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of Engineers
Waterways Experiment
Station

Final Report: RCRA Facility Investigation for Phase II, Soil Release Characterization, SWMU 10/15 Rockeye, Naval Surface Warfare Center Crane, Indiana

by *John Stephen Nohrstedt, Robert W. Magee, Bobby Willis, Eric Farr, Boyd Alig, Phil Payonk, Wilmington District*

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WES

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Final report

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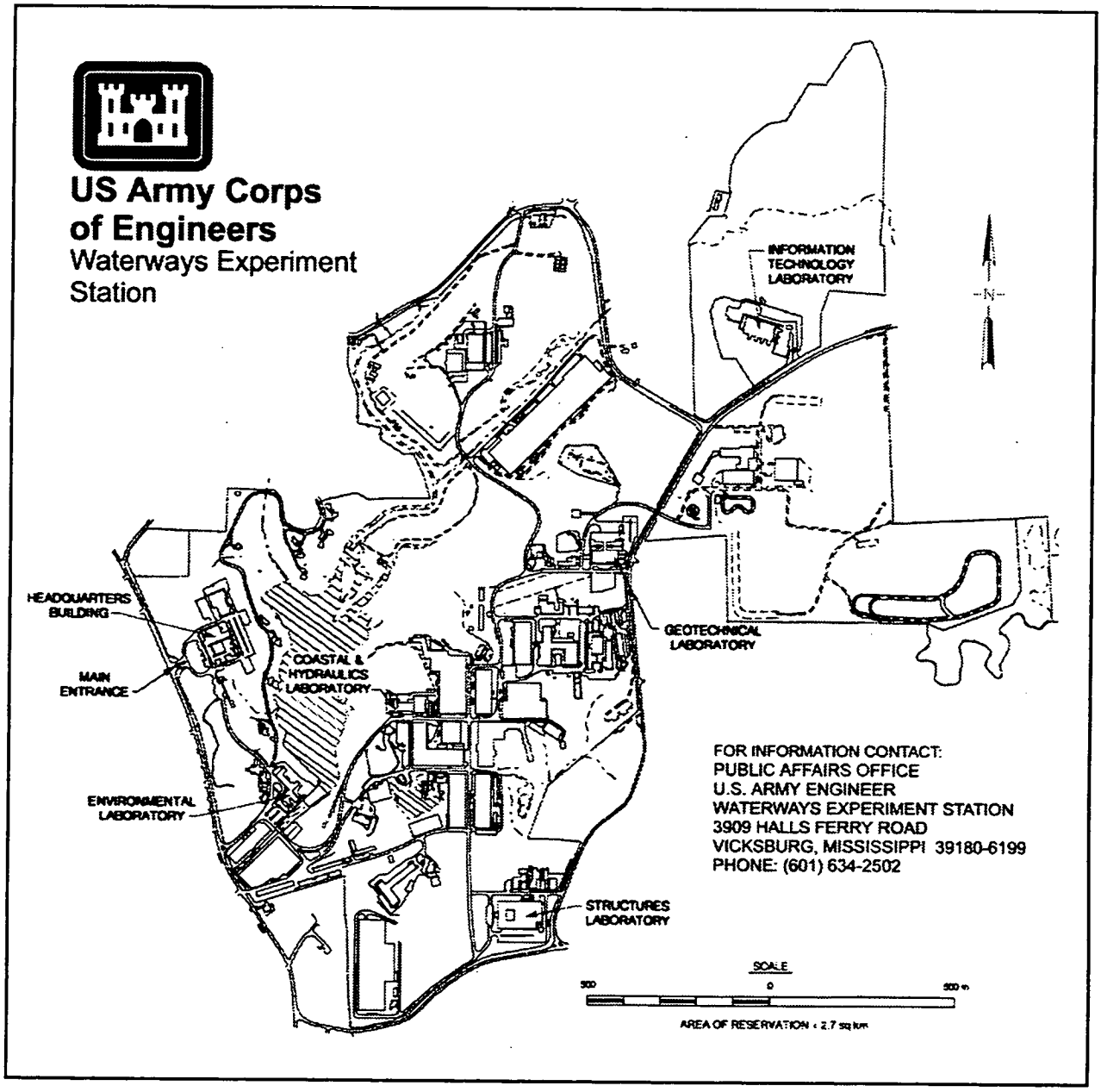

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Preface

A Resource Conservation and Recovery Act Facility Investigation Phase II Soils Study was conducted at the Rockeye site, Naval Surface Warfare Center Crane (NSWCC), Crane, Indiana, by personnel of the Geotechnical Laboratory (GL), U.S. Army Engineer Waterways Experiment Station (WES), and the U.S. Army Engineer District, Wilmington (CESAW). The field work was done in September and October 1990; analytical work in September, October, and November 1990; data reduction from December 1990 to July 1991; and report writing and revisions from February 1992 to August 1998.

The primary author of this report was Mr. Stephen Nohrstedt, CESAW. Contributing authors were Messrs. Robert Magee, Bobby Willis, Eric Farr, Boyd Alig, and Phil Payonk, CESAW, and Dr. James May, WES. Also contributing to the report were Mr. William Murphy, Mses. Benita Abraham and Evelyn Villanueva, and Mr. Bennie Washington, WES. Mr. Jeffry Ciocco provided oversight for Naval Facilities Engineering Command and Mr. James Hunsicker, Manager, Environmental Protection Department, NSWCC, and Mr. Tom Brent, Project Manager, managed the project. Mr. William Murphy was Principal Investigator and Dr. James H. May was Program Manager for WES.

At the time the study was conducted, English units were used to record data. A conversion table is presented for converting English units to metric units.

This investigation was performed in the Geotechnical Laboratory, WES, under the supervision of Dr. A. G. Franklin, former Chief, Earthquake Engineering and Geosciences Division (EEGD); Dr. Lillian Wakeley, acting Chief, EEGD; and Dr. W. F. Marcuson III, Director.

At the time of publication of this report, Dr. Robert W. Whalin was the Director and COL Robin R. Cababa was Commander of WES.

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Acronyms and Abbreviations

ABG	Ammunition Burning Ground
CAAA	Crane Army Ammunition Activity
CAR	Corrective Action Requirements
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CL	Lean clay
EPA	Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
HMTC	Hazardous Materials Technical Center
HMX	Octahydro-1,2,3,5,7-tetranitro-1,3,5,7-tetrazocine
HNu	Brand name for photoionization meter
HSWA	Hazardous and Solid Waste Amendments
HW	Hazardous Waste
IAS	Initial Assessment Study
IRP	Installation Restoration Program
MCL	Maximum Contaminant Level
ML	Lean silt
MSL	Mean Sea Level
NAD	Naval Ammunition Depot
NEESA	Naval Energy & Environmental Support Activity
NSWCC	Naval Surface Warfare Center Crane
ORR	Old Rifle Range
QA/QC	Quality Assurance/Quality Control
RBC	Risk-Based Concentration

RCRA/HSWA	Resource Conservation and Recovery Act/Hazardous and Solid Waste Amendments
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RMF	Rockeye Munitions Facility
SM	Silty sand
SWMU	Solid Waste Management Unit
TIC	Tentatively Identified Compounds
TNT	2,4,6-trinitrotolune
TSD	Treatment, storage disposal
USACE	United States Army Corps of Engineers
USACEWES	United States Army Corps of Engineers Waterways Experiment Station
USATHAMA	Unites States Army Toxic and Hazardous Materials Agency
USCS	Unified Soils Classification System
WES	Waterways Experiment Station

Executive Summary

The Naval Surface Warfare Center, Crane (NSWCC), Crane, Indiana, is a naval facility located in southwestern Indiana. Its mission is to provide material, technical, and logistic support to the Navy. One of its primary tasks is that of an inland ammunition production, storage, and disposal center.

In 1989, NSWCC was given a Final Resource Conservation and Recovery Act (RCRA) Storage Permit. The permit contained Corrective Action Requirements to be done at its Solid Waste Management Units (SWMU). The requirements included the need for RCRA Facilities Investigations (RFI) to be done at its hazardous waste disposal units.

An RFI Phase II, soils investigation was performed by U.S. Army Corps of Engineers personnel at Rockeye, an NSWCC Operational Unit. The field work was done in September and October 1990, analytical work in September, October, and November 1990, the data reduction and report writing from December 1990, to July 1991, and report revisions from February 1992 to June 1992.

Rockeye is a production facility that was formerly a press-loading operation for 3-in. projectiles and later converted to a case-filling operation to produce cluster bombs. A large volume of wastewater is produced by the operation and collected in sumps. Prior to 1978, explosive-contaminated waters from full sumps were discharged directly to a branch of Sulphur Creek on the north side of the facility and to Turkey Creek, a tributary to Boggs Creek, on the south. Residues from the sumps are now pumped and trucked to the Ammunition Burning Ground (ABG), and pollution abatement equipment has been installed at the site. The result has been a reduction in the release of explosive-contaminated waters.

A surface and shallow subsurface soils investigation was instituted at the site. The objectives of the study were to:

a. Describe the soil conditions around the site.

b. Identify and characterize contaminants coming from the individual sumps.

c. Trace the route of the contamination movement away from the sumps.

Soil samples were collected from soil borings and surface scrapes. Samples were taken outside the sump areas. These samples were used to determine the chemical character of the contaminant(s) at the source. Samples from the borings and surface scrapes located away from the sumps were used to verify the contaminant release. One soil sample, Sample H, was taken in an effort to determine why there was a spot of bare earth on an otherwise grassed berm. This spot was situated near an exhaust vent.

The Quality Control (QC) level selected for this study is a Naval Energy and Environmental Support Activity (NEESA) QC Level "C." Since the only contaminants mentioned in the historical documentation, the Initial Assessment Study (IAS), were aqueous explosive wastes, these were the primary contaminants of concern. Therefore, all soil samples were analyzed for the presence of explosive compounds. United States Army Toxic and Hazardous Materials Agency (USATHAMA) methods, now incorporated in Environmental Protection Agency (EPA) Method 8330, were used to detect these compounds. As a precautionary step, lesser numbers of the soils samples were tested for the presence of a selected list of inorganic compounds, including toxic metals and volatile and semivolatile organic compounds (EPA Methods 8240 and 8270). All other analytical methods used were EPA SW 846 analytical methods.

The present day land surface resulted from an extensive fill and leveling operation. Thirteen auger borings were drilled in 1990. Soil descriptions from 35 groundwater monitoring wells drilled in 1981 and 1983, field observations, and physical soil test data were used to develop site soil descriptions. Soils were classified according to the Unified Soil Classification System. These soils were generated by processes including weathering of the parent rock and backfilling. Soil thicknesses vary from 0.5 ft to 17 ft, and soil types are predominately clays (CH). Organic matter was found in the soils. HNu readings that ranged from 0.5 ppm to 300 ppm were found in some of the soil boring holes. Groundwater was encountered in four borings. Prior studies indicate that groundwater movement at the Rockeye site is away from the site toward the intermittent streams that drain the site. Groundwater flow is enhanced by rock fractures. The groundwater is contaminated with explosive compounds, based on analyses of monitoring wells sampled in 1991. These analyses have been performed in the ongoing Phase III Site Characterization for Groundwater at Rockeye.

A clear case for the presence of explosive compound contamination in the soils of the Rockeye facility has been made. A less firm conclusion about the presence of volatile and semivolatile organic contamination in the Rockeye soils can be made. The data from the study are indefinite with respect to the presence of inorganic contamination. The clear evidence that explosives compounds are reaching the surrounding drainage ways (Areas B, E, F, and G) indicates that explosive contamination is moving in the ground and surface water systems. This is supported by visual observation (pink or red water in the north stream, NEESA 1983), groundwater analysis, (Dunbar 1984), and the presence of explosive compounds under the sumps and in the discharge channel soils. Evidence of airborne contamination was found in surface soil sample H, taken near an exhaust vent from a bare area on an otherwise grassed berm. This sample was heavily contaminated with explosive compounds

(TNT - 295 ppm, RDX - 3,350 ppm, and HMX - 10,400 ppm). Indications are that past operations have been, and present operations may be, contaminating the environment of the Naval Surface Warfare Center Crane.

The following recommendations are made:

a. An RCRA Facilities Investigation, Phase III, Soils Study is recommended. Specifically, the following sampling is suggested:

(1) Additional surface soil sampling along with air monitoring/testing near production building exhaust vents to determine the extent of explosives contamination near those facilities.

(2) Soil borings for the background areas (Background North and Area C) to gain a better subsurface control model for inorganic analytes.

(3) Soil borings near the facility perimeter where metals and explosives concentrations in the surface soils were highest to determine the vertical extent of contaminants there.

(4) Surface water and sediment samples from drainageways and receiving streams to better determine the extent of contamination.

b. Removal of the sumps should be considered.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
feet	0.3048	meters
feet per mile	0.1893935	meters per kilometer
inches	2.54	centimeters
miles (U.S. statute)	1.609347	kilometers

1 Introduction

Background

Naval Surface Warfare Center Crane (NSWCC) is a naval facility located in southwestern IN. It is located 40 miles southwest of Bloomington, IN and 74 miles south of Indianapolis, Indiana. NSWCC's location is shown on Figure 1. The facility covers approximately 62,463 acres in Davies, Greene, and Martin Counties. The base is located in a rural, sparsely populated area, and the acreage surrounding the base is primarily wooded or farmed land. The majority of NSWCC is covered by forest. The surface topography is defined by rugged terrain cut by well-defined stream valleys. The surface elevations range from 470 ft mean sea level (msl) in the valleys to 800 ft msl on the ridges.

Facility History

The facility, originally called Naval Ammunition Depot (NAD), Burns City, was opened in 1941 to serve as an inland ammunition production and storage center. The name of the Depot was changed to NAD Crane in 1943. The name was changed again in 1975 to Naval Weapons Support Center, Crane. Today, the center is known as the Naval Surface Warfare Center Crane, and its mission is to provide material, technical, and logistic support to the Navy for ships and crafts equipment, shipboard weapons systems, and assigned expendable and nonexpendable ordnance items; and to perform additional functions as directed by the Commander, Naval Sea Systems Command. In 1977, all of the Department of Defense (DOD) ammunition procurement responsibility was transferred to the Army. The Army has assumed ordnance production, storage, and related responsibilities under the single service manager directive.

The Army conducted an Initial Installation Assessment (IIA) for its activities at Crane in 1978, updating it in 1986, to assess past and current use of toxic and hazardous materials, as well as the potential for these substances to migrate off the installation. As landlord of the facility, it was determined that all environmental activities, including permitting activities, would remain the responsibility of the Navy (Bonds et al. 1988).

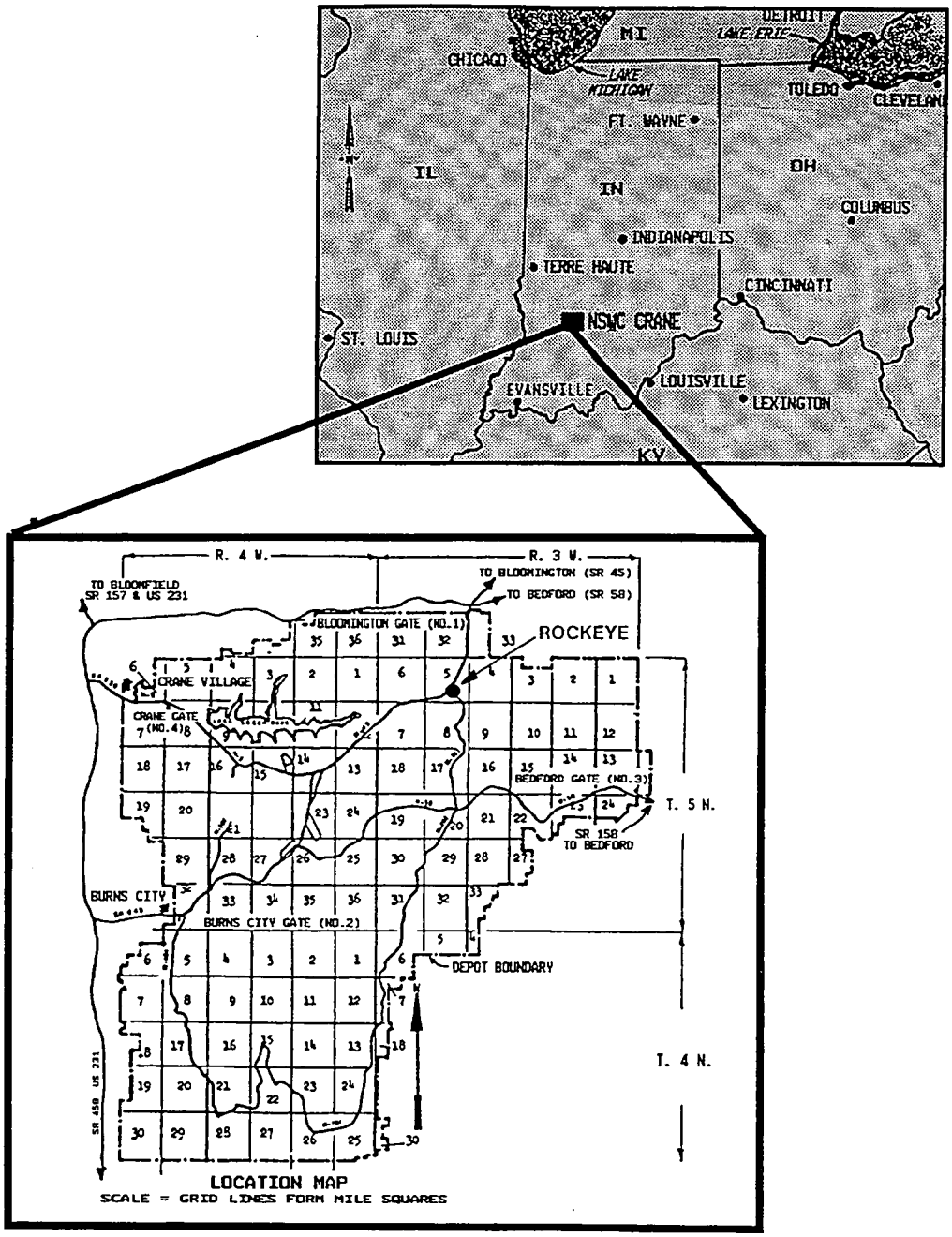


Figure 1. Location map for NSWC Crane

Subsequent to the initiation of the Environmental Protection Agency's (EPA) Resource Conservation and Recovery Act (RCRA) hazardous waste program, NSWCC filed notification and application to operate as a treatment, storage, or disposal (TSD) facility in October 1980. Interim status was granted subject to operating requirements and applicable technical standards found in Title 40 Code of Federal Regulations, Part 265 (40 CFR, Part 265). (Donahue and Associates 1992.)

In April 1981, the Navy implemented the Assessment and Control of Installation Pollutants (NACIP) Program, subsequently known as the Installation Restoration Program (IRP), (Donahue and Associates 1992). Under the authority of this program, an initial Assessment Study (IAS), or Phase I Study, was conducted in April and May 1981 by a team from the Naval Energy and Environmental Support Activity (NEESA), the Ordnance Environmental Support Office, and the U.S. Army Corps of Engineers (USACE). This study was published by NEESA in 1983. The purpose of the IAS was to collect and evaluate evidence indicating existence of pollutants which may have contaminated the site and which may post a health hazard to people on or off the installation. The result of this study, based on historical records, aerial photography, field inspections, and personal interviews, was identification of 17 potentially contaminated sites. It was concluded that while none posed immediate threat to human health or environment, 14 warranted further investigation under the NACIP Program to assess potential long-term impacts. A Phase II, or Confirmation Study, involving actual sampling and monitoring of the 14 sites, was recommended to confirm or deny existence of suspected contamination and to quantify the extent of any problems which may exist. Rockeye was one of these 14 sites, and that study is detailed in this report (NEESA 1983).

Confirmation actions at Rockeye included the installation and monitoring of two groundwater monitoring wells in 1981 to determine if the groundwater was contaminated with explosives. A total of 80 monitoring wells were installed at 6 of the 14 sites at Crane by the end of 1981. In addition to groundwater samples, surface streams exiting Crane were being monitored on a monthly frequency for cyanide, explosive compounds, and heavy metals. At the time of the NEESA report, monitoring had not indicated any problems. Even though there were specific pollutants suspected at some of the various sites due to their operations, (primary "wastes of concern" at Rockeye were the explosives TNT and RDX), it was recommended that at least a minimum screening procedure be used to include groundwater contamination indicators listed in 40CFR265 (NEESA 1983).

Completed groundwater studies at Rockeye include the Dunbar Reports (Dunbar 1982, 1983, and 1984). From the 1984 report, latest available chemical data from five monitoring wells indicated contamination. These contaminants were the explosives RDX, TNT, and HMX, resulting from surface discharge of contaminated production water (Dunbar 1984). The composition of these explosives is discussed in Chapter 3.

Corrective actions programs established as part of the RCRA Hazardous and Solid Waste Amendments (HSWA) required NSWCC to address past releases of hazardous waste or hazardous constituents at Solid Waste

Management Units (SWMU). Accordingly, NSWCC submitted a Hazardous Waste Management Report to the EPA in January 1985. The report listed the IAS-identified hazardous waste sites as SWMU. Following the Hazardous Waste Management Report, "An RCRA Facility Assessment" was conducted to characterize the potential for releases of hazardous waste or constituents from 100 SWMU. (Donahue and Associates 1992.)

An additional environmental study included the Army's Installation Assessment Relook Program, which sought aerial analysis support from the U.S. EPA's Environmental Photographic Interpretation Center (EPIC). The Relook program was initiated under the Army's IRP in which installations, assessed prior to EPA/Army interagency agreement and availability of EPIC historical reports, were reassessed for possible Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) problems. For Rockeye, the 1985 EPIC study reviewed aerial photography dated 1948, 1953, 1958, 1966, and 1974. Ground scarring and staining were evident in the 1953 photo, as the site appeared recently constructed. The drainage channel, cutting from the central portion of the site toward the northeast corner, which had reportedly received red-water discharge, was visible in this photo. In the 1958 photo, many areas, especially near drainage paths, had begun to revegetate and ground stains were no longer visible. By 1974, the discharge point of the drainage channel was obscured by vegetation, and smoke or steam was being vented from one of the onsite buildings. (EPIC 1985).

The 1988 U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) report concluded that many areas of concern in the 1978 IIA report had been addressed under the Navy's NACIP program, with the completion of the 1983 Navy IAS and initiation of confirmation studies at many potential areas of contamination. It was recommended that the Crane Army Ammunition Activity (CAAA) work with NWSCC to minimize environmental impact from Army operations.

Under the authority of RCRA as amended by HSWA, a hazardous waste treatment, storage, and disposal facility must be permitted by the EPA. On December 23, 1989 NWSCC was granted a Final RCRA/HSWA Storage Permit. The corrective action requirements of the permit were negotiated between the Navy and the U.S. EPA Region V. This permit established the HSWA Corrective Action Requirements and Compliance Schedules obligating the U.S. Navy to perform RFIs at 30 SWMU, to conduct Corrective Measures Studies (CMS) and implement corrective measures if needed. (Donahue and Associates 1992).

Surface and shallow subsurface soil investigations are parts of the RFI process. An RCRA RFI Phase II Soils Study was conducted at an area known as the Rockeye Munition Facility, referred to in the permit as Rockeye SWMU 10/15. The USACE conducted the study. The field work was done in September and October 1990, laboratory analytical work in September, October, and November 1990, the data reduction and report writing from December 1990 to July 1991, and report revisions from February to June 1992.

The USACE Waterways Experiment Station (WES) is conducting an RFI, Phase III Site Characterization for Groundwater at the Rockeye Site. Data from 107 monitoring wells and borings are being evaluated to describe the hydrogeology, determine groundwater flow patterns, determine the extent of contaminant releases to groundwater, determine the horizontal and vertical distribution of contaminants, and predict the long-term disposition of contaminants at Rockeye. Subsurface geology (soil and rock types and characteristics, stratigraphy, geologic structure and location and description of aquifers and aquicludes) is being evaluated from descriptions of rock cores obtained from the borings. Three of four scheduled rounds of groundwater sampling of the wells were completed for most Appendix IX compounds and explosives.

Site Setting

Rockeye is a 10 acre site located on a flattened ridge crest that separates Sulphur Creek and Boggs Creek in the north central portion of the base, approximately 2 miles south of North Gate No. 1. Rockeye lies in the SE one-fourth of Section 5, T.5 N, R.3 W. on SR 45 (Figure 1). Drainage to the north and east goes to Sulphur Creek. Drainage to the south goes into (and is the origin of) Turkey Creek which flows into Boggs Creek. Drainage to the west goes into Greenwood Lake (Figure 2).

Rockeye is a production facility and not a storage, treatment, or disposal site. It began operation in the mid 1950's as a press-loading operation for 3-in. projectiles using Composition A-3 explosive (RDX and wax). In 1967-68, the facility was converted to a case-filling operation to produce the MK20 series antitank Rockeye cluster bomb. The Rockeye bomb is a 500-lb unit that contains 247 steel-cased bomblets, each holding a 0.4 pound blend of Octal Type II and Composition B high explosives. Octal Type II contains 70 percent HMX and 30 percent TNT. (HMX is octahydro-1,3,5,7-tetranitro 1,2,5,7-tetrazocine, which is cyclotetramethylene tetranitramine, and TNT is 2,4,6-trinitrotoluene.) Composition B is 60 percent RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine, which is cyclo-trimethylene-trinitramine or "cyclonite"), 39 percent TNT, and 1 percent wax, used as a desensitizer.

Figures 3, 4 and 5 include past pictures of catch basins and discharge locations for explosive-contaminated waters. As part of the loading operation, the system generates a large volume of wastewater. The wastewater is collected in four sumps. These sumps are located near boreholes 1, 3 and 4, 5 and 6A and 8, 9, and 10, which are shown in Figure 6. The sumps are periodically pumped and the residue is trucked to the Ammunition Burning Ground for disposal. Prior to 1978, explosive-contaminated waters for full sumps were discharged into the local streams (NEESA 1983). On the north side of the facility, the waters were released to a branch of Sulphur Creek, and on the south side the waters were released to Turkey Creek. Discharges with TNT concentrations as high as 50 ppm have been detected at the discharge points. Drainageways (streams and ditches) are shown in Figure 6. In the spring of 1978, an activated carbon water treatment facility (Building 3044, shown in

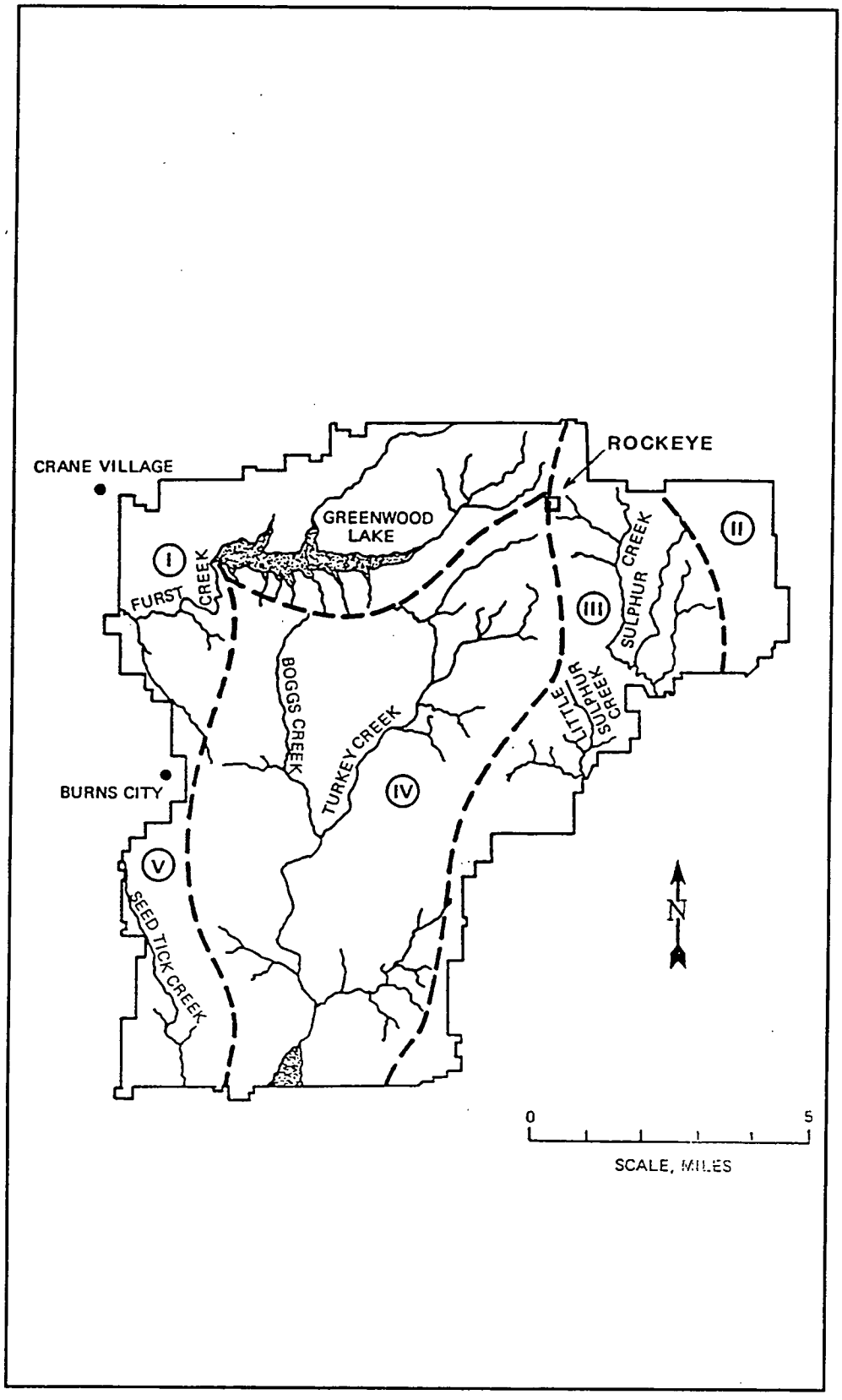
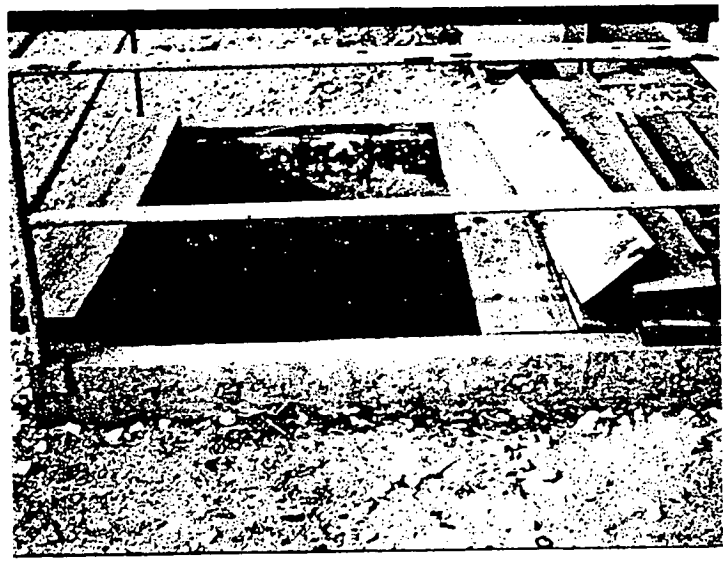


Figure 2. Surface drainage of NSWCC

"A Catch Basin in 3" Area"



"Covered to Hide Unsightliness"

Figure 3. Site photographs

"A Spill Trickles"

"Red Water Complex"

Figure 4. Site photographs

"More Red Complex"

"Red Water"

Figure 5. Site photographs

Figure 6) was brought into operation to purify the wastewater for recycled usage. In addition to a water treatment system, a scrubber system to remove contaminated particulates was designed and installed. In the tray wash area, explosive-contaminated trays are steam 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 has declined.

Groundwater conditions have been monitored at Rockeye since 1981. Groundwater contamination was detected during the 1981 groundwater sampling program (Dunbar 1982 and Hazardous Materials Technical Center (HMTC) 1985). Explosives were found in some of the groundwater samples. Additional monitoring wells were installed in 1983, 1988 and 1989, and 1990. From the ongoing RFI, Phase III Site Characterization for Groundwater at Rockeye, three of four scheduled rounds of groundwater sampling of the wells have been completed. The first two rounds have been analyzed and preliminarily evaluated. In the first round of sampling (March 1991), the following groups of parameters were analyzed for: metals, cyanide/sulfides, explosives, volatile organics, BNA organics, herbicides, pesticides, and PCB. All of the above parameters were also analyzed for in the second round, (June and July 1991), except for cyanide/sulfides. Detected levels of compounds were compared with USEPA existing and proposed drinking water standards. Drinking water standards are listed as two Maximum Contaminant Levels (MCL): primary levels which are enforceable, health-based standards; and secondary levels which are nonenforceable taste, odor, or appearance guidelines. In the first round of sampling, compounds detected above primary MCL levels were the metals beryllium, cadmium, mercury, nickel, and antimony. Compounds detected above secondary MCL levels were aluminum, iron, manganese, and mercury. Several other metals and a sulfide were detected in concentrations below MCL. In the second round, compounds detected above primary MCL levels in several wells were the same metals as round one, except for mercury. Mercury and several other metals were detected in concentrations below MCL. Mercury was detected in six wells, with the highest detected quantity being 0.0017 mg/1 in well 10C39P2. (MCL for mercury is 0.002 mg/1.)

Samples from several Rockeye wells contained explosives. (See Plates 1 and 2 for well locations.) A summary of the type of explosives found in concentrations above "B" and "J" levels, and in which wells they occur, is shown in Table 1. (A "J" value indicates that the organic compound was detected in amounts below the Instrument Detection Limit. A "B" indicates that the organic compound was also detected in the associated laboratory blank. "B" associated with an inorganic compound (metals, cyanides and sulfides) indicates detection in quantities greater than Instrument Detection Limit but less than the Quantitation Limit). All of these wells are located in or near the prominent surface drainage channel, running from the vicinity of the loading and washing Buildings 2734 and 2731 to the northeast corner of the Rockeye site and downslope to the north and east. From Round 1 sampling, the highest concentrations of HMX detected was 0.518 mg/1, of RDX was 0.806 mg/1, and of TNT was 0.379 mg/1, all in well 10-17. In Round 2 sampling, the highest concentration of HMX detected was 0.412 mg/1 in well 10C55P2. RDX was 0.632 mg/1 and TNT was 0.329 mg/1 in well 10-17. TNB was

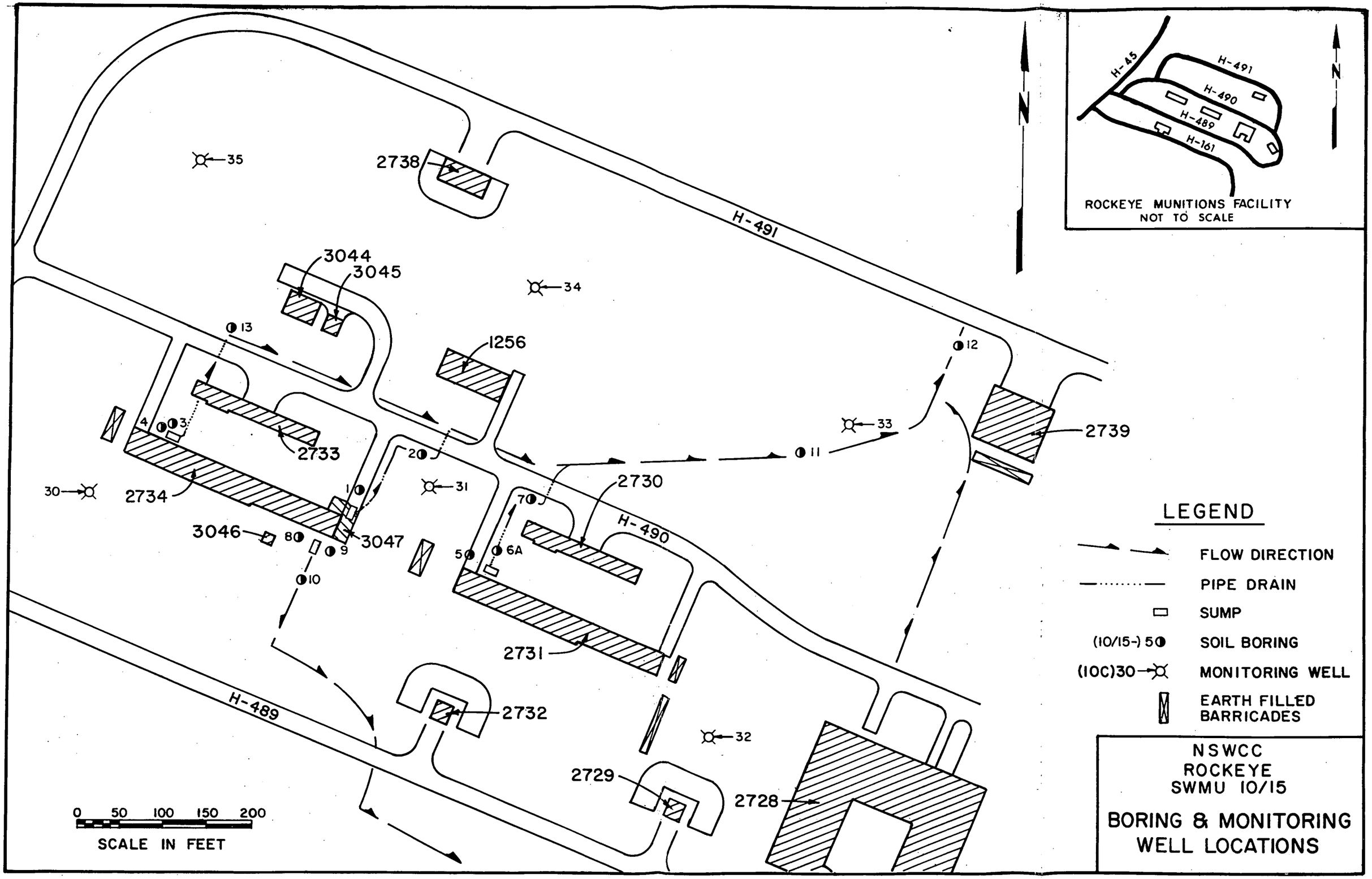


Figure 6. Boring and monitoring well locations

Table 1
Wells Contaminated with Explosives - Phase III Groundwater Study[1]

Explosive	Contaminated Wells[2]	
	Round 1	Round 2[3]
HMX	10-02, 07, 08, 17, 18, C55, C55P2, C60	10-07, 08, 17, 18, C55, C55P2
RDX	10-07, 08, 17, 18, 21, C55, C55P2, C60	10-07, 08, 17, C55, C55P2
TNT	10-17, C33, C55, C55P2	10-17, C55P2
TNB[4]	10-17	10-17

[1] Preliminary evaluation.
[2] Levels above "B" and "J" levels.
[3] Well 10-02 not sampled this round.
[4] Trinitrobenzene.

detected at 0.029 mg/1 in well 10-17. Well 10-17 also had the highest detected concentrations of explosives in Round 1.

Other compounds detected above "B" or "J" levels, but below MCL or for which no MCL exist were as follows: Round 1 - bis (2-ethylhexyl) phthalate (three wells), 1, 1, 1-trichloroethane (one well), di-N-octylphthalate (one well), and PCB-1254 (one well); Round 2 - touluene and t-xylene in well 10C39P2; and dieldrin, a pesticide, was detected in well 10C47 at 0.00003 mg/1, where the detection limit for dieldrin was 0.00002 mg/1.

Project Objective

RFI Phase II studies are release assessment studies. Their purpose is to determine if a chemical release has occurred and to characterize the host medium. The goals of this study were to determine if any lasting effects of the releases could be detected and to investigate the physical properties exhibited by the surface earth materials. To accomplish these goals, soil samples were taken at sites along the contamination routes, which were primarily drainage-ways due to pre-1978 operations. The soil borings were placed beside the sump structures and in the surface drainage ditches. Surface soil samples were collected within the stream beds of the discharge streams. The physical characterization of the soils was accomplished using standard USACE procedures (Unified Soil Classification System (USCS)). The chemical characterization was accomplished using EPA SW 846 methods and U.S. Army developed method of explosive waste detection.

2 Previous Studies

The environmental condition at Rockeye has been described in several reports. (A summary of results of many of these was presented in Chapter 1.) These reports, in chronological order, include a Pollution Control Program report prepared by Crane (NAD 1971); a Pollution Control Research Memorandum (McNulty et al. 1975); the initial Army installation assessment (USATHAMA 1978); the Dunbar reports (1982 and 1983); the Navy initial site assessment (NEESA 1983); the Dunbar report (1984); the Hazardous Material Technical Center confirmation study for Sites 2, 4, 6, and 10, June (1985); the EPIC report (Dial 1985), published as a working document for USATHAMA; and the USATHAMA initial assessment update (final report) (Bonds et al. 1988).

3 Procedures

Sampling Procedures

Detection of explosive waste contaminants in the soil is the primary concern of this study because Rockeye is a bomb production facility. Also, historical discussions of operations refer only to explosive pollutants at the site. A secondary concern is other contamination with inorganic and organic materials because some of these substances may be used in the manufacturing process. Samples were taken from vertical soil borings (near the sumps and in the base of the surface drainage ditches) and from surface scrapings (in the drainageways). Samples from boring locations shown in Figure 6 were used to identify sources of contamination and to determine any vertical migration of contaminants found. No control (background) boring samples were taken because an area not likely to receive discharges, Background North (BN), (removed from the operation but adjacent to the site), was selected to be used as a location for background samples. (BN 1 through 3 were taken at a depth of 3 to 6 in. below ground surface, discarding vegetation down to 3 in. This was accomplished using individual precleaned strips of plexiglas, as hand scoops, for each sample). Background subsurface soil information from the Ammunition Burning Ground and Old Rifle Range were used for comparative purposes.

The only identified waste disposal operation at this site was the sump system, which includes the sumps, open ditches leading from the sumps to the discharge point, and streams which received these discharges. Therefore, emphasis was placed on sampling near the sumps, ditches, and stream beds. The ditch and streambeds were examined to detect residual contamination. Surface scrapes were taken to define the horizontal migration of contaminants via the drainageways. Due to the possibility of ditch overflow during high discharges, the location of individual sampling points was determined using a sampling grid. Grid spacing was small enough to detect contamination within a 6-ft diameter. Areas where contaminant migration was probable were selected as sampling locations. Since residues from past operational releases would have been removed from the stream bed sediments due to natural flushing action, the areas of primary sampling were located on the stream banks and in overflow areas. Sample identification numbers for the surface scrapes consist of grid area identified by an alpha character and location within the grid identified by two numeric characters. For example, sample number A-0-1 was taken in grid Area A at location 0,1.

Vertical borings were drilled and discrete soil samples were taken to identify sources of contamination, to track the vertical migration of contamination through the soils, and to characterize the physical properties of the soil. For testing of the physical properties of the soils, at least one disturbed soil sample per boring was collected. When more than one soil horizon was detected, each soil horizon was sampled. Physical analysis was not performed on any of the surface scrape samples. Thirteen borings were drilled, using a truck-mounted drilling rig. The boring locations are shown in Figure 6. In the drainage ditches, soil borings were placed in the base of the ditch channels, since the ditch channels are not eroding. In the ditch borings (where soil thickness allowed), soil samples for chemical analyte detection were taken at the following depth intervals, 3 in. to 6 in., 12 in. to 18 in. and 6 in. above the water table or top of rock. Figure 7 is a schematic showing vertical sample locations within the borings. The deepest sample was tested for the presence of organic wastes. Those soils are the closest to the underlying groundwater zones and the most removed from the ground surface where evaporative forces and oxidation would have reduced the organic compound concentrations. From around the sumps, soil samples were taken from vertical auger holes. Modes of release from the sumps would be spillage and leakage. To detect spillage, a shallow soil sample was collected. To detect leakage, a soil sample was taken from just below the sump base. Each vertical soil boring and sample was assigned a unique identification number. It consists of the SWMU number, the boring number, the year the sample was taken, and, for the individual soil samples, the sampling order. The boring locations were determined by field personnel. Distances from existing wells whose coordinates were previously established were measured. The location coordinates were converted from latitude and longitude to Indiana State Grid coordinates (Table 2).

During the drilling operation, an area devoid of grass on an otherwise grassy berm behind Building 2734 and situated near an exhaust vent was observed. The observation was reported and it was decided that a sample of that soil should be taken. The sample was taken using scrape sample procedures and was analyzed for volatile and semivolatile organics, metals, and explosives.

Field Methods

Soil borings were placed using a Failing 1500 drilling rig equipped with a hollow stem auger. Samples were taken at specified depths. All sample depths were above the groundwater table and top of the rock. A Shelby tube sampler was advanced through a hollow stem auger, pressed to its full length, and then extracted. At the surface, the soil was extracted from the sampler, peeled, and bottled in the shortest time possible. Peeling is the process that removes that portion of the sample which is in direct contact with the sampler. Ends of the sample were not used. Soil samples were placed into clear sterilized (ICHEM) sample jars, bottles, and vials. Samples for volatile analysis were taken, bottled, and capped within 15 sec from the time the sampler was opened. All other samples were extruded into wide-mouth glass jars or other containers with minimal disturbance of the sample.

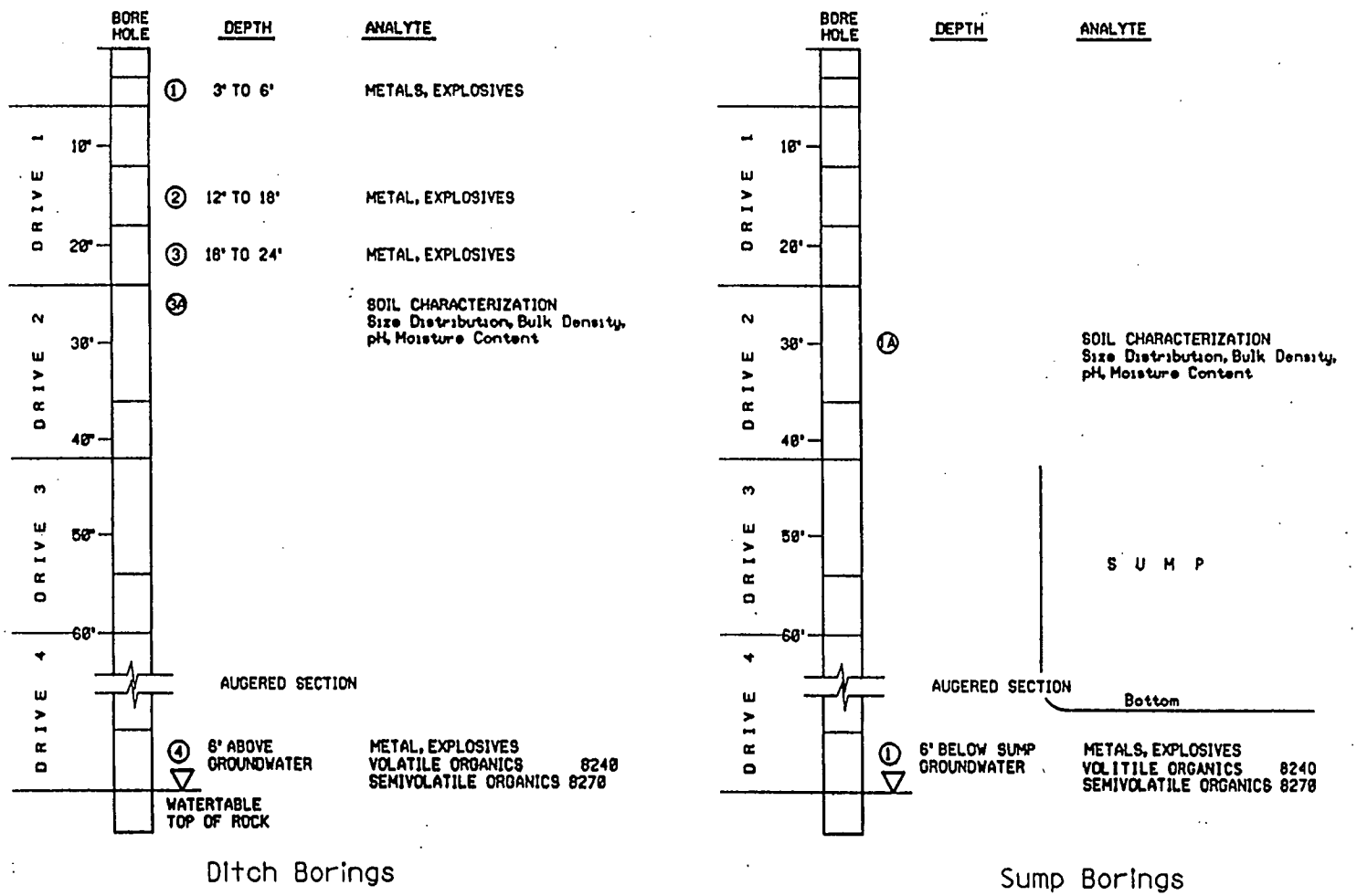


Figure 7. Simplified boring diagram showing sample depths

Table 2
Bore Hole Locations (Coordinates in Indiana State Grid Coordinates)

Boring Number	Northing	Easting
10\15-1-90	507200	591328
10\15-2-90	507242	591397
10\15-3-90	507278	591110
10\15-4-90	507272	591102
10\15-5-90	507125	591460
10\15-6A-90	507133	591485
10\15-7-90	507195	591520
10\15-8-90	507148	591260
10\15-9-90	507133	591293
10\15-10-90	507098	591262
10\15-11-90	507248	591830
10\15-12-90	507372	592110
10\15-13-90	507388	591178

Following sample collection, the hole was backfilled using a Bentonite cement grout. The cuttings from the hole, not removed for sampling, were contained in drums. The drums were marked and left on the site. The markings included information describing the contents of the drum and the boring from which the cuttings were taken. NSWCC has custody of the drums and is responsible for the disposal of their contents. One 16-oz soil sample was collected for inorganic, explosive, and semivolatile organic compound testing. Two 40 ml samples were taken for volatile organic compound analysis. The sample jars or bottles were sealed and placed in secured ice chests (coolers) for storage at a temperature of 4° Celsius. The coolers containing the samples with their accompanying Chain of Custody forms were transported to the Corps of Engineers WES Analytical Lab Group for analysis. Transport was by an overnight air freight carrier service. A seal was placed on each cooler to ensure that the samples had not been disturbed during transport to the laboratory. Chemical preservatives were not used. Table 3 lists the sample container used for each type of chemical analysis.

Parameters and Analytical Methods

Analytical parameters and methods are shown on Table 4. All analytical methods, except for explosive compounds, were according to *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*, Third Edition, November 1986 with December 1988 revisions, published by the

Table 3
Chemical Analysis Summarization of Sample Containers

Matrix	Parameters	Containers
Soil	Volatiles	2X40 Ml glass
Soil	Semivolatiles Explosives Inorganics	1 X 16 oz glass

Table 4
Summary of Methods for Determination of Chemical Compound Analyses

	Techniques[1]	Soils Methods from SW-846	
		Extraction	Analysis
Organic Analyses			
Volatiles	GC/MS	Inc. No.	8240
Semivolatiles	GC/MS	3540/3550	8270
Explosives HMX, RDX, TNB, Tetryl, 24DNT, 26DNT, TNT	HPLC	USATHAMA (now 8330)	USATHAMA (now 8330)
Inorganic Analyses			
Aluminum	ICP	3050	6010
Antimony	ICP	3050	6010
Arsenic	GF	3050	7060
Barium	ICP	3050	6010
Beryllium	ICP	3050	6010
Cadium	ICP	3050	6010
Chromium	ICP	3050	6010
Cobalt	ICP	3050	6010
Copper	ICP	3050	6010
Iron	ICP	3050	6010
Lead	ICP	3050	6010
Magnesium	ICP	3050	6010
Nickel	ICP	3050	6010
Tin	ICP	3050	6010
Zinc	ICP	3050	6010

[1] Abbreviations: GF = Graphite Furnace, and ICP = Inductively Coupled Plasma, Inc. No. = extraction procedure included in method procedure.

U.S. Environmental Protection Agency. Explosive compounds were analyzed by USATHAMA Methods, now incorporated in EPA Method 8330 of SW-846.

To ensure the samples and their resultant chemical data are representative of the site conditions, a quality control program was begun. As part of this quality control program, a sample tracking procedure was used. This process starts in the field with chain of custody procedures and sample isolation and preservation. The tracking procedures are continued in the laboratory. A complete laboratory quality assurance/quality control plan was followed. Document management was started upon the receipt of the samples. Log books, bench sheets, and reports were kept. All data are checked by the analyst, the inorganic team leader or the organic team leader, and the laboratory Chief before the data were released. The data were checked for completeness. The completeness check was to ensure that: (a) all samples and analyses have been processed; (b) complete records including Chain of Custody for each analysis and associated QC samples were used, (c) procedures specified in project planning were followed, and (d) all calibrations were performed.

The following items were checked:

a. Completeness.

b. Duplicate values for precision.

c. Recovery of spikes for accuracy.

d. Method blanks for contamination.

e. Surrogate recoveries for organic analysis.

f. Data for QA check samples.

g. Reasonableness and trends.

If data fell outside of acceptable limits as described in the analytical methods, the sample was rerun if the required amount of sample was available. If the rerun results continued to fall outside acceptable limits and the QA check sample data were good, then data were reported with qualifying explanations. Acceptable data were usually defined by the specific procedural method (i.e., SW-846).

Final data reports went through several review and approval levels. The generated data were finally checked for validity. The data were evaluated with respect to:

a. Detection limits.

b. Control limits for duplicates, spikes, blanks, and surrogates.

c. Data control within control limits and corrective actions

d. Flagging consistently out of control data.

A validation report was prepared by WES-ALG as a final step in the data preparation process, and is contained in Appendix D.

Physical Parameter Analysis

Soil samples were characterized using standard USACE geotechnical methods. These methods are described in Corps of Engineers manual 1110-2-1906, *Laboratory Soils Testing* (Headquarters, Department of the Army (HQDOA) 1970). The soil samples were described and classified in the field by the field crew and in the laboratory by the analyst. The lab classification consisted of a visual classification, a sieve and hydrometer analysis, determination of natural water content, USCS classification, and organic content. The sieve analysis determines the gradation of grain sizes ranging from the No. 4 sieve (4.76 mm) to the number 200 sieve (0.074 mm). To determine the percentage of silt and clay in the fine fraction of the sample, hydrometer analytical methods were used.

4 Site Characterization

Geologic Setting

Rockeye is located on a flattened ridge crest, which separates the Sulphur Creek and the Turkey/Boggs Creek drainage basins. Rockeye is underlain by Pennsylvanian age sedimentary rocks of the Mansfield Formation. The dominant rock types are sandstones and shales.

The geology of the Rockeye site was characterized by information from borings emplaced for 35 groundwater monitoring wells (Dunbar 1984). As a part of the Phase II Soils Study, 13 auger borings were drilled by WES. Soil samples were taken and analyzed for contamination and physical character. The locations of the well borings are presented in geologic sections A-A', B-B', and C-C' in Figures 8, 9 and 10, respectively (modified from Dunbar 1984). A description of the sections was presented in the Dunbar (1984) report. Geologic section D-D', (Figure 11), presents the 1981 core barrel/rock bit boring data. The detailed individual field boring logs from the 1990 sampling are found in Appendix B. The geological description of subsurface units at Rockeye has been modified extensively with information from the 107 well borings (1988-1990), many of which were cored. The modified geological description will be presented in the Phase III RFI Groundwater Release Characterization Report to be released later.

There are currently 107 monitoring wells in place at Rockeye. An RFI Phase III Site Characterization for Groundwater is being conducted by WES. A summary of some of the preliminary findings of this study have been included in Chapter 1 of this report.

Soil Conditions

The soil thickness at the Rockeye site ranges from 0.5 ft to almost 17.0 ft. The areal variability of soil thickness is shown in Figure 12. To level out the Rockeye site, fill was placed in the eroded stream valleys. Therefore, the sites of thicker soil today coincide with the filled stream valleys. Surface drainage is to the north, southwest, and northeast, and flows into Furst Creek, Turkey Creek and Sulphur Creek, respectively (Figure 2). The thicker (greater than

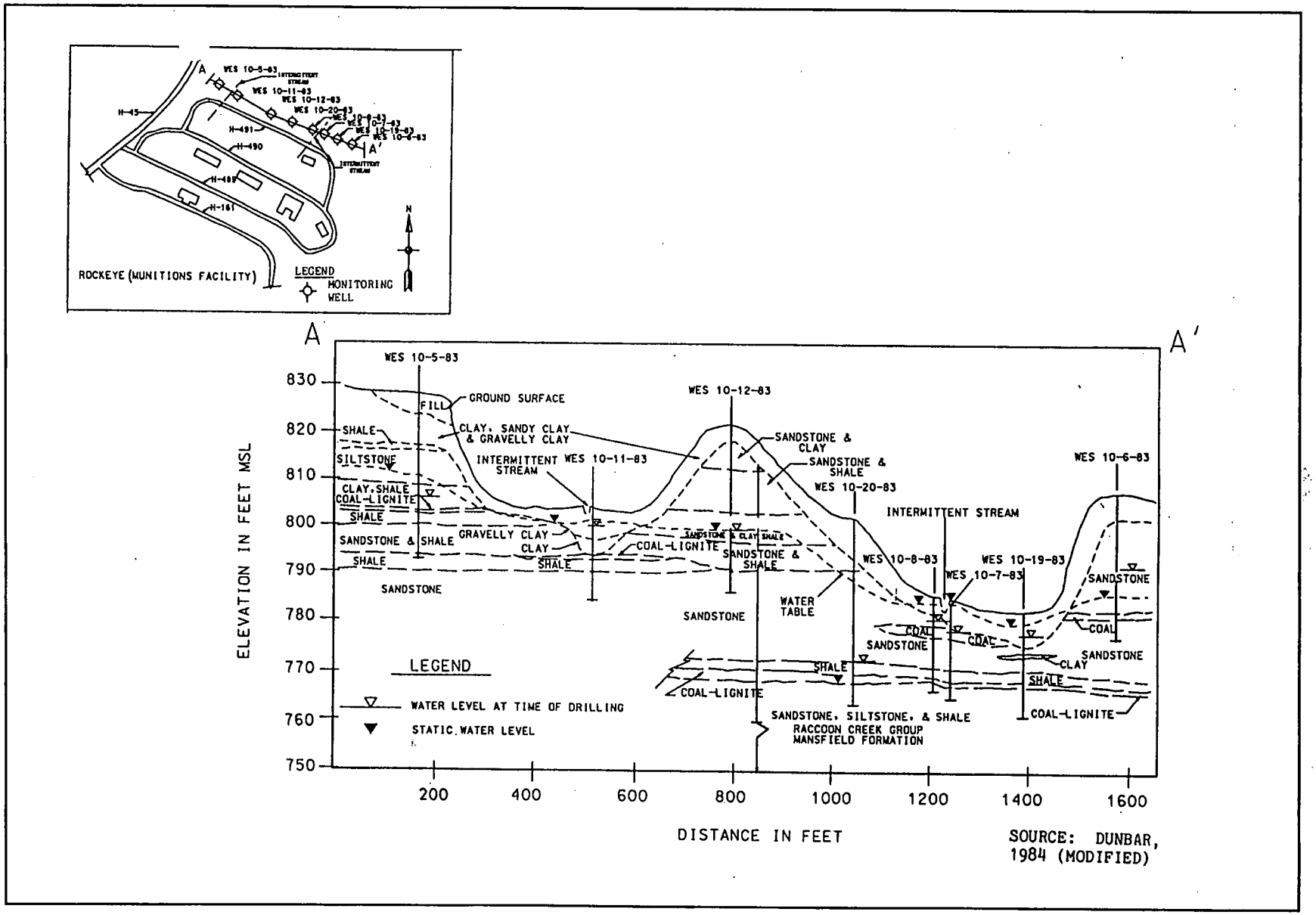
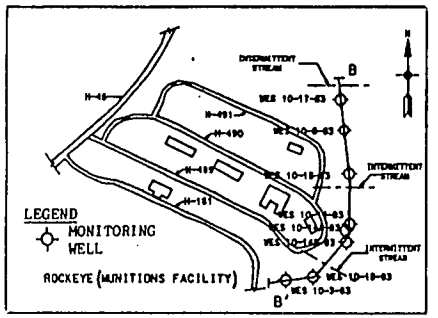
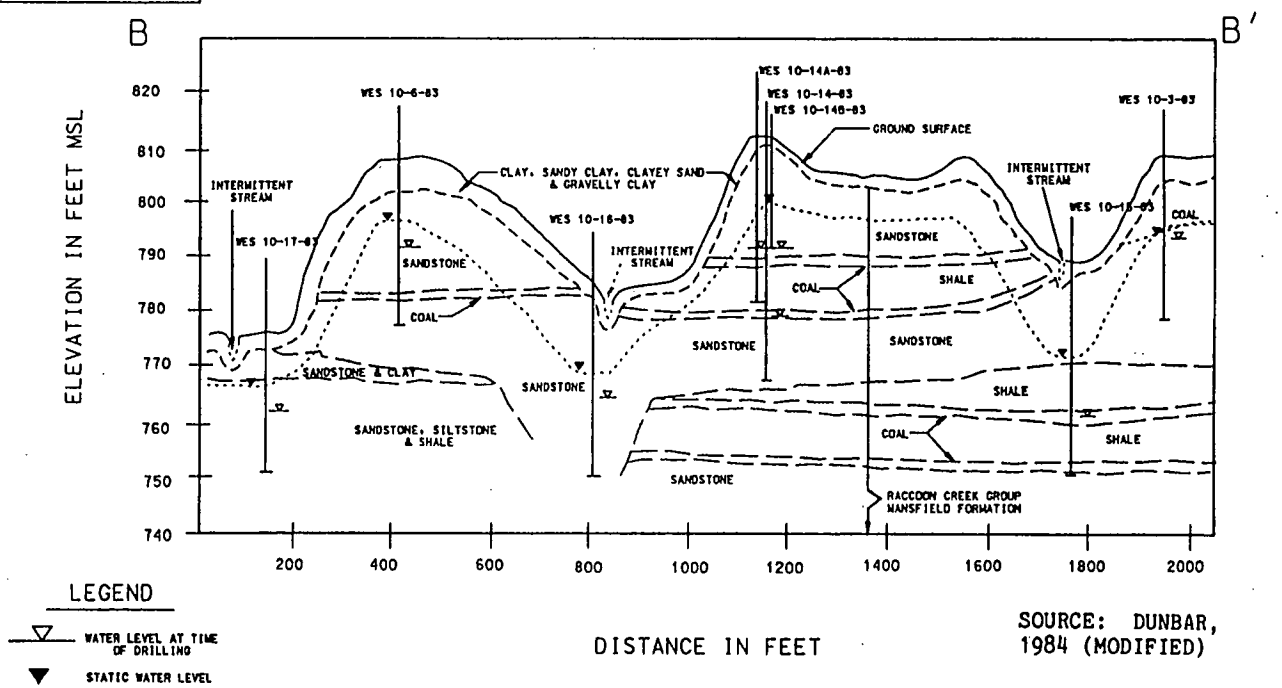


Figure 8. Geological cross section A-A





LEGEND

WATER LEVEL AT TIME OF DRILLING

STATIC WATER LEVEL

SOURCE: DUNBAR, 1984 (MODIFIED)

Figure 9. Geological cross section B-B

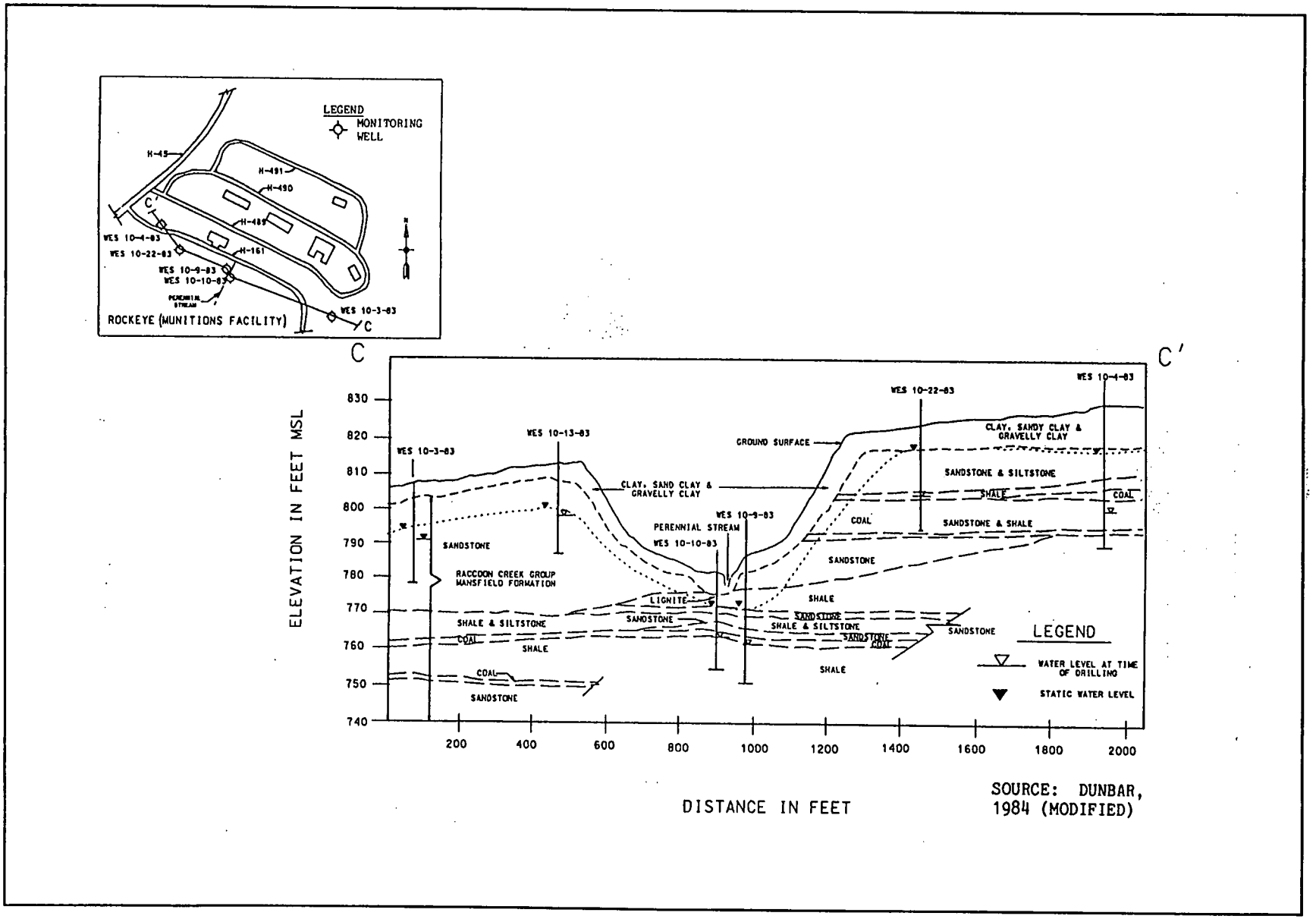


Figure 10. Geological cross section C-C

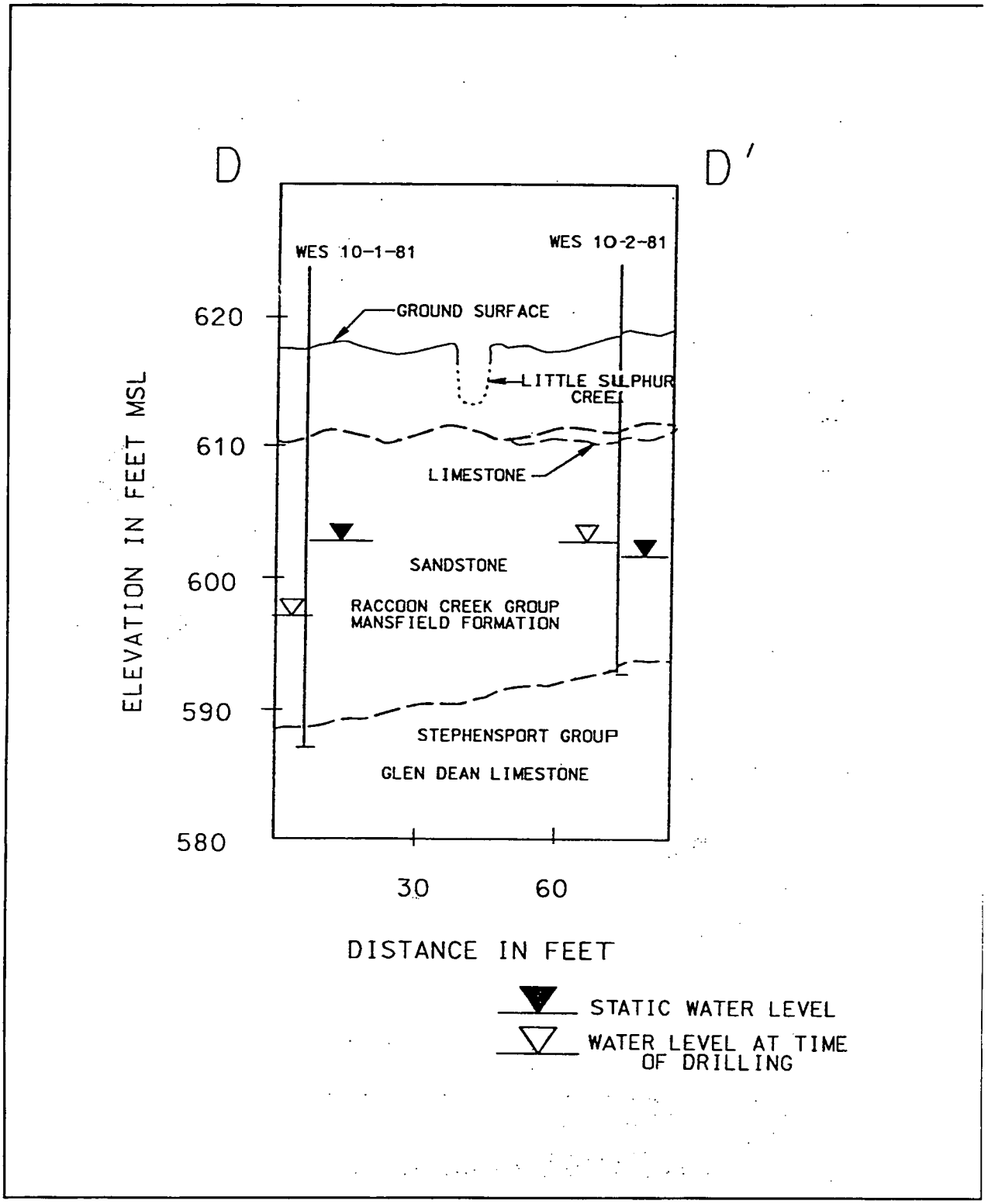


Figure 11. Geological cross section D-D

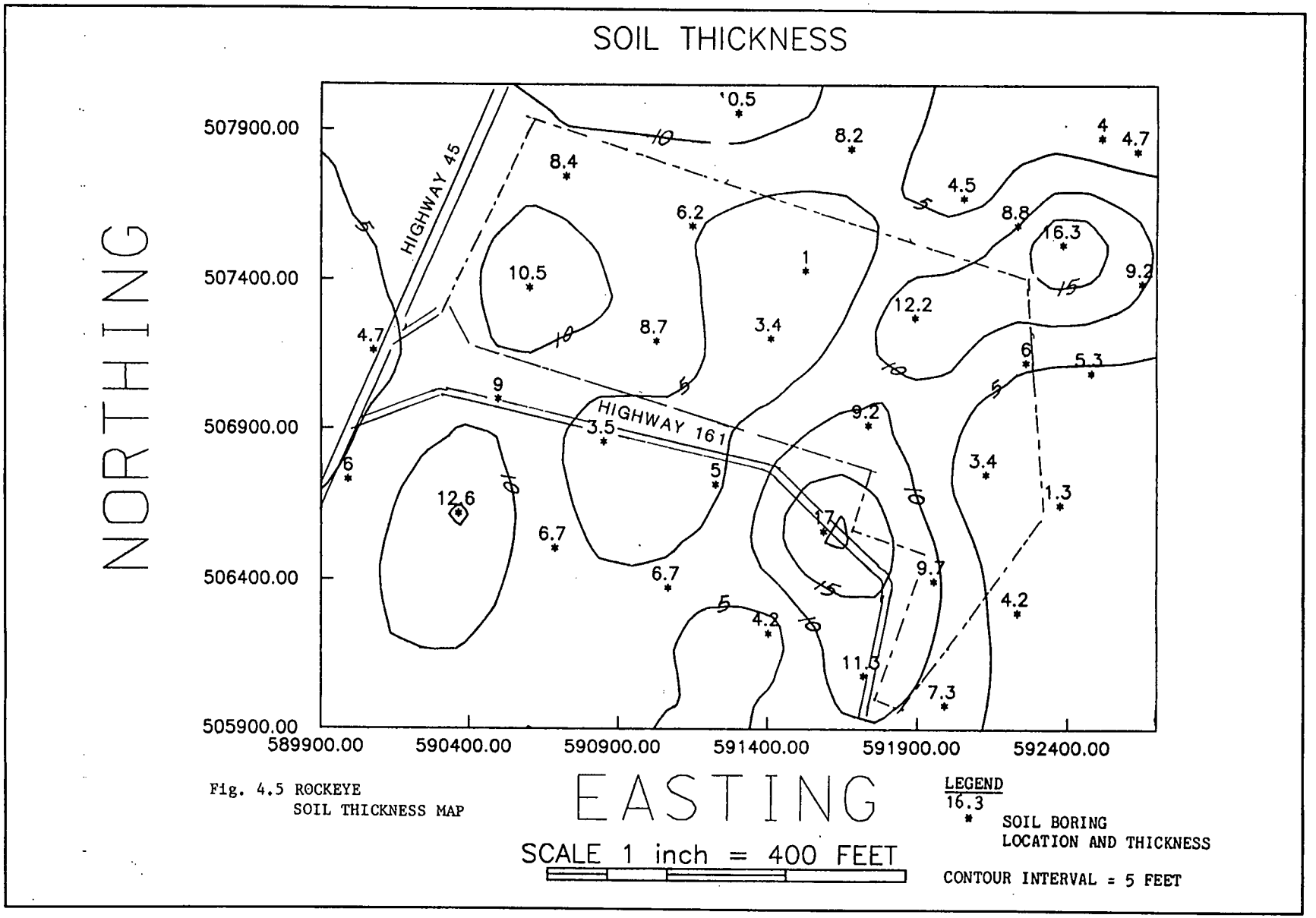


Figure 12. Soil thickness map

5 ft) sections of soil are alluvial and fill material. The fill at the Rockeye site contains CL and CH (clays) material. Prior to fluvial incision, a residual soil formed from the weathering of parent rock material. Remnants of the residual soil make up a portion of the soil stratigraphic sequence.

