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DEPARTMENT OF THE NAVY
NAVAL WEAPONS SUPPORT CENTER
CRANE, INDIANA 47522-5000

IN REPLY REFER TO:
5090/H11.9
0924
0 10CT 1990

U.S. Environmental Protection Agency,
Region V, 5HR-13
Attn: Ms. Carol Witt-Smith
230 South Dearborn Street
Chicago, Illinois 60604

Gentlemen:

Submitted for review is the draft RFI Phase II Soils Work Plan for the Old Burn Pit, Solid Waste Management Unit (SWMU) #05/03. The requirement for submittal of this report was set forth in the Corrective Actions portion of the Hazardous Waste Part B Permit issued to Naval Weapons Support Center Crane (NWSCC) in January 1990.

NWSCC point of contact is Mr. Jim Hunsicker, Code 0924, telephone 812-854-3233.

Sincerely,

Encl:
(1) Draft RFI Phase II Soils Work Plan for the Old Burn Pit, SWMU #05/03.
(2) Certification Statement

Copy to:
NORTHNAVFACENGCOM, Philadelphia (Code 142)
COMNAVSEASYSCOM (SEA-6541)
WES

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J. W. HAYS
Commander, CEC, USN
Public Works Officer
By direction of the
Commanding Officer

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Writer: J Hunsicker 0924 3114
Typist: Same 9/28/90

CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE

J. W. HAYS
Commander, CEC, USN
Public Works Officer

TITLE

0 1 OCT 1990

DATE

Enclosure (2)

DRAFT RFI PHASE II SOILS WORK PLAN

FOR THE

OLD BURN PIT

SOLID WASTE MANAGEMENT UNIT #05/03

Enclosure (1)

First Draft
RFI Phase II Soils Work Plan for:
Naval Weapons Support Center, Crane, Indiana
Old Burn Pit, SWMU #05/03

Prepared By:
U.S. Army Corps of Engineers;
Waterways Experiment Station
Geotechnical Section
3909 Halls Ferry Rd.
Vicksburg, Mississippi

Prepared for:
Northern Division,
Naval Facilities Engineering Command
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APPENDICES

Appendix A Site Specific Safety and Health Plan
Appendix B Excerpts for ALG's Submission to the Navy
Appendix C ORR Groundwater Analytical Results

1.0 INTRODUCTION

1.1.0 SITE DESCRIPTION

1.1.1 Background. To fulfill the Corrective Action Requirements of the Federal Portion of the Final RCRA/HSWA Part B Permit, Naval Weapons Support Center (NWSC), Crane, Indiana is evaluating its hazardous waste management practices at its past and present disposal sites. This RCRA Facility Investigation (RFI) Phase II (soils) study will be conducted at an area known as the Old Burn Pit (OBP). The US Army Corps of Engineers' (USACE), Waterways Experiment Station (USACEWES) will be conducting the study.

1.1.2 Location. NWSC Crane is a Navy facility located in Martin County Indiana. NWSC covers approximately 62,463 acres. The OBP occupies approximately 25 acres. The OBP is located in the northwest corner of the facility in the NE 1/4 of section 8, T5N, R4W. The area is approximately 2000' east of the the Crane Gate, Gate #4. It is accessed using Crane Road H-331 off of Crane Road H-5 (Figure 1.1.2).

1.1.3 Site History. The Old Burn Pit site was used from 1942 to 1972. Garbage and trash was burned at the site. This rubbish included wood, paper, building material and industrial wastes. No explosive wastes were burned here. The material was burned in a depression or pit structure. Ash residue from this burning operation along with metallic objects were buried in the gully to the north of the burn pit. Today the site is used as a parking area for delivery trailers. Since 1972 the site has revegetated. Contaminated leachate is migrating from the area.

1.1.4 Site Hydrogeology. The OBP is located on unconsolidated stream deposits, which are classified as part of the Atherton Formation of the Illinoian and Wisconsinan Stage of the Pleistocene Series. At this location, these deposits are primarily interbedded deposits of sand, silt, and clay. Small amounts of coarse sand or gravel are found. The horizontal and vertical character of the sediments change very quickly. The bedrock in the area is expected to be Pennsylvanian aged shales of the Raccoon Creek Group, Mansfield Formation. The soils are from 1' to 10' in thickness, and are described as being a clay (CL) to clayey sand (SP-SC). Their permeabilities range from 2.35x10-5 to 8.0x10-6 cm/sec. It is difficult to determine what is soil and what are Pleistocene deposits.

The surface aquifer in the area is made up of Pleistocene deposits . It is unconfined and it discharges into the local streams. The groundwater studies indicate that the water table is at around 18' below the ground surface, and its gradient is to the north and northwest. Surface drainage is to Culpepper Branch into First (Furst) Creek.

1.2.0 STUDY HISTORY

1.2.1 Previous Investigations. In 1981 a team from the USACEWES completed a groundwater and soils investigation at the OBP. Between 1981 and

1983 a total of nineteen monitoring wells were installed at this site. Groundwater quality testing resulted in the detection of organic contaminants. Amounts of Trans-1,2 dichloroethylene, chloroform, and trichloroethylene exceeding 50 ppb. have been detected in some of the groundwater samples drawn from monitoring wells at the OBP. (Appendix C).

1.2.2 Regulatory Status. RCRA as amended by HSWA, a hazardous waste treatment, storage, and disposal facility must be permitted by the EPA. In 1989 NWSC Crane was issued a Storage Operating Permit. The facility was required to complete a RCRA Facility Investigation (RFI). The OBP was named as a Solid Waste Management Unit (SWMU). Corrective Action Requirements were negotiated between NWSC CRANE and the USEPA Region V. As part of the Corrective Action Requirements, NWSC CRANE is to conduct a RFI at its SWMUs. Surface and shallow subsurface soil investigations are parts of that RFI process. A RFI is a three part study, consisting of a Phase I or Environmental Monitoring Report, a Phase II or Release Assessment, and a Phase III or Release Characterization study. Table 1.2.2 is a list of those SWMUs which require Phase II (soils) investigations. A RFI Phase II (soils) study for the Old Burn Pit site, SWMU 05/03, is to be discussed in this work Plan.

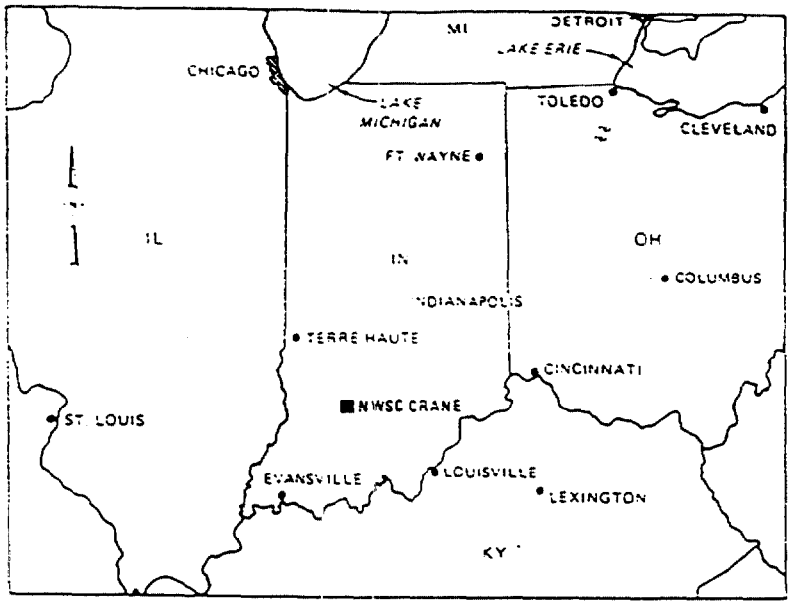
TABLE 1.2.2
RCRA Solid Waste Management Units identified
for Phase II Release Assessment, Soils

Priority	Solid Waste Management Unit	Site Number
1.	Rockeye Munitions Facility	10/15
2.	Demolition Area	06/09
3.	Old Burn Pit	05/03
4.	Pesticide Control Area	09/05
5.	Old Burning Pad	05/03
6.	Mc Comish Gorge	04/02
7.	Mustard Gas Burial Grounds	01/12
8.	Old Storage Bldg. 225	11/00
9.	Load & Fill Area, Bldg 106 Pond	08/17
10.	Mine Fill A	12/14
11.	Mine Fill B	13/14
12.	Road & Grounds Area	15/06
13.	Load & Fill Area Bldgs.	18/13
14.	Pyrotechnic Test Area	19/00
15.	CAAA QA/QC Test Area	20/00
16.	DMRO Storage Lot	21/00
17.	Lead Azide	22/00
18.	Battery Shop, Bldg. 36	23/00
19.	Sludge Drying Beds	24/00
20.	Sanitary Landfill and Lithium Batteries	14/00

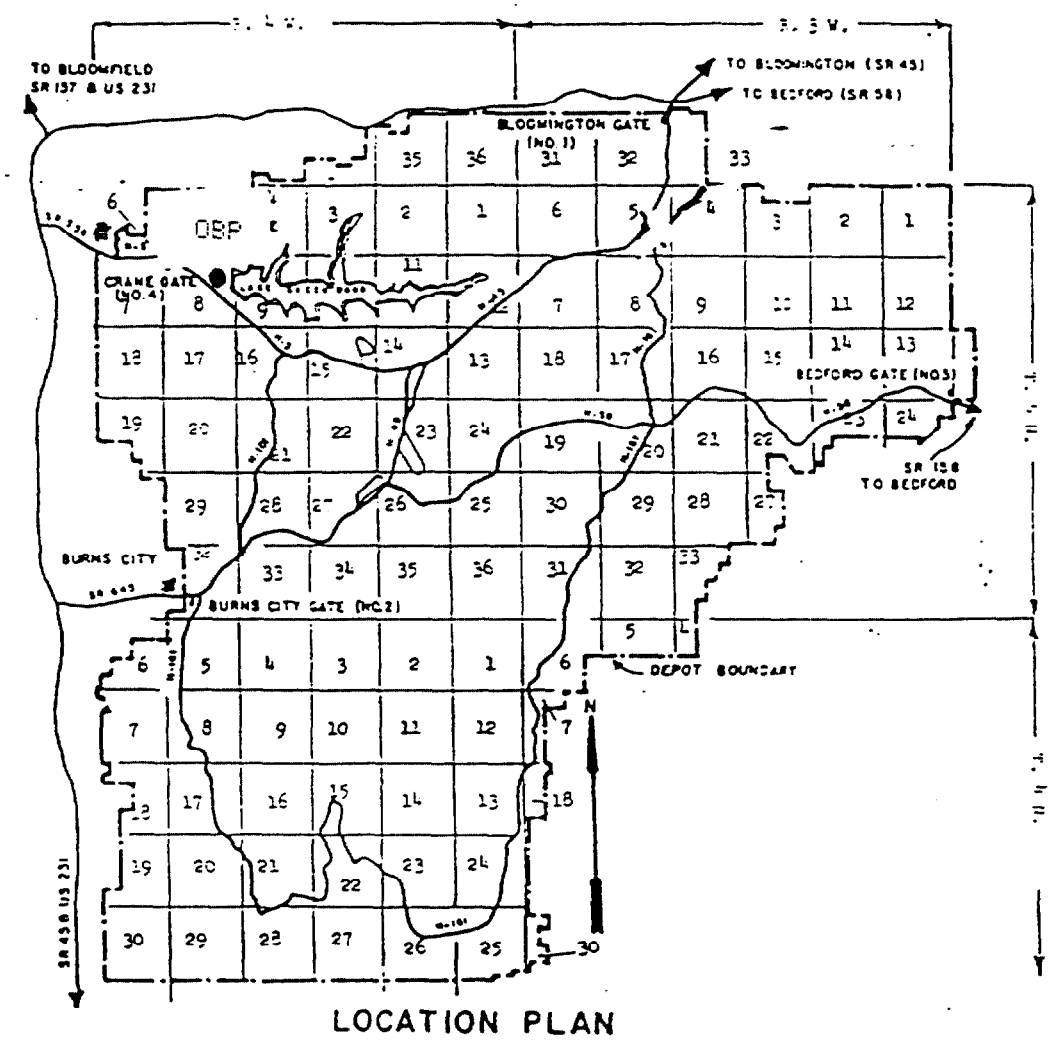
1.3.0 OBP WORK PLAN

1.3.1 Work Plan Objectives. This work plan is intended to adequately describe the site to be investigated, the rational underlying procedural decisions implemented by the plan, and the quality controls methods needed to assure defensible conclusions. Included in this plan are detailed directions which are to be used by the field personnel, laboratory chemist, and report writers. This work plan is intended to be reviewed and used by people familar with commonly used drilling, sampling, and RCRA terms.

1.3.2 Work Plan Structure. A RFI Phase II Release Assessment is to cover four main tasks. They are the development of a Work Plan, a Facility Investigation, an Investigation Analysis, and a Report. The enclosure is the Work Plan which is made up of five plans. Those plans are a project management plan, a sampling and analysis plan, a Quality Assurance/Quality Control plan, a health and safety plan, and a data management plan. Those individual plans will be treated as major headings and elements.



Location Map showing the location of NWSC CRANE in the SW Center of Indiana & the Old Burn Pit located in the northwest corner of NWSC CRANE.



LOCATION PLAN

SCALE = GRID LINES FORM MILE SQUARES

Figure 1.1.2a

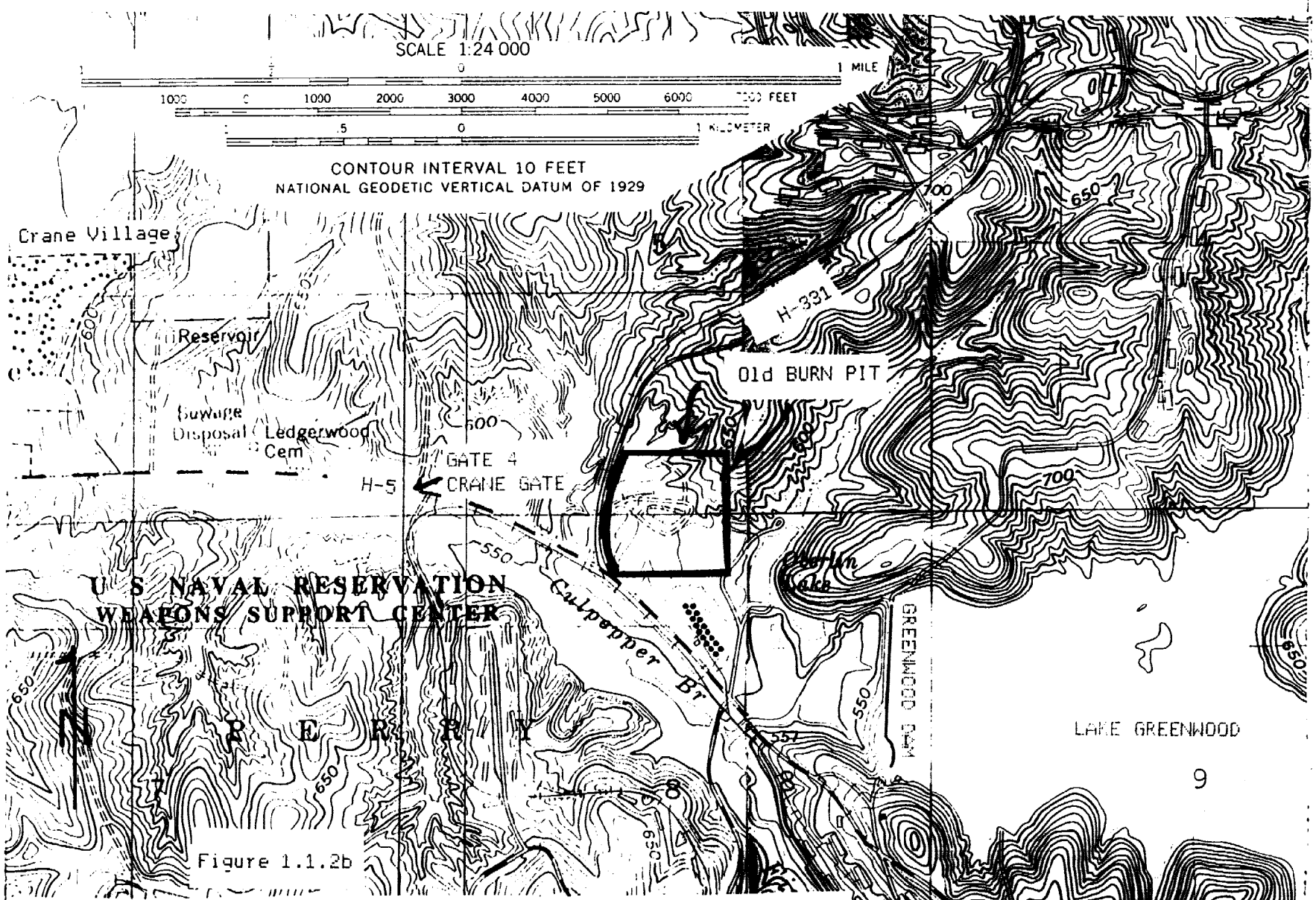


Figure 1.1.2b

USGS topographic map of the northwest portion of NWSC Crane showing the Old Burn Pit, Lake Greenwood, and Crane Village.

2.0 ELEMENT A: MANAGEMENT PLAN

2.1.0 PROJECT OBJECTIVES

2.1.1 Study Intent. The intent of this Phase II investigation is to:1) determine if a hazardous release to the soil has occurred; 2) describe the hazardous release if it exists; 3) characterize the host medium, the soil; 4) and to address the affects the hazardous wastes and constituents have manifested on the host medium.

2.1.2 Project Description. The project is to quickly determine if there are any residual contaminants present in the soils at the site. This objective will be reached by concentrating the search at probable sites of surface and subsurface contamination. Soil samples will be gathered at those sites. Those samples will be tested for the presence of contamination. Conclusions concerning the presence or absence of contamination, the risk posed by those contaminants, and the possible future steps to be taken will be drawn. A report explaining the findings, conclusions, and future studies will be issued.

2.2.0 TECHNICAL APPROACH

2.2.1 Sample Locations. The soils portion of this RFI is to use a procedural outline provided in the Generic Work Plan for the NWSC CRANE's RFI. This Generic Work Plan has been submitted to the EPA for review. The individual studies are to be site specific. At this site trash, and other waste were burnt and the resultant ash was buried. Any contamination at the site should be concentrated in the burn pit, and at the ash disposal site. Following that reasoning the sampling will be biased to locations in the pit in the vicinity of the pit, and at the ash disposal location. Three background borings will be dug at a site. They will be located within the unit boundary but removed from the burn pit and disposal site. They will be dug, sampled, and analyzed using the identical procedures as were used at the other boring locations (boring locations are shown on Figure 2.2.1).

2.2.2 Sample Collection. Disturbed soil samples will be collected using Shelby tube sampling methods. The boring will be advanced in 1&1/2' drive lengths. Eight borings are planned at this site. Two samples per boring will be taken. These samples will be taken from a shallow subsurface soil interval and an evident or suspected contaminated zone. In cases where contaminanted zones are not found, the sample will be taken from the first encountered of the following zones: the base of the landfill, the top of the groundwater table, or the top of the rock.

2.2.3 Sample Testing. Considering the wide variety of wastes reportedly burned at the site, and the limited descriptions of those wastes, a wide spectrum analytical program must be run. Soil testing for the presence of inorganics, PCBs, pesticides, herbicides, and 8240 and 8270 organics will be done (Table 2.2.3). For physical testing of the soils at least one disturbed soil sample per boring will be collected. Additional samples for

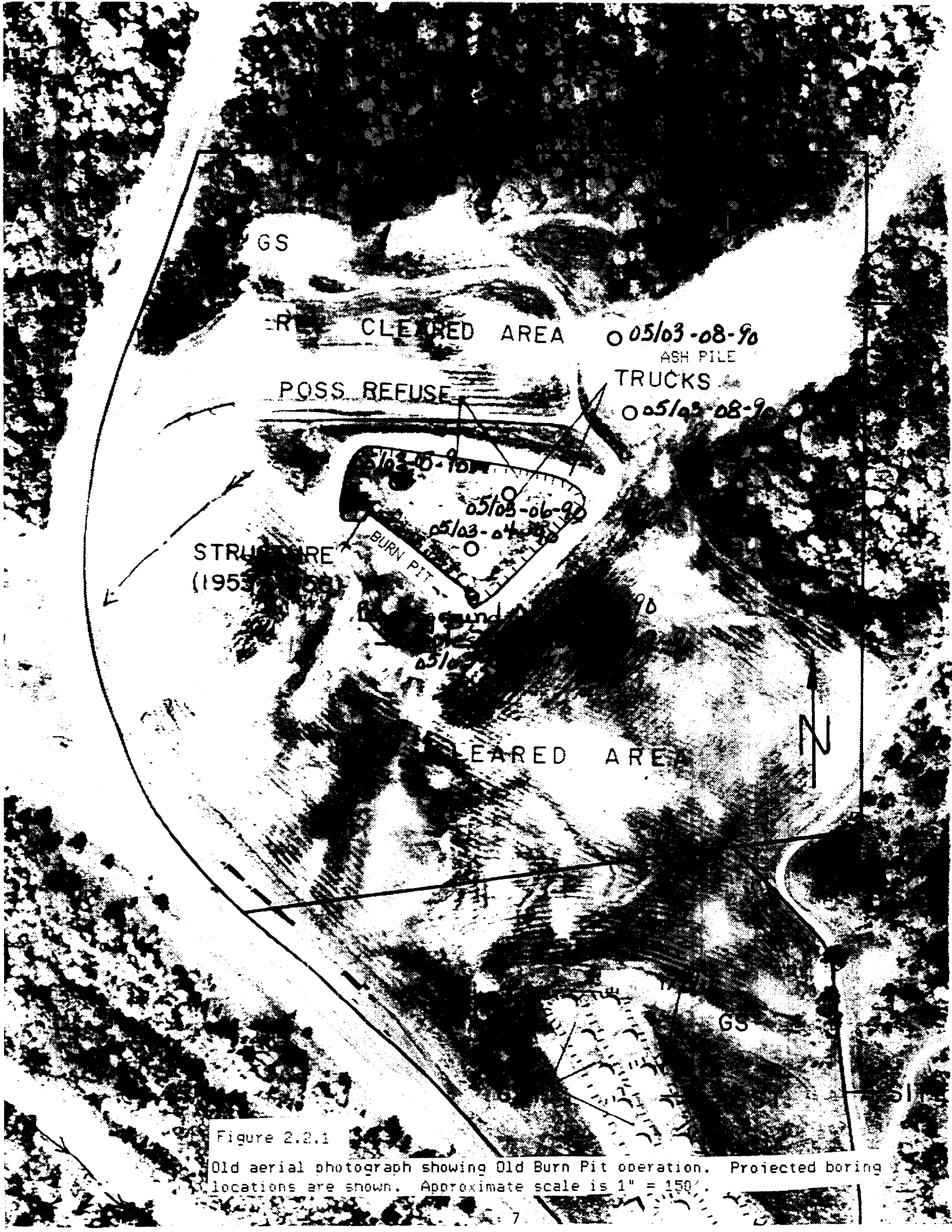


Figure 2.2.1

Old aerial photograph showing Old Burn Pit operation. Projected boring locations are shown. Approximate scale is 1" = 150'.

Table 2.2.3

Types and Numbers of Samples Collected

OLD BURN PIT SWMU 05/03

	Field Samples	Quality Assurance and Quality Control: Splits/Dups OC(AE)	Splits/Dups OA(CE)	Field Blanks Rinsates	Field Blanks Source	Trip Blanks OC(AE)	Trip Blanks OA(CE)	
GROUNDWATER:								
Volatiles	___	___	___	___	___	___	___	
B/N/A	___	___	___	___	___	NR	NR	
Pesticides/PCB's	___	___	___	___	___	NR	NR	
TRPH	___	___	___	___	___	NR	NR	
Metals	___	___	___	___	___	NR	NR	
Other: ___	___	___	___	___	___	___	___	
SURFACE WATER:								
Volatiles	___	___	___	___	___	___	___	
B/N/A	___	___	___	___	___	NR	NR	
Pesticides/PCB's	___	___	___	___	___	NR	NR	
TRPH	___	___	___	___	___	NR	NR	
Metals	___	___	___	___	___	NR	NR	
Other: ___	___	___	___	___	___	___	___	
SURFACE SOILS:								
Volatiles	___	___	___	NR	NR	NR	NR	
B/N/A	___	___	___	NR	NR	NR	NR	
Pesticides/PCB's	___	___	___	NR	NR	NR	NR	
TRPH	___	___	___	NR	NR	NR	NR	
Metals	___	___	___	NR	NR	NR	NR	
Other:explosives	___	___	___	NR	NR	NR	NR	
SUBSURFACE SOILS:								
Volatiles 8240	16	1	___	NR 8	NR	NR 6	NR	31
B/N/A 8270	16	1	___	NR 8	NR	NR	NR	24
Pesticides/PCB's	16	1	___	NR 8	NR	NR	NR	24
Herbicides	16	1	___	NR 8	NR	NR	NR	24
Metals	16	1	___	NR 8	NR	NR	NR	24
Explosives	16	1	___	NR 8	NR	NR	NR	24

physical testing will be collected at major stratigraphic breaks. This information will be used to characterize the soils and in the remedial technique selection. Samples collected for chemical analysis will be sent to USACEWES' Analytical Laboratory Group (ALG) in Vicksburg Mississippi, and the samples collected for physical characterization will be sent to USACEWES' Geotechnical Laboratory also in Vicksburg, MS. ALG's (POC Ann Strong) address is: 3909 Halls Ferry Rd.; Vicksburg, Mississippi. The address for the Soils Investigation Laboratory (POC Mr. Jesse Oldham) is: 3909 Halls Ferry Rd.; Vicksburg, Mississippi.

2.3.0 STUDY MANAGEMENT

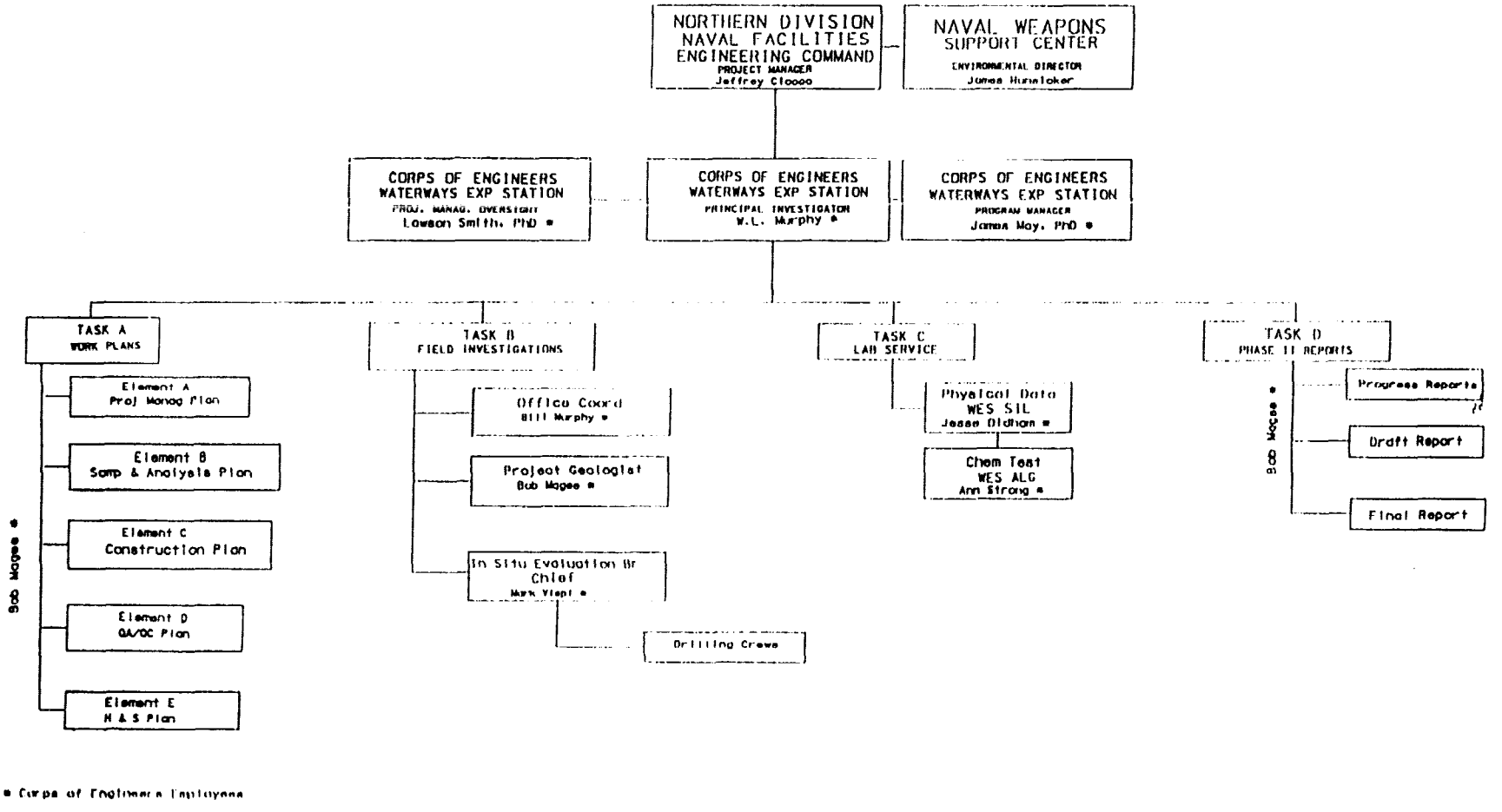
2.3.1 Management Responsibilities. USACEWES is the Navy's prime contractor for this Phase II (soils) investigation. A project team, which is made up of United States Army Corps of Engineers (USACE) personnel, was assembled (Diagram 2.3.1). Oversight and management responsibility will be handled by William Murphy of USACEWES' Geotechnical Section. The planning, scope writing, and report preparation is the responsibility of Robert Magee of USACE Engineering District, Wilmington, N.C. Field work supervision and soil sampling will be the responsibility of Robert Magee of USACE Engineering District, Vicksburg, Ms. Drilling will be done by personnel from the In situ Section, Geotechnical Branch of USACEWES. Mr. Mark Vispi is the Section Chief. The chemical analysis is to be processed through the USACEWES' Analytical Laboratory Group (ALG) under the supervision of Ann Strong. All chemical data validation will be done by Ann Strong's group. Soils classification and physical testing will be done at USACEWES' Soils Investigation Laboratory under the supervision of Mr. Jesse Oldham.

2.3.2 Program Schedule. Diagram 2.3.2 is a work schedule which illustrates expected work durations, phase structure, phase completion dates, and milestone dates. The dates are time figures shown in working days. Allowances for exact start dates, off days, and work delays are not shown. Field work weeks are to be 6 day weeks. The field work is scheduled to take 9 days total. This is figuring on 1 borings per day. To expedite data reduction the field data will be forwarded to the Wilmington Engineering District office were it will be processed in final form. 45 days are set aside for chemical and physical analysis. This is followed by 35 days of data reduction, and report preparation. The final report should be ready in 115 working days after commencement of the field work. Following the start of the soils investigation, bimonthly progress reports will be issued. These reports will include overall project progress, individual study progress, impending schedule targets, and expected or existent schedule adjustments. Because the bimonthly progress reports are independent of the individual study work plans, they are not shown on the work schedule (Diagram 2.3.2).

RCRA FACILITY INVESTIGATION, PHASE II SOILS

OLD BURN PIT 05/03

PROJECT ORGANIZATION CHART



* Corps of Engineers Employees

Figure 2.3.1

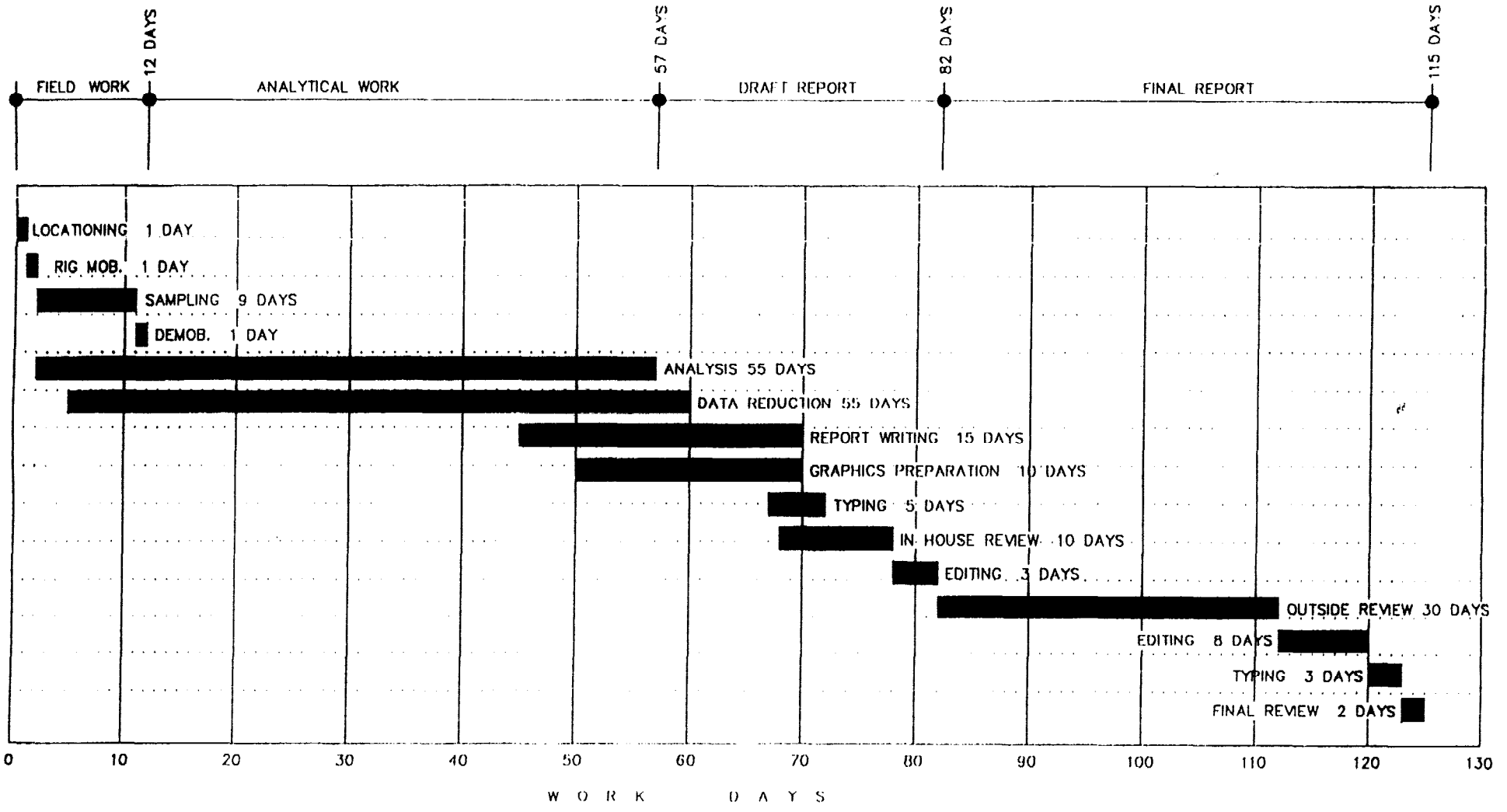


Diagram 2.3.2
Time Schedule

3.0 ELEMENT B: SAMPLE AND ANALYSIS PLAN

3.1.0 SELECTION PROCEDURES

3.1.1 Selection Rational. At the Old Burn Pit (OBP) a wide variety of wastes were burned. The OBP was identified as a Solid Waste Management Unit (SWMU). A Phase II release assessment must be performed at the OBP. The intent of a Phase II study is to evaluate the presence or absence of a release, and to characterize the hazardous waste and its constituents. Chemical analysis will be done using SW-846 analytical methods, or other accepted methods when no SW-846 methods are available. The soil will be physically characterized using US Army Corps of Engineers geotechnical procedures. This Release Assessment will be accomplished by judiciously selecting sample locations, selecting the appropriate analytes, and using proper analytical methods.

3.1.2 Sample Location. Borings and sample locations were selected with a bias toward areas having the greatest probability of contamination. These locations are the previously used burn pit, and the ash disposal area. Figure 3.1.2 is an aerial photograph taken while the Burn Pit was still active. The burn pit is easily seen (A), and the ash disposal site as described in the IAS is thought to be site B. Site C is picked as the location for the background borings. These borings must within the unit boundary but removed from the past operations. Site C is an area located within the unit boundary but situated away from the inactive operations. Groundwater data from the installed monitoring wells indicate that Site C is up gradient and uncontaminated. The borings locations shown in Figure 3.1.2 are approximate. The exact location for the individual borings will be picked in the field. The field selected boring locations will be surveyed by field personnel. At those sites the upper soil horizon, and a contaminanted layer if one is evident is to be sampled. Should no contaminanted layer be found then other horizons will be sampled.

3.1.3 Chemical Analyte Selection. Analyte selection is based on the probability of a contaminant occurring at the site. The area was used to to burn rubbish, solid wastes,and liquid wastes. No explosive wastes were burned here. The principle contaminants could be organics and metal wastes. Groundwater monitoring has been performed at the site and the detected contaminants were organics. The groundwater testing results from OBP wells are listed in Appendix C. In each soil boring two sets of samples are planned. These sample sets will be one shallow subsurface sample and one sample from an evident or suspected contaminanted zone. Should no contaminanted zone be found then the sampled horizon will be the first horizon which meets one of the following conditions: 1) the base of the disturbed soil zones,2) the top of the groundwater table,3) the top of bedrock. To determine what soil contaminants are found in the soil, soil samples must be taken. The list of analytical test parameters shown in Table 3.1.3 were selected on the bases of their probability of occurring at the site. The 8240 and 8270 organics were selected, because of their common industrial usage, their reported disposal and their detected presence in the groundwater. Pesticides, PCBs, and herbicides are used at NWSC Crane and they may have been burned at the site. Metals are always a possible contaminant at a landfill site.

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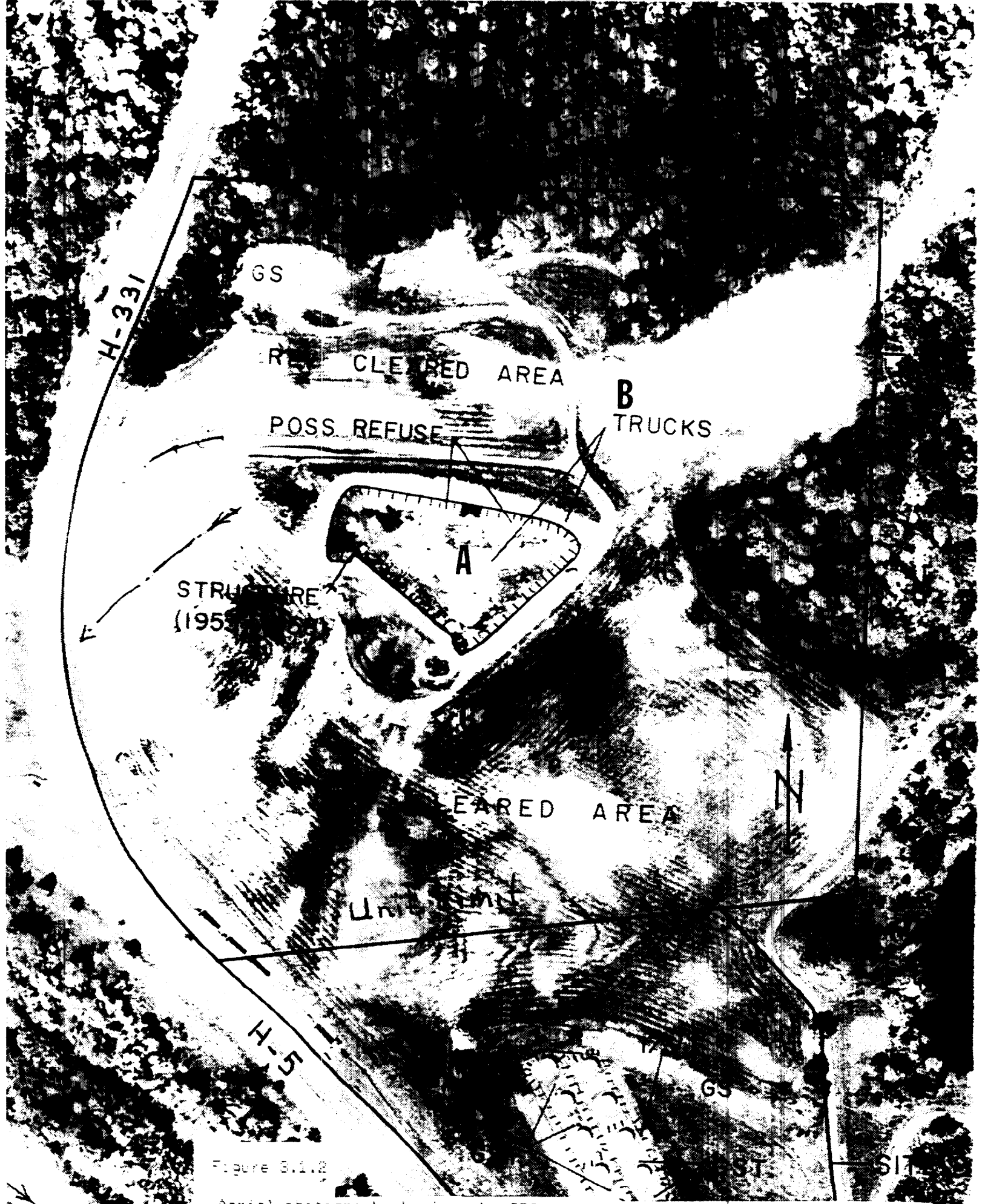

Figure 3.1.8

Aerial photograph showing the OBG in operation. The burn pit (A), the northern disposal area (B), intended background sample location (C), and the unit boundary are depicted. The photo scale is approximately 1" = 150'.

TABLE 3.1.3
LIST OF PARAMETERS

INORGANICS		ORGANICS
Aluminum	Magnesium	8240 Volatiles
Antimony	Manganese	8270 Semivol.
Arsenic	Mercury	Organochloride Pesticides
Barium	Nickel	Organophosphorus Pesticides
Beryllium	Phosphorus	Chlorinated Herbicides
Cadmium	Selenium	PCBs
Calcium	Silver	
Chromium	Sodium	
Cobalt	Thallium	
Copper	Zinc	
Iron		
Lead		

3.1.4 Analytical Methods Selection. Analytical method selection for chemical analytes is a mater determined by environmental regulation. US EPA mandates that RCRA studies adhere to procedures and methods set out in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" SW-846, Third Edition. Organic and inorganic test methods are given in Tables 3.1.4a and 3.1.4b.

