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Remedial Investigation Work Plan for Bear Creek Valley Operable Unit 2 (Rust Spoil Area, SY-200 Yard, Spoil Area 1) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee

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MARTIN MARIETTA ENERGY SYSTEMS, INC.
managing the

Oak Ridge K-25 Site
Oak Ridge Y-12 Plant
Oak Ridge National Laboratory
under contract DE-AC05-84OR21400

Paducah Gaseous Diffusion Plant
Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-76OR00001

for the
U.S. DEPARTMENT OF ENERGY

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ACRONYMS

1,2-DCE	trans-1,2-dichloroethene
AAS	atomic absorption spectroscopy
ALARA	as low as reasonably achievable
ANPRM	Advance Notice of Proposed Rulemaking
ANSI/ASME	American National Standards Institute/American Society of Mechanical Engineers
APR	average or mean percent recovery
ARARs	applicable and relevant or appropriate requirements
ASC	Analytical Services Coordinator
ATDL	Atmospheric Turbulence and Diffusion Laboratory
BCK	Bear Creek Kilometer
BCV	Bear Creek Valley
CAA	Clean Air Act
CAR	Corrective Action Report
CDB	Consolidated Data Base
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
CPFs	carcinogen potency factors
DCA	dichloroethane
DCE	dichloroethene
DMC	Data Management Coordinator
DOD	U. S. Department of Defense
DOE	U. S. Department of Energy
DOE-OR	DOE Oak Ridge Field Office
DQO	Data Quality Objectives
EA	Environmental Assessment
EFPC	East Fork Poplar Creek
Energy Systems	Martin Marietta Energy Systems, Inc.
EPA	U.S. Environmental Protection Agency
EP tox	extraction procedure toxicity
ER	Environmental Restoration
ESD	Environmental Sciences Division
ESF	Environmental Support Facility
FDA	U.S. Food and Drug Administration
FFA	Federal Facility Agreement
FID	flame ionization detector
FR	*Federal Register*
FS	Feasibility Study
FSP	field sampling plan
FTA	Fire Training Area
FTL	Field Team Leader

HPD	Health Physics Department
HSWA	Hazardous and Solid Waste Amendments
IAEA	International Atomic Energy Agency
ICF	inductively coupled plasma
IRIS	Integrated Risk Information System
LCS	Laboratory Control Sample
LDR	land disposal restrictions
LLW	low-level waste
MCL	maximum contaminant level
MDL	method detection limit
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NCP	National Contingency Plan
NCR	Nonconformance Report
NEPA	National Environmental Policy Act
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPRM	Notice of Proposed Rulemaking
NRC	Nuclear Regulatory Commission
NT	North Tributary
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PA	Preliminary Assessment
PAHs	polycyclic aromatic hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability Information
PC	personal computer
PCBs	polychlorinated biphenyls
PCE	perchloroethene (or tetrachlorethene)
PGDP	Paducah Gaseous Diffusion Plant
PID	photoionization detector
PPE	Personal Protective Equipment
PQL	practical quantitation limits
PSS	Plant Shift Superintendent
QA	quality assurance
QAMS	Quality Assurance Management Staff
QAPP	quality assurance project plan
QAS	quality assurance specialist
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RfCs	reference concentrations

RfDs	reference doses
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RSA	Rust Spoil Area
S&A	sampling and analysis
SA-1	Spoil Area 1
SARA	Superfund Amendments and Reauthorization Act
SAS	Statistical Analysis System
SD	standard deviation
SDWA	Safe Drinking Water Act
SEG	Scientific Ecology Group
SHSO	site safety and health officer
SI	Site Investigation
SOW	statement of work
ST	South Tributary
SWMU	solid waste management unit
TBC	to be considered
TCA	trichloroethane
TCA	Tennessee Code Annotated
TCE	trichloroethene
TCL	target compound list
TDEC	Tennessee Department of Environment and Conservation
TDS	total dissolved solids
TIMS	Thermal Ionization Mass Spectrometry
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSS	total suspended solids
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
UEFPC	Upper East Fork Poplar Creek
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VOCs	volatile organic compounds
WMA	Waste Management Area
WOM	White Oak Mountain

EXECUTIVE SUMMARY

The enactment of the Resource Conservation and Recovery Act (RCRA) in 1976 and the Hazardous and Solid Waste Amendments (HSWA) to RCRA in 1984 created management requirements for hazardous waste facilities. The facilities within the Oak Ridge Reservation (ORR) were in the process of meeting the RCRA requirements when ORR was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) on November 21, 1989. Under RCRA, the actions typically follow the RCRA Facility Assessment (RFA)/RCRA Facility Investigation (RFI)/Corrective Measures Study (CMS)/Corrective Measures Implementation process. Under CERCLA, the actions follow the PA/SI/Remedial Investigation (RI)/Feasibility Study (FS)/Remedial Design/Remedial Action process. The development of this document will incorporate requirements under both RCRA and CERCLA into an RI work plan for the characterization of Bear Creek Valley (BCV) Operable Unit (OU) 2.

OU 2 is located within the U.S. Department of Energy (DOE) ORR in Anderson County, Tennessee. The unit is located in BCV, near the headwaters of Bear Creek, just west of the Oak Ridge Y-12 Plant main facilities. OU 2 comprises two construction spoil areas, Rust Spoil Area (RSA) and Spoil Area 1 (SA-1), and an equipment storage yard, SY-200 Yard.

The RSA was used as a disposal area for solid waste (spoil material) generated from various renovation, maintenance, and construction operations at the Y-12 Plant. Although no detailed records are available, the bulk of spoil material disposed at RSA consisted of soil, masonry materials, and metal. Discussions with Y-12 Plant personnel indicated the possibility that small quantities of solvent-contaminated material, and material containing asbestos, mercury, and uranium, may have been disposed in the RSA. However, existing administrative and other established in-plant controls prevented the disposal of significant amounts of chemicals, wastes, or contaminated material at the RSA. Previous investigations at the site indicate that contaminants of concern at RSA include arsenic, beryllium, lead, mercury, selenium, thorium, uranium, and tetrachloroethene.

SA-1 was used for the disposal of what was considered to be nonhazardous, nonradioactively contaminated construction debris from various renovation, maintenance, and construction operations at the Y-12 Plant. The bulk of the solid waste known to have been disposed of included asphalt, brick, concrete, roofing materials, brush, metal, rock, and tile. However, the results of soil and groundwater studies in the area confirmed the presence of heavy metals and radiological contamination. Contaminants of concern include arsenic, beryllium, barium, chromium, lead, mercury, fluoranthene, phenanthrene, pyrene, radium, and uranium.

The SY-200 Yard was operated as a "hold for future use" storage area. The yard was an outside graveled area used to store nonradioactively contaminated equipment, electrical transformers, piping, tanks, mercury flasks, and miscellaneous items. All items stored at the site were removed by September 1986. Based on data obtained through soil sampling, contaminants of concern include barium, chromium, lead, mercury, polychlorinated biphenyls (PCBs), and uranium.

This RI work plan contains summaries of geographical, historical, operational, geological, and hydrological information specific to the unit. The potential for release of contamination to receptors through the various media is addressed, and a sampling and analysis plan is presented to determine the extent of release of contamination to the surrounding environment. Proposed activities include walkover radiation surveys at all sites, soil borings at SY-200, piezometer installation and water table sampling at SA-1 and SY-200, and surface water and sediment runoff sampling at all three sites. Data from the site characterization activities will be combined with data from ongoing site-wide monitoring programs (i.e., groundwater, surface water, and biological monitoring) to provide input for a screening-level risk assessment and evaluation of alternative remedial actions.

1. INTRODUCTION

1.1 REGULATORY INITIATIVE

The Oak Ridge Reservation (ORR) is composed of three major installations: the Oak Ridge National Laboratory (ORNL), the Oak Ridge Y-12 Plant, and the Oak Ridge K-25 Site (formerly referred to as the Oak Ridge Gaseous Diffusion Plant). These installations were constructed in the early to mid-1940s by the U.S. Department of Energy (DOE) as research, development, and process facilities in support of the Manhattan Project. These installations, along with the Paducah Gaseous Diffusion Plant (PGDP) in Paducah, Kentucky, and the Portsmouth Gaseous Diffusion Plant in Piketon, Ohio, are currently administered by the DOE Oak Ridge Field Office (DOE-OR) in Oak Ridge, Tennessee.

During the construction and operation of these research, development, and process facilities, the associated decontamination, maintenance, and fabrication processes resulted in the generation of various hazardous and radioactive waste by-products. Hazardous waste treatment, storage, and disposal (TSD) facilities were created at each of the DOE-OR facilities to handle such by-products. Some of these facilities continue to receive hazardous wastes while others have been decommissioned. All DOE-OR TSD facilities are currently subject to the requirements of several laws:

- **Resource Conservation and Recovery Act (RCRA)**-created in 1976 as a management system for hazardous wastes that mandates permitting currently operating TSD facilities. Under RCRA, these TSD facilities are referred to as solid waste management units (SWMUs). RCRA defines a SWMU as any "discernible waste management unit at a RCRA facility from which hazardous waste or hazardous constituents might migrate, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which hazardous waste or hazardous constituents have been routinely and systematically released.

- **Hazardous and Solid Waste Amendments (HSWA)**-amendments to RCRA (1984) which provide the U.S. Environmental Protection Agency (EPA) with the authority to enforce corrective actions by broadening the scope of the RCRA Corrective Action Program. In addition to evaluating and correcting releases to the uppermost aquifier from regulated RCRA units, HSWA promotes the cleanup of continuing releases to any media resulting from waste management units and practices at RCRA facilities. Among the most significant provisions of the HSWA are the following.

  - **Section 3004(u): Corrective Action for Continuing Releases.** Section 3004(u) states that for permits issued after November 8, 1984, corrective action is required for releases of hazardous waste or constituents from any SWMU at any TSD facility seeking permit for permanent operation, regardless of when waste was placed in the unit. Thus, corrective actions apply to releases presently occurring as well as past releases.

- **Section 3004(v): Corrective Action Beyond the Facility Boundary.** Section 3004(v) authorized EPA to require that corrective action be taken by the facility owner or operator for releases that have migrated beyond the facility boundary (off site). Such action should be taken where necessary in order to protect human health and the environment unless the owner/operator demonstrates to the satisfaction of the administrator that permission to undertake such action was denied.

- **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also referred to as Superfund)**–created in 1980 to establish a program to identify sites [operable units (OUs)] from which environmental releases of hazardous substances might occur or have occurred. At such sites, Superfund promotes the evaluation of damage to natural resources, ensures cleanup by the responsible party or the government, and creates a claims procedure for parties involved in site cleanup and natural resource reclamation. Sites identified by CERCLA are evaluated and then placed on the National Priorities List (NPL), if appropriate. The ORR was listed on the NPL in the December 1989 *Federal Register* (54 *FR* 48184).

- **Superfund Amendments and Reauthorization Act (SARA)**–created in 1986 as a 5-year extension of the Superfund/CERCLA program to clean up hazardous releases at uncontrolled or abandoned hazardous waste sites.

- **National Environmental Policy Act (NEPA)**–created in 1968, directed federal agencies to consider the impacts of their actions (e.g., construction, remediation) on the human environment as a part of all decision-making processes.

In anticipation of the ORR being listed on the NPL, DOE, the Tennessee Department of Environment and Conservation (TDEC), and EPA formulated a Federal Facility Agreement (FFA) for ORR. The FFA was designed to ensure that all necessary steps were undertaken to protect the public health and the environment during the investigation, evaluation, and remediation of all OUs (OUs contain one or more contaminated sites or areas formerly identified at Y-12 as SWMUs). The FFA also outlines all deliverables, review times, and schedules to ensure that activities are undertaken in a timely manner.

DOE and TDEC have formulated an oversight agreement/agreement-in-principle. As stated in this agreement, TDEC is the lead agency for the state of Tennessee. The purposes of this agreement are to (1) ensure compliance with applicable federal, state, and local environmental laws and (2) assure the citizens of Tennessee that their health, safety, and environment are being protected through a program of independent monitoring and oversight by the state.

Each of these agreements provides a measure of oversight for all environmental restoration at the ORR installations. The PGDP and the Portsmouth facility are not listed on the NPL and as such have no FFA. (They do however have agreements-in-principle with their respective states.)

1.2 DOE-OR ENVIRONMENTAL RESTORATION (ER) PROGRAM

The mission of the DOE-OR ER Program is "to eliminate or reduce to prescribed safe levels the risks to the environment or to human health and safety posed by inactive and surplus OR-managed sites and facilities that have been contaminated by radioactive, hazardous, or mixed wastes" (Energy Systems 1991c). As a result of ORR's placement on the NPL in December 1989, all remedial activities including characterization, alternative selection, and implementation must meet the requirements of RCRA, CERCLA, and NEPA. Therefore, the DOE ER Program decided to address the requirements of all applicable laws in a series of "integrated" documentation for each OU.

To facilitate consistency in the preparation of these integrated documents at all DOE-OR facilities, the managing and operating contractor for DOE-OR facilities established an ER Division. Along with central staff which serve to oversee the main program areas, ER site program managers were appointed at each of the DOE-OR facilities. These site program managers oversee the day-to-day operations of the facility-specific programs and interface with the central ER Division staff.

1.3 Y-12 SITE CORRECTIVE ACTION PROGRAM

To meet the requirements of RCRA and the additional requirements of CERCLA, two types of RCRA Facility Investigation/Remedial Investigation (RFI/RI) plans were prepared for the Y-12 site. The RCRA Facility Investigation Plan, General Document, Vols. I, II, and III, (Welch 1989a, Wiggins 1988, and Wiggins et al. 1988) (herein referred to as the General Document*), contains information applicable to all Y-12 Plant SWMUs (now areas within OUs). The General Document, begun under RCRA, serves as a reference document for the second type of RFI/RI plan, the site-specific RI plan for each OU. RI plans for many of the Y-12 Plant SWMUs/OUs are now under review by EPA Region IV and TDEC.

The Y-12 Plant OUs have been grouped not only by their proximity but also by common physical and hydrogeological parameters. Extensive study of groundwater movement and its relation to contaminant transport at the Y-12 Plant indicates that groundwater can be subdivided into three distinct hydrogeological regimes: Upper East Fork Poplar Creek (UEFPC), Bear Creek, and Chestnut Ridge. This subdivision is based on topography, surface water drainage, and groundwater flow patterns. It offers the advantages of providing a basis for unifying monitoring efforts at the Y-12 Plant and for tailoring monitoring efforts to the hydrogeologic characterization of each regime. The strategy used to delineate boundaries of each regime is included in *Comprehensive Groundwater Monitoring Plan for the DOE Y-12 Plant, Oak Ridge, Tennessee* (Geraghty and Miller 1990a). The Bear Creek Hydrogeologic regime, in general, and specifically the Bear Creek Valley (BCV) OU 2, is the focus of this RI plan.

*The General Document is currently under revision.

1.4 SITE ER PROGRAM

A major objective of CERCLA investigations is to characterize the nature and extent of contamination at uncontrolled hazardous waste sites. HSWA requires assessments to be conducted at all former and current SWMUs at RCRA-permitted facilities. Descriptions of many of the individual SWMUs at the Y-12 Plant are provided in a report titled *Solid Waste Management Unit Information for the Y-12 Plant RCRA 3004(u) Facility Assessment* and its supplements (Welch et al. 1987, Welch 1987a, Welch and Poore 1987, Wiggins and Welch 1988, Murphy 1989). For SWMUs that are suspected to be the source of contaminant release to the environment, an RFI is required to define the nature and extent of the release.

Under RCRA, actions typically follow the RCRA Facility Assessment (RFA)/ RFI/Corrective Measures Study (CMS) implementation process. The RFA that was conducted for the Y-12 Plant (Welch et al. 1987) resulted in the decision to perform RFIs for the Rust Spoil Area (RSA) (SWMU D-106) and the Spoil Area 1 (SA-1) (SWMU D-107). The decision was based on the likelihood that these units received solid waste containing hazardous or potentially hazardous constituents. The SY-200 Yard was scheduled for further investigation after traces of mercury were observed in fill material excavated during 1988 construction activities (Perkins 1989). Under CERCLA, actions typically follow the Preliminary Assessment (PA)/Site Investigation (SI)/Remedial Investigation (RI)/ Feasibility Study (FS)/remedial design/remedial action process. The development of this document incorporates the requirements under both RCRA and CERCLA into an RI work plan.

1.5 SPECIAL PROBLEMS

No special problems have been identified at the site.

1.6 OBJECTIVES

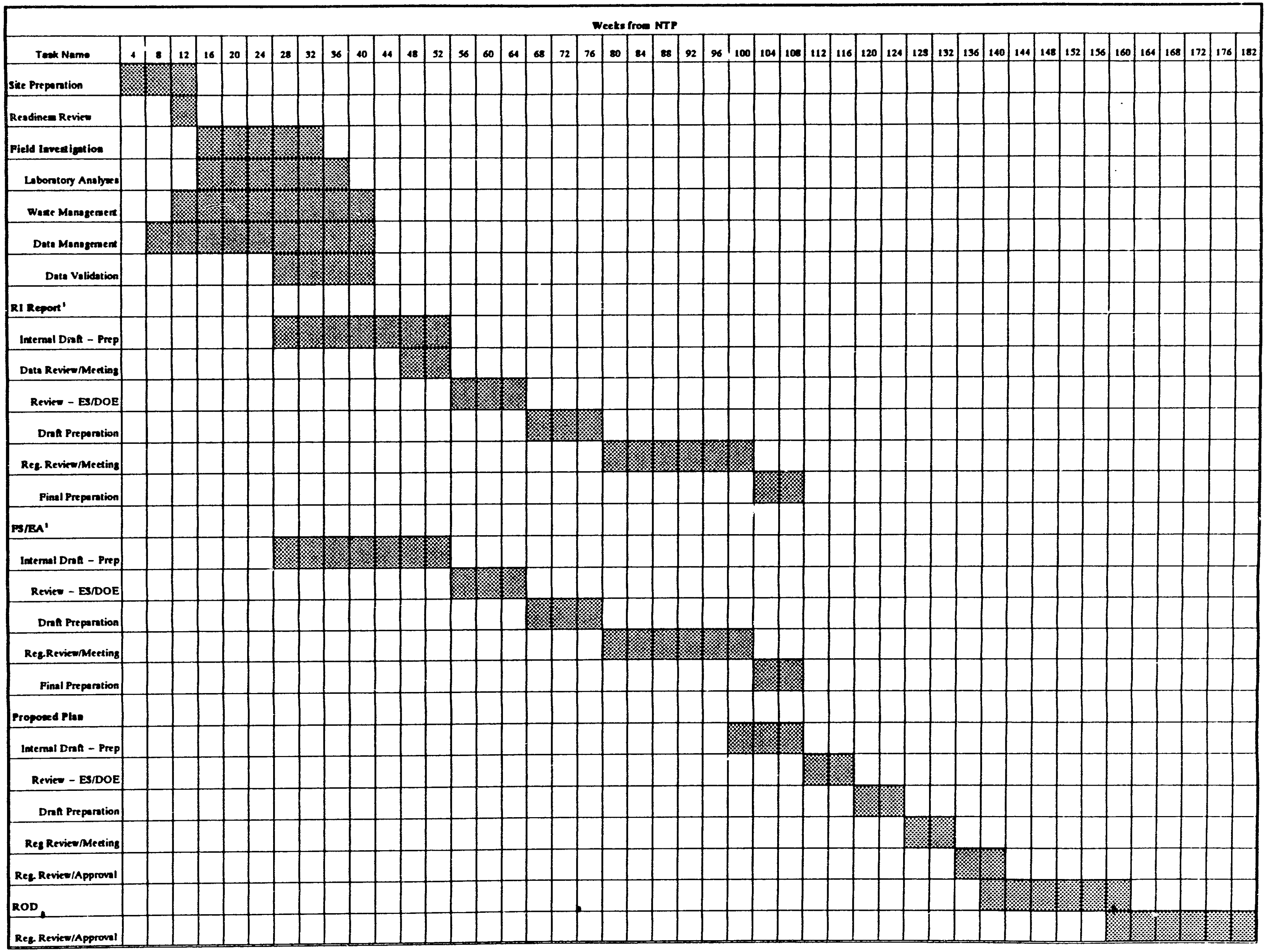
The results of previous investigations within OU 2, summarized in this plan, have helped to define the nature and extent of contamination. The general objectives of the OU 2 RI include (1) defining further the nature and extent of contamination in media of concern (i.e., soil), especially at the SY-200 Yard, and (2) gathering information for the specific needs of the risk assessment and FS. Specific objectives are to

- define the nature of soil contamination at SY-200;
- define the extent (vertical and horizontal) of soil contamination at SY-200;
- fill any identified data gaps in the extent of soil contamination at RSA and SA-1;
- define the interaction (transfer mechanism), if any, between soil contaminants and shallow groundwater; and

- define the relative contribution of OU 2 contaminants to BCV groundwater and surface water/sediment contamination.

1.7 SCHEDULE

The schedule of the BCV OU 2 RI sampling and analysis activities is provided in Fig. 1.1.



[1] The Remedial Investigation Report and the Feasibility Study Report will be two separate individual documents that will have the same submittal date.

Fig. 1.1. Schedule for the OU 2 RI/FS.

OU2PJSCH WK1

2. CHARACTERIZATION OF THE ENVIRONMENTAL SETTING

2.1 GEOGRAPHY

The DOE ORR is located within the corporate limits of the city of Oak Ridge in eastern Tennessee, ~16 km (10 mi) southeast of the Cumberland Mountains and 113 km (70 mi) northwest of the Great Smoky Mountains. Figure 2.1 shows the city's location approximately midway between Nashville, Tennessee, and Asheville, North Carolina, on an east-west line and between Lexington, Kentucky, and Atlanta, Georgia, on a north-south line. The area is serviced by Interstates 40 and 75, which intersect in nearby Knoxville, Tennessee, east of Oak Ridge. The reservation, 14,300 ha (35,300 acres) of federally owned land, houses three facilities (the K-25 Site, ORNL, and the Y-12 Plant) (Fig. 2.2) which are managed by Martin Marietta Energy Systems, Inc. (Energy Systems).

The Y-12 Plant contains ~800 acres and is located adjacent to the corporate center of the city of Oak Ridge between Chestnut Ridge, located to the south, and Pine Ridge, located north of the plant (Fig. 2.2). The plant complex, built predominately in the mid-1940s, is roughly divided into two portions; the western portion is devoted to DOE ongoing weapons-manufacturing activities, and the eastern portion is devoted to ORNL research programs.

The Y-12 Plant is located in the Valley and Ridge Physiographic Province, which lies between the Cumberland Mountains to the northwest and the Great Smoky Mountains to the southeast. This province is characterized by roughly parallel, alternating ridges and valleys. The main facilities of the Y-12 Plant lie on the BCV floor, with auxiliary facilities along Pine Ridge and Chestnut Ridge. OU 2 is located on the BCV floor immediately west of the Y-12 main plant facilities.

2.2 TOPOGRAPHY, GEOLOGY, AND SOILS

2.2.1 Topography and General Geology

OU 2 is located in the Valley and Ridge Physiographic Province, part of the Appalachian fold and thrust belt. The area is characterized by a succession of northeast-trending ridges and valleys, which formed as a result of differential erosion of the clastic and carbonate lithologies that make up the individual thrust sheets.

OU 2 is located in BCV, which is bounded to the north and south by Pine Ridge and Chestnut Ridge, respectively. Maximum relief of the ridges is ~200 ft. The elevation of BCV is 975 ± 50 ft above mean sea level (MSL), and Pine Ridge and Chestnut Ridges have an approximate elevation of 1200 ± 50 ft above MSL. These ridges and valley are part of the White Oak Mountain (WOM) thrust sheet, which exposes Lower Cambrian to Ordovician rock units in the immediate area (Fig. 2.3). The stratigraphy of the area, from oldest to youngest (and exposed from grid-north to grid-south), includes the Lower Cambrian Rome Formation (exposed on Pine Ridge), the Cambrian Conasauga Group (exposed in BCV), and the Knox Group (exposed on Chestnut Ridge).

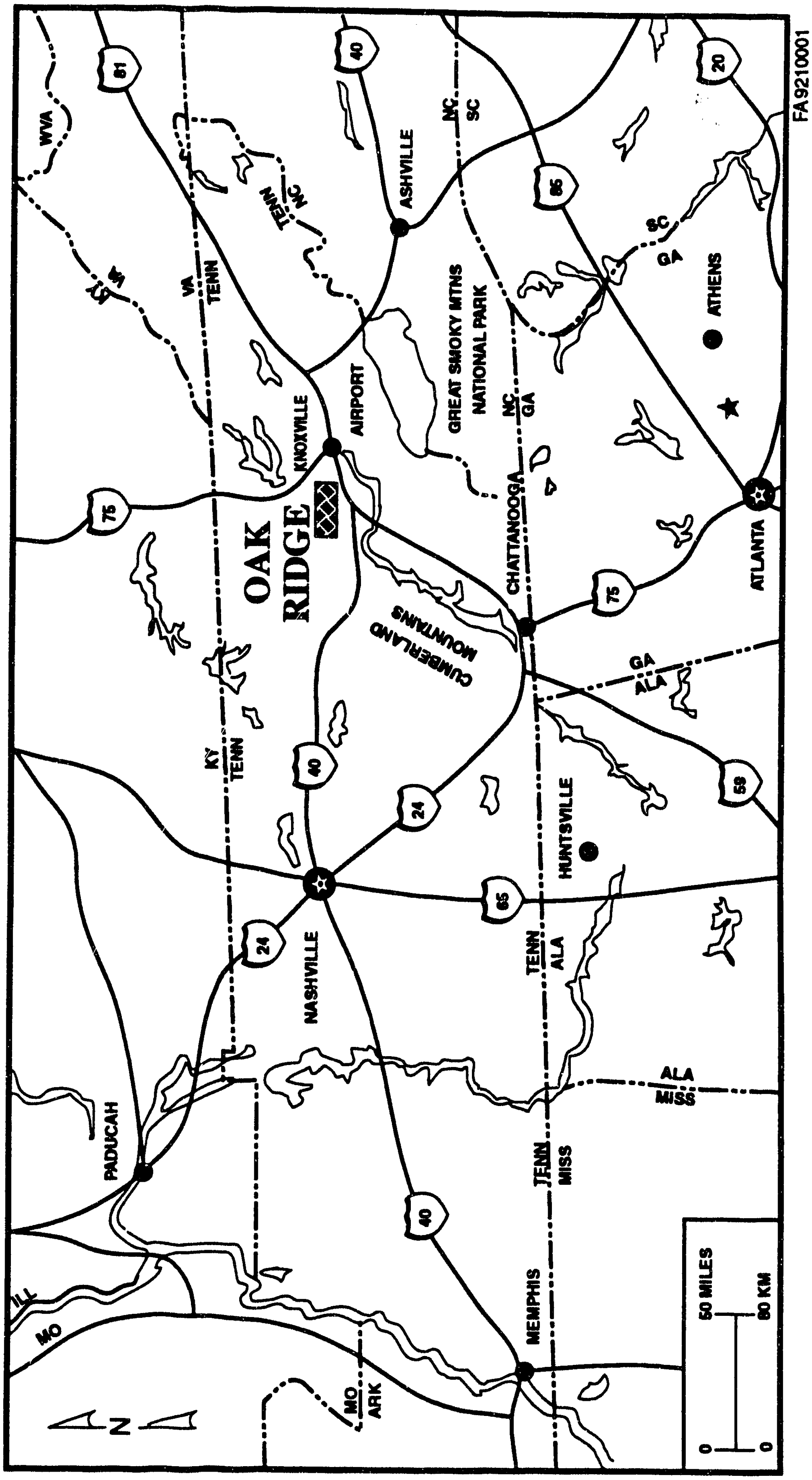


Fig. 2.1. Location of Oak Ridge.

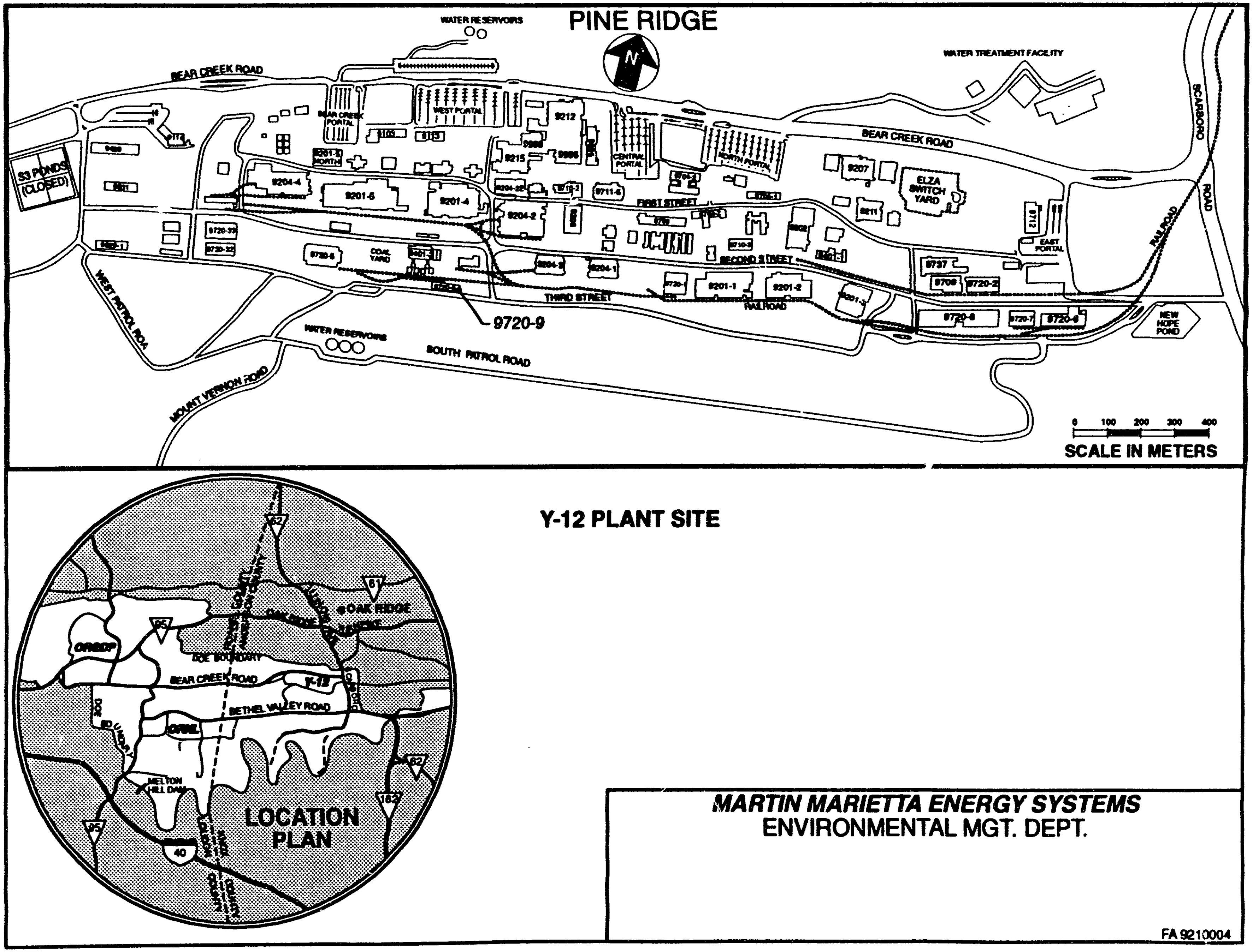


Fig. 2.2. Location of the Y-12 Plant.

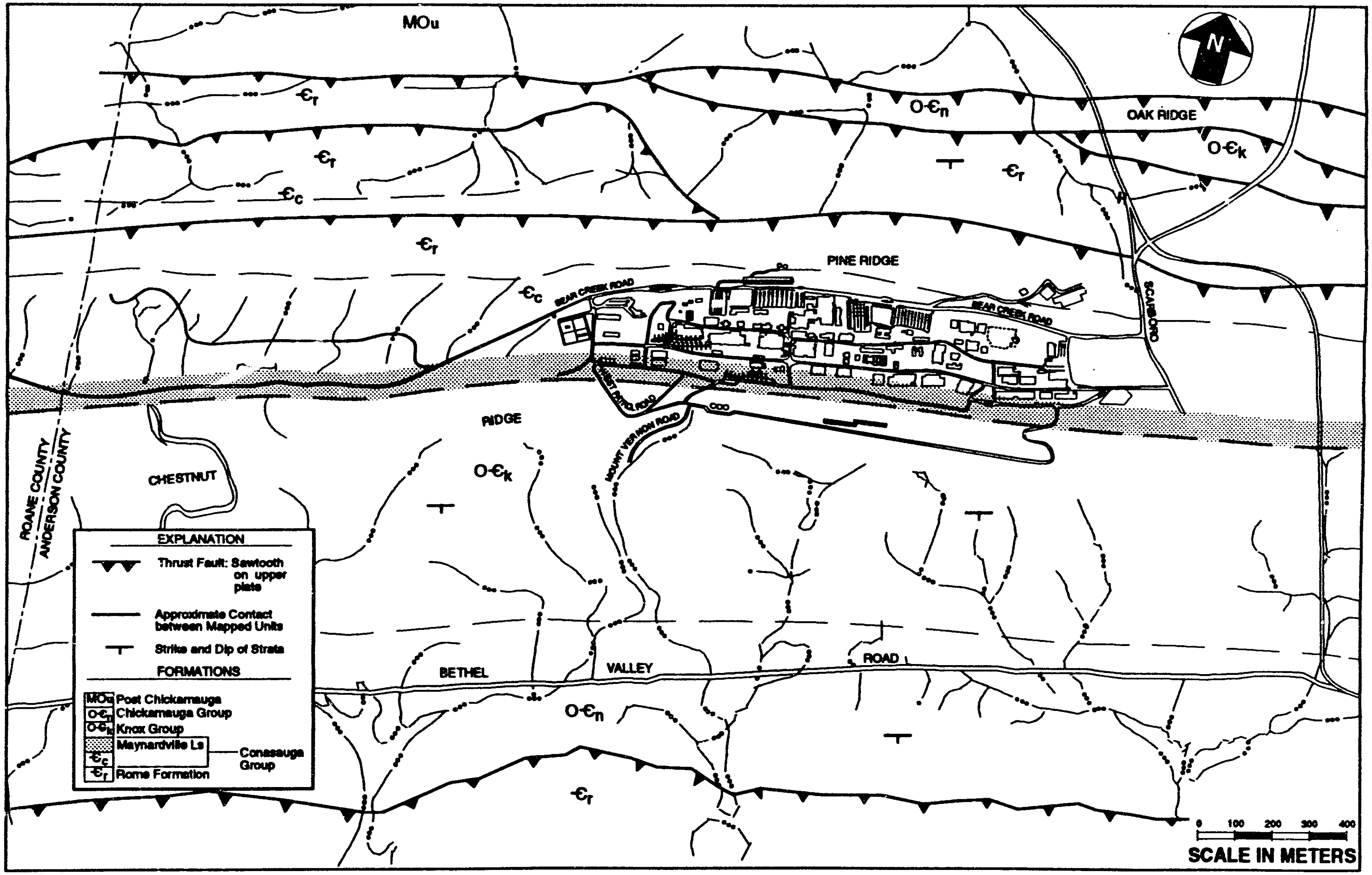


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Fig. 2.3. Bedrock geology at Y-12 (Geraghty and Miller 1990).

The Conasauga Group, which underlies OU 2, is further divided into six formations of alternating shale and carbonate-rich lithologies. From oldest to youngest these are the Pumpkin Valley Shale, the Rutledge Limestone, the Rogersville Shale, the Maryville Limestone, the Nolichucky Shale, and the Maynardville Limestone (Table 2.1).

Table 2.1. Stratigraphy of the Y-12 area

Age	Group or formation	Thickness[a] (ft)	General comments
Upper Cambrian-Lower Cambrian	Knox Group		Only the lowermost formation, the Copper Ridge Dolomite, occurs in the Y-12 area on Chestnut Ridge. This formation consists mainly of siliceous dolomites.
Cambrian	Conasauga Group		This group underlies BCV. UEFPC flows along strike with the Maynardville Limestone.
	Maynardville Limestone	410–440	
	Nolichucky Shale	490–540	
	Maryville Limestone	380–400	
	Rogersville Shale	100–120	
	Rutledge Limestone	100–120	
	Pumpkin Valley Shale	320	
Lower Cambrian	Rome Formation		This formation is exposed on Pine Ridge and consists predominately of sandstones and sandy shales.

[a]Only thicknesses of the formations of the Conasauga Group at the Y-12 Plant are given.
Source: Energy Systems (1989).

2.2.1.1 Stratigraphy

The strata of greatest interest, with respect to contaminant migration in BCV, include the Maynardville and Nolichucky Formations of the Conasauga Group. For general descriptions of the stratigraphy of other units in the ORR, the reader is referred to Haase et al. (1985) (Conasauga Group and Rome Formation), Lee and Ketelle (1987) (Knox Group), and Lee and Ketelle (1988) (Chickamauga Group).

Maynardville Limestone (King and Haase 1987; Rothschild et al. 1984; Geraghty & Miller 1987). In BCV, the Maynardville Formation varies from 418 to 450 ft in thickness and shows a gradational lower contact with the Nolichucky Shale (King and Haase 1987). The Maynardville Limestone comprises light-gray to tan, massive to thinly bedded limestone with subordinate amounts of dolostone. This formation can be divided into two members on the ORR (Haase et al. 1985). The uppermost Chances Branch member consists of medium to thinly bedded buff and light-gray dolostones, ribbon-bedded dolostones/ limestones, and thinly bedded medium-gray limestones. The lower Low Hollow Member is principally wavy to even thinly bedded (oo)microsparite, with alternating horizons of dolomite bearing, ribbon-bedded microsparite and calcarenite. The Low Hollow Member and the lower portion of the Chances Branch Member are oolitic, and soft sediment deformation fabrics have been observed (Geraghty & Miller 1987). Both members are locally stylolitic.

Drilling in the Y-12 Plant area (Rothschild et al. 1984; Army Corps of Engineers 1954a,b) and further west in the Y-12 Plant burial grounds (Bechtel 1984) shows that, in the near subsurface, the Maynardville Limestone is characterized by numerous solution cavities, which generally range in thickness from less than 1 to 3 ft, although cavities from 8 to 11 ft thick have been noted (Rothschild et al. 1984). The cavities commonly parallel bedding planes. Where Bear Creek lies in the Maynardville Limestone, the position of the channel is controlled by preferential solution along joints and fractures (Geraghty & Miller 1987).

Nolichucky Shale (King and Haase 1987; Rothschild et al. 1984). In BCV, the Nolichucky Shale ranges in thickness from 422 to 550 ft (King and Haase 1987). In eastern Tennessee, the Nolichucky Shale can be divided into three members: the Upper Shale, the Bradley Creek, and the Lower Shale Members (Hasson and Haase 1988), although identification of these members in BCV is not straightforward. The formation consists of maroon-brown to rare green-gray, massive to very thinly bedded, locally calcareous mudstones and shales interstratified with thinly bedded, medium gray limestones and calcareous siltstones. The maroon-brown color of the shales is characteristic of the Nolichucky Shale. The interbedded limestones typically contain limestone-pebble conglomerates and oolite-rich beds similar to those occurring in the underlying Maryville Limestone. Throughout much of the Nolichucky Shale, mudstone/shale and limestone lithologies alternate on a scale of 1 to 3 ft, giving the formation a thickly bedded appearance.

During drilling at the Y-12 Plant, solution cavities, opened fractures, and iron precipitate were commonly observed up to downhole depths of 50 ft (Rothschild et al. 1984). Comparison of Maynardville Limestone and Nolichucky Shale descriptions suggests the solution cavity development is not as extensive in the Nolichucky Shale as it is in the Maynardville Limestone.

2.2.1.2 Structural geology

Faults. Pine Ridge, BCV, and Chestnut Ridge all are part of the WOM thrust sheet, which is floored by the WOM thrust fault. The WOM fault is a regional thrust fault of the Valley and Ridge, which shows at least several kilometers of displacement. The fault formed during the Permian-Pennsylvanian Alleghanian Orogeny and has not been historically active. At the ORR, the fault trends parallel to regional strike (N55E) and dips steeply (45°) to the southeast (King and Haase 1987). Bedding plane dip values measured in outcrops cluster around 45° but may steepen to vertical as a result of localized small-scale folding or faulting.

The WOM thrust fault north of Pine Ridge is very complex and is characterized by a sequence of cross-cutting imbricate splay faults that repeatedly stack the Rome Formation. In the vicinity of Bear Creek, this fault superposes the Cambrian Rome Formation over the younger Cambrian Copper Ridge Dolomite member of the Knox Group. In addition, north of the WOM thrust fault, in the underlying Kingston Thrust Sheet, Bear Creek flows over slices of the Knox Group and Chickamauga Group that have been complexly stacked and rotated as a result of footwall deformation associated with displacement along the WOM fault. Because of the complex deformation associated with the WOM thrust fault and the immediately underlying Kingston Sheet, it is anticipated that this region contains numerous fault-related fracture zones of enhanced permeability.

BCV is characterized by numerous cross-strike streams with a consistent northwestern trend. Such a consistent orientation suggests that the location of these creek beds is controlled by a geological structural feature, either a minor tear fault or a prominent fracture trend. Both features are possible, and in Melton Valley the White Oak Creek Tear Fault shows a similar north trend. If these structures are faults, they show minor displacement but should have an associated fracture zone.

Fractures. Because of the large-scale faulting, all geologic units in the ORR are highly fractured. Recent detailed investigations of Conasauga Group core by Lutz and Dreier (1988) show that five fracture sets occur consistently throughout the core. One set is parallel to bedding, but the other four are generally perpendicular to bedding. The parallel bedding fractures are mainly release joints. Recent studies elsewhere in the Appalachians suggest that release joints can form at depths up to a kilometer (Engelder 1985). Assuming a regional strike of N55E, the strikes of the high angle sets are approximately N55E, N75W, N15E, and N20W.

Fracture density varies throughout the cores. The two variables that have the greatest effect on density are lithology and bedding thickness. Density is inversely proportional to bedding thickness. High fracture densities are found in shales and interbedded limestone and shale, whereas limestones exhibit lower densities. Mineralization is almost entirely confined to limestone beds. All fracture sets exhibit vein development; however, the N55E direction is most commonly mineralized.

2.2.2 General Soil Characteristics

Bedrock units in BCV are overlain by unconsolidated deposits of varying thicknesses consisting of residuum, which comprises the majority of the unconsolidated materials, man-made fill, alluvium, and colluvium (Petrich et al. 1984). Soils of particular importance to OU 2 are those characteristic of the Conasauga Group. These soils include, but are not limited to, the Armuchee, Fullerton, Greendale, Hamblen, Jefferson, Leadvale, Newark, and Sequoia. Depth to bedrock varies from less than 10 ft to 30 ft, with the Montevallo series being the most shallow (Lietzke et al. 1986). In general, these soils are classed as poor for crop growth or pasture. With the exception of a few areas that are suitable for pasture, the general classification of Y-12 Plant soils is for forestry. In BCV the Armuchee and Sequoia soil series are most prevalent. The Armuchee is a shaley, silty clay loam becoming more shaley with depth, and the Sequoia is a yellowish-brown silt loam overlying a residuum of acid shale. Chemical and physical properties of these soils are given in Tables 4.2 and 4.3 in Vol. I of the General Document.

The presence and extent of virgin soils below the OU 2 sites are not well known due to the extensive filling that took place during its operational lifetime. Lithologic logs from soil borings at SA-1 (Appendix C) provide much of the existing soils information for the site. Based on a comparison of the description of soil types as provided in the *Soil Survey of Anderson County, Tennessee* (USDA 1981) and these lithologic logs, Fullerton is the most important soil series for area.