Soil samples from the auger borings of this Phase II Soils Study were classified in the field according to the USCS. Selected soil samples were analyzed later in the laboratory. The soil types which compose the Rockeye site are predominately clays (CL) with lesser amounts of sand (SM) and silt (ML). The fill material contains clay and gravel. The sub-surface clays and silts contain sassafras root and natural organic debris. The clay (CL) represents the residual soil, a weathering product of the shale and sandstone as observed in all borings except 10/15-01- 90. Residual soil is also found as silt (ML) with scattered sandstone fragments and roots in borings 10/15-01-90, 10/15-08-90, 10/15-09-90, 10/15-10-90 and 10/15-12-90. See Appendix B for boring logs and Appendix C for soil data.

Hydrogeology

Thirteen soil borings were drilled at the Rockeye site. Water was encountered in borings 10/15-01-90, 10/15-06-90, 10/15-12-90, and 10/15-13-90 during drilling. All the other soil auger borings were dry holes. Previous investigations (Dunbar 1982) also found the soil to be unsaturated with the exception of the borings located on the flattened ridge crest. Groundwater was found in the fractures of the underlying Pennsylvanian age sedimentary rock. The average depth to this groundwater surface was approximately 17 ft (Elevation 795 ft msl) below ground surface. The soil is, practically speaking, impermeable with most rainfall exiting the site as surface runoff. This is because the soil is mostly compacted clay which is impermeable. During periods of infiltration, the soil acts as a very slow conduit for groundwater and its contaminants. The surface of the groundwater table roughly parallels the topographic surface. The groundwater flows to the east from the ridge summit. Dunbar's (1982) study shows that the Rockeye site is coincident with a groundwater divide which trends southwest-northeast. Groundwater moves away from this divide. The direction of groundwater flow depends on whether the point of concern is east or west of the divide. Based on the available evidence, groundwater moves very slowly through the soil by downward vertical infiltration, then laterally along the soil/rock interface until it reaches fractured rock and enters the rock aquifer system. Characterization of groundwater flow at the Rockeye site will be presented in the Phase III RFI Groundwater Release Characterization Report to be released later.

5 Chemical Analytical Results

Introduction

Surface and subsurface soil samples were taken at Rockeye, NSWCC, Solid Waste Management Unit (SWMU) #10/15 between September 5 and October 14, 1990. Figure 13 shows the location of the soil borings and surface sample collection areas and the Rockeye layout. Parameters analyzed for in this Phase II soils study were selected metals, volatiles, semivolatiles, and explosives.

Design of the soils sampling program was based on the Initial Assessment Study (IAS), prepared by NEESA in 1983. The IAS indicated that wash water from the munitions production line, which contained explosive compound contaminants (TNT, HMX, and RDX), was discharged into sumps where suspended material settled. Effluent from the sumps was occasionally allowed to flow via open ditches and drainage courses into nearby creeks. Since 1978, the effluent has been treated by an activated carbon treatment facility.

For this soils investigation, soil samples were taken at sites where wash water from the munition production lines was released and would likely have made contact with soils, i.e., in the sumps, the open ditches leading from the sumps, and in the drainage courses at the facility perimeter, which receive runoff water from the munitions facility. Contaminants were released from Rockeye through the discharge of wash water effluent.

The objective of this soils sampling program was to determine if contaminants were retained in the soils of Rockeye. The sampling of the pathways of release, i.e., the sumps, ditches, and drainage courses, should provide some indication of that occurrence. A release is defined as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, dumping, or disposing into the environment (definition set forth in 40 CFR 302.3).

Figure 13 and Figure 6 show the subsurface and surface soil sample locations. Soil Borings 1 through 13 (inclusive) were made to sample soils adjacent to Rockeye effluent sumps and ditches leading from the sumps. Borings 1, 3, 4, 5, 6A, 8, 9, and 10 sampled the sumps while Borings 2, 7, 11, 12, and 13 were associated with ditches. (Boring 6A replaced boring 6 because the original bore hole could not be sampled. The sample location was

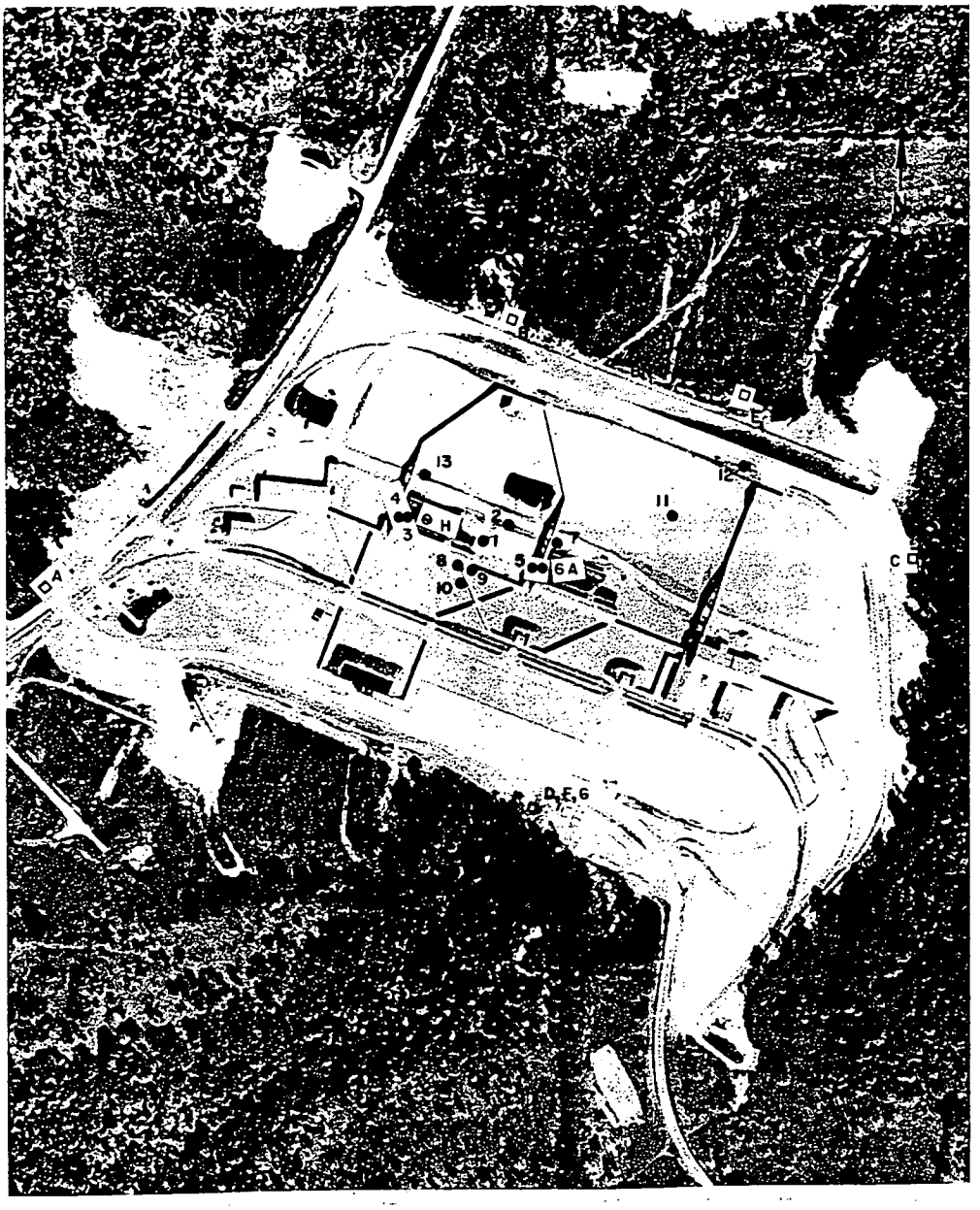


Figure 13. Locations of soil borings and sample areas

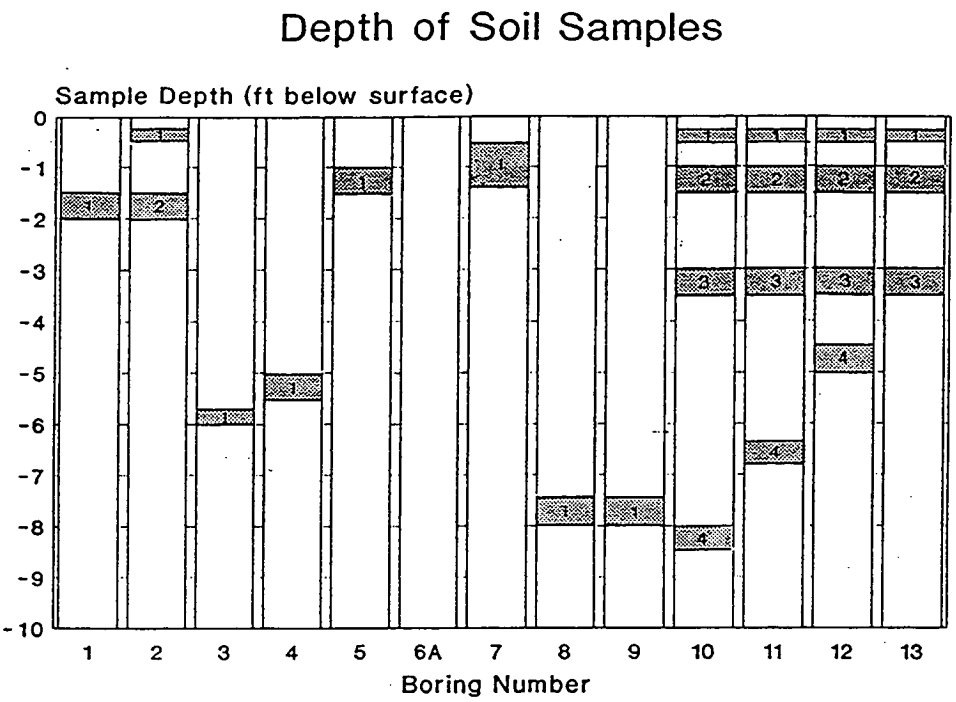
moved and labeled 6A.) Subsurface soil samples were taken using 3-in. Shelby tubes at a depth equal to the bottom depth of the sump or at specified intervals. The depth from which each soil sample was taken is indicated in Figure 14. Also provided on Figure 14 are the dates the borings were made and samples collected.

No background subsurface samples were taken. Subsurface samples from the Ammunition Burning Ground (ABG) and the Old Rifle Range (ORR), and other NSWCC locations, were used as background for comparative purposes, as soils from these areas are similar to Rockeye. Surface soil samples selected to be background samples, indicated as BN (Background North) 1 through 3, were taken at locations adjacent to and north of Rockeye. Not all "BN" samples were analyzed for all inorganic and organic parameters. Topography indicates that these sites likely did not receive surface water discharges from the Rockeye sumps and ditches. Soils from sample sites BN1-3 were sampled to identify characteristics of soils in the vicinity of Rockeye as if no waste disposal activities had occurred at those facilities, but all other influences on soil characteristics had taken place.

To provide an even more representative background, surface samples from Area C, located on the northeast edge of Rockeye, have also been included as background. These samples were included after chemical analyses indicated that this area was at least as "clean" of contaminants as Background North.

Surface soil samples were taken from drainage courses which lead from Rockeye. Surface samples were taken from Areas A through E (inclusive) in grid patterns with sample locations 5 ft apart. Samples were not taken from the drainage courses in grid Areas A, B, and C, due either to significant erosion or depth of water. While all grid samples were analyzed for explosive compounds, only selected samples were analyzed for inorganic, semivolatile organic, and volatile organic compounds. Surface samples were also taken at locations F, G, and H. The F and G samples were not grid samples, but were taken within and adjacent to a drainage course (ditch). Figures 15 through 17 are illustrations of the surface soil grid sampling areas. At the request of NSWCC, a surface soil sample (sample H) was taken in the area of an air vent discharge from one of the Rockeye buildings. All surface soil samples were taken at a depth of 3 to 6 in. below the ground surface using a precleaned plexiglas hand scoop. Soil and vegetation to 3 in. below ground surface were discarded. As discussed previously, three surface soil samples, BN 1 through 3, and samples from Area C, were selected to be background samples.

To assist in data interpretation and determine sources of error, the results of the analyses of method blanks and equipment rinses are given. Method blanks are determined by following the analytical procedure step by step including all of the reagents and solvents, in the quantity required by the analytical method. Method blanks are a measure of cumulative interferences from the laboratory or the analytical method. Equipment rinses are samples obtained by running analyte-free water over/through sample equipment after it has been cleaned. Analyses of equipment rinses are used to evaluate equipment cleaning



Rockeye (SWMU# 10/15) - NSWC Crane, Indiana
Dates Samples Collected

Boring 1	14 SEP 90	Boring 4	22 SEP 90	Boring 7	13 OCT 90	Boring 10	14 OCT 90
Boring 2	13 OCT 90	Boring 5	14 SEP 90	Boring 8	14 OCT 90	Boring 11	12 OCT 90
Boring 3	24 SEP 90	Boring 6A	21 SEP 90	Boring 9	14 OCT 90	Boring 12	12 OCT 90
						Boring 13	13 OCT 90

Features Sampled

Boring 1	SUMP	Boring 4	SUMP	Boring 7	DITCH	Boring 10	SUMP
Boring 2	DITCH	Boring 5	SUMP	Boring 8	SUMP	Boring 11	DITCH
Boring 3	SUMP	Boring 6A	SUMP	Boring 9	SUMP	Boring 12	DITCH
						Boring 13	DITCH

Figure 14. Depth of soil samples and dates of collection

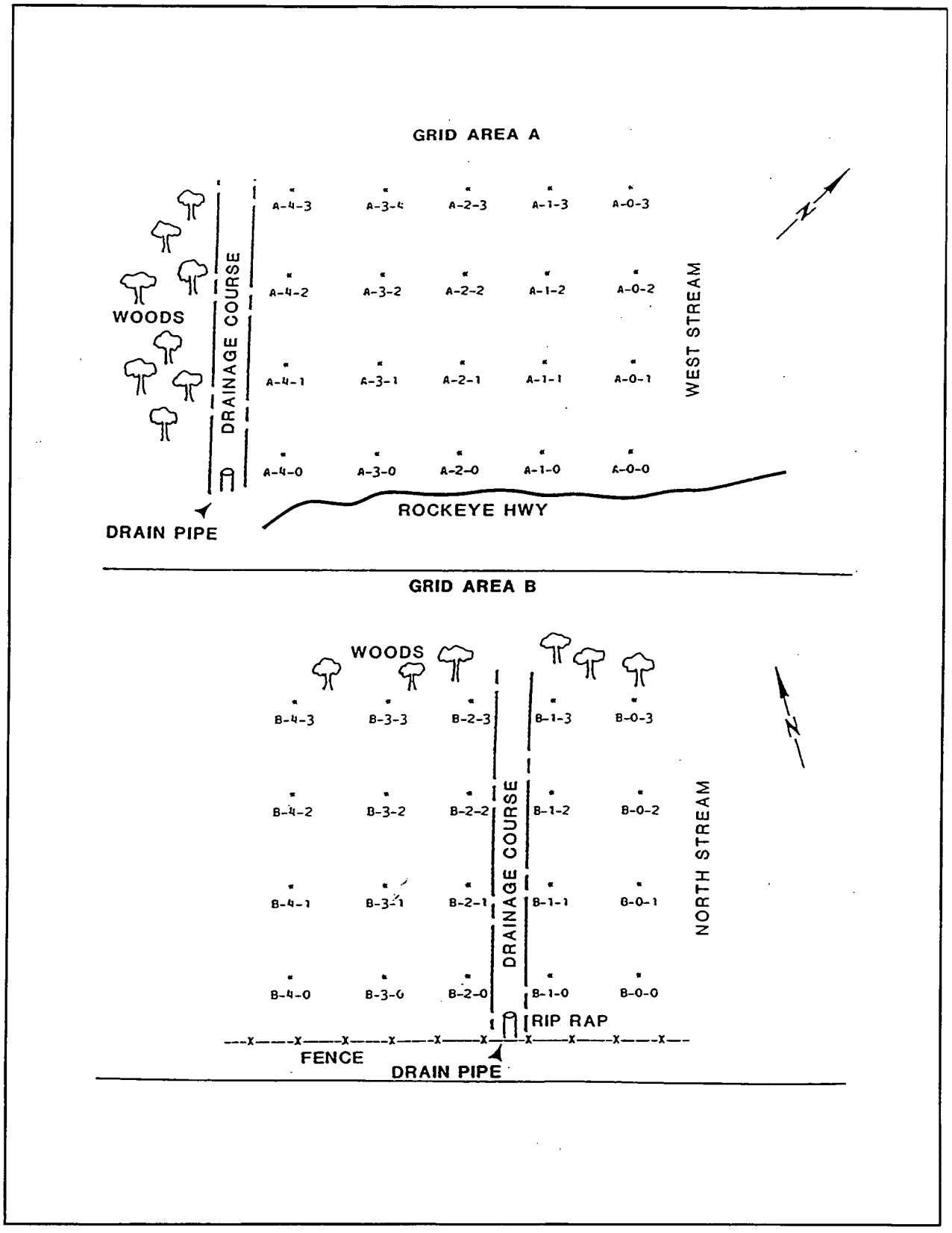


Figure 15. Grid sample Areas A and B

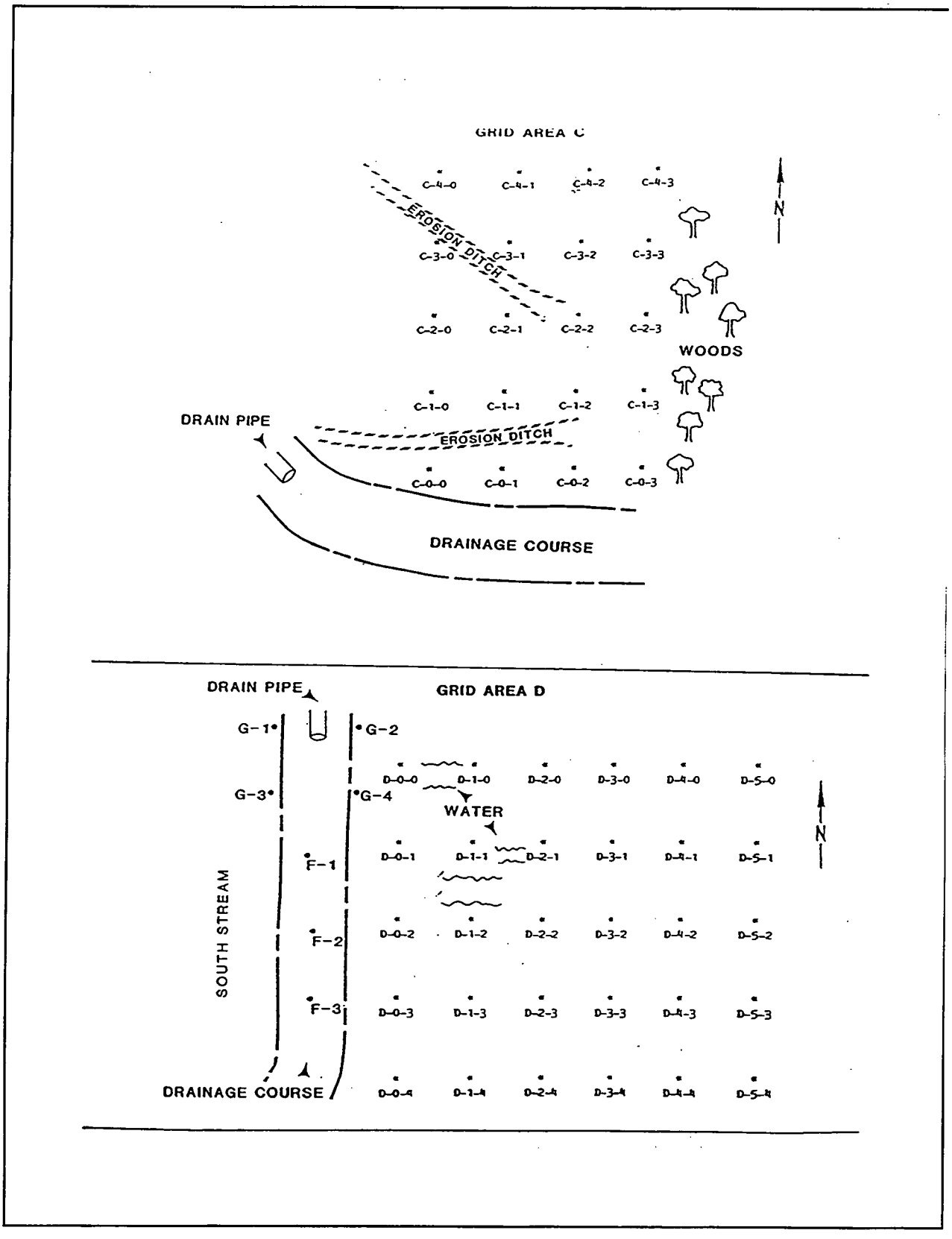


Figure 16. Grid sample Areas C and D

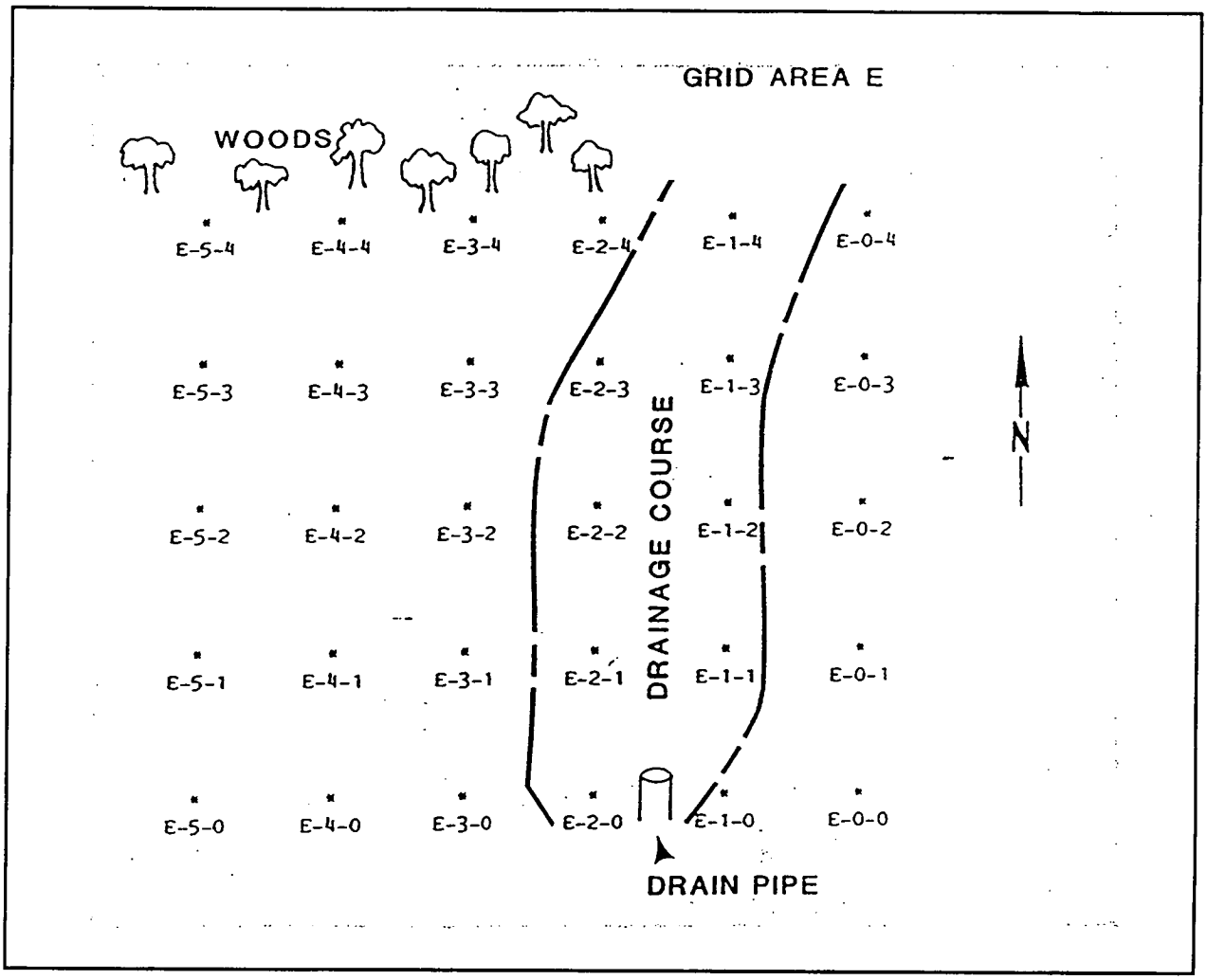


Figure 17. Grid sample area E

To ensure validity of the chemical data obtained, a chemical data quality control program was followed during the Rockeye soil sampling and subsequent laboratory analyses. Quality Control Level "C," as explained in the NEESA guidance 20.2-047b "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program," (NEESA 1983) was followed. In summary, the NEESA Quality Control Level C plan requires the use of USEPA approved methods when available, a duplication of at least 10 percent of the samples, the collection and analysis of equipment rinse blanks (samples of final equipment rinses) on a daily basis, the collection and analysis of field blanks (samples of organic-free water exposed to the sample environment) and the use of trip blanks with all samples specified for volatile organic analyses. The intent of the plan is to ensure that sources of extraneous contamination can be determined and that decisions made using the data are meaningful and supported. An exception to Quality Control Level C for the Rockeye soils investigations was that no field blanks were collected. This exception to the quality control plan was apparently a field crew

oversight. Additionally, no field duplicates were taken. However, it is believed that the data as obtained have value and are meaningful for determining the presence or absence of the tested-for contaminants in this study phase. Increased efforts to better implement appropriate field quality control will be made in the next phase of investigations at this site. The Chemical Analytical Data, Validation Report, which summarizes the chemical data quality control program results, is included in Appendix D.

Because inorganic analytes are naturally occurring elements in the earth's crust, the identification of soil contaminants, which are also naturally occurring soil constituents, is better accomplished using statistical comparisons between background or "uncontaminated" soil concentrations and those of the test soil. Due to the small number of subsurface soil samples, (primarily one sample at a given elevation per boring), meaningful statistical analysis would not be possible. Therefore, comparison between Rockeye subsurface soils and those from the ABG and Old Rifle Range backgrounds were done using graphical representations. Due to the greater number of surface samples which were taken at Rockeye, statistical comparisons have been made between those test soils and surface soil background samples. In all cases, surface samples were taken at a depth of from 3 to 6 in., to eliminate vegetative material from the sample. The specific information obtained from each sample is presented and qualitative observations are made from that data.

Mean concentrations of inorganic constituents from test surface areas were compared to those of the background samples using a t-test with $p = 0.05$ (95 percent level of confidence). Means were computed from all samples from a specific area; however, background means were computed using all samples taken from surface sample Area C and background north, BN2. Assumptions were made that both means were obtained from random samples and that both means were obtained from normal populations. The first hypothesis, tested with a 95 percent confidence level F test, was that the variance of the two means being compared were equal or alternately not equal. Based on the results of the first tests of hypotheses, a common population variance was or was not computed and appropriate degrees of freedom computed. Subsequently, a second hypothesis was tested with a t test. This hypothesis tested if the sample area and the background mean constituent concentrations were equal, or alternately, if the test mean was greater than the background mean. An example of the calculations used for arsenic follows.

For arsenic (As) test background (Area C +BN No. 2 versus Area A. Test to see if variances are significantly different at 95 percent level of confidence $\alpha = .05$ (Table 5).

Table 5
Mean-Variance Calculations

Background	Area A
Mean = 3.55 Variance = 0.7569 n = 5	Mean = 7.28 Variance = 4.9284 n = 4

Null Hypothesis Ho: $\sigma_1^2 = \sigma_2^2$ $F = s_1^2/s_2^2 = 4.9284/0.7569 = 6.511$
Alt Hypothesis Ha: $\sigma_1^2 \neq \sigma_2^2$
Use F test - Critical value F = 5.19 with 3 and 4° of freedom

6.511 > 5.19 therefore we reject Ho and accept Ha

Now test sample mean to see if means are significantly different

Ho: $U_1 - U_2 = 0$ Use t as test statistic

Ha: $U_1 - U_2 > 0$ t = (mean 1 - mean 2) /sd = -3.17

sd = sqrt (variance 1 / n + variance 2 / n)

sd = 1.176

Critical values of t = ± 2.132 and ± 2.353 with 4 and 3° of freedom.

Therefore reject Ho and accept Ha; arsenic present.

Discussion of Analytical Results

Metals

The results of selected metals analyses of Rockeye soils are given in tabular form in Tables A4 through A11 of Appendix A. The results of soils sampled by boring are given in Table 5.1 of Appendix A. Analyte concentrations in the soils are given as milligrams per kilogram (parts per million) on a dry weight basis. The detection limit is provided (following the < symbol) where specific metals in the soils were not detected. Table A5 (Appendix A) provides the results of metals analyses of soils sampled as surface scrapes. Table A6 (Appendix A) indicates the maximum concentrations of selected inorganic analytes determined for the Rockeye soils sampled. Statistical analyses of the sample data are provided in Tables A7 and A8 of Appendix A, respectively.

The results for specific inorganic constituents are also given graphically in Figures 18 through 19 from data contained in Appendix A. These bar charts provide constituent concentrations for each sample taken from a boring. The bars are oriented from shallowest sample in the boring, on the left, to deepest sample in the boring, on the right. Graphs are not provided for tin as all soil boring analyses results were <7.60 mg/kg.

As stated previously, no subsurface control samples were taken at Rockeye. Instead, background subsurface samples from ABG (SWMU 03/10) and ORR (SWMU 07/09) have been used for comparative purposes. Three-dimensional histograms shown in Figures 22 through 43 depict the relationship between the metals concentrations of soils from the Rockeye borings and these background samples.

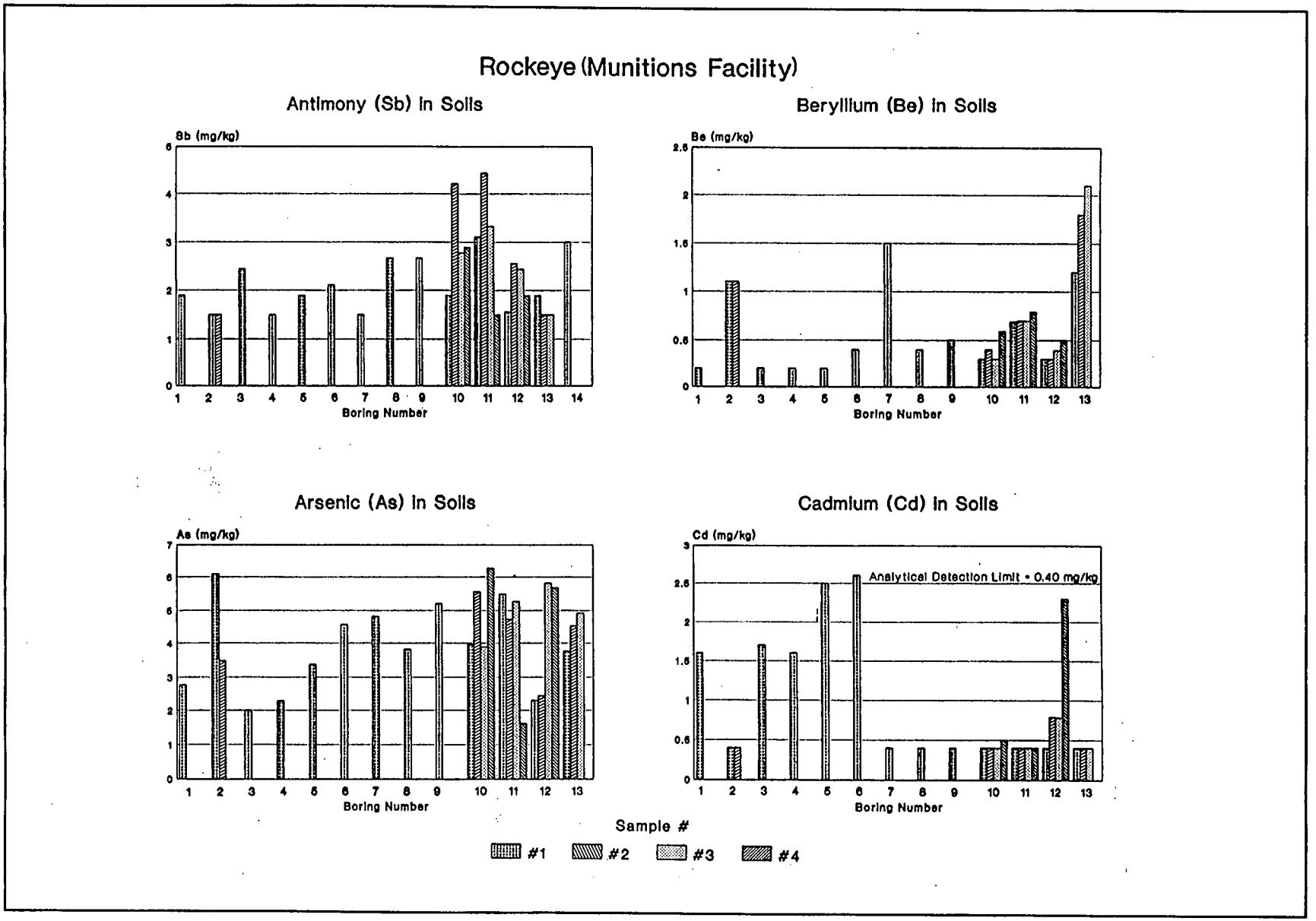


Figure 18. Antimony, beryllium, arsenic and cadmium concentrations

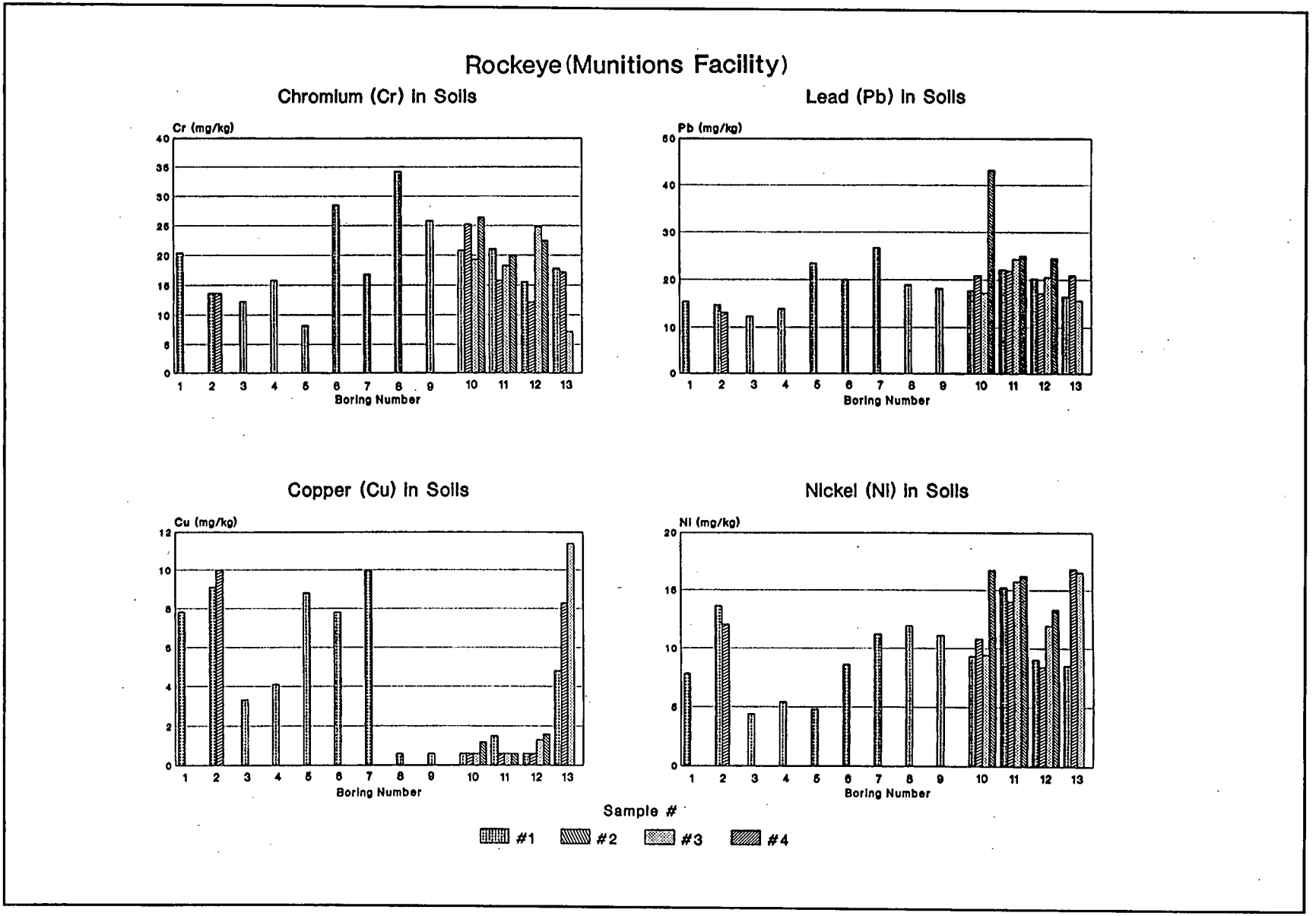


Figure 19. Chromium, lead, copper and nickel concentrations

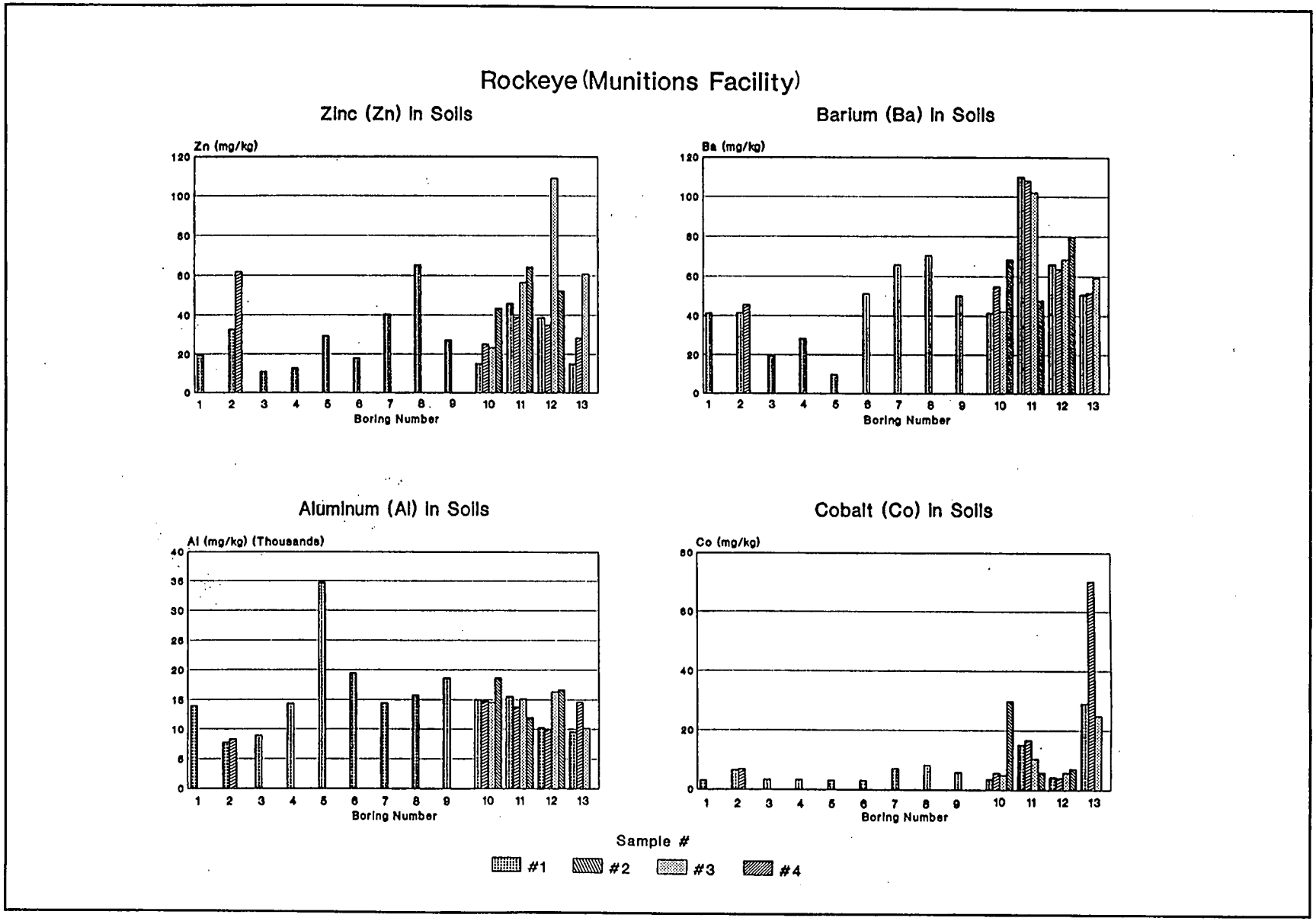
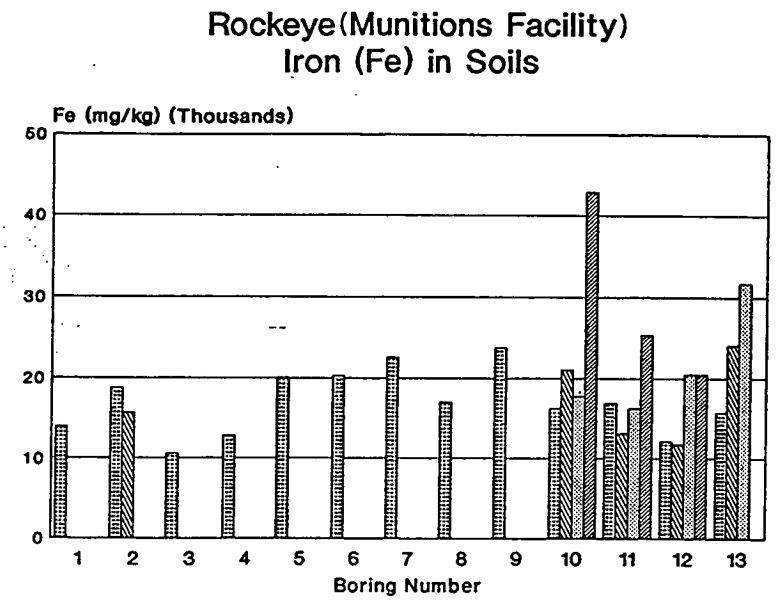


Figure 20. Zinc, barium, aluminum and cobalt concentrations



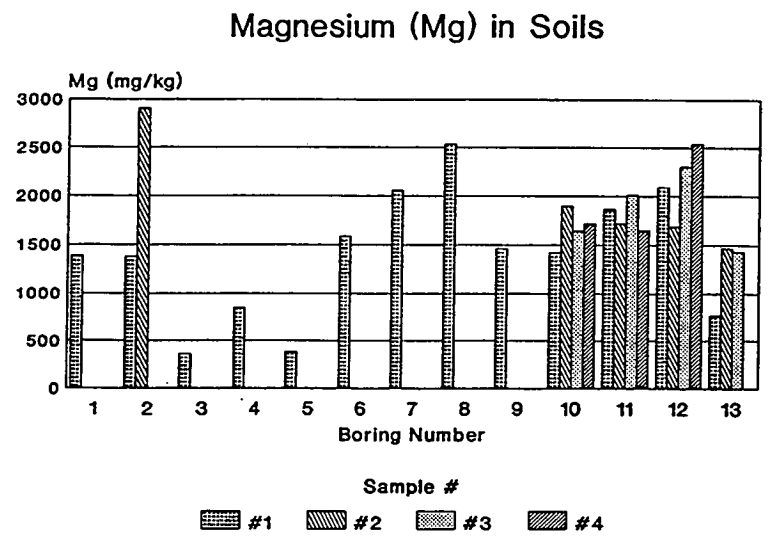
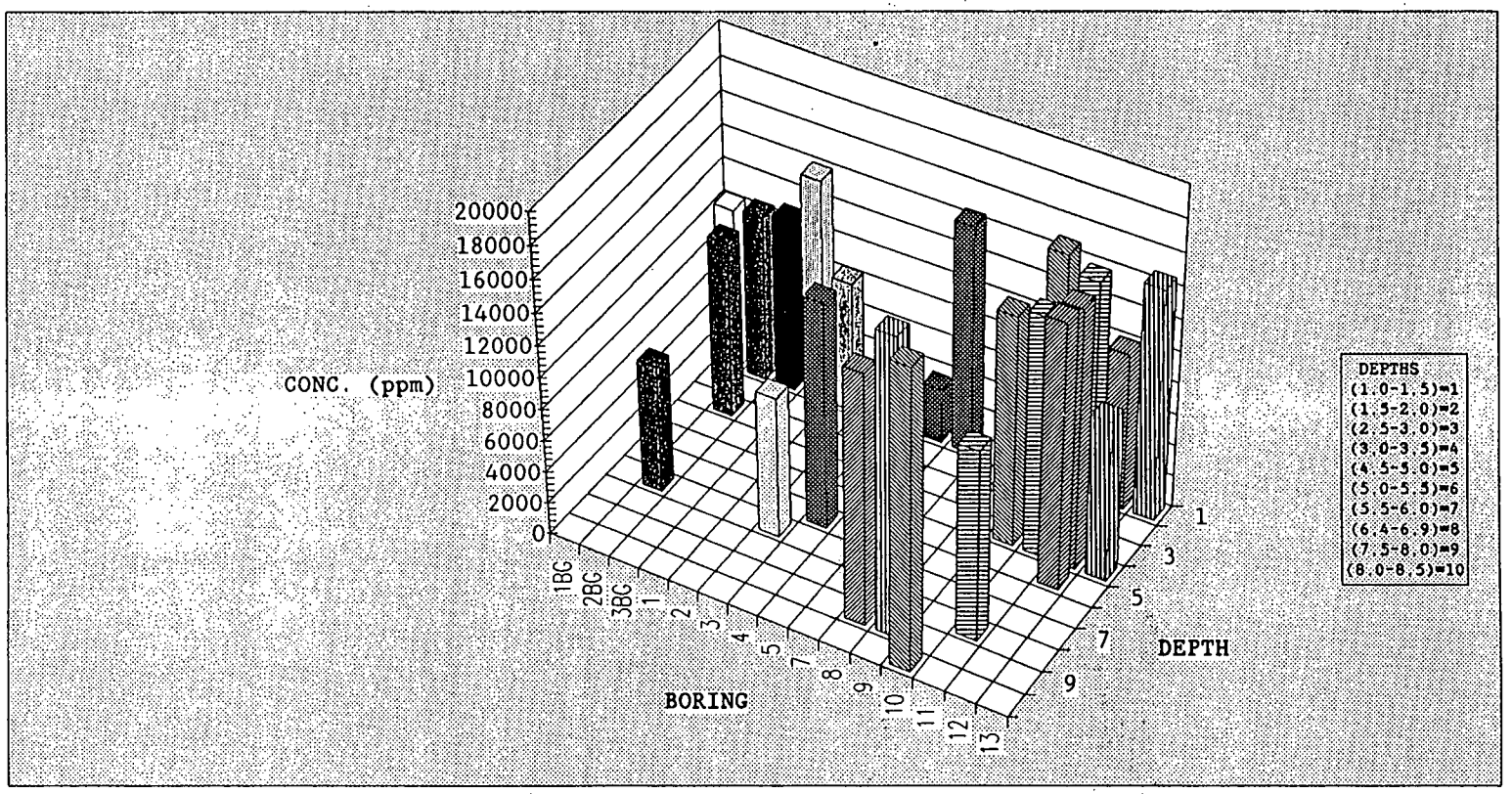
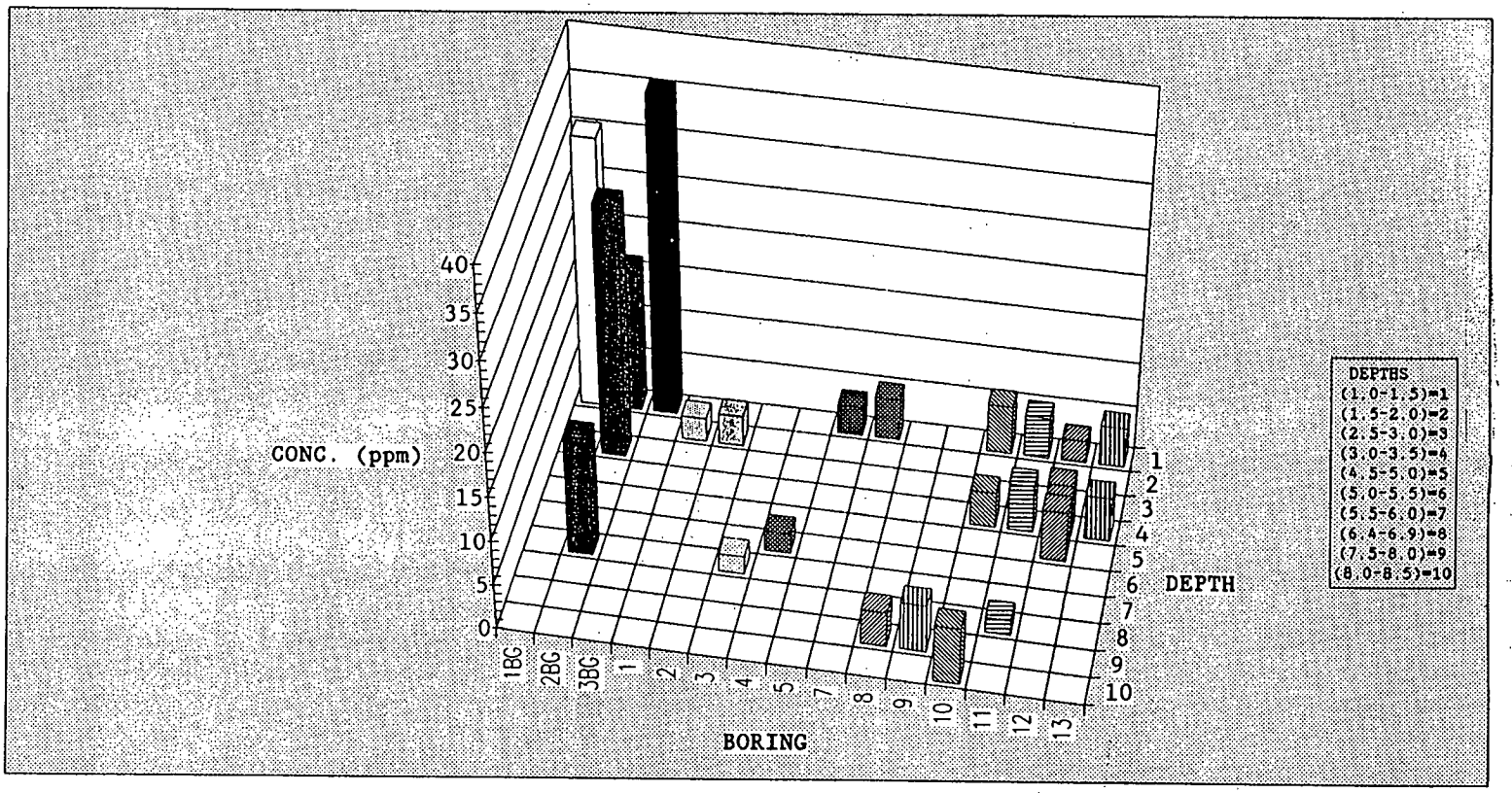


Figure 21. Iron and magnesium concentrations



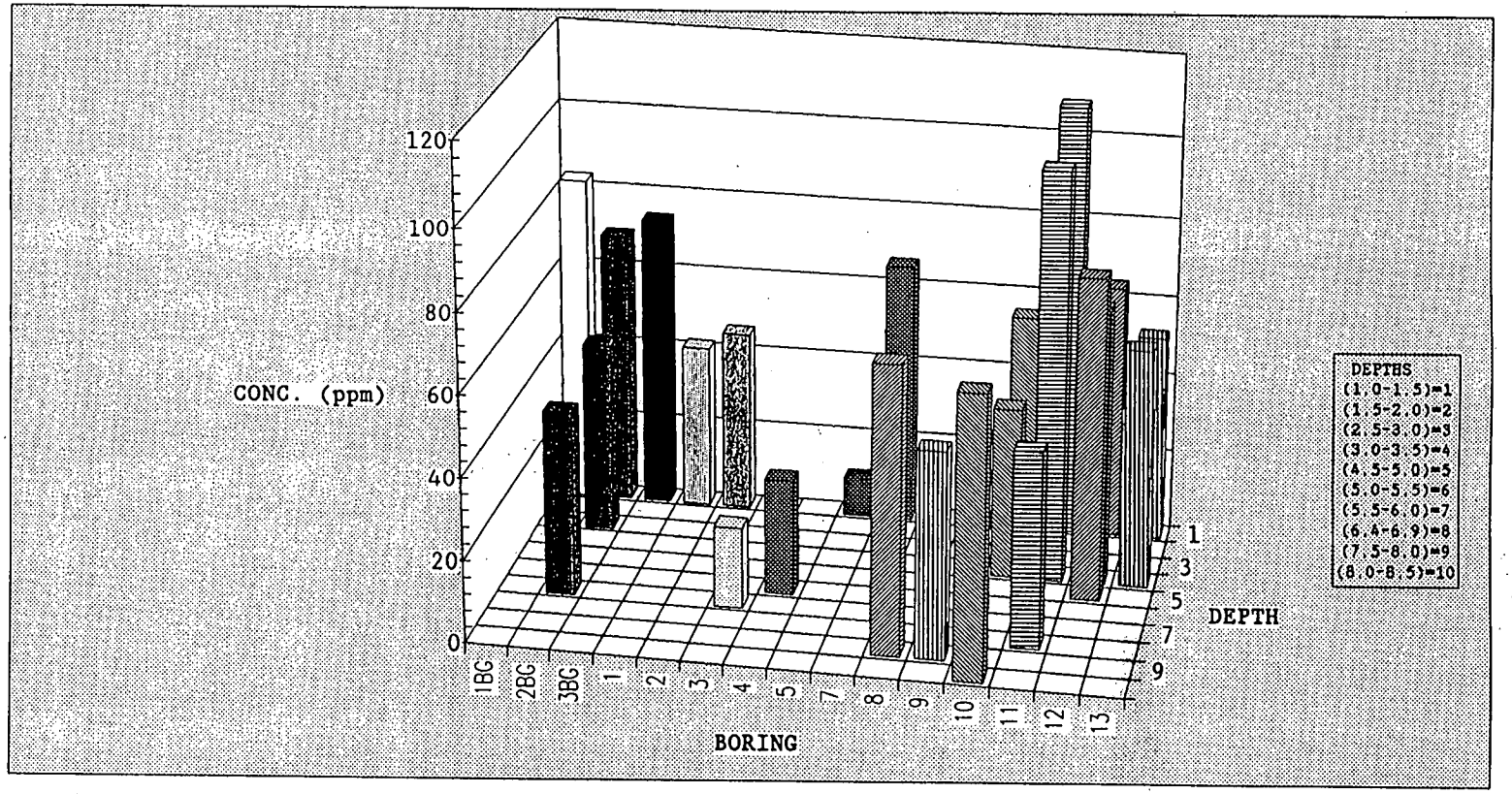
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 22. Comparison with background at ABG for Al



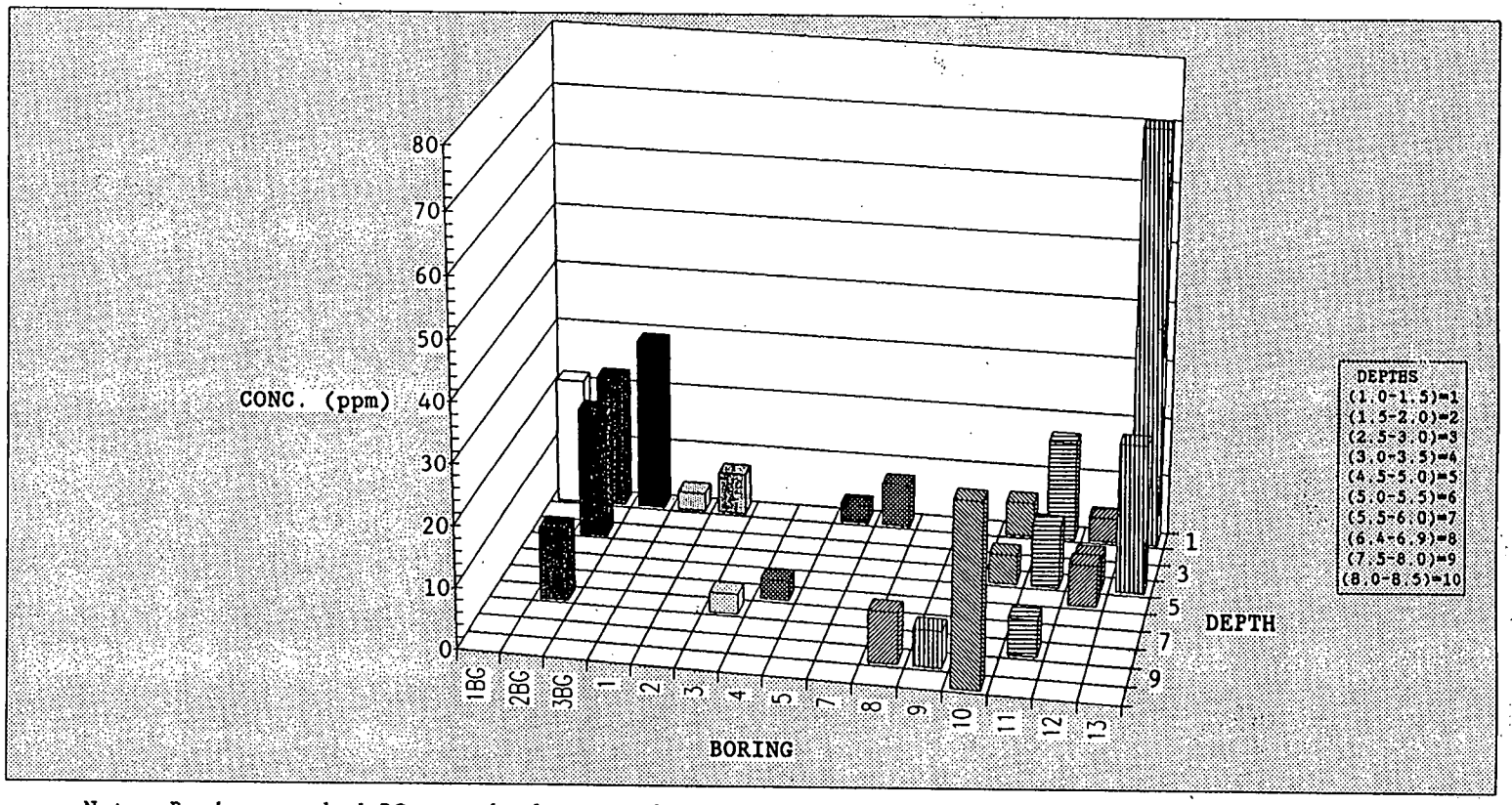
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 23. Comparison with background at ABG for As



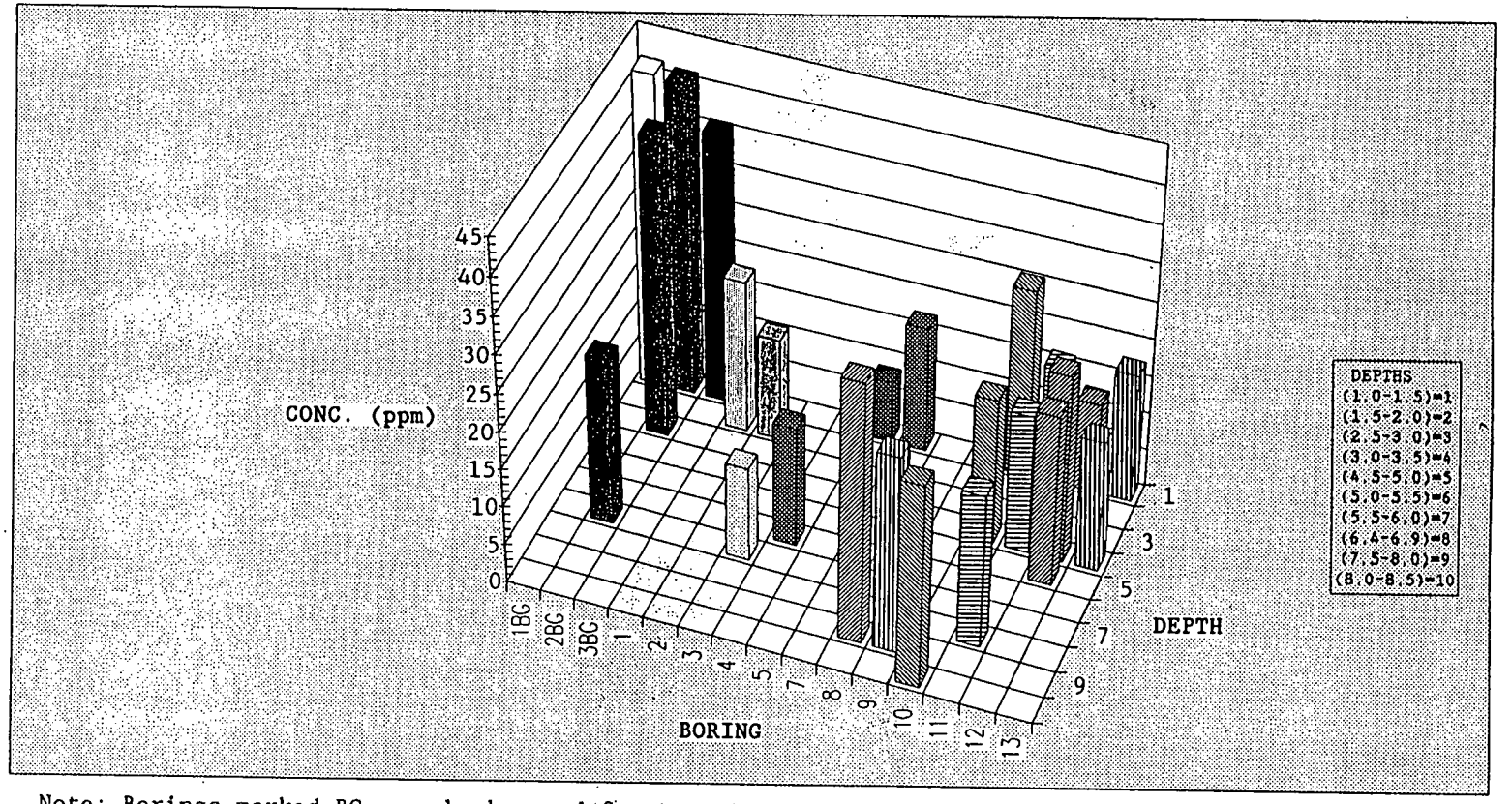
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 24. Comparison with background at ABG for Ba



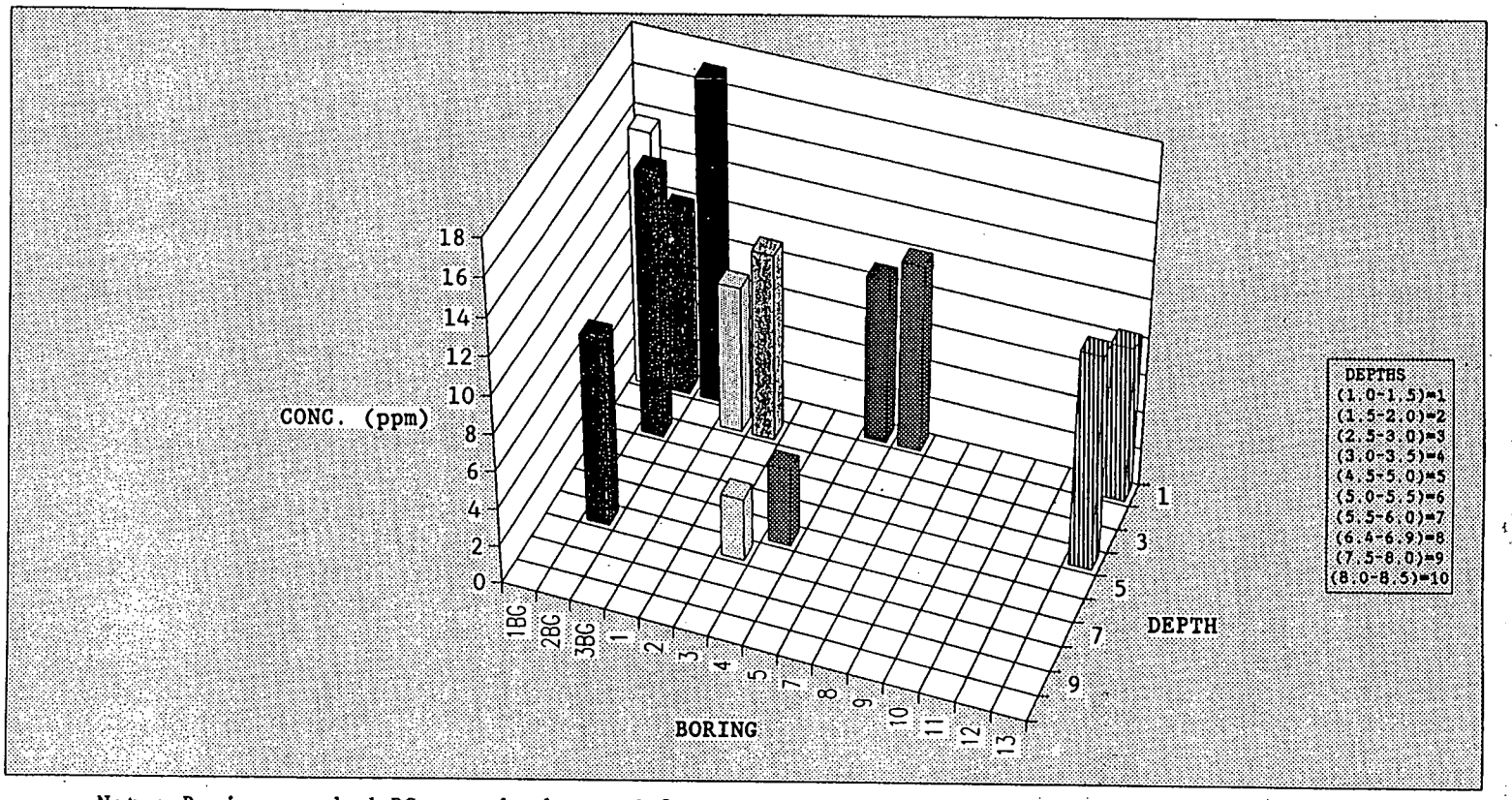
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 25. Comparison with background at ABG for Co



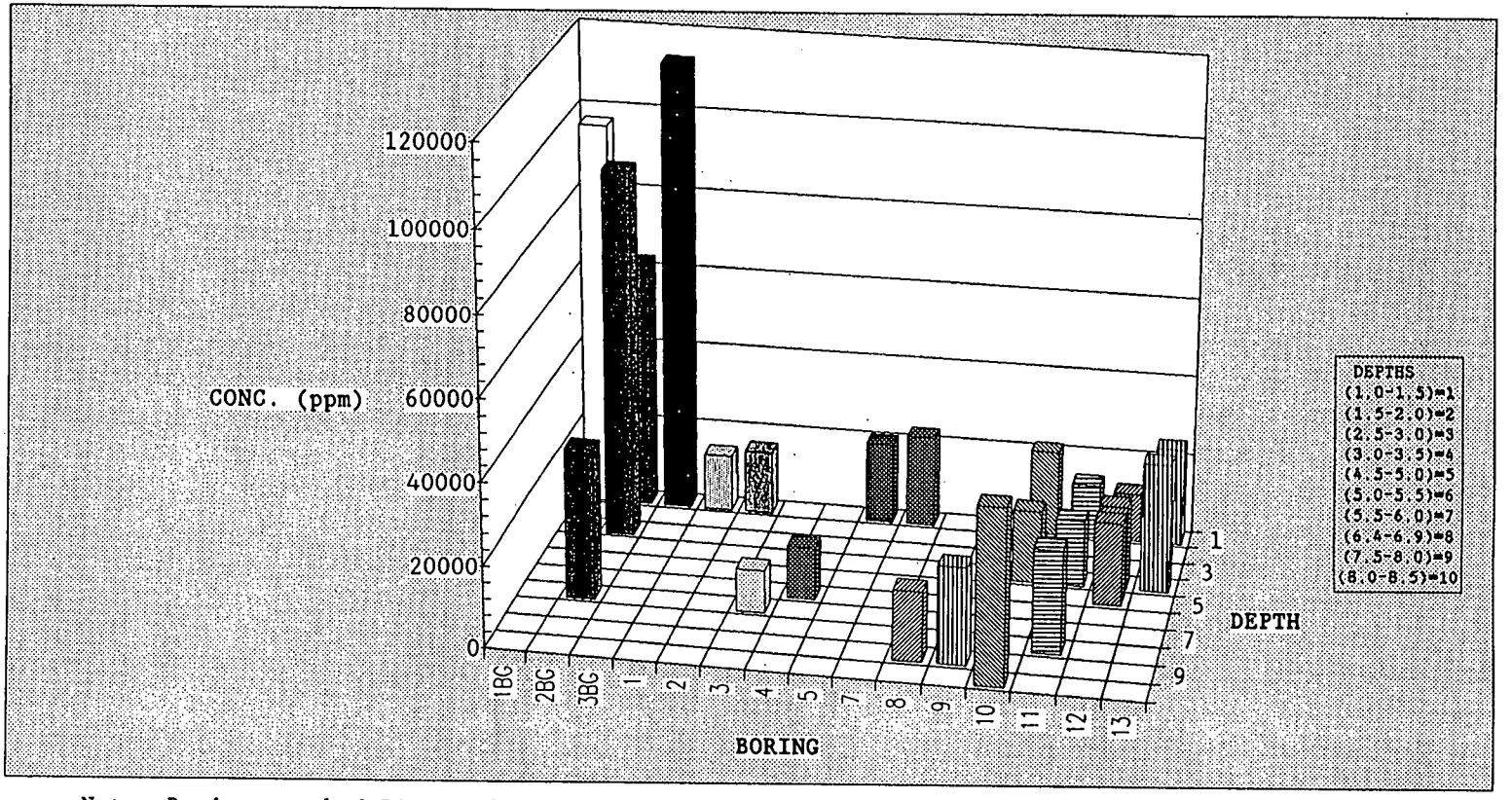
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 26. Comparison with background at ABG for Cr



