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

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949

58

9-7-1990

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 Rockeye, Solid Waste Management Unit (SWMU) #10/15. 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,

J. B. [illegible]
By direction

Encl:
(1) Draft RFI Phase II Soils Work Plan for the Rockeye, SWMU #10/15.
(2) Certification Statement

Copy to:
NORTHNAVFACENGCOM, Philadelphia (Code 142) (w/o encl.)
COMNAVSEASYSCOM (SEA-6541) (w/o encl.)
WES (w/o encl.)

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

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Writer: [illegible] Code 0924 Ext 3114
Typist: [illegible] 9/18/90

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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. B. ALLEN
Assistant Public Works Officer

14 SEP 1990

TITLE DATE

Enclosure (2)

FIRST DRAFT
7 September 1990

RFI Phase II Soils Work Plan for Naval Weapons Support Center, Crane, Indiana Rockeye Munitions Facility, SWMU #10/15

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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Appendix A Site Specific Safety and Health Plan
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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 Storage 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 Rockeye Munitions Facility (Rockeye). 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 Rockeye occupies approximately 10 acres. The Rockeye is located in the north central portion of the base in the SW 1/4 of section 5, T5N, R3W (Figure 1.1.2a). The area is approximately located on H-45, 2 miles south of North Gate #1. It is situated on a flattened ridge crest which separates the Little Sulphur Creek and the Boggs Creek drainage basins (Figure 1.1.2b). Drainage to the north and east goes to Little Sulphur Creek, drainage to the south goes into Boggs Creek, and drainage to the west goes into Greenwood Lake.

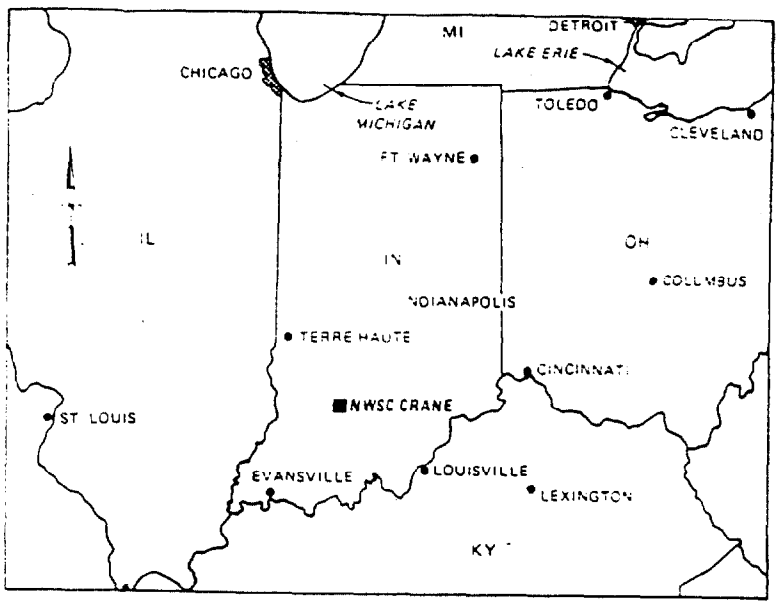
1.1.3 Site History. The Rockeye Facility is a production facility not a storage, treatment, or disposal site. It began operation in the mid 1950's as a press loading operation for 3-inch projectiles using Comp. A-3 explosive (RDX and Wax). In 1967-68, the facility converted to a case-filling operation in order to produce the MK20 series anti-tank Rockeye cluster bomb, a 500 pound unit that contains 247 steel cased bomblets each holding 0.4 pound of Octol/Comp. B (RDX, HMX,TNT, and Wax) high explosive. As part of the operation, the system generates a large volume of wastewater. The wastewater was collected in sumps. The sumps were periodically pumped and the residue was sent to the Ammunition Burning Grounds (03/10). Previous to 1978, when the sumps were full, explosive contaminated waters were discharged directly into the local streams. On the north side of the facility, the waters were released to a branch of the Little Sulphur Creek, and on the south side the waters were released to Boggs Creek. Red water was frequently seen

WASTEWATER ANALYSIS FOR DISCHARGES
ROCKEYE MUNITION FACILITY (from the IAS)

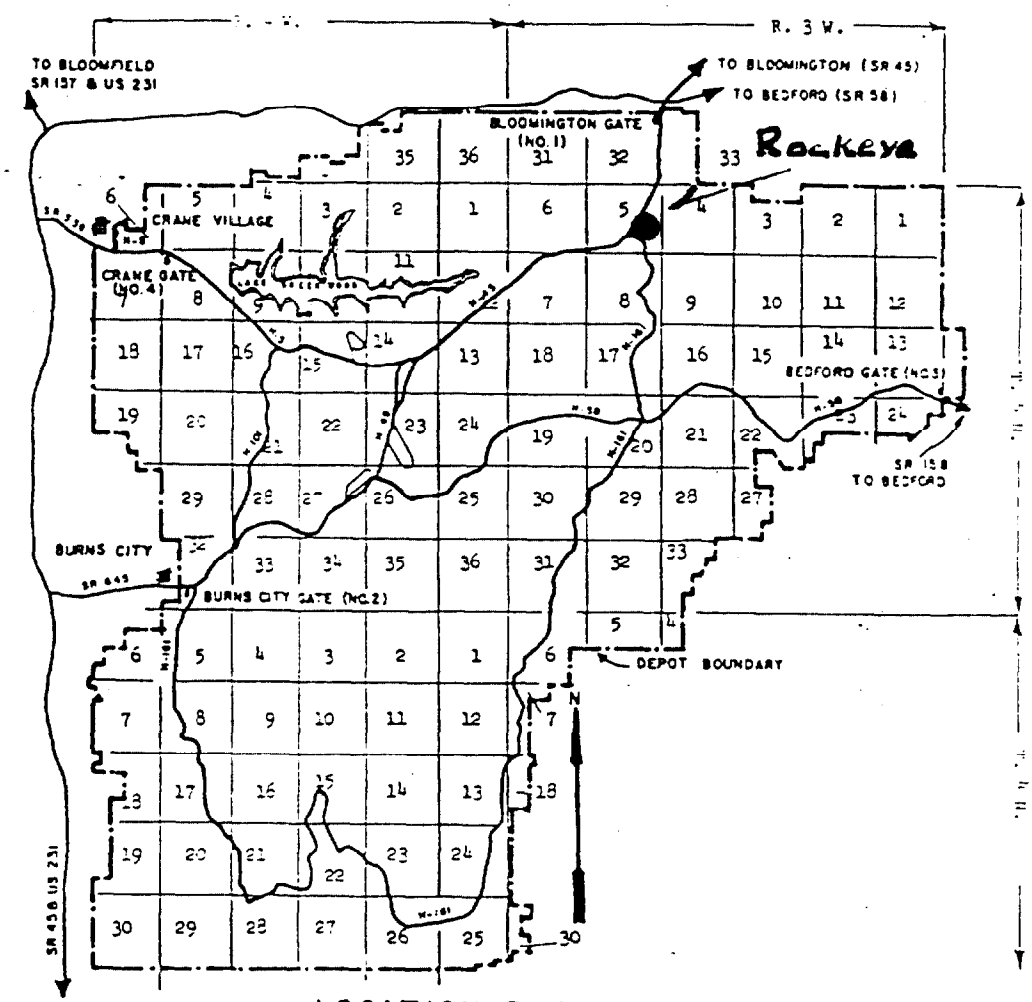
PARAMETERS DRAIN	NORTH DRAIN	SOUTH
1972		
TNT	50.8 ppm.	35.2 ppm.
HMX	08.4	01.8
RDX	----	----
FLOW	.048 MGD.	.015 MGD
1979		
TNT	45.0 ppm.	35.2 ppm.
HMX	16.0	01.9
RDX	36.0	01.9
FLOW	20 GPM.	20 GPM.

exiting the northeast side of the facility, and was seen as far as 3 miles downstream. In the Spring of 1978, an activated carbon water treatment Facility (Bldg. 3044) was brought into operation to purify the wastewater for recycled usage. In addition to water treatment, a scrubber system was designed in 1979 to remove contaminated particulates in the steam-fed tray wash area. In the tray wash area explosive contaminated trays are steamed cleaned. Before the scrubber was installed, emissions were discharged directly to the atmosphere. With the installation of the pollution abatement equipment, the release of explosive contaminated waters have declined.

Rockeye was identified by the Navy as a site needing further investigation. The EPA identified the Rockeye Munition Facility as a Solid Waste Management Unit. This RFI soils investigation will be looking for soil contamination associated with releases from the wastewater discharge system.



Location Map showing the location of NWSC CRANE in the BU Center of Indiana & the Rockeye located in the north central portion of NWSC CRANE.



LOCATION PLAN

SCALE = GRID LINES FORM MILE SQUARES

Figure 1.1.2a

Aerial Photo showing Rockeye Facility and surrounding drainage.

Figure 1.1.2b

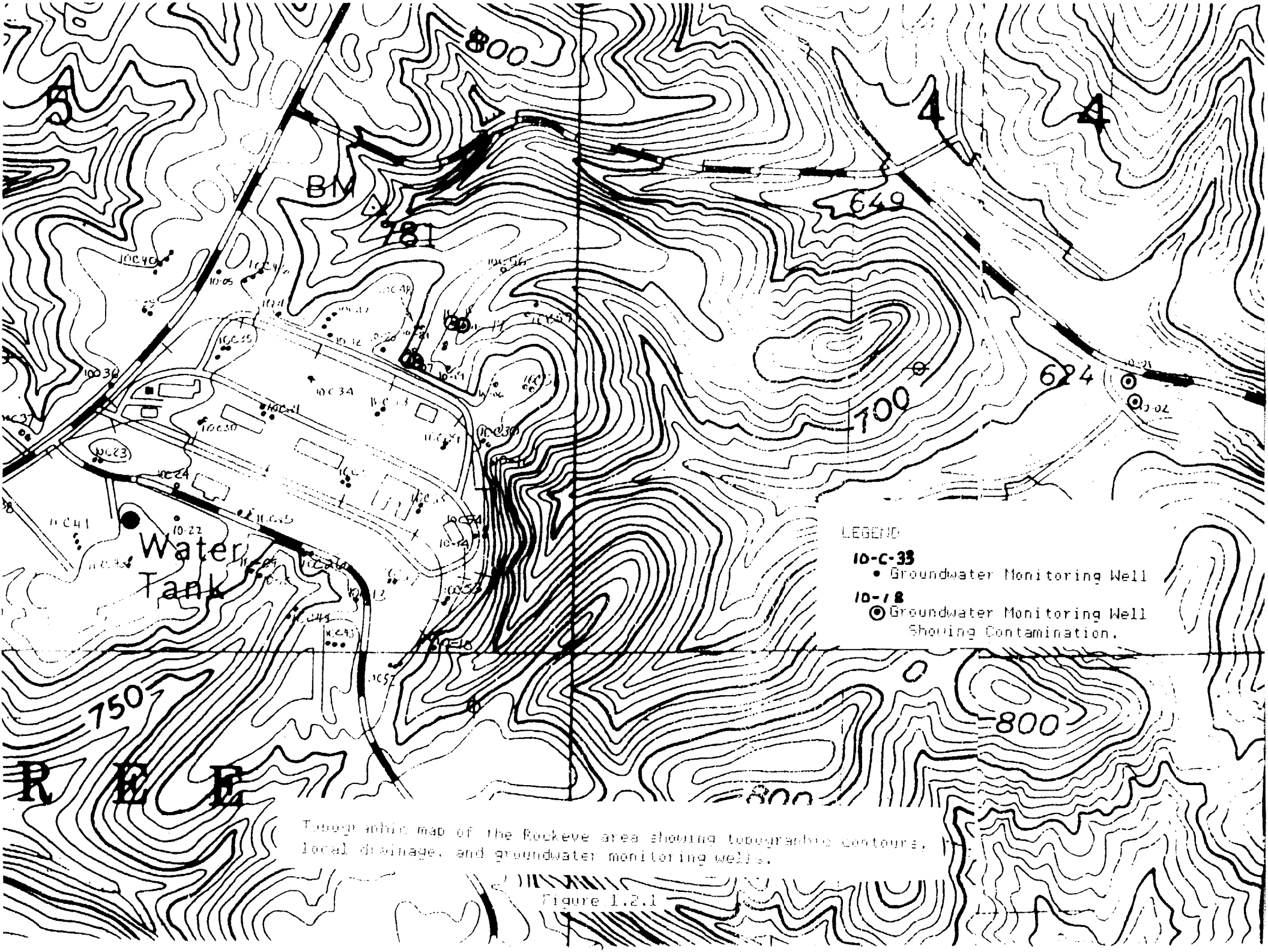
1.1.4 Site Hydrogeology. The local geology in the Rockeye Munition Facility area consists of 1' to 12' of soil underlain by Pennsylvanian-aged sedimentary rock of the Mansfield Formation, Raccoon Creek Group. The Mansfield Formation consists of interbedded sandstone, shale, and coal beds. The rocks change character rapidly in both horizontal and vertical direction. Quartz sandstones are the predominant rock type in the area. They are described as being brown to tan or light gray, moderately friable, uniform and very fine-grained. These sandstone beds vary in thickness from 20' to less then 1". The shales are weathered, brownish grey in the surface and unweathered grey to dark grey at depth. Their thickness varies from 10' to less then 1 ". The bituminous coal beds are less than 2' thick.

Groundwater flow is primarily in the fractured bedrock. The primary porosity in the sandy-bedrock is very low. Movement in the fractures could be very fast due to the small total cross-sectional area of the void spaces through which the water has to travel. The average depth to the water table is approximately 17' below the ground surface. Some surface areas exhibit poor drainage and perched water table conditions can develop. The hydrogeology of the Rockeye Munition Facility is explained in a draft report entitled "Hydrogeological Investigation of Waste Disposal Sites at the Naval Weapons Support Center, Crane Indiana" (Dunbar, 1982). An additional report detailing the 1988-89 groundwater investigation just completed by USACEWES is presently being prepared.

1.2.0 STUDY HISTORY

1.2.1 Previous Investigations. Groundwater conditions have been monitored at Rockeye since 1981. Two monitoring wells were installed and tested by USACEWES. Groundwater contamination was detected. Explosives were found in the water drawn from wells 1 and 2. More monitoring wells were installed by USACEWES in 1983 and 1988-89. Additional groundwater testing was done, and again explosive contaminants were found. Appendix C is a listing of those analytical results. All of the monitoring wells which have tested positive for explosive contaminants are located in or along the north discharge pathway (Figure 1.2.1). Many of the wells at Rockeye remain to be tested. Monitoring wells along the southern drainage way have not been tested. A comprehensive round of groundwater sampling is scheduled for the Fall of 1990.

1.2.2 Regulatory Status. Under the authority of 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 Permit. A RCRA Facility Assessment (RFA) for the Crane Facility was completed. The Rockeye site was named as a Solid Waste Management Unit (SWMU). Corrective Action Requirements (CAR) were negotiated between NWSC Crane and the USEPA Region V. As part of the CAR the NWSC Crane is to conduct a RFI at its SWMU. Table 1.2.2 is a list of Crane's SWMUs where Phase II soils investigations are required. Surface and shallow subsurface soil investigations are parts of that RFI. A RFI is a three part study, consisting of a Phase I, Environmental Monitoring Report, a Phase II, Release Assessment, and a Phase III, Release Characterization study. A RFI Phase II soils study for the Rockeye Munitions Facility, SWMU 10/15, is to be discussed in this work plan.



Topographic map of the Rockeye area showing topographic contours, local drainage, and groundwater monitoring wells.

Figure 1.2.1

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 Rifle Range	07/09
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

1.2.3 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 document is the Work Plan which is made up of five subplans. Those subplans are a project management plan, a sampling and analysis plan, a Quality Assurance/Quality Control plan, a data management plan, and a health and safety plan. Those individual plans will be treated as major headings and elements.

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 address the effects 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 developed. A report explaining the findings, conclusions, and future studies will be issued.

2.2.0 TECHNICAL APPROACH

2.2.1 Sample Locations. In 1981 the on-site portion of the Initial Assessment Study (IAS) was completed by personnel from the Naval Energy and Environmental Support Activity (NEESA). The IAS is the first environmental study step to be taken under the Navy's Installation Restoration Program. An IAS is equivalent to the Army's Initial Installation Assessment (IAS) and the EPA's CERCLA Preliminary Assessment (PA). It included a record search, interviews, and field investigations. The IAS was a thorough study of the facilities industrial operations. The area of concern, as determined by the IAS, at Rockeye was the waste water collection system. Wash water from the munition production lines were collected and discharged into sumps where the suspended material was allowed to settle. Figure 2.2.1 is a schematic drawing of the collection system. The drawing was taken from the IAS (NEESA, 1983 pg. 6-25). Effluent from the sumps were allowed to flow into the surrounding creeks. It was reported that water in the northeastern creek was observed to be red in color some 2 miles downstream of the discharge point. This was supposed to have resulted from the discharge of "pink water", TNT contaminated water, into the streams. Today, that effluent flows through a treatment system and is recycled in the plant or discharged into the base's wastewater sewer system. At this site the only identified waste disposal operation was the sump system. This system includes The sumps, the open ditches leading from the sumps to the discharge point, and the stream bed. Any contamination should be concentrated at the sumps, in the ditches, and in those stream beds which received the direct discharges from the system. Other streams, which receive runoff water from the site, could possibly have been contaminated by the operating conditions. Following that reasoning, the sampling will be biased to locations in the stream bed beds, in the open ditches, and at the sumps. See Plate 1 for the approximate boring locations. These locations are only approximate and they will be fixed in the field.

2.2.2 Sample Collection. Disturbed soil samples will be collected using hand tools and truck mounted augering/Shelby Tube methods. In the stream beds, only surface samples will be taken. In the streams to locate the exact sampling point a grid will be constructed over the stream bed. This

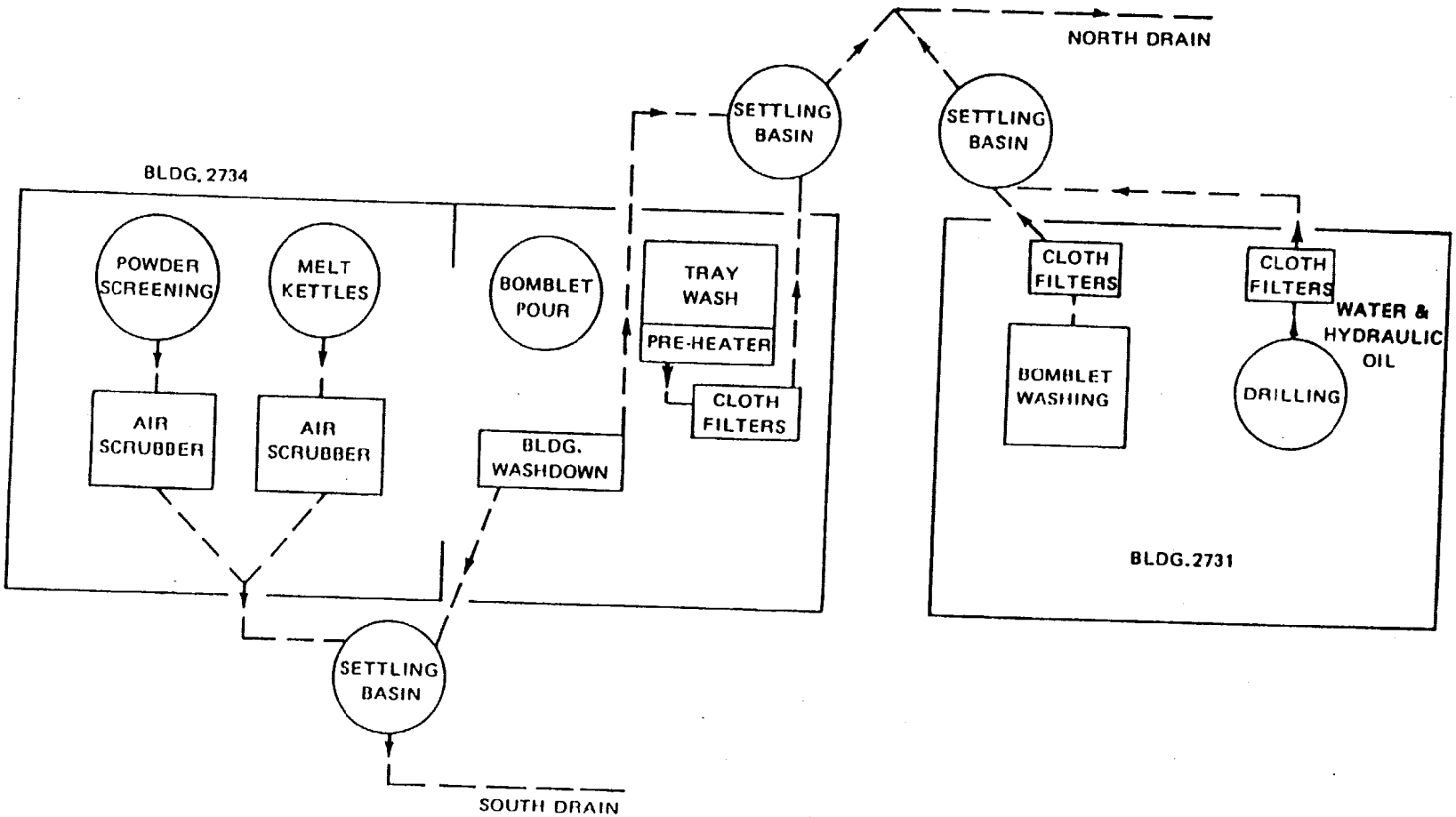
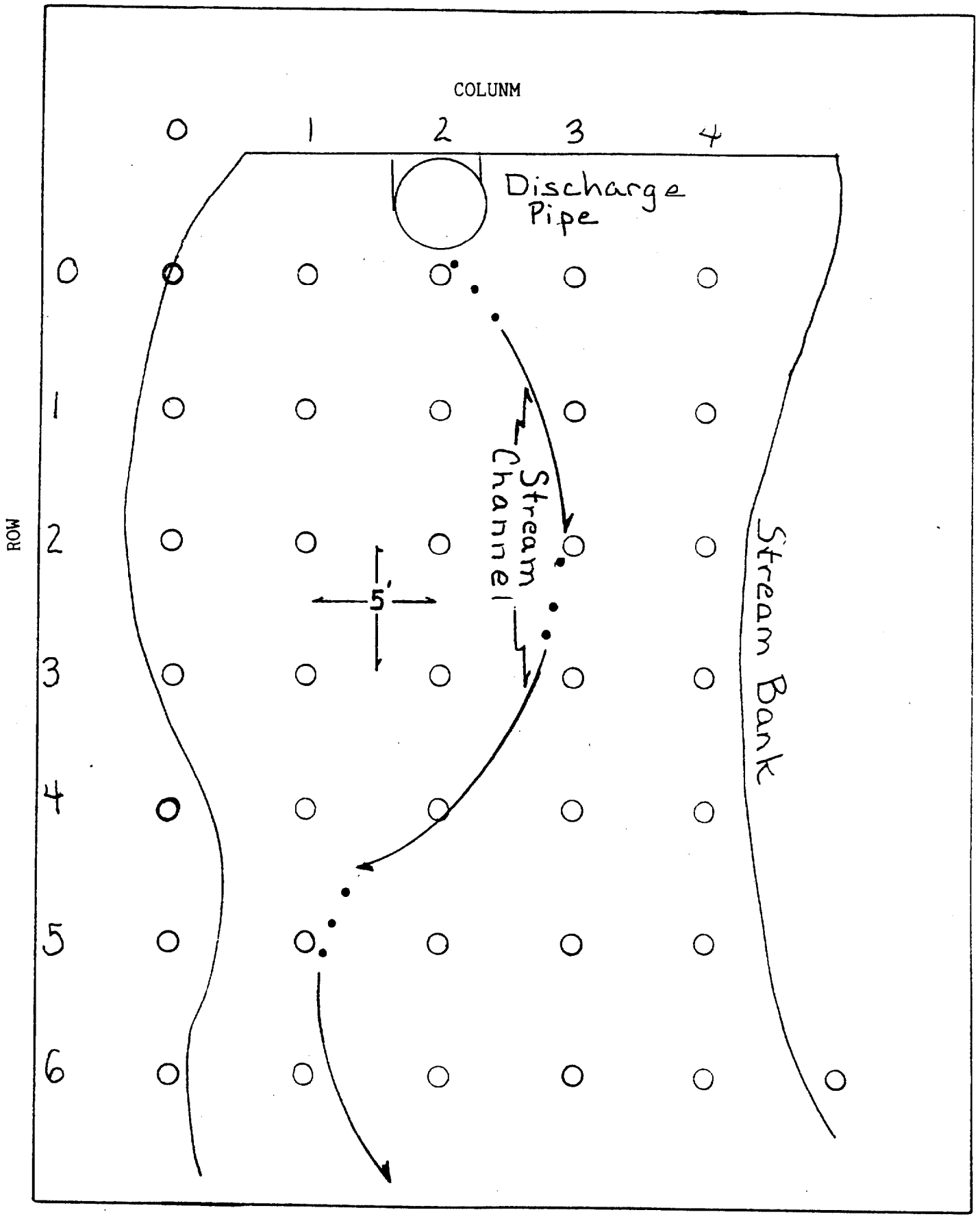


Figure 2.2.1 ROCKEYE/3-Inch Loading Area Process Flow Diagram

grid will be anchored at a prominent marker such as the discharge pipe. Grids in the discharge pathways will be 20' wide and 25' long, and the grid in the runoff streams will be 20' X 15'. Sample points will be 5' apart. This sample spacing can find a circular target with a 2.8' radius at a 90% confidence level (Gilbert, R. O., 1987, Statistical Methods for Environmental Pollution Monitoring). Figure 2.2.2 is a schematic diagram of the grid scheme. Hand tools will be used to collect those soil samples. Deeper soil contamination should not be found because the wastewater was discharged into the streams at high flow conditions and much of the contaminant would have by-passed the site, and whatever contaminants did collect would be bound to the fine soil in the stream bed sediment. Also, due to the erosive nature of the stream channel, the topsoil is very thin in the stream valley. Deeper soil contamination should not be found. Around the sumps the soil samples will be taken using a truck mounted rig. These borings will be taken using a truck mounted rig. At the sumps the boring will be advanced with the auger to a depth equal to the bottom depth of the sump. At that point a sample will be collected using a hollow stem auger and Shelby Tube Sampler. This is done to obtain a soil sample from the soil most likely to have been effected by spill coming from the sump. Contaminated water could have stood in the ditches for some time and the vertical migration of contamination is very possible. Samples will be collected at intervals of 3" to 6", 12" to 18", 18" to 24", and at the top of the rock or the watertable.