The Fullerton series is made up of the Fullerton cherty silt loam which consists of 5 to 45% slopes. This deep, well drained, sloping soil is on rolling ridgetops and the sides of ridges and hills. The soils formed in a residuum of dolomite.

Typically, the surface layer is brown cherty silt loam 7 in. thick. It overlies a 5-in. layer of strong brown cherty loam. The subsoil extends to a depth of more than 64 in. It is strong brown cherty silt loam in the upper part and yellowish red cherty silty clay and cherty clay in the lower part.

This soil is low in natural fertility and has a medium available water capacity. It is strongly acid or very strongly acid throughout except where the surface layer is limed. Permeability is moderate. Runoff is medium. On the average the soil contains more chert than other phases of the Fullerton soils.

The physical and chemical properties of this soil follow (USDA 1981):

Permeability	0.6–2.0 in./h
Available water capacity	0.1–0.16 in./in.
Soil reaction (pH)	4.5–5.5

A soil leaching and contaminant transport model will be developed to help determine the risk for contaminants to move off site. The model can also be used to evaluate the potential for contaminant migration during screening of alternative technologies in the FS. The Multi-Media model (Salhotra et al. 1990) will be used to develop the site-specific model. Data requirements for the model will be satisfied as follows:

- Site physical characteristics. Data already available and summarized in this Work Plan.
- Site hydrologic characteristics. Hydrologic properties of the Conasauga Group and its residuum on the ORR are detailed in Rothschild et al. 1984. Average infiltration and recharge rates for the Bear Creek Valley are given in Solomon et al. 1992. Determination of site-specific physical parameters required by Multimed, such as depth to groundwater, aquifer thickness, and soil layering, is outlined in the Work Plan.
- Soil geochemical properties. The normalized distribution coefficient (Koc) values for volatile and semivolatile contaminants will be taken from standard references (e.g., EPA/540/2-89/057). Hydrolysis rate constants for a wide variety of VOCs are available in the literature as outlined in Salhotra et al. 1990.

Distribution coefficients (Kd's) and retardation factors (R's) of common radionuclides are available for the Conasauga Group and its residuum on the ORR in Rothschild et al. 1984, Meyer et al. 1987, and Davis et al. 1984. Average Kd's of metals in soils and sand are available in Gilbert and Yu 1989 and Baes and Sharpe 1983. No Kd values for metals are available for the ORR at this time; however, most metals of interest have high average Kd values for soils (>100 cm^3/g) and moderate to high Kd values for sand (>10 cm^3/g). A worst-case scenario for these metals can be modeled using Kd values for sand. For metals with low average Kd values [As, Cd, Cr(VI), Cu, and Zn], a worst-case scenario can be modeled using Kd's in sand; if this scenario shows high potential leachability, site-specific Kd values can be determined for these metals which are present in soils above target cleanup levels.

2.3 CLIMATE

Detailed discussions of climate can be found in Sect. 4.4 of Vol. I of the General Document (Welch 1989a) and in Sect. 3.1 of the *Clinch River RCRA Facility Investigation Plan* (Energy Systems 1990). The Oak Ridge area has a temperate climate that is moderated by the Blue Ridge Mountains to the east and the Cumberland Plateau to the west.

Weather patterns in Oak Ridge are generally temperate, with warm, humid summers and cool winters. The annual mean temperature is about 15°C (58°F), with a January mean of about 3.5°C (38°F) and a July mean of about 25°C (77°F). Relative humidity in mid-afternoon averages about 55%. At night humidity is higher, averaging 85% at dawn.

The mean annual rainfall is about 136 cm (Fig. 2.4), but during the drought of 1981-88 yearly precipitation was about 30–35 cm less than average. Winter months usually have the most rain, with another peak in July, when thunderstorms are common. Autumn is usually the season of lowest rainfall.

Prevailing winds in the area follow the general topography of the surrounding ridges (Fig. 2.5). The down-valley draft, coming from the northeast and identified with gravitational flow down local slopes and the Tennessee Valley, prevails during inversion conditions of late evening through mid-morning. Daytime up-valley flow is from the southwest when regional or synoptic flows aloft become strong enough to dominate the opposing local gravitational winds.

Oak Ridge is one of the country's calmest wind areas. Average wind speed for the Oak Ridge area is 4.4 mph. The Cumberland Plateau and the Smoky Mountains divert severe storms; local irregular ridges further minimize the air movement and wind impact.

2.4 ECOLOGY

OU 2 lies outside the main Y-12 complex and as such is in close proximity to areas of potential ecological sensitivity. Bear Creek runs along the northwest edge of the unit, and one spring exists along the northern edge of the RSA. OU 2 is not likely to have a significant detrimental impact on the ecology of Bear Creek in relation to the other

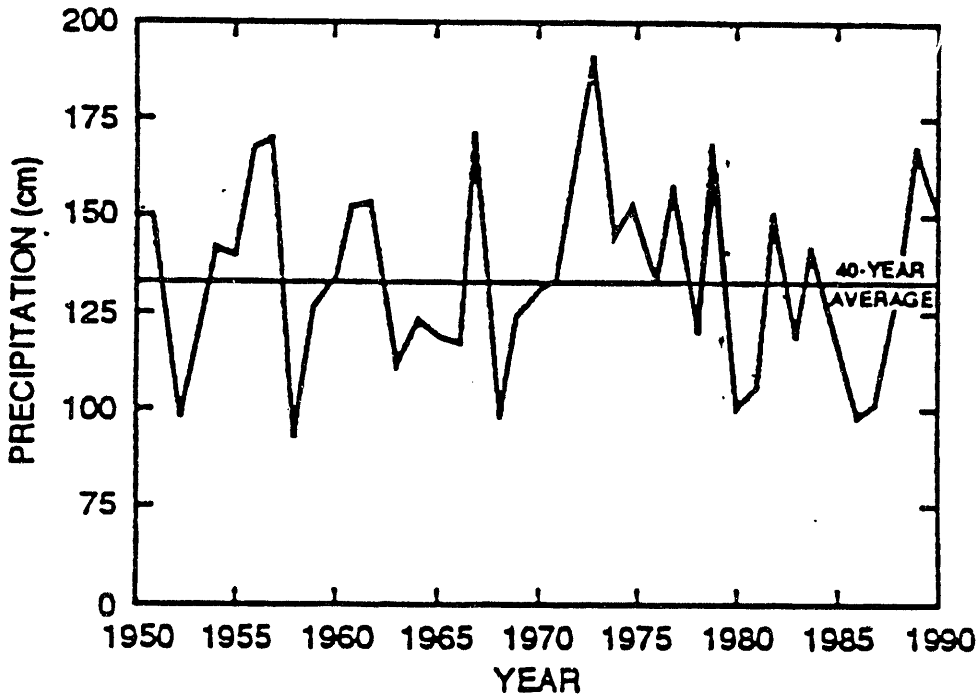

Fig. 2.4. Annual precipitation in the Oak Ridge area.

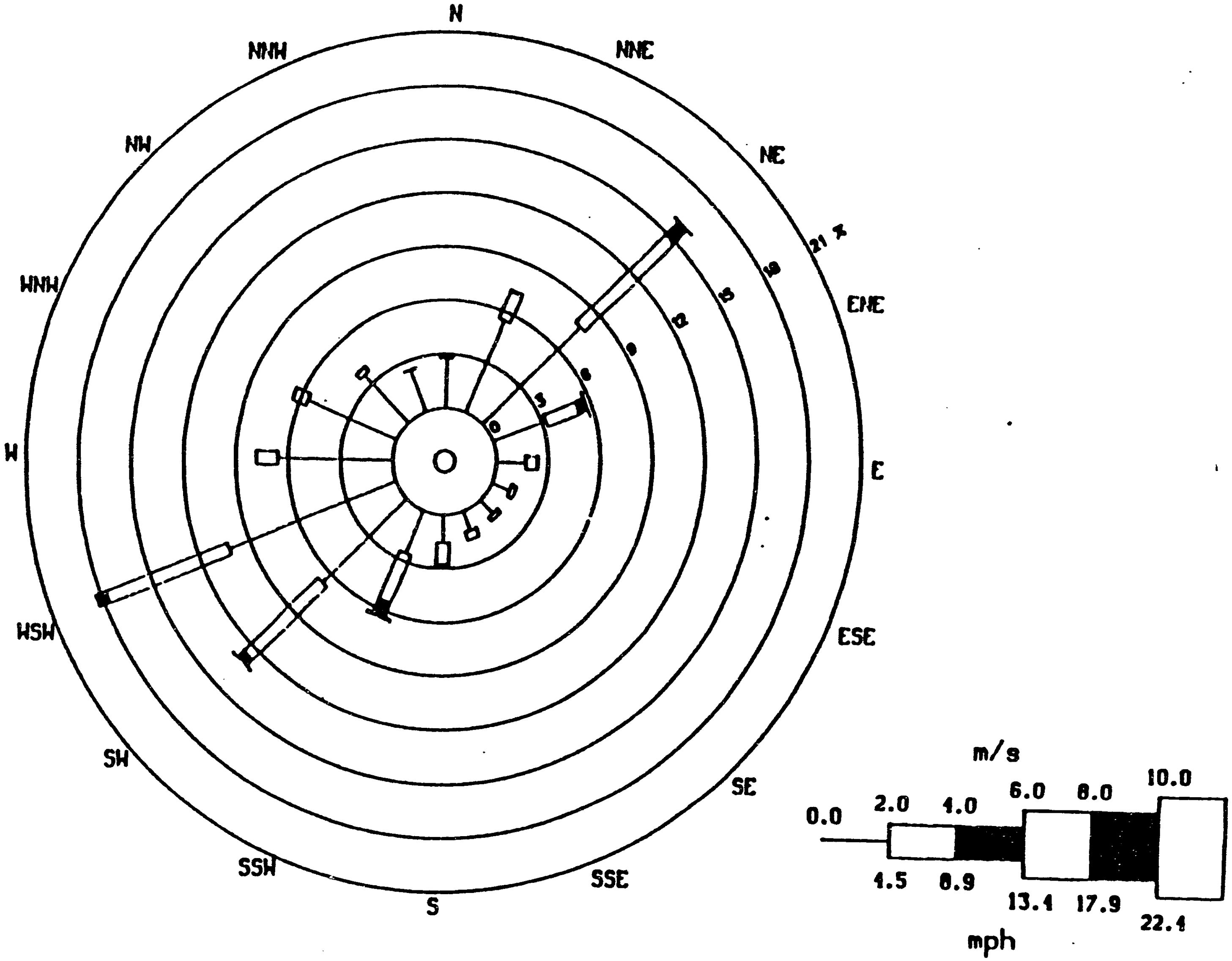

Fig. 2.5. 1990 wind rose for Y-12 tower.

upgradient sources of contamination. Ecological monitoring is ongoing at the Y-12 Plant under separate programs that are beyond the scope of this RI plan.

The environs surrounding OU 2 are typical of the ecological systems of the Appalachian region. The dominant plant community is the old hickory forest, which has extensive stands of mixed yellow pine and hardwoods. Nonforest areas include grasslands, devegetated areas, and developed locations.

The forests of ORR serve as hosts for many forest wildlife species. Recorded wildlife species include ~60 species of reptiles and amphibians; more than 120 species of terrestrial birds; 32 species of waterfowl, wading birds, and shore birds; and about 40 species of mammals (Nix et al. 1986).

The ecology of OU 2 is discussed in detail in Sect. 4.2.2 of this document. The potential ecological impacts of OU 2 on surrounding environs will be addressed as part of the phased Bear Creek Valley ecological studies proposed in the *Remedial Investigation Work Plan for Bear Creek Valley Operable Unit 4 (Shallow Groundwater in Bear Creek Valley) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 1992).

2.5 DEMOGRAPHY

2.5.1 Population Information

The Y-12 Plant is located at the northeast boundary of ORR adjacent to the commercial center of Oak Ridge, which has a population of 27,310 (U.S. Department of Commerce 1991). The employment at the Y-12 Plant, as of January 1992, consisted of 6934 full-time Energy Systems employees and ~1000 on-site employees of M-K Ferguson, DOE, and ORNL. No drinking water supplies are located within the ORR boundary: a pumping station located on the north bank of Melton Hill Lake at Clinch River supplies water to the Y-12 Plant and the Oak Ridge water plant.

2.5.2 Land Use

The East Tennessee Development District, which includes Oak Ridge, is rural in character. Knoxville is the district's regional center and the only city with a population in excess of 50,000. Oak Ridge and other cities in the district are within the 7500 to 50,000 population range, are incorporated, and have a definite central core that provides major employment and trade opportunities. Of the district's 1,700,010 ha (4,200,800 acres), ~80% is in agricultural and forest land use (Table 2.2).

In contrast to the district's general land use patterns, the city of Oak Ridge is an urban center with minimal agricultural activities. Land not owned by the federal government consists of 5510 ha (13,615 acres) and is divided into more than 9500 parcels. Table 2.3 categorizes urban land use data for the city of Oak Ridge. Most of this land is either residential or vacant, with over 1903 ha (4700 acres) of the vacant land suitable for housing (DOE 1982).

Table 2.2. Land use data for the Eastern Tennessee Development District

Land use category	Hectares	Acres	Percent
Residential	35,074	86,670	2.1
Commercial	1,950	4,820	0.1
Industrial	20,700	51,150	1.2
Recreational	269,129	665,030	15.8
Agricultural	685,904	1,694,900	40.3
Public and quasi-public	28,430	70,250	1.7
Forest	658,823	1,627,980	38.8
	1,700,010	4,200,800	100.0

Source: DOE 1982.

Table 2.3. Urban land use data for the city of Oak Ridge, Tennessee[a]

Land use category	Hectares	Acres	Percent
Residential	1,640	4,050	28.9
Vacant	2,247	5,550	39.6
Recreational	749	1,850	13.2
Commercial	104	256	1.8
Industrial	47	115	0.8
Public transportation, Parking	480	1,185	8.5
Private transportation	33	82	0.6
Utilities and communications	52	129	0.9
Services	314	775	5.5
	5,666	13,992	99.9

[a]Excludes federally owned lands within the corporate city limits.
Source: DOE 1982.

Several categories of land use are in close proximity to the ORR. The nearest privately owned residential properties are in the Poplar Springs, Sugar Grove Valley, and Oak Ridge communities. Relative to ORR boundaries, Poplar Springs is located 2 miles west across the Clinch River, and Sugar Grove Valley is located 1.5 miles north. Other residential areas include Bradbury, Edgewood, and Lawnville. Bradbury is located across the Clinch River $\sim$5 miles to the south. Edgewood and Lawnville are located immediately west-northwest of the Poplar Springs community (see Fig. 2.2). Agricultural use includes limited-scale private gardening; raising of tobacco, corn, wheat, and soybeans as cash crops; raising of beef cattle; and dairy farming. Some areas are also used for commercial logging.

Industrial land use includes Phyton Technologies, Inc.; Scientific Ecology Group (SEG); and IT Corporation's Bear Creek Radiological Laboratory. SEG, Phyton, and the IT Corporation laboratory are within 2 miles of the Y-12 Plant. Tennessee Valley Authority (TVA) facilities, including the Melton Hill Dam, the Bull Run Steam Plant, and the Kingston Steam Plant, are all greater than 6 miles from the Y-12 Plant.

Recreational areas in close proximity to ORR include the Watts Bar Lake Embayment/Clinch River waterway, which is used as a recreational area by both pleasure boaters and fishermen; a number of small camping areas and boat launching ramps, one of which is located only slightly more than a mile upstream of the K-25 Site; a small dirt-surface racetrack located $\sim$4 miles south which attracts several thousand spectators during the racing season; and a public swimming area 7 miles southeast at Melton Hill Dam. There are no public recreational facilities, except the previously mentioned boat launching ramp, within 2 miles of ORR. Sport hunting of gamebirds and game animals occurs seasonally in the region, and deer hunting is authorized on some parts of the ORR as a conservation measure.

The ORR lies within the corporate limits of the city of Oak Ridge. A buffer zone surrounds each of these facilities to provide security, space for expansion, and isolation from the general public. Tracts totalling about 5666 ha (14,000 acres) are allocated around operating reactors, waste disposal areas, and streams that receive routine waste releases and burial ground seepages. Acreage used for high-voltage transmission lines, pipelines, transportation corridors, and security fences amounts to about 2023 ha (5000 acres) (DOE 1982).

About 80% of the ORR is part of a comprehensive forest management program that divides the ORR into 27 compartments. These compartments range in size from 148 to 486 ha (365 to 1200 acres). Vegetational features unique to the area are excluded from timber harvest operations, and 40 individual sites are designated for environmental research.

The Y-12 Plant is situated at the eastern end of the ORR, adjacent to the commercial center of Oak Ridge and contains $\sim$800 acres. Land uses associated with the Y-12 Plant facility include several waste storage or disposal areas, of which (1) a parcel of $\sim$61 ha (150 acres) serves as a sanitary waste landfill for solid wastes; (2) $\sim$26 ha (65 acres) located west of the main plant is used as a burial ground for low-level radioactively contaminated solid wastes generated by the Y-12 Plant; and (3) $\sim$1.6 ha (4 acres) is an abandoned quarry formerly used as a disposal and dilution basin for selected nonradioactive chemical wastes, primarily sodium, lithium, and potassium from Y-12 Plant operations.

2.6 SURFACE WATER AND SEDIMENTS

2.6.1 Surface Water Network

Bear Creek flows southwestward from its headwaters at the S-3 Ponds for ~4.5 miles, where it then turns northward to flow into EFPC (Fig. 2.6). EFPC ultimately enters Poplar Creek, which discharges to the Clinch River. The drainage area of Bear Creek at its confluence with EFPC is 7.4 miles^2. Altitudes of the land surface in the entire watershed of Bear Creek range from 755 ft MSL to about 1200 ft MSL on Pine Ridge and Chestnut Ridge.

Bear Creek is fed by small tributaries originating on the slopes of Pine and Chestnut Ridges, which border the valley, and by springs emanating mainly from the base of Chestnut Ridge. The trellis type drainage pattern is strongly influenced by the underlying geologic structure.

The headwaters of Bear Creek are characterized by a relatively steep-banked channel cut to a depth of about 5 ft or more into the silts and clays of the fill and unconsolidated material. Bear Creek tributaries have been numbered, beginning with North Tributary 1 (NT-1) near the S-3 Ponds. The total area of the Bear Creek Watershed above the point where it crosses the Anderson/Roane County line slightly downstream of NT-8 is 1.57 miles^2. The area of the watershed at the National Pollutant Discharge Elimination System (NPDES) station at Bear Creek Kilometer (BCK) 4.55 is about 4.2 miles^2. The area of the flood-of-record floodplain is 164 acres, with an average width of 169 ft.

2.6.2 Surface Water Hydrology

The hydrology of Bear Creek and its tributaries reflects the underlying geology of the watershed. Mainstem Bear Creek above the U.S. Geological Survey (USGS) gauging station at BCK-4.55 is characterized by reaches of stream where flow is lost to the solution-cavity system (McCauley 1985a). A major losing reach is located between the Burial Grounds and oil landfarm near BCK-10.41, and another is located just above BCK-4.70. Periods of zero flow are common in Bear Creek near BCK-10.41 but occur less frequently at BCK-4.70 (Table 2.4). The north tributaries of Bear Creek above the SS-5 spring, especially NT-3, NT-4, NT-5, and NT-6 (Fig. 2.7), drain portions of Pine Ridge; these streams are intermittent and are usually dry during summer and early fall. The south tributaries, on the other hand, originate as springs in the Knox Dolomite of Chestnut Ridge and are perennial streams. There is evidence that springs receive at least some flow from the solution-cavity system, although the precise outlets of the system are unknown (McCauley 1985a).

The characterization of surface water hydrology in Bear Creek Watershed is based on weekly or continuous flow measurements at 10 main-stem stations and 15 tributaries. Continuous USGS records of stream flow are available at BCK-4.55 (the NPDES site on lower Bear Creek) since March 1985 and at BCK-6.24 and BCK-3.88 since September and October 1986, respectively. The USGS has also monitored flows on two north tributaries (NT-14 and NT-15) and an east tributary (ET-1) from October 1986 to December 1989 (Fig. 2.6 with flow monitoring on NT-14 only continuing. Stream flow measurements were conducted weekly between March 19, 1984, and October 16, 1987, by staff in the ORNL

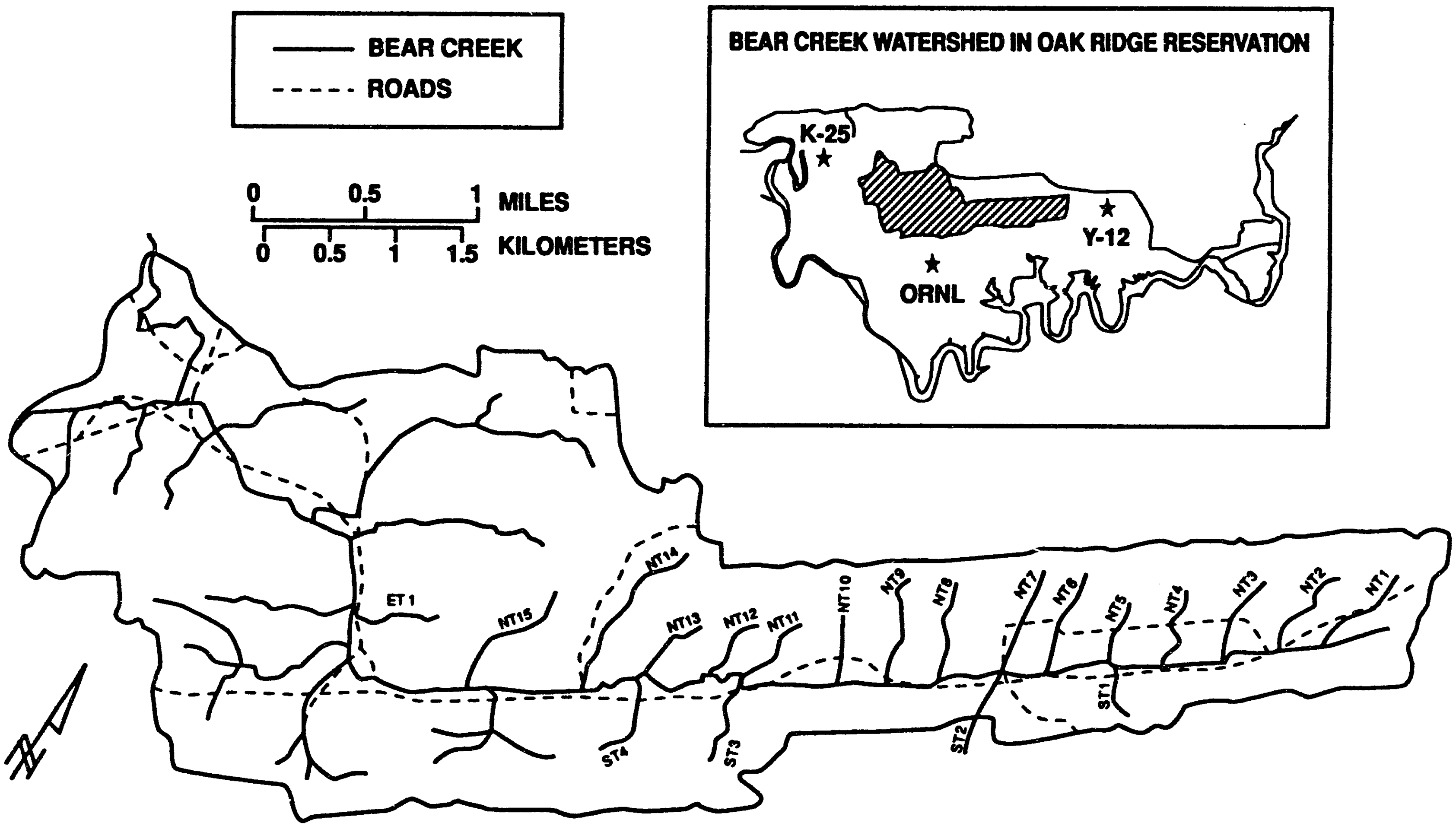

Fig. 2.6. Bear Creek watershed.

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Table 2.4. Mean, standard deviation (SD), and range of stream flows in Bear Creek and selected tributaries, 1985–87[a]

Site	Drainage area (km^2)	1985 (L/s)			1986 (L/s)			1987 (L/s)		
		$\bar{X}$	SD	Range	$\bar{X}$	SD	Range	$\bar{X}$	SD	Range
BCK-12.46	0.43	0.76	0.54	0.08–2.6	0.71	0.85	0.06–5.1	1.53	3.82	0.06–20.7
BCK-11.64	1.57	7.4	6.8	1.13–26.3	7.9	12.7	0.28–67.7	10.2	19.5	0.0–118.4
BCK-11.17	1.91	9.1	9.1	0.3–34.0	11.9	22.1	0.0–124.0	18.4	59.8	0.0–388.0
BCK-10.41	2.81	9.6	12.7	0.0–51.5	13.3	28.3	0.0–160.3	20.4	70.5	0.0–456.0
BCK-9.53	3.92	13.6	16.4	1.1–63.4	16.4	36.2	0.0–217.5	23.2	68.5	0.0–436.7
BCK-9.41[b]	4.07[c]	28.3	24.6	5.4–95.7	29.2	51.8	0.8–302.4	37.4	88.6	0.8–557.3
BCK-7.87	5.96	32.3	31.7	2.8–138.8	38.5	71.9	1.4–431.9	47.6	123.2	1.4–791.0
BCK-6.24[d]	8.29		NA[e]			*f*		63.8	191.4	0.3–2974
BCK-4.70	NA	46.2[g]	45.3	3.7–199.4	74.2	160.6	0.0–965.4	83.3	192.6	0.0–1186
BCK-4.55[d]	11.03	103.9[h]	159.8	12.2–2237	106.0	227.6	6.5–2[illegible]36	110.9	232.9	5.4–2974
BCK-3.88[d]	12.95		NA			*i*		119.9	351.4	6.8–5579
					Tributaries[j]					
SS1 (BCK-12.38)[k]	0.10	0.45	0.31	0.03–1.42	0.34	0.31	0.0–1.70	0.42	0.57	0.0–3.40
SS2 (BCK-11.68)	NA		NA			*l*		1.6	1.8	0.23–6.8
SS3 (BCK-11.67)	0.23	0.76	0.68	0.17–2.55	0.68	0.88	0.08–3.40	1.02	1.19	0.06–5.10
SS4 (BCK-10.14)	0.22	4.0	1.7	1.7–9.3	3.7	2.8	0.6–11.9	3.7	2.8	0.4–11.0
SS5 (BCK-9.41)	0.12	11.9	6.8	4.0–27.5	9.9	12.2	0.8–63.2	10.2	10.8	0.8–45.0
NT14[d] (BCK-6.24)	0.78	4.0	4.2	0.6–18.1	5.1	11.6	0.03–74.2	7.6 (5.3)[i,m]	19.8 (19.5)[i,m]	0.31–124.6 (0.0-311.5)[i,m]
NT15[d] (BCK-5.32)	0.36		NA			*i*		2.7	9.2	0.0–141.6
ET1[d] (BCK-4.07)	0.36		NA			*i*		2.2	6.9	0.0–102.0

[a]Flows were measured weekly except at those USGS sites on lower Bear Creek where stream flow is monitored continuously and average daily values are computed. Number of samples (N) = 45 in 1985, 47 in 1986, and 42 in 1987, except the USGS sites and unless noted otherwise.
[b]Tabular values based on summation of flows at BCK-9.53, NT8, and SS5 (see Fig. 2.7).
[c]BCK-9.42 (McMaster 1967).
[d]USGS station; tabular data are based on average daily values.
[e]NA = no data available.
[f]N = 98 in 1986 and N = 365 in 1987.
[g]N = 40 in 1985 because monitoring was initiated on February 21, 1985.
[h]N = 306 in 1985 because monitoring was initiated on March 1, 1985. N = 365 in 1986 and N = 360 in 1987.
[i]N = 92 in 1986 and N = 360 in 1987.
[j]Tributaries are named sequentially from the headwaters of Bear Creek; NT and ET denote rain-fed streams and SS denotes spring-fed streams.
[k]Confluence with Bear Creek is given in parentheses.
[l]N = 6 in 1986.
[m]USGS data in parentheses.

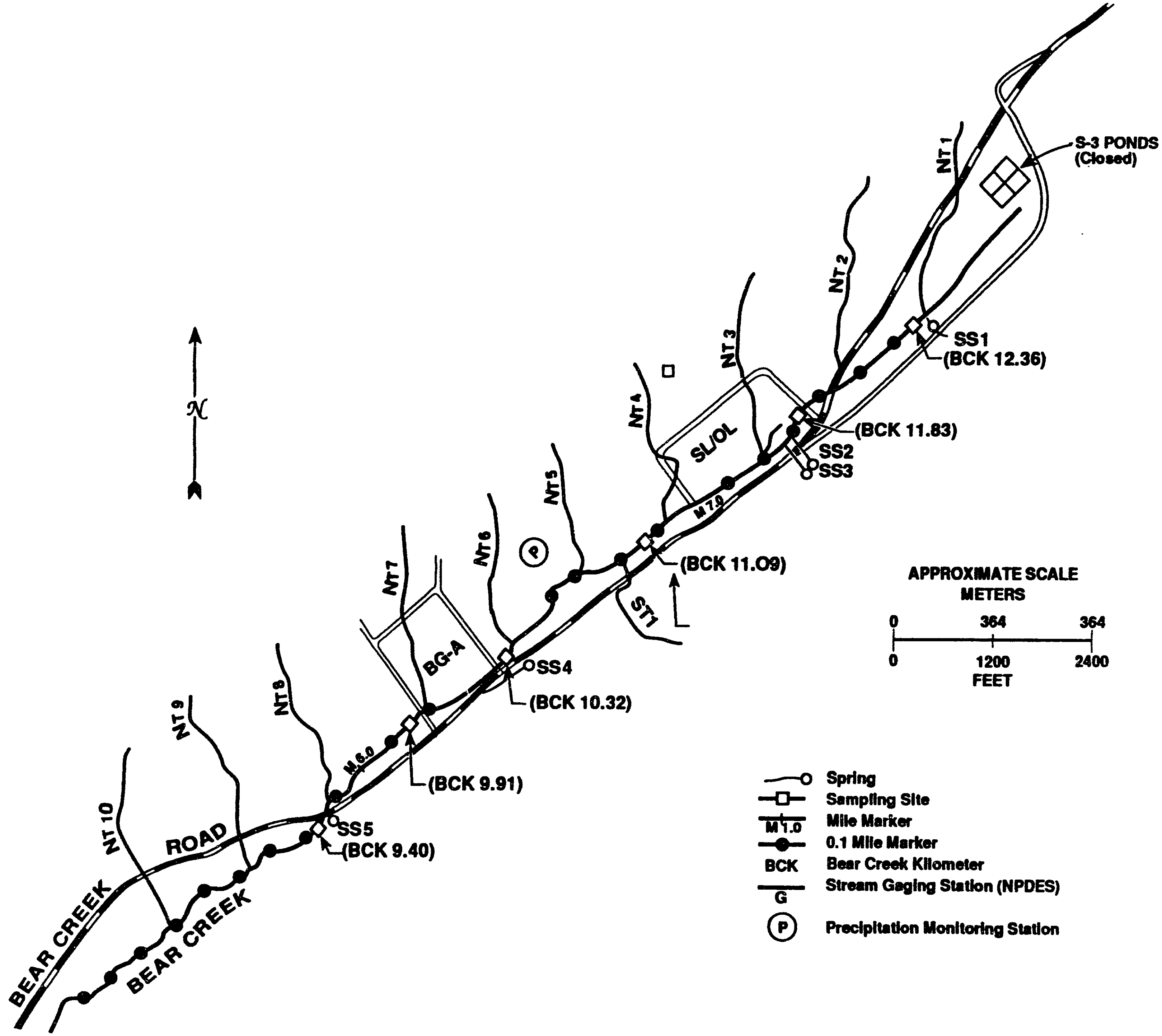

Fig. 2.7. Upper Bear Creek hydrologic system.

Environmental Sciences Division (ESD) at 19 sites, all but 3 of which were located in Bear Creek Watershed at or above the SS-5 spring. Since November 1987, monitoring has been conducted monthly. The flow measuring techniques utilized in the ESD program are described in McCauley (1985a, Sect. 6.2.1).

Flow data collected on Bear Creek and selected tributaries from 1985 through 1987 by both USGS and ESD personnel are summarized in Table 2.4. Because the ESD program was primarily a hydrologic characterization of Bear Creek during low-flow periods, the increase in the mean annual discharge observed from 1985 to 1987 at all main-stem sites except BCK-12.46 is probably spurious. High flows could not be accurately measured, and peak flows could have been missed by the weekly sampling frequency. Moreover, the maximum flow measured at ESD site BCK-4.70 was only 40% of that observed at USGS site BCK-4.55 in 1986 and 1987 and <10% in 1985. Although two large springs (SS-7 and SS-8) enter Bear Creek between these two sites, their contribution to the flow at BCK-4.55 would not significantly increase the annual maximum flow. The decrease in the annual minimum flow observed between 1985 and 1987 was most likely real, reflecting the effects of an extended drought.

2.6.3 Bear Creek Hydrograph

The 3-year hydrograph for lower Bear Creek at the NPDES monitoring station (BCK-4.55) was dominated by extensive periods of low flow in both 1986 and 1987 (Fig. 2.8). In both years, the mean annual flow at BCK-4.55 (Table 2.4) was ~50% of that estimated by McMaster (1967) for the period 1936–1960. From late July through October of 1986 and 1987, mean daily flow was consistently below 10 L/s and contrasted sharply with 1985 when stream flow never fell below 10 L/s. Minimum flows were always more than double the 7Q10 (i.e., the lowest mean discharge for 7 consecutive days with a recurrence interval of 10 years) of 2.8 L/s, but in 1986 and 1987 flows were less than the estimated 7Q2 of 8.5 L/s for this site (McMaster 1967).

The occurrence of minimum flows at BCK-4.55 in excess of the 7Q10 during a period of severe drought can probably be attributed to the location of the site just below two large springs (SS-7 and SS-8). Upstream at BCK-9.53, which is located just above the SS-5 spring, the minimum flow was zero in both 1986 and 1987 compared with the estimated 7Q10 and 7Q2 for that site of 0.85 and 0.57 L/s, respectively (McMaster 1967). Because the flow rates of springs are less variable than those of other tributaries, reaches of Bear Creek immediately below these springs are less affected by extended periods of drought than other reaches not in proximity to upstream springs.

Because of below normal precipitation during the study period, especially during the period from November to April, the Bear Creek hydrograph exhibited infrequent periods of high flow. There were eight major storms (i.e., greater than 5 cm of precipitation in a 24-h period) during 1985–87, but only one had a recurrence interval greater than 1.5 years. The maximum 24-h rainfall during this period occurred on August 16–17, 1985, when 10.9 cm of rain was recorded at the Atmospheric Turbulence and Diffusion Laboratory (ATDL) station in Oak Ridge (NOAA 1985, 1986, 1987). A storm of this magnitude has a recurrence interval

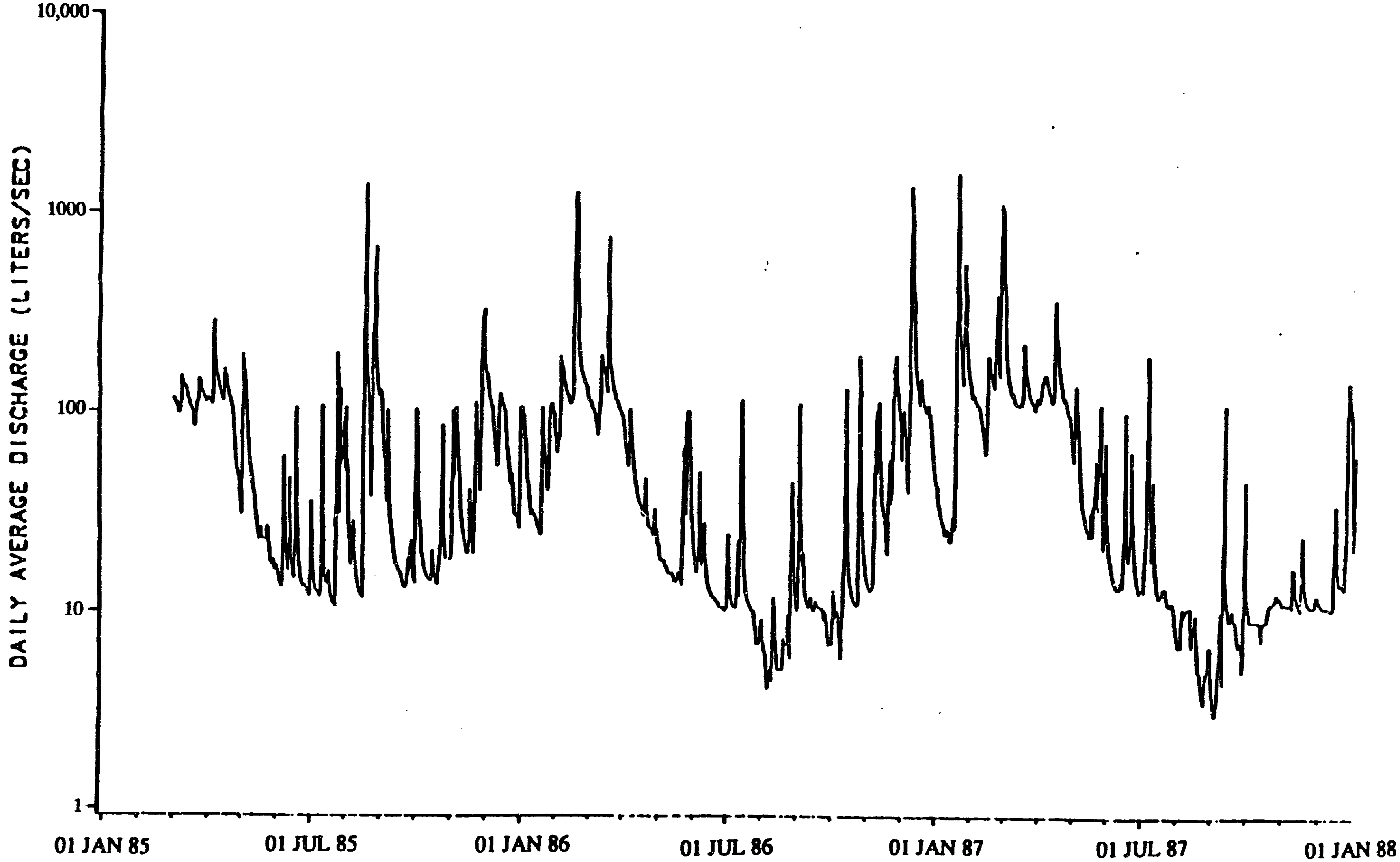

Fig. 2.8. Mean daily stream flow in Bear Creek at USGS gauging station 03538270 at BCK-4.55, March 1985 - December 1987. The mean flow during this period was 107.1 L/s.
***Source*: Lowery et al. (1986, 1987, 1988).**

of 3 years (Sheppard 1974). Runoff from the August 1985 storm resulted in a peak flow (2240 L/s) in Bear Creek that was similar to those observed in the winter and early spring, when runoff is usually high because of minimal evapotranspiration. This peak in flow was more than an order of magnitude greater than the peak flows that occurred during the summer and fall of 1986 and 1987.

2.6.4 Importance of Springs

The numerous springs that originate on the north slope of Chestnut Ridge are a dominant feature of the hydrograph of upper Bear Creek, especially during drought periods. At such times, most of the flow in the main-stem Bear Creek is contributed by springs. The best example of the importance of these springs occurred in the fall of 1987, a time of low precipitation (e.g., rainfall was 24% and 47% of normal in October and November, respectively) that followed a period of extended drought. Four of the five flow-monitoring stations on the main-stem Bear Creek above the SS-5 spring were dry (Fig. 2.7). The only flow in this reach of stream was immediately below the SS-2, SS-3, and SS-4 springs and in the headwaters (BCK-12.46) below the S-3 Ponds.

The springs in upper Bear Creek differ greatly in flow rate. Flow rates are highest in the SS-5 spring at BCK-9.41 and lowest in the SS-1 spring at BCK-12.38, where flow was intermittent between late August and mid-October 1987. Several springs also occur downstream of the SS-5 spring, and two of the largest (SS-7 and SS-8) are located less than 100 m above the USGS/NPDES monitoring station at BCK-4.55. Although flow at this site was never zero, a section of stream at BCK-4.70 immediately above the SS-7 and SS-8 springs was periodically dry in both 1986 and 1987. Thus, springs in this limited section of Bear Creek, like those in the 3-km reach above the SS-5 spring, provide a significant portion of the flow in Bear Creek during periods of low rainfall.

2.6.5 Thermal Characteristics

Continuous monitoring of water temperatures began in September 1985 at the SS-5 spring and three sites in Bear Creek located just above, immediately below, and 1.5 km below the spring. In April 1987, two additional sites, BCK-11.98 and Grassy Creek, a reference stream, were added to the monitoring program.

Springs are important in stabilizing flows, but they also influence the thermal regime of Bear Creek, especially the upper reaches where springs are numerous and flows are intermittent in summer and early fall. The thermal characteristics at a given site depend, in part, on the proximity of springs. Mean temperatures at BCK-9.40 just below the SS-5 spring were ~2–3°C warmer in the winter and 4–8°C cooler in the summer than BCK-9.91 above the spring (Fig. 2.7). The temperature differential between the two sites was greater in summer than in winter because of the seasonal difference in flow and smaller effect of the spring on main-stem flows in winter. Although BCK-9.91 is 250 m below the SS-4 spring, the flow rate of this spring is only one-third that of the SS-5 spring. The thermal regime at BCK-9.91 is nearly identical to that at BCK-7.87, ~1.5 km below the SS-5 spring. These comparisons indicate that the moderating effect of springs on mean temperatures in Bear Creek is highly localized.

The effect of springs on temperature extremes, however, was more pronounced and extended over greater distances. The maximum temperature at BCK-9.91 was 24.9°C, which was similar to that at BCK-9.40 (23.4°C) but 6.7°C below the maximum observed at BCK-7.87. Temperatures as high as 38°C were recorded at BCK-11.98 during a period of near-zero flow in July and August 1987. This site is not significantly influenced by springs; the nearest upstream spring is SS-1, which was dry in late August 1987. Minimum winter temperatures were higher at BCK-9.91 than at BCK-7.87 and, like the trend in maximum temperatures, indicate a greater moderating effect on temperature at BCK-9.91, the site nearest a spring.

Springs have their greatest influence on stream temperatures during periods of low rainfall in summer and fall. Both the mean and maximum temperatures in August 1987 exceeded those in June and July at BCK-9.91 and BCK-7.87. At BCK-9.40, however, August temperatures were actually lower than those observed in the two previous months. Rainfall for August 1987 totaled only 3.2 cm in the Bear Creek Burial Grounds (51% of normal at the Oak Ridge site), and no precipitation occurred on 22 consecutive days before August 2. Thus, the importance of springs in moderating the effects of elevated stream temperatures caused by decreased stream flow during a drought is directly related to the severity of the drought.

2.6.6 General Sediment Description

The substrate materials of Bear Creek vary considerably among several general types, including rock ledges, sand/gravel bars, indurated cohesive clay, flocculent precipitates/clays, and mixtures of these types. In most areas the creek is stable to degradational with respect to net sediment accumulation. The supply of sediment from upland areas and the floodplain is small with respect to the ability of stream flow to export sediment from the watershed. A high percentage of forest cover and stabilization of bank deposits by riparian vegetation limit significant soil erosion during peak stream flows. Thus the most voluminous sediment deposits tend to be fairly coarse-grained, the finer material having been winnowed and exported out of the watershed. Between high flow events, fine-grained sediment deposits do accumulate in low-energy environments (pools, leeward of obstacles, inside of bends) in the creek. These deposits are typically silty sands or sandy silts, with small and variable amounts of gravel and clay. Figure 2.9 exhibits sediment size distributions for several locations on Bear Creek. These distributions were measured on samples collected for chemical analysis and may be biased in favor of fine particles.