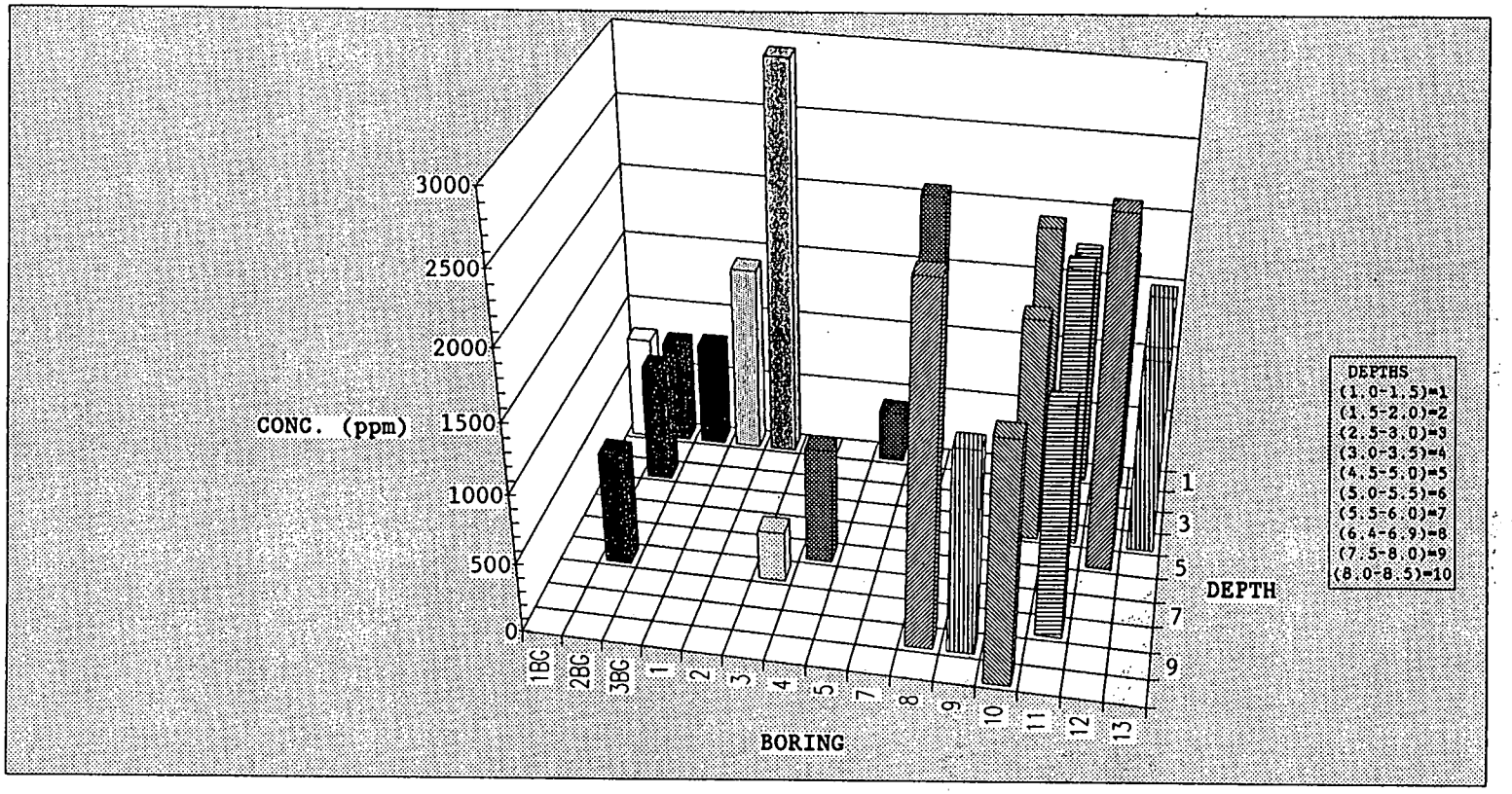
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 27. Comparison with background at ABG for Cu



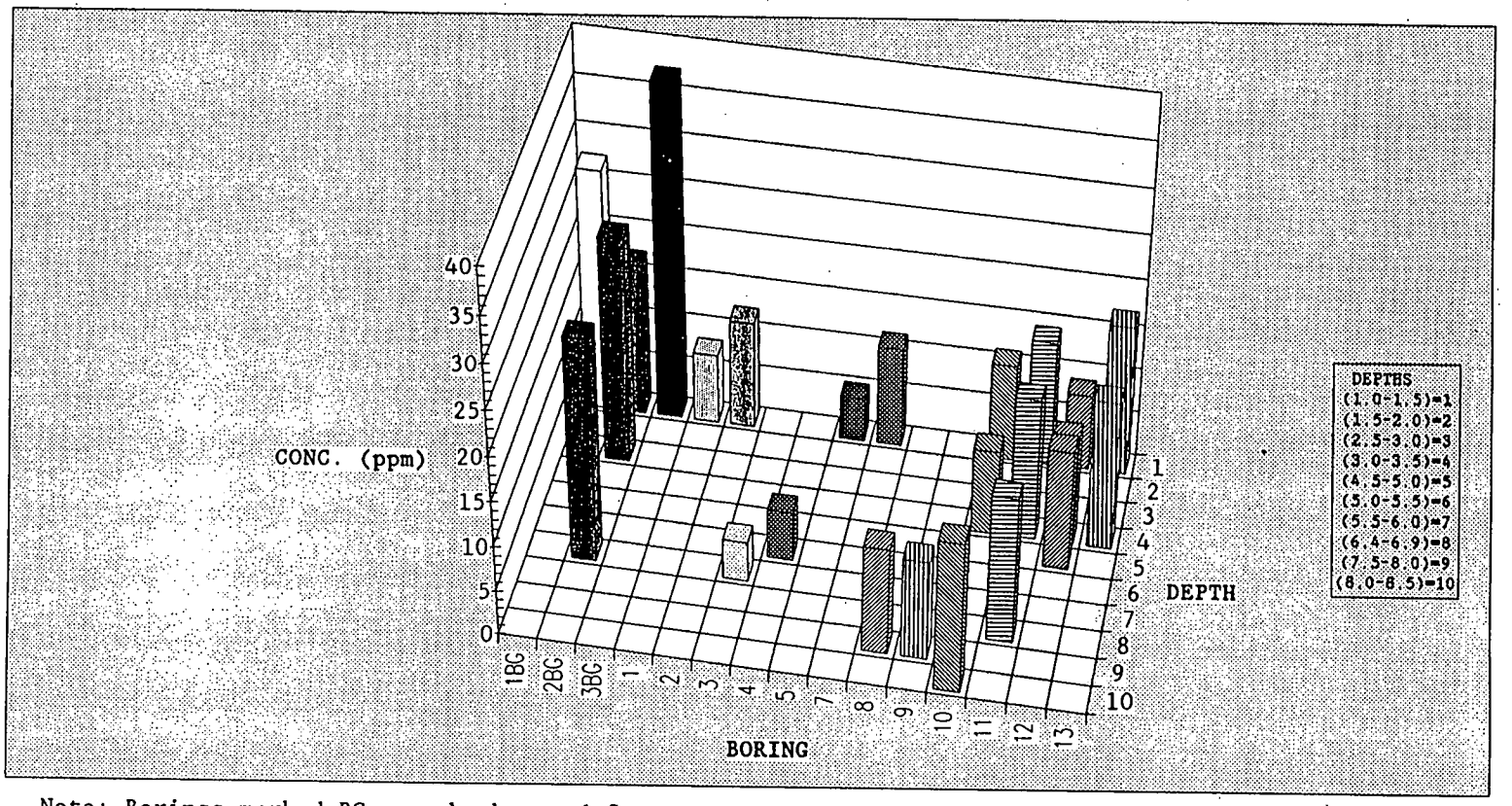
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 28. Comparison with background at ABG with Fe



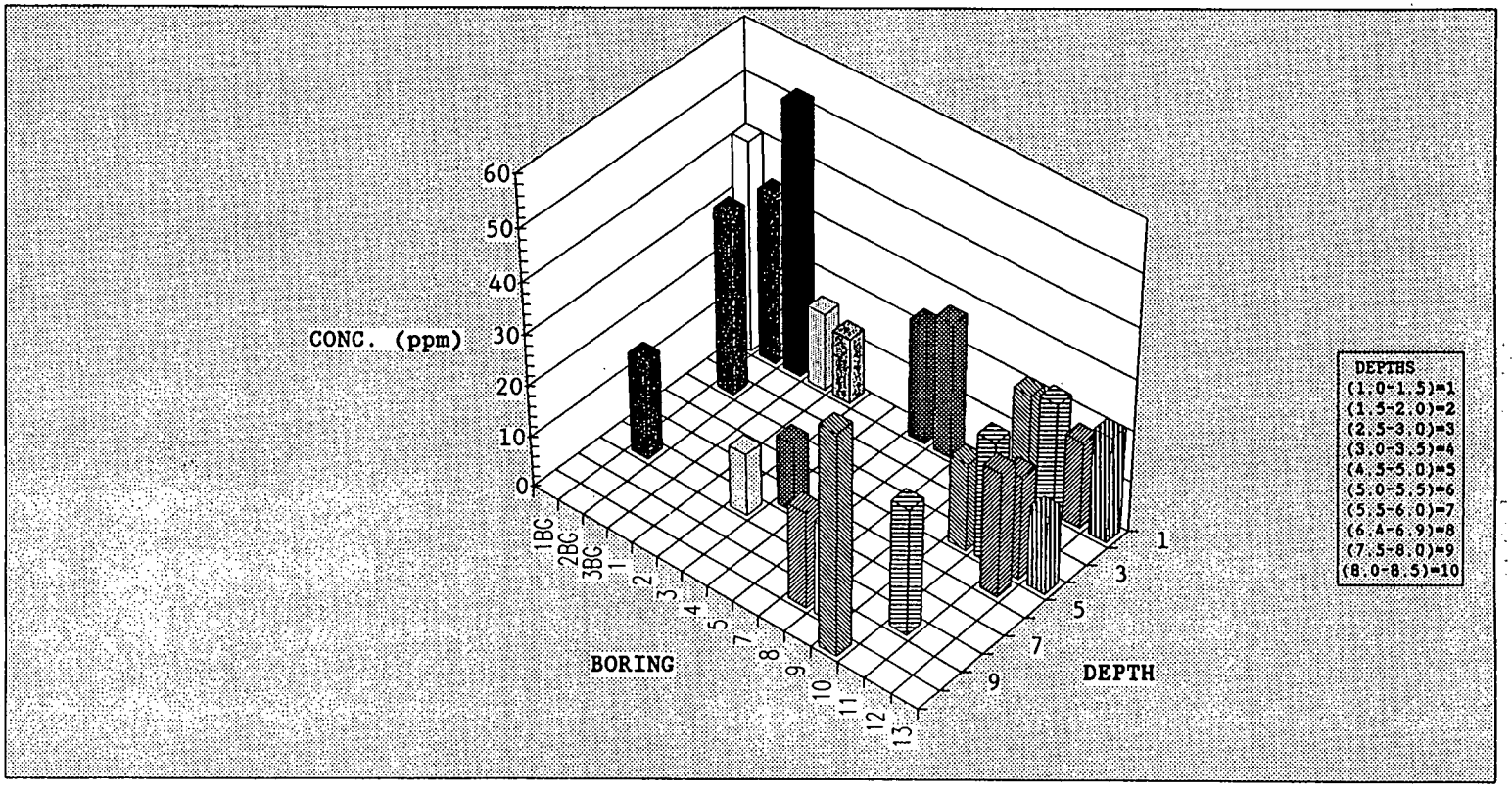
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 29. Comparison with background at ABG for Mg



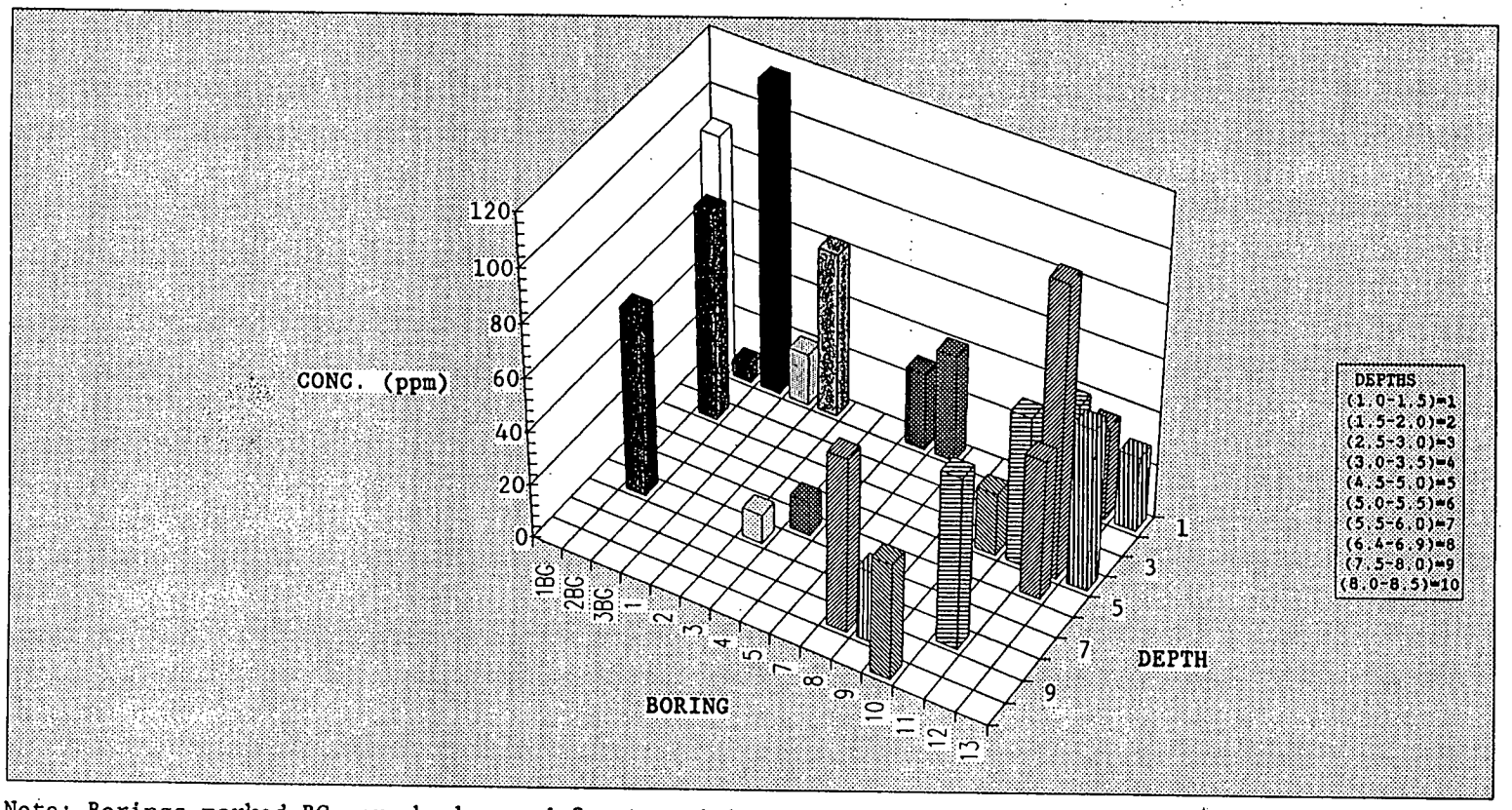
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 30. Comparison with background at ABG for Ni



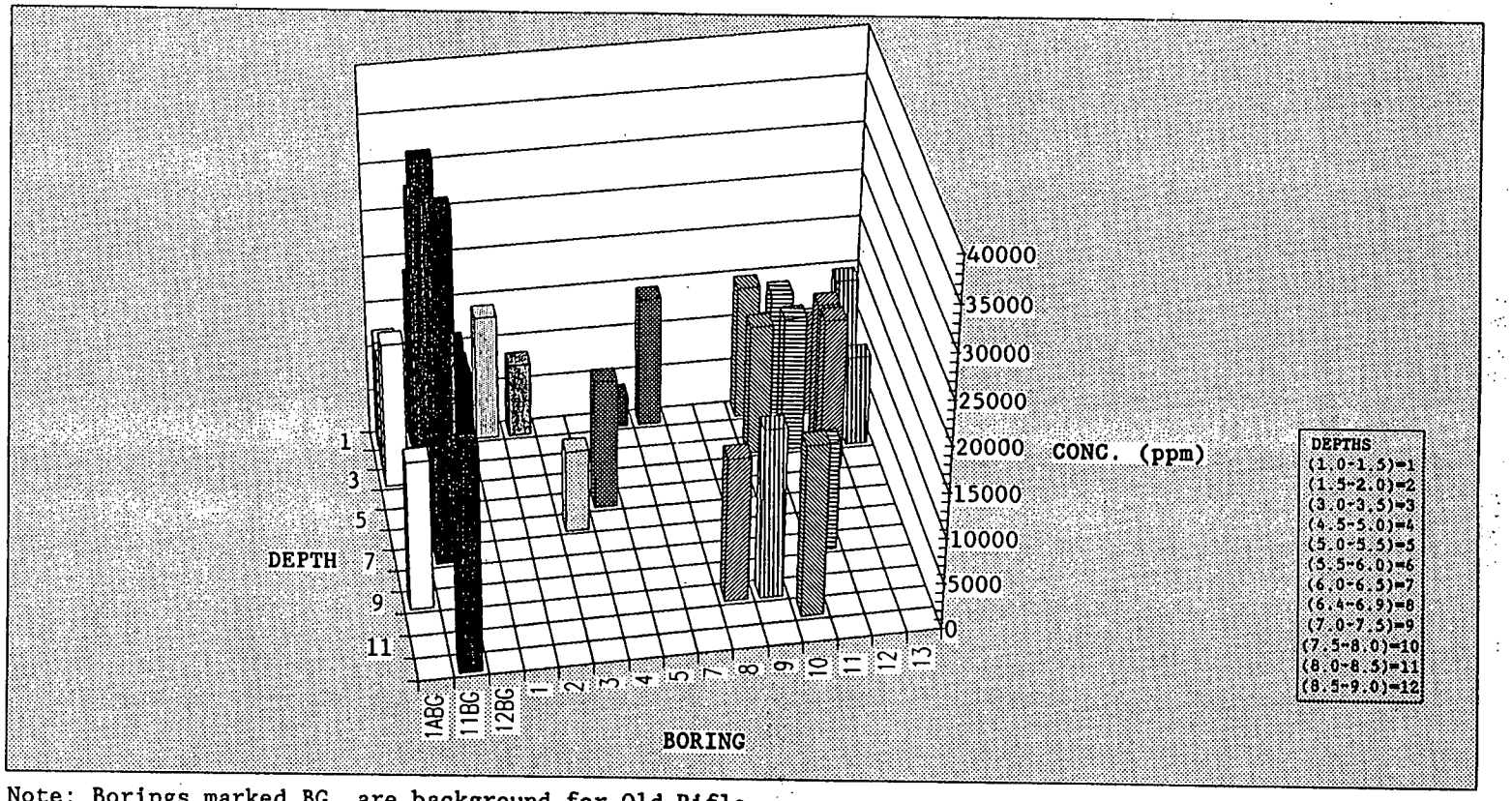
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 31. Comparison with background at ABG for Pb



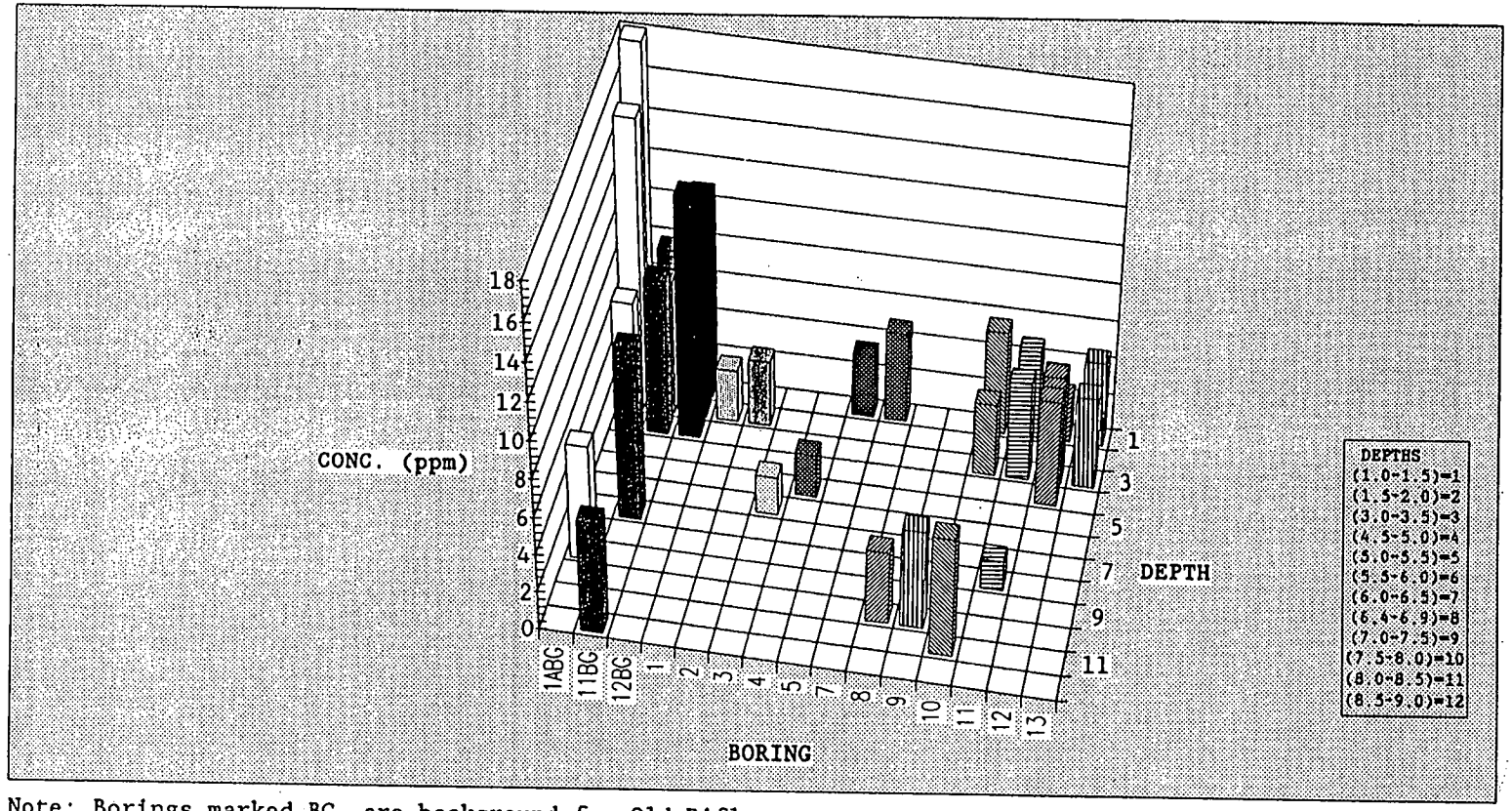
Note: Borings marked BG are background for Ammunition Burning Ground

Figure 32. Comparison with background at ABG for Zn



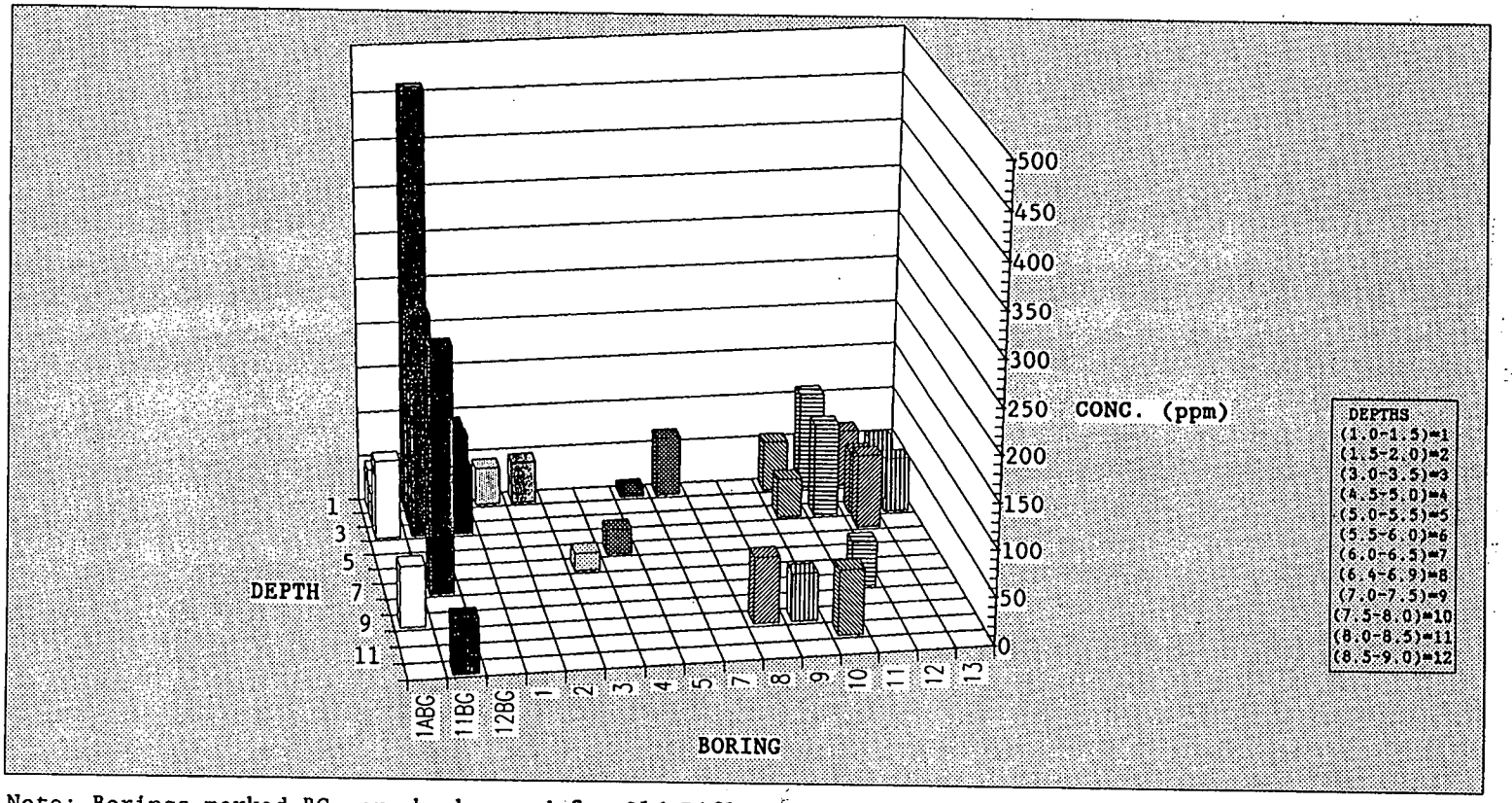
Note: Borings marked BG are background for Old Rifle

Figure 33. Comparison with background at ORR for Al



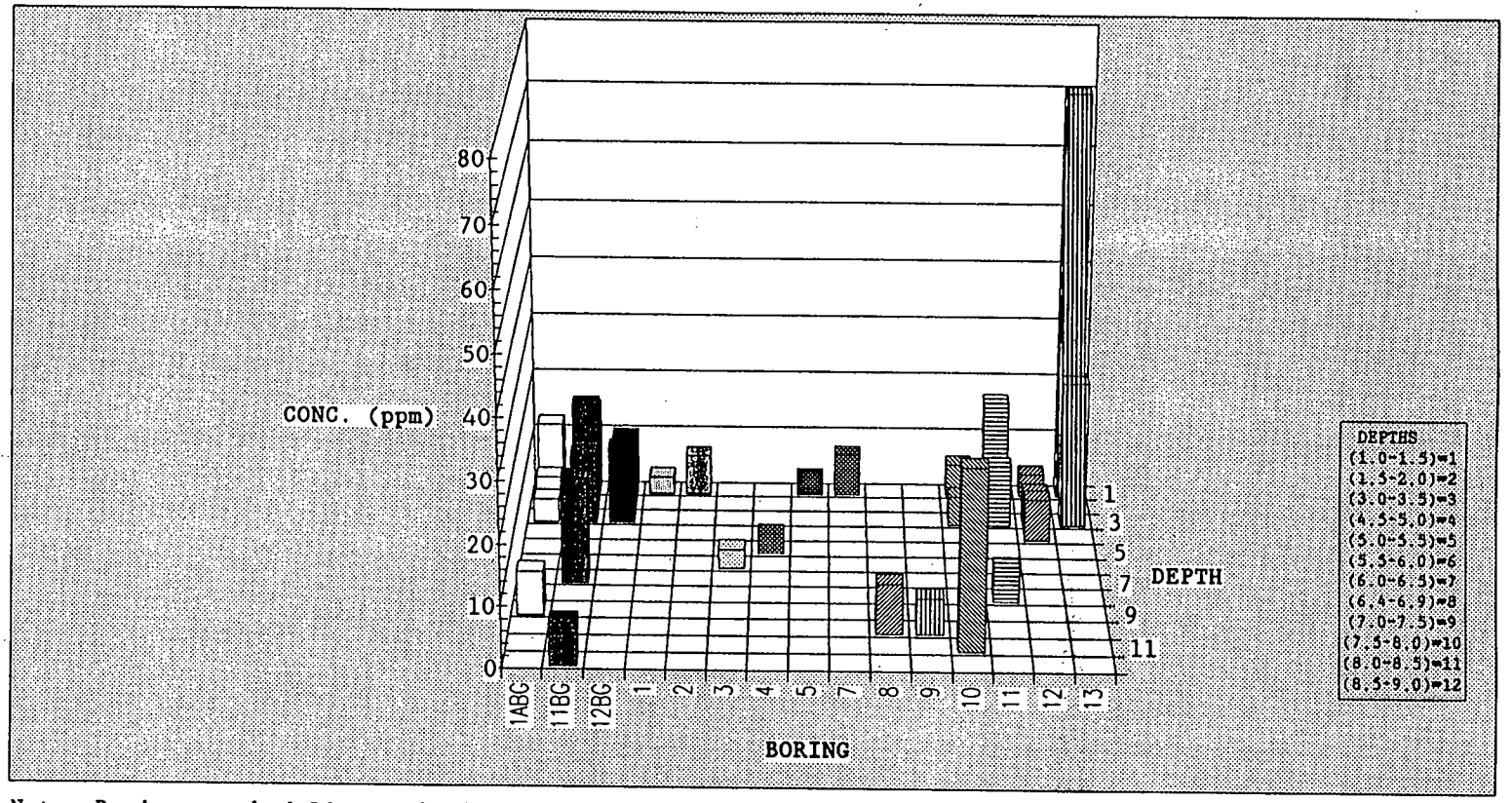
Note: Borings marked BG are background for Old Rifle

Figure 34. Comparison with background at ORR for As



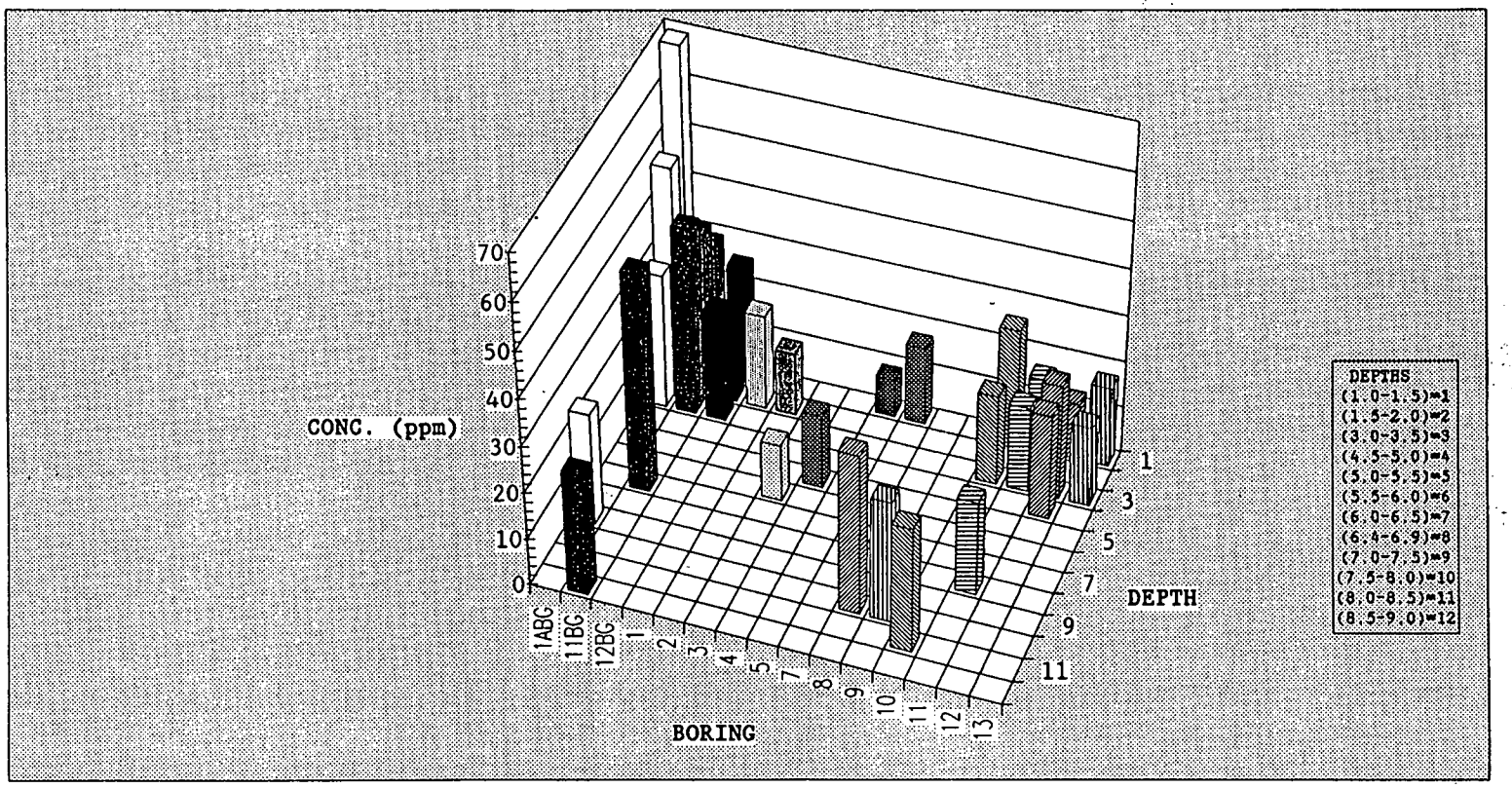
Note: Borings marked BG are background for Old Rifle Range

Figure 35. Comparison with background at ORR for Ba



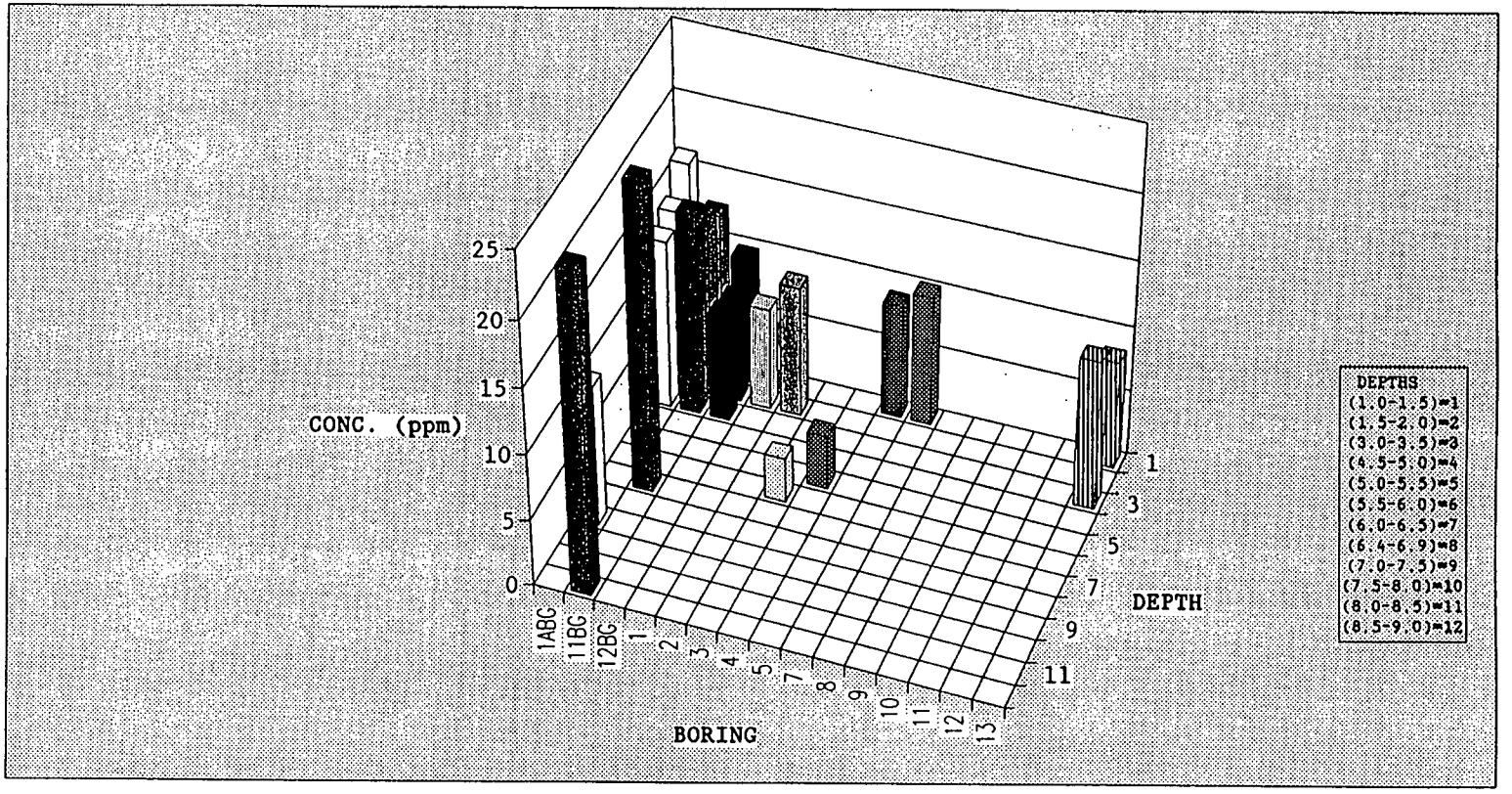
Note: Borings marked BG are background for Old Rifle Range

Figure 36. Comparison with background at ORR for Co



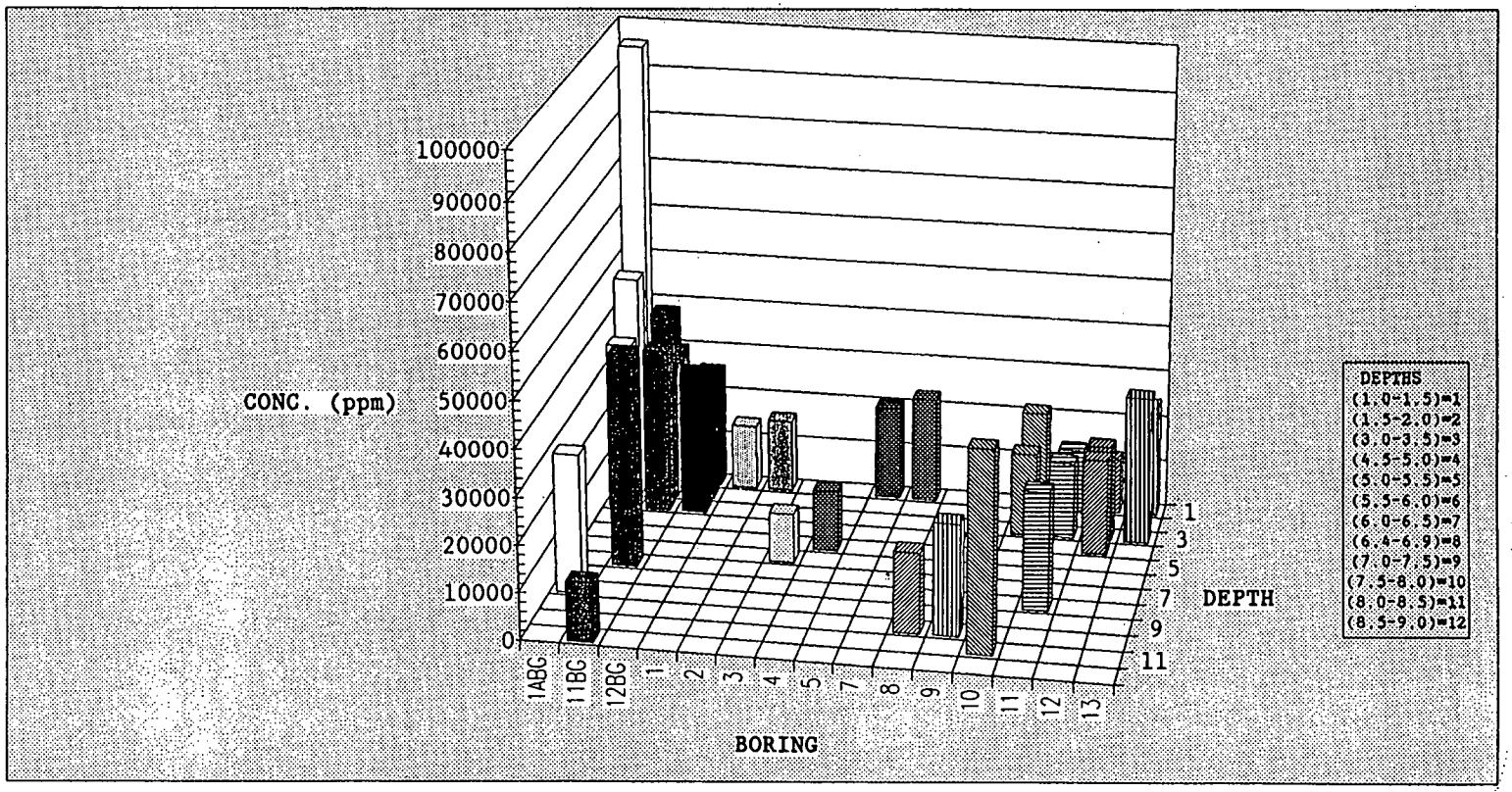
Note: Borings marked BG are background for Old Rifle Range

Figure 37. Comparison with background at ORR for Cr



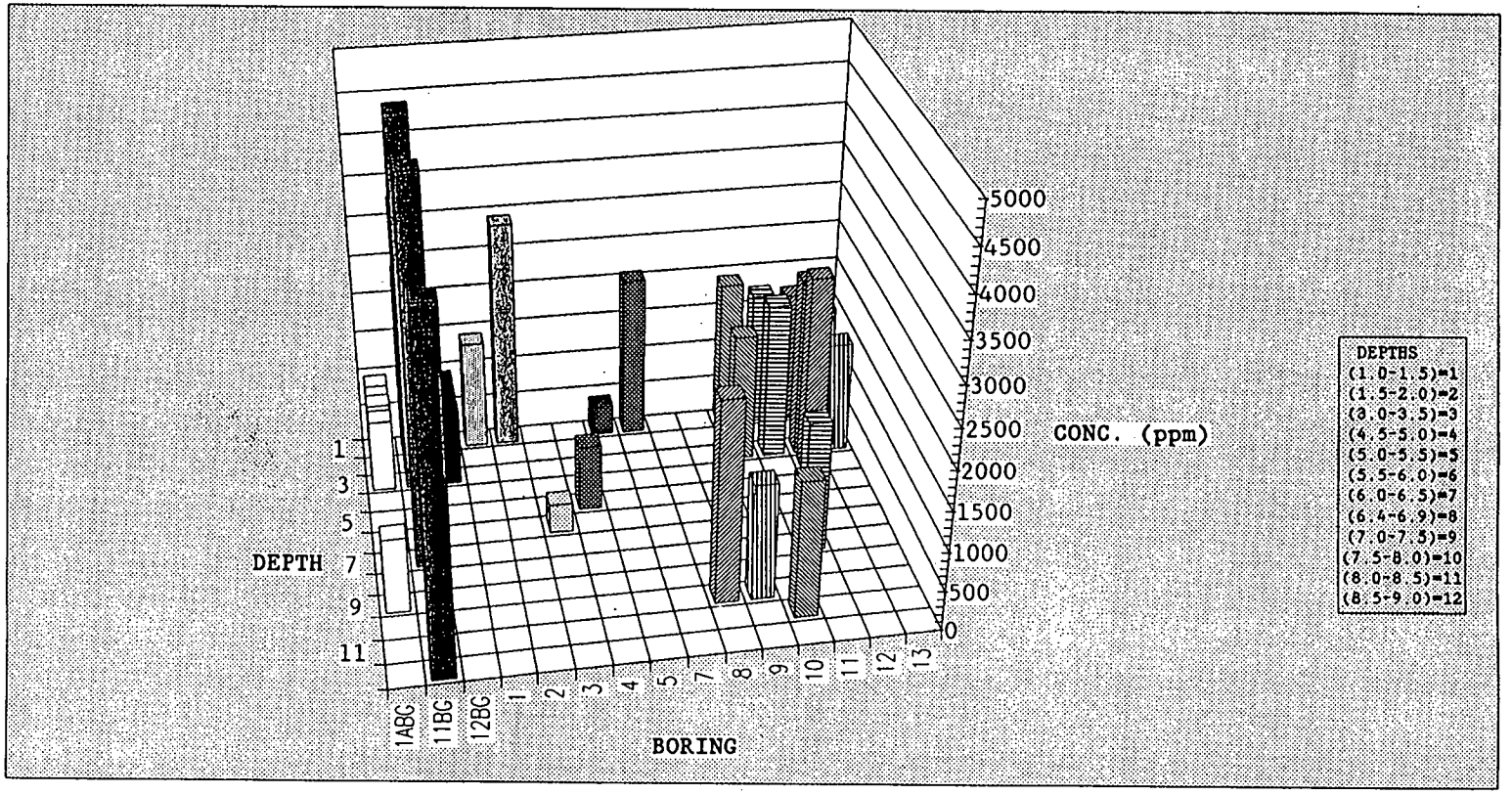
Note: Borings marked BG are background for Old Rifle Range

Figure 38. Comparison with background at ORR for Cu



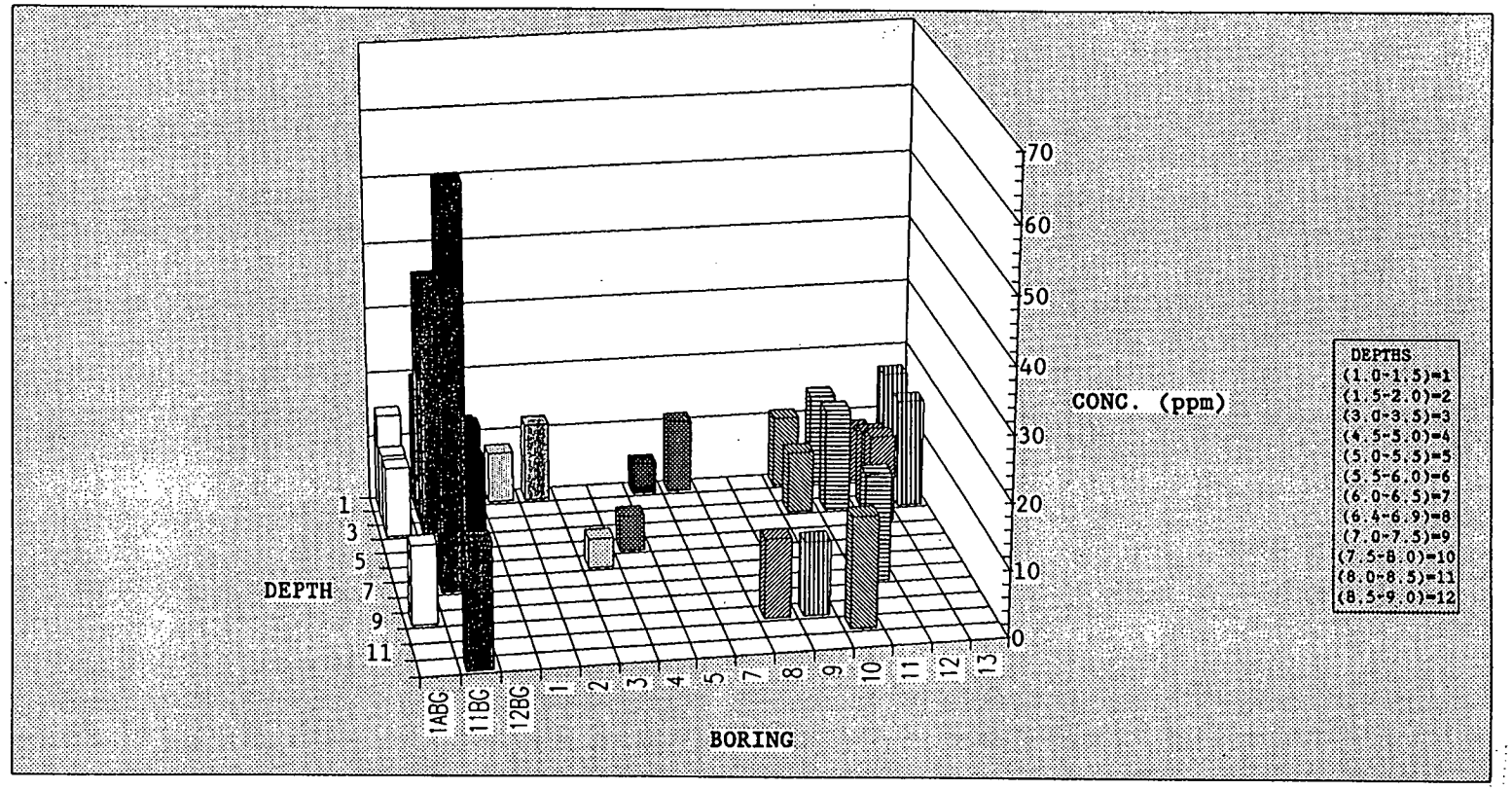
Note: Borings marked BG are background for Old Rifle Range

Figure 39. Comparison with background at ORR for Fe



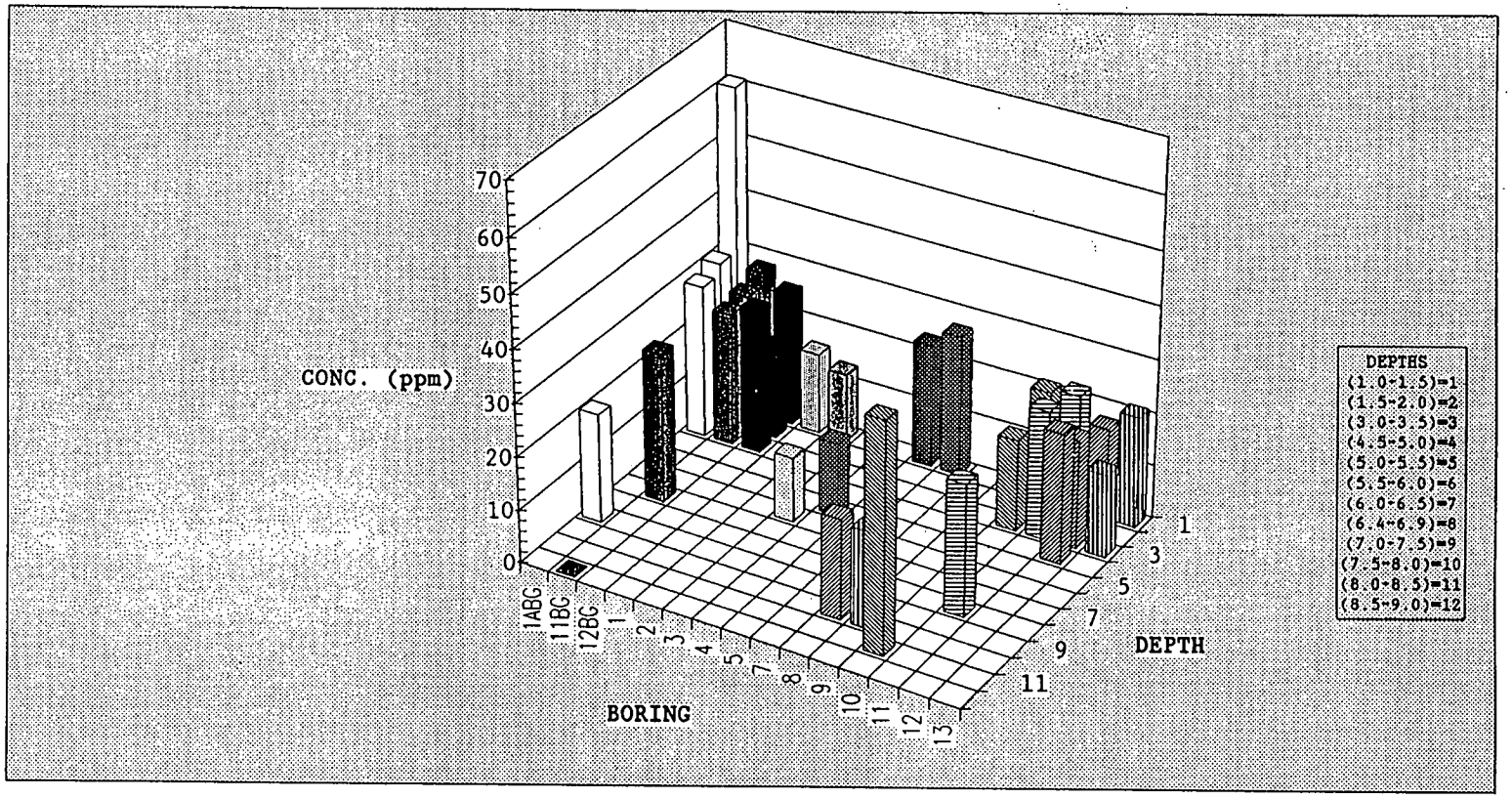
Note: Borings marked BG are background for Old Rifle Range

Figure 40. Comparison with background at ORR for Mg



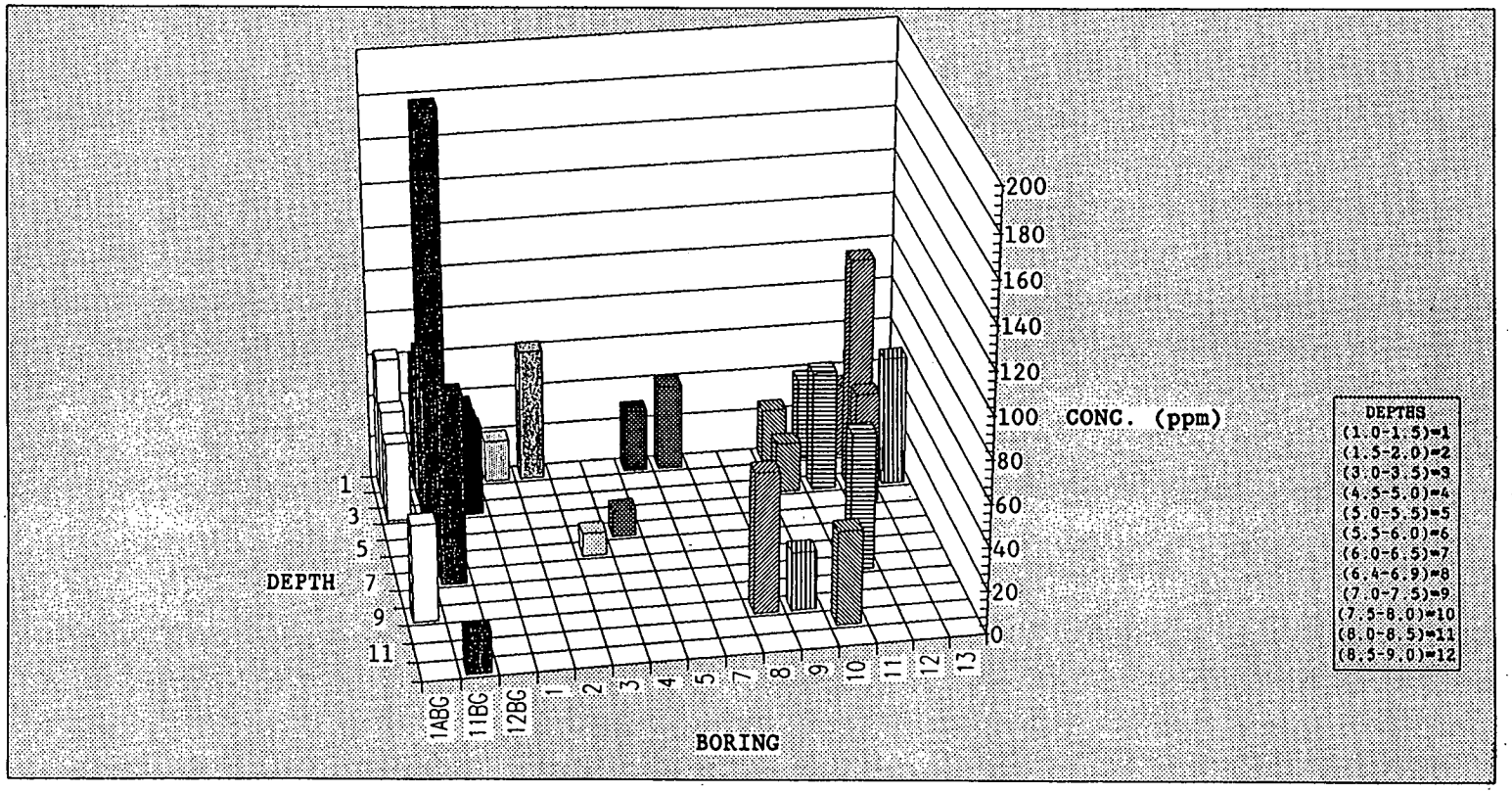
Note: Borings marked BG are background for Old Rifle Range

Figure 41. Comparison with background at ORR for Ni



Note: Borings marked BG are background for Old Rifle Range

Figure 42. Comparison with background at ORR for Pb



Note: Borings marked BG are background for Old Rifle Range

Figure 43. Comparison with background at ORR for Zn

Comparison of the maximum metals concentrations of Rockeye subsurface to background subsurface soils (Table A9, Appendix A) does not appear to yield conclusive evidence as to whether or not a release of metals has occurred at Rockeye. For instance, the analyses indicate that maximum metals concentrations of antimony, cadmium, and cobalt at Rockeye are generally twice or greater than the background sites. However, maximum concentrations of arsenic, beryllium, and iron are generally twice or more at the control sites than at Rockeye. In addition, some Rockeye maximum concentrations are less than specific NSWCC means.

As stated previously, surface soil samples from an area to the north of the Rockeye perimeter fence were selected to be background surface samples. Topography indicates that these "BN" sites did not receive surface water discharges from the Rockeye sumps and ditches. Only one sample, BN-2, from the background area was collected and analyzed for metal analytes. As indicated in Table A8 (Appendix A), the mean analyte concentrations for surface soil sample Area C were always less than the corresponding concentration determined from the BN sample. Therefore, for further data analyses, Area C and Background North (BN-2) were combined and considered background stations for inorganic analyses. The assumption was made that Area C and Background North soils are characteristics of soils in the vicinity of Rockeye as if no waste disposal activities had occurred as those facilities, but all other influences on soil characteristics had taken place. The four samples taken from Area C combined with the one BN sample permitted computation of a background mean and standard deviation and the statistical comparisons indicated in Tables A7 and A8 (Appendix A).

Comparison of metals analyses of Rockeye surface test soils with background samples may be more definitive than that of the subsurface samples. Such comparison indicates that test soil maximum concentrations were higher than the background, except for antimony and nickel. In addition, the test soil maximum concentrations of arsenic, beryllium, lead, and cobalt were higher than Risk-Based Concentrations (RBC), as listed in an RBC table prepared by Region III of EPA, dated February 1992. However, these metals in the background generally also had concentrations above the RBCs, although not nearly as high as those in the test soils. RBCs for the analyzed metals are included in Tables A9 and A10 of Appendix A. (In reference to the RBC table, Region III toxicologists use this information as a risk-based screen for Superfund sites and as a desk reference to help with emergencies and requests for immediate information. It has also been used in evaluating preliminary site investigation data and contractor-prepared preliminary remediation goals).

Comparison of the metals analyses from the Rockeye subsurface and surface soils indicate that, with the exception of aluminum and antimony, the maximum metals concentrations were found in the surface soil samples (Table A6, Appendix A). Additionally, with the exceptions of antimony and aluminum in surface sample H and magnesium, tin, and copper in surface sample Areas E, B, and D, respectively, the maximum metals concentrations were found in surface sample Areas F and G. Except for sample H, the surface soil samples were taken on the facility perimeter, within and adjacent to drainage features leading from Rockeye, while subsurface soil samples were taken at the

Rockeye sumps and the ditches leading from them. As discussed previously, the Rockeye sumps represent possible sources of metal contaminants as a result of the discharge of wash water effluent. No patterns were evident between the Rockeye sumps and ditches with respect to the metallic analyte concentrations in the subsurface soils sampled. However, metals concentrations from soil samples associated with the contaminant sources (sumps and ditches) were generally less than those in soil samples from the facility perimeter. Therefore, a general metallic analyte low-to-high concentration gradient from the Rockeye sumps to the drainage features at the Rockeye perimeter was observed. The reason for this metallic constituent gradient cannot be adequately determined with available information. However, this situation may be explained in that, after 1978, the sumps were periodically pumped to remove accumulated residue from process washwater. This residue was taken to the ABG for disposal. (Prior to 1978, full sumps were allowed to discharge into local drainageways.) The pumping would likely have removed the highest concentration of contaminants from the sumps. The effluent from the sumps would have been washed into the drainageways and streams and deposited in the surface soil along the facility perimeter.

The sample means for arsenic, zinc, and cobalt at sample Area F and barium and cobalt at Area G were the greatest or near the greatest observed for the surface samples, and yet those concentrations were not significantly different from Area C and BN-2.

The test surface sample situations where the mean concentrations for metal constituents were significantly greater ($p < 0.05$) than in the background (Table A8, Appendix A) are summarized as follows in Table 6.

Table 6
Surface Sampling Grid

Grid or Surface Sample Area	
A	arsenic, aluminum, magnesium, iron
B	arsenic, zinc, magnesium
D	arsenic, lead, aluminum, iron, magnesium
E	arsenic, cadmium, lead, nickel, zinc, barium, iron, magnesium
F	beryllium, cadmium, chromium, copper, lead, nickel, barium, iron, magnesium
G	arsenic, lead, magnesium

In summary, comparisons of metal constituent concentrations in background subsurface soils from other NSWC sites and sampled subsurface soils (test borings) from Rockeye did not necessarily indicate that releases of metals may have occurred. On the other hand, surface soils samples from Rockeye drainage features did have evidences of possible metal constituent contaminants, when compared to background soils. Possible surface soil sample contaminants included arsenic, beryllium, cadmium, chromium, copper, lead, nickel, zinc, aluminum, barium, iron, and magnesium. A greater number of metal

constituents were possible contaminants (significantly greater concentration of metal constituents ($P < 0.5$) in test than background samples) in the surface soil sample areas than in the subsurface samples from the Rockeye (source) sumps and ditches. The maximum metals concentrations from the borings (source samples) were less (except for antimony and aluminum) than those sampled from soils sampled from drainage features. There is insufficient information to adequately determine the source of the contaminants observed at the surface sample drainage locations or the reasons for the observed concentrations.

All the tested metal analytes occur naturally in soils. Another possible explanation of the differences in inorganic chemical characteristics between background and test soils could be due to natural variability in the soils and not a function of anthropogenic activities. Additional data are required to determine the validity of the background site data and assess the natural variability of the Rockeye soils.

Method blanks. The results of analysis of method blanks used in association with the metals analyses of Rockeye soils are provided in Table A10 (Appendix A). The concentration of constituents in the method blanks was always less than 1/40 of the concentrations determined for the soil samples. These method blank analyses do not change the interpretation of inorganic constituent data previously presented.

Equipment rinses. Metal analytes were found in all equipment rinses analyzed (Table A11, Appendix A). However, the concentrations of inorganic constituents in the rinses were not great enough to change the interpretation of data as previously discussed.

Explosive compounds in Rockeye Munitions Facility soils

The results of analyses of Rockeye Munitions Facility soils for selected explosive compounds are given in Tables A12 through A14 (Appendix A). No explosive compounds were found in soil samples from the background samples, surface soil Samples BN1, BN2, and BN3 (although J values of two explosives were found in one sample from Area C). In addition, subsurface soil samples from Borings 1, 3, 4, 5, 9, and 13 and from surface sample Areas A and D did not have detectable amounts of explosive compounds. Explosive compounds were found in subsurface soil samples from Borings 2, 6A, 7, 8, 10, 11, and 12 and from surface soils from sample Areas B, E, F, G, and H. Thus, explosive compounds were found in subsurface soil samples taken from borings around the Rockeye wash water sumps (Borings 2, 6A, 8, and 10) and in the surface drainage ditches (Borings 7, 11, and 12). Explosive compounds were found in surface soil samples taken from drainage courses which lead from Rockeye (sample Areas B, E, F, and G). Also, explosive compounds were found in high concentrations beneath a Rockeye building ventilator (Sample H).

Table A14 (Appendix A) summarizes the analyses of the surface and subsurface soil samples for explosive compounds. Tetryl was not found in any

soil samples taken. The explosives 2,4-DNT and TNB were found only in one surface sample from grid Area C, which was used for background, and in two subsurface samples from Boring 12, respectively. TNB and 2,4-DNT were found only in concentrations below quantitation limits (the concentration reported was an estimated J value). TNT was found in surface samples from Areas E (maximum concentration was a J value), F (maximum concentration 0.75 mg/kg), and H (maximum concentration 295.00 mg/kg), and subsurface samples from Boring 12 (maximum concentration 1.40 mg/kg). DNB was found only as J value concentrations in surface samples from grid Areas B and C. RDX was found in concentrations below quantitation limits (J values) in surface soils from Areas E and G and subsurface soils from Borings 2, 6A, 7, and 11. An RDX concentration of 3,350 mg/kg was found in soils at surface Sample H. HMX was found in more soil samples than any other explosive compound and at greater concentrations than any other explosive compound analyzed. However, for surface soil Areas A through F, only Samples B-3-2 and E-3-4 had detectable concentrations above the quantitation limits. HMX was found in surface soil samples from Areas G, and H, and from subsurface soil samples from Borings 2, 6A, 7, 8, 10, 11, and 12. Of these samples from Areas G and H and Borings 12 and 7 contained concentrations of HMX above quantitation limits. HMX concentrations of 1,960.0 and 10,400 mg/kg were found in surface soil samples from Areas G and H, respectively. These were the highest explosive compound concentrations found in the Rockeye soils sampled. The maximum HMX concentration in a Rockeye facility subsurface soil sample was 42.7 mg/kg from Boring 12.

Surface soil sample Area E had 10 soil samples with detectable concentrations of explosive compounds, more in number than any other surface sample area. As stated previously, Boring 12 produced soil samples with the greatest concentrations of explosive compounds among the Rockeye subsurface soils tested. The ditch sampled by Boring 12 drains into the Area E sample area.

The surface soils beneath the exhaust of a Rockeye building ventilator (Sample H), contained noteworthy concentrations of TNT, RDX, and HMX at 295, 3,350, and 10,400 mg/kg, respectively. These concentrations were maximums for these compounds in the Rockeye soils sampled.

Risk-based concentrations (RBC) for screening purposes have been developed (EPA Region III, February 1992) for TNT and RDX, which are 16/200 and 15/26, respectively, where the concentrations shown are in parts per million and represent residential soil/occupational soil applications. The surface soil sample taken behind the building ventilator (Sample H) had concentrations above these RBC for these two explosives, with RDX being over 100 times the RBC. An RBC was not listed for HMX, but a concentration of 10,400 ppm represents over 1 percent of the sample matrix.

Integrating the explosive compound analyses results (Table A13, Appendix A) with the sample maps of the surface sample areas (Figures 15 through 17) indicates that explosive compound contamination within the grid and other surface sampling areas (Areas A through G) was generally related to the drainage courses or areas where ponding of runoff water occurred.

In summary, evidences of a release of explosive compounds were observed in the soils tested. Explosive compound contamination within the surface sampling and grid sampling areas (Areas A through G) appeared to be related to the drainage courses or areas where ponding of runoff water occurred, since the surface soil samples with explosive compound contaminants were usually within or closely adjacent to these areas. The explosive contaminant concentrations decreased with distance from the drainage pipes leading from Rockeye. It is not known for certain, however, if the soils contaminants observed were the result of wash water releases which were discontinued in 1978 or the result of other pathways. Indications of an airborne release of explosive compounds from a Rockeye building ventilator (Building 2734) were seen by the area void of vegetation beneath the vent, and surface soil Sample H was taken from this area. The highest concentrations of TNT, RDX, and HMX observed in the Rockeye soils came from this sample.

Method blanks. No explosive compounds were detected in the method blanks analyzed in association with the Rockeye soils analyses (Table A15, Appendix A). These method blank analyses do not change the interpretation of explosive compound data previously presented.

Equipment rinses. No explosive compounds were detected in equipment rinses (Table A15, Appendix A). Therefore, contamination of field samples by the sample equipment is not evident.

Volatile organics (EPA Method 8240)

The results of analyses of Rockeye soils for volatile organic compounds (EPA Method 8240 in *Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods SW846*, Third Edition, November 1986 with December 1988 revisions) are given in Tables A16 and A17 (Appendix A). Volatile organic compounds that were tentatively identified during the volatile organic soils analysis are provided in Table A18 (Appendix A). Methylene chloride and acetone were found in all but two soil samples taken. These constituents were also found in the associated method blanks (Table A19). These results indicate likely sample contamination from the laboratory environment rather than processes associated with the field conditions. Volatiles which may not be solely associated with laboratory environment contaminants were also detected. The following volatile organic compounds were detected:

The reported concentrations of 2-butanone, trans-1,3, dichloropropene, t-xylene, and 1,1,2-trichloroethane were "J" values, detected by the analytical instrumentation but not in sufficient amounts to accurately quantify. Therefore, those concentrations are estimated. The compound 2-butanone is a common laboratory contaminant reported for volatile organic analyses as shown in Table 7.

Table 7 Summary of Common Laboratory Contaminants	
Volatile Organic	**Sample No.**
2-butanone	A-4-1, 9 No. 1
Trans-1,3, dichloropropene	D-0-0
T-Xylene	B-4-1
1,1,1-Trichloroethane	1 No. 2
1,1,2-Trichloroethane	5 No. 1

Therefore, that volatile organic compound may not be a soil contaminant at Rockeye. 2-butanone was not reported from associated method blanks but was reported, along with 1,1,2,-trichloroethane, in equipment rinses (see "*Equipment rinses*"). The concentration of 1,1,1-trichloroethane reported for the Boring 1 sample was 0.011 mg/kg dry weight basis, the only incidence of a determined concentration of organic volatiles above a "J" value.