2.2.3 Sample Testing. At the Rockeye site the discharged wastes were aqueous explosive (RDX, HMX, and TNT) wastes. The IAS does not mention the discharge of other contaminants. The contaminants of concern are explosive wastes. As a precautionary step soil samples will be tested for the presence of a selected list of common metals, and 8240 and 8270 organics (Figure 2.2.3). To screen for the presence of organic contaminants, 8240 and 8270 organic analysis will be run on a 10% basis in the surface samples. In the borings only the deepest sample will be tested for the presence of 8240 and 8270 organics. This decision to test only the deepest soil samples in the borings is based on the premise that many of the organics would have evaporated from the shallower samples. Metal analysis will be done on a 20% basis in the surface samples, and on all of the boring samples. From the borings taken around the sump and in the ditches, at least one disturbed sample per boring will be collected for physical testing. In the area where the background samples are collected, one soil sample for physical characterization will be collected. One sample per grid will be collected from the stream bed for soil characterization. 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. The samples collected for physical characterization will be sent to USACEWES Geotechnical Laboratory also in Vicksburg, Mississippi. 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.



Schematic drawling of a genric 20' X 25' sample grid pattern.

Figure 2.2.2

Table 2.2.3

Types and Numbers of Samples Collected

Rockeye Munition Facility

	Field Samples	Splits/Dups QC(AE)	Splits/Dups QA(CE)	~~Field Blanks~~ Results	~~Field Blanks~~ Source	Trip Blanks QC(AE)	Trip Blanks QA(CE)	Total No
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 8240	12	1	___	NR 3	NR 1	NR 6	NR	23
B/N/A 8270	12	1	___	NR 3	NR	NR	NR	16
Pesticides/PCB's	___	___	___	NR	NR	NR	NR	
TRPH	___	___	___	NR	NR	NR	NR	
Metals	24	2	___	NR 3	NR 1	NR	NR	30
Other:explosives	120	12	___	NR 3	NR 1	NR	NR	136
SUBSURFACE SOILS:								
Volatiles 8240	13	1	___	NR 3	NR	NR 6	NR	23
B/N/A 8270	13	1	___	NR 3	NR	NR	NR	17
Pesticides/PCB's	___	___	___	NR	NR	NR	NR	
TRPH	___	___	___	NR	NR	NR	NR	
Metals	31	3	___	NR 3	NR	NR	NR	37
Explosives	31	3	___	NR 3	NR	NR	NR	37

Total's
- 67 metals
- 173 Explosives
- 6 Volatiles
- 33 Semi-volatiles

Total Dups
- Dups
- M&E = 16
- Vols = 2
- Semi = 2

Metals List

Aluminum	Copper
Antimony	Iron
Arsenic	Lead
Barium	Magnesium
Beryllium	Nickel
Cadmium	Tin
Chromium	Zink
Cobalt	

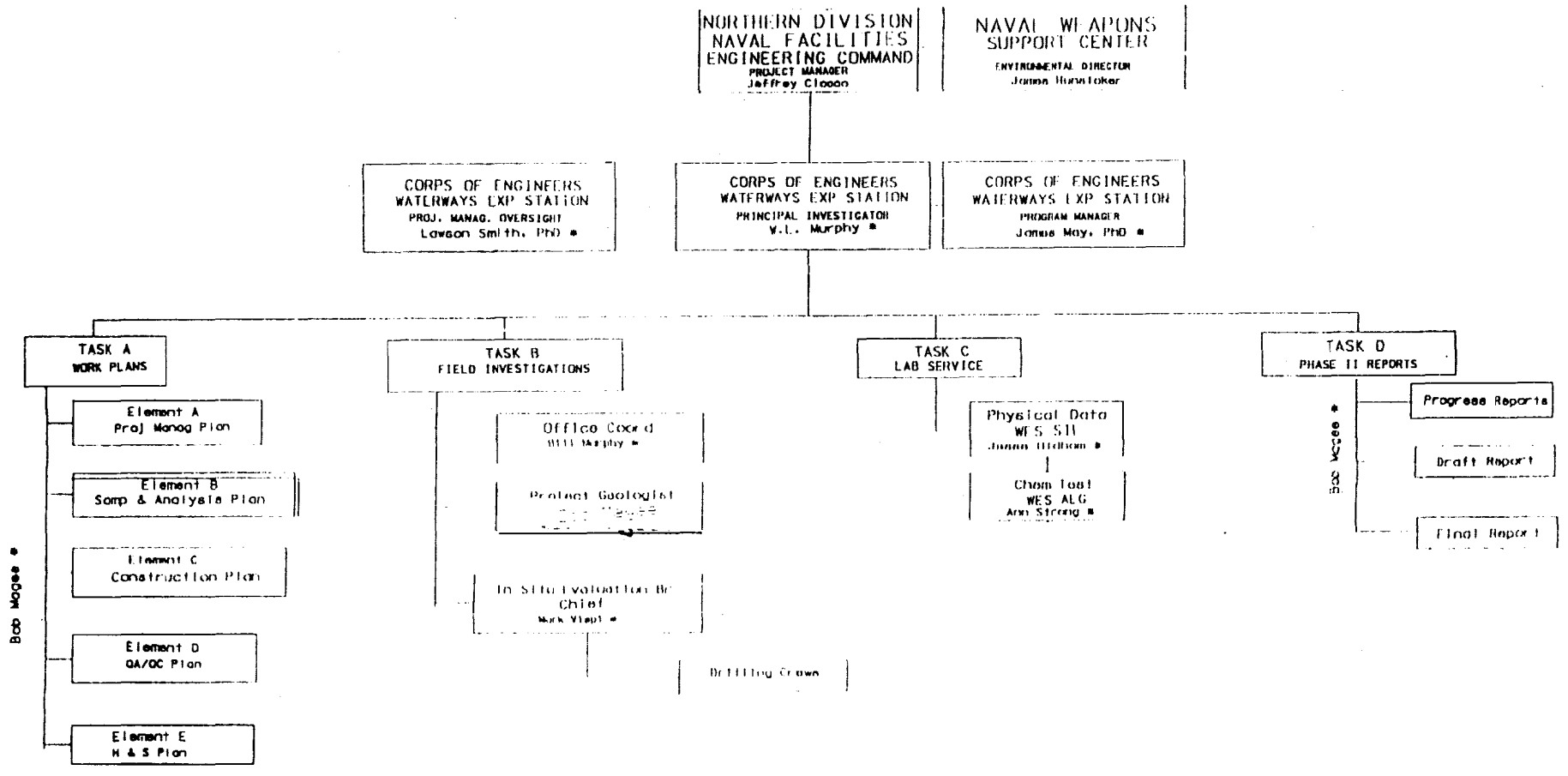
2.3.0 STUDY MANAGEMENT

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 Paul Albertson 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. The explosive testing is to be done by the USACE Cold Regions Research & Engineering Lab (CRREL). 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 figured using 2 borings per day, and four working days for the sump sampling. To expedite data reduction the field data will be forwarded to the Wilmington Engineering District office were it will be processed into final form. 45 working days are set aside for chemical and physical analysis. This is followed by 24 working days of data reduction, and report preparation. The final report should be ready in 125 working days after commencement of the field work.

RCRA FACILITY INVESTIGATION, PHASE II SOILS
ROCKEYE MUNITION FACILITY SMWU 10/15

PROJECT ORGANIZATION CHART



* Corps of Engineers Employees

Figure 2.3.1

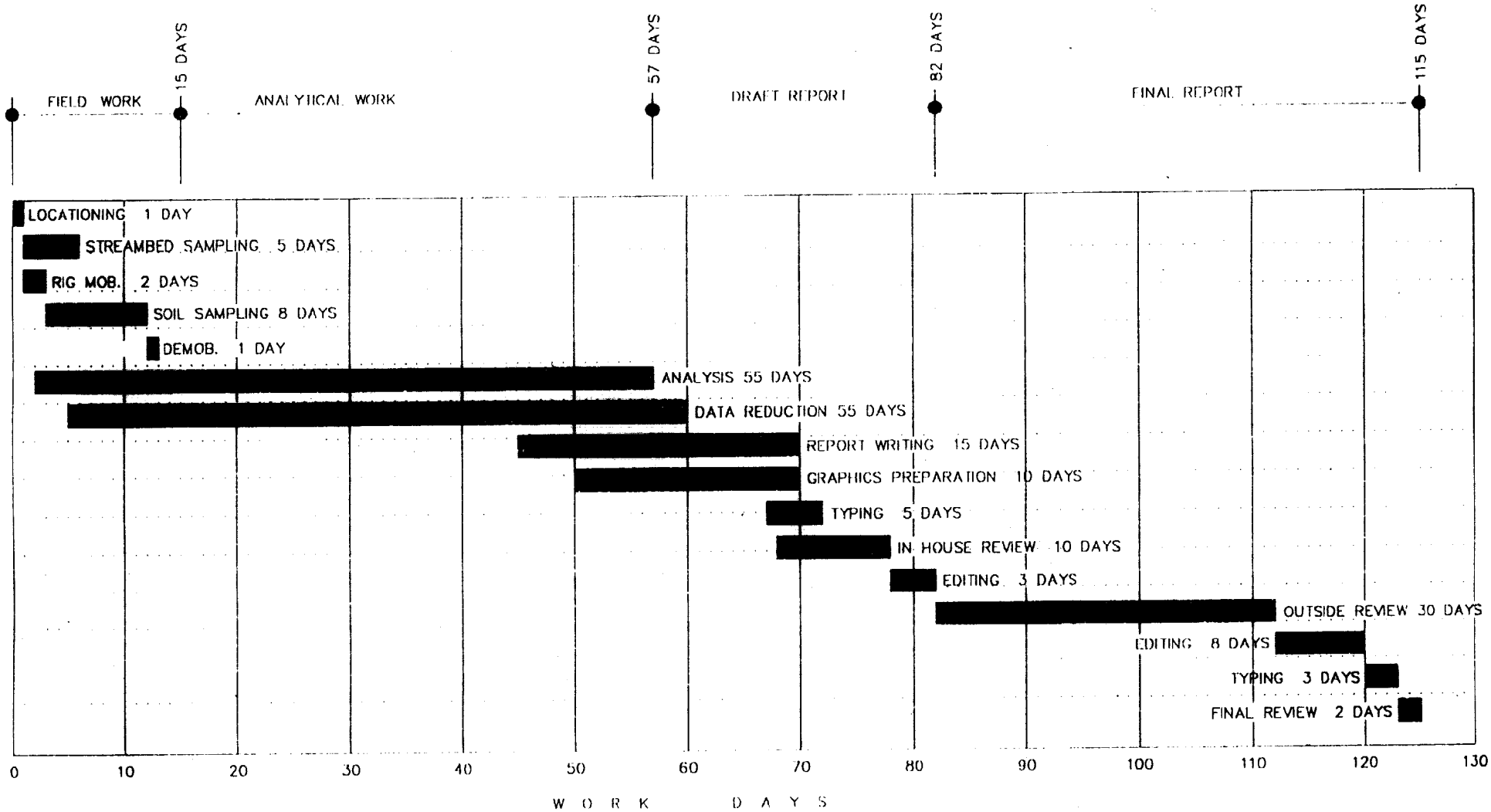


Diagram 2.3.2
Time Schedule

3.0 ELEMENT B: SAMPLE AND ANALYSIS PLAN

3.1.0 SELECTION PROCEDURES

3.1.1 Selection Rational. Because untreated munition contaminated aqueous waste were released to the environment at the Rockeye Site, a Phase II release assessment must be performed. 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 parameters, 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. Background samples will be taken from the ridge separating the north drainage. These locations are the previously used discharged points, the area surrounding the sumps, the ditches leading from the sumps to the discharge points, and the other stream valleys (Figure 3.1.2a). Sampling is planned in the other stream beds on the chance that some contaminants have been carried from the site in storm runoff waters. A programmed sample routine will be used at the boring locations. In the stream beds, the upper soil surface will be sampled. Subsurface samples will be taken at the sumps and in the ditches to evaluate the possibility of a release from those structures.

3.1.3 Chemical Analyte Selection. Analyte selection is based on the probability of a contaminant occurring at the site. Each sample will be tested for the presence of common explosive contaminants. As a precautionary step organic testing and metals testing will be done. Organic solvents could have been mistakenly discharged into the waste stream, and metals are commonly found with munition wastes. The selected analytes are shown on Table 3.1.3.

TABLE 3.1.3
LIST OF PARAMETERS

EXPLOSIVES	INORGANICS	ORGANICS
HMX	Aluminum	8240 Volatiles
TNT	Antimony	8270 Semivol.
RDX	Arsenic	
24 DNT	Barium	
26 DNT Beryllium		
TNB	Cadmium	
TETRYL Chromium		
	Cobalt	
	Copper	
	Iron	
	Lead	
	Magnesium	
	Nickel	
	Tin	
	Zinc	

TABLE 3.1.4a
SUMMARY OF METHODS FOR
DETERMINATION OF NON-METALLIC ANALYSIS

ORGANIC ANALYSIS	TECHNIQUE	SOILS METHODS EXTRACTION	SOILS METHODS ANALYSIS
Volatiles	GC/MS	INC. *	8240
Semivolatiles	GC/MS	3540/3550	8270
Explosives	HPLC	USATHAMA	USATHAMA

* INC. is used when the extraction method is included in the analysis method.

TABLE 3.1.4b
SUMMARY OF METHODS FOR
DETERMINATION OF INORGANIC ANALYSIS

INORGANIC ANALYSIS	TECHNIQUE*	SOILS METHODS from SW-846 EXTRACTION**	SOILS METHODS from SW-846 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
Cobalt	ICP	3050	6010
Copper	ICP	3050	6010
Iron	ICP	3050	6010
Lead	ICP	3050	6010
Manganese	ICP	3050	6010
Mangnesium	ICP	3050	6010
Mercury	CV		7471
Nickel	ICP	3050	6010
Phosphorous	GLC		CRL* 435
Selenium	GF	3050	7740
Silver	ICP	3050	6010
Sodium	ICP	3050	6010
Thallium	ICP	3050	6010
Tin	ICP	3050	6010
Zinc	ICP	3050	6010

* Abbreviations: GF = Graphite Furnace, CV = Cold Vapor, and ICP = Inductively Coupled Plasma, CRL = EPA Central Regional Laboratory - Region V.
**Extraction process, when not noted, is included in the analytical method.

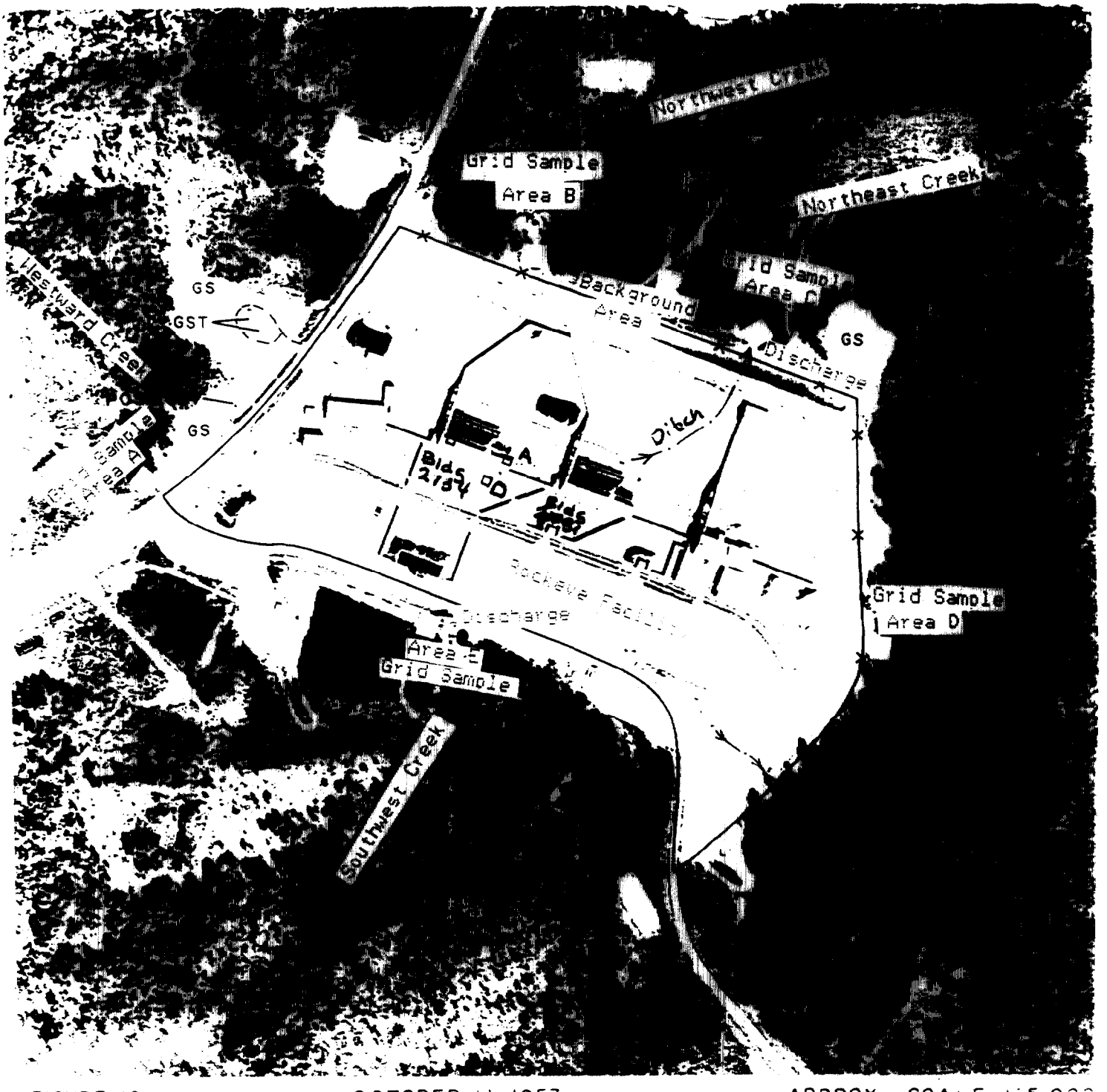


FIGURE 10
SITE 3

OCTOBER 11, 1953

APPROX. SCALE 1:5,000

Aerial Photo of Rockeye Area showing discharge points, grid sampling areas, building numbers, and approximate locations for the sump structures.

Figure 3.1.2

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 test methods are given in Tables 3.1.4a and 3.1.4b. There are no EPA methods for the detection of explosives contaminants. The USATHAMA method SO2, developed for USATHAMA by CRREL, is the recognized detection method and will be used in this study.

3.1.5 Physical Parameter Selection. Soil samples will be characterized using standard US Army COE geotechnical methods. The soil samples will be physical 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, organic content and density. 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 using a Shelby Tube sampler and hand tools. All sampling equipment and drilling equipment will be decontaminated between usage. A hollow stem auger and sampler will be used to take the soil samples around the sumps and in the ditches. Hand tools will be used to take the other soil samples. In the stream beds, samples of the top soil will be taken. Outside of each sump two borings are to be taken. At a location situated out of the stream valley, three background will be taken. The background samples will be the first samples to be taken at this site. They will be taken at a place which is probably removed from sites of contamination. Borings are to be augered at the sump locations, and along the ditches leading from the sumps. At each of the sump auger hole, soil samples will be taken at a depth below the bottom of the sump. In the ditches the soil will be sampled at set depths. All of these samples are to be above the water table or top of rock. These sample intervals are shown on Figure 3.2.1a and 3.2.1b. Past soil borings in the area encountered the top of rock at a depth of 2' to 20' and encountered the water table at a depth of about 17'.

3.2.2 Surface Sampling. Surface samples will be collected in the following manner. Sod and top soil will be removed to a depth of approximatel 3" below the ground surface. A soil sample will be taken from 3" to 6" using a precleaned plastic hand scoop. Eight ounces of soil will be taken. Explosives, metals, and sometimes organic analysis will be performed on the samples. When 8420 analysis is to be done two 40 mL. volatile samples will be needed.

3.2.3 Subsurface Sampling. Soil borings will be drilled using a Failing 1500 truck mounted drilling rig. Samples will be taken at specified depths all above the water table and refusal. A Shelby 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

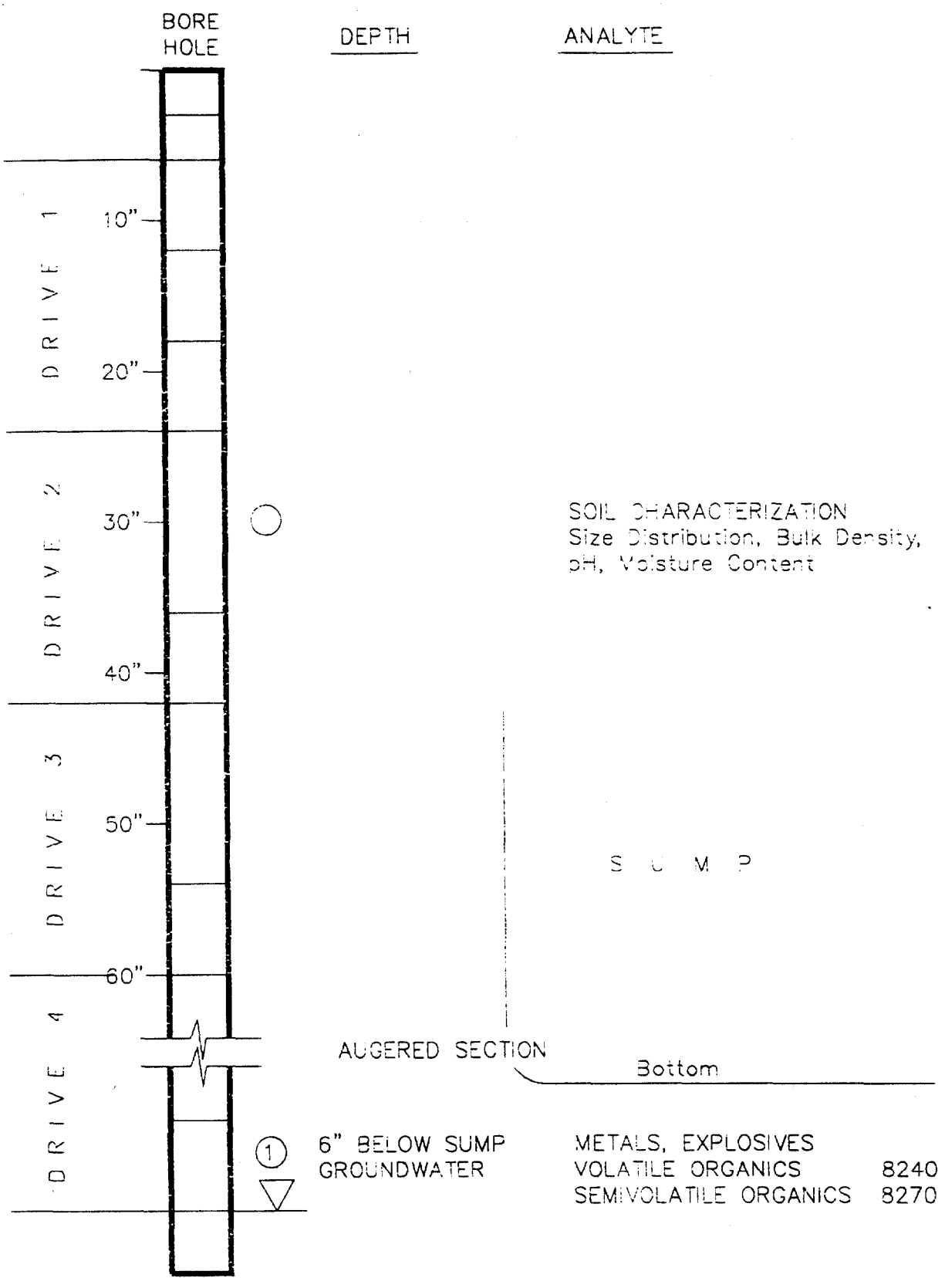


Figure 3.2.1a
Diagram of Boring Log with Smaple Points
NWSC Crane Phase II Soils
Sump Borings