Although no mineralogical investigations have been conducted on Bear Creek sediment, such investigations carried out on streams flowing over rocks and soils derived from the Knox, Conasauga, and Rome Groups have reported illite, quartz, and feldspar, with minor amounts of hematite and hydrous manganese oxides. Common clay minerals include kaolinite, mica, vermiculite, hydroxy-interlayered vermiculite, and gibbsite. White to yellowish-white precipitates occur in the upper reaches (above BCK-11.83) and are presumed to be amorphous aluminum hydroxide resulting from the neutralization of acidic groundwater that originates from the plume of the former S-3 Ponds (Turner and Kamp 1984).

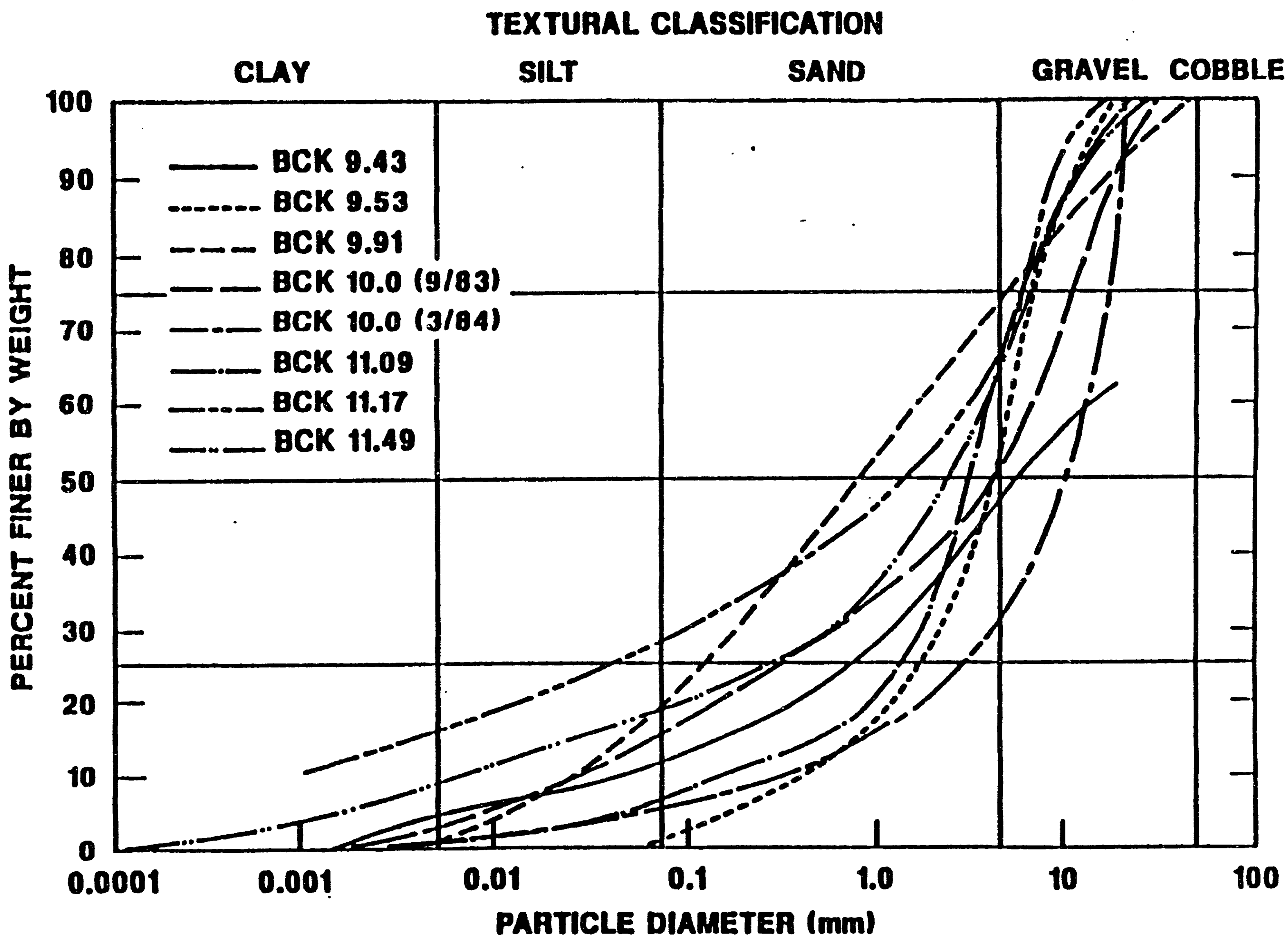

Fig. 2.9. Particle size distribution of sediment samples collected in Bear Creek for chemical analysis.

2.7 GROUNDWATER

The hydrologic regime underlying BCV has two major components, regional flow component and local flow component. In general, a groundwater flow component of regional scale is defined by relatively deep circulation that is independent of local topography and small-scale surface water systems. The regional flow system underlying BCV is virtually undefined because of the limited number of deep wells that are available and have been included in past characterization studies. Currently, the only hint to the depth at which regionally controlled groundwater flow may predominate comes from examination of a few scattered chemical analyses that have been obtained in the deep wells. For example, see the partial analyses presented in Geraghty & Miller (1988a and b) for wells GW-117, -118, -119, -123, and -125. These and more extensive, but as yet unpublished, analyses show that below depths of ~500 ft the groundwater appears to become more highly mineralized with sodium, chloride, and sulfate than the relatively dilute, shallow groundwaters typical of this region. The nature of any interaction between the compositionally distinguishable shallow and deep groundwaters beneath BCV is unknown at this time but probably is limited.

The local flow component includes groundwater contained within the unconsolidated weathered residuum and the upper part of the underlying bedrock. Groundwater flow within this hydrologic component is strongly influenced by topography and surface drainage patterns. Hydrologic investigations reported by Geraghty & Miller (1988a) show that the surface-drainage divide that separates EFPC from Bear Creek near the S-3 Ponds also is a groundwater divide that defines the eastern boundary of the shallow BCV hydrologic system (Fig. 2.10).

Results of numerous studies (e.g., Geraghty & Miller 1988b; Bailey and Lee 1991) within BCV and along its bounding ridges demonstrate that recharge of this flow component occurs along the ridges through infiltration of precipitation. Groundwater flow paths typically are directed away from the bounding ridges and generally follow the topography, converging within the valley in the vicinity of Bear Creek. Figure 2.11 presents a generalized cross-section of BCV that illustrates the idealized subsurface flow of groundwater described above. In the zone underlying Bear Creek, the direction of groundwater flow is southwest along the valley axis. These results are consistent with those obtained in other regions of BCV.

Flow within the shallow groundwater component, while dominated by the topography of the drainage system, is strongly influenced by structural properties of the bedrock. For example, several recent studies have investigated the fractures in bedrock material obtained from coreholes along a transect across BCV near the head of Bear Creek (Lutz and Dreier 1988). These studies demonstrate that several major fracture sets exist, dominated by a strike-parallel set. The results of these studies provide reasonable confirmation for observations from a pumping test performed in this area which showed that hydraulic properties of bedrock are not isotropic (Geraghty & Miller 1987). Rather, hydraulic conductivity values in the strike-parallel direction are at least several times larger than in any other direction. Anisotropy in hydraulic properties means that the direction of groundwater flow deviates somewhat from that predicted by the potentiometric contours such as those presented in Fig. 2.10.

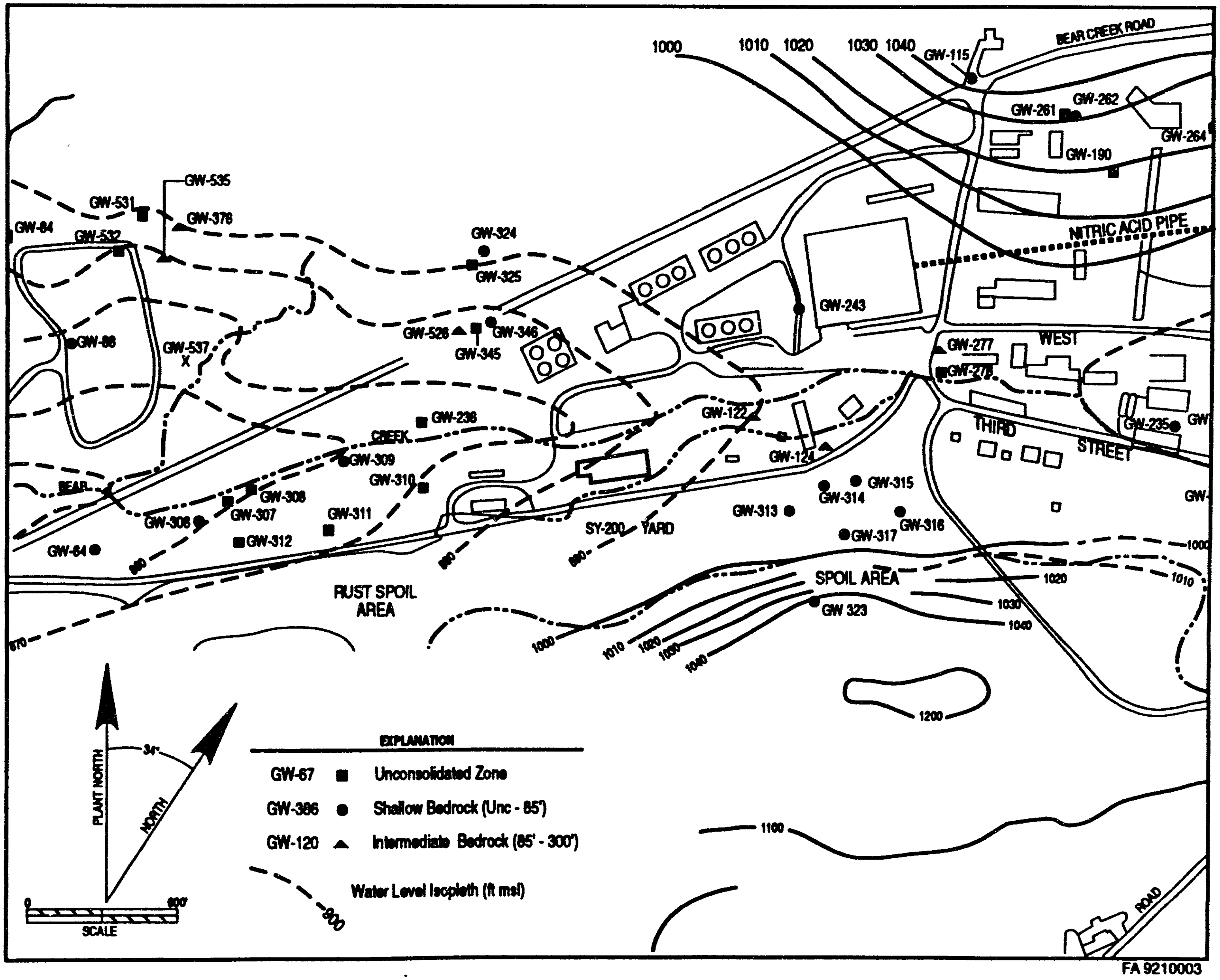

Fig. 2.10. Water-table surface in the Bear Creek hydrologic regime (April 16-19, 1990).

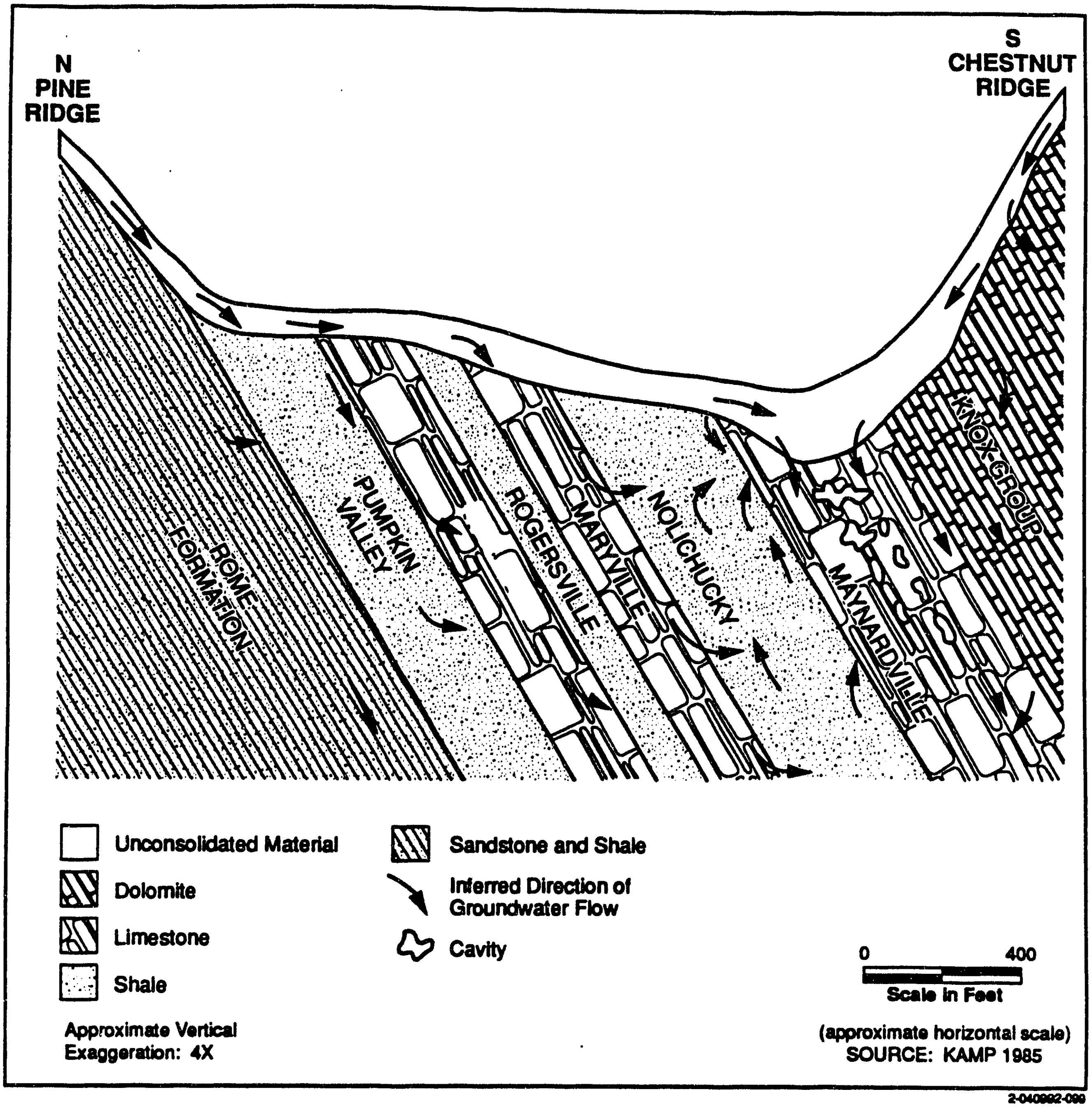

Fig. 2.11. Generalized cross section of BCV showing inferred groundwater flow paths.

In addition to small-scale deformation features such as the fracture sets discussed above, it is probable that large-scale features, including fracture zones and faults, exist in BCV and influence groundwater flow. The nearly parallel southerly flow of most tributaries draining the southern slope of Pine Ridge is one example of the type of surface expression anticipated from parallel fracture zones. At present, the identity of these structural features and their potential for affecting groundwater flow paths, contaminant migration, and the interaction between shallow and deep hydrologic components are unknown.

In the vicinity of Bear Creek the interaction between the creek and the shallow groundwater component has not been systematically investigated. It is believed that an extensive network of solution channels within the Maynardville Limestone that underlies Bear Creek makes it an efficient drain for the local groundwater component and is the principal cause for the existence of losing reaches along the length of the stream. The results of a recent tracer study (Geraghty & Miller 1989a) clearly demonstrate that some spring discharge is composed of water that enters the groundwater in an upstream losing reach.

2.8 UNIT DESCRIPTION

2.8.1 Geographic Information

OU 2 is located in BCV in Anderson County ~0.4 miles west of the Y-12 Plant on Old Bear Creek Road (Fig. 2.12).

2.8.2 Background Information

The Oak Ridge Y-12 Plant was built by the U.S. Army Corps of Engineers in 1943 as part of the Manhattan Project. The original mission of the Plant was to separate the fissionable isotope of uranium (^{235}U) using an electromagnetic separation process. After World War II, this process was discontinued in favor of a more economical gaseous diffusion process conducted at the nearby Oak Ridge K-25 Site (Welch 1989a).

Since the early years, the Y-12 Plant has developed into a highly sophisticated manufacturing and developmental engineering facility. Current manufacturing activities at the Y-12 Plant include chemical processing of lithium and uranium compounds, and precision fabrication of components from lithium compounds, uranium, and many other materials. In support of these activities, areas were needed for disposal of uncontaminated fill and construction debris (RSA and SA-1) and for the temporary storage of equipment (SY-200 Yard).

OU 2 is composed of the RSA, the SA-1, and the SY-200 Yard.

2.8.3 Operational Information

The following subsections contain descriptions of the wastes managed in each OU as well as information about their generation, disposal methods, and any subsequent treatment or cleanup activities at the OU. Where monitoring data have been obtained which are site-specific to an OU, those results are also included.

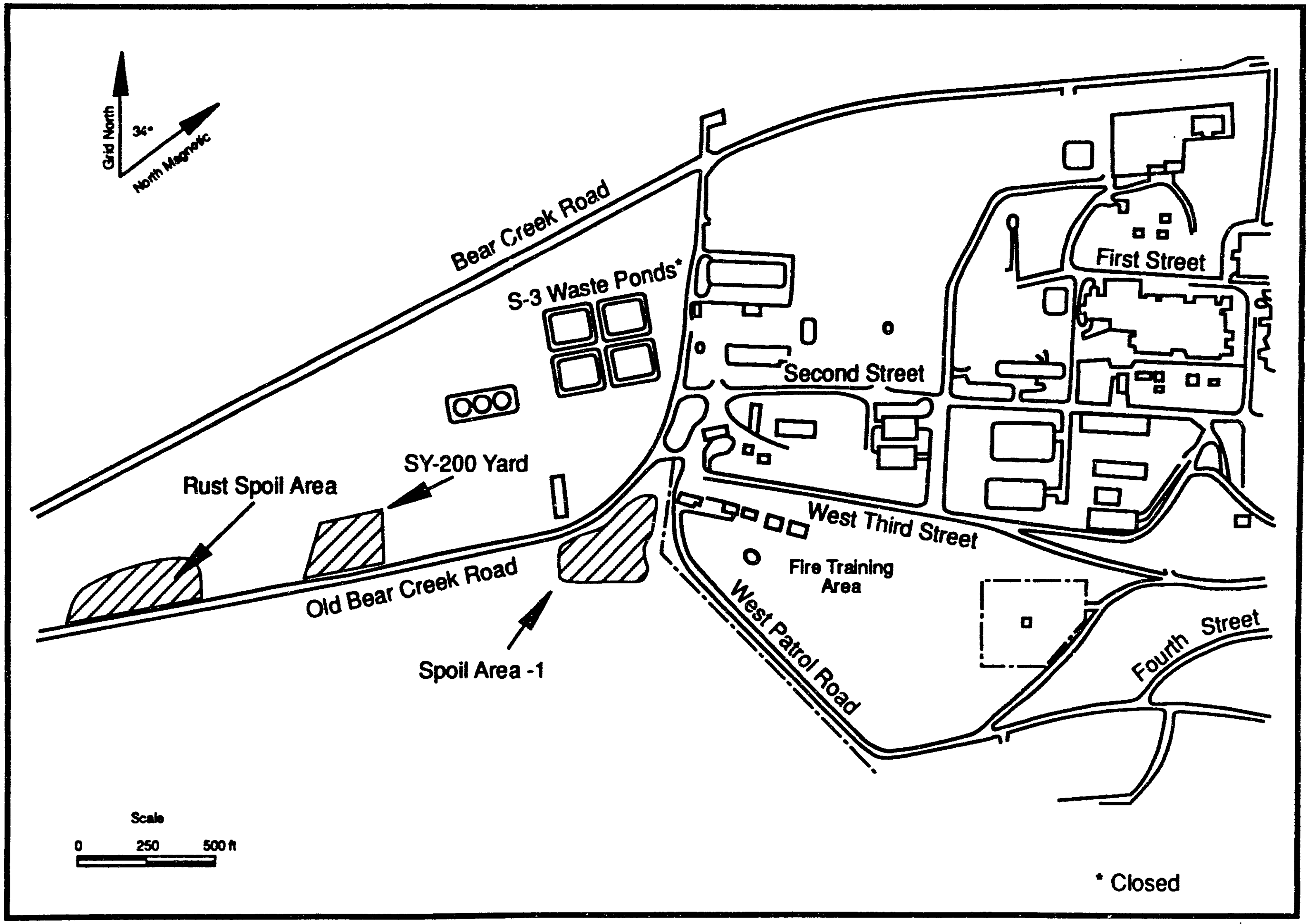

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Fig. 2.12. Bear Creek OU 2.

2.8.3.1 Rust Spoil Area

Rust Engineering, formerly a DOE prime contractor, conducted various renovation, maintenance, and construction operations at the Y-12 Plant. Solid waste (spoil material) generated during these operations was disposed of in an area on ORR known as the RSA. The RSA was operated from 1975 to 1983. The 5.4-acre site measures ~300 by 900 ft in area (Welch 1989c). A walkdown by Energy Systems/SAIC staff showed the RSA to be either vegetated or graveled. Equipment at the site was segregated into lots for storage.

The RSA was operated as a dump with periodic grading (typically once a month) to promote positive drainage. Dumping progressed northward from Old Bear Creek Road. As dumping occurred, the natural topography was elevated and a portion of the Bear Creek Channel was filled. Eventually, the stream channel course was relocated to the north to compensate for the outslope progression. Based on a review of maps depicting the topography before and after the disposal operations, it is estimated that less than 100,000 yd^3 of construction debris and spoil were disposed of at the site. The spoil material apparently was not covered with soil. Because routine compaction of the soil was not intended but occurred only as grading took place, it is likely that the compaction operations at the site were somewhat deficient.

The RFI plan for this SWMU (Welch 1987b) indicates that no formal design plans were developed for the disposal area and that no detailed disposal records are available for the wastes disposed of there. The bulk of the waste is reported to consist of demolition debris, including soil, masonry materials, and metal (steel rebar in concrete). The RFI plan also indicated the possibility that minor amounts of solvent-contaminated material, and material containing asbestos, mercury, and uranium, may have been disposed of in this area.

Site closure activities began in the fall of 1983 with the preparation of the site's closure plan. The plan called for grading and shaping the existing fill, capping the entire fill area with a minimum of 2 ft of soil, and establishing vegetative growth over all the disturbed areas. The specifications of the capping plan called for a minimum of 1.5 ft of compacted clay and 0.5 ft of topsoil to be placed over the site. The clay layer would be compacted in maximum 8-in. lifts. Closure began in late 1983 and was completed in mid-1984 (Welch 1987b).

2.8.3.2 Spoil Area 1

SA-1 is located west of the Y-12 Plant on Old Bear Creek Road near the junction with West Patrol Road (Fig. 2.12). Various renovation, maintenance, and construction operations at the Y-12 Plant produced construction debris that included concrete, asphalt, brick, brush, rock, and tile. Solid waste (spoil material) generated during these operations has been disposed of in SA-1 since about 1980, but the RFI plan for this SWMU (Welch 1989b) indicates that no detailed disposal records are available. The site is ~5 acres. Since 1985, SA-1 has had a permit from TDEC as a landfill for rubble and noncombustible, nonputrescible solid waste. It is estimated that roughly 100,000 yd^3 of nonuranium-contaminated construction debris had been disposed of at the site (Welch 1989b). The waste was determined to be nonradioactively contaminated according to health physics requirements established for the Y-12 Plant, although construction material disposed of in this area may have contained minor amounts of asbestos, mercury, beryllium, uranium, thorium, and other contaminants, according to the RFI plan.

Soil borings were completed in September 1990 at various locations within SA-1. Subsurface soil samples were collected and analyzed for metals, organics, and selected radiologicals (see Appendix C).

2.8.3.3 SY-200 Yard

From the 1950s to 1986, the SY-200 Yard was operated as an aboveground "hold for future use" storage area. The site was surrounded by a 6-ft fence with gate access. During operation there were no underground utilities or piping at the site. The Y-12 Plant operations divisions that used the yard included the Assembly Division, Engineering Technology Division, Metal Preparation Division, and ORNL Fusion Energy Division. Items stored at the site were segregated with respect to ownership by the various operating divisions using the yard.

Fill soil was placed in the SY-200 area in the 1950s, and there are no records of the sources of this soil fill. Similarly, there are no detailed records available on the items that were stored and removed during the early operational period of the SY-200 Yard. All items stored at the site were removed by September 1986 to prepare the area as the future site for an Environmental Support Facility (ESF) to include a maintenance shop, office complex, tanker terminal, and security portal. Before removal, all items stored at the site were surveyed by the Y-12 Plant Health Physics Department (HPD) and flagged for proper disposal and handling. Construction of the ESF was temporarily postponed due to the presence of mercury and asbestos in some of the excavated soils. Table 2.5 summarizes an inventory of items removed from the site before closure in 1986. This inventory is based on available records and discussions with Y-12 Plant personnel.

The SY-200 Yard area remained unused until ESF construction activities were initiated in December 1988. At that time, the fence surrounding the SY-200 Yard was removed and a larger one encompassing all proposed ESF operations was erected. The planned construction of the ESF building and support facilities is shown on Fig. 2.13.

During construction of the ESF building foundation, the top 6 in. of gravel and soil were removed and stored in the southwest corner of the site. Excavation for the building foundation progressed until ~8 ft of fill material was removed and bermed along the north and east corners of the excavation. Because no natural soils were encountered during the excavation, construction activities ceased for evaluation of engineering designs. Construction activities resumed in September 1989, when the top 6 in. of soil that had been removed in December 1988 was spread and graded over the bottom of the excavation. A silt fence was placed along Bear Creek to intercept runoff and eroded soils. In light of the RFI process, construction of the ESF on the SY-200 Yard site has ceased. In early 1990, the material bermed along the north and east corners of the ESF excavation was placed back in the excavated area and covered with about 5 ft of clean borrow material. The ESF is currently under construction immediately south of Old Bear Creek Road. Old Bear Creek Road is being moved north ~75 ft to make room for the ESF parking area. This will place the new location of the road across the southern part of the SY-200 Yard.

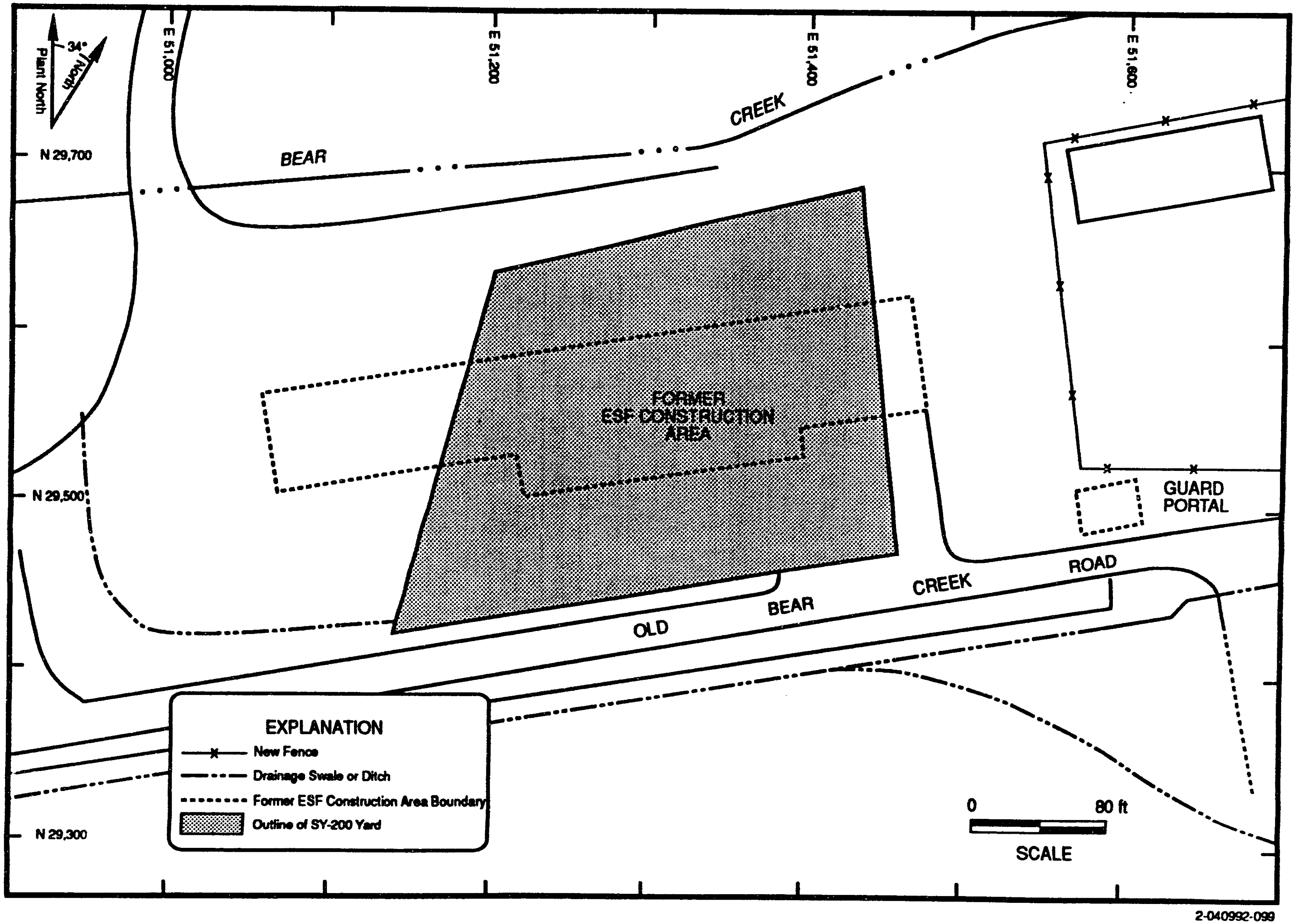

Fig. 2.13. SY-200 Yard and former ESF construction area.

Table 2.5. Summary of 1986 inventory at the SY-200 Yard

Rubber-Lined Steel Tank	Pit Furnace Hearth
Nickel Plating Tank	Work Roll Bearings
Caustic Exhaust Fan	Plate Lifting Arms
Plating Tank Liner	Shaft Heat Treat Fixture
Head Tank F5000-7	Drive and Sleeve Set
Plating Tanks	Vacuum Tank for DCX2
Waste Storage Tank	Transformers (five)
Ni Strip Fix K25 Gas DF	Radiators for Power Supply
Handling FXT for Bells	Lead Shielding Plates
Tank BRK LND 12 × 15 × 8 Deep	Aluminum Plate and Buss
Tank 13 RK BOTM	Cooling Fins (12 crates)
Fiberglass Tank Liner	CRBRP Demineralizer
31D1A × 30 length Exhaust Fan	CRBRP Chemical Feed Equipment
Support Tanks	Lube Oil Cooler
Duct Ext 48-diam Fiberglass	Bullard Hood
E10 Pipe 4 for Lindberg	Converxor Roller
Flange Lindberg Furnace	High Rise Rack with Shelving
Retort Hold Furnace Cover	Hardware for Shelving
E-K Evaporator Parts	Well Cabinets
TurbaFilm Evaporator Parts	Well Positioner
100-gal. Tank	Table Stand with Racks
6-in. Stainless Steel Piping	Braces for Racks
B-1 col. Dissolver Parts (13)	Bed Plate
DPU Retort	Loading Frames
Steam Coil for F6005	48 × 48 × 60 Steel Tank
Nitric Acid Still	Railroad Ties
Table Roll Parts	Blocks
Used Table Roll	Bricks
Backup Roll Lift Fixture	Fencing Material
Strip Pallets	

Source: Perkins 1989.

2.8.4 Releases

The RSA and SA-1 were used as disposal areas for solid waste (spoil material) generated from various renovations, maintenance, and construction operations at the Y-12 Plant. Although no detailed records are available, the bulk of disposed spoil material consisted of (1) soil, (2) masonry materials (i.e., brick and concrete), and (3) metal (i.e., steel and rebar). A portion of the demolition debris was packaged and disposed of at RSA in open-top metal containers. These containers were determined to be nonradioactively contaminated, according to health physics requirements established for the Y-12 Plant. Discussions with Y-12 Plant personnel indicated the possibility that small quantities of solvent-contaminated material and material containing asbestos, mercury, and uranium may have been disposed of in these areas. However, existing administrative and other established in-plant controls prevented the disposal of significant amounts of chemicals, wastes, or contaminated material at the sites. Storage of materials at SY-200 may have resulted in minor releases of mercury, lead, and PCBs to the surface soils.

2.9 EXISTING DATA

Existing characterization and monitoring data relevant to OU 2 have been collected in conjunction with sitewide studies of the Bear Creek Hydrogeological Regime (surface water, groundwater, biomonitoring) as well as site-specific sampling programs (groundwater, soil chemistry). In the following discussions, site data are often compared to reference values. Reference values are used in the absence of site-specific background values. Reference values often represent concentrations observed in the media from areas of east Tennessee beyond the influence of the Oak Ridge facilities; however, differences in similar geologic formations and the soils developed on them have not been examined in detail.

2.9.1 Surface Water Data

In April 1984, a program of weekly streamflow measurements was initiated by Energy Systems at 14 sites along Bear Creek and its tributaries. The streamflow network currently consists of 8 stations (Fig. 2.14), with the farthest downstream site located at an NPDES weir (BCK-4.55). The highest flows in Bear Creek generally occur in the spring, the period of greatest precipitation. Low flows occur in the late summer and early fall, when several tributaries go dry and all or part of the main channel is dry as far downstream as station BCK-9.53. After periods of rainfall, the first several hundred feet of the channel may contain water from surface runoff, but at other times the channel remains dry upstream of the SY-200 Yard.

Energy Systems and USGS are operating recording gauges at the NPDES weir (BCK-4.55). The estimated flow at this point on Bear Creek is ~7.3 ft^3/s (McMaster 1967). This value may be taken as an estimate of the total outflow from the Bear Creek Watershed at its exit point through Pine Ridge.

In addition to streamflow measurements, monitoring of water chemistry was initiated in 1983 and has continued as part of the Y-12 Plant environmental surveillance efforts. The analyses performed have included both inorganic and organic contaminants and have typically been fairly comprehensive, including one sampling and analysis event for hazardous

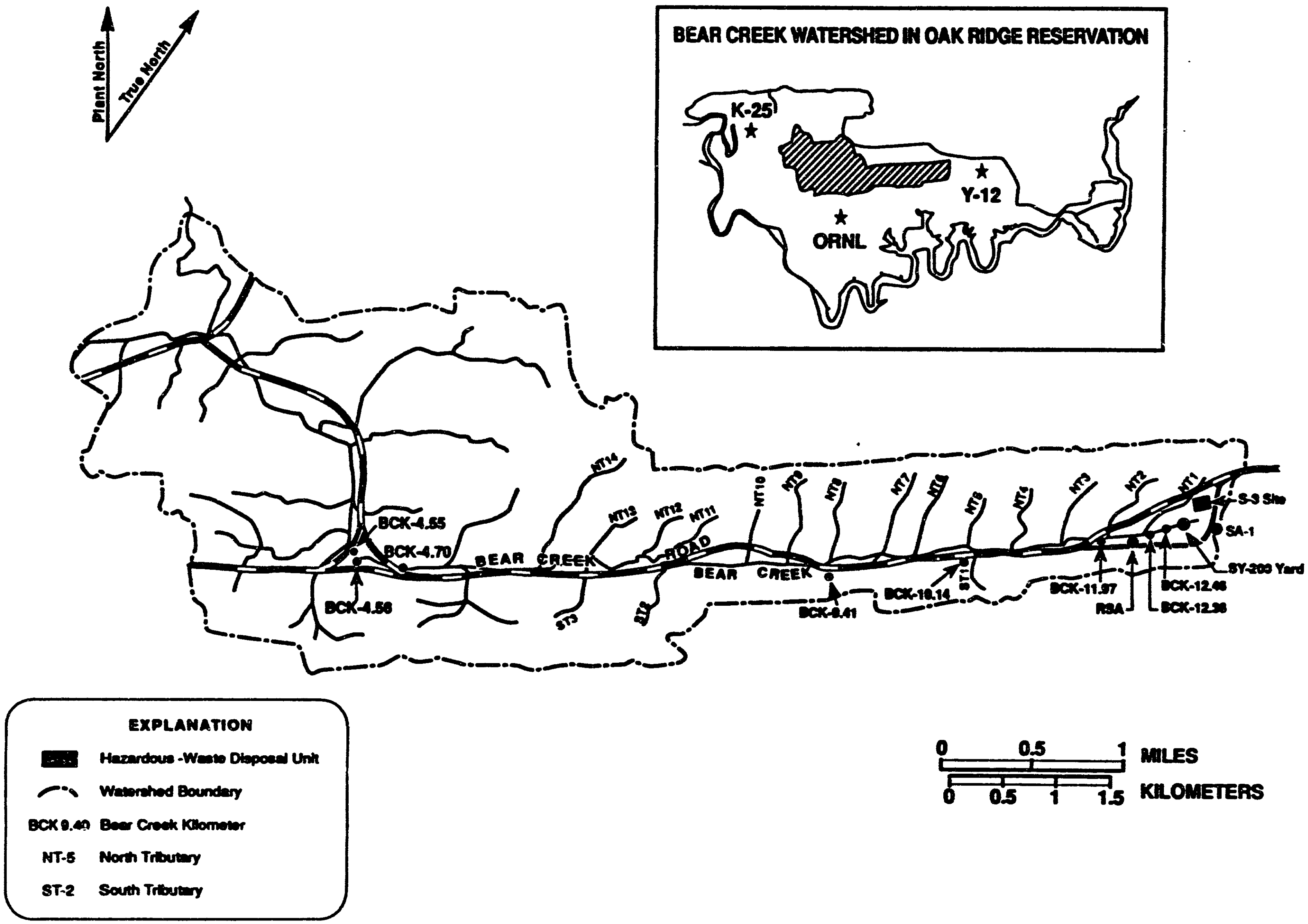

Fig. 2.14. BCV watershed and location of stream gauging sites.

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constituents listed in Appendix IX of *Code of Federal Regulations*, Title 40, Part 264. Results of these analyses suggest that total dissolved solids, nitrate, uranium, aluminum, and cadmium have been the chief contaminants warranting health and ecological concern. The concentrations of all these contaminants decrease downstream from the headwaters near the S-3 Ponds, suggesting that the primary release to surface water is related to this site. The occurrence of these contaminants in several springs, which seem to sustain flow in parts of Bear Creek during dry periods, appears to result from recharge of shallow groundwater by Bear Creek upstream of these springs and the subsequent discharge of this shallow groundwater back into Bear Creek. If this interpretation is correct, corrective measures applied at the S-3 Ponds should continue to reduce both surface water and shallow groundwater contamination in upper Bear Creek.

Stream water quality data have been collected at BCK-12.4 and BCK-11.97 (Fig. 2.14) where, due to decreased flow from the S-3 Ponds, BCK-11.97 has been proposed as the permanent monitoring station to replace BCK-12.4. The 1990 monitoring results for some metals and nitrate that are characteristic of groundwater contamination in OU 2 for the two surface water sites are summarized in Table 2.6.

Table 2.6. 1990 summary of surface water concentrations from sampling stations BCK-12.4 and 11.97[a] (µg/L)

Analyte	BCK-12.4	BCK-11.97	Maximum contaminant level
Barium	76.4	481	1000
Boron	63	50	
Cadmium	*b*		10
Chromium			50
Copper			1300[c]
Lead			50
Mercury			2
Nickel		44	100[c]
Strontium	422	714	
Uranium	512	211	
Zinc			5000[d]
Nitrate	31,400	150,100	10,000

Source: Energy Systems 1991.
[a]Average values for analytes found in OU 2 groundwater samples.
[b]Average concentration was below the detection limit.
[c]Proposed.
[d]Secondary level.

Elevated concentrations of nitrate are characteristic of the S-3 Pond source area and exceed the Safe Drinking Water Act (SDWA) maximum contaminant level (MCL) at both surface water sampling locations. None of the metals exceeds its MCL. Surface water quality, as measured by nitrate and uranium concentrations, has improved over time (Fig. 2.15) as the S-3 source has diminished.

2.9.2 Groundwater Data

Groundwater monitoring is conducted in the Bear Creek Hydrogeological Regime as part of a Y-12 program of groundwater assessment monitoring. The regional groundwater flow system has been described in Sect. 2.7. Site-specific data on both the groundwater flow system and the groundwater quality are discussed in the following paragraphs.

2.9.2.1 Rust Spoil Area

Groundwater monitoring wells at RSA are illustrated in Fig. 2.16. Water-level fluctuations in the wells completed in the unconsolidated zone (GW-307, GW-308, GW-310, GW-311, and GW-312) parallel those changes seen in the wells that were completed in the Maynardville Limestone (GW-306 and GW-309). This is consistent with observations made in other monitoring well networks in the valley and supports the concept that the unconsolidated zone and the upper sections of the bedrock can be considered as one interconnected aquifer (Welch 1989c).

The lowest water levels seem to occur in the summer months and possibly continue dropping into the fall, with the highest levels occurring in late winter and spring. These fluctuations are due to the seasonal variations in precipitation and evapotranspiration.

The groundwater flow patterns in BCV have been studied over the past 10 to 15 years (Welch 1989c). The general pattern is one in which water infiltrating into the ground from precipitation ultimately moves toward the lowest elevation, Bear Creek, and is discharged into the creek as springs and seeps or may be discharged to a series of solution cavities in the Maynardville Limestone (Welch 1989c). In the low-lying areas of the valley, heads in deeper wells (50 to 150 ft) are higher than heads in shallower wells. This supports the concept of an upward flow component in the valley bottom. The resulting discharge of groundwater sustains the flow in lower reaches of Bear Creek and, at times of low or no surface water flow in the upper reaches of Bear Creek, the groundwater moves through the solution cavities under the creek. Some water from the solution cavity system is discharged farther downstream in Bear Creek (Welch 1989c).

A map of the general groundwater flow paths at the RSA (based on 1989 data) is shown in Fig. 2.17. Groundwater elevations from monitoring wells indicate that the direction of flow in the shallow aquifer system parallels the creek and proceeds down the valley to the west. However, these elevations may only indicate the general direction of groundwater flow. The aquifer underlying the RSA is anisotropic, and localized flow paths may occur because of joints, fractures, and solution cavities in the Maynardville Limestone.