A characteristic suite of volatile organic compounds was not identified in Rockeye soils tested. Only 2-butanone was found from more than one sample (it was reported in two samples), but it is a common laboratory contaminant (although not found in associated method blanks). These findings indicate that a release of trans-1,3,dichloropropene, t-xylene, 1,1,1-trichloroethane, and 1,1,2-trichloroethane may have occurred at Rockeye, although the concentrations are very small, (generally near or below quantitation limits) and are not considered significant.

A release of several tentatively identified volatile organic compounds may have occurred at Rockeye.

It should be noted that the assigned identity and estimates of concentrations of tentatively identified compounds (TIC) are in most cases highly uncertain. The concentration estimates could be orders of magnitude higher or lower than the actual concentration. In view of these uncertainties, information on TICs is supplied primarily to complete the presentation of data.

Method blanks. Acetone and methylene chloride were reported in the method blanks for the volatile organic analyses (Table A19, Appendix A) and indicate a laboratory contamination source for these constituents. These method blank analysis results were considered in the interpretation of the volatile organic soils analyses.

Equipment rinses. Samples were taken from the final boring equipment decontamination rinses associated with Boring 3, 7, and 10. The surface scrape samples were taken with disposable scoops. Therefore, this sampling equipment was not washed and no rinse samples taken. Acetone and methylene chloride were reported in most of the sampling equipment rinses (Table A20, Appendix A). As acetone and methylene chloride were detected in the method blank associated with the analyses of these rinses, these constituents are believed to be laboratory contaminants. The following volatile

organics were also detected in equipment rinses: chloroform; bromodichloromethane; 1,1,2-trichloroethane; 2-butanone; toluene; and 2-hexanone. Chloroform and 2-butanone were found in all three rinses analyzed. Of the volatiles found in the equipment rinses analyzed, 2-butanone was detected in soil boring Sample 9 No.1 and 1,1,2-trichloroethane in soil boring Sample 5 No. 1. No other volatile organics were detected in the soil boring samples (other than those which were also determined in associated method blanks).

With the exception of the chloroform in the rinse associated with Boring 3 and volatiles which were also in method blanks, volatile organics found in the Rockeye equipment rinses were present at concentrations which were below quantitation limits ("J" values) and are not considered significant.

The volatile organic compounds found in the rinses may have been derived from the initial washings with potable water and subsequent washings with methanol and hexane. These equipment rinse results were considered in the interpretation of volatile organic soils analyses.

Semivolatile organics (EPA Method 8270)

The results of analyses of Rockeye soils for semivolatile organic compounds (EPA Method 8270 in *Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods SW846*, Third Edition, November 1986 with December 1988 revisions) are given in Tables A21 and A22 and summarized in Table A23 (Appendix A). Dimethyl phthalate, diethylphthalate, dibutyphthalate, bis(2-ethylhexyl) phthalate, and di-N-octyl phthalate were frequently found in soil boring samples and surface scrape soil samples. Thus, dimethyl phthalate, diethyl phthalate, dibutyphthalate, bis(2-ethylhexyl) phthalate, and di-N-octylphthalate are likely sampling equipment and analytical contaminants rather than soil constituents associated with munitions manufacturing activities at Rockeye.

In addition to the above described phthalates which were frequently found in associated method blanks, soils from surface sample Areas A, D, E, G, and H, and subsurface soil samples from Borings 13 and 10 contained semivolatile organic compounds as summarized in Table 5.20 (Appendix A). Surface soil Sample H contained greater numbers of semivolatile organic compounds than any other surface sample location. Soils from Sample H also contained the highest concentrations of semivolatile organic compounds found in any of the Rockeye soils sampled. Phenanthrene, fluoranthene, and pyrene were found in Sample H soil at concentrations of 5.5, 3.9, and 3.9 mg/kg, respectively. Risk-based numbers for these contaminants in residential soil/occupational soil applications are 2,300/30,000, 3,100/41,000, and 3.6/6.1 mg/kg, respectively (EPA Region III, February 1992). All other semivolatiles organics found in Sample H as well as all other Rockeye samples were in concentrations that were detected by the analytical instrumentation but not in sufficient amounts to accurately quantify (J values). Therefore, those concentrations are estimated.

The most frequent type of semivolatile organic compound present in the surface soil sample areas was polycyclic aromatic hydrocarbons (PAH). The

PAH, phenanthrene, was detected in soils from Areas A, D, and E. Area E soils also contained the PAH, fluoranthene and pyrene. Sample H contained the PAH; phenanthrene, fluoranthene, pyrene (previously discussed) as well as acenapthene, fluorene, anthracene, chrysene, benzo(a)anthracene, benzo (b)fluoranthene, and benzo(k)fluoranthene. In addition to the PAHs found in the Rockeye surface soil samples, aniline was found in an Area G sample. N-nitrosomethanamine , 2,6-dinitrotoluene, 2,4-dinitrotoluene, and dibenzofuran were found in Sample H. All concentrations, except for phenanthrene, fluoranthene, and pyrene in Sample H, were J values.

PAH were not found in subsurface soil samples analyzed. Subsurface soil samples from the Borings 13 and 10 contained N-nitrosodimethylamine and butyl benzyl phthalate, respectively, but were J values.

In summary, semivolatile organic compounds were found in the sampled surface and subsurface Rockeye soils. For soil samples other than sample H, all semivolatile compounds determined in the surface and subsurface soil samples were in concentrations that were detected by the analytical instrumentation but not in sufficient amounts to quantify (J values). Surface soil Sample H contained greater numbers and highest concentrations of semivolatile organic compounds than any other Rockeye soil sampled. Four compounds, phenanthrene, fluoranthene, pyrene, and N-nitrodisomethylamine found in Sample H were found in at least one of the other surface or subsurface soil samples taken. Considering all sampled soils other than Sample H, only phenanthrene was found in more than one soil sample location, and that at J values. Thus, available data did not indicate a significant concentration of semivolatile organic contaminants at any sampled location, other than at Sample H, which was near a building ventilator. At this location, only concentrations of pyrene were near the RBC. The source of this contamination may have been Building 2734, a part of the manufacturing facilities at Rockeye.

Table A24 (Appendix A) provides a list of tentatively identified semivolatile organic compounds detected in Rockeye soil samples. A release of tentatively identified semivolatile organic compounds may have occurred at Rockeye. As mentioned previously, assigned identity and concentrations of TIC are generally highly uncertain. The list of TIC is provided to complete the presentation of data.

Method blanks. As discussed previously, method blanks analyzed for semivolatile organic compounds contained several phthalates including dimethyl phthalate, diethyl phthalate, dibutyphthalate, bis(2-ethylhexyl) phthalate, and di-N-octylphthalate at estimated concentrations below the instrument detection limits ("J" Values) (Table A25, Appendix A). Diethyl phthalate and bis(2-ethylhexyl) phthalate were found in two method blanks in concentrations sufficient to accurately quantify. These method blank analysis results were considered in the interpretation of the semivolatile organic soils analyses.

Equipment rinses. Equipment rinses were collected following the taking of soil samples at Borings 10 and 7 and were analyzed for semivolatile organic analytes. A rinse associated with Boring 3 was also taken; however, the sample was lost during the extraction process. The rinses analyzed contained three

phthalates including diethyl phthalate, dibutylphthalate, and bis(2-ethylhexyl) phthalate (Table A26, Appendix A). Because these phthalates were also found in the method blanks analyzed with the rinses, those phthalates are likely the result of laboratory contamination and not the result of actual occurrence of those materials in the equipment rinses.

The results of analyses of equipment rinses for semivolatile organic compounds indicate that cross contamination of samples or equipment contamination did not occur and was not a factor in the results obtained from the analyses of Rockeye soils for semivolatile organic compounds.

6 Summary

The Rockeye site is located on a dissected ridge, and during construction of the facility large amounts of fill were placed in the gullies to level the construction site. Soils data from 13 auger borings and 35 groundwater monitoring wells were used to develop the site soil descriptions. The results showed that: the bedrock surface is irregular; the soil types are predominately clay (CL) and lesser amounts of sand (SM) and silt (ML); much of the soil materials are fill materials; and the soils contained natural organic debris. Ground water was encountered in 4 of the 13 soil borings drilled at the site.

Results of prior ground water studies (Dunbar 1982, and 1984) indicated that the water movement is enhanced by rock fracturing; the site straddles a east/west trending drainage divide; the configuration of the water table surface mirrors the land surface configuration; and that the soil with permeabilities in the range of 2.3×10^{-7} and 3.20×10^{-5} cm/sec are nearly impermeable. These soils can at best act as a very slow conduit for groundwater and its contaminants. The majority of the rain falling on the site would exit the site by the surface runoff routes. The direction of the groundwater flow is affected by a drainage divide. The ground water moves to the creeks.

To determine what effects the activities at Rockeye may have had on the environment, 115 soil samples were taken for chemical analysis. The analyte parameter list included inorganic, explosive, and organic compounds. The methods used were either RCRA recognized methods or EPA accepted methods. Due to the nature of the Rockeye facility, the analytes of major concern at the activity are explosive compounds. Other organic and inorganic compounds were considered less likely contaminants. The study was structured to test for the presence of explosive compounds. Only 10 percent of the surface scrape samples were tested for the presence of volatile organic, semivolatile organic, and inorganic compounds. All of the soil samples from the borings were analyzed for inorganic parameters. Only the deepest of the soil boring samples were tested for the presence of volatile and semivolatile organic contamination. NEESA Level C procedures for QA/QC were followed, with some exceptions.

No explosive compounds were detected in the soil samples from the background area (BN) and only in J values in one sample at background Area C. Detectable amounts of explosive contaminants were not found in soil samples in Borings 1, 3, 4, 5, 9, and 13 and Areas A and D. Explosive compounds

were found in soil samples from the borings around the sumps (2, 6A, 8, and 10) and in the surface drainage ways (7,11, and 12) and in the surface Areas B, E, F, and G. Of the test explosive analytes, DNB, DNT, RDX, and HMX were detected. HMX was found in more soil samples and in greater concentrations than any other explosive compound for which analysis was done. "J" level concentration, 2,4 DNT, was detected in one sample taken from Area C. "J" levels of DNB were found in soil samples from Areas B and C. "J" values are detected analyte concentrations which are found by the analytical instrumentation but in amounts which are below accurately quantifiable detection levels. "J" levels of TNT were found in samples for Areas E and F and Boring 12. Levels of HMX were found in soil samples from Areas B, E, F, and G and from Borings 2, 6A, 8, 10, 11, and 12. A maximum concentration of 1,960 mg/kg was detected in one soil sample from Area G (the south stream). HMX concentration of 42.7 mg/kg was detected in the soil from Boring 12. Ten surface soil samples (the most of any area) from Area E were contaminated with explosive compound residues.

Noteworthy concentrations of TNT, RDX, and HMX at 295, 3,350, and 10,400 mg/kg, respectively, were found in soil Sample H. This sample was taken from a spot of bare earth on the grassed berm behind Building 2734. This spot of bare earth is located where particulates, exhausted from a nearby exhaust vent, might fall. Risk-based concentrations of TNT and RDX, developed by EPA Region III, are 16/200 mg per kg (ppm) and 15/26 ppm, respectively. These concentrations represent residential soil/occupational soil applications.

In addition to soil, preliminary results from the ongoing RFI Phase III Site Characterization for Groundwater at Rockeye also indicate explosive contamination above "B" and "J" levels in several Rockeye monitoring wells. The contaminated wells are located in or near the prominent surface drainage channel, running from the vicinity of the loading and washing Buildings 2734 and 2731 to the northeast corner of the Rockeye site, and continuing downslope to the north and east.

Evidence of explosive compound releases were observed in soils tested. Since no explosives were detected in any of the QA blanks or rinses, it appears that the results are valid and that they support the proposal that a release has occurred. The explosives contamination detected was associated with areas of drainage and disposal sumps. Indications from the chemical data are that there likely has been a release of explosive compounds to the soils at the Rockeye facility.

Because inorganic compounds are naturally occurring compounds, the inorganic analytical data must be compared to established background samples. For surface soil comparisons, mean concentrations from Area C and BN-2 from Background North were used as a background population. The Area C and BN-2 sample size, five soil samples, was of sufficient size to be used as a comparative standard. Its mean inorganic analyte concentrations were generally less than concentrations found at other Rockeye sites. No background subsurface soils (boring) samples were taken at Rockeye. Instead, background

boring data from two other NSWCC sites (ABG and ORR) were used for comparative purposes with Rockeye test boring data.

Comparisons of the data from the analysis of soil from Rockeye borings and surface scrapes indicate that, with the exception of antimony and aluminum, the maximum inorganic concentration levels were detected in the surface soil samples. Additionally, the maximum concentrations of all inorganic parameters, except copper and tin, were detected in the analysis of soils from the surface samples from the northeast stream (E) and the south stream (F and G). Inorganic analyte concentrations from soil samples associated with the waste sources (the sumps and ditches) were generally less than corresponding stream soil samples.

Preliminary results from the ongoing Phase III groundwater study indicate that concentrations of several metals, namely beryllium, cadmium, nickel, and antimony, were detected above primary MCLs in two rounds of sampling from monitoring wells in the vicinity of Rockeye. Four metals were also detected in concentrations above the secondary MCL, and several metals plus a sulfide were detected below MCL.

The factors contributing to the pattern or lack of pattern in the inorganic concentrations in the soils from Rockeye cannot be determined with certainty from the available data. There is insufficient information to link the inorganic concentrations detected in the soil samples from the surface drainage to identified possible contaminant sources (i.e., the sumps). It is possible that metal contaminants could have been carried by surface drainage away from the sumps and deposited along the Rockeye perimeter, hence yielding higher concentrations in the surface soils than the subsurface soils near the sumps. However, the elemental concentrations found in the Rockeye soil samples could be totally natural in their occurrence and not caused by human activities. Soil analytical data from the sumps and ditches do not rule out or support the conclusion that a release of inorganic contaminants has occurred.

Concentrations of volatile organic compounds (methylene chloride, acetone, 2 butanone, 1.1,2-trichloroethane, trans-1,3, dichlorpropene, t-xylene, and 1,1,1-trichloroethane) were detected in the soil samples collected at the Rockeye site. Methylene chloride and acetone found in all but two soil samples and many of the associated blanks are considered analytical process associated contaminants and not contaminants related to the Rockeye operation. Analysis of the equipment rinse samples indicate that the soil samples may have been contaminated with 2-butanone and 1,1,2-trichloroethane during field collection. The common laboratory contaminant, 2-butanone, may not be a soil contaminant at the Rockeye facility. A concentration of 1,1,1-trichloroethane of 0.11 mg/kg (approximately 110 ppb, or about twice the detection limit) was detected in the basal soil sample for Boring 1. Other compounds, trans-1,3 dichlorpropene, and t-xylene, were detected at "J" value levels. Only 1,3 trans-dichlorpropene, t-xylene, and 1,1,1-trichloroethane were detected in the soils and were not detected in the QA control samples. In summary, evidence was found that supports the premise that release of volatile organic compounds (trans-1,3 dichlorpropene, 1,1,2-trichloroethane, t-xylene, and 1,1,1-trichloroethane) may have occurred at Rockeye, although, concentration are

small (mostly J values) and are not considered significant. No consistent and characteristic suite of volatile organic compounds could be identified.

Concentrations of a number of semivolatile compounds were detected in the soil samples collected at the Rockeye sites. Many of the detected semivolatile compounds can be classed as phatalates. Frequently, phthalate concentrations were found in the associated method blanks. It is considered that the detected phthalate concentrations resulted from sampling and analytical procedures and are not associated with the munitions manufacturing activities at Rockeye. The other semivolatile organic compounds (except those identified in sample No. H), identified in the Rockeye soil samples were found in concentration at the "J" value level, which would not be considered significant.

The most frequently detected type of semivolatile organic compound were polycyclic aromatic hydrocarbons (PAH). In particular, the PAHs phenanthrene, fluoranthene, and pyrene were detected in the Rockeye soils. Only phenanthrene was found in more than one soil sample and at more than one location. These PAH can be naturally derived from the erosion of coals, and there are coal seams in the rock underlying the Rockeye facility. These PAH are also common petroleum-derived contaminants. Concentrations of phenanthrene, fluoranthene, and pyrene were detected at levels above detection levels in scrape Sample H. This soil sample was taken from an area of bare earth on a grassed berm behind Building 2734. The sample was taken near an exhaust air vent where particulates exhausted with the air would drop. This evidence indicates that the detected PAHs could be contaminants resulting from the Rockeye operations.

Other 8270 semivolatiles detected were nitrosodimethylamine and butyl benzyl phthalate. Several tentatively identified semivolatile compounds were detected. The majority of these compounds were found both in the samples and in the method blanks. These compounds are considered compounds associated with the analytical methods used and not contaminants.

In summary, a clear case for the presence of explosive compound contamination in the soils of the Rockeye facility has been made. Concentrations above EPA risk-based concentrations were detected in the surface soil near a building ventilator. A less firm conclusion about the presence of volatile and semivolatile organic contamination in the Rockeye soils can be made. The data from the study is indefinite to the presence of inorganic contamination. The clear evidence that explosive compounds have reached the surrounding drainage ways (Areas B, E, F, and G) indicates that explosive contamination has moved in the groundwater and surface water systems. This is supported by visual observation (NEESA, 1983) and groundwater analysis (Dunbar 1984 and WES 1992). Explosive compounds in the soils at the sumps and in the discharge channel soils appear to be acting as a source for the explosive compound contamination detected in the site's groundwater. The northeast (Area E) and the south (Areas F and G) streams are the most effective migration routes for contamination from the site. Any leakage or spillage from the sumps drain into these streams. In the past explosive contaminated waste water discharged to the streams and the ditches leading to those streams. Because of the probable influence these streams have on the local groundwater gradient,

upper contaminated groundwaters are drawn toward these streams. The past operation of Rockeye may have contributed contaminants to the environment of the Naval Surface Warfare Center, Crane, Indiana.

7 Conclusions

The presence of explosive compound contamination in the soils of the Rockeye Facility and the surface soils in the surrounding drainage areas is verified.

The sumps are acting as a source for explosive contamination.

A pattern for the presence of other contaminants (organic and inorganic) could not be clearly verified using the existing data.

8 Recommendations

The following recommendations concerning this report are offered:

A RCRA Facilities Investigation, Phase III, Soils Study is recommended. Specifically, the following sampling is suggested:

a. Additional surface soil sampling along with air monitoring/testing near production building exhaust vents to primarily determine the extent of explosives contamination near those facilities.

b. Soil borings for the background areas (Background North and Area C) to gain a better subsurface background model for inorganic analytes.

c. Soil borings near the facility perimeter where metals and explosives concentrations in the surface soils were highest, so as to determine the vertical extent of contaminants there.

d. Surface water and sediment samples from drainageways and receiving streams to better determine the extent of contamination.

Removal of the sumps should be considered.

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Appendix A
Compound Names and Chemical Analytical Tables

Table A1. EPA method 8240, Volatile compounds, (Test Methods for Evaluating Organic and Inorganic Wastes, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions). Abbreviations used in report tables along with full analyte names.

C1METH - Chloromethane
BrMETH - Bromomethane
VnlC1 - Vinyl Chloride
C1ETHA - Chloroethane
MeC1 - Methylene Chloride
11DC1ETE - 1,1-Dichloroethene
11DC1ETA - 1,1-Dichloroethane
t-DC1ETE - Trans-1,2-Dichloroethene
c-DC1ETE - cis-1,2-Dichloroethene
CHC13 - Chloroform
12DC1ETA - 1,2-Dichloroethane
111TCA - 1,1,1-Trichloroethane
CC14 - Carbon Tetrachloride
BrDC1Me - Bromodichloromethane
12DC1PR - 1,2-Dichloropropane
t13C1PRE - Trans-1,3-Dichloropropene
TCE - Trichloroethene
DBrC1Me - Dibromochloromethane
c13C1PRE - Cis-1,3-Dichloropropene
112TCA - 1,1,2-Trichloroethane
BENZENE - Benzene
CHBR3 - Bromoform
1122TC1A - 1,1,2,2,-Tetrachloroethane
TEC1ETE - Tetrachloroethene
TOLUENE - Toluene
C1BEN - Chlorobenzene
ETBEN - Ethylbenzene
ACETONE - Acetone
BUTANO - 2-Butanone
CS2 - Carbondisulfide
2HEXANO - 2-Hexanone
4Me2PE - 4-Methyl-2-Pentanone
STYRENE - Styrene
VnACETA - Vinyl Acetate
T-XYLENE - T-Xylene

Table A2. EPA method 8270 semivolatile compounds, (Test Methods for Evaluating Organic and Inorganic Wastes, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions). Abbreviations used in report tables along with full analyte names.

PHENOL - Phenol
2ClPHEN - 2-Chlorophenol
2NIPHE - 2-Nitrophenol
24DMePHE - 2,4-Dimethylphenol
24DClPHE - 2,4-Dichlorophenol
4Cl3MePH - 4-Chloro-3-Methylphenol
246TClPH - 2,4,6-Trichlorophenol
24DNPH - 2,4-Dinitrophenol
4NPHE - 4-Nitrophenol
2M46DNPH - 2-Methyl-4,6-Dinotrophenol
PClPHE - Pentachlorophenol
BENZOAC - Benzoic Acid
2MEPHE - 2-Methylphenol
4MEPHE - 4-Methylphenol
245TClPH - 2,4,5-Trichlorophenol
BZLAL - Benzyl Alcohol
NNDMEAM - N-Nitrosodimethylamine
BCl1PrE - Bis(2-Chloroisopropyl)Ether
NNDNPAM - N-Nitroso-Di-N-Propylamine
NITROBEN - Nitrobenzene
ISOPHOR - Isophorone
BClEtoME - Bis(2-Chloroethoxy)Methane
26DNTOL - 2,6-Dinitrotoluene
24DNTOL - 2,4-Dinitrotoluene
12DPHYD - 1,2-Diphenylhydrazine
BENZIDI - Benzidine
33DClBEZ - 3,3'Dichlorobenzidine
BClEtE - Bis(2-Chloroethyl)Ether
13DClB - 1,3-Dichlorobenzene
14DCLB - 1,4-Dichlorobenzene
12DClB - 1,2-Dichlorobenzene
HClETA - Hexachloroethane
124TClB - 1,2,4-Trichlorobenzene
NAPHTH - Naphthalene
HClBU - Hexachlorobutadiene
HClCYPD - Hexachlorocyclopentadiene
2ClNAPH - 2-Chloronaphthalene
ACENAY - Acenaphthylene
DMePHTH - Dimethyl Phthalate
ACENAP - Acenaphthene
FLUORE - Fluorene
DEtPHTH - Diethyl Phthalate
4ClPHPHE - 4-Chlorophenyl Phenyl Ether
NNDPHAM - N-Nitrosodiphenyl Amine
4BrPHET - 4-Bromophenyl Ether
HClBEN - Hexachlorobenzene
PHENAN - Phenanthrene
ANTRAC - Anthracene
DBuPHTH - Dibutylphthalate
FLANTHE - Fluoranthene
PYRENE - Pyrene
BuBePHTH - Butylbenzylphthalate
CHRYSE - Chrysene
BAANTHR - Benzo(a)Anthracene
B2EHPH - Bis(2-Ethylhexyl)Phthalate
DNOcPHT - Di-N-Octylphthalate
BBFLANT - Benzo(b)Fluoranthene
BKFLANT - Benzo(k)Fluoranthene
BAPYRE - Benzo(a)Pyrene
I123PYR - Indeno(1,2,3-C,D)Pyrene
B-GHI-PY - Benzo(G,H,I)Perylene
ANILINE - Aniline
4ClANIL - 4-Chloroaniline
DBENZOFU - Dibenzofuran
2MeNAPH - 2-Methylnaphthalene
2NANIL - 2-Nitroaniline
3NANIL - 3-Nitroaniline
4NANIL - 4-Nitroaniline

Table A3. EPA method 8330. Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC), (Test methods for Evaluating Organic and Inorganic Wastes. Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions). Abbreviations used in report tables along with full analyte names.

Abbrev	Compound
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
TNB	1,3,5-Trinitrobenzene
DNB	1,3-Dinitrobenzene
Tetryl	Methyl-2,4,6-trinitrophenylnitramine
NB	Nitrobenzene
TNT	2,4,6,-Trinitrotoluene
24DNT	2,4-Dinitrotoluene
26DNT	2,6-Dinitrotoluene
2NT	o-Nitrotoluene
3NT	m-Nitrotoluene
4NT	p-Nitrotoluene

Table A4. (Page 1 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of inorganic analyses of subsurface soil samples collected in the vicinity of SWMU 10/15. Concentrations are mg/kg (ppm) dry weight.

Sample Id*/ Analyte	SB	AS	BE	CD	CR	CU	PB	NI
01/#1 (1.5 - 2.0)	1.89BN	2.76	0.20B	1.60N	20.4N	7.8	15.3	7.8
02/#1 (0.25 - 0.5)	<1.50UN	6.09	1.10	<0.40UN	13.6ND	9.1	14.6	13.6
02/#2 (1.5 - 2.0)	<1.50UN	3.48	1.10	<0.40UN	13.6ND	10.0	13.0	12.0
03/#1 (5.7 - 6.0)	2.44BN	2.01	0.20B	1.70ND	12.2N	3.3	12.2	4.4
04/#1 (5.0 - 5.5)	<1.50UN	2.28	0.20B	1.60ND	15.8N	4.1	13.8	5.4
05/#1 (1.0 - 1.5)	1.89BN	3.37	0.20B	2.50N	8.2N	8.8	23.4	4.8
06A/#1 (not ident)	2.11BN	4.56	0.40B	2.60ND	28.5N	7.8	19.9	8.6
07/#1 (0.5 - 1.4)	<1.50UN	4.81	1.50	<0.40UN	16.8ND	10.0	26.7	11.2
08/#1 (7.5 - 8.0)	2.67B	3.82	0.40B	<0.40UN	34.2ND	<0.6U	18.9	11.9
09/#1 (7.5 - 8.0)	2.67B	5.19	0.50	<0.40UN	25.8ND	<0.6U	18.2	11.1
10/#1 (0.25 - 0.5)	1.89B	3.96	0.30B	<0.40UN	20.8ND	<0.6U	17.7	9.3
10/#2 (1.0 - 1.5)	4.22B	5.56	0.40B	<0.40UN	25.2ND	<0.6U	20.8	10.8
10/#3 (3.0 - 3.5)	2.78B	3.89	0.30B	<0.40UN	19.3ND	<0.6U	17.2	9.4
10/#4 (8.0 - 8.5)	2.89B	6.27	0.59	0.50N	26.4ND	1.2B	43.2	16.7
11/#1 (0.25 - 0.5)	3.11B	5.49	0.69	<0.40UN	21.1ND	1.5B	22.1	15.2
11/#2 (1.0 - 1.5)	4.44B	4.73	0.70	<0.40UN	15.8ND	<0.6U	21.8	14.0
11/#3 (3.0 - 3.5)	3.33B	5.27	0.70	<0.40UN	18.3ND	<0.6U	24.3	15.7
11/#4 (6.4 - 6.9)	<1.50U	1.62	0.79	<0.40UN	20.0ND	<0.6U	24.9	16.2
12/#1 (0.25 - 0.5)	1.56B	2.30	0.30B	<0.40UN	15.5ND	<0.6U	20.2	9.0
12/#2 (1.0 - 1.5)	2.56B	2.44	0.30B	0.79N	12.1ND	<0.6U	17.1	8.4
12/#3 (3.0 - 3.5)	2.44B	5.82	0.39B	0.78N	24.8ND	1.3B	20.5	11.9
12/#4 (4.5 - 5.0)	1.89B	5.67	0.50B	2.30N	22.5ND	1.6B	24.5	13.3
13/#1 (0.25 - 0.5	1.89BN	3.76	1.20	<0.40UN	17.8ND	4.8	16.4	8.5
13/#2 (1.0 - 1.5)	<1.50UN	4.53	1.80	<0.40UN	17.2ND	8.3	20.9	16.8
13/#3 (3.0 - 3.5)	<1.50UN	4.91	2.10	<0.40UN	17.2ND	11.4	15.6	16.5

Note:

- * Sample ID is as follows - Boring Number/Sample Number (sample depth in feet below the surface). See Figures 13 and 14.
- U Analyte was analyzed for but not detected
- B Reported value is less than the Contract Required Detection Limit but greater than the Instrument Detection Limit
- W Post-digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance
- N Spiked sample recovery not within control limits
- D Duplicate analysis not within control limits
- (not ident) - The sample depth for this sample was not identified on the drilling logs

Table A4. (Page 2 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of inorganic analyses of soil subsurface samples collected in the vicinity of SWMU 10/15. Concentrations are mg/kg (ppm) dry weight.

Sample Id*/ Analyte	ZN	AL	BA	CO	FE	MG	SN
01/#1 (1.5 - 2.0)	19.5	13900	41.2	<3.0U	14000	1390	<7.60U
02/#1 (0.25 - 0.5)	32.5	7740	41.4	6.5	18800	1380	<7.60U
02/#2 (1.5 - 2.0)	61.9	8230	45.6	6.8	15700	2910	<7.60U
03/#1 (5.7 - 6.0)	10.7	8890	19.5B	3.3B	10600	363	<7.60U
04/#1 (5.0 - 5.5)	12.5	14300	28.1	3.3B	12900	846	<7.60U
05/#1 (1.0 - 1.5)	29.2	3470	9.7B	<3.0U	20100	386B	<7.60U
06A/#1 (not ident)	17.7	19500	51.3	<3.0U	20300	1590	<7.60U
07/#1 (0.5 - 1.4)	40.3	14400	65.9	7.1	22600	2060	<7.60U
08/#1 (7.5 - 8.0)	65.2	15700	70.4	8.2	17100	2540	<7.60U
09/#1 (7.5 - 8.0)	27.0	18600	50.2	5.8	23800	1460	<7.60U
10/#1 (0.25 - 0.5)	15.0	15000	41.3	3.6B	16300	1420	<7.60U
10/#2 (1.0 - 1.5)	24.9	14700	54.8	5.6	21100	1900	<7.60U
10/#3 (3.0 - 3.5)	23.2	14500	42.2	4.9B	17800	1640	<7.60U
10/#4 (8.0 - 8.5)	43.3	18700	68.5	29.8	42900	1720	<7.60U
11/#1 (0.25 - 0.5)	45.8	15500	110.0	15.0	17000	1870	<7.60U
11/#2 (1.0 - 1.5)	38.7	13700	108.0	16.6	13200	1720	<7.60U
11/#3 (3.0 - 3.5)	56.4	15100	102.0	10.3	16300	2010	<7.60U
11/#4 (6.4 - 6.9)	64.3	11900	47.7	5.9	25400	1650	<7.60U
12/#1 (0.25 - 0.5)	38.5	10200	66.1	4.2B	12200	2090	<7.60U
12/#2 (1.0 - 1.5)	34.7	9940	63.7	4.0B	11800	1690	<7.60U
12/#3 (3.0 - 3.5)	109.0	16300	68.4	5.7	20500	2300	<7.60U
12/#4 (4.5 - 5.0)	52.2	16700	79.9	7.0	20500	2540	<7.60U
13/#1 (0.25 - 0.5)	15.0	9530	50.8	29.1	15800	767	<7.60U
13/#2 (1.0 - 1.5)	28.1	14600	51.7	70.2	24100	1470	<7.60U
13/#3 (3.0 - 3.5)	60.9	10100	59.2	24.8	31700	1430	<7.60U

Note:

- * Sample ID is as follows - Boring Number/Sample Number (sample depth in feet below the surface). See Figures 13 and 14.
- U Analyte was analyzed for but not detected
- B Reported value is less than the Contract Required Detection Limit but greater than the Instrument Detection Limit
- W Post-digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance
- N Spiked sample recovery not within control limits
- D Duplicate analysis not within control limits
- (not ident) - The sample depth for this sample was not identified on the drilling logs

Table A5. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of inorganic analyses of surface soil samples. Concentrations are mg/kg (ppm) dry weight.

Sample*	Analyte															
ID	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Zn	Al	Ba	Co	Fe	Mg	Sn
A-0-1	<1.50U	6.01	0.20B	2.00D	18.1	10.5	25.7	10.1	33.7	14400	63.1	7.3	16200	1630	<7.60U
A-1-2	<1.50U	6.38	0.30B	2.50D	19.4	11.2	32.7	12.8	48.0	14300	94.0	9.8	15500	1940	<7.59U
A-2-3	<1.50U	10.60	0.40B	2.10D	22.3	11.0	43.2	11.9	63.9	12100	98.0	10.8	19200	1720	<7.59U
A-4-0	<1.50U	6.14	0.30B	1.70D	15.5	10.0	29.2	10.0	95.1	11800	83.2	8.7	13900	1850	<7.60U
B-0-1	<1.50U	6.69	0.40B	2.50D	21.4	16.6	32.2	17.9	74.1	13400	89.3	10.1	23900	2840	<7.60U
B-1-2	<1.50U	11.18	0.80	3.20D	31.8	16.6	40.1	26.6	84.2	14100	79.2	11.9	41500	2580	8.49
B-2-3	<1.50U	7.44	0.50	2.30D	24.2	13.9	31.1	18.8	57.8	14400	93.8	12.4	20500	3400	<7.60U
B-4-0	<1.50U	4.65	0.40B	1.50D	15.6	8.9	18.7	12.8	66.1	8660	66.9	6.6	14000	1060	<7.60U
C-0-1	<1.50U	3.01	0.50	0.80D	13.2	6.6	18.8	10.3	33.9	7800	53.9	19.7	9930	852	<7.60U
C-1-2	<1.50U	3.01	0.50	1.90D	12.5	6.0	19.1	9.4	37.0	7800	58.9	16.9	9760	896	<7.60U
C-2-3	<1.50U	2.74	0.50	1.60D	16.4	7.2	20.1	13.8	40.3	11100	81.3	19.8	11000	1140	<7.60U
C-3-2	<1.50U	4.30	0.60	1.60D	19.1	11.2	28.9	13.9	56.2	11300	76.8	13.0	17600	1260	<7.60U
D-0-0	<1.50U	5.04	0.40	1.00D	33.2	21.4	46.2	20.5	55.7	13400	86.3	11.2	18600	1820	<7.62U
D-1-0	<1.50U	5.10	0.20	1.30D	18.6	12.8	34.7	14.0	39.3	13300	103.0	11.3	17900	1880	<7.62U
D-2-0	<1.50U	4.33	0.20	1.50D	17.0	11.0	35.7	10.1	32.4	11700	78.2	9.0	14900	1690	<7.62U
D-3-0	<1.50U	5.22	0.30	1.90D	19.9	10.3	28.1	10.4	33.7	13400	66.0	8.9	19500	1710	<7.62U
D-4-0	<1.50U	5.00	0.30	1.50D	15.9	9.0	28.7	10.0	36.9	10600	73.1	9.5	16000	1430	<7.62U
D-5-0	<1.50U	5.11	0.30	1.20D	20.0	10.8	29.6	11.3	33.8	13600	84.0	10.1	18500	1720	<7.62U
E-0-0	1.67B	9.63	0.70	2.70N	35.7	14.0	53.4	18.2	67.3	14400	134.0	20.7	42900	2210	<7.62U
E-1-0	1.56B	11.20	0.60	4.50N	36.7	14.3	58.3	18.4	88.2	11900	131.0	20.7	37600	3320	<7.62U
E-2-0	<1.50U	3.04	<0.20U	2.80N	15.1	9.3	28.6	10.2	77.7	10000	77.1	9.0	12600	2030	<7.62U
E-3-0	<1.50U	4.81	0.60	1.70N	15.7	14.2	29.4	10.8	52.4	4980	46.0	10.3	29400	1150	<7.62U
E-4-0	<1.50U	5.72	0.50	2.50N	19.4	12.2	34.4	15.8	81.8	10300	152.0	21.2	17900	5850	<7.62U
E-5-0	<1.50U	4.04	0.30B	2.30N	17.5	15.0	34.0	13.5	119.0	8430	125.0	15.8	13700	4070	<7.62U
F-1	<1.50UN	35.60	1.50	5.80ND	74.2N	15.6	141.0	25.4	125.2	10800	210.0	48.1	122000	3770	<7.60U
F-2	<1.50UN	82.20	1.50	7.10ND	99.9N	10.6	158.0	27.2	146.0	9480	141.0	37.7	132000	2630	<7.60U
F-3	<1.50UN	17.00	0.90	3.80ND	36.6N	11.7	78.2	25.7	61.5	11600	119.0	24.3	59200	2630	<7.60U
G-1	<1.50UN	10.10	11.50	<0.40UN	10.6ND	7.6	86.3	<1.1U	44.0	5800	498.0	82.0	285000	2130	<7.60U
G-2	<1.50UN	4.40	1.50	<0.40UN	16.4ND	10.4	21.2	10.4	35.8	12400	129.0	10.3	23900	1980	<7.60U
G-3	<1.50UN	16.4	3.10	3.10N	28.1ND	15.8	58.9	15.0	97.7	13780	116.0	40.6	53600	1750	<7.60U
G-4	<1.50UN	15.0	2.90	1.80N	23.4ND	12.8	48.5	13.1	92.2	11500	155.0	22.9	47900	1710	<7.60U
BN#2	<1.50UN	4.67	0.70	2.60D	59.5	14.2	36.3	39.3	48.5	15700	129.0	19.3	13900	1530	8.00
H	3.00BN	6.36	0.60	1.90ND	24.4	9.7	26.8	12.3	43.6	17500	85.2	8.9	19400	1840	<7.60U

Note:

* Sample ID - A-0-1 - Grid Sample Area A; Location 0,1 within the grid sample pattern. See Figures 13 and 15 through 17.

U Analyte was analyzed for but not detected

B Reported value is less than the Contract Required Detection Limit but greater than the Instrument Detection Limit

W Post-digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance

N Spiked sample recovery not within control limits

D Duplicate analysis not within control limits

Table A6. (Page 1 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana. SWMU 10/15. Comparison of maximum and mean concentrations of selected metal analytes determined for surface and subsurface soil samples.

Max. Concentration Determined mg/kg dry weight
Surface Sample or Grid Surface Sample

Analyte	A	B	C	D	E	F	G	14	BN//2	All Sur. Samples	All Sub. Samples	Risk-Based Concentration[1]
Sb	<1.50	<1.50	<1.50	<1.50	1.67	<1.50	<1.50	3.00	<1.50	3.00	4.44	47000/610000
As	10.60	11.18	4.30	5.22	11.20	82.20	16.40	6.36	4.70	82.20	6.27	0.97/1.6
Be	0.40	0.80	0.60	0.40	0.70	1.50	11.50	0.60	0.70	11.50	2.10	0.4/0.67
Cd	2.50	3.20	1.90	1.90	4.50	7.10	3.10	1.90	2.60	7.10	2.60	39/510
Cr	22.3	31.8	19.1	33.2	36.7	99.9	28.1	24.4	59.5	99.9	34.2	390//5100[2]
Cu	11.2	16.6	11.2	21.4	15.0	15.6	15.8	9.7	14.2	21.4	11.4	2900/38000
Pb	43.2	40.1	28.9	46.2	58.3	158.0	86.3	26.8	36.3	158.0	43.2	0.0078/0.1
i	12.8	26.6	13.9	20.5	18.4	27.2	15.0	12.3	39.3	39.3	16.8	1600/20,000
Zn	95.1	84.2	56.2	55.7	119.0	146.0	97.7	43.6	48.5	146.0	109.0	16000/200000
Al	14400.0	14400.0	11300.0	13600.0	14400.0	11600.0	13780.0	17500.0	15700.0	17500.0	19500.0	230000/3000000
Ba	98.0	93.8	81.3	103.0	152.0	210.0	498.0	85.2	129.0	498.0	110.0	5500/72000
Co	10.8	12.4	19.8	11.3	21.2	48.1	82.0	8.9	19.3	82.0	70.2	0.78/10
Fe	19200.0	41500.0	17600.0	19500.0	42900.0	132000.0	285000.0	19400.0	13900.0	285000.0	42900.0	
Mg	1940.0	3400.0	1260.0	1880.0	5850.0	3770.0	2130.0	1840.0	1530.0	5850.0	2910.0	
Sn	<7.60	8.49	<7.60	<7.62	<7.62	<7.60	<7.60	<7.60	8.00	8.49	<7.60	47000/610000

Max. Concentration Determined mg/kg dry weight
Subsurface Sample /Boring Number

Analyte	1	2	3	4	5	6A	7	8	9	10	11	12	13
Sb	1.89	<1.50	2.44	<1.50	1.89	2.11	<1.50	2.67	2.67	4.22	4.44	2.56	1.89
As	2.76	6.09	2.01	2.28	3.37	4.56	4.81	3.82	5.19	6.27	5.49	5.82	4.91
Be	0.20	1.10	0.20	0.20	0.20	0.40	1.50	0.40	0.50	0.59	0.79	0.50	2.10
Cd	1.60	<0.40	1.70	1.60	2.50	2.60	<0.40	<0.40	<0.40	0.50	<0.40	2.30	<0.4
Cr	20.4	13.6	12.2	15.8	8.2	28.5	16.8	34.2	25.8	26.4	21.1	24.8	17.8
Cu	7.8	10.0	3.3	4.1	8.8	7.8	10.0	<0.6	<0.6	1.2	1.5	1.6	11.4
Pb	15.3	14.6	12.2	13.8	23.4	19.9	26.7	18.9	18.2	43.2	24.9	24.5	20.9
Ni	7.8	13.6	4.4	5.4	4.8	8.6	11.2	11.9	11.1	16.7	16.2	13.3	16.8
Zn	19.5	61.9	10.7	12.5	29.2	17.7	40.3	65.2	27.0	43.3	64.3	109.0	60.9
Al	13900.0	8230.0	8890.0	14300.0	3470.0	19500.0	14400.0	15700.0	18600.0	18700.0	15500.0	16700.0	14600.0
Ba	41.2	45.6	19.5	28.1	9.7	51.3	65.9	70.4	50.2	68.5	110.0	79.9	59.2
Co	<3.0	6.8	3.3	3.3	<3.0	<3.0	7.1	8.2	5.8	29.8	16.6	7.0	70.2
Fe	14000.0	18800.0	10600.0	12900.0	20100.0	20300.0	22600.0	17100.0	23800.0	42900.0	25400.0	20500.0	31700.0
Mg	1390.0	2910.0	363.0	846.0	386.0	1590.0	2060.0	2540.0	1460.0	1900.0	2010.0	2540.0	1470.0
Sn	<7.60	<7.60	<7.60	<7.60	<7.60	<7.60	<7.60	<7.60	<7.60	<7.60	<7.60	<7.60	<7.60

[1] Residential Soil/Occupational Soil (From EPA Region III, February 1992)
[2] Chromium VI and compounds

Table A6. (Page 2 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana. SWMU 10/15. Comparison of maximum and mean concentrations of selected metal analytes determined for surface and subsurface soil samples.

Maximum and Mean Concentrations Determined mg/kg dry weight

	Rockeye Facility				Rockeye Facility Perimeter			
	Sumps		Ditches		(A-G)		C +BN2	
Analyte	max	mean	max	mean	max	mean	max	mean
Sb	4.22	2.45	4.44	2.16	1.67	1.51	<1.50	<1.50
As	6.27	3.97	6.09	4.35	82.20	11.41	4.67	3.55
Be	0.59	0.34	2.10	0.94	11.50	1.14	0.70	0.56
Cd	2.60	1.14	2.30	0.59	7.10	2.41	2.60	1.70
Cr	34.2	21.5	24.8	17.6	99.9	26.7	59.5	24.1
Cu	8.8	3.3	11.4	4.4	21.4	12.5	14.2	9.0
Pb	43.2	20.1	26.7	20.2	158.0	47.6	36.3	24.6
Ni	16.7	9.1	16.8	13.0	27.2	14.9	39.3	17.3
Zn	65.2	26.2	109.0	48.5	146.0	68.3	56.2	43.2
Al	19500.0	14296.0	16700.0	12424.0	14400.0	11649.0	15700.0	10740.0
Ba	70.4	43.3	110.0	68.6	498.0	118.2	81.3	80.0
Co	29.8	6.7	70.2	15.2	82.0	18.6	19.8	17.7
Fe	42900.0	19718.0	31700.0	18971.0	285000.0	42511.0	17600.0	12438.0
Mg	2540.0	1386.0	2910.0	1849.0	5850.0	2314.0	1260.0	1136.0
Sn	<7.60	<7.60	<7.60	<7.60	8.49	7.64	<7.60	<7.60

Note:
Sumps - subsurface samples, borings 1, 3, 4, 5, 6A, 8, 9, and 10
Ditches - subsurface samples, borings 2, 7, 11, 12, and 13
A-G - surface samples from grid areas A-G, with the exception of area C
C+BN2 - surface samples from grid area C and background north sample BN2. These areas were used as surface background for data comparisons.

Table A7. (Page 1 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Statistical analysis of results of inorganic analyses of subsurface soil samples. Statistics were computed using all samples from each boring location. Statistical analyses were made by comparing surface sample (area C + BN2) means with means from borings 10, 11, 12, and 13. Results from borings 1-9, inclusive, were not statistically compared to area C samples because the number of samples (n=1) for those borings did not allow the computation of a variance. No control subsurface soil samples (borings) were taken.

Boring ID		Analyte Concentration mg/kg dry weight (ppm)														
		Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Zn	Al	Ba	Co	Fe	Mg	Sn
1	n=1	1.89	2.76	0.20	1.60	20.4	7.8	15.3	7.8	19.5	13900	41.2	<3.0	14000	1390	<7.60
3	n=1	2.44	2.01	0.20	1.70	12.2	3.3	12.2	4.4	10.7	8890	19.5	3.3	10600	363	<7.60
4	n=1	<1.50	2.28	0.20	1.60	15.8	4.1	13.8	5.4	12.5	14300	28.1	3.3	12900	846	<7.60
5	n=1	1.89	3.37	0.20	2.50	8.2	8.8	23.4	4.8	29.2	3470	9.7	<3.0	20100	386	<7.60
6A	n=1	2.11	4.56	0.40	2.60	28.5	7.8	19.9	8.6	17.7	19500	51.3	<3.0	20300	1590	<7.60
7	n=1	<1.50	4.81	1.50	<0.40	16.8	10.0	26.7	11.2	40.3	14400	65.9	7.1	22600	2060	<7.60
8	n=1	2.67	3.82	0.40	<0.40	34.2	<0.6	18.9	11.9	65.2	15700	70.4	8.2	17100	2540	<7.60
9	n=1	2.67	5.19	0.50	<0.40	25.8	<0.6	18.2	11.1	27.0	18600	50.2	5.8	23800	1460	<7.60
2	n=2															

Table A7. (Page 2 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Statistical analysis of results of inorganic analyses of subsurface soil samples. Statistics were computed using all samples from each boring location. Statistical analyses were made by comparing surface sample (area C+ BN2) means with means from borings 10, 11, 12, and 13. Results from borings 1-9, inclusive, were not statistically compared to area C + BN2 samples because the number of samples (n=1) for those borings did not allow the computation of a variance. No control subsurface soil samples (borings) were taken.

Analyte Concentration mg/kg dry weight (ppm)

Subsurface Sample/Boring ID ID	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Zn	Al	Ba	Co	Fe	Mg	Sn
10 n=4															
mean	2.95	4.92*	0.40	0.43	22.9*	0.8	24.7	11.6	26.6	15725*	51.7	11.0	24525	1670*	<7.60
s.d.	0.96	1.19	0.14	0.05	3.4	0.3	12.4	3.5	11.9	1994	12.8	12.6	12413	199	-
max	4.22	6.27	0.59	0.50	26.4	1.2	43.2	16.7	43.3	18700	68.5	29.8	42900	1900	-
min	1.89	3.89	0.30	<0.40	19.3	<0.6	17.2	9.3	15.0	14500	41.3	3.6	16300	1420	-
11 n=4															
mean	3.10	4.28	0.72*	0.40	18.8	0.8	23.3	15.3*	51.3	14050*	91.9	12.0	17975	1813*	<7.60
s.d.	1.21	1.80	0.05	0.00	2.3	0.5	1.6	0.9	11.3	1628	30.0	4.8	5218	160	-
max	4.44	5.49	0.79	<0.40	21.1	1.5	24.9	16.2	64.3	15500	110.0	16.6	25400	2010	-
min	<1.50	1.62	0.69	<0.40	15.8	<0.6	21.8	14.0	38.7	11900	47.7	5.9	13200	1650	-
12 n=4															
mean	2.11	4.06	0.37	1.07	18.7	1.0	20.6	10.7	58.6	13285	69.5	5.2	16250	2155*	<7.60
s.d.	0.47	1.95	0.10	0.84	5.9	0.5	3.0	2.3	34.4	3717	7.2	1.4	4910	360	-
max	2.56	5.82	0.50	2.30	24.8	1.6	24.5	13.3	109.0	16700	79.9	7.0	20500	2540	-
min	1.56	2.30	0.30	<0.40	12.1	<0.6	17.1	8.4	34.7	9940	63.7	4.0	11800	1690	-
13 n=3															
mean	1.63	4.40*	1.70*	0.40	17.4	8.2	17.6	13.9	34.7	11410	53.9	41.4	23867	1222	<7.60
s.d.	0.23	0.59	0.46	0.00	0.4	3.3	2.9	4.7	23.6	2777	4.6	25.0	7953	395	-
max	1.89	4.91	2.10	<0.40	17.8	11.4	20.9	16.8	60.9	14600	59.2	70.2	31700	1470	-
min	<1.50	3.76	1.20	<0.40	17.2	4.8	15.6	8.5	15.0	9530	50.8	24.8	15800	767	-
C+BN/2	n=5	(area C + BN/2 was used as "background" for statisical comparisons)													
mean	<1.50	3.55	0.56	1.70	24.1	9.0	24.6	17.3	43.2	10740	80.0	17.7	12438	1135.6	-
s.d.	-	.87	0.09	0.65	19.9	3.5	7.7	12.4	9.1	3253	29.8	2.9	3328	278	-
max	-	4.7	0.7	2.6	59.5	14.2	36.3	39.3	56.2	15700	129.0	19.8	17600	1530	-
min	-	2.74	0.50	0.80	12.5	6.0	18.8	9.4	33.9	7800	53.9	13.0	9760	852	-

Table Notes:

mean - The following 2 situations may exist:
(a) all data was reported as < detection limits and detection limit is given after the < symbol
(b) means are computed using all samples from boring including using the detection limit for those samples with results reported as < detection limits.

mean - the reported mean was greater than the corresponding mean for area C + BN2 which was used as a background area.

mean* - the reported mean was significantly different (greater) (P <.05) than the corresponding mean for area C +BN2.

n - number of samples.

Sb (antimony) and Sn (tin) - no statistical comparisons made because Sb and Sn were below detection limits for area C soil samples.

Table A8. (Page 1 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Statistical analysis of results of inorganic analyses of soil samples. Statistics were computed using all samples from each grid location. Statistical analyses were made by comparing area C + BN2 means with means from areas A, B, D, E, F and G.

Analyte Concentration mg/kg dry weight (ppm)

Grid Area ID	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Zn	Al	Ba	Co	Fe	Mg	Sn
A n=4															
mean	<1.50	7.28*	0.30	2.08	18.8	10.7	32.7	11.2	60.2	13150*	84.6	9.2	16200*	1785*	<7.60
s.d.	-	2.22	0.08	0.33	2.8	0.5	7.6	1.4	26.3	1391	15.6	1.5	2219	137	-
max	-	10.60	0.40	2.50	22.3	11.2	43.2	12.8	95.1	14400	98.0	10.8	19200	1940	-
min	-	6.01	0.20	1.70	15.5	10.0	25.7	10.0	33.7	11800	63.1	7.3	13900	1630	-
B n=4															
mean	<1.50	7.49*	0.52	2.38	23.3	14.0	30.5	19.0	70.6*	12640	82.3	10.3	24975	2470*	7.82
s.d.	-	2.73	0.19	0.70	6.7	3.6	8.8	5.7	11.3	2686	11.9	2.6	11757	1000	-
max.	-	11.18	0.80	3.20	31.8	16.6	40.1	26.6	84.2	14400	93.8	12.4	41500	3400	8.49
min	-	4.65	0.40	1.50	15.6	8.9	18.7	12.8	57.8	8660	66.9	6.6	14000	1060	<7.60
D n=6															
mean	<1.50	4.97*	0.28	1.40	20.8	12.6	33.8*	12.7	38.6	12667*	81.7	10.0	17567*	1708*	<7.62
s.d.	-	.32	0.08	.31	6.3	4.5	6.8	4.1	8.7	1229	12.8	1.1	1752	155	-
max	-	5.22	0.40	1.90	33.2	21.4	46.2	20.5	55.7	13600	103.0	11.3	19500	1880	-
min	-	4.33	0.20	1.00	15.9	9.0	28.1	10.0	32.4	10600	66.0	8.9	14900	1430	-
E n=6															
mean	1.53	6.41*	0.48	2.75*	23.4	13.2	39.7*	14.5	81.1*	10002	110.9*	16.3	25683*	3105*	<7.62
s.d.	-	3.27	0.19	0.94	10.1	2.1	12.8	3.6	22.4	3185	40.5	5.5	12865	1691	-
max	1.67	11.2	0.70	4.50	36.7	15.0	58.3	18.4	119.0	14400	152.0	21.2	42900	5850	-
min	<1.50	3.04	<0.20	1.70	15.1	9.3	29.4	10.2	52.4	4980	46.0	9.0	12600	1150	-
F n=3															
mean	<1.50	44.9	1.30*	5.57*	70.2*	12.6*	125.7*	26.1*	110.9	10627	156.7*	36.7	104400*	3010*	<7.60
s.d.	-	33.6	0.35	1.66	31.8	2.6	42.0	1.0	44.0	1071	47.5	11.9	39462	658	-
max	-	82.2	1.50	7.10	99.9	15.6	158.0	27.2	146.0	11600	210.0	48.1	132000	3770	-
min	-	17.0	0.90	3.80	36.6	10.6	78.2	25.4	61.5	9480	119.0	24.3	59200	2630	-
G n=4															
mean	<1.50	11.5*	4.75	1.43	19.6	11.7	53.7*	9.9	67.4	10870	224.5	39.0	102600	1893*	<7.60
s.d.	-	5.4	4.56	1.30	7.7	3.5	26.9	6.2	32.0	3508	183.1	31.3	122279	198	-
max	-	16.4	11.50	3.10	28.1	15.8	86.3	15.0	97.7	13780	498.0	82.0	285000	2130	-
min	-	4.4	1.50	<0.40	10.6	7.6	21.2	<1.1	35.8	5800	116.0	10.3	23900	1710	-
H n=1															
	3.00	6.4	0.60	1.90	24.4	9.7	26.8	12.3	43.6	17500	85.2	8.9	19400	1840	<7.60
C+BN/2	n=5	(area C + BN/2 was used as "background" for statisical comparisons)													
mean	<1.50	3.55	0.56	1.70	24.1	9.0	24.6	17.3	43.2	10740	80.0	17.7	12438	1135.6	-
s.d.	-	.87	0.09	0.65	19.9	3.5	7.7	12.4	9.1	3253	29.8	2.9	3328	278	-
max	-	4.7	0.7	2.6	59.5	14.2	36.3	39.3	56.2	15700	129.0	19.8	17600	1530	-
min	-	2.74	0.50	0.80	12.5	6.0	18.8	9.4	33.9	7800	53.9	13.0	9760	852	-

Table A8. (Page 2 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Statistical analysis of results of inorganic analyses of soil samples. Statistics were computed using all samples from each grid location. Statistical analyses were made by comparing area C + BN2 means with means from areas A, B, D, E, F and G.

Table Notes:

mean - The following 2 situations may exist:
(a) all data was reported as < detection limits and detection limit is given after the < symbol
(b) means are computed using all samples from boring including using the detection limit for those samples with results reported as < detection limits.

mean - the reported mean was greater than the corresponding mean for area C + BN2 which were used as a background or area.

mean* - the reported mean was significantly different (greater) (P <.05) than the corresponding mean for area C + BN2.

n - number of samples.

Sb (antimony) and Sn (tin) - no statistical comparisons made because Sb and Sn were below detection limits for area C soil samples.

Table A9. Rockeye (Munitions Facility) - NSWC Crane, Indiana. SWMU 10/15. Comparison of maximum and mean concentrations of selected metal analytes determined for surface (sur) and subsurface (sub) soil samples from two other Naval Weapons Support Center locations.

	Maximum and Mean Concentration Determined mg/kg dry weight										
	Rockeye Munitions Facility						Old Rifle Range		Ammunition Burning Ground		Risk-Based
Analyte	Bkgrnd	Area C+BN2	All Sur. Smpls		All Sub. Smpls		Bkgrnd	Sub. Samples	Bkgrnd	Sub. Samples	Concentrations[1]
	max	mean	mean	max	mean	max	max	mean	max	mean	
Sb	<1.50	<1.50	<1.50	3.00	2.29	4.44	0.4	0.3	<1.50	<1.50	47000/610000
As	4.67	3.55	20.1	82.20	4.18	6.27	18.0	9.5	35.4	18.7	0.97/1.6
Be	0.70	0.56	1.04	11.50	0.67	2.10	6.1	2.9	9.1	4.7	0.4/0.67
Cd	2.60	1.70	2.29	7.10	0.83	2.60	0.5	0.5	0.7	0.5	39/510
Cr	59.5	42.1	26.3	99.9	19.3	34.2	68.8	34.2	45.7	32.8	390/5100[2]
Cu	14.2	9.0	11.9	21.4	3.9	11.4	24.3	13.9	18.5	12.7	2900/38000
Pb	36.3	24.6	43.5	158.0	20.1	43.2	60.7	27.1	52.1	31.8	0.0078/0.1
Ni	39.3	17.3	15.2	39.3	11.3	16.8	60.8	19.8	37.1	23.5	1600/20000
Zn	56.2	43.2	64.0	146.0	38.7	109.0	190.0	59.4	115.0	80.3	16000/200000
Al	11300.0	10740.0	11604.0	17500.0	13248.0	19500.0	38100.0	18480.0	12200.0	10673.0	230000/3000000
Ba	81.3	80.7	41.4	498.0	57.5	110.0	460.0	149.9	135.0	81.2	5500/72000
Co	19.8	17.7	18.1	82.0	11.6	70.2	18.0	11.7	29.0	18.4	0.78/10
Fe	17600.0	12438.0	37254.0	285000.0	19300.0	42900.0	95700.0	35007.0	113000.0	65655.0	
Mg	1260.0	1136.0	2122.0	5850.0	1645.7	2910.0	4740.0	2070.0	1080.0	869.0	
Sn	<7.60	<7.60	<7.60	8.49	<7.60	<7.60	9.00	7.70	<7.60	<7.60	47000/610000

Table Notes:

Rockeye (Munitions Facility) SWMU 10/15 - Area C + BN2, n=5;
All Sub. (subsurface) samples (borings), n=26;
All Sur. (surface) samples (scrapes), n=33.

Old Rifle Range - SWMU 07/09 - Control Subsurface (Borings) 12, 11, and 1A, n=15.

Ammunition Burning Ground - SWMU 03/10 - Control Subsurface (Borings) 1, 2, and 3, n=9.

Mean - if reported concentration was less than detection limit, the detection limit was used to compute mean

[1] Residential soil/occupational soil (EPA Region III, 2/92)

[2] Chromium VI and compounds

Data Sources:

U.S. Army Corps of Engineers, Waterways Experiment Station, 1991. RFI Phase II, Old Rifle Range Report for: SWMU 07/09, Naval Weapons Support Center, Crane Indiana. Prepared for Northern Division, Naval Facilities Engineering Command, U.S. Naval Base, Bldg. 77 Low, Philadelphia, Pennsylvania. Final Draft.

U.S. Army Corps of Engineers, Waterways Experiment Station, 1991. RFI Phase III, Part I, Soils, Ammunition Burning Ground: SWMU 03/10, Naval Weapons Support Center, Crane Indiana. Prepared for Northern Division, Naval Facilities Engineering Command, U.S. Naval Base, Bldg. 77 Low, Philadelphia, Pennsylvania. Internal Draft.

U.S. Environmental Protection Agency, Region III, Risk-Based Concentration Table, First Quarter 1992, Roy L. Smith, PhD, February 1992.

Table A10. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of inorganic analyses of method blanks associated with analyses of soil samples. Concentrations are mg/kg (ppm) dry weight. Detectable concentrations are shown in **bold**.

Method*	Analyte														
Blank	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Zn	Al	Ba	Co	Fe	Mg	Sn
MB-1	<0.003U	<0.002U	<0.002U	<0.004UN	**0.033ND**	<0.006U	<0.114U	<0.011U	<0.008U	<0.038U	<0.011U	<0.030U	**0.192**	<0.748U	<0.076U
MB-2	**0.0244B**	<0.002U	<0.002U	<0.004UN	**0.017ND**	<0.006U	<0.114U	<0.011U	<0.008U	**0.075B**	<0.011U	<0.030U	**0.089B**	<0.748U	<0.076U
MB-3	**0.0212BN**	<0.002U	<0.002U	**0.007N**	**0.023N**	**0.008B**	<0.114U	<0.100U	**0.008B**	<0.038U	<0.011U	<0.030U	**0.070B**	<0.748U	<0.076U
MB-4	**0.0185BN**	<0.002U	<0.002U	**0.006ND**	**0.021N**	**0.014B**	<0.114U	<0.11U	<0.008U	<0.038U	<0.011U	<0.030U	**0.063B**	<0.748U	<0.076U
MB-5	<0.003U	<0.002U	<0.002U	<0.004UD	**0.17**	<0.006U	<0.114U	<0.11U	**0.027**	**0.220**	<0.011U	<0.030U	**0.21B**	<0.748U	<0.076U
MB-6	<0.003U	<0.002U	<0.002U	<0.004UD	**0.026**	<0.006U	<0.114U	<0.11U	<0.008U	<0.038U	<0.011U	<0.030U	**0.066B**	<0.748U	<0.076U
MB-7	<0.003U	<0.002U	**0.004B**	<0.004UD	**0.026**	<0.006U	<0.114U	<0.11U	**0.020**	**0.076B**	<0.011U	<0.030U	<0.010U	<0.748U	<0.076U
MB-8	<0.003U	<0.002U	<0.002U	**0.007N**	<0.011U	<0.006U	<0.114U	<0.11U	<0.008U	**0.091B**	<0.011U	<0.030U	<0.010U	<0.748U	<0.076U
MB-9	<0.003U	<0.002U	<0.002U	<0.004UND	<0.011U	<0.006U	<0.114U	<0.11U	<0.008U	<0.038U	<0.011U	<0.030U	**0.087B**	<0.748U	<0.076U

Note:

* Method Blank ID; MB-1 (Method Blank associated with the following analyses. See Figures 5.1 through 5.5 for sample locations.
MB-1 (borings 13, 7, and 2) (surface scrapes G-1 through G-4)
MB-2 (borings 12, 11, 10, 9, and 8)
MB-3 (borings 5 and 1)
MB-4 (borings 6A, 4, and 3 and surface scrape 14)
MB-5 (surface scrapes A-0-1, A-1-2, A-2-3, A-4-0, B-0-1, B-1-2, B-2-3, B-4-0)
MB-6 (surface scrapes C-0-1, C-1-2, C-2-3, C-3-2, Background North #2)
MB-7 (surface scrapes D-0-0, D-1-0, D-2-0, D-3-0, D-4-0, D-5-0)
MB-8 (surface scrapes E-0-0, E-1-0, E-2-0, E-3-0, E-4-0, E-5-0)
MB-9 (surface scrapes F-1, F-2, F-3).

U Analyte was analyzed for but not detected
B Reported value is less than the Contract Required Detection Limit but greater than the Instrument Detection Limit
W Post-digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance
N Spiked sample recovery not within control limits
D Duplicate analysis not within control limits

Table A11. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of inorganic analysis of water collected from final equipment rinses. Results are in mg/l (ppm). Results in **bold** are concentrations greater than detection limits. Detection limits are given after the < symbol.

Sample ID Analyte/Boring	RINSE 07	RINSE 10	RINSE 3
Sb	<0.003U	<0.003U	<0.003U
As	<0.002U	<0.002U	<0.002U
Be	<0.002U	<0.002U	<0.002U
Cd	<0.004U	<0.004U	<0.004U
Cr	<0.011U	<0.011U	<0.011U
Cu	<0.006U	<0.006U	<0.006U
Pb	<0.003U	<0.003U	<0.003U
Ni	<0.011U	<0.011U	<0.011U
Zn	**0.041**	**0.039**	<0.008U
Al	**0.145B**	**0.149B**	**0.315**
Ba	<0.011UN	<0.011UN	<0.011U
Co	<0.030U	<0.030U	<0.030U
Fe	<0.010U	**0.017B**	<0.010U
Mg	<0.748U	<0.748U	**1.45**
Sn	<0.076U	<0.076U	<0.076U

Note:
U - Analyte was analyzed for but not detected
B - Reported value is less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit

Table A12. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of analyses of subsurface soil samples for explosive compounds. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**.

Boring Sample	Explosive Analyte						
ID	2,4-DNT*	TNT	TETRL	DNB	TNB	RDX	HMX
-1#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
-2#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	**0.645J**	**0.31J**
2#2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
-3#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
-4#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
-5#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
-6A#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	**0.455J**	**0.48J**
-7#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	**0.368J**	**11.40**
-8#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.15J**
-9#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
-10#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.86J**
10#2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.37J**
10#3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
10#4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
-11#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.36J**
11#2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.30J**
11#3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	**0.058J**	**0.62J**
11#4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
-12#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**1.07J**
12#2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**1.13J**
12#3	<0.25U	**0.96**	<0.65U	<0.25U	**0.16J**	<1.00U	**17.3**
12#4	<0.25U	**1.40**	<0.65U	<0.25U	**0.20J**	<1.00U	**42.7**
-13#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
13#2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
13#3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U

Note:
Sample ID is as follows: 1#1, boring 1/sample 1. See Figures 13 and 14.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
* - Lab reports indicate that 2,4-DNT could not be separated from 2,6-DNT.

Table A13. (Page 1 of 3). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of analyses of surface scrape soil samples for explosive compounds. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of explosive compound analyte are shown in **bold**. See Figures 5.1 and 5.3 through 5.5 for sample locations.

Surface Sample	Explosive Analyte						
ID	2,4-DNT*	TNT	TETRL	DNB	TNB	RDX	HMX
A-0-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-0-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-0-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-0-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-1-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-1-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-1-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-1-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-2-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-2-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-2-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-2-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-3-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-3-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-3-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-3-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-4-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-4-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-4-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
A-4-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-0-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-0-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-0-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-0-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-1-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-1-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-1-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-1-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-2-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-2-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-2-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-2-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-3-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-3-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-3-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**5.37**
B-3-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-4-0	<0.25U	<0.25U	<0.65U	**0.195J**	<0.25U	<1.00U	<2.2U
B-4-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-4-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
B-4-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U

Table Notes: See Page 3 of 3

Table A13. (Page 2 of 3). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of analyses of surface scrape soil samples for explosive compounds. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of explosive compound analyte are shown in **bold**. See Figures 5.1 and 5.3 through 5.5 for sample locations.

Surface Sample	Explosive Analyte						
ID	2,4-DNT*	TNT	TETRL	DNB	TNB	RDX	HMX
C-0-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-0-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-0-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-0-3	**0.099J**	<0.25U	<0.65U	**0.104J**	<0.25U	<1.00U	<2.2U
C-1-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-1-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-1-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-1-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-2-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-2-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-2-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-2-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-3-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-3-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-3-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-3-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-4-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-4-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
C-4-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-0-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-0-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-0-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-0-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-0-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-1-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-1-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-1-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-1-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-1-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-2-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-2-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-2-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-2-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-2-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-3-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-3-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-3-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-3-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-3-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-4-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-4-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-4-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-4-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-4-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-5-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-5-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-5-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-5-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
D-5-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U

Table Notes: See Page 3 of 3

Table A13. (Page 3 of 3). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of analyses of surface scrape soil samples for explosive compounds. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of explosive compound analyte are shown in **bold**. See Figures 5.1 and 5.3 through 5.5 for sample locations.

Surface Sample ID	Explosive Analyte 2,4-DNT*	TNT**	TETRL	DNB	TNB	RDX**	HMX
E-0-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-0-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-0-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-0-3	<0.25U	**0.07J**	<0.65U	<0.25U	<0.25U	<1.00U	**0.68J**
E-0-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-1-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-1-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-1-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.25J**
E-1-3	<0.25U	**0.12J**	<0.65U	<0.25U	<0.25U	<1.00U	**0.26J**
E-1-4	<0.25U	**0.15J**	<0.65U	<0.25U	<0.25U	<1.00U	**0.50J**
E-2-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-2-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.31J**
E-2-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	**0.26J**	**0.28J**
E-2-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	**0.20J**	**0.41J**
E-2-4	<0.25U	**0.11J**	<0.65U	<0.25U	<0.25U	<1.00U	**0.46J**
E-3-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-3-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-3-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-3-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**1.72J**
E-3-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	**0.51J**	**2.36**
E-4-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-4-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-4-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-4-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-4-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-5-0	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-5-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-5-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-5-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
E-5-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
F-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.45J**
F-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	**0.16J**
F-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
G-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
G-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
G-3	<0.25U	**0.75**	<0.65U	<0.25U	<0.25U	**0.14J**	**1960.0**
G-4	<0.25U	**0.19J**	<0.65U	<0.25U	<0.25U	<1.00U	**540.0**
BN#1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
BN#2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
BN#3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
H	<0.25U	**295.00**	<0.65U	<0.25U	<0.25U	**3350.00**	**10400.0**

Note:

Sample ID is as follows: A-0-0 - Grid Area A, column 0, row 0. See Figure 5.x.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

* - Lab reports indicate that 2,4-DNT could not be separated from 2,6-DNT.

** - Risk-based concentrations for TNT = 16/200 and RDX = 15/26, where concentrations shown are for residential soil/ocupational soil. (From EPA Region III Risk-based Concentrations, Roy L. Smith, PhD., Feb. 1992.)

Table A14. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Summary of analyses of surface and subsurface soil samples for explosive compounds. See Figures 5.1 and 5.3 through 5.5 for sample locations.

Surface Samples

Area	Explosive Analyte						
	2,4-DNT*	TNT**	TETRYL	DNB	TNB	RDX**	HMX
A n=20	ND	ND	ND	ND	ND	ND	ND
B n=20	ND	ND	ND	0.20J/1	ND	ND	5.37/1
C n=19	0.10J/1	ND	ND	0.10J/1	ND	ND	ND
D n=30	ND	ND	ND	ND	ND	ND	ND
E n=30	ND	0.15J/4	ND	ND	ND	0.51J/3	2.36/10
F n=3	ND	ND	ND	ND	ND	ND	0.45J/2
G n=4	ND	0.75/2	ND	ND	ND	0.14J/1	1960.0/2
BN n=3	ND	ND	ND	ND	ND	ND	ND
14 n=1	ND	295.00/1	ND	ND	ND	3350.00/1	10400.00/1

Subsurface Samples

Boring Number	Explosive Analyte						
	2,4-DNT*	TNT**	TETRYL	DNB	TNB	RDX**	HMX
1 n=1	ND	ND	ND	ND	ND	ND	ND
2 n=2	ND	ND	ND	ND	ND	0.65J/1	0.31J/1
3 n=1	ND	ND	ND	ND	ND	ND	ND
4 n=1	ND	ND	ND	ND	ND	ND	ND
5 n=1	ND	ND	ND	ND	ND	ND	ND
6An=1	ND	ND	ND	ND	ND	0.46J/1	0.48J/1
7 n=1	ND	ND	ND	ND	ND	0.37J/1	11.40/1
8 n=1	ND	ND	ND	ND	ND	ND	0.15J
9 n=1	ND	ND	ND	ND	ND	ND	ND
10 n=4	ND	ND	ND	ND	ND	ND	0.86J/2
11 n=4	ND	ND	ND	ND	ND	0.06J/1	0.62J/3
12 n=4	ND	1.40/2	ND	ND	0.20J/2	ND	42.7/4
13 n=3	ND	ND	ND	ND	ND	ND	ND

Notes:

ND - Not Detected. Explosive analyte was not detected during analysis.

J - Analyte detected at concentrations below statistical quantitation limits. 5.37/1 - First number (5.37) is the maximum concentration (in mg/kg dry weight) of the specific explosive determined for the indicated grid area or boring. The second number following the / (1) is the total number of samples with a detectable concentration of analyte reported.

n - Number of soil samples taken.

