schedule established. The inspector discusses the review of the laboratory's QA/QC plan and the results of the proficiency testing.

2. Observation, Examination, and Review

   According to the schedule, the inspector does the following.

   - Witnesses performance of specified analytical procedures.
   - Reviews sample handling and storage procedures. The inspector will follow the trail of the performance samples through the laboratory.
   - Examines the QC records including QC manuals, instrument calibration and maintenance records, control charts, instrument run logs, sample preparation logs, notebooks used to document analysis, corrective action reports for out-of-control events, and performance data generated for other programs such as Superfund CLP and state drinking water.

3. Findings

   The inspector conducts an exit interview with the laboratory director, the LQAC, and any other laboratory personnel the director deems appropriate. The inspector summarizes the findings of the visit and details specific deficiencies to be addressed by corrective action.

Recommendations regarding corrective action may be provided. A written report summarizing the findings is provided to the LQAC, the Navy EIC and NCR, and engineering contractor within ten working days of the inspection.

4. Corrective Action (if required)

Within ten days of receipt of the findings, the laboratory submits to the NCR and the EIC a plan to correct the deficiencies identified in the inspection. The plan should include for each deficiency, a description of the corrective action and a date indicating when the action is to be implemented or completed.

A repeat inspection may be required in instances where the number of deficiencies requiring corrective actions are complex. Repeat inspections will be scheduled for the earliest possible date after the last corrective action plan is received by the NCR.

The laboratory shall send a follow-up report which supplies information indicating the proof that the plan has been carried out. For example, if no control charts exist, then the plan would state that these would be in place by a specific date, and the follow-up report would contain copies of the control charts.

7. ANALYTICAL METHODS

An analytical method is a series of steps or procedures that must be performed to determine the identity and quantity of analyte in a sample. The methods to be employed by the Navy-approved laboratory fall mainly into two categories--those which have been approved by the EPA and those which have been developed by the Army. The former refer primarily to the methods presented in the *Federal Register* of October 26, 1984 (49 FR 43234), where the EPA has listed ~250 pollutants (pp. 43251-43258) or pollutant categories and the method(s) by which each must (by virtue of final or final interim ruling status of the methods) be tested. The acceptance of methods not under either status will be handled on a case-by-case basis among the concerned parties. Non-standard methods shall be submitted to the NCR who will discuss the method with Navy and EPA personnel prior to use on Navy projects. Other applicable EPA methods include the *SW-846* methods which are applicable to Resource Conservation and Recovery Act sites and the Superfund CLPs which are applicable to the CERCLA sites.

Many of the EPA methods are found in the documentation of other organizations (e.g., U.S. Geological Services, ASTM) and are incorporated by reference into the regulations. Such incorporation involves listing the organization, the specific document and its date, the method number assigned by the other organization, and perhaps a page number in the document of the other organization. Technically speaking, to maintain the applicability of the regulation, no deviations from the given citations are allowed by the EPA, even in cases where an organization (ASTM, for example) may have an updated version of the method. However, there are instances where EPA regional offices have granted exceptions to different laboratories for the testing of various substances. If a laboratory has such a variance, in writing, from the EPA (either to use a different ASTM method, for example, than the one cited in the October 26, 1984 *Federal Register* or to use a somewhat modified method, for example, than the one cited in the October 26, 1984 *Federal Register*), a copy of the variance (sent to the NCR) may be used to seek Navy approval of the different or modified method. It must also be shown that the conditions for which the variance was issued by the EPA are similar to the expected conditions (sampling and handling techniques, environmental matrix, concentration range, interferences, etc.) in the IRP.

It is also recognized that the analyst may have some leeway resulting from the regulations themselves. For instance, in the October 26, 1984 *Federal Register*, several methods are listed involving GC. Typically, in paragraph 8.1.2, these methods allow the analyst "certain options," provided various subsequent QC requirements are met. For example, the EPA allows some flexibility in the procedures (and no written permission is needed from the EPA) once a sample has been extracted and placed into the instrument. On the other hand, changes in operations prior to this instrumental analysis (e.g., preparation, storage) would probably require written documentation.

The *Federal Register* of October 26, 1984 (49 FR 43437) also contains a proposed ruling where additional substances and methods are listed: specifically, some proposed modifications to Tables IC and ID (Tables 7.1 through 7.5 of this guide) of the previously mentioned final rule. In those cases where a substance/method does not appear on one of the earlier tables but does occur on one of the proposed listings, the method in the proposed listing is recommended by the EPA (Medz, 1985) but without any regulatory force.

For the analytical method to be used in the case of munition-related substances, the laboratory should consult the NCR who will forward a copy(s) of the appropriate method developed by the Army Toxic and Hazardous Materials Agency.

For biota and air samples, the methods must be evaluated individually by the NCR to determine whether they may be used for the work in question.

A list of references containing methods, statistics, and sampling information is supplied in the Bibliography of this document.

For Level D QC sites, the current CLP methods and documentation must be followed. For methods not covered by CLP and for sites requiring Level D, the latest edition of *SW-846* or other methods listed in Tables 7.1 through 7.5, may be used. For the Levels C and E sites, CLP methods, *SW-846* methods, or other methods listed in Tables 7.1 through 7.5 shall be used. The exception to the Levels C and E method requirement occurs in the volatile and semivolatile area. In any level of QC and for any site where volatiles and semivolatiles are analyzed by GC/MS, the current CLP methods shall be used.

7.1 QC REQUIREMENTS FOR THE LABORATORY

The following are the minimum QC requirements for the laboratory analyses. For Level D QC, the current CLP QC requirements are specified. For methods not defined in the CLP, the blank, blank/spike, matrix spike, and matrix spike duplicate shall be performed for every 20 samples of similar matrix. The batch size for Level D QC is 20 samples.

In Levels C and E, the optimum batch size is determined by the number of samples of similar matrix which can be processed simultaneously through the entire preparation and analysis process. For example, if 5 samples can be extracted and 20 analyzed by the instrument, the batch size is 5. Once this is determined, it is used with the blank/spike control program in the following manner.

In Levels C and E, a blank/spike control shall be analyzed with each batch and shall be plotted on control charts as described in Sect. 4.4. For metals, anions, and other wet chemical analysis, a method blank shall also be processed with each batch and shall contain less than the method detection limit for compounds of interest. In any method using surrogates spiked into the blank, the blank shall serve as both the method blank

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1983	SW 846
Titanium	AA-Direct Aspiration	303C	283.1	
	AA-Furnace	304	283.2	
Vanadium	AA-Direct Aspiration	303C	286.1	7910
	AA-Furnace	304	286.2	7911
	ICP AES		200.7	6010
Zinc	AA-Direct Aspiration	303A	289.1	7950
	AA-Furnace	304	289.2	7951
	ICP AES		200.7	6010

3. WASTES & OIL ANALYSIS

Parameter	Method	Standard Methods 15th Ed.	ASTM	SW 846
% Ash	Gravimetric	209F		
% Chlorine	Bomb Calorimeter		D808-81	
Density	Gravimetric	213E		
Flash Point Closed Cup	Tag		D93-80	1010
Free Liquids	Paint Filter			9095
Heat of Combustion	Bomb Calorimeter		D240-76	
Leach Test. EP Toxicity	Extraction			1310
ASTM Water	Extraction		D3987-85	
% Sulfur	Bomb Calorimeter		D129-64	

Parameter	Method	Standard Methods 15th Ed.	ASTM
Viscosity	Saybolt		D88-81
% Water	Distillation		D95-83

Parameter	Method	Standard Methods 15th Ed.	EPA Methods 1982	SW 846
Sulfide, Total	Titration			9030
Reactive	Titration		261.23	Chap. 7 7.3.4.2
pH	Electrode			9040
Specific Conductance	Meter			9050
Specific Gravity	Mass Displacement	213E		
Cyanide, Total	Pyridine-Barbituitic Acid Colorimetic			9010
Amenable	Chlorination-Colorimetric			9010
Cyanide, Reactive	Pyridine-Barbitutic Acid Colorimetric		261.23	Chap. 7 7.3.3.2
TCLP			40CFR268	

4. **List of Sample Preparation Methods**

3510	Separatory Funnel Liquid - Extraction
3520	Continuous Liquid - Extraction
3540	Soxhlet Extraction
3550	Sonication Extraction
3580	Waste Dilution
5080	Purge and Trap
3005	Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by Flame AA or ICP
3010	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by Flame AA or ICP
3020	Acid Digestion of Aqueous Samples and Extracts for Total Metals by Furnace AA
3050	Acid Digestion of Sediments, Soils, and Sludges

Method numbers refer to EPA Methods except:

1. S.M. = Standard Methods for the Examination of Water and Wastewater
2. USATHAMA = U.S. Army Toxic and Hazardous Materials Agency
3. NIOSH = Manual of Analytical Methods
4. Hach, Chevron, Calgon = Industrial Methods

B. **GAS CHROMATOGRAPHY PROCEDURES**

1. **Calibration and Calibration Verification**

All GC methods are calibrated by external calibration procedures using three to five standard concentrations, depending upon the method. A new calibration is performed at least once per month or as needed on routine analyses. Methods not utilized on a daily basis are calibrated before each run.

2. **Laboratory Control Sample (LCS)**

An EPA check sample is analyzed at least once per week, and when a new initial calibration is performed.

3. **Matrix Spike**

Performed at a minimum of every 20 samples or as required by either state or project-specific requirements.

4. **Surrogate Spike**

Surrogates are added to and analyzed for in every sample for methods 601, 602, 8010, 8020, 608, 8080, 8015, 615, 8150.

5. **Duplicate Sample Analysis**

Performed at a minimum of every 20 samples or as specified by state/project requirements. Many samples contain non-detectable amounts of the parameters to be measured, therefore, the matrix spike is duplicated. (Matrix Spike Duplicate)

6. **Blank Analysis**

The reagent/method blank must have no contaminants greater than the detection limit of the method. In the case of volatile organic analysis, common laboratory solvents may be present at a concentration of less than 5 times the MDL. Blank subtraction is normally not allowed by contract/project protocols, unless specified by terms of the contract/project.

7. **Other**

Method 608/8080 are also subject to the following QC criteria:

a. Combined breakdown of endrin and DDT may not exceed 20%. This is monitored through the daily analysis of an LCS containing these compounds.

b. Two LCS (each containing 1/2 the compounds of the method) are alternately analyzed after every tenth sample.

C. **GAS CHROMATOGRAPHY/MASS SPECTROMETRY PROCEDURES**

1. **Calibration and Continuing Calibration**

An internal three point calibration is performed when indicated by the continuing calibration. One check standard is analyzed at the beginning of each 12-hour shift to verify calibration. The acceptance limit for the check standard is 25% RSD. Recalibration is necessary from once per week to once per month. Fresh calibration standards must be prepared weekly.

2. **Validation of Mass Spectrometer**

The mass spectrometers are tuned at the start of each run period and at 12-hour intervals. The tuning procedure utilizes the EPA recommended compounds 4-bromofluorobenzene (BFB) for 624/8240 and decafluorotriphenyl phosphine (DFTPP) for 625/8270.

3. **Internal Standards**

All sample results are quantified using the internal standard technique described in EPA methods 624, 8240, 625, 8270. Three (VOA) or six (BNA) internal standard compounds are added to each sample immediately before analysis. The internal standard nearest the retention time of the analyte of interest is used in the quantitation of the analyte.

4. **Laboratory Control Sample**

An EPA check sample is analyzed at a minimum once every month. A standard is run every 12 hour shift.

5. **Matrix Spike and Matrix Spike Duplicate**

Performed at a minimum of every 20 samples or as specified by state/project requirements. This is the same procedure as the GC section.

6. **Surrogate Spikes**

Surrogate spiking compounds are added to and analyzed for, with every sample. A surrogate is a volatile sample prior to purging and prior to extracting a semi-volatile sample.

7. **Reagent/Method Blank**

VOA - one per 12-hour per shift
BNA - one per batch of samples extracted

Common laboratory solvents present in the blank at a concentration less than 5 times the MDL will be footnoted on the analysis report. Common solvents at greater concentrations or the presence of any contaminant not considered a common laboratory solvent at a concentration greater than the MDL indicates the need to re-extract/re-analyze the blank and associated samples.

D. **METALS PROCEDURES**

1. **Calibration and Calibration Verification**

All instruments are calibrated at the start of each run. The graphite furnace requires 4 point calibration. The Flame AA and ICP methods utilize a minimum of 3 points. Cold vapor analysis of mercury requires a 5 point calibration. Recalibration is performed after 50 samples, or more often if indicated by the laboratory control sample.

2. **Laboratory Control Sample**

Performed at a minimum of every 20 samples, or as specified by state/project requirements.

3. **Matrix Spike**

Performed at a minimum of every 20 samples, or as specified by state/project requirements.

4. **Duplicate Samples**

Performed at a minimum of every 20 samples, or as specified by state/project requirements.

5. **Blank Analysis**

a. Method Blank

If the concentration of the blank exceeds the MDL, all samples associated with the blank are redigested and reanalyzed concurrent with a new blank. Samples with a concentration greater than 10 times the blank are reported, without blank value correction.

b. Reagent Blank

Any reagent blank result greater than the MDL terminates the analysis until corrective action resolves the problem. For ICP metals, a negative blank value greater than two times the MDL also requires corrective action. In rare cases, if all corrective action fails to resolve the problem and the blank value still hovers at 1-3 times the MDL, the analyst may run the samples, report all values greater than 10 times the blank value, and correct the sample values less than that amount for the blank value.

E. **GENERAL CHEMISTRY PROCEDURES**

1. **Calibration and Verification**

All instruments are calibrated daily with 3-6 point curves, depending upon instrument requirements. The calibration is continuously verified throughout the run, with either a calibration standard or laboratory control standard inserted after every 10th sample.

2. **Laboratory Control Sample**

A laboratory control sample is analyzed at least once during each batch of samples.

3. **Matrix Spike and Duplicate Samples**

Performed at a minimum of every 20 samples, or as specified by state/project requirements.

F. RECORD KEEPING AND REVIEW

All records and data are stored in safe places such as metal cabinets or hard cover bound books.

The extractions section utilizes method-specific bound books to record all data pertaining to sample extraction and preparation. A copy of the extraction benchsheet is transferred to GC or GC/MS with each extracted sample (Exhibit 16 and 17).

The organic and inorganic departments utilize benchsheets, maintained by analysts; specific for injection data and instrument maintenance. Spectras and chromatograms are filed by acquisition date.

The individual analysts and technicians are responsible for maintaining accurate, legible records and logs in accordance with standard operating procedures. The supervisors are responsible for ensuring adherence to procedures.

Secondary review of all records and logs is performed periodically by someone other than the person generating the document, preferably the department supervisor. Evidence of secondary review is provided on the document as initials and review date by the secondary person.

See Section X for magnetic media storage.

PROJECT #

GC-MS EXTRACTABLES

BATCH #

Sample Location	Sample Number	Date/Time of Extraction	Initial Volume	Surrogate	Spike	Final Volume	Date of Conc.	% Emulsion	Comments	Extract Location

EXTRACTION METHOD

- Separatory Funnel ☐
- Continuous Liq/Liq ☐
- Soxhlet ☐
- Sonication ☐
- Other: _____ ☐

Spike #

Dup. Spike #

QUALITY CONTROL INFORMATION

Surrogate:

Spike:

ROUTING

Person Who:	Initial
Extracted	_____
Concentrated	_____
Supervisor	_____
GC/MS	_____

WPPWGJ5

PROJECT #

GC EXTRACTION

BATCH #

Location	Sample Number	Weight of Sample	Date & Time of Extraction	Final Volume	Date of Conc.	% Emulsion	Comments	Extraction Location	Column	NCLSON File	% Recovery	Date & Time

EXTRACTION METHOD

- Separatory Funnel ☐
- Continuous Liq/Liq ☐
- Soxhlet ☐
- Sonication ☐
- Other: _____ ☐

Spike #

Dup. Spike #

QUALITY CONTROL INFORMATION

Surrogate:

Spike:

ROUTING

Person Who:	Initial
Extracted	_____
Concentrated	_____
Supervisor	_____
GC/MS	_____

G. ACCEPTANCE LIMITS AND CONTROL CHARTS

Acceptance criteria for quality control samples and instrument calibration/verification are summarized in Table 3.

TABLE #3

ACCEPTANCE CRITERIA FOR QUALITY CONTROL SAMPLES & INSTRUMENT CALIBRATION

	MATRIX SPIKE % RECOVERY	SURROGATE SPIKE % RECOVERY	RPD DUPLICATE SAMPLES	INITIAL CALIBRATION LINEARITY	CALIBRATION VERIFICATION	LCS/EPA QC SAMPLE
GC	Within calculated control limits*	Within calculated control limits	≤ maximum RPD acceptance limit	RSD ≤ 20%	± 15% of true value or initial response	±15% of true value or EPA limit
MS	Within calculated control limits*	Within calculated control limits	≤ maximum RPD acceptance limit	RSD ≤ 30%	± 30% of initial average RF	± 15% of true value or EPA limit
GENERAL CHEMISTRY	Within calculated control limits*	N/A	0-67 on samples < 10x MDL 0-20 on samples > 10x MDL MDL = Method Detection Limit	Correlation coefficient ≥ .995	± 10% of true value	± 15% of true value or EPA limit
METALS	Within calculated control limits*	N/A	0-67 on samples < 10x MDL 0-20 on samples > 10x MDL MDL = Method Detection Limit	Correlation coefficient of: ≥ .995 ≥ .995 :AA ≥ .995 :Cold Vapor	± 10% of true value	± 15% of true value or EPA limit

Establishment and Utilization of Acceptance Limits

X. DATA REDUCTION, VALIDATION AND REPORTING

Final results are entered into the LDMS system by the analyst, independently validated, and reviewed by the department supervisor for verification (Exhibit 18).

Result verification sheets are attached to the QC files and reviewed by the QC manager. After QC file review by the QC manager, the department manager verifies the completeness and the validity of the report. When all required analyses on all of the samples in a project are complete, entered and verified, a report is generated. The report goes to the project manager for review. Each project is assigned to a project manager after samples are received at PACE. The project manager is responsible for tracking sample progress while in-house and ensuring timely analysis.

When the data re complete, the project manager reviews the final report according to these criteria:

- Reasonableness of data, i.e., whether the various sample analyses results make sense when compared to each other. Analyses such as BOD, COD, amount of organic contamination, general mineral balances, volatile organics measured by different methods, pH and electrical conductivity, and other analytical interrelationships are compared. Data on samples within the same project number are compared and if descriptive information about the samples is available, then it may be concluded that the results are reasonable in comparison to each other.

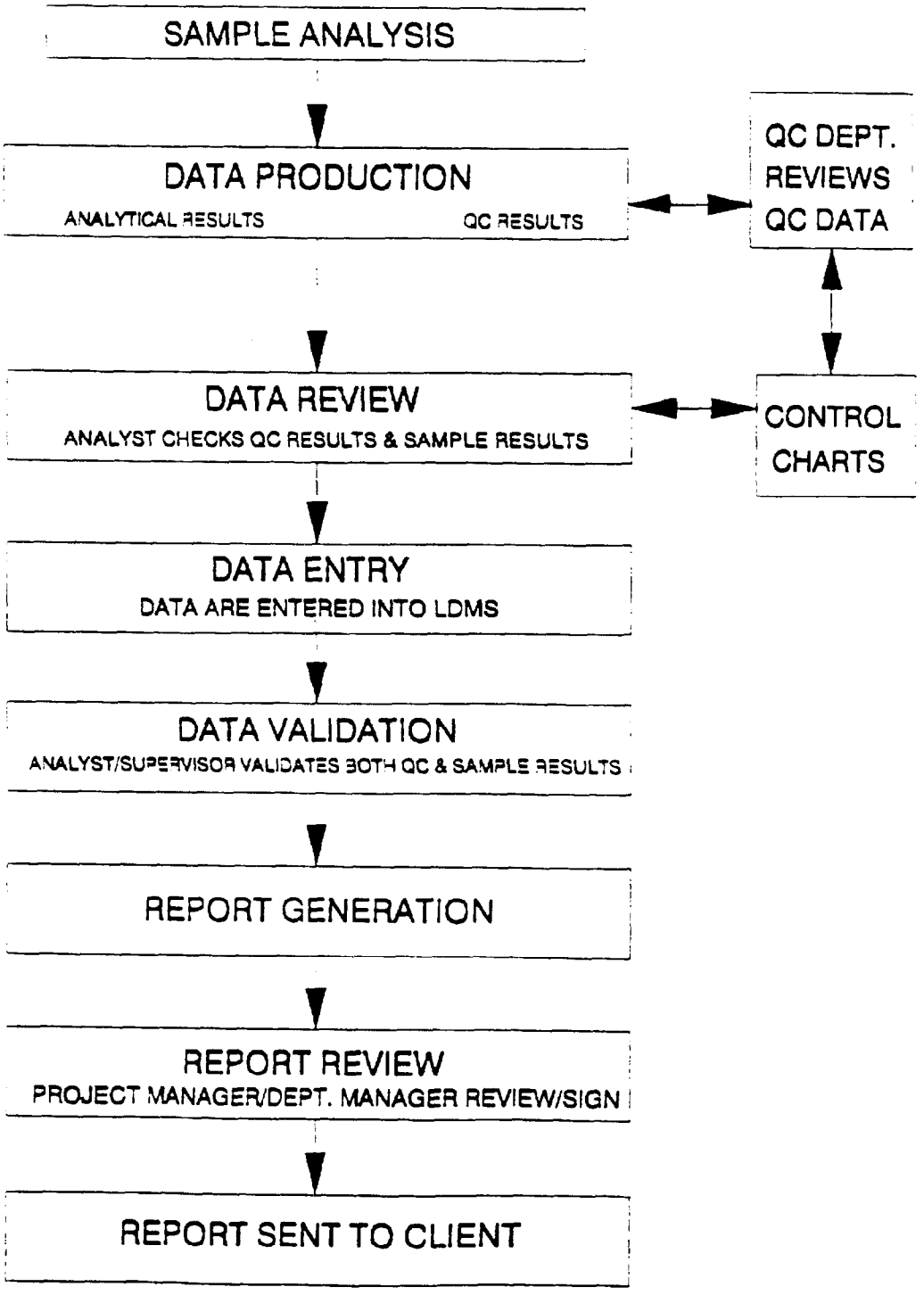
The report requires the signature of the project manager and the department manager. Client questions about the final report may be directed to these individuals or the Client Services manager when appropriate.

- Data Storage

  Data and reports are archived onto computer tape and written in documents for either off-site storage within a secured building, or within a locked storage cabinet.

EXHIBIT 18

LABORATORY DATA FLOW CHART



XI. INTERNAL QUALITY CONTROL

The Quality Assurance Plan is a document that reflects the actual operating and quality control programs in use at PACE. The reliability and credibility of analytical results is established by inclusion of a program of randomly scheduled replicate analyses, analysis of standard of spiked samples, and the cooperative analysis of split samples by several laboratories. These quality control checks are an integral part of the sampling and analytical plan.

Quality assurance, as practiced at PACE, consists of general quality control and assessment procedures that are adapted to the specific operating conditions within each section. The general elements of quality control are outlined below.

A. BLANK ANALYSIS

Reagent/Method Blanks: A reagent blank consists of laboratory pure water and any reagents added to a sample during analysis only, or straight solvent. A method blank is a water or soil blank which undergoes all of the preparation procedures applied to a sample (i.e., extraction, digestion).

It is standard policy throughout the laboratory to prepare and analyze a reagent or method blank (whichever is appropriate) with each sample batch. Separate water and soil method blanks are prepared for mixed matrix batches.

Reagent blanks may also be inserted at regular intervals on large (20 samples) batches, or after highly concentrated samples to check for carryover/contamination. For methods utilizing surrogate compounds, the surrogates are added to all blanks and are subject to meeting acceptance criteria.

A trip blank is submitted for analysis with most samples analyzed for volatile organic compounds. A field blank or procedure blank may also be submitted at the discretion of the client. Field, procedure, and trip blanks are analyzed upon request of the client. Reagent blanks are run daily on each instrument to check the contaminant level (Exhibit 19).

METHOD BLANK SUMMARY FORM

METHOD:

EXHIBIT 19

INST. ID:

Y	M	D	CONTAMINANT/ PPB	CORRECTION	S.R.	COMMENT
		1				
		2				
		3				
		4				
		5				
		6				
		7				
		8				
		9				
		10				
		11				
		12				
		13				
		14				
		15				
		16				
		17				
		18				
		19				
		20				
		21				
		22				
		23				
		24				
		25				
		26				
		27				
		28				
		29				
		30				
		31				

RE= REEXTRACTED

S.R.= PERCENT SURROGATE RECOVERY

ND= NOT DETECTED

P.Q.C.= PASS Q.C.

B. MATRIX SPIKE AND SURROGATE ADDITIONS

Accuracy and matrix biases are monitored using spiked samples and where possible, surrogate additions. It is standard policy throughout the laboratory to prepare and analyze at least one matrix spike for each batch of 20 samples, for each matrix type within the batch, or as specified by state/project requirements.

Surrogate spiking compounds (if available), are added to and analyzed for, with every sample. A measured amount of spike/surrogate concentration is added to the sample before extraction of preparation. Surrogate spiking is utilized for GC and GC/MS analyses only.

C. DUPLICATE SAMPLE ANALYSIS

Precision is assessed by result comparison of a sample prepared and analyzed in duplicate. It is standard policy throughout the laboratory to prepare and analyze at least one duplicate sample for each batch of 20 samples and matrix type within the batch, or as specified by state/project requirements.

D. STANDARDS

The term standard shall apply to any analyte solution of known concentration which is traceable to a certified reference material. This includes calibration standards, spiking solutions, and laboratory control samples. Claims of traceability establishes the accuracy of measurements. Therefore, maintaining standard traceability is critical to the achievement of known and defensible data quality.

To establish traceability, all purchased reference materials (neat and stock solutions) are recorded into section-specific standard log books when received.

All entries and PACE standard labels contain a unique PACE ID number, date received, date opened, and expiration date. Log book entries also include the manufacturer's lot number, certified purity, and storage location. Subsequent preparations of stock, intermediate, and working solutions are also recorded in the standard log books. These entries must include all discrete measurements made during a preparation, parent materials, solvent used, and a PACE ID number.

Exhibit 20 illustrates a standard log book entry. Standard Operating Procedure for standards preparation contains further instructions for assigning unique ID numbers, proper syringe technique, shelf life of standards, and good laboratory practices.

Labeling: The standard vial should have a reference label (covered with cellophane tape) with the following information:

1 - Standard
2 - Name of Standard
3 - Prep. Date
4 - Prep. Personnel Initials
5 - Solvent

Certified reference standards from the EPA Repository are used for calibration or laboratory control standards in many organic analyses. Reference standards may also be purchased from approved commercial vendors. Currently approved vendors for organic reference standards are Ultra-Scientific, Supelco, Chem-Service, Inc., and Aldrich Chemical Company, Inc. Inorganic standards are purchased from major scientific supply companies (Fisher, American Scientific, and VWR). Certificates of analyses are requested with each purchase.

E. METHOD DETECTION LIMIT

The method detection limit (MDL) is defined as the minimum substance concentration that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero. In general, the protocol described in Appendix B to 40CFR 136 (Federal Register, Vol. 49, No. 209, 10/26/84) is used to establish MDL's.

For GC/MS analyses and organochlorine pesticides by GC/EDC, the MDL has been determined according to EPA Contract Required Detection Limits (CRDL) as established for the Contract Laboratory Program. The MDL's for other organic analyses are set according to industry standards, client requirements, and instrument/method limitations. The MDL is validated using prepared standard solutions analyzed at detection limit concentrations.

The metals analyses MDL's correspond to instrument detection limits, and are established in the following manner: A standard solution of analyte in laboratory pure water with a concentration of 3-5 times the estimated instrument detection limit is analyzed seven consecutive times. The MDL is set at 3 times the standard deviation of the seven consecutive measurements.

EXHIBIT 20

NEAT STANDARDS:

NAME: Acephate CODE: Acephate-1

OTHER NAMES: Methamidophos

BRAND: Chem Service WARNING: POISON

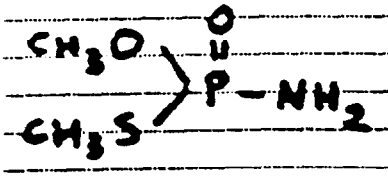
CAT. NO: PS-728

LOT NO: 30-13 LOCATION: Fr. # 1

PURITY: 98% Rack # 1

EXP. DATE: 2-90 position # 23

RECEIV. DATE:



Solvent used: Acetone

Source:

Purity:

Lot #:

GC Extraction

DILUTIONS:

CODE: Acephate-D 1

STOCK SOLUTIONS AND STANDARDS

STD #	CONC. (PPM)	SOLVENT	PREP. DATE	LOCATION
# 502	2,000 ppm	Acetone	3-1-89	Fr. #1, Rack # 6
# 503	0.5M. 80 ppm	Hexane	3-2-89	Fr. #1, Rack #7
# 503 A	40 ppm	"	"	"
# 503 B	60 ppm	"	"	"
# 503 C	100 ppm	"	"	"

GC Extraction

For general (wet) chemistry methods, the MDL is established using a calibration standard analyzed at doubled dilutions until it becomes impossible to distinguish an instrument response for the analyte. The MDL is set at the lowest observable standard concentration.

F. CONTROL CHARTS

Control charts monitor daily variations in precision and accuracy of routine analysis and detect variation trends. QC charts are constructed from performance data of the complete analytical method. Control chart construction requires initial data to establish the mean and range of measurements. Currently, spikes, spike duplicates, RPD's and external check sample values are charted.

G. LABORATORY CONTROL SAMPLES

EPA quality control check samples are analyzed at least once per week, and when new calibrations are performed. They provide a means of assessing the accuracy and precision of a measurement system's performance. Parameters of interest that initially fall outside of QC acceptance criteria are compared against a prepared EPA QC check sample. If laboratory performance for the parameter is found to be out of control, then necessary corrective actions are implemented.

XII. PERFORMANCE AND SYSTEM AUDITS

A. PACE's INTERNAL SYSTEM AUDITS

1. All records, logs, and data files are routinely audited for completeness, accuracy, and adherence to standard operating procedures by an on-site auditing team. Audit team members generally include Corporate Vice-Presidents and Regional Directors. Several random project files are evaluated quarterly for compliance to procedure throughout the analytical process (i.e., from sample receipt through the final report). Supervisors, QC managers, and lab analysts routinely check all records for the same criteria.

2. System Audits:

   PACE is audited as required by regulatory agencies to maintain laboratory certifications, and by various commercial clients with laboratory auditing programs. These audits include audits by USEPA, USATHAMA, AIHA, and other appropriate federal, state and private agencies.

3. Performance Audits:

   a. USEPA Performance Evaluation Studies - PACE participates in the EPA semi-annual drinking water (WS Series) and semi-annual wastewater (WP Series) performance evaluation studies (four studies per year).

   b. PACE participates in various client sponsored performance evaluations by analyzing QC samples prepared and submitted by commercial clients in conjunction with their own QA program.

   c. Several government proficiency samples are analyzed annually to maintain various laboratory certifications (Exhibit 21).

   d. PACE regional offices are provided blind QC check samples quarterly.

4. Total Quality System Audit:

   The Corporate Quality Office performs a yearly on-site audit at each regional facility. Examples of the forms used as shown in Exhibit 22.

pace. laboratories, inc

CONTRACTS AND CERTIFICATIONS

- ✔ U.S. Environmental Protection Agency Contract Laboratory (CLP) - 3 Facilities
  MN, KS, NY
- ✔ U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Certification
  MN
- ✔ Department of Energy Hazardous Waste Remedial Action Program (HAZWRAP) Certification
  NY
- ✔ American Industrial Hygiene Association (AIHA) Laboratory Accreditation - 2 Facilities
  MN, NC
- ✔ Contracted as an Analytical Support Laboratory for Minnesota Superfund Projects
  MN
- ✔ Accreditation in the National Voluntary Laboratory Accreditation Program (NVLAP) for Bulk Asbestos Analysis
  MN, NCA, FL
- ✔ Successfully Audited by the Missouri River Division of the U.S. Army Corps of Engineers
  NCA, FL
- ✔ Successful Participation in the National Institute for Occupational Safety and Health (NIOSH) Proficiency in Analytical Testing (PAT) Program
  MN
- ✔ Alabama Drinking Water Certification
  FL
- ✔ California Air Resources Board Certification for Emissions Monitoring
  NCA, MN
- ✔ California Drinking Water Certification
  NCA
- ✔ California Hazardous and Toxic Waste Certification - 3 Facilities
  NCA, SCA, MN
- ✔ California Pesticide Analysis Certification
  NCA
- ✔ Connecticut Laboratory Certification
  NY
- ✔ Florida Drinking Water Certification - 3 Facilities
  FLA, MN, NY (pending)
- ✔ Florida Environmental Laboratory Certification - with Approved Generic Quality Assurance Plan
  FL, MN, NY (pending)
- ✔ Iowa Drinking Water Certification
  IA, FL
- ✔ Kansas Drinking Water Certification
  KS, MN
- ✔ Kansas Solid & Hazardous Waste Certification
  KS, MN
- ✔ Minnesota Drinking Water Certification for Microbiological Analysis
  MN
- ✔ New Jersey Dept. of Environmental Protection Contract Laboratory for Environmental Analysis
  NY
- ✔ New Jersey Laboratory Certification
  NY
- ✔ New York Drinking Water Analysis Certification - 2 Facilities
  MN, NY
- ✔ New York Environmental Laboratory Certification - 2 Facilities
  MN, NY

March, 1990

- ✔ North Carolina Drinking Water Certification
  NC, FL
- ✔ North Carolina Wastewater Certification
  NC, FL
- ✔ North Carolina Biological Toxicity Certification
  NC
- ✔ South Carolina Laboratory Certification - 2 Facilities
  NC, FL
- ✔ Tennessee Drinking Water Certification
  NC
- ✔ Virginia Drinking Water Certification
  NC
- ✔ Virginia Wastewater Certification
  NC
- ✔ Wisconsin Drinking Water Certification
  MN
- ✔ Wisconsin Environmental Laboratory Certification
  MN

RATING SC...

(Doc. 349 - 27-31)

THE FOLLOWING SCALE MAY BE USED FOR ANY APPLICABLE AREA

1) UNSATISFACTORY Performance below acceptable level. Expected results have not been achieved.	2) PROVISIONAL Some requirements satisfied but needs improvement in several areas.	3) FULLY ADEQUATE All requirements met. Satisfied all standards and achieved expected results.	4) SUPERIOR Results above job standards. Achieved more than expected results.	5) DISTINGUISHED Results far in excess of standards extraordinary and exceptional results.

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control	SOP's: 1. Quality Control Manager aware of and familiar with Standard Operating Procedures for the company.								
	2. Documented Standard Operating Procedures for the Quality Control department.								
	3. Standard Operating Procedures for program areas on file in the Quality Control office.								
	4. Documented procedures for all Quality Control activities are displayed in the appropriate area.								
	5. Standard Operating Procedures updated regularly for analytical areas.								
	6. Analytical procedures updated regularly.								

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control (Cont.)	7. Analytical procedures are dated and initialed by QC Manager and Department Supervisor at time of update.								
	8. Procedure sections are updated rather than replacement of entire document.								
	Staff: 1. Defined roles for the Quality Control Manager, adherence to job description.								
	2. Defined roles for staff in the Quality Control department.								
	3. Staffing is adequate and staff assignments are documented.								
	Administrative: 1. Regularly scheduled meetings with Quality Control staff. Agenda for meetings are documented.								

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control (Cont.)	2. Regularly scheduled meetings with Analytical Department staff/managers. Agenda for meetings are documented.								
	3. Regularly scheduled meetings with Sampling and Analytical Services Division Director. Meeting agenda documented								
	<u>Control Charts/Corrective Actions</u>: 1. Quality Control charts available in Quality Control area for all analytical procedures.								
	2. Control chart acceptance limits are based upon current data. - Specify "current" date range of control charts/last update - Specify frequency of acceptance limits updating								
	3. Preventative maintenance records for all instruments present in Quality Control.								

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control (Cont.)	4. Provision of quality control charts are in on a timely manner to analytical threats.								
	5. Record of corrective action taken when out-of-control situations are noted.								
	<u>QC Samples</u>: 1. Records of performance evaluations on blind PE samples in-house kept in Quality Control area.								
	2. Records of performance on quality control samples (MS, MSD, LCS, surrogates, & blanks) are available in Quality Control department.								
	3. Record of standard traceability to NIST present in the Quality Control area.								
	4. Standards are labeled with purchase date, date opened, expiration date, analyst initials.								

SECTION	RESULTS/STANDARDS OF PERFORMANCE	RATING 1	2	3	4	5	YES	NO	COMMENTS/RECOMMENDATIONS
Quality Control (Cont.)	<u>Sample Check-In</u>: 1. Chain-of-custody records kept on file when necessary, in the Quality Control area.								
	2. Sample check-in documentation present in sample check-in area.								

B. TRAINING AND TECHNICAL REVIEW

PACE considers competent, well-trained personnel to be a key to successful production of valid and reliable data. An extensive training and technical review program is in place at PACE, Inc. It includes:

1. Training Plans

The type and schedule of training required for each new or transferred employee is determined individually. A training plan is established to reflect individual and general training needs.

2. Training Classes

All sections conduct regularly scheduled training sessions specific to their needs.

Audio/visual training programs and open learning texts are available for use by all personnel.

Other laboratory QA and general training classes are offered periodically.

3. Technical Review Program

All employees are subject to technical reviews with their supervisor. The technical review assesses an individual's training progress and technical development and provides an opportunity to redirect the training plan accordingly to comprehensively cover further developmental needs. The schedule for technical reviews is:

a. New hire or transfer to new position/responsibilities: 6 months, 1 year.

b. After 1 year in same position/responsibilities: annually.

4. Support Programs

Attendance at outside seminars, classes, etc., is highly encouraged. PACE participates in many of these throughout the year. In-house seminars are presented by employees for employee bi-monthly meetings. Various topics are covered, including regulatory items and information from attendance at outside seminars. The PACE in-house library contains current periodicals and journals pertinent to the environmental industry and analytical chemistry, in addition to reference books, text books, and regulatory publications.

XIII. PREVENTIVE MAINTENANCE

PACE maintains service contracts for most major analytical equipment including all chromatography instruments, balances, atomic absorption, and inductively coupled plasma instruments. All instruments and equipment receive routine preventive maintenance, which is recorded in instrument specific maintenance logs. Routine maintenance insures that all equipment is operating under optimum conditions, reducing the possibility of instrument malfunction (consequently affecting sample results). An example of an instrument maintenance log is included (Exhibit 23).

EXHIBIT 23

INSTRUMENT MAINTENANCE LOGBOOK FORM

INSTRUMENT I.D.:

DATE	MAINTENANCE ACTIVITY	NAME

XIV ASSESSMENT OF PRECISION, ACCURACY, COMPLETENESS REPRESENTATIVENESS, AND COMPARABILITY

The Quality Control Program at PACE uses precision and accuracy data to determine the acceptability of analytical results. Precision refers to result reproductibility and accuracy measures the degree of difference between observed and true values. One of every 20 analyses performed at PACE is run in duplicate (precision). Also, one of every 20 samples is spiked with a synthetic standard to assist in evaluating the accuracy of the method. Once 20 sets of precision or accuracy data have been obtained, a quality control chart is prepared. The Shewhart technique is the statistical method used to construct the charts. These quality control charts provide a quick visual means for monitoring the daily performance of the laboratory. Exhibits 24 and 25 contain examples of accuracy and precision charts along with their corresponding data sheets (Exhibits 26 and 27).

A. ACCURACY

The actual test result is compared to the theoretical result of 100% recovery and the percent recovery is calculated.

$$\% \text{ Recovery} = \frac{\textbf{Spiked Sample Result - Sample Result}}{\textbf{Spike Quantity}} \times 100$$

The percent recovery must fall within specific control limits for the results to be accepted and subsequent data validated. (See Table 2)

B. PRECISION

The results of the duplicate analyses are computed and the absolute relative percent difference (RPD) is calculated.

$$\text{RPD} = \frac{|\textbf{Sample Result - Duplicate Result}|}{\textbf{Average Result}} \times 100$$

The RPD must fall within set control limits for the results to be accepted and subsequent data validated. A one-sided distribution with zero as a target value is typical, given absolute value requirements (CLP).

C. WARNING LIMITS

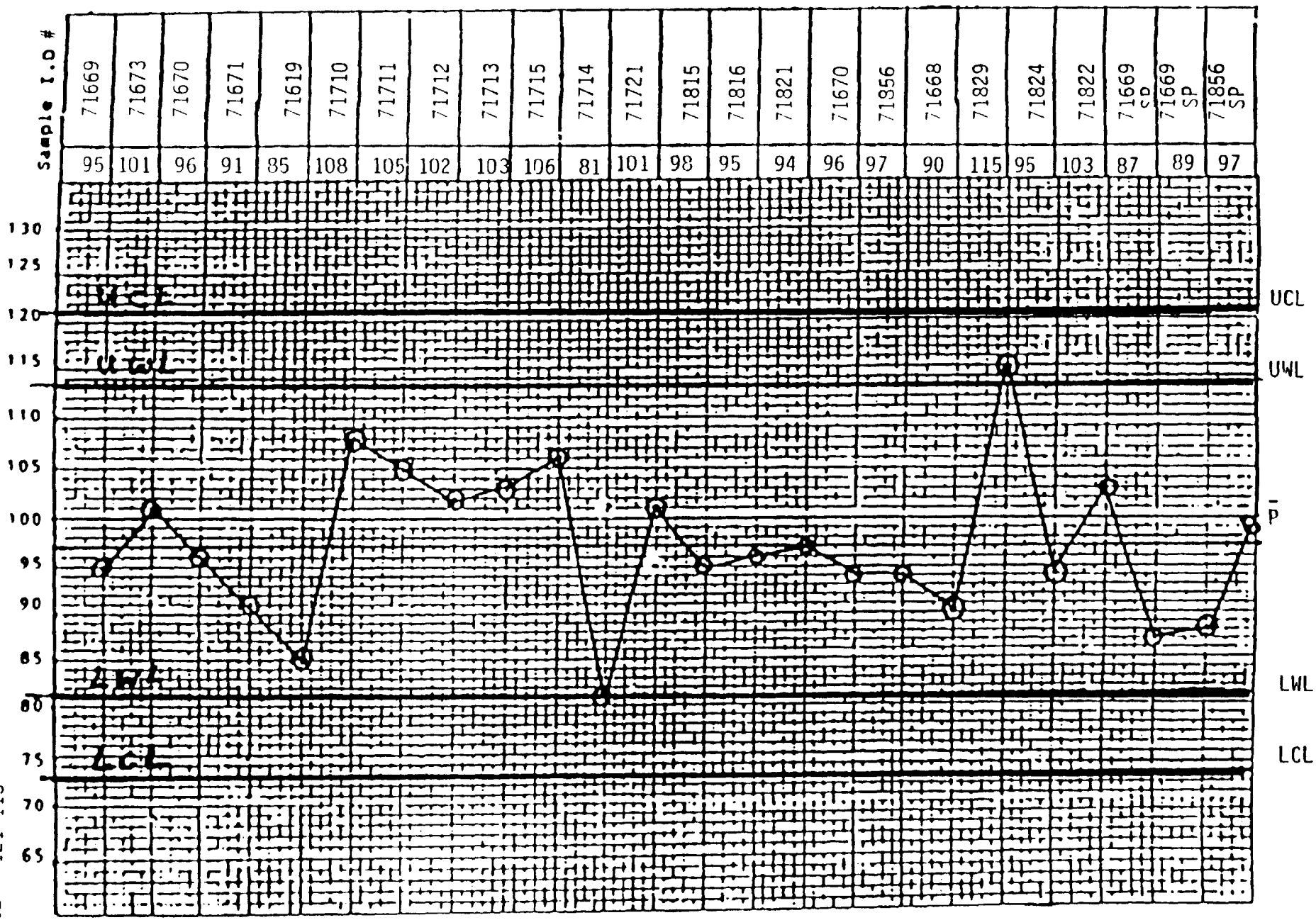
Warning limits represent the 95% confidence interval and are equal to the mean value for the control sample, plus or minus two standard deviations ($\pm$ 2S). Exceeding these limits is a warning that the analytical system may be approaching an out-of-control situation, and should be inspected for possible sources of error before continuing the analysis. Analysts will inform the QC manager or the supervisor of such problems.

EXHIBIT 24

SURROGATE % RECOVERY CHART

Matrix: Soil

Sample I.D #	%
71669	95
71673	101
71670	96
71671	91
71619	85
71710	108
71711	105
71712	102
71713	103
71715	106
71714	81
71721	101
71815	98
71816	95
71821	94
71670	96
71856	97
71668	90
71829	115
71824	95
71822	103
71669 SP	87
71669 SP	89
71856 SP	97



WL = 73-81
CL = 121-113

INSTRUMENT:

METHOD: 5030/8015 ANALYTE: Fluorobenzene

Date: 4/3-4/5

Average Recovery= 97%

3 Standard= 24

EXHIBIT 2!

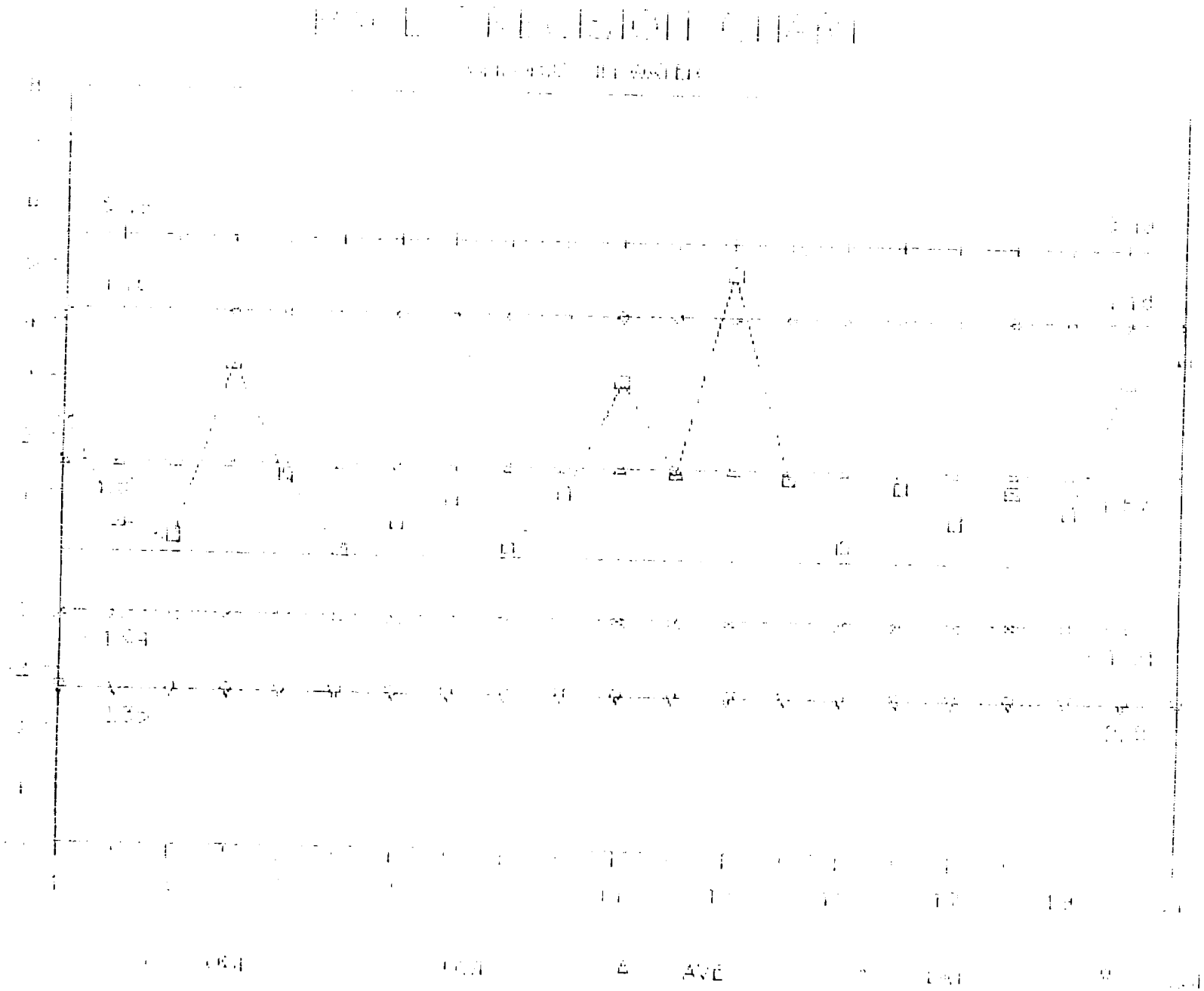


EXHIBIT 26

ANALYSIS:

RAW DATA SHEET

CLIENT NAME: _____ DATE ANALYZED _____

PROJECT NAME: _____ ANALYZED BY: _____

FILE #: _____ TIME: _____

DATE COLLECTED: _____ DATA REVIEWED BY: _____

DATE RECEIVED: _____ ENTERED BY: _____

SAMPLE #	ANALYSIS			SAMPLE VOL (mls) A	RESULT OF DIL SAMPLE B
	RESULTS	UNITS	COMMENTS		

A = SAMPLE VOLUME USED (mls)

B = RESULT OF DILUTED SAMPLE

EXHIBIT 27

SPIKE SUMMARY FORM

Soil Matrix TPH/BTX

Date			Benzene					Toluene					O-Xylene					TPH-L				
Y	M	D	S	SD	$\bar{P}$	R	$\bar{R}$	S	SD	$\bar{P}$	R	$\bar{R}$	S	SD	$\bar{P}$	R	$\bar{R}$	S	SD	$\bar{P}$	R	$\bar{R}$
98	4																					
		3																				
		4	87	89		2		91	91		0		93	95		2		114	89		25	
		5	101	101		0		100	111		10		102	104		2		120	100		18	
		6	94	85		10		83	81		2		85	96		12		96	98		2	
		7																				
		10	92	101		9		120	100		18		94	92		2		75	77		3	
		11																				
		12																				
		13																				
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		26																				
		27																				
		28																				
		31																				
			} S_p = ±					} S_p = ±					} S_p = ±					} S_p = ±				

S= Spike Recovery SD= Spike Dup. Recovery $\bar{P}$ = Average Recovery S_p = Stand. Deviation

R= Relative Deviation R= Average Relative Deviation

D. CONTROL LIMITS

Control limits represent the 99% confidence interval and are equal to the mean value of the control sample, plus or minus three standard deviations (±3S). Exceeding these limits indicates that the analytical system is out-of-control. The QC manager or the supervisor shall be informed and corrective action shall be taken.

1. Method of Setting Limits

Control limits are established via statistical analysis, using QC sample results. Limits are determined for a parameter of each method as analyzed on a specific instrument.

The mean value (P) and the standard deviation (S) for each data set is calculated and the limits are set as:

Warning (WL) = P + 2S = 95% Confidence limit
Control (CL) = P + 3S = 99% Confidence limit

Where $P = \frac{X1 + X2 + X3 \ldots Xn}{n}$ x = Sample result

and $S = \sqrt{\frac{\Sigma(X - P)^2}{n-1}}$ n = Total # of results in set
P = mean value

The minimum number of results to be used for statistical calculation (n) is 15-20. Limits will generally be calculated from a data point set every thirty days, depending on the method. Updated limits are issued at the beginning of every month.

2. Utilization of Acceptance Limits

QC sample results must fall within the established warning limits (P ± 2S) for each parameter.

Results that fall outside of warning limits, but remain within the control limits (P ± 3S), are considered suspect. These results must be carefully examined for possible sources of error in the analysis, or justified as a matrix bias effect. All such results are recorded in a Discrepancy Report form/Corrective Action form (See Section XV).

Any three consecutive results outside of warning limits but within control limits is an out-of-control event which shall be documented and corrected.

Results that fall outside of control limits (P ± 3S) must be documented and corrective action taken.

E. COMPLETENESS

Data completeness can be quantified during data assessment. It is expected that laboratories should provide data, meeting QC acceptance criteria, for 90% or more of the requested determinations. It is incumbent for planners to identify any sample types, such as control or background locations, which require 100% completeness.