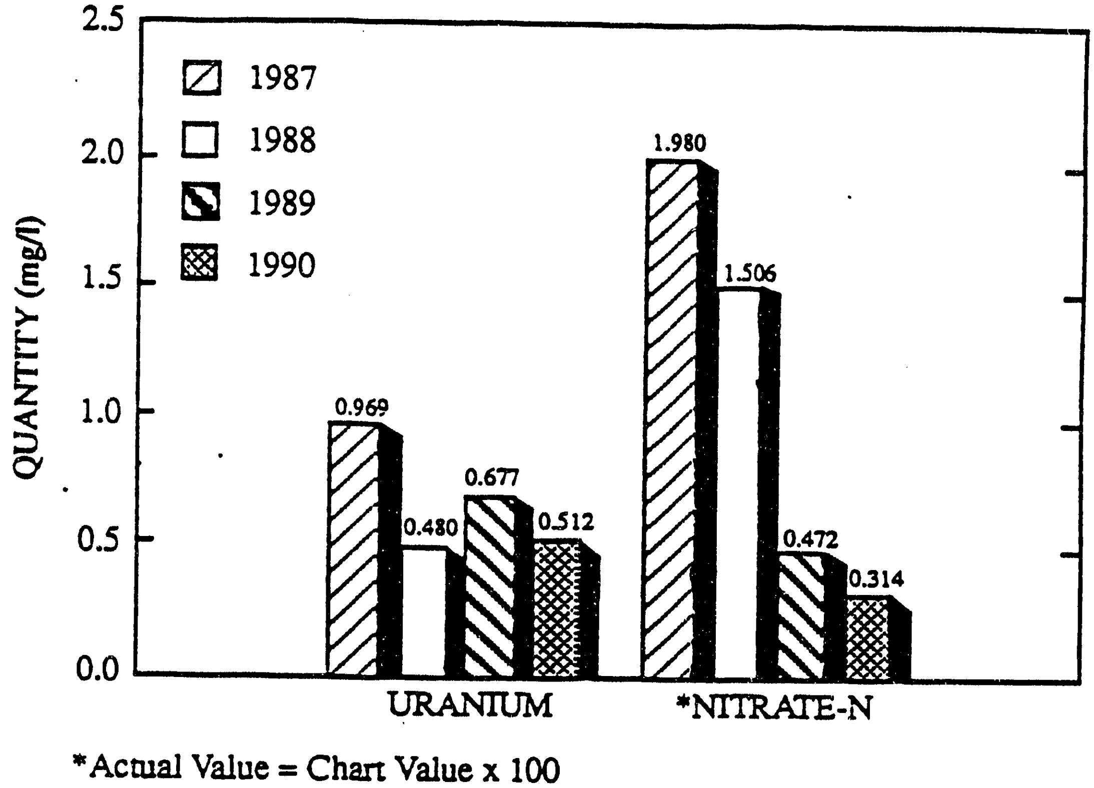

Fig. 2.15. Upper Bear Creek trend chart, 1987-1990.

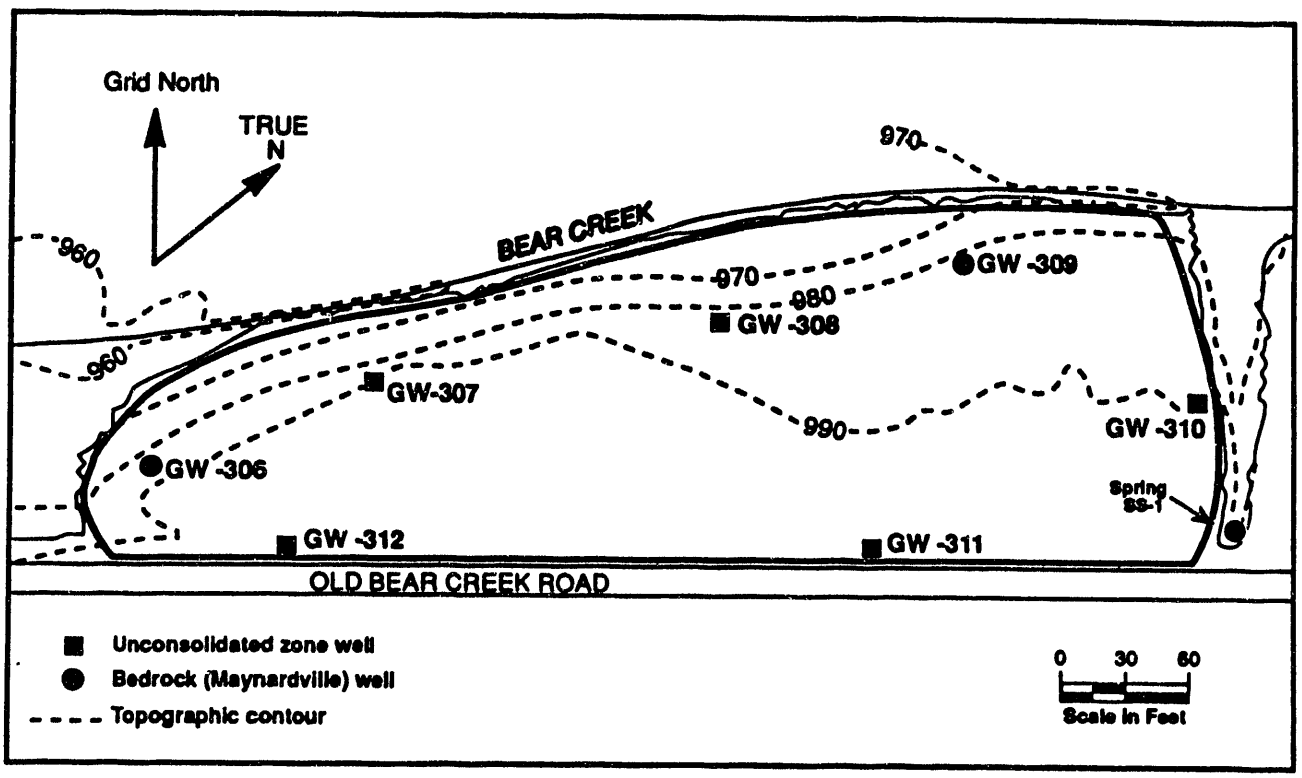

Fig. 2.16. RSA groundwater monitoring wells.

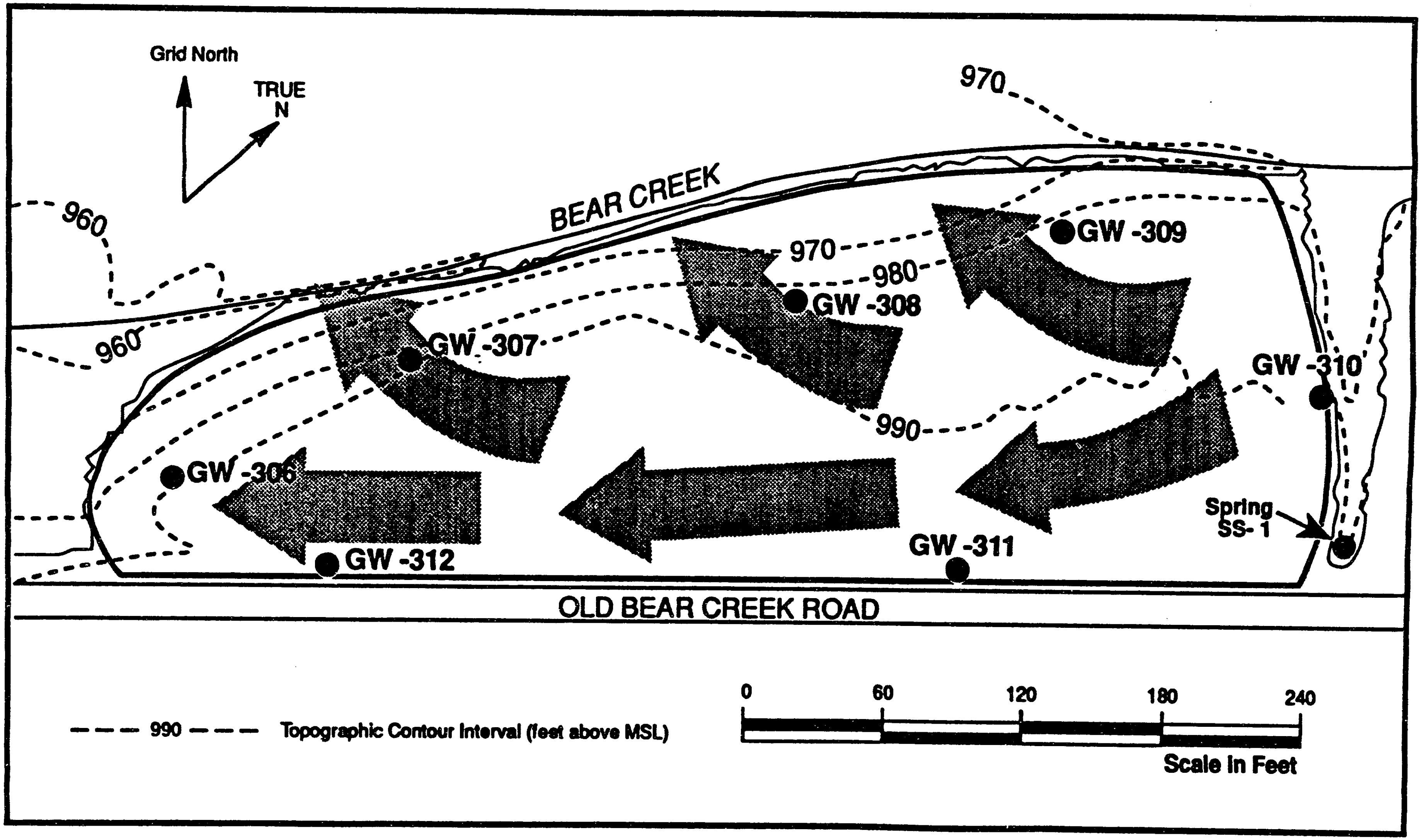

Fig. 2.17. Location of groundwater monitoring wells and generalized groundwater flow directions under the site.

The groundwater flow pattern at the RSA is further complicated by the fact that the area is bordered by Bear Creek and the SS-1 spring. Because of operations at RSA, the original creek channel was filled, and Bear Creek was rerouted to the north. The old channel may still act to influence drainage in the area. Data from stream gauging stations located along Bear Creek indicate that, during times of high surface water discharge, Bear Creek is a gaining (effluent) stream. However, during periods of low water discharge, at least some reaches of Bear Creek act as a losing (influent) stream (Welch 1989c). Analysis of water levels in shallow monitoring wells along Bear Creek indicates that the portion of Bear Creek located adjacent to the RSA is a gaining (effluent) stream (Turner et al. 1988).

The monitoring well network at the RSA has been sampled quarterly since February 1988, and the groundwater quality results for 1990 are summarized in Table 2.7.

The results of the analyses indicated elevated concentrations of radioactivity, nitrate, chloride, sulfate, and volatile organic compounds (VOCs). Heavy metals, polychlorinated biphenyls (PCBs), pesticides, and herbicides did not appear to show elevated concentrations or were below detection limits.

Individual quarterly analyses for alpha activity indicated that wells GW-309 and GW-312 exceeded 15 pCi/L but that the semiannual average of the analysis was well below the 15 pCi/L drinking water standard (Welch 1989c).

The results for individual quarters show that the beta activity standard of 50 pCi/L (Welch 1989c) was exceeded in all wells except GW-308 and that wells GW-309 and GW-312 had high values of 2102 and 403 pCi/L, respectively. The semiannual average indicated that monitoring wells GW-306, GW-309, GW-310, and GW-312 exceeded 50 pCi/L. These results suggest that some contamination from radionuclides has occurred.

Average uranium levels in the wells at the RSA were below 2 μg/L. The elevated levels of alpha and beta activity and uranium may be caused by the RSA but may be due to the influence of other sources such as the upgradient S-3 Ponds.

The average concentrations of chloride, nitrate, and sulfate are above reference levels of less than 5 mg/L, 0.1 mg/L, and 5 mg/L, respectively, in all the RSA wells except GW-311 and GW-312, which were only above background for nitrate. All chloride concentrations were below the applicable standard of 250 mg/L (Rogers et al. 1989). Sulfate concentrations are elevated but still below the applicable standard of 250 mg/L (Welch 1989c).

Elevated concentrations of nitrate are characteristic of the BCV headwaters. The nitrate applicable standard of 10 mg/L (Welch 1989c) was exceeded in all wells except GW-311 and GW-312. The history of the RSA does not suggest that nitrates in any form were disposed of here. The source of the nitrates is most likely the S-3 Ponds. The findings confirm the presence of a plume emanating from the S-3 Ponds and migrating down the valley which extends at least 2000 ft from the ponds. The nitrates found in the groundwater may be the direct result of groundwater flow or influent surface water/groundwater interaction of contaminated water from Bear Creek. It is probable that both transport mechanisms have contributed to the elevated nitrate concentrations in the wells completed in the unconsolidated and the bedrock zones.

Table 2.7. RSA—1990 average groundwater concentrations[a] ($\mu g/L$, except where noted)

Analyte	GW-306[b]	GW-307	GW-308	GW-309	GW-310	GW-311	GW-312
Barium	46	87	95	46	96	18	41
Boron	300	260	38	370	160	260	250
Cadmium	*c*	2					
Chromium			62		34		34
Copper	11	30	38	3.6	8.6	7.8	9.3
Lead		30	50		22		50
Mercury			0.2		0.2		
Nickel	13	19	16				15
Strontium	180	270	320	420	330	70	580
Uranium	1	1	2	2	0.9	0.8	
Zinc	18	40	44	9	12	15	34
Chloride	17,800	35,500	31,200	34,000	32,500	3,750	1,000
Nitrate	11,000	17,800	15,000	17,800	23,000	750	280
Sulfate	36,000	91,500	13,100	64,700	68,000	4,250	2,750
1,2-DCE	12.6	20.2	16.8	16.8	19.2		
PCE		1.75	1.5	1.8	2.4		
TCA	2.4	2.5	2.2				
TCE	75	55.5	37	19.7	27.2	33.5	57.5
Gross alpha, pCi/L	2.64	5.33	5.57	2.38	3.50	1.25	1.36
Gross beta, pCi/L	26.7	49.0	40.5	49.9	61.9	2.36	21.4

[a]Average values for quarterly samples with a minimum of two analyses above detection limit. Values below detection limit were treated as one-half the detection limit.
[b]Groundwater well designation.
[c]Analyte not detected above reference more than once during the year.
Source: HSW (1991).

The results of VOC analyses, summarized in Table 2.7, indicate that the RSA may be a source area for trichloroethene (TCE), trans-1,2-dichloroethene (1,2-DCE), and to a lesser extent trichloroethane (TCA) and tetrachloroethene (perchloroethene or PCE). TCE concentration exceeded the applicable standard of 5 $\mu g/L$ in all wells. The downgradient monitoring wells GW-306, GW-307, and GW-312 at the RSA show the highest average concentrations of TCE.

2.9.2.2 SY-200 Yard

There are no groundwater monitor wells at the SY-200 Yard. Groundwater east and west of the site has been monitored since 1986 in accordance with RCRA assessment monitoring at TSD units.

The SY-200 Yard is located ~700 ft southwest of the S-3 Site. The RSA and the Oil Landfarm are located about 600 and 2000 ft, respectively, west of the SY-200 Yard. Based upon data presented in the 1988 Groundwater Quality Assessment Reports for the S-3 Site and the Oil Landfarm (Geraghty & Miller, Inc. 1989b and 1989c), groundwater contamination is present in the vicinity of the SY-200 Yard, the RSA, and the Oil Landfarm. Data suggest that a VOC plume beneath the RSA has intermingled with the VOC plume from the Oil Landfarm. In addition, groundwater monitoring data for BCV indicate that a nitrate plume originating at the S-3 Site has migrated into the Maynardville Limestone underlying the SY-200 Yard and extends as far west as the Oil Landfarm. Details on the groundwater quality east and west of the SY-200 Yard are presented in the above-referenced reports.

2.9.2.3 Spoil Area 1

The monitoring well network at SA-1, which includes wells GW-313 through GW-317 and GW-323 (see Fig. 2.18), has been sampled quarterly since February 1988.

The 1988 groundwater results for SA-1 wells were summarized in the RFI plan for SA-1 (Welch 1989b). Results indicated elevated concentrations of radioactivity, total coliform bacteria, total organic carbon, total organic halides, iron, and nitrate. PCBs, pesticides, and herbicides were below detection limits.

The 1989 results for SA-1 wells were reported in a summary document (Geraghty & Miller 1990b) that assesses the groundwater quality for the Bear Creek Hydrogeologic Regime. However, this document has limited information on SA-1 wells because only GW-317 was sampled in the 1989 sampling campaign and only for the first two quarters of 1989.

The 1990 groundwater results are summarized in the latest valleywide groundwater quality assessment report (HSW 1991). The discussion in this section is based on those results, which are summarized in Table 2.8.

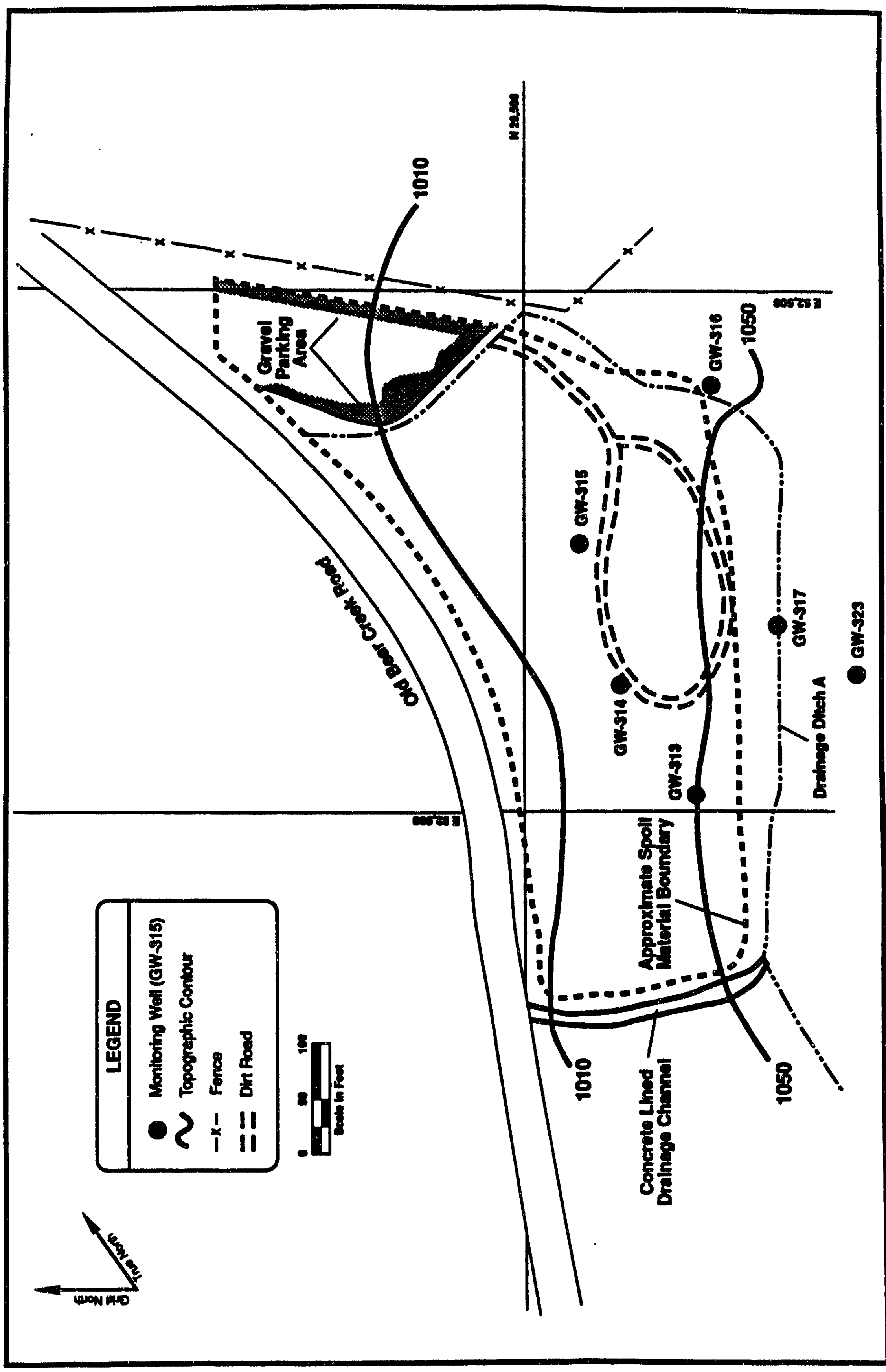

Fig. 2.18. SA-1 groundwater monitoring wells.

Table 2.8. SA-1 1990 average groundwater concentrations[a] (μg/L, except where noted)

Analyte	GW-313[b]	GW-314	GW-315	GW-316	GW-317	GW-323
Barium	23	39	47	37	16	34
Boron	10	30	22	13	23	16
Cadmium	*c*					3
Copper	9	6	5	7	8	
Lead	28	3		6		
Strontium	78	93	141	39	45	21
Uranium			1	0.7		
Zinc	8	9	10	32	12	13
Chloride	2,000	4,600	6,800	2,000	880	1,000
Nitrate	900	10,800	16,000	400	180	
Sulfate	2,600	6,200	11,200	2,600	7,000	2,000
1,2-DCE	7.5	11.7	26.6			
PCE	8.6	13.3	33.3			
TCE	4.7	5.7	13.5			
Gross alpha, pCi/L	0.30	1.00	1.30	1.01	0.38	1.14
Gross beta, pCi/L	3.12	32.3	54.9	2.54	3.01	1.80

[a]Average values for quarterly samples with a minimum of two analyses above detection limit. Values below detection limit were treated as one-half the detection limit.
[b]Groundwater well designation.
[c]Analyte not detected above reference more than once during the year.
Source: HSW 1991.

Organic compounds in the SA-1 groundwater. Table 2.8 summarizes the detections of VOCs from the 1990 sampling events from the monitoring wells at SA-1. No semivolatile organic compounds, pesticides, PCBs, or herbicides were detected. Phthalate detections were not considered further because detection of these compounds were determined to be false positives through the use of a screening procedure developed by EPA (EPA 1988b), and these chemicals have not been used at the Y-12 Plant. In addition, concentrations of methylene chloride, acetone, and toluene were not considered further because of similar screening criteria (EPA 1988b).

The upgradient wells for SA-1 are GW-316, GW-317, and GW-323. The other wells, GW-313, GW-314, and GW-315, are positioned down slope near the center of the site. In comparing these two groups of upgradient and on-site wells, the on-site wells have all of the detections of organic constituents. This observation suggests a slight degradation of water quality in a direction downgradient across the site.

Of the compounds listed in Table 2.8, promulgated MCLs are available for TCE (5 μg/L); PCE (5 μg/L); and the degradation product 1,2-DCE (0.07 mg/L for cis-1,2,dichloroethene and 0.1 mg/L for trans-1,2,dichloroethene). TCE and PCE exceeded their respective MCLs in the on-site wells GW-314 and GW-315. The PCE concentration in well GW-313 exceeded the MCL. The dichloroethenes did not exceed their MCL in any well.

No available data directly tie the soil to the groundwater as a source for the VOC contaminants found in the groundwater. For example, TCE was found in groundwater samples collected from SA-1 wells, but TCE was not found in any of the soil samples collected from the site and was not known to be disposed of at SA-1. However, TCE is a component of the VOC groundwater plumes documented in upper BCV (HSW 1991). The primary VOCs found in plumes emanating throughout the Bear Creek Hydrogeologic Regime include TCE, PCE, 1,2-DCE, 1,1,1-trichloroethane (1,1,1-TCA), and 1,1-dichloroethane (1,1-DCA). The extended plumes may be the reason for the slight degradation across the site if these contaminants have reached the on-site wells but not the upgradient wells.

Two potential sources of the VOC groundwater contamination at SA-1 are the former Fire Training Area (FTA) and the S-3 Ponds (see Fig. 2.12). The FTA, located about 450 ft east of SA-1 in the UEFPC Hydrogeologic Regime, has significant (>1 mg/L) VOC contamination detected in samples from on-site wells. The S-3 site, located ~500 ft north of SA-1, is considered to be the primary source of nitrates, metals, and radionuclides in the Bear Creek Hydrogeologic Regime and may also be one of the contributors of VOC contamination found in SA-1 groundwater.

Contaminant plume maps (HSW 1991) indicate that contamination from the S-3 Ponds and other nearby sites within the Y-12 Plant intersect the northern half of the SA-1. The existence of these plumes at SA-1 is supported by valleywide piezometric surface maps, which indicate that groundwater at the S-3 Ponds flows toward the northern edge of SA-1 and then turns westward down BCV (HSW 1991). Site-specific groundwater elevation data collected as part of a recent investigation indicate that flow at SA-1 is generally down Chestnut Ridge toward the center of BCV (see Fig. 2.18). Under these conditions, contamination from the S-3 Ponds and other nearby Y-12 Plant sites is not likely to be migrating onto SA-1. However, the Karstic nature of the Maynardville Limestone, the likely conduit for S-3 Pond contaminants, makes predictions based on potentiometric surfaces tenuous.

This anamoly in flow direction is perhaps the result of short-term fluctuations in groundwater elevations. An additional consideration is that until 1984, the S-3 Ponds served as a local groundwater recharge basin and affected local groundwater gradients (Geraghty & Miller 1989b). Thus, groundwater flow directions during operation of the S-3 Ponds may have been different from today's directions. Based on this observation and the existence of the documented contaminant plumes, groundwater flow (and associated contamination) from the S-3 Ponds and other nearby Y-12 Plant sites may have reached SA-1 at some time in the past.

According to HSW (1991), the following supporting evidence links the FTA, rather than the S-3 Ponds, to SA-1 as the principal source of VOC groundwater contamination:

- The types and relative percentages of the VOCs detected in groundwater samples from the FTA are similar to those reported for SA-1 groundwater samples.

- 1,2-DCE was found in both SA-1 and FTA samples but not in samples from wells located in the immediate vicinity of the S-3 Ponds.

- Both SA-1 and the FTA sites overlie the Maynardville Limestone in the water table "saddle" between the Bear Creek and UEFPC Hydrogeologic Regimes. Past variations in the water table may have enabled flow from the FTA to SA-1.

Inorganics in SA-1 groundwater. Principal metal contaminants in the Bear Creek Hydrogeologic Regime are barium, cadmium, chromium, lead, and mercury. The metals contamination is most widespread at the S-3 Waste Management Area (WMA), located north of SA-1.

As noted previously, the upgradient wells for SA-1 are GW-316, GW-317, and GW-323. These wells are used as indicators of the quality of water entering the site and as a basis for comparison with the wells near the center of the site (GW-313, GW-314, and GW-315). Table 2.8 compares average values for the metals detected in the on-site wells with average concentrations of metals found in the upgradient wells.

The highest average on-site concentration of barium (47 μg/L) was found in the on-site well GW-315. Average concentrations in the upgradient wells ranged from 16-37 μg/L. However, the barium results were well below the MCL of 2 mg/L.

The maximum average copper concentration found in the upgradient wells was 8 μg/L. This concentration was exceeded by the average concentration of 9 μg/L from the on-site well GW-313. However, all these concentrations are well below the 1.3 mg/L MCL for copper.

The highest average lead concentration was 28 μg/L in on-site well GW-313. Lead was below detection limits in most upgradient wells, with the exception of well GW-316 where the average concentration was 6 μg/L. All average values are below the 50 μg/L MCL for lead.

The maximum average zinc concentration (32 μg/L) was found in upgradient well GW-316. All concentrations are well below the zinc secondary standard of 5 mg/L.

The highest average strontium concentration was 141 μg/L in on-site well GW-315. Background well average concentrations ranged from 21 to 45 μg/L and were consistently lower than values in on-site wells.

The data suggest that the on-site wells have slightly higher metals concentrations than the upgradient wells for most of the metals discussed. Thus, there appears to be a slight degradation of water quality across the site. However, metals concentrations in the upgradient and on-site wells were less than reference levels for BCV (HSW 1991).

Total uranium in SA-1 groundwater. Total uranium (via fluorometric analyses) was found at maximum concentrations of 1 μg/L in the upgradient wells and 2 μg/L in the on-site wells. These values are less than or equal to the maximum reference concentration of 2 μg/L specified for BCV (HSW 1991).

In comparison with these data, the 1988 groundwater results for SA-1 wells (Welch 1989b) listed both an on-site well (GW-313) and an upgradient well (GW-317) as having concentrations above background (12 and 14 μg/L, respectively).

Radioactivity in SA-1 groundwater. Table 2.8 summarizes the results for the gross alpha and gross beta analyses performed on the 1990 samples. The mean gross alpha activity ranged from 0.3 to 1.30 pCi/L. However, the statistical errors of each datum overlapped the others, indicating that the results for each well are similar. The mean gross alpha activity of the wells located at SA-1 did not exceed the Primary Drinking Water Standard of 15 pCi/L during 1990.

The average gross beta results ranged from 2.54 to 54.89 pCi/L. Individual quarterly samples from two wells exceeded the gross beta reporting level of 50 pCi/L: GW-314 with 51.59 and 57.33 pCi/L, and GW-315 with 54.32, 90.2, and 77.60 pCi/L. Both of these wells are downgradient and are the wells closest to the S-3 WMA. Although the S-3 site is the primary source of radionuclide contamination in the Bear Creek Hydrogeologic Regime, it is not possible to determine with available data whether the source of the radiological contamination is from SA-1 or an extended plume from off site.

Groundwater indicator parameters. The principal indicator parameters for which water quality standards exist are chloride, nitrate (as nitrogen), and sulfate. Table 2.8 presents the average results from the 1990 groundwater monitoring program.

Using wells GW-316, GW-317, and GW-323 as background (upgradient) wells for the site, we found that the chloride, nitrate, and sulfate concentrations in the on-site wells GW-314 and GW-315 exceed background concentrations. However, the chloride and sulfate concentrations are still well below the federal standards of 250 mg/L for these indicators. The nitrate nitrogen concentrations are < 2 times their MCL of 10 mg/L. As previously suggested (HSW 1991), the nitrate plume from the S-3 site has extended southward to the Maynardville Limestone, near its contact with strata of the Knox Group. However, it does not appear from these data that the plume has reached far enough to affect GW-313, GW-316, GW-317, or GW-323.

2.9.3 Soil Chemistry Data

Site-specific data on soil chemistry, collected as part of recent characterization investigations at SA-1 and RSA are presented in Appendix C and summarized in the following sections.

2.9.3.1 Rust Spoil Area soil chemical data

In order to characterize the nature and extent of soil contamination at RSA, subsurface soil samples were taken from soil borings drilled at seven sampling points around the perimeter of the site (Fig. 2.19). Soil samples were collected at each sampling point at 5-ft intervals until refusal was reached. The depth to refusal at the sampling points ranged from a minimum of 5 ft in RSA-6 and RSA-7 up to a maximum of 25 ft in RSA-3 and RSA-4. It is anticipated that the shallow and variable depth to refusal across the site is due to the variable depths to bedrock. Without exception, boring logs indicate that the entire thickness of fill was encountered.

A total of 24 subsurface soil samples were collected at the RSA and analyzed for metals, VOCs, asbestos, cyanide, and radiologicals. Table 2.9 presents a statistical summary of the analytes detected, their frequency of occurrence, the range of detected concentrations, and the BCV background concentration for each analyte. Table 2.10 presents a summary of the nature and extent of the detected contaminants at the RSA.

The results of the current soil characterization at RSA indicate that no significant concentrations of VOCs exist at RSA. PCE was detected in one sample, but at only slightly elevated levels. The majority of the contaminants of concern detected at RSA were metals.

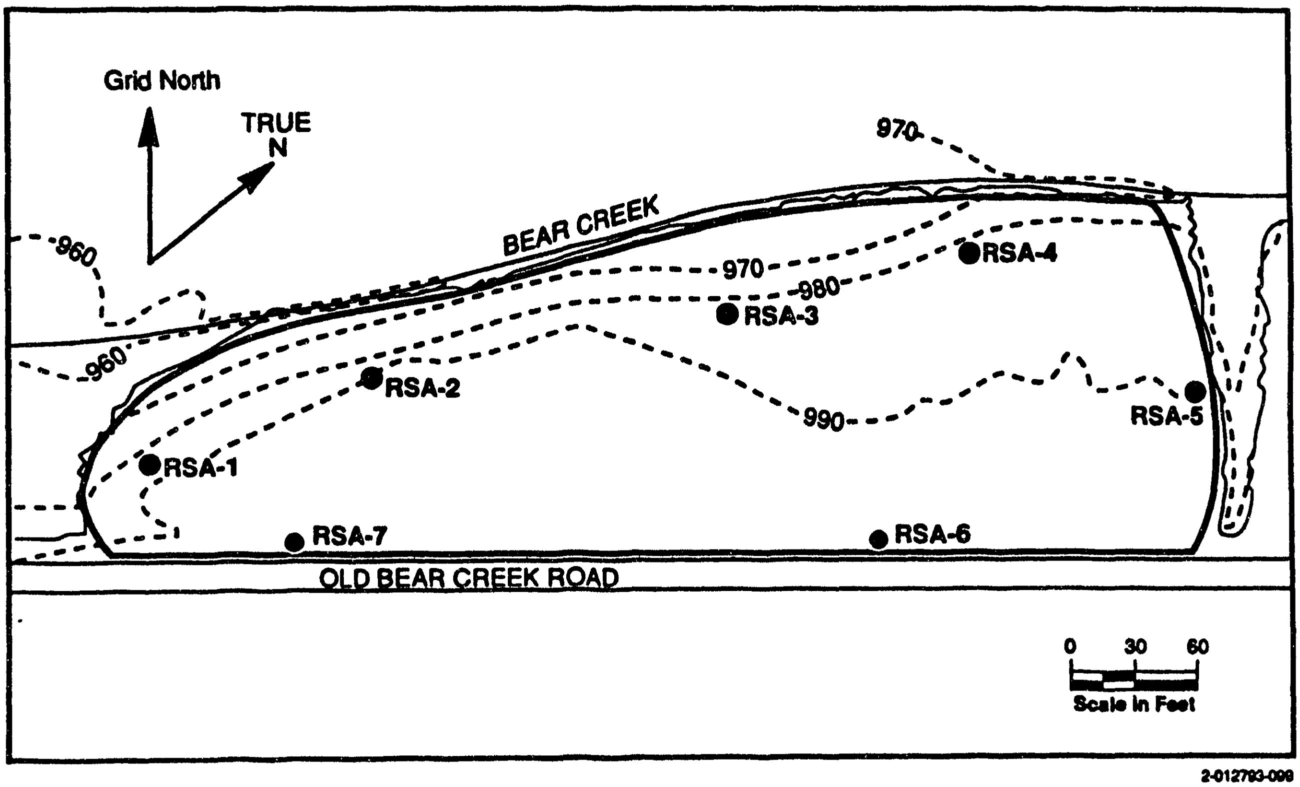

Fig. 2.19. RSA soil boring locations.

Table 2.9. Summary of soil chemical data, RSA soil borings

Chemical/element	Number of detections/ analyses	Detected minimum[a] (mg/kg)	Detected maximum[a] (mg/kg)	BCV soil background levels (ppm)[b]
		Volatile Organic Compounds		
Acetone	9/24	0.16	0.49	
Tetrachloroethene (PCE)	1/24		0.072	
		Metals		
Arsenic	24/24	2.8	26	6.758
Barium	24/24	24	820	149.5
Beryllium	23/24	0.67	2.1	1.34[c]
Cadmium	23/24	2.4	7.3	0.2453
Chromium	23/24	17	41	14.70
Cobalt	23/24	9.4	66	34.81
Copper	24/24	14	740	21.22
Lead	24/24	13	150	42.28
Mercury	5/24	1.1	7.5	0.1639
Nickel	23/24	15	55	54.86[c]
Uranium	24/24	2	14.5	2.30
Vanadium	23/24	20	70	49.18
Zinc	24/24	44	230	46.35
		Radiological		
Gross alpha, pCi/g	24/24	1.45	4.37	
Gross beta, pCi/g	24/24	1.87	5.07	
Uranium-235, wt %	3/3	0.04	1.18	

[a]Concentration units are mg/kg unless otherwise indicated.
[b]From Turner et al. 1988.
[c]Represents mean background for East Tennessee based on data in Maker (1973), Bowen (1966), Davis (1990), and Bechtel (1991).

Table 2.10. Summary of detected soil contaminants, RSA

Contaminant	Summary
	Volatile Organic Compounds
Acetone	Detected in several samples; however, it was similarly detected in the correlative laboratory blanks. Consequently, it is believed to be associated with laboratory processes and is eliminated from concern.
Tetrachloroethene (PCE)	Detected in only one sample from RSA-2 (5 to 10 ft) at slightly elevated levels.
	Metals
Arsenic	Detected concentrations are slightly above background levels. Highest concentrations are isolated in RSA-6 (5 to 10 ft and 10 to 15 ft).
Barium	Detected concentrations are at background levels in all samples except RSA-4 (20 to 25 ft) where levels are moderately elevated.
Beryllium	Detected concentrations are at background levels.
Cadmium	All samples indicated concentrations significantly above BCV background levels. Detected concentrations are relatively consistent in distribution throughout sampled area. Detected concentrations are only slightly to moderately above the mean background concentrations for the east Tennessee region.
Chromium	Detected concentrations are very slightly elevated in comparison to the BCV background values and are within the mean background levels for the east Tennessee region. Consequently, detected concentrations are possibly background levels.
Cobalt	Detected concentrations are likely background levels.
Copper	All detected concentrations represent background levels except RSA-3 (20 to 25 ft) and RSA-6 (10 to 15 ft). RSA-3 (20 to 25 ft) levels are high, while RSA-6 (10 to 15 ft) concentrations are only slightly elevated.
Lead	All detected concentrations represent background levels except RSA-3 (20 to 25 ft) and RSA-6 (10 to 15 ft). RSA-3 (20 to 25 ft) levels are high, while RSA-6 (10 to 15 ft) concentrations are only slightly elevated.
Mercury	All detected concentrations are <1 mg/kg except RSA-4 (0 to 5 ft and 15 to 20 ft) and RSA-3 (0 to 5 ft, 5 to 10 ft, and 20 to 25 ft). All concentrations detected in RSA-3 and RSA-4 are significantly above BCV background levels. The highest concentrations were detected in RSA-3 (0 to 5 ft and 20 to 25 ft).
Nickel	All detected concentrations represent background levels.
Uranium	Slightly to moderately elevated concentrations above background were detected in RSA-2 (5 to 10 ft), RSA-3 (5 to 10 ft), RSA-4 (0 to 5 ft), and RSA-7 (0 to 5 ft). RSA-3 (5 to 10 ft) and RSA-7 (0 to 5 ft) exhibited the highest levels.
Vanadium	All detected concentrations likely represent background levels.

Table 2.10 (continued)

Contaminant	Summary
Zinc	All detected concentrations appear to be background or very low levels except RSA-3 (20 to 25 ft) and RSA-6 (5 to 10 ft and 10 to 15 ft). Concentrations in RSA-3 and RSA-6 are slightly to moderately elevated.
	Radiological
Gross alpha	All detected concentrations represent very low levels in terms of DOE-established action limit.
Gross beta	All detected concentrations represent very low levels in terms of DOE-established action limit.
^{235}U	Very low levels were detected in RSA-2 (5 to 10 ft), RSA-3 (10 to 15 ft), and RSA-7 (0 to 5 ft).

The results of current soil sampling indicate that there is no widespread occurrence of metals at significantly elevated concentrations at RSA. The occurrence of most metals identified at RSA is sporadic, and the concentrations are slightly to moderately elevated above background levels. The most commonly detected metal contaminants were uranium, cadmium, mercury, arsenic, copper, lead, and zinc. Radiological analyses of the soil samples collected at RSA indicate that very low levels of gross alpha and gross beta radiation exist at the RSA with regard to the DOE established action limits. Three soil samples analyzed for ^{235}U similarly indicated that very low levels exist at the RSA.

2.9.3.2 SY-200 Yard

Previous soil sampling at the SY-200 Yard has consisted of three sampling events: July 1986, January 1988, and January 1989. The first sampling event was initiated to investigate possible surface contamination from the storage of lead shielding plates and transformers at the SY-200 Yard. The subsequent sampling events were conducted to identify possible contaminants of the soils in the area proposed for construction of the ESF building.

Sampling was first conducted on July 3, 1986, during which three surface soil samples (EP-1, EP-2, and EP-3) were collected from the lead shielding storage areas and one composite surface sample and two soil samples from depths of 2 to 4 in. was collected from an oil-stained area where the transformers were stored. A total of six samples was collected in 1986 at locations shown on Fig. 2.20. Samples from the lead shielding storage areas were analyzed for mercury and extraction procedure toxicity (EP tox) metals. All three samples passed the EP tox test. Samples from the transformer storage area were analyzed for mercury and PCBs. PCB concentrations detected in these samples ranged from 2.8 to 32 μg/g. All six samples were analyzed for mercury. Mercury concentrations in these samples ranged from 3.8 μg/g in the composite surface sample to 17,000 μg/g in EP-3. Results of these analyses are presented in Table 2.11.

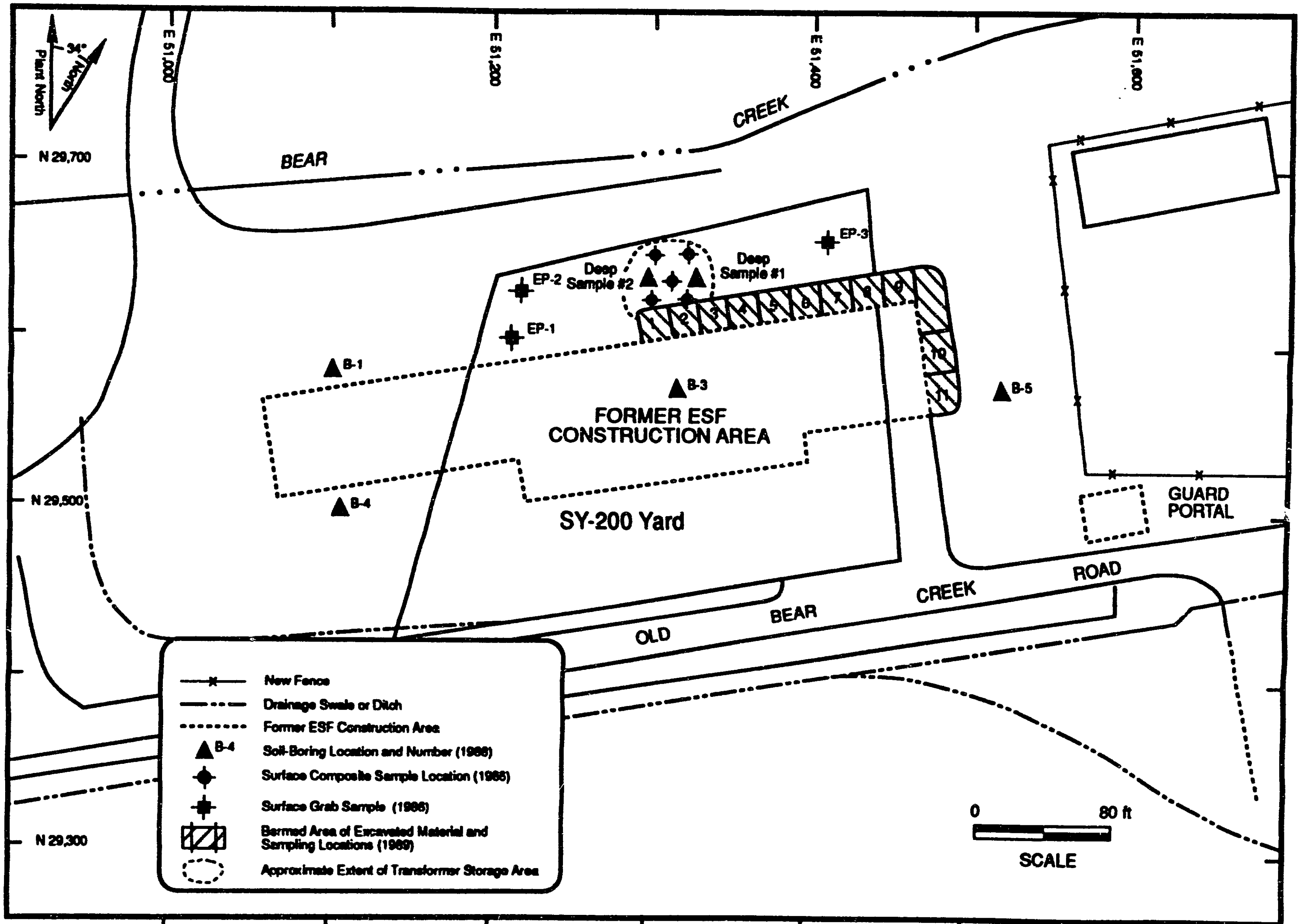

Fig. 2.20. Previous soil sampling locations in the vicinity of the SY-200 Yard.