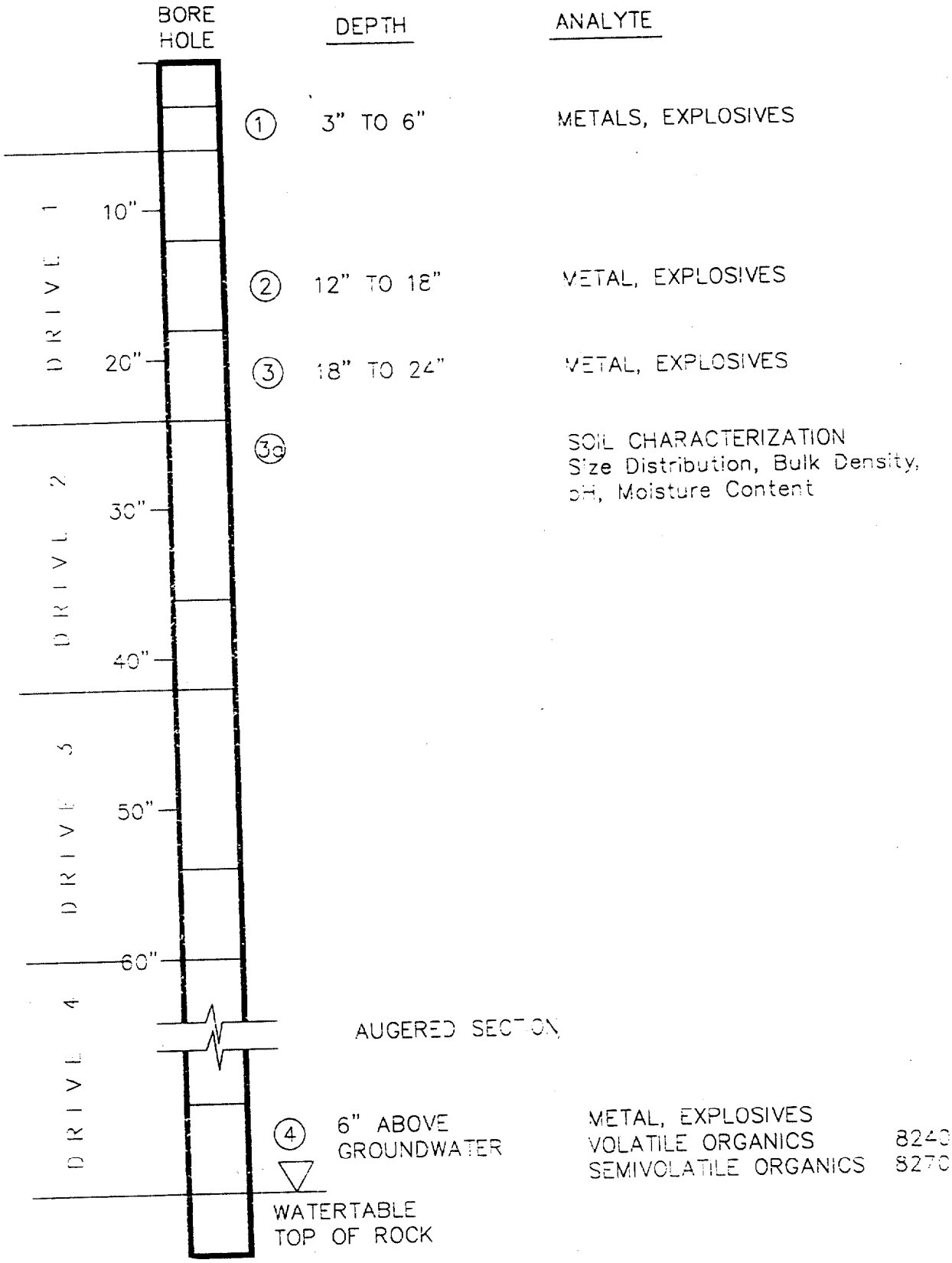


Figure 3.2.1b
Diagram of Boring Log with Smaple Points
NWSC Crane Phase II Soils
Ditch Borings

casing is advanced which will prevent the hole from caving. At the surface, the sample will be 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. The sample jars or bottles will then be sealed. 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. Eight ounces of soil will be collected for organic detection explosives detection. Two 40 ml VOA vials will be filled for volatile organic analysis.

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. Air dry.
9. 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 nonphosphoric detergent can be used. The washing is to

TABLE 3.3.3
CHEMICAL ANALYSIS
SUMMARIZATION OF SAMPLE CONTAINERS,
PRESERVATION AND HOLDING TIMES

MATRIX	PARAMETERS	CONTAINERS
Soil	Volatiles	2x40 mL glass Septa vial
Soil	Semivolatiles Explosives	1 X 8 oz. glass

remove all soil from the rig and drill equipment. A decontamination pad will be constructed at the site. The wastewater generated during decon 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.

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 prelabled, 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

Figure 3.4.2

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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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 3.4.8 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-G150.13GR21/22
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 3" 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	

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED *Jar sample given to NWSC for chemical analysis

Sheet 1 of 7 Sheets

Figure 3.4.4

Boring log with sample data.

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.

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. Reinsate 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 (Table 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 Explosives	Ice to 4 Deg.	7 d.	40 d.

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 Rockeye. 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. The surface soil samples will be taken with a hand trowel. The borings will be advanced using a hollow stem auger. In each sump boring one soil sample will be taken at a depth equal to the depth directly below the sump. In other borings samples will be taken at different intervals. Surface samples will be collected at each drainage way. The soil samples will be tested for the presence of metals, explosives 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 shallowest sample taken. At the time of sample collection the collected samples will be placed in prelabled, 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.

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 samples containers are then put into sealed plastic bags. 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 C to this Work Plan.

Figure 4.2.2

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Figure 4.2.2

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

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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4.4.2 Sample Receipt. Laboratory procedures outlined in Appendix C 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 C.

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 quantitation limits are presented in Appendix C. 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

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 procedures (i.e. SW-846).

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

4.4.7 Document Management. The sample management officer is also in charge of the 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 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 DATA MANAGEMENT PLAN

5.1.0 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 part of the Work Plan that explains the movement of the data into 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. To be done concurrent with the bimonthly reports of progress for the overall soil investigation program, will be issued. These bimonthly progress reports are are to be done at the same time as work on the individual sites is being done. They are covered under the generic work plan for the RFI soils investigation.

5.2.0 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.

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

5.4.0 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 contaminant spread. Cross sections of the soil profile will be made to display the vertical distribution of soil type and contaminate 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.

5.5.0 Report Format. A draft and final report will be written. A period of time for commenting will occur between the draft and final report. This comment period will allow for important prespectives 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 easy removal, addition, or

replacement of pages. Each report shall identify the persons with title of the staff which had significant, specific input into teh report's preparation or review. This statement shall be included in the appendix of the draft report only.

6.0 ELEMENT D: HEALTH AND SAFETY PLAN

SEE APPENDIX A

APPENDIX A

SITE SPECIFIC SAFETY AND HEALTH PLAN
RFI PHASE II SOILS STUDY
ROCKEYE MUNITIONS FACILITY
NWSC CRANE

FIRST DRAFT
19 August 1990

SITE-SPECIFIC SAFETY and HEALTH PLAN
NAVAL WEAPONS SUPPORT CENTER, CRANE, INDIANA
ROCKEYE MUNITIONS FACILITY

PREPARED FOR

U.S ARMY CORPS OF ENGINEERS (WES)

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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 Rockeye Munitions Facility of the Naval Weapons Support Center (NWSC) Crane. 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

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 exact site location is designated as Rockeye Munitions Facility and(ABG) and is located in the north central portion of the base in the SW 1/4 of section 5, T5N, R3W. The area is approximately located on H45, 2 miles South of North Gate #1 It is situated on a flattened ridge crest which separates the Little Sulphur Creek, drainage to the south goes into Boggs Creek, and drainage to the west goes into Greenwood Lake (Figure 2,3,). The facility was used to assemble 3" munitions and later Rockeye bombs. It is stated in the IAS that " contamination results from wastewater from the " tray and bomblet washing ". It is expected that the contaminants of concern are aqueous explosive wastes, Trinitrotoluene (TNT), Cyclotrimethylenetritramine (RDX), Tetrly (2,4,6-trinitrophenylmethylnitramine), Dinitrotoluene (DNT), Cyclotetramethylenetrantramine (HMX), Dinitrobenzene, and Trinitrobenzene.

3.0 Site Investigation Personnel. A four-person Corps of Engineers' sampling (drill crew) under the direction of a Corps of Engineers geologist will perform the investigation activities. The geologist in the supervisory capacity will act as the Site Safety Coordinator (SSC).

4.0 Hazard Assessment and Contaminant Characterization

4.1 Physical

4.1 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 to workers. Severe weather with thunderstorms is also a possible feature of the area (Appendix A).

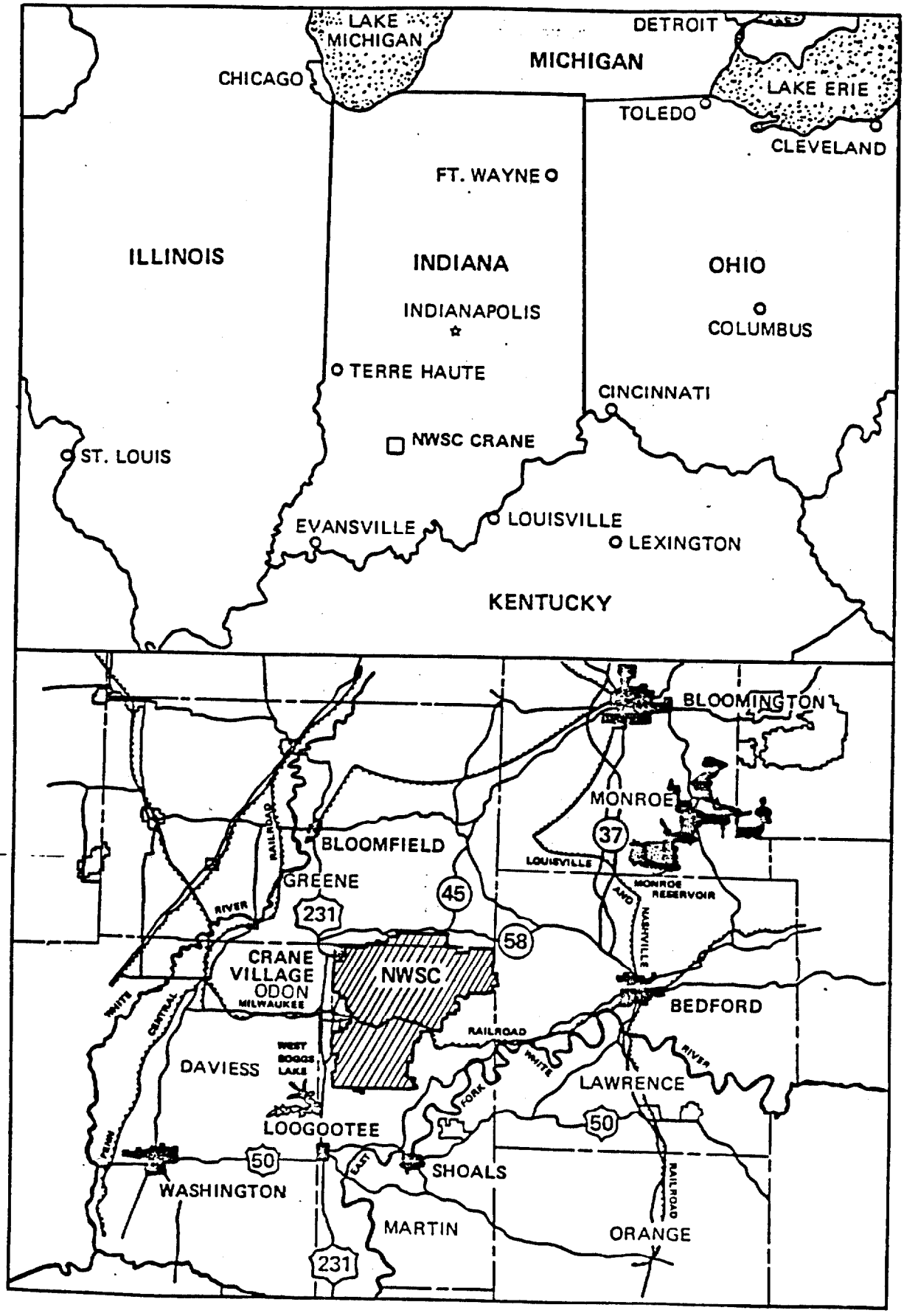

Figure 1. NWSC and Vicinity

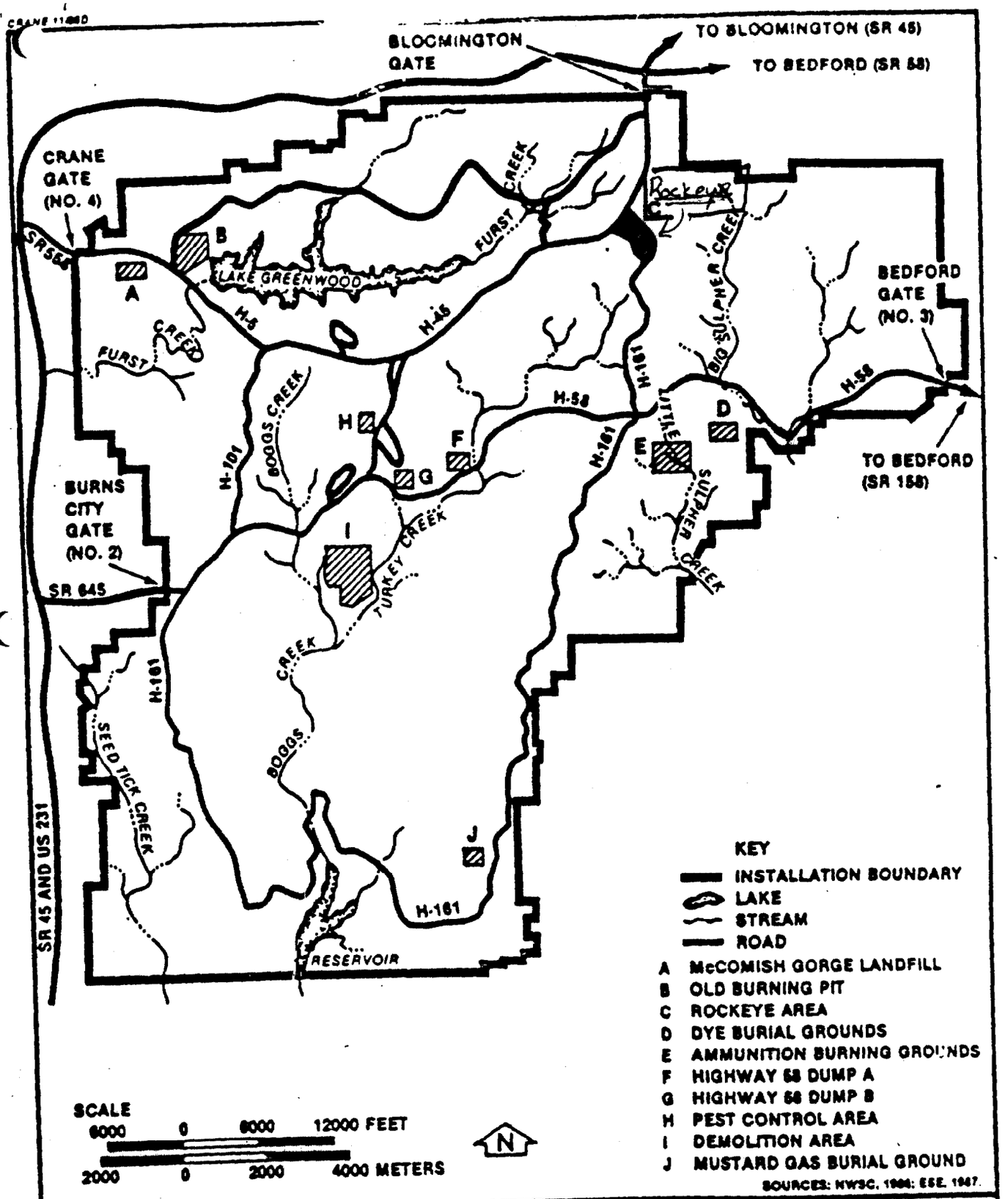

Figure 1.1.2.a
LOCATIONS OF AREAS WHERE CONTAMINATION STUDIES HAVE BEEN [illegible]

Prepared for:
U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland

3-2

Figure. 2 NWSC

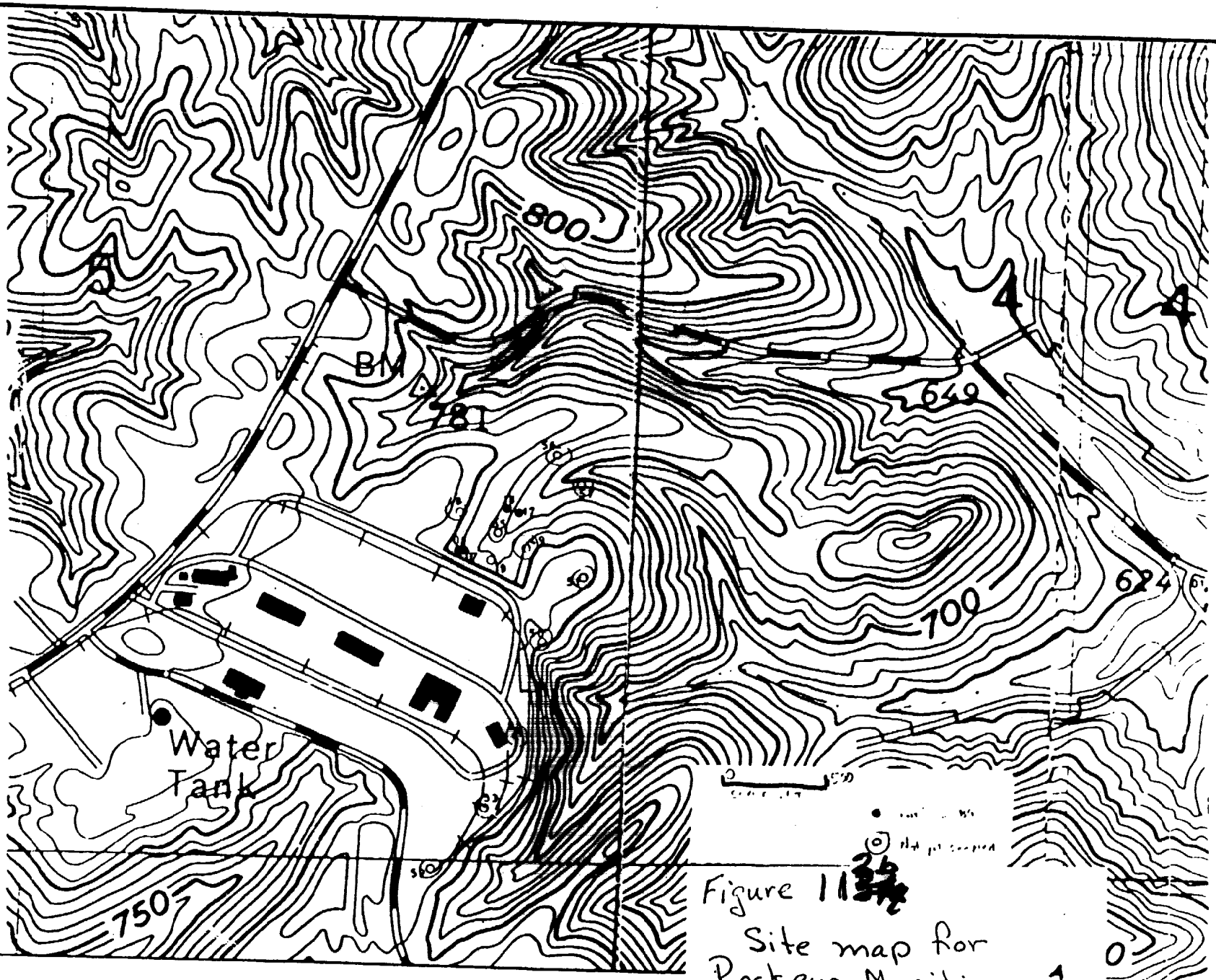

Figure. 3. Rockeye Munitions Facility

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

4.1.3 Chemical. A description of contaminants found in monitoring wells and a listing of possible contaminants is provided in (Appendix C).

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

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

5.0 Investigation Activities and Associated Hazards

5.1 Drilling. Drilling will be performed at the site for the collection of soil samples. 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 or soil particulates carrying heavy metal contaminants. Primary exposure routes during drilling operations will be skin absorption, ingestion and possible inhalation due to vapors and contaminant volatilization from the drill cuttings.

6.0 Worker Protection Requirements

6.1 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 an 8 hrs of annual update training as required. This training must comply with OSHA regulations found in 29 CFR 1910.120(e). 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 restrictions on the eating, drinking, and smoking on the site will be discussed.
4. Rights and Responsibilities of Workers under OSHA. Applicable provisions of the Occupational Safety and Health Act (29 CFR 1910) and the Corps of Engineers Safety and Health Program 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 will be provided with instruction in communicating with the press and local community.

6.2 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 1. 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 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 such as DDT, DDE. The following signatures from each individual on the site verifies completion of requirements:

1. _____ 2. _____

3. _____ 4. _____

6.3 Site Inspections Meetings. To ensure that the SSHP is followed, the SSC shall conduct safety meetings before each day's work. 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.

Table 1. 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.

6.4 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.

6.5 Personnel Protection.

6.5.1 Division of Work Area. Considering the isolated area of the ORR in which the flash pans are located 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).

6.5.1.1 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.

6.5.1.2 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.

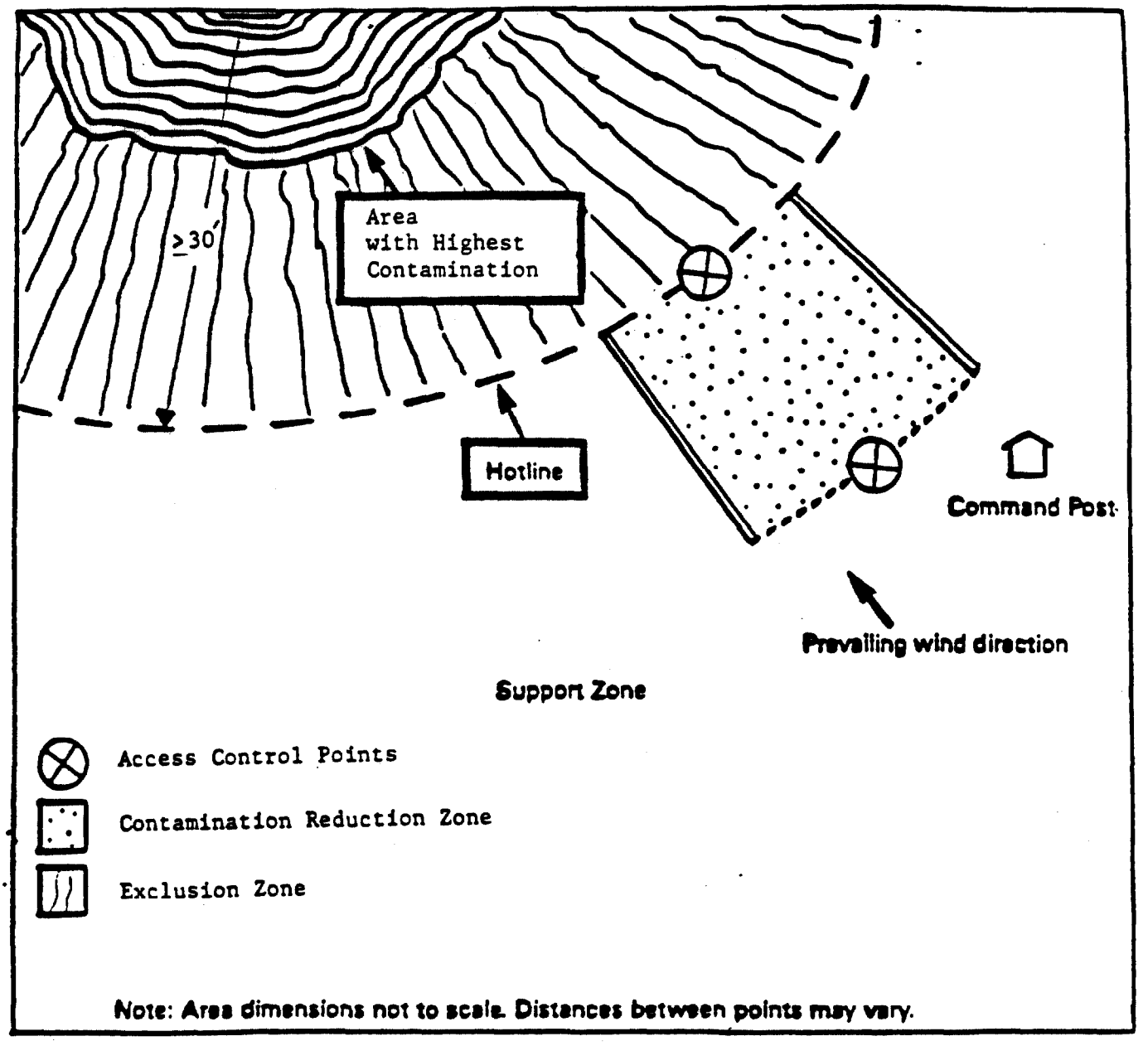

Figure 4. Site Work Zones

6.5.1.3 Support Zone. 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.

6.5.1.4 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 only after having given proper identification, authorization and certification of required training and medical examinations. The Site Safety Coordinator will record each person's:

- 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.