* - Lab reports indicate that 2,4-DNT could not be separated from 2,6-DNT.

** - Risk-based concentrations for TNT = 16/200 and RDX = 15/26, where concentrations shown are for residential soil/ocupational soil. (From EPA Region III Risk-based Concentrations, Roy L. Smith, PhD., Feb. 1992.)

Table A15. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of analyses of method blanks and equipment rinses associated with analyses of soil samples (both surface and subsurface samples) for explosive compounds. Detection limits given after the < symbol and are in mg/kg (ppm) dry weight units.

Method Blank/Rinse	Explosive Analyte						
ID	2,4-DNT*	TNT	TETRL	DNB	TNB	RDX	HMX
MB-1	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
MB-2	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
MB-3	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
MB-4	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
MB-5	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
MB-6	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
MB-7	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
MB-8	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
MB-9	<0.25U	<0.25U	<0.65U	<0.25U	<0.25U	<1.00U	<2.2U
R-1	<0.020U	<0.020U	<0.050U	<0.020	<0.020U	<0.020U	<0.020U
R-2	<0.020U	<0.020U	<0.050U	<0.020	<0.020U	<0.020U	<0.020U
MB-10	<0.020U	<0.020U	<0.050U	<0.020	<0.020U	<0.020U	<0.020U

Note:

* Method Blank/Rinse Identification; MB-1 (Method Blank associated with the following analyses. See Figures 5.1 and 5.2 for sample locations.

MB-1 (borings 13, 7, 7 duplicate, and 2) (surface scrapes G-1 through G-4)
MB-2 (borings 12, 11, 10, 9, and 8)
MB-3 (borings 5 and 1)
MB-4 (borings 6A, 4, and 3 and surface scrape 14)
MB-5 (surface scrapes, grid areas A and B)
MB-6 (surface scrapes grid area C and Background North (BN) 1, 2, and 3)
MB-7 (surface scrapes grid area D)
MB-8 (surface scrapes grid area E)
MB-9 (surface scrapes F-1, F-2, F-3).
MB-10 (equipment rinses R-1 and R-2.
R-1 (boring 10 equipment rinse)
R-2 (boring 7 equipment rinse)

Table A16. (Page 1 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8240 * (volatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for full compound names.

Analyte/Sample ID	1#2	2#2	3#3	4#3	5#1	6A#1	7#1
ClMETH	<0.011U	<0.013U	<0.012U	<0.012U	<0.011U	<0.012U	<0.012U
BrMETH	<0.011U	<0.013U	<0.012U	<0.012U	<0.011U	<0.012U	<0.012U
VNLCL	<0.011U	<0.013U	<0.012U	<0.012U	<0.011U	<0.012U	<0.012U
ClETHA	<0.011U	<0.013U	<0.012U	<0.012U	<0.011U	<0.012U	<0.012U
MECL	**0.0098B**	**0.021B**	**0.11B**	**0.0077B**	**0.21B**	**0.0093B**	**0.066B**
11DCLETE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
11DCLETA	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
t-DCLETE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
c-DCLETE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
CHCL3	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
12DCLETA	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
111tCA	**0.011**	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
CCL4	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
BrDClME	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
12DClPR	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
t13ClPRE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
TCE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
DBrClME	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
c13ClPRE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
112TCA	<0.0056U	<0.0064U	<0.006U	<0.0059U	**0.001J**	<0.0058U	<0.0059U
BENZENE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
CHBr3	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
1122TClA	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
TECLETE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
TOLUENE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
ClBEN	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
ETBEN	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
ACETONE	**0.007BJ**	**0.20B**	**0.044BJ**	**0.011BJ**	**0.32B**	**0.0089BJ**	**0.10J**
BUTANO	<0.11U	<0.13U	<0.12U	<0.12U	<0.11U	<0.12U	<0.12U
CS2	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
2 HEXANO	<0.056U	<0.064U	<0.060U	<0.059U	<0.057U	<0.058U	<0.059U
4 Me2PE	<0.056U	<0.064U	<0.060U	<0.059U	<0.057U	<0.058U	<0.059U
STYRENE	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U
VNACETA	<0.056U	<0.064U	<0.060U	<0.059U	<0.057U	<0.058U	<0.059U
T-Xylene	<0.0056U	<0.0064U	<0.006U	<0.0059U	<0.0057U	<0.0058U	<0.0059U

Note: Sample ID is as follows: 1#1 - Soil Boring 1, sample #1. See Figures 5.1 and 5.2.

J - Indicates an estimated value below the statistical quantification limits

U - Indicates compound was analyzed for but not detected. Detection limits are given after the < symbol.

B - Indicates analyte is found in the associated blank as well as in the sample.

* - EPA Method 8240 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A16. (Page 2 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8240 * (volatile organics) soil analyses (soil boring samples). Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for full compound names.

Analyte/Sample ID	8#1	9#1	10#4	11#4	12#4	13#3
CLMETH	<0.050U	<0.012U	<0.012U	<0.011U	<0.028U	<0.34U
BrMETH	<0.050U	<0.012U	<0.012U	<0.011U	<0.028U	<0.34U
VNLCL	<0.050U	<0.012U	<0.012U	<0.011U	<0.028U	<0.34U
CLETHA	<0.050U	<0.012U	<0.012U	<0.011U	<0.028U	<0.34U
MECL	**0.15B**	**0.064B**	**0.045B**	**0.037B**	**0.032B**	**0.041B**
11DCLETE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.014U
11DCLETA	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
t-DCLETE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
c-DCLETE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
CHCL3	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
12DCLETA	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
111tCA	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
CCL4	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
BrDClME	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
12DClPR	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
t13ClPRE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
TCE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
DBrClME	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
c13ClPRE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
112TCA	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
BENZENE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
CHBr3	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
1122TClA	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
TECLETE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
TOLUENE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
ClBEN	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
ETBEN	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
ACETONE	**0.42B**	**0.023B**	<0.12U	<0.11U	**0.31B**	**0.35B**
BUTANO	<0.50U	**0.020J**	<0.12U	<0.11U	<0.28U	<0.34U
CS2	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
2 HEXANO	<0.25U	<0.06U	<0.059U	<0.057U	<0.14U	<0.17U
4 Me2PE	<0.25U	<0.06U	<0.059U	<0.057U	<0.14U	<0.17U
STYRENE	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U
VNACETA	<0.25U	<0.06U	<0.059U	<0.057U	<0.14U	<0.17U
T-Xylene	<0.025U	<0.006U	<0.0059U	<0.0057U	<0.014U	<0.017U

Note: Sample ID is as follows: 8#1 - Soil Boring 8, sample #1. See Figures 5.1 and 5.2.
J - Indicates an estimated value below the statistical quantification limits
U - Indicates compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Indicates analyte is found in the associated blank as well as in the sample.
* - EPA Method 8240 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A17. (Page 1 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8240 * (volatile organics) surface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for full compound names.

Analyte/Sample ID	A-0-0	A-3-3	A-4-1	B-0-0	B-3-3	B-4-1	C-0-0	C-4-1	D-0-0	D-1-3
ClMETH	<0.015U	<0.014U	<0.014U	<0.015U	<0.012U	<0.012U	<0.013U	<0.012U	<0.012U	<0.017U
BrMETH	<0.015U	<0.014U	<0.014U	<0.015U	<0.012U	<0.012U	<0.013U	<0.012U	<0.012U	<0.017U
VNLCL	<0.015U	<0.014U	<0.014U	<0.015U	<0.012U	<0.012U	<0.013U	<0.012U	<0.012U	<0.017U
ClETHA	<0.015U	<0.014U	<0.014U	<0.015U	<0.012U	<0.012U	<0.013U	<0.012U	<0.012U	<0.017U
MECL	**0.030**	**0.037**	**0.034**	**0.030B**	**0.021B**	**0.480B**	**0.095B**	**0.170B**	**0.0059BJ**	**0.012B**
11DCLETE	<0.0067U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
11DCLETA	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
t-DCLETE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
c-DCLETE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
CHCL3	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
12DCLETA	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
111tCA	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
CCL4	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
BrDClME	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
12DClPR	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
t13ClPRE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	**0.0007J**	<0.0087U
TCE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
DBrClME	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
c13ClPRE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
112TCA	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
BENZENE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
CHBr3	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
1122TClA	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
TECLETE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
TOLUENE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
ClBEN	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
ETBEN	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
ACETONE	**0.11J**	**0.029J**	**0.083J**	**0.036BJ**	**0.026BJ**	**0.022BJ**	**0.099BJ**	**0.14B**	**0.029BJ**	**0.24BJ**
BUTANO	<0.15U	<0.14U	**0.021J**	<0.15U	<0.12U	<0.12U	<0.13U	<0.12U	<0.12U	<0.17U
CS2	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
2 HEXANO	<0.076U	<0.070U	<0.069U	<0.075U	<0.059U	<0.061U	<0.067U	<0.062U	<0.061U	<0.087U
4 Me2PE	<0.076U	<0.070U	<0.069U	<0.075U	<0.059U	<0.061U	<0.067U	<0.062U	<0.061U	<0.087U
STYRENE	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	<0.0061U	<0.0067U	<0.0062U	<0.0061U	<0.0087U
VNACETA	<0.076U	<0.070U	<0.069U	<0.075U	<0.059U	<0.061U	<0.067U	<0.062U	<0.061U	<0.087U
T-Xylene	<0.0076U	<0.0070U	<0.0069U	<0.0075U	<0.0059U	**0.0007J**	<0.0067U	<0.0062U	<0.0061U	<0.0087U

Note: Sample ID is as follows: A-0-0 - Surface scrape sample from Grid A, location 0,0. See Figures 5.1 and 5.2.

J - Indicates an estimated value below the statistical quantification limits

U - Indicates compound was analyzed for but not detected. Detection limits are given after the < symbol.

B - Indicates analyte is found in the associated blank as well as in the sample.

* - EPA Method 8240 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A17. (Page 2 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8240 * (volatile organics) surface sample soil analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for full compound names.

Analyte/Sample ID	D-3-1	D-4-4	E-0-0	E-1-3	E-3-1	E-4-4	F-2	F-3	H
ClMETH	<0.014U	<0.014U	<0.013U	<0.011U	<0.010U	<0.010U	<0.013U	<0.012U	<0.012U
BrMETH	<0.014U	<0.014U	<0.013U	<0.011U	<0.010U	<0.010U	<0.013U	<0.012U	<0.012U
VNLCL	<0.014U	<0.014U	<0.013U	<0.011U	<0.010U	<0.010U	<0.013U	<0.012U	<0.012U
ClETHA	<0.014U	<0.014U	<0.013U	<0.011U	<0.010U	<0.010U	<0.013U	<0.012U	<0.012U
MECL	**0.010B**	**0.0091B**	**0.014B**	**0.23B**	**0.074B**	**0.064B**	**0.15B**	**0.088B**	**0.028B**
11DCLETE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0050U	<0.0050U	<0.0064U	<0.006U	<0.006U
11DCLETA	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
t-DCLETE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
c-DCLETE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
CHCL3	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
12DCLETA	<0.0069U	<0.0070U	<0.0063U U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U	
111tCA	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
CCL4	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
BrDClME	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
12DClPR	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
t13ClPRE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
TCE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
DBrClME	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
c13ClPRE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
112TCA	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
BENZENE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
CHBr3	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
1122TClA	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
TECLETE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
TOLUENE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
ClBEN	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
ETBEN	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
ACETONE	**0.025BJ**	**0.059BJ**	**0.064BJ**	**0.036J**	**0.039J**	**0.070J**	**0.15B**	**0.089B**	**0.015BJ**
BUTANO	<0.14U	<0.14U	<0.13U	<0.11U	<0.10U	<0.10U	<0.13U	<0.12U	<0.12U
CS2	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
2 HEXANO	<0.069U	<0.070U	<0.063U	<0.056U	<0.052U	<0.052U	<0.064U	<0.060U	<0.060U
4 Me2PE	<0.069U	<0.070U	<0.063U	<0.056U	<0.052U	<0.052U	<0.064U	<0.060U	<0.060U
STYRENE	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U
VNACETA	<0.069U	<0.070U	<0.063U	<0.056U	<0.052U	<0.052U	<0.064U	<0.060U	<0.060U
T-Xylene	<0.0069U	<0.0070U	<0.0063U	<0.0056U	<0.0052U	<0.0052U	<0.0064U	<0.006U	<0.006U

Note: Sample ID is as follows: A-0-0 - Surface scrape sample from Grid A, location 0,0. See Figures 5.1 and 5.2.
J - Indicates an estimated value below the statistical quantification limits
U - Indicates compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Indicates analyte is found in the associated blank as well as in the sample.
* - EPA Method 8240 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A18. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Volatile organic compounds* tentatively identified from soil samples. Estimated concentrations are mg/kg (ppm) dry weight.

Sample #	Compound	RT	CAS No.	Est. Conc. (mg/kg)	RBC**
5#2	hexane	5.36	110543	39.00	4700-61000 (n-hexane)
8#1	3-methylpentane	5.70	96140	58.00	
B-1-4	dichlorodifluoromethane	4.36	87	22.00	16000/200000
	3,4-dimethyl-1-hexene	5.47	16745941	12.00	
B-4-1D	4,5-dimethyl-1-hexene	5.45	16106595	32.00	
D-1-3	2,4-dimethylpentane	5.43	108087	34.00	
D-1-3D	1-butene	5.44	106989	19.00	
D-3-1	ethylether	2.76	60297	7.60	16000/200000
E-0-0D	hydrocarbon	5.53	none	23.00	
E-1-3	unknown	4.37	none	10.00	
E-3-1	unknown	4.29	none	5.40	
E-4-4	unknown	19.98	none	9.20	
F-2	unknown	5.39	none	38.00	
F-3	2-methylpentane	5.35	107835	7.30	

Note: RT - Retention Time; CAS No. - Chemical Abstract Service Registry numbers Sample Number - 12#4 Boring 12/sample 4. See Figures 5.1 and 5.2. * - EPA Method 8240 -in Test Methods for Evaluating Soil Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

**RBC - Risk-Based Concentrations from EPA Region III, Roy L. Smith, PHD, February 1992.

Table A19. (Page 1 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU# 10/15. Results of volatile organics* analyses of method blanks associated with soils analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for full compound names.

Analyte/Blank/ Method #	MB-1	MB-2	MB-3	MB-4	MB-5	MB-6	MB-7	MB-8	MB-9	MB-10	MB-11
CLMETH	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U
BrMETH	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U
VNLCL	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U
C1ETHA	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U
MECL	<0.005U	**0.012**	**0.011**	**0.011**	**0.011**	<0.005U	**0.0039J**	**0.011**	**0.0039J**	**0.014**	**0.0086**
11DCLETE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
11DCLETA	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
t-DCLETE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
c-DCLETE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
CHCL3	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
12DCLETA	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
111tCA	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
CCL4	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
BrDC1ME	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
12DC1PR	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
t13C1PRE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
TCE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
DBrC1ME	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
c13C1PRE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
112TCA	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
BENZENE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
CHBr3	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
1122TC1A	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
TECLETE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
TOLUENE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
C1BEN	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
ETBEN	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
ACETONE	<0.10U	**0.015J**	**0.0096J**	**0.0063J**	**0.006J**	<0.10U	**0.004J**	**0.0096J**	**0.0044J**	**0.0046J**	**0.006J**
BUTANO	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U
CS2	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
2 HEXANO	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U
4 Me2PE	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U
STYRENE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
VNACETA	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U
T-Xylene	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U

Note: See Page 2 for Table Notes.

Table A19. (Page 2 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU# 10/15. Results of volatile organics* analyses of method blanks associated with soils analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for full compound names.

Notes for Table 5.16.

J - Indicates an estimated value below the statistical quantification limits
U - Indicates compound was analyzed for but not detected. Detection limits are given after the < symbol.
* - EPA Method 8240 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Method Blank Identification; MB-1 (Method Blank associated with the following analyses. See Figures 5.1 and 5.2 for sample locations.

MB-1 (surface scrapes A-0-1, A-3-3, A-4-1, B-0-0, B-3-3, B-4-1)
MB-2 (surface scrapes A-0-1, A-3-3, A-4-1, B-0-0, B-3-3, B-4-1)
MB-3 (surface scrapes C-0-0, C-4-1)
MB-4 (surface scrapes D-0-0, D-1-3, D-3-1, D-4-4)
MB-5 (surface scrapes E-0-0, E-1-3, E-3-1, E-4-4)
MB-6 (surface scrapes E-0-0, E-1-3, E-3-1, E-4-4)
MB-7 (boring 1)
MB-8 (boring 5)
MB-9 (borings 6A, 4, and 3 - surface scrape H).
MB-10 (borings 6A, 4, and 3 - surface scrape H).
MB-11 (surface scrapes F-2 and F-3)

Table A20. (Page 1 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of volatile organics* analyses of method blanks, rinses,and equipment rinses associated with soils analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for full compound names.

Analyte/ID	Sample R#3	MB/R#3	R#7	R#10	MB/R-7,10	MB/R-7,10	TB-1	MB/TB-1	TB-2	TB-3	TB-4	TB-5
CLMETH	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U
BrMETH	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U
VNLCL	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U
CLETHA	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U	<0.010U
MECL	**0.031B**	**0.014**	<0.005U	**0.011B**	**0.011**	**0.0084**	**0.0095B**	**0.0006J**	**0.0038BJ**	**0.002BJ**	**0.003BJ**	<0.005U
11DCLETE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
11DCLETA	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
t-DCLETE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
c-DCLETE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
CHCL3	**0.018**	<0.005U	**0.004J**	**0.0044J**	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
12DCLETA	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
111tCA	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
CCL4	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
BrDClME	**0.0022J**	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
12DClPR	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
t13ClPRE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
TCE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
DBrClME	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
c13ClPRE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
112TCA	<0.005U	<0.005U	**0.0011J**	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	**0.0006J**
BENZENE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
CHBr3	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
1122TClA	<0.005U	**0.0005J**	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
TECLETE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
TOLUENE	**0.0008J**	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
ClBEN	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
ETBEN	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
ACETONE	**0.072BJ**	**0.009J**	**0.10B**	**0.095BJ**	**0.004J**	**0.035J**	**0.012BJ**	**0.019J**	**0.047BJ**	**0.064BJ**	**0.035BJ**	<0.10U
BUTANO	**0.067J**	<0.10U	**0.043J**	**0.047J**	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U	<0.10U
CS2	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
2 HEXANO	**0.022J**	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U
4 Me2PE	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U
STYRENE	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U
VNACETA	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U	<0.050U
T-Xylene	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U	<0.005U

Note: See Page 2 for Table Notes.

Table A20. (Page 2 of 2) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of volatile organics* analyses of method blanks, rinses,and equipment rinses associated with soils analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for full compound names.

Notes for Table 5.17.

J - Indicates an estimated value below the statistical quantification limits
U - Indicates compound was analyzed for but not detected. Detection limits are given after the < symbol.
* - EPA Method 8240 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Rinse, Method Blank, and Trip Blank Identification is as follows:

R#3 - Rinse water collected following final decontamination rinse after sampling boring 3#.
MB/R#3 - Method Blank associated with the analysis of boring #3 equipment rinse.
TB-1 - Trip Blank transported to the lab in a cooler containing samples from Grid Area E (collected on 9/06/90)
TB-2, TB-3, TB-4, TB-5 - Trip blanks transported in coolers containing the following samples:
Boring #8, 9, 10 (1 cooler)
Boring #11, and 12 (1 cooler)
Boring #13, Scrape Sample Area G (1 cooler)
Boring #2 and 7 (1 cooler)
Method Blanks associated with analysis of TB-2, TB-3, TB-4, and TB-5 were MB/R#7,10 (2 method blanks as indicated above)

Table A21. (Page 1 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	1#1	2#1	2#2	3#1	4#1	5#1	6A#1	7#1	8#1	9#1
PHENOL	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
2ClPHEN	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
2NIPHE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
24DMePHE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
24DClPHE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
4Cl3MePHE	<1.50U	<1.60U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.60U
246TClPH	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
24DNPH	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U
4NPHE	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U
2M46DNPH	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U
PClPHE	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U
BENZOAC	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U
2MEPHE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
4MEPHE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
245TClPH	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
BZLAL	<1.50U	<1.60U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.60U
NNDMEAM	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
BClIPRE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
NNDNPAM	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
NITROBEN	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
ISOPHOR	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
BClEtoME	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
26DNTOL	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
24DNTOL	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
12DPHYD	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
BENZIDI	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U
33DClBEZ	<1.50U	<1.60U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.60U
BClETE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
13DClB	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
14DClB	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
12DClB	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
HClETA	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
124TClB	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
NAPHTH	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
HClBu	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U

Note: Sample ID is as follows: 1#1 - Soil Boring 1, sample #1. See Figures 5.1 and 5.2.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Analyte is found in the associated blank as well as in the sample.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A21. (Page 2 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	1#1	2#1	2#2	3#1	4#1	5#1	6A#1	7#1	8#1	9#1
HCLCYPD	<0.75U	<0.79U	<0.75U	<0.75U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
2CLNAPH	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
ACENAY	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
DMePHTH	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
ACENAP	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
FLUORE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
DEtPHTH	<0.75U	**0.072BJ**	**0.074BJ**	<0.76U	<0.75U	**0.05J**	<0.74U	**0.079BJ**	<0.77U	<0.80U
4ClPHPHE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
NNDPHAM	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
4BrPHET	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
HCLBEN	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
PHENAN	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
ANTRAC	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
DBuPHTH	**0.04J**	<0.79U	<0.75U	<0.76U	<0.75U	**0.10BJ**	<0.74U	<0.76U	**0.068**	**0.12BJ**
FLANTHE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
PYRENE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
BuBePHTH	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
CHRYSE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
BAANTHR	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
B2EHPH	**0.34J**	**0.15BJ**	**0.42BJ**	**0.24J**	**0.16J**	**1.30B**	**0.41J**	**0.15BJ**	**0.061**	**0.37J**
DNOcPHT	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	**1.30B**	<0.74U	<0.76U	<0.77U	<0.80U
BBFLANT	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
BKFLANT	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
BAPYRE	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
I123PYR	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
DBAHANT	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
B-GHI-PYR	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
ANILINE	<1.50U	<1.60U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.60U
4CLANIL	<1.50U	<1.60U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.50U	<1.60U
DBENZOFU	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
2MeNAPH	<0.75U	<0.79U	<0.75U	<0.76U	<0.75U	<0.75U	<0.74U	<0.76U	<0.77U	<0.80U
2NANIL	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U
3NANIL	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U
4NANIL	<3.80U	<4.00U	<3.80U	<3.80U	<3.80U	<3.70U	<3.80U	<3.80U	<4.00U	<4.00U

Note: Sample ID is as follows: 1#1 - Soil Boring 1, sample #1. See Figures 5.1 and 5.2.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

B - Analyte is found in the associated blank as well as in the sample.

* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A21. (Page 3 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	10#1	10#2	10#3	10#4	11#1	11#2	11#3	11#4	12#1	12#2
PHENOL	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
2ClPHEN	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
2NIPHE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
24DMePHE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
24DClPHE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
4Cl3MePHE	<1.50U	<1.50U	<1.60U	<1.50U	<1.60U	<1.60U	<1.50U	<1.50U	<1.60U	<1.70U
246TClPH	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
24DNPH	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U
4NPHE	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U
2M46DNPH	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U
PClPHE	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U
BENZOAC	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U
2MEPHE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
4MEPHE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
245TClPH	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BZLAL	<1.50U	<1.50U	<1.60U	<1.50U	<1.60U	<1.60U	<1.50U	<1.50U	<1.60U	<1.70U
NNDMEAM	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BCIIPRE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
NNDNPAM	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
NITROBEN	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
ISOPHOR	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BClEtoME	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
26DNTOL	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
24DNTOL	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
12DPHYD	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BENZIDI	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U
33DClBEZ	<1.50U	<1.50U	<1.60U	<1.50U	<1.60U	<1.60U	<1.50U	<1.50U	<1.60U	<1.70U
BClETE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
13DClB	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
14DClB	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
12DClB	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
HClETA	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
124TClB	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
NAPHTH	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
HClBu	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U

Note: Sample ID is as follows: 10#1 - Soil Boring 10, sample #1. See Figures 5.1 and 5.2.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

B - Analyte is found in the associated blank as well as in the sample.

* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A21. (Page 4 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	10#1	10#2	10#3	10#4	11#1	11#2	11#3	11#4	12#1	12#2
HC1CYPD	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
2C1NAPH	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
ACENAY	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
DMePHTH	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
ACENAP	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
FLUORE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
DEtPHTH	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
4C1PHPHE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
NNDPHAM	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
4BrPHET	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
HCLBEN	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
PHENAN	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
ANTRAC	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
DBuPHTH	**0.077BJ**	**0.059BJ**	**0.081BJ**	**0.082BJ**	**0.18BJ**	**0.11B**	**0.12BJ**	**0.10BJ**	**0.091BJ**	<0.83U
FLANTHE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
PYRENE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BuBePHTH	<0.76U	<0.76U	**0.066J**	**0.049J**	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
CHRYSE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BAANTHR	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
B2EHPH	**0.068J**	**0.077BJ**	**0.091BJ**	**0.16BJ**	**0.14BJ**	**0.080**	**0.31BJ**	<0.76U	**0.17BJ**	**0.18BJ**
DNOcPHT	<0.76U	**0.049J**	<0.79U	**0.056J**	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BBFLANT	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BKFLANT	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
BAPYRE	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
I123PYR	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
DBAHANT	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
B-GHI-PYR	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
ANILINE	<1.50U	<1.50U	<1.60U	<1.50U	<1.60U	<1.60U	<1.50U	<1.50U	<1.60U	<1.70U
4CLANIL	<1.50U	<1.50U	<1.60U	<1.50U	<1.60U	<1.60U	<1.50U	<1.50U	<1.60U	<1.70U
DBENZOFU	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
2MeNAPH	<0.76U	<0.76U	<0.79U	<0.75U	<0.78U	<0.79U	<0.76U	<0.76U	<0.81U	<0.83U
2NANIL	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U
3NANIL	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U
4NANIL	<3.80U	<3.80U	<4.00U	<3.80U	<3.90U	<4.00U	<3.80U	<3.80U	<4.00U	<4.20U

Note: Sample ID is as follows: 10#1 - Soil Boring 10, sample #1. See Figures 5.1 and 5.2.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

B - Analyte is found in the associated blank as well as in the sample.

* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A21. (Page 5 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	12#3	12#4	13#1	13#2	13#3
PHENOL	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
2ClPHEN	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
2NIPHE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
24DMePHE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
24DClPHE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
4Cl3MePHE	<1.60U	<1.60U	<1.50U	<1.50U	<1.50U
246TClPH	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
24DNPH	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U
4NPHE	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U
2M46DNPH	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U
PClPHE	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U
BENZOAC	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U
2MEPHE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
4MEPHE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
245TClPH	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
BZLAL	<1.60U	<1.60U	<1.50U	<1.50U	<1.50U
NNDMEAM	<0.81U	<0.82U	<0.77U	0.079J	<0.77U
BClIPRE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
NNDNPAM	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
NITROBEN	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
ISOPHOR	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
BClEtoME	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
26DNTOL	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
24DNTOL	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
12DPHYD	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
BENZIDI	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U
33DClBEZ	<1.60U	<1.60U	<1.50U	<1.50U	<1.50U
BClETE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
13DClB	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
14DClB	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
12DClB	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
HClETA	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
124TClB	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
NAPHTH	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
HClBu	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U

Note: Sample ID is as follows: 12#3 - Soil Boring 12, sample #3. See Figures 5.1 and 5.2.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Analyte is found in the associated blank as well as in the sample.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A21. (Page 6 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	12#3	12#4	13#1	13#2	13#3
HC1CYPD	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
2C1NAPH	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
ACENAY	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
DMePHTH	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
ACENAP	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
FLUORE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
DEtPHTH	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
4C1PHPHE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
NNDPHAM	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
4BrPHET	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
HCLBEN	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
PHENAN	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
ANTRAC	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
DBuPHTH	<0.81U	**0.097J**	<0.77U	<0.75U	**0.14BJ**
FLANTHE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
PYRENE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
BuBePHTH	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
CHRYSE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
BAANTHR	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
B2EHPH	**1.20**	**0.22J**	**0.099J**	<0.75U	**0.085J**
DNOcPHT	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
BBFLANT	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
BKFLANT	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
BAPYRE	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
I123PYR	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
DBAHANT	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
B-GHI-PYR	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
ANILINE	<1.60U	<1.60U	<1.50U	<1.50U	<1.50U
4CLANIL	<1.60U	<1.60U	<1.50U	<1.50U	<1.50U
DBENZOFU	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
2MeNAPH	<0.81U	<0.82U	<0.77U	<0.75U	<0.77U
2NANIL	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U
3NANIL	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U
4NANIL	<4.00U	<4.10U	<3.80U	<3.80U	<3.80U

Note: Sample ID is as follows - 12#4, boring 12/sample 4. See Figures 5.1 and 5.2.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

B - Analyte is found in the associated blank as well as in the sample.

* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A22. (Page 1 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU# 10/15. Results of EPA Method 8270 * (semivolatile organics) surface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	BN#3	A-0-0	A-3-3	A-4-1	B-0-0	B-3-3	B-4-1	C-0-0	C-3-3	D-0-0
PHENOL	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
2ClPHEN	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
2NIPHE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
24DMePHE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
24DClPHE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
4Cl3MePHE	<1.60U	<2.00U	<1.90U	<1.80U	<1.90U	<1.50U	<1.60U	<1.60U	<1.60U	<1.60U
246TClPH	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
24DNPH	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U
4NPHE	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U
2M46DNPH	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U
PClPHE	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U
BENZOAC	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U
2MEPHE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
4MEPHE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
245TClPH	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
BZLAL	<1.60U	<2.00U	<1.90U	<1.80U	<1.90U	<1.50U	<1.60U	<1.60U	<1.60U	<1.60U
NNDMEAM	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
BCl1PRE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
NNDNPAM	<0.82U	<0.66U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
NITROBEN	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
ISOPHOR	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
BClEtoME	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
26DNTOL	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
24DNTOL	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
12DPHYD	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
BENZIDI	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U
33DClBEZ	<1.60U	<2.00U	<1.90U	<1.80U	<1.90U	<1.50U	<1.60U	<1.60U	<1.60U	<1.60U
BClETE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
13DClB	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
14DClB	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
12DClB	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
HClETA	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
124TClB	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
NAPHTH	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
HClBu	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U

Note: Sample ID is as follows: A-0-0 - Surface scrape sample from Grid A, location 0,0. See Figures 5.1 and 5.2.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Analyte is found in the associated blank as well as in the sample.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A22. (Page 2 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) surface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	BN#3	A-0-0	A-3-3	A-4-1	B-0-0	B-3-3	B-4-1	C-0-0	C-3-3	D-0-0
HC1CYPD	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
2C1NAPH	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
ACENAY	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
DMePHTH	<0.82U	**0.15BJ**	<0.93U	<0.90U	**0.05BJ**	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
ACENAP	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
FLUORE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
DEtPHTH	<0.82U	**2.20B**	**1.70B**	**1.30B**	**1.40B**	**0.91B**	**0.82B**	<0.82U	<0.78U	<0.78U
4C1PHPHE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
NNDPHAM	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
4BrPHET	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
HCLBEN	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
PHENAN	<0.82U	**0.03J**	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
ANTRAC	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
DBuPHTH	<0.82U	**0.19BJ**	**0.12BJ**	**0.11BJ**	**0.11BJ**	<0.76U	<0.79U	<0.82U	**0.10BJ**	**0.38BJ**
FLANTHE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
PYRENE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
BuBePHTH	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
CHRYSE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
BAANTHR	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
B2EHPH	**0.83B**	**0.08BJ**	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	**0.96B**	**0.99B**	**0.05BJ**
DNOcPHT	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	**0.92B**	<0.78U	<0.78U
BBFLANT	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
BKFLANT	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
BAPYRE	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
I123PYR	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
DBAHANT	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
B-GHI-PYR	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
ANILINE	<1.60U	<2.00U	<1.90U	<1.80U	<1.90U	<1.50U	<1.60U	<1.60U	<1.60U	<1.60U
4CLANIL	<1.60U	<2.00U	<1.90U	<1.80U	<1.90U	<1.50U	<1.60U	<1.60U	<1.60U	<1.60U
DBENZOFU	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
2MeNAPH	<0.82U	<0.99U	<0.93U	<0.90U	<0.97U	<0.76U	<0.79U	<0.82U	<0.78U	<0.78U
2NANIL	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U
3NANIL	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U
4NANIL	<4.10U	<5.00U	<4.60U	<4.50U	<4.80U	<3.80U	<4.00U	<4.10U	<3.90U	<3.90U

Note: Sample ID is as follows: A-0-0 - Surface scrape sample from Grid A, location 0,0. See Figures 5.1 and 5.2.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

B - Analyte is found in the associated blank as well as in the sample.

* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A22. (Page 3 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) surface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	D-1-3	D-3-1	D-4-4	E-0-0	E-1-3	E-3-1	E-4-4	F-1	F-2	F-3
PHENOL	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
2ClPHEN	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
2NIPHE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
24DMePHE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
24DClPHE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
4Cl3MePHE	<2.40U	<1.80U	<1.90U	<1.70U	<1.40U	<1.40U	<1.40U	<1.50U	<1.60U	<1.90U
246TClPH	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
24DNPH	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U
4NPHE	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U
2M46DNPH	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U
PClPHE	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U
BENZOAC	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U
2MEPHE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
4MEPHE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
245TClPH	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
BZLAL	<2.40U	<1.80U	<1.90U	<1.70U	<1.40U	<1.40U	<1.40U	<1.50U	<1.60U	<1.90U
NNDMEAM	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
BC11PRE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
NNDNPAM	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
NITROBEN	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
ISOPHOR	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
BClEtoME	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
26DNTOL	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
24DNTOL	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
12DPHYD	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
BENZIDI	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U
33DC1BEZ	<2.40U	<1.80U	<1.90U	<1.70U	<1.40U	<1.40U	<1.40U	<1.50U	<1.60U	<1.90U
BClETE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
13DC1B	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
14DC1B	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
12DC1B	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
HClETA	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
124TClB	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
NAPHTH	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
HClBu	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U

Note: Sample ID is as follows: D-1-3 - Surface scrape sample from Grid D, location 1,3. See Figures 5.1 and 5.2.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Analyte is found in the associated blank as well as in the sample.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A22. (Page 4 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) surface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	D-1-3	D-3-1	D-4-4	E-0-0	E-1-3	E-3-1	E-4-4	F-1	F-2	F-3
HClCYPD	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
2ClNAPH	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
ACENAY	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
DMePHTH	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
ACENAP	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
FLUORE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
DEtPHTH	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
4ClPHPHE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
NNDPHAM	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
4BrPHET	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
HCLBEN	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
PHENAN	<1.20U	<0.89U	**0.02J**	**0.04J**	**0.03J**	**0.02J**	**0.03J**	<0.74U	<0.78U	<0.93U
ANTRAC	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
DBuPHTH	**0.12BJ**	**0.05BJ**	**0.47BJ**	**0.11BJ**	**0.12BJ**	**0.21BJ**	**0.11BJ**	<0.74U	<0.78U	<0.93U
FLANTHE	<1.20U	<0.89U	<0.94U	<0.84U	**0.03J**	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
PYRENE	<1.20U	<0.89U	<0.94U	<0.84U	**0.04J**	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
BuBePHTH	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
CHRYSE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
BAANTHR	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
B2EHPH	**0.28BJ**	**0.12BJ**	**0.12BJ**	**0.54BJ**	**0.09BJ**	**0.09BJ**	**0.15BJ**	<0.74U	<0.78U	<0.93U
DNOcPHT	<1.20U	**0.17J**	<0.94U	<0.84U	**0.05J**	**0.08J**	<0.69U	<0.74U	<0.78U	<0.93U
BBFLANT	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
BKFLANT	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
BAPYRE	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
I123PYR	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
DBAHANT	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
B-GHI-PYR	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
ANILINE	<2.40U	<1.80U	<1.90U	<1.70U	<1.40U	<1.40U	<1.40U	<1.50U	<1.60U	<1.90U
4CLANIL	<2.40U	<1.80U	<1.90U	<1.70U	<1.40U	<1.40U	<1.40U	<1.50U	<1.60U	<1.90U
DBENZOFU	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
2MeNAPH	<1.20U	<0.89U	<0.94U	<0.84U	<0.68U	<0.69U	<0.69U	<0.74U	<0.78U	<0.93U
2NANIL	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U
3NANIL	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U
4NANIL	<6.00U	<4.40U	<4.70U	<4.20U	<3.40U	<3.40U	<3.40U	<3.70U	<3.80U	<4.60U

Note: Sample ID is as follows: D-1-3 - Surface scrape sample from Grid D, location 1,3. See Figures 5.1 and 5.2.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

B - Analyte is found in the associated blank as well as in the sample.

* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A22. (Page 5 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) surface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	G-1	G-2	G-3	G-4	14
PHENOL	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
2ClPHEN	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
2NIPHE	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
24DMePHE	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
24DClPHE	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
4Cl3MePHE	<2.20U	2.20U	2.00U	<1.90U	<7.6U
246TClPH	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
24DNPH	<5.50U	<5.50U	<4.90U	<4.80U	<19.0U
4NPHE	<5.50U	<5.50U	<4.90U	<4.80U	<19.0U
2M46DNPH	<5.50U	<5.50U	<4.90U	<4.80U	<19.0U
PClPHE	<5.50U	<5.50U	<4.90U	<4.80U	<19.0U
BENZOAC	<5.50U	<5.50U	<4.90U	<4.80U	<19.0U
2MEPHE	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
4MEPHE	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
245TClPH	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
BZLAL	<2.20U	2.20U	2.00U	<1.90U	<7.6U
NNDMEAM	<1.10U	<1.10U	<0.98U	<0.95U	**1.13J**
BClIPRE	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
NNDNPAM	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
NITROBEN	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
ISOPHOR	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
BClEtoME	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
26DNTOL	<1.10U	<1.10U	<0.98U	<0.95U	**0.68J**
24DNTOL	<1.10U	<1.10U	<0.98U	<0.95U	**0.61J**
12DPHYD	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
BENZIDI	<5.50U	<5.50U	<4.90U	<4.80U	19.0U
33DClBEZ	<2.20U	2.20U	2.00U	<1.90U	<7.6U
BClETE	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
13DClB	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
14DClB	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
12DClB	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
HClETA	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
124TClB	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
NAPHTH	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
HClBu	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U

Note: Sample ID is as follows: G-1 - Surface scrape sample from Grid G, location 1. See Figures 5.1 and 5.2.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Analyte is found in the associated blank as well as in the sample.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A22. (Page 6 of 6) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) surface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

ANALYTE/SAMPLE	G-1	G-2	G-3	G-4	14
HClCYPD	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
2ClNAPH	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
ACENAY	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
DMePHTH	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
ACENAP	<1.10U	<1.10U	<0.98U	<0.95U	**0.35J**
FLUORE	<1.10U	<1.10U	<0.98U	<0.95U	**0.39J**
DEtPHTH	<1.10U	**0.12BJ**	**0.11BJ**	**0.12BJ**	<3.8U
4ClPHPHE	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
NNDPHAM	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
4BrPHET	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
HCLBEN	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
PHENAN	<1.10U	<1.10U	<0.98U	<0.95U	**5.5**
ANTRAC	<1.10U	<1.10U	<0.98U	<0.95U	**0.65J**
DBuPHTH	**0.14BJ**	**0.19BJ**	**0.58BJ**	**0.35BJ**	<3.8U
FLANTHE	<1.10U	<1.10U	<0.98U	<0.95U	**3.9**
PYRENE	<1.10U	<1.10U	<0.98U	<0.95U	**3.9**
BuBePHTH	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
CHRYSE	<1.10U	<1.10U	<0.98U	<0.95U	**2.4J**
BAANTHR	<1.10U	<1.10U	<0.98U	<0.95U	**1.4J**
B2EHPH	<1.10U	**0.12BJ**	**0.25BJ**	**0.086BJ**	<3.8U
DNOcPHT	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
BBFLANT	<1.10U	<1.10U	<0.98U	<0.95U	**1.3J**
BKFLANT	<1.10U	<1.10U	<0.98U	<0.95U	**1.1J**
BAPYRE	<1.10U	<1.10U	<0.98U	<0.95U	**1.2J**
I123PYR	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
DBAHANT	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
B-GHI-PYR	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
ANILINE	<2.20U	2.20U	**0.21J**	<1.90U	<7.6U
4CLANIL	<2.20U	2.20U	<2.00U	<1.90U	<7.6U
DBENZOFU	<1.10U	<1.10U	<0.98U	<0.95U	**0.19J**
2MeNAPH	<1.10U	<1.10U	<0.98U	<0.95U	<3.8U
2NANIL	<5.50U	<5.50U	<4.90U	<4.80U	<19.0U
3NANIL	<5.50U	<5.50U	<4.90U	<4.80U	<19.0U
4NANIL	<5.50U	<5.50U	<4.90U	<4.80U	<19.0U

Note: Sample ID is as follows: G-1 - Surface scrape sample from Grid G, location 1. See Figures 5.1 and 5.2.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Analyte is found in the associated blank as well as in the sample.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A23. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Summary of semivolatile organic analytes (EPA Method 8270 compounds) found in soil analyses. Semivolatile analytes frequently found in method blanks are not included.

Subsurface and Surface Samples with No Detectable Semivolatile Analytes

Boring 12	Background North #3
Boring 11	Area B
Boring 9	Area C
Boring 8	Area F
Boring 7	
Boring 6A	
Boring 5	
Boring 4	
Boring 3	
Boring 2	
Boring 1	

Semivolatile Organic Analytes in Surface Soil Samples

Area A	Area D	Area E	Area G
phenanthrene (J)(1)	phenanthrene (J)(1)	phenanthrene (J)(4)	aniline (J)(1)
		fluoranthene (J)(1)	
		pyrene (J)(1)	

Sample H
N-nitrosodimethylamine (J)(1)
2,6-dinitrotoluene (J)(1)
2,4-dinitrotoluene (J)(1)
acenaphthene (J)(1)
fluorene (J)(1)
phenanthrene
anthracene (J)(1)
fluoranthene
pyrene
chrysene (J)(1)
benzo(a)anthracene (J)(1)
benzo(b)fluoranthene (J)(1)
benzo(k)fluoranthene (J)(1)
dibenzofuran (J)(1)

Semivolatile Organic Analytes in Subsurface Soil Samples

Boring 13	Boring 10
N-nitrodisomethylamine (J)(1)	butylbenzylphthalate (J)(1)

Note:
(J) - Indicates an estimated value below the quantitation limits
(1) - Indicates the number of soil samples with detectable concentrations of that analyte.

Table A24. (Page 1 of 7) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Semivolatile organic compounds* tentatively identified from soil samples. Estimated concentrations are mg/kg (ppm) dry weight.

Sample #	Compound	RT	CAS No	Est. Conc. (mg/kg)
1#1	unknown	5.28		4.20
	dicyclohexylpropaned nitrite	8.37	7474286	1.50
	2,3-dimethoxy-2 -methylbutane	11.77	74421004	0.93
	2-butyl-1,3-dioxolane	12.02	4360763	1.40
	2-(dichloromethyl-1, 3-dioxolane	12.20	2612353	1.50
2#1	unknown	4.99		21.00
	unknown	6.81		0.92
	1-(3-ethyloxiranyl)ethanone	7.40	17257817	2.00
	1-(3-butyloxiranyl)ethanone	7.66	17257806	2.50
	3-hexen-2-one	7.99	763939	5.60
2#2	unknown	4.92		25.00
(7686)	2,5-dimethyl-1,5-heptadiene 3,4-dial	6.78	22607165	1.70
	1-(3-ethyloxiranyl)ethanone	7.40	17257817	3.60
	2,3,3,4-tetramethylpentane	7.68	16747384	4.80
	dicyclohexylpropanedinitrite	8.01	7474286	8.90
	2,3,4,5-tetrahydropyridine	8.58	505180	0.86
2#2	unknown	4.88		29.00
(7806)	unknown	6.75		1.80
	1-(3-ethyloxiranyl)ethanone	7.35	17257817	3.80
	1-(3-butyloxiranyl)ethanone	7.61	17257806	4.70
	3-hexen-2-one	7.94	763939	10.00
	dicyclohexylpropanedinitrite	8.53	7474286	0.76
	sulfur, S8	31.12	10544500	5.70
3#2	unknown	4.86		28.00
	2,5-dimethyl-1,5-heptadiene 3,4-dial	6.79	22607165	2.70
	1-(3-ethyloxiranyl)ethanone	7.39	17257817	6.00
	2,3,3,4-tetramethylpentane	7.69	16747384	7.50
	dicyclohexylpropanedinitrite	8.01	7474286	14.00
	cyclohexanecarboxylic acid, ethenyl	8.58	48407608	1.40
4	unknown	5.12		21.00
	unknown	7.07		2.70
	1-(3-ethyloxiranyl)ethanone	7.70	17257817	5.30
	1-(3-butyloxiranyl)ethanone	8.00	17257806	7.20
	cyclohexanecarboxylic acid, ethenyl	8.34	4840760	14.00
	4-methyl-4H-1,2,4-triazole	8.90	10570408	1.60
5#1	3-hydroxy-3-methyl- 2-butanone	4.78	115220	20.00
	3-hexen-2-one	7.87	763939	1.50
6A	3-hydroxy-3-methyl- 2-heptanone	5.11	13757910	28.00

Note: RT - Retention Time; CAS No - Chemical Abstract Service Registry numbers
Sample Number - 12#4 Boring 12/sample 4. See Figures 5.1 and 5.2.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A24. (Page 2 of 7) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Semivolatile organic compounds* tentatively identified from soil samples. Estimated concentrations are mg/kg (ppm) dry weight.

Sample #	Compound	RT	CAS No	Est. Conc. (mg/kg)
6A	2,5-dimethyl-1,5-heptadiene 3,4-dial	7.05	22607165	2.90
	1-(3-ethyloxiranyl)ethanone	7.71	17257817	7.10
	1-(3-butyloxiranyl)ethanone	8.00	17257806	9.00
	dicyclohexylpropanedinitrite	8.35	7474286	19.00
	cyclohexanecarboxylic acid, ethenyl	8.90	48407608	2.80
7#1	unknown	4.90		26.00
(7807)	unknown	6.75		1.50
	1-(3-ethloxiranyl)ethanone	7.35	17257817	2.90
	1-(3-butyloxiranyl)ethanone	7.63	17257806	3.70
	3-hexen-2-one	7.96	763939	7.50
	1,3,5-trimitro-2-methylbenzene (TNT)	25.04	118967	0.20
7#1	unknown	4.93		25.00
(7808)	2,5-dimethyl-1,5-heptadiene 3,4-dial	6.76	22607165	1.30
	1-(3-ethyloxiranyl)ethanone	7.35	17257817	2.50
	1-(3-butyloxiranyl)ethanone	7.61	17257806	2.90
	3-hexen-2-one	7.94	763939	6.20
8#1	unknown	4.96		6.20
(7773)	dicyclohexylpropanedinitrite	8.03	7474286	1.50
8#1	unknown	4.83		170.00
(7721)				
8#2	unknown	4.79		61.00
9#1	unknown	4.93		30.00
	unknown	6.78		1.20
	1-(3-ethyloxiranyl)ethanone	7.36	17257817	2.00
	2,3,3,4-tetramethylpentane	7.64	16747384	2.50
	dicyclohexylpropanedinitrite	7.95	7474286	5.40
10#1	unknown	4.96		23.00
	unknown	6.81		1.40
	1-(3-ethyloxiranyl)ethanone	7.42	17257817	2.60
	2,3,3,4-tetramethylpentane	7.70	16747384	3.30
	dicyclohexylpropanedinitrite	8.01	7474286	6.70
10#2	unknown	4.88		7.40
	unknown	4.97		4.40
	3-hexen-2-one	7.96	763939	1.50
10#3	unknown	4.92		8.70
	dicyclohexylpropanedinitrite	7.96	7474286	1.60
10#4	unknown	5.03		22.00
	dicyclohexylpropanedinitrite	7.93	7474286	1.50
11#1	unknown	4.97		24.00
	2,3,3,4-tetramethylpentane	6.85	1674389	0.97
	2,3,3,4-tetramethylpentane	7.42	1674389	1.70
	3-ethyl-2,4-dimethylpentane	7.70	1068877	2.10
	unknown	8.01		4.50
11#2	unknown	5.16		11.00

Note: RT - Retention Time; CAS No - Chemical Abstract Service Registry numbers
Sample Number - 12#4 Boring 12/sample 4. See Figures 5.1 and 5.2.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A24. (Page 3 of 7) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Semivolatile organic compounds* tentatively identified from soil samples. Estimated concentrations are mg/kg (ppm) dry weight.

Sample #	Compound	RT	CAS No	Est. Conc. (mg/kg)
11#3	unknown	4.95		13.00
	unknown	7.94		1.50
	octadecanoic acid	33.06	57114	1.50
11#4	unknown	5.05		17.00
	unknown	7.98		1.50
12#1	unknown	5.05		23.00
	dicyclohexylpropanedinitrite	7.96	7474286	1.60
12#2	unknown	5.03		15.00
	bromocyclohexane	7.96	108850	1.70
12#3	unknown	5.13		23.00
	dicyclohexylpropanedinitrite	7.97	7474286	1.50
12#4	unknown	4.94		9.40
	unknown	5.21		22.00
	bromocyclohexane	7.95	108850	1.60
13#1	unknown	5.04		14.00
13#2	unknown	4.98		8.20
	unknown	5.24		17.30
	dicyclohexylpropanedinitrite	7.97	7474286	1.50
13#3	unknown	5.08		29.00
	unknown	5.20		4.70
	3-hexen-2-one	7.91	763939	1.50
13#5	unknown	4.76		18.00
	unknown	6.95		1.60
	1,1-dimethoxy-2-butene	7.58	21962243	3.80
	hexylisopropylether	7.85	18636652	4.80
	3-hexen-2-one	8.10	763939	8.20
	2,5-dimethoxy-2,5 -dimethylhexane	11.99	53273135	1.40
14	unknown	5.23		100.00
	3-hexen-2-one	8.20	763939	7.70
	2-methyl-1,3,5-trinitro-pengene	25.87	118967	7.70
A-0-0	unknown	4.58		26.00
	unknown	6.14		2.10
A-0-0	3-nonazone	6.86	925780	1.80
	hydrocarbon	7.44		3.70
	1-(3-ethyloxiranyl)ethanone	7.71	17257817	4.40
	3-hexen-2-one	7.92	763939	8.90
	9-hexadecenoic acid	27.29	2091294	1.00
	hexadecanoic acid	29.54	57103	1.90
A-3-3	unknown	4.63		24.00
	unknown	6.21		3.20
	2,5-dimethyl-1,5-heptadiene 3,4-dial	6.91	22607165	1.60
	3-methylpyrrolidine	7.49	34375898	3.00
	2,2-dimethylpentanol	7.75	14250885	6.70
A-4-1	unknown	4.65		19.00
	unknown	6.34		4.90

Note: RT - Retention Time; CAS No - Chemical Abstract Service Registry numbers
Sample Number - 12#4 Boring 12/sample 4. See Figures 5.1 and 5.2.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A24. (Page 4 of 7) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Semivolatile organic compounds* tentatively identified from soil samples. Estimated concentrations are mg/kg (ppm) dry weight.

Sample #	Compound	RT	CAS No	Est. Conc. (mg/kg)
A-4-1	2,2-dimethylpentanol	6.99		2.30
	1-(3-ethyloxiranyl)ethanone	7.56	17257817	4.90
	1-(3-ethyloxiranyl)ethanone	7.83	17257817	6.30
	unknown	8.07		12.00
	hexadecanoic acid	29.53	57103	1.30
B-0-0	unknown	4.61		34.00
	unknown	6.18		5.60
	2,2-dimethylpentanol	6.88	14250885	2.00
	3-methylpyrrolidine	7.47	34375898	3.80
	1-(3-butyloxiranyl)ethanone	7.73	17257806	4.80
	dicyclohexylpropanedinitrite	7.96	74764286	9.90
B-3-3	unknown	4.67		23.00
	unknown	6.23		2.30
	2,2-dimethylpentanol	6.91	14250885	1.70
	1-(3-ethyloxiranyl)ethanone	7.50	172578172	3.70
	2,2-dimethylpentanol	7.78	14250885	4.70
	4-penten-2-one	8.01	13891877	9.30
B-4-1	unknown	4.64		28.00
	unknown	6.23		2.10
	2,2-dimethylpentanol	6.88	14250885	2.00
	1-(3-ethyloxiranyl)ethanone	7.50	17257817	4.50
	2,2-dimethylpentanol	7.76	14250885	5.70
	4-methyl-4H-1,2,4-triazole	7.99	10570408	11.00
C-0-0	3-hydroxy-3-methyl-2-butanone	4.79	115220	28.00
	3-hexen-2-one	7.87	763939	1.60
C-3-3	unknown	4.71		31.00
	1-(3-ethyloxiranyl)ethanone	7.45	17257817	1.40
	hexylisopropylether	7.71	18636652	1.70
	3-hexen-2-one	7.92	763939	3.50
D-0-0	unknown	4.89		29.00
	unknown	6.30		1.10
	hydrocarbon	6.95		0.87
	1-(3-ethyloxiranyl)ethanone	7.54	17257816	1.70
	unknown	7.82		2.00
	3-hexen-2-one	8.05	763939	5.40
D-1-3	unknown	4,88		25.00
	unknown	6.56		2.50
	1-(3-ethyloxiranyl)ethanone	7.72	17257817	2.00
	2-iodohexane	7.99	18589270	5.70
	bromocyclohexane	8.22	108850	6.10
	2-methoxyl,-2-octen-4-one	13.89	24985486	2.30
D-3-1	unknown	4.81		28.00
	2-bromohexane	7.02	3377864	1.80
	2,3,3,4-tetramethylpentane	7.61	16747389	3.80
	unknown	7.88		4.80
	3-hexen-2-one	8.13	7639390Q	11.00
	hexadecanoic acid	29.62	57103	1.20

Note: RT - Retention Time; CAS No - Chemical Abstract Service Registry numbers
Sample Number - 12#4 Boring 12/sample 4. See Figures 5.1 and 5.2.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A24. (Page 5 of 7) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Semivolatile organic compounds* tentatively identified from soil samples. Estimated concentrations are mg/kg (ppm) dry weight.

Sample #	Compound	RT	CAS No	Est. Conc. (mg/kg)
D-4-4	unknown	4.94		23.00
	dimethoxy-2-butene	7.60	21962243	1.50
	1-(3-butyloxiranyl)ethanone	7.60	17257086	1.90
	3-hexen-2-one	8.09	763939	4.80
E-0-0	unknown	4.77		16.00
	2-methyl-propoxypropane	6.42	15268492	2.50
	unknown	7.06		1.30
	2,3,3,4-tetramethylpentane	7.63	16747389	2.40
	1-(3-butyloxiranyl)ethanone	7.88	17257806	3.10
	bromocyclohexane	8.12	1088503	7.70
	9-hexadecenoic acid	29.42	2091294	1.80
	hexadecanoic acid	29.67	57103	2.00
	ditriacontane	45.05	544854	1.70
E-1-3	unknown	4.94		25.00
	unknown	7.01		1.40
	1-(3-ethyloxiranyl)ethanone	7.62	17257817	2.80
	unknown	7.90		3.70
	3-hexen-2-one	8.14	763939	7.60
E-3-1	unknown	4.84		27.00
	unknown	6.95		1.20
	2,3,3,4-tetramethylpentane	7.57	1674389	2.80
	unknown	7.87		3.50
	3-hexen-2-one	8.10	763939	7.70
E-4-4	unknown	4.89		14.00
	1-(3-ethyloxiranyl)ethanone	7.57	17257817	0.94
	1-(3-butyloxiranyl)ethanone	7.84	17257806	1.10
E-4-4	3-hexen-2-one	8.07	763939	2.70
F-1	unknown	5.28		3.50
	dicyclohexylpropanedinitrite	8.44	7474286	1.50
F-2	unknown	5.29		3.40
	1-(3-ethyloxiranyl)ethanone	8.08	17257817	0.80
	cyclohexanecarboxylic acid, ethenyl	8.42	48407608	1.60
F-3	unknown	5.39		26.00
	2,5-dimethyl-1,5-heptadiene 3,4-dial	7.14	22607165	26.00
	1-(3-ethyloxiranyl)ethanone	7.75	17257817	2.60
	1-(3-butyloxiranyl)ethanone	8.04	17257806	3.50
	cyclohexanecarboxylic acid, ethenyl	8.40	48407608	7.30
G-1	unknown	5.05		31.00
	2-methoxy-1,1-biphenyl	5.61	86260	1.30
	3-hexen-2-one	7.96	763939	2.20
G-2	unknown	4.90		40.00
	2-methyl-1,3-dioxolane-2 - butanol	6.59	5745755	4.70
	unknown	6.80		1.30
	1-(3-ethyloxiranyl)ethanone	7.36	17257817	1.90

Note: RT - Retention Time; CAS No - Chemical Abstract Service Registry numbers
Sample Number - 12#4 Boring 12/sample 4. See Figures 5.1 and 5.2.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A24. (Page 6 of 7) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Semivolatile organic compounds* tentatively identified from soil samples. Estimated concentrations are mg/kg (ppm) dry weight.

Sample #	Compound	RT	CAS No	Est. Conc. (mg/kg)
G-2	1-(3-butyloxiranyl)ethanone	7.62	17257806	2.50
	3-hexen-2-one	7.93	763939	5.60
	sulfur, S8	31.02	10544500	1.70
	hexanadioic acid, dioctyl ester	36.26	123795	2.30
	heptacosane	44.94	593497	1.30
G-3	unknown	5.15		28.00
	2-methyl-1,3-dioxolane-2 - butanol	6.66	5745755	2.10
	bromocyclohexane	7.95	108850	1.90
G-4	unknown	4.91		30.00
	2-methoxy-1,1-biphenyl	5.45	86260	1.30
	2-methyl-1,3-dioxolane-2 - butanol	6.58	5745755	4.30
	1-(3-ethyloxiranyl)ethanone	7.59	17257817	1.20
	4-butoxy-3-penten-2-one	7.89	3431876	2.20
	hexanadioic acid, dioctyl ester	36.25	123795	no data
BN#3	unknown	4.64		9.60
	unknown	4.98		2.70
	3-hexen-2-one	7.91	763939	1.70
Method Blanks				
Blk#1	unknown	4.93		26.00
(7410B)	(2,3,3,4-tetramethylpentane	6.99	16747389	1.00
(D-0-0)	2,3,3,4-tetramethylpentane	7.60	16747389	2.30
	unknown	7.87		2.80
	bromocyclohexane	8.12	108850	6.20
BLK	3-hydroxy-3-methyl-			
(7545B)	2-butanone	4.81	115220	14.20
(C-0-0)	3-hexen-2-one	7.90	763939	1.30
Blk#1	unknown	4.63		18.00
(7442B)	3-nonanone	6.87	925780	1.90
(A-0-0)	1-(3-ethyloxiranyl)ethanone	7.49	17257817	4.70
	1-(3-ethyloxiranyl)ethanone	7.79	17257817	6.10
	3-hexen-2-one	8.03	763939	7.70
	2,3,4,5-tetralydropyridine	8.85	505180	1.50
BLK	unknown	5.02		28.00
(7802B)	2,3,3,4-tetramethylpentane	6.88	16747389	0.92
(G-2)	1-(3-ethyloxiranyl)ethanone	7.44	17257817	1.40
	1-(3-butyloxiranyl)ethanone	7.68	17257806	1.80
	3-hexen-2-one	8.01	763939	3.30

Note: RT - Retention Time; CAS No - Chemical Abstract Service Registry numbers
Sample Number - 12#4 Boring 12/sample 4. See Figures 5.1 and 5.2.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A24. (Page 7 of 7) Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Semivolatile organic compounds* tentatively identified from soil samples. Estimated concentrations are mg/kg (ppm) dry weight.

Sample #	Compound	RT	CAS No	Est. Conc. (mg/kg)
Blk#1	unknown	4.63		18.00
(7442B)	3-nonanone	6.87	925780	1.90
(A-0-0)	1-(3-ethyloxiranyl)ethanone	7.49	17257817	4.70
	1-(3-ethyloxiranyl)ethanone	7.79	17257817	6.10
	3-hexen-2-one	8.03	763939	7.70
	2,3,4,5-tetralydropyridine	8.85	505180	1.50
BLK	unknown	4.85		23.00
(7776B)	2,5-dimethyl-1,5-heptadiene			
(Boring 10)	3,4-dial	6.75	22607165	1.50
	2,3,3,4-tetramethylpentane	7.37	16747389	3.50
	2,3,3,4-tetramethylpentane	7.64	16747389	4.20
	3-hexen-2-one	7.97	763939	9.30
	cyclohexanecarbonylic acid, ethenyl	8.54	4840760	0.73
BLK	unknown	5.07		17.00
(SV-BLK)	unknown	7.96		1.30
BLK	3-hydroxy-3-methyl-2			
(7618B)	-heptanone	5.28	13757910	18.00
(Boring 1)	2,5-dimethyl-1,5-heptadiene			
	3,4-dial	7.10	22607165	1.40
	1-(3-ethyloxiranyl)ethanone	7.75	17257817	2.90
	1-(3-butyloxiranyl)ethanone	8.06	17257806	3.70
	unknown	8.39		7.60
	4-methyl-4H-1,2,4-triozole	8.95	10570408	1.20

Note: RT - Retention Time; CAS No - Chemical Abstract Service Registry numbers
Sample Number - 12#4 Boring 12/sample 4. See Figures 5.1 and 5.2.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A25. (Page 1 of 5). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

METHOD ANALYTE/BLANK	MB1	MB2	MB3	MB4	MB5	MB6	MB7	MB8	MB9	MB10**
PHENOL	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
2ClPHEN	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
2NIPHE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
24DMePHE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
24DClPHE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
4Cl3MePHE	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U
246TClPH	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
24DNPH	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U
4NPHE	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U
2M46DNPH	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U
PClPHE	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U
BENZOAC	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U
2MEPHE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
4MEPHE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
245TClPH	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BZLAL	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U
NNDMEAM	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BCl1PRE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
NNDNPAM	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
NITROBEN	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
ISOPHOR	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BClEtoME	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
26DNTOL	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
24DNTOL	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
12DPHYD	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BENZIDI	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U
33DClBEZ	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U
BClETE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
13DClB	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
14DClB	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
12DClB	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
HClETA	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
124TClB	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
NAPHTH	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
HClBu	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U

Note: Method Blank ID - see Notes on last page of Table.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

** - Three method blanks were analyzed, all with these same results.

* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A25. (Page 2 of 5). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

METHOD ANALYTE/BLANK	MB1	MB2	MB3	MB4	MB5	MB6	MB7	MB8	MB9	MB10
HClCYPD	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
2ClNAPH	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
ACENAY	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
DMePHTH	**0.12J**	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
ACENAP	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
FLUORE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
DEtPHTH	**1.50**	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	**0.045J**	<0.67U	<0.67U	<0.67U
4ClPHPHE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
NNDPHAM	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
4BrPHET	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
HCLBEN	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
PHENAN	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
ANTRAC	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
DBuPHTH	**0.39J**	**0.10J**	**0.21J**	**0.21J**	<0.67U	**0.043J**	**0.045J**	<0.67U	<0.67U	<0.67U
FLANTHE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
PYRENE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BuBePHTH	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
CHRYSE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BAANTHR	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
B2EHPH	**0.06J**	**0.50J**	**0.033J**	**0.033**	<0.67U	<0.67U	**0.083J**	<0.67U	<0.67U	<0.67U
DNOcPHT	<0.66U	**0.60J**	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BBFLANT	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BKFLANT	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
BAPYRE	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
I123PYR	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
DBAHANT	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
B-GHI-PYR	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
ANILINE	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U
4CLANIL	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U	<1.30U
DBENZOFU	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
2MeNAPH	<0.66U	<0.67U	<0.66U	<0.66U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U	<0.67U
2NANIL	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U
3NANIL	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U
4NANIL	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U	<3.30U

Note: Method Blank ID - see Notes on last page of Table.

J - Estimated value below the statistical quantitation limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

** - Three method blanks were analyzed, all with these same results.

* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A25. (Page 3 of 5). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU# 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

METHOD ANALYTE/BLANK	MB11	MB12
PHENOL	<0.67U	<0.67U
2ClPHEN	<0.67U	<0.67U
2NIPHE	<0.67U	<0.67U
24DMePHE	<0.67U	<0.67U
24DClPHE	<0.67U	<0.67U
4Cl3MePHE	<1.30U	<1.30U
246TClPH	<0.67U	<0.67U
24DNPH	<3.30U	<3.30U
4NPHE	<3.30U	<3.30U
2M46DNPH	<3.30U	<3.30U
PClPHE	<3.30U	<3.30U
BENZOAC	<3.30U	<3.30U
2MEPHE	<0.67U	<0.67U
4MEPHE	<0.67U	<0.67U
245TClPH	<0.67U	<0.67U
BZLAL	<1.30U	<1.30U
NNDMEAM	<0.67U	<0.67U
BCl1PRE	<0.67U	<0.67U
NNDNPAM	<0.67U	<0.67U
NITROBEN	<0.67U	<0.67U
ISOPHOR	<0.67U	<0.67U
BClEtoME	<0.67U	<0.67U
26DNTOL	<0.67U	<0.67U
24DNTOL	<0.67U	<0.67U
12DPHYD	<0.67U	<0.67U
BENZIDI	<3.30U	<3.30U
33DClBEZ	<1.30U	<1.30U
BClETE	<0.67U	<0.67U
13DClB	<0.67U	<0.67U
14DClB	<0.67U	<0.67U
12DClB	<0.67U	<0.67U
HClETA	<0.67U	<0.67U
124TClB	<0.67U	<0.67U
NAPHTH	<0.67U	<0.67U
HClBu	<0.67U	<0.67U

Note: Method Blank ID - see Notes on last page of Table.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A25. (Page 4 of 5). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU# 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

METHOD ANALYTE/BLANK	MB11	MB12
HC1CYPD	<0.67U	<0.67U
2C1NAPH	<0.67U	<0.67U
ACENAY	<0.67U	<0.67U
DMePHTH	<0.67U	<0.67U
ACENAP	<0.67U	<0.67U
FLUORE	<0.67U	<0.67U
DEtPHTH	<0.67U	<0.67U
4C1PHPHE	<0.67U	<0.67U
NNDPHAM	<0.67U	<0.67U
4BrPHET	<0.67U	<0.67U
HCLBEN	<0.67U	<0.67U
PHENAN	<0.67U	<0.67U
ANTRAC	<0.67U	<0.67U
DBuPHTH	**0.08J**	<0.67U
FLANTHE	<0.67U	<0.67U
PYRENE	<0.67U	<0.67U
BuBePHTH	<0.67U	<0.67U
CHRYSE	<0.67U	<0.67U
BAANTHR	<0.67U	<0.67U
B2EHPH	**0.50J**	<0.67U
DNOcPHT	**0.60J**	<0.67U
BBFLANT	<0.67U	<0.67U
BKFLANT	<0.67U	<0.67U
BAPYRE	<0.67U	<0.67U
I123PYR	<0.67U	<0.67U
DBAHANT	<0.67U	<0.67U
B-GHI-PYR	<0.67U	<0.67U
ANILINE	<1.30U	<1.30U
4CLANIL	<1.30U	<1.30U
DBENZOFU	<0.67U	<0.67U
2MeNAPH	<0.67U	<0.67U
2NANIL	<3.30U	<3.30U
3NANIL	<3.30U	<3.30U
4NANIL	<3.30U	<3.30U

Note: Method Blank ID - see Notes on last page of Table.
J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A25. (Page 5 of 5). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU# 10/15. Results of EPA Method 8270 * (semivolatile organics) subsurface soil sample analyses. Concentrations are mg/kg (ppm) dry weight. Samples with detectable concentrations of analyte are shown in **bold**. Analytes are given as abbreviations; see Appendix A for compound names.

Note: Method Blank Identification; MB1 (Method Blank associated with the analyses indicated as follows. See Figures 5.1 and 5.2 for sample locations.

MB1 (surface scrapes A-0-0, A-3-3, A-4-1, B-0-0, B-3-3, and B-4-1.
MB2 (surface scrapes C-0-0, C-3-3, and Background North #3)
MB3 (surface scrapes D-0-0, D-1-3, D-3-1, D-4-4)
MB4 (surface scrapes E-0-0, E-1-3, E-3-1)
MB5 (surface scrapes F-1, F-2, and F-3))
MB6 and MB7 (surface scrapes G-1, G-2, G-3, and G-4, borings 13, 2, and 7.
MB8 and MB9 (boring 6A, 4, and 3 and surface sample 14))
MB10 (boring 8, 9, 10, 11, and 12) (three Method Blanks analyzed with same results as presented above)
MB11 (boring 5)
MB12 (boring 1)

J - Estimated value below the statistical quantitation limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
* - EPA Method 8270 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A26. (Page 1 of 2). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU# 10/15. Results of semivolatile organic analyses * of sampling equipment rinses and associated method banks. Concentrations are mg/l (ppm). Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see appendix A for full compound names.

Sample Analyte/ID	RINSE 3	RINSE 10	RINSE 07	MB R10,7
PHENOL	-	<0.011U	0.011U	0.010U
2ClPHENOL	-	<0.011U	0.011U	0.010U
2NIPHE	-	<0.011U	0.011U	0.010U
24DMePHE	-	<0.011U	0.011U	0.010U
24DClPHE	-	<0.011U	0.011U	0.010U
4Cl3MePHE	-	<0.022U	0.022U	0.020U
246TClPH	-	<0.011U	0.011U	0.010U
24DNPH	-	<0.055U	0.055U	0.050U
4NPHE	-	<0.055U	0.055U	0.050U
2M46DNPH	-	<0.055U	0.055U	0.050U
PClPHE	-	<0.055U	0.055U	0.050U
BENZOAC	-	<0.055U	0.055U	0.050U
2MEPHE	-	<0.011U	0.011U	0.010U
4MEPHE	-	<0.011U	0.011U	0.010U
245TClPH	-	<0.011U	0.011U	0.010U
BZLAL	-	<0.022U	0.022U	0.020U
NNDMEAM	-	<0.011U	0.011U	0.010U
BClIPRE	-	<0.011U	0.011U	0.010U
NNDNPAM	-	<0.011U	0.011U	0.010U
NITROBEN	-	<0.011U	0.011U	0.010U
ISOPHOR	-	<0.011U	0.011U	0.010U
BClEtoME	-	<0.011U	0.011U	0.010U
26DNTOL	-	<0.011U	0.011U	0.010U
24DNTOL	-	<0.011U	0.011U	0.010U
12DPHYD	-	<0.011U	0.011U	0.010U
BENZIDI	-	<0.055U	0.055U	0.050U
33DClBEZ	-	<0.022U	0.022U	0.020U
BClETE	-	<0.011U	0.011U	0.010U
13DClB	-	<0.011U	0.011U	0.010U
14DClB	-	<0.011U	0.011U	0.010U
12DClB	-	<0.011U	0.011U	0.010U
HClETA12	-	<0.011U	0.011U	0.010U
124TClB	-	<0.011U	0.011U	0.010U

Note:

Sample ID - Rinse 10 - Rinse performed following sampling at boring 10.
MB R10/7 - method blank associated with analysis of rinses for borings 7 and 10.

(-) - No analysis, sample lost during sample extraction

J - Estimated value below the statistical quantification limits

U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.

* - EPA Method 8240 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Table A26. (Page 2 of 2). Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU# 10/15. Results of semivolatile organic analyses * of sampling equipment rinses and associated method banks. Concentrations are mg/l (ppm). Samples with detectable concentrations of organic analyte are shown in **bold**. Analytes are given as abbreviations; see appendix A for full compound names.