Table 2.11. SY-200 Yard soil sample analytical results, July 1986

Sample name	Interval	Mercury (μg/g)	PCB (μg/g)	EP tox
EP-1	Surface	20		Pass
EP-2	Surface	42		Pass
EP-3	Surface	17,000		Pass
Surface composite transformer area	Surface	3.80	32	
Deep sample 1	2–4 in.	29	2.8	
Deep sample 2	2–4 in.	19	7.7	

The next sampling event took place in January 1988 in an effort to identify any contaminated soils on the site where the ESF building was to be located. Fifteen samples were collected from boreholes B-1, B-3, B-4, and B-5 (Fig. 2.20). The samples collected were analyzed for the following parameters: alpha activity, beta activity, gamma activity, PCBs, EPA Primary Drinking-Water metals, and the EP tox metals. The results are summarized in Table 2.12.

Table 2.12. Summary of SY-200 Yard soil sample analytical results, January 1988

Parameter	Units	Range		Average	Comments
		Upper	Lower		
Alpha activity	pCi/g	170	8.6	38	
Beta activity	pCi/g	250	15	71	
Gamma activity	pCi/g	420	<300		Detected in 1 of 15 samples
Arsenic	mg/kg		<40		Not detected in any sample
Barium	mg/kg	340	182	239	
Cadmium	mg/kg				Not detected in any sample
Chromium	mg/kg	80	29	51	
Lead	mg/kg	370	<20	93	Detected in 11 of 15 samples
Mercury	μg/kg	200	0.18	28	Detected in 14 of 15 samples
Selenium	mg/kg		<0.1		Not detected in any samples
Silver	mg/kg		<4		Not detected in any samples
PCB	μg/kg	0.3	<0.1		Detected in 3 of 15 samples
EP-tox leach test					All samples passed

The analytical results indicate that samples collected in boring B-5 had the highest radiological readings in addition to the highest concentrations of mercury. It should be noted, however, that sample location B-5 is about 60 ft east of the SY-200 Yard boundary. Trace levels of PCBs were detected in the top 4 ft of B-4 and in the top 2 ft of B-3. PCB concentrations were less than or equal to 0.3 $\mu g/g$. The highest concentrations of lead, barium, and chromium were detected in samples from B-1, B-4, and B-3, respectively. All samples passed the EP tox test. In addition, no measurable amounts of arsenic, cadmium, or silver were detected in any of the samples analyzed.

As discussed in Sect. 2.8.3.3, about 8 ft of fill material in the SY-200 Yard was excavated as part of ESF construction and bermed along the north and east corners of the excavation. The excavated material was ~20 ft high, 20 ft wide, and 180 ft long. In January 1989, 22 composite samples from 1 to 2 ft and 3 to 5 ft in depth were collected from the excavated material. The bermed area was divided into 11 sections, and four hand auger holes were drilled into each section to obtain the samples (Fig. 2.20). Each sample was analyzed for thorium, uranium, percent ^{235}U, and mercury. The results for thorium, uranium, and mercury concentrations are summarized in Table 2.13.

Table 2.13. Summary of soil sample analytical results, January 1989 ($\mu g/g$)

Parameter	Range		Average
	Upper	Lower	
Thorium	15.3	3.71	7.34
Uranium	8.06	0.52	2.56
Mercury	2100	3.4	244

Results of the three soil sampling events at the SY-200 Yard indicate that the fill materials are contaminated with mercury. It is believed that the presence of mercury in these fill materials is not the result of operations at the SY-200 Yard but that mercury was present in the fill materials placed at the site. Lead contamination is indicated in the northwest corner of the site (B-1) where lead shielding plates were stored. PCB contamination of the surface soils was indicated in the north central portion of the site where transformers were stored. In addition, contamination with radiological constituents is also indicated, although the highest levels of radioactivity were detected east of the SY-200 Yard.

2.9.3.3 Spoil Area 1

The results of soil (fill and residuum) contamination conducted as part of the SA-1 characterization are summarized in the following sections. Samples were collected from six soil borings (Fig. 2.21) and analyzed for VOCs, inorganics (metals and cyanide), radiological

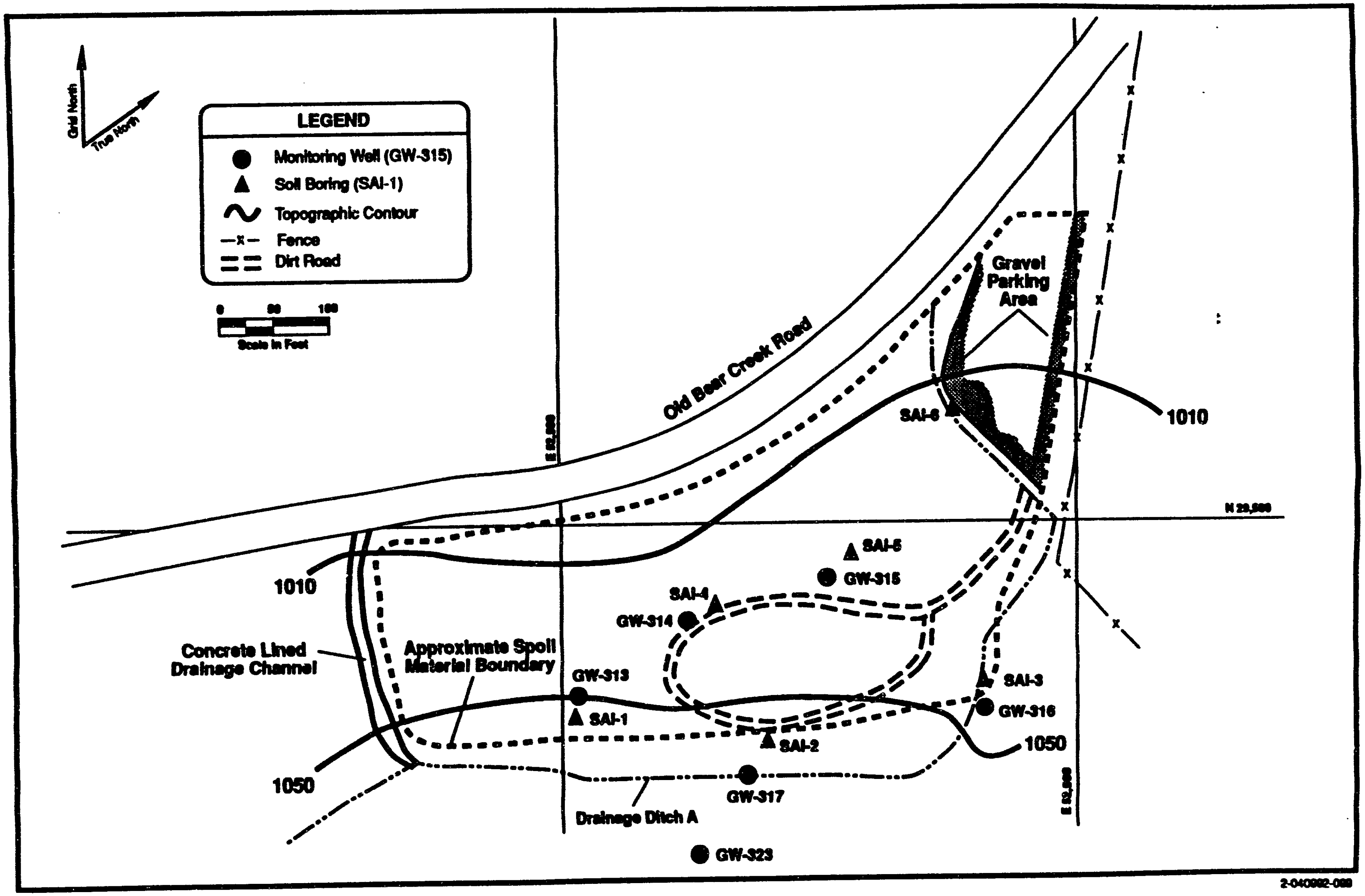

Fig. 2.21. SA-1 soil boring locations.

parameters, and semivolatile organics. Three of the borings were placed along the southern edge of SA-1, where the fill and debris were <15 ft deep. Two of the borings were placed along a diagonal traversing the center of the site. In these locations, the fill material and debris were 35 to 40 ft deep. The sixth boring was in the northeastern corner of the site, where the fill depth had again decreased to <15 ft.

Volatile organic compounds. Disregarding the common laboratory artifacts, the detected VOCs can be grouped as follows:

- gasoline constituents [benzene and xylene (total)];
- chlorinated solvents/potential degradation products [1,1-dichloroethane, 1,2-dichloroethene (total), and tetrachloroethene (PCE)]; and
- other solvents and applicants [4-methyl-2-pentanone (also used in extraction processes, including extraction of uranium from fission products), carbon disulfide (also generated in anaerobic biodegradation of organics), and chloroform].

The detection frequency for the VOCs was generally ≤5%. Chloroform was the exception, with a detection frequency of 10%. The detected maximum concentrations were at 0.012 mg/kg (12 ppb) or less.

The infrequent detection and low concentrations of VOCs suggest that no widespread contamination of these constituents exists at SA-1. Indeed, this finding was expected given the disposal restrictions outlined in the site's operating permit.

Semivolatile organic compounds. Table 2.14 presents a summary of the semivolatile organic compounds discovered in the SA-1 soil samples. The semivolatiles most often found were primarily polycyclic aromatic hydrocarbons (PAHs), other polycyclic hydrocarbons, and benzene derivatives. The primary industrial sources of these types of compounds are the high-temperature distillate fractions from coal tar and petroleum Examples include heavy lubricating oils, asphalt or petroleum coke, and wood preservatives. A debris landfill such as SA-1 would be expected to contain some road-building and roofing materials (asphalt), as well as treated lumber, ties, or poles (creosote) from Y-12 Plant demolition activities. Field personnel observed pieces of asphalt at the site.

The detection frequency for the semivolatiles ranged from 1 to 25%. The maximum detected concentrations ranged from 0.055 to 4.1 mg/kg (ppm), with the highest levels associated with fluoranthene, phenanthrene, and pyrene. As expected, the semivolatile contamination is greater than the volatile contamination primarily due to the types of materials disposed of at the landfill, but also partially due to the tendency for volatiles to escape during debris transport, dumping, and grading. However, the detection frequency and maximum detected concentrations suggest that the semivolatile contamination in the soil is not widespread.

All of the semivolatile contaminants detected were located in the fill/debris material or along the interface between the fill and residuum. Detection of the compounds at or above the fill/residuum interface suggests that downward leaching of these compounds is minimal and that the semivolatiles have been retained in the fill or debris material.

Table 2.14. Chemical summary, SA-1 soil borings

Chemical/element	Number of detects/analyses	Detected minimum[a] (mg/kg)	Detected maximum[a] (mg/kg)
	Semivolatile organic compounds		
Acenaphthene	4/53	0.079	0.41
Acenaphthylene	1/53	0.11	0.11
Anthracene	7/53	0.14	0.85
Benzo(a)anthracene	12/53	0.14	1.7
Benzo(a)pyrene	11/53	0.12	1.3
Benzo(a)fluoranthene	10/53	0.11	1.4
Benzo(ghi)perylene	9/53	0.085	0.8
Benzo(k)fluoranthene	11/53	0.15	1.4
Chrysene	12/53	0.16	1.7
Dibenzofuran	3/53	0.17	0.25
Fluoranthene	13/53	0.07	4.1
Fluorene	6/53	0.18	0.45
Indeno(1,2,3-cd)pyrene	8/53	0.099	0.77
Naphthalene	3/53	0.12	0.21
Phenanthrene	13/53	0.059	3.6
Pyrene	13/53	0.055	3.1
	Metals		
Arsenic	44/51	1.9	45.7
Barium	51/51	15.3	385
Beryllium	50/51	0.27	11
Cadmium	50/51	1.1	10.9
Chromium	50/51	6.4	54.2
Cobalt	50/51	1.7	110
Copper	50/51	13.3	109
Lead	51/51	6.5	670
Mercury	38/51	0.05	31.5
Nickel	51/51	4.7	173
Uranium	51/51	2	80
Vanadium	50/51	6.8	128
Zinc	51/51	26.4	591
	Radiological		
Gross alpha, pCi/g	50/51	0.03	12
Gross beta, pCi/g	48/51	1.56	37.4
Total radium, pCi/g	51/51	0.973	7.568
Uranium-235, wt%	21/57	0.29	1

[a]Concentration units are mg/kg unless otherwise noted.

Most of the concentration maxima were located in boring SAI-5. Boring SAI-5 is located near the center of the landfill and penetrated the greatest depth (39.5 ft) of fill/debris of the six borings. Within boring SAI-5, the highest concentrations were located in the fill approximately midway between the surface and fill/residuum interface.

Samples collected from boring SAI-4 contained the second greatest amount of semivolatile compounds, some of which were detected at their maximum concentrations.

Boring SAI-2 had no semivolatile detections. Borings SAI-1 and SAI-6 contained only a few semivolatile compounds, and these were found in the uppermost samples within the fill material. Thus, most of the semivolatile contamination is found near the center of the landfill where the debris/fill has the greatest depth.

Metal contaminants. Background soil samples for metals were not collected as part of the investigation of SA-1. Therefore, background data from a published literature source were used. The published values are for two sampling locations near Blountville and Bristol in northeastern Tennessee (Maher 1973). The samples were taken from residuum overlying Knox Dolomite. These published concentrations are generally lower than concentrations found in soil samples collected at SA-1. They were used as a screening tool to indicate which analytes found at SA-1 may require further evaluation.

Bedrock underneath SA-1 is Maynardville Limestone of the Conasauga Group. The bedrock upslope of SA-1 (e.g., the location of GW-323) is the Copper Ridge Dolomite formation of the Knox Group. In addition, the lithologic log for monitoring well GW-317, located at the southern (upgradient) edge of the site, shows a gradational contact between the Knox Group and the Maynardville Limestone at a depth of 60 to 70 ft (Welch 1989b). The soils present at SA-1 and on the adjacent, upslope part of Chestnut Ridge are classified as belonging to the Fullerton cherty silt loam (USDA 1981), and the soil classification does not change with a change in underlying bedrock. Because the soils developed over both the Maynardville and Knox bedrock units exhibit similar physical characteristics and are classified alike, there is enough similarity in the residual soils to justify using the published chemical data from the Knox Group soils as indicative of background concentrations of metals at SA-1 even though the soils are underlain by the Maynardville Limestone.

One on-site boring, SAI-2 (Fig. 2.21), may be representative of background conditions for the following reasons:

- The boring did not penetrate any debris material; it penetrated only residuum.
- The boring is located on the edge of SA-1 in an upslope direction from the known debris area.
- No organic constituents were identified in soil samples collected from the borehole.
- Concentrations of some metals, such as mercury, barium, and lead, are consistently lower in samples from SAI-2 than in samples from other borings.

Note, however, that the concentrations of inorganics (and radiation parameters) are highly variable in the SAI-2 samples and in some cases exceed concentrations in other borings. The use of SAI-2 as a background reference is questionable because of its relatively high concentrations and variability of some inorganics.

Metals data comparison. Table 2.14 presents a summary of the metals detected in the SA-1 samples. The detection frequency for the metals was usually >75%. The exceptions were phosphorus at 51% and niobium at 8%. Table 2.15 shows, for comparison purposes, the maximum and minimum inorganic concentrations for all soil sampled in SA-1 and relevant soil samples from borings in Tennessee (published values).

In comparing the published maximum concentrations with those from the borings, the SA-1 concentrations were higher for almost every element. The only two exceptions were niobium and potassium. Chromium maxima were about the same—the SA-1 maximum is only 10% higher than the published maximum.

In summary, all of the detected metals concentrations appear to be higher than background, except for niobium, potassium, and possibly chromium. The high detection frequencies suggest that the contamination is widespread throughout the site.

To facilitate discussion of the extent of metals contamination detected in soil samples at SA-1, this section focuses on only 11 of the 19 metals: arsenic, cadmium, lead, vanadium, barium, chromium, mercury, zinc, beryllium, copper, and nickel.

These metals were selected as indicators for, or representative of, the group of 19 metals. The physical and chemical properties of these 11 metals are believed to be representative of the range of properties for the 19 metals identified as contaminants. Additionally, the list of indicator metals includes those believed to be most potentially dangerous to human health. In contrast with the semivolatiles, which were located almost entirely in the debris, many of the metal maxima appear to be concentrated in the residuum.

Of the metals listed, only barium and mercury have their three uppermost concentrations limited to the fill or debris region. Chromium has relatively high concentrations in both the fill and the residuum. However, soils such as those found at SA-1 may be characterized by high levels of native chromium.

Except for nickel, all of the metal maxima for the fill and debris layer are from borings SAI-4 and SAI-5. These are the same borings that contained the semivolatile maxima. For the residuum layer, the maxima are primarily from borings SAI-1 and SAI-4. The only metals with maximum concentrations in samples from boring SAI-2 were chromium and vanadium. Boring SAI-2 did not penetrate any fill material or debris.

It is useful to compare the fill/debris and residuum maximum concentrations with the literature background concentrations. Most of the fill/debris and residuum maximum concentrations are elevated above background. The exceptions are the barium concentrations in the residuum and chromium concentrations in the fill. The chromium concentration in the residuum is only ~10% above background.

Table 2.15. Comparison of field and background inorganics data for SA-1 soils

Element	Concentrations from soil borings (mg/kg)		Background concentrations from literature[a] (mg/kg)	
	Minimum	Maximum	Minimum	Maximum
Aluminum	3,370	61,800	13,000	19,500
Arsenic	1.9	45.7	10	10
Barium	15.3	385	150	150
Beryllium	0.27	11	0.10	*b*
Cadmium	1.1	10.9	<0.2	<0.2
Calcium	42.9	102,000	300	2,000
Chromium	6.4	54.2	30	50
Cobalt	1.7	110	8	30
Copper	13.3	109	10	20
Iron	6,360	88,700	15,000	42,000
Lead	6.5	670	10	30
Magnesium	532	25,200	1,500	5,000
Manganese	88.6	6,930	2	2
Mercury	0.05	31.5	No detect	0.015
Nickel	4.7	173	20	50
Niobium	1.8	3.3	0.5	5
Phosphorus	48.8	720	80	100
Potassium	411	5,430	3,500	10,000
Sodium	61.8	458	9	20
Vanadium	6.8	128	20	20
Zinc	26.4	591	30	70

[a]This information corresponds to analyses of residual clay overlying a Knox Dolomite at two locations near Blountville and Bristol in northeastern Tennessee; reference is Table 3 of Mahler (1973) for map locations 10 and 12.

[b]Maher (1973) reported that the concentration was anomalous; the average concentration of Be is ≤2 ppm.

Note: Data summarized from CH_2M HILL investigation data, Appendix C.

Statistically significant differences in the fill vs residuum were observed for arsenic, barium, cadmium, copper, lead, vanadium, and zinc. Barium is characterized by higher concentrations in the fill than the residuum; the others have higher concentrations in the residuum. Chromium appears to have roughly equal distributions in the fill and residuum. Beryllium and nickel show a tendency toward higher concentrations in the residuum, but the difference between the fill and residuum profiles is not statistically significant. Mercury shows a tendency toward higher concentrations in the fill than in the residuum, but this difference also is not statistically significant.

Total uranium. Uranium has an average concentration in the crust of the earth of ~4 mg/kg (3.0 pCi/g). Literature values for uranium in Knox residuum range from 0.2 to 1 mg/kg (Maher 1973). These relatively low concentrations suggest that naturally occurring uranium is probably not very prevalent in the soils at SA-1.

In contrast to the literature values, a review of Table 2.14 shows that uranium was detected in every boring and in every sample (detection frequency of 100%). For most of the borings, the detected concentrations ranged from 2 to 10 mg/kg and thus exceeded published values for Knox residuum (Maher 1973). This upper limit of 10 mg/kg is low, but it typically corresponds more to a mineral-rich soil than to Knox residuum. Samples from two of the borings produced uranium concentrations >10 mg/kg: boring SAI-5 had a maximum of 42 mg/kg, and SAI-6 had a maximum of 80 mg/kg.

The Y-12 Plant is a probable source of the uranium. The Y-12 Plant now has ~85 exhaust stacks serving operations that have the potential for generating airborne radioactive uranium. Stacks exist for both depleted and enriched uranium operations. Those stacks that did not meet National Emission Standards for Hazardous Air Pollutants (NESHAP) standards were equipped with emission-control systems. In addition, wind rose patterns for the Y-12 Plant indicate that predominant wind directions are to the southwest and the northeast (Energy Systems 1991). Because SA-1 is located in the southwest corner of the Y-12 Plant, some deposition of uranium particles could occur at the site. Assuming deposition occurred before, during, and after operation or buildup of SA-1, the uranium would be distributed at all depths throughout the landfill.

Three of the four highest concentrations of uranium (80, 68.9, and 18 mg/kg) were found in boring SAI-6. One sample in boring SAI-5 residuum had a uranium concentration of 42 mg/kg. All of the other concentrations are ≤10 mg/kg. The distribution of uranium concentrations in residuum does appear to be displaced toward higher concentrations than the fill/debris distribution.

Radiological contaminants. Table 2.14 summarizes the radiological constituents detected in soil samples. The analyses performed were for gross alpha, gross beta, total radium, and ^{235}U. The first three analyses were reported in units of picocuries per gram, whereas the ^{235}U analysis was in weight percent of total uranium.

Gross alpha. Gross alpha was detected on all the samples except one. This finding corresponds to a detection frequency of 98%. The maximum specific activity detected was 12 pCi/g. Background levels of gross alpha for SA-1 are unknown. More importantly, the SA-1 results are less than the adopted reporting level of 15 pCi/g. Although gross alpha was detected in almost all the SA-1 samples and appears to be widespread, the gross alpha results are not high enough to warrant a significant concern for alpha-emitting contamination.

Gross beta. The detection frequency for gross beta was 94%. The maximum specific activity detected was 37.4 pCi/g. Background levels of gross beta for SA-1 are unknown. However, the maximum concentration is below the adopted reporting level of 50 pCi/g. Thus, although beta-emitting contamination appears to be widespread, the gross beta results do not appear to be high enough to warrant significant concern.

Total radium. The detection frequency for radium was 100%. The maximum concentration detected was 7.6 pCi/g. Background concentrations of radium at the site are unknown. It has been estimated that radium concentrations in soils located in the United States have a general range of 0.8 to 2.81 pCi/g (IAEA 1990). Some of the concentrations detected at SA-1 are higher than the upper bound of this estimated range.

In summary, radium appears to be prevalent over the site and exists at slightly elevated levels, but it is still below the adopted reporting level of 15 pCi/g. Thus, total radium does not appear to warrant significant concern.

Uranium-235. One of the isotopes of uranium is ^{235}U. All soil samples collected were to have been analyzed for total uranium using fluorometric uranium analysis. When a result from the total uranium analysis was >5 mg/kg, that sample was analyzed for ^{235}U using Thermal Ionization Mass Spectrometry (TIMS). TIMS provided a value for the $^{235}U/^{238}U$ ratio in units of weight percent of total uranium. If the total uranium result was <5 mg/kg, the value obtained was reported, and no ^{235}U analysis was performed. Weight percent results were reported for 21 samples.

The detected minimum, average, and maximum values for ^{235}U in soil were 0.29, 0.627, and 1.0 wt %, respectively. The natural abundance of ^{235}U is 0.72 wt %. This value can vary by as much as 0.1 wt %, depending on the source. However, the detected range at SA-1 (0.29 to 1.0%) is wider than the expected range (0.62 to 0.82%) for naturally occurring uranium. This finding suggests that the elevated levels of uranium at the site contain enriched and depleted fractions of uranium. This finding was not unexpected given that stack emissions occur at the Y-12 Plant from both enriched and depleted uranium operations.

2.9.4 Biomonitoring Data

Ecological studies of the Bear Creek Watershed were initiated by staff in the ORNL ESD in May 1984 and are continuing at present. The study plan consisted of an initial, detailed characterization of the benthic invertebrate and fish communities in Bear Creek in the first year followed by a subsequent reduction in sampling intensity during the monitoring phase of the study.

The objectives of the ecological studies on Bear Creek have initially been to characterize the ecological condition of Bear Creek and then to monitor any ecological recovery associated with various remedial actions to be taken in the watershed. To accomplish the first objective the existing environment in Bear Creek was characterized using two approaches: (1) instream sampling of the benthic invertebrate and fish communities to identify spatial and temporal patterns in distribution and abundance and (2) laboratory bioassays on water samples from

Bear Creek and selected tributaries to identify potential sources of toxicity to biota. Periodic monitoring has continued following completion of the initial characterization studies in July 1985.

Because of the existence of an established biological monitoring program that is highly directed toward monitoring recovery of Bear Creek and the location of a biological monitoring site adjacent to OU 2 (Fig. 2.22), biological monitoring is not addressed in this RI Plan.

2.9.5 Radiation Survey

There are no indications that radiation surveys have been conducted at any of the sites in OU 2.

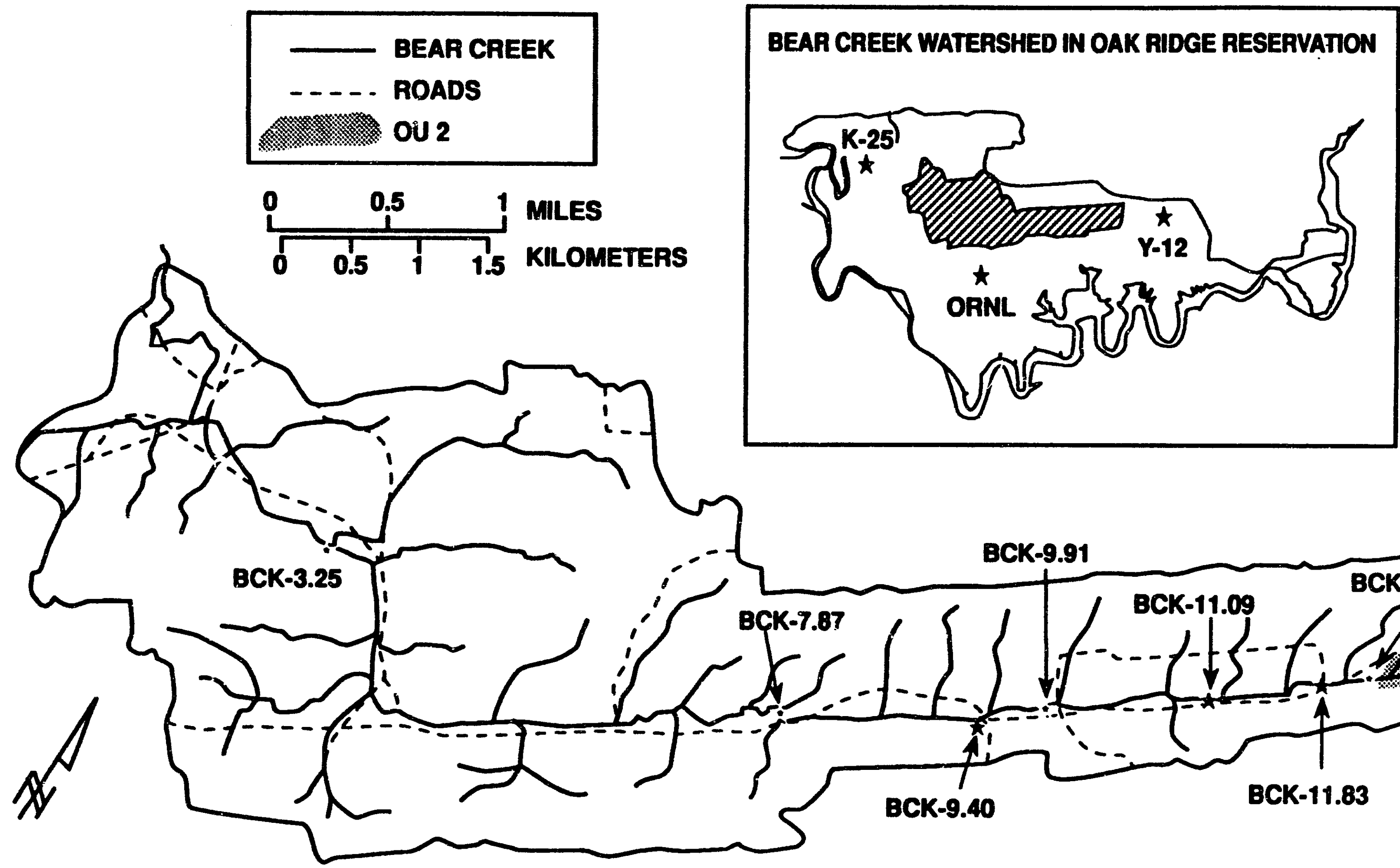

Fig. 2.22. Locations of existing biological monitoring sites.

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3. DATA QUALITY OBJECTIVES (DQOs)

3.1 DQO STAGE 1: IDENTIFICATION OF DECISION TYPES

3.1.1 Identification and Involvement of Data Users

In addition to characterization of the nature and extent of contamination, data collected as part of the RI will be used in risk assessment and alternative evaluation for the OU. The immediate decisions resulting from analysis of the OU 2 RI results will be based on the level of risk associated with the site and the need to conduct an immediate corrective action, further investigations, or no further investigation. At the same time, decisions about the types of remedial actions, whether to reduce imminent dangers or to address long-term solutions, will be considered. A primary objective of the RI is to provide the data necessary for evaluation of risk and remedial alternative evaluations. To ensure adequate quality and quantity of data, experts in risk assessment and remedial alternative development have been involved in development of the work plan.

3.1.2 Evaluation of Available Information

Available information for the site (e.g., operational information, historical monitoring data) have been summarized Sect. 2. Evaluation of the available data proceeds from a determination of the data quality (based on protocols and procedures used in sampling and analysis) to an analysis of the data, in conjunction with the site conceptual model, to identifying any site-characterization data gaps.

Characterization data collected as part of previous RI investigations at the RSA and SA-1 were subject to strict quality measures (EPA Level III, see Appendix C) as are all groundwater quality data collected as part of the sitewide groundwater quality assessment program. As a result, these data are acceptable in terms of data quality. Characterization data from the SY-200 site appear to be of acceptable quality, but incomplete with the extent of the contaminants unknown because of site activities (i.e., filling and subsequent disturbances).

3.1.3 Conceptual Site Model

A conceptual site model has been developed for the site and is discussed in detail in Sect. 4. In summary, the conceptual site model focuses on the soil medium, the transformations within that medium, and the pathways to receptors. The groundwater and surface water/sediment media are being characterized as parts of the sitewide assessment monitoring programs.

3.1.4 Remedial Investigation Objectives

The results of previous investigations within OU 2 have helped to define the nature and extent of contamination. The general objectives of the OU 2 RI include (1) further definition of the nature and extent of contamination in media of concern (i.e., soil), especially at the

SY-200 Yard, and (2) gathering information for the specific needs of the risk assessment and FS. Specific objectives include:

- defining the nature of soil contamination at SY-200;
- defining the extent (vertical and horizontal) of soil contamination at SY-200;
- filling any identified data gaps in the extent of soil contamination at RSA and SA-1;
- defining the interaction (transfer mechanism) between soil contaminants and shallow groundwater; and
- defining the relative contribution of OU 2 contaminants to BCV groundwater and surface water contamination.

3.2 DQO STAGE 2: IDENTIFY DATA USES/NEEDS

3.2.1 Identification of Data Uses

Data collected during the OU 2 RI (described in Sect. 7) will be used for site characterization (e.g., nature and extent of contamination, transfer paths), an evaluation of risks to receptors from contaminants at the site, and the evaluation of possible site remedial actions.

3.2.2 Identification of Data Types

Table 3.1 summarizes the DQOs of the OU 2 RI by listing sampling plan objectives, required sample media and analytical parameters, and the ultimate use of the data.

3.2.3 Identification of Data Quantity Needs

Based on the results of previous investigations at the RSA and SA-1, data quantity needs are limited. The history of SY-200 suggests that characterization of distributed contamination will require more data from an extensive, systematic sampling program (see Sect. 7).

3.2.4 Identification of Data Quality Needs

With the exception of health and safety monitoring data and physical measurements collected during site operations (EPA Level I), all data collected as part of the OU 2 RI will be accompanied by an EPA Data Quality Level IV deliverable (see Sects. 6 and 7). All data will be validated at Level IV.

Table 3.1 Data Quality Objectives for OU 2 RI

Sampling plan objective	Priority	Sample media	Parameters[a]							Data use[a]			DQO level
			Metals	Rad	VOC	SVOC	TPH	Asb	PCB	SC	RA	EA	
Define the nature and extent of soil contamination at SY-200	High	Soil	X	X	X	X		X	X	X	X	X	IV[b]
Define the contribution of SY-200 and SA-1 to BCV groundwater contamination	High	Ground-water	X	X	X	X				X	X	X	IV[b]
Define the contribution of all sites to BC surface water and sediment contamination	High	Surface water and sediment	X	X	X	X	X[b]		X	X	X	X	IV[b]
Define the extent of surface radiological contamination (radiation survey)	High	Surface soil		X						X	X	X	I

[a]Definitions of acronyms:

Asb asbestos
EA evaluation of alternatives
PCB polychlorinated biphenyls
RA risk assessment
Rad radiological
SC site characterization
SVOC semivolatile organic compounds
TPH total petroleum hydrocarbons
VOC volatile organic compounds

[b]Level IV deliverables will be requested for all samples. Level III validation will be done on all samples. Level IV validation will be done on 10% of all samples.

3.2.5 Evaluation of Sampling and Analysis Options

All sampling activities at the sites will be preceded by walkover radiation surveys. The results of those surveys will be evaluated to verify that the proposed level of field health and safety is adequate and to identify any previously unidentified areas warranting investigation.

After incorporating the walkover results into the sampling plan, the field team will implement the field sampling plan (FSP). Implementation of the FSP entails collecting samples from targeted locations and depths. Throughout the sampling events, the field team will use direct reading instruments (e.g., radiation meters, mercury vapor analyzers, photoionization detectors) and visual examination to identify additional or preferable sample intervals.

3.2.6 Reviewing and Utilizing Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) Information

The PARCC parameters have been reviewed and incorporated in the planning for the field sampling and analyses. Incorporation of field duplicates into the sampling plan (Sect. 7) will provide some measure of precision (a combination of sampling and analytical factors). Requirements for a minimum of Level III analytical data with accompanying analyses of QC samples will provide an adequate measure of accuracy.

Representativeness and comparability are addressed by use of standard sampling and analysis procedures (Kimbrough et al. 1990). Completeness is a goal (e.g., 85-90%) for the amount of acceptable data sufficient to support the decisions at a site. Critical samples (e.g., shallow groundwater samples at SA-1 and SY-200) have been identified and plans made to achieve valid data from them (e.g., duplicates or resampling).

3.3 DQO STAGE 3: DESIGN DATA COLLECTION PROGRAM

3.3.1 Assemble Data Collection Components

A detailed summary of all proposed samples and corresponding quality assurance/quality control (QA/QC) samples is presented in the FSP (Sect. 7).

3.3.2 Develop Data Collection Documentation

The data collection documentation (e.g., specific sampling and analysis procedures, forms, data tracking procedures) are discussed in the FSP (Sect. 7) and in the field and laboratory QA plans (Sects. 8 and 9).

4. CONCEPTUAL SITE MODEL

A conceptual site model has been developed (Fig. 4.1) to guide RI sampling design. The components of that model are discussed in the following sections.

4.1 POTENTIAL PATHWAYS OF MIGRATION

4.1.1 Soil

Leachate produced by water moving through the soil may provide aqueous transport for dissolved chemicals within the unsaturated soil sequence. In a porous, homogeneous soil, contaminants tend to move primarily downward within the unsaturated zone through diffusion and mass flow mechanisms until they reach the water table or an impermeable horizon. However, contaminants also move laterally through dispersion and diffusion caused by changes in the soil structure or composition, or fractures, of seasonally water-saturated soil. In addition, debris buried in spoil areas can affect contaminant migration. Buried debris can create impermeable layers that laterally divert leachate or that enhance vertical movement of leachate because of density or compaction differences. Therefore, contaminant migration in the soil media within spoil areas may be enhanced both vertically and horizontally. Soil or clay caps have been placed over both spoil areas (RSA and SA-1) to reduce water infiltration into the soil matrix and, consequently, to reduce contaminant migration resulting from leachate movement.

Existing evidence indicates that the majority of the metal contaminants of concern at SA-1 are migrating from the fill material present at the sites and are being absorbed in the underlying native soil residuum. This process of absorption of contaminants into the soil matrix is believed to inhibit the transport of certain contaminants of concern into the groundwater media especially if the soil matrix possesses a neutral or elevated pH. A few of the metals, in particular mercury, barium, and chromium, appear to be relatively immobile in the soil and are expected to be retained in the fill and debris of the landfill. In addition, the semivolatile organic compounds detected at RSA are characterized by relatively low volatility and low solubility in water. The semivolatiles are expected to be relatively immobile in the soil and to remain partitioned in the fill and debris of the landfill.

4.1.2 Surface Water

Surface water transport of contaminants from sites within OU 2 is possible. The flow of surface water over and through areas of contaminated soil provides a potential for transportation and redeposition of contamination. The potential for surface water transport of contaminants at the spoil areas has been greatly reduced by capping these sites with compacted clay and top soil followed by the establishment of a vegetative cover. However, no such activity has taken place at the SY-200 site, leaving it more susceptible to the potential effects of surface water on contaminant migration. In addition, surface water will eventually erode and penetrate the clay/top soil cap at SA-1, thereby increasing the potential for surface water transport of contaminants at this site.

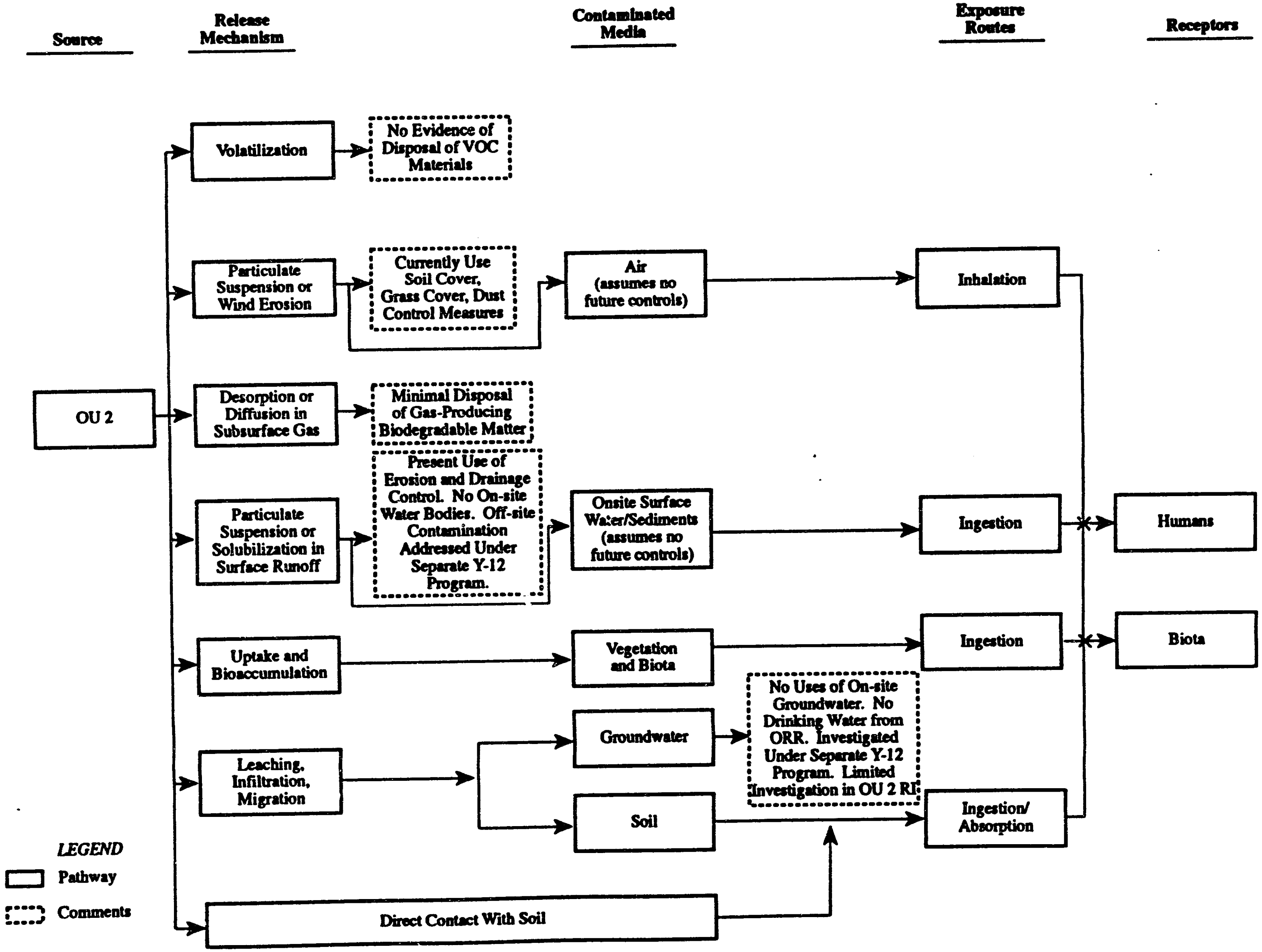

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Fig. 4.1. On-site conceptual model for OU 2.

4.1.3 Groundwater

The most likely mechanism for contaminant transport is precipitation infiltration resulting in contaminant leaching into the groundwater system. As previously mentioned in the discussion of SA-1, the potential for contaminant movement into the groundwater system is reduced because the sorptive properties of the soils and contaminants restrict the mobility of the contaminants. These conditions are also expected to occur in the SY-200 area. In addition, clay/top soil caps installed at the spoil areas reduce the leaching potential by reducing surface water infiltration. Nevertheless, groundwater is believed to present the greatest potential for contaminant migration at each site, particularly at SY-200, which does not currently have a surface cap to reduce surface water infiltration.

The potential for groundwater transport of contaminants from OU 2 will be appraised by evaluating existing groundwater analytical data from monitoring wells located hydraulically downgradient of the sites. In general, contaminant transport parallels the direction of groundwater movement. The large number of potential contaminant sources located hydraulically upgradient and cross-gradient of OU 2 makes it necessary to evaluate existing groundwater analytical data in the area to accurately determine the groundwater migration of contaminants from OU 2.

4.1.4 Air

Airborne contamination from OU 2 is believed to be minimal. The greatest potential for airborne transport of contaminants would be resuspension of contaminated particles into the atmosphere caused by excavation of soils at the sites. The potential for airborne transport of contamination has been reduced at the spoil areas by installing the compacted clay/top soil caps and the vegetative covers.

4.1.5 Biological

The possibility of uptake of contaminants by biota is expected to be minimal. No surface vegetation is present at the SY-200 site, and the compacted clay cap overlying the spoil areas is believed to reduce the potential for biota uptake at these sites.

4.2 POTENTIAL RECEPTORS

4.2.1 Human Populations

The Y-12 Plant is a part of the DOE ORR, which covers ~35,000 acres. The Y-12 Plant is located along the northeastern boundary of the ORR adjacent to the city of Oak Ridge. Although adjacent to Oak Ridge, the Y-12 Plant is situated in a rural area, and no residences or drinking water sources are located on the plant site. In addition, because of security precautions, the presence of persons at the facility is controlled. Consequently, the potential for human exposure to contamination is minimized. The operational period of the plant is projected to be 30 years.