6.5.2 Personal Protective Equipment

6.5.2.1 Proposed Levels of Protection. Modified Level D is prescribed for all activities on this except for the Support Zone, where no level of protection will be required.

Modified Level D protection includes:

- Tyvex disposable coveralls
- Disposable inner and outer gloves
- Chemical-resistant safety boots with steel toes and shanks
- Disposable boot covers
- Hard hat
- Safety glasses or chemical splash goggles
- Hearing protection

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, which requires in addition a full-face, air-purifying, organic vapor, dust, mist canister-equipped respirator.

6.5.2.2 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

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.

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

6.5.2.4 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

6.5.2.5 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

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

6.5.2.7 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.

6.5.3 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.

6.5.3.1 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.

6.5.3.2 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.
>50 units above background	Evacuation of Exclusion Zone

6.5.4 Decontamination

6.5.4.1 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

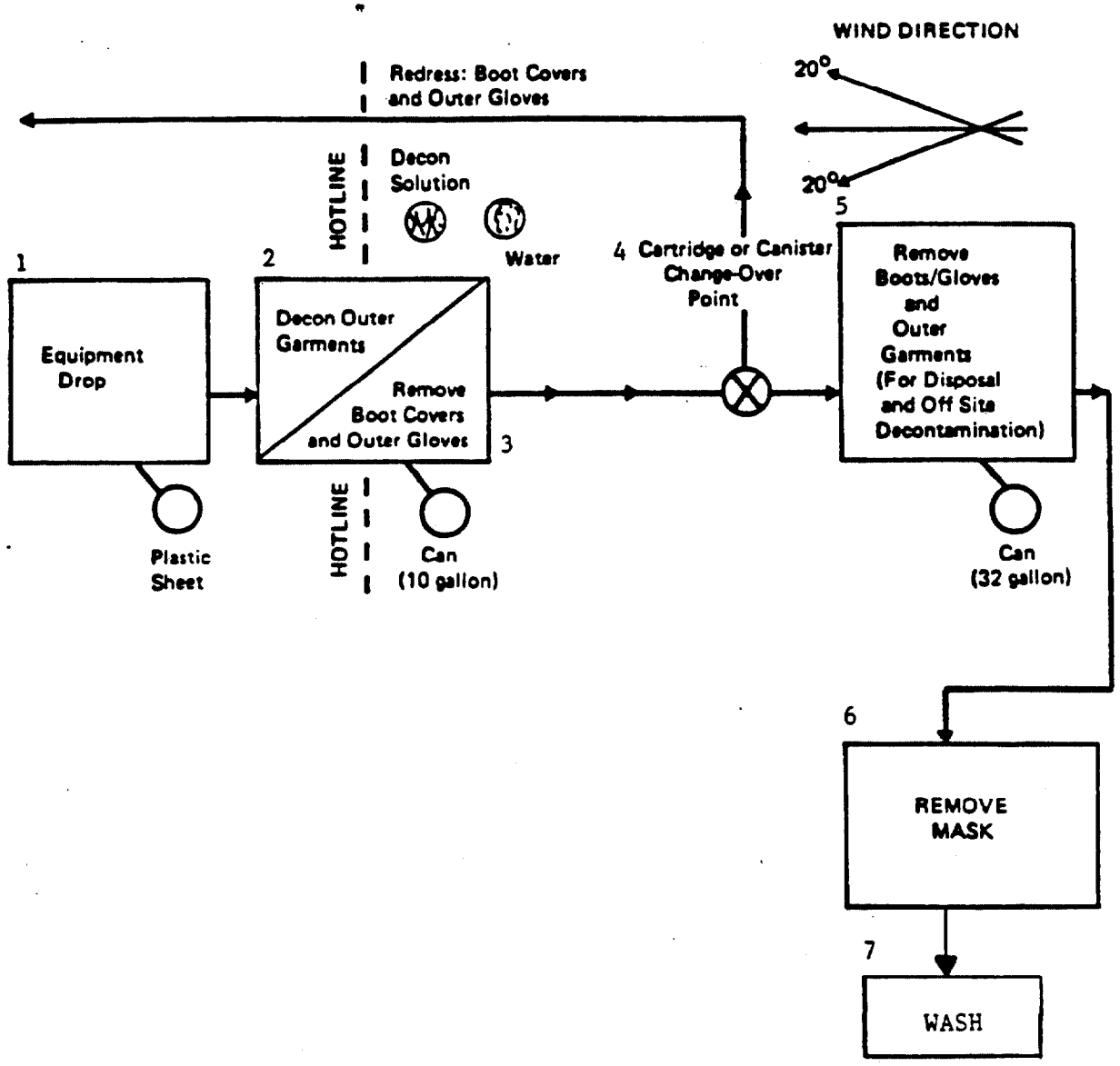

Figure 5. Contamination Reduction Zone Layout

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
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.

6.5.4.2 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.

7.0 Contingency Plan

7.1 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.

7.2 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. This equipment shall include:

- Mobile telephone (optional) And in this project not authorized.
- First Aid Kits
- Portable Eyewash and shower
- Blankets
- Stretchers
- Water in portable containers
- Fire-fighting equipment and supplies
- Level B PPE, available from NWSC

7.3 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).

7.3.1 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.

7.3.2 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.

7.4 Emergency Information

7.4.1 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.

7.4.2 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 _____	
- Health & Safety Officer	
- Fire Department	
- Police/Security Department	
- State Police	
- Hospital	
- Ambulance On-Site/Off-Site	
- Poison Control Center	

****

Name of Hospital:

Telephone Number:

Hospital Address:

Route to Hospital (Also, note route on a map and attach to plan)

Distance to Hospital: _____ miles

7.5 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.

8.0 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).

9.0 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.

10.0 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.

11.0 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.

APPENDICES

APPENDIX A
STANDARD OPERATING PROCEDURES

SOP	TITLE	PAGE
A	SEVERE THUNDERSTORMS/TORNADOES	A-1
B	DRILLING JHA	A-2
C	SNAKE BITE	A-3
D	TEMPERATURE STRESS	A-4

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 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
	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 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.

STANDARD OPERATING PROCEDURE C

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.).

STANDARD OPERATING PROCEDURE B

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.

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.).

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

<u>Stages of Frostbite</u>

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

<u>Stages of Hypothermia</u>

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

- 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.

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 noti~ied 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)he 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. Identification of Hazardous Materials: 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. Assessment: 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;

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. <u>Required Reports:</u> 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.

AIR MONITORING WORKSHEET

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 ______________________

AIR MONITORING WORKSHEET

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

APPENDIX C

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

APPENDIX C PART 1

1. Cyclotetramethylenetrantramine (HMX)
2. Cyclotrimethylenetritramine (RDX)
3. Dinitrobenzene (DNB)
4. Dinitrotoluene (DNT)
5. Trinitrobenzene (TNB)
6. Trinitrotoluene (TNT)
7. 2,4,6-trinitrophenylmethylnitramine (Tetryl)

APPENDIX C PART 2

1. Analytical Laboratory Group, Groundwater Test Data Results, 19 May 1989.

APPENDIX C PART 3

1. TM 9-1300-200 AMMUNITION GENERAL

but improved models retain particles as small as 20 microns. Cyclones are also used in cleaning and firing pulverized coal.

cyclonite. (sym-trimethylene trinitramine; hexahydro-1,2,5-trintro-sym-triazine; trinitrotrimethylenetriamine; cyclotrimethylenetrinitramine; RDX). CAS: 121-82-4. $N(NO_2)CH_2N(NO_2)CH_2N(NO_2CH_2$.
Properties: White, crystalline solid; d 1.82; mp 203.5C;, soluble in acetone; insoluble in water, alcohol, carbon tetrachloride, and carbon disulfide; slightly soluble in methanol and ether.
Derivation: Reaction of hexamethylenetetramine with concentrated nitric acid.
Hazard: High explosive, easily initiated by mercury fulminate. Toxic by inhalation and skin contact. TLV: 1.5 mg/m³ of air.
Use: Explosive 1.5 times as powerful as TNT.

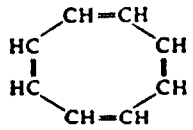
3-cyclooctadiene. CAS: 29965-97-7. C_8H_{12}.
Intermediate for such compounds as suberic acid

1,5-cyclooctadiene.

$HC{:}CH(CH_2)_2CH{:}CHCH_2CH_2$. A butadiene dimer.
Properties: Liquid, fp −56.39C, distillation range 301–303F (technical), bp 149.34C (pure), d 0.88328 (20/4C), lb/gal 7.38, vap press 0.50 psia (37.7C), refr index 1.4933 (20C), flash p 100F (37.7C), combustible.
Derivation: Catalytic dimerization of butadiene.
Grade: Technical 95%, 99%, 99.8 mole %.
Hazard: Moderate fire risk.
Use: Resin intermediate, third monomer in EPT rubber.

cyclooctane. C_8H_{16}.
Properties: Colorless liquid, d 0.835, bp 148C, mp 14C, combustible.

1,3,5,7-cyclooctatetraene. CAS: 629-20-9. C_8H_8.
Properties: Colorless liquid, fp −7C, bp 140C, d 0.943 (0/4C), refr index 1.5394 (20C). It behaves like an aliphatic hydrocarbon, is relatively reactive, and resinifies on standing in air. Combustible.

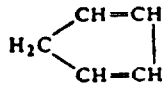


Derivation: Nickel-catalyzed polymerization of acetylene, a reaction discovered by Reppe in Germany about 1940. The mechanism has several possible pathways.
Use: Organic research
See also polyacetylene.

cycloolefin. An alicyclic hydrocarbon having two or more double bonds, e.g., the very reactive and widely used cyclopentadiene derived from coal tar as well as cyclohexadiene and cyclooctatetraene containing six and eight carbon atoms respectively. The latter has four double bonds and is a polymer of acetylene.

cycloparaffin. An alicyclic hydrocarbon in which three or more of the carbon atoms in each molecule are united in a ring structure and each of these ring carbon atoms is joined to two hydrogen atoms or alkyl groups. The simplest members are cyclopropane (C_3H_6), cyclobutane (C_4H_8), cyclopentane (C_5H_{10}), cyclohexane (C_6H_{12}), and derivatives of these such as methylcyclohexane ($C_6H_{11}CH_3$).
Hazard: All members of the cycloparaffin series are narcotic and may cause death through respiratory paralysis. For most of the members there appears to be a narrow range between the concentration causing deep narcosis and those causing death.

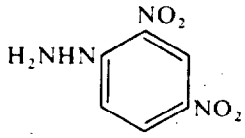
1,3-cyclopentadiene. CAS: 542-92-7. C_5H_6.



Properties: Colorless liquid with d 0.805 and bp 425C. Insoluble in water; soluble in alcohol, ether, and benzene.
Derivation: From coal tar and cracked petroleum oils.
Hazard: Decomposes violently at high temperature. Toxic. TLV: 75 ppm in air.
Use: Chemical intermediate, organic synthesis (Diels-Alder reaction), starting material for synthetic prostaglandin, chlorinated insecticides, and formation of sandwich compounds by chelation, e.g., cyclopentadienyl iron dicarbonyl dimer $[C_5H_5Fe(CO)_2]_2$.

cyclopentamine hydrochloride. (1-cyclopentyl-2-methyl-aminopropane hydrochloride). $C_5H_9CH_2(CH_3)NHCH_3{:}HCl$.
Properties: White, crystalline powder. Mild characteristic odor and bitter taste. Mp 113.0–116.0C. Freely soluble in water, alcohol, and chloroform; soluble in benzene; slightly soluble in ether; pH (1% solution) approximately 6.2.

dinitrophenylhydrazine. $(NO_2)_2C_6H_3NHNH_2$.



Properties: Red, crystalline powder; mp about 200C; slightly soluble in water and alcohol; soluble in moderately dilute inorganic acids; readily soluble in diglyme.
Hazard: Severe explosion and fire risk.
Use: Explosive, reagent for aldehydes and ketones.

2,4-dinitrophenyl methyl ether. See 2,4-dinitroanisole.

3,5-dinitrosalicylic acid.
$C_6H_2(OH)(NO_2)_2COOH$.
Properties: Yellow crystals, slightly soluble in water, soluble in alcohol and benzene, mp 174C.
Derivation: Nitration of salicylic acid.
Use: Determination of glucose.

dinitrosopentamethylenetetramine. (DNPT).
$(NO)_2C_5H_{10}N_4$. A bicyclic compound.
Properties: Light cream-colored powder; decomposes in air at 190–200C; soluble in dimethyl formamide; somewhat soluble in pyridine, methyl ethyl ketone, and acetonitrile. Combustible.
Hazard: May explode at 200C (390F).
Use: Blowing agent for rubber and plastics.

2,4-dinitrosoresorcinol. CAS: 35860-51-6.
$C_6H_2(OH)_2(NO)_2 \cdot H_2O$.
Properties: Light brown powder, mp 162–163C, decomposes sometimes violently, soluble in water and most organic solvents.
Grade: Technical (13.7% N).
Hazard: Severe explosion risk when shocked or heated. An irritant.
Use: Chelation of heavy metals, cross-linking agent, blasting caps and explosive primers.

3,5-dinitro-o-toluamide. See zoalene.

dinitrotoluene. (DNT). CAS: 121-14-2.
$C_6H_3CH_3(NO_2)_2$. (a) 2,4-; (b) 3,4-; (c) 3,5-.
Properties: Yellow crystals, soluble in alcohol and ether, very slightly soluble in water, d (a) 1.3208, (b) 1.32, (c) 1.277; mp (a)70.5C, (b) 61C, (c) 92.3C. A commercial grade consisting of a mixture of the three isomers is an oily liquid. Combustible.
Derivation: Nitration of nitrotoluene with mixed acid.
Method of purification: Crystallization.
Hazard: Absorbed by skin. TLV: 1.5 mg/m^3 of air.
Use: Organic synthesis, toluidines, dyes, explosives.

dinker. A machine for cutting forms from flat sheets of plastic, rubber, metal, paper, etc., by impact of a metal die.

dinocap. CAS: 6119-92-2. Generic name for 2-(2-methylheptyl)-4,6-dinitrophenyl crotonate.
$CH_3CH{:}CHCOOC_6H_2(NO_2)_2CH(CH_3)C_6H_{13}$.
Properties: Brown liquid, bp 138–140C (0.05 mm), insoluble in water, soluble in most organic solvents.
Hazard: Toxic by ingestion and inhalation, strong irritant.
Use: Acaricide, fungicide.

dinonyl adipate. Ester of nonyl alcohol.
Properties: Colorless liquid, bp 201–210C (1 mm), d 0.926 (25C), refr index 1.4523 (20C), viscosity 14.9 centistokes (100F). Combustible.
Use: Plasticizer where special low-temperature properties are desired.

dinonyl carbonate. $(C_9H_{19})_2CO_3$. Ester of nonyl alcohol, colorless liquid, bp 135–140C (0.3 mm), d 0.894 (25C), refr index 1.4427 (20C). Combustible.

dinonyl ether. $C_9H_{19}OC_9H_{19}$.
Properties: Colorless liquid, bp 148–153C (5 mm), d 0.817 (25C), refr index 1.4405 (20C). Can be made from nonyl alcohol plus nonyl halide by the Williamson synthesis. Combustible.

dinonylmaleate.
$C_9H_{19}OOCCH{:}CHCOOC_9H_{19}$.
Ester of nonyl alcohol, colorless liquid, bp 157–167C (0.1 mm), d 0.941 (25C), refr index 1.4586 (20C), viscosity 6900 centistokes (−40F), 17.47 centistokes (100F), 3.50 centistokes (210F). Combustible.

dinonyl phenol. $(C_9H_{19})_2C_6H_3OH$.
Properties: Colorless liquid, insoluble in water, soluble in common organic solvents. Combustible.
Hazard: See phenol.
Use: Solvent.

dinonyl phthalate. (DNP).
$C_6H_4(COOC_9H_{19})$. Ester of nonyl alcohol.
Properties: Colorless liquid, bp 205–220C (1 mm), d 0.979 (25C), refr index 1.4871 (20C), viscosity 55.3 centistokes (37.7C), flash p 420F (215C). Combustible.

Use: General-purr
for vinyl resins;
phase in chroma

dinoseb. Legal lat
sec-butyl-phenol

DIOA. Abbreviat

dioctadecylamine.

2,6-dioctadecyl-p-c
sol.

dioctadecyl ether.

dioctadecyl sulfide

3,3'-dioctadecyl thi
thiodipropionate

dioctyl adipate. S

dioctylamine. Sec

dioctylaminoethan
nolamine.

dioctyl azelate. S

dioctyl chlorophos
ridate). (C_8
Properties: Water
index 1.445 (25
soluble in comm
ble in water. Co
Use: Intermediat

di(n-octyl-n-decyl)
Properties: Clear
25C); refr index
Use: Low-temper

di(n-octyl-n-decyl
Properties: Clear
(as phthalic acic
25C); crystalliz
mm); flash p 4.
Use: Plasticizer
vinyls.

di-n-octyl dipheny
$C_8H_{17}C_6H_4NH$
Properties: Light
soluble in benz
ene dichloride;
Use: Antioxidan
thetic lubricant

"Di-MoN."[93] TM for modified diammonium phosphate.
Use: Low cost source of phosphorus and nitrogen as nutrients in biological waste treatment.

dimpylate. See diazinon.

Dimroth rearrangement. Rearranagement of N-alkylated or arylated iminoheterocycles to the corresponding alkylamino or arylamino heterocycles.

dimyristyl amine. (ditetradecylamine). $(C_{14}H_{29})_2NH$.
Solid, mp 52C, d 0.89, almost insoluble in water.
Use: Intermediate.

dimyristyl ether. (ditetradecyl ether). $(C_{14}H_{29})_2O$.
Properties: Liquid, mp 38–40C, bp 238–248C (4 mm) d 0.8127 (45/4C). Combustible.
Grade: 95% (min) purity.
Use: Electrical insulators, water repellents, lubricants in plastic molding, antistatic substances, chemical intermediates.

dimyristyl sulfide. (ditetradecyl sulfide, dimyristyl thioether). $(C_{14}H_{29})_2S$.
Properties: Solid, mp 49–50C, bp decomposes, d 0.8258 (50/4C).
Grade: 95% (min) purity.
Use: Organic synthesis (formation of sulfonium compounds).

N,N'-di-β-2-naphthyl-m-phenylenediamine. $C_6H_4(NHC_{10}H_7)_2$.
Properties: Colorless needles, mp 191C, sparingly soluble in alcohol, insoluble in water and ether.
Derivation: By heating m-phenylenediamine with β-naphthol and extraction with alcohol.
Use: Organic synthesis.

N,N'-di-β-naphthyl-p-phenylenediamine. (sym-di-β-naphthyl-p-phenylamine; DNPD). $C_6H_4(NHC_{10}H_7)_2$.
Properties: Gray powder, d 1.25, set point 225C (min), purity 98% (min), insoluble in water, slightly soluble in acetone and chlorobenzene.
Use: Antioxidant, stabilizer, polymerization inhibitor, intermediate in organic synthesis.

dinitolmide. See zoalene.

dinitraniline orange. (Permanent Orange). A pigment made from dinitroaniline and β-naphthol. It is a reddish shade of orange that has excellent light-fastness.
Hazard: Toxic by ingestion.

dinitroaminophenol. See picramic acid.

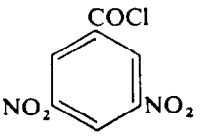
2,4-dinitroaniline. (2,4-dinitraniline). CAS: 92-02-9. $C_6H_3NH_2(NO_2)_2$.
Properties: Yellow crystals, slightly soluble in alcohol, insoluble in water, d 1.615, mp 188F, flash p 435F (223C). Combustible.
Derivation: Nitration of p-nitroaniline with hot mixed acid.
Grade: Technical, pure.
Hazard: Toxic by ingestion and inhalation, strong irritant.
Use: Intermediate for azo pigments, toner pigment in printing inks, corrosion inhibitor.

2,4-dinitroanisole. (2,4-dintriophenyl methyl ether). $CH_3OC_6H_3(NO)_2$.
Properties: Colorless to yellow, monoclinic needles from water or alcohol; mp 88C; d 1.341 (20/4C) sublimes; slightly soluble in hot water; soluble in alcohol and ether.
Hazard: Toxic by ingestion.
Use: Ovicide, effective against moths, furniture and carpet beetles, cockroaches, and body lice.

dinitrobenzene. CAS: o- 528-29-0; m- 99-65-0; p- 100-25-4. $C_6H_4(NO_2)_2$. M-, o-, and p-isomers.
Properties: Yellow crystals, soluble in chloroform and ethyl acetate, sparingly soluble in benzene, slightly soluble in water; d m- 1.546, o- 1.565, p- 1.6; mp m- 89.9C, o- 117.9C, p- 172–173C; bp m- 302.8C, o- 319C, p- 299C.
Derivation: Nitration of nitrobenzene with hot mixed acid.
Hazard: o-isomer explodes when shocked or heated. Toxic By inhalation and ingestion, absorbed by skin. TLV: 1 mg/m³ of air.
Use: Organic synthesis, dyes, camphor substitute in cellulose nitrate.

5,7-dinitro-1,2,3-benzoxadiazole. See diazodinitrophenol.

3,5-dinitrobenzoyl chloride. $(NO_2(_2C_6H_3COCl)$.



Properties: Yellow crystals, mp 66–68C, bp 196C (12 mm), decomposed by water and. alcohol.
Hazard: An irritant.
Use: Reagent for amino acids and presence of alcohols in acetals and ketals.

e: propylene tetramer).
$_2H_{24}$. A mixture of

.770 (20/20C), boiling
6.44 lb/gal (15.5). Com-

ı obtained from catalytic
lene.
ɔenzene), lubricant addi-

de.

color; d 1.13 (20/20C);
: musty odor; soluble in
e, chloroform, and gaso-
and 10% caustic. Com-

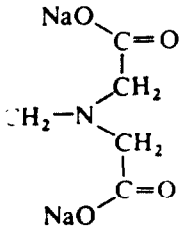
9-1. Si_4H_{10}.
id, fp −93.5C, bp 109C,

xplosion risk, can ignite

See sodium pyrophos-
hosphate.

ıylenediaminetetraacetic
EDTA Na_4; sodium
2-8. $C_{10}H_{12}N_2Na_4O_8$

, freely soluble in water.
lating agent.



tetraacetic acid (note).

n tripolyphosphate.

ine solid; mp 580–600C;
er 30 g/100 mL (26C).

e. See sodium pyro-
olyphosphate.

anic intermediate, adhe-
dispersant.

tetrazene. (4-amidino-1-[nitrosamino-amidino]-1-tetrazene). CAS: 27120-23-6.
$H_2NC(:NH)NHNHN:NC(:NH)NHNHNO$.
Properties: Colorless or pale yellow fluffy solid, apparent d 0.45 but yields a pellet of d 1.05 under pressure of 3000 psi. Practically insoluble in water, alcohol, ether, benzene, and carbon tetrachloride; slightly hygroscopic.
Derivation: Interaction of an aminoguanidine salt with sodium nitrite in absence of free mineral acid.
Use: Initiating explosive.

tetrazolium chloride. (tetrazolium salt; TTC; 2,4,5-triphenyltetrazolium chloride).
$CN_4Cl(C_6H_5)_3$.
Properties: White to pale-yellow crystalline powder which darkens on exposure to light. Readily soluble in water, mp (with decomposition) 245C.
Use: In germination and viability tests. Viable parts of seed are stained red by deposition of red insoluble triphenyl formazan.

tetrol. See furan.

"Tetron."[88] TM for tetraethyl pyrophosphate (tepp), technical and in liquid formulations for insecticidal use.
Hazard: Highly toxic.

"Tetrone" A.[23] TM for dipentamethylenethiuram tetrasulfide rubber accelerator.

"Tetronic."[203] TM for a nonionic tetrafunctional series of polyether block-polymers ranging in physical form from liquids through pastes to flakable solids. They are polyoxyalkylene derivatives of ethylenediamine. Physical state varies with molecular weight and oxyethylene content, 100% active.
Use: Low-foaming detergent formulations; defoaming agents, flexible and rigid polyurethane foams, emulsifying and demulsifying agents, textile processing.

tetryl. (tetralite and nitramine are common commercial names for trinitrophenylmethylnitramine).
CAS: 479-45-8. $(NO_2)_3C_6H_2N(NO_2)CH_3$.
Properties: Yellow crystals; mp 130–132C; d 1.57 (19C); explodes at 187C; insoluble in water; soluble in alcohol, ether, benzene, glacial acetic acid.
Hazard: Dangerous fire and explosion risk. Skin irritant, absorbed by skin. TLV: 1.5 mg/m³ of air.
Use: Detonating agent for less sensitive high explosives, indicator (colorless at pH 10.8, dull red at pH 13.0).