SAMPLE Analyte/ID	RINSE 3	RINSE 10	RINSE 07	MB R10,7
NAPHTH	-	<0.011U	<0.011U	<0.010U
HClBu	-	<0.011U	<0.011U	<0.010U
HClCYPD	-	<0.011U	<0.011U	<0.010U
2ClNAPH	-	<0.011U	<0.011U	<0.010U
ACENAY	-	<0.011U	<0.011U	<0.010U
DMePHTH	-	<0.011U	<0.011U	<0.010U
ACENAP	-	<0.011U	<0.011U	<0.010U
FLUORE	-	<0.011U	<0.011U	<0.010U
DEtPHTH	-	**0.001BJ**	**0.001BJ**	**0.001J**
4ClPHPHE	-	<0.011U	<0.011U	<0.010U
NNDPHAM	-	<0.011U	<0.011U	<0.010U
4BrPHET	-	<0.011U	<0.011U	<0.010U
HCLBEN	-	<0.011U	<0.011U	<0.010U
PHENAN	-	<0.011U	<0.011U	<0.010U
ANTRAC	-	<0.011U	<0.011U	<0.010U
DBuPHTH	-	**0.001BJ**	**0.001BJ**	**0.001J**
FLANTHE	-	<0.011U	<0.011U	<0.010U
PYRENE	-	<0.011U	<0.011U	<0.010U
BuBePHTH	-	<0.011U	<0.011U	<0.010U
CHRYSE	-	<0.011U	<0.011U	<0.010U
BAANTHR	-	<0.011U	<0.011U	<0.010U
B2EHPH	-	**0.001BJ**	**0.001BJ**	**0.002J**
DNOcPHT	-	<0.011U	<0.011U	<0.010U
BBFLANT	-	<0.011U	<0.011U	<0.010U
BKFLANT	-	<0.011U	<0.011U	<0.010U
BAPYRE	-	<0.011U	<0.011U	<0.010U
I123PYR	-	<0.011U	<0.011U	<0.010U
DBAHANT	-	<0.011U	<0.011U	<0.010U
B<GHI<PYR	-	<0.011U	<0.011U	<0.010U
ANILINE	-	<0.022U	<0.022U	<0.020U
4CLANIL	-	<0.022U	<0.022U	<0.020U
DBENZOFOU	-	<0.011U	<0.011U	<0.010U
2MeNAPH	-	<0.011U	<0.011U	<0.010U
2NANIL	-	<0.055U	<0.055U	<0.050U
3NANIL	-	<0.055U	<0.055U	<0.050U
4NANIL	-	<0.055U	<0.055U	<0.050U

Note:
Sample ID - Rinse 10 - Rinse performed following sampling at boring 10.
MB R10/7 - method blank associated with analysis of rinses for borings 7 and 10.
(-) - No analysis, sample lost during sample extraction
J - Estimated value below the statistical quantification limits
U - Compound was analyzed for but not detected. Detection limits are given after the < symbol.
B - Analyte is found in the associated blank as well as in the sample.
* - EPA Method 8240 -in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Third Edition, November 1986, with December 1988 revisions.

Appendix B
Boring Logs

Hole No. 10/15-1-90

DRILLING LOG	DIVISION NOR. DIV. (SWMU 10/15)	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-1-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: ~~DISTURBED~~ ATL 2; ~~UNDISTURBED~~ SOIL 1
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 9/14/90; COMPLETED 9/14/90
7. THICKNESS OF OVERBURDEN 4.1'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 4.1'	19. SIGNATURE OF INSPECTOR BEN BRYANT

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
	0		GM SILTY gravel, 1" Maximum, moist, The above material is Probably fill.			NOTE: WATER Level during drilling 4.1'. Augered from 0.0' TO 4.1', 3½" HSA.
	1				1	NOTE: HOLE WILL be grouted with cement and bentonite grout.
	2					HNU Readings. d BGS BZ 0.0 0ppm 0ppm
	3		ML Sandy CLAYEY SILT, WITH TRACE Rock fragments, 1" maximum, moist, Brown.		2 1V	2.5 7ppm 0ppm; 4.1 1ppm 0ppm
			TAN		1A 2V	
	4		BOTTOM OF HOLE 4.1'			Auger Refusal @ 4.1'

Hole No. 10/15-02-90

DRILLING LOG	DIVISION NOR DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT (SWMU 10/15) NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM & MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-02-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN ~~DISTURBED~~ ATL 2 ~~UNDISTURBED~~ SOIL 1
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE STARTED 10-13-90 COMPLETED 10-13-90
7. THICKNESS OF OVERBURDEN 2.0'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 2.0'	19. SIGNATURE OF INSPECTOR Larry Benjamin

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
	0		1/4" ROCK 0.0'-0.1'			SAMPLED W/3"
			CH FAT CLAY, BROWN,		1	SHELBY TUBE PUSHED
			WITH Sandstone Lenses.			W/ Kelly EXTRUDED
						SOIL. Skined Samples
	1					W/ Stainless Steel
						Knifes.
					1A	W.L. During
						DRILLING NOT ENCOUNTERED
					2 / 2V	24 hrs. DRY
			TOP OF ROCK @ 2.0'			AUGER REFUSAL @ 2.0'
	2		BOTTOM OF HOLE 2.0'			W/ SCRAPING
			Possibly Sandstone			sound.

Hole No. 10/15-3-90

DRILLING LOG	DIVISION NOR. DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT (SWMU 10/15) NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-3-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: ~~DISTURBED~~ AFTL 3; ~~UNDISTURBED~~ SOIL
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 9/24/90; COMPLETED 9/24/90
7. THICKNESS OF OVERBURDEN 6.7'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 6.7'	19. SIGNATURE OF INSPECTOR BEN BRYANT

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
	0		FILL MATERIAL			NOTE: WATER Level during drilling NE. AUGERED from 0.0' to 6.7', 3 1/2" HSA.
	1		CH BROWN, Sandy FAT CLAY, WITH TRACE rock fragments 1 1/2" MAX., MOIST.		1	NOTE: Hole will be grouted Later. NOTE: STRONG sweet odor Coming out hole.
	2					
	3		NO ROCK fragments.		2	HNU Readings d BGS BZ 0.0 0ppm 0ppm; 3.0 110 ppm 0ppm; 5.5 30 ppm 2ppm After 15 min; 6.7 2.5ppm 0ppm
	4					
	5					
	6				3 4V 5V	
	6.7		BOTTOM OF HOLE 6.7'			AUGER Refusal @ 6.7'

Hole No. 10/15-4-90

DRILLING LOG	DIVISION NOR. DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT (SWMU 10/15) NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-4-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: ~~DISTURBED~~ ATL 3; ~~UNDISTURBED~~ SOIL
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 9/22/90; COMPLETED 9/22/90
7. THICKNESS OF OVERBURDEN 6.8'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 6.8'	19. SIGNATURE OF INSPECTOR BEN BRYANT

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
	0		FILL MATERIAL			NOTE: water level during drilling NE. Augered from 0.0' TO 6.8', 3½" HSA. NOTE: Hole will be grouted later. NOTE: HNU machine not working properly, needs charging. Strong sweet odor coming out of hole.
	1		GM SILTY gravel, 1½" maximum, moist (obtained from shovel.) (FILL material-Crushed Limestone.		1	
	2					
	3		CH sandy fat CLAY, MOIST.		2	HNU Readings d BGS BZ 0.0 0ppm 0ppm 3.0 " "
	4					
	5				3 4V 5V	5.5 " "
						6.8 " "
	6					
	6.8		BOTTOM OF HOLE 6.8'			AUGER REFUSAL @ 6.8'

Hole No. 10/15-5-90

DRILLING LOG	DIVISION NOR. DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT (SWMU 10/15) NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE PLAN	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-5-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: ~~DISTURBED~~ ATL 2; ~~UNDISTURBED~~ SOIL 1
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 9/14/90; COMPLETED 9/14/90
7. THICKNESS OF OVERBURDEN 5.7'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 5.7'	19. SIGNATURE OF INSPECTOR BEN BRYANT

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
	0		FILL MATERIAL			NOTE: Water Level during drilling NE. Augered from 0.0' to 5.7', 3 1/2" HSA. NOTE: Hole will be grouted with Cement and Bentonite grout.
	1		CH Brown and grey, ~~FAT~~ clay, with trace rock fragments, 1" maximum, moist.		1	
	2					HNU Reading: d / BGS / BZ
	3				2	0.0 / 0ppm / 0ppm
						2.5 / 1.5 ppm / 0ppm
						4.7 / 5.5ppm / 0ppm
						5.7 / 0 ppm / 0ppm
	4		Brown, no rock fragments.		1A 1V 2V	
	5		Brown and Red, weathered sandstone.			
	5.7		Bottom of Hole 5.7'			Auger Refusal @ 5.7'

Hole No. 10/15-6-90

DRILLING LOG	DIVISION NOR. DIV.	INSTALLATION NWSC CRANE	SHEET OF SHEETS

1. PROJECT (SWMU 10/15) NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM & MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-6-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: ~~DISTURBED~~ ATL ~~UNDISTURBED~~ SOIL
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 9-15-90 COMPLETED 9-20-90
7. THICKNESS OF OVERBURDEN 3.0'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 3.0'	19. SIGNATURE OF INSPECTOR BEN BRYANT

ELEVATION a	DEPTH 0 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
			FILL MATERIAL			NOTE: Water Level during drilling 1.0'. 5 days 1.0'. NOTE: Cleaned out with HSA 3 1/2" Auger. NOTE: HOLE was grouted ON 9-20-90 with Cement and bentonite grout.
	1		CH BROWN and gray, FAT CLAY, WITH TRACE rock fragments, 1" maximum, MOIST.			HNU Readings d BGS BZ
	2			w/ Respirator	Time 0900 0915 1000	0.0 0ppm 0ppm; 3.0 110ppm 110 ppm; " 210ppm 210 ppm; " 300 ppm 300 ppm
	3		BOTTOM OF HOLE 3.0'			Auger refusal @ 3.0'. NOTE: DRILL Crew moved off hole at 3.0'. With the HNU machine in proper working condition readings would probably be higher.

Hole No. 10/15-6A-90

DRILLING LOG	DIVISION NOR. DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT (SWMU 10/15) NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-6A-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: ~~DISTURBED~~ ATL 1; ~~UNDISTURBED~~ SOIL 1
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 9-21-90; COMPLETED 9-21-90
7. THICKNESS OF OVERBURDEN 3.0'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 3.0'	19. SIGNATURE OF INSPECTOR BEN BRYANT

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
	0		FILL MATERIAL			NOTE: water level during drilling 1.0' 2 hrs. 1.0' Augered from 0.0' TO 3.0', 3 1/2" HSA. NOTE: HOLE WILL be grouted at Later date.
	1		CH BROWN, Sandy fat CLAY, MICA, MOIST.			HNU Reading d BGS BZ 0.0' 0ppm 0ppm 3.0' 0.5ppm 0ppm
	2					
	3		BOTTOM OF HOLE 3.0'			Auger Refusal at 3.0'

Hole No. 10/15-07-90

DRILLING LOG	DIVISION NOR DIV.	INSTALLATION ~~NSC~~ NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT (SWMU #10/15) ROCKEYE AREA CRANE	10. SIZE AND TYPE OF BIT 3" SELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-07-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: ~~DISTURBED~~ ATL 1; ~~UNDISTURBED~~ SOIL 0
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 10-13-90; COMPLETED 10-13-90
7. THICKNESS OF OVERBURDEN 1.2'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 1.2'	19. SIGNATURE OF INSPECTOR Larry Benjamin

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
	0		@ 1/4" gravel and Clay. FILL material			SAMPLED W/3" SHELBY TUBE pushed w/Kelly EXTRUDED SOIL
	1		CH FAT CLAY, BROWN TOP OF ROCK @ 1.2'		1 V	W.L. During DRILLING NOT ENCOUNTERED 24 hrs. DRY AUGER REFUSAL @ 1.2'
			BOTTOM OF HOLE 1.2' Possibly Sandstone			Duplicate Samples were taken on this Borings. H-NU Reading @ 1400 hrs. 0

Hole No. 10/15-08-90

DRILLING LOG	DIVISION NOR DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT (SWMU # 10/15) NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-08-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: ~~DISTURBED~~ ATL 1; ~~UNDISTURBED~~ SOIL 2
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 10-14-90; COMPLETED 10-14-90
7. THICKNESS OF OVERBURDEN N/A	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK N/A	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 8.0'	19. SIGNATURE OF INSPECTOR Larry Bergamini

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
	0		CH FAT CLAY, BROWN.			SAMPLED W/3" Shelby TUBE pushed W/Kelly Extruded soil. skined Samples W/STAINLESS STEEL KNIFES
	1				1A	W.L. During DRILLING NOT ENCOUNTERED ~~HOLE~~ was backfilled after completion of Drilling. H-NU Reading @ 0908 = 0
	2					
	3					H-NU Reading @ 0930 = 0
	4				2A	NOTE: We Smell a Sweet ODOR. The odor came from the roots IN the SOIL
	5		MOIST.			NOTE: The bottom OF the Sump 7.4'.
	6					H-NU Reading @ 0940 = 0
	7		ML SANDY SILT, GRAY W/ROOTS and TRACE OF CLAY.		1 1/V	
	8		BOTTOM OF HOLE 8.0'			

Hole No. 10/15-09-90

DRILLING LOG	DIVISION NOR DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT NWSC CRANE; ROCKEYE AREA (SWMU #10/15)	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA CDE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-09-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED ATL 1; UNDISTURBED SOIL 2
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 10-14-90; COMPLETED 10-14-90
7. THICKNESS OF OVERBURDEN N/A	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK N/A	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 8.0'	19. SIGNATURE OF INSPECTOR Larry Benjamin

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
	0		1/4" gravel 0.0'-0.2' CH FAT Clay, Brown.			Sampled w/ 3" Shelby Tube pushed w/ Kelly Extruded Soil-skined Samples w/ Stainless Steel Knifes. W.L. During Drilling NOT Encountered Hole was backfilled after completion of Drilling. H-NU Reading @ 0810 = 0
	1				1A	
	2					
	3				2A	H-NU Reading @ 0815 = 0 NOTE: The bottom of Sump 7.4'.
	4					
	5					
	6		MOIST.			H-NU Reading @ 0830 = 0
	7					
	8		ML Sandy SILT, GRAY, TRACE OF WOOD and WITH CLAY, SWEET ODOR.		1	
			BOTTOM OF HOLE 8.0'			

Hole No. 10/15-10-90

DRILLING LOG	DIVISION NOR. DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT (SWMU #10/15) NWSC CRANE: ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-10-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED ATL 4; UNDISTURBED SOIL 1
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 10-14-90; COMPLETED 10-14-90
7. THICKNESS OF OVERBURDEN 8.5'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 8.5'	19. SIGNATURE OF INSPECTOR Larry Benjamin

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
	0		1/4" gravel 0.0"-0.3" clay mixtures. CH FAT CLAY, BROWN.		1	SAMPLED W/3" SHELBY TUBE PUSHED W/Kelly EXTRUDED SOIL. Skined Samples W/STAINLESS STEEL KNIFES.
	1				2	H-NU Reading @ 1015 = 0
	2					W.L. During DRILLING NOT ENCOUNTERED HOLE WAS BACKFILLED AFTER Completion OF DRILLING.
	3				3	H-NU Reading @ 1030 = 0
	4					
	5		ML GRAY Sandy SILT TRACE OF ROOTS,		1A	
	6					H-NU Reading @ 1045 = 0
	7		CH BROWNISH ORANGE FAT CLAY, TRACE OF SHALE fragments			
	8		TOP OF ROCK @ 8.5'		4 / 4 ✓	AUGER REFUSAL @ 8.5 W/ SCRAPING SOUND.
	9		BOTTOM OF HOLE 8.5' possibly SHALE			

Hole No. 10/15-11-90

DRILLING LOG	DIVISION NOR DIV. (SWMU #10/15)	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS
1. PROJECT NWSC CRANE; ROCKEYE AREA		10. SIZE AND TYPE OF BIT 3" SHELBY TUBE	
2. LOCATION (Coordinates or Station) SEE MAP		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY USA COE WES		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 10/15-11-90		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4 ATL; UNDISTURBED 2 SOIL	
5. NAME OF DRILLER ELASTIC BROWN		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE: STARTED 10-12-90; COMPLETED 10-12-90	
7. THICKNESS OF OVERBURDEN 6.9'		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK N/A		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 6.9		19. SIGNATURE OF INSPECTOR Larry Benjamin	

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
			CL LEAN Clay, Gray, Sandy.			SAMPLED W/3" SHELBY TUBE PUSHED W/Kelly EXTRUDED SOIL. Skined Samples W/STAINLESS Steel Knifes.
			CH FAT Clay, BROWN WITH 1/4" gravel		1	
	1				1A	
			NO gravel		2	H-NU Reading @ 1400 = 0
	2					W.L. During DRILLING NOT ENCOUNTERED 24 hrs. 4.5'
					2A	
	3				3	H-NU Reading @ 1420 = 0
			MOIST			
	4					
			STIFF Clay.			
	5					
	6					
			TOP OF ROCK @ 6.9		4	4 V AUGER REFUSAL @ 6.9
	7		BOTTOM OF HOLE @ 6.9			

Hole No. 10/15-12-90

DRILLING LOG	DIVISION NDR DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 2 SHEETS
1. PROJECT (SWMU #10/15) NWSC CRANE, ROCKEYE AREA		10. SIZE AND TYPE OF BIT 3" SHELBY TUBE	
2. LOCATION (Coordinates or Station) SEE MAP		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY USA CDE WES		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 10/15-12-90		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED ATL 4 / UNDISTURBED SPL 2
5. NAME OF DRILLER ELASTIC BROWN		14. TOTAL NUMBER CORE BOXES N/A	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED 10-12-90 / COMPLETED 10-12-90
7. THICKNESS OF OVERBURDEN N/A		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK N/A		18. TOTAL CORE RECOVERY FOR BORING N/A %	
9. TOTAL DEPTH OF HOLE 14.6'		19. SIGNATURE OF INSPECTOR Larry Benjamin	

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
			ML SANDY SILT, TAN		1	SAMPLED W/3" SHELBY TUBE PUSHED W/ KELLY EXTRUDED SOIL. SKINED Samples W/ StainLESS Steel KnIFES.
	1				1A	
					2	H-NU Reading @ 1010 = 0
	2					W.L. DURING DRILLING 5.0' 24 hrs. 4.0'
	3		CH FAT CLAY, BROWN TRACE OF 1/4" gravel.		3	H-NU Reading @ 1045 = 0
	4					
			greenish gray w/1/4" gravel.		4	4 ✓
	5					
			NO gravel			
	6					
	7		7.0' TO 7.5' 1/4" gravel ZONE.			
	8					
	9					

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE **Hole No.** 10/15-12-90

PROJECT (SWMU #10/15) NWSC CRANE; ROCKEYE AREA | INSTALLATION NWSC CRANE | SHEET 2 OF 2 SHEETS

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
	10		CH FAT CLAY, BROWN.			
	11					
	12					
	13					
	14				2A	
			BOTTOM OF HOLE @ 14.6'			
	15					

Hole No. 10/15-13-90

DRILLING LOG	DIVISION NOR DIV.	INSTALLATION NWSC CRANE	SHEET 1 OF 1 SHEETS

1. PROJECT NWSC CRANE; (SWMU #10/15) ROCKEYE AREA	10. SIZE AND TYPE OF BIT 3" SHELBY TUBE
2. LOCATION (Coordinates or Station) SEE MAP	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY USA COE WES	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500
4. HOLE NO. (As shown on drawing title and file number) 10/15-13-90	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED ATL 3; UNDISTURBED 1 SOIL
5. NAME OF DRILLER ELASTIC BROWN	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 10-13-90; COMPLETED 10-13-90
7. THICKNESS OF OVERBURDEN 5.5'	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A %
9. TOTAL DEPTH OF HOLE 5.5'	19. SIGNATURE OF INSPECTOR Larry Benjamin

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
			CL LEAN CLAY, TAN, Sandy.		1	SAMPLED W/3" SHELBY TUBE PUSHED W/KELLY EXTRUDED SOIL. skined Samples w/stainless steel knifes.
	1		CH FAT CLAY, Brown		2	H-NU Reading @ 1005 = 0 W.L. DURING DRILLING 3.5' 24 hrs. 1.0'
	2					
			T/ purple shale fragments.		1A	
	3				3 (3 V)	H-NU Reading @ 1021 = 0
	4					
	5		TOP OF ROCK @ 5.5'			AUGER REFUSAL @ 5.5'
	6		BOTTOM OF HOLE @ 5.5' Possibly SHALE.			W/ SCRAPING Sound.

Appendix C
Soil Data

To: U.S. Army Corps of Engineers
Wilmington District
Attn. CESAW-EN-GG (Mr. Bob Magee)
P.O. Box 1890
Wilmington,NC 28402-1890

Subject: Performance of Soils Tests on Samples from Crane

1. Inclosed are 42 test report sheets for 21 samples from site Rockeye Mun. Fac., NWSC, Crane, IN. on which particle size distribution, and organic content are presented. The assigned tests on sample 2, boring 10/15-11-90 was not performed. The jar labeled for this sample was empty..

Jessie Oldham

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-1-90 SAMPLE: 1 DF: MD2991 .DAT
DEPTH: 1.0 - 1.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 5.20 OC: .60
CLASSIFICATION: 108
SANDY CLAYEY GRAVEL (GC), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 357.6 gms.
PARTIAL WEIGHT AFTER SPLIT: 54.5 gms.
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

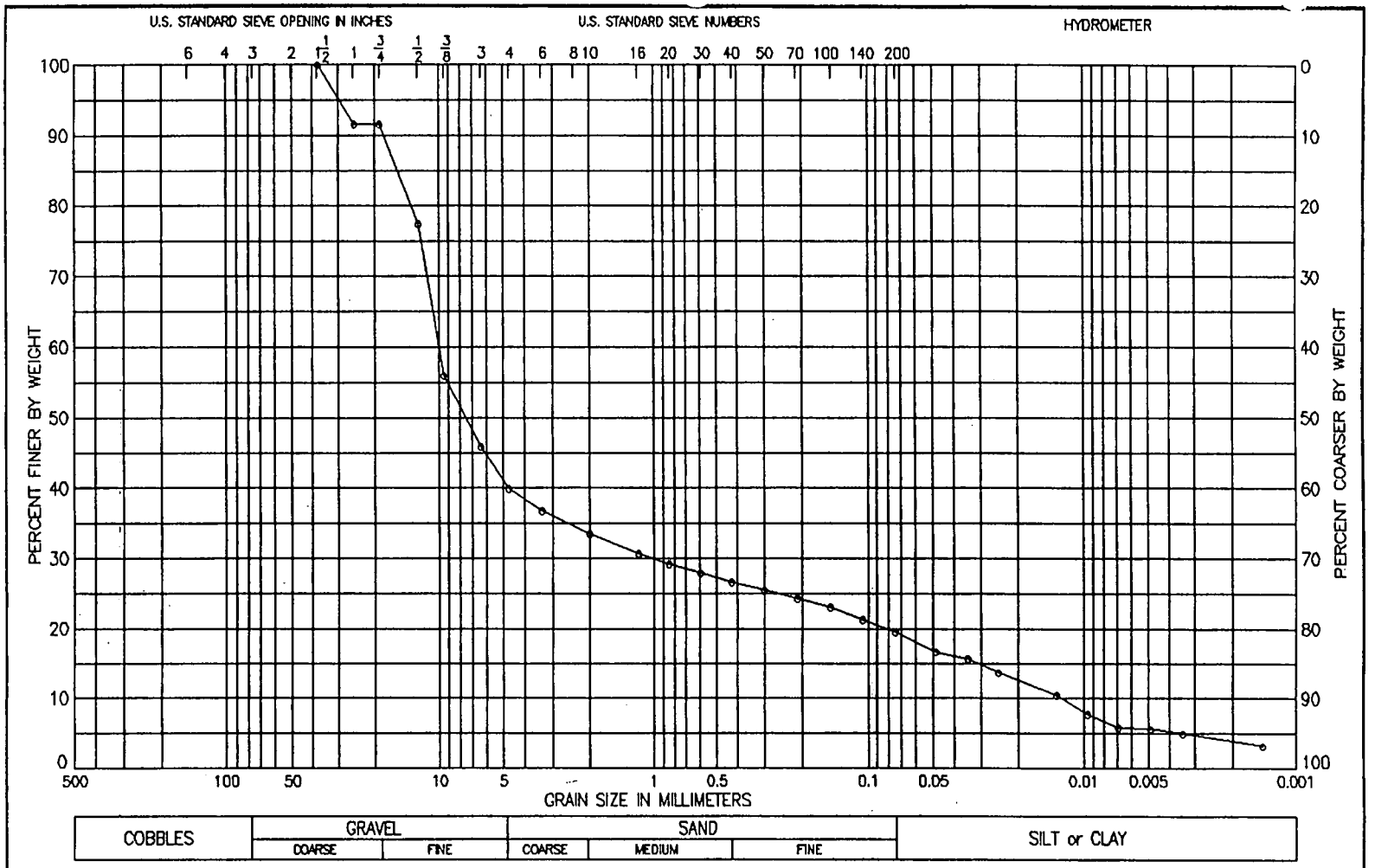
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1.5 in	37.500	100.0	.0
29.9	1 in	25.000	91.6	8.4
.0	3/4 in	19.100	91.6	8.4
51.0	1/2 in	12.500	77.4	22.6
76.3	3/8 in	9.500	56.0	44.0
36.4	No 3	6.350	45.9	54.1
21.2	No 4	4.750	39.9	60.1
11.2	No 6	3.350	36.8	63.2
11.7	No 10	2.000	33.5	66.5
4.6	No 16	1.180	30.7	69.3
7.0	No 20	.850	29.2	70.8
9.1	No 30	.600	27.9	72.1
11.2	No 40	.425	26.6	73.4
13.1	No 50	.300	25.5	74.5
15.0	No 70	.212	24.3	75.7
17.0	No 100	.150	23.1	76.9
19.9	No 140	.106	21.3	78.7
22.7	No 200	.075	19.6	80.4

HYDROMETER:

RDGS	TEMP			
17.1	22.0	.0487	16.6	83.4
16.1	22.0	.0348	15.6	84.4
14.1	22.0	.0251	13.7	86.3
10.8	22.0	.0133	10.5	89.5
8.0	22.0	.0097	7.7	92.3
6.1	22.0	.0069	5.9	94.1
5.8	22.5	.0049	5.7	94.3
5.0	23.0	.0035	5.0	95.0
3.3	22.5	.0014	3.2	96.8

PERCENT GRAVEL = 60.1
PERCENT SAND = 20.4
PERCENT FINES = 19.6

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 5.2	ORG,% .6

CLASSIFICATION
SANDY CLAYEY GRAVEL (GC), BROWN VISUAL

INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-1-90 SAMPLE NO. 1

DEPTH/ELEV 1.0 – 1.5 DATE 02 APR 91

GRADATION CURVE | LABORATORY USAE WES – STF/GL

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-1-90 SAMPLE: 2 DF: MD2991 .DAT
DEPTH: 3.0 - 3.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 15.50 OC: 1.90
CLASSIFICATION: 126
SANDY CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 378.5 gms.
PARTIAL WEIGHT AFTER SPLIT: 58.5 gms.

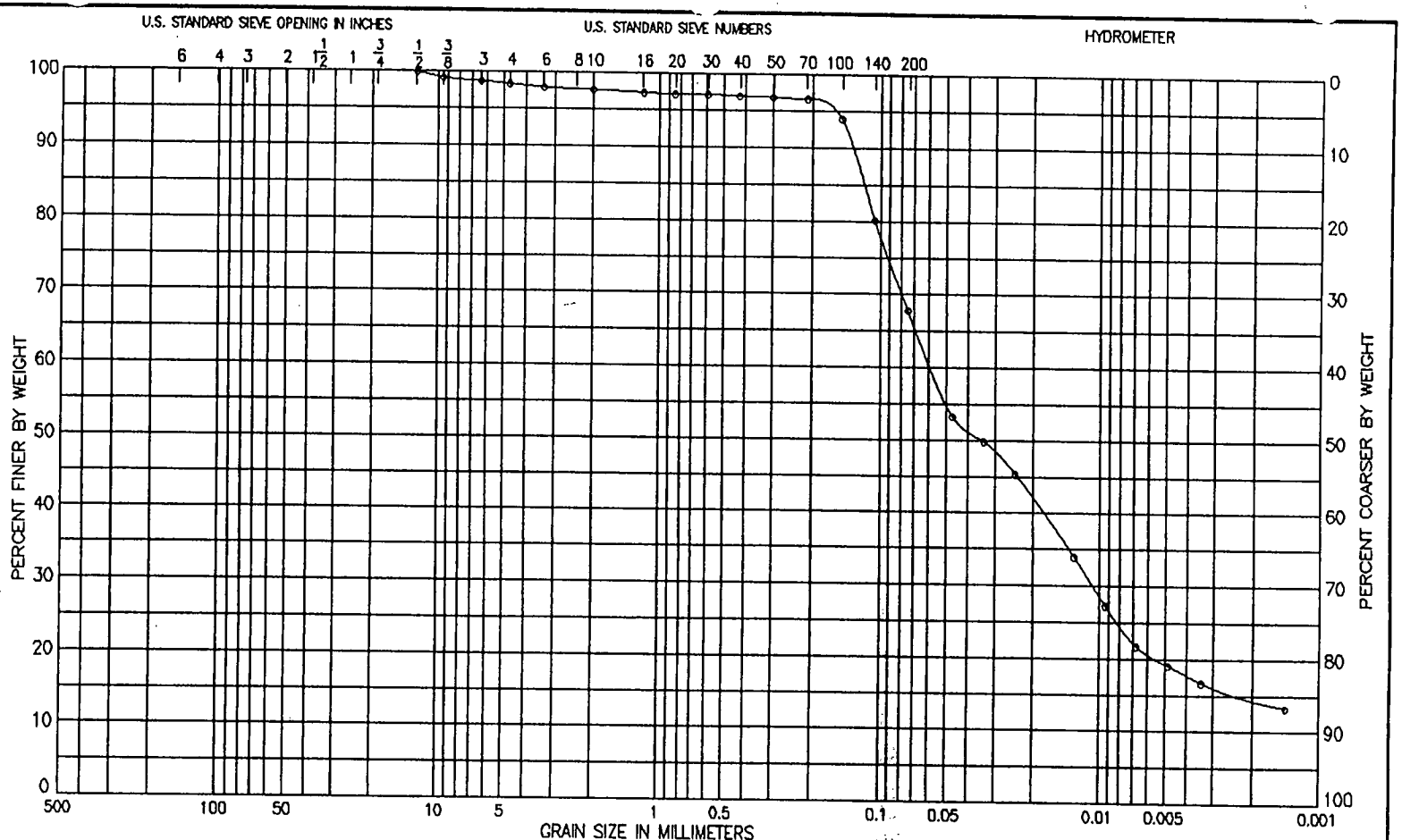
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1/2 in	12.500	100.0	.0
3.0	3/8 in	9.500	99.2	.8
1.7	No 3	6.350	98.8	1.2
1.3	No 4	4.750	98.4	1.6
1.7	No 6	3.350	98.0	2.0
1.0	No 10	2.000	97.7	2.3
.2	No 16	1.180	97.4	2.6
.3	No 20	.850	97.2	2.8
.3	No 30	.600	97.2	2.8
.4	No 40	.425	97.0	3.0
.5	No 50	.300	96.9	3.1
.6	No 70	.212	96.7	3.3
2.2	No 100	.150	94.0	6.0
10.5	No 140	.106	80.2	19.8
17.9	No 200	.075	67.8	32.2

HYDROMETER:

RDGS	TEMP			
20.2	22.0	.0472	53.3	46.7
18.9	22.0	.0338	49.9	50.1
17.2	22.0	.0243	45.4	54.6
12.9	22.0	.0131	34.0	66.0
10.4	22.0	.0095	27.3	72.7
8.3	22.0	.0068	21.8	78.2
7.2	22.5	.0049	19.1	80.9
6.2	23.0	.0034	16.7	83.3
5.0	22.5	.0014	13.3	86.7

PERCENT GRAVEL = 1.6
PERCENT SAND = 30.6
PERCENT FINES = 67.8

EDE



COBBLES	GRAVEL		SAND			SILT or CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS 2.70 EST	NAT W,% 15.5	ORG,% 1.9

CLASSIFICATION
SANDY CLAY (CL), BROWN VISUAL

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-1-90 SAMPLE NO. 2

DEPTH/ELEV 3.0 – 3.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-02-90 SAMPLE: 1A DF: MD2991 .DAT
DEPTH: 1.0 - 1.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 15.90 OC: 2.80
CLASSIFICATION: 144
SANDY CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 332.0 gms.
PARTIAL WEIGHT AFTER SPLIT: 54.0 gms.
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

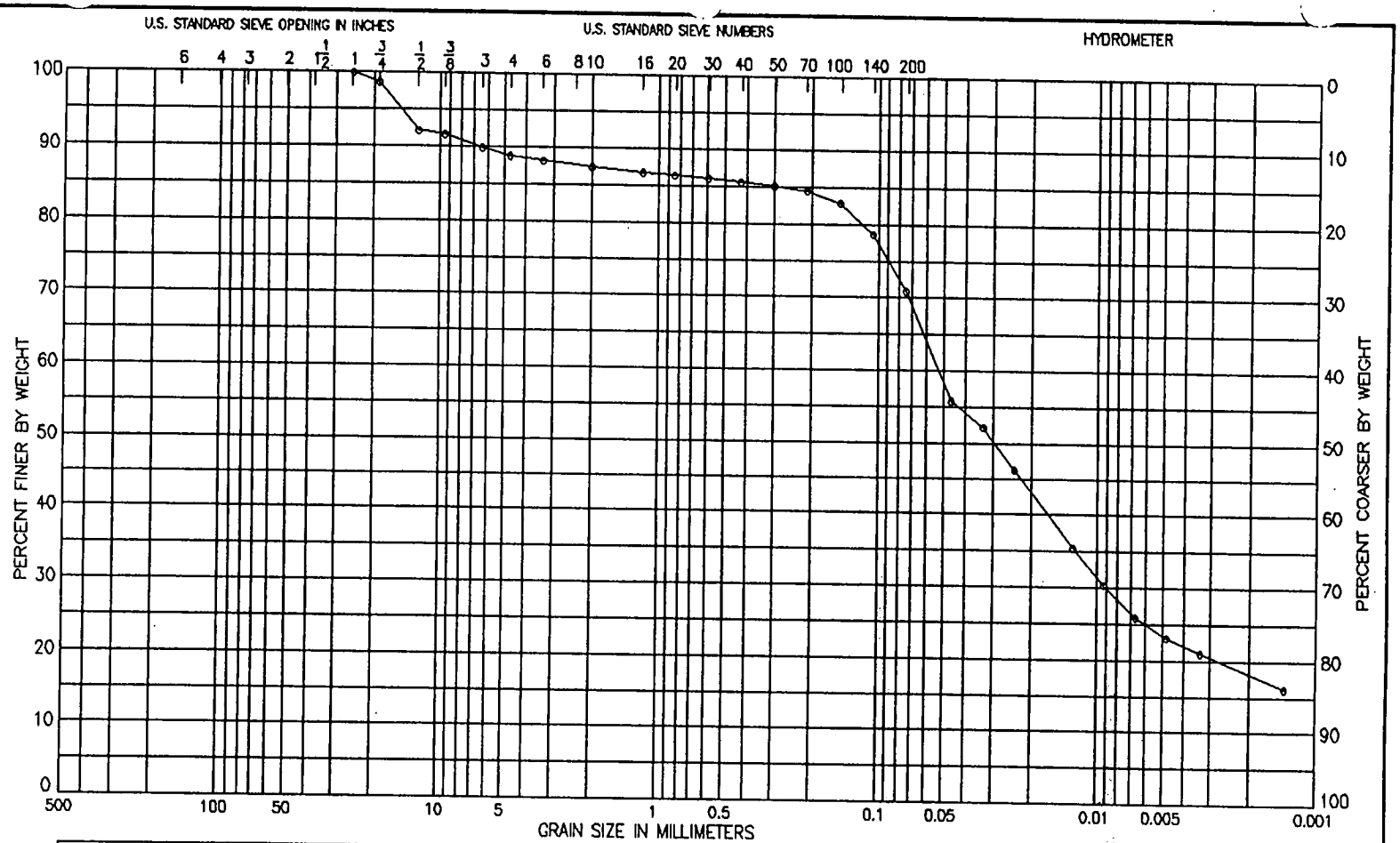
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1 in	25.000	100.0	.0
4.3	3/4 in	19.100	98.7	1.3
21.8	1/2 in	12.500	92.1	7.9
1.6	3/8 in	9.500	91.7	8.3
5.9	No 3	6.350	89.9	10.1
3.5	No 4	4.750	88.8	11.2
2.1	No 6	3.350	88.2	11.8
2.6	No 10	2.000	87.4	12.6
.4	No 16	1.180	86.8	13.2
.6	No 20	.850	86.4	13.6
.8	No 30	.600	86.1	13.9
1.1	No 40	.425	85.6	14.4
1.4	No 50	.300	85.1	14.9
1.8	No 70	.212	84.5	15.5
2.8	No 100	.150	82.9	17.1
5.4	No 140	.106	78.7	21.3
10.2	No 200	.075	70.9	29.1

HYDROMETER:

RDGS	TEMP			
21.8	22.0	.0464	55.8	44.2
20.4	22.0	.0333	52.2	47.8
18.1	22.0	.0241	46.3	53.7
13.9	22.0	.0130	35.5	64.5
11.9	22.0	.0093	30.3	69.7
10.2	22.0	.0067	26.0	74.0
9.0	22.5	.0048	23.1	76.9
8.1	23.0	.0034	21.1	78.9
6.2	23.0	.0014	16.2	83.8

PERCENT GRAVEL = 11.2
PERCENT SAND = 17.9
PERCENT FINES = 70.9

EDE



COBBLES	GRAVEL		SAND			SILT or CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W,%	ORG,%
			2.70 EST	15.9	2.8

CLASSIFICATION
SANDY CLAY (CL), BROWN VISUAL

INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE	LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-02-90 SAMPLE NO. 1A

DEPTH/ELEV 1.0 – 1.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-3-90 SAMPLE: 1 DF: MD2991 .DAT
DEPTH: 1.0 - 1.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 14.60 OC: 4.80
CLASSIFICATION: 162
SANDY GRAVELLY CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 269.6 gms.
PARTIAL WEIGHT AFTER SPLIT: 51.6 gms.
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

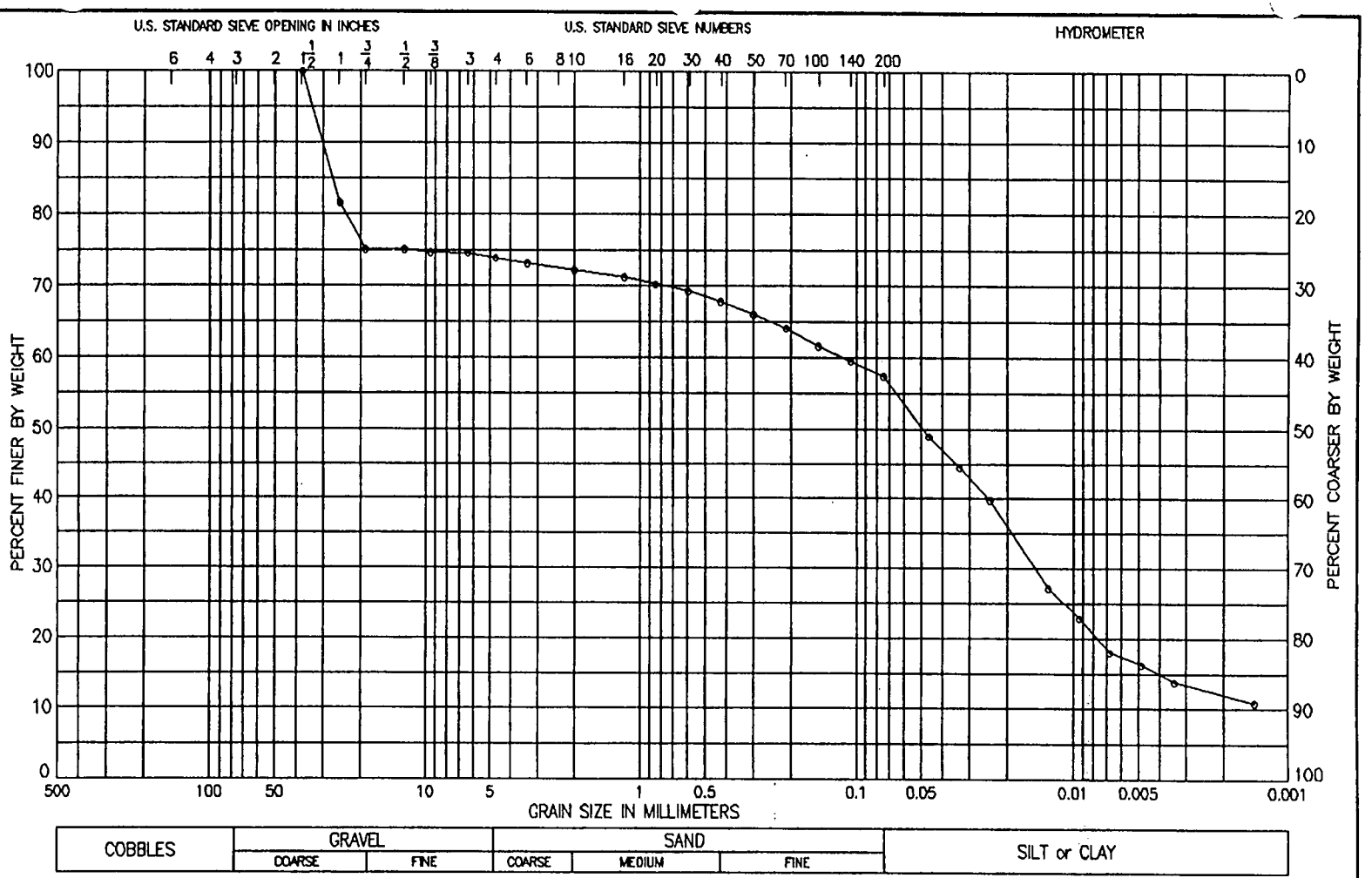
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1.5 in	37.500	100.0	.0
49.6	1 in	25.000	81.6	18.4
17.5	3/4 in	19.100	75.1	24.9
.0	1/2 in	12.500	75.1	24.9
1.1	3/8 in	9.500	74.7	25.3
.3	No 3	6.350	74.6	25.4
1.8	No 4	4.750	73.9	26.1
1.9	No 6	3.350	73.2	26.8
2.6	No 10	2.000	72.3	27.7
.7	No 16	1.180	71.3	28.7
1.4	No 20	.850	70.3	29.7
2.1	No 30	.600	69.3	30.7
3.1	No 40	.425	67.9	32.1
4.4	No 50	.300	66.1	33.9
5.8	No 70	.212	64.1	35.9
7.6	No 100	.150	61.6	38.4
9.1	No 140	.106	59.5	40.5
10.6	No 200	.075	57.4	42.6

HYDROMETER:

RDGS	TEMP			
22.1	22.0	.0463	48.9	51.1
20.1	22.0	.0334	44.5	55.5
18.0	22.0	.0242	39.8	60.2
12.3	22.0	.0132	27.1	72.9
10.4	22.0	.0095	22.9	77.1
8.2	22.0	.0068	18.0	82.0
7.3	22.5	.0049	16.2	83.8
6.1	23.0	.0034	13.8	86.2
4.9	22.5	.0014	10.9	89.1

PERCENT GRAVEL = 26.1
PERCENT SAND = 16.5
PERCENT FINES = 57.4

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 14.6	ORG,% 4.8

CLASSIFICATION
SANDY GRAVELLY CLAY (CL), BROWN VISUAL

INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-3-90 SAMPLE NO. 1

DEPTH/ELEV 1.0 – 1.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-3-90 SAMPLE: 2 DF: MD2991 .DAT
DEPTH: 3.0 - 3.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 17.60 OC: 1.80
CLASSIFICATION: 180
GRAVELLY SANDY CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 330.9 gms.
PARTIAL WEIGHT AFTER SPLIT: 58.2 gms.

WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	3/8 in	9.500	100.0	.0
.5	No 3	6.350	99.8	.2
.2	No 4	4.750	99.8	.2
1.2	No 6	3.350	99.4	.6
2.6	No 10	2.000	98.6	1.4
.5	No 16	1.180	97.8	2.2
.9	No 20	.850	97.1	2.9
1.2	No 30	.600	96.6	3.4
1.4	No 40	.425	96.3	3.7
1.6	No 50	.300	95.9	4.1
2.2	No 70	.212	94.9	5.1
3.7	No 100	.150	92.4	7.6
5.5	No 140	.106	89.3	10.7
7.5	No 200	.075	85.9	14.1

HYDROMETER:

RDGS	TEMP			
26.3	22.0	.0441	70.5	29.5
23.0	22.0	.0324	61.6	38.4
20.0	22.0	.0237	53.6	46.4
12.4	22.0	.0132	33.1	66.9
10.0	22.0	.0095	26.6	73.4
7.6	22.0	.0069	20.2	79.8
6.2	22.5	.0049	16.7	83.3
5.2	23.0	.0035	14.3	85.7
4.2	22.5	.0014	11.3	88.7

PERCENT GRAVEL = .2
PERCENT SAND = 13.9
PERCENT FINES = 85.9

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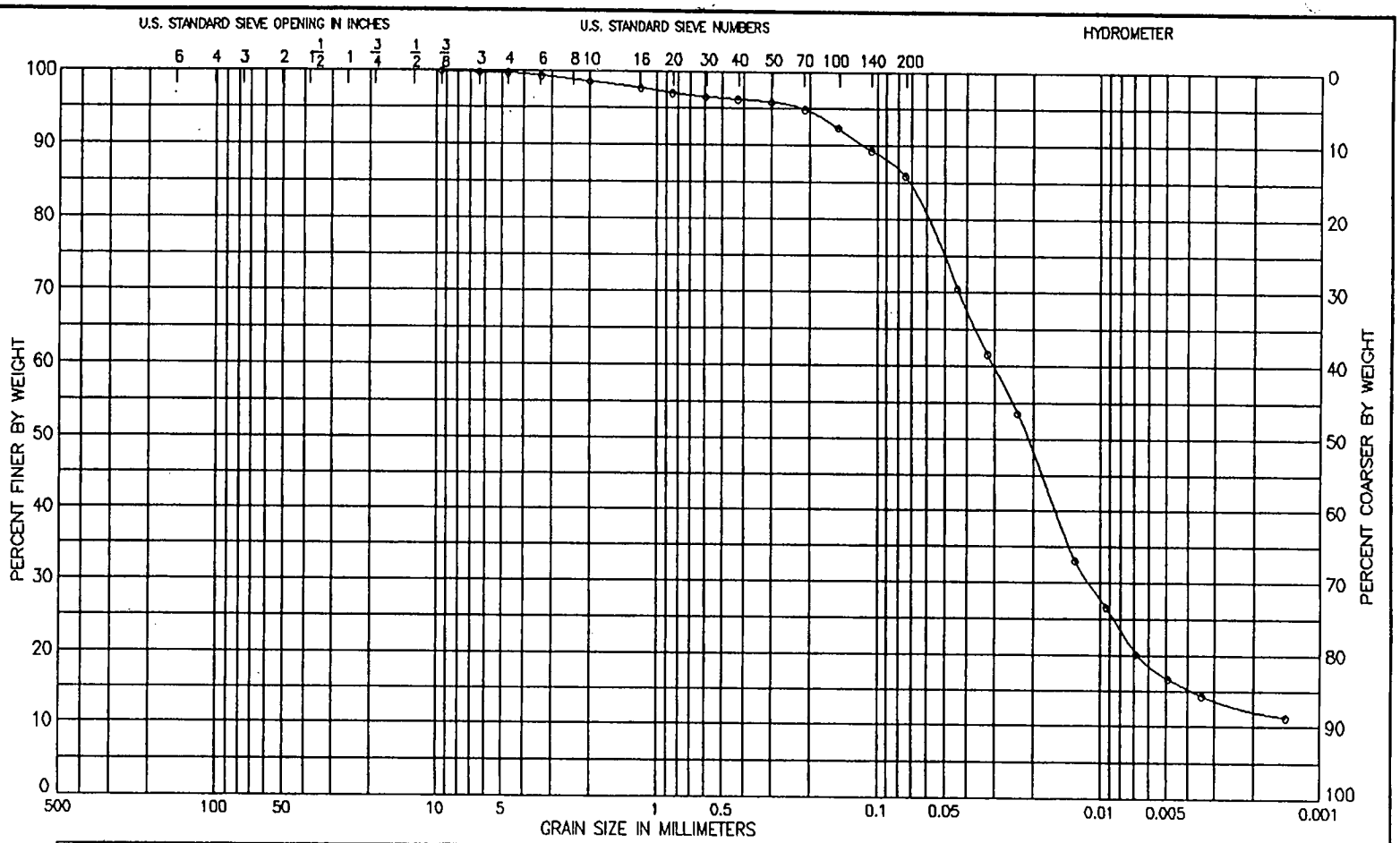


LL	PL	PI	GS 2.70 EST	NAT W,% 17.6	ORG,% 1.8

CLASSIFICATION
GRAVELLY SANDY CLAY (CL), BROWN VISUAL

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-3-90 SAMPLE NO. 2
DEPTH/ELEV 3.0 – 3.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-4-90 SAMPLE: 1 DF: MD2991 .DAT
DEPTH: 1.0 - 1.5 DATE: 02 APR 91

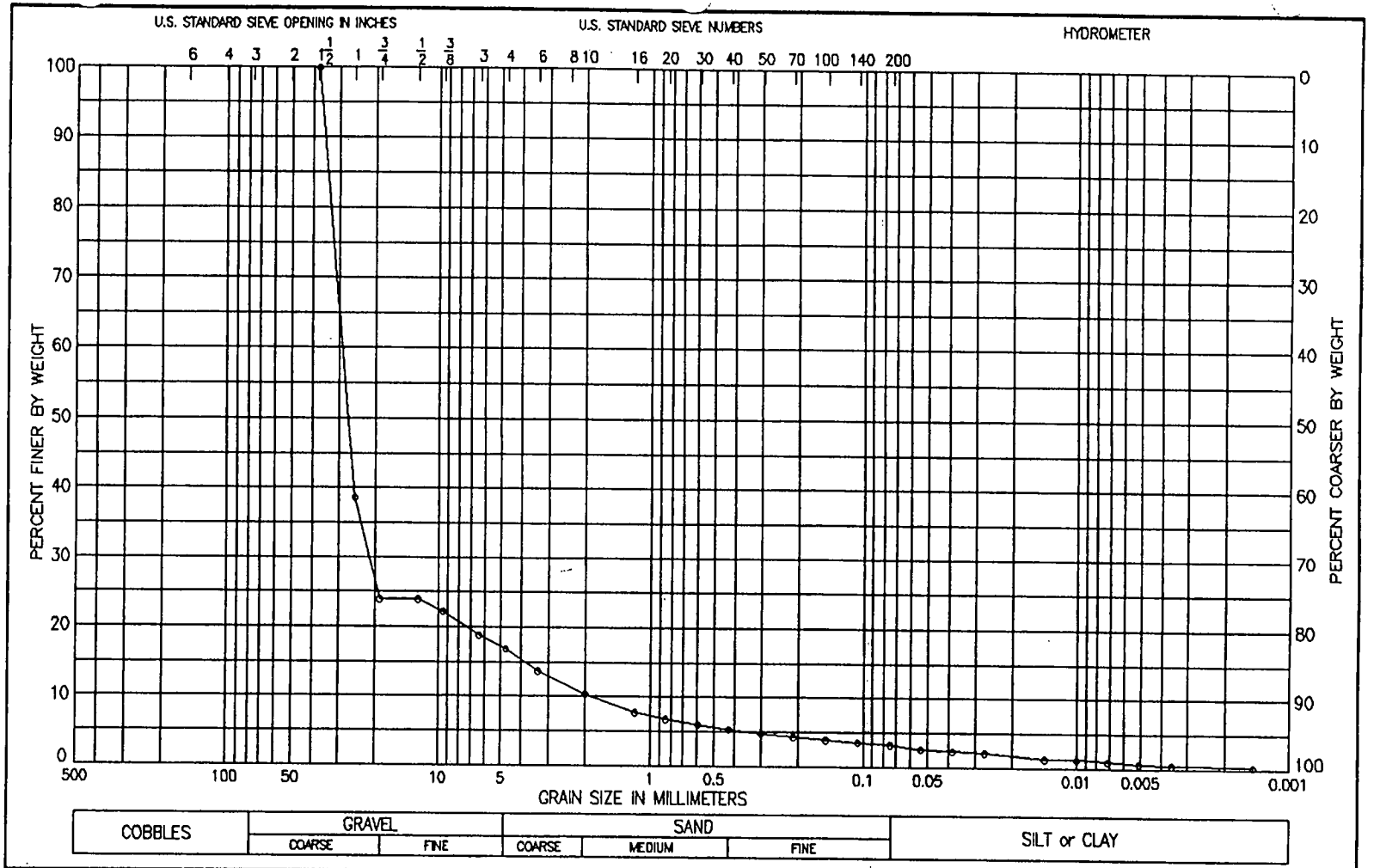
NO-LIMITS-RAN GS: 2.70 est WC: 3.70 OC: .80
CLASSIFICATION: 198
SANDY GRAVEL (GP), GRAY

TOTAL WEIGHT OF SAMPLE: 408.2 gms.
PARTIAL WEIGHT AFTER SPLIT: 33.7 gms.
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1.5 in	37.500	100.0	.0
250.6	1 in	25.000	38.6	61.4
60.0	3/4 in	19.100	23.9	76.1
.0	1/2 in	12.500	23.9	76.1
7.0	3/8 in	9.500	22.2	77.8
13.7	No 3	6.350	18.8	81.2
8.0	No 4	4.750	16.9	83.1
13.0	No 6	3.350	13.7	86.3
13.6	No 10	2.000	10.4	89.6
8.6	No 16	1.180	7.7	92.3
11.7	No 20	.850	6.8	93.2
14.1	No 30	.600	6.0	94.0
16.3	No 40	.425	5.4	94.6
18.1	No 50	.300	4.8	95.2
19.6	No 70	.212	4.3	95.7
20.9	No 100	.150	3.9	96.1
22.0	No 140	.106	3.6	96.4
23.0	No 200	.075	3.3	96.7
HYDROMETER:				
RDGS	TEMP			
5.5	22.0	.0540	2.6	97.4
5.0	22.0	.0384	2.4	97.6
4.6	22.0	.0272	2.2	97.8
2.9	22.0	.0142	1.4	98.6
2.8	22.0	.0101	1.3	98.7
2.2	22.0	.0072	1.0	99.0
1.5	22.5	.0051	.7	99.3
1.1	23.0	.0036	.6	99.4
.7	22.5	.0015	.3	99.7

PERCENT GRAVEL = 83.1
PERCENT SAND = 13.6
PERCENT FINES = 3.3

D60 = 29.36
D30 = 21.54
D10 = 1.89
CU = 15.55
CC = 8.38



LL	PL	PI	GS 2.70 EST	NAT W,% 3.7	ORG,% .8

CLASSIFICATION

SANDY GRAVEL (GP), GRAY

INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC

CRANE, IN

BORING NO. 10/15-4-90 SAMPLE NO. 1

DEPTH/ELEV 1.0 – 1.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-4-90 SAMPLE: 2 DF: MD2991 .DAT
DEPTH: 3.0 - 3.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 20.30 OC: 1.80
CLASSIFICATION: 216
CLAY (CL), BROWN; TRACE OF SAND VISUAL

TOTAL WEIGHT OF SAMPLE: 315.6 gms.
PARTIAL WEIGHT AFTER SPLIT: 54.4 gms.

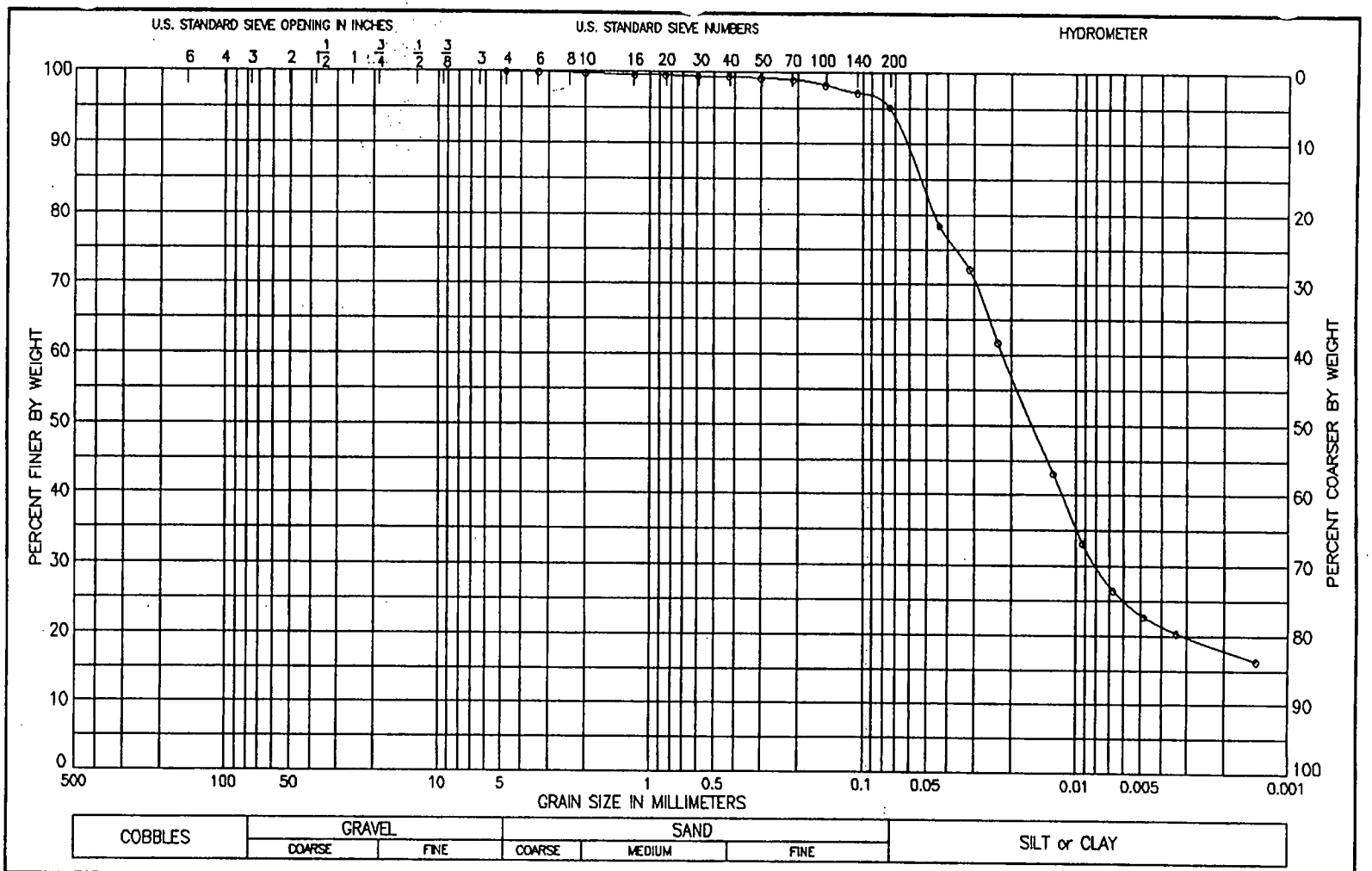
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	No 4	4.750	100.0	.0
.2	No 6	3.350	99.9	.1
.4	No 10	2.000	99.8	.2
.1	No 16	1.180	99.6	.4
.1	No 20	.850	99.6	.4
.2	No 30	.600	99.4	.6
.2	No 40	.425	99.4	.6
.3	No 50	.300	99.3	.7
.4	No 70	.212	99.1	.9
.8	No 100	.150	98.3	1.7
1.4	No 140	.106	97.2	2.8
2.5	No 200	.075	95.2	4.8

HYDROMETER:

RDGS	TEMP			
27.0	22.0	.0437	78.4	21.6
24.9	22.0	.0317	72.3	27.7
21.3	22.0	.0233	61.8	38.2
14.9	22.0	.0129	43.1	56.9
11.5	22.0	.0094	33.2	66.8
9.2	22.0	.0068	26.5	73.5
7.8	22.5	.0048	22.7	77.3
6.9	23.0	.0034	20.4	79.6
5.6	22.5	.0014	16.3	83.7

PERCENT GRAVEL = .0
PERCENT SAND = 4.8
PERCENT FINES = 95.2

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 20.3	ORG,% 1.8

CLASSIFICATION
CLAY (CL), BROWN; TRACE OF SAND VISUAL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-4-90 SAMPLE NO. 2
DEPTH/ELEV 3.0 – 3.5 DATE 02 APR 91

GRADATION CURVE | LABORATORY USAE WES – STF/GL

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-5-90 SAMPLE: 1 DF: MD2991 .DAT
DEPTH: 1.0 - 1.5 DATE: 02 APR 91

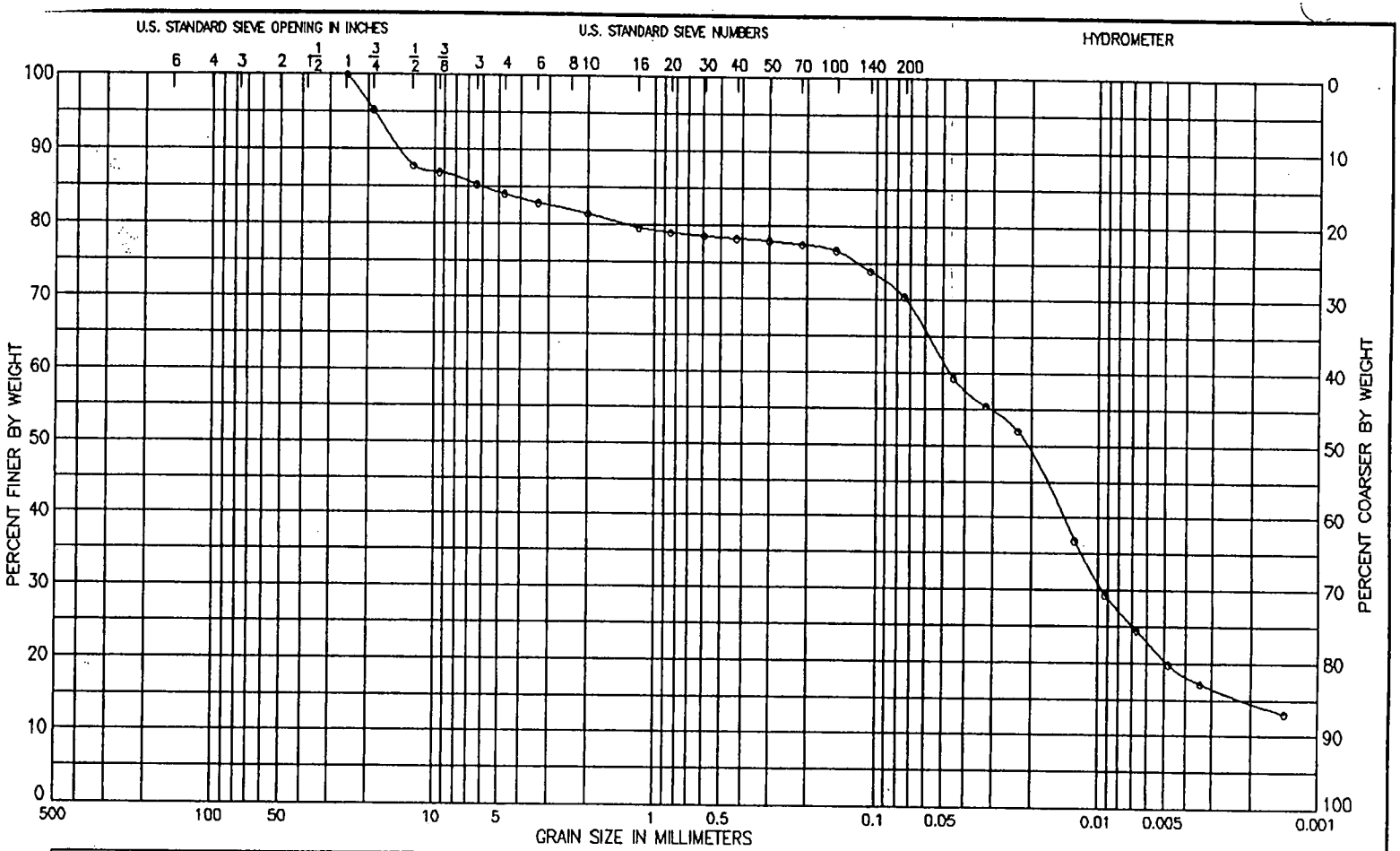
NO-LIMITS-RAN GS: 2.70 est WC: 10.30 OC: 1.70
CLASSIFICATION: 234
SANDY GRAVELLY CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 462.3 gms.
PARTIAL WEIGHT AFTER SPLIT: 53.4 gms.
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1 in	25.000	100.0	.0
21.7	3/4 in	19.100	95.3	4.7
34.7	1/2 in	12.500	87.8	12.2
4.1	3/8 in	9.500	86.9	13.1
7.6	No 3	6.350	85.3	14.7
5.8	No 4	4.750	84.0	16.0
5.4	No 6	3.350	82.8	17.2
6.6	No 10	2.000	81.4	18.6
1.2	No 16	1.180	79.6	20.4
1.6	No 20	.850	79.0	21.0
1.9	No 30	.600	78.5	21.5
2.1	No 40	.425	78.2	21.8
2.3	No 50	.300	77.9	22.1
2.6	No 70	.212	77.5	22.5
3.1	No 100	.150	76.7	23.3
4.9	No 140	.106	73.9	26.1
7.2	No 200	.075	70.4	29.6
HYDROMETER:				
RDGS	TEMP			
24.6	22.0	.0450	59.3	40.7
23.0	22.0	.0324	55.5	44.5
21.6	22.0	.0233	52.1	47.9
15.3	22.0	.0128	36.8	63.2
12.2	22.0	.0093	29.3	70.7
10.2	22.0	.0067	24.5	75.5
8.2	22.5	.0048	19.9	80.1
7.1	22.5	.0034	17.2	82.8
5.4	22.5	.0014	13.1	86.9

PERCENT GRAVEL = 16.0
PERCENT SAND = 13.6
PERCENT FINES = 70.4

EDE



COBBLES	GRAVEL		SAND			SILT or CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS 2.70 EST	NAT W,% 10.3	ORG,% 1.7

CLASSIFICATION
SANDY GRAVELLY CLAY (CL), BROWN VISUAL

INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-5-90 SAMPLE NO. 1

DEPTH/ELEV 1.0 – 1.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-5-90 SAMPLE: 2 DF: MD2991 .DAT
DEPTH: 3.0 - 3.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 21.80 OC: 3.60
CLASSIFICATION: 252
SANDY GRAVELLY CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 340.7 gms.
PARTIAL WEIGHT AFTER SPLIT: 52.0 gms.
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

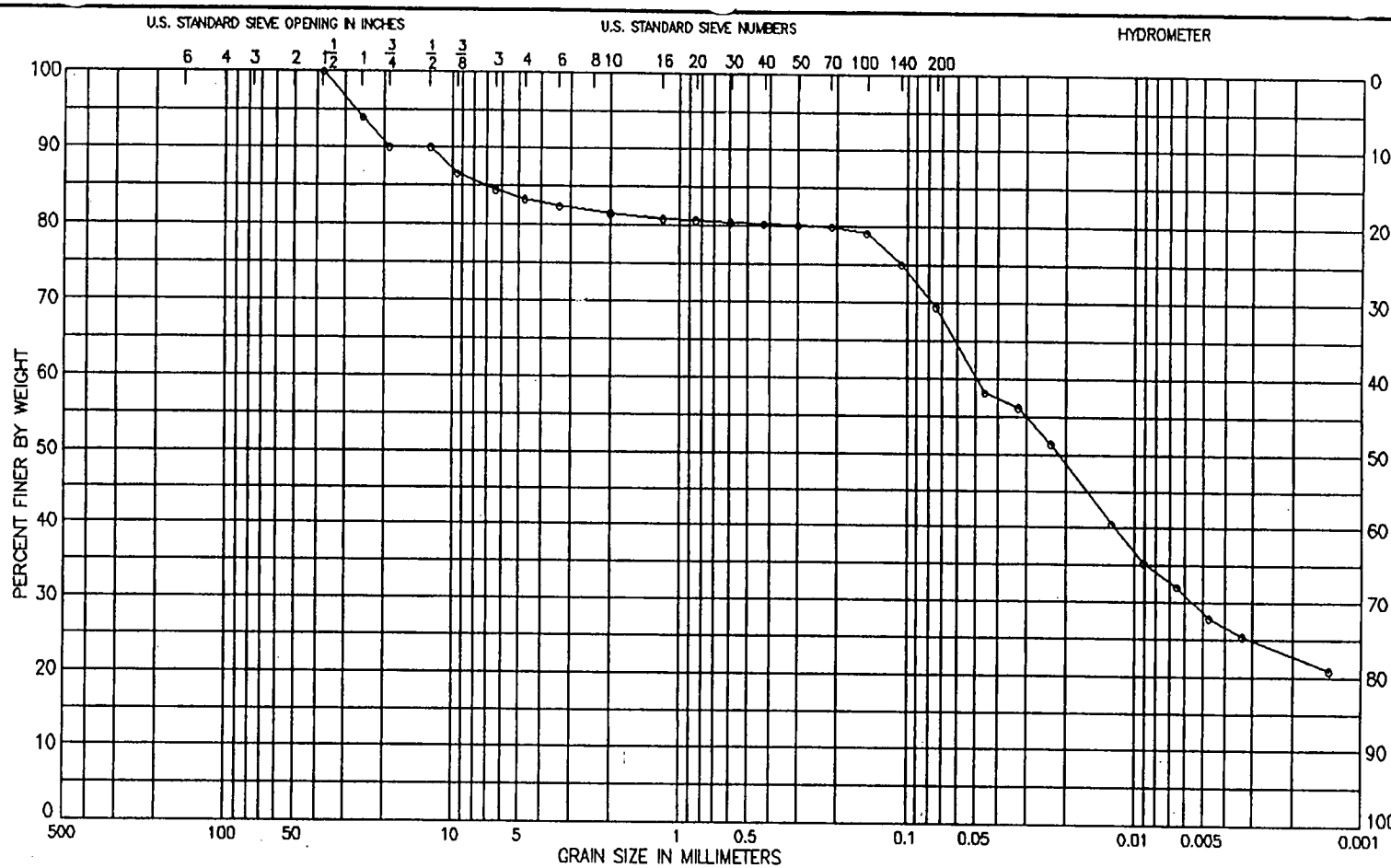
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1.5 in	37.500	100.0	.0
20.3	1 in	25.000	94.0	6.0
13.6	3/4 in	19.100	90.0	10.0
.0	1/2 in	12.500	90.0	10.0
11.8	3/8 in	9.500	86.6	13.4
7.3	No 3	6.350	84.4	15.6
4.0	No 4	4.750	83.3	16.7
3.1	No 6	3.350	82.4	17.6
3.1	No 10	2.000	81.4	18.6
.4	No 16	1.180	80.8	19.2
.5	No 20	.850	80.7	19.3
.7	No 30	.600	80.4	19.6
.8	No 40	.425	80.2	19.8
.9	No 50	.300	80.0	20.0
1.0	No 70	.212	79.9	20.1
1.5	No 100	.150	79.1	20.9
4.1	No 140	.106	75.0	25.0
7.6	No 200	.075	69.5	30.5

HYDROMETER:

RDGS	TEMP			
23.5	22.0	.0456	58.2	41.8
22.7	22.0	.0325	56.2	43.8
20.8	22.0	.0235	51.5	48.5
16.4	22.0	.0127	40.5	59.5
14.3	22.0	.0091	35.3	64.7
13.0	22.0	.0065	32.1	67.9
11.2	22.5	.0047	27.9	72.1
10.2	22.5	.0034	25.4	74.6
8.4	22.5	.0014	20.9	79.1

PERCENT GRAVEL = 16.7
PERCENT SAND = 13.7
PERCENT FINES = 69.5

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 21.8	ORG,% 3.6

CLASSIFICATION

SANDY GRAVELLY CLAY (CL), BROWN VISUAL

INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

PROJECT ROCKEYE MUN. FAC.,NWSC

CRANE, IN

BORING NO. 10/15-5-90 SAMPLE NO. 2

DEPTH/ELEV 3.0 – 3.5 DATE 02 APR 91

GRADATION CURVE | LABORATORY USAE WES – STF/GL

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-6-90 SAMPLE: 1 DF: MD2991 .DAT
DEPTH: 1.0 - 1.5 DATE: 02 APR 91

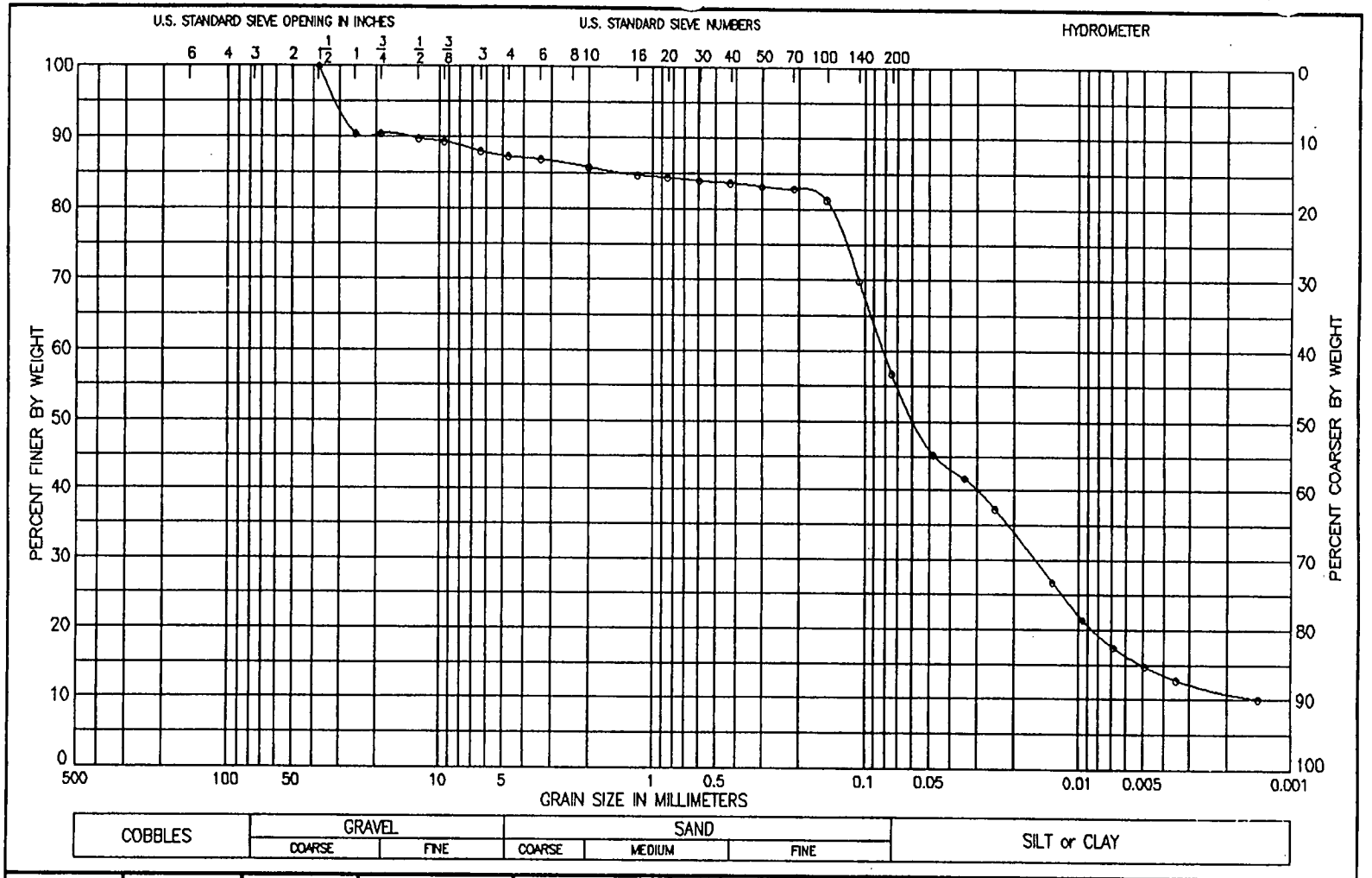
NO-LIMITS-RAN GS: 2.70 est WC: 16.20 OC: .80
CLASSIFICATION: 270
GRAVELLY SANDY CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 468.8 gms.
PARTIAL WEIGHT AFTER SPLIT: 55.5 gms.
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1.5 in	37.500	100.0	.0
44.9	1 in	25.000	90.4	9.6
.0	3/4 in	19.100	90.4	9.6
3.1	1/2 in	12.500	89.8	10.2
1.8	3/8 in	9.500	89.4	10.6
6.6	No 3	6.350	88.0	12.0
3.2	No 4	4.750	87.3	12.7
1.9	No 6	3.350	86.9	13.1
5.0	No 10	2.000	85.8	14.2
.7	No 16	1.180	84.7	15.3
.9	No 20	.850	84.4	15.6
1.2	No 30	.600	84.0	16.0
1.4	No 40	.425	83.7	16.3
1.7	No 50	.300	83.2	16.8
1.9	No 70	.212	82.9	17.1
2.9	No 100	.150	81.3	18.7
10.3	No 140	.106	69.9	30.1
18.8	No 200	.075	56.7	43.3
HYDROMETER:				
RDGS	TEMP			
18.5	22.0	.0481	45.2	54.8
17.1	22.0	.0345	41.7	58.3
15.3	22.0	.0248	37.3	62.7
11.0	22.0	.0133	26.8	73.2
8.8	22.0	.0096	21.4	78.6
7.2	22.0	.0069	17.4	82.6
6.0	22.5	.0049	14.7	85.3
5.2	22.5	.0035	12.8	87.2
4.1	22.5	.0014	10.1	89.9

PERCENT GRAVEL = 12.7
PERCENT SAND = 30.5
PERCENT FINES = 56.7

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 16.2	ORG,% .8

CLASSIFICATION

GRAVELLY SANDY CLAY (CL), BROWN VISUAL

INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC

CRANE, IN

BORING NO. 10/15-6-90 SAMPLE NO. 1

DEPTH/ELEV 1.0 – 1.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-6A-90 SAMPLE: 1 DF: MD2991 .DAT
DEPTH: 1.0 - 1.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 16.60 OC: 2.70
CLASSIFICATION: 288
SANDY CLAY (CL), BROWN; WITH GRAVEL VISUAL

TOTAL WEIGHT OF SAMPLE: 404.3 gms.
PARTIAL WEIGHT AFTER SPLIT: 59.2 gms.