4.2.1.1 On-site potential human receptors

Employment at the Y-12 Plant, as of January 1992, consisted of 7934 full-time on-site personnel, the majority of which work in the main Y-12 Plant complex in the northeast part of the ORR. OU 2 is situated to the southwest of the main Y-12 Plant complex in an area that the majority of employees do not frequent. Therefore, the exposure potential for the majority of facility employees is minimal.

On-site workers have the greatest risk of exposure to contaminants from OU 2. Because the spoil areas have been closed and no activity now takes place at the SY-200 site, exposure to on-site personnel is limited to a small group of maintenance-type workers. The exposure to on-site workers will increase slightly with implementation of this work plan and possible future remedial actions at each site. However, occupational exposure will be negligible because of health and safety measures that will be employed.

A hypothetical future use scenario, involving a resident on the site, will be included to address the potential for land-use change.

4.2.1.2 Off-site potential human receptors

It is anticipated that no off-site human receptors will be exposed to contamination resulting from OU 2 because of the rural and unpopulated nature of the Y-12 Plant. The off-site exposure potential is further minimized by access to the facility being restricted to authorized personnel and the remote nature of OU 2. In addition, there are no drinking water sources on the ORR. The greatest potential for off-site human exposure is believed to be from surface water runoff into the adjacent Bear Creek. The potential for exposure to off-site populations is again considered to be minimal.

Regional demography. The regional demography is discussed in detail in Sect. 2.5 of this document.

Sensitive subpopulations. Because of the remote location of OU 2, no sensitive subpopulations are believed to be potentially at risk.

4.2.2 Ecological Populations

4.2.2.1 Flora

Vegetation in the Bear Creek Watershed is predominantly oak, oak-hickory associations on the upper slopes and ridgetops, and planted pine along the creek and floodplain area. Pine Ridge is generally an oak, oak-hickory association with chestnut oak, red oak, tulip poplar, white oak, and hickory as the dominant species. The lower areas along Bear Creek and Bear Creek Road are mainly planted loblolly pine with some scattered areas of planted shortleaf, natural pine, and oak-hickory communities. Also of interest is a large area of big bluestem grass that grows along Bear Creek Road. Large stands of this species are uncommon in east Tennessee. This site is being considered as a National Environmental Research Park (NERP) Reference Area. More detailed information is available for portions of the Bear Creek Watershed area in forest compartment maps and various documents (Bradburn and Rosenbalm 1984; Parr and Pounds 1987). Table 4.1 contains a listing of flora and fauna found within the ORR.

4.2.2.2 Terrestrial fauna

OU 2 contains elements of the majority of wildlife habitat types found on the ORR (Table 4.1), and, therefore, the expected terrestrial fauna is that described for the entire reservation (Welch 1989a).

Hardwood and mixed hardwood/conifer habitats compose the most abundant habitat type in Bear Creek Watershed, followed by pine plantation and grassland habitats, with considerable riparian habitat along the length of Bear Creek. Species commonly found in these habitats are listed below.

Old-field and grassland habitat. In the grassland/forb stage of vegetation, the principal species of small mammals are the southeastern shrew, least shrew, short-tailed shrew, eastern harvest mouse, hispid cotton rat, pine mouse, and the eastern cottontail rabbit. The eastern mole occurs in areas of loose soil. Closely mowed or grazed areas and dense kudzu growth is good habitat for the groundhog. Also found there are the striped skunk, coyote, red fox, and white-tailed deer. In more brushy vegetation, the white-footed mouse, golden mouse, and opossum may be found. Bird species found in this habitat include bobwhite, red-tailed hawk, field sparrow, towhee, blue grosbeak, meadowlark, and red-winged blackbird. The eastern bluebird population has increased with the establishment of bluebird nesting boxes. The yellow-breasted chat is found in old fields. Numerous frog, toad, lizard, and snake species are found in the old-field areas.

Hardwood and mixed hardwood/conifer habitats. In wooded areas the eastern gray and southern flying squirrels, southeastern shrew, eastern mole, short-tailed shrew, white-footed mouse, white-tailed deer, and eastern chipmunk may be found. Predators such as the bobcat and weasel occur here. Birds commonly found in forest areas (Kroodsma 1991) include the yellow-shafted flicker, red-bellied woodpecker, hairy woodpecker, downy woodpecker, blue jay, Kentucky warbler, pine warbler, ovenbird, Carolina chickadee, tufted titmouse, and scarlet tanager. Hawks (red-shouldered, red-tailed, and broad-winged) are commonly found on the ORR, as are wild turkeys, which have been reintroduced to the area in recent years. Amphibians and reptiles found in the forest habitat include the dusky salamander, American toad, eastern box turtle, ground skunk, worm snake, black racer, rat snake, black king snake, milk snake, and copperhead.

Pine plantation habitat. Very early stages of planted pine areas contain species similar to those in old-field habitats, and the small mammals present are much the same as in the late stages of old fields. The populations tend to be smaller, though, because of less tree diversity. Pine plantations with a dense canopy and no understory are essentially barren of both small and large mammals except around the edges. As plantations are thinned and canopies opened, undergrowth develops and provides habitat for species similar to those found in early- to mid-stage hardwood-mixed hardwood/conifer forests. Avian species have a low preference

Table 4.1. Flora and fauna found within the Oak Ridge Reservation

Common name	Scientific name
	Flora
American chestnut	*Castanea dentata*
Northern red oak	*Quercus borealis*
Chestnut oak	*Q. prinus*
Yellow poplar	*Liriodendron tulipifera*
Shortleaf pine	*Pinus echinata*
Virginia pine	*P. virginiana*
Beech	*Fagus grandifolia*
Sugar maple	*Acer saccharum*
Magnolia	*Magnolia acuminata* and *M. tripetala*
Buckeye	*Aesculus glabra*
Willow	Salix sp.
Sycamore	*Platanus occidentalis*
Boxelder	*Acer negundo*
Loblolly pine	*Pinus taeda*
Hickory	*Carya* sp.
Hemlock	*Tsuga canadensis*
White pine	*Pinus strobus*
Eastern red cedar	*Juniperus virginianus*
Redbud	*Cercis canadensis*
Sassafras	*Sassafras albidum*
Cottonwood	*Populus deltoides*
Elm	*Ulmus* sp.
Ash	*Fraxinus* sp.
Silver maple	*Acer saccharinum*
River birch	*Betula nigra*
White oak	*Quercus alba*
Black oak	*Q. velutina*
Scarlet oak	*Q. coccinea*

Table 4.1 (continued)

Common name	Scientific name
Post oak	*Q. stellata*
Black gum	*Nyssa sylvatica*
Dogwood	*Cornus florida*
Basswood	*Tilia americana*
Bluestem	*Andropogon* sp.
Bluegrass	*Poa* sp.
Orchard grass	*Dactylis glomerata*
Ragweed	*Ambrosia artemisifolia*
Crabgrass	*Digitaria* sp.
Horse week	*Conyza canadensis*
Primrose	*Oenothera* sp.
Honeysuckle	*Lonicera japonica*
Broomsedge	*Andropogon virginicus*
Trumpet creeper	*Campsis radicans*
Sumac	*Rhus typhina* and *R. copallina*
Persimmon	*Diospyros virginiana*
White poplar	*Populus alba*
Watercress	*Nasturtium* sp.
Cattail	*Typha* sp.
	Mammals
Little brown bat	*Myotis lucifugus*
Keen's bat	*Myotis keenii*
Silver-haired bat	*Lasionycteris noctivagans*
Eastern pipistrelle	*Pipistrellus subflavus*
Big brown bat	*Eptesicus fuscus*
Red bat	*Lasiurus borealis*
Hoary bat	*Lasiurus cinereus*
Virginia oppossum	*Didelphis virginiana*
Least shrew	*Cryptotis parva*

Table 4.1 (continued)

Common name	Scientific name
Southeastern shrew	*Sorex longirostis*
Short-tailed shrew	*Blarina breyicauda*
Southern short-tailed shrew	*B. carolinensis*
Gray myotis	*Myotis grisescens*
Indiana myotis	*M. sodalis*
Eastern cottontain	*Sylvilagus floridanus*
Eastern chipmunk	*Tamias striatus*
Gray squirrel	*Sciurus carolinensis*
Fox squirrel	*S. niger*
Southern flying squirrel	*Glaucomys Volans*
Marsh rice rat	*Oryzomys palustris*
Cotton rat	*Sigmodon hispidus*
Norway rat	*Rattus norvegicos*
White-footed mouse	*Peromyscus leucopus*
House mouse	*Mus muscolus*
Cotton mouse	*P. gossypinus*
Golden mouse	*Ochrotomys nuttali*
Eastern harvest mouse	*Reithrodontomy shumulis*
Woodland (Pine) vole	*Microfus pinetorum*
Eastern mole	*Scalopos aquaticos*
Muskrat	*Ondatra zibethica*
Red fox	*Vulpes vulpes*
Gray fox	*Urocyon cinereoargenteus*
Coyote	*Canis latrans*
Black bear	*Ursus americanus*
Ground hog	*Marmota monax*
Racoon	*Procyon lotor*
Striped skunk	*Mephitis mephitis*
Eastern spotted skunk	*Spilogale putorius*
Long-tailed weasel	*Mustela frenata*

Table 4.1 (continued)

Common name	Scientific name
Mink	*Mustela vison*
Beaver	*Castor canadensis*
Mountain lion (eastern cougar)	*Felis concolor*
Bobcat	*Lynx rufus*
White-tailed deer	*Odocoileus virginianus*
Birds	
Sharp-shinned hawk	*Acciptier striatus*
Cooper's hawk	*A. cooperii*
Red-shouldered hawk	*Buteo lineatus*
Broad-winged hawk	*B. playtpterus*
Southern bald eagle	*Haliaeetus l. leucocephalus*
Marsh hawk	*Circus cyaneus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
Ruffed grouse	*Bonasa umbellus*
Bobwhite	*Colinus virginianus*
Turkey	*Meleagris gallopavo*
Mourning dove	*Zenaida macroura*
Common (yellow-shafted) flicker	*Colaptes auratus*
Red-bellied woodpecker	*Melanerpes carolinus*
Hairy woodpecker	*Picoides villosus*
Downy woodpecker	*P. pubescens*
Red-cockaded woodpecker	*P. borealis*
Blue jay	*Cyanocitta cristata*
Common crow	*Corvus brachyrhynchos*
Carolina chickadee	*Parus carolinensis*
Tuffed titmouse	*P. bicolor*
Bewick's wren	*Thryomanes bewickii*
Wood thrush	*Hylocichla mustelina*

Table 4.1 (continued)

Common name	Scientific name
Red-eyed vireo	*Vireo olivaceus*
Pine warbler	*Dendrocia pinus*
Ovenbird	*Seiurus aurocapillus*
Kentucky warbler	*Oporornis formosus*
Yellow-breasted chat	*Icteria virens*
Scarlet tanager	*Piranga olivacea*
Summer tanager	*P. rubra*
Cardinal	*Cardinalis cardinalis*
Rufous-sided towhee	*Pipilo erythrophthalmus*
Grasshopper sparrow	*Ammodramus savannarum*
Bachman's sparrow	*Aimophila aestivalis*
White-throated sparrow	*Zonotrichia albicollis*
Reptiles and amphibians	
Eastern narrowmouth toad	*Gastrophryne carolinensis*
Northern cricket frog	*Acris creptians*
Spring peeper	*Hyla crucifer*
Gray treefrog	*Hyla versicolor*
Upland chorus frog	*Pseudacris triseriata*
Bullfrog	*Rana catesbeiana*
Green frog	*Rana clamitans*
Pickerel frog	*Rana palustris*
Southern leopard frog	*Rana sphenocephala*
American toad	*Bufo americanus*
Fowler's toad	*B. woodhousei*
Hellbender	*Cryptobranchus alleganiesis*
Northern dusky salamander	*Desmognathus fuscus*
Red-spotted newt	*Notophthalmus viridescens*
Tennessee cave salamander	*Gyrinophilus palleucus*
Mudpuppy	*Necturus malulosus*

Table 4.1 (continued)

Common name	Scientific name
Red-backed salamander	*Plethodon cinereus*
Slimy salamander	*P. glutinosus*
Northern red salamander	*Pseudotriton r. Tuber*
Spotted salamander	*Ambystoma maculatum*
Marbled salamander	*Ambystoma opacum*
Two-lined salamander	*Eurycea bislineata*
Spring salamander	*Gyrinophilus porphyriticus*
Mud salamander	*Pseudotriton montanus*
Snapping turtle	*Chelydra serpentia*
Map turtle	*Graptemys geographica*
Eastern must turtle	*Sternotherus odoratus*
Stripe-necked musk turtle	*Sternotherus minor*
Spiny softshell turtle	*Apalone spinifera*
Yellow-bellied turtle	*Chrysemys scripta*
Eastern box turtle	*Terrapene carolina*
Northern copperhead	*Agkistrodon contortrix mokasen*
Six-lined racerunner	*Cnemidophorus sexlineatus*
Northern black racer	*Coluber constrictor*
Timber rattlesnake	*Crothalus h. horridus*
Black rat snake	*Elaphe obsoleta*
Ground skink	*Scincella lateralis*
Five-lined skink	*Eumeces fasciatus*
Broodhead skink	*Eumeces laticeps*
Eastern hognose snake	*Heterodon platyrhinos*
Northern water snake	*Natrix s. sipedon*
Fence lizard	*Sceloporus undulatus*
Northern brown snake	*Storeria d. dekayi*
Eastern garter snake	*Thamnophis s. sirtalis*
Worm snake	*Carphophis amoenus*
Scarlet snake	*Cemophera coccinea*

Table 4.1 (continued)

Common name	Scientific name
Ringneck snake	*Diadophis punctatus*
Corn snake	*Elaphe guttata*
Mole snake	*Lampropeltis calligaster*
Milk snake	*Lampropeltis tringulum*
Common king snake	*Lampropeltis getula*
Pine snake	*Pituophis melanoleucus*
Common water snake	*Nerodia sipedon*
Rough green snake	*Ophedodrys aestivus*
Queen snake	*Regina septemvittata*
Brown snake	*Storeria dekayi*
Redbelly snake	*Storeria occipitomaculata*
Smooth earth snake	*Virginia valeriae*
Fish	
Rock bass	*Ambloplites rupestris*
Common shiner	*Notropis cornutus*
White sucker	*Catostomus commersoni*
Blacknose dace	*Rhinichthyscatratolos*
Mountain red belly dace	*Phoxinos oreas*
Stoneroller	*Campostoma anomalum*
Creek chob	*Semotilus atromaculatus*
Northern hogsucker	*Hypentelium nigricans*

for the pure pine areas bordering the transmission line corridors. Pine warblers and white-throated sparrows are common, but few other species are evident. These habitats are little used by reptiles or amphibians (Johnson 1964).

Aquatic and riparian habitats. Many reptiles and amphibians occur in the various aquatic and wetland areas, including turtles, queen snake, water snake, salamanders, and frogs. The muskrat and beaver are bound closely to aquatic habitats. Rice rats, mink, and raccoons are also found in these areas. Many large mammals come frequently to this habitat to drink, and various small species are present at the water's edge. The American bald eagle occurs occasionally as a transient. The Canada goose, great blue herons, and green-backed herons nest on the ORR.

Rare and endangered species. Three mammal species on the federal list as endangered may occur on the ORR but have not been verified. These are the gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*) and eastern cougar (*Felis concolor*). Only one mammal species listed by the Tennessee Wildlife Resources Agency (TWRA) as in need of management, the southeastern shrew (*Sorex longirostris*), is known to occur on the reservation (Kroodsma 1987). The pine snake, *Pituophis melanoleucas*, is listed as threatened by the TWRA, and its presence in the Bear Creek Watershed has been verified. The Cooper's hawk (*Accipiter striatus*) occurs in forests throughout the ORR and is listed by the state as threatened (Kroodsma 1987).

4.2.2.3 Aquatic fauna

Nineteen species of fish have been found in Bear Creek in recent quantitative monitoring efforts conducted at seven sites along virtually the entire length of Bear Creek. Minnows (blacknose dace, *Rhinichthys atratulus*; mountain redbelly dace, *Phoxinus oreas*; stoneroller, *Campostoma anomalum*; and creek chub, *Semotilus atromaculatus*) were the predominant constituents of the fish fauna upstream from the weir at BCK-4.55. Below the weir, larger species (northern hogsucker, *Hypentelium nigricans*; white sucker, *Catastomus commersoni*; and rockbass, *Ambloplites rupestris*) were more common, the diversity of minnow species increased, and darters were found. Conclusions of the recent fish-monitoring studies were that much of Bear Creek had a limited fish fauna (low species richness) characterized by robust population parameters (high densities and biomass). The uppermost site (BCK-12.36) did not have a stable, resident fish population. Water from this site was commonly toxic to fathead minnow larvae in toxicity testing and contained high levels of dissolved salts as a result of input of contaminated groundwater from the S-3 Pond site. The next two monitoring sites downstream, BCK-11.83 and BCK-11.09, had low fish density and biomass in 1984–85 but showed recovery in later sampling. No impacts on the fish fauna of Bear Creek were evident in the vicinity of inputs from the burial grounds (BCK-9.91 and BCK-9.40) despite the fact that qualitative surveys of tributaries (NT-6-8) draining that site found no fish to be present.

No endangered or threatened fish species have been found in Bear Creek. However, the mountain redbelly dace, a major constituent of the fish population above the weir at BCK-4.55, is listed as a species in need of management. Its habitat is protected by the state of Tennessee (Starnes and Etnier 1980). In Bear Creek, it occurs at every site above the weir and in at least four tributaries (NT-13, NT-14, NT-18, and ST-7).

Quantitative sampling of benthic invertebrates was conducted monthly at nine sites from BCK-12.36 to BCK-3.25 from June 1984 through May 1985 as part of Phase I of the ecological monitoring program for Bear Creek and at quarterly intervals thereafter. A total of 126 distinguishable taxa was collected in Bear Creek, including crustaceans (Isopoda, Amphipoda, and Decapoda), aquatic worms (Oligochaeta), snails (Gastropoda), mussels (Pelecypoda) and insects (Insecta). Eleven orders of insects were collected in Bear Creek, including springtails (Collembola), mayflies (Ephemeroptera), dragonflies and damselflies (Odonata), crickets and grasshoppers (Orthoptera), stoneflies (Plecoptera), true bugs (Hemiptera), alderflies and fishflies (Megaloptera), caddisflies (Tricoptera), butterflies and moths (Lepidoptera), beetles (Coleoptera), and true flies (Diptera).

The invertebrate fauna of Bear Creek showed a pattern of increasing density, biomass, and taxonomic diversity and richness with increasing distance downstream from the uppermost sampling site (BCK-12.36). The paucity of benthic invertebrates found in the upper reaches of Bear Creek contrasted sharply with reference sites (unimpacted streams of similar size), which had relatively diverse and abundant assemblages of macroinvertebrates. Water from BCK-12.36 and BCK-11.83 was toxic to *Ceriodaphnia*, an invertebrate test species, but not to fathead minnow larvae, in toxicity tests run in March 1988. At the time of these tests, streamflow in Bear Creek was higher than normal, and contaminants from the S-3 Pond groundwater plume were diluted more than would be the case under baseflow conditions. Under low-flow conditions, it is likely that Bear Creek water would be toxic to *Ceriodaphnia* as far downstream as BCK-9.4. While evidence of adverse effects on the fish communities of Bear Creek was not noted at sites downstream from BCK-11.83, the benthic fauna appeared to be more sensitive, with clear differences in faunal composition from unimpacted reference sites at all sites except BCK-3.25, where complete recovery appears to have occurred. Species intolerant of pollution (mayflies, stoneflies, and caddisflies) were absent in the upper reaches and became more common downstream. Mayflies, which are particularly sensitive to toxic metals, were virtually absent at all sites except BCK-3.25. Unlike the fish data, which provide evidence of ecological recovery in Bear Creek since 1984, the benthic macroinvertebrate fauna do not appear to have changed in a manner indicative of either improving or degrading water quality since 1984.

No threatened or endangered species of aquatic macroinvertebrates have been collected in Bear Creek.

A limited amount of data have been collected on the bioaccumulation of contaminants by aquatic biota in Bear Creek. Fish collected from lower Bear Creek contained elevated levels of mercury (0.2–0.5 μg/g, wet weight) in 1982 (Van Winkle et al. 1984), and 1984 (TVA 1985). While well below the U.S. Food and Drug Administration action level, these data do indicate the presence of biologically available mercury in the Bear Creek system. Fish from lower Bear Creek were also analyzed for cadmium, chromium, silver, arsenic, and nickel in 1984 (TVA 1985), and levels were found to be typical of fish from uncontaminated environments.

PCB contamination in fish from Bear Creek was evident in 1982, when rockbass collected from the lower reaches of the creek were found to contain 0.65 ± 0.29 ppm (wet wt) PCBs. TVA analyzed fish from lower Bear Creek for organic priority pollutants, including PCBs in 1984; levels of all substances were below detection limits. Fish were collected from lower Bear Creek in 1987 as part of an effort to evaluate the importance (relative to other sources) of the EFPC discharge at New Hope Pond as a source of PCB contamination to lower Poplar Creek and the Clinch River. In this collection, PCBs in rockbass averaged 0.28 ± 0.12 ppm (n=8), a value comparable to the level of contamination found in sunfish in the lower third of EFPC and well above the level typical of fish from uncontaminated sites (0.02 ± 0.01 ppm). Clams held in Bear Creek (BCK-4.55) for 1 month as part of the same study accumulated 1.01 ppm PCBs (vs 0.05 ppm in controls), indicating that Bear Creek now contains a source of biologically available PCBs.

PCB contamination has been observed in fish in EFPC, Poplar Creek, and the Clinch River/Watts Bar Reservoir downstream from Bear Creek (TVA 1985). It is unlikely that a substantial fraction of this contamination is attributable to Bear Creek because sources of PCBs and similar levels of contamination are found in fish from these systems far upstream from the mouth of Bear Creek (TVA 1985). A similar situation exists for mercury (TVA 1985).

4.3 POTENTIAL EXPOSURE PATHWAYS

A potential exposure pathway is the means by which a contaminant moves from a source to a receptor. Generally, a complete exposure pathway has five elements:

- a contaminant source,
- a mechanism for contaminant release,
- an environmental transport medium,
- a point of potential human contact with the contaminated medium referred to as the exposure point, and
- a feasible route of exposure.

Exposure could occur if soil contaminants migrate from the site to an exposure point or when a receptor comes into direct contact with waste or contaminated media at the site. An exposure pathway is complete if there is a way for the receptor to take in contaminants through ingestion, inhalation, or dermal absorption of contaminated media or waste. The following subsections discuss the potential exposure pathways in terms of OU 2.

4.3.1 Ingestion

The potential exists for ingestion of contaminants released as a result of activities at OU 2. Ingestion of contaminants could occur from exposure to groundwater, soil, and surface water that may function as transport mediums for contaminants released at OU 2. The soil medium is believed to pose the greatest risk of contaminant exposure through ingestion and inhalation.

The soil medium presents the potential risk for ingestion of contaminants through incidental contact with on-site workers during site characterization and potential remedial actions. The potential for ingestion is greatly lessened during these activities because workers are safety-trained and a site-specific health and safety plan is implemented. Because of the limited population potentially exposed to the soil medium and the health and safety planning, the potential for exposure to contaminants through soil ingestion is very limited.

Exposure to contaminants through ingestion of groundwater could occur if the groundwater has become contaminated by soil leachate and if the groundwater is used as a drinking water source. The potential exists for contaminants leaching into the groundwater at OU 2; however, the groundwater on the ORR is not used as a drinking water source. Furthermore, many of the contaminants of concern are suspected to be immobilized in the soil and thus are not likely to leach into the groundwater in high concentrations. Because of the documented groundwater contamination at the Y-12 Plant, which is being addressed under a separate RI, it is believed that OU 2 will likely have an insignificant impact on groundwater. Consequently, the potential for exposure to populations by ingestion of contaminants that may result from OU 2 is considered minimal or nonexistent.

Exposure to contaminants through the ingestion of surface water could occur if the surface water is used as a drinking water source and it has been contaminated by groundwater recharge or surface water erosion and transport of contaminated soil. Surface water is not used as a drinking water source, and there are no downgradient residential uses on the ORR. The potential for surface water contamination due to soil erosion and transport is lessened by the compacted-clay and top-soil caps installed at OU 2 spoil areas. The potential exposure of populations to contaminants through surface water ingestion is considered minimal or nonexistent.

4.3.2 Inhalation

The potential exists for inhalation of contaminants at OU 2. Inhalation of potentially contaminated particulates will likely only occur in situations where the subsurface soil is disturbed. The presence of compacted clay and top soil caps and vegetative covers at the spoil areas significantly reduces the potential for inhalation exposure at undisturbed sites. The potential for inhalation exposure is likely to be greatest for on-site workers participating in site characterization and remedial actions in which subsurface soils are disturbed. Because of the limited population potentially exposed in this scenario and the implementation of site-specific health and safety plans during these activities, the potential for inhalation of contaminants is very low.

4.3.3 Dermal Contact

Dermal contact is a potential exposure pathway at OU 2. Potential exposure through dermal contact will be limited to on-site workers participating in site characterization and remedial actions. The potential for exposure through dermal contact is very low due to the implementation of site-specific health and safety plans during these activities and the limited population potentially exposed.

4.3.4 External Exposure to Radionuclides

The potential for external exposure to radionuclides exists at OU 2. Potential radiological exposure could occur from being directly exposed to external gamma from contaminated soil. Under current conditions, exposure is limited to on-site patrol guards and maintenance workers. Future exposure could occur to on-site workers participating in site characterization or remedial activities. The exposure potential for on-site workers is lessened by the implementation of on-site health and safety plans. The risk of external radiological exposure is considered to be low because of the limited population potentially affected.

4.4 RISK ASSESSMENT METHODOLOGY

A screening risk assessment will be prepared for OU 2 from existing data and data collected during the RI. The methodology employed to conduct the risk assessment will follow the guidelines established in the risk assessment guidance document for Superfund (EPA 1989). In addition, recommendations from the ER Central Risk Assessment Council and other supporting documentation will be followed. Data collected as part of this RI will support development of an ecological risk assessment as part of an integrated Bear Creek Valley RI.

5. SCOPING

5.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

CERCLA was passed by Congress and signed into law on December 11, 1980 (Public Law 96-510). This act was intended to provide for "liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive waste disposal sites." SARA, adopted on October 17, 1986 (Public Law 99-499), did not substantially alter the original structure of CERCLA but provided extensive amendments to it.

In particular, Sect. 121 of CERCLA specifies that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site. Inherent in the interpretation of ARARs is the assumption that protection of human health and the environment is ensured.

The purpose of this section is to supply a preliminary list of available federal and state chemical- and location-specific ARARs that might be considered for OU 2. This list of ARARs represents a compilation of potential ARARs of which subsets will be used or additional ARARs added as site-specific contamination at OU 2 is characterized. No action-specific ARARs are presented here; they will be developed as remedial alternatives are identified during the RI/FS.

RSA is located 0.4 miles west of the Y-12 Plant on Old Bear Creek Road. It served as a solid waste disposal area for nonuranium contaminated construction debris generated by Rust Engineering, a DOE prime contractor, during various renovation, maintenance, and construction operations from 1975 to 1983. The site was closed in 1984 under the TDEC Division of Solid Waste Management regulations by capping the fill area with 2 ft of clean soil and planting vegetation. Although Bear Creek borders the northern edge of the area and the eastern edge is bordered by a spring-fed tributary of Bear Creek which discharges into Bear Creek, there are no surface waters directly on the Spoil Area. Storm runoff flows directly into Bear Creek or indirectly via the tributary on the eastern border. Direct soil exposure and surface runoff of contaminants is unlikely because the site was closed and capped with the 2-ft layer of clean soil (Welch 1989c). Contaminants identified in the soil at the RSA include heavy metals, VOCs, and radionuclides. The identified contaminants are arsenic, beryllium, lead, mercury, tetrachloroethene, uranium, vanadium, selenium, and thorium (see Record of Conversation, Appendix A, page A-3).

SA-1 is a 5-acre site located west of the Y-12 Plant on Old Bear Creek Road. It began operation in 1980, and TDEC permitted it in 1985 as a landfill for solid waste (Registration Number DML-10-103-0012). In addition, it is listed in the *RCRA Facility Investigation Plan General Document for the Y-12 Plant* (Welch 1989a) as a RCRA Sect. 3004(u) SWMU under the HSWA general permit for the ORR. Wastes deposited at the site include asphalt, masonry and roofing materials, brush, metal, rock, and tile from renovation, maintenance, and construction activities (Welch 1989b). Preliminary assessment has revealed the presence of the following contaminants at the site: aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, iron, lead, mercury, nickel, vanadium, zinc, total uranium, total radium, benzo(*a*)anthracene, benzo(*a*)pyrene, benzo(*a,k*)fluoranthene, chrysene, dibenzofuran, fluoranthene, phenanthrene, pyrene, and bis(*2-ethylhexl*)phthalate (see Record of Conversation, Appendix A, page A-3).

The SY-200 Yard lies in BCV between the RSA and SA-1. The site lies just south of the headwaters of Bear Creek near the base of the northern slope of Chestnut Ridge. Surface runoff from the area drains to the northwest into Bear Creek, which flows along the northern perimeter of the area. No detailed records are available that list all items that have been stored at the SY-200 Yard. Known or suspected contaminants are uranium, thorium, PCBs, lead, mercury, asbestos, and alpha activity (see Record of Conversation, Appendix A, page A-3).

Some site-specific characterization of the nature and extent of groundwater contamination will be conducted at the individual sites. Groundwater for the RSA and SA-1 will be characterized as part of the Y-12 Comprehensive Groundwater Monitoring Program. ARARs for groundwater remediation for all three sites in OU 2 will be addressed under that program. Any contamination of Bear Creek will be addressed and remediated under the program for Bear Creek, and ARARs for surface water remediation for Bear Creek will be discussed in that report. This document will address ARARs for the remaining media of concern, soil.

5.1.1 Definitions

Applicable requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site" (52 *FR* 32496, August 27, 1987).

Relevant and appropriate requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site" (52 *FR* 32496).

CERCLA on-site remedial response actions must only comply with the substantive requirements of a regulation and not the administrative requirements to obtain federal, state, or local permits [CERCLA §121(e) and FFA §XXII]. To ensure that CERCLA response actions proceed as rapidly as possible, EPA has reaffirmed this position in the final National Contingency Plan (NCP) (55 *FR* 8756, March 8, 1990). *Substantive requirements* pertain directly to the actions or conditions at a site, while *administrative requirements* facilitate their implementation. EPA recognizes that certain of the administrative requirements such as consultation with state agencies, reporting, etc., are accomplished through the state involvement and public participation requirements of the NCP. These administrative requirements should be observed if they are useful in determining cleanup standards at the site (55 *FR* 8757).

In the absence of federal- or state-promulgated regulations, there are many criteria, advisories, guidance values, and proposed standards that are not legally binding but may serve as useful guidance for setting protective cleanup levels. These are not potential ARARs but are "to-be-considered" (TBC) guidance.

5.1.2 Chemical-Specific ARARs

"Chemical-specific requirements set health or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances, pollutants, or contaminants" (52 *FR* 32496). These requirements generally set protective cleanup levels for the chemicals of concern in the designated media or else indicate a safe level of discharge that may be incorporated when considering a specific remedial activity.

5.1.2.1 Soil

Very little legislation or guidance is available governing cleanup criteria for contaminated soils at CERCLA sites. Because SA-1, RSA, and SY-200 Yard are listed as RCRA Sect. 3004(u) SWMUs, any remedial actions at OU 2 are subject to RCRA corrective action regulations if toxicity testing of soils reveals the presence of RCRA characteristic hazardous waste as defined in 40 *CFR* 261. Requirements for corrective action for SWMUs have been proposed (55 *FR* 30798, July 27, 1990). A final rule is expected to appear in January 1993. EPA proposes a risk-based approach to establish media cleanup standards for surface water, groundwater, soil, and air. These standards are to be established at concentrations that ensure protection of human health and the environment and are to be set for each media of concern during the remedy selection process. Target cleanup levels may initially be set at the proposed RCRA action levels and modified as appropriate to reflect site-specific exposure assumptions (55 *FR* 30826).

SA-1 is registered with TDEC as a solid waste landfill, making it subject to Tennessee state regulations [Tennessee Code Annotated (TCA) 68-31-101-107] governing solid waste disposal facilities. One of the conditions listed in the registered permit for SA-1 states that a final cover of at least 2 ft of compacted soil shall be applied within 1 week following completion of the demolition site. In addition, Rules of the TDEC, Chapter 1200-1-7-.03, require the submittal of a closure/postclosure plan for solid waste disposal facilities. TDEC has already contacted the Y-12 Plant Manager requesting submittal of a closure/postclosure plan for SA-1 by November 1992 (see TDEC correspondence, Appendix A, pages A-4 and A-5). Negotiation with state officials may be necessary to coordinate closure under the state solid waste disposal regulations with closure under CERCLA.

EPA has promulgated a final rule establishing a new 40 *CFR* Part 258, which sets forth revised minimum federal criteria for municipal solid waste landfills (56 *FR* 50978, October 9, 1991). These include closure and postclosure care requirements (40 *CFR* 258.60 and 258.61), including a final cover consisting of a 6-in. erosion layer underlain by an 18-in. infiltration layer and 30-year postclosure maintenance and groundwater monitoring. Although not legally applicable to remedial action sites found at OU 2, they may prove relevant and appropriate for closure of landfills. These regulations will be analyzed further as action-specific ARARs are addressed.

RCRA has addressed land disposal of treated hazardous wastes in its land disposal restrictions (LDRs) (40 *CFR* Part 268). The LDRs are triggered by movement of RCRA hazardous waste from one unit (SWMU) and placement into another unit. However, EPA has determined that current best demonstrated achievable technologies listed in the LDR regulations are generally inappropriate or unachievable for soil and debris from CERCLA response actions (55 *FR* 8760). Therefore, EPA is proposing separate rulemakings to establish treatment standards for disposal of such contaminated soil and debris. The Advance Notice of Proposed Rulemaking (ANPRM) for debris appeared in 56 *FR* 24444, May 30, 1991; the Notice of Proposed Rulemaking (NPRM) January 9, 1992 (57 *FR* 958); and the final rule, June 1992. The proposed rule requires contaminated debris to be treated prior to land disposal using extraction, destruction, or immobilization technologies. Six different categories of debris and ten different categories of contaminants are specified in the rule. As with mixed waste, debris contaminated with both hazardous and radioactive waste must comply with the treatability standards for contaminated debris as well as those under the Atomic Energy Act. Disposal of treated debris and resultant wastes are discussed in the proposed rule.

The ANPRM for soil appeared October 24, 1991 (56 *FR* 55160), the NPRM is scheduled for May 1992, and the final rulemaking for May 1993. These will be analyzed as ARARs or TBC when available. EPA has developed guidance for obtaining and complying with a treatability variance for soil and debris that are contaminated with RCRA hazardous wastes for which treatment standards have already been set (Office of Solid Waste and Emergency Response Directive 9347.3-06FS, July 1989). Alternate treatment levels are presented for structural functional groups of organics and for ten inorganics based on actual treatment of soil and best management practices for debris. These will be considered as TBC guidance when remedial alternatives are selected and more information becomes available on waste types.

Several sections of RCRA require promulgation of corrective action regulations; when finalized, these requirements will most likely be ARARs for CERCLA remedial actions. Currently, only the 40 *CFR* 264 Subpart F regulations on groundwater protection at units regulated by RCRA are potential ARARs to CERCLA corrective actions within facility boundaries, and these include groundwater protection standards (40 *CFR* 264.92 and 264.94) and groundwater monitoring requirements (40 *CFR* 264.97). The corrective action standards developed under RCRA Sect. 3004(u) will be applicable to any CERCLA cleanup site that is also an active or a formerly active RCRA facility with an active SWMU; thus, the standards will also be applicable to a CERCLA site where disposal is currently occurring. In addition, RCRA Sect. 3004(v) authorizes cleanup beyond facility boundaries.

The regulations found in the Toxic Substances Control Act (TSCA) contain storage, disposal, and cleanup requirements for materials contaminated with PCBs. These regulations limit concentrations of PCBs disposed of in soil to 50 ppm and require that any soils containing concentrations of PCBs greater than 50 mg/kg (ppm) (40 *CFR* 761.60) be incinerated (40 *CFR* 761.70) or stored in a chemical waste landfill (40 *CFR* 761.75). TSCA also specifies requirements that must be achieved for PCBs disposed of by incineration (40 *CFR* 761.70), in a chemical waste landfill (40 *CFR* 761.75), or by other disposal methods [40 *CFR* 761.60(a)(5)(iii)].

5.1.2.2 Other TBC guidance

EPA has suggested cleanup values for lead in soils based on studies of blood lead levels in exposed children. The EPA OSWER Directive 9355.4-02 (dated September 7, 1989) recommends a cleanup level for soils of 500 to 1000 ppm lead.

In the absence of federal- or state-promulgated ARARs, or in the case where ARARs are not adequately protective, EPA states a preference for reference doses (RfDs) and reference concentrations (RfCs) for systemic toxicants and slope factors or carcinogen potency factors (CPFs) for carcinogens (EPA 1989). RfDs, RfCs, and CPFs are available through the EPA *Integrated Risk Information System (IRIS)* (EPA 1990b) and EPA *Health Effects Assessment Summary Tables* (EPA 1992). The information found in IRIS is frequently in flux, as it is constantly undergoing EPA review and verification. Therefore, chemical-specific values are not included here.

Although not an ARAR, EPA has published a TSCA PCB spill cleanup policy (52 *FR* 10688) which recommends cleanup standards for PCBs of 25–50 ppm for sites with restricted access; a 10-ppm cleanup level is recommended for residential and unrestricted access rural areas. In this latter case, a 10-in. cap of clean soil must cover the site. In the EPA guidance report for remedial actions at Superfund sites containing PCBs, preliminary remediation goals are set at 1 ppm for residential land use (a risk of 10^{-5}) and between 10 and 25 ppm for industrial and/or remote areas (a risk of 10^{-4}) (EPA 1990a). Alternatives should reduce concentrations to these levels or limit exposures. EPA also presents an approach to deriving cleanup levels of PCBs in sediments (EPA 1990c). This approach results in "sediment quality criteria" as a function of organic carbon concentrations and is meant to protect wildlife consumers of freshwater benthic species. These values are considered TBC guidance, not ARARs.

5.1.3 Radiation Protection Standards

There are presently no EPA regulations appropriate for consideration of cleanup of radioactively contaminated soils. DOE is authorized to control all types of nuclear materials at sites under its jurisdiction and is exempt from the U.S. Nuclear Regulatory Commission (NRC) licensing and regulatory requirements. Therefore, NRC regulations are not considered to be ARARs for CERCLA cleanup at DOE facilities. However, all or parts of individual NRC regulations may be considered relevant and appropriate, depending on the particular conditions at each OU. DOE regulations for handling and cleanup of radioactive materials are outlined in a series of DOE orders that are legally binding to DOE contractors but are not considered by EPA to be ARARs. Therefore, for the purposes of development of ARARs, DOE orders will be treated, along with the NRC regulations, as TBC guidance. Table 5.1 summarizes dose limits that appear in the various regulations and DOE orders.

Table 5.1. Radiation protection standards that may be ARARs[a] for OU 2

Regulation	Applicability	Exposure conditions	Standard
10 *CFR* 20	Radiation from facilities licensed by NRC	Worker exposure limits in unrestricted areas	5 rem/year[b]
		Public exposure, unrestricted areas	100 mrem/year[b]
10 *CFR* 61	Licensing requirements for land disposal of radioactive waste	Public exposure, all sources	25 mrem/year (total body) 75 mrem/year (thyroid)
DOE Order 5400.5	Radiation Protection of the Public and the Environment	Public exposure, all sources	100 mrem/year
		Temporary exemption maximum limit	500 mrem/year
		Aquatic organism exposure, absorbed dose	1 rad/d
DOE Order 5820.2A	Radioactive Waste Management	Public exposure, all sources, excluding air	25 mrem/year
		Public exposure, atmospheric releases	10 mrem/year
DOE Order 5480.11	Radiation Protection for Occupational Workers	Worker exposure limits, continuous exposure	5 mrem/year, cancer effects[c] 50 mrem/year, noncancer effects[c]
		Public exposures, controlled areas	100 mrem/year[c]

[a]ARARs = applicable or relevant and appropriate requirements.
[b]Final rule of May 22, 1991 (56 *FR* 23360), effective June 21, 1991. Implementation of this regulation by NRC licensees may be deferred until January 1, 1993. This rule deleted the quarterly limits for occupational exposures and lowered the limit for public exposure from 500 mrem/year to 100 mrem/year.
[c]Proposed as 10 *CFR* 835 (56 *FR* 64334, December 9, 1991).

In addition to hazardous wastes, OU 2 shows evidence of possible radiological contamination of soils with uranium, radium, and thorium. The proper definition of "mixed low-level radioactive and hazardous waste" has caused considerable debate with regard to dual jurisdiction by EPA and NRC. However, EPA has published a clarification of the problem (53 *FR* 37045, September 23, 1988), as did DOE previously [52 *FR* 15937, May 1, 1987, and DOE Order 5400.3 ("Hazardous and Radioactive Mixed Waste Program," dated February 22, 1989)]. In effect, mixed wastes are those containing a RCRA hazardous waste as defined in 40 *CFR* 261 as well as radioactive waste subject to the AEA. RCRA regulations apply to the hazardous component of the waste, and AEA regulations apply to the radioactive component.

When the application of both standards is conflicting or inconsistent, RCRA yields to the Atomic Energy Agency. Tennessee received final authorization to regulate radioactive mixed waste on July 3, 1986 (53 *FR* 37045, September 23, 1988); however, the state has not implemented any regulations or guidance related to the handling of mixed waste (see Memorandum of Conversation, Appendix A, page A-6). On October 24, 1991, the U.S. Senate approved legislation granting DOE an extension through 1993 for storage of mixed waste without penalty (DPW 1991). After that date, DOE would have to seek EPA capacity variances yearly through June 30, 1997, accompanied with annual reports on the availability of technology to meet the RCRA storage requirements. Final passage of the bill is undetermined at this time.

5.1.3.1. EPA regulations

Subpart H of 40 *CFR* 61 addresses atmospheric radionuclide emissions from DOE facilities and may be applicable to airborne emissions during cleanup of OU 2. EPA has issued a final NESHAP rule (54 *FR* 51654, December 15, 1989) that limits emissions of radionuclides to the ambient air from DOE facilities to amounts that would not cause any member of the public to receive an effective dose equivalent of 10 mrem/year (40 *CFR* 61.92).

EPA intends to develop environmental radiation protection standards for the disposal of low-level waste (LLW) under 40 *CFR* 193 and 764. The intent of these standards will be to protect the public health and general environment from potential adverse effects from LLW disposal. These proposed regulations may provide TBC guidance for cleanup of OU 2 and, when promulgated, will be considered as ARARs. This proposed rule, however, is currently on hold pending resolution of the issue with the NRC (Houlberg et al. 1992).

In addition, EPA is developing public health and environmental radiation protection criteria for cleanup of residual radioactive materials at decommissioned DOE, Department of Defense, and NRC-licensed sites, as well as others. These criteria may provide useful TBC guidance for remedial response at OU 2. This rulemaking initiative is presently on hold; however, EPA plans to reactivate it in May 1992 (Houlberg et al. 1992).

5.1.3.2 NRC regulations

As mentioned previously, DOE is not regulated by NRC; however, NRC regulations may be relevant and appropriate and may provide some TBC guidance for cleanup of radioactive waste at OU 2. Thus the regulations are summarized here. The standards for protection against radiation (10 *CFR* 20) were revised recently (56 *FR* 23360, May 21, 1991). They are designed to limit radiation exposures from NRC-licensed activities. They provide permissible worker exposure limits for restricted areas of 5 rem/year (10 *CFR* 20.1201) and lowered radiation exposure limits to the general public in unrestricted areas from 500 mrem/year to 100 mrem/year (10 *CFR* 20.1301) (Table 5.1).