"Texicote."[263] TM for a series of vinyl, acrylic, and styrene polymer and copolymer emulsions, plasticized and unplasticized; available in many grades.
Use: Adhesives, paint, carpet backsizing, pigment binder in clay coatings, self-polishing finishes.

"Texicryl."[263] TM for a series of acrylic and methacrylic polymer and copolymer emulsions.
Use: Paper coating, paint, leather finishes, textiles, adhesives, and wall paper.

"Texigel."[263] TM for a series of polyacrylic thickening agents, water-soluble anionic colloids.
Use: Stabilizers, protective colloid and thickeners for natural and synthetic latices and other aqueous dispersions, binders, and flocculants.

"Texilac."[263] TM for a series of vinyl and acrylic polymer and copolymer solutions in various solvents, plasticized and unplasticized.
Use: Wet-bond and heat-seal adhesives, impregnants, specialty lacquers, paper coating, nitrocellulose finishes, and printing inks for plastic films.

textile oil. Any of various specially compounded oils used to condition raw fibers, yarns, or fabric for manufacturing, bleaching, dyeing, and finishing operations.

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texture. The physical structure of a solid or semisolid material that results from the shape, arrangement, and proportions of its components. The term is used in the textile industry to characterize fabrics of various types and in the food industry to describe quality characteristics of bakery products, margarines, meats, spun proteins, etc. It is also regarded by geologists as a property of rocks and soils.
See also protein, textured.

textured protein. See protein, textured.

textryl. Generic name for nonwoven structures which may be manufactured by wet-processing from staple fibers and fibrid binder.

"Texzyme."[114] TM for a proteolytic enzyme which digests blood, albumin, food, beverage, urine, perspiration, etc.
Use: Silk and filament rayon fabric to accelerate the rate of desizing and insure good results in dyeing, bleaching, and finishing.

trimethyl phosphate. CAS: 512-56-1. $(CH_3O)_3PO$.
Properties: Colorless liquid, 22.1% phosphorus, density 1.210 at 68F, flash p above 300F (148C), bp 193C, refr index 1.397 (20C), pour point −46C, soluble in both gasoline and water. Combustible.
Hazard: Toxic by ingestion and inhalation, strong irritant to skin and eyes.
Use: For controlling spark plug fouling, surface ignition and rumble in gasoline engines.

trimethyl phosphite. CAS: 121-45-9. $(CH_3O)_3P$.
Properties: Colorless liquid, bp 108–108.5C, pour point below −60C, d 1.046 (20/4C), flash p (COC) 100F (37.7C). Insoluble in water; soluble in hexane, benzene, acetone, alcohol, ether, carbon tetrachloride, and kerosene.
Hazard: Flammable, moderate fire risk. TLV: 2 ppm in air.
Use: Chemical intermediate, especially for insecticides.

trimethyl phosphorothionate. $(CH_3O)_3PS$.
Properties: Water-white liquid, bp 78C (12 mm).
Hazard: Toxic by ingestion and inhalation.
Use: Extraction of mineral salts from alkyl acid phosphate solvent solutions, plasticizer.

1,2,4-trimethylpiperazine. $(CH_3)_3C_4H_7N_2$.
Properties: Colorless liquid, d 0.851 (25/25C), fp −44C, bp 151C, refr index 1.4480 (20C), flash p (OC) 257F (125C), miscible in water. Combustible.
Use: Polymerization catalyst.

trimethylpropylmethane. See 2,2-dimethylpentane.

2,4,6-trimethylpyridine. See 2,4,6-collidine.

2,4,6-trimethyl-1,3,5-trioxane. See paraldehyde.

1,3,5-trimethyl-2,4,6-tris(3,5-di-tert-butyl-4-hydroxybenzyl)benzene.
Properties: Free-flowing, white, crystalline powder; mp 244C; no odor. Partially soluble in benzene and methylene chloride, insoluble in water, permissible in contact with food products. Combustible.
Use: Antioxidant for polypropylene, high-density polyethylene, spandex fibers, polyamides and specialty rubbers.

2,6,10-trimethyl-9-undecen-1-al.
$(CH_3)_2C{:}CHC_2H_4CH(CH_3)C_3H_6CH(CH_3)CHO$.
Properties: Clear, yellow liquid; strong, pungent, ozone-like odor. D 0.850–0.860 (25/25C), refr index 1.4530–1.4630 (20C). Combustible.
Use: Perfume.

trimethylvinylammonium hydroxide. See neurine.

trimethylxanthine. See caffeine.

"Trimulso."[236] TM for a liquid synthetic surfactant used in the preparation of oil-in-water emulsion drilling muds, effective in both fresh water and brine muds.

trimyristin. The glyceride of myristic acid, glyceryl trimyristate.

trinickelous orthophosphate. See nickel phosphate.

trinitite. Green glazed glass material produced by the 100 million degree Fahrenheit heat from an atomic explosion. It was named for Trinity, New Mexico, a sand covered site 80 miles from the Almagordo atom bomb test site.

trinitroaniline. (picramide).
CAS: 26952-42-1. $C_6H_2NH_2(NO_2)_3$.
Properties: Orange-red crystals, mp 188C, bp explodes, d 1.762.
Derivation: Nitrating aniline in glacial acetic acid solution or by the use of mixed nitric-sulfuric acid in limited amounts.
Hazard: Dangerous, explodes by heat or shock.
Use: Explosive compositions.

trinitroanisole. (methyl picrate; 2,4,6-trinitrophenyl methyl ether). $CH_3OC_6H_2(NO_2)_3$.
Properties: Crystals, mp 68.4C, d 1.408 (20/4C).
Hazard: High. Dangerous, explodes by heat or shock.
Derivation: Interaction of methyl iodide and silver picrate, nitration of anisic acid.
Use: Explosive compositions.

1,3,5-trinitrobenzene. (TNB). CAS: 99-35-4. $C_6H_3(NO_2)_3$.
Properties: Yellow crystals, d 1.688 (20/4C), mp 122C, soluble in alcohol and ether, insoluble in water.
Derivation: From trinitroluene by removal of methyl group.
Hazard: Dangerous, explodes by heat or shock.
Use: Explosive compositions.

2,4,6-trinitrobenzoic acid. (trinitrobenzoic acid). CAS: 129-66-8. $C_6H_2(NO_2)_3COOH$.
Properties: Orthorhombic crystals, mp 228.7C, sublimes with decomposition forming carbon dioxide and trinitrobenzene, slightly soluble in water and benzene, soluble in alcohol, ether, and acetone.
Derivation: Oxidation of 2,4,6-trinitrotoluene with chromic acid.

Hazard: Dangerou
Use: Explosive com

2,4,6-trinitro-m-cres
$(NO_2)_3C_6H(CH_3)($
Properties: Yellow c
ble in alcohol, eth
Derivation: Prepare
similar to which
phenol.
Hazard: Explodes a
sion risk when sh
Use: Bursting char
uses.

trinitroglycerin. See

trinitromethane. CA
Properties: White cr
decomposes above
cal/g, soluble in w
Derivation: Reaction
Hazard: Explodes
above 50% in air n
Use: Manufacture of

1,3,5-trinitronaphthale
$C_{10}H_5(NO_2)_3$. C
mixture of isomers
Hazard: Explosion ri
Use: Explosive, stabil

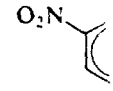
trinitrophenol. See pi

2,4,6-trinitrophenyl me
sole.

trinitrophenylmethylnit

2,4,6-trinitroresorcinol.
styphnic acid.

2,4,6-trinitrotoluene.
zene). CAS: 118-
$CH_3C_6H_2(NO_2)_3$.



Properties: Yellow, mo
mp 80.9C; soluble in al
in water.
Derivation: Nitration of

tetrazene. (4-amidino-1-[nitrosamino-amidino]-1-tetrazene). CAS: 27120-23-6. $H_2NC(:NH)NHNHN:NC(:NH)NHNHNO$.
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Hazard: Dangerous fire and explosion risk. Skin irritant, absorbed by skin. TLV: 1.5 mg/m³ of air.
Use: Detonating agent for less sensitive high explosives, indicator (colorless at pH 10.8, dull red at pH 13.0).

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Use: Silk and filament rayon fabric to accelerate the rate of desizing and insure good results in dyeing, bleaching, and finishing.

Hazard: Dangerous, explodes by heat or shock.
Use: Explosive compositions.

2,4,6-trinitro-m-cresol. (cresolite; cresylite). $(NO_2)_3C_6H(CH_3)OH$.
Properties: Yellow crystals; mp 106C; readily soluble in alcohol, ether, and acetone.
Derivation: Prepared from m-cresol by a process similar to which picric acid is prepared from phenol.
Hazard: Explodes at 300F (148.8C), severe explosion risk when shocked or heated.
Use: Bursting charges and other high explosive uses.

trinitroglycerin. See nitroglycerin.

trinitromethane. CAS: 517-25-9. $CH(NO_2)_3$.
Properties: White crystals, mp 15C, d 1.469 (25C), decomposes above 25C, heat of combustion 746 cal/g, soluble in water.
Derivation: Reaction of acetylene with nitric acid.
Hazard: Explodes on heating, concentrations above 50% in air may explode.
Use: Manufacture of propellants and explosives.

1,3,5-trinitronaphthalene. (naphite). $C_{10}H_5(NO_2)_3$. Commercial preparation is a mixture of isomers which melts at 110C.
Hazard: Explosion risk when shocked or heated.
Use: Explosive, stabilizer for nitrocellulose.

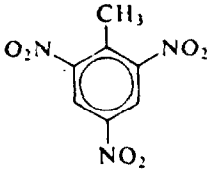
trinitrophenol. See picric acid.

2,4,6-trinitrophenyl methyl ether. See trinitroanisole.

trinitrophenylmethylnitramine. See tetryl.

2,4,6-trinitroresorcinol. Legal label name for styphnic acid.

2,4,6-trinitrotoluene. (TNT; methyltrinitrobenzene). CAS: 118-96-7. $CH_3C_6H_2(NO_2)_3$.



Properties: Yellow, monoclinic needles; d 1.654; mp 80.9C; soluble in alcohol and ether; insoluble in water.
Derivation: Nitration of toluene with mixed acid. Small amounts of the 2,3,4- and 2,4,5-isomers are produced which may be removed by washing with aqueous sodium sulfite solution.
Grade: Technical.
Hazard: Flammable, dangerous fire risk, moderate explosion risk, will detonate only if vigorously shocked or heated to 450F (232C). Toxic by ingestion, inhalation, and skin absorption. TLV: 0.5 mg/m³ of air.
Use: Explosive, intermediate in dyestuffs and photographic chemicals.

trinitrotrimethylenetriamine. See cyclonite.

trioctadecyl phosphite. $(C_{18}H_{37}O)_3P$.
Properties: White, waxy solid; mp 45–47C; d 0.940 (25/25C).
Use: Stabilizer in polymers and an intermediate.

tri-n-octylaluminum. $(C_8H_{17})_3Al$.
Properties: Colorless, pyrophoric liquid.
Derivation: Reaction between octene and isobutylaluminum.
Hazard: Flammable, ignites in air.
Use: Polyolefin catalyst.

trioctyl phosphate. (octyl phosphate). $(C_8H_{17})_3PO_4$.
Properties: Liquid, d 0.924 (26C), bp 220–30°(8 mm). Soluble in alcohol, acetone, and ether. Combustible.
Hazard: Toxic by ingestion and inhalation.
Use: Solvent, antifoaming agent, plasticizer.

trioctylphosphinic oxide. (TOPO). $(C_8H_{17})_3PO$.
Properties: Solid, mp 55C, min purity 95%.
Use: Reagent for extraction of metals from aqueous and nonaqueous solutions, including fissionable actinide elements.

trioctyl phosphite. See tris-2-ethyl-hexyl phosphite.

triolein. See olein.

tri-o-cresylphosphate. See tricresyl phosphate.

sym-trioxane. (triformol; trioxin; metaformaldehyde). $(CH_2O)_3$ or $\overline{CH_2OCH_2OCH_2O}$. A trimer of formaldehyde, not to be confused with paraformaldehyde, which consists of eight or more formaldehyde units.
Properties: White crystals, formaldehyde odor, mp 62C, sublimes at 115C, flash p 113F (45C) (OC). Soluble in water, alcohol and ether; autoign temperature 777F (413C).

Table 1

Contaminant Concentration Ranges at the
Monitoring Wells at Rockeye Munitions
1989

CONTAMINANT	WELL	CONCENTRATION	TLV
26DNTOL	10-17-E	.0253	1.5 mg/m3
24DNTOL	"	.0032	1.5 mg/m3
TNT	"	.974	1.5 mg/m3
RDX	"	1.370	
HMX	"	.673	
TNB	"	.0431	
26DNTOL	10-18-E	<.001	
24DNTOL	"	<.002	
TNT	"	.0038	
RDX	"	.0830	
HMX	"	.135	
TNB	"	<.001	

26DNTOL - 2,6-Dinitrotoluene 24DNTOL - 2,4-Dinitrotoluene
TNT - Trinitrotoluene RDX Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
TNB - 1,3,5-Trinitrobenzene

Summary of high values taken from 19 May 89, Data Reporting Sheet.

MCL-Maximum Contamination Limit (in water), TWA-Time Weighted Average (8 hr day, 40hr week maximum exposure)

CRANE 1 TRIP

Rockeye Sampled 26 Apr 89

JOB FILE: 02395 DATE: 19 MAY 89

********** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 1 OF 18)**********

Lab analysis data

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89

CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION		1	2	3	4	5	6	ROW
02395	10-01-E	CONC	<0.001	<0.002	<0.002	0.0234	0.0248	<0.001	1
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02396	10-02-E	CONC	<0.001	<0.002	<0.002	0.0133	0.0244	<0.001	2
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02397	10-04-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020 #1	<0.001	3
		%REC							
		DUPL	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02398	10-07-E	CONC	<0.001	<0.002	0.0098	0.0830	0.101 #2	<0.001	4
		%REC							
		DUPL	<0.001	<0.002	0.0104	0.0870	A	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02399	10-08-E	CONC	<0.001	<0.002	0.0035	0.0338	0.0315	0.0012	5
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02400	10-09-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	6
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL	2,6-Dinitrotoluene	24DNTOL	2,4-Dinitrotoluene
TNT	Trinitrotoluene	RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	TNB	1,3,5-TRINITROBENZENE

FOOTNOTES:

#1 Concentrations less than estimated reporting limit.

#2 A - analyte could not be determined in this analysis.

JOB FILE: 02395 DATE: 19 MAY 89

********** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 2 OF 18)**********

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION									ROW
02401	10-17-E	CONC	0.0253	0.0032	0.974	1.37	0.673	#1	0.0431	7
		%REC								
		DUPL	0.0316	0.0044	0.981	1.42	A		0.0458	
		OID	00009131	00009131	00009131	00009131	00009131		00009131	
02402	10-18-E	CONC	<0.001	<0.002	0.0038	0.0830	0.135	#1	<0.001	8
		%REC								
		DUPL	<0.001	<0.002	0.0037	0.0867	A		<0.001	
		OID	00009131	00009131	00009131	00009131	00009131		00009131	
02403	10-19-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020		<0.001	9
		%REC								
		DUPL								
		OID	00009131	00009131	00009131	00009131	00009131		00009131	
02404	10-20-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020		<0.001	10
		%REC								
		DUPL								
		OID	00009131	00009131	00009131	00009131	00009131		00009131	
02405	10-23C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020		<0.001	11
		%REC								
		DUPL								
		OID	00009131	00009131	00009131	00009131	00009131		00009131	
02406	10-24P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020		<0.001	12
		%REC								
		DUPL								
		OID	00009131	00009131	00009131	00009131	00009131		00009131	

26DNTOL 2,6-Dinitrotoluene
24DNTOL 2,4-Dinitrotoluene
TNT Trinitrotoluene
RDX Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
TNB 1,3,5-TRINITROBENZENE

FOOTNOTES:
#1 A - analyte could not be determined in this analysis.

JOB FILE: 02395 DATE: 19 MAY 89

********** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 3 OF 18)**********

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION		1	2	3	4	5	6	ROW
02407	10-25C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	13
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02408	10-25P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	14
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02409	10-26P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	15
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02410	10-26P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	16
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02411	10-27P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	17
		%REC							
		DUPL	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02412	10-28C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	18
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL 2,6-Dinitrotoluene
24DNTOL 2,4-Dinitrotoluene
TNT Trinitrotoluene
RDX Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
TNB 1,3,5-TRINITROBENZENE

2-12. Black Powder

a. General. Black powder, the name originally applied to a mixture of charcoal, sulfur, and potassium nitrate, now applies also to compositions containing bituminous coal instead of charcoal, and sodium nitrate instead of potassium nitrate.

(1) Standard black powder contains 74.0 ± 1.0 percent potassium nitrate, 15.6 ± 1.0 percent charcoal, and 10.4 ± 1.0 percent sulfur. Its principal combustion products are CO_2, CO, N_2, K_2CO_3, K_2SO_4, and K_2S.

(2) The sodium nitrate black powder used for military purposes and blasting operations has the following composition:

	Percent
Sodium nitrate	72 ± 2
Charcoal	16 ± 2
Sulfur	12 ± 2

The grains of powder are glazed with graphite.

b. Characteristics. In appearance, black powder varies from a very fine powder to dense pellets. These may be black, or grayish-black because of a graphite-glazed surface.

(1) *Burning rate.* The type of charcoal used in manufacture of black powder is reflected by the burning rate of the powder. Black powder made from willow or alder charcoal burns much more rapidly than that made from oak charcoal. An increase in burning rate also results from confining black powder. Decrease in burning rate, on the other hand, is caused by the following:

(*a*) Increase in percentage of nitrate with corresponding decrease in percentage of charcoal.

(*b*) Presence of more than 0.2 percent of moisture.

(*c*) Simple mixing (rather than milling) of ingredients.

(*d*) Substitution of sodium nitrate for potassium nitrate.

(2) *Granulations.* Military black powder is manufactured in a range of grain sizes: from coarser than 4 mesh to finer than 200 mesh. Sodium nitrate black powder for military use is granulated in three classes: A, B and C, according to particle size. Military applications of sodium nitrate black powder include the following:

Powder class	*Use*
A	Saluting charges
B	Practice bombs
C	Torpedo impulse charges

(3) *Sensitivity.* Black powder is less sensitive than tetryl, but is very sensitive to ignition by flame, incandescent particles or electric spark. Black powder ignites spontaneously, for example, at about +300°C. (+540°F.). Sodium nitrate black powder is slightly less sensitive to impact than potassium nitrate black powder.

(4) *Stability and moisture absorption.* In the absence of moisture, black powder is highly stable. Its ingredients are essentially nonreactive with each other, even at +120°C. (+250°F.). Heating black powder above +70°C. (+160°F.) tends to vaporize the sulfur. This results in a change in composition or uniformity of composition. Black powder picks up moisture more because of the charcoal present than because of the moisture-absorbing nitrate. While moisture does not cause black powder to become unstable, it can react with and corrode such metals as steel, brass and copper. When sodium nitrate is substituted for potassium nitrate a composition is obtained that picks up moisture more readily than potassium nitrate black powder. Both black powders are comparable in stability.

c. Uses. Black powder finds application in ignition of rocket and missile propulsion units, primers, delay elements, bursting charges, saluting charges, spotting charges, expelling charges, bursters, igniters, smoke-puff charges and catapult charges. Other uses include the following:

(1) *Ignition.* Black powder is used for ignition charges for smokeless powder. The grains are glazed with graphite. Burning of black powder produces many finely divided, incandescent solid particles. These make black powder a better igniting material for smokeless powder than finely divided smokeless powder itself.

(2) *Fuzes.* Black powder is used for loading the time-train rings of fuzes. The grains of fuze powder are not glazed with graphite. Because fuze powder having the standard composition burns too rapidly for use in some fuzes, a slow-burning powder is used having the following composition:

	Percent
Potassium nitrate	70.0 ± 1.0
Semibituminous coal	14.0 ± 1.0
Sulfur	16.0 ± 1.0

Like fuze powders having the standard composition, slow-burning fuze powders is not glazed with graphite.

(3) *Special fuses.* Black powder used in manufacture of time blasting or safety fuse may have the standard black powder composition, be a modification of the proportions of the ingredients of this, or contain such inert diluents as graphite, brick dust or borax. The most common type of fuse burns at a rate of about 1 foot in 40 seconds.

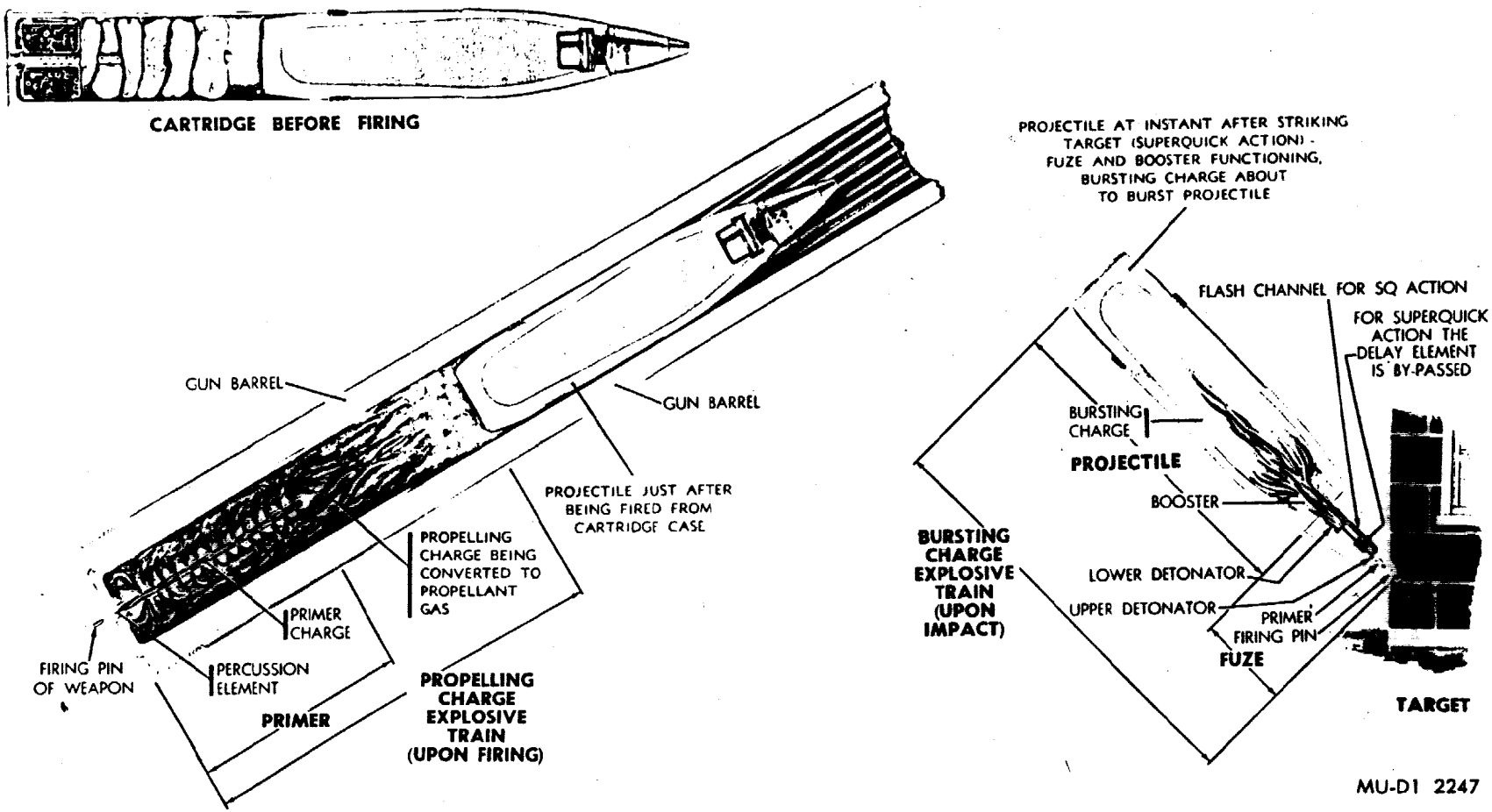


Figure 2-6. Explosive trains—artillery ammunition.

(4) *Squibs.* Squibs for military use are caused to function by heat developed by an electrical resistance wire. This may ignite a charge of either potassium nitrate or sodium nitrate black powder, or an ignition composition, and, in turn, the main charge of black powder. In some cases, the black powder charge is ignited by a matchhead composition.

d. Precautions. Black powder, which is very sensitive to friction, heat and impact, is one of the most dangerous explosives to handle. It will deteriorate rapidly on absorption of moisture but retains its explosive properties indefinitely if kept dry. Black powder may be desensitized by placing it in water. Discarding the water separately from the residue, however, permits wet black powder to dry out and regain some of its explosive properties. Combustible materials which have absorbed liquids leached from black powder constitute a severe fire hazard and may become explosive.