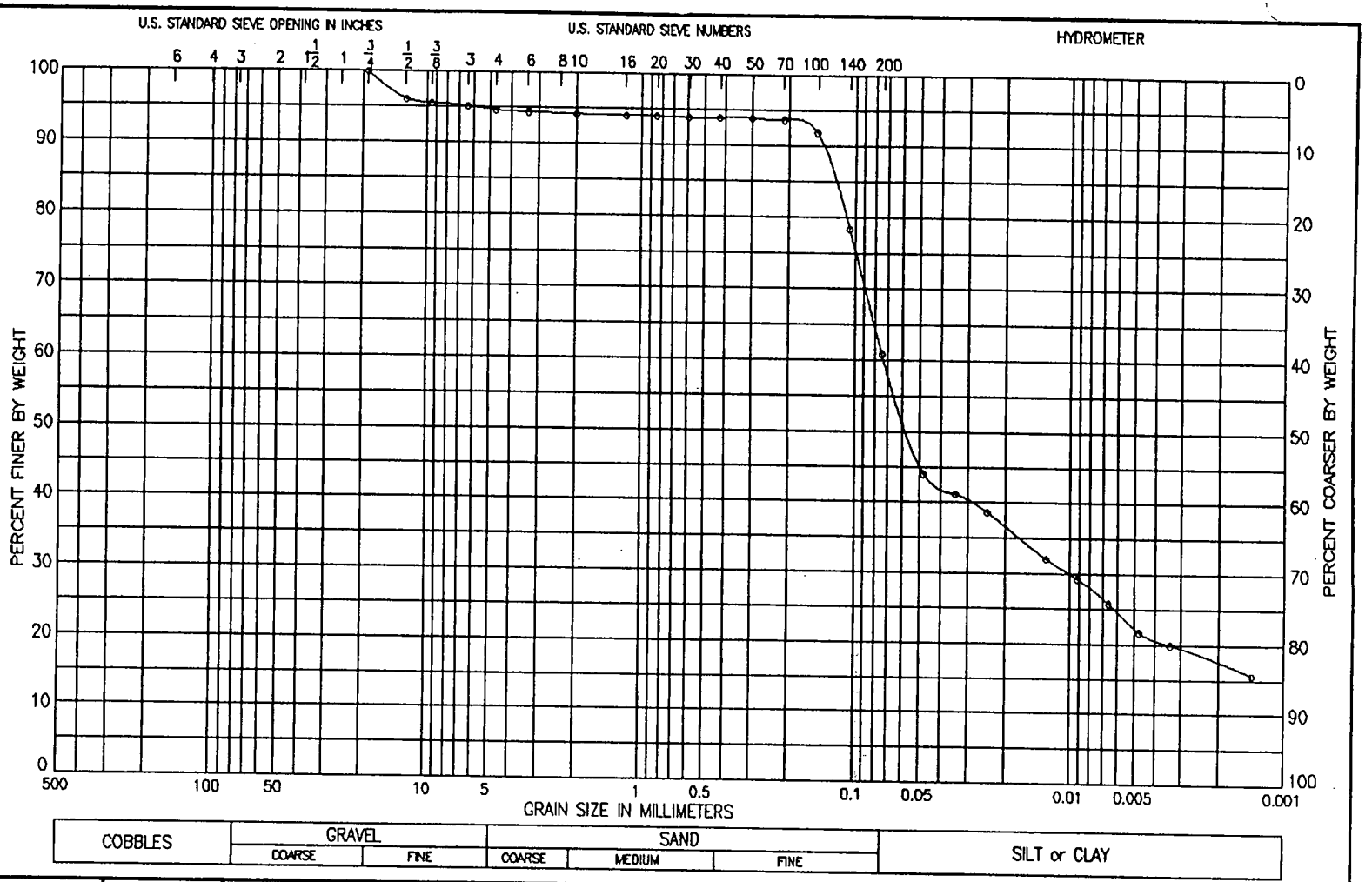
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	3/4 in	19.100	100.0	.0
15.8	1/2 in	12.500	96.1	3.9
2.2	3/8 in	9.500	95.5	4.5
1.7	No 3	6.350	95.1	4.9
2.0	No 4	4.750	94.6	5.4
1.0	No 6	3.350	94.4	5.6
.8	No 10	2.000	94.2	5.8
.1	No 16	1.180	94.0	6.0
.1	No 20	.850	94.0	6.0
.2	No 30	.600	93.9	6.1
.2	No 40	.425	93.9	6.1
.2	No 50	.300	93.9	6.1
.3	No 70	.212	93.7	6.3
1.4	No 100	.150	92.0	8.0
9.9	No 140	.106	78.4	21.6
20.9	No 200	.075	60.9	39.1

HYDROMETER:

RDGS	TEMP			
17.2	23.5	.0481	44.0	56.0
16.1	23.5	.0344	41.2	58.8
15.1	23.5	.0245	38.7	61.3
12.5	23.5	.0130	32.1	67.9
11.5	23.0	.0093	29.3	70.7
10.1	23.0	.0066	25.8	74.2
8.5	23.0	.0048	21.7	78.3
7.8	23.0	.0034	20.0	80.0
6.2	22.5	.0014	15.7	84.3

PERCENT GRAVEL = 5.4
PERCENT SAND = 33.7
PERCENT FINES = 60.9

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 16.6	ORG,% 2.7

CLASSIFICATION
SANDY CLAY (CL), BROWN; WITH GRAVEL VISUAL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-6A-90 SAMPLE NO. 1

DEPTH/ELEV 1.0 – 1.5 DATE 02 APR 91

GRADATION CURVE | LABORATORY USAE WES – STF/GL

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-08-90 SAMPLE: 1A DF: MD2991 .DAT
DEPTH: 1.0 - 1.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 17.60 OC: 2.20
CLASSIFICATION: 306
CLAY (CL), BROWN; WITH SAND VISUAL

TOTAL WEIGHT OF SAMPLE: 501.2 gms.
PARTIAL WEIGHT AFTER SPLIT: 51.1 gms.

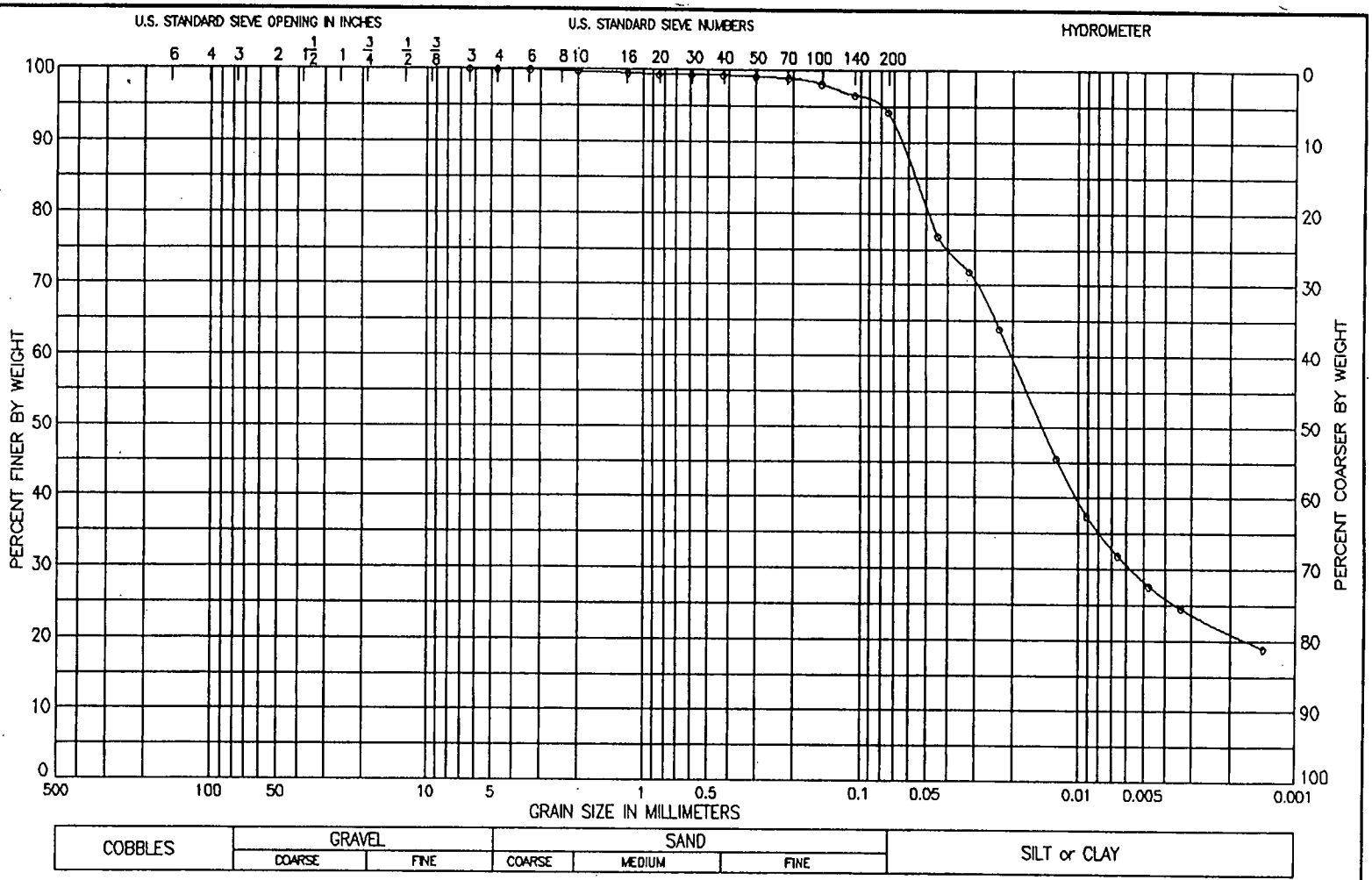
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	No 3	6.350	100.0	.0
.2	No 4	4.750	100.0	.0
.3	No 6	3.350	99.9	.1
.8	No 10	2.000	99.7	.3
.1	No 16	1.180	99.5	.5
.2	No 20	.850	99.4	.6
.2	No 30	.600	99.4	.6
.2	No 40	.425	99.4	.6
.3	No 50	.300	99.2	.8
.4	No 70	.212	99.0	1.0
.8	No 100	.150	98.2	1.8
1.6	No 140	.106	96.6	3.4
2.8	No 200	.075	94.3	5.7

HYDROMETER:

RDGS	TEMP			
24.6	23.5	.0444	76.9	23.1
23.0	23.5	.0320	71.9	28.1
20.4	23.5	.0233	63.9	36.1
14.5	23.5	.0127	45.6	54.4
12.0	23.0	.0092	37.5	62.5
10.2	23.0	.0066	31.9	68.1
8.8	23.0	.0047	27.6	72.4
7.8	23.0	.0034	24.5	75.5
6.2	22.0	.0014	18.9	81.1

PERCENT GRAVEL = .0
PERCENT SAND = 5.7
PERCENT FINES = 94.3

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 17.6	ORG,% 2.2

CLASSIFICATION
CLAY (CL), BROWN; WITH SAND VISUAL

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-08-90 SAMPLE NO. 1A

DEPTH/ELEV 1.0 – 1.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-08-90 SAMPLE: 2A DF: MD2991 .DAT
DEPTH: 3.0 - 3.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 20.40 OC: 2.50
CLASSIFICATION: 324
CLAY (CL), BROWN; TRACE OF SAND VISUAL

TOTAL WEIGHT OF SAMPLE: 496.1 gms.
PARTIAL WEIGHT AFTER SPLIT: 55.4 gms.

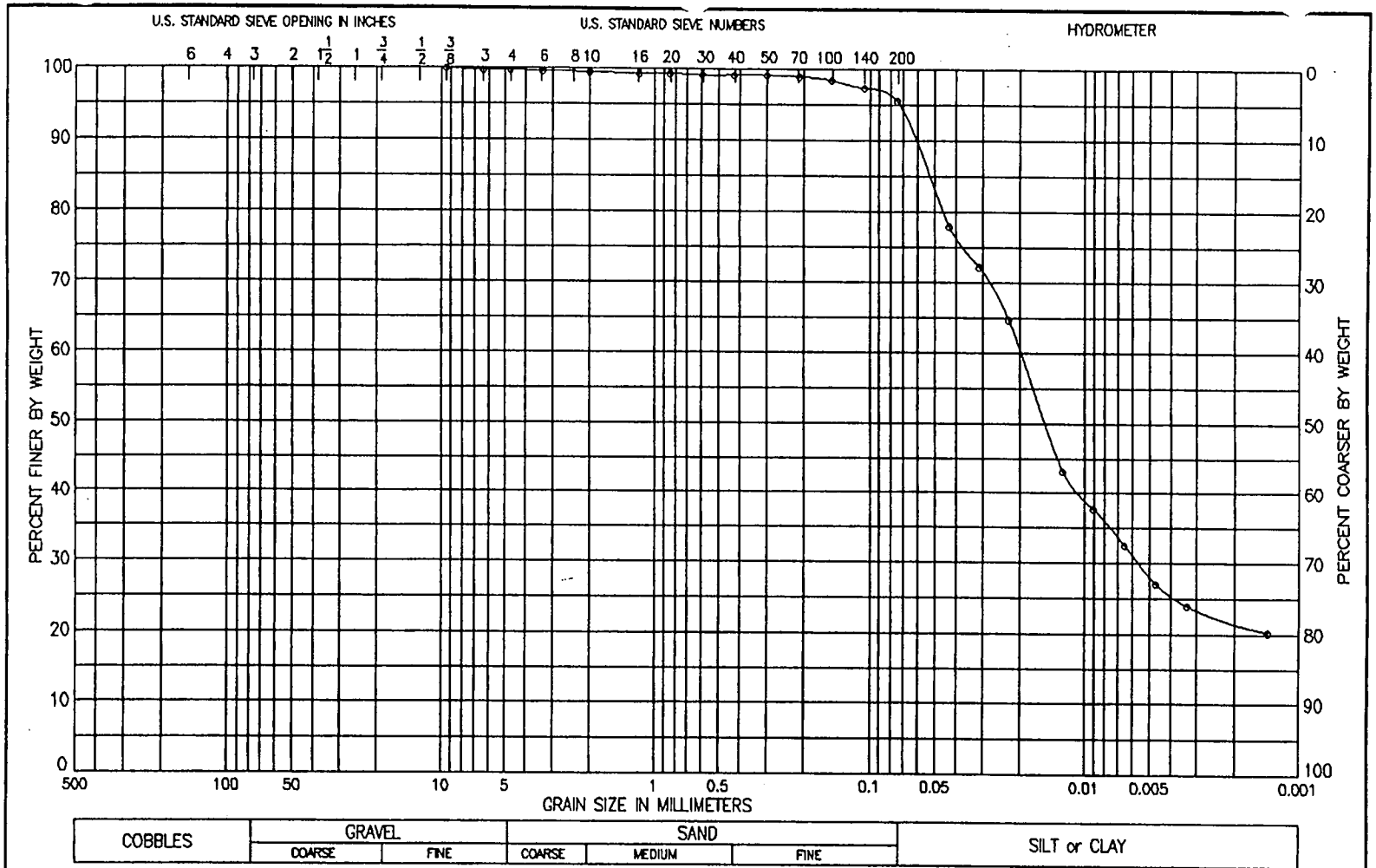
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	3/8 in	9.500	100.0	.0
1.2	No 3	6.350	99.8	.2
.0	No 4	4.750	99.8	.2
.5	No 6	3.350	99.7	.3
.5	No 10	2.000	99.6	.4
.1	No 16	1.180	99.4	.6
.1	No 20	.850	99.4	.6
.2	No 30	.600	99.2	.8
.2	No 40	.425	99.2	.8
.2	No 50	.300	99.2	.8
.3	No 70	.212	99.0	1.0
.6	No 100	.150	98.5	1.5
1.2	No 140	.106	97.4	2.6
2.2	No 200	.075	95.6	4.4

HYDROMETER:

RDGS	TEMP			
27.2	23.0	.0431	77.9	22.1
25.2	23.0	.0312	72.2	27.8
22.6	23.0	.0227	64.8	35.2
15.0	23.0	.0127	43.1	56.9
13.1	23.0	.0091	37.7	62.3
11.3	23.0	.0066	32.5	67.5
9.4	23.0	.0047	27.1	72.9
8.3	23.0	.0034	24.0	76.0
7.2	22.0	.0014	20.3	79.7

PERCENT GRAVEL = .2
PERCENT SAND = 4.2
PERCENT FINES = 95.6

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 20.4	ORG,% 2.5

CLASSIFICATION
CLAY (CL), BROWN; TRACE OF SAND VISUAL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-08-90 SAMPLE NO. 2A
DEPTH/ELEV 3.0 - 3.5 DATE 02 APR 91

GRADATION CURVE | LABORATORY USAE WES - STF/GL

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-09-90 SAMPLE: 1A DF: MD2991 .DAT
DEPTH: 0.5 - 1.0 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 15.80 OC: 2.20
CLASSIFICATION: 338
CLAY (CL), BROWN; WITH SAND VISUAL

TOTAL WEIGHT OF SAMPLE: 546.6 gms.
PARTIAL WEIGHT AFTER SPLIT: 56.4 gms.

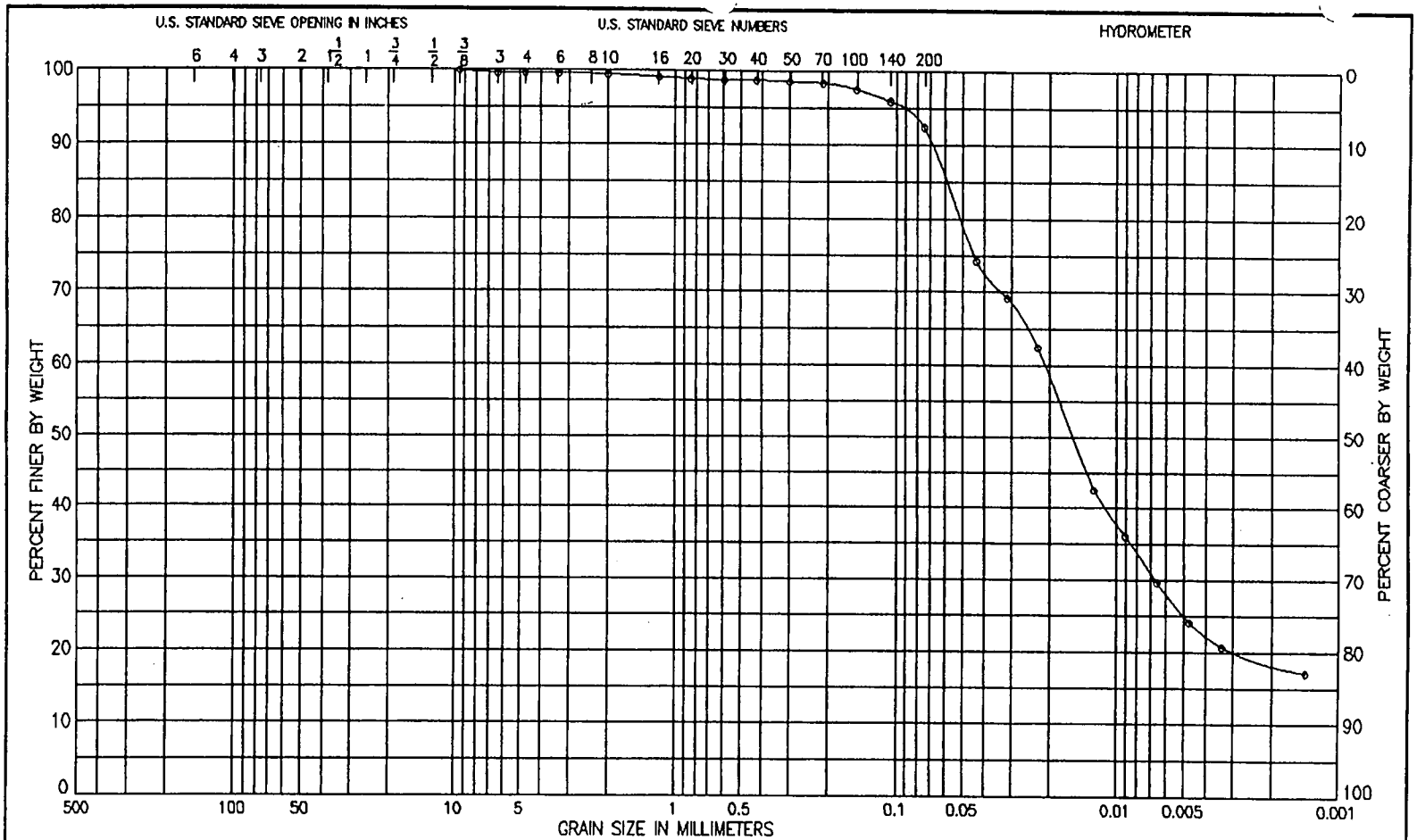
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	3/8 in	9.500	100.0	.0
1.8	No 3	6.350	99.7	.3
.0	No 4	4.750	99.7	.3
.1	No 6	3.350	99.7	.3
.7	No 10	2.000	99.5	.5
.2	No 16	1.180	99.2	.8
.3	No 20	.850	99.0	1.0
.4	No 30	.600	98.8	1.2
.4	No 40	.425	98.8	1.2
.5	No 50	.300	98.6	1.4
.6	No 70	.212	98.5	1.5
1.1	No 100	.150	97.6	2.4
2.0	No 140	.106	96.0	4.0
4.0	No 200	.075	92.5	7.5

HYDROMETER:

RDGS	TEMP			
26.3	23.5	.0436	74.3	25.7
24.5	23.5	.0315	69.2	30.8
22.1	23.5	.0229	62.5	37.5
15.0	23.5	.0127	42.6	57.4
12.8	23.0	.0092	36.2	63.8
10.5	23.0	.0066	29.7	70.3
8.5	23.0	.0048	24.1	75.9
7.3	23.0	.0034	20.7	79.3
6.2	22.0	.0014	17.1	82.9

PERCENT GRAVEL = .3
PERCENT SAND = 7.2
PERCENT FINES = 92.5

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 15.8	ORG,% 2.2

CLASSIFICATION
CLAY (CL), BROWN; WITH SAND VISUAL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-09-90 SAMPLE NO. 1A

DEPTH/ELEV 0.5 - 1.0 DATE 02 APR 91

GRADATION CURVE | LABORATORY USAE WES - STF/GL

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-09-90 SAMPLE: 2A DF: MD2991 .DAT
DEPTH: 3.0 - 3.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 21.60 OC: 2.40
CLASSIFICATION: 356
CLAY (CL), BROWN; TRACE OF SAND VISUAL

TOTAL WEIGHT OF SAMPLE: 565.7 gms.
PARTIAL WEIGHT AFTER SPLIT: 57.0 gms.

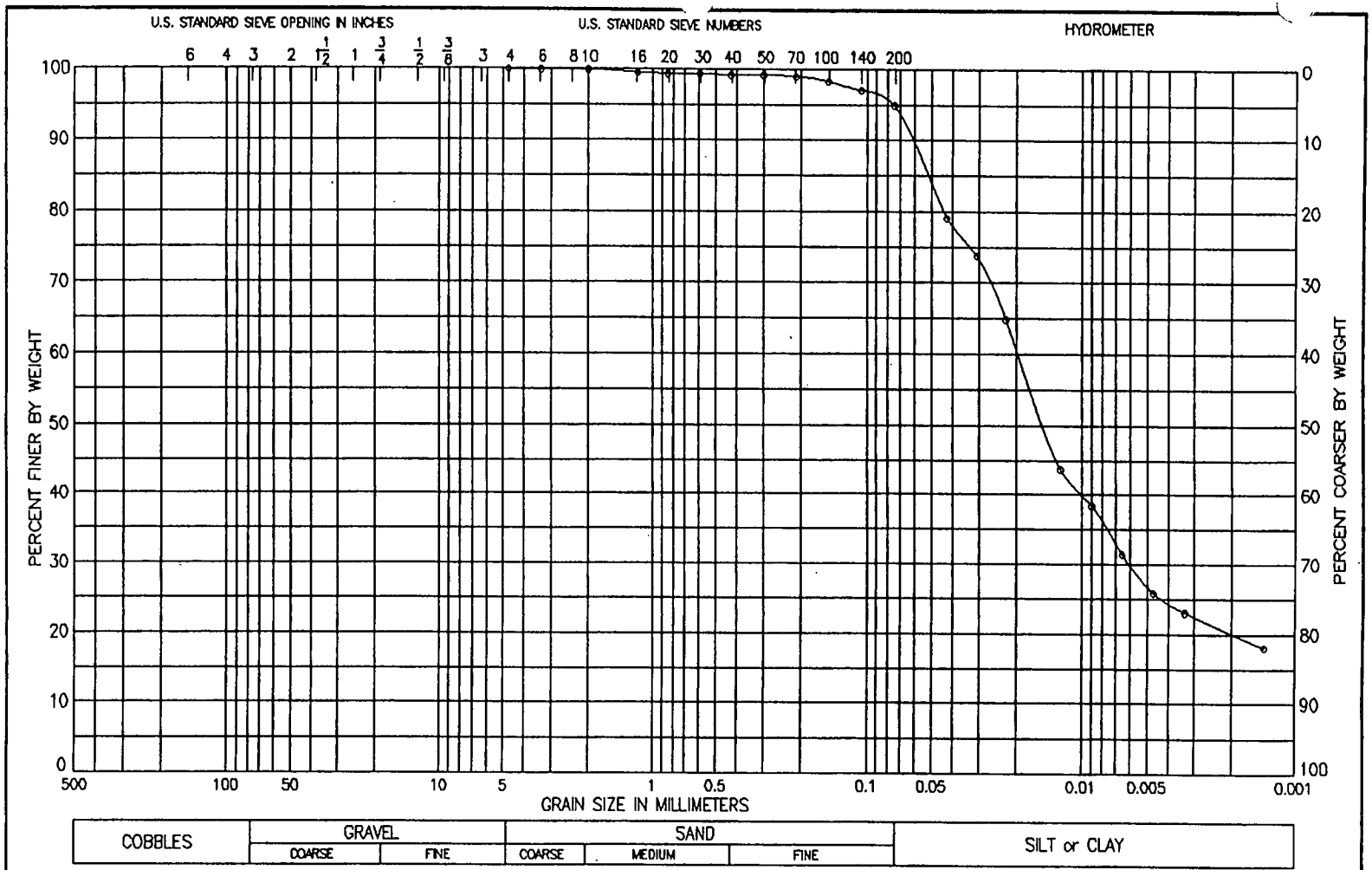
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	No 4	4.750	100.0	.0
.2	No 6	3.350	100.0	.0
.1	No 10	2.000	99.9	.1
.2	No 16	1.180	99.6	.4
.3	No 20	.850	99.4	.6
.3	No 30	.600	99.4	.6
.4	No 40	.425	99.2	.8
.4	No 50	.300	99.2	.8
.5	No 70	.212	99.1	.9
.9	No 100	.150	98.4	1.6
1.6	No 140	.106	97.1	2.9
2.8	No 200	.075	95.0	5.0

HYDROMETER:

RDGS	TEMP			
28.2	23.5	.0426	79.1	20.9
26.3	23.5	.0308	73.8	26.2
23.1	23.5	.0226	64.9	35.1
15.5	23.5	.0126	43.7	56.3
13.7	23.0	.0091	38.4	61.6
11.2	23.0	.0066	31.5	68.5
9.2	23.0	.0047	25.9	74.1
8.2	23.0	.0034	23.1	76.9
6.6	22.0	.0014	18.1	81.9

PERCENT GRAVEL = .0
PERCENT SAND = 5.0
PERCENT FINES = 95.0

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 21.6	ORG,% 2.4

CLASSIFICATION
CLAY (CL), BROWN; TRACE OF SAND VISUAL

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-09-90 SAMPLE NO. 2A
DEPTH/ELEV 3.0 – 3.5 DATE 02 APR 91

SIEVE ANALYSIS

PROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-10-90 SAMPLE: 1A DF: MD2991 .DAT
DEPTH: 5.0 - 5.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 19.40 OC: 3.10
CLASSIFICATION: 374
CLAY (CL), BROWN; WITH SAND VISUAL

TOTAL WEIGHT OF SAMPLE: 466.5 gms.
PARTIAL WEIGHT AFTER SPLIT: 58.3 gms.

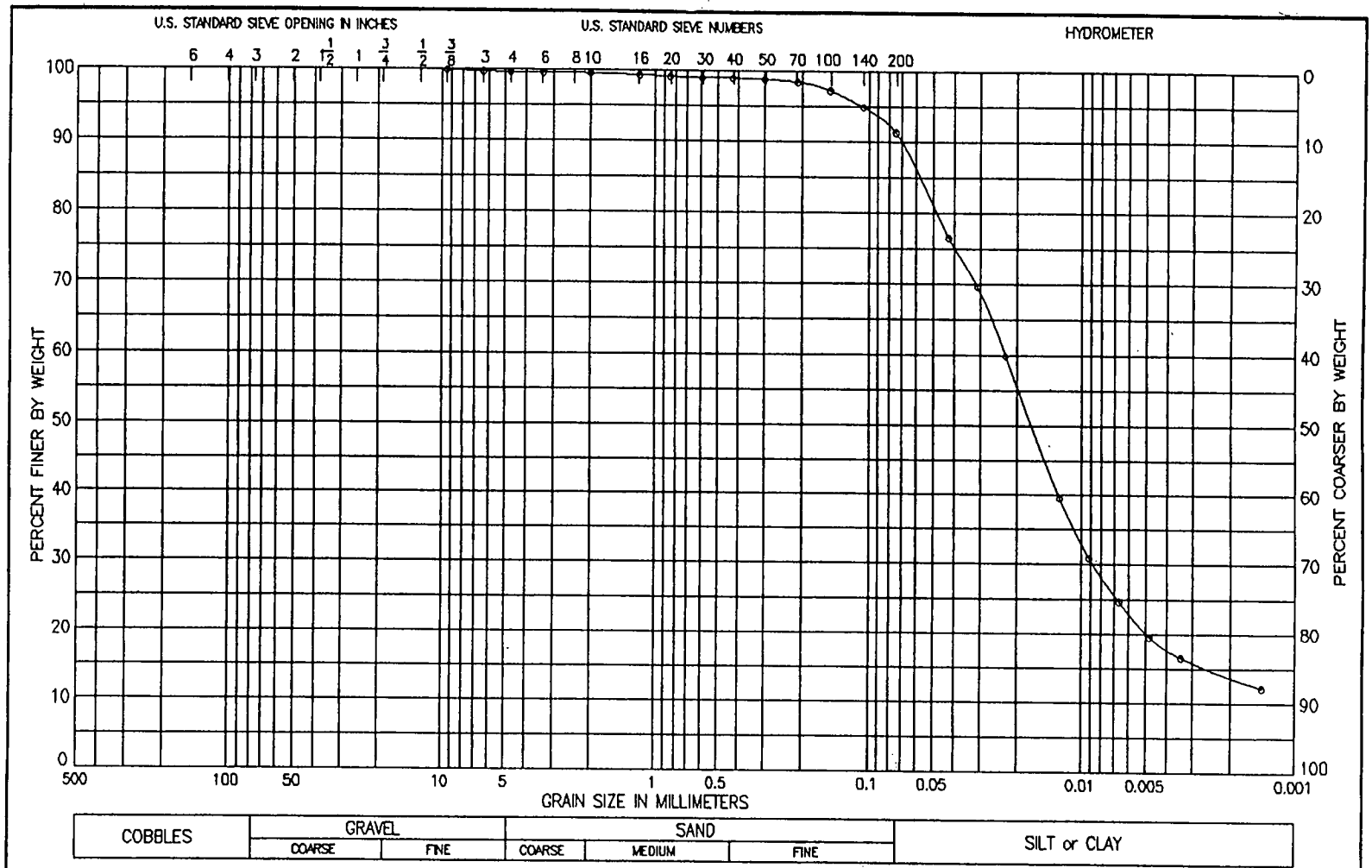
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	3/8 in	9.500	100.0	.0
1.1	No 3	6.350	99.8	.2
.3	No 4	4.750	99.7	.3
.1	No 6	3.350	99.7	.3
.5	No 10	2.000	99.6	.4
.1	No 16	1.180	99.4	.6
.2	No 20	.850	99.2	.8
.3	No 30	.600	99.1	.9
.3	No 40	.425	99.1	.9
.4	No 50	.300	98.9	1.1
.6	No 70	.212	98.5	1.5
1.3	No 100	.150	97.4	2.6
2.7	No 140	.106	95.0	5.0
4.8	No 200	.075	91.4	8.6

HYDROMETER:

RDGS	TEMP			
28.0	23.5	.0427	76.5	23.5
25.5	23.5	.0311	69.7	30.3
21.9	23.5	.0229	59.9	40.1
14.4	23.5	.0128	39.6	60.4
11.3	23.0	.0093	30.9	69.1
9.0	23.0	.0067	24.7	75.3
7.1	23.0	.0048	19.5	80.5
6.0	23.0	.0034	16.5	83.5
4.6	22.0	.0014	12.2	87.8

PERCENT GRAVEL = .3
PERCENT SAND = 8.3
PERCENT FINES = 91.4

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 19.4	ORG,% 3.1

CLASSIFICATION
CLAY (CL), BROWN; WITH SAND VISUAL

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-10-90 SAMPLE NO. 1A

DEPTH/ELEV 5.0 – 5.5 DATE 02 APR 91

SIEVE ANALYSIS

ROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-11-90 SAMPLE: 1A DF: MD2991 .DAT
DEPTH: 0.5 - 1.0 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 25.30 OC: 2.80
CLASSIFICATION: 392
CLAY (CL), BROWN; TRACE OF SAND VISUAL

TOTAL WEIGHT OF SAMPLE: 414.2 gms.
PARTIAL WEIGHT AFTER SPLIT: 54.7 gms.

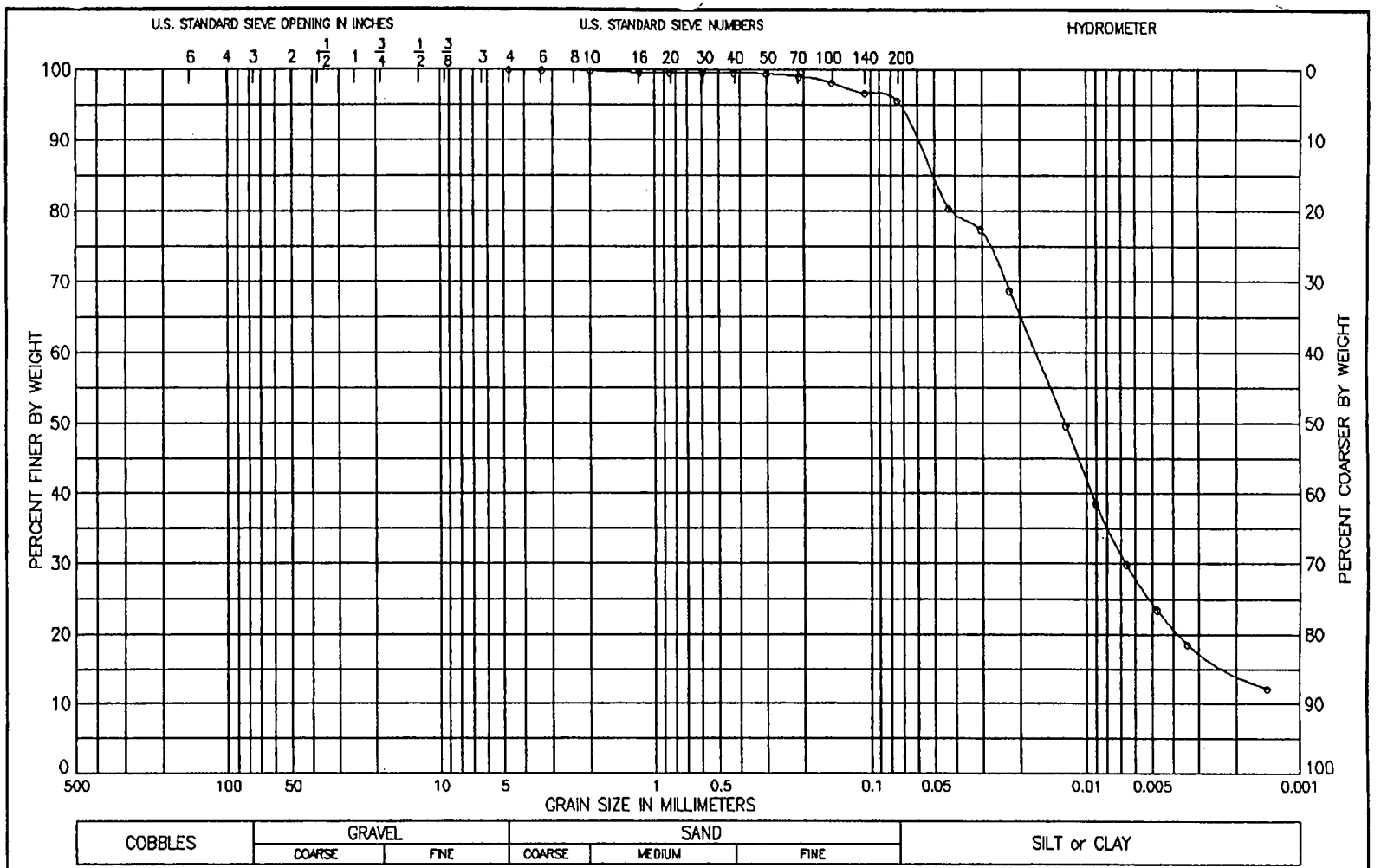
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	No 4	4.750	100.0	.0
.3	No 6	3.350	99.9	.1
.2	No 10	2.000	99.9	.1
.1	No 16	1.180	99.7	.3
.1	No 20	.850	99.7	.3
.1	No 30	.600	99.7	.3
.1	No 40	.425	99.7	.3
.2	No 50	.300	99.5	.5
.4	No 70	.212	99.1	.9
.9	No 100	.150	98.2	1.8
1.7	No 140	.106	96.8	3.2
2.3	No 200	.075	95.7	4.3

HYDROMETER:

RDGS	TEMP			
27.5	23.5	.0429	80.3	19.7
26.5	23.5	.0307	77.4	22.6
23.5	23.5	.0225	68.7	31.3
16.9	23.5	.0125	49.6	50.4
13.2	23.0	.0091	38.6	61.4
10.2	23.0	.0066	29.9	70.1
8.0	23.0	.0048	23.5	76.5
6.3	23.0	.0034	18.6	81.4
4.3	22.0	.0014	12.2	87.8

PERCENT GRAVEL = .0
PERCENT SAND = 4.3
PERCENT FINES = 95.7

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 25.3	ORG,% 2.8

CLASSIFICATION
CLAY (CL), BROWN; TRACE OF SAND VISUAL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-11-90 SAMPLE NO. 1A

DEPTH/ELEV 0.5 – 1.0 DATE 02 APR 91

GRADATION CURVE | LABORATORY USAE WES – STF/GL

SIEVE ANALYSIS

ROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-11-90 SAMPLE: 2A DF: MD2991 .DAT
DEPTH: 2.0 - 2.5 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 18.70 OC: 1.80
CLASSIFICATION: 410
SANDY CLAY (CL); BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 455.4 gms.
PARTIAL WEIGHT AFTER SPLIT: 53.3 gms.

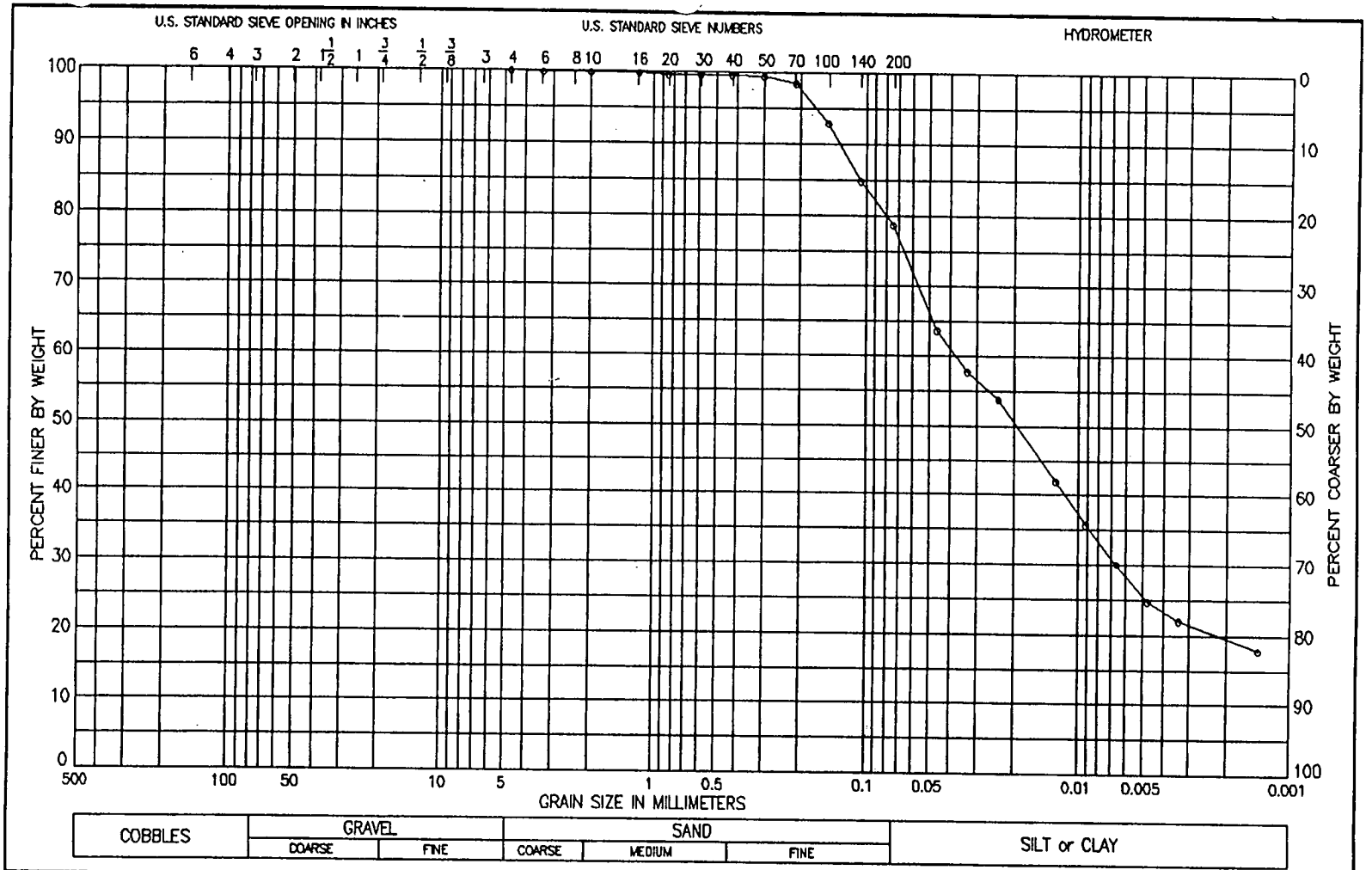
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	No 4	4.750	100.0	.0
.5	No 6	3.350	99.9	.1
.1	No 10	2.000	99.9	.1
.0	No 16	1.180	99.9	.1
.1	No 20	.850	99.7	.3
.1	No 30	.600	99.7	.3
.1	No 40	.425	99.7	.3
.2	No 50	.300	99.5	.5
.7	No 70	.212	98.6	1.4
3.7	No 100	.150	92.9	7.1
8.0	No 140	.106	84.9	15.1
11.3	No 200	.075	78.7	21.3

HYDROMETER:

RDGS	TEMP			
21.2	23.5	.0462	63.7	36.3
19.2	23.5	.0333	57.7	42.3
17.9	23.5	.0239	53.9	46.1
13.9	23.5	.0128	42.0	58.0
11.9	23.0	.0092	35.7	64.3
10.0	23.0	.0066	30.1	69.9
8.2	23.0	.0048	24.7	75.3
7.3	23.0	.0034	22.0	78.0
6.1	22.0	.0014	17.9	82.1

PERCENT GRAVEL = .0
PERCENT SAND = 21.3
PERCENT FINES = 78.7

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 18.7	ORG,% 1.8

CLASSIFICATION
SANDY CLAY (CL); BROWN VISUAL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-11-90 SAMPLE NO. 2A

DEPTH/ELEV 2.0 – 2.5 DATE 02 APR 91

GRADATION CURVE | LABORATORY USAE WES – STF/GL

SIEVE ANALYSIS

ROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-12-90 SAMPLE: 1A DF: MD2991 .DAT
DEPTH: 0.5 - 1.0 DATE: 02 APR 90

NO-LIMITS-RAN GS: 2.70 est WC: 22.60 OC: 2.10
CLASSIFICATION: 428
CLAY (CL), BROWN; WITH SAND VISUAL

TOTAL WEIGHT OF SAMPLE: 368.7 gms.
PARTIAL WEIGHT AFTER SPLIT: 55.0 gms.

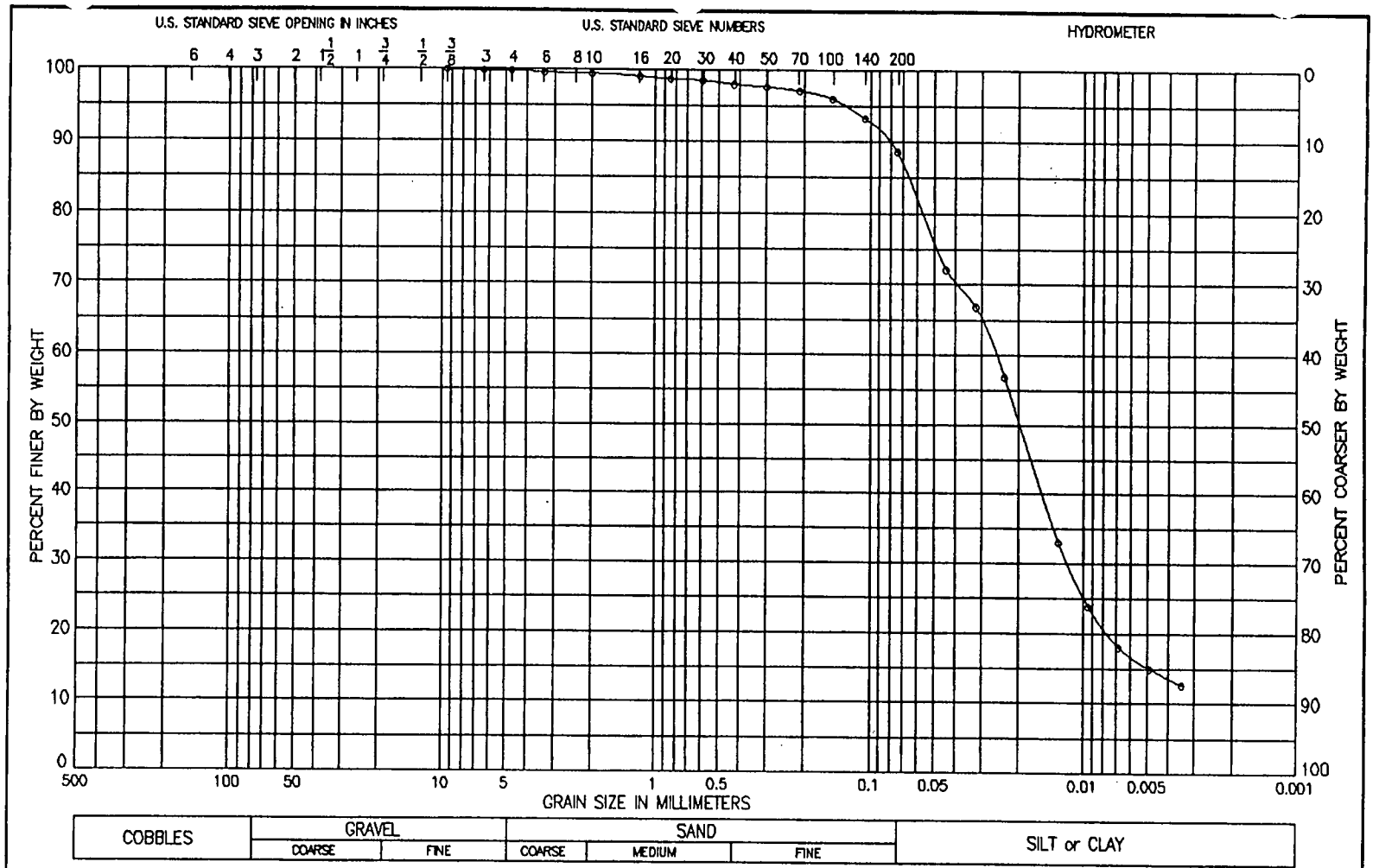
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	3/8 in	9.500	100.0	.0
.6	No 3	6.350	99.8	.2
.0	No 4	4.750	99.8	.2
.7	No 6	3.350	99.6	.4
.6	No 10	2.000	99.5	.5
.2	No 16	1.180	99.1	.9
.4	No 20	.850	98.8	1.2
.5	No 30	.600	98.6	1.4
.8	No 40	.425	98.0	2.0
1.0	No 50	.300	97.7	2.3
1.3	No 70	.212	97.1	2.9
1.9	No 100	.150	96.0	4.0
3.4	No 140	.106	93.3	6.7
6.0	No 200	.075	88.6	11.4

HYDROMETER:

RDGS	TEMP			
24.9	23.5	.0443	72.1	27.9
23.1	23.5	.0320	66.9	33.1
19.6	23.5	.0235	56.9	43.1
11.3	23.5	.0131	33.0	67.0
8.2	23.0	.0095	23.8	76.2
6.2	23.0	.0069	18.1	81.9
5.1	23.0	.0049	14.9	85.1
4.3	23.0	.0035	12.6	87.4

PERCENT GRAVEL = .2
PERCENT SAND = 11.2
PERCENT FINES = 88.6

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 22.6	ORG,% 2.1

CLASSIFICATION
CLAY (CL), BROWN; WITH SAND VISUAL

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-12-90 SAMPLE NO. 1A

DEPTH/ELEV 0.5 – 1.0 DATE 02 APR 90

SIEVE ANALYSIS

ROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-12-90 SAMPLE: 2A DF: MD2991 .DAT
DEPTH: 14.0 - 14.6 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 23.70 OC: 3.00
CLASSIFICATION: 448
CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: .0 gms.
PARTIAL WEIGHT AFTER SPLIT: 54.6 gms.

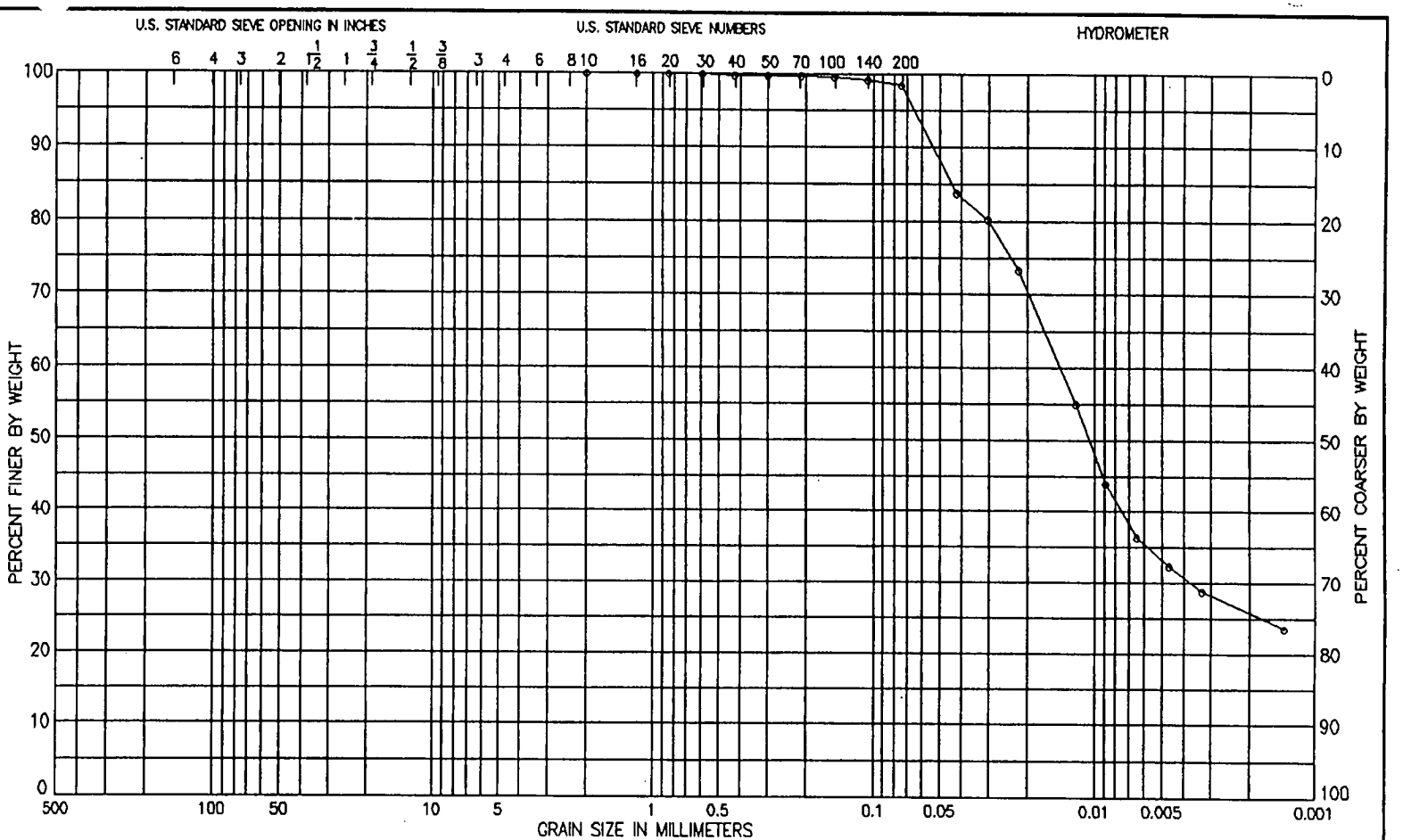
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	No 10	2.000	100.0	.0
.0	No 16	1.180	100.0	.0
.0	No 20	.850	100.0	.0
.0	No 30	.600	100.0	.0
.1	No 40	.425	99.8	.2
.1	No 50	.300	99.8	.2
.1	No 70	.212	99.8	.2
.2	No 100	.150	99.6	.4
.4	No 140	.106	99.3	.7
.8	No 200	.075	98.5	1.5

HYDROMETER:

RDGS	TEMP			
28.7	23.0	.0423	83.8	16.2
27.5	23.0	.0304	80.3	19.7
25.1	23.0	.0221	73.3	26.7
18.8	23.0	.0122	55.0	45.0
15.0	23.0	.0090	43.9	56.1
12.4	23.0	.0065	36.4	63.6
11.0	23.0	.0047	32.3	67.7
9.8	23.0	.0033	28.8	71.2
8.2	22.0	.0014	23.6	76.4

PERCENT GRAVEL = .0
PERCENT SAND = 1.5
PERCENT FINES = 98.5

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 23.7	ORG,% 3.0

CLASSIFICATION
CLAY (CL), BROWN VISUAL

GRADATION CURVE | LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING NO. 10/15-12-90 SAMPLE NO. 2A

DEPTH/ELEV 14.0 – 14.6 DATE 02 APR 91

SIEVE ANALYSIS

ROJECT: ROCKEYE MUN. FAC.,NWSC
CRANE, IN

BORING: 10/15-13-90 SAMPLE: 1A DF: MD2991 .DAT
DEPTH: 2.5 - 3.0 DATE: 02 APR 91

NO-LIMITS-RAN GS: 2.70 est WC: 15.80 OC: 6.20
CLASSIFICATION: 464
GRAVELLY SANDY CLAY (CL), BROWN VISUAL

TOTAL WEIGHT OF SAMPLE: 334.4 gms.
PARTIAL WEIGHT AFTER SPLIT: 51.2 gms.
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

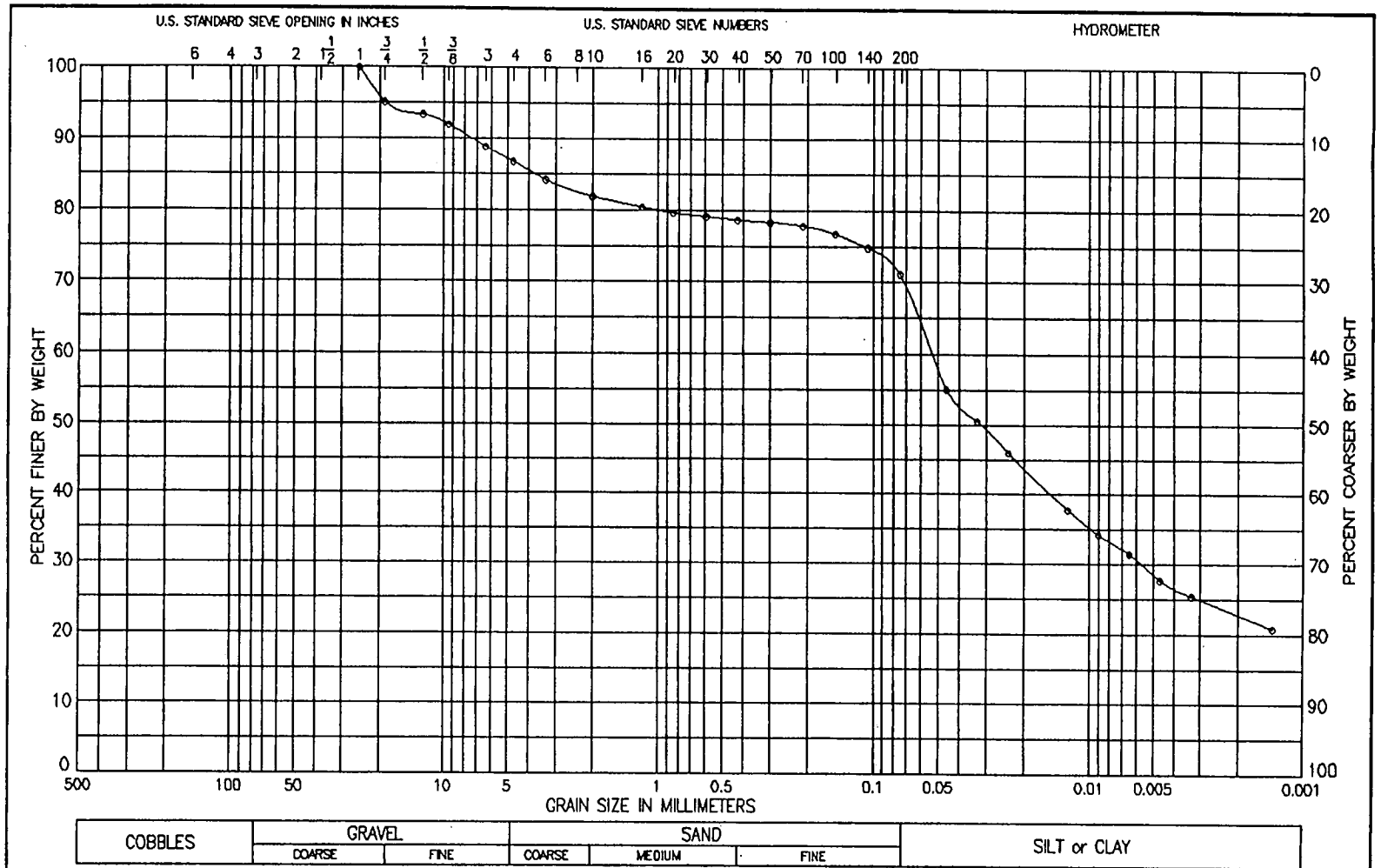
WEIGHTS gm.	SIEVE SIZE or NUMBER	OPENING mm	PERCENT FINER	CUMULATIVE PERCENTS
.0	1 in	25.000	100.0	.0
16.2	3/4 in	19.100	95.2	4.8
5.9	1/2 in	12.500	93.4	6.6
4.7	3/8 in	9.500	92.0	8.0
10.5	No 3	6.350	88.8	11.2
6.9	No 4	4.750	86.8	13.2
8.7	No 6	3.350	84.2	15.8
7.7	No 10	2.000	81.9	18.1
.9	No 16	1.180	80.4	19.6
1.4	No 20	.850	79.6	20.4
1.7	No 30	.600	79.2	20.8
2.0	No 40	.425	78.7	21.3
2.2	No 50	.300	78.4	21.6
2.5	No 70	.212	77.9	22.1
3.2	No 100	.150	76.8	23.2
4.4	No 140	.106	74.8	25.2
6.7	No 200	.075	71.2	28.8

HYDROMETER:

RDGS	TEMP			
21.6	23.0	.0460	55.1	44.9
19.8	23.0	.0331	50.5	49.5
18.0	23.0	.0239	46.0	54.0
14.8	23.0	.0127	37.8	62.2
13.4	23.0	.0091	34.3	65.7
12.3	23.0	.0065	31.5	68.5
10.8	23.0	.0047	27.7	72.3
9.9	23.0	.0033	25.4	74.6
8.3	22.0	.0014	20.8	79.2

PERCENT GRAVEL = 13.2
PERCENT SAND = 15.6
PERCENT FINES = 71.2

EDE



LL	PL	PI	GS 2.70 EST	NAT W,% 15.8	ORG,% 6.2

CLASSIFICATION

GRAVELLY SANDY CLAY (CL), BROWN VISUAL

INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE	LABORATORY USAE WES – STF/GL

PROJECT ROCKEYE MUN. FAC.,NWSC

CRANE, IN

BORING NO. 10/15-13-90 SAMPLE NO. 1A

DEPTH/ELEV 2.5 – 3.0 DATE 02 APR 91

Appendix D
Validation Report

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
3909 HALLS FERRY ROAD
VICKSBURG, MISSISSIPPI 39180 6199

REPLY TO
ATTENTION OF

23 August 1991

CEWESEE-A

MEMORANDUM FOR MR. ROBERT MAGEE, US ARMY ENGINEER DISTRICT, WILMINGTON, 69 DARLINGTON AVENUE, WILMINGTON, NC 28403

SUBJECT: Data validation for Site 3 (Rockeye), Crane samples collected 9/05/90 - 10/15/90

1. Completeness check
   a. All samples and analyses have been processed.
   b. Data reported included copies of all chain-of-custody records received from the field. QC results for blanks, spikes, duplicates, and standard reference materials were included in the data report.
   c. Procedures specified in the project planning were followed with the exception of Tin that was run by plasma emission spectrometer. An explanation of deviation was given in previous reports.
   d. A review of raw data sheets shows that all calibrations were performed in accordance with SW-846 procedures.

2. Data were evaluated with respect to detection limits. All data were reported at or below contract required detection limits.

3. Data were evaluated with respect to control limits for duplicates, spikes, blanks, and surrogates. The following problems were noted and corrective actions taken where appropriate:

a. On several samples for Base Neutral/acid extractables, (ALG sample numbers 7545,7546, 7547, 7721, 7722, 7779, 7780, 7783) the p-Terphenyl-d_{14} surrogate was high outside the acceptable range and for some samples (ALG sample number 7721, 7618, 7625, 7662, 7784, 7786,7779,7780, 7783, 7803, 7442-77477441m 7559, 7545-7547 7410,7412-7417, 7545-7547) there were low internal standard recoveries. Samples were reun and yielded essentially the same results. Reagent blank samples were within range. The high surrogate values and low internal standard recoveries were attributed to matrix effects.

b. Low internal standard areas were obtained for volatiles analysis of ALG sample numbers 7411, 7414,and 7417. Samples were reun and the problem persisted indicating a matrix effect since other samples in the group were within acceptable limits. Samples 7816 and 7817 exceeded the holding times by two days for volatile analysis due to instrument problems.

c. Antimony spikes were ommitted from the ICP digestions for sample delivery groups 9/10/90, 9/05/90, 9/06/90, 9/08/90, 9/13/90, and 10/14/90. Post digestion spikes were run with these samples.

d. Interference check samples were not run with the ICP metals analyses because the laboratory supply was depleted. A new supply had been ordered prior to the beginning of this project, but the company misplaced the order.

e. Cr, Co, Cu, Pb, Ni, and Zn were omitted from the spiking solution used for ALG samples 7433-7437, 7448-7455 and 7548-7552.