TABLE 3.1.4a
SUMMARY OF METHODS FOR
DETERMINATION OF INORGANIC METALLIC ANALYSIS

		SOILS METHODS from SW-846	
METAL ANALYSIS	TECHNIQUE*	EXTRACTION**	ANALYSIS
Aluminum	ICP	3050	6010
Antimony	ICP	3050	6010
Arsenic	GF	3050	7060
Barium	ICP	3050	6010
Beryllium	ICP	3050	6010
Cadmium	ICP	3050	6010
Calcium	ICP	3050	6010
Chromium	ICP	3050	6010
Copper	ICP	3050	6010
Iron	ICP	3050	6010
Lead	ICP	3050	6010
Manganese	ICP	3050	6010
Mercury	CV		7471
Nickel	ICP	3050	6010
Selenium	GF	3050	7740
Silver	ICP	3050	6010
Sodium	ICP	3050	6010
Thallium	ICP	3050	6010
Zinc	ICP	3050	6010

* Abbreviations: GF = Graphite Furnace, CV = Cold Vapor, and ICP = Inductively Coupled Plasma.
**Extraction process, when not noted, is included in the analytical method.

TABLE 3.1.4b
SUMMARY OF METHODS FOR
DETERMINATION OF ORGANIC COMPOUND ANALYSIS

ORGANIC ANALYSIS	TECHNIQUE	SOILS METHODS	
		EXTRACTION	ANALYSIS
Volatiles	GC/MS	INC. *	8240
Semivolatiles	GC/MS	3540/3550	8270
Organochloride Pesticides & PCBs	GC/MS	3540/3550	8080
Organophosphorus Pesticides	GC/MS	3540/3550	8140
Chlorinated Herbicides	GC/MS	INC*	8150

* INC.= extraction procedure included in method procedure.

3.1.5 Physical Parameter Selection. Soil samples will be characterized using standard US Army COE geotechnical methods. The soil samples will be described and classified in the field by the field crew. Unified Soil Classification System classification will be done at the laboratory. The classification will consist of a visual classification, a sieve and hydrometer analysis to determine grain size distribution of the sample, determination of natural water content, USCS classification, and organic content. The sieve analysis determines the gradation of grain sizes ranging from the number 4 sieve to the number 200 sieve. The hydrometer analysis determines the percentage of silt and clay sized particles in the sample.

3.2.0 SAMPLING PROCEDURES

3.2.1 General Principles. Soil samples will be taken with a Shelby Tube sampler. Direct body contact with the samples must be avoided. To minimize the spreading contamination between samples, samplers will wear disposal latex gloves. The outer pair of latex gloves are to be changed between each sampling event. All sampling equipment and drilling equipment will be decontaminated between usage. Eight borings are to planned. Three of these borings will be used as background borings. The background borings will be the first borings to be augered at the location. They will be placed at a location away from the burn pit. At each boring soil samples will be taken at the following depth, 6" to 12" and from a zone of evident or suspected contamination. If no contamination is found then the sample will be taken from the base of the landfill, the last 6" directly above the water table, or 6" directly above the top of rock which ever is encountered first. These sample intervals are shown on Figure 3.2.1. If additional intervals of evident or suspected contamination are found additional samples may be taken. The past borings dug in the area did not reach the top of rock. The water table was found at a depth of 15 to 20'. No samples are to be taken below the water table and no samples will be taken below the top of rock. The borings are to be taken to bedrock/ refusal, or a depth of 50' below the ground surface.

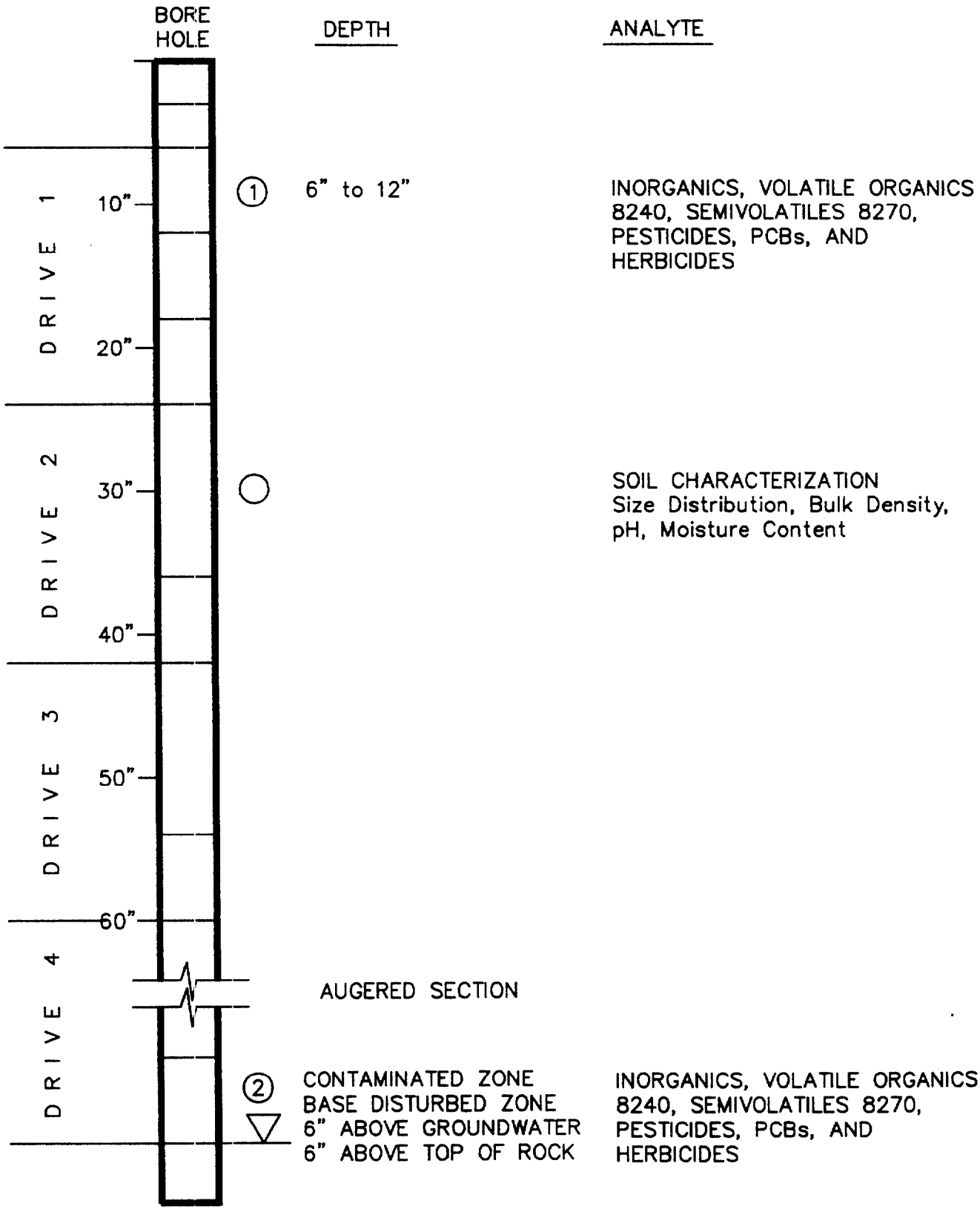

Figure 3.2.1
Diagram of Boring Log with Smaple Points
NWSC Crane Phase II Soils

3.2.2 Subsurface Sampling. Soil borings will be placed using a Failing 1500 truck mounted drilling rig. Samples will be taken at specified depths all above the water table and refusal. A Shelby Tube sampler will be used to collect the soil samples. The sampler will be advanced through a hollow stem auger. The hollow stem auger will be used because it will minimize cross contamination of samples. As the auger advances into the soil protective casing is advanced. This casing will prevent the hole from caving. At the surface, the Shelby Tube sampler will be opened and the sample extracted, peeled, and bottled in the shortest time possible. Peeling is the process that removes the portion of the sample which is in direct contact with the sampler. Ends of the sample will not be used. Samples for volatiles analysis will be taken, bottled, and capped within 15 seconds from the time the sampler is opened. All samples will be extruded into wide-mouth glass jars or other containers with minimal disturbance of the sample. Stainless steel or plastic tools will be used to place the peeled samples into the containers. Steel tools will be used to take samples for organic tests and plastic tools will be used to take samples for inorganic analysis. The sample jars or bottles will then be sealed and placed in sealed plastic packages. One sample per sealed package. Following collection, soil samples will be placed in locked ice chests (coolers) for storage at a temperature of 4 degrees C. Preservatives will not be required for the soil samples. The coolers containing the samples with their accompanying Chain of Custody forms will be transported to the analytical lab for analysis. Transport will be by air freight with an overnight carrier service. A seal will be placed on each cooler to ensure that the samples have not been disturbed during transport to the laboratory. Two 8 oz. jars of soil and two 40 mL. VOA vials of soil will be collected. These samples will be analyzed for the presence of PCBs, pesticides, herbicides, metals, and 8240 and 8270 organics.

The hole will augered to a depth of 50' or bedrock which ever is shallower. The hole will be back filled using grout and drill cuttings. The cuttings from the disturbed portion of the hole, not removed for sampling, will be contained in drums. The drums will be marked and left on site. The markings will include information describing the contents of the drum, and the boring from which the cuttings were gotten. NWSC Crane will take custody of the drums and will be responsible for the disposal of the material. The remaining cuttings from the boring will be mixed with a cement/bentonite mix and will be used to fill the hole.

3.3.0 DECONTAMINATION PROCEDURES

3.3.1 General Procedures. To prevent the spreading of contaminants from one location to another and from one level to another, the sampling and drilling equipment will be cleaned between uses. The sample containers will be pre-cleaned before being delivered to the site. All personnel involved in the equipment decontamination will wear protective clothing.

3.3.2 Sampling Devices. All sampling devices will be cleaned using the following steps.

#1. Scrub equipment with a non-phosphoric detergent and potable water.

#2. Rinse with potable water.

#3. Rinse with 0.1 N (nitric acid) when sampling for inorganics. 0.1 N is prepared by adding approximately 4.2 mL. concentrated nitric acid to approximately 500 mL water. Then dilute the solution to 1 L final volume with water. Caution: add concentrated acid to water, never add water to concentrated acid.

#4. Rinse with deionized water.

#5. Rinse with methanol (pesticide grade).

#6. Air dry.

#7. Rinse with hexane (pesticide grade).

#8. Rinse with deionized water. Collect rinsate blanks now.

#9. Air Dry

#10. Wrap or cover sampling equipment with aluminum foil (shining side out) when not in use.

3.3.3 Sample Containers. The sample containers will be obtained from a supplier. The containers will be pre-cleaned. The containers will be shipped to the location in protected containers. The sample jar types and sizes are given on Table 3.3.3. A verification of the decontamination procedure will accompany every container shipment.

3.3.4 Drilling Equipment. Before moving onto a new drilling location, the rig, its substructure, and its drill rods, bits and auger flights will be steam cleaned. A combination steam cleaner/pressure washer will be used. A non-phosphoric detergent can be used. The washing is to remove all soil from the rig and drill equipment. A decontamination pad will be constructed at the site. The wastewater generated during decontamination will be collected and drummed at the site. NWSC Crane will take custody of the wastewater and arrange for the testing and disposal of the waste.

TABLE 3.3.3
CHEMICAL ANALYSIS
SUMMARIZATION OF SAMPLE CONTAINERS

MATRIX	PARAMETERS	CONTAINERS
Soil	Volatiles	Two 40 mL glass Septa vials
Soil	Semivolatiles Pesticides, PCBs & Inorganics	Two 8 oz. glass jars

3.3.5 Rinsate Disposal. Wastewater generated during the cleaning and decontaminating of the sampling equipment, will be collected. Decontamination will be done on site. Decontamination water will be segregated into detergent wash, acid wash water, and organic wash water. These waters will be put into drums. The drums will be properly closed and marked. The drums will be collected by facility personnel. NWSC Crane will be responsible for the disposal of the material.

3.4.0 SAMPLE DOCUMENTATION PROCEDURES

3.4.1 General Procedure. Field parameters will be recorded in a field notebook. These parameters will be transferred to Data Sheets, Chain of Custody Forms, Drilling Logs, and Sample Tags. Final documentation will be made from a consolidation of those notes, data sheets, and laboratory data.

3.4.2 Chain of Custody. A Chain of Custody program will be initiated in the field upon collection of the sample. A Chain of Custody record will accompany each shipment of samples at all times. An example of a Chain of Custody record is shown in Figure 3.4.2.

3.4.3 Sample Labeling. At the time of sample collection the sample will be placed in a pre-labeled, pre-cleaned sample container. The sample label is to contain the following information:

1. Site name.
2. Field station number.
3. Date and time of sample collection.
4. Sample type (grab or composite).
5. Sample location description.
6. Signature
7. Sample preservation used.
8. Analyses type.

An example of a sample label is shown in Figure 3.4.3

3.4.4 Field Logs. Field logs will be made by the geologist or inspector of each sample boring. Figure 3.4.4 is an example of a field sample/boring log. The field log documents the sample number, the date of sampling, the depth sampled, provides a field classification of the soil or other material, the type of sampler used, the container number, and job information including type of drill rig, operator's name, site name, boring number and surface elevation if available.

3.4.5 Field Notebook. The geologist will keep a notebook. It will contain a detailed record of particulars about each sample, and sampling condition. This notebook will contain sampling dates, environmental conditions at the time of sampling, equipment conditions, soil conditions, boring locations, sample numbers, sample descriptions, sample depths, groundwater conditions, and other pertinent sampling information. Other information may include Chain of Custody data, sample shipment information, decontamination documentation, and personnel changes. This note book will remain at the site and will become a part of the project record at the end of the project.

Figure 3.4.2

USAE WATERWAYS EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME			NO. OF CONTAINERS							REMARKS
SAMPLERS: (Signature)										
DATE	TIME	SAMPLE ID								

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Date /Time	Remarks	

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CHAIN OF CUSTODY

U. S. ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION
P.O. DRAWER 631
VICKSBURG, MS 39180

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

U.S. ARMY CORPS OF ENGINEERS

Station No.	Date	Time	Sequence No.
Station Location			____ Grab ____

____ BOD ____ Solids ____ COD ____ Nutrients	____ Metals ____ Oil & Grease ____ D.O. ____ Bact. ____ Other	Remarks/Preservative:
Samplers:		

Serial Tag No. ____

Figure 3.4.3 Example of chain-of-custody sample tag. (a) Front. (b) Back.

U.S. ARMY CORPS OF ENGINEERS
OFFICIAL SAMPLE SEAL

Sample No. Date

Signature

Print Name and Title (Inspector, Analyst, Tech.)

SEAL BROKEN BY

Figure 3.2.4 Example of tamper-proof seal.

BORING LOG
FIELD DATA

Project NWSC Ground - Water Study Site Crane, IN Date:
Location Job No. 441-G150.13GB21/22
Drill Rig Failing Inspector J. Dunbar Operator G. Drake Surface El 764.37 Boring No.

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press.	Cont.	CLASSIFICATION AND REMARKS
1	25 July	0.0		0.0	0.5	0.0	1.79	Shelby 1" Tube	100	ST	Sandy Clay (CL): brown, soft, damp,
1A				0.5	1.0	1.79	1.94		200	Jar	very fine-grained sand, gravelly
				1.0	1.5				230		(sandstone)
			2.8	1.5	2.0				360		Sample length: 1.94 ft
1B				0.0	2.8	0.0	2.80	5" Folding Auger		Jar	Cleanout
				2.0	3.0			6" Rock Bit			Cleanout: room for core barrel
		2.8	--	3.0	8.0	3.0	8.0	4x5=1/2" Core Barrel		Run1	See drilling log page 2
				8.0	9.8	8.0	9.8	" "		Run2	
				9.8	14.8	9.8	14.8	" "		Run3	
				14.8	20.0	14.8	20.0	" "		Run4	
	26 July			20.0	25.0	20.0	25.0	" "		Run5	
				25.0	25.7	25.0	25.7	" "		Run6	
				25.7	30.2	25.7	30.2	" "		Run7	
				30.2	35.0	30.2	35.0	" "		Run8	

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*Jar sample given to NWSC for chemical analysis

Sheet 1 of 7 Sheets

Figure 3.4.4

Boring log with sample data.

4.0 ELEMENT C: QUALITY ASSURANCE/QUALITY CONTROL PLAN

4.1.0 GENERAL

4.1.1 Regulatory Framework. This soils investigation is a part of a Phase II RCRA Facilities Investigation. It is part of the Navy's Installation Restoration Program. Navy regulations require that its studies follow NEESA Guidance 20.2-047B "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program". USEPA regulations mandate that RCRA studies adhere to procedures and methods set out in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" SW-846, Third Edition.

4.1.2 QC Level Selection. The QC level selected for this site is a NEESA Level C.

4.1.3 CDQO. The Chemical Data Quality Objectives are assured by adhering to the procedures stipulated by the selected QC level. The Navy's Level C requires that:

1. EPA approved methods (SW-846 Third Edition), when available, be used.
2. Trip blanks must accompany every glassware shipment.
3. Rinsate blanks be collected each day.
4. Field blanks be collected from each source of water.
5. A 10% duplication of samples be taken.

The objective of such a plan is to insure that the data collected is comparable with known conditions, that sources of extraneous contamination can be determined, and that decisions made are meaningful and supported. Holding times are dictated by SW-846 procedures. Those holding times are parameter specific (Chart 4.1.3). They are to be adhered to specifically to assure the quality of the analytical data.

TABLE 4.1.3
CHEMICAL ANALYSIS
PRESERVATION AND HOLDING TIMES

MATRIX	PARAMETERS	PRESERVATION	MAX. HOLDING TIMES	
			EXTRACTION	ANALYSIS
Soil	Volatiles	Ice to 4 Deg.	14 d.	
Soil	Semivolatiles	Ice to 4 Deg.	7 d.	40 d.
Soil	Inorganics & Cyanide	Ice to 4 Deg.		180 d.
Soil	Pesticides, PCBs,& Herbicides	Ice to 4 Deg.		

When only analysis holding time is given, this implies total holding time from sampling until analysis.

4.1.4 Field QC Samples. The number of QC samples are determined by the level of QC implemented. The types of QC samples remain the same.

4.1.4.1 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.

4.1.4.2 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.

4.1.4.3 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.

4.1.4.4 Field Duplicates 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. Field duplicates should be collected at a frequency of 10% per matrix for Level C. All the duplicates should be sent to the 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 analysis of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

4.1.4 Data Comparison. US Army Corp of Engineers soil sampling procedures are to be used when collecting soil samples at the OBP site. NEESA QC Level C requirements are to be met. The analytical laboratory to be used is a Navy approved laboratory. EPA approved test methods, when available, will be used, and USATHAMA analytical methods will be used to test for explosive contaminants. Background soil samples will be collected. They will be taken in the same manner as are the other samples, processed in the same way, and analyzed for the same parameters using the same methods.

4.2.0 FIELD ACTIVITIES

4.2.1 Sampling. Eight borings are planned at this site. Two samples per boring will be taken. These samples will be taken from a shallow subsurface soil interval and an evident or suspected contaminated zone. In cases where contaminated zones are not found, the sample will be taken from

the first encountered of the of the following zones: the base of the landfill, the top of the groundwater table, or the top of the rock. The borings will be advanced using a hollow stem auger. At a site away from the burn pit and ash disposal background sample will be taken. The soil samples will be tested for the presence of PCBs, pesticides, herbicides, and metals and organics. Soil moisture, and soil temperatures should not significantly effect the samples. Samples will be taken under the most consistent condition possible. This is to be a one time sampling event.

4.2.2 Field Documentation.The geologist will keep a notebook detailing particulars about each sample, and sampling conditions. This notebook will contain environmental conditions at the time of sampling, equipment conditions, soil conditions, boring locations, sample depths, groundwater conditions, and other pertinent information.Generic Work Plan procedures will be used. Field logs will be made by the geologist or inspector of each sample boring. Figure 4.2.2 is an example of a field sample/boring log. The field log documents the sample number, the date of sampling, the depth sampled, soil classification, the type of sampler used, the container number, and job information including type of drill rig, operator's name, site name, boring number and surface elevation if available.

4.2.3 Sample Documentation. Samples will be named using the following procedure. The sample number will include the past and present (SWMU) site number followed by a medium identifier (S = soil), followed by a boring number, followed with a sample interval, and followed by the sampling year. Sample intervals are numbered by depth with the first interval being the first encountered of the samples taken. At the time of sample collection the collected samples will be placed in pre-labeled, pre-cleaned sample containers. The sample label will contain the following information:

1. Site name.
2. Field station number.
3. Date and time of sample collection.
4. Sample type (grab or composite).
5. Sample location description.
6. Signature
7. Sample preservation used.
8. Analyses type.

An example of a sample label is shown in Figure (4.2.3)

4.3.0 SHIPPING PROCEDURES

4.3.1 Chain of Custody Procedures. A chain-of custody program will be initiated in the field upon collection of the sample. A Chain of Custody record will accompany the shipping containers at all times. An example of a Chain of Custody record is shown in Figure (4.3.1).

4.3.2 Sample Containers. Sample containers will be delivered from the laboratory in a cleaned condition. They will be shipped with appropriate

documentation certifying their decontaminated condition. The containers will be stored on location in a secure location until used.

4.3.4 Sample Preservation. Each sample will be placed in an appropriate sample container. The containers will contain proper preservatives when needed. Following collection, the samples will be placed in ice chests for storage and shipping.

4.3.5 Sample Shipping. Transportation will be by commercial airfreight transporter. Delivery to the laboratory will be within 24 hours of sampling. A Chain of Custody program will be initiated in the field and a Chain of Custody form will accompany the shipment. All shipments of samples must have correct Department of Transportation placarding and documentation. The shipments will be accompanied by signed Chain of Custody forms.

4.4.0 LABORATORY QA PROCEDURES

4.4.1 General. The Corps of Engineers' Waterways Experiment Stations Analytical Laboratory Group have a set QA procedure which was covered in its application for Navy approval. Excerpts from the application document are contained in the Appendix B to this Work Plan.

4.4.2 Sample Receipt. Laboratory procedures outlined in Appendix B cover the receipt, storage, and disposal of received samples. Field samples are to be delivered to ALG within 24 hours of the sample date. Proper Chain of Custody procedures will be followed.

4.4.3 Calibration Procedures. The laboratory has set calibration procedures which are instrument and method specific. Those procedures are explained in Appendix B.

4.4.4 Detection Limits. Material contained in SW-846 are used to determine ability to meet contract required detection limits. The analytical methods and detection/practical quantification limits are presented in Appendix B. For organic analyses, the analyses are highly matrix dependent and higher detection limits are reported when interferences prohibit the reporting of the specified limits.

4.4.5 Data Evaluation. All data is checked by the analyst, the inorganic team leader or the organic team leader, and the Chief, ALG before it is submitted to the customer. The following items are checked:

1. Completeness
2. Duplicate values for precision
3. Recovery of Spikes for accuracy
4. Method blanks for contamination
5. Surrogate recoveries for organic analysis
6. Data for QA check samples
7. Reasonableness and trends

Hole No.

DRILLING LOG	DIVISION	INSTALLATION	SHEET OF SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION *(Coordinates or Station)*	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. *(As shown on drawing title and file number)*	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g

Figure 4.3.1

USAE WATERWAYS EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME

SAMPLERS: (Signature)

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS							REMARKS

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Date /Time	Remarks	

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If data falls outside acceptable limits as described in the procedures, sample are rerun if sample is available. If data falls outside acceptable limits on the reruns and QA check sample data is good, then data may be reported with qualifying explanations. Acceptable data is usually defined by the specific procedural method (i.e. SW-846).

4.4.6 Control Conditions. Control Chart construction and Corrective Actions are explained in Appendix B.

4.4.7 Document Management. The sample management officer is also in charge of the document control. The sample management officer maintains the master logbook, the computer logbook, the computer-generated bench sheets, the completed computer generated bench sheets and the final computer generated reports. Each analyst maintains the raw data files and his/her instruments. Final Data reports are approved by the team leader, the quality assurance officer and the Chief, ALG.

4.5.0 DATA VALIDATION

4.5.1 Management Responsibility. Analytical data is validated by the team leaders, the quality control officer, and the Chief, Analytical Laboratory and consists of the following steps.

4.5.2 Procedures. Completeness Check is (1) be sure that all samples and analysis have been processed, (2) ensure complete records including Chain of Custody for each analysis and associated QC sampled, (3) ensure that procedures specified in project planning have been followed, and (4) assure that all calibrations were performed.

4.5.3 Data Evaluation. Data evaluation with respect to:

1. detection limits.
2. control limits for duplicates, spikes, blanks, and surrogates.
3. data control within control limits and corrective action.
4. flagging of consistently out of control data.

4.5.4 Control Factors. Data is to be evaluated with respect to holding times and QA sample analysis results.

5.0 ELEMENT D: HEALTH AND SAFETY PLAN

SEE APPENDIX A

6.0 ELEMENT E: DATA MANAGEMENT PLAN

6.1.0 General. A RFI Work Plan is made up of five elements. The purpose of the Work Plan is to guide the investigative work through those separate elements. The Data Management Plan is the final element of the Work Plan. It is the part of the Work Plan that explains the movement of the data to final report form. Chemical and Physical Data is reduced from its raw form into final form by the laboratory personnel. The final data is then put into a report format. The data will be presented in various text, tabular, and graphic formats. Concurrent with the work on the individual sites progress reports for the overall soil investigation program, bimonthly reports of progress will be issued. These bimonthly progress reports are separate from the individual SWMUs' studies and are covered under the generic work plan for the RFI soils investigation.

6.2.0 Data Record. Recorded data will consist of site (SWMU) locations, sampling station (boring) numbers and location, sample number and depth sampled, date sampled, names of sampling personnel, sample descriptions and other boring log data, Chain of Custody information, parameters measured, laboratory results, and analysis of results. Locations will be recorded on map positions on base maps.

Chemical and Physical laboratory results will be presented as computer print outs generated by the analyzing laboratory and will include parameters such as the sample number, parameter measured, amount detected, date analyzed, units used, a lab ID number for each sample, duplicates, and results of analysis of blanks. The data will be presented in Appendixes to the Draft and Final Report.

6.3.0 Tabular Displays. Tables of data will include field data (sample station number, number of samples per station, depths sampled, date sampled, etc.) and laboratory data for chemical and physical testing results.

6.4.0 Graphical Displays. Data will be presented in various graphical formats. Sample boring locations will be presented on base maps. Contaminant Plume maps will be made to display the contaminate spread. Cross sections of the soil profile will be made to display the vertical distribution of soil type and contaminant concentrations. Bar and line graphs will be used to show contamination levels. Pertinent photographs will be included in the report to refine a point or add emphasis to a finding. Other displays are possible.

6.5.0 Report Format. A draft and a final report will be written. A period of time for commenting will occur between the draft report and final report. This comment period will allow for important perspectives to be considered. The contents of the reports shall be arranged in accordance with the suggested RFI format as presented in RFI Guidance Manual (USEPA, OSWER Directive 9502.00-6c, April 1987). The report shall consist of 8 1/2" X 11" pages with drawings to be folded, if necessary, to this size. Large displays will be presented as Plates found at the end of the report but referred to within the text. To reduce the number of drawings, data, and ideas should be combined on

drawings. But drawing details will not be cluttered or poorly organized. The data must not reduce the drawings effectiveness. All drawings shall be of engineering quality in drafted form with sufficient detail to show interrelations of major features and/or thoughts on the installation site map. A decimal paragraphing system shall be used, with each section and paragraph of the reports having a unique decimal designation. The report covers shall consist of durable 3-ring binders and shall hold pages firmly while allowing the easy removal, addition, or replacement of pages. In the appendix of the draft report only there shall be a statement listing the persons who had significant and specific input into the report's preparation. This statement will include the individual's name, job title, and telephone number.

APPENDIX A

SITE SPECIFIC SAFETY AND HEALTH PLAN
RFI Phase II (soils) STUDY
FOR OBP, NWSC CRANE

SITE-SPECIFIC SAFETY and HEALTH PLAN
for NWSC, CRANE, IN
for
OLD BURN PIT

20 September 1990

(FIRST DRAFT)

PREPARED FOR

U.S ARMY CORPS OF ENGINEERS (WES)

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APPENDICES

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APPENDIX B EMERGENCY CONTINGENCY PLAN, LOG/RECORD
APPENDIX C CHEMICAL FACT SHEETS

1.0 PURPOSE

The Site-Specific Safety and Health Plan (SSHP) establishes procedures that are to be followed in order to protect Corps of Engineers' employees from potential safety and health hazards arising from the collection of soil samples from the area of and adjacent to the Old Burn Pit, (OBP) SWMU # 05/03 of the Naval Weapons Support Center (NWSC) Crane Indiana. Any contract personnel required on this job will be required to develop and implement a SSHP that meets the minimum requirements that are outlined in the following SSHP. Supervisors are to ensure that employees understand and follow these guidelines.

2.0 LOCATION and SITE DESCRIPTION/HISTORY

The NWSC is located in the northern half of Martin County, in southwestern Indiana , approximately 75 miles southwest of Indianapolis and 71 miles northwest of Louisville, Kentucky. The nearest major metropolitan area is Bloomington Indiana approximately 40 miles northeast on State Highway 45. NWSC occupies approximately 100 sq. miles zone (62,463.46 acres) which includes 1,006 acres of improved grounds, 49,611 acres of unimproved grounds, and 800 acres of water. The area is divided into facility operations, safety buffer and security zones and surrounding farmland (Figure 1,). The area is extremely isolated,(High Security) and is not accessible to the public.

The exact site location is designated as the Old Burn Pit and is located in the central portion of the facility in the NE 1/4 of section 8, T5N, R4W. The area is approximately 2000' east of the Crane Gate, Gate #4. It is accessed using Crane Road H-331 off of Crane Road H-5 (Figure 2, 3). The area is slight rolling terrain with a canopy of deciduous tree growth.

The OBP was used from 1942 to 1972. Garbage and trash was burned at the site. This included wood, paper, building material and industrial wastes. No explosives wastes were burned here. Waste barrels have been found in the area, and the sample area will be cleared prior to drilling. The material was burned in a depression or pit structure. Ash residue from this burning operation along with metallic objects were buried in the gully to the north of the burn pit.
Contaminants have been found in groundwater samples. Amounts of trans-1,2-dichloroethylene, chloroform, and trichloroethylene exceeding 50 ppb have been detected.

3.0 Weather Extremes . The climate in the region of NWSC is a temperate climate with broad seasonal variations. Characterized by a mean January temperature of 26 degrees F and a mean July temperature of 89 degrees F. Precipitation averages approximately 44 inches annually, with 42 inches of rainfall and 15 inches of snowfall. Humidity averages 40 to 90 % in the summer and 60 to 90 % in the winter. Both heat stress and cold stress are significant potential hazards and severe weather with thunderstorms are also a possible feature of the area (Appendix A).

4.0 Investigation Activities and Associated Hazards

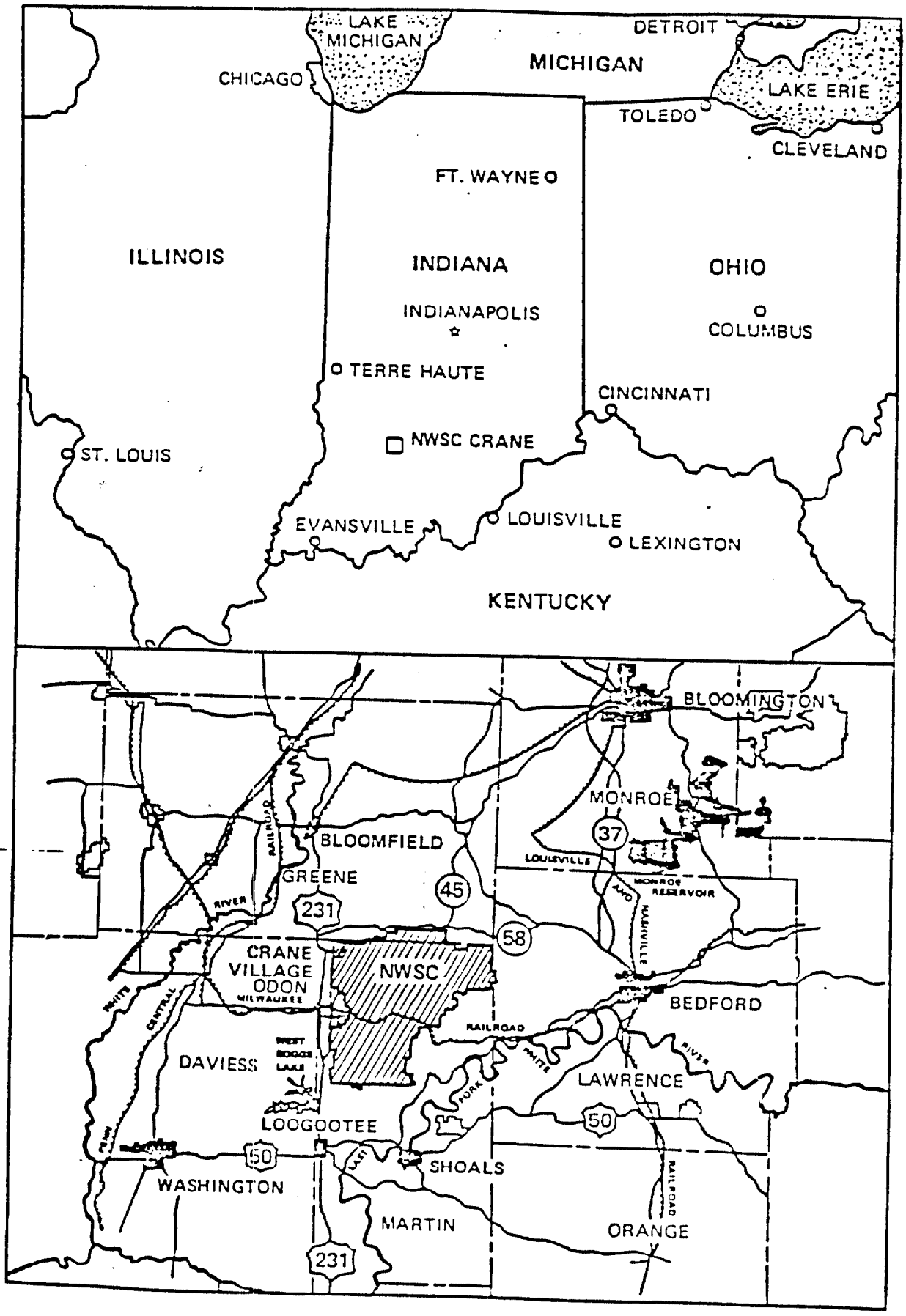
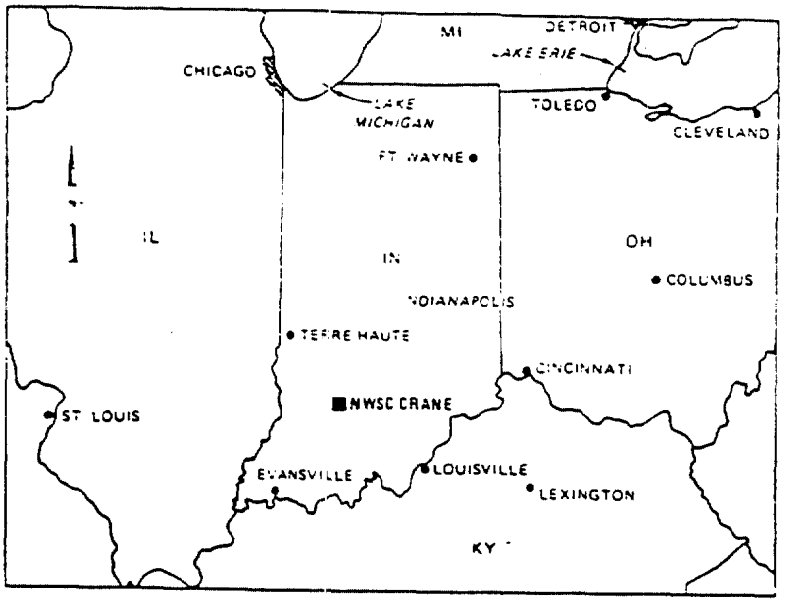


Figure 1. NWSC and Vicinity



Location Map showing the location of NWSC CRANE in the SW Center of Indiana & the Old Burn Pit located in the northwest corner of NWSC CRANE.

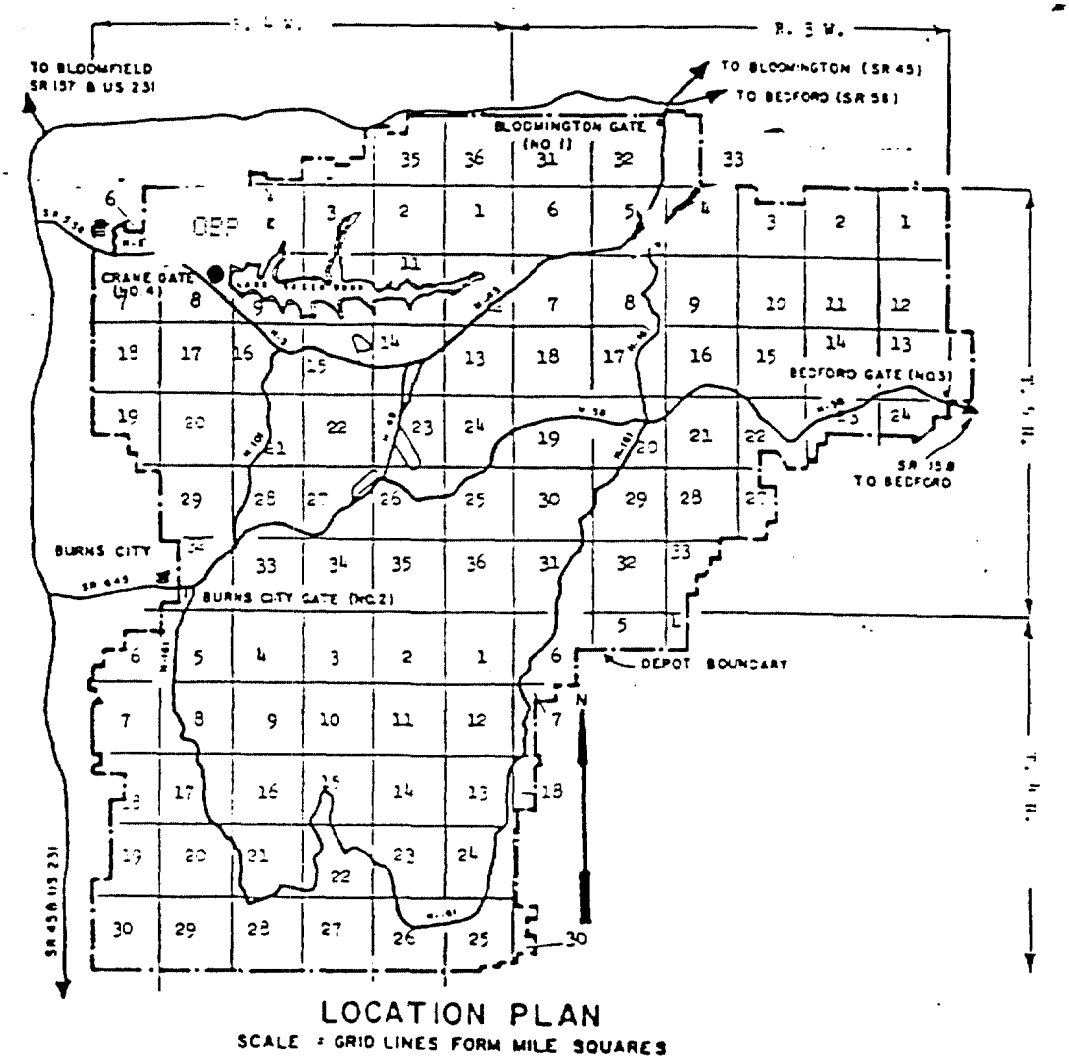


Figure 2. Location Map, NWSC CRANE, and Old Burn Pit

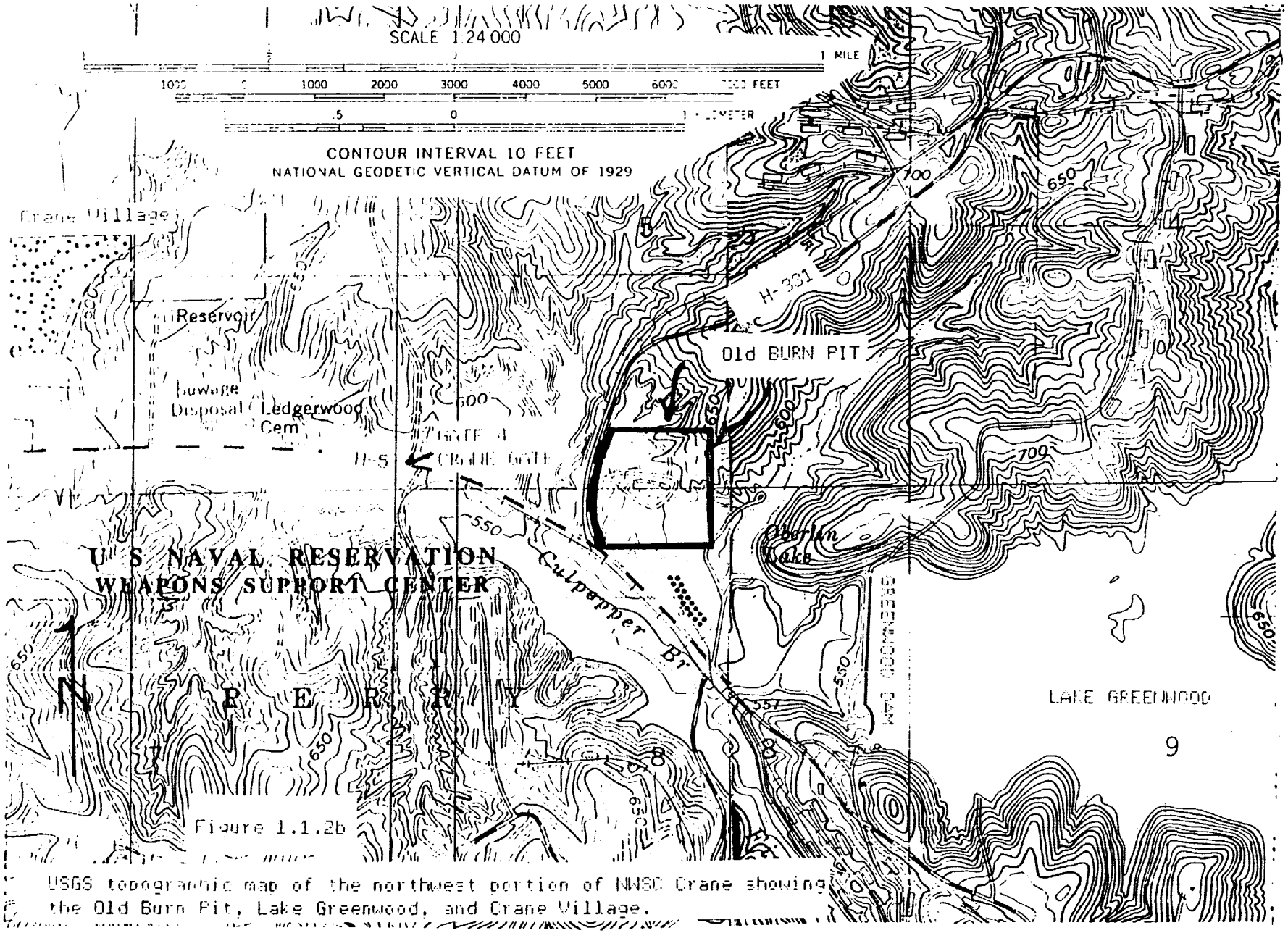


Figure 3. Topographic Map of the northwest portion of NWSC, and the Old Burn Pit.