F. REPRESENTATIVENESS

Representativeness is a qualitative element that is related to the ability to collect a sample that reflects the characteristics of that part of the environment that is to be assessed. Sample representativeness is dependent on the sampling techniques used and is considered individually for each project. It is specifically addressed in each work plan.

G. COMPARABILITY

Comparability is also considered during preparation of the work plan. The objective of comparability is to ensure that results of similar activities conducted by different parties are comparable. For example, the use of EPA-approved, etc., methods and procedures ensure comparability with other data from previous or following studies.

XV. CORRECTIVE ACTION

If, as a result of audits or QC sample analyses, methods systems prove to be unsatisfactory, corrective action shall be implemented. The project manager, department manager, Quality Control manager, supervisor, and analyst may be involved in the corrective action. If previously reported data are affected by a situation requiring correction or if the corrective action impacts a project budget or schedule, the action will directly involve the project manager (and Quality Control manager).

For immediate or long-term corrective actions, steps comprising a closed-loop corrective action system are as follows:

1. Define the problem.

2. Assign responsibilities for problem investigation.

3. Investigate and determine the cause of the problem.

   a. Check all calculations

   b. Re-analyze the sample

   c. Verify the integrity of the spiking solution, laboratory control sample, or calibration standard.

   d. Check instrument and operating conditions to preclude the possibility of malfunctions or operator error.

4. Determine the corrective action(s) necessary to eliminate the problem.

5. Assign and accept responsibilities for implementing the corrective action.

6. Establish the effectiveness of the corrective action and implement the correction.

7. Verify and document that the corrective action has eliminated the problem (Exhibit #28).

   Depending upon the nature of a problem, the corrective action implemented may be formal or informal. In either case, occurrence of the problem, the corrective action employed, and verification that the problem has been eliminated must be documented.

   In addition, if the corrective action mandates the preparation of a new standard or calibration solution(s), a comparison study between the new solution versus the old solution will be performed. The results are supplied with the weekly QC submittal as verification of problem elimination.

EXHIBIT 28

CORRECTIVE ACTION

INSTRUMENT _____
MONTH/YEAR _____

DATE	PROBLEM	ACTION	INITIAL

XVI. QUALITY ASSURANCE REPORTS TO MANAGEMENT

A. OBJECTIVE

This section describes the methods used by PACE to store and retrieve quality assurance records and issue of appropriate reports.

B. REQUIREMENTS

Comprehensive records shall be maintained to provide evidence of the quality assurance activities. All charted QC values which indicate an out-of-control situation must be evaluated and explained. Any corrective actions and re-analysis of samples must be fully explained and documented.

C. IMPLEMENTATION

Procedures for recording all aspects of the Quality Assurance Program are written and filed.

D. REPORTS TO MANAGEMENT

Quarterly reports are provided by the Quality Control officer to the President, Vice President of Quality and Regional Director. This report addresses the quarterly quality assurance activities including details of corrective actions implemented, audit results, and QC summary information.

REFERENCES

1. Handbook for Analytical Quality Control in Water and Wastewater Laboratories, U.S. EPA 600/4-79-019, March, 1979.

2. Federal Register, 40 CFR Part 136, October 26, 1984.

3. Test Methods for Evaluating Solid Waste, U.S. EPA SW-846, September, 1987.

4. Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.

5. Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WPCF: 16th Edition, 1985.

6. NIOSH Manual of Analytical Methods, U.S. Department of Health, Education, and Welfare; Second Edition, 1977.

7. Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079-C.

8. Methods for Chemical Analysis of Water, Wastes, EPA-600/4-79--020, 1983.

9. California Administration Code, Title 2, Chapter 30, Article II, "Criteria for Identification of Hazardous and Extremely Hazardous Wastes."

10. The Determination of Inorganic Anions in Water by Ion Chromotography - Method 300.0 Test Method, EPA-600/4-84-017. March, 1984.

11. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 2nd Edition, U.S. EPA, revised April, 1984.

Table 7.1. List of approved biological test procedures (40 CFR, Part 136, July 1, 1987)

Parameter and units	Method [1]	Reference (Method Number or Page)			
		EPA [2]	Standard Methods 15th Ed.	ASTM	USGS
Bacteria					
1 Coliform (fecal) number per 100 ml	MPN, 5 tube, 3 dilutions or, membrane filter (MF) [4], single step	p. 132	908C		
		p. 124	908C		B-0050-
2 Coliform (fecal) in presence of chlorine number per 100 ml	MPN, 5 tube, 3 dilution	p. 132	908C		
3 Coliform (total), number per 100 ml	MPN, 5 tube, 3 dilution, or, MF [4] single step or two step	p. 114	908A		
		p. 108	908A		B-0025-
4 Coliform (total) in presence of chlorine, number per 100 ml	MPN, 5 tube, dilution, or MF [4] with enrichment	p. 114	908A		
		p. 111	909 (A + A 5c)		
5 Fecal streptococci, number per 100 ml	MPN, 5 tube, 3 dilution, MF [4] or plate count	p. 139	910A		
	p. 138		910B	B0055-77 [5]	
	p. 143		910C		

Table IA Notes

[1] The method must be specified when results are reported

[2] "Microbiological Methods for Monitoring the Environment, Water and Wastes 1978" EPA-600/8-78-017 U.S. Environmental Protection Agency

[3] Greeson, P.E., *et al.*, Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples, "U.S. Geological Survey, Techniques of Water-Resources Investigat Book 5, Chapter A4 Laboratory Analysis, 1977

[4] 0.45 um membrane filter or other pore size certified by the manufacturer to fully retain organisms to be cultivated, and free of extractables which could interfere with their growth development

[5] Approved only if dissolution of the KF Streptococcus Agar (Section 5.1, USGS Method B-0055-77) is made in a boiling water bath to avoid scorching of the med

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
12. Cadmium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	213.1	303A or B	D3557-84(A or B)	I-3135-84 or I-3136-84	33.089[3], p.37[8]
	AA furnace,	213.2	304	—	—	
	Inductively coupled plasma,	—	—	—	—	200.7[4]
	Voltametry[16], or	—	—	D3557-84(C)	—	
	Colorimetric (Dithizone).	—	3108	—	—	
13. Calcium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	215.1	303A	D511-84(B)	I-3152-84	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Titrimetric (EDTA).	215.2	311C	D511-84(A)	—	
14. Carbonaceous biochemical oxygen demand ($CBOD_5$), mg/L[11]	Dissolved Oxygen Depletion with nitrification inhibitor	—	507(5 e.6)	—	—	
15. Chemical oxygen demand (COD), mg/L	Titrimetric, or	410.1, 410.2, or 410.3	508A	D1252-83	I-3560-84 or I-3562-84	33.034[3], p.17[8]
	Spectrophotometric, manual or automated	410.4	—	—	I-3561-84	Notes 12 or 13
16. Chloride, mg/L	Titrimetric (silver nitrate)	—	407A	D512-81(B)	I-1183-84	
	or (Mercuric nitrate), or	325.3	407B	D512-81(A)	I-1184-84	33.067[3]
	Colorimetric, manual or	—	—	D512-81(C)	I-1187-84	
	Automated (ferricyanide)	325.1, or 325.2	407D	—	I-2187-84	
17. Chlorine—Total residual, mg/L	Titrimetric					
	Amperometric direct,	330.1	408C	D1253-76(A)	—	
	Starch end point direct,	330.3	408A	D1253-76(B) Part 18.3	—	
	Back titration either end point[14], or	330.2	408B	—		
	DPD-FAS,	330.4	408D	—	—	
	Spectrophotometric, DPD,	330.5	408E	—	—	
	or Electrode	—	—	—	—	Note 15
18. Chromium VI dissolved, mg/L	0.45 micron filtration followed by					
	AA chelation-extraction,	218.4	303B	—	I-1232-84	
	or Colorimetric (Diphenylcarbazide).	—	—	—	I-1230-84	307B[16]
19. Chromium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	218.1	303A	D1687-84(D)	I-3236-84	33.089[3]
	AA chelation—extraction,	218.3	303B	—	—	
	AA furnace,	218.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Diphenylcarbazide).	—	312B	D1687-84(A)	—	
20. Cobalt—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	219.1	303A or B	D3558-84(A or B)	I-3239-84 or I-3240-84	p.37[8]
	AA furnace, or	219.2	304	—	—	
	Inductively coupled plasma	—	—	—	—	200.7[4]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page)				
		EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
21. Color, platinum cobalt units or dominant wavelength, hue, luminance, purity.	Colorimetric (ADMI), or	110.1	204D	—	—	Note 17
	(Platinum cobalt), or	110.2	204A	—	I-1250-84	
	Spectrophotometric.	110.3	204B	—	—	
22. Copper—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration.	220.1	303A or B	D1688-84(D or E)	I-3270-84 or I-3271-84	33.089[3], p.37[4]
	AA furnace.	220.2	304	—	—	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
	Colorimetric					
	(Neocuproine), or	—	313B	D1688-84(A)	—	
	(Bicinchoninate).	—	—	—	—	Note 18
23. Cyanide—Total, mg/L	Manual distillation with $MgCl_2$ followed by	—	412B	—	—	
	Titrimetric, or	—	412C	—	—	p.22[4]
	Spectrophotometric,					
	manual or	335.2	412D	D2036-82(A)	I-3300-84	
	Automated.[19]	335.3	—	D2036-82(A)	—	
24. Cyanide amenable to chlorination, mg/L	Manual distillation with $MgCl_2$ followed by titrimetric or spectrophotometric	335.1	412F	D2036-82(B)	—	
25. Fluoride—Total, mg/L	Manual distillation[5] followed by	—	413A	—	—	
	Electrode, manual or	340.2	413B	D1179-80(B)	—	
	Automated,	—	—	—	I-4327-84	
	Colorimetric (SPADNS),	340.1	413C	D1179-80(A)	—	
	or Automated complexone.	340.3	413E	—	—	
26. Gold—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	231.1	303A	—	—	
	AA furnace.	231.2	304	—	—	
27. Hardness—Total, as $CaCO_3$, mg/L	Automated colorimetric,	130.1	—	—	—	
	Titrimetric (EDTA), or	130.2	314B	D1126-80	I-1338-84	33.082[3]
	Ca plus Mg as their carbonates, by inductively coupled plasma or AA direct aspiration. (See Parameters 13 and 33.)					
28. Hydrogen ion (pH), pH units	Electrometric, measurement, or	150.1	423	D1293-84(A or B)	I-1586-84	33.006[3]
	Automated electrode.	—	—	—	—	Note 20
29. Iridium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	235.1	303A	—	—	
	AA furnace.	235.2	304	—	—	
30. Iron—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	236.1	303A or B	D1068-84(C or D)	I-3381-84	33.089[3]
	AA furnace.	236.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Phenanthroline).	—	315B	D1068-84(A)	—	Note 21

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page)				
		EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
31. Kjeldahl nitrogen—Total, (as N), mg/L	Digestion and distillation followed by	351.3	420A or B	D3590-84(A)	—	
	Titration,	351.3	417D	D3590-84(A)	—	33.051[3]
	Nesslerization,	351.3	417B	D3590-84(A)	—	
	Electrode,	351.3	417E or F	—	—	
	Automated phenate,	351.1	—	—	I-4551-78[7]	
	Semi-automated block digestor, or	351.2	—	D3590-84(A)	—	
	Potentiometric.	351.4	—	D3590-84(A)	—	
32. Lead—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	239.1	303A or B	D3559-85(A or B)	I-3399-84	33.089[3]
	AA furnace,	239.2	304	—	—	
	Inductively coupled plasma,	—	—	—	—	200.7[4]
	Voltametry[10], or	—	—	D3559-85(C)	—	
	Colorimetric (Dithizone).	—	3168	—	—	
33. Magnesium—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	242.1	303A	D511-84(B)	I-3447-84	33.089[3]
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Gravimetric	—	3188	D511-77(A)	—	
34. Manganese—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	243.1	303A or B	D858-84(B or C)	I-3454-84	33.089[3]
	AA furnace,	243.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Persulfate), or	—	3198	D858-84(A)	—	33.128[3]
	(Periodate)	—	—	—	—	Note 22
35. Mercury—Total[2], mg/L	Cold vapor, manual or	245.1	303F	D3223-80	I-3462-84	33.095[3]
	Automated.	245.2	—	—	—	
36. Molybdenum—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	246.1	303C	—	I-3490-84	
	AA furnace, or	246.2	304	—	—	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
37. Nickel—Total[2], mg/L	Digestion[2] followed by					
	AA direct aspiration,	249.1	303A or B	D1886-84(C or D)	I-3499-84	
	AA furnace,	249.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Heptoxime).	—	3218	—	—	
38. Nitrate (as N), mg/L	Colorimetric (Brucine sulfate), or Nitrate-nitrite N minus Nitrite N (See parameters 39 and 40).	352.1	—	D992-71	—	33.063[3], 419D[10], p.28[9]
39. Nitrate-nitrite (as N), mg/L	Cadmium reduction,					
	Manual or	353.3	418C	D3867-85(B)	—	
	Automated, or	353.2	418F	D3867-85(A)	I-4545-84	
	Automated hydrazine.	353.1	—	—	—	

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
40. Nitrite (as N), mg/L	Spectrophotometric.					
	Manual or	354.1	419	D1254-67	—	Note 24
	Automated (Diazotization).	—	—	—	I-4540-84	
41. Oil and grease—Total recoverable, mg/L	Gravimetric (extraction).	413.1	503A	—	—	
42. Organic carbon—Total (TOC), mg/L	Combustion or oxidation.	415.1	505	D2579-85(A or B)	—	33.044[2], p.4[22]
43. Organic nitrogen (as N) mg/L	Total Kjeldahl N (Parameter 31) minus ammonia N (Parameter 4)					
44. Orthophosphate (as P), mg/L	Ascorbic acid method.					
	Automated or	365.1	424G	—	I-4601-84	33.116[2]
	Manual single reagent,	365.2	424F	D515-82(A)	—	33.111[2]
	or Manual two reagent,	365.3	—	—	—	
45. Osmium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	252.1	303C	—	—	
	AA furnace.	252.2	304	—	—	
46. Oxygen, dissolved, mg/L	Winkler (Azide modification), or	360.2	421B	D888-81(C)	I-1575-78[7]	33.028[2]
	Electrode.	360.1	421F	—	I-1576-78[7]	
47. Palladium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	253.1	—	—	—	p.S27[9]
	AA furnace.	253.2	—	—	—	p.S28[9]
48. Phenols, mg/L	Manual distillation[25] followed by	420.1	—	D1783-80(A or B)	—	Note 26
	Colorimetric (4AAP) manual, or	420.1	—	—	—	Note 26
	Automated[19].	420.2	—	—	—	
49. Phosphorus (elemental) mg/L	Gas-liquid chromatography.	—	—	—	—	Note 27
50. Phosphorus—Total, mg/L	Persulfate digestion followed by	365.2	424C(III)	—	—	33.111[2]
	Manual or	365.2 or 365.3	424F	D515-82(A)	—	
	Automated ascorbic acid reduction, or	365.1	424G	—	I-4600-84	33.116[2]
	Semi-automated block digestor.	365.4	—	—	—	
51. Platinum—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	256.1	303A	—	—	
	AA furnace.	256.2	304	—	—	
52. Potassium—total[5], mg/L	Digestion followed by					
	AA direct aspiration,	258.1	303A	—	I-3630-84	33.103[2]
	Inductively coupled plasma	—	—	—	—	200.7[4]
	Flame photometric, or	—	322B	D1428-82(A)	—	
	Colorimetric (Cobaltinitrite).	—	—	—	—	317B[10]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page)				
		EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
53. Residue—Total, mg/L	Gravimetric, 103-105°C.	160.3	209A	—	I-3750-84	
54. Residue—filterable, mg/L	Gravimetric, 180°C.	160.1	209B	—	I-1750-84	
55. Residue—nonfilterable, (TSS), mg/L	Gravimetric, 103-105°C post washing of residue.	160.2	209C	—	I-3765-84	
56. Residue—settleable, mg/L	Volumetric (Imhoff cone) or gravimetric.	160.5	209E	—	—	
57. Residue—volatile, mg/L	Gravimetric, 550°C.	160.4	209D	—	I-3753-84	
58. Rhodium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	265.1	303A	—	—	
	AA furnace.	265.2	304	—	—	
59. Ruthenium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	267.1	303A	—	—	
	AA furnace.	267.2	304	—	—	
60. Selenium—Total[3], mg/L	Digestion[3] followed by					
	AA furnace,	270.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	AA gaseous hydride.	270.3	303E	D3859-84(A)	I-3667-84	
61. Silica—Dissolved, mg/L	0.45 micron filtration followed by					
	Colorimetric, Manual or	370.1	425C	D859-80(B)	I-1700-84	
	Automated (Molybdosilicate), or	—	—	—	I-2700-84	
	Inductively coupled plasma.	—	—	—	—	200.7[4]
62. Silver—Total[3,6], mg/L	Digestion[3] followed by					
	AA direct aspiration,	272.1	303A or B	—	I-3720-84	33.089[2], p.37[9]
	AA furnace.	272.2	304	—	—	
	Colorimetric (Dithizone), or	—	—	—	—	3198[14]
	Inductively coupled plasma.	—	—	—	—	200.7[4]
63. Sodium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	273.1	303A	—	I-3735-84	33.107[2]
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Flame photometric.	—	325B	D1428-82(A)	—	
64. Specific conductance, micromhos/cm at 25°C	Wheatstone bridge.	120.1	205	D1125-82(A)	I-1780-84	33.002[2]
65. Sulfate (as SO_4), mg/L	Automated colorimetric (barium chloranilate),	375.1	—	—	—	
	Gravimetric, or	375.3	426A or B	D516-82(A)	—	33.124[2]
	Turbidimetric.	375.4	—	D516-82(B)	—	426C[10]

Table 7.2. (continued)

Parameter and Units	Method	Reference (Method No. or Page) EPA 1979	Std. Methods 16th Ed.	ASTM	USGS[1]	Other
66. Sulfide (as S), mg/L	Titrimetric (iodine) or	376.1	427D	—	I-3840-84	228A[36]
	Colorimetric (methylene blue).	376.2	427C	—	—	
67. Sulfite (as SO_3), mg/L	Titrimetric (iodine-iodate).	377.1	428A	D1339-84(C)	—	
68. Surfactants, mg/L	Colorimetric (methylene blue).	425.1	512B	D2330-82(A)	—	
69. Temperature, °C.	Thermometric.	170.1	212	—	—	Note 31
70. Thallium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	279.1	303A	—	—	
	AA furnace, or	279.2	304	—	—	
	Inductively coupled plasma	—	—	—	—	200.7[4]
71. Tin—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	282.1	303A	—	I-3850-78[7]	
	AA furnace.	282.2	304	—	—	
72. Titanium—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration, or	283.1	303C	—	—	
	AA furnace.	283.2	304	—	—	
73. Turbidity, NTU	Nephelometric.	180.1	214A	D1889-81	I-3860-84	
74. Vanadium, Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	286.1	303C	—	—	
	AA furnace,	286.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Gallic acid).	—	327B	D3373-84(A)	—	
75. Zinc—Total[3], mg/L	Digestion[3] followed by					
	AA direct aspiration,	289.1	303A or B	D1691-84(C or D)	I-3900-84	33.089[3], p.37[4]
	AA furnace,	289.2	304	—	—	
	Inductively coupled plasma, or	—	—	—	—	200.7[4]
	Colorimetric (Dithizone) or	—	328C	—	—	
	(Zincon).	—	—	—	—	Note 32

[1] "Methods for Analysis of Inorganic Substances in Water and Fluvial Sediments," U.S. Department of the Interior, U.S. Geological Survey, Open-File Report 85-495, 1986, unless otherwise stated.

[3] "Official Methods of Analysis of the Association of Official Analytical Chemists," methods manual, 14th ed. (1985).

[4] For the determination of total metals the sample is not filtered before processing. A digestion procedure is required to solubilize suspended material and to destroy possible organic-metal complexes. Two digestion procedures are given in "Methods for Chemical Analysis of Water and Wastes, 1979." One (Section 4.1.3), is a vigorous digestion using nitric acid. A less vigorous digestion using nitric and hydrochloric acids (Section 4.1.4) is preferred; however, the analyst should be cautioned that this mild digestion may not suffice for all sample types. Particularly, if a colorimetric procedure is to be employed, it is necessary to ensure that all organo-metallic bonds be broken so that the metal is in a reactive state. In those situations, the vigorous digestion is to be preferred making certain that at no time does the sample go to dryness. Samples containing large amounts of organic materials would also benefit by this vigorous digestion. Use of the graphite furnace technique, inductively coupled plasma, as well as determinations for certain elements such as arsenic, the noble metals, mercury, selenium, and titanium require a modified digestion and in all cases the method write-up should be consulted for specific instruction and/or cautions.

NOTE: If the digestion included in one of the other approved references is different than the above, the EPA procedure must be used.

Dissolved metals are defined as those constituents which will pass through a 0.45 micron membrane filter. Following filtration of the sample, the referenced procedure for total metals must be followed. Sample digestion for dissolved metals may be omitted for AA (direct aspiration or graphite furnace) and ICP analyses provided the sample solution to be analyzed meets the following criteria:

Table 7.2. (continued)

a. has a low COD (<20)
b. is visibly transparent with a turbidity measurement of 1 NTU or less.
c. is colorless with no perceptable odor, and
d. is of one liquid phase and free of particulate or suspended matter following acidification.

[6]The full text of Method 200.7, "Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes," is given at Appendix C of this Part 136.

[7]Manual distillation is not required if comparability data on representative effluent samples are on company file to show that this preliminary distillation step is not necessary, however, manual distillation will be required to resolve any controversies.

[8]Ammonia, Automated Electrode Method, Industrial Method Number 379-75 WE, dated February 19, 1976, Technicon AutoAnalyzer II, Technicon Industrial Systems, Tarrytown, NY, 10591.

[9]The approved method is that cited in "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," USGS TWRI, Book 5, Chapter A1 (1979).

[10]American National Standard on Photographic Processing Effluents, Apr. 2, 1975. Available from ANSI, 1430 Broadway, New York, NY 10018.

[11]"Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Examination of Water and Wastewater* (1981).

[12]The use of normal and differential pulse voltage ramps to increase sensitivity and resolution is acceptable.

[13]Carbonaceous biochemical oxygen demand ($CBOD_5$) must not be confused with the traditional BOD_5 test which measures "total BOD." The addition of the nitrification inhibitor is not a procedural option, but must be included to report the $CBOD_5$ parameter. A discharger whose permit requires reporting the traditional BOD_5 may not use a nitrification inhibitor in the procedure for reporting the results. Only when a discharger's permit specifically states $CBOD_5$ is required, can the permittee report data using the nitrification inhibitor.

[14]OIC Chemical Oxygen Demand Method, Oceanography International Corporation, 512 West Loop, P.O. Box 2980, College Station, TX 77840

[15]Chemical Oxygen Demand, Method 8000, Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537

[16]The back titration method will be used to resolve controversy.

[17]Orion Research Instruction Manual, Residual Chlorine Electrode Model 97-70, 1977, Orion Research Incorporated, 840 Memorial Drive Cambridge, MA 02138

[18]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 14th Edition, 1976.

[19]National Council of the Paper Industry for Air and Stream Improvement, (Inc.) Technical Bulletin 253, December 1971.

[20]Copper, Biocinchoinate Method, Method 8506, Hach Handbook of Water Analysis, 1979, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537

[21]After the manual distillation is completed, the autoanalyzer manifolds in EPA Methods 335.3 (cyanide) or 420.2 (phenols) are simplified by connecting the re-sample line directly to the sampler. When using the manifold setup shown in Method 335.3, the buffer 6.2 should be replaced with the buffer 7.8 found in Method 335.2.

[22]Hydrogen Ion (pH) Automated Electrode Method, Industrial Method Number 378-75WA, October 1976, Technicon Auto-Analyzer II, Technicon Industrial Systems, Tarrytown, NY 10591.

[23]Iron, 1,10-Phenanthroline Method, Method 8008, 1980, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[24]Manganese, Periodate Oxidation Method, Method 8034, Hach Handbook of Wastewater Analysis, 1979, pages 2-113 and 2-117, Hach Chemical Company, Loveland, CO 80537.

[25]Goerlitz, D., Brown, E., "Methods for Analysis of Organic Substances in Water," U.S. Geological Survey Techniques of Water-Resources Inv., book 5, ch. A3, page 4 (1972).

[26]Nitrogen, Nitrite, Method 8507, Hach Chemical Company, P.O. Box 389, Loveland, CO 80537.

[27]Just prior to distillation, adjust the sulfuric-acid-preserved sample to pH 4 with 1 + 9 NaOH.

[28]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 14th Edition. The colorimetric reaction is conducted at a pH of 10.0 ± 0.2. The approved methods are given on pp. 578-81 of the 14th Edition: Method 510A for distillation, Method 510B for the manual colorimetric procedure, or Method 510C for the manual spectrophotometric procedure.

[29]R. F. Addison and R. G. Ackman, "Direct Determination of Elemental Phosphorus by Gas-Liquid Chromatography," *Journal of Chromatography*, vol. 47, No. 3, pp. 421-426, 1970.

[30]Approved methods for the analysis of silver in industrial wastewaters at concentrations of 1 mg/L and above are inadequate where silver exists as an inorganic halide. Silver halides such as the bromide and chloride are relatively insoluble in reagents such as nitric acid but are readily soluble in an aqueous buffer of sodium thiosulfate and sodium hydroxide to a pH of 12. Therefore, for levels of silver above 1 mg/L, 20 mL of sample should be diluted to 100 mL by adding 40 mL each of 2 M $Na_2S_2O_3$ and 2M NaOH. Standards should be prepared in the same manner. For levels of silver below 1 mg/L, the approved method is satisfactory.

[31]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 15th Edition.

[32]The approved method is that cited in *Standard Methods for the Examination of Water and Wastewater*, 13th Edition.

[33]Stevens, H. H., Ficke, J. F., and Smoot, G. F., "Water Temperature—Influential Factors, Field Measurement and Data Presentation," U.S. Geological Survey, Techniques of Water Resources Investigations, Book 1, Chapter D1, 1975.

[34]Zinc, Zincon Method, Method 8009, Hach Handbook of Water Analysis, 1979, pages 2-231 and 2-333, Hach Chemical Company, Loveland, CO 80537.

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Table 7.3. List of approved test procedures for nonpesticide organic compounds (40 CFR, Part 136, July 1, 1987)

Parameter [1]	EPA Method Number [2,3]			Other
	GC	GC/MS	HPLC	
1 Acenaphthene	610	625, 1625	610	
2 Acenaphthylene	610	625, 1625	610	
3 Acrolein	603	[4]624, 1624		
4 Acrylonitrile	603	[4]624, 1624		
5 Anthracene	610	625, 1625	610	
6 Benzene	602	624, 1624		
7 Benzidine		[4]625, 1625	605	Note 3, p. 1;
8 Benzo(a)anthracene	610	625, 1625	610	
9 Benzo(a)pyrene	610	625, 1625	610	
10 Benzo(b)fluoranthene	610	625, 1625	610	
11 Benzo(ghi)perylene	610	625, 1625	610	
12 Benzo(k)fluoranthene	610	625, 1625	610	
13 Benzyl Chloride				Note 3, p. 130; Note 6, p. S102.
14 Benzyl Butyl Phthalate	606	625, 1625		
15 Bis(2-chloroethoxy) methane	611	625, 1625		
16 Bis(2-chloroethyl) ether	611	625, 1625		
17 Bis(2-ethylhexyl) phthalate	606	625, 1625		
18 Bromodichloromethane	601	624, 1624		
19 Bromoform	601	624, 1624		
20 Bromomethane	601	624, 1624		
21 4-Bromophenylphenyl ether	611	625, 1625		
22 Carbon tetrachloride	601	624, 1624		Note 3, p. 130;
23 4-Chloro-3-methylphenol	604	625, 1625		
24 Chlorobenzene	601, 602	624, 1624		Note 3, p. 130;
25 Chloroethane	601	624, 1624		
26 2-Chloroethylvinyl ether	601	624, 1624		
27 Chloroform	601	624, 1624		Note 3, p. 130;
28 Chloromethane	601	624, 1624		
29 2-Chloronaphthalene	612	625, 1625		
30 2-Chlorophenol	604	625, 1625		
31 4-Chlorophenylphenyl ether	611	625, 1625		
32 Chrysene	610	625, 1625	610	
33 Dibenzo(a,h)anthracene	610	625, 1625	610	
34 Dibromochloromethane	601	624, 1624		
35 1,2-Dichlorobenzene	601, 602, 612	624, 625, 1625		
36 1,3-Dichlorobenzene	601, 602, 612	624, 625, 1625		
37 1,4-Dichlorobenzene	601, 602, 612	625, 1624, 1625		
38 3,3-Dichlorobenzidine		625, 1625	605	
39 Dichlorodifluoromethane	601			
40 1,1-Dichloroethane	601	624, 1624		
41 1,2-Dichloroethane	601	624, 1624		
42 1,1-Dichloroethene	601	624, 1624		
43 trans-1,2-Dichloroethene	601	624, 1624		
44 2,4-Dichlorophenol	604	625, 1625		
45 1,2-Dichloropropane	601	624, 1624		
46 cis-1,3-Dichloropropene	601	624, 1624		
47 trans-1,3-Dichloropropene	601	624, 1624		
48 Diethyl phthalate	606	625, 1625		
49 2,4-Dimethylphenol	604	625, 1625		
50 Dimethyl phthalate	606	625, 1625		
51 Di-n-butyl phthalate	606	625, 1625		
52 Di-n-octyl phthalate	606	625, 1625		
53 2,4-Dinitrophenol	604	625, 1625		
54 2,4-Dinitrotoluene	609	625, 1625		
55 2,6-Dinitrotoluene	609	625, 1625		
56 Epichlorohydrin				Note 3, p. 130; Note 6, p. S102.
57 Ethylbenzene	602	624, 1624		
58 Fluoranthene	610	625, 1625	610	
59 Fluorene	610	625, 1625	610	
60 Hexachlorobenzene	612	625, 1625		
61 Hexachlorobutadiene	612	625, 1625		
62 Hexachlorocyclopentadiene	612	[4]625, 1625		
63 Hexachloroethane	612	625, 1625		
64 Indeno(1,2,3-cd)pyrene	610	625, 1625	610	
65 Isophorone	609	625, 1625		
66 Methylene Chloride	601	624, 1624		Note 3, p. 130;
67 2-Methyl-4,6-Dinitrophenol	604	625, 1625		
68 Naphthalene	610	625, 1625		
69 Nitrobenzene	609	625, 1625		
70 2-Nitrophenol	604	625, 1625		
71 4-Nitrophenol	604	625, 1625		
72 N-Nitrosodimethylamine	607	625, 1625		
73 N-Nitrosodi-n-propylamine	607	[4]625, 1625		
74 N-Nitrosodiphenylamine	607	[4]625, 1625		
75 2,2-oxybis(1-chloropropane)	611	625, 1625		
76 PCB-1016	608		625,	Note 3, p. 43;
77 PCB-1221	608		625,	Note 3, p. 43;
78 PCB-1232	608		625,	Note 3, p. 43;
79 PCB-1242	608		625,	Note 3, p. 43;
80 PCB-1248	608		625,	Note 3, p. 43;
81 PCB-1254	608		625,	Note 3, p. 43;
82 PCB-1260	608		625,	Note 3, p. 43;
83 Pentachlorophenol	604	625, 1625		Note 3, p. 140;

Table 7.3. (continued)

Parameter [1]	EPA Method Number [2, 3]			Other
	GC	GC/MS	HPLC	
84. Phenanthrene	610	625, 1625	610	
85. Phenol	604	625, 1625		
86. Pyrene	610	625, 1625	610	
87. 2,3,7,8-Tetrachlorodibenzo-p-dioxin		[5] 613		
88. 1,1,2,2-Tetrachloroethane	601	624, 1624		Note 3, p. 13
89. Tetrachloroethene	601	624, 1624		Note 3, p. 13
90. Toluene	602	624, 1624		
91. 1,2,4-Trichlorobenzene	612	625, 1625		Note 3, p. 13
92. 1,1,1-Trichloroethane	601	624, 1624		
93. 1,1,2-Trichloroethane	601	624, 1624		Note 3, p. 13
94. Trichloroethene	601	624, 1624		
95. Trichlorofluoromethane	601	624,		
96. 2,4,6-Trichlorophenol	604	625, 1625		
97. Vinyl Chloride	601	624, 1624		

Table IC Notes

[1] All parameters are expressed in micrograms per liter (µg/L).

[2] The full text of Methods 601-613, 624, 625, 1624, and 1625, are given at Appendix A, "Test Procedures for Analysis of Organic Pollutants," of this Part 136. The standardize procedure to be used to determine the method detection limit (MDL) for these test procedures is given at Appendix B, "Definition and Procedure for the Determination of the Method Det Limit," of this Part 136.

[3] "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater," U.S. Environmental Protection Agency, September,

[4] Method 624 may be extended to screen samples for Acrolein and Acrylonitrile. However, when they are known to be present, the preferred method for these two compounds is M 603 or Method 1624.

[5] Method 625 may be extended to include benzidine, hexachlorocyclopentadiene, N-nitrosodimethylamine, and N-nitrosodiphenylamine. However, when they are known to be pr Methods 605, 607, and 612, or Method 1625, are preferred methods for these compounds.

[6] 625, Screening only.

[7] "Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Examin of Water and Wastewater* (1981)

[8] Each analyst must make an initial, one-time, demonstration of their ability to generate acceptable precision and accuracy with Methods 601-613, 624, 625, 1624, and 1625 (See App A of this Part 136) in accordance with procedures each in section 8.2 of each of these Methods. Additionally, each laboratory, on an on-going basis must spike and analyze 10% (5 Methods 624 and 625 and 100% for methods 1624, and 1625) of all samples to monitor and evaluate laboratory data quality in accordance with sections 8.3 and 8.4 of these Methods. The recovery of any parameter falls outside the warning limits, the analytical results for that parameter in the unspiked sample are suspect and cannot be reported to demonstrate reg compliance

Note.—These warning limits are promulgated as an "interim final action with a request for comments."

Table 7.4. List of approved test procedures for pesticides[1] (40 CFR, Part 136, July 1, 1987)

Parameter µg/L	Method	EPA[1,1]	Standard Methods 15th Ed	ASTM	Other
Aldrin	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30
	GC/MS	625			
2 Amitrole	GC				Note 3, p. 83, Note 6, p. 588.
3 Aminocarb	TLC				Note 3, p. 94, Note 6, p. 616.
4 Atrolen	GC				Note 3, p. 83, Note 6, p. 588.
5 Atrazine	GC				Note 3, p. 83, Note 6, p. 588.
6. Azinphos methyl	GC				Note 3, p. 25, Note 6, p. 551.
7 Barban	TLC				Note 3, p. 104, Note 6, p. 564.
8 α-BHC	GC	608	509A	D3086	Note 3, p. 7.
	GC/MS	[1]625			
9 β-BHC	GC	608		D3086	
	GC/MS	625			
10. δ-BHC	GC	608		D3086	
	GC/MS	[1]625			
11 γ-BHC (Lindane)	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30
	GC/MS	625			
12 Captan	GC		509A		Note 3, p. 7
13 Carbaryl	TLC				Note 3, p. 94, Note 6, p. 580
14 Carbophenothion	GC				Note 4, p. 30, Note 6, p. 573.
15 Chlordane	GC	608	509A	D3086	Note 3, p. 7
	GC-MS	625			
16 Chlorpropham	TLC				Note 3, p. 104, Note 6, p. 564
17 2,4-D	GC		509B		Note 3, p. 115, Note 4, p. 35
18 4,4'-DDD	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30
	GC-MS	625			
19 4,4'-DDE	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30
	GC/MS	625			
20 4,4'-DDT	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30
	GC/MS	625			
21 Demeton-O	GC				Note 3, p. 25, Note 6, p. 551
22 Demeton-S	GC				Note 3, p. 25, Note 6, p. 551
23 Diazinon	GC				Note 3, p. 25, Note 4, p. 30, Note 6, p. 551.
24 Dicamba	GC				Note 3, p. 115
25 Dichlorofenthion	GC				Note 4, p. 30, Note 6, p. 573
26 Dichloran	GC		509A		Note 3, p. 7
27 Dicofol	GC			D3086	
28 Dieldrin	GC	608	509A		Note 3, p. 7, Note 4, p. 30
	GC/MS	625			
29 Dioxathion	GC				Note 4, p. 30, Note 6, p. 573
30 Disulfoton	GC				Note 3, p. , Note 6, p. 551
31 Diuron	TLC				Note 3, p. 104, Note 6, p. 564
32 Endosulfan I	GC	608	509A	D3086	Note 3, p. 7
	GC/MS	[1]625			
33 Endosulfan II	GC	608	509A	D3086	Note 3, p. 7
	GC/MS	[1]625			
34 Endosulfan sulfate	GC	608			
	GC/MS	625			
35 Endrin	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30
	GC/MS	[1]625			
36 Endrin aldehyde	GC	608			
	GC/MS	625			
37 Ethion	GC				Note 4, p. 30, Note 6, p. 573
38 Fenuron	TLC				Note 3, p. 104, Note 6, p. 564
39 Fenuron-TCA	TLC				Note 3, p. 104, Note 6, p. 564
40 Heptachlor	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30
	GC/MS	625			
41 Heptachlor epoxide	GC	608	509A	D3086	Note 3, p. 7, Note 4, p. 30, Note 6, p. 573
42 Isodrin	GC/MS	625			
	GC				Note 4, p. 30, Note 6, p. 573
43 Linuron	TLC				Note 3, p. 104, Note 6, p. 564
44 Malathion	GC		509A		Note 3, p. 25, Note 4, p. 30, Note 6, p. 551
45 Methiocarb	TLC				Note 3, p. 94, Note 6, p. 580
46 Methoxychlor	GC		509A	D3086	Note 3, p. 7, Note 4, p. 30
47 Metacarbate	TLC				Note 3, p. 94, Note 6, p. 580
48 Mirex	GC		509A		Note 3, p. 7
49 Monuron	TLC				Note 3, p. 104, Note 6, p. 564
50. Monuron-TCA	TLC				Note 3, p. 104, Note 6, p. 564.
51 Neburon	TLC				Note 3, p. 104, Note 6, p. 564.
52 Parathion methyl	GC		509A		Note 3, p. 25, Note 4, p. 30
53. Parathion ethyl	GC		509A		Note 3, p. 25.
54 PCNB	GC		509A		Note 3, p. 7
55. Perthane	GC			D3086	
56. Prometon	GC				Note 3, p. 83, Note 6, p. 588.
57 Prometryn	GC				Note 3, p. 83, Note 6, p. 588.
58 Propazine	GC				Note 3, p. 83, Note 6, p. 588.
59 Propham	TLC				Note 3, p. 104; Note 6, p. 564.
60. Propoxur	TLC				Note 3, p. 94, Note 6, p. 580.
61. Secbumeton	TLC				Note 3, p. 83; Note 6, p. 588.
62 Siduron	TLC				Note 3, p. 104; Note 6, p. 564.
63 Simazine	GC				Note 3, p. 83, Note 6, p. 588.
64. Strobane	GC		509A		Note 3, p. 7.

Table 7.4. (continued)

Parameter µg/L	Method	EPA [1,2]	Standard Methods 15th Ed	ASTM	Other
66. Swep	TLC				Note 3, p. 104; Note 6, p. 564
68. 2,4,5-T	GC		509B		Note 3, p. 115, Note 4, p. 36
67. 2,4,5-TP (Silvex)	GC		509B		Note 3, p. 118.
68. Terbuthylazine	GC				Note 3, p. 63, Note 6, p. 589
69. Tocaphene	GC	608	509A	D3086	Note 3, p. 7; Note 4, p. 30.
	GC/MS	625			
70. Trifluralin	GC		509A		Note 3, p. 7

Table 7D Notes

[1] Pesticides are listed in this table by common name for the convenience of the reader. Additional pesticides may be found under Table 7C, where entries are listed by chemical

[2] The full text of methods 608 and 625 are given at Appendix A, "Test Procedures for Analysis of Organic Pollutants," of this Part 136. The standardized test procedure to be u determine the method detection limit (MDL) for these test procedures is given at Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit" of this Pa

[3] "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater," U.S. Environmental Protection Agency, September, 1971 EPA publication includes thin-layer chromatography (TLC) methods.

[4] "Methods for Analysis of Organic Substances in Water," U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 5, Chapter A3 (1972)

[5] The method may be extended to include α-BHC, δ-BHC, endosulfan I, endosulfan II, and endrin. However, when they are known to exist, Method 608 is the preferred m

[6] "Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency," Supplement to the Fifteenth Edition of *Standard Methods for the Exam of Water and Wastewater* (1981)

[7] Each analyst must make an initial, one-time, demonstration of their ability to generate acceptable precision and accuracy with Methods 608 and 625 (See Appendix A of this Part accordance with procedures given in Section 8.2 of each of these methods. Additionally, each laboratory, on an on-going basis, must spike and analyze 10% of all samples analyze Method 608 or 5% of all samples analyzed with Method 625 to monitor and evaluate laboratory data quality in accordance with Sections 8.3 and 8.4 of these methods. When the reco any parameter falls outside the warning limits, the analytical results for that parameter in the unspiked sample are suspect and cannot be reported to demonstrate regulatory comp

Note.—These warning limits are promulgated as an "interim final action with a request for comments."

Table 7.5. List of approved radiological test procedures (40 CFR, Part 136, July 1, 1987)

Parameter and units	Methods	EPA [1]	Reference (method No. or page)		
			Standard Methods 15th Ed	ASTM	USGS [2]
1 Alpha-Total, pCi per liter	Proportional or scintillation counter	900.0	703	D1943-66	pp. 75 and 78 [3]
2 Alpha-Counting error, pCi per liter	Proportional or scintillation counter	Appendix B	703	D1943-66	p. 79
3 Alpha-Counting error, pCi per liter	Proportional counter	900.0	703	D1890-66	pp. 75 and 78 [3]
4 Beta-Counting error, pCi per liter	Proportional counter	Appendix B	703	D1890-66	p. 79
5 (a) Radium-Total, pCi per liter	Proportional counter	903.0	705	D2460-70	
(b) ^{226}Ra, pCi per liter	Scintillation counter	903.1	706	D3454-79	p. 81

Table IE Notes

[1] "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032 (1980 updated), U.S. Environmental Protection Agency, August 1980.

[2] Fishman, M.J. and Brown, Eugene, "Selected Methods of the U.S. Geological Survey of Analysis of Wastewaters," U.S. Geological Survey, Open-File Report 76-177, (1976).

[3] The method found on p. 75 measures only the dissolved portion while the method on p. 78 measures only the suspended portion. Therefore, the two results must be added to obtain the total.

and blank/spike control. In methods not using surrogates such as metals, anions, and wet chemical analysis, a blank and a blank/spike (laboratory control sample) shall be analyzed. For pesticide/PCB methods, surrogates are often used. However, problems have been noted in surrogate recovery for the dibutyl chlorinate typically used. For pesticide/PCB analysis, a blank and a blank/spike shall be analyzed with each batch as separate samples. A pesticide or a PCB shall be used as the spiking compound.

In Level C, when performing analyses for petroleum hydrocarbons; oil and grease; anions such as nitrates, sulfates and chloride; and other wet chemical methods, a matrix spike and matrix spike duplicate are required for every 20 samples of similar matrix. Similar matrix is defined as either soil or water from the same military base.

All methods specified require calibration. In keeping with the method calibration requirements, the following requirements are presented. For all semivolatile and volatile analysis by GC/MS, the current CLP calibration method shall be used. The current CLP criteria shall be used for frequency of calibration, for the system performance check compounds (SPCCs), and for the calibration check compounds (CCCs).

For other methods, a minimum of three different concentration standards for each analyte shall be analyzed for initial calibration. Calibration shall be checked every 12 h of operation and prior to sample analysis. The laboratory shall use the calibration check acceptance criteria specified by the method. The daily calibration acceptance criteria to be used for each method shall be documented in the laboratory QA plan or in the site-specific QA plan. The initial calibration curve shall be plotted and the correlation coefficient and response factors evaluated. The laboratory shall indicate in the laboratory QA plan or in the site-specific QA plan the acceptance criteria to be used for the initial calibration curve. The calibration shall include one standard at a concentration at the method detection limits. The calibration curve shall bracket all samples in the concentration range. If the samples are not within the calibration range, appropriate dilution shall be performed to bring the samples into the calibration range. The aforementioned calibration requirements shall be used for Levels C and E.

In Level C, a matrix spike and matrix spike duplicate are required for volatiles, semivolatiles, and all GC analysis for every 20 samples of similar matrix. For metals analysis, a duplicate and a matrix spike are required for every 20 samples of similar matrix.

For all GC methods used in level C QC, second column confirmation shall be used for all positive responses for the analytes of interest. In Level E, second column confirmation is not required.

In Level E, no matrix spikes or duplicates are required; only the initial and continuing calibration, method blank, and blank/spike are required.

7.2 DELIVERABLES

For Level D QC, a CLP data package shall be delivered. This shall include the summary package and the remainder of the package, which includes initial and continuing calibration, matrix spikes, matrix spike duplicates, blanks, duplicates, surrogate recoveries, chromatograms, mass spectra, and absorbance data. For methods which are not defined by CLP, the calibration information, method blanks, blank/spikes, the chromatograms, absorbance, matrix spikes, and matrix spike duplicates shall be reported. The control charts plotted per Sect. 4 associated with the blank/spikes shall be presented with the data.

For Level C QC, the method blanks, blank/spike, surrogates, matrix spikes, matrix spike duplicates, duplicates, and initial and continuing calibration data shall be reported. Table 7.6 lists the required deliverables. The forms referred to in Table 7.6 are from the current CLP for organics and metals/cyanide. The form numbers will be upgraded as new revisions occur in the CLP, which require changes in form content or numbering.

In Level E, the only information to be submitted is the sample data, method blank data, and the control chart from the blank/spike.

The deliverables shall be presented to the NCR. The forms shall be used when reporting any data in the MPR and in submitting the final data package prior to its inclusion in the appendix and summary tables of the final report. The final data deliverables shall be presented to the NCR at least three weeks prior to issuing the draft of the final report.

7.3 DATA VALIDATION

7.3.1 Level D Validation

At a minimum, the data generated from Level D will be validated per the CLP criteria as outlined in the following documents.

EPA, Hazardous Site Control Division, *Laboratory Data Validation Functional Guidelines for Evaluating Pesticides/PCB's Analyses*, R-582-5-5-01, May 28, 1985.

EPA, Hazardous Site Control Division, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*, R-582-5-5-01, May 28, 1985.

EPA, Office of Emergency and Remedial Response, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*, 1985.

Table 7.6. Data set deliverables for Level C QA

	Method requirements	Deliverables
Organics	- Method blank spikes with results and control charts. Run with each batch of samples processed.	Control chart
	- Results to be reported on CLP Form 1 or spreadsheet per Sect. 9. Sample results using CLP data flags.	Form 1 or Sect. 9 1/Sample chromatograms/and mass spectra
	- Surrogate recovery from samples reported on CLP Form 2. Surrogates to be used in volatiles, semivolatiles, pesticides/PCB. For volatiles by GC, the names of surrogates should be changed to reflect the surrogate used.	Form 2
	- Matrix spike/spike duplicate 1 spike and spike duplicate per 20 samples of similar matrix reported on Form 3.	Form 3
	- Method blank reported on CLP Form 4.	Form 4 or Sect. 9
	For volatiles by GC, a similar format will be used as CLP Form 4 for blanks.	
	- GC/MS tuning for volatiles/semivolatiles. Report results on Form 5.	Form 5
	- Initial calibration data reported on Form 6.	Form 6
	For volatiles by GC, the initial calibration data with response factors must be reported.	No Form
	For pesticide/PCB data Form 9 must be used for calibration data.	Form 9
	- Continuing calibration GC/MS data reported on Form 7.	Form 7
	For volatiles, GC data, the response factors and their percent differences from the initial must be reported.	No Form
	Internal Standard Area for Volatiles and Semivolatiles.	Form 8

Table 7.6. (continued)

	Method requirements	Deliverables
Organics (cont'd)	- For pesticides/PCB data, the CLP Form 9 must be presented.	Form 9
	No chromatograms or mass spectra are presented for calibration. These data should be filed in the laboratory and available if problems arise in reviewing/validating the data. The calibration information should be available for checking during on-site audits.	
	- Internal standard area for GC/MS analyses CLP Form VIII shall be supplied.	
	- Second column confirmation shall be done for all GC work when compounds are detected above reporting limits. Chromatograms of confirmation must be provided.	Chromatograms
Metals	- Level C, requirements	Deliverables
	- Sample results with CLP flagging system	CLP Form 1 or Sect. 9
	- Initial and continuing calibration	CLP Form 2, Part 1 only
	- Blanks 10% frequency	Form 3
	- Method blank taken through digestion (1/20 samples of same matrix)	Form 3 or Sect. 9
	- ICP interference check sample	Form 4
	- Matrix spike recovery (1 per 20 samples of similar matrix)	Form 5, Part 1
	- Postdigestion spike sample recovery for ICP metals. Only done if predigest spike recovery exceed CLP limits.	Form 5, Part 2 (never used for GFAA work)
	- Postdigest spike for GFAA	Recovery will be noted on raw data
	- Duplicates (1 per 20 samples will be split and digested as separate	Form 6 samples

Table 7.6. (continued)

	Method requirements	Deliverables
Metals (cont'd)	- Method blank spike information will be plotted on control chart, one per batch of samples processed.	Control chart
	- Standard addition. The decision process outlined in CLP page E-3 will be used to determine when standard additions are required.	Form 8
	Holding times	Form 10
Wet Chemistry	Level C	
	- Blank spike 1/batch	Control chart
	- Method Blank 1/batch	Report result No format
	- Sample results	Report result No format
	- Matrix spike/spike duplicate or calibration information	Report result if applicable
	- Calibration check report percent RSD or percent difference from initial calibration	Report percent or percent difference No format

7.3.2 Level C Data Validation Guidelines

Listed below are the validation criteria which will be utilized in evaluating the analytical data for a Level C QC site. For methods not listed here, a similar procedure will be submitted by the prime contractor and the laboratory which outlines validation of the holding times, initial calibration, continuing calibration, and blank-vs-sample results. The validation procedure will be approved by the NCR.

1. For Petroleum Hydrocarbons (418.1/SW-3540, EPA 418.1)

   Holding Times - Holding times are 28 days for water samples which are preserved and refrigerated. No holding times are cited for soils.

Calibration - Ensure that a three-to-five point curve bracketing the sample concentration is performed daily.

Blanks - A blank should be run with each batch. If the blank concentration exceeds the reporting limit, the reporting limit shall be raised and the data flagged as estimated (UJ).

2. Target Compound List (TCL) for VOAs (CLP Methods)

Holding Times - Samples must be analyzed within the holding times specified in Sect. 3 or the data should be marked as estimated (J).

GC/MS Tuning - Check that bromofluorobenzene tune is completed each 12-h shift of operation. Check that it meets the CLP criteria. Assure that each sample is associated with a tune.

Initial Calibration - The maximum relative standard deviation [(RSD) percent RSD] shall not be >30% for indicted CLP CCC. The maximum mean relative response factor (RRF) for SPCC shall be >0.300 (0.250 for bromoform). The SPCCs are chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene. The CCC compounds are vinyl chloride, 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, and ethylbenzene.

Continuing Calibration - The minimum response factor for the SPCC components for VOAs analyses shall not be <0.300 (0.250 for bromoform). The maximum response factor percent deviation for indicated CLP CCC components from the mean initial calibration response factor shall not exceed 25%. If these criteria are exceeded, a new calibration for the compound shall be employed.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data analyzed with the out-of-control point shall be discussed in the QC section of the MPR and final report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples within the holding times or the data will be flagged with an "R," and the data are not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Method Blanks - A method blank should be run each day following the Continuing Calibration Standard. Common laboratory solvents should not be found in the blank at levels over five times the detection

limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries shall meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blank spike data from the batch are satisfactory, the data is usable, and the low recovery is discussed in the final report QA/QC and in the QC report sent to the NCR.

Field, Trip and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

3. TCL Semivolatile Organics (CLP Methods)

Holding Times - Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction. Any samples which do not meet these requirements must be flagged as estimated.

GC/MS Tune - Make certain that a decafluorotriphenylphosphine tune is completed every 12 h of sample analysis, that each sample is associated with a tune, and that each tune meets CLP requirements. Data are not reported if the instrument does not meet tune.