Appendix B of 10 *CFR* 20.1001-20.2401 sets annual average concentration limits for radionuclides in airborne and liquid effluents. These represent the radionuclide concentrations which, if inhaled or ingested, would produce a total annual effective dose equivalent of 50 mrem.

NRC has promulgated licensing requirements for land disposal of radioactive waste (10 *CFR* 61). Part 61 contains procedural requirements and performance standards applicable to any method of land disposal, with specific technical requirements for near-surface disposal of radioactive waste. Although not legally applicable, the substantive requirements found in this regulation may be relevant and appropriate or provide TBC guidance for remedial options selected at Bear Creek OU 2 and will be addressed when remedial alternatives are selected. 10 *CFR* 61.41 states that concentrations of radioactive materials released to the environment in all media must not result in an annual dose to an individual that exceeds 75 mrem to the thyroid and 25 mrem to the total body or all other organs (Table 5.1). In addition, reasonable effort must be made to maintain releases of radioactive materials to levels that are "as low as reasonably achievable" (ALARA).

5.1.3.3 DOE orders

As mentioned previously, DOE orders are not promulgated regulations and thus are not considered to be ARARs by EPA. They are, however, legally binding between DOE and Energy Systems because of contractual agreements. The radiation exposure limits defined in DOE Order 5400.5 ("Radiation Protection of the Public and the Environment," February 8, 1990) are an effective dose equivalent of 100 mrem/year from all exposure pathways and all DOE sources of radiation and a dose of less than 500 mrem/year for a single acute exposure. In addition, effluent releases to surface water must not result in exposures to aquatic organisms which exceed an absorbed dose of 1 rad/d. The overriding principle of the DOE order is that all releases of radioactive material shall be ALARA.

DOE Order 5820.2A ("Radioactive Waste Management," September 9, 1988) states that the management of LLW must ensure that external exposure to the waste and concentrations of radioactive material that may be released into surface water and soil does not exceed 25 mrem/year to any member of the public. Releases to the atmosphere shall not exceed 10 mrem/year. Reasonable effort should be made to maintain releases to the environment to ALARA levels. The order pertains to the management of radioactive waste that is not mixed with RCRA hazardous waste.

DOE Order 5480.11 contains guidelines for worker protection which are similar to those of 10 *CFR* 20 [i.e., 5 rem/year and 50 rem/year annual effective dose equivalent for stochastic (cancer) and nonstochastic (systemic) effects, respectively, from both internal and external sources for continuous exposures]. Also included in the order are standards for the general public when entering a controlled area. Exposures to the public are limited to an effective dose equivalent of 100 mrem/year. As with the other DOE orders, the ALARA principle prevails. Remediation of radionuclide-contaminated soils must be handled so that exposures to on-site workers or public intruders do not exceed these standards. DOE has proposed for codification in 10 *CFR* 835 the primary standards for radiation protection of occupational workers from normal operation of DOE facilities (56 *FR* 64334, December 9, 1991). No date for a final rule has been established; however, when promulgated, these standards will then be legally applicable for CERCLA cleanup at DOE sites.

5.1.3.4 TBC guidance for radiological risk assessment

The EPA Office of Radiation Programs has derived slope and unit risk factors for radionuclides of concern at remedial sites for each of three major exposure pathways (inhalation, ingestion, and external exposure to contaminated soil). These are available in the EPA *Health Effects Assessment Summary Tables* (EPA 1992).

5.1.4 Location-Specific ARARs

Location-specific requirements "set restrictions upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations" (53 *FR* 51394).

5.1.4.1 Caves, salt-dome formations, salt-bed formations, and underground mines

There are no indications of salt-dome formations, salt-bed formations, or underground mines on or near any of the three sites (Lee 1991). However, there apparently are limestone structures under OU 2 which may be subject to cave formation, sinkhole development, and trends of groundwater movement that could cause problems for site modifications (Welch 1989b; Murphy 1988). If any caves are located in areas where remedial activities may occur, the regulations found in RCRA [40 *CFR* 264.18(c)] which prohibit the placement of noncontainerized or bulk liquid hazardous waste in caves might be ARARs.

5.1.4.2 Faults

Two regionally extensive thrust faults transect ORR, the WOM and Copper Creek thrust faults (Ketelle 1991). Although no faults occur directly in the BCV near the Y-12 Plant, the WOM fault has induced some minor folding and major jointing and fracturing of the bedrock near the site (Ketelle 1991). The faults on the ORR are ancient (pre-Holocene) and are stable (Ketelle 1991). The possibility of fault movement is considered extremely unlikely (Chance 1986).

5.1.4.3 Wilderness areas, wildlife refuges, wildlife resources, and scenic rivers

There are no known designated wilderness areas, wildlife refuges, or scenic rivers at OU 2 or within range of the area such that remedial action would likely impact these resources. However, if any remedial action is taken that will impact Bear Creek,which borders OU 2 on the north, the Fish and Wildlife Coordination Act and the Tennessee Water Quality Control Act of 1977 [TCA Sect. 69-3-101 *et seq.* (1987)] may be ARARs.

5.1.4.4 Wetlands and floodplains

The northern portions of the RSA and the SY-200 Yard are within the 100-year flood plain of Bear Creek (Welch 1989c). There is no evidence of wetlands located at, or in the immediate vicinity of OU 2 (Cunningham and Pounds 1991). The Cunningham and Pounds 1991 survey does not purport to be complete however. Therefore the presence or absence of wetlands at the area should be confirmed by on-site inspection. If any remedial actions are chosen that would impact floodplains or wetlands, consideration should be given to Executive Order 11990, 40 *CFR* 6.302(a), 40 *CFR* Appendix A, 10 *CFR* 1022, the Clean Water Act Sect. 404, 40 *CFR* 230, and 33 *CFR* 320-330 for applicable requirements.

5.1.4.5 Historic sites and archaeological findings

A number of studies have indicated the presence of abundant archaeological and historic resources on the reservation (Sanders 1984). These surveys are summarized in Volume 3 of the *Resource Management Plan for the U.S. Department of Energy Oak Ridge Reservation* (Sanders 1984). Although the surveys are not exhaustive of the entire reservation, there appears to be no known archaeological or historic resources at OU 2 (Sanders 1984).

5.1.4.6 Rare, threatened, or endangered species

Many of the animal or plant species known to occur on ORR are listed in the *Resource Management Plan for the Oak Ridge Reservation*, Vols. 4 and 24 (Parr 1984, Kroodsma 1987). In addition, more recent information on rare plants at the ORR is being compiled (Parr 1992). Although there are a number of state- and federal-listed species on ORR, there are at present no known rare, threatened, or endangered species at OU 2 (Parr 1984, Kroodsma 1987).

5.1.5 Action-Specific ARARs

Performance, design, or other action-specific requirements set controls or restrictions on particular kinds of activities related to the management of hazardous waste (52 *FR* 32496). Selection of a particular remedial action at a site will invoke the appropriate action-specific ARARs that may specify particular performance standards or technologies, as well as specific environmental levels for discharged or residual chemicals. Action-specific ARARs are derived primarily from RCRA, the Clear Air Act, and the Clean Water Act; the action-specific ARARs for OU 2 will be developed during selection of remedial action alternatives.

5.2 IDENTIFICATION OF POTENTIAL TECHNOLOGIES

The purpose of this section is to identify potential treatment technologies that may apply to OU 2. Based on existing data, each potentially contaminated medium identified is evaluated so that additional data may be collected as a part of the RI to identify and develop the most effective remedial action plan.

The media that are potentially contaminated from OU 2 are soil and debris, groundwater, and surface water. Because the potential remediations of groundwater and surface water are being addressed as part of separate assessment programs covering Bear Creek Valley, they are not considered in this RI. Consequently, the treatment alternatives for the soil media are solely addressed in the RI.

Based on the information gathered during previous studies, objectives for the remediation of the site will be formulated and an assessment of the alternatives will be completed. The goal of the alternatives assessment will be to develop cost-effective alternatives that can meet the remediation objectives. To accomplish this goal, remediation technologies and process options will be identified, evaluated for technical feasibility, and screened to eliminate those that are obviously unsuited to site conditions or contaminants. The retained technology process options will then be assembled into alternatives. These alternatives will be evaluated based on implementability, effectiveness, and cost to reduce the number of alternatives and yet retain a reasonable range of alternatives. The process will be completed in the FS report, in which the alternatives will be defined in detail and evaluated relative to each other.

The remedial action alternatives considered for OU 2 are listed in Table 5.2. The remedial technologies are presented in association with the applicable general response action. General response actions have been developed for contaminated soil and debris suspected at OU 2. The response action categories are designed to address the environmental and public health effects of the contaminants, possible migration pathways, and exposure routes of the contaminated media.

The remedial technologies have undergone preliminary screening to identify those that potentially apply to OU 2. Table 5.3 presents the results of the screening process along with the options available for each technology and comments on the potential effectiveness, implementability, and cost of each technology.

Table 5.2. Remedial action alternatives

General response action	Remedial technology	Process options	Description	Screening comments
No action	None	Not applicable	No action	Required for consideration by NCP
Institutional controls	Access restrictions	Fencing	Limit entry to area by fencing	Potentially applicable
	Monitoring	Surface water and groundwater monitoring	Ongoing surface water sampling	Not in RI scope
Source containment	Capping	Clay and soil	Compacted clay covered with soil over areas of contamination	Potentially applicable
		Asphalt	Spray application of a layer of asphalt over areas of contamination	Potentially applicable
		Concrete	Installation of concrete slab over areas of contamination	Potentially applicable
		Multimedia cap	Clay and synthetic membrane covered by soil over areas of contamination	Potentially applicable
	Vertical barriers	Slurry wall	Trench around areas of contamination filled with a soil or cement bentonite slurry	Not feasible because of fractured bedrock
		Grout curtain	Pressure injection of grout in a regular pattern of drilled holes	Not feasible because of fractured bedrock
		Vibrating beam	Vibrating force to advance beams into the ground with injection of slurry as beam is withdrawn	Not feasible because of fractured bedrock

Table 5.2. (continued)

General response action	Remedial technology	Process options	Description	Screening comments
	Horizontal barriers	Grout injection	Pressure injection of grout at depth through closely spaced drilled holes	Not feasible because of fractured bedrock
		Block displacement	In conjunction with vertical barriers, injection of grout in notched injection holes to displace a block of soil and form a seal beneath the block	Not feasible because of fractured bedrock
	Surface controls	French drain	Trenching around the contaminated area to lower the water table	Potentially applicable
		Surface water rerouting	Trenching around the contaminated area to reroute surface water around the contaminated area	Potentially applicable
Excavation and treatment/disposal	Solidification/ fixation	Cement-based solidification	Mixing waste with Portland cement to solidify soil	Potentially applicable
		Silicate-based processes	Mixing soil with a siliceous material and other settling agents to form a solid	Potentially applicable
		Vitrification	Combining soil with molten glass and cooling to a stable, noncrystalline solid	Potentially applicable
	Biological treatment	Aerobic	Degradation of organics using microorganisms in an aerobic environment	Not effective for inorganics

Table 5.2. (continued)

General response action	Remedial technology	Process options	Description	Screening comments
		Anaerobic	Degradation of organics using microorganisms in an anaerobic environment	Not effective for inorganics
	Chemical treatment	Extraction	Chemical extraction of contaminants from soil	Potentially applicable
		Solvent washing	Washing of soil with a solvent to remove organics	Not effective for inorganics
	Incineration	Rotary kiln	Thermal oxidation of waste in a rotating, refractory cylinder	Not effective for inorganics
		Multiple hearth	Combustion of waste in several increasingly hotter combustion zones	Not effective for inorganics
		Fluidized bed	Injection of waste into an agitated bed of heated inert particles	Not effective for inorganics
In-situ treatment	Bioreclamation	Aerobic	Degradation of organics using microorganisms in an aerobic environment	Not effective for inorganics
		Anaerobic	Degradation of organics using microorganisms in an anaerobic environment	Not effective for inorganics
	Chemical treatment	Soil flushing	Extraction of contaminants by flooding soil with water or water-chemical mixture	Potentially applicable
	Physical treatment	Vitrification	Electrical vitrification of soils, which immobilizes inorganics	Potentially acceptable

Table 5.2. (continued)

General response action	Remedial technology	Process options	Description	Screening comments
		In-situ heating	Destruction or removal of organics through thermal decomposition, vaporization, and distillation	Not effective for inorganics
		Ground freezing	Installation of freezing loops in the ground and a self-contained refrigeration system, which pumps coolant around the freezing loop	Potentially applicable
		Steam/air stripping	Stripping of organics from soils by steam and air piped into the ground	Not effective for inorganics
		Soil venting	Volatilization of organics from soil by induced air flow through the soil	Not effective for inorganics

Table 5.3. OU 2 remedial action alternatives

General response action	Remedial technology	Process options	Effectiveness	Implementability	Cost
No action	None	Not applicable	Does not achieve remedial action objectives	Not acceptable	None
Institutional controls	Access restrictions	Prevent excavation within the area	Does not reduce contamination	Legal requirements and authority	None
Source containment	Capping	Clay and soil	Effective, susceptible to cracking but has self-healing properties	Easily implemented restrictions on future land use	Low capital, low maintenance
		Asphalt	Effective but susceptible to weathering and cracking	Easily implemented restrictions on future land use	Low capital, high maintenance
		Concrete	Effective but susceptible to weathering and cracking	Easily implemented restrictions on future land use	Moderate capital, high maintenance
		Multimedia cap	Effective, least susceptible to weathering	Easily implemented restrictions on future land use	Moderate capital, moderate maintenance
	Surface controls	French drain	Trenching around the contaminated area to lower the water table	Readily implemented	Moderate capital, moderate maintenance

Table 5.3. (continued)

General response action	Remedial technology	Process options	Effectiveness	Implementability	Cost
		Surface water rerouting	Trenching around the contaminated area to reroute surface water around the contaminated area	Readily implemented	Moderate capital, moderate maintenance
Excavation and treatment	Solidification	Cement-based	Most effective for metals	Readily implemented	Low capital, moderate operation and maintenance
		Vitrification	Effective, very high degree of containment	Extremely energy intensive; requires sophisticated machinery and highly trained personnel	High capital, high operation and maintenance
	Chemical treatment	Extraction	Effective and reliable	Readily implemented	High capital, moderate operation and maintenance
In-situ treatment	Chemical treatment	Soil flushing	Effective for soluble organics	Readily implemented	Moderate capital, moderate operation and maintenance
	Physical treatment	Vitrification	Emerging technology	Difficult to implement	High capital, high operation and maintenance
		Ground freezing	Emerging technology; never used for actual hazardous waste containment; temporary solution only	Difficult to implement	High capital, high operation and maintenance

6. SUMMARY OF DATA NEEDS

Based on the presentation and discussion of the existing monitoring and characterization data available for OU 2, several data needs have been identified. Specifically, data are needed to fully characterize several possible contaminant migration pathways and to evaluate the relative contribution of the OU 2 sites to contaminants in BCV groundwater, surface water, and sediments.

6.1 ENVIRONMENTAL CHARACTERIZATION

6.1.1 Spoil Area 1

6.1.1.1 Soils

Subsurface soils (fill and residuum) have been adequately characterized by previous investigations.

6.1.1.2 Groundwater

Groundwater contamination at SA-1 is characterized by elevated concentrations of nitrate and uranium, characteristic of the S-3 plume, and VOCs which may originate at another source (e.g., FTA). However, the available groundwater characterization data may not be indicative of contaminants from SA-1. Groundwater wells at the site are screened in the bedrock, whereas most of the identified soil contamination is located either in the fill material or concentrated at the fill/residuum contact. At several locations within SA-1 the water table intersects the zone of concentrated soil contamination. Groundwater samples from the water table in contact with SA-1 soil contaminants are needed to evaluate the contribution of SA-1 to BCV groundwater contaminant plumes.

Anecdotal accounts of seepage outbreaks on the downslope face of SA-1 should be investigated, and samples of affected soil and liquid should be collected and analyzed. The location of the seeps relative to the water table may indicate the presence of perched water within SA-1.

6.1.1.3 Surface water/sediment

The incomplete soil cap and evidence for erosion of the cap in places suggest that surface water runoff may be transporting contaminants to the headwaters of Bear Creek. Stormwater and sediment runoff are channelled around the periphery of SA-1 and should be sampled to assess this transport pathway.

6.1.2 SY-200 Yard

6.1.2.1 Soils

Site history suggests that contaminants in the subsurface were the result of disposal of contaminated soils from several sources. With the exception of near-surface contamination associated with known storage of lead shielding and transformers, the vertical and horizontal distribution of contaminants may be nearly random. The nature and extent of soil contamination at SY-200 are essentially unknown.

6.1.2.2 Groundwater

No groundwater assessment program monitoring wells exist in the immediate vicinity of SY-200. Given the preceding discussion on the distribution of subsurface contamination and the likelihood that contaminated soils are in direct contact with the water table, shallow groundwater samples are required to assess the relative contribution of SY-200 to BCV groundwater plumes.

6.1.2.3 Surface water/sediment

Observations at the site suggest that surface water runoff (and entrained sediments) may be discharging directly into Bear Creek. Runoff from an adjacent waste oil/PCB facility merges with that runoff from the west end of SY-200 before entering Bear Creek. Stormwater runoff samples, with separate analyses for water and sediment, should be collected to assess the relative contribution of SY-200 to Bear Creek contamination.

6.1.3 Rust Spoil Area

6.1.3.1 Soils

The nature and extent of soil contamination at RSA will be verified with additional sampling.

6.1.3.2 Groundwater

The groundwater monitoring wells at RSA include a mix of unconsolidated and bedrock-zone screen intervals. As a result, data from these wells should be adequate to characterize the nature and extent of any groundwater contamination at the site.

6.1.3.3 Surface water/sediment

Observations at the site suggest that surface water runoff (and entrained sediments) may be discharging directly into Bear Creek, especially along the east side of the site where an intermittent spring (SS-1) discharges into a steep tributary channel. Runoff from an adjacent waste oil/PCB facility enters the same channel (through a discharge pipe) near its headwaters and before entering Bear Creek. Stormwater runoff samples, with separate analyses for water and sediment, should be collected to assess the relative contribution of RSA to Bear Creek contamination.

6.2 ENGINEERING TECHNOLOGY SCREENING

Data needs for continued screening of engineering technologies should be satisfied by the data collected for site characterization with the addition of geotechnical data (e.g., permeability, grain size) on subsurface soils at SY-200.

7. FIELD SAMPLING PLAN

7.1 SAMPLING PLAN SCOPE

The scope of sampling activities at OU 2 includes soil borings and soil sampling (at SY-200), groundwater piezometer installation for water table sampling at SA-1 and SY-200, seep sampling (soil and/or water) at SA-1, and storm event surface water and sediment sampling at all sites. Proposed sampling rationales and locations are discussed in the following sections and illustrated in Figs. 7.1 through 7.3. Prior to any invasive sampling, a walkover radiation survey will be conducted by Energy Systems personnel. The result of the surveys may indicate affitional locations for soil sampling.

7.1.1 Soils

Based on the results of previous soil sampling, contaminants of concern in soil at OU 2 include metals and PCBs at SY-200, metals and radiological contaminants at RSA, and metals and VOCs at SA-1.

Soil characterization at SA-1 has covered the readily available portions of the site. Because of relatively steep slopes near the western end of the site (Fig. 7.1), no soil borings are proposed.

The history of the SY-200 site suggests that contaminated soils were brought to the site and used as fill. Subsequent construction activities have redistributed those soils such that the horizontal and vertical distribution of contamination is unpredictable. Observations at the site during earlier construction activities suggest there are areas of particular concern which warrant focused sampling. The proposed sampling plan for SY-200 was generated by overlaying a 100-ft triangular grid over the site and systematically selecting grid nodes as locations for soil borings (Fig. 7.2). Within historical areas of concern, the sampling grid has been reduced to a 25-ft triangular grid.

Fifty-six soil borings will be installed within and outside the SY-200 Yard boundary. Each boring will be drilled to the water table, and continuous samples will be collected with a split barrel device. Where possible, the final soil sample in each boring will be collected from just beneath the water table surface. Twenty-two of the borings will be submitted for a complete suite of analyses. A random selection of 34 borings from the 25-ft grid will be analyzed for a more limited suite of analytes.

Extensive cutting and filling in the area during plant construction has resulted in a mixture of soils making up the fill materials; thus it is unlikely that background soil characteristics can be identified. However, upgradient soil conditions will be determined from borings located east of the site and downgradient conditions from borings located west of the site.

Soil characterization at RSA will be completed by locating five borings along two transects through the center of the site (Fig. 7.3).

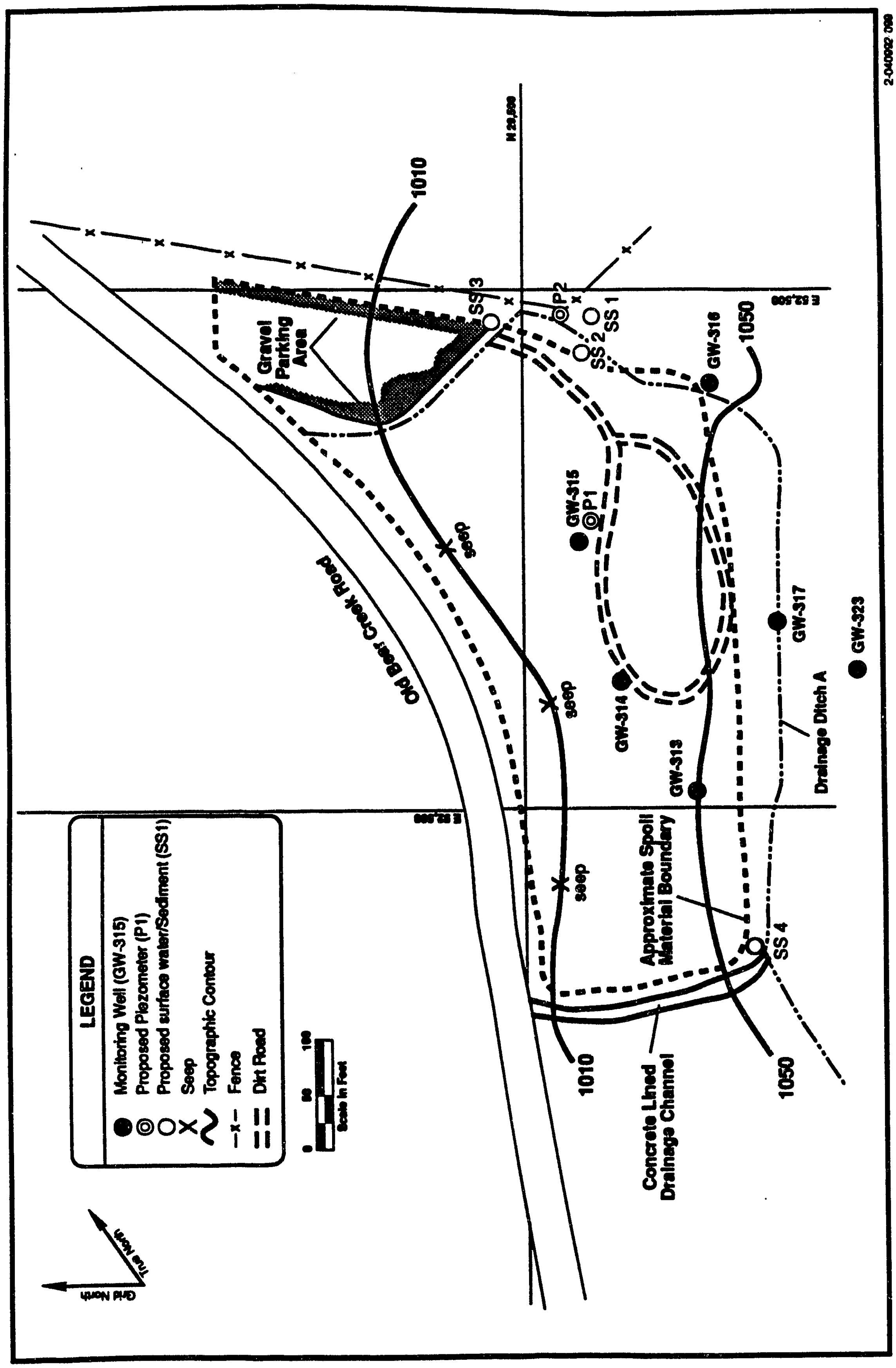

Fig. 7.1. Proposed locations for piezometers, surface water/sediment and seep sampling, SA-1.

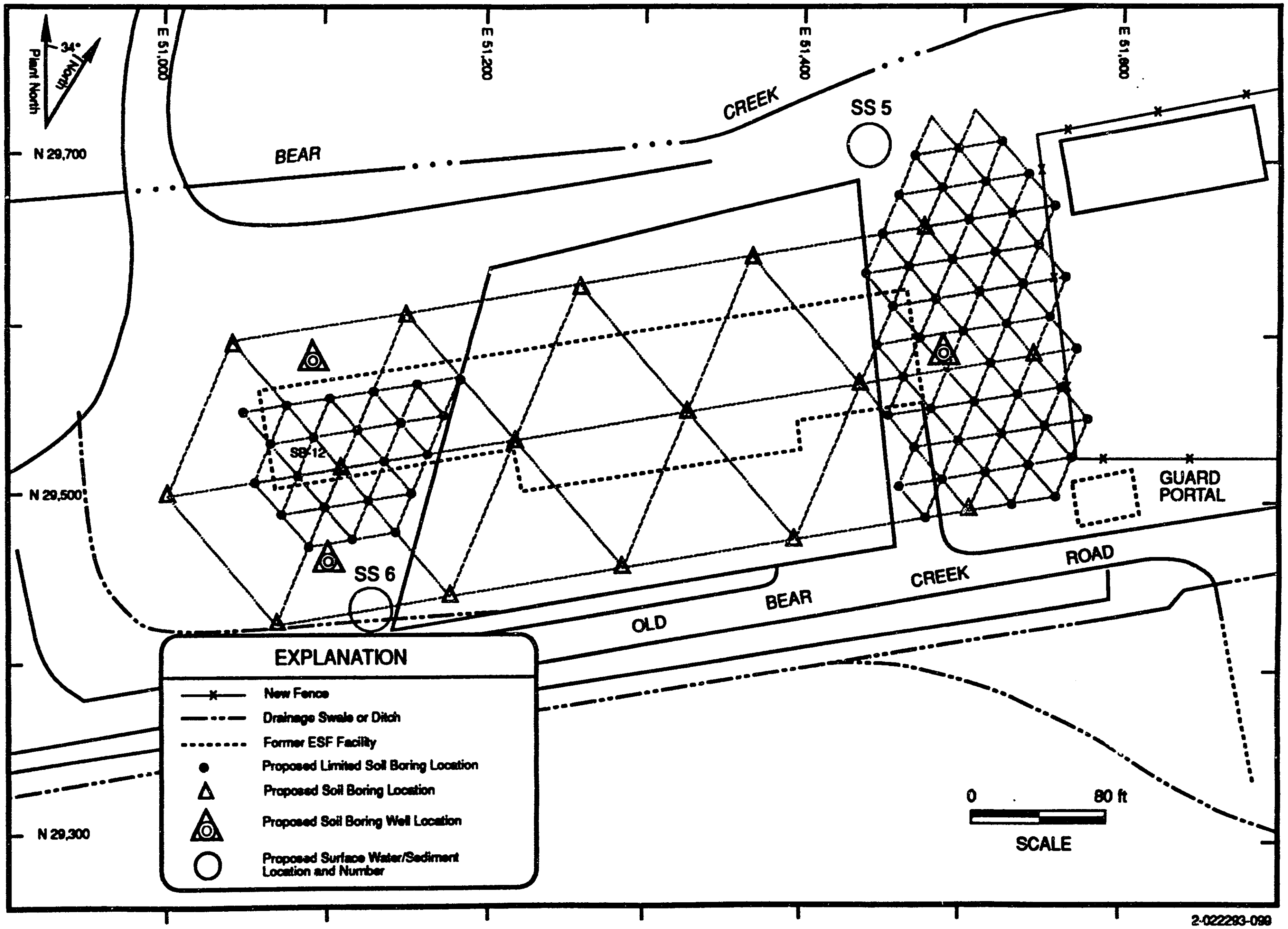

Fig. 7.2. Proposed sampling locations (soil borings), SY-200.

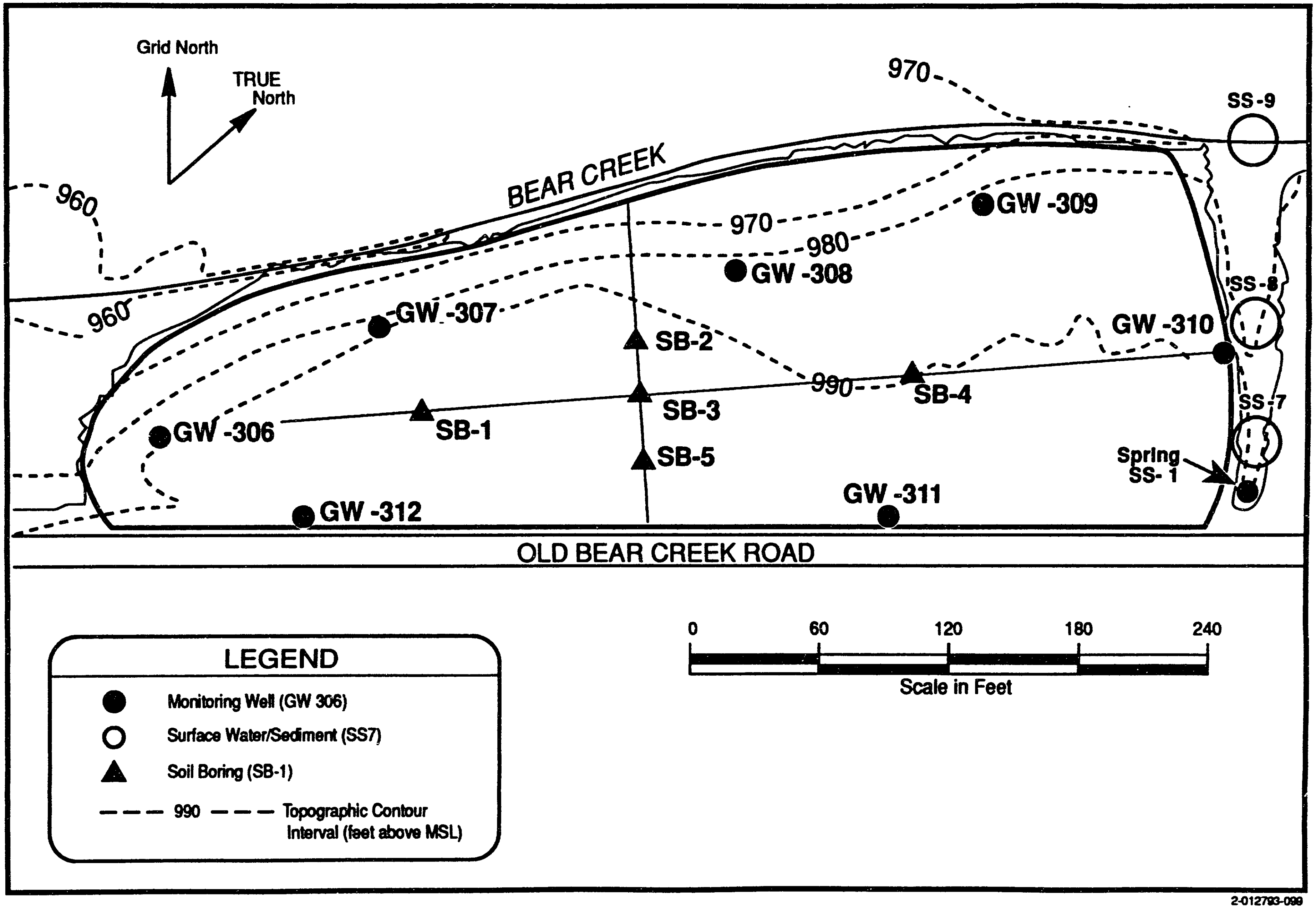

Fig. 7.3. Proposed sampling locations, RSA.

All soil borings will be advanced using an auger drill rig. Split-spoon soil samples will be collected every 5 ft following the procedures outlined in Method 303-4 (Kimbrough et al. 1990). The standard split-spoon sample length is 2 ft. Soil samples will be screened for the presence of contaminants to determine selection of samples for laboratory analysis. Screening procedures will include field observations for oil staining and mercury and instrumental measurements for VOC content and radionuclides. Once the dimensions of the fill material are more fully defined, three subsequent sampling intervals will be selected for collection of geotechnical samples with a Shelby tube (ESP-303-5).

Three to five feet of clean borrow material caps the SY-200 area; continuous samples will be collected in this area beginning at a depth of 3 ft. Based upon water table elevations, the average boring depth is expected to be about 18 ft. It is estimated that four samples will be collected from each boring totaling 224 samples. The average boring depth at RSA is expected to be about 20 ft. It is estimated that a maximum of five samples will be collected from each boring for a total of 25 samples. Composite samples will include, at most, two contiguous 2-ft split spoon samples. The required excavation permits will be obtained, ensuring clearance from underground utilities, and all soil boring locations will be surveyed using the National Geodetic Vertical Datum for Vertical Control.

7.1.2 Groundwater

Several well and piezometer installations are proposed for the OU 2 RI, specifically for the SA-1 and SY-200 sites.

The results of previous investigations at SA-1 demonstrate that contaminants of concern within the fill at SA-1 have migrated to the fill/residuum boundary. Furthermore, this boundary is often intersected by the water table in the center of the site. A piezometer installation is proposed at location P1 (Fig. 7.1) for the collection of a water table sample from an area with associated contaminant concentration in the fill/residuum.

Another piezometer installation proposed for SA-1 (P2, Fig. 7.1) is located upgradient of the site but downgradient of the FTA; this location is a possible source for VOC contamination at the site. Data from this sampling point will be used to resolve the shallow groundwater flow directions in this area (on or near the groundwater divide) and help to identify the source of VOC contamination observed in SA-1 groundwater. Both piezometers will be sampled once, however, multiple groundwater level measurement events will occur.

Three soil borings at SY-200 will be converted to stainless steel monitoring well installations (Fig. 7.2). The proposed locations will provide local groundwater quality samples both upgradient and downgradient of the site.

Data from the new wells and piezometers will be evaluated with the data from existing groundwater assessment monitoring wells to determine which, if any, of the piezometer locations should be retained as potential future locations for permanent groundwater monitoring wells.

A field reconnaisance survey will be conducted to identify areas of visible seepage on the downslope face of SA-1. If seeps are located (Fig. 7.1 and Tables 7.2 and 7.3 assume identification of three seeps), they will be sampled (soil and water) once during a period of wet weather flow.

7.1.3 Surface Water/Sediment

Surface water and sediment samples will be collected from several locations throughout OU 2 during or immediately after major runoff events. The rationale for this effort is to determine, especially in the cases of SA-1 and SY-200, whether the lack of sufficient capping of the site leads to significant contaminant transport. A secondary objective of the sampling will be, if possible, to isolate the contribution to runoff from the study sites from that of other facilities in the area (e.g., the waste oil and PCB facility between RSA and SY-200).

Surface water and sediment sampling locations SS1 through SS4 (Fig. 7.1) are located in drainage channels surrounding SA-1. Drainage on the east side of SA-1 is complicated, and several sampling points (SS-1, SS-2, SS-3) have been proposed to separate the component of runoff associated with SA-1 from that associated with facilities farther up the ridge.

Surface water and sediment samples will be collected at two locations in Bear Creek adjacent to SY-200 (Fig. 7.2). Sampling location SS5 is proposed to sample runoff from the east end of SY-200. Sampling location SS6 is proposed for comparison with data from SS5 and to evaluate the runoff from the west end of the site.

Proposed surface water and sediment sampling locations at RSA are concentrated on the upstream (east) side of the site (Fig. 7.3). Sampling location SS7 is proposed to collect surface water and sediment from a point upstream of runoff input from the adjacent waste oil and PCB facility and as close as feasible to the discharge point of the SS-1 spring. Sampling location SS8 is located immediately downstream of the surface water runoff input from that facility. Sampling location SS-9 is upstream of all influences of the RSA. Data from the sitewide Bear Creek monitoring station at BCK-11.97 will be used to assess the downstream effects of runoff from RSA.

7.2 FIELD SAMPLING AND SAMPLE ANALYSIS

The following sections discuss the technical procedures that will be used as guidelines to implement the sampling activities at OU 2. All sampling activities, where applicable, will follow the technical procedures established in the *Environmental Surveillance Procedures, Quality Control Program* (Kimbrough et al. 1990). All technical methods referenced in the subsequent sections, except where otherwise noted, are contained within the above-referenced document. Sample apportionments by medium are summarized in Table 7.1. Detailed summaries of maximum numbers of samples, quality assurance samples, and analytical methods are presented in Tables 7.2 through 7.4.

Table 7.1. Sample apportionment by medium

Media	Source	Location	No. of samples	Frequency	Analysis	Rationale
Soils	Soil borings	SY-200 and RSA	249	Once	Metals, radiological VOCs, semivolatiles, PCBs, asbestos (SY-200)	Define nature and extent of contamination at RSA and SY-200 and supplement groundwater contamination determination at SA-1
	Seeps	Seep-1, Seep-n	1 per seep	One wet weather		
Groundwater	Monitoring well and piezometers	P1, P2, and SY-200	1 per well	Once	Metals, radiological, VOCs, semivolatiles, PCBs	Define the contribution of OU 2 sites to groundwater contamination
Surface water	Stream	SS1 through SS9	9	One storm event	Metals, radiological, VOCs, semivolatiles, PCBs, total petrol hydrocarbons (TPH)[a]	Define the contribution of OU 2 sites to Bear Creek contamination
Sediment	Stream	SS1 through SS9	9	One storm event	Metals, radiological, VOCs, semivolatiles, PCBs, TPH	Define the contribution of OU 2 sites to Bear Creek contamination

[a]TPH analyses for RSA only.

Table 7.2. Numbers of samples and quality control for water samples

Medium	Parameter	Number of sites	Number of sampling events	Number of samples	QC samples: Duplicates[a]	QC samples: Trip blanks[b]	QC samples: Field blanks[c]	QC samples: Equipment rinsate blanks[d]	Total samples
Surface water[e,f]	Metals[g]	9	1	18	2		1	1	22
	Radiologicals[g]	9	1	18	2		1	1	22
	Gross alpha								
	Gross beta								
	Isotopic uranium								
	Volatiles	9	1	9	1	2	1	1	14
	Semivolatiles	9	1	9	1		1	1	12
	PCBs/pesticides	9	1	9	1		1	1	12
	Anions	9	1	9	1		1	1	12
	Sulfate								
	Fluoride								
	Nitrate								
	Chloride								
	Cyanide								
	Miscellaneous	9	1	9	1				10
	Alkalinity								
	Total suspended solids								
	Total dissolved solids								
	pH								
	Specific conductance								
	Turbidity								
Groundwater[e,f,g]	Metals[h]	8	1	16	1		1	1	19
	Radiologicals[h]	8	1	16	1		1	1	19
	Gross alpha								
	Gross beta								
	Isotopic uranium								

Table 7.2 (continued)

Medium	Parameter	Number of sites	Number of sampling events	Number of samples	QC samples: Duplicates[a]	Trip blanks[b]	Field blanks[c]	Equipment rinsate blanks[d]	Total samples
	<u>Volatiles</u>	8	1	8	1	1	1	1	12
	<u>Semivolatiles</u>	8	1	8	1		1	1	11
	<u>PCBs/pesticides</u>	8	1	8	1		1	1	11
	<u>Anions</u>	8	1	8	1		1	1	11
	Sulfate								
	Fluoride								
	Nitrate								
	Chloride								
	Cyanide								
	<u>Miscellaneous</u>	8	1	8	1				9
	Alkalinity								
	Total suspended solids								
	Total dissolved solids								
	pH								
	Specific conductance								
	Turbidity								

[a]Minimum 10% of field samples, groundwater samples are critical.
[b]One trip blank per cooler, one set of samples per cooler.
[c]One field blank per day per sampling event.
[d]One per piece of equipment used per day.
[e]See Table 7.4 for analytical methods and reporting detection limit.
[f]One storm event sampling only for surface water, minimum of two quarterly samples for groundwater.
[g]Includes samples from five wells/piezometers and three (assumed) seeps.
[h]Both filtered and unfiltered samples will be collected.

Table 7.3. Numbers of samples (maximum) and quality control for sediment and soil sampling

					QC samples				
Medium	Parameter	Number of sites	Number of sampling events	Number of samples	Duplicates[a]	Trip blanks[b]	Field blanks[c]	Equipment rinsate blanks[d]	Total samples
Sediment[e]	Metals	9	1	9	1		1	1	12
	Radiologicals Gross alpha Gross beta Isotopic uranium	9	1	9	1		1	1	12
	Volatiles	9	1	9	1	1	1	1	13
	Semivolatiles	9	1	9	1		1	1	12
	PCBs/Pesticides	9	1	9	1		1	1	12
	TPH (RSA only)	3	1	3	1		1	1	6
Soil[e]	Metals	61	1	249	25		28	28	330
	Anions Cyanide	27	1	113	11		28	28	180
	Radiologicals Gross alpha Gross beta Isotopic uranium	61	1	249	25		28	28	330
	Volatiles	27	1	113	1	28	28	28	236
	Semivolatiles	27	1	113	1		28	28	180

Table 7.3 (continued)

Medium	Parameter	Number of sites	Number of sampling events	Number of samples	QC samples: Duplicates[a]	QC samples: Trip blanks[b]	QC samples: Field blanks[c]	QC samples: Equipment rinsate blanks[d]	Total samples
	PCBs/pesticides	61	1	249	25		28	28	330
	Asbestos (SY-200)	22	1	88	8				96

[a]Minimum of 10% of field samples.
[b]One trip blank per cooler; one set of samples per cooler.
[c]One field blank per day per sampling event.
[d]One per piece of equipment used per day.
[e]See Table 7.4 for analytical methods and reporting detection limits.

Table 7.4. Proposed analytical parameters for surface water and groundwater and for soil and sediment samples during RI at Bear Creek OU 2

Parameter	Method[a,b]
Surface water and groundwater	
CLP metals	SOW 3/90
Total	
Dissolved	
Atomic absorption spectroscopy (AAS) metals	SOW 3/90
Chromium	
Cadmium	
Lead	
Mercury	
CLP volatile organics	SOW 3/90
CLP semivolatile organics	SOW 3/90
CLP polychlorinated biphenyls (PCBs)/pesticides	SOW 3/90
Anions	
Chloride	300.0[c]
Cyanide	SOW 3/90
Nitrate	300.0[c]
Sulfate	300.0[c]
Fluoride	340.2[c]
Radiologicals	
Gross alpha	9310
Gross beta	9310
Isotopic uranium	TP183708[d]
Miscellaneous	
pH	9040
Specific conductance	9050
Total suspended solids (TSS)	160.2[c]
Total dissolved solids (TSD)	160.1[c]
Alkalinity	310.1[c]
Turbidity	180.1[c]
Total petroleum hydrocarbons (TPH)	418.1[c]
Soil and sediment	
CLP metals	SOW 3/90
AAS metals	SOW 3/90
Chromium	
Cadmium	
Lead	
Mercury	
CLP volatile organics	SOW 3/90

Table 7.4 (continued)

Parameter	Method[a,b]
CLP semivolatile organics	SOW 3/90
CLP PCBs/pesticides	SOW 3/90
CLP cyanide	SOW 3/90
Radiologicals	
Gross alpha	9310
Gross beta	9310
Isotopic uranium	TP183708[d]
Asbestos	Y/P65-8540[e]

[a]The methods cited, unless otherwise indicated, are from *Statement of Work for Organic/Inorganic Analysis, Multi-Media, Multi-Concentration* (SOW 3/90) (EPA 1990d), and *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1986).
[b]The detection limits presented for CLP methods represent those established by the laboratory for the analytical method indicated. See Appendix B for CLP detection limits.
[c]EPA 1979b.
[d]Total uranium analyses will be compared with gross alpha analyses to determine whether additional isotopic analyses should be performed.
[e]Asbestos in Bulk Material Samples by Polarized Light Microscopy, based on NIOSH Method No. 9002 (NIOSH 1989).