4.1 Drilling. Drilling will be performed at the site for the collection of soil samples for chemical analysis. Some of the bore holes will penetrate material known or suspected to contain hazardous material. The sampling and drilling have limited potential for exposing employees to parts per million (ppm, mg/m3) levels of organic vapors, carcinogens, and heavy metals. Primary exposure routes during drilling operations will be skin absorption, ingestion and inhalation due to vapors and contaminant volatilization from the drill cuttings. Drilling will take place in and adjacent to the possible source of contamination. Health hazards risks due to drilling and sample handling are considered, minimal .

All work shall comply with all Federal, State and Local health and Safety requirements, including the Occupational Safety an Health Administration's (OSHA) requirements (29 CFR 1910 and 1926), the U.S. Environmental Protection's Agency's (EPA) hazardous waste requirements (40 CFR 260-270), the U.S. Army Corps of Engineers Safety and Health Manual (EM 385-1-1, April 1981, Revised October 1987 and all NWSC CRANE and U.S. Army Corps of Engineers safety directives and policies.

All drill sites will be cleared with local utilities to ensure that there are no underground utilities present. All known underground utilities will be located and marked. All drilling sites will be inspected for health

5.0 Hazard Assessment and Contaminant Characterization

5.1 Physical

5.1.1 Heat and Cold Stress Appendix A.

5.1.2 Heavy Equipment. A truck-mounted drilling operations present inherent noise and equipment hazards, a Job Hazard Analysis is attached (Appendix A).

5.1.3 Chemical. A description of contaminants found in monitoring wells and a listing of possible contaminants (TLV's,STEL's,PEL's) is provided in (Table 1). Chemical data sheets and pertinent information of contaminants is found in Appendix C.

5.1.4 Radiological. Contact with radiological contaminants is not anticipated based on the results of previous WES testing.

5.1.5 Biological. Biological Hazards include insects (ticks, mosquitoes) and two species of poisonous snakes (Appendix A).

6.0 Site Investigation Personnel. The following US Army Corps of Engineer personnel sampling (drill crew) under the direction of a Corps of Engineers supervisor will perform the investigation activities.

PROJECT MANAGER _____
ON-SITE TEAM LEADER _____
ALTERNATE _____
SITE SAFETY COORDINATOR (SSC) _____
PUBLIC INFORMATION OFFICER _____
SECURITY OFFICER _____

Table 1

High Contaminant Concentration Ranges at the
Monitoring Wells at Old Burn Pit
1982

CONTAMINANT	TLV-TWA	PEL	STEL	IDLH
Trichloroethylene	50ppm 269mg/m3		200ppm 1070mg/m3	1000mg/m3
NIOSH-Reduce to lowest Possible				Ca
Chloroform	10ppm 49mg/m3		50ppm for 10 min	1000ppm
synonym(Trichloromethane)				Ca
NIOSH-Reduce to Lowest Possible				
Trichlorofluoromethane	1000ppm	5620 mg/m3	NO DATA AVAILABLE	NO DATA
synonym(Freon 11)		C(Synergistic)		
Dichloromethane	50ppm	103mg/m3	100ppm/207mg/m3	
synonym(Methyl Chloride)				Ca
NIOSH-Reduce to Lowest Possible				
1,2-Dichloroethylene	200ppm	793mg/m3	NO DATA	4000ppm
synonym(Acetylene dichloride)				
1,1-Dichloroethane	200ppm	810mg/m3	250ppm 1010mg/m3	1000ppm
synonym(Ethylidene chloride)				
1,1,1-Trichloroethane	350ppm	1910mg/m3	450ppm 2460mg/m3	1000ppm
synonym(Methyl chloroform)				
Vinyl chloride	1ppm		** Confirmed Ca	
synonym(Chloroethane)	5ppm ACGIH			
Benzene	1ppm		Ca	
synonym(Coal tar naptha)				
Mercury	.01mg/m3		.03mg/m3	
** Skin Hazard				
Lead	.15mg/m3		Ca	
Chromium	.5mg/m3		Ca	
Selenium	.2mg/m3		100mg/m3	
Silver	.1mg/m3			
NIOSH-Lowest Possible Exposure				
Arsenic	.2mg/m3			Ca

ACGIH-TLV/TWA Threshold Limit Value-Time Weighted Average, An airborne concentration of substance under which it is believed that nearly all workers may be repeatedly exposed day after day (8hr ,40hr workweek) without adverse effects.

" Skin " Notation. Listed substances followed by skin, refer to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either by airborne or more particularly, by direct contact with the substance.

Ca Confirmed or Suspect Carcinogen. Note, if high values occur, no cartridge filter respirators are approved protection.

STEL Defined as a 15 min TWA exposure which should not be exceeded at anytime during a work day even if the 8hr TWA is within the TLV-TWA.

IDLH Immediately Dangerous to Life and Health. No exposure at all, allowed at this level.

NIOSH-Lowest Possible Exposure Recommended exposure below ACGIH TWA.

RECORD KEEPER _____
FIELD TEAM LEADERS (DRILLERS) _____
FIELD TEAM HELPERS
OTHER AGENCY REPRESENTATIVES _____
_____
CONTRACTOR (S) _____

7.0 Responsibility

7.1 On Site Team Leader

Responsible for managing field operations coordinating permission for site access, briefing site workers on specific assignments, arranging safe secure storage of drill cuttings and water brought to the surface and enforcing site control.

7.2 Site Safety and Health Officer

The Site Safety and Health Officer (SSHO) or Site Safety Coordinator (SSC), has the responsibility and qualifications to implement the site specific safety and health plan on this project. This is to include the authority to cease the operation if he/she determines any unsafe conditions exist or if the Site Safety and Health Plan is not being implemented correctly. He/She will monitor or inspect site conditions, equipment, protective clothing and other safety plan requirements. He/she is responsible for safety meetings and the monitoring of personnel for signs of environmental stress (i.e heat/cold).

The SSC will modify the SSHP as required due to additional information discovered during on-site work.

7.3 Public Information Officer

Responsible for releasing any information to news media and the public concerning site activities.

7.4 Security Officer

In conjunction with a high level of security at the Crane to restrict public access, the security officer will help establish safe working zones (Exclusion Zone) and restrict access to unauthorized personnel.

7.5 Recordkeeper

Records all field activities, including monitoring results, and visiting personnel.

7.6 Field Team Leader (Driller)

Responsible for Drill Crew operation and safety. Following the job hazard analysis attached and managing the drilling, sampling and well installations. All drilling sites will be inspected for health and safety hazards by the Site Safety Coordinator or Driller, prior to entering the site with drilling equipment. The SSC will then take all corrective measures necessary to safely

work at the site. This inspection and all corrective measures will be documented and communicated to all site workers.

7.7 Field Team Members (Helpers)

Responsibility to comply with all aspects of the Site-Specific Safety and Health Plan, and to notify the SSC or supervisor of any unsafe conditions.

8.0 Worker Protection Requirements

8.1 Training Requirements. All personnel who will be engaged in hazardous waste operations must first present to the SSC certification of completion of a 40 hr hazardous waste site investigation course and 8 hrs of annual update training as required. This training must comply with OSHA regulations found in 29 CFR 1910.120(e). At least two members of each crew will have a valid certification in First Aid and CPR. Personnel not safety trained will not be allowed within the control zone (a 30 foot radius) of any field investigations being conducted at the site.
Besides initial training, all personnel involved in field investigations will be required to have site-specific training. Topics to include, in site training sessions for on-site personnel include:

1. Biological, Chemical, and Physical Hazards. The biological, chemical and physical hazards at the site and their respective properties will be discussed.
2. Toxicology. The potential routes of exposure to chemicals, the possible toxic effects, the IDLH (Immediately Dangerous to Life and Health) and TLV (Threshold Limit Value) values of chemical hazards at the site, and the level of personal exposure which can be anticipated will be discussed.
3. Personal Hygiene. Personal cleanliness and the prohibiting on the eating, drinking, and smoking on the site will be discussed. Note, all eating, drinking, smoking is prohibited in the exclusion zone.
4. Rights and Responsibilities of Workers under OSHA. Applicable provisions of the Occupational Safety and Health Act (29 CFR 1910,1926 the US Environmental Protection Agency's Hazardous waste requirements (40 CFR 260-270) and the Corps of Engineers Safety and Health Program (EM 385-1-1) will be discussed.
5. Monitoring Equipment. The functions, capabilities, limitations use and maintenance of monitoring equipment will be discussed. A hands-on review will be held with persons assigned to use the equipment.
6. Site-Specific Safety and Health Plan. The full SSHP will be reviewed, and a field SSHP will be available to each on-site worker.
7. Standard Operating Procedures. SOP's for this work will be reviewed. These SOP's are included in the appendices.
8. Personal Protective Equipment. The use, care, and disposition of the specific PPE selected for this work will be discussed. The PPE will be available for hands-on familiarity and practice donning, as needed. Individual respirator fit testing will be conducted at this time, if needed.
9. Medical Program. Handling of medical emergencies will be discussed. The names, locations and telephone numbers of an available physician, ambulance, and hospital will be posted and available.
10. Decontamination. The decontamination procedures established for this work will be discussed.

11. Emergencies. The Emergency Contingency Plan contained in the SSHP will be reviewed.
12. Public Relations. The SSC and Public Affairs Officer will be provided with instruction in communicating with the press and local community.

8.2 List of Trained Personnel

The following is a list of all trained personnel, training content (initial, supervisory, refresher, etc., date received, trainer and location, for the specific HTW operation.

PERSONNEL	TRAINING	DATE	TRAINER/LOCATION
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____

9.0 Medical Monitoring Requirements. All site personnel will participate in a medical monitoring program. The respective components and divisions of this plan are shown in Table 2. All examinations are implemented by a licensed physician who is board-certified/board-eligible in occupational medicine. All personnel who will be engaged in hazardous waste operations must first

Table 2 . Medical Monitoring Program

1. Pre-employment Screening
   a. Medical history.
   b. Occupational history
   c. Physical examination
   d. Determination of fitness to work wearing protective equipment.
   e. Baseline monitoring for specific exposures.

2. Periodic Medical Examinations
   a. Yearly update of medical and occupational history; yearly physical examination ; testing based upon (1) examination results, (2) exposures, and (3) job class and task.
   b. More frequent testing based on specific exposures.

3. Record-keeping and Review
   a. Maintain and provide access to medical records in accordance with OSHA and state regulations.
   b. Report and record occupational injuries and illnesses.
   c. Review health and safety plan periodicallly to determine if additional testing is needed.
   d. Review medical monitoring program periodically in light of current site hazards, exposures, and industrial hygiene standards.

present to the SSC certification of completion of the comprehensive medical monitoring examination within 12 months prior to the beginning of site activities. The medical monitoring program complys with OSHA regulations found at 29 CFR 1910.120(f) and Corps of Engineers requirements.
The COE provides their employees with an annual indepth physical examination, including blood chemistry with complete blood count and differential; urinalysis; medical history; required chest X-ray; audiograms; pulmonary function testing; and a physician's interpretation of the employee's ability to wear a respirator. The examination may include testing for heavy metals, i.e. lead, arsenic, mercury and pesticides (i.e DDT,DDE).

The following signatures from each individual on the site verifies completion of requirements and Date of latest examination received:

PERSONNEL	DATE

10.0 Site Inspections Meetings. To ensure that the SSHP is followed, the SSC shall conduct safety meetings before and after each day's work. All individuals will attend these meetings. The purpose of these meetings is to:

- Coordinate site work activities.
- Describe any changes in the SSHP.
- Obtain worker feedback on conditions affecting health and safety.
- Obtain feedback on how well the HSP is working, and discuss needed changes
- Reinforce proper work habits (i.e use of "Buddy System).

10.1 Site Inspections. The SSC will inspect daily site conditions, facilities , equipment, and activities to determine whether the SSHP is adequate and being followed. In order to make inspections effective, the SSC shall:

- Have a checklist applicable for each site and activity, listing the items to be inspected.
- Review results of these inspections with supervisors and workers in the safety meetings.
- Inspect again any identified problems to ensure that they have been corrected.
- Document all inspections and subsequent follow-up actions. Retain these records until site activities are completed and turn them in to the Geotechnical Branch at the conclusion of the work.

The frequency of inspections shall be made more or less commensurate with the characteristics of the site the equipment used on the site, and the progress of the work on the site.

10.2 Personnel Protection.

10.2.1 Division of Work Area. Considering the isolated area and the low levels of contaminants revealed in earlier sampling, no formal division of the work area will be made at the start of sampling. However, if air monitoring indicates the need to minimize the transfer of hazardous substances from the work site and to ensure proper protection of personnel, three zones will be established. The three contiguous work zones are (1) Zone 1: Exclusion Zone, (2) Zone 2: Contamination Reduction Zone, and (3) Zone 3: Support Zone (Figure 4).

10.2.1.1 Exclusion Zone. Contamination does or could not occur in this zone. All people entering the Exclusion Zone must wear Modified Level D protection as a minimum. An entry and exit point for personnel and equipment will be established at the periphery of the Exclusion Zone to regulate the flow of personnel and equipment by the Site Safety Coordinator.
The outer boundary of Zone 1, the Hotline, will initially be established as a 30-ft radius circle surrounding the drill rig or completed hole when bore samples are gathered. This Hotline will be defined in the field by a printed hazard ribbon or equal. Factors that will be considered in extending this boundary will be air monitoring data, the physical area necessary to conduct site operations, and the potential for contaminants to be blown from the area, but in no case will the circular boundary have a radius of less than 30-ft.

10.2.1.2 Contamination Reduction Zone. Between the Exclusion Zone and the Support Zone will be the Contamination Reduction Zone which will provide a transition between the potentially contaminated zone and the clean zone. Zone 2 will serve as a buffer to further reduce the probability of the clean zone becoming contaminated. It will provide additional assurances that the physical transfer of contaminating substances on people equipment, or in the air will be limited through a combination of decontamination, zone restrictions, and work functions. Exit from the Exclusion Zone will be through this Contamination Reduction Zone.

10.2.1.3 Support Zone/Command Post The Support Zone will be considered a non-contaminated area. The location of support facilities in the Support Zone and readily accessible to the nearest road. Support facilities (i.e command post. equipment trailer, first aid station,) will be located in this zone. Since normal work clothes are appropriate within this zone, potentially contaminated personal clothing, equipment, and samples are not permitted in this zone. The on-site support zone/command post have been established at_____ _____. The prevailing wind conditions are _____ _____. This location is upwind from the Exclusion Zone.

10.2.1.4 Work Zone Integrity. The integrity of the division of the work zone during duty hours shall be maintained by control of access and egress. Before crossing into another zone, a person will be admitted by the Site Safety Coordinator or Security Officer only after having given proper identification, authorization and certification of required training and medical examinations. The Site Safety Coordinator will record each person's:

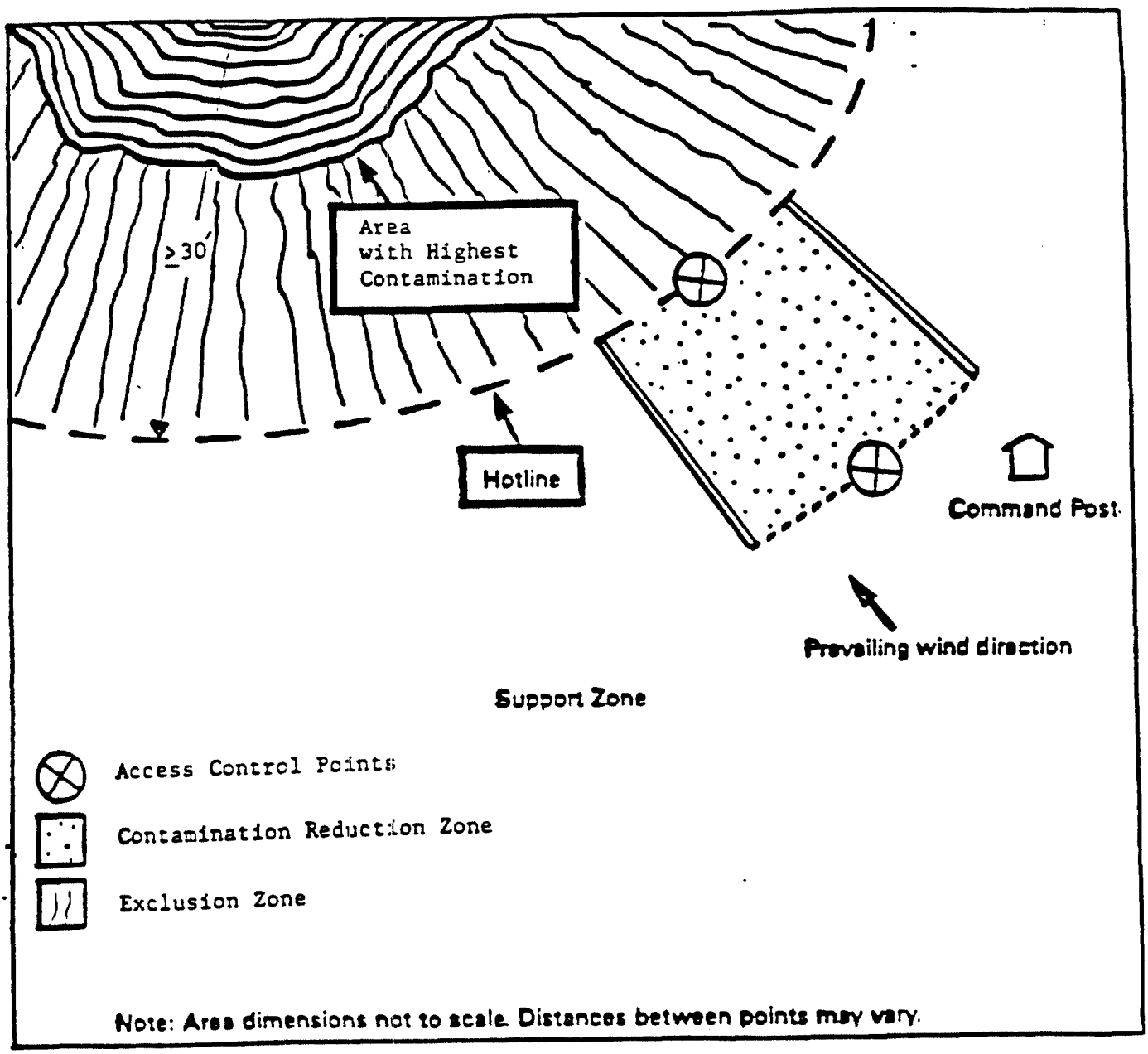


Figure 4. Site Work Zones

- Name
- Status (in or out)
- Time of entry
- Anticipated exit time
- Areas to be entered
- Task to be performed
- PPE worn if applicable

Access to any divisions of the work zone during off-duty hours shall be controlled by security at NWSC. They will be appraised of the work at the site and its hazards and will be instructed in contacting emergency services.

10.2.2 Personal Protective Equipment

10.2.2.1 Proposed Levels of Protection. Personal protective equipment will be worn or used as required by this SSHP. No downward changes to the level of protection is allowed without the approval of the SSC. In addition, a first aid kit, fire extinguishers and some form of emergency will be available on site.

Based on the evaluation of potential hazards, the Modified Level D is prescribed for all activities on this activity, Level C PPE will be available on the site. Except for the Support Zone, where no level of protection beyond general safety PPE (i.e Hardhat/boots) will be required.

Modified Level D protection includes:
- Tyvex disposable coveralls
- Gloves latex, Gloves chemical resistant
- Chemical-resistant safety boots with steel toes and shanks
- Disposable boot covers
- Hard hat
- Safety glasses or chemical splash goggles
- Hearing protection (ear plugs, ear canal caps or muffs)
- Splash Gear (rubber gloves, boots and rainsuit or apron)

Monitoring will be periodically performed with a photoionization detection in the breathing zone during all investigation activities to ensure that the level of protection is proper. Upon detection and identification of contaminants by air monitoring surveillance the Site Safety Coordinator will, if necessary, upgrade the level of protection to Level C.

Level C protection includes:
- Full-face respirator
- HEPA particulate filter cartridges
- HEPA organic vapor/acid gas cartridges
- Splash gear
- Steel toes boots, Boot Covers
- Hearing protection
- gloves, chemical resistant
- Boots, chemical resistant
- Gloves, latex
- Disposable coveralls
- Hard Hat

10.2.2.2 PPE Inspection. All PPE will be inspected by the Site Safety Coordinator prior to being issued to workers on the job. The exception will be individually issued items such as respirators, which are previously fit tested by each individual. The Site Safety Coordinator will:

- Inspect and operational testing of newly received equipment
- Inspection of equipment prior to issue to workers
- Inspect multiple-use equipment after use or training and prior to maintenance
- Periodically inspect stored safety equipment
- Insure all site workers have been trained in the use of PPE

Equipment inspection will follow procedures specified by PPE manufacturers.

The SSC will maintain records of all inspection procedures. Individual identification numbers shall be assigned to all multiple-use pieces of equipment, and records will be maintained by that number. Inspections, will record the ID number, date, inspector's name and findings. Damaged or otherwise objectionable equipment shall be repaired or removed from the job.

10.2.2.3 Donning PPE. A routine will be established for donning PPE. Once the equipment has been donned, fit will be evaluated by the SSC.

10.2.2.4 Work Mission Duration. Before the workers actually begin work in their PPE ensembles, the anticipated duration of their work mission will be established. Several factors will be considered in determining mission length. These include:

- Suit/ensemble permeation and penetration by chemical contaminants.
- Ambient temperatures

10.2.2.5 In-use Monitoring. During equipment use, workers will be encouraged to report any perceived difficulties to their supervision. These difficulties include, but are not limited to:

- Degradation or permeation of PPE
- Perception of odors
- Skin irritation
- Unusual residues on PPE
- Discomfort
- Resistance to breathing (if respirators are worn)
- Fatigue due to respirator use
- Interference with vision or communication
- Restriction of movement
- Personal response such as rapid pulse, nausea, and chest pain

10.2.2.6 Temperature Stress. Site training will address the topics of heat stress and cold stress as presented in (Appendix A).

10.2.2.7 Storage. PPE will be stored properly to prevent damage or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures and/or impact. The SSC shall be responsible for proper storage of PPE.

10.2.3 Air Monitoring. A program will be established for the periodic surveillance to detect changes in the areas of investigation sites so as to continually ensure the accuracy of the division of the work area and the adequacy of worker protection. During investigation activities, the Site Safety Coordinator will monitor the work site for (1) combustible gas concentrations and for (2) organic vapors.

10.2.3.1 Combustible Gas Concentrations. During drilling, the SSC will monitor the work area to detect, measure, and document any explosive concentrations of contaminants. Explosion potential measurements will be made using a combination combustible gas/oxygen (CGM) (Neotronics Meter, Exotox Model 40-OFH) and hydrogen sulfide meter. Drill crews shall use the CGM while drilling to determine if any explosive potential exists within the working area. Readings taken at the barrel or opening of the boring are indicative of vapor-gas escape, but may be inaccurate or inconclusive. Readings taken approximately one foot above the source indicate a greater potential for a hazardous condition developing. Readings one foot above a source showing 20% of LEL or greater requires an immediate shut down of operation and area evacuation of the Exclusion Zone until bore readings return to background levels. The Industrial Hygienist (IH) or Safety Office shall be notified to determine further action. All readings shall be recorded on direct reading forms (Appendix B). Potential for oxygen deficient atmosphere is unlikely for the work being conducted. Hydrogen sulfide will generally not be a problem in this project, but any readings greater than 10ppm of Hydrogen Sulfide above a source require an immediate shut down. The IH or Safety Office shall be notified immediately to determine further action.

10.2.3.2 Organic Vapors/Photoionization Indicating Device (PID) The SSC shall use a photoionization detector (HNU Systems Model 101, Hazardous Waste Detector) to monitor the levels of ionizable vapors at the investigation site. Depending on the investigation activity, 1-min measurements will be made in the bore hole, at ground level, and at the worker's breathing zone. The PID will be calibrated relative to benzene concentration or to standards traceable to benzene. In the event that the PID detects a contaminant(s), a 0.5a Draeger tube for benzene will be used to confirm the presence of benzene and its concentration. Benzene will be specifically monitored for each drilling. If benzene is detected, but its concentration is below 5ppm in the breathing zone, work will stop, and the IH or Safety Office will be notified to inquire about donning respirators. If the benzene level exceeds 5ppm in the breathing zone, all personnel will evacuate the Exclusion Zone until bore hole readings return to background values, and the SSC will call the designated Safety Office or IH for further instruction.

If benzene is not detected, the protection level will be based on total organic concentration levels for a 1-min detector reading in the breathing zone. The following protection levels will be used for concentration measurements in the breathing zone:

Concentration	Protection Level or Action
0-5 units above background	Modified Level D PPE will be worn

5-50 units above background	The SSC will suspend work and consult the IH or Safety Office about donning respirators (Level C PPE) and dividing the work area into zones.
>50 units above background	Evacuation of Exclusion Zone

10.2.4 Decontamination

10.2.4.1 Standard Procedures. All personnel, clothing and equipment leaving the Exclusion Zone (if applicable) must be decontaminated to remove any contaminants. Decontamination activities will be conducted in the Contamination Reduction Zone. The location of the Contamination Reduction Zone is shown in Figure 4 Site Work Zone, and its layout is shown in Figure 5. For personnel, the following steps will be taken for decontamination:

Station 1. Deposit equipment (tools, sampling devices and containers, monitoring instruments, clipboard etc.) on plastic drop cloths.
Station 2. Scrub outer boots, outer gloves, and splash suit with decon solution or detergent water. Rinse thoroughly with water.
Station 3. Remove outer boots and gloves. Deposit in a canister lined with a plastic liner.
Station 4. If a worker leaves the Exclusion Zone to change a canister or mask, this is the last step in the decontamination procedure. Obtain a new canister, don new outer gloves and boot covers, tape joints, and return to work.
Station 5. Remove boots, chemical-resistant splash suit, and inner gloves and deposit in separate containers lined with plastic.
Station 6. Remove facepiece/shield, and deposit it on a plastic sheet.
Station 7. Wash hands and face thoroughly. Shower as soon as possible.

The equipment needed to perform the decontamination steps as follows:

Station 1. Containers of variable sizes
Plastic liners
Plastic drop cloths
Station 2. Containers (20-30 gallons)
Decon solution
Rinse water
2 to 3 long-handled, soft-bristled brushes
Station 3. Container (20-30 gallons)
Plastic liners
Bench or stools
Station 4. Masks and cartridges
tape
Boot covers
gloves
Station 5. Containers (20-30) gallons
plastic liners
Bench or stools
Station 6. Plastic sheets
Wash basin or bucket
Bench and stools
Station 7. Water

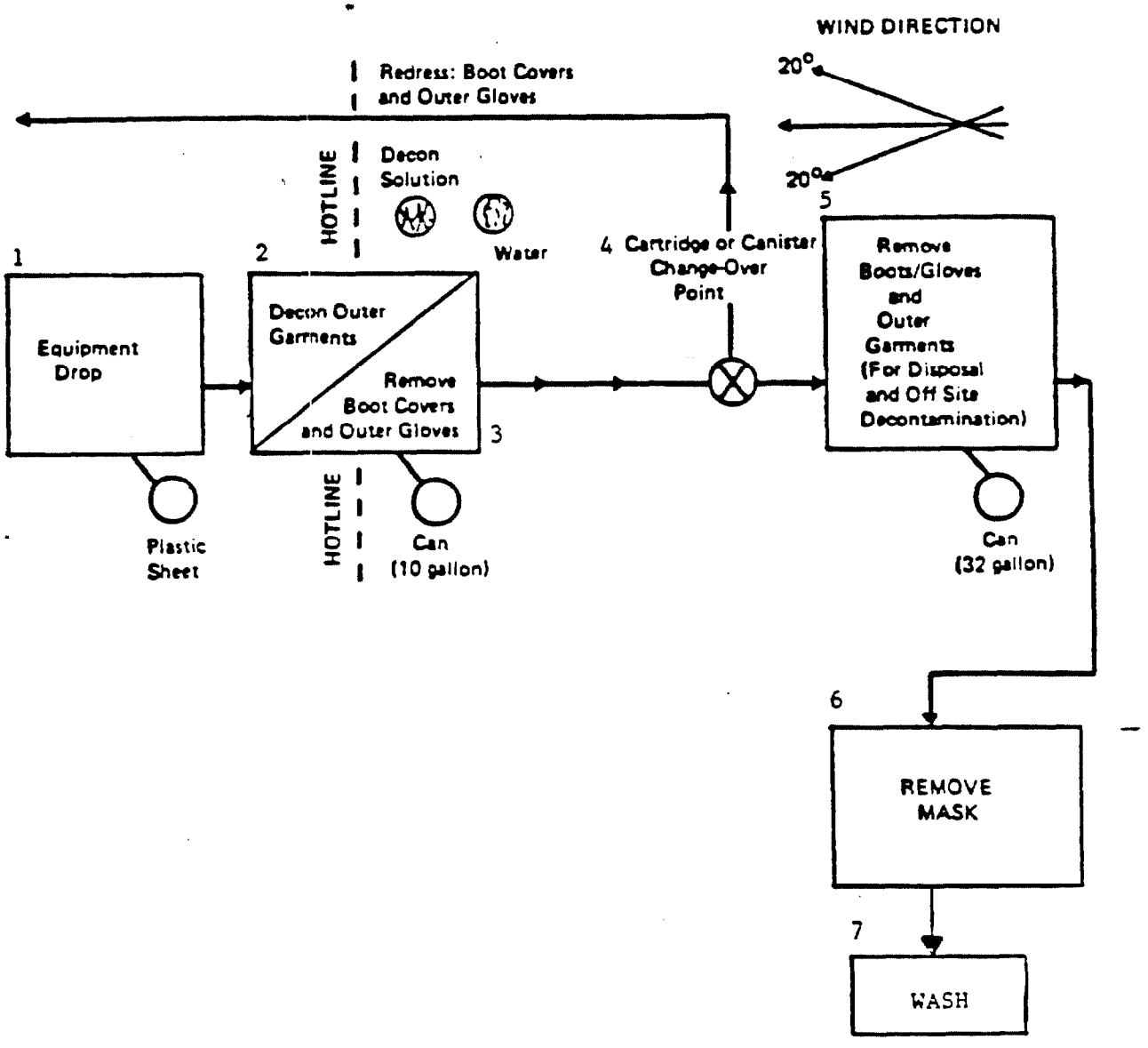


Figure 5. Contamination Reduction Zone Layout

Soap
Tables
Wash basin or bucket

For equipment, the following steps will be taken for decontamination:

1. Remove any solid particles from the equipment by brushing and then rinsing with tap water. For drilling equipment , steam cleaning is necessary.
2. Wash equipment with a detergent solution.
3. Rinse with tap water by submerging or spraying.
4. For organic contaminants, an optional rinse with a solvent (methanol or acetone) may be used to dissolve and remove contaminants.
5. Rinse thoroughly with distilled water.
6. Air dry equipment or rinse with methanol.

To protect delicate instruments prior to use in the Exclusion and Contamination Zones, they shall be placed in a clear plastic bag, and the bag shall be taped and secured around the instrument. Openings are made in the bag for sample intake. The plastic bag shall be discarded appropriately in lieu of decontamination.

The supplies needed to decontaminate equipment follows:

- Decontamination solutions.
- Cleaning liquids: detergent solutions, tap water, distilled water, and methanol.
- Chemical-free paper towels.
- Cleaning brushes.
- Cleaning containers; plastic buckets and galvanized steel pans.
- Waste storage containers: drums and plastic bags.

Decontamination solutions and rinses shall be contained collected and stored until they shall be analyzed to determine suitable disposal methods.

10.2.4.2 Emergency Decontamination. If immediate medical treatment is required to save a life, decontamination will be delayed until the victim is stabilized. If decontamination can be performed without interfering with essential first aid , decontamination will be performed immediately.

11.0 Contingency Plan

11.1 Line of Authority. The SSC will be responsible for all decisions relating to site safety. This includes overseeing all the worker protection requirements. The SSC will ensure that all participants conduct their work in accordance with the SSHP, and will direct any employee to leave the site if the employee fails to observe safety requirements or in any way creates a safety hazard. The SSC will be backed up by a specified alternate. Other personnel who may be involved in emergency response will be identified and their respective roles defined, at least two emergency response personnel on the job shall be certified in CPR and First Aid.

11.2 Pre-emergency Planning. The SSC will contact the local hospital emergency room, the local poison control center, and the NWSC security, fire and ambulance services before activities begin. The SSC will

inform the hospital emergency and ambulance service of probable emergencies. At the investigation site, the SSC shall ensure that adequate emergency equipment is at the investigation site, and designated emergency signals audible and universal hand signals are understood,in case of radio failure.

- Three vehicle horn blasts is an emergency signal to leave Exclusion Zone
- Hands gripping throat (Out of AIR), Grip Partners Wrist (Leave Area NOW) Hands on Head (Need Assistance), Thumbs Up(OK, Allright), Thumbs Down(No)

Emergency equipment shall include:
- Mobile telephone/Radio Communication (optional) And in this project not authorized, Phone Number _____
- First Aid Kits
- Portable Eyewash and shower
- Blankets
- Stretchers
- Water in portable containers
- Fire-fighting equipment and supplies
- Level B PPE, available from NWSC

11.3 Fire and Accident Procedures. All employees will be made aware of the fire and accident response procedures by site-specific training prior to start of work. And the available support from the local Crane Spill Response Team (Appendix B, Spill/Emergency Contingency Plan).

11.3.1 Fire Response

1. Report fire
2. Secure equipment and vehicles.
3. Only attempt to extinguish small controllable fires which can be easily controlled with portable fire fighting equipment (i.e 5 lb ABC, Co2) until help arrives, unless imminent danger exists. Evacuation will be necessary whenever an uncontrollable fire threatens health and safety at the site. Notify the NWCS fire department immediately following evacuation.

11.3.2 Accident Response

1. Remove the injured or exposed worker(s) from the immediate danger.
2. If decontamination can be done, first wash, rinse and/or cut off protective clothing and equipment next render first aid as needed, and then call for transport to the hospital.
3. If decontamination cannot be done, first wrap the victim in blankets or plastic to reduce contamination of other personnel. Next alert emergency and off-site medical personnel of potential contamination and instruct them of specific procedures if necessary.

4. Evacuate other personnel from the immediate affected area to a safe location until the Safety Coordinator determines that the site is safe for work to resume.

11.4 Emergency Information

11.4.1 Site Maps. Site maps showing topographic features, prevailing wind direction, work zones, and evacuation routes shall be posted conspicuously at the work site in locations known to all personnel. Site personnel must verify these numbers upon arrival to the site and prior to beginning any activities.

11.4.2 Emergency Telephone Numbers The following list of emergency telephone numbers will be posted conspicuously. And all site personnel will be told their locations. (attached)

EMERGENCY SERVICE/CONTACTS	TELEPHONE NUMBER
- USEPA Environmental Response Team	201/321-6460
- US Coast Guard Environmental Response Team	800/424-8802
- Association of American Railroads Response Team	202/293-4048
- Project Manager Robert Magee	919/251-4709
- Health & Safety Officer Ben Bryant	
- Fire Department NWSC CRANE	812/845-1235 or 854-1333
- Police/Security Department NWSC CRANE	812/854-3300
- State Police INDIANA STATE POLICE	812/332-4411
- Hospital NWSC CRANE	854-1220
BEDFORD MEDICAL CENTER	854-1339
- Ambulance On-Site/Off-Site NWSC CRANE	854-1100
LAWRENCE CO	279-6545
- Poison Control Center	800/382-9097

****

Name of Hospital: BEDFORD MEDICAL CENTER

Telephone Number: 812/275-1200

Hospital Address: 2900 WEST 16th ST.
BEDFORD IN. 47432

Route to Hospital Take left at Bedford Gate South, directly to city of Bedford, take first left onto 16th St.

Distance to Hospital: approx. 20 miles

11.5 Emergency Documentation. All incidents involving personal injury shall be investigated and documented so that preventive measures may be taken to avoid similar incidents. At a minimum, the following steps shall be taken:

- Notify the Safety and Occupational Health Office
- Prepare the Accident Report, Eng 3394, in accordance with Corps of Engineers regulations.
- Prevent the work area from being disturbed until the accident investigation is completed.
- Notify NWSC personnel in accordance with their regulations.

12.0 Logs, Records, and Reports The following logs, reports, and records shall be developed, retained and made available to entitled regulatory agencies upon request: (1) Training logs; (2) Medical records; (3) Daily safety meeting reports; (4) Daily air monitoring logs; and (5) Daily safety inspection logs. The daily records for safety meetings, air monitoring, and inspections will be kept in a separate safety and health log book, Appendix B contains blank record forms.

13.0 Field SSHP Appendix C contains a condensed version of this SSHP for consultation by Corps of Engineer employees at the work site. Copies of the field SSHP will be made available to each worker and also to the Site Safety Coordinator in addition to the full version of the SSHP.

14.0 Changes to the SSHP The Site Safety Coordinator will submit changes to the SSHP for approval by the District Safety and Occupational Health Office prior to implementing the changes.

15.0 Plan Approval

District Safety Officer

Name	Signature	Date
THOMAS L. MUST	Thomas L Must	24 Sept 90

Other Approval

16.0 Statement of Understanding

All site personnel have read the above plan or field copy and are familiar with its provisions. The following signature certifies that they have read, understand and comply with the guidelines set forth in this Safety Plan.

Site Safety Officer:

Name	Signature	Date

Project Team Leader:

_____ _____ _____

Site Personnel

_____ _____ _____
_____ _____ _____
_____ _____ _____
_____ _____ _____

Name Signature Date

17.0 References

(1) U.S Army Corps of Engineers (USACE), Safety and Health Requirements Manual, EM 385-1-1, October 1987.

(2) Occupational Safety and Health Administration (OSHA), Construction Industry Standards, 29 CFR 1926, and General Industry Standards, 29 CFR 1910; 29 CFR 1910.120 " Hazardous Waste Site Operations and Emergency Response ",
Federal Register, Vol. 54, NO. 42, dated 6 March 1990.

(3) NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities", October 1985.

(4) EPA " Standard Operating Safety Guides", July 1988.

(5) Hawley's , Condensed Chemical Dictionary, 11 Edition, Van Nostrand Reinhold Company, NY. 1987.

(6) Sax, Dangerous Properties of Industrial Materials, Fifth Edition, Van Nostrand Reinhold Company, NY,79.

(7) ACGIH, Threshold Limit Values and Biological Exposure Indices for 1989-1990, 2nd Edition, Cincinnati, Ohio.

APPENDIX A
STANDARD OPERATING PROCEDURES

SOP	TITLE	PAGE
A	SEVERE THUNDERSTORMS/TORNADOES	A-1
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STANDARD OPERATING PROCEDURE A

SEVERE THUNDERSTORMS AND TORNADOES

Meteorological conditions shall be closely watched, especially in the spring, when severe thunderstorms and tornadoes are most likely. Often they occur late in the afternoon on hot spring days, but they can occur at any time of the day in any season of the year. Usually, tornadoes are preceded by severe thunderstorms with frequent lightning, heavy rains, and strong winds.

A severe storm watch or a tornado watch announcement on radio or television indicates that a severe thunderstorm or tornado is possible. No work is permitted in the Exclusion Zone during thunderstorms, severe thunderstorm watches or tornado watches.

A severe thunderstorm warning or a tornado warning signify that a severe thunderstorm or a tornado has been sighted or detected by radar and may be approaching. All work on site shall stop during the time of a severe thunderstorm warning or tornado warning.

Personnel on site during a tornado shall take the following steps:

- Leave office trailers or vehicles.
- If outdoors, lie flat in a nearby ditch.
- Beware of lighting hazards. Stay away from power poles, electrical appliances, and metal objects.
- Do not try to outrun a tornado.

ACTIVITY Earth drilling operations

ANALYZED BY REVIEWED BY DATE

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
	Defective equipment.	Pre-operation check of fluids, pressures, clearances, gauges, warning devices, safety devices, operation of controls, belts, hoses, nuts/bolts, drilling fluid levels, etc.
	Two-blocking of hoist.	Anti two-blocking device and alarm.
	Operation of hoists beyond capacities.	Know capacities and loads; use hoists only for their designed intent, not for lifting other materials and personnel.
Drill operations	Personnel caught in machinery during start-up and operation.	Sound alarm to warn persons prior to starting/engaging equipment; proper machine guarding; lubrication points shall be located in safe positions; use long-handled shovels to move auger cuttings away from the auger; clean augers only when the rotation mechanism is in neutral and the auger stopped.
	Contact w/hazardous chemicals agents in soil.	Pre-work surveys to identify previous use of land; soil sampling, if necessary to determine type and concentrations of hazards; use protective clothing.
	Contact with hazardous drilling fluids.	Train workers in hazards of fluids (MSDS); proper protective cothing.
	Defective equipment.	Periodically inspect (same as above).
	Hoisting hazards.	Use slings/chains - don't wrap hoist line around object.
	Clothing/equipment caught in reciprocating equipment.	Don't wear loose clothing, jewelry; keep body parts, rags, tools, etc. away from equipment.
	Tripping (housekeeping) hazards.	Keep work area clean and equipment properly stored/secured
	Striking head, head struck.	Use of hard hats.
	Object falling on foot.	Use of steel-toed safety boots.

ACTIVITY HAZARD ANALYSIS

ACTIVITY Earth drilling operations

ANALYZED BY REVIEWED BY DATE

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
General	Lack of knowledge in safety requirements and safe use of equipment.	Training in safety requirements (EM 385-1-1); training in manufacturer's literature (e.g., operator,s manual); review of activity hazard analyses.
	Pre-existing physical condition; physically unqualified.	Pre-employment and follow-up physical examinations.
	Unfamiliar with project rules and procedures.	Project safety and health orientation; make accident prevention plan available to employees.
	Exposure to the elements.	Meet minimum clothing requirements.
Traveling	Collision.	Know dimensions/capacities of rig; trained and licensed operators.
	Persons riding rig.	Prohibit persons riding on rig in other than proper seating arrangements.
	Running over objects.	Require use of spotter.
	Moving equipment w/mast up.	Prohibit moving equipment with mast up; interlock to prevent movement of equipment with mast up; warning device to sound when equipment is moved with mast up.
	Traveling on rough terrain.	Survey terrain prior to travel; if necessary, smooth terrain prior to operation; move equipment parallel to slope; use of spotter to identify terrain hazards.
Set-up	Contact w/overhead electrical lines.	Use of proximity warning devices; warning signs; training.
	Unstable ground.	Check ground stability prior to set-up.
	Machinery out of level.	Extend and level outriggers; use of warning device.