Initial Calibration - Ensure that a 5-point curve has been completed. The RRF of the BNA compounds shall be a minimum of 0.050 for the SPCC listed in the current revision of the CLP. The maximum RSD for the CCC listed in the CLP procedure is 30.0%. The minimum RRF for the SPCC is 0.050, and the maximum percent difference for the CCC is 25%. If these limits are exceeded, a new calibration curve shall be generated.

Continuing Calibration - The continuing calibration check will be performed once every 12 h during operation. The minimum RRF for the SPCC is 0.05, and the maximum percent difference from the initial calibration shall not exceed 25% for the CCC. If these limits are exceeded, a new calibration curve shall be generated.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and the out-of-control point shall be discussed in the QC section of

the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data is not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Blanks - A method blank should be run each day following the Continuing Calibration Standard. Phthalate should not be found in the blank at levels over five times the detection limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries should meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blanks spike data from the batch is satisfactory, the data are usable, and the low recovery is discussed in the final QC report sent to the Analytical Environmental Support Section.

4. Metals

Holding Times - Samples must be analyzed within six months, except mercury shall be analyzed in 28 days from sample collection.

ICP Initial Calibration - A calibration blank and at least one standard must be analyzed daily. An initial calibration verification standard must be within 90 to 110% recovery or the samples should be reanalyzed. If it is not possible to perform reanalysis, the data are rejected and flagged with an "R."

AA Calibration - Calibration blank and at least three standards shall be used in establishing the curve prior to sample analysis. A curve shall be analyzed each day prior to sample analysis.

Calibration Verification - Verification using a standard obtained from a source other than that of the initial calibration shall be used and the result shall be within 90 to 110% of the true value for

both ICP and AA work. Calibration verification shall be done at a minimum frequency of 10% or every 2 h, whichever is more frequent, and shall be done at the end of the analytical run.

Method Blanks - At least one preparation blank shall be prepared with each batch of samples. The blanks shall contain less than the detection limit for all analytes. If the concentration of the associated blanks is above the detection limit and if the lowest analyte concentration is <10 times the blank, reanalysis of the sample must occur. If reanalysis is not done, the data shall be reported and flagged as estimated. The blank shall never be subtracted from the sample.

Field and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

Blank/Spike Laboratory Control Samples - Any laboratory control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and out-of-control point shall be discussed in the QC section of the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented. A discussion of data reported when the blank/spike laboratory control sample is out of control shall be presented in the QC section of both the final report and the MPR.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data are not usable.

8. MAINTAINING LABORATORY APPROVAL

Once a laboratory has received Navy approval to begin analysis of samples, maintaining that approval requires adherence to the QA plan and reporting of QA-related information. The performance and reporting requirements outlined below are essential to ensuring that data of known and defensible quality are being generated throughout the course of a site investigation. Topics covered include control samples, control charts, out-of-control events, corrective action reports, significant changes in the QA plan, and other reporting requirements.

8.1 MONTHLY PROGRESS REPORT

The primary means of communication from the laboratories to the NCR will be the MPR to be submitted by the laboratories to the NCR on the 15th of each month in which work for the Navy is performed. The following information is to be included in the MPR.

1. Site name and contract number.

2. Numbers, types and locations of samples collected and analyzed for Navy project only.

3. Data for blanks, spikes, laboratory duplicates and controls related to Navy samples.

4. New methods used for analysis and changes in old methods.

5. Copies of all control charts pertinent to Navy samples and to which results have been added over the reporting period.
6. Summaries of out-of-control incidents during the reporting period, including references to documentation and corrective action reports.

7. Descriptions of and justifications for significant changes in the QA.

8. Changes in LQAC personnel and other key technical personnel; resumes of new personnel must be submitted.

9. Completed sample data.

Much of the information presented in an MPR is incremental in nature and relates to changes and findings since the previous MPR.

1. Control charts from the minimizing control charts program and any additional control charts from monitoring matrix spikes, duplicates, or other QC parameters.

2. Personnel changes relating to QA responsibilities.

3. Method changes (e.g., a minor modification with an attached EPA variance).

4. Procedural changes in establishing control limits and/or the preparation and use of control charts.

Since the first such report for each laboratory has no precedent, more explanation and detail may be necessary; subsequent MPRs will likely not require as much detail in some areas.

8.2 FINAL REPORT

A draft of the final report shall be reviewed by the NCR prior to its release. This report is the final deliverable from the engineering subcontractor. An outline for a typical report is as follows.

1. Site name and Navy contract number.

2. Foreword--signed by those with major responsibilities for the QA program and by project management.

3. Executive Summary--brief review of the report.

4. Table of Contents--with specificity at approximately the same level as the Table of Contents in this Navy document.

5. Introduction--summarize the Navy field sites of interest, when the study occurred (dates of sampling, dates of analysis) and the objectives of the QA plan as they relate to the study.

6. Data Summary--summarize the results on a site-by-site basis.

7. Other Information--present any other information requested in the statement of work such as risk assessment, recommendation to perform more site characterization, or recommend site closure. This information was specified prior to beginning work and is directed by the Navy EIC.

8. The final report shall present the findings from the analytical, geological, and hydrogeological studies. The summary of analytical data will exclude non-detected compounds. No subtraction of blanks is allowed. Data will be flagged if blank contamination occurs. All data flags will follow the result in the summary.

9. QC Summary--the QC summary section will include a discussion of are data which flagged. Flagged data defined as data for which trip, field, or laboratory blanks were contaminated, matrix spike/spike duplicates exceed limits, calibration criteria are not met, and laboratory controls exceed limits. The QC summary will also discuss the results of laboratory blanks, matrix spikes/spike duplicates,

duplicates, control charts, surrogate holding times, field blanks, trip blanks, rinsates, and field duplicates. This section will also discuss precision, accuracy, and completeness.

10. Appendices--the appendices of the report shall include all field and analytical data. One appendix shall contain field logs and forms. A second appendix shall contain the laboratory data of each sample. These data shall be presented in a spreadsheet similar to the Format Section of this report. All trip, field, and laboratory blanks shall be marked so that each sample can be associated with the appropriate blanks.

    A third appendix shall include the method blank spike control charts, surrogate recoveries, matrix spike and duplicate, field, and laboratory duplicates for all spike samples.

8.3 FINAL QC DATA REPORT

A QC data report shall be sent to the NCR. This report shall contain the following.

For Level D QC, the contractor shall submit a subset of data from the CLP data packages. For 20% of the water and 20% of the soil samples, the subcontractor shall submit the full CLP package.

For Level C QC, the deliverables listed in Table 7.7 will be presented.

For Level E QC, the initial and continuing calibration forms, method blank, and blank spike control chart are required.

The report shall indicate the duration and location of storage for the data. The stored data consists of all raw data, QC charts, corrective action, logs, sample lists, COC information, notebooks, work sheets, automated data processing system output, and calibration.

The report shall be delivered to the NCR three weeks prior to the final report.

9. DATA FORMAT

The data format refers to the format in the final report. The contractor may use its own format in the body of the report. However, in the appendices (which contain sample and blank data) a spreadsheet type of format may be used, or the CLP forms for reporting samples and equipment, trip, field, and method blanks may be used. The spreadsheet format allows for more samples per page and for more information on blanks and their association with samples. The spreadsheet format is not meant to be a rigid form. The information listed in Fig. 9.1 must be present. The contractor may add other information which will assist it in review. For calibration, tuning, spikes, surrogates, and duplicates, the current CLP forms are required for data presentation. If any other format is to be used, this shall be discussed with the NCR.

Sample Number	J25019	JS5020
Date Sampled	03-18-87	03-18-87
Sample Prep..Date	11-25-87	11-25-87
Sample Analysis Date	11-26-87	11-26-87
Sample Numbers of Associated Analytes, Field, Trip, and Equipment Blanks	J4455667	L4455667

	Detection limit	Sample	Results
VOLATILE ORGANIC COMPOUNDS (µg/kg)			
TETRACHLOROETHANE	5	50	50
CHLOROBENZENE	5		
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)			
BIS(2-ETHYLHEXYL) PHTHALATE	330		750
2-METHYLNAPTHALENE	330		2500
INORGANIC COMPOUNDS (mg/kg)			
LEAD	10	360	25
HYDROCARBONS (2)			
PETROLEUM HYDROCARBON	1	0.611	0.268
OIL AND GREASE	1		

Sample Results

Analyte

Note: Petroleum hydrocarbon, oil, and grease results recorded in percent.

Fig. 9.1. Example of data format for final report.

GLOSSARY

Accuracy - The nearness of a result or the mean of a set of results to the true or accepted value.

Analyte - A chemical component of a sample to be determined or measured.

Analytical Method - Defines the samples preparation and instrumentation procedures or steps that must be performed to estimate the quantity of analyte in a sample.

Analytical Spike - The furnace postdigestion spike. The addition of a known amount of standard after digestion.

Background Correction - A technique to compensate for variable background contribution to the instrument signal and the determination of trace metals.

Calibration - The establishment of an analytical curve based on the absorbance, emission intensity, or other measured characteristic of known standards. The calibration standards must be prepared using the same type of acid or concentration of acids as used in the sample preparation.

Calibration Blank - A volume of acidified deionized/distilled water.

Comparability - is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions.

Completeness - Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is to generate sufficient amount of valid data based on project needs.

Continuing Calibration - Analytical standard run every ten analytical samples or every 2 h, whichever is more frequent, to verify the calibration of the analytical system.

Control Limits - A range within which specified measurement results must fall to be compliant. Control limits may be mandatory, requiring corrective action if exceeded, or advisory, requiring that noncompliant data be flagged.

Correlation Coefficient - A number (r) which indicates the degree of dependence between two variables (concentration - absorbance). The more dependent they are, the closer the value to one. Determined on the basis of the least squares line.

Data Quality Objectives - are qualitative and quantitative statements which specify the quality of the data required to support decision during

GLOSSARY (continued)

remedial response activities. Data quality objectives are determined based on the end uses of the data to be collected.

Detection Limit - The minimum concentrations which must be accurately and precisely measured by the laboratory and/or specified in the quality assurance plan.

Dissolved Metals - Analyte elements which have not been digested prior to analysis and which will pass through a 0.45-μm filter.

Duplicates - Identical splits of individual samples which are analyzed by the laboratory to test for method reproducibility. In this case, samples are split in the laboratory.

Equipment Rinsates - The final analyte-free water rinse from equipment cleaning collected daily during a sampling event.

Field Blanks - Blanks are collected and analyzed to determine the level of contamination introduced into the sample due to sampling technique. They may consist of the source water used in decontamination and steam cleaning. At minimum, one sample from each event and each source of water must be collected and analyzed.

Field Duplicates/Splits - Samples that have been divided into two or more portions while in the field. Each portion is then carried through the remaining steps in the measurement process. A sample may be replicated in the field or at different points in the analytical process. For field replicated samples, precision information would be gained on homogeneity, handling, shipping, storage, preparation, and analysis.

Replicate samples divided into two portions and sent to different laboratories and subjected to the same environmental conditions and steps in the measurement process as the split samples.

Instrument Detection Limit - is defined in several ways. For example, (1) that concentration of analyte which produces an output signal twice the root mean square of the background noise may be determined under ideal conditions or (2) determined by multiplying by 3 the standard deviation obtained for the analysis of a standard solution (each analyte in reagent water) at a concentration of 3x-5x instrument detection limit on three nonconsecutive days with seven consecutive measurements per day.

Internal Standards - Compounds added to every standard, blank, matrix spike, matrix spike duplicate, sample (for volatile), and sample extract (for semivolatile) at a known concentration prior to analysis. Internal standards are used as the basis for quantitation of the target compounds.

GLOSSARY (continued)

Laboratory Control Sample - A control sample of known composition. Aqueous and solid laboratory control samples are analyzed using the same sample preparation, reagents, and analytical methods employed for samples received.

Laboratory Quality Assurance Coordinator - An employee of a laboratory with no analysis or production responsibilities and who implements QA and QC. This person is responsible for ensuring all quality problems are resolved.

Matrix - The predominant material comprising the sample to be analyzed. The most common matrices are water, soil/sediment, and sludge.

Matrix Spike - An aliquot of a matrix (water or soil) spiked with known quantities of compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

Matrix Spike Duplicate - A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method.

Method Blank - A blank sample run to ensure reported analytical results are not the results of laboratory contamination.

Method Blank/Spike - Is the distilled and/or deionized water for soil or sand spiked with known compounds or elements. The method blank as defined by Contract Laboratory Protocol for organics and the laboratory control sample as defined by Contract Laboratory Protocol maybe use as the method blank/spike in the Navy Installation Restoration Program.

Method Detection Limits - Minimum concentrations of a substance that can be measured and reported with 99% confidence that the value is above zero. The sample is carried through the entire method under ideal conditions.

Method of Standard Additions - The addition of three increments of a standard solution (spikes) to sample aliquots of the same size. Measurements are made on the original and after each addition. The slope, x-intercept, and y-intercept are determined by least-squares analysis. The analyte concentration is determined by the absolute value of the x-intercept. Ideally, the spike volume is low relative to the sample volume (~10% of the volume). Standard addition may counteract matrix effects; it will not counteract spectral effects. It is also referred to as standard addition.

Out of Control - One or more of several conditions relating to the plotting of control data and indicating unacceptable results.

GLOSSARY (continued)

Percent Solids - The proportion of solid in a soil sample determined by drying an aliquot of the sample.

Precision - Measure of the reproducibility of a set of replicate results among themselves or the agreement among repeat observations made under the same conditions.

Preparation Blank (Reagent Blank, Method Blank) - An analytical control that contains distilled, deionized water and reagents, which is carried through the entire analytical procedure (digested and analyzed). An aqueous method blank is treated with the same reagents as a sample with a water matrix; a solid method blank is treated with the same reagents as a soil sample.

Purge and Trap - An analytical technique used to isolate volatile (purgable) organics by stripping the compounds from water or soil by a stream of inert gas, trapping the compounds on a porous polymer trap, and thermally desorbing the trapped compounds onto the gas chromatographic column.

Quality Assurance - A planned system of activities (program) whose purpose is to provide assurance of the reliability and defensibility of the data.

Quality Control - A routine application of procedures for controlling the monitoring process. QC is the responsibility of all those performing the hands-on operations in the field and in the laboratory.

Reagent Water - Water in which an analyte is not observed at or above the minimum quantitation limit of the parameters of interest.

Recovery - Usually expressed as a percent. The numerical ratio of the amount of analyte measured by the laboratory method divided by the known amount of analyte added to the matrix (i.e., spiked sample) to be analyzed.

Reporting Detection Limits - The same as method detection limits with consideration given for practical limitation such as sample size, matrix interferences, and dilutions.

Representativeness - Expresses the degree to which sample 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.

Sample Holding Times - Times used to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis or sample preparation. Holding times may vary depending on the analysis, EPA regional preference, etc.

GLOSSARY (continued)

Semivolatile Compounds - Compounds amenable to analysis by extraction of the sample with an organic solvent. Used synonymously with base neutral acid or extractable compounds.

Serial Dilution - The dilution of a sample by a known factor. When corrected by the dilution factor, the diluted sample must agree with the original undiluted sample within specified limits. Serial dilution may reflect the influence of interferents.

Spikes - Known amounts of specific chemical constituents added by the laboratory to selected samples to test the appropriateness and recover efficiencies of specific analytical methods within the actual sample matrices.

Standard Deviation - The square root of the variance of a set of values.

Surrogates - Compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard and used to evaluate analytical efficiency of the method by measuring recovery. Surrogates are brominated, fluorinated, or isotopically labelled compounds not expected to be detected in environmental media. These are used typically in organic methods.

Tentative Identified Compounds - Compounds detected in samples that are not target compounds, internal standards or surrogate standards. Up to 30 peaks (those greater than 10% of peak areas or heights of nearest internal standards) are subjected to mass spectral library searches for tentative identification.

Total Metals - Analyte elements which have been digested prior to analysis.

Variance - The sum of the squares of the difference between the individual values of a set and the arithmetic mean of the set, divided by one less than the number of values.

Volatile Compounds - Compounds amendable to analysis by the purge and trap techniques. Used synonymously with purgable compounds.

Data Qualifiers' Definitions as defined by the Contract Laboratory Protocol for Organic Analysis

U - Indicates compound was analyzed for but not detected. The sample quantitation limit must be corrected for dilution and for percent moisture.

J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed, or when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero.

GLOSSARY (continued)

C - This flag applies to pesticide results where the identification has been confirmed by gas chromatography/mass spectrometry. Single component pesticides ≥10 ng/ul in the final extract shall be confirmed by gas chromatography/mass spectrometry.

B - This flag is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action. This flag must be used for a TIC as well as for a positively identified TCL compound.

E - This flag identifies compounds whose concentrations exceed the calibration range of the gas chromatography/mass spectrometry instrument for that specific analysis. This flag will not apply to pesticides/PCBs analyzed by GC/EC methods. If one or more compounds have a response greater than full scale, the sample or extract must be diluted and reanalyzed. If the dilution of the extract causes any compounds identified in the first analysis to be below the calibration range in the second analysis, then the results of both analyses shall be reported.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor. If a sample or extract is reanalyzed at a higher dilution factor, as in the "E" flag above, the "DL" suffix is appended to the sample number on the Form I for the diluted sample, and all concentration values reported on that Form I are flagged with the "D" flag.

A - This flag indicates that a TIC is a suspected aldol-condensation product.

X - Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the Sample Data Summary Package and the Case Narrative. If more than one is required, use "Y" and "Z," as needed. If more than five qualifiers are required for a sample result, use the "X" flag to combine several flags, as needed. For instance, the "X" flag might combine the "A," "B," and "D" flags for some sample.

R - Quality control indicates that data are not usable (compound may or may not be present). Resampling and reanalysis are necessary for verification.

Q - No analytical result.

GLOSSARY (continued)

Inorganic Data Qualifiers

E - The reported value is estimated because of the presence of interference. An explanatory note must be included under Comments on the cover page (if the problem applies to all samples) or on the specific FORM I-IN (if it is an isolated problem).

M - Duplicate injection precision not met.

N - Spiked sample recovery not within control limits.

S - The reported value was determined by the Method of Standard Additions.

W - Postdisgestion spike for Furnace Atomic Absorption analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.

* - Duplicate analysis not within control limits.

+ - Correlation coefficient for the Method of Standard Addition is less than 0.995.

M (Method) Qualifier

"P" for ICP

"A" for Flame AA

"F" for Furnace AA

"CV" for Manual Cold Vapor AA

"AV" for Automated Cold Vapor AA

"AS" for Semiautomated Spectrophotometric

"C" for Manual Spectrophotometric

"T" for Titrimetric

"NR" if the analyte is not required to be analyzed

BIBLIOGRAPHY

American Public Health Association, American Water Works Association, and the Water Pollution Control Federation, *Selected Analytical Methods Approved and Cited by the United States Environmental Protection Agency.* Supplement to the 15th ed. of *Standard Methods for the Examination of Water and Wastewater,* 1981.

American Public Health Association, American Water Works Association, and the Water Pollution Control Federation. *Standard Methods for the Examination of Water and Wastewater,* 16th ed., Washington, DC, 1985.

American Society for Testing and Materials, *1984 Annual Book of ASTM Standards: Water and Environmental Technology,* Sect. 11, Vols. 11.01 and 11.02, Water, Philadelphia, Pennsylvania, 1984.

Association of Official Analytical Chemists, *Offical Methods of Analysis of the Association of Official Analytical Chemists,* 14th ed., Arlington, Virginia, 1984.

C. F. Bauer, C. L. Grant, and T. F. Jenkins, *Interlaboratory Evaluation of High-Performance Liquid Chromatography Determination of Nitro Organics in Munition Plant Wastewater, Anal. Chem. 58, 176 (1986).*

R. R. Compton, Manual of Field Geology, John Wiley and Sons, Inc., New York, p. 378, 1962.

Federal Register, *Toxicity Characteristic Leaching Procedure,* 40 CFR, 51 FR, Appendix I to Part 268, pp. 40643-40653, November 7, 1986.

Federal Register, *Air and Stack Gas Monitoring,* 40 CFR, Revised, Parts 53-80, July 1, 1985.

Federal Register, Guidelines Establishing Testing Procedures for the Analysis of Pollutants under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule, 40 CFR Part 136.3, July 1, 1987.

F. M. Garfield, *Quality Assurance Principles for Analytical Laboratories,* Association of Official Analytical Chemists, Arlington, Virginia, 1984.

B. G. Kratochvil and J. K. Taylor, *A Survey of Recent Literature on Sampling for Chemical Analysis.* National Bureau of Standards Technical Note, 1153, Gaithersburg, Maryland, January 1982.

G. Kulin and P. R. Compton, *A Guide to Methods and Standards for the Measurement of Water Flow.* National Bureau of Standards, Spec. Publication 421, p. 9.

R. D. Morrison, *Groundwater Monitoring Technology,* TIMCO Manufacturing, Inc., Prairie du Sac, Wisconsin, p. 111, 1983.

BIBLIOGRAPHY (continued)

National Bureau of Standards: A Guide to Methods and Standards for the Measurement of Water Flow. National Technical Information Services, SD Catalog No. C13.10:421, NBS Special Publication 421, 1975.

National Institute of Occupational Health and Safety Manual of Analytical Methods, 3rd ed., NIOSH 84-100, May 15, 1985.

RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, September 1986.

Reversed Phase High-Performance Liquid Chromatography Determination of Nitro Organics in Munitions Wastewater, Anal. Chem., 58, 170, (January 1986).

The American Society of Mechanical Engineers, *Quality Assurance Program Requirements for Nuclear Facilities,* ANSI/ASME NQA-1-1986 ed., July 1, 1986.

U.S. Army Toxic and Hazardous Materials Agency, *USATHAMA QA Program,* Aberdeen Proving Ground, MD, December 1985, 2nd ed., March 1987.

U.S. Department of Agriculture, *Soil Survey Manual,* U.S. Government Printing Office, Washington, DC, 1981.

U.S. Department of Agriculture, *Soil Taxonomy: Basic Systems of Soil Classification for Making and Interpreting Soil Surveys,* U.S. Government Printing Office, Washington, DC, 1975.

U.S. Department of Interior, *National Handbook of Recommended Methods for Water-Data Acquisition,* U. S. Geological Survey, Vol. 2, Reston, Virginia, 1977.

U. S. Environmental Protection Agency, *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses,* R-582-5-01, NUS Corporation, Superfund Division, May 28, 1985.

U. S. Environmental Protection Agency, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis,* R-582-5-5-01, NUS Corporation, Superfund Division, May 28, 1985.

U.S. Environmental Protection Agency Contract Laboratory Programs, *Statement of Work for Organic Analysis,* Rev., July 1987.

U.S. Environmental Protection Agency Contract Laboratory Programs, *Statement of Work for Organic Analysis,* Rev. 1987.

U.S. Environmental Protection Agency Contract Laboratory Programs, *Statement of Work for Organic Analysis,* September 1983.

BIBLIOGRAPHY (continued)

U.S. Environmental Protection Agency, *Determinations of PCBs in Transformer Fluid and Waste Oils*, EPA-600/4-81-045, September 1982.

U.S. Environmental Protection Agency, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.* QAMS 005/80, National Technical Information Service, EPA-600/4-83-004, February 1983.

U.S. Environmental Protection Agency, *Practical Guide for Groundwater Sampling*, EPA-600/2-85-104, p. 169, 1985.

U.S. Environmental Protection Agency, *Handbook - Groundwater*, EPA-625/6-87-016, p. 212, 1987.

U.S. Environmental Protection Agency, *Microbiological Methods for Monitoring the Environment*, National Technical Information Services, EPA-600/-78-017, 1978.

U.S. Environmental Protection Agency, *RCRA Groundwater Monitoring Technical Enforcement Document*, U.S. Government Printing Office, Washington, DC, p. 208, 1987.

U.S. Environmental Protection Agency, *Soil Sampling Quality Assurance User's Guide*, EPA-600/4-84-043, p. 113, 1984.

U.S. Environmental Protection Agency, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories*, EPA-600/4-79-019, Cincinnati, Ohio, March 1979.

U.S. Environmental Protection Agency, *Methods of Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater*, Interim Document, Cincinnati, Ohio, September 1978.

U.S. Environmental Protection Agency, *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, Cincinnati, Ohio, March 1983.

U.S. Environmental Protection Agency, *NPDES Compliance Sampling Inspection Manual*, Office of Water Enforcement, MCD-51, Washington, DC, 1985.

U.S. Environmental Protection Agency, *Radiochemistry Procedures Manual*, Office of Radiation Programs, Eastern Environmental Radiation Facility, August 1984.

U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, EPA/SW-846, Vols. 1A, B, C, and 2, Rev., November 1986, Washington, DC, 1987.

U.S. Environmental Protection Agency, *Manual on Groundwater Quality Sampling Procedures*, EPA-600/2-81-160, p. 105, 1981.

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APPENDIX B

ANALYTICAL DATA VALIDATION CHECKLISTS

FIELD DATA VALIDATION CHECKLIST

Project Name:_____
Project Number:_____
Sample Identification:_____
Sampling Team:_____
Analyzing Laboratory:_____
Analyses Performed:_____
Sample Matrix:_____
QA Reporting Level:_____

REPORTING REQUIREMENTS

FIELD DATA PACKAGE DOCUMENTATION	YES	NO	NOT REQUIRED
1. Field (water and soil sample logs completed properly and signed			
2. Sampling dates noted			
3. Sampling team indicated			
4. Sample identification traceable to location collected			
5. Sample location provided			
6. Sample depth for soils indicated			
7. Collection technique (bailer, pump etc.)			
8. Field preparation techniques and sample type indicated (grab, composite)			
9. Sample container type described			
10. Sample container type proper for analysis			
11. Preservation methods indicated			
12. Chain-of-custody form completed			
13. Proper analytical methods requested			
14. Proper number and type of field QC samples were collected (blanks, replicates, splits, etc.)			
15. Field equipment was properly calibrated before use and results documented.			

COMMENTS:_____

FIELD DOCUMENTATION IS COMPLETE:_____
QA Officer

ANALYTICAL DATA VALIDATION CHECKLIST

Project Name:_____
Project Number:_____
Sample Identification:_____
Sampling Team:_____
Analyzing Laboratory:_____
Analyses Performed:_____
Sample Matrix:_____
QA Reporting Level:_____

REPORTING REQUIREMENTS
ANALYTICAL DATA PACKAGE DOCUMENTATION
LEVEL A (QUALITATIVE)

Section I: General Information	YES	NO	NOT REQUIRED
1. Sample results complete			
2. Proper parameters analyzed			
3. Method of analysis reported			
4. Detection limits of analysis reported			
5. Master tracking list provided			
6. Sample collection date provided			
7. Sample received date provided			
8. Sample preparation/extraction date provided			
9. Sample analysis date provided			
10. Copy of Chain-of-Custody form signed by the lab sample custodian			
11. A narrative summary of QA or sample problems is provided			

COMMENTS:_____

Section II: Inorganic Analyses	YES	NO	NOT REQUIRED
1. Results of ICVS and CCVS, %R, expected values			
2. Results of Digested LCS (may be called QC Check sample), %R and expected value			
3. Results of undigested QC Check sample, %R, Source (Lot No. and manufacturer)			
4. Results of method blanks			
5. Results of interference check sample (ICS) and expected value (ICP only)			
6. Results of a dilution check sample and expected value (ICP only)			
7. Results of laboratory duplicate analysis and %RSD or RPD and control			
8. Results of Matrix spike (digested spike) analysis, amount spiked, %R and control limits			
9. Results of analytical (post-digested) spike analysis, amount spiked, %R, and control limits (furnace AAS only)			

COMMENTS:_____

_____

_____

_____

_____

Documentation

Section III: Organic Analyses	YES	NO	NOT REQUIRED
A. GAS CHROMATOGRAPHY (NO MASS SPEC)			
1. Results of water blanks (VOA), Extraction blanks, and/or trip blanks			
2. Results of latest independent QC check samples, expected value %R and source (Lot No. and manufacturer			
3. Results of analysis of reagent water spike, expected value %R, control limits			
4. Results of reagent water spike duplicate, expected value, %R, RPD and control limits			
5. Results of matrix spikes, amount spiked, %R and control limit			
6. Results of matrix spike duplicates, amount spiked, %R, RPD or $RSD and control limit			
7. Results of laboratory duplicates (if performed), RPD or %RSD and control limit			
8. Results of surrogate spikes, %R, control limits			

COMMENTS:_____

Documentation

B.	GAS CHROMATOGRAPHY/MASS SPECTROMETER	YES	NO	NOT REQUIRED
1.	Verification statement acknowledging tuning with BFB or DFTPP that indicates compliance with acceptance criteria			
2.	Results of continuing calibration standards (SPCC and CCC), expected value			
3.	Results of water blanks, extraction (method) blanks, and trip blanks.			
4.	Results of analysis of reagent water spike, expected value, %R, control limits			
5.	Results of reagent water spike duplicate, expected value, %R, RPD, and control limits			
6.	Results of matrix spikes analysis, amount spiked, %R, and control limits			
7.	Results of matrix spike duplicate analysis amount spiked, %R, RPD or %RSD and control limits			
8.	Results of surrogate spike analysis, %R, control limits			
9.	Results of latest Independent QC check samples (EPA or NBS traceable) analyzed expected value, and source (Lot No. and manufacturer)			
10.	Results of blank spike analysis for matrix spike or matrix spike duplicate parameters not meeting recovery requirements			

COMMENTS:_____

QUANTITATIVE STATISTICAL SIGNIFICANCE
LEVEL B (QUANTITATIVE)

DATA EVALUATION	PASS	FAIL	NOT APP
1. Samples were properly collected			
2. Samples were properly preserved			
3. Field measurements of pH and specific conductance are consistent with historical data			
4. Samples were analyzed by the proper methods			
5. Sample extracted within holding time			
6. Sample analyzed within holding time			
7. Required detection limits were employed by the laboratory			
8. Results of Sampler rinsate blanks were contaminant free or less than five times the detection limit			
9. Sampler rinsate blanks were not contaminant free and field blanks were analyzed properly			
10. Field blanks were contaminant free			
11. Field blanks were not contaminant free and trip blanks were properly analyzed			
12. Trip blanks were contaminant free			
13. Trip blanks were not contaminant free			
14. Laboratory blanks (method blanks, extraction blanks, water blanks) are contaminant free			

15. Blanks summary (conclusions reached):_____

_____

QUANTITATIVE STATISTICAL SIGNIFICANCE (Continued)
LEVEL B (QUANTITATIVE)

DATA EVALUATION	PASS	FAIL	NOT APP
16. RPD of field replicates is less than 25% for water matrices and less than 40% for soil matrices or the difference can be explained			

COMMENTS:_____

_____

INORGANIC ANALYSES	PASS	FAIL	NA
1. ICVS and CCVD %R within control limits			
2. LCS %R within control limits			
3. QC Check Sample %R within control limits and source given			
4. Laboratory blanks acceptable			
5. Interference Check sample within control limits (ICP only)			
6. Dilution Check sample within control limits (ICP only)			
7. RPD for laboratory duplicate within allowable limits			
8. Matrix spike %R within control limits			
9. Analytical post digested spike within control limits (furnace AAS only)			

COMMENTS:_____

_____

_____

_____

_____

ORGANIC ANALYSES	PASS	FAIL	NA
1. Laboratory blanks are acceptable			
2. QC check samples %R were within control limits and source given			
3. GC/MS properly tuned with BFB or DFTPP			
4. GC/MS continuing calibration (SPCC and CCC) standards within acceptable control limits			
5. Matrix spikes or reagent water spikes %R within control limits			
6. Matrix spike duplicates %R within control limits			
7. RPD of matrix spike duplicate or reagent water spike duplicate was within control limits			
8. Surrogate spikes within control limits			
9. Laboratory duplicates have acceptable RPD			

COMMENTS:_____

_____

_____

_____

_____

DATA VALIDATION QUALIFIER CODES
FOR ORGANIC ANALYSES

The analytical data validation
level is (check one):

EXPLANATION:_____

FINAL CONCLUSION:_____

VALIDATION PERFORMED BY:_____

REPORTING QUALIFIERS:

U code: Indicates that compound was analyzed for but not detected. Report the minimum detection limit for the sample with the U (e.g., I0U) based on necessary concentration/dilution actions. (This is not necessarily the instrument detection limit.) The footnote should read: U-Compound was analyzed for but not detected. The number is the minimum attainable detection limit for the sample.

J code: Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed or when the mass spectral data indicates the presence of a compound the meets the identification criteria but the result is less than the specified detection limit but greater than zero (e.g., 10J)>

C code: This flag applies to pesticide parameters where the identification has been confirmed by GC/MS. Single component pesticides > 19 bg.yk in the final extract should be confirmed by GC/MS.

B code: This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probably blank contamination and warns the data user to take appropriate action.

E code: Indicates a value estimated or not reported due to the presence of interference. Explanatory note included on cover page.

R code: Indicates spike sample recovery is not within control limits.

s code: Indicates value determined by Method of Standard Addition.

REPORTING QUALIFIERS: (Continued)

* code: Indicated duplicate analysis is not within control limits.

+ code: Indicates the correlation coefficient for method of standard addition is less than 0.995.

Other: Other specific flags and footnotes may be required to properly define the results. If used, they must be fully described and such description attached to the data summary report.

DATA CLASSIFICATION SUMMARY CHECKLIST
Class A Criteria

To be classified for Class A use, the data must meet the following criteria:

Criteria	Evaluation Result
1. Sampling dates were recorded;	
2. Signatures of Sampling Team on each water sample log or soil sample log;	
3. Sampling locations were clearly designated and described;	
4. Sampling depth increment for soils was recorded;	
5. Sample collection technique was described on water sample log or soil sample log;	
6. Field preparation techniques were clearly described where applicable;	
7. Sample preservation techniques were clearly described, consistent, and adequate for the parameters to be analyzed and the sample matrix;	
8. Shipping bill of lading or constant surveillance documentation is available;	
9. The laboratory sample preparation or extraction date is recorded and available;	
10. The laboratory sample analysis date is recorded and available;	

Class A Criteria (continued)

Criteria	Evaluation Result
11. The laboratory sample preparation technique is recorded and available either in the laboratory report or in the laboratories approved SOP;	
12. The methods of analysis are listed in the laboratory reports and are consistent with the methods specified in the QAPP and laboratory contract;	
13. The laboratory analytical detection limits or limits of quantitation (LCQ) are given in lab reports and are adequate for project objectives;	
14. Field records include: • Soil/sediment log sheets • Water sampling log sheets • QC field checklist • Field instrument calibration logs • Master bound log book with sequentially numbered pages • Daily log book • Chain-of-custody forms	
15. All applicable records described above were properly created and are on file;	
16. Samples passed laboratory data validation without any R flags (samples with J flags may be accepted at this level).	

Remarks:

Conclusion:

DATA CLASSIFICATION SUMMARY CHECKLIST
Class B Criteria

To be classified for Class B use, the data must meet the following criteria:

Criteria	Evaluation Result
A. Data Validation Result	
1. Samples of this matrix have not been flagged J or R during data validation;	
2. All samples of this matrix have been classified as Level A data;	
B. Quantitative Statistical Significance	
1. Laboratory and field instruments were properly standardized (calibrated) employing proper methods and records are available;	
2. Sample bottle preparation was proper and appropriate for the parameters measured and the sample matrix;	
3. All laboratory procedures were referenced to approved EPA methods and were contained in an approved SOP manual;	
4. Analytical QC data was available to demonstrate proper instrument calibration;	
5. Laboratory QC check sample standards are EPA and NBS traceable and were used at least once each three months;	
6. Laboratory reagent (method) blanks were analyzed at frequency of at least 1 per 20 samples;	
7. Laboratory duplicates were analyzed at a frequency of at least 1 per 20 samples;	

Class B Criteria (continued)

Criteria	Evaluation Result
8. Laboratory matrix spikes and matrix spike duplicates were analyzed at a frequency of at least 1 per 20 samples;	
9. Field replicates if required were analyzed at a frequency of at least 1 per 10 samples;	
10. Field blanks were submitted at a frequency of at least 1 per 20 samples;	
11. One trip blank was submitted for VOCs analysis with each cooler;	
12. Field split samples if required were analyzed at a frequency of at least 1 per 20 samples per matrix;	
13. Appropriate and sufficient QC data with acceptance criteria were presented to allow data validation by the project QA officer;	
14. If required for the project, the laboratories used were approved by the EPA for participation in the Contract Laboratory Program (CLP);	
15. The laboratories participated in round-robin testing program by WPA or other accrediting agency;	
16. Quality control limits were consistent with or exceed the limits established by the EPA for all methods of analysis or the EPA CLP;	
17. All samples submitted were analyzed for the requested parameters.	

Class B Criteria (continued)

Criteria	Evaluation Result
C. Custody and Document Control	
1. Field custody of all samples was noted in a bound field log book;	
2. Transfer of custody documentation (chain-of-custody form) signed by field and laboratory sample custodians is available and properly completed;	
3. Laboratory custody is documented by a designated lab sample custodian in a master log and a secured sample storage area;	
4. Sample identification and assigned laboratory tracking numbers are traceable through the entire monitoring system;	
5. Field notebooks, log sheets, log books, checklists, reports, data validations, and custody documents are stored in a secure repository or under the control of a document custodian;	
6. All records, forms log books, etc., are filled out completely in indelible ink without alterations except as initialed;	
7. All sample log sheets have been signed by the sample collector;	
8. Field log book sheets signed by the field sample custodian.	
D. Sample Representativeness	
1. Compatibility exists between field and laboratory measurements or incompatibilities have been suitably explained;	

Class B Criteria (continued)

Criteria	Evaluation Result
2. Laboratory analysis and/or sample preparation or extraction were within allowable holding times established for the sample preservation and methods used;	
3. Sample storage was maintained within suitable temperature, light and moisture conditions to guarantee sample integrity;	
4. Proper sample containers were used for the parameters analyzed;	
5. Proper sample collection equipment was used such that the equipment would neither contribute nor remove any substance to or from the sample;	
6. The sample site selection criteria are consistent with the objectives of the investigation and will provide the required data.	

Remarks:

Conclusion:

APPENDIX C

CONTRACT REQUIRED DETECTION LIMITS (CRDL)

APPENDIX C CONTRACT REQUIRED DETECTION LIMITS (CRDL)*		
	Contract Required Detection Limit*	
Constituent	Soil (ug/kg)[A]	Water (ug/L)[A]
EPA Method 418.1 Petroleum Hydrocarbons	10.0	0.1
Volatiles		
Chloromethane	10.0	10.0
Bromomethane	10.0	10.0
Vinly chloride	10.0	10.0[1]
Chloroethane	10.0	10.0
Methylene chloride	5.0	5.0
Acetone	10.0	10.0
Carbon disulfide	5.0	5.0
1,1-Dichloroethene	5.0	5.0
1,1-Dichoroethane	5.0	5.0
1,2-Dichloroethene(total)	5.0	5.0
Chloroform	5.0	5.0
1,2-Dichloroethane	5.0	5.0
2-Butanone	10.0	10.0
1,1,1-Trichloroethane	5.	5.
Carbon Tetrachloride	5.	5.
Vinyl acetate	10.0	10.0
Bromodichloromethane	5.0	5.0
1,1,2,2-Tetrachloroethane	5.0	5.0
1,2-Dichloropropane	5.0	5.0
Trans-1,3-Dichloropropene	5.0	5.0
Trichloroethene	5.0	5.0
Dibromochloromethane	5.0	5.0
1,1,2-Trichloroethane	5.0	5.0
Benzene	5.0	5.0
Cis-1,3-Dichloropropene	5.0	5.0
2-Chloroethyl Vinyl Ether	10.0	10.0
Bromoform	5.0	5.0
4-Methl-2-pentanone	10.0	10.0
2-Hexanone	10.0	10.0

1,1,2,2-Tetrachloroethane	5.	5.
Toluene	5.0	5.0
Chlorobenzene	5.0	5.0
Ethylbenzene	5.0	5.0
Styrene	5.0	5.0
Xylenes(total)	5.0	5.0
Semi-Volatiles		
	Detection Limit*	
Constituent	**Soil (ug/kg)[C]**	**Water (ug/L)[B]**
N-Nitrosodimethylamine	330.0	10.0
Phenol	330.0	10.0
Aniline	330.0	10.0
bis (2-Chloroethyl) ether	330.0	10.0
2-Chlorophenol	330.0	10.0
1,3-Dichlorobenzene	330.0	10.0
1,4-Dichlorobenzene	330.0	10.0
Benzyl alcohol	330.0	10.0
1,2-Dichlorobenzene	330.0	10.0
2-Methylphenol	330.0	10.0
bis (2-Chloroisopropy) ether	330.0	10.0
4-Methylphenol	330.0	10.0
N-Nitroso-dipropylamine	330.0	10.0
Hexachloroethane	330.0	10.0
Nitrobenzene	330.0	10.0
Isophorone	330.0	10.0
2-Nitrophenol	330.0	10.0
2,4-Dimethylphenol	330.0	10.0
Benzoic acid	1600.0	50.0
bis (2-Chloroethoxy) methane	330.0	10.0
2,4-Dichlorophenol	330.0	10.0
1,2,4-Trichlorobenzene	330.0	10.0[I]
Napthalene	330.0	10.0
4-Chloroaniline	330.0	10.0
Hexachlorobutadiene	330.0	10.0
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	330.0	10.0

2-Methylnapthalene	330.0	10.0
Hexachlorocyclopentadiene	330.0	10.0
2,4,6-Trichlorophenol	330.0	10.0
2,4,5-Trichlorophenol	1600.0	50.0
2-Chloronapthalene	330.0	10.0
2-Nitroaniline	1600.0	50.0
Dimethyl phthalate	330.0	10.0
Acenaphthylene	330.0	10.0
2,6-Dinitrotoluene	330.0	10.0
3-Nitroaniline	1600.0	50.0
Acenaphthene	330.0	10.0
2,4-Dinitrophenol	1600.0	50.0
4-Nitrophenol	1600.0	50.0
Dibenzofuran	300.0	10.0
2,4-Dinitrotoluene	330.0	10.0
Diethylphthalate	330.0	10.0
4-Chlorophenyl Phenyl ether	330.0	10.0
Fluorene	330.0	10.0
4-Nitroanaline	1600.0	50.0
4,6-Dinitro-2-methylphenol	1600.0	50.0
N-Nitrosodiphenylamine(1)	330.0	10.0
4-Bromophenyl Phenyl ether	330.0	10.0
Hexachlorobenzene	330.0	10.0'
Pentachlorophenol	1600.0	50.0'
Phenanthrene	330.0	10.0
Anthracene	330.0	10.0
Di-n-butylphthalate	330.0	10.0
Fluoranthene	330.0	10.0
Benzidine	1600.0	100.0
Pyrene	330.0	10.0
Butyl Benzyl Phthalate	330.0	10.0
3,3-Dichlorobenzidine	660.0	20.0
Benzo(a)_anthracene	330.0	10.0
Chrysene	330.0	10.0
bis (2-Ethylhexyl)phthalate	330.0	10.0'

Di-n-octyl Phthalate	330.0	10.0
Benzo (b) fluoranthene	330.0	10.0
Benzo (k) fluoranthene	330.0	10.0
Benzo (a) pyrene	330.0	10.0[I]
Indeno(1,2,3-cd)pyrene	330.0	10.0
Dibenz no"o"(a,h)anthracene	330.0	10.0
Benzo (g,h,i)perylene	330.0	10.0
Pesticides/PCBs		
	Detection Limit*	
Constituent	**Soil (ug/kg)[E]**	**Water (ug/L)[D]**
Alpha-BHC	2.0	.05
Beta-BHC	2.0	.05
Delta-BHC	2.0	.05
Gamma-BHC (Lindane)	2.0	.05
Heptachlor	2.0	.05
Aldrin	2.0	.05
Heptachlor epoxide	2.0	.05
Endosulfan I	2.0	.05
Dieldrin	4.0	.1
4,4' -DDE	4.0	.1
Endrin	4.0	.1
Endosulfan II	4.0	.1
4,4' -DDD	4.0	.1
Endrin Aldehyde	4.0	.1
Endosulfan sulfate	4.0	.1
4,4' -DDT	4.0	.1
p,p' -Methoxychlor	20.0	.5
Endrin ketone	4.0	.1
Alpha chlordane	20.0	.5
Gamma chlordane	20.0	.5
Toxaphene	40.0	1.0
PCB-1016	20.0	.5
PCB-1221	20.0	.5
PCB-1232	20.0	.5
PCB-1242	20.0	.5

PCB-1248	20.0	.5
PCB-1254	40.0	1.0
PCB-1260	40.0	1.0
Metals		
	Detection Limit*	
Constituent	**Soil (mg/kg)[F]**	**Water (ug/L)[F]**
Aluminum	20.0	200.0
Antimony	6.0	60.0[I]
Arsenic	6.0	10.0[I]
Barium	6.0	200.0[I]
Beryllium	6.0	5.0[I]
Cadmium	6.0	5.0[I]
Calcium	6.0	5000.0
Chromium	6.0	10.0[I]
Cobalt	6.0	50.0
Copper	6.0	25.0
Iron	6.0	100.0
Lead	6.0	5.0
Magnesium	6.0	5000.0
Manganese	6.0	15.0
Mercury	6.0	0.2[I]
Nickel	6.0	40.0[I]
Potassium	6.0	5000.0
Selenium	6.0	5.0[I]
Silver	6.0	10.0[I]
Sodium	6.0	5000.0
Thallium	6.0	10.0[I]
Tin	6.0	40.0
Vanadium	6.0	50.0
Zinc	6.0	20.0
Cyanide	.5	10.0[I]
Percent Solids	%	%

NOTE: Plural See next Page

Medium Water/Soil/Sediment Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Water/Soil/Sediment CRDL.

B - Medium Water CRDL for Semi-Volatile HSL compounds are 100 times the individual Low Water CRDL.

C - Medium Soil/Sediment CRDL for Semi-Volatile HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

D - Medium Water CRDL for Pesticide HSL Compounds are 100 times the individual Low Water CRDL.

E - Medium Soil/Sediment CRDL for Pesticide HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

F - These CRDL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E (of CLP SOW 2/88). The detection limits for samples may be considerably higher depending on the sample matrix.

G - Sample extracted using Method 3510, Separatory Funnel Liquid-Liquid Extraction.

H - Sample extracted using Method 3540, Soxhlet Extraction

I - Exceeds Primary MCL for this compound.

* - Specific Detection Limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

1.10 - 6/1/1992 - 00003

SECTION C
HEALTH AND SAFETY PLAN

FOR

SITE INSPECTION

PHASE II

NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

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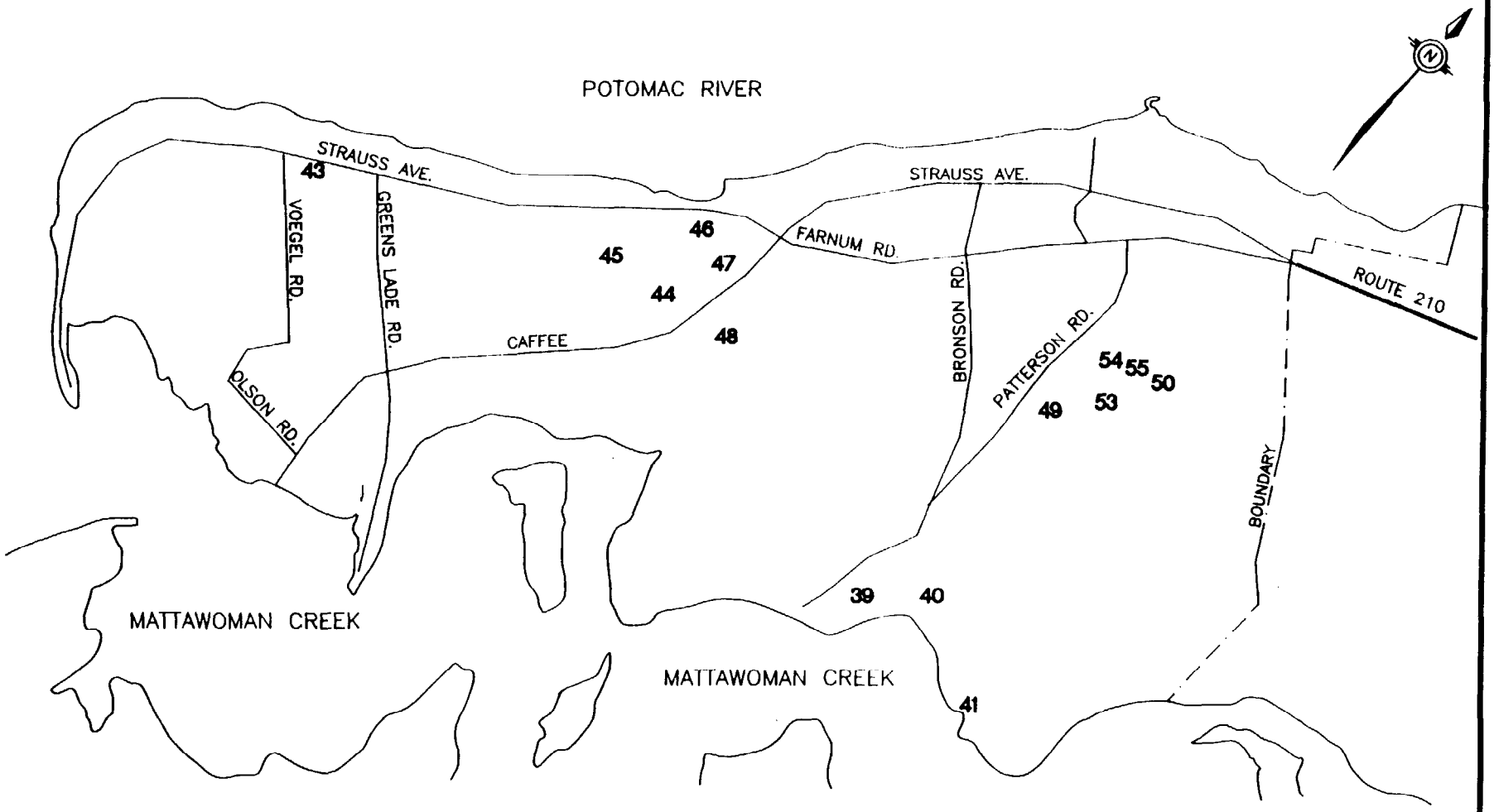
1.0 INTRODUCTION

The following is the health and safety plan for the Site Inspection (SI) and related field activities to be performed at the Indian Head Division, Naval Surface Warfare Center (NSWC) at Indian Head, Maryland. This health and safety plan specifies the procedures and protective measures that will be used to ensure the health and safety of those working in and around the site, as well as those who reside and work in the vicinity of the site. The scope of work defines the activities to be performed in order to complete Phase II of the SI at the NSWC Indian Head, Maryland. Phase II of this SI involves the assessment of 14 areas (Figure 1-1, Facility Map) at the facility to determine if contamination is present as a result of past uses and practices.

This health and safety plan has incorporated information obtained from the Draft Preliminary Assessment Report (PA), Naval Energy and Environmental Support Activity (NEESA) Document Number 13-021A of June 1991.

The SI requires the use of a broad range of sampling techniques and procedures. These include the installation of shallow soil borings and monitoring wells and the collection of soil and groundwater samples, surface and subaqueous sediment samples and bulk building materials.



LEGEND

39–ORGANICS PLANT
40–PALLADIUM IN SEDIMENTS
41–SCRAP YARD
43–TOLUENE DISPOSAL SITE
44–SOAK OUT AREA
45–ABANDON DRUMS
46–CADMIUM SAND BLAST GRIT
47–MERCURIC NITRATE DISPOSAL
48–DUMP SITE
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50–BUILDING 103
53–GENERAL LABORATORY AREA
54–BUILDING 101
55–BUILDING 102

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 1-1
FACILITY MAP AND
SITE LOCATIONS

DATE: 03/03/92 | DWG NAME: INDHD15

2.0 APPLICABILITY

The provisions of this plan are mandatory for all EnSafe/Allen & Hoshall (E/A&H) employees and E/A&H subcontractors engaged in onsite operations who will be exposed to, or have the potential to be exposed to, onsite hazardous substances.

All activity oversight personnel who will perform functions in the contamination reduction area or the exclusion area will work within the provisions of this plan. All personnel assigned to field activities for the project must read this plan and sign the plan acceptance form before the start of site activities. Subcontractors will hold E/A&H harmless from, and indemnify it against all liability in the case of any injury. At a minimum, all provisions of the E/A&H health and safety plan will be followed.