4. All samples were analyzed within acceptable holding times except as previously noted.

5. Data for QA samples were within acceptable limits.

Ann B Strong

ANN B. STRONG
Chief, Analytical
Laboratory Group

Appendix E
Chain of Custody Forms

JAR S[illegible]les WERE NOT KEEP ~~AT~~ ~~AO~~ ; SO We RESample Volatiles

USAE WATERWAY [illegible] PERIMENT STATION
CHAIN OF C[illegible]ODY RECORD

PROJECT NAME SOUTH STREAM
SITE "D" ROCKEYE AREA (CRANE)

SAMPLERS: (Signature) Larry Benjamin

SHEET 1 OF 3

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS							REMARKS
										7350 - 7379 7410 - 7413 7418 - 7423
9-5-90	10:05	D-0-0	1 JAR							
9-~~6~~-90	~~10:05~~ 14:48	D-0-0	2 V							
9-~~5~~-90	10:11	D-1-0	1 JAR							
"	10:15	D-2-0	"							
"	10:23	D-3-0	"							
"	10:28	D-4-0	"							
"	10:35	D-5-0	"							
"	10:36	D-0-1	"							
"	10:40	D-1-1	"							
"	10:50	D-2-1	"							
"	12:35	D-3-1	1 JAR							
9-~~6~~-90	~~12:35~~ 14:55	D-3-1	2 V							
9-~~5~~-90	12:40	D-4-1	1 JAR							
"	12:45	D-5-1	"							
"	12:50	D-0-2	"							
"	12:55	D-1-2	"							

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		Linda K Stevenson 9/8/90			
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	

WES FORM 2196 R Nov 86

PREVIOUS EDITIONS OBSOLETE

JAR SP OES WERE NOT KEEP
QTY I SO WE
RESample volatiles

USAE WATERWAY EXPERIMENT STATION
CHAIN OF CUSTODY RECORD

PROJECT NAME SOUTH STREAM
SITE "D" ROCKEYE AREA (CRANE)

SAMPLERS: (Signature) Larry Benjamin

SHEET 2 OF 3

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	REMARKS
9-5-90	1300	D-2-2	1 JAR	
"	1305	D-3-2	"	
"	1310	D-4-2	"	
"	1315	D-5-2	"	
"	1320	D-0-3	"	
"	1325	D-1-3	1 JAR	
9-6-90	1325	D-1-3	2 V	
9-5-90	1330	D-2-3	1 JAR	
"	1335	D-3-3	"	
"	1340	D-4-3	"	
"	1345	D-5-3	"	
"	1350	D-0-4	"	
"	1355	D-1-4	"	
"	1400	D-2-4	"	
"	14:05	D-3-4	"	
"	14:10	D-4-4	"	

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		Linda K. Stevenson 9/8/90			
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	

WES FORM 2196 R Nov 84 PREVIOUS EDITIONS OBSOLETE

JAR / wipes were on I SO W.E RESample Volatiles

USAE WATERWAY EXPERIMENT STATION
CHAIN OF CUSTODY RECORD

PROJECT NAME SOUTH STREAM SITE "D" ROCKEYE AREA CRANE

SAMPLERS: (Signature) Larry Benjamin

SHEET 3 OF 3

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	REMARKS
9-6-90	~~14:10~~ 1510	D-4-4	2V	
9-5-90	14:25	D-5-4	1 JAR	
9-6-90	14:33	TRIP BLANK	1V	

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		Linda K. Stevenson 9/8/90			
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	

WES FORM R Nov 80 2196 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY[illegible]PERIMENT STATION

CHAIN OF CU[illegible]ODY RECORD

PROJECT NAME: NORTH EAST STREAM
CRANE SITE "E" ROCKEYE AREA

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS							REMARKS
										7380-7409 7414-7417 7424-7430
9-6-90	0930	E-0-0	1 JAR							
"	0930	E-0-0	2 ✓							
"	0935	E-1-0	1 JAR							
"	0940	E-2-0	"							
"	0945	E-3-0	"							
"	0950	E-4-0	"							
"	0952	E-5-0	"							
"	0954	E-0-1	"							
"	0957	E-1-1	"							
"	10:00	E-2-1	"							
"	1005	E-3-1	"							
"	1005	E-3-1	2 ✓							
"	1010	E-4-1	1 JAR							
"	1022	E-5-1	"							
"	10:25	E-0-2	"							
"	10:30	E-1-2	"							

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		9/8/90 Linda K. Stevenson			
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	

WES FORM R Nov 88 2196 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME: NORTH EAST STREAM CRANE SITE "E" ROCKEYE AREA

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	REMARKS
9-6-90	1033	E-2-2	1 JAR	
"	1035	E-3-2	"	
"	1037	E-4-2	"	
"	1040	E-5-2	"	
"	1042	E-0-3	"	
"	1050	E-1-3	"	
"	1050	E-1-3	2 V	
"	1055	E-2-3	1 JAR	
"	1100	E-3-3	"	
"	1105	E-4-3	"	
"	1110	E-5-3	"	
"	11:13	E-0-4	"	
"	11:15	E-1-4	"	
"	11:17	E-2-4	"	
"	11:20	E-3-4	"	
"	11:25	E-4-4	"	

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
		Linda K. Stevenson 9/8/90			
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	

WES FORM 2196 R Nov 80 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME NORTHEAST STREAM CRANE SITE "E" ROCKEYE AREA

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS							REMARKS
9-6-90	11:25	E-4-4	2 V							
9-6-90	11:30	E-5-4	1 JAR							
9-6-90	14:35	TRIP BLANK	1 V							

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		Linda K. Stevenson 9/8/90			
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	

WES FORM R Nov 89 2196 PREVIOUS EDITIONS OBSOLETE

2 coolers

COOLER RECEIPT FORM

Project: CRANE - ROCKEYE - Site D & E

Cooler received on 9/8/90 and opened on 9/8/90 by Linda K. Stevenson

Linda K. Stevenson
(signature)

1) Were custody seals on outside of cooler? ---------- YES NO
   If YES, how many and where? 2 on front + 2 on back of each cooler
   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, etc.)? --------- YES NO

4) Did you sign custody papers in the appropriate place? ---------- YES NO

5) Did you attach shipper's packing slip to this form? ---------- YES NO

6) What kind of packing material was used? Peanuts + bubble plastic

7) Was sufficient ice used (if appropriate)? ---------- YES NO

8) Were all bottles sealed in separate plastic bags? ---------- YES NO

9) Did all bottles arrive in good condition (unbroken)? ---------- YES NO

10) Were all bottle labels complete (No., date, signed, anal., pres, etc.)? ---- YES NO

11) Did all bottle labels and tags agree with custody papers? ---------- YES NO

12) Were correct bottles used for the tests indicated? ---------- YES NO

13) Were VOA vials checked for absence of air bubbles and noted if found? ---- YES NO

14) Was a sufficient amount of sample sent in each bottle? ---------- YES NO

Explain any discrepancies --->

#3. Sampler did not sign papers but all seals were signed + intact.

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME NWSCC WEST STREAM
CRANE: SITE "A" ROCKEYE

SAMPLERS (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	REMARKS
				LAB ID 7432 - 7497
8-9-90	1420	A-0-0	1 JAR	
"	1420	A-0-0	2 ✓	
"	1417	A-1-0	1 JAR	
"	1424	A-2-0	"	
"	1420	A-3-0	"	
"	1426	A-4-0	"	
"	1425	A-0-1	"	
"	1428	A-1-1	"	
"	1430	A-2-1	"	
"	1431	A-3-1	"	
"	1438	A-4-1	"	
"	1438	A-4-1	2 ✓	
"	1433	A-0-2	1 JAR	
"	1436	A-1-2	"	
"	1442	A-2-2	"	
"	1443	A-3-2	"	

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		9/11/90 Linda K. Stevenson			
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	

WES FORM 2196 R Nov 88 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY EXPERIMENT STATION
CHAIN OF CUSTODY RECORD

PROJECT NAME NNSCC
CRANE : WEST STREAM SITE "A" and NORTH STREAM SITE "B" ROCKEYE

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	REMARKS
9-8-90	1444	A-4-2	1 JAR	
"	1445	A-0-3	"	
"	1446	A-1-3	"	
"	1548	A-2-3	"	
"	1453	A-3-3	"	
"	1453	A-3-3	2 V	
"	1455	A-4-3	1 JAR	
"	1500	TRIP BLANK	1 V	should be in dup.
9-10-90	0835	B-0-0	1 JAR	
"	0835	B-0-0	2 V	
"	0832	B-1-0	1 JAR	
"	0838	B-2-0	"	
"	0837	B-3-0	"	
"	0839	B-4-0	"	
"	0840	B-0-1	"	
"	0842	B-1-1	"	

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		9/11/90 Linda K. Stevenson			
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	

WES FORM 2196 R Nov 88 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME NWSCC NORTH STREAM SITE "B" ROCKEYE CRANE

SAMPLERS: (Signature) Larry Bergan

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	REMARKS
9-16-90	0843	B-2-1	1 JAR	
"	0849	B-3-1	"	
"	0847	B-4-1	1 JAR	
"	0847	B-4-1	2 V	1 vial broke
"	0853	B-0-2	1 JAR	
"	0857	B-1-2	"	
"	0858	B-2-2	"	
"	0901	B-3-2	"	
"	0903	B-4-2	"	
"	0911	B-0-3	"	
"	0912	B-1-3	"	
"	0918	B-2-3	"	
"	0927	B-3-3	"	
"	0927	B-3-3	2 V	
"	0920	B-4-3	1 JAR	
"	0930	TRIP BLANK	1 V	Should be in dup

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		9/11/90 Linda K. Stevenson			
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	

WES FORM R Nov 89 2196 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY XPERIMENT STATION

CHAIN OF C ODY RECORD

PROJECT NAME NWSCC Crane - Old Rifle Range

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS							REMARKS
9-7-90	1100	07109-13-90 No 1	1							
9-7-90	1115	" No 2	1							
9-7-90	1130	" No 3	1							
9-7-90	1130	" No 4	1							
9-7-90	1145	" No 5	1							
9-7-90	1145	" No 5.V	2							
9-7-90	1400	REINSATE	4							
9-7-90	1410	TRIP BLANK	1V							Should be in shop

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
		9/11/90 Linda K. Stevenson			
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	

WES FORM 2196 R Nov 89 PREVIOUS EDITIONS OBSOLETE

COOLER RECEIPT FORM

Project: CRANE - ROCKEYE + 1 cooler OLD RIFLE Rd.

Cooler received on 9/11/90 and opened on 9/11/90 by Linda K. Stevenson

Linda K. Stevenson
(signature)

1) Were custody seals on outside of cooler? ---------- (YES) NO
   If YES, how many and where? 2 on front of each cooler
   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, etc.)? --------- YES (NO)

4) Did you sign custody papers in the appropriate place? ---------- (YES) NO

5) Did you attach shipper's packing slip to this form? ---------- (YES) NO

6) What kind of packing material was used? Styrofoam peanuts + bubble plastic

7) Was sufficient ice used (if appropriate)? ---------- (YES) NO

8) Were all bottles sealed in separate plastic bags? ---------- (YES) NO

9) Did all bottles arrive in good condition (unbroken)? ---------- YES (NO)

10) Were all bottle labels complete (No., date, signed, anal., pres, etc.)? ---- (YES) NO

11) Did all bottle labels and tags agree with custody papers? ---------- (YES) NO

12) Were correct bottles used for the tests indicated? ---------- (YES) NO

13) Were VOA vials checked for absence of air bubbles and noted if found? ---- (YES) NO

14) Was a sufficient amount of sample sent in each bottle? ---------- (YES) NO

Explain any discrepancies --->

#3. Chain-of-Custody forms were not signed, seals were intact + signed.

#9. 1 voa vial was broken on arrival.

USAE WATERWAY 'PERIMENT STATION

CHAIN OF C;'TODY RECORD

PROJECT NAME NWSCC EAST STREAM
CRANE : SITE "C" ROCKEYE

SAMPLERS: (Signature) Ben W. Bryant

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	REMARKS
9-13-90	0945	C-0-0	1	LAB ID 7523 - 7554
	0945	C-0-0 2V	2	
	0946	C-1-0	1	
	0947	C-2-0	1	
	0950	C-3-0	1	
	0955	C-4-0	1	
	0957	C-0-1	1	
	0958	C-1-1	1	
	1000	C-2-1	1	
	1002	C-3-1	1	
	1002	C-4-1	1	
	1003	C-4-1 2V	2	
	1005	C-0-2	1	
	1007	C-1-2	1	
	1009	C-2-2	1	
9-13-90	1010	C-3-2	1	

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Ben Bryant	9-13-19 1330	Linda K. Stevenson			
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	

WES FORM 2196 R Nov 83 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME: NWSC, Crane, IN. Rockeye Mun. Fac. Site "C" Scrape Site

SAMPLERS: (Signature) Ben W. Bryant

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	REMARKS
9-13-90	1015	C-4-2	1	
	1045	C-0-3	1	
	1047	C-1-3	1	
	1048	C-2-3	1	
	1049	C-3-3	1	
	1049	C-3-3 ZV	2	Broken
	1050	C-4-3	1	Broken
	1100	Background #1	1	
	1102	Background #2	1	
9-13-90	1104	Background #3	1	

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Ben Bryant	9-13-90 / 1330	Linda K. Stevenson			
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	

WES FORM R Nov 89 2196

PREVIOUS EDITIONS OBSOLETE

COOLER RECEIPT FORM

Project: CRANE- ROCKEYE

Cooler received on 9/14/90 and opened on 9/14/90 by Linda K. Stevenson

Linda K. Stevenson
(signature)

1) Were custody seals on outside of cooler? ---------- (YES) NO
   If YES, how many and where? 2 front
   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, etc.)? ---------- (YES) NO

4) Did you sign custody papers in the appropriate place? ---------- (YES) NO

5) Did you attach shipper's packing slip to this form? ---------- (YES) NO

6) What kind of packing material was used? Styrofoam peanuts

7) Was sufficient ice used (if appropriate)? ---------- (YES) NO

8) Were all bottles sealed in separate plastic bags? ---------- (YES) NO

9) Did all bottles arrive in good condition (unbroken)? ---------- YES (NO)

10) Were all bottle labels complete (No., date, signed, anal., pres, etc.)? ---- (YES) NO

11) Did all bottle labels and tags agree with custody papers? ---------- (YES) NO

12) Were correct bottles used for the tests indicated? ---------- (YES) NO

13) Were VOA vials checked for absence of air bubbles and noted if found? ---- (YES) NO

14) Was a sufficient amount of sample sent in each bottle? ---------- (YES) NO

Explain any discrepancies --->

#9 Voa vials for site C-3-2 were broken & sample site ~~4-C-2~~ was broken
C-4-3 lb

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME (SWMU # 10/15)
NWSC CRANE: ROCKEYE AREA

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	8240	8270	METALS	EXPLOSIVES			REMARKS
10-12-90	1405	10/15-11-90 #1	2	✓		✓	✓			
"	1407	10/15-11-90 #2	2	✓		✓	✓			
"	1415	10/15-11-90 #3	2	✓		✓	✓			
"	1430	10/15-11-90 #4	2	✓		✓	✓			
"	1425	10/15-11-90 #4V	2		✓					
10-12-90	1015	10/15-12-90 #1	2	✓		✓	✓			
"	1017	10/15-12-90 #2	2	✓		✓	✓			
"	1050	10/15-12-90 #3	2	✓		✓	✓			
"	1056	10/15-12-90 #4	2	✓		✓	✓			
"	1055	10/15-12-90 #4V	2		✓					
10-15-90	0837	TRIP BLANK	2							Bubble

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Larry Benjamin	10/15-90 0915	Linda K. Stevenson			
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	

WES FORM 2196 R Nov 89 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY EXPERIMENT STATION
CHAIN OF CUSTODY RECORD

Sit 3

PROJECT NAME (SWMU# 10/15)
NWSC CRANE: ROCKEYE AREA

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	8240	8270	METALS	EXPLOSIVES			REMARKS
										7759- 7827
10-14-90	1000	10/15-08-90 #1	2	✓		✓	✓			
"	0955	10/15-08-90 #1V	2		✓					
10-14-90	0845	10/15-09-90 #1	2	✓		✓	✓			
"	0840	10/15-09-90 #1V	2		✓					
10-14-90	1020	10/15-10-90 #1	2	✓		✓	✓			
10-14-90	1025	10/15-10-90 #2	2	✓		✓	✓			
"	1040	10/15-10-90 #3	2	✓		✓	✓			
"	1120	10/15-10-90 #4	2	✓		✓	✓			
"	1115	10/15-10-90 #4V	2		✓					
10-14-90	1330	REINSATE	15 3							Bubble
10-15-90	0925	TRIP BLANK	2							Bubble

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Larry Benjamin	10/15/90 0930	Linda K. Stevenson			
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	

WES FORM 2196 (R Nov 80)

PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME (SWMU #10/15) NWSC CRANE: ROCKEYE AREA

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	8240	8270	METALS	EXPLOSIVES			REMARKS
10-13-90	1014	10/15-13-90 #1	2	✓		✓	✓			
"	1020	10/15-13-90 #2	2	✓		✓	✓			
"	1025	10/15-13-90 #3	2	✓		✓	✓			
"	1023	10/15-13-90 #3V	2		✓					
10-14-90	1405	SITE "G" G-1	1							
"	1415	SITE "G" G-2	1							
"	1410	SITE "G" G-3	1							
"	1420	SITE "G" G-4	1							
10-15-90	0845	TRIP BLANK	2							Bubble

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Larry Benjamin	10/15/90 0900	Linda K. Stevenson			
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	

WES FORM R Nov 80 2196 PREVIOUS EDITIONS OBSOLETE

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME (SWMU #10/15)
NWSC CRANE: ROCKEYE AREA

SAMPLERS: (Signature) Larry Benjamin

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	8240	8270	METALS	EXPLOSIVES			REMARKS
10-13-90	1150	10/15-02-90 #1	2	✓		✓	✓			
"	1155	10/15-02-90 #2	2	✓		✓	✓			
"	1153	10/15-02-90 #2V	2		✓					
10-13-90	1410	10/15-07-90 #1	4	✓		✓	✓			
"	1405	10/15-07-90 #1V	4		✓					
10-13-90	1530	REINSATE	4							Bubbles
10-15-90	0945	TRIP BLANK	2							Bubbles, one vial broken during unpacking

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Larry Benjamin	10/15-90 0950	Linda K. Stevenson			
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	

WES FORM 2196 R Nov 80

PREVIOUS EDITIONS OBSOLETE

COOLER RECEIPT FORM

Project: CRANE ROCKEYE 4 Coolers

Cooler received on 16 Oct 90 and opened on 16 Oct 90 by Linda K. Stevenson

Linda K. Stevenson
(signature)

1) Were custody seals on outside of cooler? ---------- (YES) NO
   If YES, how many and where? 2 ~~two~~ on front + one back
   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, etc.)? --------- (YES) NO

4) Did you sign custody papers in the appropriate place? ---------- (YES) NO

5) Did you attach shipper's packing slip to this form? ---------- (YES) NO

6) What kind of packing material was used? Bubble plastic + Styrofoam peanuts

7) Was sufficient ice used (if appropriate)? ---------- (YES) NO

8) Were all bottles sealed in separate plastic bags? ---------- (YES) NO

9) Did all bottles arrive in good condition (unbroken)? ---------- (YES) NO

10) Were all bottle labels complete (No., date, signed, anal., pres, etc.)? ---- (YES) NO

11) Did all bottle labels and tags agree with custody papers? ---------- (YES) NO

12) Were correct bottles used for the tests indicated? ---------- (YES) NO

13) Were VOA vials checked for absence of air bubbles and noted if found? ---- (YES) NO

14) Was a sufficient amount of sample sent in each bottle? ---------- (YES) NO

Explain any discrepancies --->

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME NWSC, Crane, In. Rockeye Munn. Fac.

SAMPLERS: (Signature) Ben W. Bryant

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	VOA	BNA	METALS	Explosives			REMARKS
										7657-7667
9-25-90	1230	F-1	1		✓	✓	✓			
"	1230	F-2V	1	1						
"	1230	F-3V	1	1						
"	1230	F-2	1		✓	✓	✓			
"	1230	F-3	1		✓	✓	✓			

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Ben W. Bryant	9-25-90 1300	Linda K. Stevenson			
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	

WES FORM 2196 R Nov 88

PREVIOUS EDITIONS OBSOLETE

COOLER RECEIPT FORM

Project: CRANE - ROCKEYE

Cooler received on 9/27/90 and opened on 9/27/90 by Linda K. Stevenson

Linda K. Stevenson
(signature)

1) Were custody seals on outside of cooler? ---------- (YES) NO
   If YES, how many and where? 1, front + back
   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, etc.)? --------- (YES) NO

4) Did you sign custody papers in the appropriate place? ---------- (YES) NO

5) Did you attach shipper's packing slip to this form? ---------- (YES) NO

6) What kind of packing material was used? Styrofoam Peanuts

7) Was sufficient ice used (if appropriate)? ---------- YES (NO)

8) Were all bottles sealed in separate plastic bags? ---------- (YES) NO

9) Did all bottles arrive in good condition (unbroken)? ---------- (YES) NO

10) Were all bottle labels complete (No., date, signed, anal., pres, etc.)? ---- (YES) NO

11) Did all bottle labels and tags agree with custody papers? ---------- YES (NO)

12) Were correct bottles used for the tests indicated? ---------- (YES) NO

13) Were VOA vials checked for absence of air bubbles and noted if found? ---- (YES) NO

14) Was a sufficient amount of sample sent in each bottle? ---------- (YES) (NO)

Explain any discrepancies --->

#7. Samples were room temperature

#11. VOA vials + COC sheet did not agree, called PI, he will let me know correct ID 1 Oct 90.

#14. VOA's were not sent in Dup.

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME NWSC, Crane, IN. Rockeye Mun. Fac.

SAMPLERS: (Signature) Ben L. Bryant

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	Metal ETP	Metal Exp	BNA/VOA					REMARKS
9-14-90	1040	10/15-1-90 No. 1	1	X							7557 - 7560, 7617 - 7618 *
"	1040	10/15-1-90 2V	2								*
"	1545	10/15-5-90 No 1	1	~~X~~	X						
"	1545	10/15-5-90 2V	2		X						

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Ben L. Bryant	9-17-90 0900	Linda K. Stevenson			
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	

WES FORM R Nov 89 2196 PREVIOUS EDITIONS OBSOLETE

COOLER RECEIPT FORM

Project: CRANE- ROCKEYE

Cooler received on 9/18/90 and opened on 9/18/90 by Linda K. Stevenson

Linda K. Stevenson
(signature)

1) Were custody seals on outside of cooler? ---------- YES NO
   If YES, how many and where? 3, front, side & back
   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, etc.)? --------- YES NO

4) Did you sign custody papers in the appropriate place? ---------- YES NO

5) Did you attach shipper's packing slip to this form? ---------- YES NO

6) What kind of packing material was used? Styrofoam peanuts

7) Was sufficient ice used (if appropriate)? ---------- YES NO

8) Were all bottles sealed in separate plastic bags? ---------- YES NO

9) Did all bottles arrive in good condition (unbroken)? ---------- YES NO

10) Were all bottle labels complete (No., date, signed, anal., pres, etc.)? ---- YES NO

11) Did all bottle labels and tags agree with custody papers? ---------- YES NO

12) Were correct bottles used for the tests indicated? ---------- YES NO

13) Were VOA vials checked for absence of air bubbles and noted if found? ---- YES NO

14) Was a sufficient amount of sample sent in each bottle? ---------- YES NO

Explain any discrepancies --->

USAE WATERWAY EXPERIMENT STATION

CHAIN OF CUSTODY RECORD

PROJECT NAME: NWSC, Crane, IN. Rockeye Mun. Fac.

SAMPLERS: (Signature) Ben W. Bryant

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	VOA	BNA	METAL	EXPLOSIVE		REMARKS
									LAB ID 7619-7633
9-21-90	1015	10/15-6A-1-90	1		✓	✓	✓		#1 was not on bottle
"	1015	10/15-6A-2V-90	1	✓					2V had been marked thru on vial
"	1015	10/15-6A-3V-90	1	✓					3V had been marked thru on vial
9-22-90	0820	10/15-4-1-90	1		✓	✓	✓		#1 was not on bottle
"	0820	10/15-4-2V-90	1	✓					2&3V had been marked thru-on vials
"	0820	10/15-4-3V-90	1	✓					
9-22-90	1105	10/15-14-1-90	1		✓	✓	✓		#1 was not on bottle
"	1105	10/15-14-2V-90	1	✓					2&3V had been marked thru on vials
"	1105	10/15-14-3V-90	1	✓					
9-22-90	1320	10/15-3-1-90	1		✓	✓	✓		#1 was not on bottle
"	1320	10/15-3-2V-90	1	✓					2&3V had been marked thru on vials
"	1320	10/15-3-3V-90	1	✓					
9-22-90	1500	Rinsate Sample-1	1		✓	✓	✓		
"	1500	Rinsate Sample-2	1		✓	✓	✓		
"	1500	Rinsate Sample-3V	1	✓					
"	1500	Rinsate Sample-4V	1	✓					

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Ben W. Bryant	9-24-90 0730	Linda K. Stevenson			
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	

WES FORM R Nov 80 2196 PREVIOUS EDITIONS OBSOLETE

COOLER RECEIPT FORM

Project: CRANE ROCKEYE

Cooler received on 9/25/90 and opened on 9/25/90 by Linda K. Stevenson
Linda K. Stevenson
(signature)

1) Were custody seals on outside of cooler? ---------- (YES) NO
If YES, how many and where? 1 front & back
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, etc.)? --------- (YES) NO

4) Did you sign custody papers in the appropriate place? ---------- (YES) NO

5) Did you attach shipper's packing slip to this form? ---------- (YES) NO

6) What kind of packing material was used? Styrofoam peanuts

7) Was sufficient ice used (if appropriate)? ---------- YES (NO)

8) Were all bottles sealed in separate plastic bags? ---------- (YES) NO

9) Did all bottles arrive in good condition (unbroken)? ---------- (YES) NO

10) Were all bottle labels complete (No., date, signed, anal., pres, etc.)? ---- (YES) NO

11) Did all bottle labels and tags agree with custody papers? ---------- (YES) NO

12) Were correct bottles used for the tests indicated? ---------- (YES) NO

13) Were VOA vials checked for absence of air bubbles and noted if found? ---- (YES) NO

14) Was a sufficient amount of sample sent in each bottle? ---------- (YES) NO

Explain any discrepancies --->

#7. Samples were room temperature when arrived. Informed P.F. & he said he would tell samplers to include more blue ice.

#11. VOA bottles had the 2V + 3V marked thru, #1 was not on the other bottle also

Appendix F
Response To Navy/Crane Comments

Naval Facilities Engineering Command Comments
and Replies to Internal Draft, RFI Phase II Soils,
Rockeye Munition Facility Report for
SWMU 10/15, Naval Surface Warfare Center Crane, Indiana, USAE-WES,
November 1991

A. General Comments (Pg.1 and 2 of comments)

Comment 1

INTERNAL. should precede DRAFT on the cover page. Headers (top-left and top-right) should not be included in the report cover page. The date should be listed on the cover page either below CRANE, INDIANA OR PREPARED FOR...

A copy of the Army Corps transmittal letter and accompanying distribution list must be bound in the report ahead of the cover page. The transmittal letter, attached to each report, will be a reproduction of the original letter bound in one of the copies sent to the Northern Division. The letter will be From: Army... To: Northern Division...

The proper SWMU name, based on the permit and NORTHDIV, is Rockeye, not Rockeye Munitions Facility. Please revise the cover text accordingly. The cover pages to the USAE-Wilmington reports and work plans should be consistent. The OBP Report (SEP '91), which omitted the date on the cover, is preferable with the title Installation Restoration Program - Corrective Actions on the top of the cover page.

Response

The report has been modified as suggested.

Comment 2

Place the executive summary after the Table of Contents, proceeding the "LIST OF ACRONYMS/ABBREVIATIONS. NAD on Page 44 should be "Naval Ammunition Depot," not "Naval Army Depot."

Response

The report has been modified and corrected as suggested.

Comment 3

The grammar of the report requires improvement. Grammatical errors and poorly constructed sentences were found throughout the report. The report must be proofed for grammatical and technical accuracy prior to submission to the Navy.

Response

The report has been proofed and improved as requested.

Comment 4

The statistical analysis of the data is inadequately explained and requires significant revision. The statistical analysis of the metal data seems to be obscuring rather than assisting data interpretation. This occurs--in part--from poor experimental design; in particular, the treatment of the background concentrations of the metal contaminants does not seem correct.

Response

Comparison of background concentrations of metal contaminants has now been made using subsurface soils data from the Ammunition Burning Ground (ABG) and the Old Rifle Range (ORR). Also, surface samples from Background North (BN) were included with Area C surface samples to give a larger and more representative number of samples for comparison purposes.

B. Specific Comments

1. Page i

Comment 5

The first sentence is awkward in its presentation o the acronym NWSCC. NWSCC should proceed Naval Weapons Support Center Crane (NWSCC). The second paragraphs incorrectly correlated a hazardous waste disposal unit with a SWMU. Please delete the last sentence of the paragraph and revise the 2nd: "...to be done at its Solid Waste Management Units (SWMU)." The third paragraph called the SWMU the "Rockeye Munitions Facility." That is not the SWMU name and if used it should be explained why it is different than the SWMU name in the permit.

Response

The report has been revised as suggested. Also, the name has been updated to reflect the current installation name.

Comment 6

The fourth paragraph associated the entire Rockeye operation with a sump operation. The reader is not told why the RFI was centered around a (past and/or present?) sump operation. Was the sump the only potential source of contamination? If so, specify the source which limited the area of contamination to the sumps. Please rewrite and briefly describe the significance of this operation. Specify the consequence of such an operation and state where the waste water was (and is) discharged.

Response

Historical treatments of the site (Navy and Army Initial Assessments) indicate that all wastewater from the Rockeye operation (tray wash and

baghouse) was discharged into the sumps. When the sumps filled, they were allowed to discharge to drainage ditches and north and south streams. Indications are that the pathways of all surface discharge were to these two offsite streams. Surface discharge was considered the pathway of concern. As presented in the Work Plan, the RI was designed to examine these routes and associated structures. The operation, past and present, is discussed in Section 1.3.0. and, as requested, summarized in the Executive Summary.

2. Page ii

Comment 7

(Third sentence, 1st paragraph). The statement "...was of lesser concern at the Rockeye..." does not fit the context of the paragraph. The paragraph attempts to describe the analysis performed. No rationalization is presented why every compound except explosives "was a lesser concern."

Response

The historical documentation focused only on explosive wastes. No indication of additional pollution was given. The paragraph has been modified to reflect this information.

Comment 8

(Last paragraph). Please describe the visual observations pertaining to the explosive contamination. State the matrix type for sample 10/15-14-90 (soil sample, water sample, etc.). Were any air samples collected and analyzed for explosives near the vents?

Response

The visual observation referred to from the 1983 NEESA study was pink water in the stream north of the facility. The matrix type for Sample 10/15-14 was soil, taken as a surface sample. In addition, the sample identifier has been changed to the alpha "H" in keeping with other surface samples. The paragraph has been revised to reflect this information. There were no air samples collected and analyzed for explosives near the vents.

Comment 9

The 2nd paragraph is an assortment of vague findings. For instance, without a reference, groundwater (in this case one word, 2 words in the preceding sentence) is said to be contaminated with explosives. The last round of groundwater data for the Rockeye showed very low levels of explosives in only the northeastern monitoring wells.

Response

The appropriate spelling of "groundwater" (one word) now is indicated in the revised paragraph. Also, reference is made to the current RFI Phase III Groundwater study which indicates that explosives contamination has been

detected in concentrations above "B" and "J" levels in several northeastern monitoring wells at Rockeye.

Comment 10

The 3rd paragraph referenced a "...visual observation (NEESA, 1986)..." that contamination exists at the Rockeye. I believe the NEESA document was published in 1983, not 1986. The Table of Contents listed the Bibliography as Page 40, instead of Page 44. The Bibliography did not list the title of the NEESA document correctly. The title is Initial Assessment Study, not Initial Site Assessment. The page number for ACRONYMS was also listed incorrectly.

Response

These items are revised as suggested.

Comment 11

(Last sentence). The author should be certain that present operations are "... affecting the environment..." The test should use more explicit language than "affecting the environment." Perhaps "contaminating the environment."

Response

The sentence has been revised.

3. Page 1

Comment 12

A comma should not separate Naval Weapons Support Center, Crane nor the NAD, Crane in the second paragraph.

Response

The grammatical change has been made as requested.

Comment 13

Please provide an explanation of the RFI Phase III Groundwater at Rockeye. The groundwater is a very important aspect of the RFI at the Rockeye. The reader must be made aware that the Navy is concurrently conducting a groundwater investigation at the Rockeye SWMU.

Response

An explanation of the RFI Phase III Groundwater study at Rockeye has been provided as additional paragraph in Section 1.2.0. In addition, a summary of the preliminary findings of this study, (as of March 1992), is given in Section 1.3.0.

Comment 14

The last paragraph of Section 1.2.0 should take the reader through the regulatory history of the IR Program at the NWSCC (i.e. from the IAS to the present). I do not feel Section 2.0 is adequate in such a task. Section 2.0 only lists the documents, which duplicates the Bibliography. Once such a summary is prepared, it can be used for each and every work plan and report, with only slight modifications.

Response

The last two paragraphs of Section 1.2.0 have been modified and greatly expanded to provide a summary of the IR program at NWSCC from the initial Army assessment in 1978 to the present. Also included is a summary of previous studies covering the Rockeye site and their findings.

4. Page 3

Comment 15

(2nd paragraph). Specify the percent by weight of the chemical components of "Octol Compound B". In particular, specify the presence of any TCL organics or TAL inorganics in Octol. Explain all abbreviations (e.g., "RDX") to the reader.

Response

The composition, in percent by weight, of the chemical components of Octol and Composition B (mislabeled "compound)" ar given in the revised paragraph. Octol and Composition B are actually two separate explosive compounds that are apparently blended for the Rockeye load.

Comment 16

(2nd paragraph). The text states: "The sumps are periodically pumped and the residue is sent to the Ammunition Burning Grounds." Please describe how the residue is sent to the Ammunition Burning Grounds.

Response

The paragraph has been revised to indicate that the residue is carried by truck to the ABG.

Comment 17

(3rd paragraph). Change the sentence: "Concentrations of explosives were found..." to "Explosives were found...."

Response

Sentence has been revised as requested.

Comment 18

The site map must be included for the Rockeye. Include the drainage ways and sumps and the map. Bill Murphy (USAE-WES) has several large scale maps for the Rockeye he has been using for the groundwater RFI which should also be used for this report. The report should also extract and reproduce figures from several other available sources to aid the reader through visual depictions of past sump operations and discharges at the Rockeye (e.g. Pollution Control Program, 1971, Department of the Army Installation Assessment of NWSC, 1978, etc.).

Response

A fold-up site map, at a scale of approximately 1-inch equals 100 feet, has been added as Plate 1 and enclosed in an envelope pouch with the report. The map includes the location of monitoring wells, soil borings, pertinent drainage ways, and sumps. Monitoring wells down-gradient of the site are shown on Plate 2. Figures 1.2, 1.3, and 1.4, taken from the Pollution Control Program, 1971, have also been added to the report, as suggested.

Comment 19

The last paragraph should summarize the levels of contaminants found in monitoring wells and a figure or map should show the location of the monitoring wells at the Rockeye. What concentration were found in what wells?

Response

A summary of the preliminary evaluations of monitoring wells in the Phase III Groundwater Study has been included, along with maps showing the locations of the monitoring wells. (See response to Comment 18).

Comment 20

The R has been omitted from RFI proceeding the title of Section 1.4.0.

Response

Comment noted and correction has been made.

Comment 21

(3rd sentence). Explain, or reference the appropriate paragraph, What the contamination routes are and Why they are contamination routes.

Response

The term "contamination routes" refers to the drainageways, or ditches and streams, where explosive-contaminated waters were discharged, primarily in the pre-1978 operations described in paragraph 3.0. The sentence (actually the fourth sentence) has been revised as suggested.

5. Page 4

Comment 22

The previous studies are not complete. Omitted were the Army's Assessment of 1978, and the Installation Assessment Relook Program (EPIC, 1985). Please include the information presented in the EPIC (1985) study for the Rockeye, which was called Site 3.

Response

A chronological summary of previous studies covering the Rockeye site, and their findings has been included in Section 1.2.0 along with a regulatory history of NSWCC (see Comment 14 and response.)

Comment 23

(Section 3.1.0). Describe how surface scrape samples were taken (e.g., sampling equipment). Provide some supporting evidence or source to the statement "Inorganic and organic compounds are of secondary concern."

Response

The surface "scrape" samples were actually taken at a depth of 3 to 6 inches below the ground surface, discarding vegetation up to 3 inches, using an individual strip of sheet plexiglas as a "scoop" for each sample. Since Rockeye is a facility for the production or assembly of explosive products, and historical discussions of operations do not discuss pollutants other than explosives, these compounds were the primary contaminants of concern. Organic solvents could have been mistakenly discharged into the waste stream, and metals are commonly found with munitions wastes. Therefore, some of the soil samples were also tested for other organic and inorganic compounds. The section in the report has been revised to reflect this information.

Comment 24

(Section 3.1.0). Why were no control (background) borings taken? The second paragraph stated that the stream beds were examined, but no map or figure is provided to show the proximity of the stream beds.

Response

It was thought that the chemical composition of the background surface samples would be representative of the area. Data from background borings at ABG and ORR have been included for comparison with Rockeye subsurface soil information. The location of stream beds and pertinent ditches where sampling was done is shown on Figures 3.1 and 5.3 through 5.5. The report has been modified to reflect this information.

Comment 25

(Section 3.1.0, 2nd para.) The text stated that a grid was placed at the site to detect spills. The text has been rewritten to indicate that the sumps were the primary source of contamination. What potential "spills" does the text imply?

Response

The sumps were the primary source of contamination, and the ditches and drains leading from them were the most likely receptors of that contamination. However, a grid system was established as a precautionary measure to determine the extent of possible contamination from overflowing of these ditches or drains. The paragraph has been modified to reflect this information.

6. Page 5

Comment 26

(Section 3.1.0). Please correct the grammar of the sentence: "In the ditch borings where..." Change to the following: "In the ditch borings (where soil thickness allowed) soil samples...were taken at the following depth intervals: 3" to 6"...".

Response

Sentence has been changed as suggested.

Comment 27

(Section 3.1.0). The use of the word "who's"..the contraction for "who is".. is incorrect.

Response

The appropriate word, "whose," has been used in place of the contraction.

7. Page 8

Comment 28

Add an appendix to the report and include all of the chain of custody forms.

Response

Appendix E, containing the chain of custody forms, has been added as suggested.

Comment 29

(Section 3.2.0). Refer the reader to a table which lists the sample container used for each type of chemical analysis.

Response

Table 3.11 has been added which lists the sample containers used for chemical analysis.

Comment 30

Specify in the last paragraph of Section 3.2.0 the name of the laboratory which received the air freighted samples.

Response

A statement has been added specifying the WES ANALYTICAL LAB GROUP as the laboratory which received the samples for analysis.

8. Page 9

Comment 31

(Table 3.2.). Indicate the analytical methods used to analyze the explosives and inorganics (e.g., method numbers, date of late revision, and instrumentation). Indicate the method of sample preparation and analysis for SW-846 methods.

Response

Table 3.2 has been replaced with Table 3.2.1, which contains the requested information.

Comment 32

(Section 3.3.0). Change the sentence: "To ensure the samples and their resultant chemical data is representative...." to "To ensure the samples and their resultant chemical data are representative....".

Response

The sentence has been corrected as suggested.

Comment 33

(Section 3.3.0). What "QA check samples" were reviewed (e.g., containing calibration checks)?

Response

Information is provided in Appendix B (excerpts of QA/QC) of the Phase II Soils Workplan for Rockeye, under the heading "Calibration Procedures." Any discrepancies are noted in the validation report contained in Appendix D of this report.

9. Page 10

Comment 34

(Section 3.3.0). Please explain the relevance of Figure 4.5 to QA.

Response

Figure 4.5 refers to aerial variability of soil thickness and not to QA.

Comment 35

(Section 3.3.0). Section 3.3.0 (titled "Parameters and Analytical Methods") describes chemical methodology and the soils of the Rockeye site. Since these topics are rather dissimilar, the soil results should be addressed in a separate section of the report.

Response

Section 3.30 only refers to chemical methodology. Section 3.4.0 refers to physical analysis of the soils.

Comment 36

(Section 3.3.0). State who validated the data. The criteria used to validate the data is not described in sufficient detail. For example, What criteria were used to investigate precision and accuracy for the volatile analyses--that listed in Table 7 of method 8240? NEESA Level C requires the use of control charts for assessing recoveries. How were the control chart results and the recovery criteria listed in Table 7 used to assess data quality? How was blank contamination assessed? Were EPA Functional Guidelines for the validation of CLP organic and inorganic analysis used? INCLUDE THE VALIDATION REPORT IN THE NEXT VERSION OF THIS REPORT.

Response

Discussion of control charts is contained in Appendix B (excerpts of QA/QC) of the Phase II Soils Work Plan. The Validation Report, prepared by the Analytical Laboratory Group (ALG) at WES, is enclosed as Appendix D to this report. Section 3.3.0 has been revised to indicate that ALG validated the data.

Comment 37

Please provide the Navy a copy of the Corps of Engineer manual EM 1110-2-1906, Laboratory Soils Testing, 1970. We had requested a copy of this manual with our ABG Phase III Soils comments (#23) dated 24 June 1991. We have not received a written response to those comments but have received a Draft issue of that report.

Response

A copy of the requested manual or information will be provided.

Comment 38

Section 4.1.0, second paragraphs stated that "...35 groundwater monitoring wells..." have characterized Rockeye. Please acknowledge in the text that there are currently over 100 monitoring wells existing at the Rockeye. I understand that there is not yet a published report to reference but an explanation should be provided for the RFI Phase III Groundwater under progress. USAE-WES Bill Murphy can provide information and possibly some recent cross-section.

Response

A third paragraph has been added to update the number of monitoring wells at Rockeye (107) and to reference the RFI Phase III Groundwater Study currently underway.

10. Figures

Comment 39

The source for each Figure (4.1. to 4.4) must be included on the figure. It is not acceptable to mention the source only in the text.

Response

The source for each figure has been included on the figure as suggested.

Comment 40

A legend should be included for the small reference block provided in the upper left hand corner of Figures 4.1-4.4 to distinguish wells from soil borings. The monitoring well numbers presented on Figure 3.1 do not appear to be complete, when compared those on Figure 4.1.

Response

The legend for monitoring wells has been added as suggested. The revised Figure 3.1 includes additional wells existing within the coverage area of that figure.

11. Page 11

Comment 41

A figure or map should be included with highlighted surface drainage features.

Response

Plate 2 has been added, which shows topographic features in the immediate vicinity of Rockeye. Major surface drainage features at Crane are also depicted on Figure 1.11. These illustrations are now referred to in Sections 4.2.0 and 4.30 of the report.

Comment 42

The last paragraph of Section 4.2.0 should refer the reader to the soil boring logs in Appendix B and the Appendix C Soil Data.

Response

The suggested references have been made in the last sentence of the paragraph.

Comment 43

The first paragraph of Section 4.3.0 stated that "...groundwater table roughly parallels the topographic surface." A map or figure should be included which depicts the topographic features. In the following sentence "sites" should be replaced with "areas."

Response

Plate 2 showing topographic features has been added (see comment 41 and answer). The sentence referred to in Section 4.3.0 with the word "sites" has been removed.

12. Page 17

Comment 44

I don't understand why the last sentence of the first paragraph, Section 5.1, stated the RMF would be referred to as Rockeye. A statement like this should be made at the beginning of the report and followed throughout. Rockeye is the proper SWMU or site name (see comment #1). The title of the IAS in the second paragraph is not correct. Rockeye was not included in the title of the study and the study labeled the site "Rockeye Site #15."

Response

The last sentence of the first paragraph, Section 5.1, has been eliminated, and the facility is now referred to as Rockeye throughout the report. The title of the IAS in the second paragraph has been corrected.

13. Figure 5.1

Comment 45

This figure is difficult to read (copy quality is poor--the figure is too dark).

Response

The figure has been reproduced to provide better readability.

14. Page 18

Comment 46

Please explain the rationale for the surface sample locations. In particular, why were surface samples taken on both sides of the "drainage course" (Grid Area B) in some locations but not in other locations (e.g., Grid Area A)? In addition, the report should specify the analytes that were tested at each of the surface sample locations in Figures 5.3 to 5.5.

Response

Sample locations were chosen based on accessibility and suitability - likelihood of receiving and retaining contaminated deposits. Surface samples were not taken on both sides of the drainage course at Grid Area A due to inaccessibility (wooded area) on the south side. In other locations, samples were taken in overbank areas where high flows would have likely deposited contaminated soil materials (Grid Area D).

Comment 47

The "plastic hand scoop" was composed of what type of plastic?

Response

The tool used for gathering scrape samples was a strip of plexiglas, with separate strips for each sample. The report has been modified to indicate that plexiglas was used.

15. Page 24

Comment 48

The report states: "The Chemical Analytical Data, Validation Report...is included in Appendix C." This information is not present in Appendix C. Summary chemical data is presented in Appendix A but there is no data validation report. Please include the validation report in the next version of this report.

Response

This statement incorrectly stated that the validation report was contained in Appendix C, rather than Appendix D. The report has been corrected.

Comment 49

Page 18 states: "No 'control or background' subsurface samples were taken..." However Page 24 states: "Mean concentrations of inorganic constituents from test borings were compared to those of control borings..." Please explain what samples constituted the control borings.

Response

No background borings were taken. Mean concentrations of inorganic constituents from test borings were originally compared to background surface samples. Subsurface background samples from ABG and ORR have now been used for comparison in the revised report.

Comment 50

The report states: "Means were computed from all samples from a specific boring; however, control means were computed using all samples taken from surface sample Area C." The report should justify this treatment of the data. (For example, was surface soil composition in Area C similar to the subsurface soils composition in the test borings?)

Response

It was considered that the surface samples were derived from the same material as the relatively shallow subsurface, and their data should substitute for control or background data. However, as mentioned in the response to Comment 49, subsurface background data from ABG and ORR have now been used for comparison, since those soils are somewhat similar to Rockeye soils.

Comment 51

State the confidence level that was used for the F-test.

Response

The confidence level used for the F-test is 95 percent.

Comment 52

The report should present equations and sample calculations to illustrate the statistical treatment of the data. For example, the null hypothesis for the t-test used should be expressed by equations.

Response

Comment noted. The revision has been made in the report text.

Comment 53

Several background samples could have been collected for each soil strata. This would have been particularly helpful for the analysis of metal analytes. For example, the concentration of lead found in a sample collected in a sandy layer could have been compared to the background lead concentration in a sand layer.

Response

Several background samples from each soil strata to use for comparative purposes would have been ideal. Since this was not done, background subsurface samples from ABG and ORR, which had somewhat similar soils, were also used to qualitatively compare test borings at Rockeye. (See response to Comment 49).

Comment 54

The report states: "Even if the specific soil samples were taken from the same elevation in the boring, that elevation may not correspond to the same soil strata from one boring location to the next." The report then concludes that a "comparison of a specific sample from boring to boring may not be relevant." The conclusion is well justified. However, it also tends to invalidate the statistical treatment of the data that the report does present. Mean analyte concentrations of each test boring are compared to the corresponding mean analyte concentrations for the background surface samples. Surface soil composition may not "correspond to the same soil strata" in the test borings. If it is invalid to compare results at a particular soil depth for boring to boring because soil strata differ from boring to boring, why is it valid to compare surface soil results (in the background samples) with the mean results of each test boring?--in both cases, results form different soil strata are being compared. (Each test boring is composed of several types of soil layers; these soil layers may differ from the surface soil.)

Response

Comment is well taken. This discussion has been removed from the report, and reference is made to comparison of test borings with background subsurface soils data from ABG and ORR.

16. Page 25

Comment 55

Were all samples from Area C used as control samples for the metal analyses? If not, please indicate what Area-C samples were the background samples.

Response

Due to economic reasons, 4 of the 20 samples (20%) from Area C were analyzed for metals, those being C-0-1, C-1-2, C-2-3, and C-3-2. (See Figure 5.4 for relative locations).

Comment 56

Please explain the reference to "contract required detection limits"...SW-846 and not CLP methods were specified for the chemical analyses.

Response

SW 846 methods were specified for chemical analysis. The term "contract required" has been removed from the sentence.

Comment 57

The laboratory method detection limits should be listed for all the analytes tested in the tables that summarize the analytical results.

Response

The detection limits are given after the < sign and are shown for samples with undetected contaminates (indicated by the "U", described in the footnote to the tables).

Comment 58

(Table 5.4). Table 5.4 states: "Results from borings 1-9...were not statistically compared to Area C samples..." (The results for borings 1-9 are presented on Page 1 of Table 5.4). What statistical calculations (shown on the bottom of Table 5.4, Page 1) are presented for borings 1-9? For example, "<1.50" is listed as a mean on the bottom of the "Sb" column--it is the mean of what results?

Response

The statistical information on the bottom of Table 5.4, Page 1, does not appear relevant and has been removed.

Comment 59

(Table 5.4, Page 2). Table 5.4 should list the 95% confidence interval for the mean analyte concentrations. T-test and F-test results should also be summarized. For example, was the mean Zn concentration of boring 10 found to be statistically different from the mean Zn concentration of the control samples? Listing the mean Zn concentration for boring 10 and the control samples per se does not constitute a statistical comparison.

Response

A graphical method of comparison has been used. See Figures 5.9A through 5.9V in the report text.

General

Comment 60

A discussion of the quality of the analytical data must be presented before a discussion of the statistical analysis of the data!

Response

Concur. Statements have been added to the report in Section 5.1 which address quality control.

Comment 61

Identify the four background surface samples from Area C. If the results of the BN 2 sample were believed to be consistent with background conditions, why weren't the metal results from the "BN 2" sample averaged with the surface soil results of Area C to increase reliability of the mean, background, analyte concentrations?

Response

As stated in the response to Comment 55, the four background surface samples from Area C were C-0-1, C-1-2, C-2-3, and C-3-2. The BN 2 sample has now been included with Area C samples as suggested.

17. Page 30

Comment 62

Please explain the statement: "The sample variances were large enough so that statistically significant differences between background and 'test' sample means could not be determined even though those differences may have been the largest." T-tests may be performed for populations with different variances. T-test and F-test results should be summarized in tables to support the discussion of the statistical results.

Response

The statistical analyses have been revised. This statement has been removed from the report and other relevant discussion has been added.

Comment 63

If the "Rockeye Area C (control) samples were similar to those of the other NWSC control areas", why weren't the results from the other control areas incorporated with the Control Area C results? More confident means for the control data could have been calculated.

Response

While it is true that a larger number of samples might be more meaningful statistically, it was felt that the total number of control samples (5) used from Area C and Background North was sufficient and would offer better comparison with test soils from the same site. This was not possible for subsurface soils, since no background or control subsurface soils were taken at Rockeye.

Comment 64

The conclusions presented in Table 5.4 and the tables on the bottom of Page 30 should be illustrated with at least one sample calculation. For example, Page 30 and Table 5.4 indicate that the mean Ar [As] concentration for soil boring 10, $\langle X \rangle = 4.92$, is significantly greater than the mean Ar [As] concentration for the control samples, $\langle X \rangle' = 3.27$. The standard deviations for X and X' are 1.19 and 0.7, respectively. (It is not clear if these two numbers are the standard deviations, s, for an individual result or for the means, s[mean] = s/SQR(n), where SQR = square root and n = number of trials; a conservative assumption will be made--namely, that they are the standard deviation for individual results.) The results of an F-test can be used to demonstrate that the two variances are not statistically different. Hence a pooled standard deviation may be calculated for the two means: s[pooled, mean] = SQR([(1.19) (1.19) + (0.7) (.7)]/4) = 0.69. (Hence, the 95% confidence interval for the mean Ar [As] concentration of boring 10 is: 4.92 +/- (0.69) x (3.18) = 5 +/-2, rounded to the nearest positive integer; stated another way the mean Ar [As] concentration is 3 - 7 with 95% confidence.) $\langle X \rangle = 4.92$ can now be compared to $\langle X' \rangle = 3.27$ (the mean Ar [As] concentration of the control samples) using a t-test:

Null Hyp. : $\langle X \rangle <= \langle X' \rangle$
Alt. Hyp. : $\langle X \rangle > \langle X' \rangle$

t[calculated] = [$\langle X \rangle$ - $\langle X' \rangle$] / s[pooled, mean]

t[calculated] = [4.92 - 3.27]/ 0.69 = 2.4

t[critical, 95%, 6 degrees freedom] = 1.9
(for a one sided t-test)

Since t[calculated] > t[critical], one accepts the alternative hypothesis.

Note, however, that the two means are statistically different by a small margin; the means are not statistically different at the 99% confidence level. Furthermore, the arsenic concentrations for borings 10-13 are rather similar. This seems to imply that arsenic concentrations are not significantly different from background concentrations in the soils. The incorporation of the results from previous background Ar [As] analyses might have yielded similar conclusions. For example, the mean arsenic concentration for the control samples for the Old Rifle Range is 9.5 ppm, which is significantly higher than the mean Ar [As] concentration of Area C control samples. It is recommended that the other metal results be reexamined.

Response

The statistics have been reanalyzed and comparisons have been more appropriately made between similar types of samples (ie., subsurface compared to background subsurface, surface to background surface). The other metals results have been reexamined as suggested.

18. Page 31

Comment 65

The report states: "In summary, comparisons of metal constituents in control soils and sample subsurface soils (test borings) indicated that releases of arsenic...may have occurred." The presentation of the analytical results does little to justify this conclusion.

Response

Concur with commentator. This statement has been removed and the discussion of metals revised.

Comment 65(i)

The mean analyte concentrations for the Rockeye site judged to be statistically significant (in this study) are lower than the corresponding mean control concentrations of other studies. For example, mean Cr concentrations from 17 - 23 ppm were judged to be significantly different from the Area-C background Cr concentration 15 ppm; the Old Rifle Range and Ammunition Burning Ground Cr control concentrations are over 30 ppm. The report recognizes this is true (2nd paragraph of Page 31) but does not account for difference. Why are the Area-C background results for Cr more valid?

Response

The statistics have been reanalyzed. Rockeye surface samples are now only compared with Rockeye background surface samples, which include Area C and BN-2. For chromium, the mean of 26.3 ppm for all Rockeye surface samples is similar to that of the background (24.1 ppm). Comparison with the other sites are made only for subsurface samples (borings). The report has been rewritten to better reflect the data.

Comment 65(ii)

The approach of comparing test-boring, metal concentrations (averaged with respect to several soil strata) to mean background surface-soil concentrations was not justified.

Response

Concur. The comparison technique has been revised. (See answer to comment 65(i).

Comment 65(iii)

The report states that no pattern to the metal contamination could be determined. ("The factors contributing to the patterns of metals concentrations in the soils, or the lack of them cannot be determined from available data). Hence, probable source of the metal contamination is not presented. For example, the report does not state why there statistically significant concentrations of Ar [As].

Response

The discussion of the analytical results in Section 5.2 has been revised to better reflect the available data.

Comment 65(iv)

Assuming that the Rockeye Area-C control data is reliable and one agrees with the conclusion that certain mean concentrations of metals are higher than the corresponding mean background concentrations, the reader is not presented with enough information to determine whether these metal concentrations are high enough to be hazardous (e.g, does a Cr concentration of 20 ppm in the soil exceed any ARARs?). The object of this study is not to determine whether certain chemical species are present in the soils but to determine whether certain chemical species are present in the soils at concentrations that could be hazardous. (Exposure of a sufficiently high quantity of almost any chemical is hazardous). The "RCRA Corrective Action Plan" for NWSC states RFI Phase II for the soils should "address the degree of hazard...of the pollutants considered."

Hence, the conclusion that a release of certain metals has occurred seems to be misleading.

Response

Concur. The report has been rewritten to include a discussion of how the metals concentration in the samples compare with risk-based screening numbers developed by EPA.

Comment 66

The tables presented in Appendix A would be more readable if "non-detections" were omitted.

Response

This is true. However, there is a tremendous amount of information supplied in non-detected results. This shows how free of contaminants a site is.

Comment 67

The detection limits of the explosives should be presented in a separate column of Table 5.9 (and 5.10-12). Nondetections should be omitted from the table. The report should also describe or reference the procedure used to determine the detection limits. What type of detection limits are presented (method detection limits at 99% level of confidence, instrumental detections limits at 95% level of confidence, etc.)?

Response

See response to comment 66 concerning non-detections. USATHAMA methods, now contained in EPA Method 8330, were used to detect explosive compounds. The estimated quantitation limits were listed on the table as detection limits, and came from Method 8330.

19. Page 32

Comment 68

Please define the term "statistical quantitation limits." What are the quantitation limits for the analytes tested and how were they determined?

Response

The term "statistical" has been removed. The quantitation limits for the tested explosives are shown in Tables 5.9-5.11 where no analytes were detected, and come from Method 8330.

20. Page 33

Comment 69

Please explain how an "airborne release of explosive compounds" was determined by visual observation (color, odor, etc.).

Response

The visual observation made was the bare area on an otherwise grassy berm beneath an exhaust vent. The report sentence has been revised to include this information. (The shape of the bare area was a strong indication that the release had come from the exhaust vent).

21. Page 34

Comment 70

The results of the method and reinstate blank analyses for volatiles are not shown in Appendix A.

Response

This information was inadvertently omitted from Appendix A and has now been included.

Comment 71

(71) The report should indicate the blanks associated with each of the samples.

Response

This information has now been included in Appendix A.

22. Page 35

Comment 72

Please clarify the following conclusion:

The possibility that 2-butanone and 1,2,2-trichloromethane (TCA) detected in the soil samples originated from the sampling gear and the decontamination procedures cannot be confirmed or refuted with available information.

Why is this so? If these two volatiles were found in associated equipment rinse blanks, it is reasonable to assume that these volatiles are not present in the soil--especially if there is no pattern to the detection of the volatiles. Were the concentrations detected the soil samples not similar to the concentrations in the rinse blanks?

Response

Even though these two volatiles were found in two equipment rinse blanks, (from borings 3 and 7), they were not found in the soil samples 3 and 7. Also, these two volatiles were not detected in samples taken from borings 12 and 8, which immediately followed borings 3 and 7, respectively. In any case, the concentration detected in both soil boring samples and rinses were estimated values (J values) below the quantitation limits and are not considered significant.

Comment 73

The report does not adequately address the tentatively identified volatile compounds detected. In particular, could the detection of hexane, methylpentane and the dimethylhexenes for the soil samples be attributed to the equipment rinsing procedure? Were any of these hydrocarbons found in associated blanks?

Response

Hexane and methanol were apparently used in secondary equipment rinses. A paragraph has been added suggesting that the assigned identity and estimated concentrations of tentatively identified compounds (TICs) are in most cases highly uncertain. Information on TICs has been provided primarily to complete the presentation of data.

23. Page 34

Comment 74

(Third and fourth paragraph). The report sites that a release of several volatile compound may have occurred at the Rockeye Munitions Facility. This statement seems misleading. Very low levels of volatiles were detected. Of the volatiles detected, several can be attributed to laboratory or sampling procedure contamination. Furthermore, no clear pattern of volatile contamination exists. The report does not even address the reliability of the method detection limits. (When were the method detection limits determined)? How were they determined?) The detection of a volatile near a reported method detection limit per se is not sufficient to conclude the volatile is present in the soil. Assuming certain volatiles are present in the soil at low concentrations, the report does not indicate whether these concentrations are high enough to be considered hazardous.

Response

Method detection limits are specified by EPA method 8240, part of SW 846. The report has been revised to indicate that low concentrations (near the quantitation limits) are not considered significant.

24. Page 36

Comment 75

Can of the tentatively identified semi-volatiles be attributed to the decomposition or combustion of Rockeye explosives? (From the compounds listed in Appendix A, this seems probable).

Response

The semi-volatile TIC's are most likely attributed to the presence of explosives, as suggested.

General Comment 76

Were background samples analyzed for PAH's?

Response

Yes. As indicated in Table 5.20 of Appendix A, Background North #3 and Area C samples continued no detectable semivolatile organic analytes. PAHs were included in the list of analytes.

General Comment 77

Laboratory QA/QC is not adequately addressed. For example, matrix-spike recoveries, surrogate recoveries, and duplicate precision were not discussed.

Response

Laboratory QA/QC is discussed in the Validation Report contained in Appendix D of the report.

25. Page 41

Comment 78

The report states that the BN site was rejected as a control area because an insufficient number of samples were analyzed for metals. Why weren't a sufficient number of background samples collected for metal analysis? Why weren't the results of the single BN metal analysis and previous background studies combined to generate more confident background data? A literature search should be conducted for metal concentrations that are "typical" for the region. Background concentrations obtained in this study and in previous studies should be compared to the literature values in qualitative manner.

Response

The results of the BN-2 sample have been included with Area C for composite surface background data. A literature search for "typical" metal concentrations for the region was conducted, as suggested. However, this endeavor did not yield any information for heavy metals and those of most concern relative to toxicity (i.e., arsenic, cadmium, chromium, lead, etc.). Instead, subsurface background data from two other NSWCC sites were used, which had somewhat similar soils as Rockeye.

26. Page 42

Comment 79

The report states that the highest PAH concentrations were detected in sample 14, [H] which was collected near an exhaust vent. Were HNu readings taken near the exhaust vent. What was the source of the vented air?

Response

No HNV measurements were taken for sample H. (Air quality measurements are recommended for the next study phase). The source of the vented air was apparently from Building 2734.

27. Page 42

Comment 80

The report should present more definitive conclusions concerning the TCL semivolatile contamination. TCL semivolatiles do not appear to be present at significant concentrations. Is additional sampling for TCL semi-volatiles recommended? If so, why?

Response

The report has been revised as suggested. Additional sampling for TCL semivolatiles is recommended in view of the concentrations detected in sample H, near the building ventilator. Since the highest concentrations (above J values) were noted in that location, sampling could likely be restricted to the immediate facility area (excluding facility perimeter).

28. Page 38

Comment 81

The report states:

a. A release of metal constituents (contaminants) may have occurred at the Rockeye Munitions Facility.

b. The difference in inorganic chemical characteristics between control and test soils may be due to natural variability in the soils and not a function of anthropogenic activities.

The two conclusions are incompatible with one another. Stating them both is equivalent to stating "metal contamination could not be assessed." Furthermore, the report does little to support the second hypothesis--it merely states it. The report try support the first or the second hypothesis. (Though, I believe the second hypothesis is more defensible.

Response

This section (5.3) has been removed from the report, as the information is contained in previous and following sections. The two conclusions referred to have been discussed further in Section 5.2 of the report.

29. Page 43

Comment 82

The "Recommendations" section of the report is completely inadequate. The report states a Phase III Soils Study is recommended but does not state specific objectives for the Phase III study. For example, what analytes should and what analytes should not be investigated in the Phase III study? In what locations is chemical data insufficient? What will be done with data from the additional analyses that are proposed?

Response

The "Recommendations" section has been revised to more specifically state the objectives for the Phase III study. More surface soil sampling along with air monitoring/testing is recommended near the production buildings to determine primarily the extent of explosive contamination in the vicinity of those facilities. Additionally, soil borings are recommended for the background areas to more completely represent the subsurface background for inorganic analytes. Borings near the facility perimeter are recommended to determine the vertical extent of the contaminants there. Surface water and additional sediment samples from drainageways and receiving streams are also recommended. The purpose of the additional analyses is to better define the presence and extent of contaminants, primarily metals and explosives, so as to provide information that would be useful in determining any appropriate remedial action.

NAVAL SURFACE WARFARE CENTER CRANE COMMENTS
AND REPLIES TO INTERNAL DRAFT RFI PHASE II,
SOILS, ROCKEYE MUNITION FACILITY REPORT
FOR: SWMU 10/15, NAVAL SURFACE WARFARE CENTER CRANE, INDIANA,
USAE-WES, NOVEMBER 1991

A. General Comments (Pg. 1 of Comments)

Comment 1

Check spelling, subject - verb agreement, verb tense, etc. Individual errors will not be listed. Check document thoroughly. Watch for items which will not be picked up by a spell checker (e.g., p.40, §6.0 ¶2 Last sentence: steam v. stream).

Response

The report has been revised as suggested.

Comment 2

Proper, current nomenclature: Naval Weapons Support Center Crane (NWSCC), Crane Indiana -- first use, thereafter -- NWSCC.

Response

The proper, current nomenclature: NAVAL SURFACE WARFARE CENTER, CRANE INDIANA, has been used in the beginning of the report and referred to by acronym (NSWCC) thereafter.

Comment 3

Further explanations of the purpose and location of the sumps are in order in §1.0. A full-page map showing the sumps, drainageways, and sample locations would be very helpful.

Response

The report text has been revised as suggested and Figure 3.1 has been expanded to a full-page foldout map with suggested information provided.

Comment 4

The report has several critical deficiencies which cause one to question the usefulness and reliability of the data and conclusions.

a. No background borings
b. No field duplicate (split) samples
c. No field blanks
d. No depth information for 06A/1

Response

Background boring information from two other previously studied NSWCC sites, Ammunition Burning Ground (ABG) and the Old Rifle Range (ORR) has been used for comparison with the Rockeye borings. Background borings for Rockeye are recommended in the next phase of study. While NEESA Quality Control Level C procedures were not totally adhered to as planned, it is believed that the data as obtained has value for determining the presence or absence of the analytes tested. As stated in the revised report, increased efforts to better implement appropriate field quality control will be made in the next study phase.

B. Specific Comment 5

Comment 1 (Page 1, Section 1.3.0, Sentences 1 & 2).

Redundant: "Rockeye is a 10 acre site located in the north central portion of the facility. The location is in the north central portion of the base..."

Response

The referred to text has been revised to remove redundancy.

Comment 2 (Page 1 & 3, Section 1.3.0, Paragraphs 1 & 2).

a. Drainage to the north and east goes to Sulphur Creek, not Little Sulphur Creek. Little Sulphur drains the Ammunition Burning Grounds.

b. Drainage to the south goes into (and is the origin of) Turkey Creek. Turkey Creek eventually joins Boggs Creek. See also p.10, §4.1.0 ¶1.

Response

The report has been revised as suggested.

Comment 3 (Page 3, Section 1.3.0, Paragraph 2, 7th sentence).

Cite your source of information for stating that waste waters were discharged to local streams.

Response

Reference to the 1983 NEESA Initial Assessment Study has been cited after this statement. (This entire section has been revised).

Comment 4 (Page 4, Section 3.1.0, Paragraph 1)

5th sentence, "In the drainage ways, surface soil (scrape) samples were taken." Compare to the 9th sentence, "The vertical soil borings were augered...in the base of the surface drainage ditches." Confusing to the

reader - were samples in the ditches scrape or auger?

Response

Samples taken near the sumps and ditches leading from them were from soil borings. Samples taken in and adjacent to the drainageways (stream and ditches) along the facility perimeter were surface scrape samples, actually taken at a depth of 3 to 6 inches to avoid surface vegetation. This section has been revised to more clearly define the sampling procedures.

Comment 5 (Pages 4 & 8, Section 3.2.0, Paragraph 1)

Certain explosives, particularly TNT, photodegrade. As such, were the samples collected in amber bottles?

Response

The samples tested for explosives were collected in clear bottles. If photodegradation did occur after the sample was collected, the test results could have understated the concentration found in the soil, further enforcing the conclusion that explosive contamination is evident at this site.

Comment 6 (Page 17, Section 5.1, Paragraph 2, last sentence)

Effluent treated by an activated carbon treatment facility.

Response

The statement has been revised as suggested.

Comment 7 (Page 18, Section 5.1, paragraph 7, Sentences 4-6)

I'm not sure I understand the significance of locations F&G. Why were they not grid samples? Why were they chosen? Why are E, F, & G so close together?

Response

When Area D was gridded and sampled, the stream bed was intended to be sampled as well. However, it was not sampled at that time due to standing water (which was a red color, indicating possible explosive contamination). The G-samples were taken from the stream bank and were not a part of the D grid. The F samples ware taken in the stream bed, further from the discharge pipe, at a later date than were those from grid Area D.

Comment 8 (Pages 21-23, Figures 5.3-5.5)

Was there a reason that grid E included samples from within the drainage course, yet samples A-D did not?

Response

Areas A-C were not sampled in the drainage source due to standing water or highly eroded conditions. It was felt that, if the stream bed showed evidence of high erosion, any contaminants would likely have been washed further downstream. In some cases, the stream banks were sampled instead. (See also answer to Comment 8 above).

Comment 9 (Page 18, Section 5.1, Paragraph 9, 3rd sentence)

There is no indication that field duplicate (split) samples were taken. Is there a reason for this?

Response

Duplicate samples were not taken. Ten percent of samples taken were supposed to have been duplicates, according to NEESA Level C quality control. This protocol will be followed in future field work.

Comment 10 (Table 5.1)

What is the significance of 06A? What does the A represent?

Response

Boring #6 could not be sampled due to high HNU readings encountered at that site. Instead, the drill rig was relocated, and another boring was completed at location 6A. The "A" merely indicated that boring 6 had been relocated in order to obtain subsurface samples.

Comment 11 (Table 5.10)

Evaluate explosives analyses for surface scrape samples in light of UV degradation.

Response

Since certain explosives do degrade in the presence of ultraviolent light, it seems likely that the concentrations of explosives in the samples would be less than when the contaminants were deposited. Additionally, the use of clear bottles for sample collection may have resulted in test results which showed lower concentrations than actually existed in the soil at the time it was sampled. (See answer to Comment 5). Amber bottles will be used for future sampling for explosive analytes.

Comment 12 (Page 25, Section 5.2.1, Paragraph 2)

Perhaps comparisons to background samples should be done using Area C in conjunction with BN-1 - BN-3 to provide a more representative control. The report hypothesized that due to site drainage characteristics, BN-1 - BN-3 should not be contaminated. Therefore, either they should still be considered and evaluated as control samples, or an attempt made to explain why contamination was present.

Response

Concur. Sample BN-2 was included with Area C as part of the background samples for metals analysis in the revised report.

Comment 13 (Page 32, Section 5.2.2 and Table 5.4 [5.9] and 5.10.

Another way of stating the surface scrape results is that for areas A-F, only samples B-3-2 and E-3-4 had detectable concentrations (HMX) above the statistical quantitation limits.

Response

Concur with commentator. The report has been revised to reflect this statement.

Comment 14 (Page 32, Section 5.2.2, Paragraph 5)

I agree that this is a logical conclusion, but I'm not convinced that the data is so supportive.

Response

Although the data did not indicate concentrations of explosives above J values in borings associated with the sumps, higher values were detected in ditch borings and in some surface samples. Especially noteworthy are the concentrations detected in Sample H. Considering historical accounts of possible releases (red water noted in ditches) along with the laboratory data, the conclusion made in the report does not appear unreasonable.

Comment 15 (Tables 5.15 and 5.16)

Missing. Without these tables it is hard to evaluate the other findings. Perhaps some MECl and Acetone were detected, i.e., are the reported values greater than 10 times the method blank results? (e.g., B-4-1 [MECl] = 0.48, and 13#3 [Acetone] = 0.35). Furthermore, A-0-0, A-3-3, and A-4-1 for MECl have reported concentrations of 0.030, 0.037, and 0.034 respectively without any qualifiers.

Response

Tables 5.15 and 5.16 ware inadvertently omitted in the original report and are now included in Appendix A. Methylene chloride and acetone were also detected in the associated method blanks, likely indicating that these may be laboratory contaminants rather than contaminants found in the soils.

Comment 16 (Page 34, Section 5.2.3)

In summary, the only volatile organic contaminants presented without qualifiers are MECl for A-0-0, A-3-3, and A-4-1; and 111tCA for 1#2.

Response

Due to the high incidence of occurrence in the method blanks, MECL is not considered a likely soil containment. (See answer to Comment 15).

Comment 17 (Section 5.2.4)

The only semivolatiles presented without qualifiers are:

8#1 DBuPHTH, B2EHPH
11#2 B2EHPH
12#3 B2EHPH
14 PHENAN, FLANTHE, PYRENE

Response

DBUPHTH and B2EHPH concentrations shown for Boring 8#1 and B2EHPH shown for boring 11#2 in Table 5.18 (Appendix A) appear to be J values and are now so indicated. The concentrations for B2EHPH in sample 12#3 should be correctly shown. However, this contaminant was also found in the method blanks and is not considered a soil contaminant in this sample. The contaminants indicated for sample 14 (now sample H) are above J values and are discussed in the text of the report.

Comment 18 (Pages 37-39, Section 5.3)

Perhaps this section should be deleted since most of the information was discussed in §5.2 and summarized in §6.0.

Response

Pertinent information from this section has been included in Section 5.2 and Section 5.3 has been deleted as suggested.

Comment 19 (Page 43, Section 6.0, last paragraph, 4th sentence (also Page ii, Paragraph 3, 3rd sentence).

No explosive contamination was found in Area D. See Table 5.10.

Response

The commentator is correct. Reference to Area D as containing explosives has been eliminated.

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13. ABSTRACT ***(Maximum 200 words)***

An RCRA Facility Investigation Phase II Soils Study was conducted at the Rockeye Site, Naval Surface Warfare Center Crane, Indiana, by personnel of the Geotechnical Laboratory, U.S. Army Engineer Waterways Experiment Station, and the U.S. Army Engineer District, Wilmington.. The field work was done in September and October 1990, and analytical work in September, October, and November 1990, data reduction from December 1990 to July 1991, and report writing and revisions from February 1992 to August 1998. A clear case for the presence of explosive compound contamination in the soils at the Rockeye site was made. TNT, RDX, and HMX were found in soils at the site indicating that past and present operations may be contaminating the environment.

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