2-13. Black Powder Substitutes

a. Benite. Benite is used in igniter compositions of artillery primers or in base igniter bags for separate-loading ammunition. Benite takes the form of extruded strands of black powder (KNO_3, charcoal, sulfur) embedded in nitrocellulose.

b. Eimite. Eimite is another substitute for black powder in artillery primers. When used in initiating type elements, delays and similar components, eimite takes the form of solid granulation.

c. Boron-Potassium Nitrate. Boron-potassium nitrate is used in many ignition applications. As an igniter composition, it is used in granular form, or as pellets. Its function in a delay element is to ignite and set off the rest of the explosive train at a predetermined time.

d. Mox-Type Mixtures. Mox-type mixtures are filler explosives, not igniter materials. Although classified as explosives, these mixtures are used for specialized applications. The most common mixture, MOX 2B, is used as a spotting charge in place of black powder. Unlike other filler explosives, MOX 2B was developed commercially.

2-14. Pyrotechnic Compositions

a. General. Standard military pyrotechnic compositions consist of such compounds as perchlorates and nitrates to provide oxygen; powdered metals for fuel; salts of sodium, barium or strontium for color; and binding and waterproofing materials. These compositions are sensitive to heat, flame, static electricity discharges and, particularly, to friction. Those containing chlorates are especially hazardous as regards to fires and explosions. Because they contain powdered metals, pyrotechnic compositions may become hazardous in the presence of moisture.

b. Main Charge Pyrotechnic Compositions.

(1) The earliest pyrotechnic compositions consisted of varying constituents of black powder: charcoal, sulfur and niter (potassium or sodium nitrate). Other materials, such as iron filings, coarse charcoal or realgar (arsenic sulfide), were added to produce special effects. Many other materials were added or substituted as additional knowledge was acquired.

(2) Present-day pyrotechnic compositions generally consist of various chemicals. In some cases, a single material may perform more than one of the functions in (*a*) through (*f*) below.

(*a*) Oxidizers, such as chlorates, perchlorates, peroxides, chromates and nitrates, provide oxygen for burning. Additional oxygen may be obtained from the air. Nongaseous powders, such as barium chromate-boron mixtures, which do not require oxygen from the air, are used in delay columns.

(*b*) Fuels, such as aluminum and magnesium powder, their alloys, sulfur, lactose and other easily oxidizable materials.

(*c*) Combustible binding and waterproofing agents, such as shellac, linseed oil, resins resinates and paraffin.

(*d*) Color intensifiers, such as polyvinyl chloride, hexachlorobenzene or other organic chlorides, mixed with barium and copper salts to produce green, or with strontium salts to produce red.

(*e*) Dyes, such as methylaminoanthraquinone to produce red, and auramine to produce yellow.

(*f*) Coolants, such as magnesium carbonate and sodium bicarbonate.

(3) Pyrotechnic smoke compositions are of two general types:

(*a*) Those that burn with practically no flame but give off a dense, colored smoke as a combustion product.

(*b*) Those that burn at a temperature so low that an organic dye ((2)(*e*), above) in the composition will volatilize instead of burn and therefore, color the smoke.

(4) A friction igniter consists of a primer cup and a ripple wire. The primer cup contains a mixture of potassium chlorate, charcoal and dextrin binder. The ripple wire is coated with red phosphorus in shellac and has a nitrocellulose coating. The wire extends through the primer cup.

(5) Quickmatch is a term applied to strands of cotton soaked in a mixture of black powder and gum Arabic and coated with mealed powder. It is used as an initiator to transmit flame to igniting, priming or pyrotechnic charges.

(6) The priming charge is a dried black powder paste in intimate contact with the first-fire composition. Newer pyrotechnic items use a special nonhygroscopic priming paste containing barium nitrate, zirconium hydride, silicon, tetranitrocarbazole and a plastic binder.

(7) The first-fire composition is generally a mechanical mixture of illuminant charge and black powder. However, for certain items, it may be a special nonhygroscopic, easily ignitable composition that burns with a higher temperature.

c. Characteristics. Pyrotechnic compositions are generally compressed into definite shapes or forms. On ignition and combustion, these compositions produce considerable light and decompose or burn by a process known as deflagration. Functional characteristics of pyrotechnic compositions include candlepower, burning rate, color, color value and efficiency of light production. Other important characteristics are sensitivity to impact and friction, ignitibility, stability and water absorption. Table 2-1 shows burning performance characteristics of black powder, nitrocellulose composition and pyrotechnic compositions.

d. Uses. Pyrotechnic compositions are used in items of ammunition to produce, through chemical reaction, a desired effect or combination of effects, such as light (instantaneous or continuous), smoke, heat, noise, delay timing and gas pressure. These items are used for such purposes as signaling, illumination, simulation of battlefield effects, warning, marking, tracking, screening, igniting, and incendiary effects. Pyrotechnic items produce their effect by burning and are consumed in the process. The effect produced generally falls into one of the following pyrotechnic classes:

(1) *Photoflash cartridges.* These produce a single flash of light for photographic purposes.

Table 2-1. Characteristics of Low Explosives

	Burning rate		Heat liberated	Temperature developed
	In minutes	In seconds	Cal/GM	°C.
Pyrotechnic compositions	2-14	----	500-2,500	800-3,500
Black powder	----	4	655	2,700
Nitrocellulose compositions	----	7-12	700-1,300	1,700-3,300

(2) *Flares.* A flare produces illumination, generally of high candlepower and substantial duration. Flares may be parachute supported, towed or stationary, while their primary function is illumination, they may be used for identification, ignition, locating, or warning.

(3) *Signals.* There are two types of effects obtained with signals: light and smoke. A particular model may produce both effects. Light producing signals are much smaller and faster burning than flares. They may consist of a single parachute-supported star or one to five freely falling stars, with or without colored tracers. Smoke signals are of either the slow-burning, streamer type, which leaves a trail of smoke, or the parachute-suspended type, which produces a cloud of smoke.

(4) *Simulators.* Simulators, which duplicate battle sounds and flashes of light produced by service items of ammunition, are designed for use in training.

(5) *Miscellaneous types.* Pyrotechnics other than those in (1) through (4), above, have a variety of uses.

(*a*) In illuminating artillery ammunition, the pyrotechnic elements are assembled in artillery projectile bodies. The projectiles are used in conjunction with other artillery ammunition (TM 9-1300-203).

(*b*) Smoke grenades have the form of high-explosive hand and rifle grenades but resemble smoke signals in effect (TM 9-1330-200).

e. Precautions. Pyrotechnic compositions contain materials of a hazardous nature. Although the ingredients themselves may be relatively stable, any one of them may, in time, react with

one or more of the other materials in the mixture to cause detonation. Some pyrotechnic compositions (mixtures) may become more sensitive because of exposure to moisture. Mixtures are sensitive to heat, flame, friction and static electrical discharges from the human body.

Section IV. HIGH EXPLOSIVES

2-15. General

High explosives are usually nitration products of such organic substances as toluene, phenol, pentaerythritol, amines, glycerin, and starch. Otherwise, high explosives may be nitrogen-containing inorganic substances or mixtures. A high explosive may be a pure compound or an intimate mixture of several compounds with additives, such as powdered metals (aluminum), plasticizing oils, waxes, etc., which impart desired stability and performance characteristics. A high explosive is characterized by the extreme rapidity with which its decomposition occurs. This is known as detonation. When initiated by a blow or shock, high explosives will decompose almost instantaneously, either in a manner similar to extremely rapid combustion or with rupture and rearrangment of the molecules themselves. In either case, gaseous and solid products of reaction are produced. The disruptive effect of the reaction makes some explosives valuable as a bursting charge but precludes their use as a propellant. This is due to the fact that the gases formed would develop excessive pressures that might burst the barrel of the weapon.

a. Terms and Definitions.

(1) *Primer.* A primer is a relatively small and sensitive initial explosive train component which, on being actuated, initiates functioning of the explosive train. The primer itself will not reliably initiate high-explosive charges. In general, primers are classified by method of initiation, such as percussion, stab, electric, friction, chemical, etc.

(2) *Detonator.* A detonator is an explosive train component that can be activated by a nonexplosive impulse or action of a primer. A detonator is capable of reliably initiating secondary high-explosive charges. When activated by a nonexplosive impulse, a detonator includes the function of a primer. In general, detonators are classified, according to the method of initiation, as percussion, stab, electric, friction, flash, chemical, etc.

(3) *Igniter.* An igniter is definable as follows:

(*a*) A device containing a composition, usually in the form of black powder, which burns readily. Such an igniter is used to amplify initiation of a primer in functioning of a fuze.

(*b*) A device containing a spontaneously combustible material, such as white phosphorus, used to ignite fillings of incendiary bombs and flamethrower fuels at the time of dispersion or rupture of the bomb casing.

(*c*) A device used to initiate burning of the fuel mixture in a rocket combustion chamber.

(4) *Delay.* A delay is an explosive train component that introduces a controlled time delay in functioning of the train.

(5) *Relay.* A relay is an element of a fuze explosive train that augments an otherwise inadequate output of a prior explosive component. Thus, a relay reliably initiates a succeeding train component. Relays, in general, contain a small single explosive charge, such as lead azide, and are not usually employed to initiate high-explosive charges.

(6) *Lead.* A lead is an explosive train component that consists of a column of high explosive usually small in diameter. A lead transmits detonation from one detonating component to a succeeding high-explosive component. It is generally used to transmit detonation from a detonator to a booster charge.

(7) *Booster charge.* A booster charge is the final high-explosive component of an explosive train that amplifies the detonation from the lead or detonator. Thus, a booster charge reliably detonates the main high-explosive charge of the munition.

(8) *Fuze explosive train.* A fuze explosive train is an arrangement of a series of combustible and explosive elements consisting of a primer, a detonator, a delay, a relay, a lead and a booster charge, one or more of which may be either omitted, or combined. The explosive train serves to accomplish controlled augmentation of a relatively small impulse into one of sufficient energy to cause the main charge of the munition to function.

(9) *Primer compositions.* A primer composition is an explosive that is sensitive to a blow such as that imparted by a firing pin. A primer composition transmits shock or flame to another explosive, a time element or a detonator. Most mil

itary priming compositions consist of mixtures of one or more initial detonating agents, oxidants, fuels, sensitizers and binding agents. Many compositions contain potassium chlorate, lead thiocyaate, calcium silicide, antimony sulfide, lead azide, lead styphnate, mercury fulminate and a binding agent. The potassium chlorate acts as an oxidizing agent; the lead thiocynate and calcium silicide act as the fuel, and as desensitizer to the chlorate; and the explosive acts as the detonating agent. Other materials, such as ground glass and carborundum, may be added to increase sensitivity to friction. Priming compositions for electic primers and squibs may contain barium nitrate as the oxidizing agent instead of potassium chlorate, and lead styphnate or DDNP (diazodinitrophenol) as the initiating explosive. Primer mixtures are used in percussion elements of artillery primers, in fuzes and in small-arms primers, and as the upper layer of a detonator assembly.

(10) *Bursting charge.* This is an encased explosive designed to break the metal casing into small fragments.

b. High-Explosive Train. An explosive train is a means by which a small amount of energy is built up sufficiently to assure a high-order detonation for a bursting charge. Fundamentally, an explosive train consists of a detonator, booster and bursting charge. This sequence is often interrupted by a delay or relay. The example of a 2,000-pound bomb filled with TNT, with a fuze of the firing pin type, illustrates the principle of the explosive train. The TNT by itself will not detonate from release of the firing pin. This is so because the initial source of energy, a friction or percussion effect of the firing pin, is insufficient and must be stepped up to where it will detonate the TNT. This is always accomplished by means of an explosive train, as follows:

(1) When initiated by stab action of a firing pin or by a flame, the detonator sets up a high-explosive wave. This wave is so small and weak that it will not initiate a high-order detonation in the bursting charge unless a booster is placed between the two. The booster picks up the small explosive wave from the detonator and amplifies it. The bursting charge is thus initiated and a high-order detonation results (fig. 2-6 and 2-7).

(2) To gain control of the time and place at which an explosive will function, it is necessary to

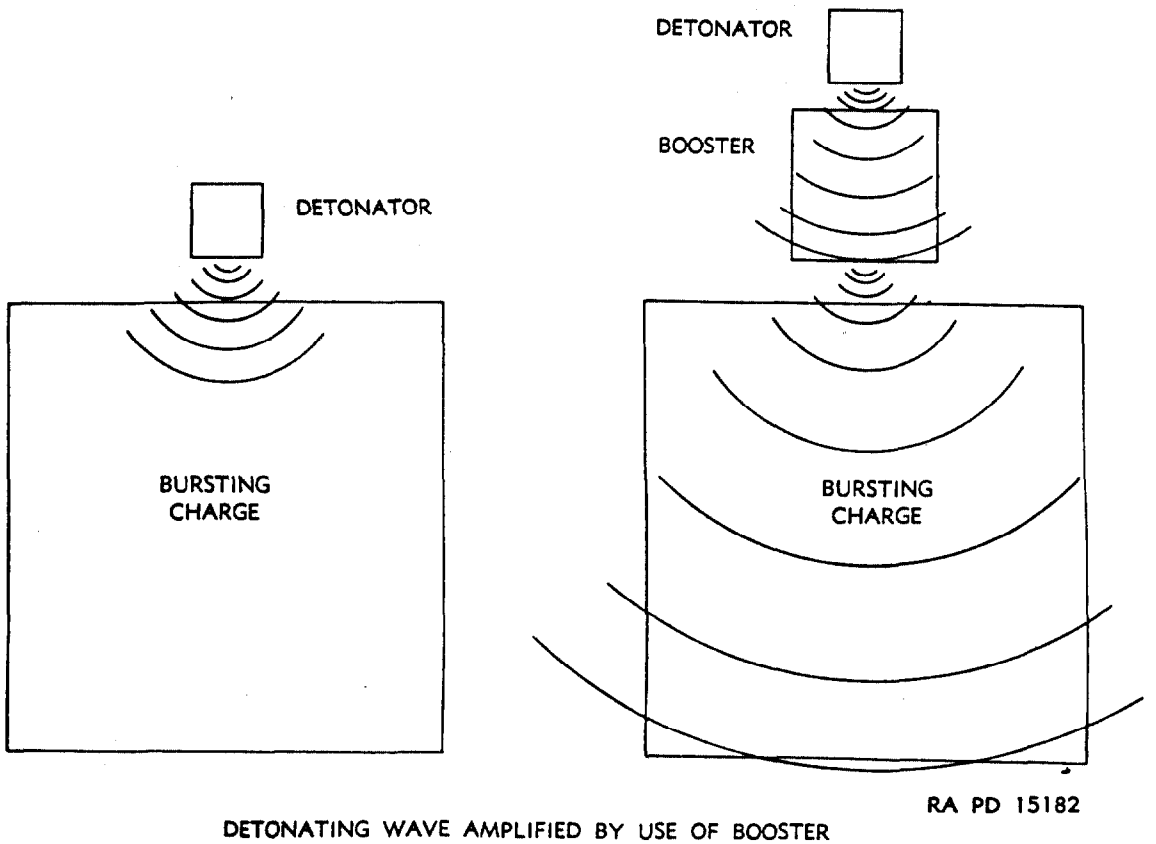


Figure 2-7. Detonating wave amplified by use of a booster.

incorporate other components in a high-explosive train. The action desired may be a burst in the air, a burst instantly upon impact with the target, or a burst shortly after the projectile has penetrated the target. The components to give these various actions may be a primer, a black powder delay pellet or train, an upper detonator or any combination of these components. Arrangement of the components does not change the basic chain. Other components are simply placed in front of the basic chain (fig. 2-8).

(3) Placing a primer and a black powder time train in front of the basic chain causes a projectile to burst in air. When the projectile leaves the weapon (or the bomb is dropped), the primer ignites the time-train rings. After the time-train rings burn the requisite time, the primer initiates action of the detonator, booster and bursting charge (schemes A and C, fig. 2-8).

(4) To burst the projectile promptly upon impact with the target, a superquick or instantaneous action is necessary. This action is usually obtained by placing an upper detonator in the extreme front of the fuze, and lower detonator in the body near the booster charge. The detonating wave is thus transmitted instantly to the bursting charge (scheme D, fig. 2-8).

(5) To permit the projectile to penetrate the target, a delay action is necessary. This is obtained by placing a primer and delay element ahead of the detonator. In some cases, this combination of primer and delay is inserted between an upper and lower detonator (scheme E, fig. 2-8).

(6) A variation of the high-explosive train is found in chemical projectiles. In this train, there is no large bursting charge as in high-explosive projectiles. It is only necessary to rupture the projectile and allow the chemical contents to escape. Actual bursting of the projectile is accomplished by an enlarged booster, known as a burster charge, contained in a tube running through the center of the projectile.

2-16. Classification

High explosives are classified according to their sensitivity as initiating, booster and bursting explosives.

a. Initiating. Initiating high explosives are extremely sensitive to shock, friction and heat. Under normal conditions, they will not burn, but will detonate if ignited. Their strength and brisance are inferior, but are sufficient to detonate high explosives. Because of their sensitivity, they are used in munitions for initiating and intensifying high-order explosions. Mercury fulminate, lead azide, lead styphnate and diazodinitrophenol are examples of such explosives.

b. Booster. Explosives of this type include tetryl, PETN and RDX. They have intermediate sensitivity between initiating explosives and explosives used as bursting charges. Booster explosives may be ignited by heat, friction or impact and may detonate when burned in large quantities.

c. Bursting. Bursting explosives include explosive D, amatol, TNT, tetryl, pentolite, picratol, tritonal, composition B, DBX, HBX and others.

2-17. Demolition and Fragmentation Explosives

a. Tetryl.

(1) *Characteristics.* Tetryl 2, 4, 6-trinitrophenylmethylnitramine is a fine yellow crystalline material. When heated, it melts, decomposes and then explodes. It burns rapidly, is more easily detonated than TNT or ammonium picrate (explosive D) and is much more sensitive than picric acid. It is detonated by friction, shock or spark. It is insoluble in water, practically nonhygroscopic. Tetryl is stable at all temperatures that may be encountered in storage. It is toxic when taken internally; on contact, it discolors skin tissue (resembles tobacco stain) and causes dermatitis.

(2) *Detonation.* Brisance tests show tetryl to have a very high shattering power. Tetryl is greater in brisance than TNT and is exceeded in standard military explosives only by PETN and RDX.

(3) *Uses.*

(a) *Charges.* Tetryl is the standard booster explosive and is sufficiently insensitive when compressed to be used safely as a booster explosive. Violence of its detonation assures a high-order detonation of the bursting charge. Tetryl is used in the form of pressed pellets. It is the standard bursting charge for small-caliber (20-mm and 37-mm) projectiles. It produces appreciably better fragmentation of these projectiles than TNT. It is also more readily detonated, and yet, in small-caliber cartridges, withstands the force of setback in the weapon. It is also a constituent of tetrytol.

(b) *Detonator.* When it is used in detonators, tetryl is pressed into the bottom of the detonator shell and covered with a small priming charge of mercury fulminate, lead azide or other initiator.

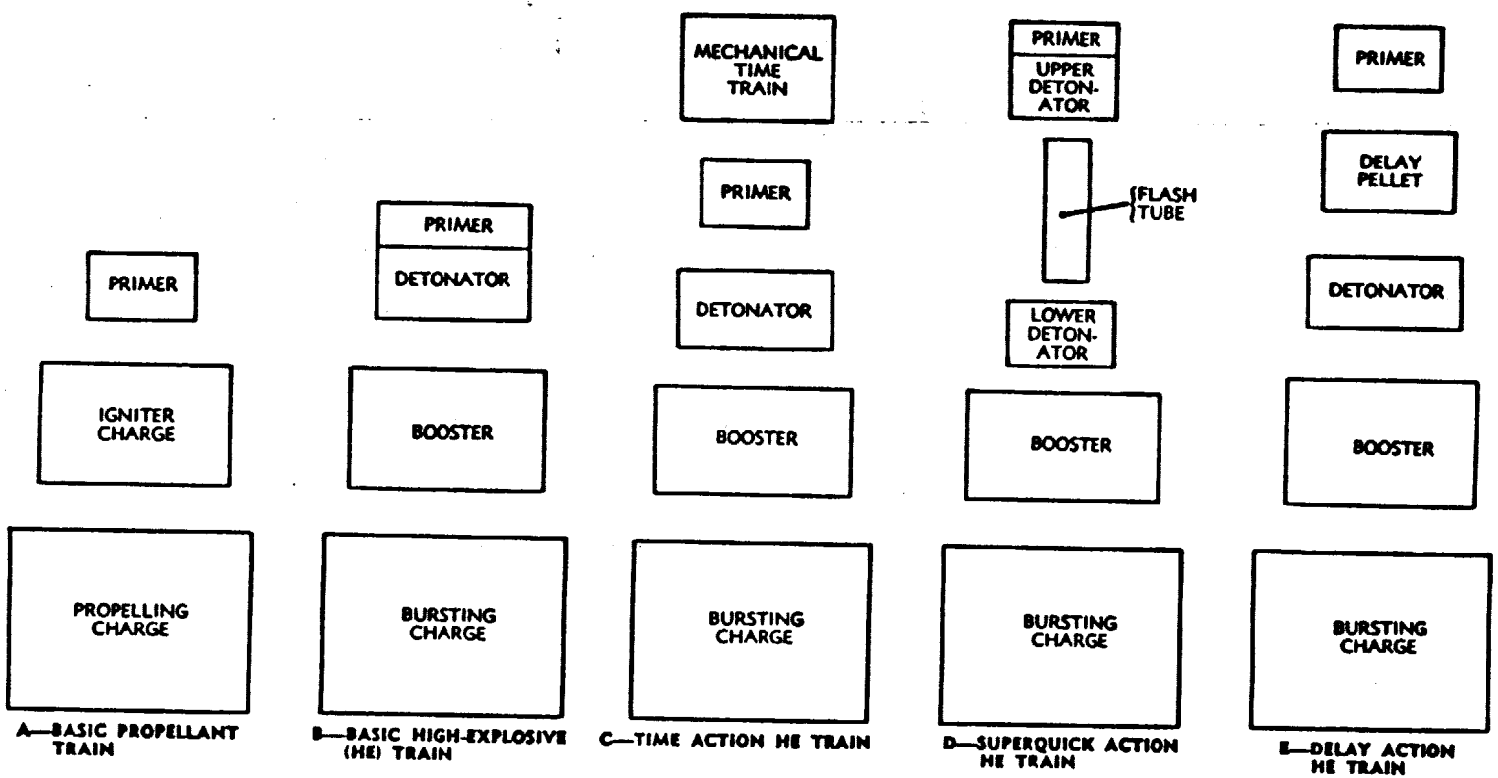


Figure 2-8. Schematic arrangement of explosive train components.

b. PETN (Pentaerythritol Tetranitrate). PETN is one of the strongest high explosives known. It is more sensitive to shock or friction than TNT or tetryl. In its pure form, PETN is a white crystalline powder; however, it may turn light gray from impurities. It will detonate under long, slow pressure. PETN in bulk must be stored wet. Its primary use is in booster and bursting charges in small-caliber ammunition; in upper detonators in some land mines and projectiles; and as the explosive core of primacord detonating fuze. It may be issued in sheet form. Suspended in TNT, with which it forms a pentolite explosive of high brisance.

c. RDX. RDX, cyclotrimethylenetrinitramine, one of the most powerful explosives, is commonly known as cyclonite; hexogen (German); T4 (Italian); and Tanoyaku (Japanese). It is a white crystalline solid having a melting point of +202°C. (+397°F.) and is very stable. It has slightly more power and brisance than PETN. It is more easily initiated by mercury fulminate than is tetryl. RDX has been used mainly in mixtures with other explosives, but can be used by itself as a subbooster, booster, and bursting charge. It is also combined with nitrohydrocarbons, which permit cast-loading, or with waxes or oils for press-loading. It has a high degree of stability in storage.

d. TNT (Trinitrotoluene). The 2, 4, 6–trinitrotoluene, commonly known as TNT, is a constituent of such explosives as amatol, pentolite, tetrytol, tritonal, picratol and composition B.

(1) *Characteristics.* TNT in a refined form is one of the most stable of high explosives. It is relatively insensitive to blows or friction and can be stored for long periods of time. Confined TNT, when detonated, explodes with violence. When ignited by a flame, unconfined TNT burns slowly, does not explode, and emits a heavy, oily, black smoke; however, burning or rapid heating of large quantities, especially in closed vessels, may cause a violent detonation. TNT is nonhygroscopic and does not form sensitive compounds with metals. It is, however, readily acted upon by alkalies to form unstable compounds that are very sensitive to heat and impact. TNT usually resembles a light brown sugar; in the pure state, it is crystalline and nearly white. When melted and poured into a projectile or bomb, it forms a solid crystalline explosive charge. TNT is a very satisfactory military explosive. The melting point of standard grade 1 TNT is 80.2°C. (+176°F.). Ammunition loaded with TNT can be stored, handled, and shipped with comparative safety.

(2) *Exudation.* When stored in warm climates or during warm summer months, some ammunition loaded with TNT may exude an oily brown liquid. This exudate oozes out around the threads at the nose of the projectile and may form a pool on the floor. The exudate is flammable and may contain particles of TNT. Pools of exudate should be removed.

(3) *Detonation.* TNT in crystalline form can be detonated readily by a No. 6 blasting cap or, when highly compressed, by a No. 8 blasting cap. Cast TNT requires a booster charge of compressed tetryl or an explosive of similar brisance to assure complete detonation.

(4) *Uses.*

(*a*) *Bursting charge.* TNT is used as a bursting charge for high-explosive rounds and bombs, either alone or in a mixture, such as tritonal or composition B. TNT is also used in mines and for parts of certain rounds and bomb bursters. Flake TNT is used in fragmentation hand grenades.