E/A&H will suspend the site work and will instruct the subcontractor to evacuate the area under the following conditions:

- If inadequate safety precautions are taken by the subcontractor or activity oversight personnel, or
- If it is believed that the subcontractor or activity oversight personnel are or may be exposed to an immediate health hazard.

All E/A&H subcontractors, activity oversight personnel and E/A&H personnel will be responsible for operating in accordance with the most current Occupational Safety and Health Administration (OSHA) regulations including 29 CFR 1910.120 — Hazardous Waste Operations and Emergency Response as well as other applicable OSHA regulations.

These regulations include the following provisions for employees exposed to hazardous substances or health and safety hazards:

- Training as described in 120(e).
- Medical surveillance as described in 120(f).
- Personal protective equipment described in 120(g).

3.0 SITE CHARACTERIZATION

3.1 Work Areas

Site control will be established and maintained according to the recommendations in the EPA's *Interim Standard Operating Safety Guides, Revised September, 1982*. Three general zones of operation will be established to reduce the potential for contaminant migration and risk of personnel exposure.

The exclusion zone will be located so that the area between the decontamination station and the work area entrances will be included. The contamination reduction zone will include the decontamination station and the support zone will be located beyond the contamination reduction zone. Only authorized personnel with a minimum of 40 hours health and safety training meeting the requirements of OSHA 29 CFR 1910.120 are permitted within the exclusion and contamination reduction zones.

The exclusion zone is considered contaminated and all personnel within the area must use the prescribed level of personal protection. A checkpoint will be established at the periphery of the exclusion zone to regulate the flow of personnel and equipment in and out of the area. The exclusion zone boundary is the hotline. All personnel crossing the hotline into the exclusion zone must use the buddy system.

The person entering the exclusion zone must be accompanied by a person who is able to:

- Provide his or her partner with assistance.
- Observe his or her partner for signs of chemical or heat/cold exposure.
- Periodically check the integrity of his or her partner's protective clothing.
- Notify the site manager, his representative or others if emergency help is needed.

Additionally, at least one person shall remain outside the exclusion zone and have available at least the same level of personal protective equipment (PPE) as the buddies who are entering the exclusion zone. The person outside the exclusion zone will act as the safety observer and perform the security duties described in the section labeled Work Area Access/Egress of this plan.

The contamination reduction zone serves as a buffer between the exclusion zone and the support zone and is intended to prevent the spread of contaminants from the work areas. All decontamination procedures will be conducted in this area. Personnel will leave the support zone and enter the contamination reduction zone through a controlled access point. They must wear the prescribed personal protective equipment. Exiting the contamination reduction zone requires the removal of all contaminants through compliance with established decontamination procedures.

The support zone is the outermost area and is considered a non-contaminated or clean area. Each site will have a support area equipped with an appropriate first-aid station and equipment to perform gross decontamination of equipment.

3.2 Work Area Access/Egress

All personnel entering the site exclusion zone must:

1. Check in with the site manager at the field office or at site. All entry to the site work area must be through this station.

2. Provide the site manager with the following information:
   - Site number where work will be performed.
   - The names of individuals entering the site work area.

- Activity to be preformed at that location.
- Duration of the planned activity.

3. The site manager will inform persons entering the site work area of the location of other activities taking place during the scheduled entry.

4. When leaving the site work area, all personnel will proceed directly to the decontamination area and check out with the site manager or his representative.

5. Perform all necessary decontamination prior to departing the decontamination station.

3.3 Site Map and Work Zones

The location of the respective sites at NSWC Indian Head are shown on the Figure 1-1, Facility map. The specific site descriptions are provided in Section 4.0 of this plan. The limits of the exclusion areas and locations and limits of the decontamination corridors and support areas will be established by the site manager on a daily basis and will be based on prevailing wind patterns and existing physical assess (i.e. location of utilities, roads, and security assess).

3.4 NSWC Indian Head Security Regulations

Authorization (work permits) to commence scope of contract work will be obtained from the NSWC Safety Department via the contracting officer/representative. Prior to the issuance of work permits all contractor personnel shall attend a required meeting in which NSWC safety and security personnel shall brief them on site standard operating procedures, emergency procedures, and regulations. See Appendix A for a summary of contractor and safety requirements.

All SI study areas are located within the Restricted Area. All equipment and personnel entering the Restricted Area may be searched and inspected for potentially hazardous materials (matches,

lighters, or other flame-producing items) or improperly functioning equipment (vehicle spark arrestors, mufflers, etc.) All individuals issued work permits will be required to attend the safety and security briefing and will be required to operate within the safety and security regulations. Any individual deviating from the regulations discussed at the briefing or presented in Appendix A will immediately be removed from the restricted area.

3.5 Site Communications

3.5.1 Communications Between Team Members

The NSWC routinely works with electro-explosive devices (EEDs) such as igniters, squibs, detonators, and blasting caps. Radio frequency transmissions can, under certain circumstances, provide enough energy to initiate or degrade performance of these devices. Inadvertent initiation of EEDs can result in injury or death of personnel and damage or destruction of property. Degradation of the EED can result in failure of the item to function properly when needed.

BECAUSE OF THESE HAZARDS, USE OF MOBILE RADIOS AND CAR PHONES IS PROHIBITED IN THE RESTRICTED AREA (AREA BEYOND POST 2).

Where audible instructions are impractical, communications between team members (including the person responsible for team safety) will be through hand signals. (See Table 3-1).

Hand signals will be used to:

- Alert team members of emergency situations.
- Transmit safety information.
- Communicate changes in work schedule.
- Maintain site control.

TABLE 3-1 SIGNALS AND THEIR MEANING	
Signal	**Definition**
Hands clutching throat	Out of air/cannot breathe
Hands on top of head	Need assistance
Thumbs up	OK/I understand
Thumbs down	No/negative
Arms waving upright	Send back support
Grip partners wrist	Exit area immediately

3.5.2 External Communications

Offsite and onsite personnel may communicate through telephones located in the site office or at locations identified by the activity.

This equipment can be used to:

- Coordinate emergency responses.
- File reports.
- Maintain contact with offsite personnel.
- Order supplies and materials.

4.0 SITE DESCRIPTIONS

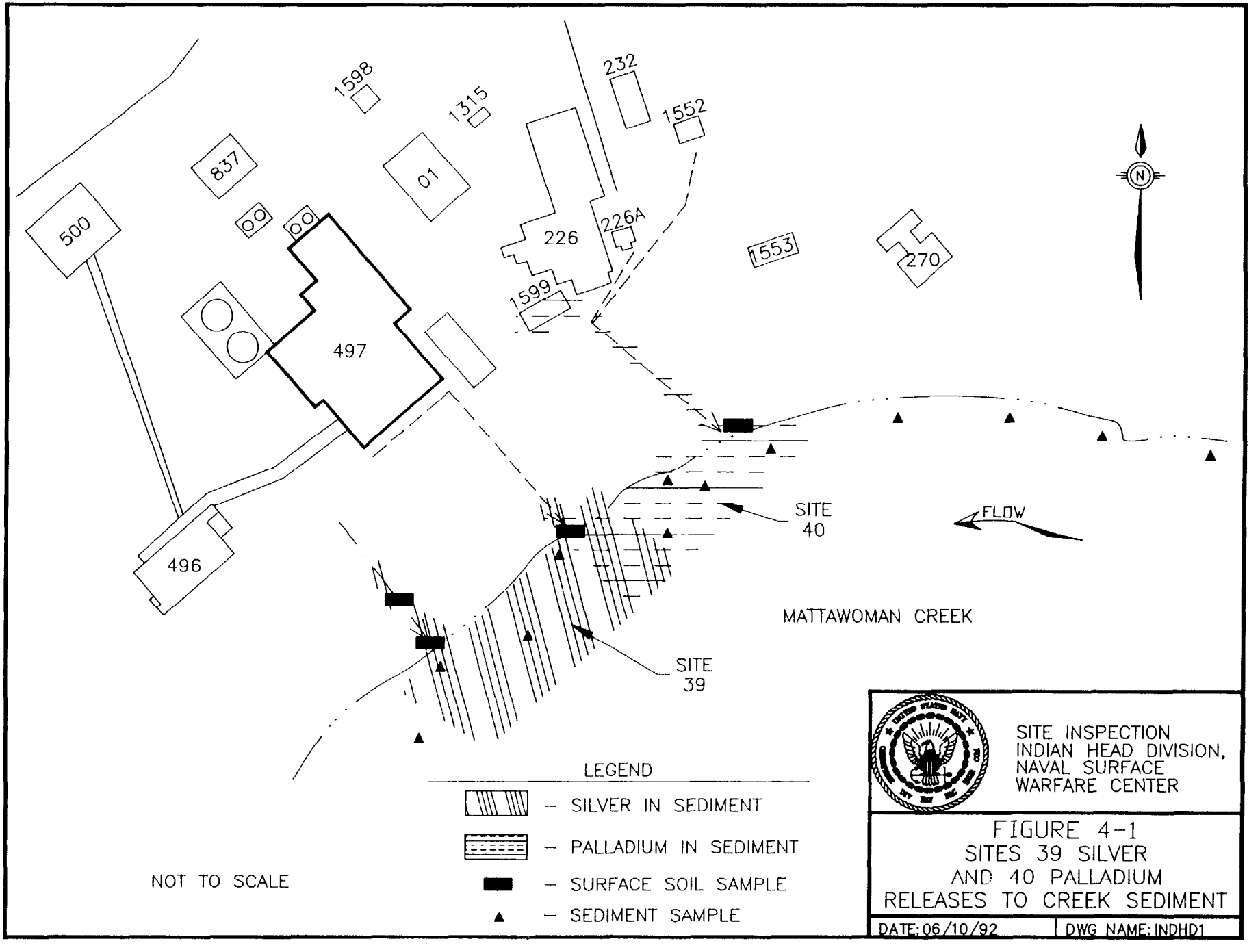
The objective of this SI is to determine if contamination exists at any of the sites identified in the PA, (June 1991), as areas where contaminants may have been released. This will be accomplished by the completion of a study designed specifically for each site. The Field Sampling Plan (FSP), Section A of the Work Plan, describes the approach to studying each site including sampling and analytical rationale.

4.1 Site Descriptions

Fourteen sites have been identified for study under the SI at NSWC Indian Head, Maryland. Because information available to E/A&H was limited, the site descriptions rely heavily on information presented in the PA and data collected during site visits conducted by E/A&H. Figure 1-1 indicates the approximate location of each site at the NSWC facility.

Each site description includes brief details of the site layout, the suspected contaminants and the possible sources of contamination. Site processes and/or history are discussed when applicable. Also included is a brief discussion on the approach for characterizing the nature of contamination, if any. Additional information is included in the FSP.

Site 39 — Organics Plant-Silver Contamination in Sediments. The organics plant area, Building 497 is identified as Site 39 (Figure 4-1). It is located in the southeastern portion of the NSWC facility, on a steep slope adjacent to Mattawoman Creek. This site is subject to an SI based on the reported accidental releases of elemental silver and other compounds to Mattawoman Creek.


1598
1315
232
1552
837
01
500
226
226A
1553
270
1599
497
496
SITE 40
FLOW
MATTAWOMAN CREEK
SITE 39
LEGEND
– SILVER IN SEDIMENT
– PALLADIUM IN SEDIMENT
– SURFACE SOIL SAMPLE
– SEDIMENT SAMPLE
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 4-1
SITES 39 SILVER
AND 40 PALLADIUM
RELEASES TO CREEK SEDIMENT
DATE: 06/10/92
DWG NAME: INDHD1

Former operations (1961 to 1965) included the formulation of bis-2,2 dinitropropanol acetal/formal (acetal/formal), which is a plasticizer (propellent binder). Silver nitrate was used as a catalyst in the production of acetal/formal where, at one stage of the process, silver was in the elemental form.

A discharge pipe extends from Building 497 to an outfall at Mattawoman Creek. Reportedly, several accidental releases occurred via the outfall resulting from an improperly closed valve. Compounds suspected of having been released include: acetal/formal, silver, dinitropropanol (DNPOH), ethylene dichloride, methylene chloride and formaldehyde. Also, as was indicated in the PA, site personnel reported that acetal/formal and silver were visible at times on the surface of Mattawoman Creek near the outfall of the organics plant.

A study will be completed to determine if silver and/or acetal/formal is present in the sediments near the outfall to Mattawoman Creek. The study will consist of collecting sediments from Mattawoman Creek and at the aforementioned outfall.

Site 40 — Palladium Catalyst in Sediments. Site 40 is defined as the area downgradient of the former hydrogenation facility. The hydrogenation facility includes buildings 232, 1552 and 1559, and is adjacent to Site 39 (Figure 4-1). Site processes included the formulation of unsymmetrical dimethylhydrazine (UDMH), a production process that hydrogenated dimethylnitrosamine (DMNA) using a palladium catalyst on carbon black. Production of UDMH was conducted at the hydrogenation facility from 1974 to 1975.

At least one release to Mattawoman Creek was reported as a result of a faulty valve. The estimated volume of this release was approximately 2000 gallons. Information from personnel interviews conducted during the PA indicated a plume of palladium on carbon black was visible on Mattawoman Creek in association with this spill.

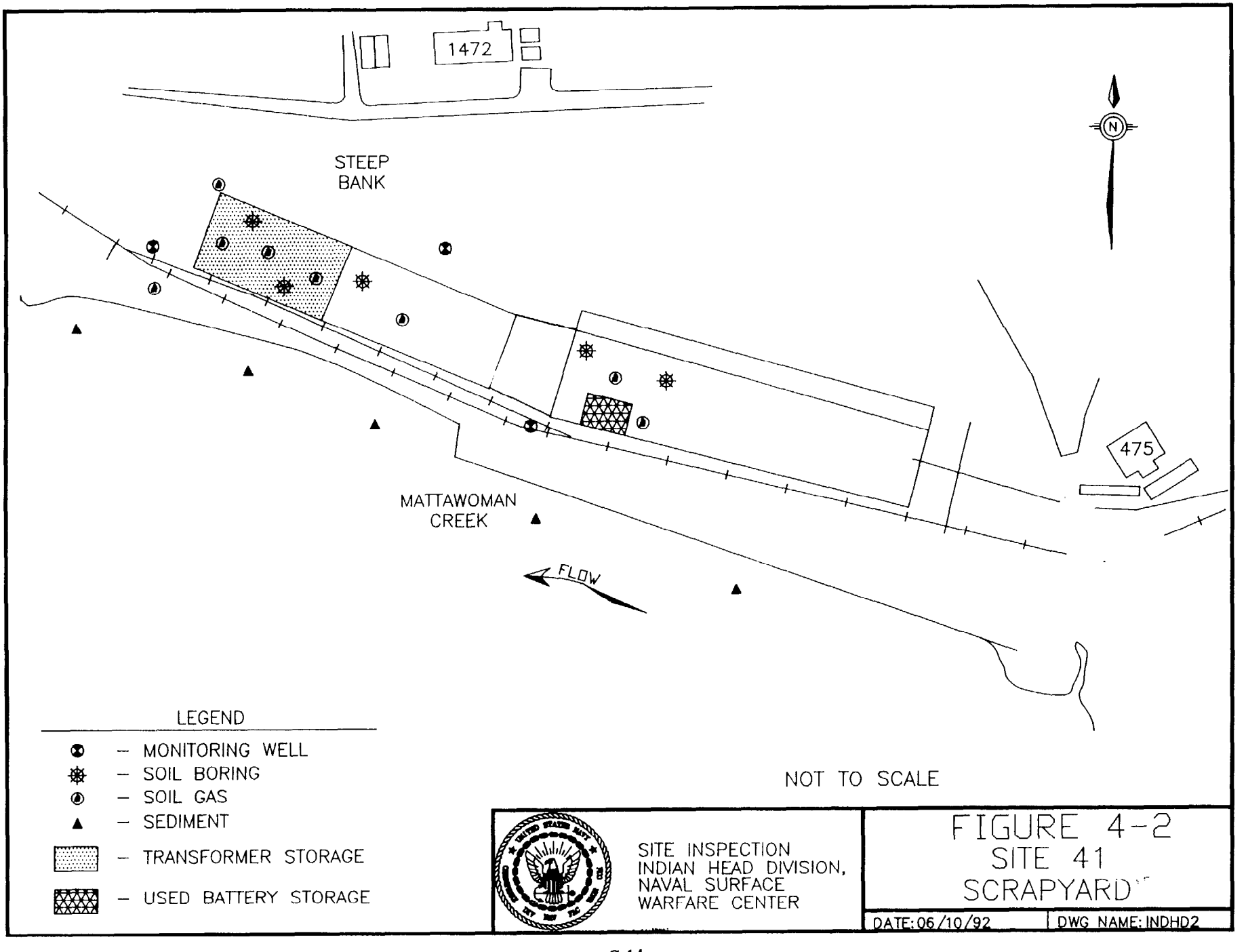
Spills were also reported during the startup of production; however, the nature and quantities of these releases are unknown. Any uncontained spills would potentially migrate down the slope toward Mattawoman Creek and/or discharge through the hydrogenation outfall. Difficulty with the corrosive nature of the compounds was believed to be the cause of numerous releases. Ultimately, production of UDMH stopped at the hydrogenation facility and was continued by an offsite contractor until DMNA was identified as a suspect carcinogen.

Site 40 was not recommended for an SI; however, it is included at the request of the Maryland Department of the Environment (MDE). The study will include collecting sediments from Mattawoman Creek and at the outfall.

Site 41 — Scrap Yard. The scrap yard is located in the southeastern section of the NSWC facility near the shore of Mattawoman Creek (Figure 4-2). The area is relatively flat and surface runoff is to the southeast toward the Mattawoman Creek. The creek is located less than 100 feet away. The scrap yard is secured by a fence and a locked gate.

Polychlorinated biphenlys (PCB) contaminated electrical transformers were stored in the scrap yard prior to disposal from the 1960s to 1988. Data from the Waste Analysis Plan conducted in 1981 indicated a total of 27 transformers (NEESA, 1983). Nine of the transformers were identified as PCB containing (> 500 parts per million (ppm) PCB oils) and eight were identified as PCB contaminated (50 to 500 ppm PCB oil). Lead batteries stored in the scrap yard may have resulted in a release of lead to the surface soils.

This site was recommended for an SI to determine if PCB contamination is present. This will be accomplished by the installation of a series of soil and soil gas borings, monitoring wells and the collection of top sediment samples from Mattawoman Creek.

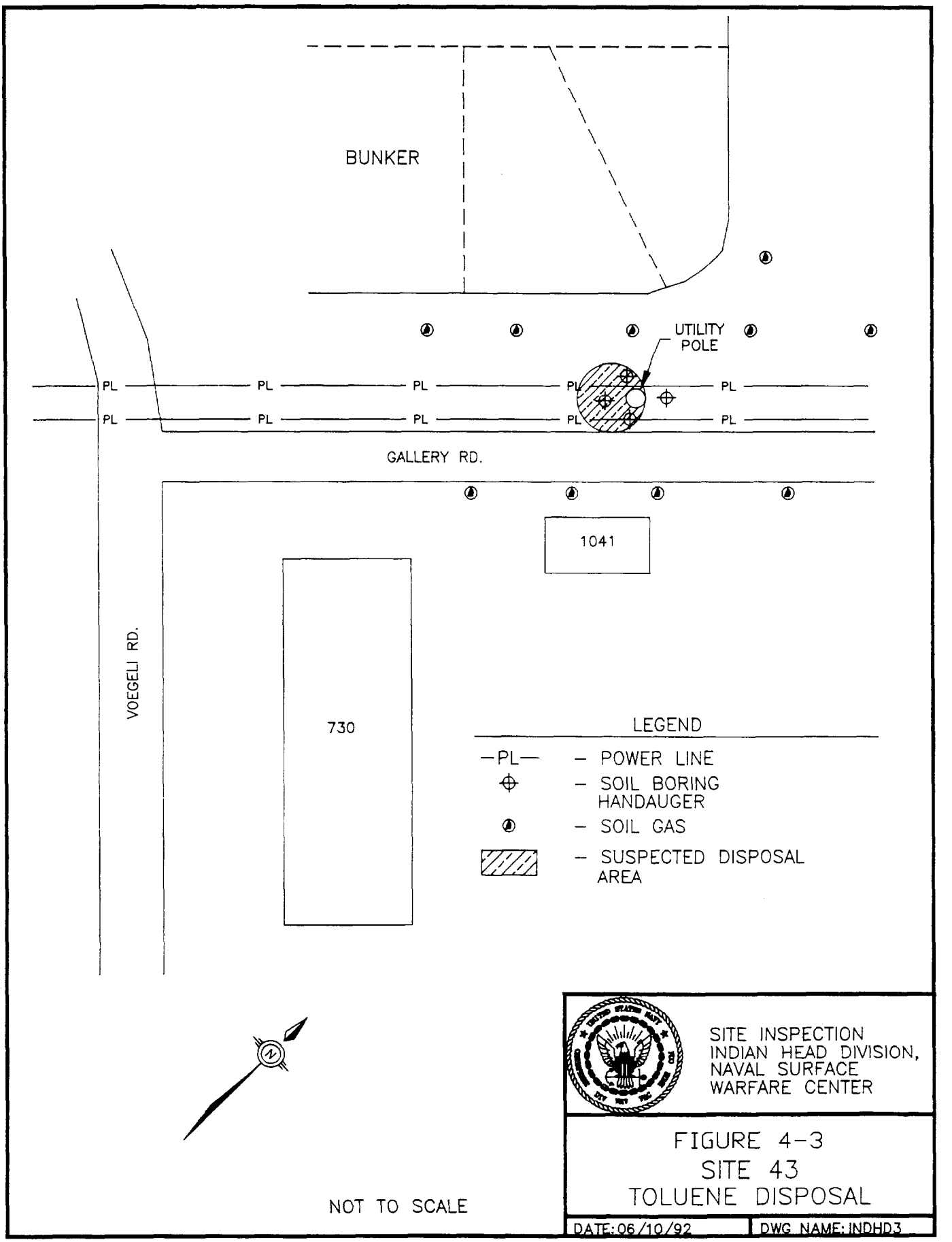

1472
STEEP BANK
N
475
MATTAWOMAN CREEK
FLOW
LEGEND
– MONITORING WELL
– SOIL BORING
– SOIL GAS
– SEDIMENT
– TRANSFORMER STORAGE
– USED BATTERY STORAGE
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 4-2
SITE 41
SCRAPYARD
DATE: 06/10/92
DWG NAME: INDHD2

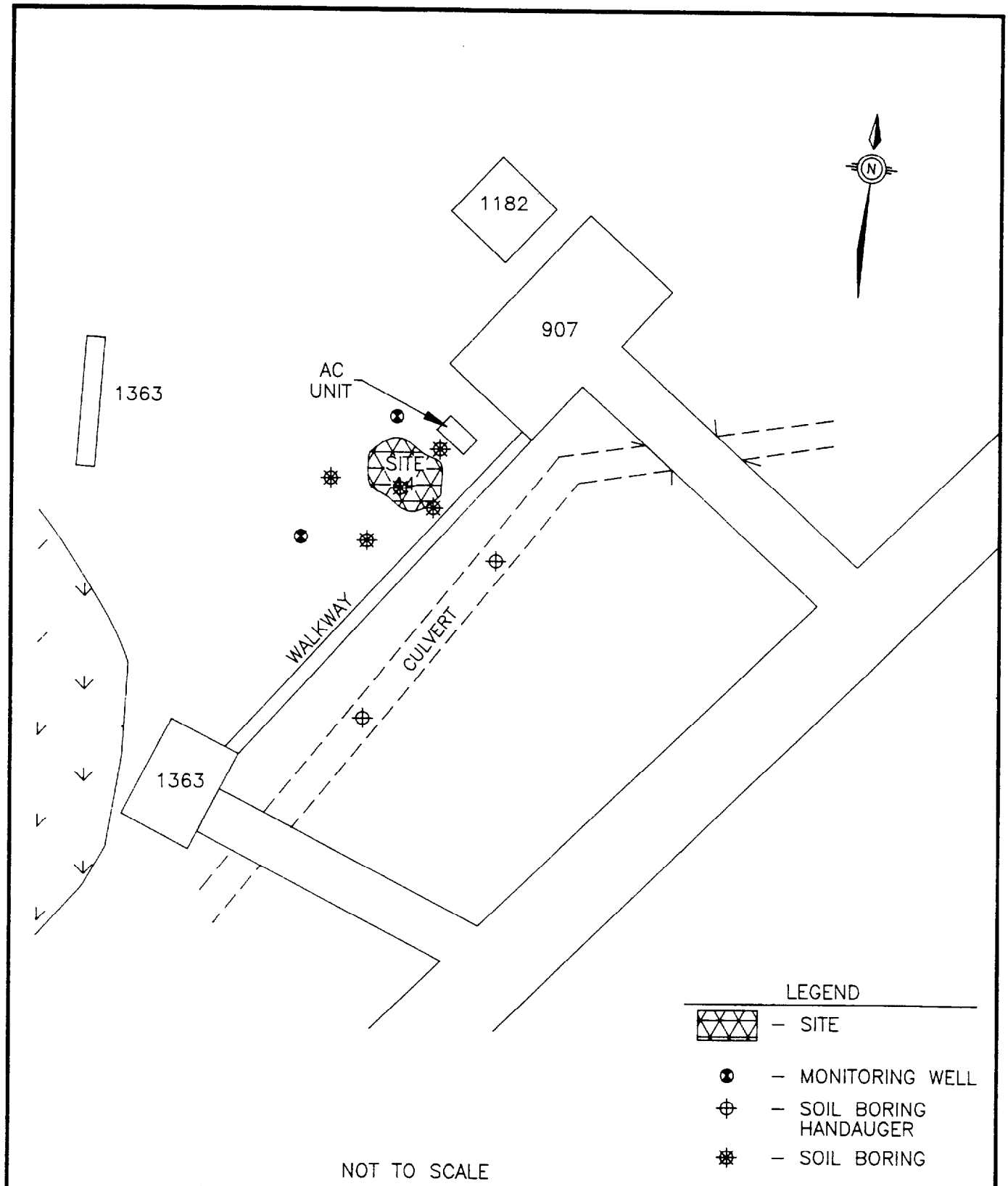
Site 43 — Toluene Disposal Site Casting Plant. The casting plant includes Buildings 1041 which is located in the western portion of the NSWC facility. Solvents such as toluene and xylene were regularly used to degrease metal parts during the casting process. Data collected during the PA indicated that improper dumping of the solvent occurred at the utility pole across the road from Building 1041 (Figure 4-3). The area surrounding the base of the pole is defined as Site 43.

Site 43 was recommended for an SI based on information that an unknown quantity of toluene was disposed at the base of the referenced utility pole. Study of this area will incorporate the collection of a series of surface soil samples for submission for laboratory analyses and the completion of a soil gas survey.

Site 44 — Soak Out Area. The soak out area is located between Buildings 907 and 1363 (Figure 4-4). Site 44 is the former location where the solvent Pennchem 9018 was used to remove propellant from rocket catapult tubes. Pennchem is a polysulfide solvent containing mercaptan. Data collected in the PA indicated that an unknown volume of the solvent was spilled due to the design of the soak out process and leaks in the holding tanks (two 55-gallon drums welded together end-to-end). The topography is relatively flat. A drainage ditch extends along the eastern edge of the area and discharges to the storm sewer system. The area was reported to be void of vegetation for several years subsequent to the close of the soak out process.

Site 44 was recommended for an SI based on the reported spills and apparent stressed vegetation. A study of this area will include the installation of a series of soil borings and three monitoring wells, a limited soil gas survey, and the collection of surface soil samples. Soil samples will be collected from the soil borings and during well installation. Groundwater samples will be collected from the completed monitoring wells.


BUNKER
UTILITY POLE
PL
GALLERY RD.
1041
VOEGELI RD.
730
LEGEND
—PL— – POWER LINE
– SOIL BORING HANDAUGER
– SOIL GAS
– SUSPECTED DISPOSAL AREA
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 4-3
SITE 43
TOLUENE DISPOSAL
DATE: 06/10/92
DWG NAME: INDHD3



NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 4-4
SITE 44
SOAK OUT AREA

DATE: 03/03/92 | DWG NAME: INDHD12

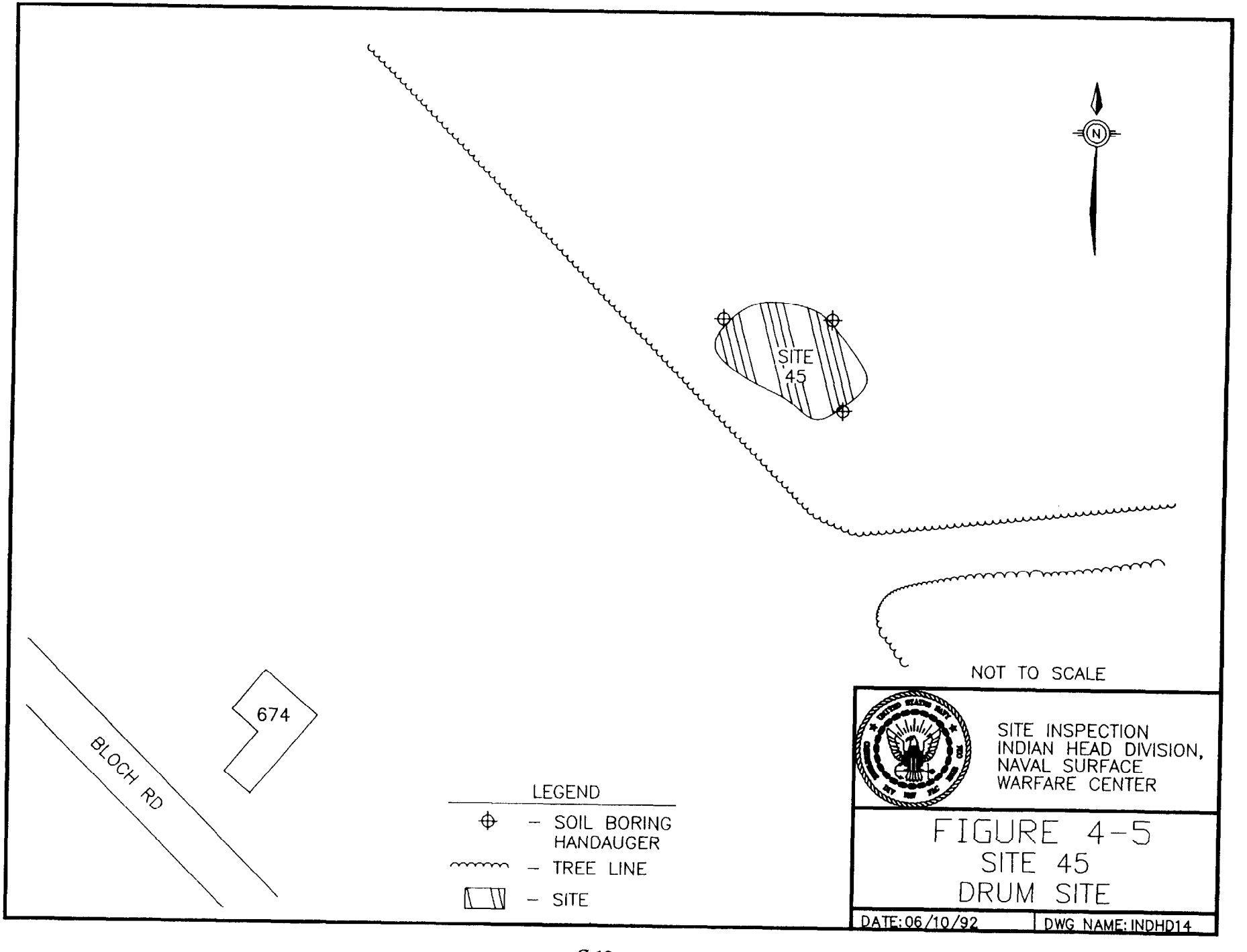
Site 45 — Abandoned Drums. This site is located in the woods approximately 200 feet northeast of Building 674 (Figure 4-5). Information gathered in the PA indicated that the drums have been in this area for 15 to 20 years. The origin of the drums and their prior contents are unknown. Data from the PA indicated that the origin of the drums may be spent solvent drums from the soak out area. Site 45 is in a wooded area with a relatively flat topography. Because the drums are structurally unsound and/or ruptured, the potential for an uncontrolled release of substances to the surface soils is high.

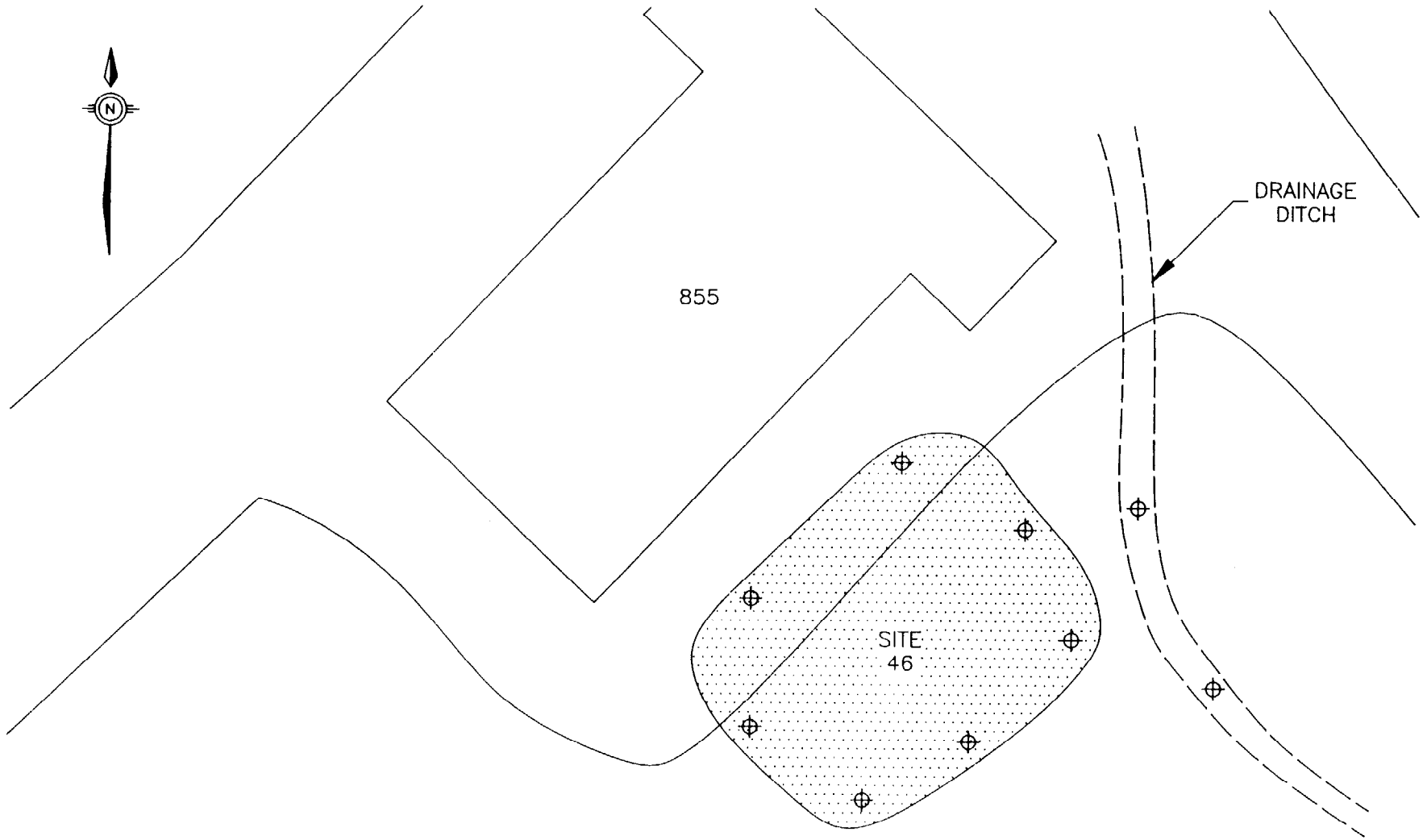
An SI due to the unknown origin and prior contents of the drums and the apparent potential for contamination of the surrounding surface soils. The study of Site 45 will involve collecting a series of surface soil samples for laboratory analyses.

Site 46 — Cadmium Sandblast Grit Area. The area behind Building 855 was identified in the PA as the disposal location of sandblast grit containing cadmium (Figure 4-6). The topography of the area is relatively flat, with the exception of the surface runoff to the drainage ditch bisecting the northern section.

Cadmium was introduced into the sandblasting grit during resurfacing of rocket catapult tubes. The grit was disposed in the gravel and the ditch behind Building 855. The PA indicated that the disposal was occasional from the mid 1970s to the early 1980s. The total volume of grit disposed cannot be determined.

This area was recommended for an SI due to the implications of sandblast grit containing cadmium in the area behind Building 855. This study will involve the collection of series of surface soil samples from the gravel area and the drainage ditch behind Building 855. Soil samples will be submitted for laboratory analyses.


SITE 45
674
BLOCH RD
N
LEGEND
– SOIL BORING HANDAUGER
– TREE LINE
– SITE
NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 4-5
SITE 45
DRUM SITE
DATE: 06/10/92
DWG NAME: INDHD14



NOT TO SCALE

LEGEND

⊕ – SOIL BORING HANDAUGER

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 4-6
SITE 46
CADMIUM SANDBLAST AREA
PROPOSED SAMPLE LOCATIONS

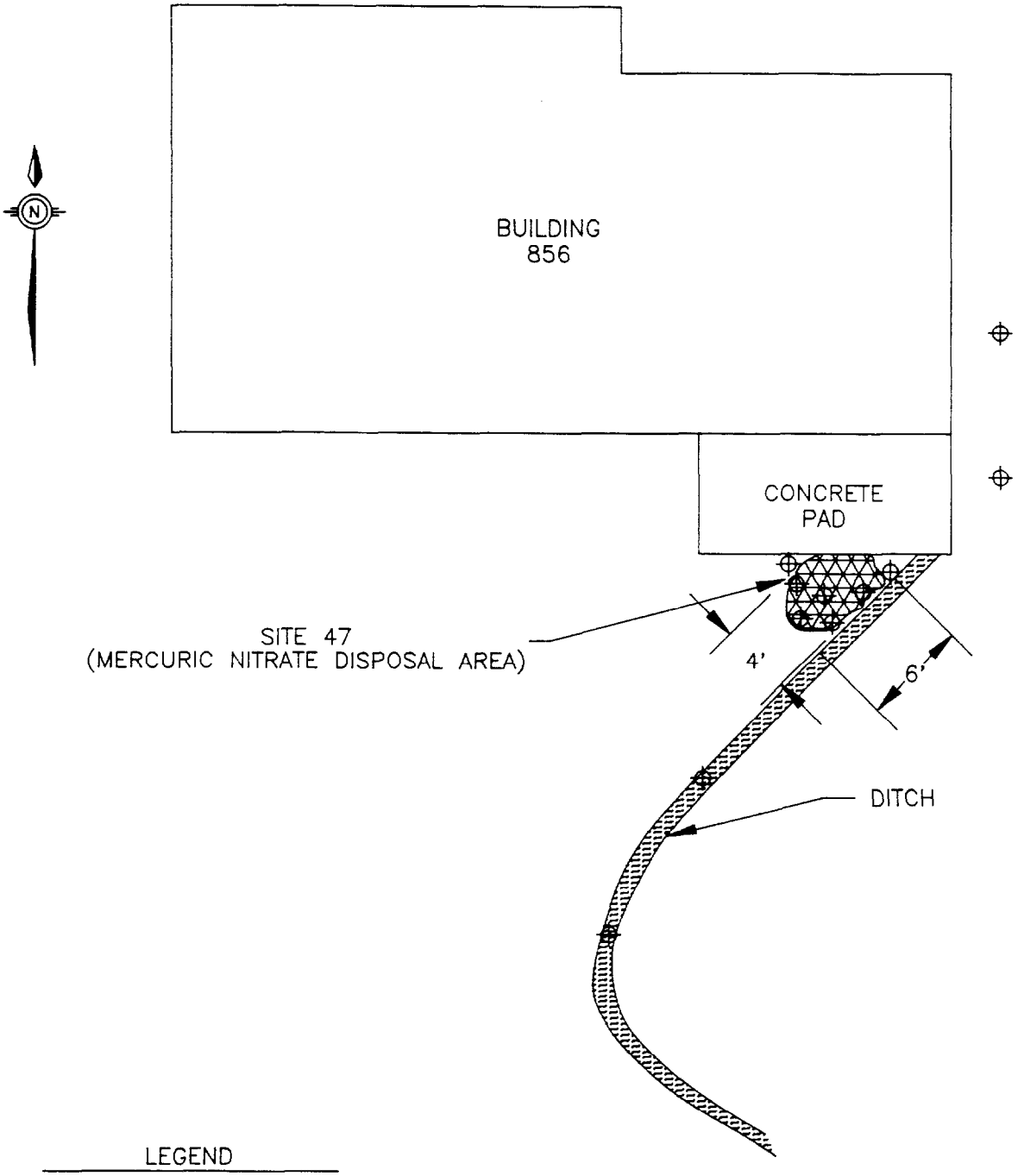
DATE: 06/10/92 | DWG NAME: INDHD11

Site 47 — Mercuric Nitrate Disposal Area. Site 47 is located behind Building 856 and is a disposal site for the mercuric nitrate catalyst used in the production of a missile propellant, hydrazinium nitroformate (Figure 4-7). The mercuric nitrate was disposed of in a 4 x 6 foot pit filled with limestone chips. The PA indicated that disposal occurred from 1957 until 1965 and that an estimated 150 to 200 pounds of mercuric nitrate were placed in the pit. A drainage ditch adjacent to the pit drains southward toward the Mattawoman Creek. Data collected during the PA and data presented in a study of the hydrology of the Indian Head peninsula (Hiortdahl, 1990) indicate that the dominant surface runoff from the surrounding area would be south toward Mattawoman Creek.

Site 47 was recommended for an SI to determine if mercury compounds have impacted soils beneath the disposal pit and if these compounds have migrated via the drainage ditch toward Mattawoman Creek. This study will be completed by collecting a series of surface and shallow soil samples for laboratory analyses. Two samples will be collected from the drainage ditch. Ten borings will be completed at the suspected location of the former disposal pit.

Site 48 — Dump Site (Nitroglycerine Plant Disposal Area). The PA notes that Site 48 consists of several containers located in the woods near Building 766 (Figure 4-8). The origin of these containers is suspected to be a nitroglycerine plant, Building 766; however, no information confirming their origin was available. The containers appear empty and are dispersed about a small area in the woods. Vegetation does not appear stressed.

The possibility exists that these containers may have once contained hazardous substances. Therefore, an SI was recommended and will involve the installation of a series of soil borings in and around the dump site to determine if contamination is present.



LEGEND

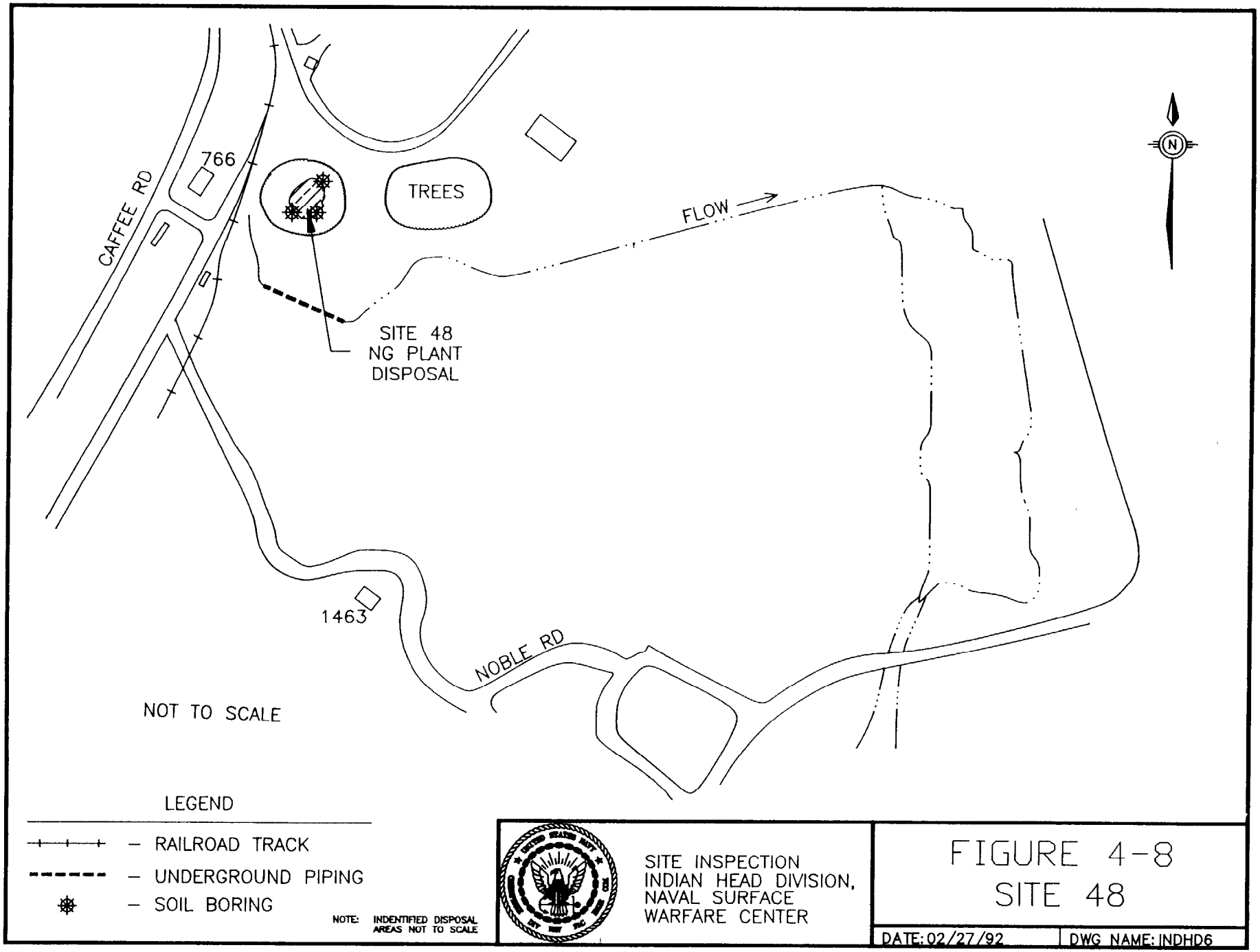
⊕ – SOIL BORING
HANDAUGER

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 4-7
SITE 47
MERCURIC NITRATE
DISPOSAL AREA

DATE: 03/03/92 | DWG NAME: INDHD5


CAFFEE RD
766
TREES
FLOW
SITE 48
NG PLANT
DISPOSAL
1463
NOBLE RD
NOT TO SCALE
LEGEND
– RAILROAD TRACK
– UNDERGROUND PIPING
– SOIL BORING
NOTE: INDENTIFIED DISPOSAL AREAS NOT TO SCALE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 4-8
SITE 48
DATE: 02/27/92
DWG NAME: INDHD6

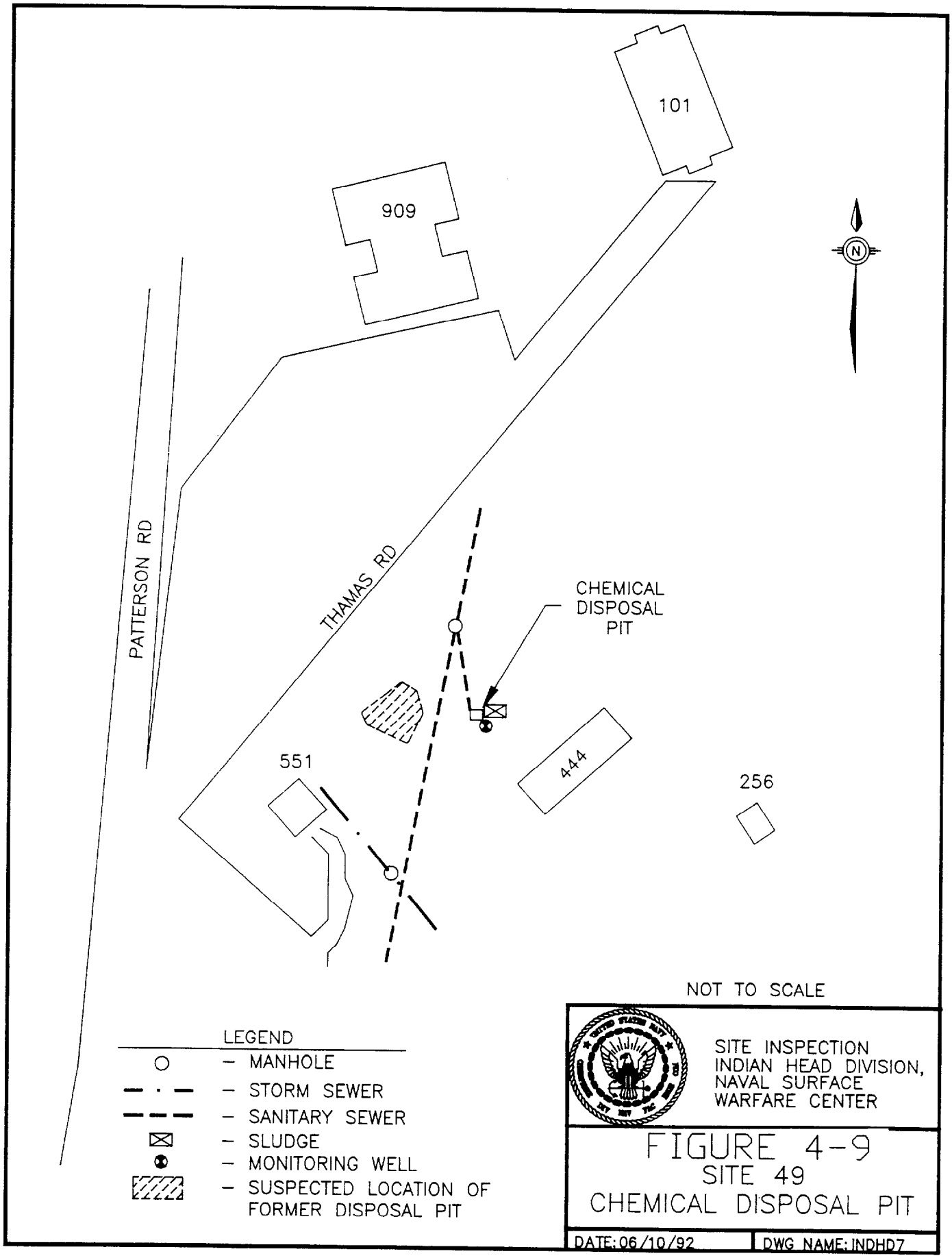
Site 49 — Chemical Disposal Pit. This site is located near Building 444 (Figure 4-9). Information from the PA report indicated the pit had limited use in the early 1970s. Disposal reportedly consisted of spent solvents and acid. Data also indicated that this pit connected to a storm sewer and not the sanitary sewer where chemicals could be treated and/or diluted.