ACTIVITY Earth drilling operations

ANALYZED BY REVIEWED BY DATE

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
	Hands cut by equipment.	Use of work gloves.
	Dust.	Use of wet drilling techniques or other dust control procedures.
	Foreign object in eye.	Use of goggles.
	Hazardous noise.	Use of hearing protection devices; enrollment, if necessary, in hearing conservation program.
	Hazards of on-line maintenance and repair.	Stop and lockout/block energized equipment; lower mast for repairs. grease/lubrication fittings located at safe positions.
	Contact w/underground utilities.	Contact utilities/review existing site plans to identify ungerground utilities.
	Climbing/falls from rig.	Use safe means of access; fall protection devices if necessary; clean mud and grease from shoes prior to climbing rig.
	Uncovered boreholes (tripping hazards).	Cap/flag boreholes.
	Operation during electrical storm.	Monitor weather if necessary; cease operations when thunderstorms are impending.
	Hazards w/rod slipping device.	Do not run/rotate drill rods through device; do not hoist more than 1 ft. of drill rod column above the top of the mast; do not hoist a drill rod column which has loose tool joints; do not make up, tighten, or loosen tool joints while the rod column is supported by a rod slipping device.
	Improperly secured/-stored rod sections.	Ensure drill rod columns which are not being used are properly stored and secured.
	Hazardous air due to operation in enclosed areas (incl. trenches).	Air monitoring; compliance with confined space procedures.
	Operator leaving station during rig operation.	Operators required to remain at station at all times of operation.

ACTIVITY Earth drilling operations ANALYZED BY REVIEWED BY DATE

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
	Hazards in using hoists (incl. cathead) and wire rope.	Keep the cathead clean and lubricated; periodically inspect rope and keep rope clean; periodically check cathead for rope wear groves; compliance with hoist and wire rope requirements.
	Rope grabbing on cathead.	Release rope and warn others to back away and keep clear of rig; shut down engine and take safe measures to release hoisted load.
	Objects pulled into cathead.	Rope handler shall maintain at least 3 ft. clearance from cathead; keep rope free and untangled.
	Starting/guiding auger.	Use auger guide on hard surfaces; apply adequate down pressure on drill rod to penetrate ground surface prior to starting auger; start auger slowly and watch to ensure a controlled penetration into the ground; if auger head slides out of alignment, stop and repeat process.
	Rotary and core drilling - hydraulic equipment.	Compliance with requirements for hydraulic equipment.
	Rotary and core drilling - general.	Inspect and maintain water swivels, hoisting plugs, and drill rod chuck jaws.

SNAKE BITES

Normally, the noise of a person approaching a snake habitat is sufficient to frighten the snakes off. However, extreme caution is necessary when exploring areas where snakes might be found, such as behind rocks, under bushes, or in holes, crevices, and abandoned pipes.

The rules to follow if bitten by a snake are:

- Do not cut the bite area as it will exacerbate the effect of the venom.
- Do not apply suction to the wound as it is minimally effective in removing venom.
- Do not apply a tourniquet since venom is most dangerous when concentrated in a small area.
- Do not allow the victim to run for help as this allows accelerates circulation.
- Do seek immediate medical attention.
- Do keep the victim calm and immobile.
- Do have the victim hold the affected extremity lower than the body while waiting for medical assistance.

TEMPERATURE STRESS

- Heat Stress. Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. Because heat stress is probably one of the most common illnesses at hazardous waste sites, regular monitoring and other preventative precautions are vital.

To monitor heat stress, the Site Safety Coordinator will have workers count their pulse during a 30-second period as early as possible in a rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the Site Safety Coordinator will shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, the Site Safety Coordinator will shorten the following work cycle by one-third.

The frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (See Table 1).

The Site Safety Coordinator will take the following preventative steps:

- Adjust work schedules as required in the following ways:

  Modify work/rest schedules according to physiological monitoring results.

  Mandate work slowdowns as needed.

  Alternate job functions to minimize overexertion at one task.

- Perform work during cooler hours of the day, if possible.

- Provide cooled shelter or shaded areas to protect personnel during rest periods.

- Maintain workers' body fluids at normal levels.

- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:

  Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.

  Cooling jackets, vests, or suits.

- Train workers to recognize and treat heat stress. As part of on-site training, identify the signs and symptoms of heat stress (See Table 2.).

Table 1

Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers

ADJUSTED TEMPERATURE[b]	NORMAL WORK ENSEMBLE[c]	IMPERMEABLE ENSEMBLE
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°–90°F (30.8°–32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°–87.5°F (28.1°–30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°–82.5°F (25.3°–28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°–77.5°F (22.5°–25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Source: Reference [13].

[a]For work levels of 250 kilocalories/hour.

[b]Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 × % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[c]A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Table 2

Signs and Symptoms of Heat Stress

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms
  - pain in the hands, feet, and abdomen
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - dizziness and confusion
  - strong, rapid pulse
  - coma

If work is performed continuously in the cold at an equivalent chill temperature (ECT) below 20°F, heated warming shelters shall be made available nearby; the frequency of use of these shelters shall depend on the severity of the environmental exposure. The onset of intense shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria, are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing shall be removed and the remainder of the clothing shall be loosened to permit sweat evaporation, or a change of dry work clothing shall be provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration occurs insidiously in cold environments and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of caffeinic beverages shall be prohibited because of diuretic and circulatory effects.

As part of on-site training, workers will be instructed in:

- Proper warming procedures and appropriate first aid treatment.

- Proper clothing practices.

- Proper eating and drinking habits.

- Recognition of impending frostbite.

- Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body (See Table 4.).

- Cold Stress. Cold injury (frostbite and hypothermia) and impaired ability to work are dangers at low temperatures and when the wind-chill factor is low. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve. Specifically, for exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of -25°F (See Table 3.), and at air temperatures of 34.6°F or less it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Table 3

Wind Chill Factor Chart*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* In < hr with dry skin. Maximum danger of false sense of security				*INCREASING DANGER* Danger from freezing of exposed flesh within one minute.				*GREAT DANGER* Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Table 4

Symptoms of Cold Exposure

Stages of Frostbite

1. Whitening of skin
2. Waxy skin
3. Skin firm to touch
4. Tissues cold, pale, and solid

Stages of Hypothermia

1. Shivering
2. Apathetic, sleepy, lowered body temperature
3. Glassy stare, slow, pulse, slow breathing, unconsciousness
4. Freezing of extremities
5. Death

APPENDIX B

SPILL CONTINGENCY PLAN

NAVAL WEAPONS SUPPORT CENTER, CRANE, INDIANA 47522

EPA IDENTIFICATION NUMBER - IN5170023498

AMENDED OCTOBER 1988

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This Document Has Been Reviewed By:

Steve Seitzinger P. E.

I. Background:

40 CFR 264.50 and 329 IAC 43 regulations require the preparation of a Spill Contingency (SC) Plan outlining in detail the emergency procedures to be effected if a spill or release of hazardous material occurs which could threaten human health or the environment. OPNAVNOTE 6240 (20 February 1980) and OPNAVINST 5090.1 (26 May 1983) directed all Navy facilities to prepare and submit a Spill Contingency Plan along with a Spill Prevention, Control and Countermeasures (SPCC) Plan and a Hazardous Waste Management Plan.

II. Purpose and Scope:

The purpose of this SC Plan is to provide response procedures for a spill or release of hazardous material and/or waste within the boundaries of the Naval Weapons Support Center Crane (NWSCC), Crane, Indiana. This plan is intended to enable the NWSCC to meet the requirements of Federal and State regulations and Navy instructions concerning hazardous material spills. This plan will be modified as necessary to meet any future requirements.

This plan will be implemented in case of incident within the boundaries of NWSCC wherever hazardous material is spilled or released in an unplanned manner and presents any threat to human health or the environment.

III. Mission

The NWSCC is situated on a 62,463-acre tract of land in southwest Indiana. It is located in the northern portion of Martin County and extends into neighboring Daviess, Greene, and Lawrence Counties.

Crane's mission is to "Provide quality and responsive engineering, technical and material support to the Fleet for combat subsystems, equipment and components; Microelectronic Technology, Microwave Components, Electronic Warfare, Acoustic Sensors Test, Electrochemical Power Systems, Conventional Ammunition Engineering Pyrotechnics, Small Arms, Electronic Module Test and Repair, Electronic Warfare, as assigned by the Commander, Naval Sea Systems Command." Under the Single Service Management Program, a segment of the Center's mission includes support of the Crane Army Ammunition Activity (CAAA). This Army activity is tasked with the production and renovation of conventional ammunition and related items; the performance of manufacturing, engineering, and product quality assurance to

support production; and the storage, shipment, and/or demilitarization and disposal of conventional ammunition and related components.

Approximately 4348 people are employed at NWSCC. Of these, about 747 personnel work for the Army. The Center engages these people in a variety of processes and functions to accomplish the missions of the Navy and Army. A tremendous assortment and volume of hazardous materials are used for this purpose.

IV. Who are the Environmental Emergency Coordinators? 329 IAC 3-43-3(d) and 3-43-6

The primary and alternate Environmental Emergency Coordinators (EEC) listed in this section are available at all times, either on-site or on-call, to coordinate emergency spill response measures. If they are unavailable, the Fire Division shift captain will act as On-Scene Commander (OSC) until the Environmental Protection Branch Manager or alternates arrives on the scene. In cases where a fire involved, the OSC will remain in charge until the fire is controlled. At that time, the OSC can transfer command to the EEC.

Three Indiana Page Beepers have been assigned to the Environmental Protection Branch (Code 0924) so that Code 0924 personnel can be reached in transit to and from work and during off-work hours.

Process for using the Beepers is:

-Dial number assigned to the beeper Wats 701_____

-It will ring 2 times and then you will hear 3 computer beeps.

-Key in the phone number you want the person to call and follow up with the * sign.

-It will then beep and you will get a busy signal. Hang up.

-It is then in the computer and the beeper will be notified.

Each person listed below is thoroughly familiar with this plan as well as operations and activities of the regulated units listed in Appendices I, II, and III. Each person has the authority to commit the resources necessary to carry out this plan.

Primary Contact: NWSCC Environmental Protection Branch Manager, Jim Hunsicker (Code 0924), work phone 812-854-1132 or 3114. Home address: 408 12th St., Huntingburg, IN 47542, home phone 812-683-3323. To make contact by beeper dial 7-0-1-278-2447.

Alternate: NWSCC Environmental Protection Assistant, Phil Keith (Code 09247), work phone 812-854-3114 or 1132. Home address: 2526 North 14 1/2 Street, Terre Haute, IN 47804, home phone: 812-466-7592. To make contact by beeper dial 7-0-1-278-2441.

2nd Alternate: NWSCC Environmental Protection Assistant, Jerry McCracken, (Code 09241), work phone 812-854-3114 or 1132. Home address: R.R.#1, Box 55, Bloomfield, IN 47424, home phone: 812-384-3073.
To make contact by beeper dial 7-0-1-278-2445.

3rd Alternate: NWSCC Fire Division Shift Captain, work phone 1235. Below is a list of potential shift captains.

Name	Title	Address	Phone # (Area Code 812)
David Anderson	Asst. Fire Chief	Box 71 Sandborn, IN 47578	694-8879
Larry Wools	Asst. Fire Chief	P.O. Box 118 Linton, IN 47441	847-9593
C. Scott Wolfe	Fire Captain	R. R. #1 Loogootee, IN 47558	295-3694
James W. Wires	Fire Captain	R. #3, Box 36 Orleans, IN 47452	849-4195
Sam Wilcoxen	Fire Captain	R. R. #1, Box 205 Milltown, IN 47145	633-7525
Phillip Burger	Fire Captain	R. R. #2, Box 218 Bloomfield, IN 47424	384-4000

V. Duties of Emergency Coordinators:
329 IAC 3-43-6 and 3-43-7

The primary duty of the EEC is to coordinate and supervise all spill response efforts. This includes:

A. Notifying and organizing the spill response team and other needed personnel.

B. Enacting further spill containment procedures.

C. Identifying the type/chemical composition of the spill.

D. Evacuating and securing the area of the spill as necessary.

E. Notifying or Reporting spill to the DUTY OFFICER AND COMMANDING OFFICER. The EEC will also contact the NATIONAL SPILL RESPONSE CENTER, INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT and outside authorities in the community (State Police, local hospitals and Local Emergency Planning Commissions) as necessary. Telephone numbers for aforementioned personnel and Agencies is found in Appendix IV.

F. Initiation of spill cleanup and equipment decontaminatio.

VI. Spill Response Team (SRT):

A. Drills: Routine drills and exercises in spill containment procedures involving key personnel will be performed periodically.

B. The regular members of the SRT will include the following:

1. Environmental Protection Branch Manager, who serves as the EEC (extension 3114/1132);

2. Hazardous Waste Handlers (extension 1192 or page by dialing extension 3125, then dial 236 or 240 after beeping tone stops);

3. Environmental Protection Assistants;

4. Public Works shops personnel, Codes 04, 104, EOD, 10, Disaster Preparedness Team, or other personnel will be notified according to the discretion of the OSC and/or the EEC.

VII. Authorization Statement: 329 IAC 3-43-6

The EEC and the OSC have the authority to call in any personnel (EOD, Public Works, Industrial Hygiene, Safety, etc.) needed in an emergency situation. In situations where the EEC and the OSC have assessed that a release, fire or explosive threatens human health or the environment outside the facility, the Captain should be advised of the situation simultaneously as outside officials are being notified. If a spill cleanup contractor is to be called in, the Captain, Technical Director, and Public Works Officer should be notified and advised of the decision, and the contractor contacted. If the Captain, Technical Director or the Public Works Officer are not available, the OSC or EEC will proceed with contacting and requesting the services of a contractor.

VIII. <u>Identification of Hazardous Materials:</u> 329 IAC 3-43-7(b)

A. If there is a release, fire, or explosion, the EEC will immediately identify the character, exact source, amount and areal extent of any released materials to the extent possible with respect to the release circumstances.

B. If the identity of the spill material is not known or relayed by the report of the spill, the EEC may be able to determine the identity on the basis of the location of the material and knowledge of the related processes in its vicinity. The Environmental Protection Branch has data files of processes and storage areas involving hazardous wastes/materials throughout the Center. This information file will also be of assistance in determining the exact source of the spill. Identification of spilled material can also be made by actual observation or production records to determine what materials are being used by process. Samples may be taken to verify the identity of the released material. Analysis could be received back if analyzed: on-Center - 24 hours; off-Center - 48 hours.

C. A member of the Center's spill response team will be dispatched by the EEC to determine or verify the reported volume of the spill, as well as to investigate the cause of the release, through observation and discussions with key personnel in the area. If a spill occurs locally during transit of a hazardous waste/material, logs and/or manifests and label information will provide data on the identity, volume and source of the spill.

IX. <u>Assessment:</u> 329 IAC 3-43-7(c) and (e)

A. Concurrently while identifying the character, exact source and areal extent of any released materials the EEC will assess possible hazards to human health and the environment due to emergency incident. This assessment would be developed through consultation and coordination with representatives from NWSCC's Safety, Medical, Fire, and Security Departments and the Explosive Ordnance Disposal detachment. The assessment should address:

1. Direct and indirect results from the release, fire, or explosion;

2. Effects of any toxic, irritating or asphyxiating gases that are generated;

3. Effects of any hazardous surface water run-off from water or chemical agents used for fire control.

B. The following resources would be reviewed by the assessment group to complete the hazards assessment:

1. Material Safety Data Syeets for material involved in incidents, to determine decomposition by-products;

2. Chemical reference documents such as Sax Dangerous Properties of Industrial Materials, Merck Index, Condensed Chemical Dictionary, Lange's Handbook of Chemistry, and Emergency Handling of Hazardous Materials;

3. Analytical data that is available for material spilled.

C. The assessment group would also have to evaluate means of egress and direction for any spill or gas/smoke cloud to leave the facility to determine what areas would have to be evacuated. After reviewing the situation and determining that a release (spill, fire or explosion) has occurred which can affect human health and the environment outside facility boundaries, the following notifications would be made:

1. Outside notification of state or local police, local hospitals in Bloomington, Linton, Vincennes, Jasper, Washington, or Bedford, will be made by the OSC or EEC. The hospitals will be advised by the Center's medical staff of any related injuries resulting in transportation of injured parties to the hospital for treatment;

2. If areas outside the Center must be evacuated, and traffic rerouted, the state police will be advised of such by the EEC, as well as the nature of the hazards involved;

3. The EEC will immediately notify either the government official designated as the on-scene coordinator for that geographical area, (in the applicable contingency plan under 40 CFR Part 300) or the National Response Center, the Indiana Department of Environmental Management's 24-hour emergency number and the Martin County Sheriff's Department and will seek outside assistance from these agencies as necessary. The key telephone numbers for emergency spill response are found in Appendix IV.

X. Emergency Plan for Off-Center Spill Incidents:

Appendix V is a formal Center instruction establishing an emergency action plan for off-Center incidents involving hazardous materials shipped by a government vehicle, or a private carrier dispatched by the Supply Department, or where the Center is the nearest government activity and assistance is requested.

XI. Notification: 329 IAC 3-43-7(a)

If an imminent or an actual situation should occur, the EEC will immediately: Activate or cause to be activated internal alarms and/or communications systems in order to notify operating personnel and will notify or cause to be notified appropriate contingency response agencies if their help is needed. As soon as possible, the Indiana Department of Environmental Management and the National Response Center will be notified. Their phone numbers are found in Appendix IV.

The following information should be available at time of call:

A. Type of material spilled;
B. Time of spill;
C. Waterway/stream affected;
D. Amount spilled;
E. Count facility located in.

XII. Evacuation Plan: 329 IAC 3-43-3(f)

Appendix IX contains a map of the facility and Primary Evacuation Routes. Site specific evacuation plans are posted in every occupied building on Center.

XIII. Control Procedures: 329 IAC 3-43-7(e)

The operations at NWSCC are so varied and complex that it is difficult to be all inclusive in one plan, therefore, site specific plans are included in Appendix I. The provisions of this plan will be carried out immediately whenever there is a fire, explosion, or release of hazardous waste, hazardous material, or hazardous waste constituents at any of the units listed in Appendices I, II, or III, which could threaten human life or the environment. The EEC will take all measures necessary to contain the incident within the affected area, and will notify the appropriate personnel. Furthermore, a Disaster Preparedness Oil and Hazardous Substances Spill Contingency Plan and Oil and Hazardous Substances Response Plan for NWSCC is enclosed as Appendix X. Descriptions of control and containment procedures of some potential incidents follow:

A. Explosion: In the event of an explosion, operation of the affected unit will be ceased immediately and the Fire Department and Explosive Ordnance Disposal Group Two Detachment (EOD) will be notified of the incident. Operation will not resume until the cause of the explosion has been determined;all repairs, if any, have been completed; and approval to resume operations has been obtained.

B. Fire: In the event of a fire, NWSCC Fire Department and the EEC will be notified immediately. The Fire Chief will be considered On-Scene Commander (OSC) until the fire is brought under control and spill cleanup/containment can begin. The EEC or his alternate will advise the OSC during the fire what action is needed to contain the spill. Such actions as building dams downstream from the fire will be done to collect runoff generated while fighting the fire. Once the fire is out the OSC will transfer authority for cleanup of the area to the EEC. At the discretion of the OSC, non-essential personnel may be evacuated from the immediate area. No operations will be resumed until inspection and approval is obtained from the EEC and/or OSC.

C. Spill: A spill of hazardous waste at any of the buildings listed in Appendices I, II, and III, or along a haul road used to move wastes could occur. However, due to posted speed limits, hazardous waste handling procedures, and safety precautions, spills are unlikely. If a spill does occur, the following procedure would be initiated:

1. Immediately notify the NWSCC Fire Department. The OSC will transfer command to the EEC once it is determined that an imminent threat to human health or safety no longer exists;

2. Notify the EEC immediately after notifying the NWSCC Fire Department;

3. Assess the extent of surface contamination to determine if a hazardous situation exists. The EEC will assess possible hazards to human health or the environment due to the emergency incident. The assessment will consider the short-term and long-term effects of the event. Examples of long-term effects could include effects of toxic gases generated or effects of run-off generated by fire fighting;

4. If the EEC determines that the incident could be harmful to personnel, he may order evacuation of the affected area. Personnel will not return to affected ?

5. Some of the hazardous wastes are in solid form and do not migrate after the spill. A solid waste spill would be cleaned up, and a report documenting the event and cleanup measures would be submitted by the EEC the next day. The operation would not restart until the EEC or his alternate has determined that the spill has been properly cleaned and has given approval for restart of operation;

2. If possible, stop the leak by plugging the hole. For a leaking drum, place the drum on its side with hole or leaking area up, put down absorbent (oil dry) or absorbent pads;

3. Select a compatible container to transfer leaking material into. For waste streams handled on a continuous basis Code 0924 knows what drums are compatible. This information is also available from MSDSs, Bureau of Explosives, Tariff No. BOE-6000, and Dangerous Properties of Industrial Materials by N. Irving Sax and Richard J. Lewis, Sr.;

4. Decontamination and/or neutralization of the area where the spill occurred. As examples, in some cases you may use soap and water to decontaminate or caustic soda;

5. Any contaminated material which cannot be decontaminated will be removed and disposed of as hazardous waste;

6. Certification that the area is clean and can be used again.

E. Major Malfunction of Process Equipment: If a major process equipment item should malfunction, that item would immediately be shut down according to SOP's, and the EEC would be notified. If no threat to human health or the environment exists, and if there is otherwise no reason to remain in a shut-down condition, the proper craftsmen would be notified and remedial action would begin. Operation of the item would not resume until certified safe by the EEC and the Safety Department. Examples of malfunctions could include leaking pumps, ruptured pipes, leaking tanks, etc.

F. Severe Weather Conditions: Occasional severe weather may threaten safe cleanup operations. If severe weather should threaten, waste handling operations would be discontinued.

If any of the aforementioned potential incidents occur, the EEC would monitor for leaks, pressure buildup, gas generation, or ruptures in equipment whenever appropriate. During an emergency, the emergency coordinator will take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous wastes at the facility. These measures will include, where (pplicable, stopping processes and operations, collecting and containing released waste, and removing or isolating containers.

XIV. Storage and Treatment of Release Material: 329 IAC 3-43-7(g)

All recovered wastes, contaminated soil, water, or other substances affected by the emergency incident will be collected to the extent possible, placed in compatible containers, and eiter treated or stored as appropriate in NWSCC's permitted hazardous waste facility.

XV. Disposal: 329 IAC 3-43-7(g)

Waste material generated in a spill cleanup will be turned over to Code 0924 for disposal via the Center's Hazardous Waste Disposal Contractor. All hazardous wastes are stored at Building 2993 while awaiting pickup by contractor for disposal.

XVI. Incompatible Waste: 329 IAC 3-43-7(h)(1)

A. In the case of an emergency incident which results in the recovery of wastes, contaminated soil or water, decontamination solution, or other collected materials, such collected materials will be stored, treated or disposed of with respect to compatibility.

XVII. Prevention of Recurrence or Spread of Fires, Explosions, or Releases: 329 IAC 3-43-7(e), (f), (g), and (h)

During an emergency, the EEC will take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, reoccur, or spread to other hazardous waste at the building. These measures will include, where applicable, stopping processes and operations, collecting and containing releasedwaste, and removing or isolating containers.

The follow-up actions for the EEC are:

A. Investigate the cause of the emergency and submit a formal report to Command within 48 hours;

B. Fire and Accident reports will be submitted;

C. Ensure that proper restoration actions are instituted as soon as possible after decontamination and clean up procedures have been completed. All decontaminationand clean up records will be submitted to the EEC;

D. Ensure that equipment repaired or replaced as a result of an incident is recertified, as necessary, prior to being placed in service;

E. Within 15 days notify Naval Facilities Engineering Command, the Naval Sea System Command, as well as the Commissioner of the Indiana Department of Environmental Management (IDEM) and the EPA Regional Administrator;

F. The EEC must notify the Commissioner of IDEM and appropriate local authorities that the facility is in compliance with, 329 IAC 3-43-7(h) and (i), and 40 CFR 264.56(h) and (i), before operations are resumed in the affected area(s) of the facility;

G. Immediately after an emergency, the EEC and/or OSC will provide for collection, storage, treatment and disposal of recovered waste, contaminated soil and any other material that results from the incident. This waste will be handled as hazardous waste until a chemical analysis can be obtained that proves otherwise. Emergency/Spill residue will be placed in compatible containers and either treated or stored in a permitted/interim status NWSCC hazardous waste storage facility. Any hazardous waste from emergency situations requiring disposal will be sent by NWSCC to and off-site RCRA permitted TSD facility;

H. If waste from an emergency situation is found by analysis to be considered a Special Waste, approvals for disposal and recommended disposal sites will be sought by NWSCC from the IDEM.

XVIII. Post-Emergency Equipment Maintenance: 329 IAC 3-43-7(h)(2)

Any emergency equipment used in response to an emergency incident covered by this Contingency Plan will be cleaned and certified fit for its intended use by the EEC before operations are resumed. This will be accomplished by:

A. Having Industrial Hygiene prescribe procedures for cleaning all respirators and breathing apparatus. After equipment (respirators etc.) have been decontaminated, Industrial Hygiene will be asked to visually inspect each item and certify if it is fit for intended use;

B. Having all boots, coats, etc. decontaminated and inspected for wear and damage;

C. Having all rubber gloves, Tyveks, etc., collected and handled as hazardous waste;

D. Having pumps, shovels, lifting mechanisms, and other equipment decontaminated, inspected by Safety and the EEC and put back in service.

NWSCC Safety and Industrial Hygiene Departments will play a large role in certifying emergency equipment fit for reuse. If there

is any question about a piece of equipment being fit for reuse, it will be discarded or sent back to the manufacturer (if possible) for recertification.

XIX. Materials and Equipment: 329 IAC 3-43-3(e)

Each department on-Center which handles hazardous material in their programs must have equipment to use for immediate response. This equipment and material, as a minimum, should include a transfer pump (of chemically compatible material), absorbent, and empty container(s) on hand to hold spilled material or contaminated absorbent. Safety eye washes and showers and alarm systems should be checked at least weekly to determine if they are functional. Industrial Hygiene can provide protective gear for personnel, and the Public Works' Environmental Protection Branch (Code 0924) has protective gear for use in material handling. Disaster Preparedness has available a large inventory of protective gear to be used if authorized. This equipment includes respirators, coveralls, boots, and gloves. The EEC, EOD Team and Industrial Hygiene have chemical-resistant Tyvek suits suitable for use in handling toxic, skin-absorbed materials or corrosive materials. See Appendix IV for phone numbers.

A variety of equipment for containment, control, cleanup, and decontamination is available. The Public Works Department has loaders, bulldozers, dump trucks, pumps, and tank trucks. Disaster Preparedness has decontamination apparatuses available, trucks, and decontamination chemicals for use if authorized. Code 0924 has a variety of pumps available for cleanup of spills as well as tank patch kits. Absorbent is available from Storeroom 2 or Code 0924. For a complete listing of items, see Appendix VI of this plan.

Facilities are available from the EEC or Disaster Preparedness personnel for decontamination. Showers (portable) and cleaning equipment can be assembled on site, if needed.

The OSC will use the Disaster Preparedness mobile communications van with self-contained generators for 110-volt power as needed. The van is equipped with two-way radios on the frequencies used for mobile communications on-Center, citizens band, and shortwave. Many vehicles assigned to the departments are equipped wity two-way radios, and portable hand-held units are available in Public Works and other departments and can be used for reporting observations in areas remote from a road.

XX. Coordination Agreement: 329 IAC 3-43-3(c) and 3-42-7

As necessary, for major spill incidents, the Center will seek the assistance of community groups (local fire departments, state police, and hospital services). Mutual aid agreements entitled, "Mutual Aid Fire-Fighting Assistance Agreement", have been established between NWSCC and the following:

Martin County (Indiana) Civil Defense, Fire and Rescue
Crane (Indiana) Volunteer Fire Department
Indiana Division of Forestry
Richland-Taylor Township (Indiana) Volunteer Fire Department
Perry Township (Indiana) Volunteer Fire Department
Loogootee (Indiana) Volunteer Fire Department
Odon (Indiana) Volunteer Fire Department
Owensburg (Indiana) Fire Fighters, Inc.
Daviess County Sheriff's Department
Greene County Sheriff's Department
Lawrence County Sheriff's Department
Martin County Sheriff's Department
Indiana State Police Department

A copy of NWSCC's Spill Contingency Plan has been provided to each of the following organizations/hospitals:

Martin County Sheriff's Department
Good Samaritan Hospital, Vincennes, Indiana
Greene County General, Linton, Indiana
Bedford Medical Center, Bedford, Indiana
Bloomington Hospital, Bloomington, Indiana
Daviess County Hospital, Washington, Indiana
Memorial Hospital and Health Care, Jasper, Indiana
Dunn Memorial Hospital and Health Care, Bedford, Indiana

Documentation concerning these agreements, arrangements, letter to Hospital and responses is found in Appendix VII.

At the present time NWSCC does not have agreements with any specific contractor(s) for cleanup of spills. Appendix VIII is a list that would be used to locate or hire a cleanup contractor.

XXI. Required Reports: 329 IAC 3-43-7(j)

The EEC will note in the operating record the time, date, and details of any incident that requires implementing the contingency plan. Within fifteen (15) days after the incident he must submit in a written report on the incident to the commissioner. The report must include:

A. Name, address, and telephone number of the owner or operator;

B. Name, address, and telephone number of the facility;

C. Date, time, and type of incident, e.g. fire, explosion;

D. Name and quantity of material(s) involved;

E. The extent of injuries, if any;

F. An assessment of actual or potential hazards to human health or the environment, where this is applicable; and

G. Estimated quantity and disposition of recovered material that resulted from the incident.

XXII. Amendments to the Contingency Plan: 329 IAC 3-43-5

The EEC will be responsible for reviewing and immediately amending the Contingency Plan, if necessary, whenever:

A. The facility RCRA permit is revised;

B. The plan fails in an emergency;

C. The facility changes in its design, construction, operation, maintenance, or other circumstances in a way that substantially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes in the response necessary in an emergency;

D. The list of emergency equipment changes (minor permit modification); or

E. The list of Emergency Coordinators changes (minor permit modification).

XXIII. Documentation and Cost Accounting:

A. The OSC will maintain a log of all activities related to the spill with times and locations noted in detail. A hand-held recorder (available from Code 0924) will be used for noting details under field conditions where hand writing of notes is slow and cumbersome and may cause loss of pertinent details.

B. Cost accounting will be handled by the Center charge number and accounting system. This system provides separate accounting of labor and material.

DATE: ____________

Site: ______________________________

Activity:
____Drilling ___Soil/Gas ___Groundwater Sampling___ Other (explain)

____

Instrument:
(P) - Photoinization Meter, Type______ Unit/Model______ Calibration______
(C) - Combust Gas/O_2 Meter, Type______ Unit/Model______ Calibration______
(HS)- Hydrogen Sulfide, Type______ Unit/Model______ Calibration______
(DT)- Detector Tubes, Type______ Unit/Model______ Calibration______

Monitoring Requirements: ______________________________

____

General Comments: ______________________________

____

READINGS:

Time	Instr.	Reading	Location	Comments

Prepared by ______________________

DATE: ____________

Site: ____

Activity:
____Drilling ___Soil/Gas ___Groundwater Sampling___ Other (explain)

____

Instrument:
(P) - Photoinization Meter, Type______ Unit/Model______ Calibration______
(C) - Combust Gas/O_2 Meter, Type______ Unit/Model______ Calibration______
(HS)- Hydrogen Sulfide, Type______ Unit/Model______ Calibration______
(DT)- Detector Tubes, Type______ Unit/Model______ Calibration______

Monitoring Requirements: ____
____

General Comments: ____
____

READINGS:

Time	Instr.	Reading	Location	Comments

Prepared by ______________________

APPENDIX C
Table of Contents

Appendix C contains information on the chemicals/compounds previously identified or suspected of being present in the area to be investigated. The tables in the appendix contain physical and chemical property data, hazard information, and toxicological data for the chemical/compound.

1. Trichloroethylene
2. Chloroform
3. Trichlorofluoromethane
4. Dichloromethane
5. 1,2-Dichloroethylene
6. 1,1-Dichloroethane
7. 1,1,1-Trichloroethane
8. Vinyl Chloride
9. Arsenic
10. Barium
11. Cadmium
12. Chromium
13. Lead
14. Magnesium
15. Mercury
16. Selenium
17. Silver
18. Benzene

TRICHLOROETHYLENE

TCL

Common Synonyms	Watery liquid	Colorless	Sweet odor
Trichloroethylene Trilene, Algylen Chlorylen Gemalgene Trichlorylene Trichloran; Trilene	Sinks in water. Irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Avoid contact with liquid and vapor.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, carbon dioxide, or foam.

Exposure

CALL FOR MEDICAL AID

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, difficult breathing, or loss of consciousness.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, difficult breathing, or loss of consciousness.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** $CHCl=CCl_2$
3.3 **IMO/UN Designation:** 9.0/1710
3.4 **DOT ID No.:** 1710
3.5 **CAS Registry No.:** 79-01-6

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Chloroform-like; ethereal

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Organic, vapor-acid gas canister; self-contained breathing apparatus for emergencies, neoprene or vinyl gloves; chemical safety goggles; face-shield; neoprene safety shoes; neoprene suit or apron for splash protection.

5.2 **Symptoms Following Exposure:** INHALATION: symptoms range from irritation of the nose and throat to nausea, an attitude of irresponsibility, blurred vision, and finally disturbance of central nervous system resulting in cardiac failure. Chronic exposure may cause organic injury. INGESTION: symptoms similar to inhalation. SKIN: defatting action can cause dermatitis. EYES: slightly irritating sensation and lachrymation.

5.3 **Treatment of Exposure:** Do NOT administer adrenalin or epinephrine; get medical attention for all cases of overexposure. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting; repeat three times, then give 1 tablespoon epsom salts in water. EYES: flush thoroughly with water. SKIN: wash thoroughly with soap and warm water.

5.4 **Threshold Limit Value:** 50 ppm
5.5 **Short Term Inhalation Limits:** 200 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 50 ppm
5.11 **IDLH Value:** 1,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 90°F C.C.; practically nonflammable
6.2 **Flammable Limits in Air:** 8.0%-10.5%
6.3 **Fire Extinguishing Agents:** Water fog
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Toxic and irritating gases are produced in fire situations.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 770°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 660 mg/l/40 hr/daphnia/kill/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical; dry cleaning; degreasing; extraction
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A

11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	1
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	1

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 131.39
12.3 **Boiling Point at 1 atm:** 189°F = 87°C = 360°K
12.4 **Freezing Point:** −123.5°F = −86.4°C = 186.8°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.46 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 29.3 dynes/cm = 0.0293 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 34.5 dynes/cm = 0.0345 N/m at 24°C
12.10 **Vapor (Gas) Specific Gravity:** 4.5
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.116
12.12 **Latent Heat of Vaporization:** 103 Btu/lb = 57.2 cal/g = 2.4×10^5 J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 2.5 psia

NOTES

TCL	TRICHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
0	94.669
5	94.410
10	94.150
15	93.889
20	93.629
25	93.370
30	93.110
35	92.849
40	92.589
45	92.330
50	92.070
55	91.809
60	91.549
65	91.290
70	91.030
75	90.770
80	90.509
85	90.250
90	89.990
95	89.730
100	89.469
105	89.209
110	88.950
115	88.690
120	88.429
125	88.169

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.220
10	.221
20	.223
30	.225
40	.226
50	.228
60	.230
70	.231
80	.233
90	.235
100	.236
110	.238
120	.240
130	.241
140	.243
150	.245
160	.246
170	.248

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	N O T P E R T I N E N T

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
15	.800
20	.775
25	.750
30	.727
35	.705
40	.684
45	.664
50	.645
55	.627
60	.610
65	.593
70	.577
75	.562
80	.548
85	.534
90	.521
95	.508
100	.496
105	.485
110	.474
115	.463
120	.453

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.110

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
40	.508
50	.678
60	.894
70	1.166
80	1.507
90	1.929
100	2.448
110	3.081
120	3.846
130	4.765
140	5.862
150	7.163
160	8.695
170	10.490
180	12.580
190	15.010
200	17.810
210	21.020

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
40	.01245
50	.01628
60	.02105
70	.02695
80	.03418
90	.04296
100	.05354
110	.06619
120	.08120
130	.09891
140	.11960
150	.14380
160	.17180
170	.20390
180	.24080
190	.28280
200	.33040
210	.38420

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.136
25	.139
50	.143
75	.146
100	.149
125	.152
150	.155
175	.157
200	.160
225	.162
250	.165
275	.167
300	.169
325	.172
350	.174
375	.176
400	.177
425	.179
450	.181
475	.182
500	.184
525	.185
550	.186
575	.187
600	.188

CHLOROFORM

CRF

Common Synonyms	Watery liquid	Colorless	Sweet odor
Trichloromethane	Sinks in water. Irritating vapor is produced.		

Avoid contact with liquid and vapor. Stay upwind.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible. Keep people away.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS AND IRRITATING GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, nausea, dizziness, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing.
Flush affected areas with plenty of water.
IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS AND HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and pollution control officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-air contaminant
Restrict access
Should be removed

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** $CHCl_3$
3.3 **IMO/UN Designation:** 9.0/1888
3.4 **DOT ID No.:** 1888
3.5 **CAS Registry No.:** 67-66-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Pleasant, sweet, ethereal

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Chemical goggles. 50 ppm to 2%: suitable full-face gas mask. Above 2%: suitable self-contained system.
5.2 **Symptoms Following Exposure:** Headache, nausea, dizziness, drunkenness, narcosis.
5.3 **Treatment of Exposure:** INHALATION: if ill effects develop, get victim to fresh air, keep him warm and quiet, and get medical attention. If breathing stops, start artificial respiration. INGESTION: induce vomiting and get medical attention. No known antidote; treat symptoms. EYES: flush with plenty of water for at least 15 minutes and get medical attention. SKIN: wash with soap and water, remove contaminated clothing and free of chemical.
5.4 **Threshold Limit Value:** 10 ppm
5.5 **Short Term Inhalation Limits:** 50 ppm for 10 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 205-307 ppm
5.11 **IDLH Value:** 1,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Poisonous and irritating gases are produced when heated.
6.6 **Behavior in Fire:** Decomposes, producing toxic gases
6.7 **Ignition Temperature:** Not flammable
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not flammable
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical, USP
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water**

Transportation: Category	Rating
Fire	1
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	0
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 119.39
12.3 **Boiling Point at 1 atm:** 142°F = 61.2°C = 334.4°K
12.4 **Freezing Point:** −82.3°F = −63.5°C = 209.7°K
12.5 **Critical Temperature:** 506°F = 263.2°C = 536.4°K
12.6 **Critical Pressure:** 790 psia = 54 atm = 5.5 MN/m²
12.7 **Specific Gravity:** 1.49 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 27.1 dynes/cm = 0.0271 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 32.8 dynes/cm = 0.0328 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** 4.1
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.146
12.12 **Latent Heat of Vaporization:** 106.7 Btu/lb = 59.3 cal/g = 2.483×10^5 J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 17.62 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 6.39 psia

NOTES

CRF	CHLOROFORM

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—50	100.799
—40	100.200
—30	99.549
—20	98.910
—10	98.259
0	97.610
10	96.950
20	96.299
30	95.639
40	94.980
50	94.320
60	93.650
70	92.990
80	92.320
90	91.650
100	90.980
110	90.309
120	89.629
130	88.950
140	88.270

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.216
10	.217
20	.219
30	.221
40	.222
50	.224
60	.226
70	.227
80	.229
90	.231
100	.232
110	.234
120	.236
130	.237
140	.239

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—70	.938
—60	.929
—50	.920
—40	.911
—30	.902
—20	.893
—10	.884
0	.875
10	.866
20	.857
30	.848
40	.839
50	.830
60	.821
70	.812
80	.804
90	.795
100	.786
110	.777
120	.768
130	.759
140	.750

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
0	.847
10	.791
20	.741
30	.697
40	.656
50	.620
60	.586
70	.556
80	.528
90	.503
100	.479
110	.458
120	.438
130	.420
140	.403

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.800

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—30	.150
—20	.217
—10	.309
0	.433
10	.598
20	.816
30	1.099
40	1.462
50	1.924
60	2.505
70	3.229
80	4.124
90	5.220
100	6.551
110	8.157
120	10.080

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—30	.00387
—20	.00548
—10	.00763
0	.01047
10	.01417
20	.01892
30	.02496
40	.03255
50	.04198
60	.05361
70	.06781
80	.08499
90	.10560
100	.13020
110	.15930
120	.19340

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.123
25	.126
50	.129
75	.131
100	.134
125	.137
150	.139
175	.142
200	.144
225	.146
250	.148
275	.150
300	.152
325	.154
350	.156
375	.158
400	.160
425	.161
450	.162
475	.164
500	.165
525	.166
550	.167
575	.168
600	.169

TRICHLOROFLUOROMETHANE

TCF

Common Synonyms
F-11; Freon 11
Genetron 11
Arcton 9
Isotron 11; Estumon 11
Frigen 11
Isotron 11; Ucon 11

Liquid | Colorless | Odorless

Sinks in water. Harmful vapor is produced. Boiling point is 75°F.

Stop discharge if possible. Keep people away.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES MAY BE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.

Exposure

CALL FOR MEDICAL AID.

VAPOR
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Not harmful.