(*b*) *Demolition.* TNT is used to demolish bridges, railroads, fortifications and other structures. For such purposes, it is used in the form of a large shaped charge or a small, highly compressed block inclosed in a waterproof fiber container. This protects the TNT from crumbling in handling. Triton blocks used by the Corps of Engineers are of pressed TNT inclosed in cardboard containers.

(*c*) *Blasting.* TNT is suitable for all types of blasting. It produces approximately the same effect as an equal weight of dynamite of 50 to 60 percent grade. TNT is also used as a surround in some amatol-loaded ammunition.

e. Amatol.

(1) *General characteristics.* Amatol, a mixture of ammonium nitrate and TNT in various percentages, has the same general characteristics as TNT. Amatol is crystalline, yellow or brownish and insensitive to friction. However, it may be detonated by severe impact. It is less sensitive to detonation than TNT, but is readily detonated by mercury fulminate and other detonators. Amatol is hygroscopic and, in the presence of moisture attacks copper, brass and bronze, forming dangerously sensitive compounds. Amatol 50/50 has approximately the same rate of detonation and brisance as TNT, while 80/20 amatol is slightly lower in velocity and brisance than TNT. Amatol

80/20 produces a white smoke on detonation, and amatol 50/50 produces a smoke less dark than straight TNT.

(2) *Composition and form.* Amatol 50/50 consists of 50 percent ammonium nitrate and 50 percent TNT by weight. When hot, amatol is sufficiently fluid to be poured or cast like TNT. Amatol 80/20 consists of 80 percent ammonium nitrate and 20 percent TNT. It resembles wet brown sugar. When hot, it becomes semiplastic (like putty) and can be pressed into rounds and bombs.

(3) *Uses.* Amatol is a substitute for TNT. Except for 80/20 amatol, amatols are obsolete. The primary use of 80/20 amatol is in bangalore torpedoes.

f. Picric Acid (Trinitrophenol).

(1) *General.* Picric acid, 2, 4, 6-trinitrophenol, a nitrated product of phenol under the name of melinite, was adopted as a military high explosive by the French in 1886. It has been used more extensively as a military explosive by foreign nations than by this country. The British designate it as lyddite.

(2) *Characteristics.* Picric acid is a lemon-yellow crystalline solid. It is stable but reacts with metals when moist, in some cases forming extremely sensitive compounds. Picric acid is more readily detonated by means of a detonator than TNT but has about the same sensitivity to shock. It is not so toxic as TNT. Although slightly soluble in water, picric acid is nonhygroscopic. Picric acid has a high melting point—approximately +122°C. (+251.6°F.).

g. Ammonium Picrate (Explosive D).

(1) *Characteristics.* Ammonium picrate is the least sensitive to shock and friction of all military explosives. This makes it well suited for use as a bursting charge in armor-piercing projectiles. A product of picric acid, it is slightly inferior in explosive strength to TNT. When heated, it does not melt but decomposes and explodes. It reacts slowly with metals; however, when wet, it may form sensitive and dangerous compounds with iron, copper and lead. It is difficult to detonate. When ignited in the open, it will burn readily like tar or resin.

(2) *Special precautions.*

(*a*) Ammonium picrate removed from a round is much more sensitive to shock or blow than fresh ammonium picrate. In contact with lead, iron or copper it forms sensitive compounds.

(*b*) Although less sensitive than TNT, ammonium picrate can be exploded by severe shock or friction. It is highly flammable and may detonate when heated to a high temperature.

(3) *Uses.* Explosive D is used as a bursting charge for armor-piercing rounds and in other types of projectiles that must withstand severe shock and stress before detonating.

h. Picratol. Picratol is a mixture of 52 percent explosive D and 48 percent TNT. It can be poured like straight TNT and has approximately the same resistance to shock as straight explosive D. The brisance of picratol is between that of explosive D and TNT. Picratol is nonhygroscopic. Picratol is a standard filler employed for all Army semi-armor-piercing bombs.

i. Pentolite. Pentolite, a 50/50 mixture of PETN and TNT also known as pentol (German) and pentritol, has largely been displaced by composition B. Pentolite should not be drilled to form booster cavities; forming tools should be used. It is superior to TNT in explosive strength and is less sensitive than PETN. Pentolite may be melt-loaded and is satisfactory for the following uses:

(1) As a bursting charge in small-arms ammunition (e.g., 20-mm).

(2) In shaped-charge ammunition of many types (e.g., antitank, rifle grenades and bazookas).

(3) In some ammunition, as a booster or booster-surround.

(4) In rockets and shaped demolition charges.

j. Tetrytol. Tetrytol is a uniform mixture of 65 to 75 percent tetryl and the remainder TNT. Tetrytol has higher brisance than TNT and is more effective in cutting through steel and in demolition work. It is less sensitive to shock and friction than tetryl and only slightly more sensitive than TNT. Tetrytol is nonhygroscopic and is suitable for underwater demolition, since submergence for 24 hours does not appreciably affect its characteristics. Tetrytol is used in chain and individual demolition blocks and in certain destructors. Tetrytol is stable in storage but exudes at +65°C. (+149°F.).

k. Nitrostarch Explosives.

(1) *Characteristics.* Nitrostarch is nitrated starch. Obtained from corn, tapioca and similar starchy material, it is used to sensitize combustibles and oxidizing agents in much the same manner that nitroglycerin is used in dynamite. It

is gray, highly flammable, can be ignited by the slightest spark, and burns with explosive violence. Nitrostarch is less sensitive than dry guncotton or nitroglycerin. As a demolition explosive, it is as insensitive to impact as explosive D and as sensitive to initiation as TNT. Nitrostarch explosives are readily detonated by a No. 6 blasting cap.

(2) *Uses.* A nitrostarch demolition explosive has been adopted as a substitute for TNT. It is available in 1-pound blocks, ½-pound blocks, and ¼-pound units. Each ¼-pound unit contains three 1/12-pound pellets (briquets) wrapped in paraffined paper, with markings to indicate the location of holes for the blasting caps. TNT formulas for computing small charges are directly applicable to the nitrostarch demolition explosive. It should be noted that fragmented blocks may cause detonation.

l. Dynamite. Commercial blasting explosives, with the exception of black powder, are referred to as dynamite. There are several types, each subdivided into a series of grades, all differing in one or more characteristics. Dynamite consists essentially of nitroglycerin absorbed in a porous material. Each composition generally is designated as straight, ammonia, gelatin or ammonia-gelatin dynamite. It is available in paraffin-coated, ½-pound sticks or cartridges, rated according to the percent, by weight, of nitroglycerin content.

(1) *Characteristics.* Dynamite of from 50-percent to 60-percent nitroglycerin content is equivalent (on an equal weight basis) to TNT in explosive strength. Dynamite of 40-percent nitroglycerin content is equivalent to TNT in the ratio of 1¼ pounds dynamite to 1 pound TNT. Straight dynamite is more sensitive to shock and friction than TNT and is capable of being detonated by a rifle bullet. Generally, the higher percentages of dynamite have very good water resistance. Explosion of the common types of dynamite produces poisonous fumes, which are dangerous in confined places. Dynamite, as well as other nitroglycerin explosives, is adversely affected by extreme cold. Nonfreezing dynamite (NG type) freezes at —30°C. (—22°F.); low-freezing dynamite freezes at 0°C. (+32°F.); and 60-percent NG dynamite freezes at +10°C. (+50°F.).

(2) *Uses.* Dynamite is used as a substitute for nitrostarch or TNT for training purposes. It is also employed by the Corps of Engineers for trench, harbor, dam, flood control, and mining demolitions. The following restrictions apply:

(*a*) Not to be issued or used for destruction of duds.

(*b*) Not to be supplied for training in use of demolition equipment.

(*c*) Not to be used in coastal defense submarine mines or mine batteries.

(*d*) Not to be carried in combat vehicles subject to extremes of temperature.

m. Tritonal. Tritonal is a generic term for explosives containing TNT and powdered aluminum, generally in the ratio of 80/20. Because of the aluminum powder, inclusion of moisture in the mixture must be avoided. Tritonal is used in light-case and general purpose bombs. It produces a greater blast effect than TNT or composition B.

n. HBX. HBX compositions (HBX-1, HBX-3, and H6) are aluminized (powdered aluminum) explosives used primarily as a replacement for the obsolete explosive, torpex. They are employed as bursting charges in mines, depth bombs, depth charges, and torpedoes. HBX-1 consists of 40 percent RDX, 38 percent TNT, 17 percent aluminum and 5 percent desensitizer. HBX-3 consists of 31 percent RDX, 29 percent TNT, 35 percent aluminum, and 5 percent desensitizer. H-6 consists of 45 percent RDX, 30 percent TNT, 20 percent aluminum, and 5 percent desensitizer. HBX-1 compares with torpex in brisance, but is less sensitive to impact and initiation. HBX-3 and H-6 have lower sensitivity to impact and much higher explosion test temperatures than torpex.

o. Composition A. Originally, composition A was a semiplastic mixture containing 91 percent RDX and 9 percent beeswax. When the beeswax was replaced by a wax derived from petroleum, and the method of adding the desensitizer changed, the designation was changed to composition A-2. Recently, the composition has been redesignated as composition A-3, because of changes in granulation of RDX and method of manufacture. Composition A-3 is granular in form, resembling tetryl in granulation. It is usually buff colored and is press-loaded in 20-mm, 37-mm and 40-mm cartridges. It is 30 percent stronger than TNT, its strength depending on the amount of wax binder. It is used as a filler for HEP rounds.

p. Composition B. Composition B (comp B) is a 60/39/1 mixture of RDX, TNT and desensitizer. Its color varies from dirty white to light yellow to brownish yellow. It is less sensitive than tetryl but more sensitive than TNT. It is intermediate between TNT and RDX with respect to sensitivity

and initiation. It is only inferior to tritonal and torpex with respect to blast effect. Composition B is an authorized filler for Army-Navy (AN) standard aircraft bombs, mines, torpedoes, antitank artillery ammunition (76-mm and 105-mm), demolition charges and rockets. Composition B containing 60 percent RDX and 40 percent TNT, exclusive of wax, is known as composition B2, a nonstandard explosive. Because of its greater sensitivity to impact, composition B2 is less suitable than composition B for use in bombs. Composition B4, used as a burster in chemical projectiles, consists of a 60/39.5/0.5 mixture of RDX, TNT and calcium silicate.

q. Composition C (Series).

(1) *General.* Composition C, sometimes referred to as PE, is a plastic explosive, an 88/12 mixture of RDX and a nonexplosive plasticizer composition. It is brown, plastic in form, and about the consistency of putty. It has a tendency to leach (sweat) out plasticizing oils, leaving pure RDX, which is too sensitive for use in the field.

(2) *Composition C2.* This putty-like composition is an 80/20 mixture of RDX and an explosive plasticizer composition. It is approximately 35 percent stronger than TNT, and was developed as a replacement for composition C as a demolition charge.

(3) *Composition C3.* This is a yellowish, putty-like mixture of 77 percent RDX and 23 percent of an explosive plasticizer. It is slightly inferior to composition B as an explosive for producing blast effect, and is considerably less sensitive than TNT. It may not always be detonated by a No. 8 blasting cap, but can be detonated by the special Corps of Engineers blasting cap. It was designed to replace Composition C2, and is used principally as a commando and demolition explosive or as a filler in some types of munitions. If its plasticity is lost by long storage at low temperatures, it may be restored to satisfactory plasticity by immersion in warm water and molding with the hands. It must not be exposed to open flame, as it catches fire easily and burns with an intense flame. If burned in large quantities, the heat generated may cause it to explode. Its explosion produces poisonous gases in such quantities that its use in closed spaces is dangerous. It is hygroscopic, volatile at elevated temperatures and hardens at temperatures below —29°C. (—20°F.).

(4) *Composition C4.* This is a 91/9 mixture of RDX and plastic nonexplosive composition. It is a semiplastic, putty-like material, dirty white to light brown in color, less sensitive, more stable, less volatile, and more brisant than composition C3. It is a nonhygroscopic material that has found application in demolition blocks and specialized uses. It hardens below —57°C. (—70°F.) and exudes when stored above +77°C. (+170°F.).

r. HMX (Cyclotetramethylene tetranitramine) is almost as powerful as RDX, but is seldom used by itself in military explosive applications. It is usually mixed with a compound, such as TNT. Variations of such compositions, their properties and uses follows:

(1) Octol 70/30 (70% HMX/30% TNT)

(2) Octol 75/25 (75% HMX/25% TNT)

(3) HTA-3 (49% HMX/29% TNT/22% Aluminum)

(4) Both octols and HTA-3 are used for HE filler in projectiles and bombs.

2-18. Initiating and Priming Explosives

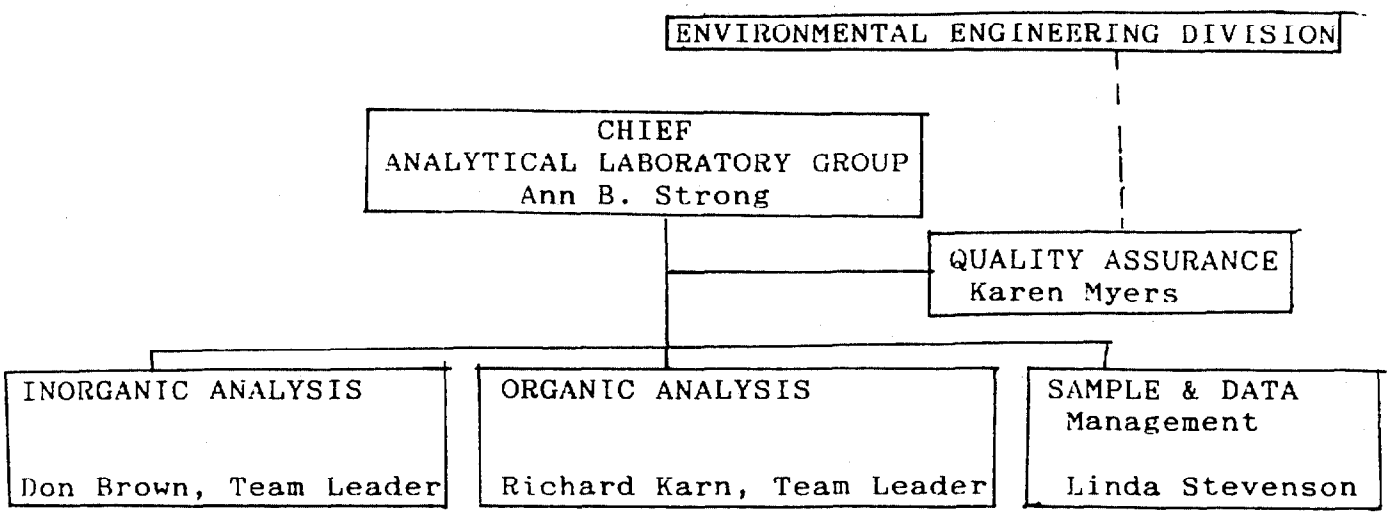
a. Lead Azide. Lead azide, one of the most stable initiators, is used to detonate high explosives. Because of its superior properties, it has replaced mercury fulminate. Lead azide flashes at much higher temperatures, stands up better in storage, and is less hazardous to manufacture. A smaller amount of lead azide is required than mercury fulminate to detonate an equal amount of TNT. Dextrinated lead azide (93% lead azide, 4% lead hydroxide and 3% dextrin and impurities), used for military purposes rather than crystalline (pure) lead azide, is a white-to-beige, powder-like material which can be compressed. Lead azide is used in primer mixtures, detonators and fuzes.

b. Lead Styphnate. This explosive, 2, 4, 6-trinitroresorcinate, is widely employed commercially and as an initiator for both foreign and domestic explosives. It is pale straw, deep yellow, orange-yellow or reddish-brown in color. Lead styphnate is slightly less sensitive to impact than mercury fulminate and has about the same strength and stability as lead azide. However, lead styphnate is more easily ignited by an electrical spark than is mercury fulminate, lead azide, or DDNP. As a primer, lead styphnate produces a very good flame. It should be stored under water in conductive rubber containers. In primer compositions, lead styphnate offers sensitivity, stability, and ample flame. It is incapable of initiating the detonation of any of the military high explosives except PETN.

APPENDIX B

EXCERPTS FROM ALG'S SUBMITAL 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.

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Appendix D

ALG PROCEDURES- FY 89

References:

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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.

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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

G-3A

A. L. G. SAMPLE LOG

* Chain of Custody

SERIES NO. 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
2806-2811	CQETN323AIE6100	Calcasieu (NOD)	78 / 6	26 May 89	2154.00	Poss HGA 1260.00			Sb, As, Be, cd, cr, cu, Pb, Hg, Ni, Se, Tl, Ag, zn
2812	"	Calcasieu (NOD)	/ 1	26 May 89	Dig-50.00 Sed 1134.00	Poss HGA 210.00			Sb, As, Be, cd, cr, cu, Pb, Hg, Ni, Se, Tl, Ag, zn, CN, Pests, PCBs, [illegible]
2813-2814	CQEWK383AIE6100	Tensas Pump Plant (VXD)	16 / 2	1 June 89	Dig-100.00 358.00 Sed	Poss HGA 70.00			Ca, Fe, Mg, Si, Cl, Hardness, PH, Alkalinity
2815-2832	RD9G107E1170001	APG (Wade)	/ 18	2 June 89	5400.00				PCB's
2833-2846	CQERA3831AES100	9th Ave PET (zappi) Sed	48 / 16	2 June 89	624.00				Na, Ca, Mg
2847-2863	CQERA3831AES100	9th Ave PET (zappi) Sed	15 / 15	2 June 89	300.00				Cl
2864-2878	CQERA3831AES100	9th Ave PET Sed (ZAPPI)	15 / 15	2 June 89	300.00				TOC
2879	RD8G107E1170001	APG-Edgewood (R. Wade)	/ 1	5 June 89	300.00				PCB

ENVIRONMENTAL LABORATORY

DATA REPORTING SHEET ANALYTICAL LABORATORY GROUP

SHEET ____ OF ____

PROJECT *		DATE RECEIVED *	SAMPLE LOCATION
DATA CHECKED BY	JOB NO. *	DATE COMPLETED	

FREEZER NO.

SHELF NO.

CHEMICAL PRESERVATIVE *	PARAMETER	*	*										
LAB I.D. NO	PROJECT I.D. NO. *												

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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				Ibid	30ug/l
ICP		200.7	6010		100ug/l
7. Antimony, DCP				Ibid	
ICP		200.7	6010		
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				Ref 7,	10ug/l
ICP		200.7	6010	D4190-82	5ug/l
14. Beryllium, DCP				Ibid	5ug/L
ICP		200.7	6010		5ug/L
15. Boron, DCP				Ibid	10ug/l
ICP		200.7	6010		
16. Cadmium, DCP				Ibid	20ug/L
ICP		200.7	6010		20ug/l
17. Cadmium, GFAA		213.2	7131		0.1ug/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	660
1,4-Naphthoquinone	10	ND
1-Naphthylamine	10	ND
2-Naphthylamine	10	ND
Nicotine	20	ND
5-Nitroacenaphthene	10	ND
2-Nitroaniline	50	3300
3-Nitroaniline	50	3300
4-Nitroaniline	20	ND
5-Nitro-o-anisidine	10	ND
Nitrobenzene	10	660
4-Nitrobiphenyl	10	ND
Nitrofen	20	ND
2-Nitrophenol	10	660
4-Nitrophenol	50	3300
5-Nitro-o-toluidine	10	ND
4-Nitroquinoline-1-oxide	40	ND
N-Nitrosodibutylamine	10	ND
N-Nitrosodiethylamine	20	ND
N-Nitrosodiphenylamine	10	660
N-Nitroso-di-n-propylamine	10	660
N-Nitrosopiperidine	20	ND
N-Nitrosopyrrolidine	40	ND
Octamethyl pyrophosphoramide	200	ND
4,4'-Oxydianiline	20	ND
Parathion	10	ND
Pentachlorobenzene	10	ND
Pentachloronitrobenzene	20	ND
Pentachlorophenol	50	3300
Phenacetin	20	ND
Phenanthrene	10	660
Phenobarbital	10	ND
Phenol	10	660
1,4-Phenylenediamine	10	ND
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
0,0,0-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

GROUNDWATER ANALYTICAL RESULTS FROM THE ROCKEYE AREA

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	7	8	9	10
ANALYTE.....	904	905	906	907
PPM.....	DNB	TETRYL	2-AM-DNT	4-AM-DNT

SAMP #	DESCRIPTION						ROW
02443	10-43C-E	CONC	<0.001	<0.010	<0.002	<0.002	49
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02444	10-43P3-E	CONC	<0.001	<0.010	<0.002	<0.002	50
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02445	B1-E	CONC	BROKEN	BROKEN	BROKEN	BROKEN	51
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02446	B2-E	CONC	<0.001	<0.010	<0.002	<0.002	52
		%REC					
		DUPL	<0.001	<0.010	<0.002	<0.002	
		OID	00009131	00009131	00009131	00009131	
02447	B3-E	CONC	<0.001	<0.010	<0.002	<0.002	53
		%REC					
		DUPL	<0.001	<0.010	<0.002	<0.002	
		OID	00009131	00009131	00009131	00009131	
02448	B4-E	CONC	<0.001	<0.010	<0.002	<0.002	54
		%REC					
		DUPL	<0.001	<0.010	<0.002	<0.002	
		OID	00009131	00009131	00009131	00009131	

DNB 1,3-DINITROBENZENE
TETRYL METHYL-2,4,6-TRINITROPHENYLNITRAMINE
2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE
4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE

"Hot" wells

Table 2. NWSC-CRANE

Well Number	Parameter	First Round Concentration, ppm	Second Round Concentration, ppm
10-01	RDX	0.0234	
	HMX	0.0248	
10-02	RDX	0.0133	
	HMX	0.0244	
	4-AM-DNT	0.0046	
10-07	RDX	0.0830	
	HMX	0.1010	
	4-AM-DNT	0.0150	
	TNT	0.0098	
	2-AM-DNT	0.0150	
10-08	RDX	0.0338	
	HMX	0.0315	
	4-AM-DNT	0.0221	
	TNT	0.0035	
	2-AM-DNT	0.0181	
	TNB	0.0012	
10-17	RDX	1.3900	
	HMX	0.6730	
	4-AM-DNT	0.2060	
	TNT	0.9770	
	2-AM-DNT	0.2180	
	TNB	0.0445	
	24DNTOL	0.0038	
	26DNTOL	0.0285	
10-18	RDX	0.0849	
	HMX	0.1350	
	TNT	0.0038	
	2-AM-DNT	0.0036	

4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE 24DNTOL 2,4-Dinitrotoluene

2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE 26DNTOL 2,6-Dinitrotoluene

Sampling data

Table 1

Well Number	Well Depth (ft)	Water Level (ft)	Volume Purged (gals)	After Sampling		
				pH	(µmhos)	°C
10-01	32.1	17.8	7.0	7.52	160	18.5
10-02	25.9	16.6	4.0*	7.25	110	15.4
10-04	43.3	17.1	13.0	6.21	3100	18.0
10-07	22.4	4.2	9.0	6.15	460	17.0
10-08	22.2	4.8	9.0	7.56	295	14.8
10-09	39.0	20.3	10.0	6.60	650	17.3
10-17	28.0	12.2	8.0	6.78	500	17.5
10-18	28.0	9.2	9.5	6.82	290	14.7
10-19	25.0	4.7	11.0	6.17	370	14.9
10-20	42.0	24.0	8.5*	4.52	220	15.3
10-23C	103.6	63.6	11.5**	10.79	455	16.6
10-24P3	32.5	9.0	12.0	5.80	420	14.9
10-25C	90.0	49.0	20.5	6.15	210	20.6
10-25P2	62.2	48.3	7.0	5.55	300	18.8
10-26P2	68.5	46.5	11.0	3.02	600	17.6
10-26P3	29.2	15.8	7.0	5.01	390	18.0
10-27P2	32.5	14.0	9.5	6.31	415	16.9
10-28C	86.6	51.2	17.5	6.21	3100	18.0
10-28P2	42.2	16.2	13.0	6.49	800	17.2
10-29C	68.6	48.9	10.0	5.74	1000	18.8
10-29P2	33.3	19.7	7.0*	3.99	2100	19.5
10-30C	87.4	55.8	16.0	6.01	550	17.7
10-30P2	25.9	9.7	8.0*	3.43	1800	18.3

* slow recharge ** slow recharge and purged dry

Table 1 (cont'd)

Well Number	Well Depth (ft)	Water Level (ft)	Volume Purged (gals)	After Sampling		
				pH	(µmhos)	°C
10-31C	66.9	52.5	7.0	6.00	485	20.0
10-31P2	45.5	-	- @	-	-	-
10-31P3	23.5	20.7	1.5**	5.89	2800	14.4
10-32C	81.0	51.1	15.0	5.77	1500	16.4
10-32P2	32.0	14.9	3.5**	5.51	1050	17.6
10-33C	63.3	47.2	8.0*	9.59	-	15.4
10-33P2	36.3	30.7	3.0	5.99	235	17.0
10-34C	80.0	56.6	12.0	4.66	1600	18.0
10-34P2	53.6	46.5	3.5	6.00	900	17.5
10-34P3	26.6	18.4	4.0*	5.76	1800	17.0
10-35C	84.4	66.4	9.0	5.13	1800	19.7
10-35P3	28.2	18.3	5.0*	6.29	2300	18.3
10-36P2	52.4	12.9	20.0	3.95	2300	18.4
10-36P3	29.5	11.2	9.0	6.18	2400	17.4
10-37C	94.7	58.7	18.0	6.28	390	17.1
10-37P3	36.5	22.3	7.0	4.68	1300	18.0
10-38C	92.1	67.8	12.5	3.41	1250	17.5
10-38P2	38.0	-	- @	-	-	-
10-39C	105.6	64.3	20.5	5.47	1400	19.5
10-39P2	45.4	26.4	8.5	3.83	3200	20.3
10-40C	289.0	248.6	21.0	8.02	950	17.7

* slow recharge ** slow recharge and purged dry
@ dry well

Table 1 (concluded)

Well Number	Well Depth (ft)	Water Level (ft)	Volume Purged (gals)	After Sampling		
				pH	(µmhos)	°C
10-40P2	86.7	67.4	10.0	6.29	750	17.4
10-40P4	36.4	20.1	8.0	3.66	1150	18.2
10-41C	103.5	71.4	16.0	5.76	1800	15.6
10-41P2	57.1	56.6	- @	-	-	-
10-41P3	39.1	34.8	2.0*	5.95	1900	17.1
10-42C	89.6	70.5	9.5*	5.87	1000	16.4
10-42P2	31.7	23.4	4.0*	5.52	1450	20.7
10-43C	86.6	51.3	18.0	6.08	230	18.4
10-43P3	39.4	22.2	10.0	5.24	500	16.7

* slow recharge @ dry well

CKHNZ 1 TRIP

Rockeye Sampled 26 Apr 89

JOB FILE: 02395 DATE: 19 MAY 89

********** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 1 OF 18)**********

Lab analysis data

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89

CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION								ROW
02395	10-01-E	CONC	<0.001	<0.002	<0.002	0.0234	0.0248	<0.001	1
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02396	10-02-E	CONC	<0.001	<0.002	<0.002	0.0133	0.0244	<0.001	2
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02397	10-04-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020 #1	<0.001	3
		%REC							
		DUPL	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02398	10-07-E	CONC	<0.001	<0.002	0.0098	0.0830	0.101 #2	<0.001	4
		%REC							
		DUPL	<0.001	<0.002	0.0104	0.0870	A	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02399	10-08-E	CONC	<0.001	<0.002	0.0035	0.0338	0.0315	0.0012	5
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02400	10-09-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	6
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL	2,6-Dinitrotoluene	24DNTOL	2,4-Dinitrotoluene
TNT	Trinitrotoluene	RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	TNB	1,3,5-TRINITROBENZENE

FOOTNOTES:

#1 Concentrations less than estimated reporting limit.