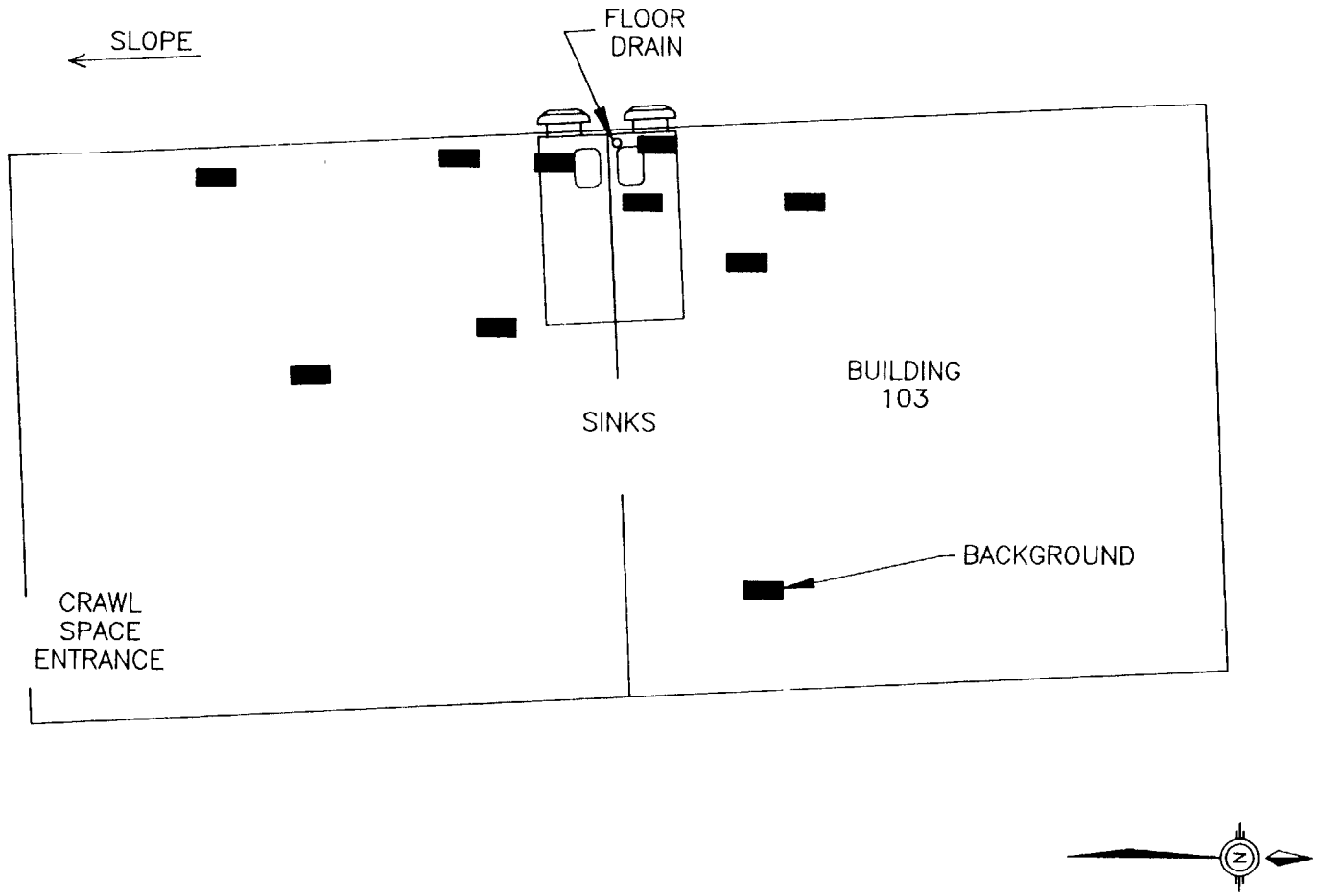
Site 49 was not recommended for an SI in the PA; however, at the request of the MDE, this site is included in the scope of work and will be included in the SI. A study will be completed in this area consisting of the installation of one soil boring and the collection of a sediment sample from within the pit. The boring installed at this site maybe completed as a shallow monitoring well as part of the scope of work at Site 53.

Site 50 — Building 103 Crawl Space. Site 50 consists of the crawl space underneath Building 103 (Figure 4-10). The building is a small single story wood frame structure on a raised concrete block foundation. During the replacement of two sinks in the building, workers discovered that the drain pipes discharged directly beneath the building and not to the sanitary sewer. Evidently, the open drainage pipes had been discharging underneath the building since the date of construction, 1902, until the sinks were replaced in 1988.

The possibility exists that a number of solvents, including mercury containing compounds and nitrate ester compounds, were introduced to the soil beneath the building via open drain pipes. The amount of mercury and solvents released in the soil beneath the building is unknown. Study of this site will include the collection of a series of surface soil samples from beneath the building for laboratory analyses.

Site 53 — Mercury Contamination in Laboratory Area. The sewer lines in the general laboratory area are defined as Site 53 (Figure 4-11). Information collected during the PA estimated that 28,000 pounds of mercury may have been released to the soils surrounding these


101
909
PATTERSON RD
THAMAS RD
CHEMICAL
DISPOSAL
PIT
551
444
256
N
NOT TO SCALE
LEGEND
– MANHOLE
– STORM SEWER
– SANITARY SEWER
– SLUDGE
– MONITORING WELL
– SUSPECTED LOCATION OF FORMER DISPOSAL PIT
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 4-9
SITE 49
CHEMICAL DISPOSAL PIT
DATE: 06/10/92
DWG NAME: INDHD7



LEGEND

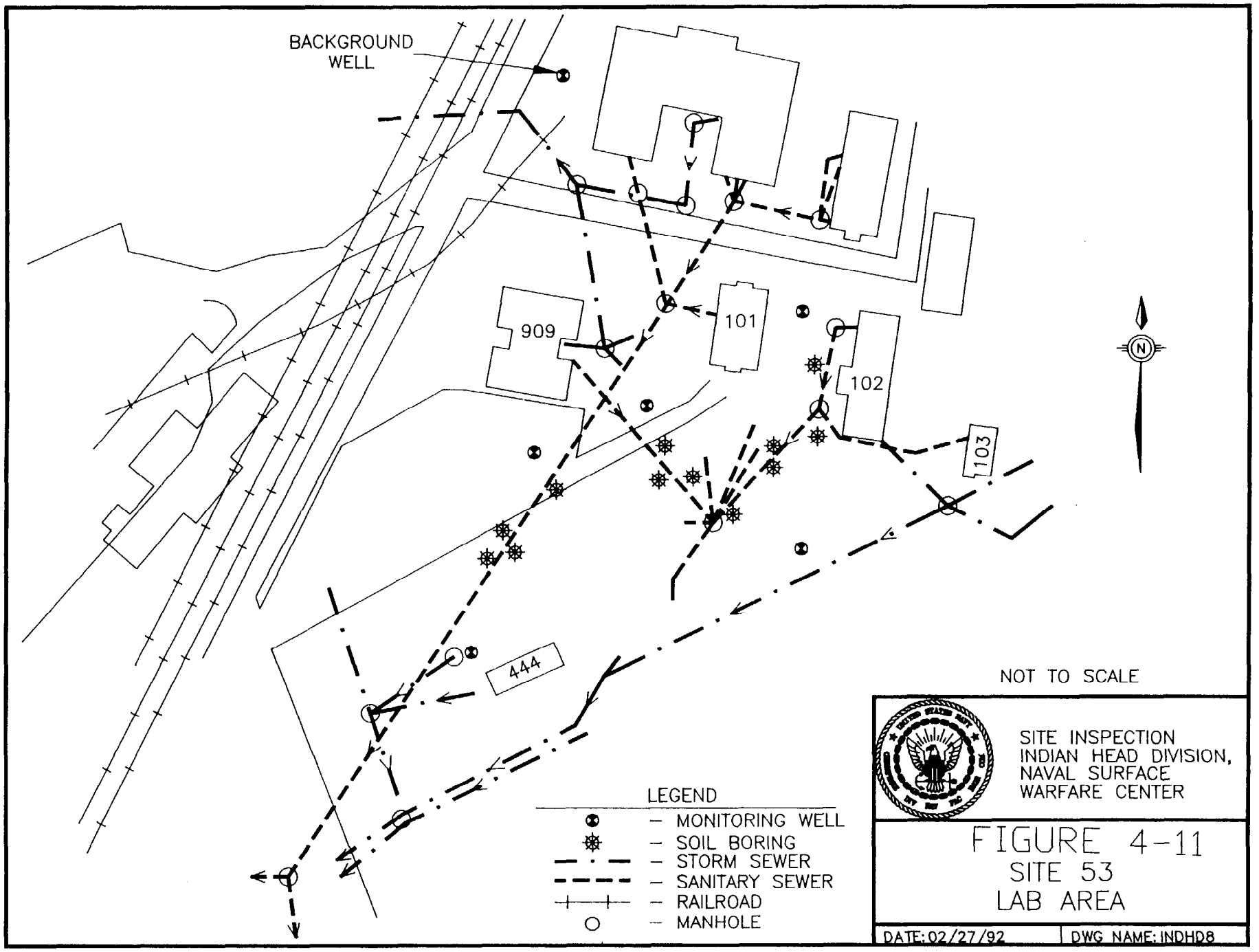
■ – SURFACE SAMPLE

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 4-10
SITE 50
BUILDING 103
FLOOR PLAN

DATE: 06/10/92 | DWG NAME: INDHD9


BACKGROUND WELL
909
101
102
103
444
N
NOT TO SCALE
LEGEND
– MONITORING WELL
– SOIL BORING
– STORM SEWER
– SANITARY SEWER
– RAILROAD
– MANHOLE
SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER
FIGURE 4-11
SITE 53
LAB AREA
DATE: 02/27/92
DWG NAME: INDHD8

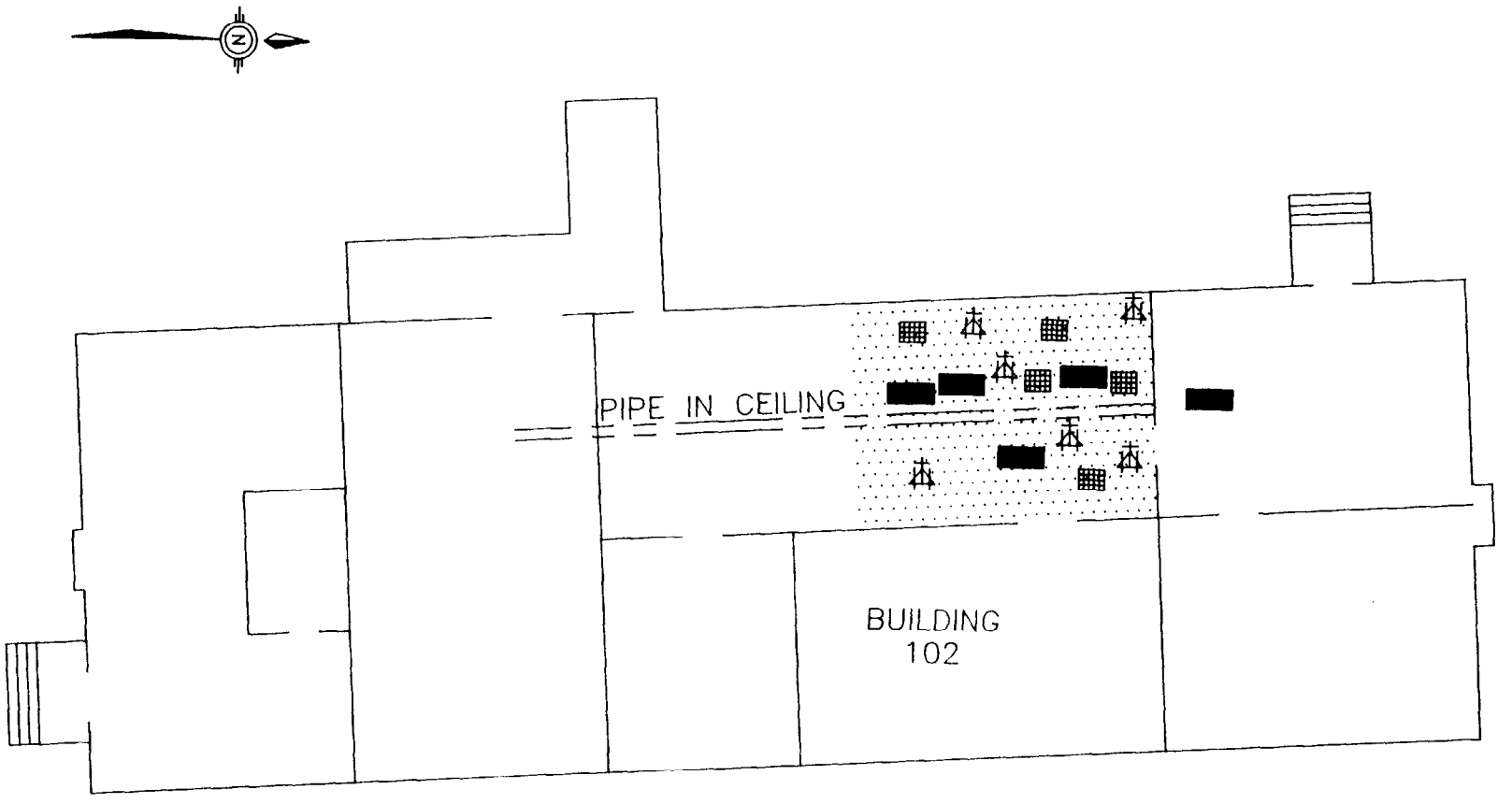
sanitary sewer lines. A survey conducted by NSWC Indian Head personnel found the sewer lines to be in poor condition.

A study will be conducted in this area to determine if mercury contamination, originating from the sewer system has impacted surrounding soils. Shallow soil borings will be completed adjacent to the sewer line. In addition, six groundwater monitoring wells will be installed in the general laboratory area.

Site 54 — Building 101 Mercury Contamination. Building 101 is a two-story brick building where mercury compounds were used in research and development. Droplets of mercury were detected on the insulation of a steam pipe in the first floor, southeast corner room. This first floor room is defined as the study area. During the PA it was discovered that laboratory equipment containing mercury had been located in the southeast corner room of the second floor, directly above the study area. It was noted in the PA that the source of the mercury droplets may be due to leaks and spills associated with the laboratory equipment on the floor above.

Site 54 was recommended for an SI based on discovery of the mercury on the pipes and mercury vapors detected in the room by NSWC safety personnel. The SI will involve the collection of wipe samples from the surface of selected building materials, the collection of media samples from selected building materials, and the possible collection of soil samples from beneath the concrete floor of the basement.

Site 55 — Building 102 Mercury Contamination. In 1987, mercury was discovered dripping from the ceiling onto the coffee mess located in the basement of Building 102 (Figure 4-12). Reportedly a spill of mercury occurred in the upstairs of the building in the early 1960s and was identified in the PA as the probable source of the mercury. The PA outlines a brief site history which indicates the building was used for a number of processes involving mercury for nearly 80 years.



LEGEND

- WIPE SAMPLE
- MEDIA SAMPLE
- CONCRETE SAMPLE
- AREA OF SUPECTED MERCURY CONTAMINATION

NOT TO SCALE

SITE INSPECTION
INDIAN HEAD DIVISION,
NAVAL SURFACE
WARFARE CENTER

FIGURE 4-12
SITE 55
BUILDING 102
BASEMENT FLOOR PLAN

DATE: 06/10/92 | DWG NAME: INDHD10

Building 102 was recommended for an SI due to the discovery of mercury permeating through the floor and entering into the basement. The SI will include the collection of wipe samples from the surface of selected building materials, and the collection of media samples from selected building materials. Soil samples from beneath the concrete basement floor may also be collected and submitted for laboratory analyses. This building contains friable and nonfriable asbestos containing material throughout the structure.

Industrial Wells Onsite. In addition to these sites discussed above, groundwater samples will be collected from five industrial wells on the NSWC facility. These samples will be submitted for laboratory analyses.

5.0 HAZARD EVALUATION

5.1 Energetic Hazards

All Site Inspection locations at Indian Head Division Naval Surface Warfare Center (NSWC) are located within the Restricted Area. Authorization (work permits) to commence scope of contract work within the Restricted Area will be obtained from the NSWC Safety Department via contracting officer/representative. Prior to the issuance of work permits, all contractor personnel shall attend a required meeting in which NSWC safety and security personnel shall brief them on site standard operating procedures, emergency procedures, and regulations.

The NSWC routinely works with electro-explosive devices (EEDs) such as igniters, squibs, detonators, and blasting caps. Radio frequency transmissions can, under certain circumstances, provide enough energy to initiate or degrade performance of these devices. Inadvertent initiation of EEDs can result in injury or death of personnel and damage or destruction of property. Degradation of the EED can result in failure of the item to function properly when needed.

BECAUSE OF THESE HAZARDS, USE OF CB RADIOS AND CAR PHONES IS PROHIBITED IN THE RESTRICTED AREA (AREA BEYOND POST 2)

See Appendix A for a summary of contractor safety requirements.

5.2 Chemical Hazards

The potential chemical hazards for the respective site locations discussed in this section are based on information obtained from the Preliminary Assessment Report (June 1991). The constituents identified by the PA include: cadmium, mercuric nitrate, pennchem 9018, toluene, elemental mercury, polychlorinated biphenyls, elemental silver, silver nitrate, ethylene dichloride, methyl chloride, formaldehyde and palladium.

Pennchem 9018 is a polysulfide solvent containing mercaptan. The NSWC safety department did not have an Material Safety Data Sheet (MSDS) available and there are no toxicological or exposure data readily available through industry research documents. Mercaptans, however causes both convulsions and narcosis; high concentrations can cause death by respiratory paralysis. Mercaptans are eye and respiratory tract irritants. Low level acute exposures can result in eye and mucous membrane irritation, headache, dizziness, staggering stance, nausea and vomiting.

Palladium is a rare platinum-group metal that is used as a catalyst and exhibits generally minor toxicological effects. Some toxic effects noted in studies are allergic dermatitis and "asthmatic syndrome" with coughing, wheezing, and shortness of breath. There is no OSHA PEL for palladium or palladium dust.

Physical and toxicological properties of substances listed by NIOSH, OSHA, and/or the American Conference of Governmental Industrial Hygienists. ACGIH for each respective site are presented in MSDS forms in Appendix B. These documents will be reviewed at site-specific health and safety meetings before work at the respective site begins. The MSDSs will also be available at each respective site. Table 5-1 presents the chemical hazards that may potentially be encountered at the respective sites.

Flammable gases such as methane, acetylene, ethylene, ethane, and hydrogen are also defined as simple asphyxiants by the American Conference of Governmental Industrial Hygienists. Inhalation of these gases may cause any or all of the following symptoms: need for fresh air, rapid, occasionally irregular, breathing, headache, fatigue, mental confusion, nausea and vomiting, giddiness, exhaustion, loss of consciousness, convulsions, or death.

Table 5-1
Chemical Hazards that May be Encountered at NSWC Sites 39-55

Site	Mercury	Formal-dehyde	Ethylene dichloride	Silver-nitrate	Silver	PCBs	Toluene	Cadmium	Dimethyl-hydrazine	Mercuric Nitrate	Acetal/ Formal	Palladium	dinitro propanol	Methyl-chloride	Penn chem 9018	Unknown Solvent	Asbestos
39		X	X	X	X						X		X	X			
40									X			X					
41						X											
43							X										
44															X	X	
45																X	
46								X									
47										X							
48																X	
49																X	
50	X															X	X
53	X																X
54	X																X
55	X																X

Notes:

X = Chemical Hazard Present
- = Chemical Hazard Not Present

Site 39 - Organics Plant
Site 40 - Organics Plant
Site 41 - Scrap Yard
Site 43 - Casting Plant
Site 44 - Soak Out Area
Site 45 - Abandoned Drums
Site 46 - Cadmium Sandblast Grit Area
Site 47 - Mercury Nitrate Disposal Area
Site 48 - Dump Site (NG Plant)
Site 49 - Chemical Disposal Pit
Site 50 - Building 103 Crawl Space
Site 53 - Laboratory Area
Site 54 - Building 101
Site 55 - Building 102

Flammable gases present the additional hazard of fire or explosion. All lights, test instruments and other electrical equipment must be explosion proof or intrinsically safe if operated in areas previously identified as containing flammable gases. Open flames and smoking are not permitted.

Equipment with internal combustion engines must be equipped with flame and spark arresters. Before entering any subgrade areas the atmosphere must be sampled for the presence of flammable gases. If concentrations of flammable gases exceed 10 percent of the lower explosive limits, a careful investigation of the area must be made. Before resumption of onsite activities, project personnel must develop a refined safety plan in consultation with personnel skilled in fire or explosion hazards.

If the concentration of flammable gases exceeds 20 percent of the lower explosive limits, all operations must be terminated immediately and the area evacuated. Operations may not be restarted until the atmosphere in the area contains less than 20 percent lower explosive limits of flammable gas.

Physical effects resulting from the inhalation or ingestion of dust may result in any combination of the effects. No respiratory protection is required where techniques limit dust in inspirable levels or where adequate ventilation conditions exist.

If airborne concentration is high (TLV-TWA 5.0 mg/m^3), a dust and mist air purifying respirator is recommended. If concentration exceeds the capacity of the respirator, higher levels of protection are recommended.

5.3 Mechanical, Physical and Temperature Hazards

The mechanical, physical and temperature hazards associated with field activities are summarized in Table 5-2.

TABLE 5-2
MECHANICAL, PHYSICAL AND TEMPERATURE HAZARDS

FIELD ACTIVITY	MECHANICAL EQUIPMENT USED	ELECTRICAL HAZARD	CHEMICAL HAZARD	PHYSICAL HAZARD	TEMPERATURE HAZARD
Surface soil sampling	None	None	Inhalation of dust particles, vapors, or gases Accidental ingestion, skin absorption eye contact	Slip, trip, fall, snake bites, ticks	H/C Stress
Subsurface soil sampling	Auger	None	Inhalation of dust particles, vapors, or gases Accidental ingestion, skin absorption, eye contact	Slip, trip, fall snake bites, ticks	H/C Stress
Groundwater monitoring well, install	Drill Rig	None	Inhalation of dust particles, vapors, or gases Accidental ingestion, skin absorption, eye contact	Struck by, caught between, pinch points on machinery, snake bites, ticks, slip, trip, fall noise	H/C Stress
Surface water sampling	Boat	None	Inhalation of vapors, or gases, Accidental ingestion, skin absorption, eye contact	Slip, trip, fall, drowning	H/C Stress

5.4 Site Hazard Abatement Methodology

5.4.1 Equipment Operations

Before any machinery or mechanized equipment (i.e. drill rig) is placed in use, it must be inspected by the subcontractor and the equipment operator. Defects that affect safety will be corrected in a timely manner to prevent a hazard to humans. When defects do make continued operation hazardous to humans, the defective equipment will be taken out of service and placed in the designated area for repair. Once removed from service, the equipment cannot be used again until the defects are repaired.

Defects that affect safety will be reported to the E/A&H project geologist if they are not corrected immediately. A record of the defect will be kept that will include the date the defect was reported, the identification of the piece of equipment, a description of the defect, and the date of repair.

Operators of drill rigs or other mobile equipment will maintain control of the equipment while it is in motion. Speed will be consistent with conditions of roadways, grades, clearances, visibility, and traffic and the type of equipment used. Equipment will be operated at speeds that permit stopping and maneuvering in the tight work area determined by the site topography and layout. The vehicle will not carry more persons than the number of seats on that vehicle.

All drill rigs or other mobile equipment will have a service brake system capable of stopping and holding the equipment with its typical load on the maximum grade it travels. (This does not apply to equipment that was not originally equipped with brakes). If equipped, the parking brake on mobile equipment will be capable of holding the equipment under typical load conditions on the maximum travel grade. All braking systems installed on mobile equipment will be maintained in a functional condition.

Repair or maintenance of equipment will be performed only after the power is off and the equipment blocked against hazardous motion. Starting or moving the equipment is allowed for adjusting or testing, provided that precautions are taken to protect the people involved.

Seat belts will be provided and worn in all site vehicles. They will be maintained in functional condition and replaced when necessary to assure proper performance. Furthermore, seat belts will meet the requirements of SAE J386, *Operator Restraint Systems for Off-Road Work Machines*, 1985.

Drill rigs and other mobile equipment will not be left unattended unless the controls are placed in the park position and the parking brake, if provided is set, and the ignition turned off. Persons will not work on top of, under, or from mobile equipment in a raised position until the equipment has been blocked or secured to prevent it from rolling or falling accidently.

All mobile drill rigs will be moved only when the drill rig boom in the down position. Care will be taken to locate all overhead power lines before raising the drill rig boom. Under no circumstances, should the drill rig boom (or any other part of it) be positioned within 10 feet of exposed and energized electrical wires for voltages to including 345 kv and 16 feet for voltages above 345 kv. The drill rig operator will be sure that there is sufficient overhead clearance before raising the drill rig through careful planning, (i.e., the drill rig will not hit or touch any overhead obstruction when raised nor will it hit or touch any object while being raised).

When waterborne operations involve the use of a boat, the boat must be equipped with oars, an anchor with a line equal to three times the maximum expected depth of the water, and a U.S. Coast Guard-approved life jacket for each person aboard the boat.

5.4.2 Chemical Hazards

Sources of ignition such as matches and lighters will not be taken into the restricted area of NSWC (Appendix A). The supervisor will ensure that personnel entering work sites leave all ignition sources outside the restricted area. The following section describes methods of protection from chemical hazards.

5.4.3 Physical Hazards During Non-Self-Propelled Mobile Equipment Operations

When conducting operations or survey work on foot, personnel will walk at all times. Running greatly increases the probability of slipping, tripping, and falling. When working at sites that support habitat for poisonous snakes, personnel shall wear protective chaps made of a heavy material designed to prevent snake bites to the legs.

During all activities on or near water, U.S. Coast Guard-approved life jackets will be worn. If the chance of falling into the water exists, a harness and life line will be worn in addition to a life jacket.

During operations or survey work, all personnel will approach the edges of cliffs, ravines, gullies, and ditches with caution. Personnel will carefully examine the edges before approaching to determine the stability of the soil. When descending into a ditch, ravine or gully that is: (1) more than 5 feet deep **and** (2) less than half as wide as it is deep, the following safety precautions will be taken. A safety person will remain outside the ditch with a safety harness and a life line long enough to reach the bottom and the individual entering the subgrade area will carry a O_2 and combustible gas meter equipped with alarms. Furthermore, when working in wet areas, personnel will wear boots with good tread and remain alert to the terrain to decrease the chances of slipping.

5.4.4 Temperature Hazards

See the section labeled Employee Protection, Procedures and Equipment for Extreme Weather Conditions of this plan for methods for addressing heat stress and cold exposure.

5.4.5 Site Preparation

A site survey will determine if any electric, gas, water, steam, sewer or other service lines may potentially be damaged by site activities. These lines will be shut off, capped, tagged and locked out before work begins. Locations of all electric, gas, water, steam, sewer, and other service lines will be determined and marked by NSWC facilities engineering or safety department.

The NSWC Safety Department will determine if any hazardous chemicals, gases, explosives, flammable materials, or hazardous substances have been used in any pipes, tanks, or other equipment on the site or at facilities near the site. When these substances are present, testing and purging will be performed and the hazard eliminated before work in the vicinity of underground utilities is started.

5.5 Noise Hazards

In addition to the hazards presented in Table 5-2, tests will be conducted for occupational exposure to noise for field activities that produce excessive noise to determine if hearing protection is needed. Positive hearing conversation measures will be taken: (1) In areas where employees are exposed to noise equal to or exceeding an 8-hour time weighted average sound level (TWA) of 80 decibels. (Decibels are measured on the A scale, slow response.)
(2) When noise exposures equal a dose of 50 percent.

The work environment will be modified or personal protective equipment will be used to prevent employees' hearing loss due to exposure to industrial noise.

Because of the types of operations at this site, it is not anticipated that administrative or engineering controls will be feasible. Therefore, earmuff hearing protection will be issued to those working in areas where the sound level exceeds an 8-hour TWA of 80 decibels. The hearing protection will comply with ANSI S12.6-1984. The instrument used to measure sound levels will be field calibrated before and after each use.

Sound monitoring will be repeated when changes are made that will affect the noise level, including changes in equipment or operating locations. Monitoring will be repeated at least monthly whenever operations are being conducted at a site where the initial 8-hour TWA was determined to be less than 80 decibels. Hearing protection will be required for continued activity at any site where the sound level exceeds an 8-hour TWA of 80 decibels. Hearing protection will be provided to the individual employees. Each employee will be educated in effective hearing conservation practices.

The project geologist is responsible for ensuring that hearing protectors are worn by:

- Employees who work in areas where the noise level has been determined to equal or exceed 80 decibels.

- Employees who have not had a baseline audiogram, **or**

- Employees who have experienced a standard threshold shift.

A log will be maintained onsite which shows the date of testing, the location, the type of field activity being monitored, personnel working at that location, a record of the calibration of the meter used in monitoring, and the 8-hour TWA at that site.

5.6 Eye Hazards

This program applies to all employees, subcontractors, and visitors to NSWC Indian Head. It provides for compliance with federal and E/A&H eye protection standards. Suitable eye protection equipment will be required where machines or operations present the hazard of chips, other flying objects, glare, compressed gases, liquids, injurious radiation, or a combination of these hazards to the eye.

These areas include, but are not limited to:

- All E/A&H facility SI work sites.
- All assembly, warehouse and development areas (welding and machine shops, processing and sheet metal shops, electrical and tubing production areas, explosive and functional test areas).
- Electrical and electronic test laboratories.
- Maintenance and salvage operations.
- Experimental shops.
- Chemical, fluid, and mechanical testing laboratories.

5.6.1 Wearing Eye Protection

Workers and observers will wear safety glasses (with side shields) or goggles in those areas outlined above. Personnel will wear sealed chemical protective goggles when exposed to chemical reaction and spills, or fluids under pressures.

5.6.2 Obtaining Eye Protection Equipment

E/A&H employees who do not require corrective lenses are furnished standard, non-prescription safety glasses with side shields at no cost. The E/A&H project geologist will ensure that safety glasses are available. Safety glasses for visitors can also be obtained from the site manager. All subcontractors are required to supply their employees safety glasses with side shields at all times for work in areas listed above.

E/A&H employees who wear corrective lenses may purchase prescription safety glasses with side shields with the approval of the E/A&H health and safety manager. Note that employees with monocular vision (vision in one eye) are required to wear approved eye protection at all times in areas listed above.

If these employees require additional eye protection, they will wear goggles or spectacles of the following types:

- Spectacles that met or exceed the ANSI Z87.1-1968 standard.
- Goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles.
- Goggles that incorporate corrective lenses mounted behind the protective lenses.

5.6.3 Enforcement

The E/A&H project geologist, E/A&H site health and safety manager and subcontractor supervisors are responsible for:

- Determining the potential eye-hazard operations in the area under their control and ensure that proper eye protection is worn by all persons entering those areas.

- Ensuring compliance with the eye protection standards in this plan.

- Requesting that individuals leave a specified eye protection area if they are not wearing proper eye protection. (They may return as soon as they obtain the proper eye protection.) This responsibility extends to individuals over whom the E/A&H project geologist and site health and safety manager, or subcontractor supervisor might have no immediate control.

- Requesting additional or replacement EYE PROTECTION REQUIRED signs when needed.

- Setting a good example by following the eye protection requirements without exception.

- Reviewing changes in processes, operations, and facilities to determine the need for eye protection requirements.

6.0 EMPLOYEE PROTECTION

Employee protection for this project includes standard safe work practices, personal protective equipment, procedures and equipment for extreme weather conditions, work limitations and exposure evaluation.

6.1 Standard Safe Work Practices

Standard safe work and personal hygiene practices that will be followed include:

- Eating, drinking, chewing gum or tobacco, smoking or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated, unless authorized by the site health and safety manager.

- Hands and face must be thoroughly washed as soon as leaving the work area.

- Contact lenses shall not be worn onsite.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact with surfaces suspected of being contaminated should be avoided. Whenever possible, employees should not walk through puddles, leachate or discolored surfaces, or lean, sit or place equipment on drums, containers or on soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified

physician. Consumption of alcoholic beverages or use of illegal drugs will not be allowed before or during operations.

- Undergarments should be made from natural fibers (i.e., cotton or wool).

NSWC Indian Head General Rules of Conduct

1. Liquor, firearms, cameras, narcotics, tape recorders, sources of ignition, and other contraband items are not permitted on the premises.

2. Any violation of local, state, or federal laws, or conduct which is outside the generally accepted moral standards of the community is prohibited.

3. Violation of the Espionage Act, willfully hindering or limiting production or sabotage is not permitted.

4. Willfully damaging or destroying property, or removing government records is forbidden.

5. Misappropriation or unauthorized altering or changing of any government records is forbidden.

6. Securing government tools in a personal or contractors tool box is forbidden.

7. Gambling in any form; selling tickets, articles, taking orders, soliciting subscriptions, taking up collections, is forbidden.

8. Doing personal work in an government shop or office, using government property or material for unauthorized purposes, or using government telephones for unnecessary or unauthorized local or long distance telephone calls is forbidden.

9. Compliance with posted signs and notices is required.

10. Adjusting or repairing government machinery without authorization is forbidden.

11. Boisterousness and noisy or offensive work habits, abusive language, or any verbal, written, symbolic, or other communicative expression which tends to disrupt production or morale is forbidden.

12. Fighting or threatening bodily harm to another is forbidden.

13. Defacing any government property is forbidden.

14. Wearing shorts of any type and/or offensive logos, pictures, or phrases on clothing is forbidden. Shirts, shoes and pants or slacks or coverall-type garments will be worn at all times on government property.

15. All persons operating motor vehicles will obey all NSWC Indian Head traffic regulations as presented in Appendix A and as will be discussed at the Restricted Area site safety and security briefing.

6.2 Personal Protective Equipment (PPE)

The selection of personal protective equipment is based on information obtained from the Draft Preliminary Assessment Report from Naval Ordnance Station Indian Head, Maryland, as prepared by the Naval Energy and Environmental Support Activity (NEESA), document Number

13-021A of June 1991. The information in the report was obtained by searching available records and interviewing long term activity employees who may have observed or participated in past facility operations.

Site activities at the NSWC will utilize Level D personnel protection except Sites 50, 54, and 55 where Level C protection will be required. Site inspection activities at the remaining sites (i.e. 39, 40, 41, 43, 44, 45, 46, 47, 48, 49, and 53) will be completed using a modified Level D PPE. See Table 6-1 for a description of Levels C and D PPE. A modified Level D protection was selected because concentrations of the constituents at the respective sites distinct from sites 50, 54, and 55 are not expected to reach the action levels prescribed for this site (50 percent of TLV-TWA per constituent). The handling of soil and water samples activities represent the greatest potential chemical hazards to individuals working on the site.

Air monitoring for volatile organic compounds, respirable dust, oxygen (O_2), and flammable gases will be performed continuously during selected sampling activities. Instruments will be continuous reading and intrinsically safe. Personal air monitoring shall also be performed to determine exposure levels of site personnel per 29 CFR 1910.1000. Air sampling for mercury (NIOSH Method 6009) and asbestos (NIOSH Method 7400) will be performed at sites 50, 54, and 55 during all sampling activities (Section 6.2.2.6 Special Conditions for asbestos area preparation and decontamination provisions). Additional PPE upgrades to Level B will be initiated as if concentrations of any contaminant exceeding 50 percent of PEL are encountered. See Table 6-1 for the specific criteria for use and equipment for each level of protection.

TABLE 6-1
LEVEL OF PROTECTION AND CRITERIA

Level of Protection	Criteria for Use	Equipment
Level A	• When atmospheres are "immediately dangerous to life and health" (IDLH in the NIOSH/OSHA Pocket Guide to Chemical Hazards or other guides.) • When known atmospheres or potential situations exist that would affect the skin or eyes or be absorbed into the body through these surfaces. Consult standard references to obtain concentrations hazardous to skin, eyes or mucous membranes. • Potential situations include those where immersion may occur, vapors may be generated or splashing may occur through site activities. • Where atmospheres are oxygen with the conditions above. • When the type(s) and or potential concentration of toxic substances are not known.	• Positive pressure-demand full facepiece self-contained breathing apparatus or positive pressure-demand supplied air respirator with escape SCBA. • Totally-encapsulating chemical protective suite. • Chemical-resistant inner and outer gloves. • Steel toe and shank chemical resistant boots. • Hard hat under suit. • Two-way radios worn inside suit. • Optionally: coveralls, long cotton underwear, disposable protective suit, gloves and boots, work over fully encapsulating suit.
Level B	• When work areas contain less than 19.5 percent oxygen. • When concentrations of any contaminant exceed 50% of PEL.	• Chemical resistant clothes, long sleeves, hooded, one or two pieces. • Full-faced positive-pressure supplied air breathing apparatus or airline system with a 30 minute escape bottle. • Hard hat. • Inner gloves and chemical resistant gloves. • Steel toe and shank boots. • Optionally: coveralls and disposable outer boots.
Level C	• When airborne particulates (dust) warrant respiratory protection. • When work areas contain at least 19.5 percent oxygen. • When friable asbestos-containing materials may be damaged or disturbed as a result of sampling activities.	• Double layer of chemical resistant clothes, long sleeves, hood optional, one or two pieces. • Full-faced piece, air purifying respirator equipped with cartridges suitable for the hazard. • Hard hat. • Inner gloves and chemical resistant gloves. • Steel toe and shank boots. • Coveralls and disposable outer boots.
Level D	• When level B or C is not indicated. • When airborne particulates do not warrant respiratory protection. • When work areas contain at least 19.5 percent oxygen.	• Inner gloves and chemical-resistant gloves needed to handle soil or water samples. • Steel toe and shank boots. • Hard hat (ANSI Z891-1969 standard). • Eye protection (ANSI Z87.1-1968) standard. • Optionally: coveralls and disposable outer boots.

6.2.1 General Measures

A primary goal of E/A&H is the prevention of all occupationally related injuries and illnesses. The following practices are presented as general precautionary measures for reducing the risks associated with hazardous waste and spill operations. Failure to adhere to the measures will result in disciplinary action.

6.2.1.1 Personal Protection

1. Be familiar with and knowledgeable about standard operating safety procedures.

2. Be familiar with, knowledgeable about, and adhere to instructions in site safety plan.

3. Identify and arrange for emergency medical assistance. The location, telephone number and transportation capabilities of the nearest emergency medical facilities should be known. For particularly hazardous operations, onsite medical facility alerted.

4. Consider fatigue, heat stress, cold exposure and other environmental factors influencing efficiency of personnel.

5. Wear only NIOSH-approved or designated respiratory protective devices and protective clothing.

6.2.1.2 Operations

1. In emergencies and routine operations in respirators, oral and/or semaphore safety protocols must be established by the team consistent with the site safety plan.

2. E/A&H personnel going onsite must be thoroughly briefed on the practices, emergency procedures and communication methods.

3. Initial entry team entrance and exit routes must be planned and emergency escape routes delineated.

4. Unfamiliar operations must be rehearsed before implementation.

5. Personnel onsite use the buddy system.

6. Visual contact is maintained between pairs onsite with the team members remaining in close proximity in order to assist each other in case of emergencies.

7. The number of personnel and equipment in the contaminated area must be minimized consistent with site operations.

8. Appropriate work areas for support, contamination reduction and exclusion must be established.

9. Appropriate decontamination procedures for leaving the site must be established.

Sites 50, 54, and 55 are areas in which asbestos or suspect asbestos-containing materials have been identified. E/A&H shall retain a licensed asbestos abatement subcontractor to perform or assist in the performance of all required site preparation and personnel decontamination activities including the construction of decontamination facilities, the decontamination of equipment, and the demobilization and packaging of all equipment and wastes. A personnel and equipment decontamination area shall be constructed immediately adjacent to each area in which E/A&H personnel may damage or disturb asbestos containing material as a result of scheduled sampling activities. Personnel and equipment asbestos decontamination shall be accomplished using a high efficiency particulate air (HEPA) filtering system and wet wiping. All wastes will be double

bagged and transferred to an approved storage location at NSWC Indian Head. NSWC Indian Head will be responsible for the disposal of the waste materials.

6.2.3 Safety Equipment

All site personnel must be adequately protected from potential health and safety hazards. Therefore, a sufficient and diverse inventory of all safety equipment necessary to meet anticipated hazards will be available to all employees. Personnel and site visitors must be instructed in the proper use of this equipment before entry to the work area is permitted. A list of all safety equipment available at the site will be maintained and incorporated into the specific site safety plan. The list will include first aid, firefighting, communications, respiratory protection, protective clothing (suits, gloves, boots, hard hats, goggles, etc.) and monitoring equipment.

6.2.4 Decontamination

As a part of the system to prevent or reduce the physical transfer of contaminants by people or equipment from onsite areas, provisions must be made for decontaminating anything exiting the exclusion and contamination reduction zones. All equipment leaving the exclusion zone should be decontaminated to prevent the offsite migration of hazardous contaminants. In addition, all equipment used at the site should be decontaminated upon completion of field activities. In limiting the potential environmental exposures, the following procedures should be used. All contaminated surfaces will be rinsed with a potable water/detergent wash followed by a potable water rinse.

6.3 Procedures and Equipment for Extreme Weather Conditions

Field activities for this site are scheduled to last two months. Therefore, both heat and cold stress will be concerns for the health and safety personnel. Adverse weather conditions are

important considerations in planning and conducting site operations. Extremes in hot and cold weather can cause physical discomfort, loss of efficiency and personal injury.

6.3.1 Heat Stress

Heat stress can result when the protective clothing decreases natural body ventilation even when temperatures are moderate. Working under various levels of personal protection may require wearing low permeability disposable suits, gloves and boots which prevents most natural body ventilation. Discomfort due to increased sweating and body temperature (heat stress) will therefore be expected at the work site.

Heat stress is the metabolic and environmental heat to which an individual is exposed. Heat strain is the adjustment made by an individual in response to the stress. The three most important categories of heat-induced illness are: heat exhaustion, heat cramps, and heat stroke. These disorders can occur when the normal responses to increased sweat production are not adequate to meet the needs for body heat loss or when the temperature-regulating mechanisms fail to function properly.

Heat exhaustion is a state of collapse brought about by an insufficient blood supply to the cerebral cortex portion of the brain. The crucial event is low blood pressure caused by inadequate heart output and widespread expansion of blood vessels.

Heat Exhaustion Factors — Three significant factors can lead to heat exhaustion:

- Increased expansion of blood vessels which causes a decreased capacity of circulation to meet the demands for heat loss due to the environment, exercise, and digestive activities.
- Decreased blood volume due to dehydration.
- Reduced blood volume due to lack of physical training, infection, intoxication (from industrial contaminants as well as from drinking alcohol), or heart failure.

Heat Exhaustion Symptoms — The symptoms include extreme weakness or fatigue, dizziness, nausea, or headache. More severe cases may also involve vomiting and possible unconsciousness. The skin becomes clammy and moist, the complexion pale, and the oral temperature stays normal or low but the rectal temperature is usually elevated (99.5°F - 101.3°F). Workers who are unacclimated run the highest risk.

Heat Exhaustion Treatment — In most cases, treatment of heat exhaustion is fairly simple. The victim will be moved to a cool place. If the victim is unconscious, medical assistance must be sought. Victims with mild cases of heat exhaustion may experience immediate recovery; however, more severe cases may require several days care. No permanent effects have ever been reported.

Heat cramps result when the working muscles go into painful spasms. Heat cramps may occur in those who perspire profusely in heat and who drink large quantities of water, but fail to replace their bodies' low salt. It is the low salt content in the blood that causes the cramping. The abdominal muscles as well as the muscles in the arms and legs may be affected. The cramps may appear during or even after work hours. Victims of heat cramps who are on a low sodium diet should not be given salt. A physician must be consulted on the care of people with this condition.

Heat stroke is the most serious of the health problems that arise while working in hot environments. It is caused by the breakdown of the thermoregulatory system under stress. When this happens, perspiration stops and the body can no longer regulate its own temperature.

Heat Stroke Symptoms — A heat stroke victim may be identified by hot, dry, and usually red or spotted skin. The body core temperature can exceed 105°F. Mental confusion, irritability and chills are common symptoms of heat-stroke victims. These symptoms are all early warning

signs of heat stroke; if the sufferer is not removed from the hot environment at once, more severe symptoms can follow,, including unconsciousness, delirium, and convulsions, possibly ending in death.

Heat Stroke Treatment — Heat stroke victims must be treated as a major medical emergency.When someone is suffering from heat stroke, medical assistance must be summoned immediately.

Additional treatment for heat stroke:

- First aid must be administered.
- The individual must be moved to a cool location.
- The individual must be cooled through wetting, fanning, or immersion.

Early recognition and treatment of heat stroke are the only means of preventing permanent brain damage or death. Care should be taken to avoid over-cooling and treatment for shock, by raising the legs should be given.

To reduce heat strokes:

- Drink plenty of fluids (to replace loss through sweating).
- Wear cotton undergarments to act as a wick to absorb moisture.
- Make adequate shelter available for taking rest breaks to cool off.

Additional Measures:

In extremely warm weather, the site health and safety officer may also require these additional measures:

- Wear cooling devices to aid in ventilation. (Note: The additional weight may affect efficiency.)
- Install portable showers or hose down facilities to cool clothing and body.
- Shift working hours to early morning and early evening. Avoid the hottest time of the day.
- Frequently rotate crews wearing the protective clothing.

If environmental conditions or consistent in-field hazards warrant, an emergency medical technician may be summoned to monitor personnel for signs of heat stress and to keep a record of the individual's body temperature, blood pressure, pulse rate, and fluid intake for each work day. (See the example log in Figure 6-1.) These records will be maintained as a permanent part of the site personnel's medical file and retained for the same time period as the medical record.

6.3.2 Cold Exposure

Persons working outdoors in temperatures at or below freezing may experience frostbite or hypothermia. Extreme cold for a short time may cause severe injury to the surface of the body. Areas of the body that have a high surface-area-to volume ratio, such as fingers, toes, and ears are the most susceptible.

Two factors influence the development of cold injury: Ambient temperature and the velocity of the wind. As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. thus, the body cools suddenly when protective equipment is removed if the clothing underneath is soaked with perspiration.

Frostbite is a condition in which the cold forms ice crystals in the cells and tissues, dehydrating protoplasm and killing tissues. At the same time, circulation of the blood is blocked. Frostbite could lead to gangrene and amputation.

Frostbite damage occurs in several degrees:

- Frost nip, or incipient frostbite, is characterized by sudden whitening of the skin.
- When superficial frostbite occurs, the skin has a waxy or whitish look and is firm to the touch; however, the tissue underneath has retained it resiliency.
- In deep frostbite, the tissues are cold, pale, and solid. The injury is severe.

FIGURE 6-1

INDIVIDUAL HEAT STRESS MONITORING LOG

Name_____ **Date**_____ **Shift**_____

	START OF SHIFT	MID-SHIFT	END OF SHIFT
AMBIENT AIR TEMPERATURE (°F)			
PULSE RATE			
BODY TEMPERATURE (°F)			
BLOOD PRESSURE			
WEIGHT (POUNDS)			
FLUID INTAKE (IN OUNCES)			

In addition to frostbite, other physiological reactions to cold may be experienced as well. Trench foot, for example, may result from prolonged exposure to low temperatures near, though possibly above, freezing. Walking on the foot is very painful. In very severe cases, the flesh dies and the foot may have to amputated. Immersion foot is very similar although it is less severe. Although amputation is unusual, some mobility of the limb is lost. Blisters may occur around the lips, nostrils and eyelids.

Chilblain (pernio) which is an inflammation of the hands and feet caused by exposure to cold and moisture, is characterized by a recurrent localized itching, swelling, and painful inflammation on the fingers, toes, or ears, produced by mild frostbite. Such a sequence produces severe spasms, accompanied by pain.

Hypothermia occurs when the body loses heat faster than it can produce it. The initial reaction involves the constriction of blood vessels in the hands and feet in an attempt to conserve the heat. After the initial reaction, involuntary shivering begins in an attempt to produce more heat.

Temperature is only a relative factor in cases of hyperthermia. Cases of exposure have occurred in temperatures well above freezing. Humidity is another important factor. Moisture on the skin and clothing will allow body heat to escape many times faster than when the skin and clothing are dry.

Hypothermia occurs when the body's core temperature drops below 96°F. When this happens, the affected person becomes exhausted. He may begin to behave irrationally, move more slowly, stumble and fall. The speech becomes weak and slurred. If these preliminary symptoms are allowed to pass untreated, stupor, collapse, and unconsciousness occur, possibly ending in death.

To reduce effects of cold exposure:

Stay dry. When the temperature drops below 40°F, change perspiration soaked clothes frequently. When clothes get wet, they lose about 90 percent of their insulating value.

Beware of the wind. A slight breeze carries heat away from bare skin much faster than still air. Wind drives cold air under and through clothing. Wind refrigerates wet clothes. Wind multiplies the problems or staying dry.

Understand cold. Most hypothermia cases develop in temperatures between 30°F and 50°F. Cold water running down the neck and legs or cold water held against the body by sopping clothes causes hypothermia.

Make adequate dry, warm shelter available.

Provide warm drinks.

Never ignore shivering. Persistent shivering is a clear warning that a person is on the verge of hypothermia. Allow for the fact that exposure greatly reduces normal endurance. Physical activity may be the only factor preventing hypothermia.

6.4 Work Limitations

All site activities will be conducted during daylight hours only. All personnel scheduled for these activities will have completed initial health and safety training and actual field training as specified in 29 CFR 1910.120. All supervisors must complete an additional eight hours of training in site management. All personnel must complete an 8-hour refresher training course on an annual basis in order to continue working at this site.

6.5 Exposure Evaluation

All personnel scheduled for site activities will have a baseline physical examination which includes a physical examination, stressing examination of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems, pulmonary function testing, multi-chemistry panel and urinalysis and be declared fit for duty. An exposure history form will be completed for each worker participating in site activities. An examination and updated occupational history will be repeated on an annual basis and upon termination of employment as required by 29 CFR 1910.120(f). The content of the annual or termination examination will be the same as the baseline physical. A qualified physician will review the results of the annual examination and exposure data and request further tests or issue medical clearances as appropriate.

After any job-related injury or illness, there will be a medical examination to determine fitness for duty or for the need for any job restrictions. The site health and safety manager will review the results with the examining physician before releasing the employee for work. A similar examination will be performed if an employee has missed at least three days of work due to a non-job related injury or illness requiring medical attention. Medical records shall be maintained by the employer or the physician for at least 30 years following the termination of employment. The symptoms of exposure to site contaminants are presented in Appendix B in the respective site contaminant MSDS.

7.0 MONITORING REQUIREMENTS

7.1 Air Monitoring

Air monitoring for volatile organic compounds, respirable dust, oxygen(O_2), and flammable gases will be performed continuously during all sampling activities. Instruments will be continuous reading and intrinsically safe. Air sampling for mercury (NIOSH Method 6009) and asbestos (NIOSH Method 7400) will be performed at sites 50, 54, and 55 during all sampling activities. Additional PPE upgrades to Level B will be initiated as if concentrations of any contaminant exceeding 50 percent of PEL are encountered.

Air monitoring will be accomplished using a photoionization volatile organic compound (VOC) detector during all surface soil sampling, subsurface soil borings and groundwater monitoring well installations. Monitoring instruments will be calibrated before site activities begin each day and at the end of each day. Before calibration at the end of the day, each instrument will be checked for surface contamination.

A record of all air monitoring activities will be maintained in the field logbook. The field log will indicate the date and time of the readings, the location, the activity that is performed in the area where the readings were taken, the concentrations observed on the instruments and the types of instruments used, and the signature of the person taking the readings. Table 7-1 on the following page summarizes exposure guidelines for expected site chemicals. In addition to calibrating the instruments as outlined above, all real-time direct reading survey instruments will be maintained in accordance with the manufacturers' recommendations.

TABLE 7-1
EXPOSURE GUIDELINES FOR EXPECTED SITE CHEMICAL HAZARDS

Chemical Name	Odor Threshold (ppm)	OSHA PEL (ppm) [1]	ACGIH TLV (ppm) [2]	NIOSH REL (ppm) [3]	Auto-ignition Temp.	Flammable range (% by volume)
Cadmium	N.A.	0.6 mg/m3 ceiling	0.05 mg/m3	Potential Occupational Carcinogen	N.A.	N.A.
Mercuric Nitrate	N.A.	0.1mg/m3 Ceiling Skin	0.1 mg/m3 Skin	N.A.	N.A.	N.A.
Toluene	40 ppm	100 ppm	100 ppm	100 ppm	996.5 F	1.3 to 7.1%
Mercury	N.A.	0.05 mg/m3 Skin	0.1 mg/m3 Skin	0.05 mg/m3	N.A.	N.A.
Polychlorinated Biphenyl(s)	N.A.	1 ppm	N.A.	N.A.	N.A.	N.A.
Silver	N.A.	0.01 mg/m3	0.1 mg/m3	N.A.	N.A.	N.A.
Silver Nitrate	N.A.	0.01 mg/m3	0.01 mg/m3	N.A.	N.A.	N.A.
Ethylene Dichloride	100 ppm	1 ppm	10 ppm	1 ppm Potential Occupational Carcinogen	774.9 F	6.2 to 15.6%
Methylene Chloride	214 ppm	500 ppm	50 ppm Suspect carc.	Pot. Occ. Carcinogen	1183.7 F	12 to 19%
Formaldehyde	1 ppm	1 ppm	1 ppm Suspect carc.	0.016 ppm Pot. Occ. Carc.	05.7 F	7 to 73%
Dimethylhydrazine	6 to 14 ppm	0.5 ppm Skin	0.5 ppm Skin Suspect carc.	0.06 ppm Pot. Occ. Carc.	-1 F	2 to 95%

TABLE 7-1
EXPOSURE GUIDELINES FOR EXPECTED SITE CHEMICAL HAZARDS

Chemical Name	Odor Threshold (ppm)	OSHA PEL (ppm) [1]	ACGIH TLV (ppm) [2]	NIOSH REL (ppm) [3]	Auto-ignition Temp.	Flammable range (% by volume)
Acetal/Formal	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Asbestos	N.A.	N.A.	2 Fibers/cc Confirmed Human Carcinogen	0.1 Fibers/cc Potential Occupational Carcinogen	N.A.	N.A.
Dinitropropanol	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1,1,1-Trichloroethane	100 ppm	350 ppm	350 ppm	350 ppm Ceiling	997.9 F	7 to 16%

Notes:

[1] 29 CFR 1910.1000, Table Z-1-A. Limits For Air Contaminants, as amended through 1/15/91.
[2] 1990 - 1991 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH
[3] NIOSH Pocket Guide to Chemical Hazards, September 1985
[4] Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989, Range of All Reference Values
N.A. = Substance information not available, or substance unlisted.