Water Pollution

Not harmful to aquatic life.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** CFCl$_3$
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** Data not available
3.5 **CAS Registry No.:** 75-69-4

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Odorless; weak chlorinated solvent

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Air line respirator; rubber gloves; monogoggles
5.2 **Symptoms Following Exposure:** Breathing concentrations approaching 10% in air will cause dizziness and drowsiness. Contact with tissues may cause frostbite.
5.3 **Treatment of Exposure:** INHALATION: remove victim to non-contaminated area and apply artificial respiration if breathing has stopped; call a physician immediately; oxygen inhalation may be utilized. SKIN: if frostbite has occurred, flush areas with warm water.
5.4 **Threshold Limit Value:** 1000 ppm
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Data not available
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Non-irritating
5.9 **Liquid or Solid Irritant Characteristics:** May cause frostbite.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Produces irritating and toxic products when heated to decomposition temperatures.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** Not flammable
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not flammable
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** None
8.2 **Waterfowl Toxicity:** None
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Safety relief

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-C-I-J

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Data not available
11.3 **NFPA Hazard Classification:** Data not available

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Data not available
12.2 **Molecular Weight:** Data not available
12.3 **Boiling Point at 1 atm:** Data not available
12.4 **Freezing Point:** Data not available
12.5 **Critical Temperature:** Data not available
12.6 **Critical Pressure:** Data not available
12.7 **Specific Gravity:** Data not available
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** Data not available
12.11 **Ratio of Specific Heats of Vapor (Gas):** Data not available
12.12 **Latent Heat of Vaporization:** Data not available
12.13 **Heat of Combustion:** Data not available
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

TCF — TRICHLOROFLUOROMETHANE

12.17 SATURATED LIQUID DENSITY	
Temperature (degrees F)	Pounds per cubic foot
—35	100.200
—30	99.809
—25	99.459
—20	99.110
—15	98.770
—10	98.419
—5	98.070
0	97.730
5	97.379
10	97.030
15	96.690
20	96.339
25	95.990
30	95.650
35	95.299
40	94.950
45	94.610
50	94.259
55	93.910
60	93.570
65	93.219
70	92.870
75	92.520
80	92.179
85	91.830
90	91.480

12.18 LIQUID HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
—140	.189
—120	.191
—100	.193
—80	.196
—60	.198
—40	.200
—20	.202
0	.204
20	.207
40	.209
60	.211
80	.213
100	.216
120	.218
140	.220
160	.222

12.19 LIQUID THERMAL CONDUCTIVITY	
Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	NOT PERTINENT

12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Centipoise
	NOT PERTINENT

12.21 SOLUBILITY IN WATER	
Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.110

12.22 SATURATED VAPOR PRESSURE	
Temperature (degrees F)	Pounds per square inch
—50	.560
—40	.780
—30	1.072
—20	1.451
—10	1.937
0	2.554
10	3.329
20	4.291
30	5.473
40	6.914
50	8.655
60	10.740
70	13.220
80	16.150
90	19.580
100	23.580
110	28.210
120	33.550

12.23 SATURATED VAPOR DENSITY	
Temperature (degrees F)	Pounds per cubic foot
—50	.01749
—40	.02381
—30	.03193
—20	.04223
—10	.05514
0	.07113
10	.09072
20	.11450
30	.14310
40	.17710
50	.21740
60	.26450
70	.31950
80	.38300
90	.45600
100	.53930
110	.63390
120	.74080

12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F (estimate)
30	.127
35	.127
40	.127
45	.127
50	.127
55	.127
60	.127
65	.127
70	.127
75	.127
80	.127
85	.127
90	.127
95	.127
100	.127
105	.127
110	.127
115	.127
120	.127
125	.127
130	.127
135	.127
140	.127
145	.127
150	.127
155	.127

DICHLOROMETHANE

DCM

Common Synonyms	Watery liquid	Colorless	Sweet, pleasant odor
Methylene chloride Methylene dichloride	Sinks in water. Irritating vapor is produced.		

Stop discharge if possible
Avoid contact with liquid and vapor
Isolate and remove discharged material
Notify local health and pollution control agencies

Fire

Not flammable
POISONOUS GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea and dizziness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and pollution control officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Disperse and flush

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** CH_2Cl_2
3.3 **IMO/UN Designation:** 9.0/1593
3.4 **DOT ID No.:** 1593
3.5 **CAS Registry No.:** 75-09-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Pleasant, aromatic; like chloroform; sweet, ethereal

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Organic vapor canister mask, safety glasses, protective clothing.
5.2 **Symptoms Following Exposure:** INHALATION: anesthetic effects, nausea and drunkenness. CONTACT WITH SKIN AND EYES: skin irritation, irritation of eyes and nose.
5.3 **Treatment of Exposure:** INHALATION: remove from exposure. Give oxygen if needed. INGESTION: no specific antidote. CONTACT WITH SKIN AND EYES: remove contaminated clothing; wash skin or eyes if affected.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 500 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard if spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 205-307 ppm
5.11 **IDLH Value:** 5,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable under conditions likely to be encountered.
6.2 **Flammable Limits in Air:** 12%-19%
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Dissociation products generated in a fire may be irritating or toxic.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 1184°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Not pertinent
8.2 **Waterfowl Toxicity:** Not pertinent
8.3 **Biological Oxygen Demand (BOD):** Not pertinent
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Aerosol grade; technical grade
9.2 **Storage Temperature:** Data not available
9.3 **Inert Atmosphere:** Inerted
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	1
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	2
Aquatic Toxicity	1
Aesthetic Effect	2
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	0
Reactivity (Yellow)	1

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 84.93
12.3 **Boiling Point at 1 atm:** 104°F = 39.8°C = 313.0°K
12.4 **Freezing Point:** −142°F = −96.7°C = 176.5°K
12.5 **Critical Temperature:** 473°F = 245°C = 518°K
12.6 **Critical Pressure:** 895 psia = 60.9 atm = 6.17 MN/m²
12.7 **Specific Gravity:** 1.322 at 20°C (liquid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** 2.9
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.199
12.12 **Latent Heat of Vaporization:** 142 Btu/lb = 78.7 cal/g = 3.30 X 10⁵ J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 16.69 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 13.9 psia

NOTES

DCM	DICHLOROMETHANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—70	91.320
—60	90.700
—50	90.080
—40	89.450
—30	88.830
—20	88.200
—10	87.580
0	86.959
10	86.330
20	85.709
30	85.080
40	84.459
50	83.830
60	83.209
70	82.589
80	81.959
90	81.341
100	80.709

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	.274
40	.275
45	.276
50	.277
55	.278
60	.279
65	.279
70	.280
75	.281
80	.282
85	.283
90	.284
95	.284
100	.285

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—110	1.205
—100	1.192
—90	1.179
—80	1.166
—70	1.154
—60	1.141
—50	1.128
—40	1.115
—30	1.102
—20	1.090
—10	1.077
0	1.064
10	1.051
20	1.038
30	1.025
40	1.013
50	1.000
60	.987
70	.974
80	.961

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
	N O T P E R T I N E N T

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	1.380

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—10	.866
—5	1.013
0	1.180
5	1.370
10	1.586
15	1.830
20	2.105
25	2.414
30	2.762
35	3.151
40	3.585
45	4.068
50	4.606
55	5.201
60	5.860
65	6.588
70	7.389
75	8.270
80	9.237
85	10.300

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—10	.01525
—5	.01763
0	.02031
5	.02333
10	.02671
15	.03050
20	.03472
25	.03941
30	.04462
35	.05039
40	.05676
45	.06378
50	.07149
55	.07996
60	.08922
65	.09934
70	.11040
75	.12240
80	.13540
85	.14960

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.126
10	.129
20	.131
30	.133
40	.135
50	.137
60	.139
70	.142
80	.144
90	.145
100	.147
110	.149
120	.151
130	.153
140	.155
150	.156
160	.158
170	.159
180	.161
190	.163
200	.164
210	.165
220	.167
230	.168
240	.169
250	.171

1,2-DICHLOROETHYLENE

DEL

Common Synonyms	Liquid	Colorless	Sweet pleasant odor
Acetylene dichloride sym-dichloroethylene Dyfoorm cis-1, 2-dichloroethylene trans-1, 2-dichloroethylene	Sinks in water. Flammable, irritating vapor is produced.		

[illegible] apparatus
[illegible] ignition sources. Call fire department
[illegible] discharge if possible. Keep people away
[illegible] and remove contaminated material.
[illegible] local health and pollution control agencies

Fire

FLAMMABLE
POISONOUS GASES MAY BE PRODUCED IN FIRE
Containers may explode in fire
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
[illegible] foam or carbon dioxide
Water may be ineffective on fire
Cool exposed containers with water

Exposure

[illegible]

VAPOR
If inhaled will cause dizziness, nausea, vomiting, or difficult breathing.
[illegible]
If breathing has stopped, give artificial respiration
If breathing is difficult, give oxygen

LIQUID
Harmful if swallowed.
[illegible] If victim is CONSCIOUS, have victim drink water
[illegible]

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
[illegible] local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Restrict access
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: ClCH = CHCl
3.3 IMO/UN Designation: 3.2/1150
3.4 DOT ID No.: 1150
3.5 CAS Registry No.: 540-59-0

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Ethereal, slightly acrid; pleasant, chloroform-like

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Rubber gloves; safety goggles; air supply mask or self-contained breathing apparatus.
5.2 Symptoms Following Exposure: Inhalation causes nausea, vomiting, weakness, tremor, epigastric cramps, central nervous depression. Contact with liquid causes irritation of eyes and (on prolonged contact) skin. Ingestion causes slight depression to deep narcosis.
5.3 Treatment of Exposure: INHALATION: remove from further exposure; if breathing is difficult, give oxygen; if victim is not breathing, give artificial respiration, preferably mouth-to-mouth; give oxygen when breathing is resumed, call a physician. EYES: flush with water for at least 15 min. SKIN: wash well with soap and water. INGESTION: give gastric lavage and catharics.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; oral LD_{50} = 770 mg/kg (rat)
5.7 Late Toxicity: Produces liver and kidney injury in experimental animals
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 4,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 37°F C.C.
6.2 Flammable Limits in Air: 9.7%-12.8%
6.3 Fire Extinguishing Agents: Dry chemical, foam, carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.
6.5 Special Hazards of Combustion Products: Phosgene and hydrogen chloride fumes may form in fires.
6.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 860°F
6.8 Electrical Hazard: Data not available
6.9 Burning Rate: 2.6 mm/min.
6.10 Adiabatic Flame Temperature: Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Will not occur under ordinary conditions of shipment. The reaction is not vigorous.
7.6 Inhibitor of Polymerization: None used
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	2

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 97.0
12.3 Boiling Point at 1 atm:
cis: 140°F = 60°C = 333°K
trans: 118°F = 48°C = 321°K
12.4 Freezing Point:
cis: −114°F = −81°C = 192°K
trans: −58°F = −50°C = 223°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.27 at 25°C (liquid)
12.8 Liquid Surface Tension: 24 dynes/cm = 0.024 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 30 dynes/cm = 0.030 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 3.34
12.11 Ratio of Specific Heats of Vapor (Gas): 1.1468
12.12 Latent Heat of Vaporization: 130 Btu/lb = 72 cal/g = 3.0×10^4 J/kg
12.13 Heat of Combustion: −4,647.2 Btu/lb = −2,592.9 cal/g = -112.67×10^3 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

6. FIRE HAZARDS (Continued)

6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

DEL	1,2-DICHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	81.020
40	80.820
45	80.610
50	80.400
55	80.190
60	79.980
65	79.780
70	79.570
75	79.360
80	79.150
85	78.940
90	78.740
95	78.530
100	78.320
105	78.110
110	77.900
115	77.690
120	77.490
125	77.280
130	77.070
135	76.860
140	76.650

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	.193
40	.196
45	.198
50	.200
55	.202
60	.204
65	.207
70	.209
75	.211
80	.213
85	.216
90	.218
95	.220
100	.222
105	.224
110	.227
115	.229
120	.231
125	.233
130	.236
135	.238
140	.240

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
65	.907
70	.894
75	.882
80	.869
85	.857
90	.844
95	.832
100	.819
105	.807
110	.794
115	.782
120	.769
125	.757
130	.744

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
40	.478
50	.454
60	.432
70	.411
80	.393
90	.376
100	.360
110	.345
120	.331
130	.319
140	.307
150	.296
160	.286
170	.276
180	.267
190	.259
200	.251
210	.244

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68	.630

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
55	3.009
60	3.396
65	3.824
70	4.297
75	4.817
80	5.389
85	6.016
90	6.702
95	7.453
100	8.272
105	9.164
110	10.130
115	11.190
120	12.330
125	13.560
130	14.900
135	16.340
140	17.890

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
55	.05284
60	.05906
65	.06587
70	.07330
75	.08141
80	.09023
85	.09980
90	.11020
95	.12140
100	.13360
105	.14660
110	.16070
115	.17590
120	.19220
125	.20960
130	.22830
135	.24820
140	.26960

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.150
20	.153
40	.156
60	.159
80	.162
100	.165
120	.167
140	.170
160	.173
180	.176
200	.179
220	.182
240	.185
260	.188
280	.191
300	.194
320	.197
340	.200
360	.203
380	.205
400	.208
420	.211
440	.214

1,1-DICHLOROETHANE

DCH

Common Synonyms	Oily liquid	Colorless	Chloroform like ethereal
Ethylidene chloride Ethylidene dichloride Chlorinated hydrochloric ether	Sinks and mixes with water.		

Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	Flammable. POISONOUS GAS MAY BE PRODUCED IN FIRE OR WHEN HEATED. Containers may explode in fire. Wear goggles and self-contained breathing apparatus. Extinguish with alcohol foam, carbon dioxide, or dry chemical. Water may be ineffective on fire.
Exposure	CALL FOR MEDICAL AID. **LIQUID** If swallowed may cause nausea, vomiting and faintness. Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS have victim drink water or milk and induce vomiting.
Water Pollution	Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability.
Restrict access.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** $C_2H_4Cl_2$
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** 2362
3.5 **CAS Registry No.:** 75-34-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Oily liquid
4.2 **Color:** Colorless
4.3 **Odor:** Chloroform

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** In areas of poor ventilation or high concentration, a self-contained breathing apparatus with full face mask should be worn. Chemical workers goggles, rubber gloves, and protective clothing should be worn.

5.2 **Symptoms Following Exposure:** INHALATION: Irritation of respiratory tract. Salivation, sneezing, coughing, dizziness, nausea, and vomiting. EYES: Irritation, lacrimation, and reddening of conjunctiva. SKIN: Irritation. Prolonged or repeated skin contact can produce a slight burn. INGESTION: Ingestion incidental to industrial handling is not considered to be a problem. Swallowing of substantial amounts could cause nausea, vomiting, faintness, drowsiness, cyanosis, and circulatory failure.

5.3 **Treatment of Exposure:** Call a doctor. INHALATION: Remove from contaminated area; keep warm and quiet. If breathing has stopped, give artificial respiration. Administer oxygen. EYES: Flush with large amounts of water or weak bicarbonate of soda solution. SKIN: Dilute with large amounts of water. Remove contaminated clothing. INGESTION: Attempt to empty stomach, dilute by administering fluids (tap water, soapy water, salt water, or milk).

5.4 **Threshold Limit Value:** 200 ppm.
5.5 **Short Term Inhalation Limits:** 250 ppm.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 **Late Toxicity:** Chronic exposure may cause liver damage and dermatitis. Animal experimentation has shown this compound to be slightly embryo-toxic and to retard fetal development.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 4,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 57°F O.C. = 22°F C.C.
6.2 **Flammable Limits in Air:** 5.6% to 11.4%
6.3 **Fire Extinguishing Agents:** Alcohol foam, water, foam, CO_2, dry chemical, carbon tetrachloride
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** When heated to decomposition emits highly toxic fumes to phosgene.
6.6 **Behavior in Fire:** Explosion hazard
6.7 **Ignition Temperature:** 856°F
6.8 **Electrical Hazard:** Data not available
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Data not available
7.3 **Stability During Transport:** Data not available
7.4 **Neutralizing Agents for Acids and Caustics:** Data not available
7.5 **Polymerization:** Data not available
7.6 **Inhibitor of Polymerization:** Table Data not available
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
TL_m (Marine pinperch) 250 to 275 mg/l
24-hour TL_m Brine shrimp: 320 mg/l
24-hour TL_m Pinperch: 160 mg/l
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Percent, 0.05 g/g for 10 days Percent, 0.002 g/g for 5 days
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Data not available
9.2 **Storage Temperature:** Cool
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-R-S

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 98.97
12.3 **Boiling Point at 1 atm:** 135.14°F = 57.3°C = 330.5°K
12.4 **Freezing Point:** −143.32°F = −97.4°C = 175.75°K
12.5 **Critical Temperature:** 502.7°F = 261.5°C = 534.65°K
12.6 **Critical Pressure:** 734.8 psia = 50 atm = 5.065 MN/m²
12.7 **Specific Gravity:** 1.174 at 20°C
12.8 **Liquid Surface Tension:** 24.75 dynes/cm = 0.02475 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** 3.42
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.136 at 20°C (68°F)
12.12 **Latent Heat of Vaporization:** 131.6 Btu/lb = 73.1 cal/g = 3.06 X 10⁵ J/kg
12.13 **Heat of Combustion:** −4,774 Btu/lb = −2,652 cal/g = −111 X 10⁵ J/kg
12.14 **Heat of Decomposition:** Data not available
12.15 **Heat of Solution:** Data not available
12.16 **Heat of Polymerization:** Data not available
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 7.35 psia

NOTES

DCH	DICHLOROETHANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	75.198
40	74.929
45	74.660
50	74.389
55	74.120
60	73.851
65	73.580
70	73.311
75	73.042
80	72.771
85	72.502

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	D
	A
	T
	A
	N
	O
	T
	A
	V
	A
	I
	L
	A
	B
	L
	E

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
35	.804
40	.799
45	.795
50	.791
55	.786
60	.782
65	.778
70	.773
75	.769
80	.765
85	.760
90	.756
95	.752
100	.747
105	.743
110	.739

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
35	.617
40	.595
45	.574
50	.555
55	.537
60	.520
65	.504
70	.489
75	.475
80	.462
85	.449
90	.437
95	.426
100	.415
105	.405
110	.395
115	.386
120	.377

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68	.500

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—70	—1.334
—60	—1.944
—50	—.555
—40	.835
—30	.225
—20	.386
—10	.996
0	1.607
10	2.217
20	2.827
30	3.438
40	4.048
50	4.658
60	5.269
70	5.879
80	6.489
90	7.100
100	7.710
110	8.321
120	8.931
130	9.541

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—100	.07407
—80	.05000
—60	.02594
—40	.00187
—20	.02219
0	.04626
20	.07032
40	.09439
60	.11845
80	.14252
100	.16658
120	.19065
140	.21471
160	.23878

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	D
	A
	T
	A
	N
	O
	T
	A
	V
	A
	I
	L
	A
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NFPA

Fire 1
Health 2 0 Reactivity

RELTON CORPORATION

MATERIAL SAFETY DATA SHEET

HMIS

Health	3
Fire	1
Reactivity	1

Meets requirements of 29 CFR 1910.1200
(Federal Hazard Communication Standard)

SECTION I

Manufacturer's Name: RELTON CORPORATION

Emergency Telephone No.: (213) 681-2551 (818) 351-8469

Address: 317 Rolyn Place, Arcadia, California 91006

Chemical Name and Synonyms: 1,1,1-Trichloroethane(Methyl Chloroform)

Trade Name and Synonyms: "Rapid Tap"

Chemical Family: Inhibited Chlorinated Hydrocarbon

Formula: >80% CH_3CCl_3 (1,1,1-Trichloroethane)
<20% Inhibitors

DOT: Shipping Name: 1,1,1-Trichloroethane UN Number: UN2831
Hazard Class: ORM-A (only regulated when shipped by air)

SECTION II - INGREDIENTS

		%Vol	PPM TLV	PPM PEL	PPM STEL
	A natural glyceride(a fatty animal oil)-Trade Secret	<10	NE	NE	NE
	An aliphatic polyol - Trade Secret	<10	NE	NE	NE
	Cinnamon oil perfume	Tr	NE	NE	NE
* °	1,1,1-Trichloroethane(Methyl Chloroform) CAS#71-55-6	>80	350	350	350
* #	Glycol Methylene Ether CAS#646-06-0	< 2	NA	NA	NA

(See Section V for Health Data)

Data is based on testing mixture as a whole. Neither the mixture nor any of its ingredients is on the carcinogen or suspected-carcinogen list of the NTP, the IARC, or OSHA.

SECTION III - PHYSICAL DATA

Boiling Point(°): 72°C 162°F	Specific Gravity(H_2O=1) @25°C: 1.276
Vapor Pressure(mmHg) @20°C: 100	Percent Volatile by Volume: >80
Vapor Density(Air=1): 4.6	Evaporation Rate(1,1,1-Trichloroethane=1): 1.3

Solubility in Water .07g/100g @ 25°C: Slight

Appearance and Odor: liquid--clear, amber; cinnamon odor

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point(Method Used): None to boiling(162°F) TCC (162°F) COC

Flammable Limits @25°C: LFL 8. UFL 10.5 in air (% by vol.)

Extinguishing Media: Water fog

Special Fire Fighting Procedures: Avoid exposure to open flame; use self-contained respiratory equipment. However, Rapid Tap is not considered a flammable-liquid hazard in normal use.

Unusual Fire and Explosion Hazards:
Products of combustion in open flame: CO_2, CO, HCl, $COCl_2$

 (Continued on reverse side)

NE = not established NA = not applicable
* Subject to SARA Section 313 reporting beginning in 1989.
° Present in mixture at 90.6% by weight.
\# Present in mixture at 1.4% by weight.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value of Rapid Tap as a mixture: 350ppm

Routes of Entry and Symptoms of Overexposure:

inhalation: drunkenness, uncoordination, depression; skin: drying and irritation; eyes: irritation; ingestion(swallowing): nausea

First Aid:

inhalation - remove to fresh air; skin - wash with soap and water; eyes - flush with water and call doctor; ingestion(swallowing) - do not induce vomiting; call doctor; (Doctor: Maintain adequate oxygenation; do not give sympathomimetic amines such as epinephrine, which may cause arrhythmias.)

SECTION VI - REACTIVITY DATA

Stability:		Conditions to Avoid:
Unstable		Exposure to high temperature sources(open flame, welding arcs, etc.) which induce thermal decomposition.
Stable	X	

Incompatability(Materials to avoid): Avoid mixing with water(forms HCl). Avoid use with aluminum. Avoid contact with caustic soda or other strong alkali.

Hazardous Decomposition Products: CO_2, CO, HCl, $COCl_2$

Hazardous Polymerization		Conditions to avoid:
May occur.		NA
Will not occur.	X	NA

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled:

Prevent contact with open flame. Small leaks: mop, wipe, or soak up immediately and remove absorbent material out of doors. Large spills: evacuate area; contain liquid and transfer to closed metal containers. Keep out of water supply.

Waste Disposal Method: For small amounts: none needed; material will evaporate, leaving very slight oily coating. For large amounts: considered a toxic waste #U226 under RCRA 40 CFR 261.33; incinerate or landfill in permitted hazardous waste facility.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection(specify type):

Below 350ppm - none**

Normal ventilation: Limit concentration to TLV.

Ventilation:		
Local Exhaust: At point of cutting-tool contact	Special:	NA
Mechanical(General): NA	Other:	NA

Protective Gloves: Not under normal use

Eye Protection: Protective goggles to guard against splashing

Other Protective Equipment: None needed.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be Taken in Handling and Storing:

None necessary-except to store away from open flame and in a cool, dry place. Do not torch-cut drums which contain or have contained Rapid Tap until the fluid and vapors have been completely expelled.

Other Precautions: Use with adequate ventilation.

**If no environmental control exists, use full face mask with organic canister for levels up to 2% for ½ hr. or less. Above 2% and for emergencies, use a self-contained breathing apparatus.

NE = not established NA = not applicable

William C. Kinard

Revised by William C. Kinard 8/1/86
(Obsoletes 12/23/85)
Revised by William C. Kinard 1/1/89 Wm. C. Kinard
(Obsoletes 8/1/86)

RELTON CORPORATION

317 ROLYN PLACE P.O. BOX 779 • ARCADIA CALIFORNIA 91006

PHONE (213) 681-2551 • (818) 351-8469

VINYL CHLORIDE

VCM

Common Synonyms	Gas	Colorless	Sweet odor
Chloroethylene VCL Vinyl C Monomer VCM	Liquid floats and boils on water. Flammable, irritating vapor cloud is produced.		

[illegible] discharge is possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Evacuate area in case of large discharge.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
POISONOUS GAS IS PRODUCED IN FIRE.
Flashback along vapor trail may occur.
May explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Cool exposed containers and protect men effecting shutoff with water.
Stop flow of gas if possible.
Let fire burn.
Extinguish small fires with dry chemical.

Exposure

CALL FOR MEDICAL AID

VAPOR
Irritating to eyes, nose, and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will cause frostbite.
Flush affected areas with plenty of water.
DO NOT RUB AFFECTED AREAS.

Water Pollution

Not harmful to aquatic life.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area

2. LABEL

2.1 Category: Flammable gas
2.2 Class: 2

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Vinyl halides
3.2 Formula: $CH_2=CHCl$
3.3 IMO/UN Designation: 2.0/1086
3.4 DOT ID No.: 1086
3.5 CAS Registry No.: 75-01-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquefied compressed gas
4.2 Color: Colorless
4.3 Odor: Pleasant, sweet

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Rubber gloves and shoes; gas-tight goggles; organic vapor canister or self-contained breathing apparatus.
5.2 Symptoms Following Exposure: INHALATION: high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite; phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate.
5.3 Treatment of Exposure: INHALATION: remove patient to fresh air and keep him quiet and warm; call a doctor; give artificial respiration if breathing stops. EYES AND SKIN: flush with plenty of water for at least 15 min.; for eyes, get medical attention; remove contaminated clothing.
5.4 Threshold Limit Value: 5 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 5 min.
5.6 Toxicity by Ingestion: Not pertinent
5.7 Late Toxicity: Chronic exposure may cause liver damage.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin. May cause frostbite.
5.10 Odor Threshold: 260 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: —110°F O.C.
6.2 Flammable Limits in Air: 4%-26%
6.3 Fire Extinguishing Agents: For small fires use dry chemical or carbon dioxide. For large fires stop flow of gas. Cool exposed containers with water.
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Forms highly toxic combustion products such as hydrogen chloride, phosgene, and carbon monoxide.
6.6 Behavior in Fire: Container may explode in fire. Gas is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 882°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4.3 mm/min.

(Continued)

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Polymerizes in presence of air, sunlight, or heat unless stabilized by inhibitors.
7.6 Inhibitor of Polymerization: Not normally used except when high temperatures are expected. Then 40-100 ppm of phenol used.
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 35

8. WATER POLLUTION

8.1 Aquatic Toxicity: None
8.2 Waterfowl Toxicity: None
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial or technical 99+%
9.2 Storage Temperature: Under pressure; ambient At atm. pressure; low
9.3 Inert Atmosphere: No requirement
9.4 Venting: Under pressure; safety relief At atm. pressure; pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-B-C-D-E-F-G-Z

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable gas
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	4
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	0
Aquatic Toxicity	0
Aesthetic Effect	0
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	2

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	4
Reactivity (Yellow)	1

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Gas
12.2 Molecular Weight: 62.50
12.3 Boiling Point at 1 atm: 7.2°F = 13.8°C = 259.4°K
12.4 Freezing Point: —244.8°F = —153.8°C = —119.4°K
12.5 Critical Temperature: 317.1°F = 158.4°C = 431.6°K
12.6 Critical Pressure: 775 psia = 52.7 atm = 5.34 MN/m²
12.7 Specific Gravity: 0.969 at —13°C (liquid)
12.8 Liquid Surface Tension: 16.0 dynes/cm = 0.0160 N/m at 25°C
12.9 Liquid Water Interfacial Tension: (est.) 30 dynes/cm = 0.03 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 2.2
12.11 Ratio of Specific Heats of Vapor (Gas): 1.186
12.12 Latent Heat of Vaporization: 160 Btu/lb = 88 cal/g = 3.7×10^5 J/kg
12.13 Heat of Combustion: —8136 Btu/lb = —4520 cal/g = -189.1×10^6 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: —729 Btu/lb = —405 cal/g = 16.9×10^6 J/kg
12.25 Heat of Fusion: 18.14 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 75 psia

6. FIRE HAZARDS (Continued)

6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: 5.490 (Est.)
6.12 Flame Temperature: Data not available

VCM	VINYL CHLORIDE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
0	61.000	—30	.259		N	—10	.287
5	60.710	—20	.265		O	—5	.281
		—10	.272		T	0	.276
		0	.279			5	.271
					P		
					E		
					R		
					T		
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					N		
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12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.600	—50	3.384	—50	.04810	0	.185
		—40	4.501	—40	.06245	25	.192
		—30	5.908	—30	.08005	50	.198
		—20	7.658	—20	.10140	75	.205
		—10	9.814	—10	.12710	100	.211
		0	12.440	0	.15760	125	.217
		10	15.610	10	.19360	150	.224
		20	19.410	20	.23560	175	.230
		30	23.920	30	.28440	200	.235
		40	29.220	40	.34050	225	.241
		50	35.430	50	.40470	250	.247
		60	42.630	60	.47760	275	.252
		70	50.940	70	.56000	300	.257
		80	60.480	80	.65250	325	.263
		90	71.349	90	.75570	350	.268
		100	83.669	100	.87050	375	.273
		110	97.580	110	.99740	400	.277
		120	113.200	120	1.13700	425	.282
						450	.286
						475	.291
						500	.295
						525	.299
						550	.303
						575	.307
						600	.311

hesives, fertilizers, roofing granules, putties, caulking compounds, etc.

Bardhan-Sengupta phenanthrene synthesis. Formation of octahydrophenanthrene derivatives by cyclodehydration of derivatives of 2-(β-phenethyl)-1-cyclohexanol and consequent dehydration to phenanthrenes with selenium.

bar disintegrator. See cage mill.

Bardol[175]. TM for a coal-tar oil with aromatic content.
Properties: Dark-colored liquid, d 1.07–1.12 (25/25C), distillation at 300C 60% max, low viscous at 4.4C. Combustible.
Use: Swelling agent for natural and synthetic elastomers, dispersing agent for blacks and mineral fillers, tackifier, plasticizer.

Barfoed's reagent. Aqueous solution of copper acetate.
Use: To distinguish monosaccarides from disaccharides (red cuprous oxide forms in presence of glucose).

barite. ($BaSO_4$). Natural barium sulfate, barytes, heavy spar.

barium. CAS: 7440-39-3. Ba. Alkaline-earth element of atomic number 56, Group IIA of Periodic Table; aw 137.34; valence 2; 7 stable isotopes.
Properties: Silver-white, somewhat malleable metal, d 3.6, values for melting and boiling points are reported ranging from 704C to 850C for mp and from 1140C to 1637C for bp. The most acceptable values based on reliable original work appear to be mp 710C and bp 1500C. Extremely reactive, reacts readily with water, ammonia, halogens, oxygen, and most acids. Gives green color in flame. Extrudable and machinable.
Occurrence: Ores of barite and witherite are found in Georgia, Missouri, Arkansas, Kentucky, California, Nevada, Canada, Mexico.
Derivation: Reduction of barium oxide with aluminum or silicon in a vacuum at high temperature.
Forms: Rods, wire, plate, powder.
Grade: Technical, pure.
Hazard: Flammable (pyrophoric) at room temperature in powder form; store under inert gas, petroleum, or other oxygen-free liquid. When heated to approximately 200C in hydrogen, barium reacts violently forming BaH_2. TLV: For all soluble barium compounds, 0.5 mg/m³ in air (as barium).
Use: Getter alloys in vacuum tubes, deoxidizer for copper, Frary's metal, lubricant for anode rotors in x-ray tubes, spark-plug alloys.

barium-137. Radioactive isotope of barium. See Cs-137.

barium acetate. CAS: 543-80-6. $Ba(C_2H_3O_2)_2 \cdot H_2O$.
Properties: White crystals, soluble in water, insoluble in alcohol, d 2.02, mp decomposes.
Derivation: Acetic acid is added to a solution of barium sulfide. The product is recovered by evaporation and subsequent crystallization.
Grade: Technical, CP. See barium.
Use: Chemical reagent, acetates, textile mordant, catalyst manufacturing, paint and varnish driers.

barium aluminate. $3BaO \cdot Al_2O_3$.
Properties: Gray pulverized mass, soluble in water, acids. See barium.

barium azide. CAS: 18810-58-7. $Ba(N_3)_2$.
Crystalline solid, d 2.936, loses nitrogen at 120C, soluble in water, slightly soluble in alcohol.
Hazard: Explodes when shocked or heated. See also barium.
Use: High explosives.

barium binoxide. See barium peroxide.

barium borotungstate. (barium borowolframate). $2BaO \cdot B_2O_3 \cdot 9WO_3 \cdot 18H_2O$.
Properties: Large, white crystals. Effloresces in air. Keep well stoppered! Soluble in water.
Hazard: A poison. TLV: See barium.
Use: Making borotungstates.

barium borowolframate. See barium borotungstate.

barium bromate. CAS: 13967-90-3. $Ba(BrO_3)_2 \cdot H_2O$.
Properties: White crystals or crystalline powder. Slightly soluble in water, insoluble in alcohol, d 3.820, decomposes at 260C.
Derivation: By passing bromine into a soluble of barium hydroxide, barium bromide and barium bromate being formed which are separated by crystallization.
Grade: Pure, reagent.
Hazard: A poison. Moderate fire risk in contact with organic materials. TLV: See barium.
Analytical reagent, oxidizing agent, corrosion inhibitor.

barium bromide. $BaBr_2 \cdot 2H_2O$.
Properties: Colorless crystals. Soluble in water and in alcohol, d 3.852, mp (anhydrous) 847C.
Derivation: Interaction of barium sulfide and hydrobromic acid with subsequent crystallization.
Grade: Technical, CP.

Derivation: Sulfonation of naphthalene with fuming sulfuric acid at low temperature followed by separation from the 1,6-isomer.
Use: Dye intermediate.

Arndt-Eistert synthesis. Procedure for converting an acid to its next higher homolog.

"Arnel."[352] TM for an acetate fiber made from cellulose triacetate. It has a higher melting point, and is less soluble than cellulose acetate.
See acetate fiber, cellulose triacetate.

"Arnox"[245]. TM for a family of 1-component liquid and solid epoxy resins designed for compression and transfer molding, injection molding, filament winding and pultrusion.

aromatic. (arene). A major group of unsaturated cyclic hydrocarbons containing one or more rings, these are typified by benzene which has a 6-carbon ring containing three double bonds. The vast number of compounds of this important group derived chiefly from petroleum and coal tar are rather highly reactive and chemically versatile. The name is due to the strong and not unpleasant odor characteristic of most substances of this nature. Certain 5-membered cyclic compounds such as the furan group (heterocyclic) are analogous to aromatic compounds. *Note*: The term "aromatic" is often used in the perfume and fragrance industries to describe essential oils which are not aromatic in the chemical sense.

aromaticity. A stable electron shell configuration in organic molecules, especially those related to benzene.
See resonance, orbital theory.

aromatization. See hydroforming.

"Aromin."[51] TM for a highly aromatic solvent widely used as a carrier for chemical pesticides.

Arrhenius, Svante. (1859–1927) A native of Sweden, he won the Nobel prize in chemistry in 1903. He is best known for his fundamental investigations on electrolytic dissociation of compounds in water and other solvents, and for his basic equation stating the increase in the rate of a chemical reaction with rise in temperature:

$$\frac{d \ln k}{dT} = \frac{A}{RT^2}$$

in which, k is the specific reaction velocity, T is the absolute temperature, A is a constant usually referred to as the energy of activation of the reaction, and R is the gas law constant.

arsacetin. (sodium acetylarsanilate; sodium p-acetyl aminophenylarsonate).
$CH_3CONHC_6H_4AsO(OH)ONa$.
Properties: White, crystalline powder; odorless; tasteless; free of arsenous or arsenic acid; solutions will admit of thorough sterilization. Soluble in cold water, but more so in warm water.
Use: Medicine (antisyphilitic).

arsanilic acid. (atoxylic acid; p-aminobenzenearsonic acid; p-aminophenylarsonic acid).
$C_6H_4 \cdot C_6H_8AsNO_3$.
Properties: White, crystalline powder; practically odorless; soluble in hot water; slightly soluble in cold water, alcohol, and acetic acid; insoluble in acetone, benzene, chloroform, and ether. Mp 232C.
Derivation: By condensing aniline with arsenic acid removing the excess of aniline by steam distillation in alkaline solution and setting the acid free by hydrochloric acid.
Hazard: Yields flammable vapors on heating above melting point. A poison.
Use: Arsanilates, manufacture of arsenical medicinal compounds such as arsphenamine, etc., veterinary medicine, grasshopper bait.

arsenic, "As." CAS: 7440-38-2. A nonmetallic element of atomic number 33, group VA of Periodic Table, aw 74.9216, valence=2,3,5; no stable isotopes.
Properties: Silver-gray, brittle, crystalline solid that darkens in moist air. Allotropic forms: black, amorphous solid (β-arsenic), yellow, crystalline solid, d 5.72 (commercial product ranges from 5.6 to 5.9), mp 814C (36 atm), sublimes at 613C (1 atm), Mohs hardness 3.5, insoluble in water, caustic and nonoxidizing acids. Attacked by hydrochloric acid in presence of oxidant. Reacts with nitric acid. Low thermal conductivity; a semiconductor.
Derivation: Flue dust of copper and lead smelters from which it is obtained as white arsenic (arsenic trioxide) in varying degrees of purity. This is reduced with charcoal. The commercial grade is not made in US.
Grade: Technical, crude (90–95%), refined (99%), semiconductor grade 99.999%, single crystals.
Hazard: Carcinogen and mutagen. TLV OSHA standard for employee exposure is 10 μg/m3 of air. Respirators required for worker exposure to atmospheres of over 500 μg/m3. ACGIH TLV is 200 μg/m3 (arsenic and soluble compounds).
Uses (metallic form): Alloying additive for metals, especially lead and copper as shot, battery grids, cable sheaths, boiler tubes. High-purity (semiconductor) grade: used to make gallium arsenide

:hloride; insoluble in

- and nylon.

:auses tempo-
·ative of lysergic

C

C. Symbol for carbon.

^{14}C. (carbon-14). The naturally occurring radioactive isotope of carbon used in chemical dating, tracer studies, etc.

Ca. Symbol for calcium.

CA. Abbreviation for cellulose acetate and cortisone acetate, also for controlled atmosphere.

C_3A. Abbreviation for tricalcium aluminate as used in cement.
See cement, Portland.

CAB. Abbreviation for cellulose acetate butyrate.

"Cab-O-Sil."[275] TM for colloidal silica particles sintered together in chain-like formations. Surface area ranges from 50 to 400 m^2/g, depending on grade.
Grade: Standard M-5, L-5, SD-20.
Use: Thickening and emulsifying agent for oil/water systems, drilling muds, cattle-feed supplements, tile cleaners, disperson of oil slicks on sea water, plastics, solar-heated ceiling tiles.

"Cab-O-Sperse."[275] TM for aqueous dispersions of pyrogenic silica for use in the paper and textile industries.

cacao butter. (cocoa butter). See theobroma oil.

C acid. (2-naphthylamine-4,8-disulfonic acid). $C_{10}H_5(NH)_2(SO_3H)_2$.
Properties: White, crystalline solid; slightly soluble in water.
Derivation: Reduction of 2-nitronaphthalene-4,8-disulfonic acid. The sodium salt is recrystallized from water.
Use: Azo dye intermediate.

cacodylic acid. (dimethylarsinic acid). $(CH_3)_2AsOOH$.
Properties: Colorless, odorless, deliquescent crystals; mp 200C; soluble in water, alcohol, and acetic acid; insoluble in ether.
Derivation: By distilling a mixture of arsenic trioxide and potassium acetate, and oxidizing the resulting product with mercuric oxide.
Hazard: Toxic by ingestion.
Use: Herbicide especially for control of Johnson grass on cotton, soil sterilant, chemical warfare, timber thinning.

cactinomycin. USAN name for an antibiotic produced from *Streptomyces* which is 10% dactinomycin and 90% two kinds of actinomycin C.

"Cadalume" L.[238] TM for a bright cadmium electroplating process for a protective coating on iron and steel. Materials used are CdO, NaCN, and addition agents.

"Cadalyte."[28] TM for a series of compounds for cadmium electroplating.

cadaverine. (1,5-diaminopentane; pentamethylenediamine). $NH_2(CH_2)_5NH_2$. A ptomaine formed in the decay of animal proteins after death, also made synthetically.
Properties: Syrupy, colorless, fuming, odorous liquid; mp 9C; bp 178–179C; soluble in water and alcohol, slightly soluble in ether.
Hazard: Toxic by ingestion, absorbed by skin, a skin and eye irritant.
Use: Preparation of high polymers, intermediate, biological research.

"caddy."[48] TM for a liquid cadmium fungicide used on turf grass.
Hazard: See cadmium.

Cade oil. See juniper tar oil.

cadiene. See sesquiterpene.

"Cadmate."[69] TM for cadmium diethyldithiocarbamate.
Hazard: See cadmium.

"Cadminate."[329] TM for a turf fungicide containing 60% cadmium succinate and 40% inert matter.
Hazard: See cadmium.

cadmium. CAS: 7440-43-9. Cd.
Metallic element of atomic number 48, group IIB of the periodic table. Aw 112.40. Valence 2. There are eight stable isotopes.
Properties: Soft, blue-white, malleable metal or grayish-white powder. Tarnishes in moist air, corrosion resistance poor in industrial atmospheres, becomes brittle at 80C. Resistant to alkalies, high neutron absorber. D 8.642, mp

320.9C, bp 767C, refr index 1.13, Mohs hardness 2.0. Soluble in acids, especially nitric, and in ammonium nitrate solution. Lowers melting point of certain alloys when used in low percentages. Combustible.

Occurrence: A greenockite (cadmium sulfide) ore containing zinc sulfide also with lead and copper ores containing zinc. Canada, central and western US, Peru, Australia, Mexico, Zaire.

Derivations: (1) Dust or fume from roasting zinc ores is collected, mixed with coal or coke and sodium or zinc chloride, and sintered. The cadmium fume is collected in an electrostatic precipitator, leached, fractionally precipitated, and distilled. (2) By direct distillation from cadmium-bearing zinc (3) By recovery from electrolytic zinc process (approximately 40%).

Hazard: Flammable in powder form. Toxic by inhalation of dust or fume. A carcinogen. Cadmium plating of food and beverage containers has resulted in a number of outbreaks of gastroenteritis (food poisoning). Soluble compounds of cadmium are highly toxic; however, ingestion usually induces a strong emetic action which minimizes the risk of fatal poisoning. Use as fungicide may be restricted. TLV: (Dust and soluble compounds) 0.05 mg/m³ of air; (oxide fume as Cd) ceiling 0.05 mg/m³ of air.

Grade: Technical, powder, pure sticks, ingots, slabs, high-purity crystals (less than 10 ppm impurities).

Use: Electrodeposited and dipped coatings on metals, bearing and low-melting alloys, brazing alloys, fire protection systems, nickel-cadmium storage batteries, power transmission wire, TV phosphors, basis of pigments used in ceramic glazes, machinery enamels, baking enamels, Weston standard cell control of atomic fission in nuclear reactors, fungicide, photography and lithography, selenium rectifiers, electrodes for cadmium-vapor lamps and photoelectric cells.

cadmium acetate. (a) $Cd(OOCCH_3)_2 \cdot 3HOH$; (b) $Cd(OOCCH_3)_2$.

Properties: Colorless crystals, soluble in water and alcohols. (a) d 2.01, mp loses water at 130C; (b) d 2.341, mp 256C.

Derivation: Interaction of acetic acid and cadmium oxide.

Hazard: See cadmium.

Use: Ceramics (iridescent glazes), manufacture of acetates, assistant in dyeing and printing textiles, electroplating baths, laboratory reagent.

cadmium ammonium bromide. (ammonium-cadmium bromide). $CdBr_2 \cdot 4NH_4Br$.

Properties: Colorless crystals. Soluble in alcohol and water.

Hazard: See cadmium.

cadmium antimonide. A semiconductor used in thermoelectric devices.

Hazard: See cadmium and antimony.

cadmium-base Babbitt. See Babbitt metal.

cadmium borotungstate. $Cd_5(BW_{12}O_{40}) \cdot 18HOH$.

Properties: Yellow, heavy crystals; mp 75C; soluble in water. The solution is yellow to light brown.

Grade: Technical.

Hazard: See cadmium.

Use: Separating minerals.

cadmium bromate. $Cd(BrO_3)_2 \cdot HOH$.

Properties: White crystals or crystalline powder, d 3.758, mp decomposes. Soluble in water, insoluble in alcohol.

Derivation: By adding cadmium sulfate to a solution of barium bromate.