#2 A - analyte could not be determined in this analysis.

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	7	8	9	10
ANALYTE.....	904	905	906	907
PPM.....	DNB	TETRYL	2-AM-DNT	4-AM-DNT

SAMP #	DESCRIPTION						ROW
02395	10-01-E	CONC	<0.001	<0.010	T #1	T #1	1
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02396	10-02-E	CONC	<0.001	<0.010	<0.002	0.0046	2
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02397	10-04-E	CONC	<0.001	<0.010	<0.002	<0.002	3
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02398	10-07-E	CONC	<0.001	<0.010	0.0135	0.0133	4
		%REC					
		DUPL	<0.001	<0.010	0.0164	0.0173	
		OID	00009131	00009131	00009131	00009131	
02399	10-08-E	CONC	<0.001	<0.010	0.0181	0.0221	5
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02400	10-09-E	CONC	<0.001	<0.010	<0.002	<0.002	6
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	

DNB 1,3-DINITROBENZENE TETRYL METHYL-2,4,6-TRINITROPHENYLNITRAMINE
2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE 4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE

FOOTNOTES:
#1 T - Analyte detected but concentration below estimated reporting limit.

JOB FILE: 02395 DATE: 19 MAY 89

********** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 2 OF 18)**********

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION								ROW
02401	10-17-E	CONC	0.0253	0.0032	0.974	1.37	0.673	#1 0.0431	7
		%REC							
		DUPL	0.0316	0.0044	0.981	1.42	A	0.0458	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02402	10-18-E	CONC	<0.001	<0.002	0.0038	0.0830	0.135	#1 <0.001	8
		%REC							
		DUPL	<0.001	<0.002	0.0037	0.0867	A	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02403	10-19-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	9
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02404	10-20-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	10
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02405	10-23C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	11
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02406	10-24P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	12
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL 2,6-Dinitrotoluene
24DNTOL 2,4-Dinitrotoluene
TNT Trinitrotoluene
RDX Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
TNB 1,3,5-TRINITROBENZENE

FOOTNOTES:
#1 A - analyte could not be determined in this analysis.

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

	COLUMN.....	7	8	9	10
	ANALYTE.....	904	905	906	907
	PPM.....	DNB	TETRYL	2-AM-DNT	4-AM-DNT
SAMP #	DESCRIPTION				ROW
02401	10-17-E	CONC <0.001	<0.010	0.205	0.198	7
		%REC			
		DUPL <0.001	<0.010	0.231	0.216
		OID 00009131	00009131	00009131	00009131
02402	10-18-E	CONC <0.001	<0.010	0.0034	T #1	8
		%REC			
		DUPL <0.001	<0.010	0.0029	T
		OID 00009131	00009131	00009131	00009131
02403	10-19-E	CONC <0.001	<0.010	<0.002	<0.002	9
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02404	10-20-E	CONC <0.001	<0.010	<0.002	<0.002	10
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02405	10-23C-E	CONC <0.001	<0.010	<0.002	<0.002	11
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02406	10-24P3-E	CONC <0.001	<0.010	<0.002	<0.002	12
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131

DNB 1,3-DINITROBENZENE
2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE
TETRYL METHYL-2,4,6-TRINITROPHENYLNITRAMINE
4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE

FOOTNOTES:
#1 T - Analyte detected but concentration below estimated reporting limit.

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION								ROW
02407	10-25C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	13
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02408	10-25P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	14
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02409	10-26P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	15
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02410	10-26P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	16
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02411	10-27P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	17
		%REC							
		DUPL	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02412	10-28C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	18
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL	2,6-Dinitrotoluene	24DNTOL	2,4-Dinitrotoluene
TNT	Trinitrotoluene	RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	TNB	1,3,5-TRINITROBENZENE

JOB FILE: 02395 DATE: 19 MAY 89

********** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 12 OF 18)**********

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	7	8	9	10
ANALYTE.....	904	905	906	907
PPM.....	DNB	TETRYL	2-AM-DNT	4-AM-DNT

SAMP #	DESCRIPTION						ROW
02407	10-25C-E	CONC	<0.001	<0.010	<0.002	<0.002	13
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02408	10-25P2-E	CONC	<0.001	<0.010	<0.002	<0.002	14
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02409	10-26P2-E	CONC	<0.001	<0.010	<0.002	<0.002	15
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02410	10-26P3-E	CONC	<0.001	<0.010	<0.002	<0.002	16
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02411	10-27P2-E	CONC	<0.001	<0.010	<0.002	<0.002	17
		%REC					
		DUPL	<0.001	<0.010	<0.002	<0.002	
		OID	00009131	00009131	00009131	00009131	
02412	10-28C-E	CONC	<0.001	<0.010	<0.002	<0.002	18
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	

DNB 1,3-DINITROBENZENE
2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE
TETRYL METHYL-2,4,6-TRINITROPHENYLNITRAMINE
4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION								ROW
02413	10-28P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	19
		%REC							
		DUPL	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02414	10-29C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	20
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02415	10-29P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	21
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02416	10-30C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	22
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02417	10-30P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	23
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02418	10-31C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	24
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL 2,6-Dinitrotoluene
24DNTOL 2,4-Dinitrotoluene
TNT Trinitrotoluene
RDX Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
TNB 1,3,5-TRINITROBENZENE

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	7	8	9	10
ANALYTE.....	904	905	906	907
PPM.....	DNB	TETRYL	2-AM-DNT	4-AM-DNT

SAMP #	DESCRIPTION						ROW
02413	10-28P2-E	CONC	<0.001	<0.010	<0.002	<0.002	19
		%REC					
		DUPL	<0.001	<0.010	<0.002	<0.002	
		OID	00009131	00009131	00009131	00009131	
02414	10-29C-E	CONC	<0.001	<0.010	<0.002	<0.002	20
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02415	10-29P2-E	CONC	<0.001	<0.010	<0.002	<0.002	21
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02416	10-30C-E	CONC	<0.001	<0.010	<0.002	<0.002	22
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02417	10-30P2-E	CONC	<0.001	<0.010	<0.002	<0.002	23
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02418	10-31C-E	CONC	<0.001	<0.010	<0.002	<0.002	24
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	

DNB 1,3-DINITROBENZENE
2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE
TETRYL METHYL-2,4,6-TRINITROPHENYLNITRAMINE
4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE

JOB FILE: 02395 DATE: 19 MAY 89

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION								ROW
02419	10-31P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	25
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02420	10-32C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	26
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02421	10-32P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	27
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02422	10-33C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	28
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02423	10-33P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	29
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02424	10-34C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	30
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL	2,6-Dinitrotoluene	24DNTOL	2,4-Dinitrotoluene
TNT	Trinitrotoluene	RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	TNB	1,3,5-TRINITROBENZENE

JOB FILE: 02395 DATE: 19 MAY 89

********** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 14 OF 18)**********

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....		7	8	9	10
ANALYTE.....		904	905	906	907
PPM.....		DNB	TETRYL	2-AM-DNT	4-AM-DNT
SAMP #	DESCRIPTION				ROW
02419	10-31P3-E	CONC <0.001	<0.010	<0.002	<0.002 25
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02420	10-32C-E	CONC <0.001	<0.010	<0.002	<0.002 26
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02421	10-32P3-E	CONC <0.001	<0.010	<0.002	<0.002 27
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02422	10-33C-E	CONC <0.001	<0.010	<0.002	<0.002 28
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02423	10-33P2-E	CONC <0.001	<0.010	<0.002	<0.002 29
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02424	10-34C-E	CONC <0.001	<0.010	<0.002	<0.002 30
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131

DNB 1,3-DINITROBENZENE
TETRYL METHYL-2,4,6-TRINITROPHENYLNITRAMINE
2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE
4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....		1	2	3	4	5	6
ANALYTE.....		269	270	900	901	902	903
PPM.....		26DNTOL	24DNTOL	TNT	RDX	HMX	TNB
SAMP #	DESCRIPTION						ROW
02425	10-34P2-E	CONC <0.001	<0.002	<0.002	<0.005	<0.020	<0.001 31
		%REC					
		DUPL					
		OID 00009131	00009131	00009131	00009131	00009131	00009131
02426	10-34P3-E	CONC <0.001	<0.002	<0.002	<0.005	<0.020	<0.001 32
		%REC					
		DUPL					
		OID 00009131	00009131	00009131	00009131	00009131	00009131
02427	10-35C-E	CONC <0.001	<0.002	<0.002	<0.005	<0.020	<0.001 33
		%REC					
		DUPL					
		OID 00009131	00009131	00009131	00009131	00009131	00009131
02428	110-35P3-E	CONC <0.001	<0.002	<0.002	<0.005	<0.020	<0.001 34
		%REC					
		DUPL					
		OID 00009131	00009131	00009131	00009131	00009131	00009131
02429	10-36P2-E	CONC <0.001	<0.002	<0.002	<0.005	<0.020	<0.001 35
		%REC					
		DUPL					
		OID 00009131	00009131	00009131	00009131	00009131	00009131
02430	10-36P3-E	CONC <0.001	<0.002	<0.002	<0.005	<0.020	<0.001 36
		%REC					
		DUPL					
		OID 00009131	00009131	00009131	00009131	00009131	00009131

26DNTOL 2,6-Dinitrotoluene
24DNTOL 2,4-Dinitrotoluene
TNT Trinitrotoluene
RDX Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
TNB 1,3,5-TRINITROBENZENE

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

	COLUMN.....	7	8	9	10
	ANALYTE.....	904	905	906	907
	PPM.....	DNB	TETRYL	2-AM-DNT	4-AM-DNT
SAMP #	DESCRIPTION				ROW
02425	10-34P2-E	CONC <0.001	<0.010	<0.002	<0.002 31
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02426	10-34P3-E	CONC <0.001	<0.010	<0.002	<0.002 32
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02427	10-35C-E	CONC <0.001	<0.010	<0.002	<0.002 33
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02428	110-35P3-E	CONC <0.001	<0.010	<0.002	<0.002 34
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02429	10-36P2-E	CONC <0.001	<0.010	<0.002	<0.002 35
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131
02430	10-36P3-E	CONC <0.001	<0.010	<0.002	<0.002 36
		%REC			
		DUPL			
		OID 00009131	00009131	00009131	00009131

DNB 1,3-DINITROBENZENE
TETRYL METHYL-2,4,6-TRINITROPHENYLNITRAMINE
2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE
4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION								ROW
02431	10-37C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	37
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02432	10-37P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	38
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02433	10-38C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	39
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02434	10-39C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	40
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02435	10-39P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	41
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02436	10-40C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	42
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL	2,6-Dinitrotoluene	24DNTOL	2,4-Dinitrotoluene
TNT	Trinitrotoluene	RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	TNB	1,3,5-TRINITROBENZENE

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	7	8	9	10
ANALYTE.....	904	905	906	907
PPM.....	DNB	TETRYL	2-AM-DNT	4-AM-DNT

SAMP #	DESCRIPTION						ROW
02431	10-37C-E	CONC	<0.001	<0.010	<0.002	<0.002	37
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02432	10-37P3-E	CONC	<0.001	<0.010	<0.002	<0.002	38
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02433	10-38C-E	CONC	<0.001	<0.010	<0.002	<0.002	39
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02434	10-39C-E	CONC	<0.001	<0.010	<0.002	<0.002	40
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02435	10-39P2-E	CONC	<0.001	<0.010	<0.002	<0.002	41
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	
02436	10-40C-E	CONC	<0.001	<0.010	<0.002	<0.002	42
		%REC					
		DUPL					
		OID	00009131	00009131	00009131	00009131	

DNB 1,3-DINITROBENZENE
2-AM-DNT 2-AMINO-4,6-DINITROTOLUENE
TETRYL METHYL-2,4,6-TRINITROPHENYLNITRAMINE
4-AM-DNT 4-AMINO-2,6-DINITROTOLUENE

JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION								ROW
02437	10-40P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	43
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02438	10-40P4-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	44
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02439	10-41C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	45
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02440	10-41P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	46
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02441	10-42C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	47
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02442	10-42P2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	48
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL 2,6-Dinitrotoluene
24DNTOL 2,4-Dinitrotoluene
TNT Trinitrotoluene
RDX Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
TNB 1,3,5-TRINITROBENZENE

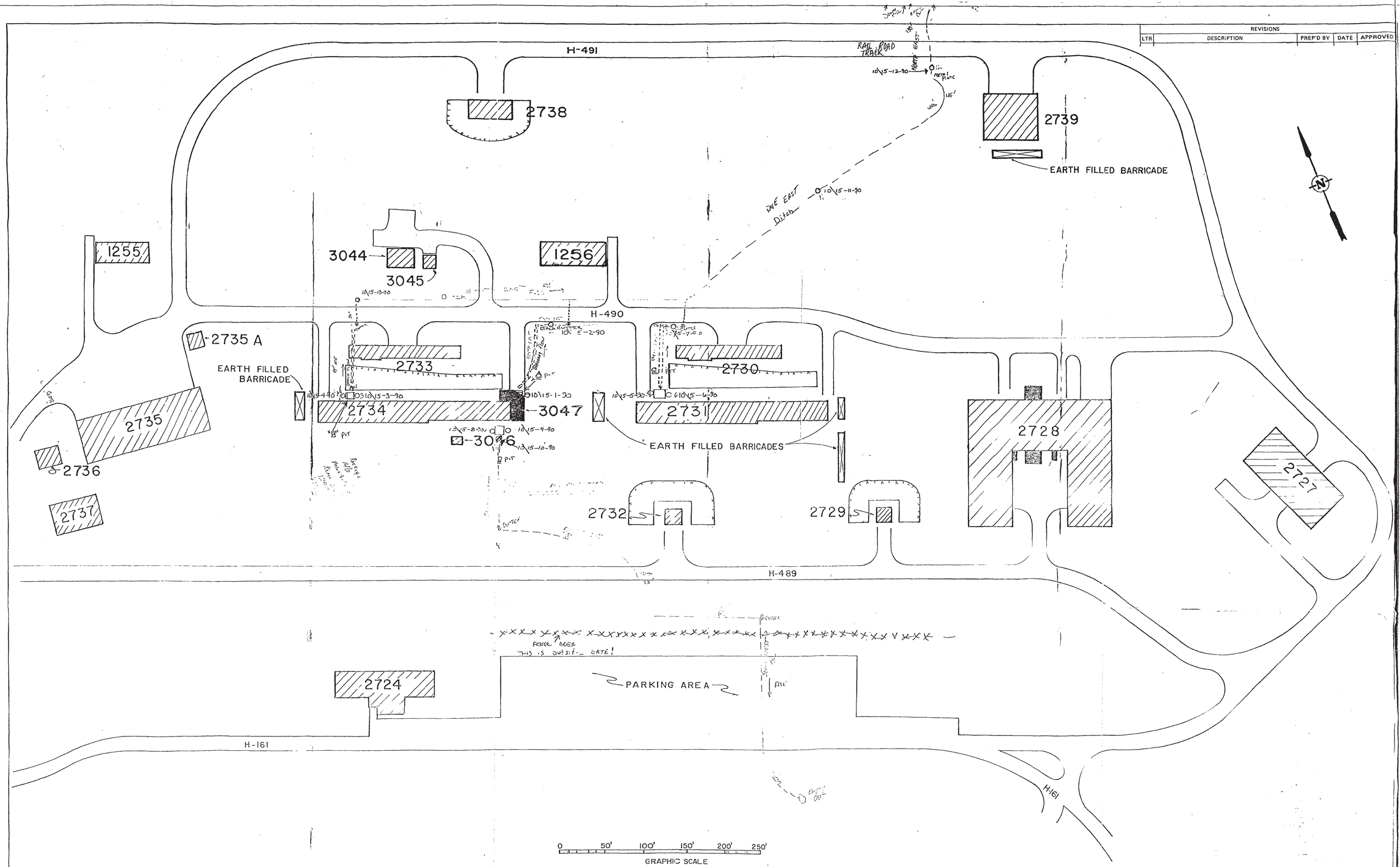
JOB DESCRIPTION: CRANE - ROCKY SITE (WADE) JOB NUMBER: RD9G114E1170001 RECEIPT DATE: 01 APR 89
CHEM. PRESERVATIVE: TYPE OF SAMPLE: Water EST. COMP. DATE: 23 JUN 89

COLUMN.....	1	2	3	4	5	6
ANALYTE.....	269	270	900	901	902	903
PPM.....	26DNTOL	24DNTOL	TNT	RDX	HMX	TNB

SAMP #	DESCRIPTION								ROW
02443	10-43C-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	49
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02444	10-43P3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	50
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02445	B1-E	CONC	BROKEN	BROKEN	BROKEN	BROKEN	BROKEN	BROKEN	51
		%REC							
		DUPL							
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02446	B2-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	52
		%REC							
		DUPL	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02447	B3-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	53
		%REC							
		DUPL	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	
02448	B4-E	CONC	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	54
		%REC							
		DUPL	<0.001	<0.002	<0.002	<0.005	<0.020	<0.001	
		OID	00009131	00009131	00009131	00009131	00009131	00009131	

26DNTOL	2,6-Dinitrotoluene	24DNTOL	2,4-Dinitrotoluene
TNT	Trinitrotoluene	RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	TNB	1,3,5-TRINITROBENZENE

REVISIONS				
LTR	DESCRIPTION	PREP'D BY	DATE	APPROVED



SATISFACTORY TO DATE	PWO DWG REF PWO DRAWING NO. 3529	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND NAVAL WEAPONS SUPPORT CENTER CRANE, INDIANA
SATISFACTORY TO DATE	DESIGN HE Stone DRAWN 4-7-76 HE Stone CHECKED SUPV.	PLATE No. 1 ROCKEYE AREA PLOT PLAN Showing Projected Bore Hole Locations
SATISFACTORY TO DATE	APPROVED DATE PUBLIC WORKS OFFICER	SIZE F — CODE IDENT. NO. 80091 — NAVFAC DRAWING NO. — CONSTR. CONTR. NO. N62465-C-
		SCALE 1" = 50' — SPEC. NO. — SHEET 1 OF 1

SND-C-1309

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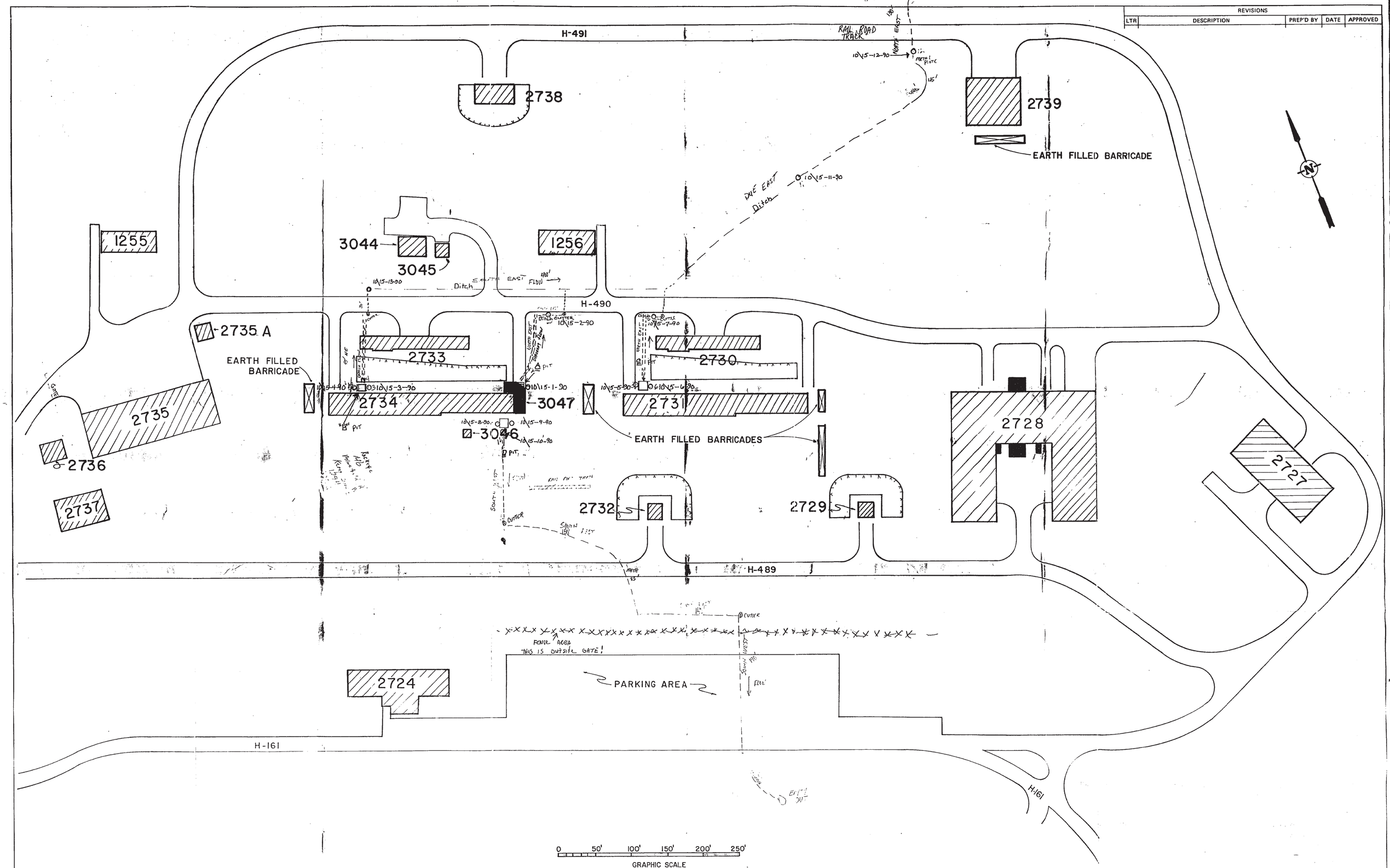
REVISIONS				
LTR	DESCRIPTION	PREP'D BY	DATE	APPROVED



SATISFACTORY TO DATE	PWO DWG REF PWO DRAWING NO. 3529	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND NAVAL WEAPONS SUPPORT CENTER CRANE, INDIANA
SATISFACTORY TO DATE	DESIGN HE Stone DRAWN 4-7-76 HE Stone CHECKED SUPV.	PLATE No. 1 ROCKEYE AREA PLOT PLAN Showing Projected Bore Hole Locations
SATISFACTORY TO DATE	APPROVED DATE PUBLIC WORKS OFFICER	SIZE F — CODE IDENT. NO. 80091 — NAVFAC DRAWING NO. CONSTR. CONTR. NO. N62465-C- SCALE 1" = 50' — SPEC. NO. — SHEET 1 OF 1

9ND-C-1309

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