7.2 Confined Space Entry Procedures

7.2.1 Introduction

A confined space provides the potential for unusually high concentrations of contaminants, explosive atmospheres, limited visibility, and restricted movement. The crawl space of Site 50 and sewer areas of Site 53 will treated as confined spaces for the purpose of entering those areas for site sampling and inspection activities. This section will establish requirements for safe entry into, continued work in, and safe exit from confined spaces. The requirements of 29 CFR 1926.21, 29 CFR 1910, and NIOSH 80-106 will be adhered to in these procedures, as applicable.

A confined space is a work area not designed for normal human occupancy, having limited means of egress and poor natural ventilation and any structure, including buildings or rooms, with limited means of egress.

This is how the intensity of potential and actual exposure of respiratory hazards to respirator wearing is determined: instruments measure the concentrations of air contaminants or oxygen present in the breathing zone of the respirator wearers. Adequate air sampling and analysis or appropriate calculations should be carried out to determine both the time-weighted average concentration and the peak concentration of the respiratory hazard to which a respirator wearer may be potentially exposed or is actually exposed. Concentrations of a substance causing a respiratory hazard should be determined during the work shift to accurately define both the time-weighted average concentration and the peak concentration of the substance. The concentrations of a substance in air may be affected by changes in process operation, rate and direction of air movement, temperature from day to night operation, seasons. These factors should be taken into account in monitoring air for respiratory hazards.

It is essential that the volume of air sampled during a sampling test contain a sufficient quantity of the hazardous substance to accurately determine the concentration of the substance in the workplace atmosphere.

The volume of air to be sampled or the duration of the air-sampling depends upon:

- Estimated concentration of the substances in air.
- Sensitivity of the sampling instrument and sampling procedures.
- Established permitted time-weighted average concentration and established permitted peak concentration for the substances in air.

Although personnel cannot always measure or calculate the concentration of a hazardous substance during an emergency, every reasonable effort should be made to estimate what this concentration would be. Consider using a continuously operating monitor and alarm which would alert respirator wearers when a high concentration of a hazardous substance suddenly occurs.

7.2.2 Oxygen Deficiency — Immediately Dangerous to Life or Health

An atmosphere is classified as: *oxygen deficient — immediately dangerous to life or health* when it causes: (1) an oxygen partial pressure of 100 millimeters of mercury column or less in the freshly inspired air in the upper portion of the lungs **and** (2) the upper portion of the lungs is saturated with water vapor. The rationale for this classification is that: (1) these conditions correspond to an oxygen partial pressure of 60 millimeters of mercury column in the alveoli of the lungs and (2) at these alveolar conditions, the hemoglobin of the alveolar blood is 90 percent

saturated with oxygen. When the oxygen content drops below 90 percent saturation, oxygen-deficiency symptoms become noticeable.

7.2.3 General Provisions for Confined Spaces in the Regulations

When possible, confined spaces should be identified with a posted sign which reads:
Caution — Confined Space. Only personnel trained and knowledgeable about procedures for confined space entry will be authorized to enter a confined space or be a confined space observer. A confined space entry permit (CSEP) will be issued before performing work within a confined space. The permit will become a part of the permanent and official record of the site.

Natural ventilation will be provided for the confined space before initial entry and for the duration of the CSEP. Positive or forced mechanical ventilation may be required. However, care should be taken to avoid spreading contamination outside the enclosed area. If flammable liquids are be contained within the confined space, explosion-proof equipment will be used. All equipment will be positively grounded.

The contents of any confined space will, be removed before entry, if necessary. All sources of ignition must also removed before entry. Hand tools used in confined spaces will be in good repair, explosion proof, spark proof, and selected according to intended use. Where possible, pneumatic power tools are to be used.

Compressed gas cylinders, except cylinders used for self-contained breathing apparatus, will not be taken into confined spaces, except when it is necessary to take oxy-acetylene cutting equipment into the underground portion of the site in order to perform work necessary to remove a damaged vehicle. When oxy-acetylene cutting equipment is taken underground, a person with an instrument suitable for determining the concentrations of flammable gases will accompany

the cutting equipment and continuously monitor the atmosphere. Gas hoses will be removed from the space and the supply turned off at the cylinder valve when personnel exit from the confined space.

Only self-contained breathing apparatus or NIOSH-approved air line respirators equipped with a minimum 5-minute emergency air supply (egress bottle) will be used in untested confined spaces or in any confined space with conditions determined immediately dangerous to life and health.

Where air-moving equipment is used to provide ventilation, chemicals will be removed from the vicinity to prevent introduction into the confined space. Vehicles will not be left running near confined space work or near air-moving equipment being used for confined space ventilation.

Smoking in confined spaces is prohibited at all times.

7.2.4 Initial Monitoring of Respiratory Hazard.

Recognizing and evaluating the respiratory hazard (oxygen deficiency or contaminants) will be carried out to obtain data needed to determine the proper respiratory protection.
The data must include:

Identification or characterization of the respiratory hazard.

- Oxygen deficiency **or**
- Specific contaminants

Nature of contaminants.

- Particulates **or**
- Vapors or gases

Concentration of respiratory hazard.

7.2.5 Classification of Respiratory Hazards According to their Biological Effects

Oxygen Deficiency: The minimum legal requirements are 19.5 percent by-volume oxygen for respirable air at sea-level conditions. Oxygen deficiency occurs in confined or unventilated cellars, wells, mines, ships holds, tanks, burning buildings, and enclosures containing inert atmospheres. Table 7-2 presents the atmospheric oxygen content versus expected conditions and their physiological effects.

TABLE 7-2
ATMOSPHERIC OXYGEN CONTENT (PERCENT BY VOLUME) VERSUS EXPECTED CONDITIONS

Percent[1]	Physiological Effects
16% - 12%	Loss of peripheral vision, increased breathing volume, accelerated heartbeat, impaired attention and thinking, impaired coordination.
12% - 10%	Very faulty judgement, very poor muscular coordination. Muscular exertion causes fatigue that may cause permanent heart damage, intermittent respiration.
10% - 6%	Nausea, vomiting, inability to perform vigorous movement, unconsciousness, followed by death.
< than 6%	Spasmatic breathing, convulsive movements, death in minutes.

Note:

[1] Percent = Oxygen volume percent at sea level

Gas and Vapor Contaminants: Refer to Table 7-3 for a comparison of gas and vapor contaminants and their biological effects.

TABLE 7-3
GAS AND VAPOR CONTAMINANTS AND THEIR BIOLOGICAL EFFECTS

Categories	Examples	Biological Effects
Simple asphyxiants	Nitrogen, hydrogen, helium, methane	Physiologically inert substances that dilute oxygen in air
Chemical asphyxiants	Carbon monoxide, hydrogen cyanide, cyanogen, and nitriles	Low concentrations interfere with supply or use of oxygen in the body
Irritants	Ammonia, hydrogen chloride, formaldehyde, sulfur dioxide, chlorine, ozone, nitrogen dioxide, phosgene, and arsenic trichloride	Corrosive in action. May cause irritation and inflammation of parts of the respiratory system (also skin and eyes) and pulmonary edema.
Anesthetics	Nitrous oxide, hydro-carbons, and ethers. Carbotetrachloride (liver and kidneys), chloroform (liver and heart), benzene (bone marrow), and carbon disulfide (nervous system)	Cause loss of feeling with unconsciousness and death possible. Some anesthetics injure body organs.
Sensitizers	Socyantes, epoxy resin systems	Cause increased probability of physiological reactions.
Systemic poisons	Mercury (nervous system) phosphorus (bone), hydrogen sulfide (respiratory paralysis), arsine (red blood cells,liver).	Damage organs and systems in the body
Carcinogens	Vinyl chloride, benzene	Produce cancer in some individuals after a latent period.

Combination of Gas, Vapor, and Particulate Contaminants: Combinations of contaminants may occur simultaneously in the atmosphere. Contaminants may be entirely different substances (dusts and gases from blasting) or the particulate and vapor forms of the same substance. Synergistic effects may occur, that is, the joint action of two or more agents that results in an

effect which is greater than the sum of their individual effects. Synergistic effects may require extraordinary protective measures. See Tables 7-4 and 7-5 for additional information.

TABLE 7-4
[1] PARTICULATE CONTAMINANTS AND THEIR BIOLOGICAL EFFECTS

Categories	Examples	Biological Effects
Relatively inert	Marble, gypsum	May cause discomfort and minor irritation, but generally without injury at reasonable concentrations
Pulmonary-fibrosis producing	Quartz, asbestos	Produce nodulation and fibrosis in the lungs, possibly leading to complications
Carcinogens	Asbestos, chromates, radioactive particulates	Produce cancer in some individuals after latent period
Chemical irritants	Acidic mists, alkalies	Produce irritation, inflammation, and ulceration in upper respiratory tract
Systemic poisons	Lead, manganese, cadmium	Produce pathologic reaction in various systems of the body
Febrile-reaction producing	Zinc and copper fumes	Produce chills followed by fever
Allergy-producing	Pollens, spices, and animal fur	Produce reaction such as itching, sneezing, and asthma

Note:

[1] (dust, fog, fume, mist, smoke, and spray)

TABLE 7-5
CLASSIFICATION OF RESPIRATORY HAZARDS ACCORDING TO PROPERTIES WHICH INFLUENCE RESPIRATOR SELECTION

Category	Examples	Properties which influence selection
Gas, Vapor and Fumes		
Inert	Helium, neon, argon	Substances that do not react with other substances under most conditions, but create a respiratory hazard by displacing air and producing oxygen deficiency
Acidic	Hydrogen chloride, sulfur dioxide, fluorine, nitrogen dioxide, acetic acid, carbon dioxide, hydrogen sulfide, and hydrogen cyanide	Substances that are acids or that react with water to produce an acid. In water, they produce positively charged hydrogen ions (H^{+1}) and a pH of less than 7. They taste sour, and many are corrosive to tissues.
Alkaline	Ammonia, amines, phosphine, arsine, and stibine	Substances that are alkalies or that react with water to produce and alkali. In water, they result in the production of negatively charged hydroxyl ions (OH^{-1}) and a pH greater than 7. They taste bitter, and many are corrosive to tissues.
Organic	Saturated hydrocarbons, unsaturated hydrocarbons, alcohols, aldehydes, ketones, organic acids, halides, amides, nitriles, isocyanates, amines, epoxies, and aromatics.	The compounds of carbon.
Organometallic	Ethyl silicate, tetraethyl lead, and organic phosphate	Compounds in which metals are chemically bonded to organic groups
Hydrides	Diborane and tetraborane	Compounds in which hydrogen is chemically bonded to metals and certain other elements

Particulate Contaminants: Particles are produced by mechanical means by disintegration processes such as grinding, crushing, drilling, blasting, and spraying or by physicochemical reaction such as combustion, vaporization, distillation, sublimation, calcination, and condensation. Table 7-6 lists common particle contaminants and their descriptions.

TABLE 7-6
PARTICULATE CONTAMINANTS

Particle	Description
Dust	A solid mechanically produced particle with sizes varying form submicroscopic to visible or macroscopic.
Spray	A liquid, mechanically produced particle with sizes generally in the visible or macroscopic range.
Fume	A solid condensation particle of extremely small particle size, generally less than one micrometer in diameter.
Mist	A liquid condensation particle with sizes ranging form submicroscopic to visible or microscopic.
Fog	A mist of sufficient concentration to perceptibly obscure vision.
Smoke	A system which includes the products of combustion, pyrolysis, or chemical reaction of substances in form of visible and invisible solid and liquid particles and gaseous products in air. Smoke is usually of sufficient concentration to perceptibly obscure vision.

7.2.6 Characteristics of Hazardous Operation or Process

The following factors will be considered in selecting the proper respirator:

- Operation or process characteristics.
- Work-area characteristics.
- Materials, including raw materials, end products and by products (actual and potential).
- Worker activities.

Modification in the operation or process will be taken into account, since modifications may change the hazard and hence require the selection of a different respirator.

7.2.7 The specific steps to follow before and during a confined space entry

1. Test the atmosphere in each confined space to be entered prior to entry.

2. Isolate or block all pipelines connected to the confined space.

3. Lock out and tag electrical and hydraulic equipment or any equipment that has stored energy that may cause it to function when a person is in the confined space. (The kinetic energy of machines and equipment must be at its lowest value.)

4. If the air in a confined space cannot be tested without going in, use a positive-pressure, supplied air, respirator and clothing appropriate for the dermal hazards expected. If dermal hazards are unknown, Level A protective clothing must be worn.

5. If you must enter the space to test it, obtain approval from the health and safety officer beforehand and verify the personal protective equipment required. A safety observer must be outside the space during entry. (See the section describing his duties.) An additional

person, equipped like the one testing the confined space, must be available in the immediate proximity if needed to perform rescue duties.

6. The confined space will be tested for:

Oxygen content — Oxygen content must be between 19.5 percent and 22 percent by-volume to use an air purifying respirator or no respiratory protection (provided no other contaminant is detected).

Flammable gases — If the oxygen content is less than 16 percent by-volume, flammable gas detectors may not provide accurate readings. Purge and or ventilate the confined space and repeat steps 1 and 2.

Toxic gases — Knowledge of the materials stored in the underground portion this site was used to determine what instruments were needed to detect ammonia, hydrogen sulfide, and carbon monoxide.

Concentrations must be compared with the permissible exposure limits (PELs) in 29 CFR 1910.1000, Table Z-1.A. Where concentrations are greater than the PELs, respiratory protection is required. Additionally, concentrations must be compared with IDLH (immediately dangerous to life and health) concentrations to determine if a higher level of respiratory protection is needed. IDLH values for certain chemicals can be found in the NIOSH *Pocket Guide to Chemical Hazards*. If the PEL and IDLH cannot be found in these references, consult the material safety data sheets or the manufacturer for additional information.

7. After characterizing the atmosphere in the confined space, the following procedures must be followed for entry into the space:

   - The time needed to effectively ventilate a confined space depends on the size and shape of the space. After ventilation begins, confined spaces must be tested before anyone enters the space for any reason. Ventilation must remain in effect as long as personnel remain in the space.

   - Ensure that source air for forced air ventilators is not contaminated.

   - Only non-sparking tools may be used in a confined space.

   - No cylinders, except supplied air cylinders for breathing purposes, are permitted in confined spaces, except during emergency cutting operations. All hoses must be removed during any break period and at the end of each shift.

   - Ensure that any hot work (welding, burning, open flames, or spark producing operation) that is to be performed in the confined space has been approved by the E/A&H site manager and is indicated on the permit.

   - Ensure that the personnel who enter the confined space and the confined space observer are familiar with the contents and requirements of this instruction.

   - The CSEP will be considered void if work in the confined space does not start within one hour after the testing of the confined space atmosphere or if significant changes within the confined space atmosphere or job scope occurs.

- No more than the amount of fuel gas and oxygen cylinders necessary to perform cutting work during an emergency will be permitted underground.

7.2.8 Entry Permit

The following information must be maintained for the official site record. This information may be in the form of an entry permit or any combination of documents that provide all of the required information:

Entry Permit Information:

- The hazards associated with the confined space.
  - — atmospheric — engulfment
  - — mechanical — electrical
  - — chemical — physical
- The type of work.
- Location of work.
- Length of work period.

  Personal protective equipment required (if any).
- Ventilation requirement.
- Name of safety observer.

7.2.9 Duties of the Safety Observer

The safety observer monitors the activities of personnel working within a confined space. In addition to monitoring activities, the observer provides external assistance to those inside the confined space. The observer summons rescue personnel in the event of an emergency and assists the rescue team.

Safety observer responsibilities:

- Read and understand the entry permit documents. It is especially important to understand the hazards associated with the space: the type, location, and length of work, the personal protective equipment required to perform the work, and the ventilation requirements.

- Monitor the performance of the person inside the confined space. If the person inside the confined space becomes euphoric, giddy, sings or yells loudly for no apparent reason, have the person leave the space.

- If an accident occurs, summon help. **Never enter the space to rescue someone without the proper personal protective equipment and your safety observer being present.**

- Keep internal combustion engines or other objects which may effect the quality of source air away from the supply for forced air ventilators.

- Be alert to outside changes for example, weather conditions that may affect operations inside the space.

7.2.10 Site Specific Information

This health and safety plan lists specific information relating to chemical hazards, biological hazards, mechanical hazards, check-in and out procedures and emergency procedures used at individual sites.

8.0 DECONTAMINATION

A decontamination zone will be established at individual sites and will include an area for sampling equipment and personnel decontamination. The decontamination procedures that take place at each site decontamination reduction station will focus primarily on personnel decontamination. A formal decontamination station with capabilities for thorough decontamination of the drill rig and sampling tools will be constructed at the site office.

8.1 Personnel Decontamination

The decontamination procedures, based on Level C protection, will consist of:

- Brushing heavily soiled boots and rinsing outer gloves and boots with soap and water.
- Removing outer gloves and depositing them in a plastic lined container.
- Washing and rinsing safety suit and respiratory protection equipment (facepiece, etc.)
- Removing safety suit and boots. Safety suits are to be deposited in a plastic-lined container.
- Washing and rinsing inner gloves, removing facepiece, washing and rinsing inner gloves and removing inner gloves. Facepieces will be decontaminated and cleaned for reuse. Inner gloves will be deposited in a plastic lined container.
- Respiratory protection equipment will be inspected and serviced as needed before next use.

Decontamination procedures will be conducted at the lunch break and at the end of each work day. If the field activities zone is left at other times during the work day, contaminated clothing will be left at the decontamination station on plastic sheeting to be reworn on returning.

If higher or lower levels of protection are needed, adjustments will be made to these procedures by the site health and safety officer and an amendment will be made to this health and safety plan.

8.2 Asbestos Area Decontamination

Sites 50, 54, and 55 are areas in which asbestos or suspect asbestos-containing materials have been identified. E/A&H shall retain a licensed asbestos abatement subcontractor to perform or assist in the performance of all required site preparation and personnel decontamination activities including the construction of decontamination facilities, the decontamination of equipment, and the demobilization and packaging of all equipment and wastes. A personnel and equipment decontamination area shall be constructed immediately adjacent to each area in which E/A&H personnel may damage or disturb asbestos containing material as a result of scheduled sampling activities. Personnel and equipment asbestos decontamination shall be accomplished using a high efficiency particulate air (HEPA) filtering system and wet wiping. All wastes will be double bagged and transferred to an approved storage location at NSWC Indian Head. NSWC Indian Head will be responsible for the disposal of the waste materials.

8.3 Closure of the Personnel Decontamination Station

All disposable clothing and plastic sheeting used during site activities will be double-bagged and disposed in a refuse container. Decontamination and rinse solutions will be allowed to drain onsite. Reusable clothing will be dried and prepared for future use. All washtubs, pails, buckets, etc. will be washed, rinsed and dried at the end of each workday.

9.0 AUTHORIZED PERSONNEL

Personnel anticipated to be onsite at various times during site activities include:

• E/A&H Task Order Manager	Mr. Paul Stoddard
• E/A&H Project Geologist	Mr. Joe Matthews/Mr. Dave Fuerher(Alt.)
• E/A&H Health & Safety Officer	Mr. John Borowski/Mr. Rick Barlow(Alt.)
• E/A&H Representatives	Staff Geologists

9.1 Responsibilities of the E/A&H Project Geologist

The project geologist will direct the site activities and operation, and is responsible for the following:

Ensuring that all personnel are aware of:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on the site
- Use of personnel protection equipment and assuring that the equipment is available.
- Work practices which can minimize risks from hazards
- Safe use of engineering controls and equipment on the site
- Medical surveillance requirements including recognition of symptoms and signs which might indicate over-exposure to hazards
- Site control measures, decontamination procedures, site standard operating procedures and the contingency plan and responses to emergencies including the necessary PPE.

Employee Training Requirements

The project geologist will also ensure that all employees have received at least 40 hours of health and safety instruction off the site, and actual field experience under the direct supervision of a trained experienced supervisor. Workers who may be exposed to unique or special hazards will receive additional training.

Monitoring the performance of personnel to ensure that mandatory health and safety procedures are being performed and correcting any performances that do not comply with the health and safety plan.

Medical Surveillance Requirements

Ensuring that all field personnel employed on the site are covered by a medical surveillance program as required by 29 CFR 1910.120(f):

- Consulting with the health and safety officer and/or other personnel.
- Preparing and submitting project reports, including progress, accident, incident, contractual, etc.
- Monitoring personnel decontamination to ensure that all personnel are complying with the established decontamination procedures.

9.2 Responsibilities of the Site Health and Safety Manager

It is the responsibility of the site health and safety manager to:

- Assure that a copy of the health and safety plan is maintained onsite during all field activities.
- Advise the project manager on all health and safety related matters involved at the site.
- Direct it and ensure that the safety program is being correctly followed in the field, including the proper use of personal protective and site monitoring equipment.
- Ensure that the field personnel observe the appropriate work zones and decontamination procedures.
- Report any safety violations to the project manager.
- Conduct or schedule safety briefings during field activities. The items in Table 9-1 will be discussed by a qualified individual at the site pre-entry briefings (the MSDS for each site chemical hazard will be available at each site and will be

discussed prior to the initiation of site activities), as well as at daily or periodic site briefings.

TABLE 9-1
ITEMS TO BE DISCUSSED AT SAFETY BRIEFINGS

Frequency	Items to be discussed
Initial at each site	• Site Chemical Hazards • Use of Air Purifying Respirators • Air Monitoring • Location and Use of Emergency Equipment • Decontamination Procedures
Seasonal	• Heat Stress • Cold Exposure
As needed	Confined Space Entry

The person responsible for daily health and safety will be trained to use the air monitoring equipment, and interpret the data collected with the instruments, and be familiar with symptoms of heat stress and cold exposure and the location and use of safety equipment onsite. He will also be familiar with this health and safety plan.

9.3 Responsibilities of Onsite Field Personnel

The responsibilities of onsite field personnel are:

- All personnel going on the site must be thoroughly briefed on anticipated hazards and trained on equipment to be worn, safety procedures to be followed, and emergency procedures and communications.
- Required respiratory protective devices and clothing must be worn by all personnel going into areas designated for protective equipment.
- Personnel must be fit-tested before use of respirators.

- No facial hair which intrudes on the sealing surface of the respirator is allowed on personnel when respiratory protection is required.
- Personnel on the site must use the buddy system when wearing respiratory protective equipment. As a minimum, a third person suitably equipped as a safety backup, is required during all entries.
- Visual contact must be maintained between pairs and the site safety personnel. Field personnel should remain close together to assist each other during emergencies.
- All field personnel should alert themselves to potentially dangerous situations which they should avoid, e.g., presence of strong and irritating or nauseating odors.
- Personnel must practice unfamiliar operations before implementation in the field.
- Field personnel will be familiar with the physical characteristics of the site:
  - wind direction relative to contamination zones
  - accessibility to associates, equipment and vehicles
  - communications
  - operation zones
  - site access
  - nearest water sources
- The number of personnel and equipment in the contaminated area must be kept to a minimum, consistent with effective site operations.
- Procedures for leaving a contaminated area must be planned and implemented before going onsite according to the health and safety plan.
- All visitors to the job site must comply with the health and safety plan procedures. Personal protection equipment may be modified for visitors depending on the situation. Modifications must be approved by the site health and safety manager.

10.0 EMERGENCY INFORMATION

10.1 Site Resources

Telephones for emergency use are located at the site office. Additionally emergency alarm pull boxes with a direct line to NSWC Indian Head Fire Department will be identified and located for each site at the required safety and security briefing. NSWC Indian Head Safety and Fire Department will provide all emergency response. Two-way radios or mobile telephones shall not be allowed within the Restricted Area at NSWC Indian Head. First aid equipment is located at the site office. Primary first aid equipment including eye wash facilities is to be available at each remote site location. Restrooms and water will be located at designated stations at NSWC Indian Head.

10.2 Pre-Emergency Planning

Authorization (Work Permits) to commence scope of contract work will be obtained from NSWC Indian Head Safety Department via contracting officer/representative. Prior to the issuance of work permits, all contractor personnel shall attend a required meeting in which NSWC safety and security personnel shall brief them on site standard operating procedures, emergency procedures, and regulations. See Appendix A for a summary of contractor and safety requirements.

The locations of the NSWC site activities are located within the Restricted Area. All equipment and personnel entering the Restricted Area at NSWC may be searched and inspected for potentially hazardous materials (matches, lighters, or other flame-producing items) or improperly functioning equipment (vehicle spark arrestors, mufflers, etc.) All individuals issued work permits will be required to attend the safety and security briefing and will be required to operate within the safety and security regulations. Any deviation from the regulations discussed at the briefing or presented in Appendix A will immediately be removed from the restricted area.

During the site briefings that are to be held daily and at special periodic meetings, all employees will be trained in and reminded of the provisions of the emergency response plan, communications systems, and evacuation routes. This plan will be reviewed and revised if necessary, on a regular basis by the E/A&H health and safety officer to ensure that the plan is adequate and consistent with prevailing site conditions. All hazardous waste site activities present a potential risk to onsite personnel. During routine operations, risk is minimized by establishing good work practices, staying alert and using proper personal protective equipment. Unpredictable events such as physical injury, chemical exposure or fire may occur and must be anticipated.

10.3 Personnel Roles and Lines of Authority

The E/A&H site manager has primary responsibility for responding to and assisting NSWC Indian Head personnel in correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public.

If any situation or unplanned occurrence requires outside or support services, the NSWC Indian Head representative, Mr. Shawn Jorgensen will be informed and the appropriate contact from the list in Table 10-1 will be made:

Table 10-1
Emergency Contact List

Contact	Person or Agency Name	Telephone Number
NSWC Indian Head	Mr. Shawn Jorgensen	(301) 743-6745
Law Enforcement	NSWC Indian Head Police Dept.	(301) 743-4333 (Station Phone) 4333
Fire Department	NSWC Indian Head Fire Dept.	(301) 743-4281 (Station Phone) 4333
Regional Poison Control Center	Physicians Memorial Hospital La Plata, Maryland	(301) 645-0100
CHEMTREC	———	(800) 424-9300
EnSafe Project Geologist	Mr. Joe Matthews	(901) 372-7962 (a.m.) (901) 387-0109 (p.m.)
Navy, Chesapeake Division	Mr. Paul Berkman	(202) 433-3760
EnSafe Inc.	Mr. Paul Stoddard	(901) 372-7962
Primary Hospital Emergency	Physicians Memorial Hospital La Plata, Maryland	(301) 645-0100
Ambulance Service	NSWC Indian Head Rescue	(301) 743-4449

10.4 Emergency Procedures

In the event that an emergency develops onsite, the procedures delineated herein are to be immediately followed. Emergency conditions are considered to exist if:

- Any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on site; or

- A condition is discovered that suggests the existence of a situation more hazardous than anticipated.

The following emergency procedures should be followed:

- Report any emergency situation, such as fire, or personnel injury immediately to the project manager.

- Emergency alerting will be accomplished through use of hand signals.

- Exclusion Zone will be evacuated through the hotline control point. After emergency decontamination, all personnel will muster at the command post/site office. All other persons on site who are not in the Exclusion Zone will evacuate the site through the nearest exit but may not cross through the Exclusion Zone.

- In the event that any member of the field team experiences any effects or symptoms of exposure while on the scene, the entire field crew will immediately halt work and act according to the instructions provided by the Site Health and Safety Officer.

- For applicable site activities, wind indicators visible to all onsite personnel will be provided by the site safety officer to indicate possible routes for upwind escape.

- The discovery of any conditions that would suggest the existence of a situation more hazardous than anticipated will result in the suspension of work until the safety officer has evaluated the situation and provided the appropriate instructions to the field team. During this evaluation, all personnel in the exclusion zone will muster in the contamination reduction zone.

- In the event of fire or other disaster, evacuate the exclusion zone, muster in the contamination reduction zone and notify local authorities of the incident.

- In the event of an accident, decontamination of the injured person, as well as any persons accompanying the injured person to the hospital, will be required. A minimal level of decontamination will be needed to prevent contamination of the hospital and medical personnel. Care must be exercised so as not to cause further or additional injury to the individual.

- In the event of an emergency, entry into the exclusion zone will initially be controlled by the site manager and will be limited to life saving operations.

- Emergency response beyond evacuation of the exclusion zone and operations necessary for life saving shall not be attempted by on-site personnel. Those type operations will be left for organizations who have been trained for these type activities (e.g. fire department).

- In the event that an accident occurs, the project geologist is to complete an accident report form for submittal to the project task order manager.

- This contingency plan shall be updated whenever changes occur which may affect the effective implementation. After each incident/accident, the effectiveness of this plan shall be evaluated and the plan shall be modified as needed.

10.5 Location of the Nearest Hospital Capable of Treating Chemical Exposures

The primary source of medical assistance for the site is:

PHYSICIANS MEMORIAL HOSPITAL, LA PLATA, MARYLAND

Directions To Primary: **TAKE INDIAN HEAD HIGHWAY (MD. ROUTE 210) NORTH TO MD. ROUTE 225. TURN RIGHT ON 225, AND FOLLOW UNTIL JUNCTION WITH MD. ROUTE 301. TURN RIGHT ON 301. TURN LEFT AT FIRST TRAFFIC LIGHT. THE HOSPITAL IS ON THE RIGHT, ABOUT 1/2 BLOCK PAST THE RAILROAD TRACKS.**

The alternate source of medical assistance for the site is:

SOUTHERN MARYLAND HOSPITAL, CLINTON, MARYLAND

Directions to Alternate: **TAKE INDIAN HEAD HIGHWAY (MD. ROUTE 210) NORTH TO MD. ROUTE 373. FOLLOW UNTIL INTERSECTION WITH BRANCH AVE. (MD. ROUTE 5). TURN LEFT ON BRANCH AVE., AND FOLLOW UNTIL INTERSECTION WITH SURRATTS ROAD. TURN RIGHT ON SURRATTS ROAD. THE HOSPITAL IS JUST PAST THE COLONY SOUTH HOTEL.**

10.6 Contingency Plans

The site safety plan addresses emergency medical care and treatment of all personnel, including possible exposures to toxic substances and injuries due to accidents or physical problems. The

following items are included in the emergency care provision:

- Name, address, and telephone number of the nearest medical treatment facility is in the site safety plan and will be posted in a conspicuous location. A map and/or directions for locating the facility, plus travel time, are included.
- The facility's ability to provide care and treatment of personnel exposed to toxic or other hazardous substances should be ascertained. If the facility lacks toxicological capability, the joint venture's safety and health officer should be consulted.
- All administrative arrangements for accepting patients will be made in advance with the facility.
- Arrangements will be made to obtain ambulance, emergency, fire, and police services. Telephone numbers and procedures for obtaining these services will be readily available.
- Emergency showers, eye wash fountains, and first aid equipment will be readily available onsite. Personnel qualified in first aid and CPR will be available.
- Provisions for providing medical personnel with information involving the nature and extent of the accident or injury will be made.

An evaluation for the possibility of events leading to evacuation of the site and surrounding community will be performed and protocols included in the site safety plan as appropriate.

Appendix A

Summary, Contractor Health and Safety Requirements

SUMMARY, CONTRACTOR AND SAFETY REQUIREMENTS,
NAVAL ORDNANCE STATION, INDIAN HEAD, MD
FOR ALL MAINTENANCE, REPAIR, OR CONSTRUCTION

1. Prior to starting any maintenance, repair, or construction, contract job superintendent must meet with a NAVORDSTA Safety Department representative to become familiar with NAVORDSTA safety regulations.

2. Authorization (Work Permits) to commence scope of contract will be obtained from the NAVORDSTA Safety Department via contracting officer/representative.

3. Smoking, carrying matches, lighters, or other flame- or spark-producing items on person, in vehicles, or other carriers, is prohibited in the Restricted Area of NAVORDSTA. Smoking areas will be designated by the Safety Department, upon request, via the contracting officer. Approval will be based on the specific operational safety concerns within the area requested.

4. The use of welding equipment, tar pots, gas burners, etc., is prohibited unless authorized by the Safety Department. Once approved these instruments that may be lighted by use of striker must be done so. If matches are required, they will be provided by the Safety Department--for use only as authorized--to the contract superintendent. Note: LPG is not allowed within the explosives areas of NAVORDSTA.

5. All open-flame work will be secured 30 minutes prior to leaving work area unless a watchman is on duty for at least 30 minutes after end of work period. At no time will open-flame burning for debris disposal or other purposes be authorized.

6. Prior to any maintenance or repair to explosives-contaminated equipment, such equipment must be inspected by the Safety Department and by NAVORDSTA area supervisor. All explosives-contaminated materials must be decontaminated by NAVORDSTA methods and supervision prior to removal from the Restricted Area.

7. All traffic rules, regulations, and control devices must be adhered to. Speed limits as posted prevail, intra-plant area roadways require 15 mph unless posted otherwise, and 10 mph must be maintained on Nobel Road. All other roads 25 mph unless otherwise posted.

8. Only necessary, approved, contractor vehicles will be allowed in the Restricted Area. These must be equipped with adequate exhaust systems and maintained in good mechanical and physical condition at all times. Spark arrestor devices, where designated must be provided by contractor and subjected to inspection by the Safety Department prior to entering posted haz-

ards. For all vehicles entering into the explosive areas of NAVORDSTA Safety Inspections will be required prior to receiving a vehicle pass from the Safety Department.

9. Blocking of roadways with equipment will not be allowed at any time. Securing roadways with barricades will be accomplished only upon approval of the Safety Department and notification of Security and Fire Departments. Where possible, an adequate fire lane must be provided around approved obstruction(s) for emergency equipment.

10. Securing of plant utilities (air, steam, water, etc.) will be accomplished only upon approval of NAVORDSTA Utilities Division, then, only when written outage has been obtained via contracting representative.

11. Securing of Fire Protection devices will be accomplished only on the approval of the Fire Chief, or his designated acting Chief.

12. All roadways and walkways will be kept clear of debris at all times. Cleaning of same will be accomplished by the contractor at least daily, or as frequently as conditions necessitate.

13. No powder actuated tools or devices may be used.

14. Contract employees are restricted from entering buildings not included in contract with exception of lunchrooms, change houses, etc., agreed to by area Division Head and contracting officer/representative.

15. Fuels, oils, and lubricants

a. Refueling of equipment and vehicles with flammable liquids will be done in areas designated by the Safety Department. All equipment used in flammables handling or operations must be of an approved type, per Underwriters' Laboratory or Factory Mutual certifications. Adequate fire protection devices must be on the scene during refueling operations.

b. Used oil, oil filters, and empty oil cans will be removed from NAVORDSTA by the contractor.

c. The contractor must inform the NAVORDSTA Safety and Public Works Department representatives of all contractor-owned Hazardous Material that will be used, stored, or handled at NAVORDSTA. If NAVORDSTA employees are exposed to these materials, or potential for exposure exists, NAVORDSTA employees shall:

(1) Be informed and trained as required by NAVORDSTAINST 5100.28G.

(2) Have a Material Safety Data Sheet accessible at the workplace for each material used for their review.

d. The contractor shall ensure that contractor employees have been informed/trained about the identification and hazards of the hazardous materials used at NAVORDSTA.

16. The Naval Ordnance Station routinely works with electro-explosive devices (EEDs) such as igniters, squibs, detonators, and blasting caps. Radio frequency transmissions can, under certain circumstances, provide enough energy to initiate or degrade performance of these devices. Inadvertent initiation of EEDs can result in injury or death of personnel and damage or destruction of property. Degradation of the EED can result in failure of the item to function properly when needed.

BECAUSE OF THESE HAZARDS, USE OF CB RADIOS AND CAR PHONES IS PROHIBITED IN THE RESTRICTED AREA (AREA BEYOND POST 2).

17. Vehicle and construction equipment inspections include the appropriate factors listed below for safe use and conditions. Any one discrepancy is disqualifying for entry into NAVORDSTA Restricted Areas.

a. Steering mechanism; must be free of defects or excessive play.

b. Horns and warning devices must be operative.

c. Windshield wipers; must be provided and operative.

d. Windshield and other window glass; must be free of defects. Windshield must be free of defects. Windshield must be provided on standard equipped vehicle.

e. Rearview mirrors; must be provided and free of defects.

f. Lights; all standard lights must be provided, operative, and free of defects - including lens coverings.

g. Exhaust systems; must be provided, free of defects, and properly supported.

h. Fuel systems; must not indicate evidence of defects.

i. Brakes; operative without drag, including serviceable emergency brakes.

j. Tires; must have ample tread and be free of defects.

k. Electrical wiring; must not have exposed surfaces or be loosely supported.

l. Body conditions; must be well maintained, no loose or jagged edges, excessive grease or oil on engine, and all standard features provided and operable.

m. Where applicable, inspection will include other such items as gauges, thermometers, controls, relief valves, piping, mechanical locks, limit switches, connectors, and other safety-related devices associated to vehicles and equipment admitted to the station.

18. Contract trailers will be equipped with plexiglass windows when spotted within the quantity distance arcs of explosive-operating areas.

19. Additional requirements will be designated on the Work Permit based upon contract scope and NAVORDSTA area involved.

Manager, OSH & Explosives Safety Inspection Branch	Date

Firm Principal	Contract #	Date

Appendix B

Site Material Safety Data Sheets

CHEMTOX DATA

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

CHEMTOX RECORD 272 LAST UPDATE OF THIS RECORD: 12/03/91
NAME: MERCURY
SYNONYMS: COLLOIDAL MERCURY; KWIK (Dutch); MERCURE (French); MERCURIO (Italian); MERCURY, METALLIC (DOT); METALLIC MERCURY; NCI-C60399; QUECKSILBER (German); QUICK SILVER; RTEC (Polish); QUICKSILVER
CAS: 7439-97-6 RTECS: OV4550000
FORMULA: Hg MOL WT: 200.59
WLN: HG
CHEMICAL CLASS:Metal

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION: SILVERY,MOBILE, ODORLESS LIQUID

BOILING POINT:	629.791 K	356.6 C	673.9 F
MELTING POINT:	234.275 K	-38.9 C	-38 F
FLASH POINT:	255.37 K	-17.8 C	-.1 F
AUTO IGNITION:	255.37 K	-17.8 C	-.1 F
CRITICAL TEMP:	1735 Kelvin	1461.85 C	2663.33 F
CRITICAL PRESS:	160.8 kN/M2	1585.4 atm	23298 psia

VAPOR PRESSURE: .0012mm @ 25 C
UEL: NA
LEL: NA
IONIZATION POTENTIAL (eV): 112.9
VAPOR DENSITY: No data
SPECIFIC GRAVITY: 13.55 20C
DENSITY: 13.546*20C
WATER SOLUBILITY: 0.002%
INCOMPATIBILITIES: ACETYLENES, AMMONIA GAS, BORON DIIODOPHOSPHIDE, ETHYLENE OXIDE, METALS, METHYL AZIDE, METHYLSILANE, OXYGEN, OXIDANTS, TETRACARBONYL NICKEL, OXYGEN ■SAX

REACTIVITY WITH WATER: NO REACTION Source: HCDB
REACTIVITY WITH COMMON MATERIALS: NO REACTION Source: HCDB
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: NOT PERTINENT Source: HCDB
POLYMERIZATION POSSIBILITIES: NOT PERTINENT Source: HCDB

TOXIC FIRE GASES: TOXIC VAPORS
ODOR DETECTED AT (ppm): Unknown
ODOR DESCRIPTION: Unknown Source:CHRIS
100 % ODOR DETECTION: No data

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

DOT hazard class: 8 CORROSIVE
DOT guide: 60
Identification number: UN2809
DOT shipping name: Mercury
Packing group: III
Label(s) required: CORROSIVE
Special provisions:
Packaging exceptions: 164
Non bulk packaging: 164
Bulk packaging: 240
Quantity limitations-
Passenger air/rail: 35 kg
Cargo aircraft only: 35 kg
Vessel stowage: B
Other stowage provisions:40,97
STCC NUMBER:

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:No
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.002 mg/mL»(07/30/92)
Maximum Contaminant Level Goals (MCLG): 0.002 mg/mL»(07/30/92)
CLEAN AIR ACT: CAA '90 By category
EPA WASTE NUMBER: U151,D009
CERCLA REF: Y
RQ DESIGNATION: X 1 pound (0.454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: corrosive
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

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

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

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

SHORT TERM TOXICITY: COUGHING, CHEST PAIN, DYSPNEA, BRONCHITIS, PNEUMONIA, TREMORS, INSOMNIA, IRRITABILITY, INDECISION, HEADACHES, FATIGUE, WEAKENSS, STOMATITIS, SALIVATION, GI DISTURBANCE, ANOREXIA, WEIGHT LOSS, PROTEMURIA, IRRITATION OF EYES AND SKIN ** Source: THIC

LONG TERM TOXICITY: DESTRUCTION OF CNS, TEETH, GUMS; DEVELOPMENT OF MERCURY POISONING ** Source: HCDB

TARGET ORGANS: SKIN, RESP. SYSTEM, CNS, GIT, KIDNEYS, EYES

SYMPTOMS: NO IMMEDIATE SYMPTOMS. AS POISONING BECOMES ESTABLISHED, SLIGHT MUSCULAR TREMOR, LOSS OF APPETITE, NAUSEA, AND DIARRHEA ARE OBSERVED. PSYCHIC, KIDNEY, AND CARDIOVASCULAR DISTURBANCES MAY OCCUR. Source: CHRIS

CONC IDLH: 28mg/M3

NIOSH REL: 0.05 mg/M3 Time weighted averages for 8-hour exposure

ACGIH TLV: TLV = 0.1 MG/M3; (VAPOR) 0.05 mg/M3 SKIN

ACGIH STEL: Not specified

OSHA PEL: Final Rule Limits:
TWA = 0.05 mg/M3(SKIN)

MAK INFORMATION: 0.01 ppm
0.1 mG/M3
Substance with systemic effects, onset of effect over 2 hours: Peak = 10xMAK for 30 minutes, once per shift of 8 hours.

CARCINOGEN?: STATUS:

CARCINOGEN LISTS:

IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

ihl-man TCLo:44300 ug/m3/8H JJOMDZ 20,532,78
BEHAVIORAL
Muscle weakness
LIVER
Other changes
NUTRITIONAL AND GROSS METABOLIC
Changes in:
Body temperature increase

ihl-wmn TCLo:150 ug/m3/46D AEHLAU 33,186,78
BEHAVIORAL
Wakefulness
BEHAVIORAL
Anorexia(human)
GASTROINTESTINAL
Hypermotility,diarrhea

LD50 value: No LD50 in RTECS 1991

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1991)

ihl-rbt LCLo:29 mg/m3/30H

Reproductive toxicity (1991 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)
ihl-rat TCLo:890 ng/m3/24H (16W male) GISAAA
45(3),72,80
PATERNAL EFFECTS
Spermatogenisis

ihl-rat TCLo:7440 ng/m3/24H (16W male) GISAAA
45(3),72,80
EFFECTS ON FERTILITY
Post-implantation mortality

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

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:
AVOID CONTACT OF LIQUID WITH SKIN. FOR VAPOR USE CHEMICAL CARTRIDGE
[illegible]PCALITE) RESPIRATOR.

[illegible]OSH POCKET GUIDE TO CHEMICAL HAZARDS

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

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

** WORK CLOTHING SHOULD BE CHANGED DAILY:
If there is any reasonable possibility that the clothing may be contaminate

** REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes contaminated.

** REFERENCE: NIOSH

FIRST AID (NIOSH):
EYE:
IRRIGATE IMMEDIATELY; CONSULT A PHYSICIAN
SKIN:
WASH PROMPTLY WITH SOAP AND WATER
INHALATION:
MOVE TO FRESH AIR AND GIVE ARTIFICIAL RESPIRATION
INGESTION:
GIVE LARGE QUANTITIES OF WATER. INDUCE VOMITING

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

US Department of Transportation Guide to Hazardous Materials Transport

Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Mercury
DOT ID NUMBER: UN2809

ERG90 GUIDE 60

* POTENTIAL HAZARDS *

*HEALTH HAZARDS
Contact causes burns to skin and eyes.
If inhaled, may be harmful.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.
*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.
Flammable/poisonous gases may accumulate in tanks and hopper cars.
Some of these materials may ignite combustibles (wood, paper, oil, etc.).

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Some of these materials may react violently with water.
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
*SPILL OR LEAK
Do not touch spilled material; stop leak if you can do it without risk.
Small Spills: Take up with sand, or other noncombustible absorbent material and place into containers for later disposal.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID
Move victim to fresh air; call emergency medical care.
In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.
Remove and isolate contaminated clothing and shoes at the site.
Keep victim quiet and maintain normal body temperature.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the

guidelines and limitations of the user's CHEMTOX license agreement.
The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output forms.

CHEMTOX DATA

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

CHEMTOX RECORD 148 LAST UPDATE OF THIS RECORD: 12/03/91

NAME: FORMALDEHYDE

SYNONYMS: ALDEHYDE FORMIQUE (French); ALDEIDE FORMICA (Italian); BFV; FA; FANNOFORM; FORMALDEHYD (Czech, Polish); FORMALDEHYDE, as FORMALIN solution (DOT); FORMALIN; FORMALIN 40; FORMALINA (Italian); FORMALINE (German); FORMALIN-LOESUNGEN (German); FORMALITH; FORMIC ALDEHYDE; FORMOL; FYDE; HOCH; IVALON; KARSAN; LYSOFORM; METHANAL; METHYL ALDEHYDE; METHYLENE GLYCOL; METHYLENE OXIDE; MORBICID; NCI-C02799; OPLOSSINGEN (Dutch); OXOMETHANE; OXYMETHYLENE; PARAFORM; POLYOXYMETHYLENE GLYCOLS; SUPERLYSOFORM; TETRAOXYMETHYLENE; TRIOXANE; SOLUTIONS KNOWN AS FORMALIN

CAS: 50-00-0 RTECS: LP8925000

FORMULA: CH20 MOL WT: 30.03

WLN: VHH

CHEMICAL CLASS: Aldehyde

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION: GAS OR LIQUID WITH A STRONG, PUNGENT ODOR

BOILING POINT:	253.71 K	-19.5 C	-3 F
MELTING POINT:	155.38 K	-117.8 C	-180 F
FLASH POINT:	323.15 K	50 C	122 F
AUTO IGNITION:	703 K	429.8 C	805.7 F

VAPOR PRESSURE: .95 mm @ -109.3 C

UEL: 73 %

LEL: 7 %

IONIZATION POTENTIAL (eV): 10.88

VAPOR DENSITY: No data

SPECIFIC GRAVITY: 0.815 @ -20/4 anhydrous form

DENSITY: 1.083

WATER SOLUBILITY: MISCIBLE

INCOMPATIBILITIES: STRONG OX, STRONG ALKALIES, ACIDS, PHENOLS, UREA

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: MANY ACIDS, BASES, METAL SALTS, NO2; AT HIGH TEMP THIS SOLUTION BECOMES EXPLOSIVE Source: CSDS

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: PURE FORMALDEHYDE POLYMERIZES READILY Source: SAX

TOXIC FIRE GASES: NA

ODOR DETECTED AT (ppm): 0.05 - 1.0 PPM

ODOR DESCRIPTION: PUNGENT AND SUFFOCATING Source:NYDH
100 % ODOR DETECTION: No data

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

DOT hazard class: Not given
DOT guide: 29
Identification number: UN2209*UN1198
DOT shipping name: FORMALDEHYDE SOLUTION (FORMALIN)
Packing group:
Label(s) required:
Special provisions:
Packaging exceptions:
Non bulk packaging:
Bulk packaging:
Quantity limitations-
Passenger air/rail:
Cargo aircraft only:
Vessel stowage:
Other stowage provisions:
STCC NUMBER: 4940341, 4940342, 4913144, 4913145

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:Yes
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U122
CERCLA REF: Y
RQ DESIGNATION: B 100 pounds (45.4 kg) CERCLA
SARA TPQ VALUE: 500 pounds
SA Sect. 312
categories:
Acute toxicity: adverse effect to target organs.
Chronic toxicity: carcinogen
Reactive hazard: unstable/reactive.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

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

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (2) This material must be moderately heated before ignition will occur.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

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

SHORT TERM TOXICITY: Inhalation: IRRITATION OF THE NOSE AND THROAT CAN

OCCUR AFTER AN EXPOSURE OF 0.25 PPM TO 0.45 PPM. LEVELS BETWEEN 0.4 PPM AND 0.8 PPM CAN GIVE RISE TO COUGHING AND WHEEZING, TIGHTNESS OF THE CHEST AND SHORTNESS OF BREATH. SUDDEN EXPOSURES TO CONCENTRATIONS OF 4 PPM MAY LEAD TO IRRITATION OF LUNG AND THROAT SEVERE ENOUGH TO GIVE RISE TO BRONCHITIS AND LARYNGITIS. BREATHING MAY BE IMPAIRED AT LEVELS ABOVE 10 PM AND SERIOUS LUNG DAMAGE MAY OCCUR AT 50 PPM. Skin: DIRECT CONTACT WITH THE LIQUID CAN LEAD TO IRRITATION, ITCHING, BURNING AND DRYING. IT IS ALSO POSSIBLE TO DEVELOP AN ALLERGIC REACTION TO THE COMPOUND FOLLOWING EXPOSURE BY ANY ROUTE. Eyes: EXPOSURE TO AIRBORNE LEVELS OF FORMALDEHYDE OF 0.4 PPM HAVE BROUGHT ON TEARING AND IRRITATIN. SMALL AMOUNTS OF LIQUID SPLASHED IN THE EYE CAN CAUSE DAMAGE TO THE CORNEA. EYE IRRITATION WAS REPORTED AT LEVELS BETWEEN 0.05 - 2.0 PPM. Ingestion: AS LITTLE AS 1 LIQUID OUNCE HAS RESULTED IN DEATH TO HUMANS. SMALLER AMOUNTS CAN DAMAGE THE THROAT, STOMACH AND INTESTINE RESULTING IN NAUSEA, VOMITING, ABDOMINAL PAIN AND DIARRHEA. ACCIDENTAL EXPOSURE MAY ALSO CAUSE LOSS OF CONSCIOUSNESS, LOWERED BLOOD PRESSURE, KIDNEY DAMAGE AND, IF THE PERSON IS PREGNANT, THE POSSIBILITY OF THE FETUS BEING ABORTED.(NYDH)

LONG TERM TOXICITY: INHALATION CAN RESULT IN RESPIRATORY CONGESTION WITH ASSOCIATED COUGHING AND SHORTNESS OF BREATH. DAILY SKIN CONTACT CAN LEAD TO DRYING AND SCALING. SOME INDIVIDUALS MAY EXPERIENCE ALLERGIC REACTIONS AFTER INITIAL CONTACT WITH THE CHEMICAL. SUBSEQUENT CONTACT MAY CAUSE SKIN RASHES AND ASTHMA AND REACTIONS MAY BECOME MORE SEVERE IF EXPOSURE PERSISTS. LONG TERM INHALATION OF HIGH LEVELS OF FORMALDEHYDE VAPOR (14 PPM) IN RATS RESULTED IN AN ELEVATED INCIDENCE OF CANCER OF THE NOSE. GENETIC DAMAGE FROM EXPOSURE HAS BEEN SHOWN IN BACTERIA AND SOME INSECTS. WHETHER IT CAUSES THESE EFFECTS IN HUMANS IS UNCERTAIN.(NYDH)

TARGET ORGANS: RESP SYS, LUNGS, EYES, SKIN, MUCOUS MEMBRANES

SYMPTOMS: INHALATION: VAPORS ARE IRRITATING Source:

CONC IDLH: 30ppm

NIOSH REL: Potential occupational carcinogen 0.016 ppm Time weighted averages for 8-hour exposure 0.1 ppm Ceiling exposures which shall at no time be exceeded

ACGIH TLV: TLV = 1 ppm Suspected human carcinogen (A2)

ACGIH STEL: 2 ppm

OSHA PEL: Final Rule Limits:
TWA = 1 ppm
STEL = 2 ppm
CONSULT 29CFR 1910.1048

MAK INFORMATION: 0.5 ppm
0.6 mG/M3
Local irritant: Peak = 2xMAK for 5 minutes, 8 times

per shift.
Causes allergic reactions
A compound which is justifiably suspected of having carcinogenic potential.