Hazard: Strong oxidizer, dangerous in contact with organics. Highly toxic, irritant, oxidizer.

Use: Analytical reagent.

cadmium bromide. CAS: 7789-42-6. $CdBr_2$ or $CdBr_2 \cdot 4HOH$.

Properties: White to yellowish efflorescent crystalline, d 5.192, mp (anhydrous) 568C, bp 863C, soluble in water, acetone, alcohol, and acids.

Derivation: By heating cadmium in bromine vapor.

Grade: Technical, reagent.

Hazard: See cadmium.

Use: Photography, process engraving, lithography.

cadmium carbonate. CAS: 513-78-0. $CdCO_3$.

Properties: White, amorphous powder; d 4.258; decomposes at less than 500C; soluble in dilute acids and in concentrated solution of ammonium salts; insoluble in water.

Hazard: See cadmium.

Grade: Reagent.

cadmium chlorate. $Cd(ClO_3)_2 \cdot 2HOH$.

Properties: Colorless, prismatic crystals. Hygroscopic, d 2.28 (18C), mp 80C, soluble in alcohol, water, and acetone.

Grade: Technical.

Hazard: Dangerous in contact with organic materials.

cadmium chloride. CAS: 10108-64-2. (a) $CdCl_2$; (b) $CdCl_2 \cdot 2.5HOH$.

Properties: Small, white, odorless crystals; d (a) 4.05, (b) 3.327; mp (a) 568C; bp (a) 960C; soluble in water and acetone.

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magnesia, fused. Used as a refractory and to handle electricity at high temperatures.
See "Magnorite."

magnesia, lightburned. A special high-purity magnesium oxide.

magnesite. (natural magnesium carbonate). ($MgCO_3$). The term magnesite is loosely used as a synonym for magnesia as are also the terms caustic-calcined magnesite, dead-burned magnesite, and synthetic magnesite.
Hazard: A nuisance particulate.
Properties: White, yellowish, grayish-white, or brown crystalline solid; d 3–3.12; Mohs hardness 3.5–4.5.
Occurrence: US (California, Washington, Nevada), Austria, Greece.
Use: To make the various grades of magnesium oxide, to produce carbon dioxide, refractory.
See also magnesium carbonate and following entries.

magnesite, burnt. See magnesite, dead-burned.

magnesite, caustic-calcined. (caustic-calcined magnesia; calcined magnesite; calcined magnesia). Principally magnesia (magnesium oxide) MgO). The product obtained by firing magnesite or other substances convertible to magnesia upon heating at some temperature below 1450C so that some carbon dioxide is retained (2–10%) and the magnesium oxide displays adsorptive capacity or activity.
Grade: Technical, chemical, synthetic rubber, USP (light, medium light, heavy).
Use: Magnesium oxychloride and oxysulfate cements, 85% magnesia insulation, rubber (reinforcing agent, accelerator), uranium processing, chemical processing, rayon, refractories, paper pulp, acid-neutralizing fertilizers, welding rod coatings, fillers, glass constituents, abrasives.
See also magnesium oxide.

magnesite, dead-burned. (burnt magnesia; dead-burned magnesia; refractory magnesia; burnt magnesite; (magnesium oxide), MgO). The granular product obtained by burning (firing) magnesite or other substances convertible to magnesia upon heating above 1450C long enough to form granules suitable for use as a refractory (ASTM). Synthetic magnesium hydroxide or chloride is sometimes used instead of magnesite as a source.
Grade: 85–87% (from magnesite ores); 97–99% (from sea water and brines).
Use: Refractories, as grains or basic brick, the latter especially in open hearth furnaces for steel, furnaces for nonferrous metal smelting, and in cement and other kilns.
See also magnesium oxide.

magnesite, synthetic. Magnesium oxide, MgO, as obtained from sea water, sea water bitterns, or well brines. The preliminary product is usually magnesium hydroxide or chloride, which is then heated, or sometimes treated with steam and heated in the case of the chloride, to obtain the oxide. Synthetic magnesite constitutes the purer grades of dead-burned magnesite.

magnesium. CAS: 7439-95-4. Mg.
Metallic element of atomic number 12; Group IIA of the Periodic Table; aw 24.305; valence = 2; 3 isotopes.
Properties: Silvery, moderately hard, alkaline-earth metal; readily fabricated by all standard methods; lightest of the structural metals; strong reducing agent; electrical conductivity similar to aluminum. D 1.74, mp 650C, bp 1107C, soluble in acids, insoluble in water. Magnesium is the central element of the chlorophyll molecule; it is also an important component of red blood corpuscles.
Sources: Magnesite and dolomite; sea water and brines.
Derivation: (a) Electrolysis of fused magnesium chloride (Dow sea water process), (b) reduction of magnesium oxide with ferrosilicon (Pidgeon process).
Forms available: Ingots, bars, fine powder (up to 99.6% pure), sheet and plate, rods, tubing, ribbon, flakes.
Hazard: (solid metal) Combustible at 650C. (powder, flakes, etc.): Flammable, dangerous fire hazard. Use dry sand or talc to extinguish.
Use: Aluminum alloys for structural parts, die-cast auto parts, missiles, space vehicles; powder for pyrotechnics and flash photography, production of iron, nickel, zinc, titanium, zirconium; antiknock gasoline additives; magnesium compounds and Grignard syntheses; cathodic protection; reducing agent; desulfurizing iron in steel manufacture; precision instruments; optical mirrors; dry and wet batteries.

magnesium acetate. CAS: 142-72-3. (a) $Mg(OOCCH_3)_2$ or (b) $Mg(OOCCH_3)_2 \cdot 4HOH$.
Properties: Colorless, crystalline aggregate or monoclinic crystals; acetic acid odor; (a) mp 323C, d 1.42; (b) mp 80C, d 1.45; soluble in water and dilute alcohol.
Derivation: Interaction of magnesium carbonate and acetic acid.
Use: Dye fixative in textile printing, deodorant, disinfectant, and antiseptic.

magnesium acetylacetonate. $Mg(C_5H_7O_2)_2$.
Crystalline powder, slightly soluble in water, resistant to hydrolysis, a chelating nonionizing compound.

ercury sulfuret).
5.
arlet powder. Insoluble
.06–8.12, mp sublimes

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ublimation. A precipi-
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rcuric sulfocyanate;
mercury sulfocyanate;
CAS: 592-85-8.

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longed heating), hot concentrated sulfuric acid, hot ammonium carbonate or ammonium succinate solutions; sparingly soluble in water; insoluble in alcohol and ether; d 7.307; sublimes at 340–350C; mp 405C.
Derivation: (a) Action of potassium bromide on solution of mercurous nitrate in dilute nitric acid. (b) Sublimation from mixture of mercury and mercuric bromide.
Hazard: Highly toxic by ingestion, inhalation, and skin absorption. TLV (as mercury): 0.05 mg/m³ of air.

mercurous chlorate. (mercury chlorate). CAS: 10294-44-7. $Hg_2(ClO_3)_2$.
Properties: White crystals, d 6.409, mp 250C (decomposes), soluble in alcohol, water, and acetic acid.
Hazard: Explodes in contact with organic or combustible materials, keep away from light. Highly toxic.

mercurous chloride. (mercury monochloride; mercury protochloride; mercury chloride, mild; calomel). CAS: 10112-91-1. Hg_2Cl_2.
Properties: White, rhombic crystals or crystalline powder; odorless; stable in air but darkens on exposure to light; insoluble in water, ether, alcohol, and cold dilute acids; d 6.993; mp 302C; bp 384C; decomposed by alkalies.
Derivation: By heating mercuric chloride and mercury with subsequent sublimation.
Grade: Technical, CP, NF.
Hazard: Toxic dose is uncertain.
Use: Fungicide, electrodes, pharmaceuticals, pyrotechnics, ceramic painting, maggot control in agriculture.

mercurous chromate. (mercury chromate). Hg_2CrO_4.
Properties: Brick-red powder, variable composition, decomposes on heating, soluble in nitric acid (concentrated), insoluble in alcohol and water.
Hazard: Moderate fire hazard in contact with organic materials. Highly toxic. TLV (as mercury): 0.05 mg/m³ of air.
Use: Ceramics (coloring green).

mercurous iodide. (mercury protoiodide). CAS: 15385-57-6. HgI or Hg_2I_2.
Properties: Bright yellow powder, becoming greenish on exposure to light due to decomposition into metallic mercury and mercuric iodide. Becomes dark yellow, orange, and orange-red on heating. Undergoes same color change in opposite order on cooling. Odorless and tasteless; soluble in castor oil, liquid ammonia, aqua ammonia; insoluble in water, alcohol, and ether; d 7.6445–7.75; sublimes at 140C; mp 290C (with partial decomposition).
Derivation: (a) Action of potassium iodide on a mercurous salt. (b) Boiling a solution of mercurous nitrate containing nitric acid with excess of iodine.
Grade: Technical.
Hazard: Toxic by ingestion, inhalation, and skin absorption. TLV (as mercury): 0.05 mg/m³ of air.
Use: Medicine (topical antibacterial).

mercurous nitrate, hydrated. CAS: 10415-75-5. $HgNO_3 \cdot 2HOH$.
Properties: Short prismatic crystals, effloresces and becomes anhydrous in dry air, sensitive to light, soluble in small quantities of warm water (hydrolyzes in larger quantities)and water acidified with nitric acid, d 4.785 (3.9C), mp 70C (decomposes).
Derivation: Action of cold dilute nitric acid upon an excess of mercury and warming slightly.
Hazard: May be explosive if shocked or heated. Highly toxic. TLV (as mercury): 0.05 mg/m³ of air.
Use: Analytical agent.

mercurous oxide. CAS: 15829-53-5. Hg_2O.
Properties: Black powder, d 9.8, decomposes at 100C, soluble in acids, insoluble in water.
Derivation: Action of sodium hydroxide on mercurous nitrate.
Hazard: Highly toxic. TLV (as mercury): 0.05 mg/m³ of air.

mercurous sulfate. CAS: 7783-36-0. Hg_2SO_4.
Properties: White to yellow, crystalline powder; soluble in hot sulfuric acid, dilute nitric acid; slightly soluble in water, d 7.56, decomposes on heating.
Derivation: (a) Dissolving mercury in sulfuric acid and heating gently. (b) Adding sulfuric acid to mercurous nitrate solution.
Hazard: Highly toxic. TLV (as mercury): 0.05 mg/m³ of air.
Use: Chemical (admixed with sulfuric acid as a catalyst, in oxidation of naphthalene to phthalic acid), batteries (Clark cell, Weston cell).

mercury. (quicksilver; hydrargyrum). CAS: 7439-97-6. Hg. Metallic element of atomic number 80, group IIB of the Periodic Table, aw 200.59, valences = 1,2; 4 stable isotopes and 12 artificially radioactive isotopes.
Properties: Silvery, extremely heavy liquid, sometimes found native; insoluble in hydrochloric acid; soluble in sulfuric acid upon boiling; readily soluble in nitric acid; insoluble in water, alcohol, and ether; soluble in lipids;, extremely high sur-

face tension (480 dynes/cm) giving it unique rheological behavior: high electric conductivity; d 13.59; fp −38.85C; bp 356.6. Noncombustible.
Chief ore: Cinnabar.
Occurrence: Spain, Yugoslavia, Mexico, Canada, Algeria.
Derivation: By heating cinnabar in air or with lime and condensing the vapor.
Method of purification: Distillation; an important proportion of used mercury is recovered by redistillation.
Grade: Technical, virgin, redistilled, ACS.
Hazard: (1) Mercury, metallic: Highly toxic by skin absorption and inhalation of fume or vapor, absorbed by respiratory and intestinal tract. FDA permits zero addition to the 20 micrograms of mercury contained in average daily diet. TLV (as mercury): 0.05 mg/m³ of air. (2) All inorganic compounds of mercury are highly toxic by ingestion, inhalation, and skin absorption. TLV: 0.05 mg/m³ of air. (3) Most organic compounds of mercury are highly toxic; inorganic mercury can be converted to methylmercury by bacteria in water. TLV (as mercury): (alkyl compounds) 0.01 mg/m³ of air; all others 0.05 mg. *Note*: Spillage may be a toxic hazard due to droplet proliferation. Clean-up requires special care.
Use: Amalgams, catalyst, electrical apparatus, cathodes for production of chlorine and caustic soda, instruments (thermometers, barometers, etc.), mercury vapor lamps, extractive metallurgy, mirror coating, arc lamps, boilers, coolant and neutron absorber in nuclear power plants.

mercury, ammoniated. (mercuric chloride, ammoniated; ammonobasic mercuric chloride; ammoniated mercury chloride, white precipitate; white precipitate, fusible; aminomercuric chloride; mercury cosmetic). $HgNH_2Cl$.
Properties: White, pulverulent lumps or powder; earthy, metallic taste. Odorless, stable in air, darkens on exposure to light, soluble in ammonium carbonate and sodium thiosulfate solutions and in warm acids, insoluble in water and alcohol.
Derivation: By precipitating mercuric chloride with ammonium hydroxide in excess.
Grade: USP, technical.
Hazard: Highly toxic. TLV (as mercury): 0.05 mg/m³ of air.
Use: Medicine (local anti-infective), pharmaceuticals.

mercury bichloride. Legal label name for mercuric chloride.

mercury cell. An electrolytic cell for the production of caustic soda and chlorine from sodium chloride brine. Continuously fed brine is decomposed in one compartment between graphite anodes where chlorine is liberated and a mercury cathode where a sodium amalgam is formed. The amalgam flows continuously or intermittently to a second compartment where it is decomposed with water, forming a caustic solution. The decomposition is usually performed electrolytically by making the amalgam anodic with respect to an iron or graphite cathode. Pure water is supplied to the decomposition compartment at such a rate as to maintain a constant concentration of caustic in the product. With respect to the diaphragm cell, the mercury cathode cell has generally a more concentrated solution (50–70%), it has the disadvantages of higher operating voltage and lower efficiency (52–55%) and a high capital investment in mercury. Examples of mercury-cathode cells are Castner cell and DeNora cell.

mercury compounds. See corresponding mercurous or mercuric compound, e.g., mercury chlorate, see mercurous chlorate; mercury oxide, see mercuric oxide.

mercury dichromate. (mercuric dichromate; mercury bichromate). $HgCr_2O_7$.
Properties: Heavy, red, crystalline powder; soluble in acids; insoluble in water.
Hazard: Highly toxic. TLV (as mercury): 0.05 mg/m³ of air.

mercury fulminate. (mercuric cyanate). $Hg(CNO)_2$.
Properties: Gray, crystalline powder. Soluble in alcohol, ammonium hydroxide, and hot water; slightly soluble in cold water; d 4.42; mp explodes.
Derivation: By treating mercury with strong nitric acid and alcohol.
Grade: Technical.
Hazard: Explodes readily when dry, keep moist till use, an initiating explosive. Highly toxic. TLV (as mercury): 0.05 mg/m³ of air.
Use: Manufacture of caps and detonators for producing explosions of military, industrial, and sporting purposes.

mercury selenide. HgSe. Sublimes in a vacuum, d 8.266, insoluble in water.
Hazard: Highly toxic. TLV (as mercury): 0.05 mg/m³ of air.
Use: Semiconductor in solar cells, thin-film transistors, infrared detectors, ultrasonic amplifiers.

mercury telluride. HgTe.
Grade: 99.99%.
Use: Semiconductor in solar cells, thin-film transistors, infrared detectors, ultrasonic amplifiers.

and rubber compounds, treatment of oil well drilling fluids, replacement for cork.

silver. CAS: 7440-22-4. Ag. Metallic element, atomic number 47, Group IB of the Periodic Table, aw 107.868, valence = 1, two stable isotopes.

Properties: Soft, ductile, lustrous, white solid; highest electrical and thermal conductivity of all metals. Excellent light reflector that resists oxidation, but tarnishes in air through reaction with atmospheric sulfur compounds. D 10.53, mp 961C, bp 2212C, thermal conductivity 1.01 cal/cm/sec/C, absorbs oxygen strongly at the melting point. Soluble in nitric acid, hot sulfuric acid, and alkali cyanide solutions; insoluble in water and alkalies. Noncombustible except as powder.

Derivation: Byproduct of operations on copper, zinc, lead, or gold ores, but some smelters still operate on native silver. The recovery ranges from 166 ounces to a few thousandths of an ounce per ton.

See Parkes process, The Pattinson process.

Source: Chief silver ores are native silver, argentite (silver sulfide), and cerargyrite (silver chloride).

Forms available: Pure ("fine"), sterling (7.5% copper), various alloys, plate; ingot, bullion, moss, sheet, wire, tubing, castings, powder, high purity (impurities less than 100 ppm), single crystals, whiskers.

Hazard: Toxic material. TLV (metal): 0.1 mg/m³ of air; (soluble compounds as silver): 0.01 mg/m³ of air.

Use: Manufacture of silver nitrate, silver bromide, photographic chemicals; lining vats and other equipment for chemical reaction vessels, water distillation, etc.; mirrors, electric conductors, such as bus bars; silver plating, electronic equipment; sterilant; water purification; surgical cements; hydration and oxidation catalyst; special batteries; solar cells; reflectors for solar towers; low-temperature brazing alloys; table cutlery; jewelry; dental, medical, and scientific equipment; electrical contacts; bearing metal; magnet windings; dental amalgams. Colloidal silver is used as a nucleating agent in photography and in medicine, often combined with protein.

See "Argyrol."

Note: A sandwich assembly consisting of a layer of silver between two layers of TiO_2 is used to coat the interior of light bulbs, it is said to reduce power consumption by more than 50% and triple the life of the bulb. Each layer of the coating, applied by the sputtering technique is 180 A thick.

silver acetate. CAS: 563-63-3. CH_3COOAg.

Properties: White crystals or powder, d 3.26, moderately soluble in hot water, soluble in nitric acid.

Hazard: Toxic material. TLV: 0.01 mg/m³ of air.

Use: Lab reagent, oxidizing agent.

silver acetylide. CAS: 13092-75-6. Ag_2C_2.

Properties: White, unstable powder; a salt of acetylene.

Derivation: Reaction of acetylene with aqueous solution of argentous salts.

Hazard: Severe explosion risk when shocked or heated.

Use: Detonators.

silver bromate. $AgBrO_3$.

Properties: White powder, sensitive to light, keep in amber bottle, soluble in ammonium hydroxide, slightly soluble in hot water, decomposed by heat, d 5.2.

silver bromide. CAS: 7785-23-1. AgBr.

Properties: Pale yellow crystals or powder, darkens on exposure to light, finally turning black; d 6.473 (25C); mp 432C; bp decomposes at 700C; soluble in potassium bromide, potassium cyanide, and sodium thiosulfate solutions; very slightly soluble in ammonia water; insoluble in water; light-sensitive.

Derivation: Silver nitrate is dissolved in water and a solution of alkali bromide added slowly. The precipitated silver bromide is washed repeatedly with hot water; the operation must be carried on in a darkroom under a ruby red light.

Use: Photographic film and plates, photochromic glass, laboratory reagent.

silver carbonate. CAS: 534-16-7. Ag_2CO_3.

Properties: Yellow to yellowish-gray powder; contains 78% silver; light-sensitive; soluble in ammonium hydroxide, nitric acid; insoluble in alcohol and water; d 6.077; decomposes at 218C.

Use: Lab reagent.

silver chlorate. (argentous chlorate). CAS: 7783-92-8. $AgClO_3$.

Properties: White, crystalline solid; mp 230C; decomposes at 270C. D 4.44, partially soluble in water, light-sensitive.

Derivation: Reaction of silver nitrate and sodium chlorate.

Hazard: Oxidizing agent, may react violently when shocked or heated, store away from combustible materials. Toxic by ingestion.

Use: Organic synthesis.

silver chloride. CAS: 7783-90-6. AgCl.

Properties: White, granular powder which darkens on exposure to light, finally turning black; exists in several modifications differing in behavior toward light and in their solubility in various solvents; soluble in ammonium hydroxide, concen-

selenium. CAS: 7782-49-2. Se. A nonmetallic element, atomic number 34, Group VIA of the Periodic Table, aw 78.96, valences = 2, 4, 6. These are 6 stable isotopes.
Properties: Amorphous, red powder becoming black on standing and crystalline on heating; vitreous and colloidal forms may be prepared. Crystalline form has d 4.5, mp 217C, bp 685C; amorphous form softens at 40C and melts at 217C. Crystalline selenium is a p-type semiconductor; electrically it acts as a rectifier and has marked photoconductive and photovoltaic action (converts radiant to electrical energy); the electrical conductivity increases with increasing light irradiation. Soluble in concentrated nitric acid and (in liquid form) in common alkalies; forms binary alloys with silver, copper, zinc, lead, etc.; a necessary nutritional factor for animals.
Occurrence: Canada, Japan, Yugoslavia, Mexico; also in certain soils.
Grade: Commercial (powder or lumps), high-purity up to 99.999%.
Use: Electronics, xerographic plates, TV cameras, photocells, magnetic computer cores, solar batteries (rectifiers, relays); ceramics (colorant for glass), steel and copper (degasifier and machinability improver), rubber accelerator, catalyst, trace element in animal feeds. For further information consult Selenium Tellurium Development Association, 11 Broadway, NY, NY.

selenium diethyldithiocarbamate.
CAS: 5456-28-0. $Se[SC(S)N(C_2H_5)_2]_4$.
Properties: Orange-yellow powder, d 1.32 (20/20C), melting range 63–71C, characteristic odor, soluble in carbon disulfide, benzene, chloroform, insoluble in water.
Hazard: Toxic by inhalation, ingestion, and skin absorption. TLV (as Se): 0.2 mg/m³ of air.
Use: Vulcanization agent without added sulfur or as a primary or secondary accelerator with sulfur.

selenium dimethyldithiocarbamate. See "Methyl Selenac."

selenium dioxide. (selenous acid anhydride).
CAS: 7446-08-4. SeO_2.
Properties: White or yellowish-white to slightly reddish, lustrous, crystalline powder or needles. D 3.954 (15/15C), mp 340–350C (sublimes), soluble in alcohol, water.
Hazard: Toxic by inhalation, ingestion, and skin absorption. TLV (as Se): 0.2 mg/m³ of air.
Use: Analysis (testing for alkaloids), oxidizing agent, antioxidant in lubricating oils, catalyst.

selenium sulfide. (selenium disulfide).
CAS: 7488-56-4. SeS_2.
Properties: Bright orange powder, mp less than 100C, practically insoluble in water and organic solvents.
Grade: USP.
Hazard: Toxic by ingestion, strong irritant to eyes and skin, an animal carcinogen. TLV: (as Se): 0.2 mg/m³ of air.
Use: Medicine (treatment of seborrhea, medicated shampoos).

selenium tetrafluoride. CAS: 10026-03-6. SeF_4.
Properties: Colorless, fuming liquid; fp −10C; bp 105C; d 2.75; reacts strongly with phosphorus and with water (hydrolysis). Soluble in alcohol, sulfuric acid, ether, and carbon tetrachloride.
Derivation: Reaction of selenium chloride and silver fluoride.
Hazard: Irritant.
Use: Fluorinating agent.

selenous acid. (selenious acid). H_2SeO_3.
Properties: Transparent, colorless, deliquescent crystals. Soluble in water and alcohol, insoluble in ammonia, d 3.0066, mp 70C (decomposes)
Derivation: Action of hot nitric acid on selenium.
Hazard: Toxic by inhalation, ingestion, and skin absorption. TLV (as Se): 0.2 mg/m³ of air.
Use: Reagent for alkaloids.

selenous acid anhydride. See selenium dioxide.

Semenov, Nikolai N. (1896-) A Russian chemist and physicist who won the Nobel prize in 1956. He authored books on the chain reaction and problems of chemical kinetics and reactivity as well as many articles. His work concerning thermal combustion and explosion is utilized in rockets and jet engines. He received his doctorate at Leningrad State University.

"Semesan."[28] TM for a wettable powder containing 25.3% hydroxymercurichlorophenol.
Hazard: As for mercury compounds.

"Semesan Bel."[28] TM for a seed disinfectant containing 12.5% hydroxymercurinitrophenol and 3.8% hydroxymercurichlorophenol.
Hazard: As for mercury compounds.

semicarbazide hydrochloride. (carbamylhydrazine hydrochloride; aminourea hydrochloride).
CAS: 563-41-7. $H_2NCONHNH_2HCl$.
Properties: White crystals, mp 172–175C (decomposes), soluble in water, insoluble in absolute alcohol and ether.
Derivation: From hydrazine sulfate, potassium or sodium cyanate, and sodium carbonate, or electrolytically by the reduction of nitrourea.
Grade: CP, technical.
Hazard: Toxic by ingestion.
Use: Reagent for aldehydes and ketones, isolation of hormones and isolation of certain fractions from essential oils.

semiconductor. [illegible] an electrical [illegible] that of conductors). Most [illegible] while substances [illegible] very low conductivity [illegible] these extremes [illegible] germanium, silicon [illegible] are examples, [illegible] 10^{-2} to 10^{9} ohm-cm [illegible] in the crystalline [illegible] conduction, [illegible] conductor crystals [illegible] electron donors [illegible] ductor is dependent [illegible] on the electrical [illegible] deficits in the [illegible]
The function [illegible] the science of [illegible] in the early [illegible] of transistors, [illegible] in electronic [illegible] replaced the [illegible]
There are a [illegible] pounds which [illegible] carbon-carbon [illegible] supporting [illegible] and Ziegler [illegible] gated polymers [illegible]
See also crystal [illegible] istry.

semimicro [illegible] ally analytical [illegible] used is from [illegible]

semipermeable [illegible] permeable.

semisynthetic. [illegible] products that [illegible] terials but [illegible] example, [illegible] leather, etc.

Semmler-Wolff [illegible] unsaturated [illegible] matic amines [illegible]

"Sentry."[illegible] sorbate.
Use: Fungicide [illegible] and yeast [illegible] USP. Solvent [illegible] for baked goods [illegible] and cream [illegible]

"Separan." [illegible] agents [illegible] anionic [illegible]

Derivation: From benzoic anhydride and aniline with sodium hydroxide.
Use: Intermediate in the synthesis of dyes, drugs and perfumes.

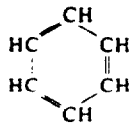
benzanthrone. $C_{17}H_{10}O$. A four-ring system.
Properties: Pale yellow needles; soluble in alcohol and other organic solvents. Mp 170C.
Derivation: (a) From anthranol and glycerol via condensation via sulfuric acid (anthranol is made from anthraquinone); (b) from anthracene in sulfuric acid solution by addition of glycerol and heating to 100–110C until the anthracene disappears. The reaction mass is then diluted with water, salted out and purified.
Method of purification: Crystallization from toluene.
Use: Dyes.

benzathine penicillin G. (N,N'-dibenzylethylenediamine dipenicillin G).
$2C_{16}H_{18}N_2O_4S \cdot C_{16}H_{20}N_2 \cdot 4H_2O$.
Properties: White, odorless, crystalline powder; slightly soluble in alcohol; almost insoluble in water; pH of a saturated solution is 4.5–7.5.
Grade: USP.
Use: Medicine (antibiotic).

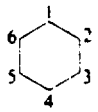
benzazimide. See 4-ketobenzotriazine.

"Benzedrine."[71] TM for amphetamine sulfate.

benzene. CAS: 71-43-2. C_6H_6. 16th highest-volume chemical produced in US (1985).


I

II


III

IV

Structure: I. Complete ring showing all elements. II. Standard ring showing double bonds only. III. Simple ring without double bonds, with numerals indicating position of carbon atoms to which substituent atoms or groups may be attached (2 = ortho, 3 = meta, 4 = para). IV. Generalized structure with enclosed circle suggesting the resonance of this compound. This structure is now in general use. These structures are also referred to as the benzene nucleus.
Properties: Colorless to light-yellow, mobile, nonpolar liquid of highly refractive nature; aromatic odor; vapors burn with smoky flame; bp 80.1C; fp 5.5C, d 0.8790 (20/4C); wt/gal 7.32 lb; refr index 1.50110 at 20C, flash p 12F (−11C) (CC), surface tension 29 dynes/cm. Autoign temperature 1044F (562C). Miscible with alcohol, ether, acetone, carbon tetrachloride, carbon disulfide, acetic acid; slightly soluble in water.
Derivation: (a) Hydrodealkylation of toluene or pyrolysis of gasoline; (b) transalkylation of toluene by disproportionation reaction; (c) catalytic reforming of petroleum; (d) fractional distillation of coal tar.
Grade: Crude, straw color; motor; industrial pure (2C); nitration (1C); thiophene-free; 99 mole %; 99.94 mole %; nanograde.
Hazard: A carcinogen. Highly toxic. Flammable; dangerous fire risk. Explosive limits in air 1.5 to 8% by volume. TLV: 10 ppm in air.
Use: Manufacturing of ethylbenzene (for styrene monomer); dodecylbenzene (for detergents); cyclohexane (for nylon); phenol; nitrobenzene (for aniline); maleic anhydride; chlorobenzene; diphenyl; benzene hexachloride; benzene-sulfonic acid; as a solvent.
See also aromatic.

benzene azimide. See 1,2,3-benzotriazole.

benzeneazoanilide. See diazoaminobenzene.

benzeneazobenzene. See azobenzene.

benzeneazo-p-benzeneazo-β-naphthol. ("Sudan" III; tetraazobenzene-β-naphthol).
$C_{22}H_{16}ON_4$. A red dye; CI 26100.444.
Properties: Brown powder; mp 195C, insoluble in water; soluble in alcohol, oils, chloroform, glacial acetic acid.
Use: Coloring oils red; biological stain.

benzeneazonaphthylethylenediamine. See azodine.

benzenecarboxylic acid. See benzoic acid.

benzenediazonium chloride. $C_6H_5N(N)Cl$.
Properties: Ionic salt. Very soluble in water; insoluble in most organic solvents.
Hazard: Highly toxic. Can explode on heating.
Use: Dye intermediate.

benzene dibromide. See dibromobenzene.

benzene-o-dicarboxylic acid. See phthalic acid.

benzene-p-dicarboxylic acid. See terephthalic acid.

benzene hexachloride. (BHC). A commercial mixture of isomers of 1,2,3,4,5,6-hexachlorocyclohexane. An insecticide.
Hazard: The gamma isomer is highly toxic. Use may be restricted.
See also lindane.

320.9C, bp 767C, refr index 1.13, Mohs hardness 2.0. Soluble in acids, especially nitric, and in ammonium nitrate solution. Lowers melting point of certain alloys when used in low percentages. Combustible.
Occurrence: A greenockite (cadmium sulfide) ore containing zinc sulfide also with lead and copper ores containing zinc. Canada, central and western US, Peru, Australia, Mexico, Zaire.
Derivations: (1) Dust or fume from roasting zinc ores is collected, mixed with coal or coke and sodium or zinc chloride, and sintered. The cadmium fume is collected in an electrostatic precipitator, leached, fractionally precipitated, and distilled. (2) By direct distillation from cadmium-bearing zinc (3) By recovery from electrolytic zinc process (approximately 40%).
Hazard: Flammable in powder form. Toxic by inhalation of dust or fume. A carcinogen. Cadmium plating of food and beverage containers has resulted in a number of outbreaks of gastroenteritis (food poisoning). Soluble compounds of cadmium are highly toxic; however, ingestion usually induces a strong emetic action which minimizes the risk of fatal poisoning. Use as fungicide may be restricted. TLV: (Dust and soluble compounds) 0.05 mg/m³ of air; (oxide fume as Cd) ceiling 0.05 mg/m³ of air.
Grade: Technical, powder, pure sticks, ingots, slabs, high-purity crystals (less than 10 ppm impurities).
Use: Electrodeposited and dipped coatings on metals, bearing and low-melting alloys, brazing alloys, fire protection systems, nickel-cadmium storage batteries, power transmission wire, TV phosphors, basis of pigments used in ceramic glazes, machinery enamels, baking enamels, Weston standard cell control of atomic fission in nuclear reactors, fungicide, photography and lithography, selenium rectifiers, electrodes for cadmium-vapor lamps and photoelectric cells.

cadmium acetate. (a) $Cd(OOCCH_3)_2 \cdot 3HOH$; (b) $Cd(OOCCH_3)_2$.
Properties: Colorless crystals, soluble in water and alcohols. (a) d 2.01, mp loses water at 130C; (b) d 2.341, mp 256C.
Derivation: Interaction of acetic acid and cadmium oxide.
Hazard: See cadmium.
Use: Ceramics (iridescent glazes), manufacture of acetates, assistant in dyeing and printing textiles, electroplating baths, laboratory reagent.

cadmium ammonium bromide. (ammonium-cadmium bromide). $CdBr_2 \cdot 4NH_4Br$.
Properties: Colorless crystals. Soluble in alcohol and water.
Hazard: See cadmium.

cadmium antimonide. A semiconductor used in thermoelectric devices.
Hazard: See cadmium and antimony.

cadmium-base Babbitt. See Babbitt metal.

cadmium borotungstate. $Cd_5(BW_{12}O_{40}) \cdot 18HOH$.
Properties: Yellow, heavy crystals; mp 75C; soluble in water. The solution is yellow to light brown.
Grade: Technical.
Hazard: See cadmium.
Use: Separating minerals.

cadmium bromate. $Cd(BrO_3)_2 \cdot HOH$.
Properties: White crystals or crystalline powder, d 3.758, mp decomposes. Soluble in water, insoluble in alcohol.
Derivation: By adding cadmium sulfate to a solution of barium bromate.
Hazard: Strong oxidizer, dangerous in contact with organics. Highly toxic, irritant, oxidizer.
Use: Analytical reagent.

cadmium bromide. CAS: 7789-42-6. $CdBr_2$ or $CdBr_2 \cdot 4HOH$.
Properties: White to yellowish efflorescent crystalline, d 5.192, mp (anhydrous) 568C, bp 863C, soluble in water, acetone, alcohol, and acids.
Derivation: By heating cadmium in bromine vapor.
Grade: Technical, reagent.
Hazard: See cadmium.
Use: Photography, process engraving, lithography.

cadmium carbonate. CAS: 513-78-0. $CdCO_3$.
Properties: White, amorphous powder; d 4.258; decomposes at less than 500C; soluble in dilute acids and in concentrated solution of ammonium salts; insoluble in water.
Hazard: See cadmium.
Grade: Reagent.

cadmium chlorate. $Cd(ClO_3)_2 \cdot 2HOH$.
Properties: Colorless, prismatic crystals. Hygroscopic, d 2.28 (18C), mp 80C, soluble in alcohol, water, and acetone.
Grade: Technical.
Hazard: Dangerous in contact with organic materials.

cadmium chloride. CAS: 10108-64-2. (a) $CdCl_2$; (b) $CdCl_2 \cdot 2.5HOH$.
Properties: Small, white, odorless crystals; d (a) 4.05, (b) 3.327; mp (a) 568C; bp (a) 960C; soluble in water and acetone.

(a) 3.012; (b) 1.867; (c) 1.70. (a) Insoluble in water and acids; (b) soluble in water, insoluble in alcohol; (c) soluble in water and alcohol.
Derivation: Action of sulfuric acid on chromium hydroxide with subsequent crystallization.
Use: Chrome plating, chromium alloys, mordant, catalyst, green paints and varnishes, green ink, ceramics (glazes). The basic form (reduction of sodium dichromate) is used in tanning.

chromite. (chrome iron ore).
CAS: 1308-31-2. $FeCr_2O_4$. A natural oxide of ferrous iron and chromium, sometimes with magnesium and aluminum present. Usually occurs in magnesium and iron rich igneous rocks.
Properties: Color iron-black to brownish-black, streak dark brown, luster metallic to submetallic, d 3.6, Mohs hardness 5.5.
Grade: Metallurgical, refractory, chemical.
Occurrence: USSR, South Africa, Zimbabwe, Philippines, Cuba, Turkey.
Hazard: A carcinogen. TLV: 0.05 mg/m³ of air.
Use: Only commercial source of chromium and its compounds.

chromium. CAS: 7440-47-3. Cr. Metallic element of atomic number 24, group VIB of the Periodic Table, aw 51.996, valences=2,3,6; 4 stable isotopes. Name derived from Greek for color.
Properties: Hard, brittle, semi-gray metal; d 7.1; mp 1900C; bp 2200C. Compounds have strong and varied colors. Cr ion forms many coordination compounds. Exists in active and passive forms, the latter giving rise to its corrosion resistance due to a thin surface oxide layer that passivates the metal when treated with oxidizing agents. Active form reacts readily with dilute acids to form chromous salts. Soluble in acids (except nitric) and strong alkalies, insoluble in water.
Occurrence: USSR, South Africa, Turkey, Philippines, Zimbabwe, Cuba.
Derivation: From chromite by direct reduction (ferrochrome), by reducing the oxide with finely divided aluminum or carbon, and by electrolysis of chromium solutions.
Grade: (ore): Chromium ores are classified as (1) metallurgical, (2) refractory, and (3) chemical and their consumption in the US is in that order. (1) Must contain a minimum of 48% Cr_2O_3 and have Cr-Fe ratio of 3:1; (2) must be high in Cr_2O_3, and Al_2O_3 and low in iron; (3) must be low in SiO_2 and Al_2O_3 and high in Cr_2O_3.
Forms available: (1) Chromium metal as lumps, granules or powder; (2) high- or low-carbon ferrochromium; (3) single crystals, high-purity crystals, or powder run 99.97% pure.
Hazard: Hexavalent chromium compounds are carcinogenic (OSHA) and corrosive on tissue, resulting in ulcers and dermatitis on prolonged contact. TLV: For chromium dust and fume is 0.5 mg/m³ of air.
Use: Alloying and plating element on metal and plastic substrates for corrosion resistance, chromium-containing and stainless steels, protective coating for automotive and equipment accessories, nuclear and high-temperature research, constituent of inorganic pigments.

chromium-51. Radioactive Chromium of mass number 51.
Properties: Half-life 26.5D, radiation: gamma (0.32 MeV).
Grade: USP (as sodium chromate Cr-51 injection).
Hazard: Radioactive poison.
Use: Diagnosis of blood volume (as tracer).

chromium acetate. See chromic acetate.

chromium acetylacetonate.
$[CH_3COCHC(CH_3)O]_3Cr$.
Properties: Purple powder or red-violet crystals, mp 216C, bp 340C, insoluble in water, soluble in acetone and alcohol.
Derivation: Reaction of chromium chloride, acetylacetone and sodium carbonate.
Use: Reduction of detonation of nitromethane.

chromium ammonium sulfate. (ammonium chromium sulfate; chrome ammonium alum).
$CrNH_4(SO_4)_2 \cdot 12HOH$.
Properties: Green powder or deep violet crystals, d 1.72, mp 94C. Soluble in water, slightly soluble in alcohol. The aqueous solution is violet when cold, green when hot.
Grade: Technical.
Use: Mordant, tanning.

chromium boride. One of several compounds of chromium and boron, e.g., CrB, CrB_2, and Cr_3B_2. They have high melting points, are very hard and corrosion-resistant and may be suitable for use in jet and rocket engines.
Properties: CrB may be crystals, d 6.2, mp 1550C, Mohs hardness 8.5, resistivity 67 μ-ohm cm (20C). CrB_2: d 5.15, mp 1850C, hardness 2010 (Knoop), resists oxidation up to 1100C. Cr_3B_2: may be crystals, d 6.1, Mohs hardness 9+.
Use: Metallurgical additives, high-temperature electrical conductors, cermets, refractories, coatings resistant to attack by molten metals.

chromium bromide. See chromous bromide.

chromium carbide. Cr_3C_2.
Properties: Ortho-rhombic crystals, d 6.65, microhardness 2700 kg/sq mm (load 50 g), mp 1890C,

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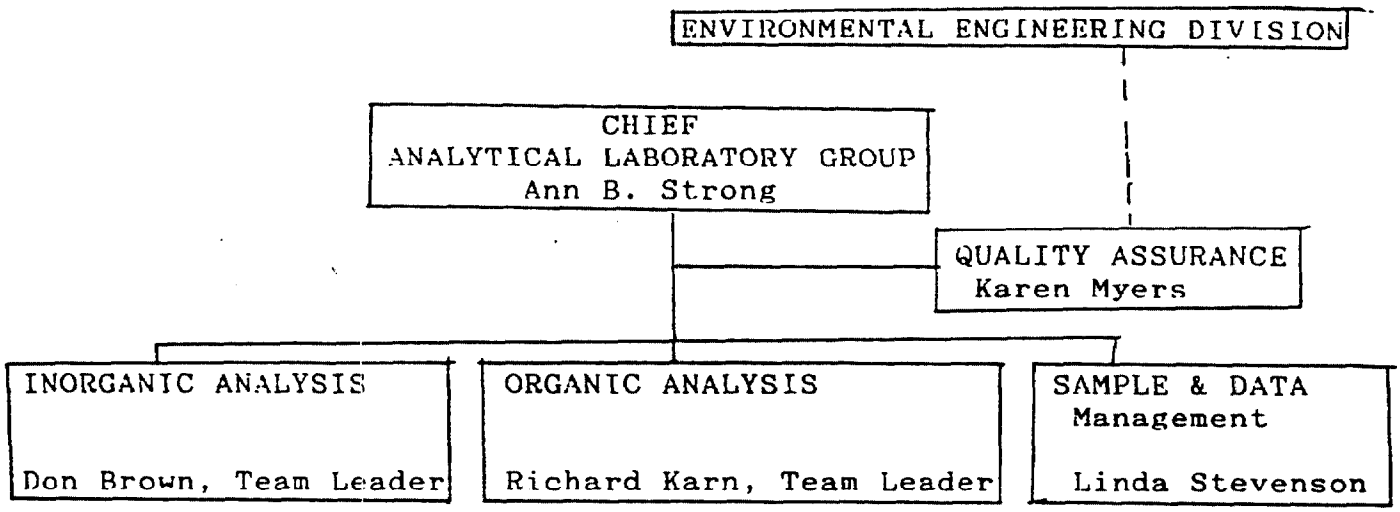
chromium nap
Properties: D

Appendix B

EXCERPTS FROM ALG'S SUBMITTAL TO THE NAVY

Appendix F



DUTIES

Ann B. Strong, GM 13, Chemist supervises overall activities of the ALG, including final check of all data prior to submission to customer.

Richard Karn, GS-12, Chemist has oversight for all organic analysis and is GC/MS expert.

Don Brown, GS-11, Chemist schedules all inorganic analysis and is an experienced analyst using the autoanalyzer, the DCP, the ICAP and the GFAA.

Linda Stevenson, GS-6, Physical Science Technician is responsible for sample and data management keeping track of all samples received, computer entry and tracking of all samples, fiscal reports, data reports.

Newberry Brown, GS-11, Chemist is primary gas chromatograph operator.

Glennard Warren, GS-11, Chemist is primary GFAA operator and also performs autoanalyzer analyses.

Karen Myers, GS-11, Biologist is experienced in operation of DCP and GC and serves as QA officer. (on long term leave September 1988-August 1989)

Agnes Morrow, GS-09, Chemist is experienced in organic extractions, and is secondary GC operator, also performs IR analyses.

Jeffretha Christian, GS-06, Physical Science Technician performs mercury and TOC analyses under Don Brown's oversight.

Willar Tyler, IPA Chemist for 7 years, performs digestions, autoanalyzer analyses, and other wet chemistry analyses.

Appendix D

ALG PROCEDURES- FY 89

References:

1. U. S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, March 1979 and EPA 600/4-82-055 Dec 1982. Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

2. U. S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, SW-846 Third Edition, November 1986 with December 1988 revisions. Office of Solid Waste and Emergency Response, Washington, DC 20460.

3. U. S. Environmental Protection Agency, Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples, EPA-600/8-80-038, June 1980. Health Effects Research Laboratory, Research Triangle Park, NC 27711.

4. Federal Register, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act", Vol 49, No. 209, Friday, October 26, 1984.

5. Plumb, Russell H.,Jr. Procedures for Handling and Chemical Analysis of Sediment and Water Analysis, EPA/CE-81-1 May 1981. Environmental Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, MS 39180.

6. American Public Health Association, Standard Methods for the Examination of Water and Wastewater 16th Edition, 1985. 1015 Fifteenth Street NW, Washington, DC 20005.

7. ASTM, 1987 Annual Book of ASTM Standards, Water and Environmental Technology Vol 11.01 & 11.02. 1987. 1916 Race Street, Philadelphia, PA 19103.

8. U. S. Environmental Protection Agency, Chemistry Laboratory Manual for Bottom Sediments and Elutriate Testing March 1979. Region V Central Regional Laboratory, 536 Clark Street, Chicago, IL 60605

9. Palermo, Michael R. "Development of a Modified Elutriate Test for Estimating the Quality of Effluent from Confined Dredged Material Disposal Areas" Technical Report D-86-4. August 1986. Department of the Army Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, Ms 39180.

6/89

cleaning procedures similar to those employed for laboratory glassware are used. Certificates of contamination checks are filed and lot numbers of bottles shipped to sample collectors are maintained in a log book.

SAMPLE SHIPPING PROCEDURES

The Analytical Laboratory Group (ALG) at WES is not normally involved with the actual field collection of samples. However, the ALG frequently provides sample bottles as described above. The field crew is requested to initiate chain-of-custody procedures for projects requiring chain-of custody using appropriate forms (WES form 2196). Field personnel are requested to label and identify samples to meet project specifications. They are given instructions as to the proper containers to use with the intended analyses, the proper preservation technique, and volumes needed.

For chain-of-custody samples, shipping containers are to be sealed, whether transported by field personnel or shipped by commercial carrier. Samples are to shipped with sufficent ice to maintain a 4° C temperature and with sufficient packing to prevent breakage.

SAMPLE RECEIPT AND LOG-IN PROCEDURES

Upon receipt at the laboratory, the sample management officer fills out a cooler receipt form (copy attached).

COOLER RECEIPT FORM

PROJECT:_____

Cooler received on_____ and opened on _____ by

Signature_____

1. Were custody seals on outside of cooler?----------YES NO
   If yes, how many and where?_____
   Were signature and date correct?----------YES NO

2. Were custody papers taped to lid inside cooler-------YES NO

3. Were custody papers properly filled out(ink, signed)-YES NO

4. Did you sign custody papers in the appropriate place?YES NO

5. What kind of packing material was used?_____

6. Was sufficient ice used(if appropriate)?----------YES NO

7. Were all bottles sealed in separate plastic bags?----YES NO

8. Did all bottles arrive in good condition(unbroken)?--YES NO

9. Were all bottle labels complete(#,date, signed,anal., preserv. etc.)? YES NO

10. Did bottle labels and tags agree with custody papers?YES NO

11. Were correct bottles used for tests indicated?------YES NO

12. Were VOA vials checked for absence of bubbles?------YES NO

13. Did each bottle contain sufficient sample?----------YES NO

14. Were acid/base preserved samples checked with pH paper?----------Yes NO

Explain any discrepancies------->

Receipt of chain-of-custody samples is recorded in a permanent receipt book. The sample collector or project manager is notified of any discrepancies noted on the cooler receipt form.

If samples are delivered by WES personnel, they are required to fill out WES Form 2079 with the information indicated by asterisks and to sign a sample receipt, WES Form 2118. The ALG sample management officer then verifies that the number of samples and the sample identification are as stated on Form 2097.

If samples are received by commercial carrier, Form 2097 is filled out by the sample management officer. The WES uses preprinted consecutively numbered duplicate gummed labels to identify samples. One label is placed on the sample bottle and the other label is placed on Form 2079 under the heading Lab I.D. No. next to the corresponding Project I. D. NO. This information is also entered into a permanent log book, WES Form 2108 (copy attached). The estimated cost is calculated, entered onto the Sample Receipt Form 2118, and the original copy returned to the Project manager.

All samples except volatiles are stored in the locked walk-in cooler which is maintained at 4° and equipped with an alarm system that goes off when the temperature deviates by more than $\pm$ two degrees. A separate refrigerator is maintained for volatile analysis and and temperatures are recorded in a refrigerator log. Two ALG employees have keys to the cooler and a permanent log is maintained to check chain-of-custody samples in and out of the cooler for analysis. The analyst is required to keep chain-of-custody samples behind locked

ALG SAMPLE RECEIPT	DIVISION	BRANCH	
PROJECT NAME	JOB NO.	DATE RECEIVED	NO. SAMPLES

SAMPLE NO.	PARAMETERS	ESTIMATED COST

PROJECT REP SIGNATURE	DATE	ALG SAMPLE RECIPIENT SIGNATURE	DATE

WES FORM MAR 77 2118

COPY 1

ALG SAMPLE RECEIPT	DIVISION	BRANCH	
PROJECT NAME	JOB NO.	DATE RECEIVED	NO. SAMPLES

SAMPLE NO.	PARAMETERS	ESTIMATED COST

PROJECT REP SIGNATURE	DATE	ALG SAMPLE RECIPIENT SIGNATURE	DATE

WES FORM MAR 77 2118

COPY 2

A. L. G. SAMPLE LOG

* Chain of Custody

02806 TO

LAB NO	JOB NO.	SOURCE	NO. ANALYSES / NO. SAMPLES	DATE RECEIVED	INITIAL COST	SPECIAL COST	DATE DATA RETURNED	DATE BOTTLES RETURNED	ANALYSES REQUIRED
2811	CQETN 3P3A1E6100	Calcasieu (NOD)	78 / 6	26 May 89	2154.00 Dig-50.00 Sed	Poss HGA 1260.00			Sb, As, Be, cd, cr, cu, Pb, Hg, Ni, Se, Tl, Ag, zn
2812	"	Calcasieu (NOD)	1	26 May 89	1134.00 Dig-100.00	Poss HGA 210.00			Sb, As, Be, cd, cr, cu, Pb, Hg, Ni, Se, Tl, Ag, zn, CN, Pesticides, PCBs
2813-2814	CQEWK383 A1E6100	Tensas Pump Plant (VXD)	16 / 2	1 June 89	358.00 Sed	Poss HGA 70.00			Ca, Fe, Mg, Si, Cl, Hardness, PH, Alkalinity
2832	RD9G107E117C001	APG (Wade)	18	2 June 89	5400.00				PCBs
2833-2848	CQERA3B31AES100	APG Air (Zappi)	48 / 16	2 June 89	624.00				Na, Ca, Mg
2849-2863	CQERA3831AES100	APG Air PCS (Zappi)	15 / 15	2 June 89	300.00				Cl
2864-2878	CQERA3831AES100	APG Air Particulate (Zappi)	15 / 15	2 June 89	300.00				TOC
2879	RD8G107E117C001	APG Elgin AFB (R. Wade)	1	5 June 89	500.00				ACS

ENVIRONMENTAL LABORATORY

DATA REPORTING SHEET ANALYTICAL LABORATORY GROUP

SHEET ___ OF ___

PROJECT *		DATE RECEIVED *	SAMPLE LOCATION	FREEZER NO.
DATA CHECKED BY	JOB NO. *	DATE COMPLETED		SHEET NO.

CHEMICAL CHECKMATE *	PARAMETER	*	*										
LAB I.D. NO	PROJECT I.D. NO *												

doors if he is away from the area where analyses are in progress.

The sample management officer then enters the information into the ALG computer data management system. Job files (example attached) are created for use by the analysts in recording their data.

SAMPLE DISPOSAL PROCEDURES

Samples are normally maintained by the ALG for a period of 6 months. At that time they are returned to the project managers if feasible. If this is not practical, the ALG requests permission from the project manager to dispose of the samples or place them in a semi-permanent repository. Samples that have been determined to contain no hazardous materials are disposed of via the sewerage system or sent to a sanitary landfill. Samples classified as hazardous are submitted to the WES Safety Office for disposal.

INSTRUMENT MAINTENANCE PROCEDURES

All Perkin-Elmer instruments (atomic absorption units) at WES are maintained by service contract that provides for twice yearly preventive maintenance and emergency repair. Permanent records are maintained of service visits.

The Plasma Emission Spectrometer (Spectrametrix) is maintained by service contract that provides for twice yearly preventive maintenance and emergency service. Permanent records are maintained of service visits.

All Hewlett-Packard Instruments (GC and GC/MS systems) are maintained by service contract that provides for twice yearly preventive maintenance and emergency repair. In addition, the GC/MS systems are tied via modem to the Analytical Response Center Support which can duplicate software problems at HP's service center. Records of all service calls are maintained in

permanent files.

All analytical balances are serviced annually by a certified balance technician.

All other instrumentation is serviced on an as needed basis and records are maintained of any repair calls.

Daily or routine maintenance of instruments is performed by the individual analysts and recorded in the instrument logs (i.e. Richard Karn is responsible for the GC/MS systems, Newberry Brown maintains the GCs, Mike Warren maintains the AAs, Don Brown maintains the ICP, DCP, and autoanalyzers, Jeffretha Christian maintains the TOC analyzer and the mercury analyzer.)

CALIBRATION PROCEDURES

Calibration of the GC/MS Systems. One instrument tune is met, the GC/MS system is calibrated before any samples or blanks are analyzed. Initial calibration is accomplished through the analysis of a minimum of five concentrations of standards. Five concentrations are used to confirm the linearity of response of the compounds examined. System calibration is verified at the start of every 12 hour analytical period. Relative response factors (RRF) are calculated for each compound based on the concentrations and areas of the characteristic ions for the compound to be measured and its assigned internal standard. Percent Relative standard (RSD) deviations are then calculated for each compound based on the mean of the initial relative response factors of the five standard concentrations. The percent RSD of the calibration check compounds listed in tables 1 and 2 are used to check calibration. The maximum

acceptable percent RSD for these compounds is 30.0.

Table 1

Volatile Calibration Check Compounds

Vinyl Chloride

1,1-Dichloroethene

Chloroform

1,2-Dichloropropane

Toluene

Ethylbenzene

Table 2

Semivolatile Calibration Check Compounds

Acenaphthene	4-Chloro-3-Methylphenol
1,4-Dichlorobenzene	2,4-Dichlorophenol
Hexachlorobutadiene	2-Nitrophenol
N-Nitroso-di-n-phenylamine	Pentachlorophenol
Di-n-octylphthalate	2,4,6-Trichlorophenol
Fluoranthene	Phenol
Benzo(a)pyrene	

In addition, system performance check compounds (SPCC) are injected to ensure that minimum RRFs are achieved. The compounds used are listed in tables 3 and 4 along with their minimum acceptable RRFs.

Table 3

Volatile System Performance Check compounds

Compound	Minimum Acceptable RRF
Chloromethane	0.300
1,1-Dichloroethane	0.30
1,1,2,2-Tetrachloroethane	0.30
Bromoform	0.25
Chlorobenzene	0.30

Table 4

Semivolatile System Performance Check Compounds

Compound	Minimum Acceptable RRF
N-Nitroso-Di-n-propylamine	0.050
Hexachlorocyclopentadiene	0.050
2,4-Dinitrophenol	0.050
4-Nitrophenol	0.050

Once the percent RSD for the CCCs and the minimum RRF for the SPCCs are met, the calibration is valid and sample analysis can begin.

Gas chromatograph calibration. A calibration Curve is determined for each of the compounds to be analyzed. Determination of the calibration curve involves preparing standards (usually three to five) from EPA standards. The samples are analyzed under normal conditions and the area under the peak is determined through integration. To determine the calibration factor, the area under the curve is divided by a standard amount (sample weight):

$$\text{Calibration factor} = \frac{\text{Area under the curve}}{\text{sample weight}}$$

To determine the variation between the Calibration Factors, a Percent Relative Deviation is calculated. The percent RSD is calculated by dividing the standard deviation of the Calibration factor by the mean of the calibration factors:

$$\%RSD = \frac{\text{Standard Deviation}}{\text{Mean}}$$

If the variation is less than 10 percent, the calibration is considered linear for all the samples analyzed for that particular compound.

Metals Analyses. Standard curves derived from data consisting of one reagent blank and three or four concentrations shall be prepared for each analyte. The response for each prepared standard shall be based upon the average of three replicate readings of each standard. the standard curve shall be used with each subsequent analysis provided that the standard curve is verified by using at least one reagent blank and one standard at a level normally encountered or expected in such samples. If the results of the verification are not within ±10% of the original curve, a reference standard should be employed to determine if the discrepancy is with the standard or the instrument. New standards should be prepared quarterly at a minimum.

Balances. Balances are checked daily using weights traceable to class S weights. Once each month the balances are checked with the Class S weights. Acceptance for balances which are direct reading to 0.01 gram shall be ±0.01 g for 0 to 100 g and ±0.1 percent of the applied weight over 100 g. A certified balance technician checks the balances annually.

DETECTION LIMITS. Procedures described in the CLP documents are used to determine ability to meet contract required detection limits (i.e. for metals, standards are run at 3 to 5 times instrument detection limits taking seven consecutive measurements on three non-consecutive days; the standard deviation is determined each day and three times the average standard deviation is used as the actual instrument detection limit.) For organic analyses, the method detection limits for the method are used, keeping in mind that the analyses are highly matrix dependent and higher detection limits are reported when interferences prohibit the reporting of the specified limits.

REFERENCE STANDARDS

The WES uses a number of sources for reference standards, including NIST (NBS) and EPA. Other Commercial sources are specified as being traceable to NIST if at all possible.

Reference Standards-Metals

NIST SPECTROMETRIC Solutions

3104 Barium

3105 Beryllium

3107 Boron

3108 Cadmium

3112 Chromium

3113 Cobalt

3114 Copper

3128 Lead

3131 Magnesium

4-8907 Supelpreme-HC Hazardous Substances Mix 1

4-8851 Purgeables A

4-8852 Purgeables B

4-8853 Purgeables C

A List of EPA Standards ordered from the repository at Research Triang Park is attached.

Chlorinated Biphenyl Standards were purchased from the National Research Council of Canada for congener analysis.

STANDARD REFERENCE MATERIALS AND CHECK SAMPLES FOR QUALITY CONTROL

The following SRMS from NIST are in the laboratory:

1642b Mercury in water

1643b Trace elements in water

1645 Trace elements in river sediment

1646 Trace elements in estuarine sediment

1566 Oyster tissue

1567 Bovine Liver

1573 Tomato leaves

Quality Control samples from Environmental Resource Associates are received on a quarterly basis for waste water, potable water, priority pollutants, and pesticides.

Additional quality control samples from EPA and NRC of Canada are ordered as needed to supplement samples listed above.

DATA EVALUATION

All data is checked by the analyst, the inorganic team leader or the organic team leader, and the Chief, ALG before it

is submitted to the customer. The following items are checked:

1. Completeness
2. Duplicate values for precision
3. Recovery of Spikes for accuracy
4. Method blanks for contamination
5. Surrogate recoveries for organic analysis
6. Data for QA check samples (EPA, ERA or NBS SRMs)
7. Reasonableness and trends

If data falls outside acceptable limits as described in the procedures, samples are rerun if sample is available. If data falls outside acceptable limits on the reruns and QA check sample data is good, then data may be reported with qualifying explanations. Acceptable data is usually defined by the procedures (i.e. SW-846, CLP, 600 methods, 500 methods).

CONTROL CHARTS

All inorganic parameters routinely analyzed are charted. A minimum of 20 points is required for limit calculations. Precision control charts are prepared from the duplicate analysis data and accuracy charts are prepared from matrix spikes. Future charts will also be prepared utilizing blank spike data. Charts are also prepared using SRMs and external QA samples. Control charts for organics are limited to the CLP spiked compounds and surrogates. PCB-1248 is the spiking compound for PCB analysis.

CORRECTIVE ACTIONS

During the performance of work under any laboratory task, out of control conditions may occur which call for corrective action.

Typically QC parameters given in the various methods are employed to determine the need for action. The type of action required shall be documented, although documentation may only require appropriate instrument and/or laboratory logbook entries, as opposed to a formal corrective action memo.

Corrective actions may also include procedural matters related to internal custody of samples, sample log-in, sample data processing and so forth. These are usually provided via inhouse memo from the Chief, ALG.

As necessary modifications to inhouse procedures, equipment, standards, policy and so forth may be needed to rectify recurring or otherwise significant laboratory problems. These are usually resolved via group meetings where a course of action is decided upon and a time for correction is defined.

When significant changes are made the QA manual will be updated to reflect the changes.

Use of a form to document corrections will be implemented October 1989.

GC/MS TUNING

GC/MS tuning is performed using Hewlett-Packard recommended procedures for the quadrapole systems and is included in the instrument manuals (copy attached).

DATA REDUCTION.

Data reduction is shown in the following flow chart. It is the responsibility of the analyst to conduct initial data reduction. The readings from the instruments or analytical system are calculated into

DFTPP TUNING

REFERENCES:

E-16	
D-98	regulations detailed
E-11	spectrum
D-102	2.6.1.2 - Demonstrates consistant spectra from MS to MS. Spells out requirements for qualitative verification that must be met.

NOTES:

A) DFTPP must be verified once per shift or every 12 hrs.

B) Note that all MS give different looking DFTPP spectra, which implies a wide range of PFTBA spectra.

```
 69 = 100 --|
219 =  55   |-- fairly normal
502 = 1.2 --|

 69 = 100 --|
219 =  20   |-- perfectly ok, often
502 = 0.2 --|   seen on benchtops
```

C) There are many different ways to tune DFTPP. The methods given below (some specific, some general) are ways that many users have found successful. In addition, there are many "markers" that different users look for during the tune that seem to indicate that the tune will be successful. Some of the more popular of these goals are:

1) Tune until 219 and 131 are approximately equal and range between 20 and 60% of 69.
2) After tuning, check spectrum scan and see if m/e 50 and m/e 502 are equal. The closer to equal, the better the chance that the tune will be successful.

Look for guidelines such as these on your MS to help guide you during tuning.

D) DO NOT TUNE UNLESS IT IS NECESSARY! It will cost you only 5 - 10 min to attempt to verify your last tune. Experience has shown that the more often you tune, the more often you have to recalibrate your ID file. This is because you are adjusting your mass response ratios when you tune.

PROCEDURE A: 5987/5988

MANUAL TUNE -- PFTBA OPEN

1) REPEAT PROFILE - set plunger to max 219
2) Set GC temp to 225-275 (ie. elution temp of DFTPP) so GC flow = flow at DFTPP elution.
3) Run AUTOTUNE - set source to 250
4) MANUAL TUNE (source @ 250, GC - 250)
5) set A/D =1 (0.5 sec/scan or faster)
6) run REPEAT PROFILE about 1 min to warm up and stabilize the source and EM.
7) PARAMETER RAMP (make sure plunger is adjusted) Begin to max 219, starting with REP
   A) REP
   B) IF
   C) DO
   D) ENT LENS

   leave the X-RAY alone at this point.
8) in REPEAT PROFILE use the X-RAY to set 69:219:502 ratio. 502/219 should be >3% and <5%. (do not be confused and set 502/69 ratio).
9) use DO to achieve final ratios, if needed.
10) do PEAK WIDTH and MASS AXIS CALIBRATION
11) check spectrum to make sure calibrations did not shift peak ratios.
12) store tune as MTDFTP

NOTES:

A) If 502 has a precursor, you will probably lose m/e 441 in DFTPP spectra. This is more of a problem on bench-tops than big systems. Cleaning the ENT LENS will often eliminate this precursor.

PROCEDURE B: 5995

A) Set oven to 250 with XFR,OVN1,250 (ie. elution temp of DFTPP, so GC flow = flow at DFTPP elution)
B) Set source to 250 with XFR,SORS,250
C) Run AUTOTUNE
D) MANUAL TUNE - PFTBA OPEN
Note: If you have previously created a manual tune file, use NEW TUNE FILE to load it.

1) Edit temp zones
   Source 250
   Analyser 180
   Transfer 280
2) Edit scan parameters to set A/D =1 (0.5 sec/scan or faster)
3) run REPEAT PROFILE about 1 min to warm up and stabalize source and EM.
4) PARAMETER RAMP - begin to max 219
   A) REP leave alone
   B) IF most useful lens
   C) ENT LENS can be useful
   leave the X-RAY alone at this point.
   NOTE: on benchtops, if we set IF = 100, this is often all that is necessary. As a first attempt just adjust the IF and leave other lenses alone.
5) in REPEAT PROFILE, use X-RAY to set 69:219:502 ratio. 502/219 ratio should be >3% and <5% (do not be confused and set 502/69 ratio). Adjust ratio using X-RAY, being careful not to adjust too far and deteriorate peak shape.
6) do PEAK WIDTH and MASS AXIS CALIBRATION
7) SPECTRUM SCAN - check spectrum to make sure calibrations did not shift peak ratios. Remember, 502/219 should be >3% and <5%. Also, look at 131/219 ratio. They should be approximately equal.
8) Store tune as MTDFTP

NOTES:

A) If 502 has a precursor, you will probably lose m/e 441 in DFTPP spectra. This is more of a problem on benchtops than big systems. Cleaning the ENT LENS will often eliminate this precursor.

DATA REDUCTION
ANALYSIS FLOW CHART

LABORATORY DATA MANAGEMENT SYSTEM
(Bench Sheets)

↓

ANALYSIS OF SAMPLES

↓

ANALYST'S NOTEBOOK

↓

RAW DATA TO BENCH SHEETS

↓

TEAM LEADER

↓

LABORATORY DATA MANAGEMENT SYSTEM ⇄ QC CHECK

↓

CHIEF, ANALYTICAL LABORATORY GROUP

↓

LABORATORY DATA MANAGEMENT SYSTEM

↓

FINAL REPORT
(Initialed by C/ALG)

appropriate concentration units for the results. Rounding occurs only after calculations are complete. The calculations are normally performed on the raw data sheets. The results are then transcribed on to the computer generated data files.

The next step in data reduction is data review by the team leader. Data is checked for validity and completeness. Questionable data is brought to the attention of the analyst and corrective action is taken if necessary.

Data is then forwarded to the sample management officer for entry into the Laboratory Data Management system.. Data entry is checked by the team leader, corrections are made, and the report is then sent to the quality assurance officer and the Chief, Analytical Lab Group for review. Any corrections are made and final report is generated that has been initialed by the Chief, ALG. All raw data is filed.

DATA OUTLIERS

Sample data that falls outside acceptable limits are reanalyzed if possible. If sample is not available to rerun the sample, data are reported with qualifying statements and with external QA data to support the results, assuring that the analytical system was in control. Method blanks are analyzed with each set of samples and reported with the sample data. Organic method blanks are spiked with surrogates.

AGENCY APPROVALS

As the primary research and development facility for Corps environmental research, the ALG has not solicited formal approval from other agencies or states, although the ALG has conducted numerous research projects for the Environmental Protection Agency, the Navy,

the Coast Guard, the Air Force, and other Army branches. The ALG is a validated Quality Assurance Laboratory for the Corps Superfund and DERP projects.

INTERNAL AUDITS

Several methods of internal audits are used including worksheet review, on-site analyst review, intra- and interlaboratory sample examination. Presently the ALG participates in the Corps of Engineers Interlaboratory Testing Program and subscribes quarterly to the Environmental Research Associates Quality Control Sample program (beginning October 1989, subscription will be bimonthly). In addition the QA officer submits EPA, NRC or NIST quality assurance samples to the laboratory for internal review of the measurement process. System audits are conducted semi-annually to evaluate sample handling, sample analysis,record control, proficiency testing, personal practices, training, workload, and manpower needs.

DOCUMENT FLOW

The sample management officer is also the in charge of document control. She maintains the master logbook, the computer logbook, the computer-generated bench sheets, the completed computer generated bench sheets and the final computer generated reports. Each analyst maintains the raw data files from his/her instruments. The document flow is outlined in the Data Reduction Analysis Flow Chart. Final Data reports are approved by the team leader, the quality assurance officer and the Chief, ALG.

QA REPORTS

QA reports are tailored to customer request. QA reports for

DERP projects where WES ALG serves as the QA lab utilize the following outline.

A. Cover letter

B. Report Narrative

1. Summary

2. QC data discussion

3. QA/QC data comparison

4. Other Problems

5. Corrective Actions

c. Data comparison tables

Table 2 Analytical Procedures for Metals

Parameter	Media	Ref 1 EPA-1979	Ref 2 SW-846	Other	Routine Meth Det. limits
1. Digest for tot rec met	Water		3005		
2. Digest for tot metals	Water		3010		
3. Digest for Metals-GFAA	Water		3020		
4. Digest for Metals	Sed., Soil & Sludge		3050		
5. Simultaneous anal by DCP				Ref 7, D4190-82	
5a. Simultaneous anal by ICP		200.7	6010		
6. Aluminum, DCP ICP		200.7	6010	Ibid	30ug/l 100ug/l
7. Antimony, DCP ICP		200.7	6010	Ibid	
8. Antimony, GFAA		204.2	7041		5ug/l
9. Arsenic,GFAA		206.2	7060		5ug/l
10. Arsenic,hydride		206.3	7061		5ug/l
11. Barium,AA		208.1	7080		100ug/l
12. Barium,GFAA		208.2			2ug/l
13. Barium, DCP ICP		200.7	6010	Ref 7, D4190-82	10ug/l 5ug/l
14. Beryllium, DCP ICP		200.7	6010	Ibid	5ug/L 5ug/L
15. Boron, DCP ICP		200.7	6010	Ibid	10ug/l
16. Cadmium, DCP ICP		200.7	6010	Ibid	20ug/L 20ug/l
17. Cadmium, GFAA		213.2	7131		0.1ug/l

18. Calcium, DCP ICP		200.7	6010	Ibid	100ug/l 200ug/l
19 Calcium, AA		215.1	7140		
20. Chromium, DCP ICP		200.7	6010	Ibid	20ug/l 20ug/l
21. Chromium, GFAA		218.2	7191		1ug/l
22. Chromium VI		218.4	7197		10ug/l
23. Cobalt, DCP ICP		200.7	6010	Ibid	30ug/l 50ug/l
24. Cobalt, GFAA		219.2	7201		1ug/l
25. Copper, DCP ICP		200.7	6010	Ibid	30ug/l 20ug/l
26. Copper, GFAA		220.2			1ug/l
27. Iron, DCP ICP		200.7	6010	Ibid	30ug/l 30ug/l
28. Iron,AA		236.1	7380		30ug/l
29. Iron,GFAA		236.2	7381		1ug/l
30. Lead, DCP ICP		200.7	6010	Ibid	200ug/l 100ug/l
31. Lead, GFAA		239.2	7421		1ug/l
32. Magnesium, DCP ICP		200.7	6010	Ibid	30ug/l 30ug/l
33. Magnesium, AA		242.1	7450		
34. Manganese, DCP ICP		200.7	6010	Ibid	30ug/l 10ug/l
35. Manganese, AA		243.1	7460		
36. Manganese, GFAA		243.2			1ug/l
37. Mercury, Cold Vapor	Water Sed.	245.1 245.5	7470 7471		0.2ug/l 0.2ug/g
38. Molydenum, DCP ICP		200.7	6010	Ibid	50ug/l 30ug/l
39. Molydenum, GFAA		246.2	7481		1ug/l

40. Nickel, DCP			Ibid	30ug/l
ICP	200.7	6010		20ug/l
41. Nickel,GFAA	249.2			1ug/l
42. Potassium, DCP			Ibid	100ug/l
ICP	200.7	6010		
43. Potassium, AA	258.1	7610		10ug/l
44. Selenium, GFAA	270.2	7740		5ug/l
45. Selenium,Hydride	270.3	7741		5ug/l
46. Silver, DCP			Ibid	30ug/l
ICP	200.7	6010		20ug/l
47. Silver, GFAA	272.1	7761		1ug/l
48. Sodium, DCP			Ibid	100ug/l
ICP	200.7	6010		100ug/l
49. Sodium, AA	273.1	7770		5ug/l
50. Thallium, DCP			Ibid	30ug/l
ICP	200.7	6010		30ug/l
51. Thallium, GFAA	279.2	7841		1ug/l
52. Tin, DCP			Ibid	50ug/l
53. Tin, GFAA	282.2			5ug/l
54. Titanium, GFAA	283.2			10ug/l
55. Vanadium, DCP			Ibid	20ug/l
ICP	200.7	6010		20ug/l
56. Vanadium,GFAA	286.2	7911		5ug/l
57. Zinc, DCP			Ibid	30ug/l
ICP	200.7	6010		10ug/l
58. Zinc, GFAA	289.2			5ug/l
59. Silicon, DCP			Ibid	100ug/l

Table 3. Organic Procedures

Parameter	Media	Reference		
		Ref 4 Fed Reg 1984	Ref 2 SW-846	Ref 6 Std Meth
1. Soxhlet Extraction	Soil & Sed.		3540	
2. Sep funnel Liq-Liq extr	Water Soluble		3510	
3. Purge & trap Prep-GC			5030	
4. Sonication Extraction	Soil, Tissue & Sed.		3550	
5. Florisil Cleanup	Pest, PCB, & ClHC		3620	
6. Silica Gel Cleanup	PAH		3630	
7. Sulfur Cleanup	Sed.		3660	
8. Volatile Organics	Water	624		
	Water & Solid Ext.		8260	
9. Semivol. Organics(BNA)	Water	625		
	Water & Solid Ext.		8270	
10. Cl-Pest & PCBs	Water	608		
	Water & Solid Ext.		8080	
11. Polynuclear Aromatic HC	Water	610		
	Water & Solid Ext		9100	
12. Organophos Pesticides	Water & Solid ext.		8140	509A
13. Chlorinated Herbicides	Water & Solid Ext.		8150	509B

Other Methods as Requested Such as Hydrazine, Nitrosoamines, & TNT

Detection limits for organic analysis are typically those given for the methods. They are, however, subject to matrix interferences and may be higher depending on the nature of the interference.

TABLE 2.
PRACTICAL QUATITATION LIMITS (PQL) FOR VOLATILE ORGANICS[a]

Volatiles	Practical Quantitation Limits[b] Ground water ug/L	Low Soil/Sediment ug/kg
Acetone	100	100
Acetonitrile	100	100
Allyl chloride	5	5
Benzene	5	5
Benzyl chloride	100	100
Bromodichloromethane	5	5
Bromoform	5	5
Bromomethane	10	10
2-Butanone	100	100
Carbon disulfide	100	100
Carbon tetrachloride	5	5
Chlorobenzene	5	5
Chlorodibromomethane	5	5
Chloroethane	10	10
2-Chloroethyl vinyl ether	10	10
Chloroform	5	5
Chloromethane	10	10
Chloroprene	5	5
1,2-Dibromo-3-chloropropane	100	100
1,2-Dibromoethane	5	5
Dibromomethane	5	5
1,4-Dichloro-2-butene	100	100
Dichlorodifluoromethane	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethane	5	5
1,1 Dichloroethene	5	5
trans-1,2-Dichloroethene	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
trans-1,3-Dichloropropene	5	5
Ethylbenzene	5	5
Ethyl methacrylate	5	5
2-Hexanone	50	50
Isobutyl alcohol	100	100
Methacrylonitrile	100	100
Methylene chloride	5	5
Methyl iodide	5	5
Methyl methacrylate	5	50
4-Methyl-2-pentanone	50	50
Pentachloroethane	10	10

TABLE 2.
(Continued)

Volatiles	Practical Quantitation Limits[b] Ground water ug/L	Low Soil/Sediment ug/kg
Propionitrile	100	100
Styrene	5	5
1,1,1,2-Tetrachloroethane	5	5
1,1,2,2-Tetrachloroethane	5	5
Tetrachloroethene	5	5
Toluene	5	5
1,1,1-Trichloroethane	5	5
1,1,2-Trichloroethane	5	5
Trichloroethene	5	5
1,2,3-Trichloropropane	5	5
Vinyl acetate	50	50
Vinyl chloride	10	10
Xylene (Total)	5	5

[a]Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achieveable. See the following information for further guidance on matrix-dependent PQLs.

[b]PQLs listed for soil/sediment are based on wet weight. Normally data is reported on a dry_weight basis; therefore, PQLs will be higher, based on the percent moisture in each sample.

Other Matrices:	Factor[1]
Water miscible liquid waste	50
High-level soil & sludges	125
Non-water miscible waste	500

[1]PQL = [PQL for ground water (Table 2)] X [Factor]. For non-aqueous samples, the factor is on a wet-weight basis.

TABLE 2.
PRACTICAL QUANTITATION LIMITS (PQL) FOR SEMIVOLATILE ORGANICS[A]

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/kg
Acenapthene	10	660
Acenaphthylene	10	660
Acetophenone	10	ND
2-Acetylaminofluorene	20	ND
1-Acetyl-2-thiourea	1000	ND
2-Aminoanthraquinone	20	ND
Aminoazobenzene	10	ND
4-Aminobiphenyl	20	ND
Anilazine	100	ND
o-Anisidine	10	ND
Anthracene	10	660
Aramite	20	ND
Azinphos-methyl	100	ND
Barban	200	ND
Benz(a)anthracene	10	660
Benzo(b)fluoranthene	10	660
Benzo(k)fluoranthene	10	660
Benzoic acid	50	3300
Benzo(g,h,i)perylene	10	660
Benzo(a)pyrene	10	660
p-Benzoquinone	10	ND
Benzyl alcohol	20	1300
Bis(2-chloroethoxy) methane	10	660
Bis(2-chloroethyl) ether	10	660
Bis(2-chloroisopropyl) ether	10	660
4-bromophenyl phenyl ether	10	660
Bromoxynil	10	ND
Butyl benzyl phthalate	10	660
Captafol	20	ND
Captan	50	ND
Carbaryl	10	ND
Carbofuran	10	ND
Carbophenothion	10	ND
Chlorfenvinphos	20	ND
4-Chloroaniline	20	1300
Chlorobenzilate	10	ND
5-Chloro-2-methylaniline	10	ND
4-Chloro-3-methylphenol	20	1300
3-(Chloromethyl) pyridine hydrochloride	100	ND
2-Chloroanaphthalene	10	660
2-Chlorophenol	10	660
4-Chlorophenyl phenyl ether	10	660

TABLE 2.
(Continued)

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/kg
Chrysene	10	660
Coumaphos	40	ND
p-Cresidine	10	ND
Crotoxyphos	20	ND
2-Cyclohexyl-4,6-dinitrophenol	100	ND
Demeton-o	10	ND
Demeton-s	10	ND
Diallate (cis or trans)	10	ND
Diallate (trans or cis)	10	ND
2,4-Diaminotoluene	20	ND
Dibenz(a,j)acridine	10	ND
Dibenz(a,h)anthracene	10	660
Dibenzofuran	10	660
Dibenzo(a,e)pyrene	10	ND
Di-n-butylphthalate	10	ND
Dichlone	NA	ND
1,2-Dichlorobenzene	10	660
1,3-Dichlorobenzene	10	660
1,4-Dichlorobenzene	10	660
3,3'-Dichlorobenzidine	20	1300
2,4-Dichlorophenol	10	660
2,6-Dichlorophenol	10	ND
Dichlorovos	10	ND
Dicrotophos	10	ND
Diethylphthalate	10	660
Diethylstilbesterol	20	ND
Diethyl sulfate	100	ND
Dimethoate	20	ND
3,3'-Dimethoxybenzidine	100	ND
Dimethylaminoazobenzene	10	ND
7,12-Dimethylbenz(a)anthracene	10	ND
3,3'-Dimethylbenzidine	10	ND
a,a-Dimethylphenethylamine	ND	ND
2,4-Dimethylphenol	10	660
Dimethyl phthalate	10	660
1,2-Dinitrobenzene	40	ND
1,3-Dinitrobenzene	20	ND
1,4-Dinitrobenzene	40	ND
4,6-Dinitro-2-methylphenol	50	3300
2,4-Dinitrophenol	50	3300
2,4-Dinitrotoluene	10	660
2,6-Dinitrotoluene	10	660
Dinocap	100	ND

TABLE 2.
(Continued)

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/kg
Dinoseb	20	ND
5,5-Diphenylhydantoin	20	ND
Di-n-octyl phthalate	10	660
Disulfoton	10	ND
EPN	10	ND
Ethion	10	ND
Ethyl carbamate	50	ND
Bis(2-ethylhexyl)phthalate	10	660
Ethyl methanesulfonate	20	ND
Famphur	20	ND
Fensulfothion	40	ND
Fenthion	10	ND
Fluchloralin	20	ND
Fluoranthene	10	660
Fluorene	10	660
Hexachlorobenzene	10	660
Hexachlorobutadiene	10	660
Hexachlorocyclopentadiene	10	660
Hexachloroethane	10	660
Hexachlorophene	50	ND
Hexachloropropene	10	ND
Hexamethyl phosphoramide	20	ND
Hydroquinone	ND	ND
Indeno(1,2,3-cd)pyrene	10	660
Isodrin	20	ND
Isophorone	10	660
Isosafrole	10	ND
Kepone	20	ND
Leptophos	10	ND
Malathion	50	ND
Maleic anhydride	NA	ND
Mestranol	20	ND
Methapyrilene	100	ND
Methoxychlor	10	ND
3-Methylcholanthrene	10	ND
4,4'-Methylenebis(2-chloroaniline)	NA	ND
Methylmethanesulfonate	10	ND
2-Methylnaphthalene	10	660
Methyl parathion	10	ND
2-Methylphenol	10	660
3-Methylphenol	10	ND
4-Methylphenol	10	660
Mevinphos	10	ND

TABLE 2.
(Continued)

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/kg
Mexacarbate	20	ND
Mirex	10	ND
Monocrotophos	40	ND
Naled	20	ND
Naphthalene	10	ND
1,4-Naphthoquinone	10	660
1-Naphthylamine	10	ND
2-Naphthylamine	10	ND
Nicotine	20	ND
5-Nitroacenaphthene	10	ND
2-Nitroaniline	50	ND
3-Nitroaniline	50	3300
4-Nitroaniline	20	3300
5-Nitro-o-anisidine	10	ND
Nitrobenzene	10	ND
4-Nitrobiphenyl	10	660
Nitrofen	20	ND
2-Nitrophenol	10	ND
4-Nitrophenol	50	660
5-Nitro-o-toluidine	10	3300
4-Nitroquinoline-1-oxide	40	ND
N-Nitrosodibutylamine	10	ND
N-Nitrosodiethylamine	20	ND
N-Nitrosodiphenylamine	10	ND
N-Nitroso-di-n-propylamine	10	660
N-Nitrosopiperidine	20	660
N-Nitrosopyrrolidine	40	ND
Octamethyl pyrophosphoramide	200	ND
4,4'-Oxydianiline	20	ND
Parathion	10	ND
Pentachlorobenzene	10	ND
Pentachloronitrobenzene	20	ND
Pentachlorophenol	50	ND
Phenacetin	20	3300
Phenanthrene	10	ND
Phenobarbital	10	660
Phenol	10	ND
1,4-Phenylenediamine	10	660
Phorate	10	ND
Phosalone	100	ND
Phosmet	40	ND
Phosphamidon	100	ND
Phthalic anhydride	100	ND
2-Picoline	ND	ND

TABLE 2.
(Continued)

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/kg
Piperonyl sulfoxide	100	ND
Pronamide	10	ND
Propylthiouracil	100	ND
Pyrene	10	660
Pyridine	ND	ND
Resorcinol	100	ND
Safrole	10	ND
Strychnine	40	ND
Sulfallate	10	ND
Terbufos	20	ND
1,2,4,5-Tetrachlorobenzene	10	ND
2,3,4,6-Tetrachlorophenol	10	ND
Tetrachlorvinphos	20	ND
Tetraethyl pyrophosphate	40	ND
Thionazine	20	ND
Thiophenol (Benzenethiol)	20	ND
Toluene diisocyanate	100	ND
o-Toluidine	10	ND
1,2,4-Trichlorobenzene	10	660
2,4,5-Trichlorophenol	10	660
2,4,6-Trichlorophenol	10	660
Trifluralin	10	ND
2,4,5-Trimethylaniline	10	ND
Trimethyl phosphate	10	ND
1,3,5-Trinitrobenzene	10	ND
Tris(2,3-dibromopropyl) phosphate	200	ND
Tri-p-tolyl phosphate(h)	10	ND
O,O,O-Triethylphosphorothioate	NT	ND

[a] PQLs listed for soil/sediment are based on wet weight. Normally data is reported on a dry weight basis, therefore, PQLs will be higher based on the % moisture in each sample. This is based on a 30-g sample and gel permeation chromatography cleanup.

[b] Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achievable.

ND = Not determined.
NA = Not applicable.
NT = Not tested.

Other Matrices	Factor[1]
Medium-level soil and sludges by sonicator	7.5
Non-water miscible waste	75

[1]PQL = [PQL for Low Soil/Sediment (Table 2)] X [Factor].