CARCINOGEN?: Y STATUS: ANIMAL POSITIVE
REFERENCES:

ANIMAL POSITIVE IARC** 29,345,82
HUMAN INDEFINITE IARC** 29,345,82

CARCINOGEN LISTS:

IARC: Carcinogen defined by IARC to be probably carcinogenic to humans with (usually) at least limited human evidence.
MAK: A compound which is justifiably suspected of having carcinogenic potential.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as reasonably anticipated to be carcinogenic, with limited evidence in humans or sufficient evidence in experimental animals.
ACGIH: Carcinogen defined by ACGIH TLV Committee as a suspected carcinogen, based on either limited epidemological evidence or demonstration of carcinogenicity in experimental animals.
OSHA: Cancer hazard - potential

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

orl-wmn LDLo:108 mg/kg 29ZWAE -,328,68

ihl-hmn TCLo:17 mg/m3/30M JAMAAP 165,1908,57
SENSE ORGANS
Eye
Lacrimation
LUNGS, THORAX, OR RESPIRATION
Other changes

ihl-man TCLo:300 ug/m3 GTPZAB 12(7),20,68
SENSE ORGANS
Nose
Other
BEHAVIORAL
Aggression

LD50 value: orl-rat LD50:800 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1991)

orl-rat LD50:800 mg/kg

ihl-rat LC50:590 mg/m3
scu-rat LD50:420 mg/kg
ivn-rat LD50:87 mg/kg
orl-mus LD50:42 mg/kg
ihl-mus LC50:400 mg/m3/2H
ipr-mus LDLo:16 mg/kg
scu-mus LD50:300 mg/kg
scu-dog LDLo:350 mg/kg
ivn-dog LDLo:70 mg/kg
ihl-cat LCLo:400 mg/m3/2H
ivn-cat LDLo:30 mg/kg
skn-rbt LD50:270 mg/kg
scu-rbt LDLo:240 mg/kg
ivn-rbt LDLo:48 mg/kg
orl-gpg LD50:260 mg/kg
par-frg LDLo:800 mg/kg
ihl-mam LC50:92 mg/m3

IRRITATION DATA: (Source: NIOSH RTECS 1991)

skn-hmn 150 ug/3D-I MLD
eye-hmn 4 ppm/5M
skn-rbt 540 mg open MLD
skn-rbt 50 mg/24H MOD
eye-rbt 750 ug SEV

Reproductive toxicity (1991 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)
orl-rat TDLo:200 mg/kg (1D male) TJADAB 26(3),14A,82
PATERNAL EFFECTS
Spermatogenisis

ihl-rat TCLo:1 mg/m3/24H (1-22D preg) HYSAAV 34(5),266,69
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)

ihl-rat TCLo:12 ug/m3/24H (15D pre/1-22D preg) HYSAAV 33(1-3),327,68
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)
EFFECTS ON NEWBORN
Other postnatal measures or effects

ihl-rat TCLo:12 ug/m3/24h (1-22D preg) HYSAAV 33(7-9),112,68
EFFECTS ON NEWBORN

ihl-rat TCLo:35 ug/m3/8H (60D male) PRKHDK 4,101,79
PATERNAL EFFECTS
Spermatogenisis
PATERNAL EFFECTS

Other effects on male

ihl-rat TCLo:12 ug/m3/24H (20D pre/1-22D preg) BEXBAN 66,868,68
EFFECTS ON NEWBORN

ihl-rat TCLo:50 ug/m3/4H (1-19D preg) TPKVAL 12,78,71
EFFECTS ON NEWBORN
Behavioral

ipr-rat TDLo:80 mg/kg (10D male) JRBED2 7,42,87
PATERNAL EFFECTS
Testes,epididymis,sperm duct
PATERNAL EFFECTS
Prostate,seminal vessel,Cowper's gland,accessory glands,urethra

scu-rat TDLo:46243 mg/kg (20D male) ENDOAO 28,129,41
PATERNAL EFFECTS
Testes,epididymis,sperm duct

itt-rat TDLo:400 mg/kg (1D male) FESTAS 24,884,73
EFFECTS ON FERTILITY
Male fertility index

ipr-mus TDLo:240 mg/kg (7-14D preg) TJADAB 28,37A,83
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ipr-mus TDLo:240 mg/kg (7-14D preg) TJADAB 30(1),34A,84
EFFECTS ON EMBRYO OR FETUS
Fetal death

ipr-mus TDLo:160 mg/kg (7-14D preg) TJADAB 30(1),34A,84
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Other developmental abnormalities

ipr-mus TDLo:500 mg/kg (5D male) MUREAV 130,417,84
PATERNAL EFFECTS
Spermatogenisis

ims-mus TDLo:259 mg/kg (11D preg) ANREAK 142,479,62
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetal death

itt-dog TDLo:7 mg/kg (1D male) AEFTAA 6,349,75
PATERNAL EFFECTS
Testes,epididymis,sperm duct

itt-mky TDLo:4 mg/kg (1D male) FESTAS 41,465,84
PATERNAL EFFECTS
Spermatogenisis

NO SIGNIFICANT
RISK LEVEL(Ca P65): N15 micrograms/day

---------- PROTECTION AND FIRST AID ----------
PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:
SELF-CONTAINED BREATHING APPARATUS; CHEMICAL GOGGLES; PROTECTIVE CLOTHING; SYNTHETIC RUBBER OR PLASTIC GLOVES.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Reasonable probability of skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Any possibility of eye contact.

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

** REMOVE CLOTHING:
Immediately remove non-impervious clothing that becomes contaminated.

** THE FOLLOWING EQUIPMENT SHOULD BE MADE AVAILABLE:
Eyewash,quick drench.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (FORMALDEHYDE)
Up to 10 ppm: Full facepiece with cartridge or canisters specifically approved for protection against formaldehyde.
Up to 100 ppm: Full-face mask, chest or back mounted type, with industrial size canister specifically approved for protection against formaldehyde. Type C supplied air respirator, demand type, with full facepiece, hood, or helmet.
Above 100 ppm or in known emergencies : Self-contained breathing apparatus (SCBA) with positive pressure full facepiece. Combination supplied-air, full facepiece positive pressure respirator with auxiliary self-contained air supply.
Firefighting : SCBA with positive pressure in full face-piece.
Escape : SCBA in demand or pressure demand mode. Full-face mask, front or back mounted type with industrial size canister specifically approved for protection against formaldehyde.
---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: FORMALDEHYDE SOLUTION (FORMALIN)
DOT ID NUMBER: UN2209

UN1198

ERG90

GUIDE 29

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION

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

*HEALTH HAZARDS

May be poisonous if inhaled.
Contact may cause burns to skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

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

*FIRE

Some of these materials may react violently with water.
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Do not get water inside container.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
Withdraw immediately in case of rising sound from venting safety device or or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.
Do not touch or walk through spilled material; stop leak if you can do it without risk.
Use water spray to reduce vapor; do not get water inside container.
Small Spills: Take up with sand, or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of spill for later disposal.

*FIRST AID

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

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement.
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---------- IDENTIFIERS ----------

CHEMTOX RECORD 210 LAST UPDATE OF THIS RECORD: 12/03/91

NAME: ETHYLENE DICHLORIDE

SYNONYMS: AETHYLENCHLORID (German); 1,2-BICHLOROETHANE; BICHLORURE D'ETHYLENE (French); BORER SOL; BROCIDE; CHLORURE D'ETHYLENE (French); CLORURO DI ETHENE (Italian); DESTRUXOL BORER-SOL; 1,2-DICHLOORETHAAN (Dutch); 1,2-DICHLOR-AETHAN (German); DICHLOREMULSION; 1,2-DICHLORETHANE; DI-CHLOR-MULSION; DICHLORO-1,2-ETHANE (French); alpha,beta-DICHLOROETHANE; sym-DICHLOROETHANE; 1,2-DICHLOROETHANE; DICHLOROETHYLENE; 1,2-DICLOROETANO (Italian); DUTCH LIQUID; DUTCH OIL; EDC; ENT 1,656; ETHANE DICHLORIDE; ETHYLEENDICHLORIDE (Dutch); ETHYLENE CHLORIDE; ETHYLENE DICHLORIDE; ETHYLENE DICHLORIDE (DOT); 1,2-ETHYLENE DICHLORIDE; FREON 150; GLYCOL DICHLORIDE; NCI-C00511; ETHANE, 1,2-DICHLORO-

CAS: 107-06-2 RTECS: KI0525000

FORMULA: C2H4Cl2 MOL WT: 98.96

WLN: G2G

CHEMICAL CLASS: FT

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION: CLEAR LIQUID WITH A SWEET ODOR LIKE CHLOROFORM

BOILING POINT:	356.7 K	83.5 C	182.3 F
MELTING POINT:	237.75 K	-35.4 C	-31.8 F
FLASH POINT:	288.7 K	15.5 C	59.9 F
AUTO IGNITION:	685.92 K	412.7 C	774.9 F
CRITICAL TEMP:	561 Kelvin	287.85 C	550.13 F
CRITICAL PRESS:	5.1 kN/M2	50.2 atm	738 psia
HEAT OF VAP:	138 Btu/lb	76.64 cal/g	3.206x E5 J/kg
HEAT OF COMB:	-3400 Btu/lb	-1890 cal/g	-79x E5 J/kg

VAPOR PRESSURE: 44MM @ 10 C

UEL: 15.6 %

LEL: 6.2 %

IONIZATION POTENTIAL (eV): 10.5

VAPOR DENSITY: 3.4 (air=1)

SPECIFIC GRAVITY: 1.2569

DENSITY: 1.256

WATER SOLUBILITY: 0.8%

INCOMPATIBILITIES: STRONG OXIDIZERS, STRONG CAUSTICS, CHEMICALLY ACTIVE METALS, SUCH AS ALUMINUM OR MAGNESIUM POWDER, SODIUM, POTASSIUM

REACTIVITY WITH WATER: N/R - SINKS IN WATER

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: TOXIC AND IRRITATING HYDROGEN CHLORIDE AND PHOSGENE GASES
ODOR DETECTED AT (ppm): 100 ppm
ODOR DESCRIPTION: ether-like Source:CHRIS
100 % ODOR DETECTION: No data

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

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 26
Identification number: UN1184
DOT shipping name: Ethylene dichloride
Packing group: II
Label(s) required: FLAMMABLE LIQUID, POISON
Special provisions: T14
Packaging exceptions: None
Non bulk packaging: 202
Bulk packaging: 243
Quantity limitations-
Passenger air/rail: 1 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions: 40,M2
SICC NUMBER: 4909166

CLEAN WATER ACT Sect.307: Yes
CLEAN WATER ACT Sect.311: No
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.005 mg/mL»(01/09/89)
Maximum Contaminant Level Goals (MCLG): 0 mg/mL»(01/09/89)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U077,D028
CERCLA REF: Y
RQ DESIGNATION: B 100 pounds (45.4 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312 categories:
Acute toxicity: adverse effect to target organs.
Chronic toxicity: carcinogen
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

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

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with

self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

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

SHORT TERM TOXICITY: Inhalation: LEVELS OF 10 TO 30 PPM MAY CAUSE DIZZINESS, NAUSEA, AND VOMITING. LEVELS UP TO 50 PPM MAY CAUSE WEAKNESS, TREMBLING, HEADACHES, ABDOMINAL CRAMPS, LIVER AND KIDNEY DAMAGE, AND FLUID BUILD UP IN LUNGS. MAY CAUSE COMA AND DEATH AT HIGH LEVELS. Skin: PROLONGED CONTACT MAY CAUSE IRRITATION AND SKIN RASHES. Eyes: MAY CAUSE REDNESS, PAIN, AND BLURRED VISION. VAPOR CAN DAMAGE THE CORNEA. Ingestion: INGESTION OF 2 OUNCES HAS RESULTED IN NAUSEA, VOMITING, FAINTNESS, DROWSINESS, DIFFICULTY BREATHING, PALE SKIN, INTERNAL BLEEDING, KIDNEY DAMAGE, AND DEATH DUE TO RESPIRATORY FAILURE. OTHER POSSIBLE SYMPTOMS MAY INCLUDE ABDOMINAL SPASMS, SEVERE HEADACHE, LETHARGY, LOWERED BLOOD PRESSURE, DIARRHEA, SHOCK, PHYSICAL COLLAPSE, AND COMA.(NYDH)

LONG TERM TOXICITY: MAY CAUSE EYE, NOSE AND THROAT IRRITATION, NAUSEA, VOMITING, LOSS OF APPETITE, NERVE DAMAGE, LIVER AND KIDNEY DAMAGE. THIS SUBSTANCE HAS BEEN DETERMINED TO CAUSE CANCER IN LABORATORY ANIMALS. WHETHER IT DOES SO IN HUMANS IS NOT KNOWN.(NYDH)

TARGET ORGANS: KIDNEYS, LIVER, EYES, SKIN, CNS

SYMPTOMS: Inhalation of vapors causes nausea, drunkenness, depression. Contact of liquid with eyes may produce corneal injury. Prolonged contact with skin may cause a burn. Source: CHRIS

CONC IDLH: 1000PPM

NIOSH REL: Potential occupational carcinogen 1 ppm Time weighted averages for 8-hour exposure 4 mg/M3 Time weighted averages for 8-hour exposure 2 ppm Ceiling exposures which shall at no time be exceeded 8 mg/M3 Ceiling exposures which shall at no time be exceeded

ACGIH TLV: TLV = 10 ppm(40 mg/M3)
ACGIH STEL: 15 ppm

OSHA PEL: Transitional Limits:
PEL = 50 PPM; CEILING = 100 PPM; MAXIMUM PEAK ABOVE CEILING
Final Rule Limits:
TWA = 1 ppm (4 mg/M3)
STEL = 2 ppm(8 mg/M3)

MAK INFORMATION: Carcinogenic working material without MAK
In the Commission's view, an animal carcinogen.

CARCINOGEN?: Y STATUS: SUSPECTED

CARCINOGEN LISTS:

IARC: Carcinogen defined by IARC to be probably carcinogenic to humans, but having (usually) no human evidence.
MAK: An animal carcinogen.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as reasonably anticipated to be carcinogenic, with limited evidence in humans or sufficient evidence in experimental animals.
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

ihl-man TCLo:4000 ppm/1H PCOC** -,500,66
PERIPHERAL NERVE AND SENSATION
Flaccid paralysis without anesthesia
BEHAVIORAL
Coma
GASTROINTESTINAL
Nausea or vomiting

orl-hmn LDLo:286 mg/kg CLCEAL 86,203,47
GASTROINTESTINAL
Ulceration or bleeding from stomach
GASTROINTESTINAL
Nausea or vomiting
LIVER
Fatty liver degeneration

orl-hmn TDLo:428 mg/kg SOMEAU 22(10),132,58
BEHAVIORAL
Somnolence(general depressed activity)
LUNGS, THORAX, OR RESPIRATION
Cough
GASTROINTESTINAL
Nausea or vomiting

orl-man TDLo:892 mg/kg WILEAR 28,983,75
GASTROINTESTINAL
Hypermotility,diarrhea
GASTROINTESTINAL
Nausea or vomiting
LIVER
Jaundice,other or unclassified

LD50 value: orl-rat LD50:670 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1991)

orl-rat LD50:670 mg/kg
ihl-rat LC50:1000 ppm/7H
ipr-rat LD50:807 mg/kg
scu-rat LD50:1 gm/kg
orl-mus LD50:489 mg/kg
ihl-mus LCLo:5 gm/m3/2H
ipr-mus LD50:470 mg/kg
scu-mus LDLo:380 mg/kg
orl-dog LD50:5700 mg/kg
ivn-dog LDLo:175 mg/kg
ihl-mky LC50:3000 ppm/7H
orl-rbt LD50:860 mg/kg
ihl-rbt LCLo:3000 ppm/7H
skn-rbt LD50:2800 mg/kg
scu-rbt LDLo:1200 mg/kg
ihl-pig LCLo:3000 ppm/7H
ihl-gpg LCLo:1500 ppm/7H
ipr-gpg LDLo:600 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1991)

skn-rbt 625 mg open MLD
eye-rbt 63 mg SEV

Reproductive toxicity (1991 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)
ihl-rat TCLo:300 ppm/7H (6-15D preg) BANRDU 5,149,80
EFFECTS ON FERTILITY
Post-implantation mortality

NO SIGNIFICANT
RISK LEVEL(Ca P65): 10 micrograms/day

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

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:
CLEAN, BODY-COVERING CLOTHES & SAFETY GLASSES WITH SIDE SHIELDS.
RESPIRATORY PROTECTION: UP TO 50 PPM, NONE; 50 PPM TO 2%, FULL FACE MASK & CANISTER; GREATER THAN 2%, SELF-CONTAINED BREATHING APPARATUS.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

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

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

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

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

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (ETHYLENE DICHLORIDE)
Greater at any detectable concentration. : Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

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

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Ethylene dichloride
DOT ID NUMBER: UN1184

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* POTENTIAL HAZARDS *

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

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

* EMERGENCY ACTION *

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

*FIRE
Small Fires: Dry chemical, CO2 or Halon, water spray or alcohol-resistant foam.
Large Fires: Water spray, fog or alcohol-resistant foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area.

Stop leak if you can do it without risk.

Water spray may reduce vapors; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.

Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.

In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water.

Remove and isolate contaminated clothing and shoes at the site.

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

CHEMTOX RECORD 347 LAST UPDATE OF THIS RECORD: 12/03/91

NAME: SILVER NITRATE

SYNONYMS: LUNAR CAUSTIC; NITRATE D'ARGENT (French); NITRIC ACID, SILVER(1+) SALT; SILVER(1+) NITRATE; SILBERNITRAT; SILVER NITRATE; SILVER NITRATE (DOT)

CAS: 7761-88-8 RTECS: VW4725000

FORMULA: AgNO3 MOL WT:

WLN: AG N-O3

CHEMICAL CLASS: Mineral acid salt

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION: ODORLESS, COLORLESS TO GRAYISH BLACK SOLID CRYSTALS

BOILING POINT:	717 K DEC	443.8 C DEC	830.9 F DEC
MELTING POINT:	485 K	211.8 C	413.3 F
FLASH POINT:	N A	NA	NA
AUTO IGNITION:	NA		

VAPOR PRESSURE:

UEL: NA

LEL: NA

VAPOR DENSITY: No data

SPECIFIC GRAVITY: 4.35 19C

DENSITY: 4.352

WATER SOLUBILITY: VERY SOL

INCOMPATIBILITIES: REDUCING AGENTS

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): Not pertinent

ODOR DESCRIPTION: Odorless Source:CHRIS

100 % ODOR DETECTION: No data

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

DOT hazard class: 5.1 OXIDIZER

DOT guide: 45

Identification number: UN1493

DOT shipping name: Silver nitrate

Packing group: II

Label(s) required: OXIDIZER

Special provisions:

Packaging exceptions: 152
Non bulk packaging: 212
Bulk packaging: 240
Quantity limitations-
Passenger air/rail: 5 kg
Cargo aircraft only: 25 kg
Vessel stowage: A
Other stowage provisions:
STCC NUMBER: 4918742

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:No
CLEAN AIR ACT: Not listed
EPA WASTE NUMBER: D011
CERCLA REF: Y
RQ DESIGNATION: X 1 pound (0.454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: oxidizer.
Acute toxicity: adverse effect to target organs.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Oxidizers - Mailable as ORM-D
Mailability: Domestic service and air transportation shipper's declaration
Max per parcel: 25 LBS

NFPA CODES:
HEALTH HAZARD (BLUE): (1) Slightly hazardous to health. As a precaution wear self-contained breathing apparatus.
FLAMMABILITY (RED) : (0) This material does not readily burn.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

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

SHORT TERM TOXICITY: Inhalation: MAY CAUSE IRRITATION OF THE NOSE, THROAT AND LUNGS. Skin: MAY CAUSE IRRITATION. CONCENTRATED SOLUTIONS MAY CAUSE BURNS, SORES AND DISCOLORATION OF SKIN. SOLID MATERIALS WILL CAUSE CHEMICAL BURNS ESPECIALLY IF SKIN IS WET. Eyes: MAY CAUSE IRRITATION WHICH CAN BE SEVERE. SOLID MATERIAL MAY CAUSE CHEMICAL BURNS. Ingestion: MAY CAUSE BURNS TO MOUTH AND THROAT, ABDOMINAL PAIN, DIARRHEA AND DIZZINESS. SHOCK AND CONVULSIONS MAY DEVELOP. ESTIMATED LETHAL DOSE IS 2 GRAMS OF 1/14 OUNCE FOR A 150 ADULT.(NYDH)
LONG TERM TOXICITY: ALL FORMS OF SILVER ACCUMULATE AND ARE EXCRETED VERY SLOWLY. BLUE-GREY DISCOLORATION OF EYES, NOSE, THROAT AND SKIN MAY OCCUR IF 1 GRAM (1/30 OUNCE) OF SILVER ACCUMULATES IN THE BODY. THIS DISCOLORATION IS LIKELY TO BE PERMANENT.(NYDH)

TARGET ORGANS: NASAL SEPTUM, SKIN, EYES, MUCOUS MEMBRANES
SYMPTOMS: Concentrated solutions will produce irritation, ulceration, and discoloration of the skin; also causes severe irritation of the eyes. Ingestion will produce violent abdominal pain and other gastroenteric symptoms. Source: CHRIS

CONC IDLH: Unknown

NIOSH REL: Not given

ACGIH TLV: TLV = 0.01 mg/M3 as SILVER
ACGIH STEL: Not specified

OSHA PEL: Transitional Limits:
PEL = 0.01mg/M3
Final Rule Limits:
TWA = 0.01 mg/M3

MAK INFORMATION: Not listed

CARCINOGEN?: STATUS:

CARCINOGEN LISTS:

IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
unr-man LDLo:29 mg/kg 85DCAI 2,73,70

LD50 value: No LD50 in RTECS 1991

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1991)

orl-mus LD50:50 mg/kg
ipr-mus LD50:23783 ug/kg
orl-dog LDLo:20 mg/kg
orl-rbt LDLo:800 mg/kg
ivn-rbt LDLo:8800 ug/kg
ipr-gpg LDLo:216 mg/kg
scu-gpg LDLo:62 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1991)

eye-rbt 1 mg SEV

Reproductive toxicity (1991 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)
scu-rat TDLo:13590 ug/kg (1D male) JRPFA4 7,21,64
PATERNAL EFFECTS

Testes,epididymis,sperm duct

itt-rat TDLo:3398 ug/kg (1D male) JRPFA4 7,21,64
PATERNAL EFFECTS
Spermatogenisis
PATERNAL EFFECTS
Testes,epididymis,sperm duct

itt-rat TDLo:400 mg/kg (1D male) FESTAS 24,884,73
EFFECTS ON FERTILITY
Male fertility index

scu-mus TDLo:13590 ug/kg (30D male) JRPFA4 7,21,64
PATERNAL EFFECTS
Spermatogenisis
PATERNAL EFFECTS
Testes,epididymis,sperm duct

scu-dog TDLo:50 mg/kg (1D male) FESTAS 24,884,73
PATERNAL EFFECTS
Testes,epididymis,sperm duct

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

ECTION SUGGESTED
THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Reasonable probability of skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Any possibility of eye contact.

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

** WORK CLOTHING SHOULD BE CHANGED DAILY:
If there is any reasonable possibility that the clothing may be contaminate

** REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes contaminated.

** THE FOLLOWING EQUIPMENT SHOULD BE MADE AVAILABLE:
Eyewash.

** REFERENCE: NIOSH

FIRST AID (NIOSH):
EYE:
IRR IMMED
SKIN:
WASH PROMPTLY.

INHALATION:

INGESTION:
GASTRIC LAVAGE WITH A DILUTE SOLUTION OF SODIUM CHLORIDE, FOLLOWED BY CATHARTICS AND DEMULCENTS.

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

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Silver nitrate
DOT ID NUMBER: UN1493

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* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
May ignite other combustible materials (wood, paper, oil, etc.).
These materials will accelerate burning when they are involved in a fire; some will react violently with fuels.
Flammable/poisonous gases may accumulate in tanks and hopper cars.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
If inhaled, may be harmful.
Contact may cause burns to skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Water only; no dry chemical, CO2 or Halon.
Large Fires: Flood fire area with water.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from fire area and let fire burn.
*SPILL OR LEAK
Keep combustibles (wood, paper, oil, etc.) away from spilled material.
Do not touch or walk through spilled material; stop leak if you can do it without risk.
Use water spray to reduce vapor; do not get water inside container.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Small Spills: Flush area with flooding amounts of water.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.
Remove and isolate contaminated clothing and shoes at the site.
Keep victim quiet and maintain normal body temperature.
Effects may be delayed; keep victim under observation.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement.
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---------- IDENTIFIERS ----------

CHEMTOX RECORD 345 LAST UPDATE OF THIS RECORD: 12/03/91
NAME: SILVER
SYNONYMS: ARGENTUM; C.I. 77820; SHELL SILVER; SILBER (GER); SO; VER ATP,
CAS: 7440-22-4 RTECS: VW3500000
FORMULA: Ag MOL WT: 107.87
WLN: AG
CHEMICAL CLASS:Metal

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION: SHINY, MALLEABLE METAL
BOILING POINT: 2485 K 2211.8 C 4013.3 F
MELTING POINT: 1234.9 K 961.7 C 1763.1 F
FLASH POINT: NA
AUTO IGNITION: NA
VAPOR PRESSURE: VERY LOW
UEL: NA
LEL: NA
VAPOR DENSITY: No data
SPECIFIC GRAVITY:
DENSITY: g/cc or 0 lb/gal
WATER SOLUBILITY: INSOLUBLE
INCOMPATIBILITIES: NONE

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

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

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

DOT hazard class: Not given
DOT guide:
Identification number:
DOT shipping name:
Packing group:
Label(s) required:
Special provisions:
Packaging exceptions:

Non bulk packaging:
Bulk packaging:
Quantity limitations-
Passenger air/rail:
Cargo aircraft only:
Vessel stowage:
Other stowage provisions:
STCC NUMBER:

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:No
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.05 mg/mL»(12/24/75)
Maximum Contaminant Level Goals (MCLG): Not specified
CLEAN AIR ACT: Not listed
EPA WASTE NUMBER: D011
CERCLA REF: Y
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA for pieces of solid metal with diameter less than 100 micrometers (0.004 inches).
SARA TPQ VALUE: Not listed
SARA Sect. 312 categories: Acute toxicity: adverse effect to target organs.
LISTED IN SARA Sect 313: Yes
De minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

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

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

SHORT TERM TOXICITY: Unknown
LONG TERM TOXICITY: PROLONGED ABSORPTION CAN LEAD TO GRAYISH BLUE DISCOLORATION OF SKIN (ARGYRIA OR ARGYROSIS); SYSTEMIC, EXTREMELY CUMULATIVE ONCE IT ENTERS BODY TISSUE ** Source: MI; HTHC
TARGET ORGANS: MANY SILVER SALTS ARE IRRITATING TO SKIN, MUCOUS MEMBRANES NA
SYMPTOMS: Source:

CONC IDLH: Unknown

NIOSH REL:

ACGIH TLV: TLV = 0.1 mg/M3

ACGIH STEL: Not specified

OSHA PEL: Transitional Limits:
PEL = 0.01mg/M3
Final Rule Limits:
TWA = 0.01 mg/M3

MAK INFORMATION: 0.01 calculated as total dust mG/M3
Substance with systemic effects, onset of effect over 2 hours: Peak = 10xMAK for 30 minutes, once per shift of 8 hours.

CARCINOGEN?: STATUS:

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

LD50 value: No LD50 in RTECS 1991

Reproductive toxicity (1991 RTECS):
This chemical has no known mammalian reproductive toxicity.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)

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

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (SILVER)
0.25 mg/M3: Any supplied-air respirator operated in a continuous flow mode. * Substance causes eye irritation or damage; eye protection needed. / Any powered air-purifying respirator with a high-efficiency particulate filter. * Substance causes eye irritation or damage; eye protection needed.
0.5 mg/M3: Any air-purifying full facepiece respirator with a high-efficiency particulate filter. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece.
20 mg/M3: Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator with a

high-efficiency particulate filter. / Any appropriate escape-type self-contained breathing apparatus.

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

No DOT Guide information for this compound.

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement.
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---------- IDENTIFIERS ----------

CHEMTOX RECORD 323 LAST UPDATE OF THIS RECORD: 12/03/91

NAME: POLYCHLORINATED BIPHENYL(S) (PCBS)

SYNONYMS: AROCLOR; AROCLOR 1221; AROCLOR 1232; AROCLOR 1242; AROCLOR 1248; AROCLOR 1254; AROCLOR 1260; AROCLOR 1262; AROCLOR 1268; AROCLOR 2565; AROCLOR 4465; BIPHENYL, POLYCHLORO-; CHLOPHEN; CHLOREXTOL; CHLORINATED BIPHENYL; CHLORINATED DIPHENYL; CHLORINATED DIPHENYLENE; CHLORO BIPHENYL; CHLORO 1,1-BIPHENYL; CLOPHEN; DYKANOL; FENCLOR; INERTEEN; KANECHLOR; KANECHLOR 300; KANECHLOR 400; KANECHLOR 500; MONTAR; NOFLAMOL; PCB; PCBs; PHENOCHLOR; PHENOCLOR; POLYCHLORINATED BIPHENYL; POLYCHLOROBIPHENYL; PYRALENE; PYRANOL; SANTOTHERM; SANTOTHERM FR; SOVOL; THERMINOL FR-1

CAS: 1336-36-3 RTECS: TQ1350000

FORMULA: MOL WT:

WLN:

CHEMICAL CLASS: Halogenated h-carbon

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION: light yellow oily liquid or white solid powder with a weak odor

BOILING POINT: NA

MELTING POINT: NA

FLASH POINT: 468.15 K 195 C 383 F

AUTO IGNITION: NA

VAPOR PRESSURE:

UEL: na

LEL: na

VAPOR DENSITY: No data

SPECIFIC GRAVITY: 1.3 - 1.8@ 20C

DENSITY: 1.3 g/cc or 12.09 lb/gal

WATER SOLUBILITY:

INCOMPATIBILITIES:

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): Data not available

ODOR DESCRIPTION: Practically odorless Source:CHRIS

100 % ODOR DETECTION: No data

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

DOT hazard class: 9 CLASS 9
DOT guide: 31
Identification number: UN2315
DOT shipping name: Polychlorinated biphenyls
Packing group: II
Label(s) required: CLASS 9
Special provisions: 9
Packaging exceptions: 155
Non bulk packaging: 202
Bulk packaging: 240
Quantity limitations-
Passenger air/rail: 100 L
Cargo aircraft only: 220 L
Vessel stowage: A
Other stowage provisions:34,M1
STCC NUMBER: 4961666

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.0005 mg/mL»(07/30/92)
Maximum Contaminant Level Goals (MCLG): 0 mg/mL»(07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER:
CERCLA REF: Y
DESIGNATION: X 1 pound (0.454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Chronic toxicity: carcinogen
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

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

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

SHORT TERM TOXICITY: Unknown
LONG TERM TOXICITY: Unknown
TARGET ORGANS: SKIN, LIVER
SYMPTOMS: Acne from skin contact. Source: CHRIS

CONC IDLH: Unknown

NIOSH REL: Not given

ACGIH TLV: Not listed
ACGIH STEL: 2 ppm

OSHA PEL: Transitional Limits:
PEL = 1.0 ppm

MAK INFORMATION: Not listed

CARCINOGEN?: Y STATUS: HUMAN SUSPECTED

CARCINOGEN LISTS:

IARC: Carcinogen defined by IARC to be probably carcinogenic to humans with (usually) at least limited human evidence.
MAK: Not listed
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as reasonably anticipated to be carcinogenic, with limited evidence in humans or sufficient evidence in experimental animals.
ACGIH: Not listed
OSHA: Not listed

LD50 value: No LD50 in RTECS 1991

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1991)

orl-mus LD50:1900 mg/kg

Reproductive toxicity (1991 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)

orl-rat TDLo:400 mg/kg (6-15D preg) FAATDF 11,440,88
EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:420 mg/kg (21D post) FAATDF 11,440,88
EFFECTS ON NEWBORN
Behavioral

ipr-rat TDLo:700 mg/kg (14D pre) FAATDF 11,440,88
EFFECTS ON NEWBORN
Behavioral

orl-mam TDLo:325 mg/kg (30D pre/1-36D preg) AMBOCX 6,239,77
EFFECTS ON NEWBORN

Stillbirth
EFFECTS ON NEWBORN
Live birth index(# fetuses per liter)
EFFECTS ON NEWBORN
Viability index(# alive at day 4 per # born alive)

NO SIGNIFICANT
RISK LEVEL(Ca P65): N0.09 micrograms/day

---------- PROTECTION AND FIRST AID ----------
PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

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

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Polychlorinated biphenyls
DOT ID NUMBER: UN2315

?G90 GUIDE 31

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.
*HEALTH HAZARDS
Contact may cause burns to skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will privide limited protection.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Do not scatter spilled material with high-pressure water streams.
Dike fire-control water for later disposal.
*SPILL OR LEAK
Stop leak if you can do it without risk.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
Cover powder spill with plastic sheet or tarp to minimize spreading.
*FIRST AID
In case of contact with material, immediately flush eyes with running

water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

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

CHEMTOX RECORD 398 LAST UPDATE OF THIS RECORD: 12/03/91
NAME: TOLUENE
SYNONYMS: TOLUOL; PHENYL METHANE; METHYL BENZENE; BENZENE, METHYL-
CAS: 108-88-3 RTECS: XS5250000
FORMULA: C7H8 MOL WT: 92
WLN: 1R
CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION: COLORLESS WATERY LIQUID WITH A PLEASANT ODOR

BOILING POINT:	383.6 K	110.4 C	230.8 F
MELTING POINT:	178.00 K	-95.2 C	-139.3 F
FLASH POINT:	277.6 K	4.4 C	40 F
AUTO IGNITION:	809 K	535.8 C	996.5 F
CRITICAL TEMP:	591.8 Kelvin	318.65 C	605.57 F
CRITICAL PRESS:	4.108 kN/M2	40.5 atm	595 psia
HEAT OF VAP:	155 Btu/lb	86.08 cal/g	3.601x E5 J/kg
HEAT OF COMB:	-17430 Btu/lb	-9690 cal/g	-405x E5 J/kg

VAPOR PRESSURE: 36.7 mm @ 30 C
UEL: 7.1 %
LEL: 1.3 %
IONIZATION POTENTIAL (eV): 8.82
VAPOR DENSITY: 3.14 (air=1)
SPECIFIC GRAVITY: 0.867 @ 20 C
DENSITY: 0.867
WATER SOLUBILITY: 0.05%
INCOMPATIBILITIES: STRONG OX

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

TOXIC FIRE GASES: None reported other than possible unburned vapors
ODOR DETECTED AT (ppm): 40 PPM
ODOR DESCRIPTION: STRONG, PLEASANT Source:NYDH
100 % ODOR DETECTION: No data

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

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27
Identification number: UN1294
DOT shipping name: Toluene

Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 150
Non bulk packaging: 202
Bulk packaging: 242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:
STCC NUMBER: 4909305

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 1 mg/mL»(07/30/92)
Maximum Contaminant Level Goals (MCLG): 1 mg/mL»(07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U220
CERCLA REF:
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Fire hazard: flammable.
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

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

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

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

SHORT TERM TOXICITY: Inhalation: 100 PPM EXPOSURE CAN CAUSE DIZZINESS, DROWSINESS AND HALLUCINATIONS. 100-200 PPM CAN CAUSE DEPRESSION. 200-500 PPM CAN CAUSE HEADACHES, NAUSEA, LOSS OF APPETITE, LOSS OF ENERGY, LOSS OF COORDINATION AND COMA. IN ADDITION TO THE ABOVE, DEATH HAS RESULTED FROM EXPOSURE TO 10,000 PPM FOR AN UNKNOWN

TIME. Skin: CAN CAUSE DRYNESS AND IRRITATION. ABSORPTION MAY CAUSE OR INCREASE THE SEVERITY OF SYMPTOMS LISTED ABOVE. Eyes: CAN CAUSE IRRITATION AT 300 PPM. Ingestion: CAN CAUSE A BURNING SENSATION IN THE MOUTH AND STOMACH, UPPER ABDOMINAL PAIN, COUGH, HOARSENESS, HEADACHE, NAUSEA, LOSS OF APPETITE, LOSS OF ENERGY, LOSS OF COORDINATION AND COMA.(NYDH)

LONG TERM TOXICITY: LEVELS BELOW 200 PPM MAY PRODUCE HEADACHE, TIREDNESS AND NAUSEA. FROM 200 TO 750 PPM SYMPTOMS MAY INCLUDE INSOMNIA, IRRITABILITY, DIZZINESS, SOME LOSS OF MEMORY, LOSS OF APPETITE, A FEELING OF DRUNKENESS AND DISTURBED MENSTRUATION. LEVELS UP TO 1,500 PPM MAY CAUSE HEART PALPITATIONS AND LOSS OF COORDINATION. BLOOD EFFECTS AND ANEMIA HAVE BEEN REPORTED BUT ARE PROBABLY DUE TO CONTAMINATION BY BENZENE. MOST OF THESE EFFECTS AREA BELIEVED TO GO AWAY WHEN EXPOSURE STOPS.(NYDH)

TARGET ORGANS: CNS, LIVER, KIDNEYS, SKIN, EYES

SYMPTOMS: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration. Source: CHRIS

IDLH: 2000ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
375 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN) 750 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: TLV = 100 ppm(375 mg/M3)

ACGIH STEL: 150 ppm

OSHA PEL: Transitional Limits:
PEL = 200 PPM; CEILING = 300 PPM; MAXIMUM PEAK ABOVE CEILING
Final Rule Limits:
TWA = 100 ppm (375 mg/M3)
STEL = 150 ppm(560 mg/M3)

MAK INFORMATION: 100 ppm
380 mG/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 5xMAK for 30 minutes, 2 times per shift of 8 hours.
Risk of damage to the developing embryo or fetus must be considered probable. Damage cannot be excluded even when the MAK values are adhered to.

CARCINOGEN?: N STATUS:

CARCINOGEN LISTS:

IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

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

ihl-hmn TCLo:200 ppm JAMAAP 123,1106,43
BRAIN AND COVERINGS
Recordings from specific areas of CNS
BEHAVIORAL
Antipsychotic
BLOOD
Changes in bone marrow not included above

LD50 value: orl-rat LD50:5000 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1991)

orl-rat LD50:5000 mg/kg
ihl-rat LCLo:4000 ppm/4H
ipr-rat LD50:1332 mg/kg
ivn-rat LD50:1960 mg/kg
unr-rat LD50:6900 mg/kg
ihl-mus LC50:5320 ppm/8H
ipr-mus LD50:640 mg/kg
scu-mus LD50:2250 mg/kg
unr-mus LD50:2000 mg/kg
ihl-rbt LCLo:55000 ppm/40M
skn-rbt LD50:12124 mg/kg
ivn-rbt LDLo:130 mg/kg
ihl-gpg LCLo:1600 ppm
ipr-gpg LDLo:4681 mg/kg
scu-frg LDLo:920 mg/kg
ipr-mam LDLo:1750 mg/kg

Reproductive toxicity (1991 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)
ihl-rat TCLo:1500 mg/m3/24H (1-8D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:1000 mg/m3/24H (7-14D preg) FMORAO 28,286,80
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:100 ppm (51W male) SAIGBL 13,501,71
PATERNAL EFFECTS

Testes,epididymis,sperm duct

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:15 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:30 gm/kg (6-15D preg) TJADAB 19,41A,79
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-mus TCLo:500 mg/m3/24H (6-13D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TCLo:1000 ppm/6H (2-17D preg) TJEMDR 7,265,82
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:400 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
EFFECTS ON NEWBORN

ihl-mus TCLo:200 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Urogenital system

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

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

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

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

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

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

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (TOLUENE)

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

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

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

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Toluene
DOT ID NUMBER: UN1294

ERG90 GUIDE 27

* POTENTIAL HAZARDS *

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

Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

* EMERGENCY ACTION *

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

*FIRE

Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
Withdraw immediately in case of rising sound of venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

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

*FIRST AID

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

DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement.
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CHEMTOX DATA

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

CHEMTOX RECORD 84 LAST UPDATE OF THIS RECORD: 12/03/91

NAME: CADMIUM
SYNONYMS: NONE
CAS: 7440-43-9 RTECS: EU9800000
FORMULA: Cd MOL WT: 112.40
WLN: .CD
CHEMICAL CLASS:Metal

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION:
BOILING POINT: 1040 K 766.8 C 1412.3 F
MELTING POINT: 593.9 K 320.7 C 609.3 F
FLASH POINT: NA
AUTO IGNITION: NA
VAPOR PRESSURE:
UEL: NA
LEL: NA
VAPOR DENSITY: No data
SPECIFIC GRAVITY:
DENSITY: 8.64
WATER SOLUBILITY:
INCOMPATIBILITIES: STRONG OX,ELEMENTAL SULFUR,SELENIUM,TELLURIUM

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

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

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

DOT hazard class: Not given
DOT guide: 37
Identification number: UN1855
DOT shipping name: CADMIUM
Packing group:
Label(s) required:
Special provisions:
Packaging exceptions:

Non bulk packaging:
Bulk packaging:
Quantity limitations-
Passenger air/rail:
Cargo aircraft only:
Vessel stowage:
Other stowage provisions:
STCC NUMBER:

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:No
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.005 mg/mL»(07/30/92)
Maximum Contaminant Level Goals (MCLG): 0.005 mg/mL»(07/30/92)

CLEAN AIR ACT:	CAA '90 By category
EPA WASTE NUMBER:	D006
CERCLA REF:	Y
RQ DESIGNATION:	A 10 pounds (4.54 kg) CERCLA for pieces of solid metal with diameter less than 100 micrometers (0.004 inches).
SARA TPQ VALUE:	Not listed
SARA Sect. 312 categories:	Acute toxicity: adverse effect to target organs. Chronic toxicity: carcinogen Chronic toxicity: adverse effect to target organ after long period of exposure. Fire hazard: flammable.
LISTED IN SARA Sect 313:	Yes
de minimus CONCENTRATION:	1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:

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

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

SHORT TERM TOXICITY: IRRITANT TO NOSE AND THROAT, COUGH, CHEST PAIN, SWEATING, CHILLS, DYSPNEA, WEAKNESS, NAUSEA, VOMITING, DIARRHEA, ABDOMINAL CRAMPS AND POSSIBLE DEATH. ** Source: 1

LONG TERM TOXICITY: LOSS OF SMELL, NOSE ULCERATION, DYSPNEA, EMPHYSEMA, KIDNEY DAMAGE AND MILD ANEMIA. ** Source: 1

TARGET ORGANS: RESP SYS,LUNGS,KIDNEYS,PROSTATE,BLOOD

SYMPTOMS: PULM EDEMA, CYPS, COUGH, TIGHT CHEST, SUBS PAIN; HEAD, CHILLS, MUSCLE ACHE; NAU, DIAR ANOSMIA, EMPHY;

PROTEINURIA, ANEMIA Source: NIOSHP

CONC IDLH: 40MG/M3

NIOSH REL: Potential occupational carcinogen --LOWEST FEASIBLE (LOQ 0.01 mg/M3)

ACGIH TLV: TLV = DUST 0.05 mg/M3 as CADMIUM
ACGIH STEL: Not specified

OSHA PEL: Transitional Limits:
PEL = (FUME) 0.1 MG/M3, (DUST) 0.2 MG/M3; CEILING = (FUME) 0
Final Rule Limits:
TWA = (FUME) 0.1 MG/M3; (DUST) 0.2 mg/M3
CEILING = (FUME) 0.3 MG/M3; (DUST) 0.6 mg/M3

MAK INFORMATION: Carcinogenic working material without MAK
In the Commission's view, an animal carcinogen.

CARCINOGEN?: Y STATUS: ANIMAL POSITIVE
REFERENCES:

ANIMAL POSITIVE IARC** 2,74,73
ANIMAL POSITIVE IARC** 11,39,76

CARCINOGEN LISTS:

IARC: Carcinogen defined by IARC to be probably carcinogenic to humans with (usually) at least limited human evidence.
MAK: An animal carcinogen.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as reasonably anticipated to be carcinogenic, with limited evidence in humans or sufficient evidence in experimental animals.
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

ihl-man TCLo:88 ug/m3/8.6Y AEHLAU 28,147,74
KIDNEY,URETER,BLADDER
Proteinuria

ihl-hmn LCLo:39 mg/m3/20M AIHAAP 31,180,70

LD50 value: orl-rat LD50:225 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1991)

orl-rat LD50:225 mg/kg
ihl-rat LC50:25 mg/m3/30M
ipr-rat LD50:4 mg/kg
scu-rat LD50:9 mg/kg

ivn-rat LD50:1800 ug/kg
unr-rat LD50:1140 mg/kg
orl-mus LD50:890 mg/kg
ihl-mus LCLo:170 mg/m3
unr-mus LD50:890 mg/kg
orl-rbt LDLo:70 mg/kg
scu-rbt LDLo:6 mg/kg
ivn-rbt LDLo:5 mg/kg

Reproductive toxicity (1991 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)
orl-rat TDLo:155 mg/kg (13W male/13W pre-3W preg) BECTA6 20,96,78
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)
EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:220 mg/kg (1-22D preg) TOLED5 11,233,82
EFFECTS ON EMBRYO OR FETUS
Other effects on embryo or fetus

orl-rat TDLo:21500 ug/kg (multigenerations) ENVRAL 22,466,80
EFFECTS ON FERTILITY
Pre-implantation mortility
EFFECTS ON NEWBORN
Germ cell effects(in offspring)

orl-rat TDLo:23 mg/kg (1-22D preg) PSEBAA 158,614,78
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ipr-rat TDLo:1124 ug/kg (1D male) TXAPA9 41,194,77
PATERNAL EFFECTS
Spermatogenisis

scu-rat TDLo:250 ug/kg (19D preg) APTOD9 19,A122,80
EFFECTS ON NEWBORN

ivn-rat TDLo:1250 ug/kg (14D preg) JJATDK 1,264,81
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Body wall
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Urogenital system

ivn-rat TDLo:1250 ug/kg (9D preg) JJATDK 1,264,81
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Central nervous system
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Eye,ear

ivn-rat TDLo:8 mg/kg (8-15D preg) JJATDK 1,264,81
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:448 mg/kg (multigenerations) AEHLAU 23,102,71
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:1700 mg/kg (8-12D preg) TCMUD8 6,361,86
EFFECTS ON NEWBORN
Viability index(# alive at day 4 per # born alive)
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ipr-mus TDLo:1686 ug/kg (7D preg) TJADAB 28,39A,83
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Central nervous system

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

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

"IOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR EYE PROTECTION TO PREVENT:

** EXPOSED PERSONNEL SHOULD WASH:
At the end of each work shift when there was a reasonable probability of co

** WORK CLOTHING SHOULD BE CHANGED DAILY:
If there is any possibility that the clothing may be contaminated.

** THE FOLLOWING EQUIPMENT SHOULD BE MADE AVAILABLE:
Eyewash.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (CADMIUM)
Greater at any detectable concentration. : Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator with a high-efficiency particulate filter. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID (NIOSH):

EYE:
IRR IMMED
SKIN:
SOAP WASH
INHALATION:
ART RESP
INGESTION:
WATER, VOMIT

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

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: CADMIUM
DOT ID NUMBER: UN1855

ERG90 GUIDE 37

* POTENTIAL HAZARDS *

*FIRE OR EXPLOSION
Flammable/combustible material.
May ignite itself if exposed to air.
May re-ignite after fire is extinguished.
May burn rapidly with flare-burning effect.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
If inhaled, may be harmful.
Contact may cause burns to skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control of dilution water may cause pollution.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection.
CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities.
*FIRE
Some of these materials may react violently with water.
Hydrosulfite Fires: Use flooding quantities of water for any size fire.
Small Fires: Dry chemical, soda ash, lime or sand.
Large Fires: Flood fire area with water from a distance.
Do not get water inside container.
Move container from fire area if you can do it without risk.
Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks.
For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
*SPILL OR LEAK
Do not touch or walk through spilled material; stop leak if you can do it without risk.
Do not get water inside containers.
Small Spills: Flush area with flooding amounts of water.

Large Spills: Dike liquid spill for later disposal.

*FIRST AID

Move victim to fresh air; call emergency medical care.

In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.

Remove and isolate contaminated clothing and shoes at the site.

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CHEMTOX DATA

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

CHEMTOX RECORD 2209 LAST UPDATE OF THIS RECORD: 12/03/91

NAME: DIMETHYLHYDRAZINE

SYNONYMS: DIMAZINE; 1,1-DIMETHYLHYDRAZIN (German); DIMETHYLHYDRAZINE; asymmetric DIMETHYLHYDRAZINE; N,N-DIMETHYLHYDRAZINE; uns-DIMETHYLHYDRAZINE; unsym-DIMETHYLHYDRAZINE; 1,1-DIMETHYLHYDRAZINE; DIMETHYLHYDRAZINE UNSYMMETRICAL (DOT); DMH; UDMH; UNSYMMETRICAL DIMETHYLHYDRAZINE; HYDRAZINE, 1,1-DIMETHYL-; 1,1-DIMETHYL HYDRAZINE

CAS: 57-14-7 RTECS: MV2450000

FORMULA: C2H8N2 MOL WT: 60.12

WLN: ZN1

CHEMICAL CLASS: Hydrazine

See other identifiers listed below under Regulations.

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

PHYSICAL DESCRIPTION: COLORLESS WATERY LIQUID WITH A FISHY OR AMMONIA-LIKE ODOR. HYDROSCOPIC, FUMES IN AIR AND GRADUALLY TURNS YELLOW.

BOILING POINT:	342.04 K	68.8 C	156 F
MELTING POINT:	215.93 K	-57.3 C	-71 F
FLASH POINT:	258 K	-15.2 C	4.7 F
AUTO IGNITION:	255 K	-18.2 C	-.7 F

VAPOR PRESSURE: 157 mm @25 C

UEL: 95 %

LEL: 2 %

IONIZATION POTENTIAL (eV): 7.46

VAPOR DENSITY: 1.94 (air=1)

SPECIFIC GRAVITY: 0.791 20C

DENSITY: 0.782

WATER SOLUBILITY: MISCIBLE

INCOMPATIBILITIES: OXIDIZERS, HALOGENS, METALLIC MERCURY, FUMING NITRIC ACID; HYDROGEN PEROXIDE

REACTIVITY WITH WATER: PYROGENIC WHEN MIXED WITH H2O Source: THIC

REACTIVITY WITH COMMON MATERIALS: DISSOLVES, SWELLS, AND DISINTEGRATES MANY PLASTICS.

STABILITY DURING TRANSPORT: STABLE BELOW 1112F

NEUTRALIZING AGENTS: FLUSH WITH WATER.