APPENDIX C

OBP GROUNDWATER ANALYTICAL RESULTS

FIRST QUARTER

Monitoring Results for the First Year

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 5-1	5-2	5-3	5-4	5-5	5-6	5-7
WATER LEVELS A	13 DEC 81		FT	591.62	575.63	576.08	573.83	574.38	560.57	566.40
ARSENIC	07 DEC 81	.010	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	07 DEC 81	.1	MGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	07 DEC 81	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	07 DEC 81	.010	MGL	ND	ND	ND	ND	ND	ND	ND
FLUORIDE	07 DEC 81	.10	MGL	.15	.12	ND	ND	.19	.18	.24
LEAD	07 DEC 81	.010	MGL	ND	ND	.015	ND	ND	ND	ND
MERCURY	07 DEC 81	.2	UGL	ND	ND	ND	ND	ND	.2	ND
NO2+NO3 AS N	07 DEC 81	.05	MGL	.03	1.10	.26	.10	.52	ND	ND
SELENIUM	07 DEC 81	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	07 DEC 81	.01	MGL	ND	.05	ND	ND	ND	ND	ND
ENDRIN	07 DEC 81	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	07 DEC 81	.08	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	07 DEC 81	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	07 DEC 81	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	07 DEC 81	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	07 DEC 81	.5	UGL	ND	ND	ND	ND	ND	ND	ND
GROSS ALPHA	07 DEC 81	1.30	PCL	ND	ND	ND	ND	ND	ND	ND
GROSS BETA	07 DEC 81	1.30	PCL	1.08	2.27	1.46	1.43	1.80	2.22	1.80
TOTCOLIBACT	08 DEC 81	1.	PHM	ND	240.*	ND	1.	ND	ND	87.*
CHLORIDE	07 DEC 81	1.0	MGL	1.9	18.6	3.8	97.4	5.7	4.0	4.5
IRON	07 DEC 81	.03	MGL	4.44 *	ND	2.85 *	.25	ND	ND	ND
MANGANESE	07 DEC 81	.01	MGL	2.04 *	1.17 *	.12 *	1.40 *	.06 *	.22 *	.36 *
PHENOL	07 DEC 81	.01	MGL	ND	ND	ND	ND	ND	ND	ND
SODIUM	07 DEC 81	1.	MGL	9.	16.	10.	44.	18.	12.	37.
SULFATE	07 DEC 81	5.0	MGL	27.4	42.4	24.2	96.8	22.7	17.8	127.0
PH(FIELD)	07 DEC 81		PH	6.4 *	6.8	6.1 *	6.4 *	6.6	7.0	7.2
PH(FIELD)	07 DEC 81		PH	6.3 *	6.8	6.1 *	6.4 *	6.8	6.9	7.2
PH(FIELD)	07 DEC 81		PH	6.4 *	6.8	6.1 *	6.5	6.6	7.0	7.1
PH(FIELD)	07 DEC 81		PH	6.4 *	6.8	6.1 *	6.4 *	6.7	7.0	7.2
SPEC COND	07 DEC 81	1.	UMC	500.	800.	135.	990.	490.	460.	720.
SPEC COND	07 DEC 81	1.	UMC	500.	80[illegible]	135.	990.	480.	480.	720.
SPEC COND	07 DEC 81	1.	UMC	500.	800.	135.	990.	490.	480.	730.
SPEC COND	07 DEC 81	1.	UMC	500.	800.	135.	990.	490.	480.	720.
TOC	07 DEC 81	1.0	MGL	3.0	17.0	12.0	5.0	3.0	2.0	3.0
TOC	07 DEC 81	1.0	MGL	3.0	16.0	12.0	4.0	3.0	3.0	3.0
TOC	07 DEC 81	1.0	MGL	3.0	17.0	11.0	4.0	3.0	3.0	3.0
TOC	07 DEC 81	1.0	MGL	3.0	16.0	12.0	5.0	3.0	2.0	3.0

25 MAR 82

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 5-1	5-2	5-3	5-4	5-5	5-6	5-7
TOX	07 DEC 81	10.	UGL	15.C	25.C	11.C	1171.C	18.C	ND	ND
TOX	07 DEC 81	10.	UGL	50.C	25.C	16.C	1225.C	17.C	ND	11.C
TOX	07 DEC 81	10.	UGL	45.C	43.C	15.C	1188.C	21.C	ND	12.C
TOX	07 DEC 81	10.	UGL	15.C	20.C	16.C	1352.C	16.C	26.C	12.C

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES; TRAILING ZEROES DO NOT ALWAYS INDICATE SIGNIFICANCE, BUT ARE THE RESULTS OF COMPUTER FORMATTING.
A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	5-8
WATER				
LEVEL, A	13 DEC 81		FT	560.48
ARSENIC	07 DEC 81	.010	MGL	ND
BARIUM	07 DEC 81	.1	MGL	ND
CADMIUM	07 DEC 81	.005	MGL	ND
CHROMIUM	07 DEC 81	.010	MGL	.010
FLUORIDE	07 DEC 81	.10	MGL	.24
LEAD	07 DEC 81	.010	MGL	ND
MERCURY	07 DEC 81	.2	UGL	ND
NO2+NO3 AS N	07 DEC 81	.05	MGL	.08
SELENIUM	07 DEC 81	.005	MGL	ND
SILVER	07 DEC 81	.01	MGL	ND
ENDRIN	07 DEC 81	.04	UGL	ND
LINDANE	07 DEC 81	.08	UGL	ND
TOXAPHENE	07 DEC 81	1.6	UGL	ND
METHOXYCHLOR	07 DEC 81	1.6	UGL	ND
2,4-D	07 DEC 81	3.8	UGL	ND
SILVEX	07 DEC 81	.5	UGL	ND
GROSS ALPHA	07 DEC 81	1.30	PCL	9.83
GROSS BETA	07 DEC 81	1.30	PCL	7.88
TOTCOLIBACT	08 DEC 81	1.	PHM	ND
CHLORIDE	07 DEC 81	1.0	MGL	15.3
IRON	07 DEC 81	.03	MGL	10.80 *
MANGANESE	07 DEC 81	.01	MGL	1.52 *
PHENOL	07 DEC 81	.01	MGL	ND
SODIUM	07 DEC 81	1.	MGL	54.
SULFATE	07 DEC 81	5.0	MGL	39.2
PH(FIELD)	07 DEC 81		PH	6.7
PH(FIELD)	07 DEC 81		PH	6.7
PH(FIELD)	07 DEC 81		PH	6.7
PH(FIELD)	07 DEC 81		PH	6.7
SPEC COND	07 DEC 81	1.	UMC	670.
SPEC COND	07 DEC 81	1.	UMC	660.
SPEC COND	07 DEC 81	1.	UMC	670.
SPEC COND	07 DEC 81	1.	UMC	660.
TOC	07 DEC 81	1.0	MGL	6.0
TOC	07 DEC 81	1.0	MGL	5.0
TOC	07 DEC 81	1.0	MGL	4.0
TOC	07 DEC 81	1.0	MGL	4.0

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	5-B
TOX	07 DEC 81	10.	UGL	ND
TOX	07 DEC 81	10.	UGL	11.C
TOX	07 DEC 81	10.	UGL	ND
TOX	07 DEC 81	10.	UGL	ND

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES; TRAILING ZEROES DO NOT ALWAYS INDICATE SIGNIFICANCE, BUT ARE THE RESULTS OF COMPUTER FORMATTING.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE

SECOND QUARTER

Monitoring Results for the First Year

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 5-1	5-2	5-3	5-4	5-5	5-6	5-7
WATER LEVELS (A)	13 APR 82		FT	594.0	579.4	579.8	578.1	578.3	562.8	567.7
ARSENIC	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	13 APR 82	.1	MGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	13 APR 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
FLUORIDE	13 APR 82	.10	MGL	.11	.14	ND	.10	.41	.21	.20
LEAD	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	13 APR 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	13 APR 82	.05	MGL	ND	1.00	1.00	.08	.55	.08	ND
SELENIUM	13 APR 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	13 APR 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
ENDRIN	13 APR 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	13 APR 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	13 APR 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	13 APR 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	13 APR 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	13 APR 82	.5	MGL	ND	ND	ND	ND	ND	ND	ND
GROSS ALPHA	13 APR 82	2.30	PCL	1.55	ND	ND	ND	ND	ND	ND
GROSS BETA	13 APR 82	1.63	PCL	ND	2.13	ND	1.40	2.23	2.83	1.20
CHLORIDE	13 APR 82	1.0	MGL	9.0	20.0	11.0	74.0	12.0	11.0	10.0
IRON	13 APR 82	.03	MGL	.76#	.26	1.01#	.51#	.32#	.14	ND
MANGANESE	13 APR 82	.01	MGL	.99#	ND	.77#	.50#	.02	ND	.38#
PHENOL	13 APR 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
SODIUM	13 APR 82	1.	MGL	3.	17.	2.	31.	18.	54.	30.
SULFATE	13 APR 82	5.0	MGL	24.0	21.0	20.0	74.0	11.0	90.0	120.0
PH(FIELD)	13 APR 82		PH	6.1#	6.1#	5.9#	6.1#	6.4#	6.7	6.6
PH(FIELD)	13 APR 82		PH	6.1#	6.1#	5.9#	6.1#	6.4#	6.7	6.6
PH(FIELD)	13 APR 82		PH	6.1#	6.1#	5.9#	6.1#	6.4#	6.6	6.5
PH(FIELD)	13 APR 82		PH	6.1#	6.1#	5.9#	6.1#	6.4#	6.7	6.6
SPEC COND	13 APR 82	1.	UMC	364.	560.	127.	850.	340.	609.	749.
SPEC COND	13 APR 82	1.	UMC	362.	560.	127.	850.	339.	609.	748.
SPEC COND	13 APR 82	1.	UMC	362.	560.	127.	850.	339.	609.	750.
SPEC COND	13 APR 82	1.	UMC	360.	560.	127.	850.	339.	610.	748.
TOC	13 APR 82	1.0	MGL	14.0	30.0	8.0	24.0	14.0	25.0	33.0
TOC	13 APR 82	1.0	MGL	14.0	30.0	8.0	24.0	13.0	25.0	34.0
TOC	13 APR 82	1.0	MGL	15.0	30.0	8.0	25.0	14.0	25.0	33.0
TOC	13 APR 82	1.0	MGL	14.0	32.0	8.0	24.0	14.0	25.0	34.0
TOX	13 APR 82	.010	MGL	.011 C	.013 C	.024 C	1.620 C	.013 C	.021 C	.014 C
TOX	13 APR 82	.010	MGL	ND	.011 C	.023 C	1.220 C	.013 C	.020 C	.015 C
TOX	13 APR 82	.010	MGL	ND	ND	.014 C	1.420 C	ND	.033 C	ND
TOX	13 APR 82	.010	MGL	ND	.010 C	.022 C	1.370 C	.012 C	.028 C	.015 C

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	5-8	
WATER LEVELS (A)	13 APR 82		FT	561.8	
ARSENIC	13 APR 82	.010	MGL	ND	
BARIUM	13 APR 82	.1	MGL	ND	
CADMIUM	13 APR 82	.005	MGL	ND	
CHROMIUM	13 APR 82	.010	MGL	ND	
FLUORIDE	13 APR 82	.10	MGL	.26	
LEAD	13 APR 82	.010	MGL	.010	
MERCURY	13 APR 82	.2	UGL	ND	
NO2+NO3 AS N	13 APR 82	.05	MGL	ND	
SELENIUM	13 APR 82	.005	MGL	ND	
SILVER	13 APR 82	.01	MGL	.05	
ENDRIN	13 APR 82	.04	UGL	ND	
LINDANE	13 APR 82	.08	UGL	ND	
TOXAPHENE	13 APR 82	1.6	UGL	ND	
METHOXYCHLOR	13 APR 82	1.6	UGL	ND	
2,4-D	13 APR 82	3.8	UGL	ND	
SILVEX	13 APR 82	.5	MGL	ND	
GROSS ALPHA	13 APR 82	1.30	PCL	6.07	
GROSS BETA	13 APR 82	1.30	PCL	3.77	
CHLORIDE	13 APR 82	1.0	MGL	20.0	
IRON	13 APR 82	.03	MGL	2.95#	
MANGANESE	13 APR 82	.01	MGL	4.30#	
PHENOL	13 APR 82	.01	MGL	ND	
SODIUM	13 APR 82	1.	MGL	66.	
SULFATE	13 APR 82	5.0	MGL	21.0	
PH(FIELD)	13 APR 82		PH	6.5	
PH(FIELD)	13 APR 82		PH	6.5	
PH(FIELD)	13 APR 82		PH	6.5	
PH(FIELD)	13 APR 82		PH	6.5	
SPEC COND	13 APR 82	1.	UMC	849.	
SPEC COND	13 APR 82	1.	UMC	850.	
SPEC COND	13 APR 82	1.	UMC	851.	
SPEC COND	13 APR 82	1.	UMC	850.	
TOC	13 APR 82	1.0	MGL	73.0	
TOC	13 APR 82	1.0	MGL	74.0	
TOC	13 APR 82	1.0	MGL	74.0	
TOC	13 APR 82	1.0	MGL	73.0	
TOX	13 APR 82	.010	MGL	.031	C
TOX	13 APR 82	.010	MGL	.026	C
TOX	13 APR 82	.010	MGL	.029	C
TOX	13 APR 82	.010	MGL	.026	C

THIRD QUARTER

Monitoring Results for the First Year

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 5-1	5-2	5-3	5-4	5-5	5-6	5-7
WATER										
LEVELS (A)	19 JUL 82		FT	591.2	578.9	577.7	576.3	577.1	562.8	568.5
ARSENIC	20 JUL 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	20 JUL 82	.1	MGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	20 JUL 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	20 JUL 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
FLUORIDE	20 JUL 82	.10	MGL	.11	.15	ND	.10	.33	.17	.18
LEAD	20 JUL 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	20 JUL 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	20 JUL 82	.05	MGL	ND	.76	.79	.09	.10	.05	.10
SELENIUM	20 JUL 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	20 JUL 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
ENDRIN	20 JUL 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	20 JUL 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	20 JUL 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	20 JUL 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	20 JUL 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	20 JUL 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
GROSS ALPHA	20 JUL 82	4.51	PCL	ND	ND		ND	11.00	ND	4.72
GROSS BETA	20 JUL 82	1.86	PCL	2.46	3.43		3.23	4.98	1.71	ND
CHLORIDE	20 JUL 82	1.0	MGL	5.0	10.0	5.0	71.0	10.0	7.0	29.0
IRON	20 JUL 82	.03	MGL	ND	ND	.12	ND	.05	.20	.08
MANGANESE	20 JUL 82	.01	MGL	.13#	ND	.52#	.31#	ND	.12#	.49#
PHENOL	20 JUL 82	.01	MGL	.04	.01	.10	.09	.01	.06	.06
SODIUM	20 JUL 82	1.	MGL	208.	10.	6.	30.	13.	15.	31.
SULFATE	20 JUL 82	5.0	MGL	47.0	22.0	25.0	85.0	16.0	35.0	150.0
PH(FIELD)	20 JUL 82		PH	6.6	6.6	6.7	6.4#	6.6	6.9	6.9
PH(FIELD)	20 JUL 82		PH	6.6	6.5	6.6	6.4#	6.6	6.9	6.9
PH(FIELD)	20 JUL 82		PH	6.7	6.6	6.8	6.4#	6.6	7.0	6.9
PH(FIELD)	20 JUL 82		PH	6.7	6.5	6.8	6.4#	6.7	6.9	6.8
SPEC COND	20 JUL 82	1.	UMC	560.	540.	165.	760.	485.	450.	705.
SPEC COND	20 JUL 82	1.	UMC	565.	545.	166.	755.	490.	455.	705.
SPEC COND	20 JUL 82	1.	UMC	550.	540.	165.	755.	490.	450.	705.
SPEC COND	20 JUL 82	1.	UMC	550.	545.	163.	760.	485.	455.	710.
TOC	20 JUL 82	1.0	MGL	38.0	42.0	9.0	50.0	38.0	39.0	33.0
TOC	20 JUL 82	1.0	MGL	37.0	41.0	9.0	50.0	36.0	39.0	33.0
TOC	20 JUL 82	1.0	MGL	37.0	42.0	9.0	49.0	38.0	40.0	34.0
TOC	20 JUL 82	1.0	MGL	37.0	42.0	9.0	50.0	38.0	40.0	34.0
TOX	20 JUL 82	.010	MGL	ND	.023 C	.023 C	1.030 C	.035 C	.024 C	.030 C
TOX	20 JUL 82	.010	MGL	ND	.023 C	.012 C	.970 C	.030 C	ND	ND
TOX	20 JUL 82	.010	MGL	ND	.022 C	.022 C	1.010 C	.033 C	.012 C	.018 C
TOX	20 JUL 82	.010	MGL	ND	.022 C	.017 C	1.000 C	.029 C	ND	.017 C

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	5-8	
LEVELS	NO WATER LEVEL INFORMATION AVAILABLE FOR 418173 OLD BURNING GROUND				FOR ABOVE WELLS FROM 82150 TO 82365
ARSENIC	20 JUL 82	.010	MGL	ND	
BARIUM	20 JUL 82	.1	MGL	ND	
CADMIUM	20 JUL 82	.005	MGL	ND	
CHROMIUM	20 JUL 82	.010	MGL	ND	
FLUORIDE	20 JUL 82	.10	MGL	.23	
LEAD	20 JUL 82	.010	MGL	ND	
MERCURY	20 JUL 82	.2	UGL	ND	
ND2+ND3 AS N	20 JUL 82	.05	MGL	ND	
SELENIUM	20 JUL 82	.005	MGL	ND	
SILVER	20 JUL 82	.01	MGL	ND	
ENDRIN	20 JUL 82	.04	UGL	ND	
LINDANE	20 JUL 82	.08	UGL	ND	
TOXAPHENE	20 JUL 82	1.6	UGL	ND	
METHOXYCHLOR	20 JUL 82	1.6	UGL	ND	
2,4-D	20 JUL 82	3.8	UGL	ND	
SILVEX	20 JUL 82	.5	UGL	ND	
GROSS ALPHA	20 JUL 82	4.26	PCL	ND	
GROSS BETA	20 JUL 82	1.30	PCL	3.93	
CHLORIDE	20 JUL 82	1.0	MGL	15.0	
IRON	20 JUL 82	.03	MGL	3.40#	
MANGANESE	20 JUL 82	.01	MGL	2.38#	
PHENOL	20 JUL 82	.01	MGL	ND	
SODIUM	20 JUL 82	1.	MGL	53.	
SULFATE	20 JUL 82	5.0	MGL	24.0	
PH(FIELD)	20 JUL 82		PH	6.5	
PH(FIELD)	20 JUL 82		PH	6.5	
PH(FIELD)	20 JUL 82		PH	6.5	
PH(FIELD)	20 JUL 82		PH	6.5	
SPEC COND	20 JUL 82	1.	UMO	680.	
SPEC COND	20 JUL 82	1.	UMO	685.	
SPEC COND	20 JUL 82	1.	UMO	690.	
SPEC COND	20 JUL 82	1.	UMO	685.	
TOC	20 JUL 82	1.0	MGL	62.0	
TOC	20 JUL 82	1.0	MGL	61.0	
TOC	20 JUL 82	1.0	MGL	62.0	
TOC	20 JUL 82	1.0	MGL	62.0	
TOX	20 JUL 82	.010	MGL	ND	
TOX	20 JUL 82	.010	MGL	.015	C
TOX	20 JUL 82	.010	MGL	.014	C
TOX	20 JUL 82	.010	MGL	.032	C

FOURTH QUARTER

Monitoring Results for the First Year

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 5-1	5-2	5-3	5-4	5-5	5-6	5-7
WATER LEVELS (A)	27 SEP 82		FT	589.5	577.4	577.3	576.1	576.6	561.8	566.7
ARSENIC	28 SEP 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	28 SEP 82	.1	MGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	28 SEP 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	28 SEP 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
FLUORIDE	28 SEP 82	.10	MGL	.19	.11	ND	ND	.32	.13	.15
LEAD	28 SEP 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	28 SEP 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	28 SEP 82	.05	MGL	.09	2.00	.63	.18	.28	.05	.08
SELENIUM	28 SEP 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	28 SEP 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
ENDRIN	28 SEP 82	.04	UGL		ND		ND	ND	ND	ND
LINDANE	28 SEP 82	.08	UGL		ND		ND	ND	ND	ND
TOXAPHENE	28 SEP 82	1.6	UGL		ND		ND	ND	ND	ND
METHOXYCHLOR	28 SEP 82	1.6	UGL		ND		ND	ND	ND	ND
2,4-D	28 SEP 82	3.8	UGL	ND	ND		ND	ND	ND	ND
SILVEX	28 SEP 82	.5	UGL	ND	ND		ND	ND	ND	ND
GROSS ALPHA	28 SEP 82	1.60	PCL	1.81	ND	ND	2.12	ND	1.40	ND
RADIUM-226	21 AUG 82	.05	PCL					.68		
GROSS BETA	28 SEP 82	2.53	PCL	3.59	1.81	2.04	ND	5.52	ND	ND
CHLORIDE	28 SEP 82	1.0	MGL	ND	23.0	ND	57.4	2.0	ND	ND
IRON	28 SEP 82	.03	MGL	.53#	ND	.58#	.29	.24	.15	ND
MANGANESE	28 SEP 82	.01	MGL	.53#	ND	.06#	.33#	ND	.25#	1.34#
PHENOL	28 SEP 82	.01	MGL	.01	.01	.02	.03	ND	ND	ND
SODIUM	28 SEP 82	1.	MGL	24.	6.	3.	20.	12.	7.	26.
SULFATE	28 SEP 82	5.0	MGL	78.0	22.0	20.0	65.0	13.0	11.0	110.0
PH(FIELD)	28 SEP 82		PH	6.7	6.4#	6.8	6.4#	6.6	6.8	6.8
PH(FIELD)	28 SEP 82		PH	6.6	6.5	6.7	6.4#	6.7	7.0	6.8
PH(FIELD)	28 SEP 82		PH	6.7	6.4#	6.6	6.4#	6.7	7.0	6.8
PH(FIELD)	28 SEP 82		PH	6.7	6.4#	6.9	6.4#	6.7	7.0	6.8
SPEC COND	28 SEP 82	1.	UMC	815.	800.		860.	550.	400.	775.
SPEC COND	28 SEP 82	1.	UMC	815.	800.		860.	550.	400.	775.
SPEC COND	28 SEP 82	1.	UMC	810.	800.		860.	550.	400.	770.
SPEC COND	28 SEP 82	1.	UMC	815.	800.		860.	550.	400.	770.
TOC	28 SEP 82	1.0	MGL	2.0	22.0	6.0	28.0	27.0	3.0	27.0
TOC	28 SEP 82	1.0	MGL	2.0	23.0	6.0	27.0	26.0	3.0	27.0
TOC	28 SEP 82	1.0	MGL	2.0	22.0	6.0	27.0	27.0	2.0	28.0
TOC	28 SEP 82	1.0	MGL	2.0	23.0	6.0	27.0	27.0	3.0	29.0
TOX	28 SEP 82	.010	MGL	ND	ND	.049 C	.620 C	.011 C	ND	.033 C
TOX	28 SEP 82	.010	MGL	ND	ND	.053 C	.077 C	ND	ND	.014 C
TOX	28 SEP 82	.010	MGL	ND	ND	.060 C	.150 C	ND	.012 C	.029 C
TOX	28 SEP 82	.010	MGL	ND	ND	.068 C	.200 C	ND	ND	.028 C

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	5-B	
WATER					
LEVELS (A)	27 SEP 82		FT	561.3	
ARSENIC	28 SEP 82	.010	MGL	ND	
BARIUM	28 SEP 82	.1	MGL	ND	
CADMIUM	28 SEP 82	.005	MGL	ND	
CHROMIUM	28 SEP 82	.010	MGL	ND	
FLUORIDE	28 SEP 82	.10	MGL	.23	
LEAD	28 SEP 82	.010	MGL	.010	
MERCURY	28 SEP 82	.2	UGL	ND	
NO2+NO3 AS N	28 SEP 82	.05	MGL	ND	
SELENIUM	28 SEP 82	.005	MGL	ND	
SILVER	28 SEP 82	.01	MGL	ND	
ENDRIN	28 SEP 82	.04	UGL	ND	
LINDANE	28 SEP 82	.08	UGL	ND	
TOXAPHENE	28 SEP 82	1.6	UGL	ND	
METHOXYCHLOR	28 SEP 82	1.6	UGL	ND	
2,4-D	28 SEP 82	3.8	UGL	ND	
SILVEX	28 SEP 82	.5	UGL	ND	
GROSS ALPHA	28 SEP 82	1.30	PCL	2.95	
GROSS BETA	28 SEP 82	1.30	PCL	5.25	
CHLORIDE	28 SEP 82	1.0	MGL	5.0	
IRON	28 SEP 82	.03	MGL	2.73#	
MANGANESE	28 SEP 82	.01	MGL	.48#	
PHENOL	28 SEP 82	.01	MGL	ND	
SODIUM	28 SEP 82	1.	MGL	35.	
SULFATE	28 SEP 82	5.0	MGL	14.0	
PH(FIELD)	28 SEP 82		PH	6.4#	
PH(FIELD)	28 SEP 82		PH	6.4#	
PH(FIELD)	28 SEP 82		PH	6.4#	
PH(FIELD)	28 SEP 82		PH	6.5	
SPEC COND	28 SEP 82	1.	UMC	790.	
SPEC COND	28 SEP 82	1.	UMC	795.	
SPEC COND	28 SEP 82	1.	UMC	790.	
SPEC COND	28 SEP 82	1.	UMC	795.	
TOC	28 SEP 82	1.0	MGL	26.0	
TOC	28 SEP 82	1.0	MGL	24.0	
TOC	28 SEP 82	1.0	MGL	26.0	
TOC	28 SEP 82	1.0	MGL	25.0	
TOX	28 SEP 82	.010	MGL	.028	C
TOX	28 SEP 82	.010	MGL	ND	
TOX	28 SEP 82	.010	MGL	ND	
TOX	28 SEP 82	.010	MGL	.031	C

RADIOLOGICAL Monitoring

Results for the First Year

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 5-1	5-2	5-3	5-4	5-5	5-6	5-7
GROSS ALPHA	07 DEC 81	3.04	PCL	ND	ND	ND	ND	ND	ND	ND
GROSS ALPHA	13 APR 82	2.30	PCL	1.55	ND	ND	ND	ND	ND	ND
GROSS ALPHA	20 JUL 82	4.51	PCL	ND	ND		ND	11.00	ND	4.72
GROSS ALPHA	28 SEP 82	1.60	PCL	1.81	ND	ND	2.12	ND	1.40	ND
RADIUM-226	20 JUL 82	.05	PCL					.68		
RADIUM-226	21 AUG 82	.05	PCL					.68		
GROSS BETA	07 DEC 81	1.30	PCL	1.08	2.27	1.46	1.43	1.80	2.22	1.80
GROSS BETA	13 APR 82	1.63	PCL	ND	2.13	ND	1.40	2.23	2.83	1.20
GROSS BETA	20 JUL 82	1.86	PCL	2.46	3.43	–	3.23	4.98	1.71	ND
GROSS BETA	28 SEP 82	2.53	PCL	3.59	1.81	2.04	ND	5.52	ND	ND

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	5-8
GROSS ALPHA	07 DEC 81	1.30	PCL	9.83
GROSS ALPHA	13 APR 82	1.30	PCL	6.07
GROSS ALPHA	20 JUL 82	4.26	PCL	ND
GROSS ALPHA	28 SEP 82	1.30	PCL	2.95
GROSS BETA	07 DEC 81	1.30	PCL	7.88
GROSS BETA	13 APR 82	1.30	PCL	3.77
GROSS BETA	20 JUL 82	1.30	PCL	3.93
GROSS BETA	28 SEP 82	1.30	PCL	5.25

Samples Collected During the Fourth Quarter
of the First Monitoring Year

RUN DATE: 18 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND.

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 5-1	5-2	5-3	5-4	5-5	5-6
1,1,1-TRICHLOROETHANE	28 SEP 82	1.	UGL	ND	ND	ND	11.	ND	ND
1,1-DICHLOROETHYLENE	28 SEP 82	1.	UGL	ND	ND	ND	3.	ND	ND
TRANS-1,2-DICHLOROETHYLENE	28 SEP 82	1.	UGL	ND	ND	ND	3800.	ND	ND
TRICHLOROETHYLENE	28 SEP 82	1.	UGL	ND	57.	ND	3700.	ND	ND

RUN DATE: 18 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: OLD BURNING GROUND.

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 5-7	5-8	5-9	5-10	5-11	5-12	5-13
1,1,1-TRICHLOROETHANE	04 NOV 82	1.	UGL	ND	ND	2.	ND	ND	ND	ND
CHLOROFORM	04 NOV 82	1.	UGL	ND	ND	24.	9.	51.	70.	43.
TRANS-1,2-DICHLOROETHYLENE	04 NOV 82	1.	UGL	ND	ND	ND	23.	ND	1300.	ND
METHYLENE CHLORIDE	04 NOV 82	1.	UGL	ND	ND	4.	ND	ND	ND	7.
TRICHLOROFLUOROMETHANE	04 NOV 82	1.	UGL	ND	ND	1.	ND	ND	ND	ND
TETRACHLOROETHYLENE	04 NOV 82	1.	UGL	ND	ND	1.	ND	ND	ND	ND
TRICHLOROETHYLENE	04 NOV 82	1.	UGL	ND	ND	3.	40.	6.	480.	2.
VINYL CHLORIDE	04 NOV 82	1.	UGL	ND	ND	ND	ND	ND	2.	ND
1,1-DICHLOROETHYLENE	04 NOV 82	1.	UGL	ND	ND	ND	ND	ND	1.	ND

Samples Collected Between

November, 1982 and January, 1983

RUN DATE: 17 MAR 83

INSTALLATION: CRANE NWSC, IN

FACILITY: NEW CRANE NWSC WELLS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 3-21	3-22	3-23	3-24	3-25	5-14
TETRACHLOROETHYLENE	31 JAN 83	1.	UGL	ND	ND	ND			
TETRACHLOROETHYLENE	10 FEB 83	1.	UGL				ND	ND	
TOLUENE	13 JAN 83	1.	UGL						ND
TOLUENE	31 JAN 83	1.	UGL	ND	ND	ND			
TOLUENE	10 FEB 83	1.	UGL				ND	ND	
TRICHLOROETHYLENE	13 JAN 83	1.	UGL						ND
TRICHLOROETHYLENE	31 JAN 83	1.	UGL	5.	22.	24.			
TRICHLOROETHYLENE	10 FEB 83	1.	UGL				83.	36.	
VINYL CHLORIDE	13 JAN 83	1.	UGL						ND
VINYL CHLORIDE	31 JAN 83	1.	UGL	ND	ND	ND			
VINYL CHLORIDE	10 FEB 83	1.	UGL				ND	ND	

RUN DATE: 17 MAR 83

INSTALLATION: CRANE NWSC, IN

FACILITY: NEW CRANE NWSC WELLS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 5-15	5-16	5-17	5-18	5-19
BENZENE	13 JAN 83	1.	UGL	4.	23.			
BENZENE	10 FEB 83	1.	UGL			ND	ND	ND
CARBON TETRACHLORIDE	13 JAN 83	1.	UGL	ND	ND			
CARBON TETRACHLORIDE	10 FEB 83	1.	UGL			ND	ND	ND
CHLOROBENZENE	13 JAN 83	1.	UGL	ND	ND			
CHLOROBENZENE	10 FEB 83	1.	UGL			ND	ND	ND
1,2-DICHLOROETHANE	13 JAN 83	1.	UGL	ND	ND			
1,2-DICHLOROETHANE	10 FEB 83	1.	UGL			ND	ND	ND
1,1,1-TRICHLOROETHANE	13 JAN 83	1.	UGL	ND	ND			
1,1,1-TRICHLOROETHANE	10 FEB 83	1.	UGL			28.	19.	19.
1,1-DICHLOROETHANE	13 JAN 83	1.	UGL	ND	ND			
1,1-DICHLOROETHANE	10 FEB 83	1.	UGL			ND	ND	ND
1,1,2-TRICHLOROETHANE	13 JAN 83	1.	UGL	ND	ND			
1,1,2-TRICHLOROETHANE	10 FEB 83	1.	UGL			ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	13 JAN 83	1.	UGL	ND	ND			
1,1,2,2-TETRACHLOROETHANE	10 FEB 83	1.	UGL			ND	ND	ND
CHLOROETHANE	13 JAN 83	2.	UGL	ND	ND			
CHLOROETHANE	10 FEB 83	2.	UGL			ND	ND	ND
2-CHLOROETHYLVINYL ETHER	13 JAN 83	2.	UGL	ND	ND			
2-CHLOROETHYLVINYL ETHER	10 FEB 83	2.	UGL			ND	ND	ND
CHLOROFORM	13 JAN 83	1.	UGL	38.	ND			
CHLOROFORM	10 FEB 83	1.	UGL			3.	3.	3.
1,2-DICHLOROBENZENE	13 JAN 83	1.	UGL	ND	ND			
1,2-DICHLOROBENZENE	10 FEB 83	1.	UGL			ND	ND	ND
1,3-DICHLOROBENZENE	13 JAN 83	1.	UGL	ND	ND			
1,3-DICHLOROBENZENE	10 FEB 83	1.	UGL			ND	ND	ND
1,4-DICHLOROBENZENE	13 JAN 83	1.	UGL	ND	ND			
1,4-DICHLOROBENZENE	10 FEB 83	1.	UGL			ND	ND	ND
1,1-DICHLOROETHYLENE	13 JAN 83	1.	UGL	ND	ND			
1,1-DICHLOROETHYLENE	10 FEB 83	1.	UGL			ND	ND	ND
TRANS-1,2-DICHLOROETHYLENE	13 JAN 83	1.	UGL	ND	ND			
TRANS-1,2-DICHLOROETHYLENE	10 FEB 83	1.	UGL			30.	ND	2.
1,2-DICHLOROPROPANE	13 JAN 83	1.	UGL	ND	ND			
1,2-DICHLOROPROPANE	10 FEB 83	1.	UGL			ND	ND	ND
1,3-DICHLOROPROPENE	13 JAN 83	1.	UGL	ND	ND			
1,3-DICHLOROPROPENE	10 FEB 83	1.	UGL			ND	ND	ND
ETHYLBENZENE	13 JAN 83	1.	UGL	ND	ND			
ETHYLBENZENE	10 FEB 83	1.	UGL			ND	ND	ND
METHYLENE CHLORIDE	13 JAN 83	1.	UGL	ND	ND			
METHYLENE CHLORIDE	10 FEB 83	1.	UGL			8.	5.	5.
CHLOROMETHANE	13 JAN 83	2.	UGL	ND	ND			

RUN DATE: 17 MAR 83

INSTALLATION: CRANE NWSC, IN

FACILITY: NEW CRANE NWSC WELLS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 5-15	5-16	5-17	5-18	5-19
CHLOROMETHANE	10 FEB 83	2.	UGL			ND	ND	ND
BROMOMETHANE	13 JAN 83	2.	UGL	ND	ND			
BROMOMETHANE	10 FEB 83	2.	UGL			ND	ND	ND
BROMOFORM	13 JAN 83	2.	UGL	ND	ND			
BROMOFORM	10 FEB 83	2.	UGL			ND	ND	ND
BROMODICHLOROMETHANE	13 JAN 83	1.	UGL	ND	ND			
BROMODICHLOROMETHANE	10 FEB 83	1.	UGL			ND	ND	ND
TRICHLOROFLUOROMETHANE	13 JAN 83	1.	UGL	ND	ND			
TRICHLOROFLUOROMETHANE	10 FEB 83	1.	UGL			3.	2.	2.
DICHLOROFLUOROMETHANE	13 JAN 83	2.	UGL	ND	ND			
DICHLOROFLUOROMETHANE	10 FEB 83	2.	UGL			ND	ND	ND
DIBROMOCHLOROMETHANE	13 JAN 83	1.	UGL	ND	ND			
DIBROMOCHLOROMETHANE	10 FEB 83	1.	UGL			ND	ND	ND
TETRACHLOROETHYLENE	13 JAN 83	1.	UGL	ND	ND			
TETRACHLOROETHYLENE	10 FEB 83	1.	UGL			ND	ND	ND
TOLUENE	13 JAN 83	1.	UGL	ND	ND			
TOLUENE	10 FEB 83	1.	UGL			ND	ND	ND
TRICHLOROETHYLENE	13 JAN 83	1.	UGL	ND	ND			
TRICHLOROETHYLENE	10 FEB 83	1.	UGL			59.	33.	40.
VINYL CHLORIDE	13 JAN 83	1.	UGL	ND	ND			
VINYL CHLORIDE	10 FEB 83	1.	UGL			ND	ND	ND

RUN DATE: 17 MAR 83

INSTALLATION: CRANE NWSC, IN

FACILITY: NEW CRANE NWSC WELLS

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.
B UPGRADIENT SITE

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

Samples Collected During the First
Half of the Second Monitoring Year

CRANE NWSC

Results of Analysis for Purgeable Organic Priority Pollutants

Samples Taken 19 Apr 83

Results in ug/L

	5-15	5-17	5-18	5-19
trans-1,2-Dichloroethylene	8	22	ND	ND
Trichloroethylene	ND	15	ND	ND

ND - Compound not detected

Analysis by Gas Chromatography; Wells 5-15 and 5-17 results confirmed by Mass Spectrometry.

APPENDIX A8

Results of Second-Year Analysis of Groundwater Samples for Group II and Group III Parameters, Explosives at Site 3, and Pesticides at Site 9

First Semi-annual Results

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: OLD BURNING GROUND

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 5-1	5-2	5-3	5-4	5-5	5-6	5-7
WATER LEVELS (A)	26 FEB 83		FT	592.7	578.8	578.0	576.2	577.8	562.9	567.7
CHLORIDE	26 FEB 83	1.0	MGL	ND	ND	ND	110.0	2.0	3.0	1.0
IRON	26 FEB 83	.03	MGL	ND	ND	ND	ND	ND	ND	ND
MANGANESE	26 FEB 83	.01	MGL	.28#	.01	.07#	.16#	ND	.68#	1.56#
PHENOL	26 FEB 83	.01	MGL	ND	ND	ND	ND	ND	ND	ND
SODIUM	26 FEB 83	1.	MGL	7.	6.	3.	47.	8.	27.	31.
SULFATE	26 FEB 83	5.0	MGL	23.0	11.0	15.0	120.0	20.0	32.0	130.0
PH(FIELD)	26 FEB 83		PH	6.7	6.4#	6.2#	6.1#	6.6	7.2	6.9
PH(FIELD)	26 FEB 83		PH	6.7	6.4#	6.2#	6.1#	6.7	7.2	7.0
PH(FIELD)	26 FEB 83		PH	6.7	6.5	6.2#	6.1#	6.7	7.1	7.0
PH(FIELD)	26 FEB 83		PH	6.7	6.4#	6.2#	6.1#	6.7	7.2	7.0
SPEC COND	26 FEB 83	1.	UMC	488.	540.	197.	765.	420.	500.	618.
SPEC COND	26 FEB 83	1.	UMC	488.	545.	195.	760.	420.	505.	620.
SPEC COND	26 FEB 83	1.	UMC	490.	540.	195.	760.	420.	505.	620.
SPEC COND	26 FEB 83	1.	UMC	485.	543.	197.	760.	418.	500.	615.
TOC	26 FEB 83	1.0	MGL	28.0	37.0	10.0	28.0	18.0	21.0	28.0
TOC	26 FEB 83	1.0	MGL	28.0	35.0	10.0	28.0	19.0	22.0	27.0
TOC	26 FEB 83	1.0	MGL	27.0	36.0	10.0	29.0	19.0	21.0	28.0
TOC	26 FEB 83	1.0	MGL	29.0	36.0	10.0	29.0	19.0	21.0	28.0
TOX	26 FEB 83	.010	MGL	ND	ND	.012 C	.016 C	ND	.018 C	.022 C
TOX	26 FEB 83	.010	MGL	ND	ND	.011 C	.020 C	ND	.012 C	.021 C
TOX	26 FEB 83	.010	MGL	ND	ND	.013 C	.021 C	ND	.020 C	ND
TOX	26 FEB 83	.010	MGL	ND	ND	.013 C	.020 C	ND	.018 C	.018 C

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	5-8	
WATER					
LEVELS (A)	26 FEB 83		FT	561.1	
CHLORIDE	26 FEB 83	1.0	MGL	13.0	
IRON	26 FEB 83	.03	MGL	2.60#	
MANGANESE	26 FEB 83	.01	MGL	3.80#	
PHENOL	26 FEB 83	.01	MGL	ND	
SODIUM	26 FEB 83	1.	MGL	10.	
SULFATE	26 FEB 83	5.0	MGL	ND	
PH(FIELD)	26 FEB 83		PH	6.8	
PH(FIELD)	26 FEB 83		PH	6.8	
PH(FIELD)	26 FEB 83		PH	6.8	
PH(FIELD)	26 FEB 83		PH	6.8	
SPEC COND	26 FEB 83	1.	UMC	795.	
SPEC COND	26 FEB 83	1.	UMC	800.	
SPEC COND	26 FEB 83	1.	UMC	800.	
SPEC COND	26 FEB 83	1.	UMC	795.	
TOC	26 FEB 83	1.0	MGL	42.0	
TOC	26 FEB 83	1.0	MGL	42.0	
TOC	26 FEB 83	1.0	MGL	42.0	
TOC	26 FEB 83	1.0	MGL	42.0	
TOX	26 FEB 83	.010	MGL	.045	C
TOX	26 FEB 83	.010	MGL	.048	C
TOX	26 FEB 83	.010	MGL	.050	C
TOX	26 FEB 83	.010	MGL	.068	C

Second Semi-annual Results

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: OLD BURNING GROUND

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 5-1	5-2	5-3	5-4	5-5	5-6	5-7
WATER LEVELS (A)	29 JUL 83		FT	589.4	577.9	578.3	575.9	576.4	561.7	565.9
PH(FIELD)	29 JUL 83		PH	7.1	6.4	6.4	6.8	5.9	7.6	7.4
PH(FIELD)	29 JUL 83		PH	7.1	6.4	6.4	6.8	5.9	7.7	7.3
PH(FIELD)	29 JUL 83		PH	7.1	6.3	6.5	6.8	6.0	7.6	7.4
PH(FIELD)	29 JUL 83		PH	7.1	6.5	6.4	6.9	5.9	7.6	7.3
SPEC COND	29 JUL 83	1.	UMC	670.	560.	220.	980.	560.	430.	770.
SPEC COND	29 JUL 83	1.	UMC	680.	560.	220.	980.	560.	430.	770.
SPEC COND	29 JUL 83	1.	UMC	670.	560.	220.	970.	560.	430.	770.
SPEC COND	29 JUL 83	1.	UMC	670.	560.	220.	980.	560.	430.	770.
TOC	29 JUL 83	1.0	MGL	61.0	54.0	19.0	51.0	49.0	38.0	50.0
TOC	29 JUL 83	1.0	MGL	62.0	53.0	18.0	50.0	49.0	38.0	49.0
TOC	29 JUL 83	1.0	MGL	61.0	53.0	19.0	50.0	48.0	37.0	49.0
TOC	29 JUL 83	1.0	MGL	62.0	54.0	18.0	51.0	50.0	37.0	50.0
TOX	29 JUL 83	.010	MGL	ND	ND	ND	1.180 C	.042 C	.019 C	ND
TOX	29 JUL 83	.010	MGL	ND	.025 C	.020 C	1.250 C	.034 C	.012 C	ND
TOX	29 JUL 83	.010	MGL	ND	ND	ND	1.010 C	.042 C	.014 C	.019 C
TOX	29 JUL 83	.010	MGL	.024 C	ND	ND	1.140 C	.037 C	.012 C	ND

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: OLD BURNING GROUND

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	5-8	
WATER LEVELS (A)	30 JUL 83		FT	559.7	
PH(FIELD)	30 JUL 83		PH	6.8	
PH(FIELD)	30 JUL 83		PH	6.7	
PH(FIELD)	30 JUL 83		PH	6.8	
PH(FIELD)	30 JUL 83		PH	6.8	
SPEC COND	30 JUL 83	1.	UMC	820.	
SPEC COND	30 JUL 83	1.	UMC	810.	
SPEC COND	30 JUL 83	1.	UMC	820.	
SPEC COND	30 JUL 83	1.	UMC	820.	
TOC	30 JUL 83	1.0	MGL	67.0	
TOC	30 JUL 83	1.0	MGL	67.0	
TOC	30 JUL 83	1.0	MGL	68.0	
TOC	30 JUL 83	1.0	MGL	66.0	
TOX	30 JUL 83	.010	MGL	.031	C
TOX	30 JUL 83	.010	MGL	.035	C
TOX	30 JUL 83	.010	MGL	.041	C
TOX	30 JUL 83	.010	MGL	.037	C