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: NOX

ODOR DETECTED AT (ppm): 6-14 ppm

ODOR DESCRIPTION: Sharp ammonia; fishy Source:CHRIS

100 % ODOR DETECTION: No data

REGULATIONS

DOT hazard class:	6.1 POISON
DOT guide:	57
Identification number:	UN1163
DOT shipping name:	Dimethylhydrazine, unsymmetrical
Packing group:	I
Label(s) required:	POISON, FLAMMABLE LIQUID, CORROSIVE
Special provisions:	2,A7,B9,B14,B32,B58,B79,T38,T43,T45
Packaging exceptions:	None
Non bulk packaging:	227
Bulk packaging:	244
Quantity limitations-	
Passenger air/rail:	Forbidden
Cargo aircraft only:	Forbidden
Vessel stowage:	D
Other stowage provisions:	21,40,49,61,100
STCC NUMBER:	4906210

CLEAN WATER ACT Sect.307:	No
CLEAN WATER ACT Sect.311:	No
CLEAN AIR ACT:	CAA '90 Listed
RCRA WASTE NUMBER:	U098
CERCLA REF:	Y
RQ DESIGNATION:	A 10 pounds (4.54 kg) CERCLA
SARA TPQ VALUE:	1000 pounds
SARA Sect. 312 categories:	Acute toxicity: adverse effect to target organs. Chronic toxicity: carcinogen Chronic toxicity: adverse effect to target organ after long period of exposure. Fire hazard: flammable.
LISTED IN SARA Sect 313:	Yes
de minimus CONCENTRATION:	0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:

Hazard class:	Not given
Mailability:	Nonmailable
Max per parcel:	0

NFPA CODES:

HEALTH HAZARD (BLUE): (3) Extremely hazardous to health. Full protection required. No skin surface should be exposed.

FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.

REACTIVITY (YELLOW): (1) Normally stable, but may become unstable at elevated temperature and pressures.

SPECIAL : Unspecified

TOXICITY DATA

SHORT TERM TOXICITY: IRRITATES EYES AND SKIN; CHOKING, CHEST PAIN, DYSPNEA,

LETHARGY, NAUSEA, ANOXIA, CONVULSIONS AND LIVER INJURY. ** Source: 2

LONG TERM TOXICITY: Unknown

TARGET ORGANS: CNS, LIVER, GI, BLOOD, RESP SYS, EYES, SKIN

SYMPTOMS: Breathing of vapor causes pulmonary irritation, delayed gastro- intestinal irritation, tremors, and convulsions. Contact with skin or mucous membranes causes chemical burns. Can be absorbed through skin to cause systemic intoxication and convulsions. Source: CHRIS

CONC IDLH: 50PPM

NIOSH REL: Potential occupational carcinogen 0.06 ppm Ceiling exposures which shall at no time be exceeded(120-MIN) 0.15 mg/M3 Ceiling exposures which shall at no time be exceeded(120-MIN)

ACGIH TLV: TLV = 0.5 ppm SKIN Suspected human carcinogen (A2)

ACGIH STEL: Not specified

OSHA PEL: Transitional Limits:
PEL = 0.5 ppm(1mg/M3)(SKIN)
Final Rule Limits:
TWA = 0.5 ppm (1 mg/M3)(SKIN)

MAK INFORMATION: Danger of cutaneous absorption and causes allergic reactions
Carcinogenic working material without MAK
In the Commission's view, an animal carcinogen.

CARCINOGEN?: Y STATUS: ANIMAL POSITIVE

CARCINOGEN LISTS:

IARC: Carcinogen defined by IARC to be probably carcinogenic to humans, but having (usually) no human evidence.

MAK: An animal carcinogen.

NIOSH: Carcinogen defined by NIOSH with no further categorization.

NTP: Carcinogen defined by NTP as reasonably anticipated to be carcinogenic, with limited evidence in humans or sufficient evidence in experimental animals.

ACGIH: Carcinogen defined by ACGIH TLV Committee as a suspected carcinogen, based on either limited epidemological evidence or demonstration of carcinogenicity in experimental animals.

OSHA: Not listed

LD50 value: orl-rat LD50:122 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1991)

orl-rat LD50:122 mg/kg
ihl-rat LC50:252 ppm/4H
ipr-rat LD50:102 mg/kg
ivn-rat LD50:119 mg/kg
ice-rat LDLo:27 mg/kg
orl-mus LD50:265 mg/kg
ihl-mus LC50:172 ppm/4H
ipr-mus LD50:113 mg/kg
ivn-mus LD50:250 mg/kg
ihl-dog LC50:3580 ppm/15M
ipr-dog LD50:60 mg/kg
ivn-dog LD50:60 mg/kg
ipr-mky LD50:60 mg/kg
ipr-cat LDLo:30 mg/kg
skn-gpg LD50:1329 mg/kg
ihl-ham LC50:392 ppm/4H

Reproductive toxicity (1991 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1991 RTECS)
ipr-rat TDLo:600 mg/kg (6-15D preg) JTEHD6 13,125,84
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

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

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:
RUBBER GLOVES, BOOTS, APRON; PLASTIC FACE SHIELD; GAS MASK WITH AMMONIA (GMD) CANISTER PROTECTS FOR 30 MIN. AGAINST 1% CONCENTRATION.FOR LONGER PERIODS OR HIGHER CONCENTRATIONS, USE SELF-CONTAINED BREATHING APPARATUS.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Any possibility of skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Any possibility of eye contact.

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

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

** THE FOLLOWING EQUIPMENT SHOULD BE MADE AVAILABLE:
Eyewash,quick drench.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (DIMETHYLHYDRAZINE)
Greater at any detectable concentration. : Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted canister providing protection against the compound of concern. / Any appropriate escape-type self-contained breathing apparatus.

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

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Dimethylhydrazine, unsymmetrical
DOT ID NUMBER: UN1163

ERG90 GUIDE 57

* POTENTIAL HAZARDS *

*HEALTH HAZARDS
Poisonous; may be fatal if inhaled, swallowed or absorbed through skin.
Contact may cause burns to skin and eyes.
Runoff from fire control or dilution water may cause pollution.
*FIRE OR EXPLOSION
May be ignited by heat, sparks or flames.
Container may explode in heat of fire.
Vapor explosion and poison hazard indoors, outdoors or in sewers.

* EMERGENCY ACTION *

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind, out of low areas, and ventilate closed spaces before entering.
Positive pressure self-contained breathing apparatus (SCBA) and chemical protective clothing which is specifically recommended by the shipper or manufacturer may be worn. It may provide littel or no thermal protection.
Structural firefighter's protective clothing is not effective with these materials.
CALL CHEMTREC AT 1-800-424-9300 AS SOON AS POSSIBLE, especially if there is no local hazardous materials team available.
*FIRE
Small Fires: Dry chemical, CO2, Halon, water spray or standard foam.
Large Fires: Water spray, fog or standard foam is recommended.
Move container from fire area if you can do it without risk.
Cool container with water using unmanned device until well after fire is out.
Fight fire from maximum distance. Stay away from ends of tanks.
Dike fire control water for later disposal; do not scatter the material.
*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.
Fully-encapsulating, vapor-protective clothing should be worn for spills

and leaks with no fire.
Do not touch spilled material; stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers form spill area.
Small Dry Spills: With clean shovel place material into clean, dry container and cover; move containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen.
In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes.
Speed in removing material from skin is of extreme importance.
Remove and isolate contaminated clothing and shoes at the site.
Keep victim quiet and maintain normal body temperature.
Effects may be delayed; keep victim under observation.

ISOLATION DISTANCES FROM ERG90

Small spills:
First isolate in all directions - 1200 ft
Then protect persons downwind - 4 miles
Large spills:
First isolate in all directions - 1500 ft
Then protect persons downwind - 5 miles

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$Hg(NO_3)_2$ - MERCURIC NITRATE

OHS13830

MATERIAL SAFETY DATA SHEET

OCCUPATIONAL HEALTH SERVICES, INC.
11 WEST 42ND STREET, 12TH FLOOR
NEW YORK, NEW YORK 10036
1-800-445-MSDS (1-800-445-6737) OR
1-212-789-3535

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000

SUBSTANCE IDENTIFICATION

CAS NUMBER: 10045-94-0
RTECS NUMBER: OW8225000

SUBSTANCE: MERCURIC NITRATE

TRADE NAMES/SYNONYMS:
MERCURY(II) NITRATE; MERCURY NITRATE; MERCURY PERNITRATE;
NITRIC ACID, MERCURY(2+) SALT; MERCURY DINITRATE; MERCURY(2+) NITRATE;
MERCURY NITRATE (HG(NO3)2); STCC 4918769; UN 1625; M-168; HGN2O6; OHS13830

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: HG-(N-O3)2

MOLECULAR WEIGHT: 324.61

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: MERCURIC NITRATE PERCENT: 100
CAS# 10045-94-0

OTHER CONTAMINANTS: NONE.

EXPOSURE LIMITS:
MERCURY, ALL FORMS EXCEPT ALKYL (AS HG):
0.05 MG/M3 OSHA TWA (VAPOR) (SKIN); 0.1 MG/M3 OSHA CEILING (SKIN)
0.05 MG/M3 ACGIH TWA (VAPOR); 0.10 MG/M3 ACGIH TWA (ARYL & INORGANIC) (SKIN)
0.05 MG/M3 NIOSH RECOMMENDED TWA (VAPOR) (SKIN);
0.1 MG/M3 NIOSH RECOMMENDED TWA (SKIN)
0.01 PPM (0.1 MG/M3) DFG MAK TWA;
0.1 PPM (1.0 MG/M3) DFG MAK 30 MINUTE PEAK, AVERAGE VALUE, 1 TIME/SHIFT

MEASUREMENT METHOD: HYDRAR(R) SORBENT TUBE; ACID; ATOMIC ABSORPTION SPECTROMETRY (COLD); (NIOSH VOL. III # 6009).

SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING
SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY WARNING AND RELEASE REQUIREMENTS- (JULY 1, 1990)

$Hg(NO_3)_2$

MERCURIC NITRATE:
10 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: WHITE TO SLIGHTLY YELLOW, DELIQUESCENT CRYSTALLINE POWDER.

BOILING POINT: DECOMPOSES MELTING POINT: 174 F (79 C)

SPECIFIC GRAVITY: 4.39 SOLUBILITY IN WATER: VERY SOLUBLE

SOLVENT SOLUBILITY: SOLUBLE IN ACETONE, AMMONIA, NITRIC ACID, DILUTE ACIDS; INSOLUBLE IN ALCOHOL.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN OR OTHER GASES WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER. CONTACT WITH EASILY OXIDIZABLE, ORGANIC, OR OTHER COMBUSTIBLE MATERIALS MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

FIREFIGHTING MEDIA:
WATER ONLY, NO DRY CHEMICAL, CARBON DIOXIDE OR HALON
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, FLOOD AREA WITH WATER FROM A DISTANCE
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. FOR MASSIVE FIRE IN CARGO AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P5800.5, GUIDE PAGE 42).

FLOOD WITH WATER! COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. EVACUATE TO A RADIUS OF 2500 FEET FOR UNCONTROLLABLE FIRES.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:
OXIDIZER

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND SUBPART E:

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OXIDIZER AND POISON

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.182
EXCEPTIONS: 49 CFR 173.153

FINAL RULE ON HAZARDOUS MATERIALS REGULATIONS (HMR, 49 CFR PARTS 171-180), DOCKET NUMBERS HM-181, HM-181A, HM-181B, HM-181C, HM-181D AND HM-204. EFFECTIVE DATE OCTOBER 1, 1991. HOWEVER, COMPLIANCE WITH THE REGULATIONS IS AUTHORIZED ON AND AFTER JANUARY 1, 1991.
(55 FR 52402, 12/21/90).

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
MERCURIC NITRATE-UN 1625

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
6.1 - POISONOUS MATERIALS

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
POISON

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS:
EXCEPTIONS: NONE
NON-BULK PACKAGING: 49 CFR 173.212
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 25 KG
CARGO AIRCRAFT ONLY: 100 KG

TOXICITY

MERCURIC NITRATE:
TOXICITY DATA:
ANHYDROUS: 75 MG/KG SKIN-RAT LD50; 26 MG/KG ORAL-RAT LD50; 25 MG/KG ORAL-MOUSE LD50; 87800 UG/KG ORAL-MAMMAL LD50; 20 MG/KG SUBCUTANEOUS-MOUSE LDLO; 7200 UG/KG INTRAPERITONEAL-MOUSE LD50.
MONOHYDRATE: NO DATA AVAILABLE.
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYE, INGESTION.
ACUTE TOXICITY LEVEL: HIGHLY TOXIC BY INGESTION AND DERMAL ABSORPTION.
TARGET EFFECTS: NEUROTOXIN, NEPHROTOXIN.*
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH CHRONIC RESPIRATORY AND KIDNEY DISEASE AND SKIN AND NERVOUS SYSTEM DISORDERS.*
ADDITIONAL DATA: CROSS-SENSITIZATION REACTIONS MAY OCCUR BETWEEN METALLIC MERCURY AND THE ORGANIC AND INORGANIC MERCURY COMPOUNDS. MAY CROSS THE PLACENTA AND BE EXCRETED IN BREAST MILK.*

* MAY BE BASED ON GENERAL INORGANIC MERCURY COMPOUND INFORMATION.

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HEALTH EFFECTS AND FIRST AID

INHALATION:
MERCURIC NITRATE:
CORROSIVE/NEUROTOXIN/NEPHROTOXIN.
28 MG(HG)/M3 IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- INHALATION OF HIGH LEVELS OF MERCURY VAPOR MAY CAUSE ALMOST IMMEDIATE DYSPNEA, COUGH, FEVER, NAUSEA, VOMITING, DIARRHEA, HEADACHE, STOMATITIS, SALIVATION, GINGIVITIS, AND METALLIC TASTE. RESPIRATORY IRRITATION MAY OCCUR WITH CHEST PAIN AND TIGHTNESS. SYMPTOMS MAY RESOLVE OR MAY PROGRESS TO NECROTIZING BRONCHIOLITIS, PNEUMONITIS, PULMONARY EDEMA, PNEUMOTHORAX, INTERSTITIAL FIBROSIS, AND DEATH. ACIDOSIS AND RENAL DAMAGE LEADING TO RENAL FAILURE MAY ALSO OCCUR.

CHRONIC EXPOSURE- INHALATION OF MERCURY VAPOR OVER A LONG PERIOD MAY CAUSE MERCURIALISM, WHICH IS CHARACTERIZED BY FINE TREMORS AND ERETHISM. TREMORS MAY AFFECT THE HANDS FIRST, BUT MAY ALSO BECOME EVIDENT IN THE FACE, ARMS, AND LEGS. ERETHISM MAY BE MANIFESTED BY ABNORMAL SHYNESS, BLUSHING, SELF-CONSCIOUSNESS, DEPRESSION OR DESPONDENCY, RESENTMENT OF CRITICISM, IRRITABILITY OR EXCITABILITY, HEADACHE, FATIGUE, AND INSOMNIA. IN SEVERE CASES, HALLUCINATIONS, LOSS OF MEMORY AND MENTAL DETERIORATION MAY OCCUR. CONCENTRATIONS AS LOW AS 0.03 MG/M3 HAVE INDUCED PSYCHIATRIC SYMPTOMS IN HUMANS. RENAL INVOLVEMENT MAY BE INDICATED BY PROTEINURIA, ENZYMURIA, AND ANURIA. DISCOLORATION OF THE CORNEA AND CRYSTALLINE LENS, TREMOR OF THE EYELIDS AND RARELY, DISTURBANCES OF VISION AND EXTRAOCULAR MUSCLES HAVE BEEN REPORTED. OTHER EFFECTS MAY INCLUDE SALIVATION, GINGIVITIS, STOMATITIS, LOOSENING OF THE TEETH, BLUE LINES ON THE GUMS, DIARRHEA, WEIGHT LOSS, ANOREXIA, SPEECH AND SENSORY DISORDERS, UNSTEADY GAIT, CHRONIC PNEUMONITIS AND MILD ANEMIA. REPEATED EXPOSURE TO MERCURY AND ITS COMPOUNDS MAY RESULT IN SENSITIZATION. MERCURY IS EXCRETED IN BREAST MILK. SEVERAL STUDIES HAVE REVEALED THAT INORGANIC MERCURY CAN CAUSE REPRODUCTIVE EFFECTS SUCH AS CHROMOSOMAL ABERRATIONS IN HUMANS AND ANIMALS; TRANSPLACENTAL PASSAGE IN FEMALE HUMANS AND ANIMALS; DECREASED OVULATION, LENGTHENING OF THE ESTRUS CYCLE, INCREASED INFANT MORTALITY, AND CONGENITAL MALFORMATION IN RODENTS. SPONTANEOUS ABORTIONS, LOW BIRTH WEIGHT AND ABNORMAL DEVELOPMENT OF THE NERVOUS SYSTEM HAVE ALSO BEEN REPORTED.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
MERCURIC NITRATE:
CORROSIVE/NEUROTOXIN/NEPHROTOXIN/HIGHLY TOXIC.

ACUTE EXPOSURE- THE LETHAL DOSE REPORTED IN RATS WAS 75 MG/KG. SOLUTIONS MAY BE CORROSIVE AND MAY CAUSE REDNESS, PAIN, AND SKIN BURNS. SMALL AMOUNTS OF MERCURY MAY BE ABSORBED THROUGH INTACT SKIN.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY RESULT IN SENSITIZATION. OTHER SYSTEMIC EFFECTS AS DETAILED IN CHRONIC INHALATION

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MAY ALSO OCCUR. REPEATED USE OF OINTMENTS CONTAINING MERCURIALS HAVE BEEN REPORTED TO CAUSE A NEPHROTIC SYNDROME AND RENAL TUBULAR ACIDOSIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
MERCURIC NITRATE:
CORROSIVE.
ACUTE EXPOSURE- SOLUTIONS ARE CORROSIVE AND MAY CAUSE REDNESS, PAIN, AND BLURRED VISION.
CHRONIC EXPOSURE- MERCURY EXPOSURE FROM INHALATION, INGESTION, OR SKIN CONTACT MAY BE INDICATED BY MERCURIALENTIS, DISCOLORATION OF THE CRYSTALLINE LENS, ON SLIT LAMP EXAMINATION OF THE EYES.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
MERCURIC NITRATE:
CORROSIVE/NEUROTOXIN/NEPHROTOXIN/HIGHLY TOXIC.
ACUTE EXPOSURE- THE LETHAL DOSE REPORTED IN RATS WAS 26 MG/KG. INGESTION OF INORGANIC MERCURY COMPOUNDS MAY CAUSE A BURNING MOUTH, SORE THROAT, METALLIC TASTE, NAUSEA, VOMITING, BLOODY DIARRHEA, THIRST, SEVERE GINGIVITIS, STOMATITIS, AND NECROSIS OF THE INTESTINAL MUCOSA. COLITIS, ABDOMINAL PAIN, WEAKNESS, FATIGUE, PALLOR, HEMATEMESIS, SHOCK, AND VASCULAR COLLAPSE MAY OCCUR. SEVERE INGESTIONS MAY RESULT IN DELAYED ANURIA AND ACUTE RENAL FAILURE. IF SUFFICIENT AMOUNTS OF MERCURY ARE RETAINED IN THE BODY AFTER A LARGE SINGLE DOSE, THE SYMPTOMS OF CHRONIC MERCURY POISONING, AS DETAILED IN CHRONIC INHALATION, MAY OCCUR. RARELY, INORGANIC NITRATES MAY BE CONVERTED TO NITRITES BY NITRATE-REDUCING BACTERIA IN THE DIGESTIVE TRACT, RESULTING IN METHEMOGLOBINEMIA.
CHRONIC EXPOSURE- REPEATED INGESTION MAY CAUSE SYSTEMIC EFFECTS AS DETAILED IN CHRONIC INHALATION. REPEATED OR PROLONGED EXPOSURE TO NITRATES MAY CAUSE ANEMIA, NEPHRITIS, AND POSSIBLY METHEMOGLOBINEMIA.

FIRST AID- IF THE PERSON IS CONSCIOUS AND NOT CONVULSING, INDUCE EMESIS BY GIVING SYRUP OF IPECAC (KEEPING THE HEAD BELOW THE HIPS TO PREVENT ASPIRATION), FOLLOWED BY WATER. REPEAT IN 20 MINUTES IF NOT EFFECTIVE INITIALLY. IN PATIENTS WITH DEPRESSED RESPIRATION OR IF EMESIS IS NOT PRODUCED, PERFORM GASTRIC LAVAGE CAUTIOUSLY. FOLLOW WITH A CATHARTIC (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GASTRIC LAVAGE SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
THE FOLLOWING ANTIDOTE HAS BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND

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ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

MERCURY POISONING:
GIVE DIMERCAPROL, 3 MG/KG (OR 0.3 ML/10 KG) EVERY 4 HOURS FOR THE FIRST 2 DAYS AND THEN 2 MG/KG EVERY 12 HOURS FOR A TOTAL OF 10 DAYS IF NECESSARY. DIMERCAPROL IS AVAILABLE AS A 10% SOLUTION IN OIL FOR INTRAMUSCULAR ADMINISTRATION. HEMODIALYSIS WILL SPEED THE REMOVAL OF THE MERCURY-DIMERCAPROL COMPLEX. PENICILLAMINE IS ALSO EFFECTIVE. GIVE UP TO 100 MG/KG/DAY (MAXIMUM 1 GR/DAY) DIVIDED INTO 4 DOSES FOR NO LONGER THAN 1 WEEK. IF A LONGER ADMINISTRATION PERIOD IS WARRANTED, DOSAGE SHOULD NOT EXCEED 40 MG/KG/DAY. GIVE THE DRUG ORALLY HALF AN HOUR BEFORE MEALS. A CHELATING AGENT SHOULD BE BE CONTINUED UNTIL THE URINE-MERCURY LEVEL FALLS BELOW 50 UG/24 HOURS (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
MERCURIC NITRATE:
- ACETYLENE: FORMS SHOCK AND HEAT SENSITIVE COMPOUND.
- ALCOHOLS: FORMS SHOCK AND HEAT SENSITIVE MERCURY FULMINATE.
- COMBUSTIBLE MATERIALS: FIRE AND EXPLOSION HAZARD.
- ETHANOL: FORMS SHOCK AND HEAT SENSITIVE MERCURY FULMINATE.
- HYDROCARBONS (AROMATIC): VIOLENT EXOTHERMIC REACTION.
- HYDROCARBONS (UNSATURATED): VIOLENT EXOTHERMIC REACTION.
- ISOBUTENE: FORMS COMPOUND WHICH IS SHOCK SENSITIVE @ 80 C.
- ORGANIC MATERIALS: EXPLOSION HAZARD.
- PETROLEUM HYDROCARBONS: POSSIBLE VIOLENT REACTION.
- PHOSPHINE: FORMS SHOCK SENSITIVE COMPOUND.
- PHOSPHINIC ACID: VIOLENT REDUCTION REACTION.
- POTASSIUM CYANIDE: POSSIBLE EXPLOSION WHEN HEATED UNDER CONFINEMENT.
- SULFUR: EXPLOSIVE REACTION.

SEE ALSO METAL NITRATES.

METAL NITRATES:
- CITRIC ACID: POSSIBLE EXPLOSION HAZARD.
- ESTERS: POSSIBLE EXPLOSION HAZARD.
- PHOSPHINATES: MAY EXPLODE WHEN HEATED.
- PHOSPHOROUS: POSSIBLE EXPLOSIVE REACTION.
- POTASSIUM HEXANITROCOBALTATE(3-): MAY EXPLODE VIOLENTLY.
- REDUCTANTS: POSSIBLE EXPLOSION HAZARD.
- TIN(II) CHLORIDE: POSSIBLE EXPLOSIVE HAZARD.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE HIGHLY TOXIC OXIDES OF NITROGEN AND MERCURY.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

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STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

KEEP CONTAINER TIGHTLY CLOSED. PROTECT FROM EXPOSURE TO AIR OR LIGHT.

TORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D001.
100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

MERCURY - REGULATORY LEVEL: 0.2 MG/L
MATERIALS WHICH CONTAIN THE ABOVE SUBSTANCE AT OR ABOVE THE REGULATORY LEVEL MEET THE EPA CHARACTERISTIC OF TOXICITY, AND MUST BE DISPOSED OF IN ACCORDANCE WITH 40 CFR PART 262. EPA HAZARDOUS WASTE NUMBER D009.

CONDITIONS TO AVOID

AVOID CONTACT WITH OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). AVOID CONTACT WITH EYES AND SKIN; MATERIAL MAY BE POISONOUS OR CORROSIVE.

SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG A HOLDING AREA SUCH AS PIT, POND OR LAGOON TO CONTAIN SPILLED MATERIAL. USE PROTECTIVE COVER SUCH AS A PLASTIC SHEET TO PREVENT DISSOLVING IN FIREFIGHTING WATER OR RAIN.

WATER SPILL:
NEUTRALIZE WITH CAUSTIC SODA.

IF MATERIAL IS DISSOLVED, USE SODIUM SULFIDE SOLUTION TO PRECIPITATE HEAVY METALS.

IF DISSOLVED, AT A CONCENTRATION OF 10 PPM OR GREATER, APPLY ACTIVATED CARBON AT TEN TIMES THE AMOUNT THAT HAS BEEN SPILLED.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND

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PRECIPITATES.

ALLOW SPILLED MATERIAL TO AERATE.

THE CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (PROPOSITION 65) PROHIBITS CONTAMINATING ANY KNOWN SOURCE OF DRINKING WATER WITH SUBSTANCES KNOWN TO CAUSE CANCER AND/OR REPRODUCTIVE TOXICITY.

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 10 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROCESS ENCLOSURE RECOMMENDED TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

MERCURY VAPOR:

0.5 MG/M3- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH CARTRIDGE(S) PROVIDING PROTECTION AGAINST MERCURY VAPOR.
ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

1.25 MG/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.
ANY POWERED, AIR-PURIFYING RESPIRATOR WITH CARTRIDGE(S) PROVIDING PROTECTION AGAINST MERCURY VAPOR.

2.5 MG/M3- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR THAT HAS A TIGHT-FITTING FACEPIECE AND

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IS OPERATED IN A CONTINUOUS-FLOW MODE.
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND CARTRIDGE(S) PROVIDING PROTECTION AGAINST MERCURY VAPOR.
ANY AIR-PURIFYING, FULL-FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE, FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST MERCURY VAPOR.
ANY POWERED, AIR-PURIFYING RESPIRATOR WITH A TIGHT-FITTING FACEPIECE AND CARTRIDGE(S) PROVIDING PROTECTION AGAINST MERCURY VAPOR.

28 MG/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING, FULL-FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE, FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST MERCURY VAPOR.
ANY APPROPRIATE ESCAPE-TYPE, SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED BY- OCCUPATIONAL HEALTH SERVICES, INC.
CREATION DATE: 11/19/84 REVISION DATE: 10/18/91

OHS13830
10045-94-0
MERCURIC NITRATE

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MERCURIC NITRATE MSDS SUMMARY SHEET
TO BE USED WITH MSDS NUMBER OHS13830

CAS#: 10045-94-0 FORMULA: HGN2O6

MERCURIC NITRATE IS A WHITE TO YELLOW SOLID.

EXPOSURE LIMITS:
THIS SUBSTANCE REGULATED BY OSHA AND/OR ACGIH. SEE MSDS.

FIRE AND EXPLOSION HAZARDS:
NO FIRE HAZARD. NO FIRE HAZARD BY ITSELF; HOWEVER, THE MATERIAL IS AN OXIDIZER. IN CASE OF A SURROUNDING FIRE, LEAVE THE AREA IMMEDIATELY. DO NOT TRY TO STOP THE FIRE YOURSELF. SEEK THE HELP OF FIREFIGHTING PERSONNEL. CONTAINERS MAY EXPLODE IN HEAT OF FIRE.

HEALTH AND FIRST AID:
SHORT TERM EXPOSURE: MAY CAUSE BURNS OF THE NOSE, THROAT, SKIN, MOUTH, STOMACH, AND EYES WITH BLURRED VISION. ADDITIONAL EFFECTS MAY INCLUDE HEADACHE, NAUSEA, BLOODY VOMITING AND DIARRHEA, STOMACH PAIN, METALLIC TASTE IN THE MOUTH, DROOLING, THIRST, REDNESS AND SWELLING OF THE GUMS, FEVER, COUGHING, DIFFICULTY BREATHING, HEART EFFECTS, AND KIDNEY DAMAGE. DEATH IS POSSIBLE BY SKIN CONTACT OR INGESTION.

LONG TERM EXPOSURE: IN ADDITION TO EFFECTS FROM SHORT TERM EXPOSURE, NERVE DAMAGE, HALLUCINATIONS, INABILITY TO URINATE, LOOSENING OF THE TEETH, UNSTEADY GAIT, TWITCHING, BLOOD AND LUNG EFFECTS, AND DISCOLORATION OF THE EYE MAY OCCUR. REPRODUCTIVE EFFECTS MAY OCCUR.

FIRST AID: IF SOMEONE IS OVERCOME BY THIS SUBSTANCE, MOVE THEM IMMEDIATELY TO FRESH AIR AND ADMINISTER ARTIFICIAL RESPIRATION (CPR). REMOVE ANY WET CLOTHING OR SHOES. WASH EXPOSED PARTS WITH WATER AND SOAP. FLUSH EYES WITH WATER FOR FIFTEEN MINUTES. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS. GET MEDICAL ATTENTION IMMEDIATELY. SEE MSDS FOR FURTHER RECOMMENDATIONS.

REACTIVITY:
STABLE UNDER NORMAL CONDITIONS. CONTACT WITH FLAMMABLE OR COMBUSTIBLE MATERIALS MAY RESULT IN A FIRE OR EXPLOSION. SEE MSDS FOR COMPLETE LISTING OF INCOMPATIBLE SUBSTANCES.

SAFETY STEPS AND PROTECTIVE EQUIPMENT:
YOU SHOULD WEAR PROTECTIVE CLOTHING, GLOVES, AND SAFETY GOGGLES. A RESPIRATOR MAY BE NEEDED WHEN WORKING IN HIGH OR UNKNOWN CONCENTRATIONS. SEE MSDS FOR OSHA/NIOSH RECOMMENDATIONS. IF AN ACCIDENT OCCURS, CONTACT SAFETY PERSONNEL.

OCCUPATIONAL HEALTH SERVICES, INC. (615) 292-1180 OR (615) 366-2000
EMERGENCY CONTACT: JOHN BRANSFORD, JR.
OHS13830
10045-94-0
MERCURIC NITRATE

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ACETAL/FORMAL : BIS-(2,2-DINITROPROPY)ACETAL/FORMAL

DPA (DIPHENYL AMINE) STABALIZED

AEROJET SOLID PROPULSION COMPANY
MATERIAL SAFETY DATA SHEET

1820

I PRODUCT IDENTIFICATION		DATE 7/88	REV NO. 1
MANUFACTURER'S NAME	Aerojet Solid Propulsion Co.	EMERGENCY TELEPHONE NO.	(916) 355-4770
ADDRESS	P. O. Box 15699C, Sacramento, CA 95852-1699		
NAME	BDNPA/F (Bis-(2,2-Dinitropropy)Acetal/Formal, DPA Stabilized)		
SYNONYMS	Nitroplasticizer		
TSCA NO (CAS NO)	See Section II	FORMULA	$C_8H_{14}N_4O_{10}$/BDNPA: $C_7H_{12}N_4O_{10}$/BDNPF

II HAZARDOUS INGREDIENTS AND GENERAL COMMENTS

Contents	%	CAS No.	ACGIH TLV	Cal/OSHA PEL
Bis-(2,2-dinitropropyl) acetal	45-55	5108-69-0	NE	NE
Bis-(2,2-dinitropropyl) formal	45-55	5917-61-3	NE	NE

BDNPA/F is stabilized with low levels (.14% - .18%) of Diphenylamine (DPA). Unstabilized BDNPA and BDNPA/F has shown mild mutagen activity in AMES Testing. LD_{50} (Oral, rat) = 2190 mg/kg. Avoid all skin contact.

NE = Not Established
NA = NOT AVAILABLE

III PHYSICAL DATA

NP = NOT APPLICABLE

BOILING POINT °C (°F) TORR (mm Hg)	150°C at 0.01 mm	MELTING POINT °C (°F)	+15°C
SPECIFIC GRAVITY H2O = 1	BDNPA 1.366 BDNPF 1.4107	VAPOR PRESSURE (TORR) AT TEMP.	0.01 @ 150°C
VAPOR DENSITY (AIR = 1)	NIL	SOLUBILITY IN H2O @ TEMP.	Negligible
% VOLATILES BY VOLUME	<1%	EVAPORATION RATE (= 1)	NA
APPEARANCE AND ODOR	Deep brown liquid		

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)	>240°F SETA	AUTOIGNITION TEMPERATURE	445°F
FLAMMABLE LIMITS IN AIR, % BY VOLUME	LOWER: NP	UPPER: NP	
EXTINGUISHING MEDIA	Carbon dioxide, foam, dry chemical.		
SPECIAL FIRE FIGHTING PROCEDURES	Use self-contained breathing apparatus to avoid combustion products.		
UNUSUAL FIRE AND EXPLOSION HAZARD	NONE		

V HEALTH HAZARD INFORMATION

Carcinogenicity: (NTP) No (IARC) No (OSHA) No

EFFECTS OF OVEREXPOSURE

ACUTE: May cause mild irritation to skin and mucous membranes.

CHRONIC: None known.

POTENTIAL ROUTE(S) OF ENTRY

X EYES X SKIN X INHALATION ___ INGESTION

28 Aug 1989 FORM NO. 1

A/F

DPA STABILIZED

V HEALTH HAZARD INFORMATION (CONT)

EMERGENCY AND FIRST AID PROCEDURES

EYES: Wash with water for at least 15 minutes. Report to Medical.

SKIN: Wash with soap and water.

INHALATION: Remove to fresh air.

INGESTION: Report to Medical.

VI REACTIVITY DATA

STABILITY (STABLE/UNSTABLE)	CONDITIONS TO AVOID
Stable	Heat

INCOMPATIBILITY (MATERIALS TO AVOID): Keep away from heat and flame.

HAZARDOUS DECOMPOSITION PRODUCTS: Oxides of carbon and nitrogen.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION: Will not occur.

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: Contain with absorbent material and place in approved containers for disposal according to instructions from Central Waste Management or other approved local, state, or federal agency.

NEUTRALIZING CHEMICALS: Any inert absorbent material.

WASTE DISPOSAL METHOD: Contact Central Waste Management (Ext. 3144/2045) for current disposal methods.

VIII SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS: For small quantities, general room ventilation is adequate. For larger quantities or in a confined area use local exhaust.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY: For small quantities in well-ventilated areas, no respirator is required. For larger quantities, use organic cartridge respirator such as MSA GMA or Scott 642-OV. Use airline respirator for use in confined areas.

EYES	GLOVES
Safety glasses	Neoprene rubber

OTHER CLOTHING AND EQUIPMENT: As necessary to prevent all skin contact.

IX SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS: BDNPA/F is a combustible liquid containing energetic oxygen and burns vigorously when ignited.

OTHER HANDLING AND STORAGE REQUIREMENTS: BDNPA/F was reduced by DOT from a flammable liquid to a non-regulated material. (Dept. of Navy letter, 8 July 1986).

ACETAL / FORMAL

PBNA (PHENYL BETA NAPHTHYLAMINE) STABILIZED

(811)

AEROJET SOLID PROPULSION COMPANY
MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

		DATE 6/88	PAGE NO. 8
MANUFACTURER'S NAME	Aerojet Solid Propulsion Co.	EMERGENCY TELEPHONE NO.	(916) 355-4770
ADDRESS	P. O. Box 15699C, Sacramento, CA 95852-1699		
NAME	BDNPA/F; Bis-(2,2-Dinitropropyl) Acetal/Formal; PBNA Stabilized		
SYNONYMS	Nitroplasticizer		
TSCA NO. (CAS NO.)	See Section II	FORMULA	$C_8H_{14}N_4O_{10}$/BDNPA; $C_7H_{12}N_4O_{10}$/BDNPF

II HAZARDOUS INGREDIENTS AND GENERAL COMMENTS

Contents	%	CAS No.	ACGIH TLV	Cal/OSHA PEL
Bis-(2,2-dinitropropyl) acetal	45-55	5108-69-0	NE	NE
Bis-(2,2-dinitropropyl) formal	45-55	5917-61-3	NE	NE

BDNPA/F is stabilized with low levels (.14% - .18%) of Phenyl Beta-Naphtylamine (PBNA). It is Aerojet's policy to treat PBNA as a suspect carcinogen. Unstabilized BDNPA and BDNPA/F has shown mild mutagen activity in AMES Testing. LD_{50} (Oral, rat) = 2190 mg/kg. Avoid all skin contact.

NE = Not Established
NA = NOT AVAILABLE

III PHYSICAL DATA

NA = NOT APPLICABLE

BOILING POINT °C (°F) FOOT POUNDS/KG	150°C at 0.01 mm	MELTING POINT, °C (°F)	+15°C
SPECIFIC GRAVITY (H2O = 1)	BDNPA 1.366 BDNPF 1.4107	VAPOR PRESSURE (NORM AT TEMP)	0.01 @ 150°C
VAPOR DENSITY (AIR = 1)	NIL	SOLUBILITY IN H2O BY WT.	Negligible
% VOLATILES BY VOLUME	<1%	EVAPORATION RATE (BUTYL ACETATE = 1)	NA
APPEARANCE AND ODOR	Deep brown liquid		

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)	>240°F SETA	AUTOIGNITION TEMPERATURE	445°F
FLAMMABLE LIMITS IN AIR, % BY VOLUME	LOWER: NA	UPPER: NA	
EXTINGUISHING MEDIA	Carbon dioxide, foam, dry chemical		
SPECIAL FIRE FIGHTING PROCEDURES	Use self-contained breathing apparatus to avoid combustion products.		
UNUSUAL FIRE AND EXPLOSION HAZARD	NONE		

V HEALTH HAZARD INFORMATION

Carcinogenicity: (NTP) Yes (IARC) Yes (OSHA) Yes for PBNA

EFFECTS OF OVEREXPOSURE

ACUTE: May cause mild irritation to skin and mucous membranes.

CHRONIC: Not known.

POTENTIAL ROUTES OF ENTRY

X EYES ___ SKIN X INHALATION ___ INGESTION

A/F
PBNA STABILIZED

V HEALTH HAZARD INFORMATION (CONT)

EMERGENCY AND FIRST AID PROCEDURES

EYES: Wash with water for at least 15 minutes. Report to Medical.

SKIN: Wash with soap and water.

INHALATION: Remove to fresh air.

INGESTION: Report to Medical.

VI REACTIVITY DATA

STABILITY (STABLE OR UNSTABLE)	CONDITIONS TO AVOID
Stable	Heat

INCOMPATIBILITY (MATERIALS TO AVOID)

Keep away from heat and flame.

HAZARDOUS DECOMPOSITION OR PRODUCTS

Oxides of carbon and nitrogen.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

Will not occur.

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

Contain with absorbent material and place in approved containers for disposal according to instructions from waste management or other approved, local, state or federal agency.

NEUTRALIZING CHEMICALS

Any inert absorbent material.

WASTE DISPOSAL METHOD

Contact Central Waste Management (Ext. 3144/2045) for current disposal methods.

VIII SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS

For small quantities, general room ventilation is adequate. For larger quantities, or in a confined area, use local exhaust.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY: For small quantities in well-ventilated areas, no respirator is required. For larger quantities or in confined areas use organic cartridge respirator, such as MSA GMA or AO R-51.

EYES	GLOVES
Safety glasses	Neoprene rubber

OTHER CLOTHING AND EQUIPMENT

As necessary to prevent all skin contact.

IX SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS

BDNPA/F is a combustible liquid containing energetic oxygen and burns vigorously when ignited.

OTHER HANDLING AND STORAGE REQUIREMENTS

BDNPA/F was reduced by DOT from a flammable liquid to a non-regulated material. (Dept. of Navy letter, 8 July 1986).

D003 HW EXPLOSIVE A

33.1

PNC - PLASTISOL NITROCELLULOSE

OR PELLETIZED NITRO CELLULOSE

Fed. Std. No. 313

MATERIAL SAFETY DATA SHEET

Form Approved Bureau Budget No. 49-R0138

SECTION I

MANUFACTURER'S NAME AND SICN (Federal Supply Code for Manufacturers)

EMERGENCY PHONE NO.

ADDRESS (Number, Street, City, State, and ZIP Code)

CHEMICAL NAME AND SYNONYMS: PLASTISOL NITROCELLULOSE

TRADE NAME AND SYNONYMS: PNC

CHEMICAL FAMILY: Stabilized Nitrate Ester

FORMULA

FEDERAL STOCK NUMBER (FSN)

GROSS WEIGHT (LBS)

OUTSIDE PACKAGE DIMENSIONS (Inches)

NFPA 704 NATIONAL FIRE PROTECTION ASSOCIATION 704 SIGNAL

FLAMMABILITY 3 HEALTH 1 REACTIVITY 3 SPECIFIC HAZARD —

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, AND SOLVENTS	%	THRESHOLD LIMIT VALUE (Units)	ALLOYS AND METALLIC COATINGS	%	THRESHOLD LIMIT VALUE (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	THRESHOLD LIMIT VALUE (Units)
Nitrocellulose stabilized with ethyl centralite		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)		SPECIFIC GRAVITY (H_2O=1)	
VAPOR PRESSURE (mm Hg.)		PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR = 1)		EVAPORATION RATE (= 1)	
SOLUBILITY IN WATER	Insoluble		

APPEARANCE AND ODOR: White powder

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	LOWER EXPLOSIVE LIMIT	UPPER EXPLOSIVE LIMIT
—		—	—

EXTINGUISHING MEDIA: Water

SPECIAL FIRE FIGHTING PROCEDURES: Explosive-evacuate building and proceed to safe area.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Dry PNC is an extreme fire hazard and may detonate if confined.

DD FORM 1 JUN 77 1813

FIGURE 8

PNC

Fed. Std. No. 313

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
None established

EFFECTS OF OVEREXPOSURE
No unusual toxic hazards.

EMERGENCY AND FIRST AID PROCEDURES

SECTION VI REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		Normally stable - prolonged exposure
	STABLE	X	To heat may cause instability

INCOMPATIBILITY (Materials to avoid)
Strong acids and caustics

HAZARDOUS DECOMPOSITION PRODUCTS
oxides of nitrogen

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Dampen with water, sweep up and dispose of as explosive scrap per SJP

WASTE DISPOSAL METHOD
Burn as per SJP.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)
Not required

VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL (General) X	OTHER

PROTECTIVE GLOVES	EYE PROTECTION
Yes	Safety glasses

OTHER PROTECTIVE EQUIPMENT
Flameproof coveralls & cap, conductive shoes

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Store wet material as Class 1 Division 3 Material.
Handle dry as per SJP. Dry material should be treated as Class 1 Division 1 Hazard.

OTHER PRECAUTIONS

SECTION X TRANSPORTATION DATA

PROPER SHIPPING (Airbill) NAME

DOT CLASSIFICATION

DOT LABEL	DOT MARKING	EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES
DOT PLACARD	PRECAUTIONS TO BE TAKEN IN TRANSPORTATION	

 HBNQ - HIGH BULK NITROGUANIDINE

MATERIAL SAFETY DATA SHEET

Form Approved
Bureau Budget No. 49-R0328

SECTION I

MANUFACTURER'S NAME AND FSCM (Federal Supply Code for Manufacturers)

EMERGENCY PHONE NO.

ADDRESS (Number, Street, City, State, and ZIP Code)

CHEMICAL NAME AND SYNONYMS: [redacted], NITROGUANIDINE

TRADE NAME AND SYNONYMS: NQ, HBNQ

CHEMICAL FAMILY: NITRAMINE

FORMULA: $NH_2(CNH)NHNO_2$

FEDERAL STOCK NUMBER (FSN)

GROSS WEIGHT (LBS)

OUTSIDE PACKAGE DIMENSIONS (Inches)

NATIONAL FIRE PROTECTION ASSOCIATION'S FLAMMABILITY 3 HEALTH 2 REACTIVITY 3 SPECIFIC HAZARD

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, AND SOLVENTS	%	THRESHOLD LIMIT VALUE (Units)	ALLOYS AND METALLIC COATINGS	%	THRESHOLD LIMIT VALUE (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	THRESHOLD LIMIT VALUE (Units)

SECTION III - PHYSICAL DATA

BOILING POINT (°F)		SPECIFIC GRAVITY (H_2O=1)	1.72
VAPOR PRESSURE (mm Hg)		PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (Butyl Acetate=1)	
SOLUBILITY IN WATER	Soluble	Melting Point	246°C

APPEARANCE AND ODOR: White Solid

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)		FLAMMABLE LIMITS	LOWER EXPLOSIVE LIMIT / UPPER EXPLOSIVE LIMIT

EXTINGUISHING MEDIA: Water

SPECIAL FIRE FIGHTING PROCEDURES: High Explosive - Evacuate Building and go to safe area.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Impact Sensitivity - Medium; Friction Sensitivity - Low; ESD Sensitivity - Low

FORM 1213

bW

HBNQ

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
None Established

EFFECTS OF OVEREXPOSURE
May irritate skin. May be toxic if swallowed.

EMERGENCY AND FIRST AID PROCEDURES

SECTION VI REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY (Materials to avoid)
Strong acids and caustics

HAZARDOUS DECOMPOSITION PRODUCTS
Oxides of Nitrogen

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Sweep up and dispose of by burning as per SJP.

WASTE DISPOSAL METHOD
Burn as per SJP

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)
Dust respirator, when handling dry material

VENTILATION		
	LOCAL EXHAUST	SPECIAL
	MECHANICAL (General) X	OTHER

PROTECTIVE GLOVES	EYE PROTECTION
Yes	Safety Glasses

OTHER PROTECTIVE EQUIPMENT
Flameproof coveralls and cap, conductive shoes

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Handle and store as high explosive in accordance with SJP.

OTHER PRECAUTIONS

SECTION X TRANS. DATA

PROPER SHIPPING (Technical) NAME	DOT CLASSIFICATION

DOT LABEL	DOT MARKING	EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES

DOT PLACARD	PRECAUTIONS TO BE TAKEN IN TRANSPORTATION

unr-mus LD50:10 g/kg	GISAAA 46(5),69,81
orl-rbt LD50:12660 mg/kg	GISAAA 47(6),76,82
orl-gpg LD50:8430 mg/kg	GISAAA 47(6),76,82
unr-gpg LD50:5600 mg/kg	GISAAA 46(5),69,81
unr-mam LD50:15950 mg/kg	GISAAA 46(5),69,81

Reported in EPA TSCA Inventory.

THR: Moderately toxic by subcutaneous route. Mildly toxic by ingestion. When heated to decomposition it emits toxic fumes of NO_x.

DSF400 ***HR: 3***

1,1-DIMETHYLHYDRAZINE

CAS: 57-14-7 NIOSH: MV 2450000

DOT: 1163

mf: $C_2H_8N_2$ mw: 60.12

PROP: Colorless liquid, ammonia-like odor. Hygroscopic, water-miscible. Bp: 63.3°, fp: −58°, flash p: 5°F, d: 0.782 @ 25°/4°, vap press: 157 mm @ 25°, vap d: 1.94, autoign temp: 480°F, lel: 2%, uel: 95%.

SYNS:

DIMAZINE
DIMETHYLHYDRAZINE
sym DIMETHYLHYDRAZINE
N,N-DIMETHYLHYDRAZINE
asc-DIMETHYLHYDRAZINE
unsym-DIMETHYLHYDRAZINE
1,1-DIMETHYLHYDRAZINE (GERMAN)
DIMETHYLHYDRAZINE UNSYMMETRICAL (DOT)
DMH
NIESYMETRYCZNA DWU METYLOHYDRAZYNA (POLISH)
RCRA WASTENUMBER U098
UDMH (DOT)

TOXICITY DATA:	CODEN:
otr-hmn:fbr 167 µmol/L	PNASA6 80,7219,83
dnd-hmn:fbr 300 µmol/L	ENMUDM 7,267,85
otr-rat-orl 200 µmol/kg	CBINA8 43,313,83
dnd-rat:ivr 30 µmol/L	MUREAV 113,357,83
hma-rat/spt 120 mg/kg/6W-I	MUREAV 139,143,84
msc-ham:lng 5 mmol/L	MUREAV 130,121,84
ipr-rat TDLo:600 mg/kg (6-15D preg):TER	JTEHD6 13,125,84
orl-rat TDLo:150 mg/kg/7W-I: ETA	NATUAS 246,491,73
scu-rat TDLo:21 mg/kg:ETA	SUPOAX 31,413,80
orl-mus TDLo:5880 mg/kg/42W-C:CAR	JNCIAM 50,181,73
ipr-mus TDLo:144 mg/kg/8W-I: ETA	JNCIAM 42,337,69
orl-ham TDLo:228 g/kg/48W-I: CAR	CANCAR 40,2427,77
orl-mus TD :288 mg/kg/8W-I: ETA	JNCIAM 42,337,69
scu-rat TD :400 mg/kg/20W-I: ETA	SUPOAX 31,413,80
orl-rat TD :300 mg/kg/14W-I: ETA	NATUAS 246,491,73
orl-rat LD50:122 mg/kg	MEPAAX 24,71,73
ihl-rat LC50:252 ppm/4H	AMIHAB 12,609,55
ipr-rat LD50:102 mg/kg	TXAPA9 6,371,64
ivn-rat LD50:119 mg/kg	MEPAAX 24,71,73
ics-rat LDLo:27 mg/kg	BCPCA6 14,1901,65
orl-mus LD50:265 mg/kg	MEPAAX 24,71,73
ihl-mus LC50:172 ppm/4H	AMIHAB 12,609,55
ipr-mus LD50:125 mg/kg	AMRL** TR-69-130,69

ivn-mus LD50:250 mg/kg	MEPAAX 24,71,73
ihl-dog LC50:3580 ppm/15M	AIHAAP 24,137,63
ivn-dog LD50:60 mg/kg	MEPAAX 24,71,73
ipr-cat LDLo:30 mg/kg	JETOAS 7(4),238,74
skn-gpg LD50:1329 mg/kg	XAWPA2 CWL 2-10,58
ihl-ham LC50:392 ppm/4H	AMIHAB 12,609,55

IARC Cancer Review: Animal Sufficient Evidence IMEMDT 4,137,74. Reported in EPA TSCA Inventory. EPA Genetic Toxicology Program. Community Right To Know List. EPA Extremely Hazardous Substances List.

OSHA PEL: TWA 1 mg/m³ (skin)
ACGIH TLV: TWA 0.5 ppm (skin); Suspected Carcinogen
NIOSH REL: (Hydrazines) CL 0.15 mg/m³/2H

DOT Classification: Flammable Liquid, Label: Flammable Liquid and Poison; Flammable Liquid; Label: Flammable Liquid, Corrosive

THR: Poison by ingestion, intraperitoneal, intravenous and intracerebral routes. Moderately toxic by inhalation and skin contact. An experimental carcinogen, tumorigen and teratogen. Human mutagenic data. A plant growth control agent. Corrosive. A powerful reducing agent. A dangerous fire hazard. It is hypergolic with many oxidants (e.g., dinitrogen tetroxide; hydrogen peroxide; and nitric acid). Dangerous when exposed to heat, flame or oxidizers; can react vigorously with oxidizing materials such as air; fuming HNO_3; (HNO_3 + N_2O_4); NO. A high energy propellant for liquid fuelled rockets. To fight fire, use alcohol foam, CO_2, dry chemical. When heated to decomposition it emits highly toxic fumes of NO_x. See also HYDRAZINE. For further information see Vol. 4, No. 3 of *DPIM Report*.

DSF600 ***HR: 3***

1,2-DIMETHYLHYDRAZINE

CAS: 540-73-8 NIOSH: MV 2625000

DOT: 2382

mf: $C_2H_8N_2$ mw: 60.12

PROP: Clear, colorless, flammable, hygroscopic liquid; fishy ammonia odor. Flash p: < 73.4°F, bp: 81°, mp: −9°, d: 0.8274 @ 20°/4°.

SYNS:

N,N'-DIMETHYLHYDRAZINE
sym-DIMETHYLHYDRAZINE
1,2-DIMETHYLHYDRAZIN (German)
DIMETHYLHYDRAZINE, symmetrical (DOT)
DMH
HYDRAZOMETHANE
RCRA WASTE NUMBER U099
SDMH
SYMETRYCZNA DWUMETYLOHYDRAZYNA (POLISH)

TOXICITY DATA:	CODEN:
otr-hmn:fbr 230 µmol/L	CALEDQ 29,265,85
dna-hmn:lng 100 µL/L	NTIS** AD-A041-973
scc-mus-rec 20 mg/kg	ENMUDM 8(Suppl 6),41,86
hma-mus/esc 50 µmol/kg	MUREAV 148,1,85
dnd-ham:lng 2 mmol/L	MUREAV 173,157,86
ipr-rat TDLo:100 mg/kg (6-15D preg):TER	JTEHD6 13,125,84