7.2.1 Soils

The soil-sampling activities include the installation of soil borings and the collection of composite soil samples from discrete intervals using split-spoon samplers. The composite soil samples will be collected in accordance with the guidelines specified in methods ESP-303-4, ESP-303-5, and ESP-308-1. Soil samples will be put in containers, preserved, and handled in accordance with methods ESP-400, ESP-701, and ESP-800. During the sampling event all soils will be screened for potential organic and radiological contamination following the guidelines established in methods ESP-307-6 and ESP-307-7. After each sample-collecting device is used during the sampling event, it will be decontaminated in accordance with method ESP-900 prior to its next use to prevent the potential for cross-contamination of samples.

All sampling and drilling equipment will be decontaminated according to the procedures detailed in method ESP-901.

7.2.2 Groundwater

The field sampling plan includes the installation of wells and piezometers to further evaluate the water table level at OU 2, and the collection of water table samples for characterization purposes. The piezometers will be installed and modified for groundwater sampling in accordance with method ESP-600. Prior to the installation of each piezometer and the initiation of each groundwater sampling event, all equipment, piezometer materials, and sampling devices will be decontaminated in compliance with ESP-900 and ESP-901. The piezometers will be developed, purged, and sampled in compliance with the guidelines specified in ESP-302-2 and ESP-302-3. All groundwater samples collected will be put into containers, preserved, and handled in accordance with ESP-400, ESP-701, and ESP-800. Water level measurements recorded from the piezometers will follow the guidance specified in ESP-302-1.

7.2.3 Surface Water/Sediments

Surface water and sediment samples will be collected at several locations at OU 2. It is anticipated that several surface water samples will have to be collected in association with a storm event because of the intermittent flow nature at some sampling locations. Surface water samples taken during storm events will be collected, as applicable, in accordance with ESP-301-1.

Surface sediment samples will be collected, as applicable, using the guidelines detailed in methods ESP-303-2 and ESP-304-1. These methods provide guidance for surface sediment/ soil samples collected at dry locations and sediment samples collected from stream beds respectively. It is anticipated that the sediment samples collected will be composited in accordance with method ESP-308-1.

Prior to each surface water and sampling event, all sampling equipment will be decontaminated following the guidelines established in methods ESP-900 and ESP-901. All samples collected will be put into containers, preserved, and handled in accordance with methods ESP-400, ESP-701, and ESP-800.

7.3 SAMPLE TRACKING AND RECORDS MANAGEMENT

The proper sample tracking and records management of technical data are critical to the overall success of this RI because (1) the data are important in determining potential environmental and human health effects, (2) the data must be legally defensible, and (3) the data collection and analysis costs are high. The key to ensuring that these activities are properly carried out is to use proper records and data management procedures that will allow complete auditability and traceability of the data.

7.3.1 Objectives

The objective of an effective sample tracking and records management program is to ensure auditable and accurate transmission of information from the RI field sampling activities through the analytical laboratory analyses to its end use in the analysis, risk assessment, and production of the RI reports. This objective will be met by using existing records management plans, information management procedures, and data base management systems.

7.3.2 Roles and Responsibilities

A Data Management Coordinator (DMC) will be designated by the RI project manager. The DMC responsibilities will be to acquire, store, validate, analyze, and report all field and analytical data collected in the performance of the RI. In addition, the DMC will acquire, store, analyze and report validated data from the appropriate Y-12 environmental data bases (e.g., groundwater, surface water, sediment). DMC will be supported by a computer programmer, records manager, and data entry clerk.

The RI Field Team Leader (FTL) will be responsible for the delivery to DMC of paper copies of all field information (e.g., field results, copies of field logbooks, and field notes). The RI project manager will be responsible for laboratory information (e.g., analytical results, blanks, surrogates, and detection limits) required for inclusion in the RI report or as supporting documentation. If electronic versions of this information are also available, FTL will work with DMC to facilitate the electronic transfer of the data.

7.3.3 Data Tracking

Before mobilizing the field sample collection personnel, all technical information contained in this RI plan (i.e., sample location, sample identification codes, chemical parameters to be collected, field measurements to be taken, and chain-of-custody details) will be entered by a data entry clerk into a presampling data base. DMC will then use this data base to preprint sample labels, sample tags, and field sampling logbook pages. The data base will also be used to track the sample and sample results as they are returned by the field teams and analytical laboratories.

The field data collected by the field team will include field sample information, details on field conditions, field instrument measurements, and any deviations from prescribed plans or procedures. FTL will send to DMC all required data packages (consisting of copies of field results, field logbooks, and field notes) on the schedule specified in the RI plan.

The data received from the analytical laboratory will include the results from routine field samples, field QA/QC samples, laboratory QA/QC samples, and any data flags placed on the results by the laboratory analysts to explain any deviations from prescribed procedures or methods. FTL will send to DMC all required data packages (consisting of copies of analytical data results, QC documentation, and lab notes) on the schedule specified in the plan.

DMC will track and reconcile both the field data packages and analytical data packages received from FTL against the presampling data base to ensure that all planned sample collection activities were performed and documented. At the beginning of each week, DMC will review for content and completeness all data packages received from FTL the previous sampling period. If the individual data packages are complete and arrive on schedule, DMC will enter the final receipt date into the presampling data base and enter a "C" into the acceptance field for "complete." If, on review, DMC determines that the data package was incomplete, DMC will enter the initial receipt date into the presampling data base and enter an "I" into the acceptance field for "incomplete." If the expected data package was not delivered on schedule (as detailed in the RFI plan), DMC will leave the initial receipt date, final receipt date, and acceptance field blank.

For both incomplete data packages and missing data packages, DMC will contact the FTL verbally (with a backup written record of communication) to determine the status of the missing information. After the missing data have been located and transferred to DMC, or the issue has been resolved to the satisfaction of FTL and DMC, a Memorandum to File will be filed explaining the problem, the process taken to resolve the problem, and the final resolution by DMC. After the entire data package has been received, reviewed, and approved, DMC will enter the final receipt date into the presampling data base and enter a "C" into the acceptance field for "complete."

7.3.4 Sample Coding Procedures

A common sample coding and data structure format (Figure 7.4) has been developed for the storage and retrieval of the field sampling and laboratory analysis data. The sample coding format used will be compatible with Energy Systems' Consolidated Data Base (CDB) for environmental compliance and restoration data.

7.3.5 Completion of Field and Laboratory Records

The field sampling data to be included in CDB will consist of (1) details on field conditions; (2) field instrument measurements; and (3) task team activity logs, including chain-of-custody information, deviations from plan, QA concerns, and any noteworthy observations. The data collected by the field sampling team will be entered into a personal computer (PC) by a data entry operator using the verified field forms following Energy Systems procedures for data entry. All chain-of-custody documentation will be filled out in accordance with *Energy Systems Chain-of-Custody Procedure* ESP-500 (January 31, 1990, Rev. 1) (Kimbrough et al. 1990). All data will be entered twice, and the resulting files will be compared. Changes will be iterated until the final correct file is produced. The actual field measurements, field observations, deviations from the sampling plan, and task team activity logs will be included in the data bases. All field information will then be transferred from the PC to a Statistical Analysis System (SAS) data base for the ER Division, which resides on a VAX computer. Paper copies of all field data will be indexed, cataloged, and placed in the project file following appropriate Energy Systems Records Management Procedures.

The analytical laboratory data collected for this study will include (1) sample management and tracking data; (2) sample custody documentation; (3) analytical results from the field samples; (4) analytical results from the field QA/QC samples (duplicates, trip, equipment, and field blanks); (5) analytical results from the laboratory QA/QC samples (e.g., spikes, duplicates, surrogates, and calibrations). Data from the analytical laboratories will be transferred electronically from a PC floppy disk prepared by the analytical laboratory to an SAS ER Division data base on the VAX computer. The analytical laboratory will have the responsibility for verifying the electronic data before release. Paper copies of all analytical data including QA forms will be indexed, cataloged, and placed in the project file.

SAIC *301 Laboratory Road, Oak Ridge, Tennessee 37831*

Sample No.: ____________ Project No: ____________

Location: ____________

Station: ____________

Sample Media: ____________

Sample Type: ____________

Analysis: ____________

Preservative: ____________ Volume: ____________

Rad Screen: ____________ Units: ____________

Sample Date/Time ____/____/____ ____________

Comments: ____________

____________ Collector's Initials: ____________

Position 1:	Site Location A-SA-1 B-SY-200 C-RSA	Position 3 to 4:	Sample Location Numbers 01-99
Position 2:	Sample Type 1-Soil 2-Sediment 3-Groundwater 4-Surface water	Position 5 to 6:	Sample Interval 00-Groundwater 01-Surface water 02-Sediment 05 to 20-Soil (depth in ft)

EXAMPLE: B30500

A groundwater sample would be taken from location 5 in the SY-200 area.

Fig. 7.4. Sample label and identification structure.

7.3.6 Data Management

Data backup activities are the responsibility of DMC. All data files that have been updated during the day will be copied to backup files on floppy disk or tape the same evening following Energy Systems procedures for data backup. On a weekly basis, all data files will be copied to backup files on floppy disk or tape and stored on site in a fireproof safe. Each month, all data files will be copied to backup files on floppy disks or tape and will be stored in a secure, off-site location. All data bases will be archived yearly in tape format.

The data received from the field activities and the analytical laboratory will initially be stored in an unvalidated data base. After the data have passed through validation procedures, they will be updated and stored in the validated data base. All subsequent summaries, statistical analyses, and reports will be generated from the data contained in the validated data base. All validation activities will follow Energy Systems procedures for data validation and correction.

After the data have been stored in the appropriate consolidated data base files, DMC will perform an internal data consistency check. This check will involve the use of data validation programs designed for sorting the data and comparing the data identifiers with one another to determine whether data are missing, mislabeled, or duplicated because of data transcription or data transmittal errors.

Manual data checks will then be performed to verify data entry accuracy, compare data values with field notes, and compare questionable data values with data previously collected at or near the same sampling or measurement location. Data flags that qualify data values will be set as required. The accuracy and precision of the data will be determined by evaluating the trip blanks, field blanks, equipment blanks, and replicate field and laboratory samples.

All data determined to be incorrect using the previously described procedures will be reconciled. DMC will perform all data reconciliation activities with accompanying error correction logs, document control, and data base update methods following Energy Systems data validation and correction procedures. Any changes to the data base from its receipt from the analytical laboratory or the field to its final form will be documented. All verified data inconsistencies will be corrected by recording information into an error correction log and updating the data base with the correct value. A log of program changes will be kept in an SAS program audit file. All changes will be annotated in the program audit file with reasons stating why changes were made. This log will specify the sample identification number, the field to be corrected, the incorrect value, the correct value, the reason for the change, and the last name of the responsible person.

After the data have passed through the verification and validation procedures, they will be updated and stored in a "validated" data base. All subsequent summaries, analyses, and reports will be generated from the data contained in the validated data base.

7.4 PROJECT DESCRIPTION

BCV OU 2 comprises two construction spoil areas (RSA and SA-1) and an equipment storage yard (SY-200) located just beyond the west end of the Y-12 Plant facilities. Previous investigations at the individual sites have identified contaminants (e.g., metals, VOCs, semivolatile organics, radionuclides) in the soils and groundwater. This project is designed to more fully characterize the nature and extent of contaminants associated with the OU and, in doing so, provide data for the subsequent risk assessment and remedial alternatives evaluation.

7.5 PROJECT ORGANIZATION

The BCV OU 2 RI project organization is illustrated in Fig. 7.5.

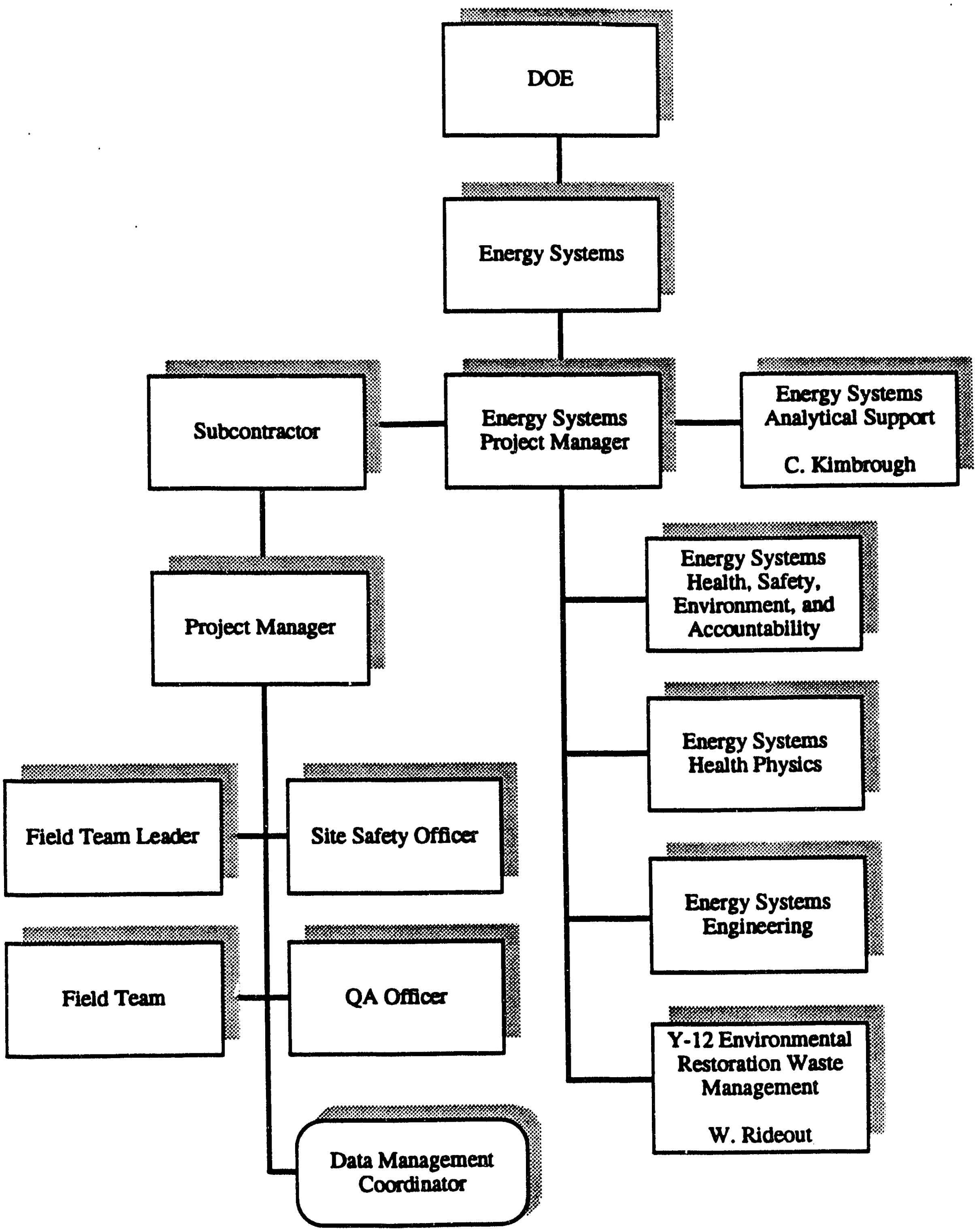

Fig. 7.5. BCV OU 2 RI functional organization chart.

Environmental Restoration Program
Field Quality Assurance Project Plan (QAP$_j$P)
for
Bear Creek Valley Operable Unit 2

Revision 2

February 1993

Technical Support Contractor Program Manager — Date: 2/19/93

Technical Support Contractor Quality Assurance/Quality Control Officer Concurrence — Date: 2/23/93

DOE-ER Division Program Manager — Date: 2/23/92

DOE-ER Division QA Program Manager — Date: 2/23/92

Energy Systems ER Site Program Manager — Date: 2/19/93

Energy Systems ER Site Project Manager — Date: 2/19/93

Energy Systems ER Site Quality Assurance Specialist — Date: 2/19/93

8. FIELD QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) has been developed for use in the site preparation and sample collection activities during the RI for OU 2 to ensure that appropriate levels of QA and QC are achieved. This QAPP defines procedures that will be followed in the collection, custody, and handling of data used in the RI for OU 2. These procedures are intended to define the methods applied to achieve the DQOs established for the OU 2 project.

This QAPP establishes QA requirements and responsibilities applicable to project participants and establishes methods through which project participants implement the requirements of the project. Where no appropriate procedure exists, this QAPP requires that one be developed by one or more cognizant individuals or organizations. At this time, the details of roles and responsibilities have not been assigned to specific individuals or organizations. When assignments are made, the QAPP will be revised.

This QAPP is designed to comply with both the EPA Quality Assurance Management Staff (QAMS) *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA 1980) and the American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) NQA-1 guidelines and the Environmental Restoration Division Quality Assurance Program Plan (Energy Systems 1991).

Table 8.1 provides a guide to the location of all relevant QA elements in this work plan.

8.1 QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT

8.1.1 Project Objectives and Intended Data Usages

The objectives for OU 2 are detailed in Sect. 1.6 of this work plan.

Soil and water samples will be collected and analyzed for the constituents shown in Tables 7.4 and 7.5 in Sect. 7.2. Data collected from the OU 2 stations will be evaluated to determine the need for additional long-term monitoring and will be reviewed for concentrations of contaminants greater than health and environmental criteria given by regulatory agencies. Specific sampling locations, including maps, and sample collection methodology are discussed in more detail in the FSP.

The purpose of this section is to implement applicable regulatory requirements and to provide internal control and review so the data are scientifically sound and legally defensible.

QA objectives for data are as follows:

- scientific data generated will withstand scientific scrutiny;

Table 8.1. Cross reference of EPA QAMS 005/80 and ES/ER/TM-4/R1 elements with OU 2 RI work plan sections

EPA QAMS 005/80	ES/ER/TM-4/R1 element	Location in RI work plan
1. Title Page	6. Document Control	Title Page, Sects. 8, 9
2. Table of Contents	6. Document Control	Table of Contents
3. Project Description	2. QA Program 6. Document Control	Executive Summary
4. Project Organization and Responsibility	1. Organization	Sect. 7.5
5. QA Objectives	3. Design Control	Sects. 8.1, 9.1
6. Sampling Procedures	3. Design Control 6. Document Control 9. Control of Processes	Sects. 8.2, 9.2, 8.6
7. Sample Custody	6. Document Control 13. Handling, Storage, and Shipping	Sects. 8.3, 9.4
8. Calibration Procedures and Frequency	8. Identification and Control of Items 12. Control of Measuring and Test Equipment	Sects. 8.4, 9.5
9. Anayltical Procedures	9. Control of Processes	Sect. 9.3
10. Data Reduction, Validation, and Reporting	9. Control of Processes	Sects. 8.7, 9.7
11. Internal QC Checks	3. Design Control	Sects. 8.8, 9.8
12. Performance and System Audits	18. Audits and Surveillance	Sects. 8.9, 9.9
13. Preventive Maintenance	12. Control of Measuring and Test Equipment	Sects. 8.5, 9.6
14. Specific Routine Procedures Used to Assess Data Precision, Accuracy, Representativeness, Completeness, and Comparability	3. Design Control	Sects. 8.10, 9.10
15. Corrective Actions	15. Control of Nonconforming Items	Sects. 8.11, 9.11
16. QA Reports to Management	2. QA Program 16. Corrective Action	Sects. 8.12, 9.12

- data will be gathered using appropriate procedures for field sampling, chain of custody, laboratory analyses, and data reporting; and
- data will be of known precision and accuracy.

The procedures to be used for assessing the quality of field data are described in Sect. 8.8.

8.1.2 Level of Analysis

The specific QA objectives for all data are to obtain reproducible, precise, and accurate measurements consistent with the intended use of the data and the limitations of the sampling procedures used. These objectives are accomplished through the assignment of measurement tasks to the appropriate analytical level (I through IV) as defined in *Data Quality Objectives for Remedial Response Activities* (EPA 1987). Field data, such as those collected during organic vapor and radiation monitoring, will meet the requirements for Level I data quality. Laboratory data will meet the requirements for Level III data quality.

8.1.3 Data Quality Parameters

Typical quantitative limits applicable to this project are presented in the EPA Contract Laboratory Program (CLP) statements of work (SOW) (EPA 1990d) as applicable, as are sample precision, accuracy, and completeness objectives. The QA objectives for QC data are designed to (1) screen out data of unacceptable precision or accuracy and (2) provide data that will meet the data quality goals for this project.

This project will follow the definitions for precision, accuracy, completeness, comparability, and sensitivity given in the *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA 1979a).

8.1.4 Field Activities

Precision between monitoring instruments is determined by comparison of readings during calibration to a standard. Precision in sampling is measured through the use of field duplicates.

Accuracy is addressed by the use of standard criteria for container and equipment cleaning, sample collection, personnel training and performance criteria, uniform sample handling techniques, and blanks to detect contamination.

Representativeness of samples collected is controlled through adherence to the sampling plan and to detailed descriptions of sampling procedures, which will be included in the final OU 2 Field Sampling and Analysis (S&A) Plan.

The QA completeness objective for this project is to obtain valid analytical results for at least 85% of the samples collected during the project. This means that completeness of sample collection (number planned vs number collected for which valid data can be obtained) must be essentially 100% to allow for some laboratory wastage. Accountability of samples collected, from field to final disposal, must be 100% complete.

Objectives for comparability between samples collected for this and other RIs are met by the following: (1) narrowly defined sampling methodologies; (2) site surveillance, use of standard sampling devices, and monitoring devices; (3) training of personnel; (4) documentation of sampling point; (5) stringent control limits for the daily QC checks; (6) reporting results in appropriate, comparable units; and (7) standard analytical methods.

Staff responsible for particular instruments must maintain a log of calibration procedures and results to remain with the instrument as a means of establishing a record of calibration. The Sampling Team Leaders will inspect such logs, which will become part of the project records. Each operator must be trained in the proper use of the instrument, be familiar with the instrument's use, and be able to interpret data from the instrument properly.

8.1.5 Readiness Review

Before mobilizing for the field effort, a readiness review is led by the QA Officer and is attended, at a minimum, by the Project Manager, key field team members, Contracts Manager, and Health and Safety Officer. The readiness review follows a checklist (Fig. 8.1) that ensures that all proper work plans and standard operating procedures are approved and controlled; all assigned personnel are trained; the drilling subcontractor is available to begin with qualified personnel, materials, and equipment; the site logistics have been handled; the laboratory is ready to accept samples; and the QA system is implemented on the field activity.

8.2 SAMPLE COLLECTION PROCEDURES

8.2.1 Field Procedures

Field procedures for the collection of samples are discussed in the S&A Plan. The equipment and the techniques that will be employed to obtain representative samples will be in accordance with approved Environmental Surveillance Procedures ESP-300 series, (Kimbrough et al. 1990).

8.2.2 Sampling Program

Soil and water samples will be collected at OU 2 for the RI investigation. Table 7.1 summarizes the sampling/monitoring locations and media. Tables 7.2 and 7.3 show the numbers of samples to be collected, the number of analyses estimated to be conducted, and the field quality control samples to be collected and sent to the analytical laboratory.

Project: ____

Site: ____

I. DOCUMENTATION

A. Are all the appropriate documents for the Project in their final, approved form? [(Work Plan, Field Sampling and Analysis Plan, QA Project Plan, Health and Safety Plan, Others (specify)]:
Yes_____ No_____ N/A_____ Comments:______________________________

B. Are copies of the approved documents (above) in the hands of the Subcontractors Project Management, assigned field personnel, and Analytical Laboratory personnel?
Yes_____ No_____ N/A_____ Comments:______________________________

C. Are applicable forms available and current with contract specifications? (Well Construction Log, Groundwater/Surface Water/Sediment Sampling Form, Field Change Request Form, etc.)
Yes_____ No_____ N/A_____ Comments:______________________________

II. STANDARD OPERATING PROCEDURES

A. Have Standard Operating Procedures (SOPs) been prepared and approved for all field activities identified in the Field Sampling and Analysis Plan, QA Project Plan, and the Health and Safety Plan?
Yes_____ No_____ N/A_____ Comments:______________________________

B. Do the Subcontractor's assigned field personnel and the selected analytical laboratory personnel have copies of, and have they been trained on, the SOPs that govern their work assignments? (Attach documentation of dates and subjects of training and names of personnel attending.)
Yes_____ No_____ N/A_____ Comments:______________________________

C. Are the appropriate documents (See I.A) on-site and available to the field personnel?
Yes_____ No_____ N/A_____ Comments:______________________________

D. Are required site and field logbooks and field personnel information available?
Yes_____ No_____ N/A_____ Comments:______________________________

E. Are the site and field logbooks of the appropriate type and construction?
Yes_____ No_____ N/A_____ Comments:______________________________

F. Are chain-of-custody forms required and have the field personnel been fully trained in the proper documentation for using and completing these forms?
Yes_____ No_____ N/A_____ Comments:______________________________

Fig. 8.1. Readiness review checklist.

III. PERSONNEL AND TRAINING

A. Have an appropriate number of personnel with the appropriate speciality training been assigned to this project to ensure appropriate and consistent results? (Attach roster of personnel and brief description of qualifications.)
Yes_____ No_____ N/A_____ Comments:_____

B. Is there documented evidence that the assigned field personnel have been adequately trained in the specifics of this project, such as field sampling methods, to accomplish their tasks?
Yes_____ No_____ N/A_____ Comments:_____

C. Is there documented evidence and or training certificates that the field personnel have been adequately trained in the Health and Safety requirements? (OSHA 40-hour training, medical records, site-specific H&S training, CPR, and first aid)
Yes_____ No_____ N/A_____ Comments:_____

D. Has chain of command from field operations to management been defined and communicated to all personnel?
Yes_____ No_____ N/A_____ Comments:_____

E. Is there backup personnel properly trained and available?
Yes_____ No_____ N/A_____ Comments:_____

F. Have personnel been trained in DOE Order 5000.3A?
Yes_____ No_____ N/A_____ Comments:_____

IV. MATERIALS AND EQUIPMENT

A. Is the drilling company ready to begin work with the appropriate equipment and personnel for this project? Are there backup pieces of key equipment available? (Attach list of equipment and personnel assigned to this project.)
Yes_____ No_____ N/A_____ Comments:_____

B. Have the qualifications of the drilling company personnel been verified? (Attach verification documentation.)
Yes_____ No_____ N/A_____ Comments:_____

C. Have the materials for well construction been verified to meet the specifications of the Statement of Work (SOW) and the Field Sampling and Analysis Plan?
Yes_____ No_____ N/A_____ Comments:_____

D. Have well materials (such as bentonite, gel and sand packs) been analyzed and certified analyte free? If not analyte free, has material background been analyzed and documented? (Attach certification or analysis documentation.)
Yes_____ No _____ N/A_____ Comments:_____

E. Have the necessary instruments/measurement equipment and associated calibration devices been assembled on-site to conduct the specified tests and analyses for this job? Is all the equipment currently in calibration? Please attach list of all equipment used on the project with measurement and calibration documentation for each piece. Ensure initial calibration logs for each piece of equipment are in the appropriate log books.
Yes_____ No_____ N/A_____ Comments:_____

Fig. 8.1 (continued)

F. Have all necessary materials and equipment been assembled to correctly collect, identify, preserve, and transport the types and number of samples to be taken for this job? (Attach a list of the type and quantity of materials/equipment available for this project.)
Yes_____ No_____ N/A_____ Comments:______________________________

G. Have all the necessary types of personnel protection and decontamination equipment (clothing, breathing apparatus, respirators, face masks, gloves, plastic sheeting, plastic baggies, spare compressed air bottles, boots, decontamination gear, etc.) been assembled and made ready for this job? (Attach a list of the types and quantities of equipment available for this project.)
Yes_____ No_____ N/A_____ Comments:______________________________

H. Has the Health and Safety Officer been identified? Have all site personnel received H&S training? Has H&S Officer verified that all health and safety precautions can be implemented? (Attach documentation of dates and subjects of training and names of personnel attending.)
Yes_____ No_____ N/A_____ Comments:______________________________

I. Have all materials and pieces of equipment (communication devices, drinking water, first aid kits, etc.) been assembled to meet the requirements of the Health and Safety Plan?
Yes_____ No_____ N/A_____ Comments:______________________________

J. Have all required interfacing arrangements (telephone numbers, site contacts, emergency signals, medical response team, etc.) been made and tested satisfactorily?
Yes_____ No_____ N/A_____ Comments:______________________________

V. SITE LOGISTICS

A. Have clearances been obtained for all job-site personnel? Is the site security organization aware of the project, the scope of activities to be accomplished, and the estimated duration of the project?
Yes_____ No_____ N/A_____ Comments:______________________________

B. Have all drilling permits/clearances been granted or a schedule established for obtaining them? Have permits/clearances been obtained for any radioactive materials to be taken on-site? (Attach permits or schedules as appropriate.)
Yes_____ No_____ N/A_____ Comments:______________________________

C. Have the appropriate site commands/facilities/functions been informed of the activities and potential interfaces in their work areas?
Yes_____ No_____ N/A_____ Comments:______________________________

D. Have arrangements been made for the disposal of drill cuttings, refuse, contaminated materials, rinsate, etc.?
Yes_____ No_____ N/A_____ Comments:______________________________

E. Have arrangements been made for the location of field laboratories (phone, electricity, etc.) and storage facilities for bottles, samples, solvents, and sampling equipment?
Yes_____ No_____ N/A_____ Comments:______________________________

Fig. 8.1 (continued)

VI. LABORATORY LOGISTICS

A. Has a contract-approved laboratory been selected and been made aware of the data quality objectives and the anticipated schedule of project activities? Have laboratory personnel been advised of any unusual requirements or circumstances? (Indicate name and address of primary laboratory.)
Yes_____ No_____ N/A_____ Comments:_______________________________

B. Has the selected laboratory been notified when sampling will begin, the projected volume of samples, the types of samples, and when samples should start arriving for analysis?
Yes_____ No_____ N/A_____ Comments:_______________________________

C. Has a secondary, backup laboratory been selected and approved in case of emergency situations? (Indicate name and address of backup laboratory.)
Yes_____ No_____ N/A_____ Comments:_______________________________

D. Has notification been made to the selected sample transportation company? Have arrangements been made to ensure that appropriate chain-of-custody and quality control requirements can be achieved? (Indicate name and address of transportation company.)
Yes_____ No_____ N/A_____ Comments:_______________________________

E. Are an appropriate number of the correct type(s) of sample containers available for the anticipated work? (Attach a list of the types and numbers of containers available for this project.)
Yes_____ No_____ N/A_____ Comments:_______________________________

VII. QUALITY ASSURANCE

A. Is a Quality Assurance Program being implemented?
Yes_____ No_____ N/A_____ Comments:_______________________________

B. Have arrangements been made to have QA audits and surveillances?
Yes_____ No_____ N/A_____ Comments:_______________________________

C. Do the various plans and manuals require a document control program? If yes, is this being implemented? (Supply the Document Control Coordinator name and address.)
Yes_____ No_____ N/A_____ Comments:_______________________________

D. Is there a system in place to identify, report, and evaluate any conditions adverse to quality?
Yes_____ No_____ N/A_____ Comments:_______________________________

ATTESTATION

By my signature, I do hereby attest, to the best of my knowledge and professional ability, that this Readiness Review Checklist accurately reflects the status of our Company to complete the authorized task(s) at ______________________________ (Base name or site) per Task Order ____ (Contract Task Order Number) scheduled to begin on ______________ (Date).

Fig. 8.1 (continued)

8.2.3 Sample Containers, Preservation, Transport, and Storage

Sample preservation, holding times, storage conditions, and container materials shall be in accordance with ESP-701 (Kimbrough et al. 1990). The procedures required to properly package containers of environmental samples for transportation are described in ESP-800 (Kimbrough et al. 1990).

8.2.4 Prevention of Cross Contamination

Sampling equipment will be decontaminated before use and between collection of each sample per ESP-900 (Kimbrough et al. 1990). Each decontamination activity will be recorded in the field logbook.

8.2.5 Decontamination of Equipment and Supplies

Decontamination of sample containers and sampling devices given in ESP-900 (Kimbrough et al. 1990) will be followed. Equipment used in field investigations—including well drilling equipment, soil sampling equipment, and field test equipment—will be decontaminated as described in ESP-901 (Kimbrough et al. 1990).

8.2.6 Field Documentation

An integral part of the QA/QC Plan for the field activities will be to maintain accurate and complete field records, including logbooks and appropriate field data forms. Field logbooks shall be hardcover with stitched bindings and water-resistant pages. Information identified in these records will be obtained from the site exploration and sampling activities and will be reviewed by the Sampling Team Leader. All information pertinent to field activities will be recorded. Entries in the logbooks or on the data forms will be made in water-resistant ink and will include the information given in ESP-500 Sect. VII, Part D (Kimbrough et al. 1990).

Appropriate field-generated data forms will be prepared based on the requirements in the QC Manual (Kimbrough et al. 1990).

8.2.7 Variance System

Procedures that properly anticipate all conditions encountered during a field sampling program cannot be prepared. Variances from approved operating procedures in the OU 2 RI Plan, S&A Plan, the QAPP, or the Health and Safety Plan will be documented in a field change request form (Fig. 8.2) and in the logbooks.

The Sampling Team Leader will initiate and chronologically maintain a variance or field change request log. A variance requires the approval of the OU 2 Project Manager and the QA specialist (QAS) before work proceeds. As appropriate, regulatory agencies will be notified of any variances that significantly affect project scope or objectives and approval will be obtained if needed. Any variances from the Health and Safety Plan must be approved by the Health and Safety Coordinator. Approval by the OU 2 Project Manager and QAS can

Revision Date: January 1989

FIELD CHANGE REQUEST FORM

Field Change No.______
Page_______ of ______

Project ______________________________

Project No. ______________________________

Applicable Document: ______________________________

Description:

____

____

____

Reason for change:

____

____

____

Recommended disposition:

____

____

____

Impact on present and completed work:

____

____

____

Final Disposition:

____

____

____

Requested by:
Field/Project Manager: ______________________________

Approvals:
Project Manager: ______________________________

Fig. 8.2. Field change request form.

be initiated verbally via the telephone or radio with follow-up sign-off. In no case will non-OU 2 project personnel initiate a variance. Copies of the field change request form will be maintained by sampling teams until the field work is complete and will then be forwarded to the OU 2 Project Manager and sent to the Document Management Center.

8.2.8 Sample Identification

The identification of samples will be established and maintained as specified by the chain-of-custody procedures described in ESP-500 (Kimbrough et al. 1990) and will be specifically described in the final S&A Plan (Sect. 7).

8.2.9 Shipping and Handling

Handling, shipping, and storage of samples and data resulting from field activities will adhere to custody (Sect. 8.3) and will ensure that sample integrity for analytical purpose is maintained. Specific shipping and handling procedures are described in ESP-800 (Kimbrough et al. 1990).

8.2.10 Sample Turnaround Time

Sample analyses will be scheduled according to site investigation needs and consistent with the sample holding times. The S&A Plan will specify the turnaround times that will meet the project schedule and objectives. These requirements shall be included in any contractual agreement between the OU 2 project and contract laboratories.

8.2.11 Field Data Management

Field records will be recorded legibly in permanent ink and will be sufficiently complete to permit reconstruction of data-gathering activities by a qualified individual (other than the originator) when data are reduced. Field notebook entries should be factual, detailed, and objective. The field records will be the basis for later written reports and all entries must be free of inappropriate terminology. The Sampling Team Leaders will collect and review field-generated data sheets daily for accuracy and completeness before being transferred to the Analytical Services Coordinator (ASC). Manual entry of field data will be coordinated by the ASC. Data entry clerks will enter field data into specified computer systems to facilitate retrieval by OU 2 personnel. Quality will be checked by double entry and verification of entered data. The OU 2 Project Manager will forward field notebooks to the Document Management Center at the conclusion of field activities.

8.3 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Chain-of-custody procedures require documented sample possession from the time of collection to disposal. Chain of custody shall be maintained in accordance with ESP-500 (Kimbrough et al. 1990). Additional details of document control are included in the *RCRA Facility Investigation Plan, General Document, Volume III: Data Management Plan* (Wiggins et al. 1988).

Sample custody will be initiated at the time of sample collection. Sample tags or other appropriate labels will be used to identify field samples with the following information: unique sample identification code, date and time of sampling, sampling location or station, preservation, analysis, and any additional comments that are applicable. Descriptions of sampling activities and sample identification data will also be recorded in a field notebook. Field chain-of-custody forms containing the same information will be completed for each set of samples. A line item on the sample chain-of-custody form will be completed for each sample, and the sampling technician will confirm (by signature) the completeness of the information on the form. Each individual who assumes responsibility for the samples will sign the chain-of-custody form.

Sample custody will be maintained by OU 2 staff until custody is transferred to an overnight express company. The overnight express company delivers samples and transfers custody to particular analytical laboratories, where their intralaboratory chain-of-custody procedures will be in effect. On completion of analyses, sample custody will be returned to OU 2 staff. Remaining samples may be archived for 1 year and disposed of as prescribed in ESP-1000 (Kimbrough et al. 1990). The chain-of-custody form terminates upon final disposal of the sample. The OU 2 Project Manager will be responsible for ensuring that the original chain-of-custody form is submitted to the Document Management Center.

8.3.1 Field Custody Procedures

Field custody procedures include the following steps:

- Before sampling begins, the QAS will instruct sampling personnel on the chain-of-custody and sample-labeling procedures, as necessary.
- A chain-of-custody record will be initiated in the field for each sample and will correspond to the sample identification label.
- Each time sample custody is transferred, the person relinquishing the sample and the new custodian will sign the record and note the date and time.
- The analyses to be performed for each sample will be recorded on a request-for-analysis form or on the chain-of-custody record.
- The Sampling Team Leader will confirm that proper custody procedures were used during the field work and that results were documented in the field logbook.
- Samples transferred to analytical laboratories are recorded in the field logbook at the end of the collection period.

8.3.2 Sample Labeling

Sample labels or tags will contain sufficient information to identify the sample in the absence of other documentation. The label or tag will be directly affixed to the sample container, will be completed with black indelible ink, and will include the following as a minimum:

- project name,
- unique sample number,
- sample location,
- sampling date and time,
- signature of individual collecting the sample, and
- preservation method employed.

In the event that samples arrive damaged or with custody seals broken, a Nonconformance Report (NCR) (Sect. 8.11) will be initiated. The Project Manager will be advised and will make a decision as to the fate of the nonconforming sample. The OU 2 Project Manager and the QAS will sign the NCR, noting the reason for sample disposition-and will initiate corrective actions if necessary.

Once samples are in the possession of the laboratory, their internal chain-of-custody and sample-handling procedures will be in effect (Sect. 9.4).

8.4 CALIBRATION PROCEDURES AND FREQUENCY

8.4.1 Instrument Calibration Procedures and Frequency

A list of all measuring and test equipment to be used, along with a schedule for calibration, will be prepared prior to initiating field work. In general, field calibration methods will be those recommended by the manufacturer. Instrument logbooks will be established.

Calibrated equipment will be uniquely identified by using either the manufacturer's serial number or other means. All equipment shall be categorized as one of the following:

- **Category A**—Casual devices and systems (rulers, tape measures, graduated cylinders, pipettes, etc.) that are not to be calibrated in service (i.e., not calibrated other than by the manufacturer).
- **Category B**—Routine devices and systems (balances, spectrophotometers, etc.) that are to be included in a calibration recall program on a regular cycle.
- **Category C**—Experimental devices and systems (pH meters, turbidimeters, etc.) that are to be calibrated by, or at the direction of, the user as deemed necessary. All pH

meters are calibrated in the field, at a minimum each morning and whenever the instrument is turned off. Calibration is also checked at the end of each day.

The appropriate category decal with the identification number and the due date of the next calibration will be attached to the equipment. If this identification is not possible, records traceable to the equipment will be readily available for reference.

8.4.2 Calibration Failures

Scheduled periodic calibration of equipment will not relieve field personnel of the responsibility to employ properly functioning equipment. If an individual suspects an equipment malfunction, he/she should remove the device from service, tag it so it is not inadvertently used, and notify project management. If equipment is found to be out of calibration, the Sampling Team Leader will evaluate and document (in the instrument logbook) the validity of previous inspection or test results and the acceptability of similar equipment previously inspected or tested. The responsible supervisor will ensure that the devices that are out of calibration are (1) tagged or segregated from other equipment and (2) disposed of or not used until they are calibrated. Any equipment that is consistently found to be out of calibration will be repaired or replaced. Any repair or replacement should be recorded in the instrument logbook.

All standards used for equipment calibration will be traceable to the EPA, the National Institute of Standards and Technology, or a commercially available certified standard. The source of the standard used must be documented in a calibration logbook.

8.4.3 Calibration Records

Calibration data will be recorded in the instrument logbook. Records will be prepared and maintained for each piece of calibrated equipment to indicate that established calibration procedures have been followed. The Sampling Team Leader will ensure that records of calibration data are kept current. Records for field equipment used will be maintained by the Sampling Team Leader and kept in the project files.

8.5 PREVENTIVE MAINTENANCE

Periodic preventive maintenance is required for all measuring and test equipment. Instrument manuals will be kept on file for reference purposes if equipment needs repair. Maintenance frequency will be based on manufacturer's recommendations, intended use, and experience. The troubleshooting section of factory manuals may be used to assist personnel in performing maintenance tasks. Routine maintenance will be performed on instruments to reduce the incidence of extensive repairs immediately prior to sampling and analysis.

8.5.1 Field Instruments

The frequency of preventive maintenance for field equipment is usually indicated in each operating instruction manual. Maintenance will be documented and maintained in permanent records by the individual responsible for each instrument. Critical spare parts will be identified and stocked to minimize equipment downtime and lost field sampling effort.

8.6 FIELD ANALYSES

All field measurements will follow the ESP-307 Series (Kimbrough et al. 1990) and will be recorded in the field logbooks or on specially designated data forms. All data will be directly entered in the field, signed, and dated. If entry changes are made, one line will be drawn through the error, and the change and explanation will be signed and dated in the notebook or on the data form. Changes made to original notes should not obliterate the original information. All field data records will be organized into standard format when possible. Team leaders are responsible for review of daily entries in the field logbooks.

8.7 DATA REDUCTION, VALIDATION, AND REPORTING

Data validation is a systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verifying, certifying, and reviewing.

All data for this project will be evaluated by QA/QC methods and internal peer review. Data reduction, verification, and reporting will be in accordance with the Data Management Plan (Wiggins et al. 1988). Data will be entered into common standardized formats. In addition to following field sampling documentation and QA/QC procedures, data are verified using a variety of computerized checks. These procedures will ensure that data are entered, encoded, and manipulated in a consistent way and are available to OU 2 investigators in a usable format.

8.7.1 Field Data Reduction and Evaluation

Data collected during field activities will be evaluated by checking the procedures used and comparing the data with previous measurements. The QA/QC Coordinator and Sampling Team Leaders will be responsible for checking field QC sample results to ensure that field measurement and sampling protocols have been observed. These reviews will check the following:

- date and time sampled,
- preservation,
- standard operating procedures,
- calibration method and frequency, and
- chain-of-custody documentation.

Reviewers are responsible for ensuring that data reduction calculations are documented and checked by qualified personnel.

Written reports that include reduced and summarized data will include the raw data in appendixes. Specific calculations used for data reduction will also be included.

8.8 FIELD QUALITY CONTROL SAMPLES

Field QC samples will be established to check sampling. Field QC samples will include blanks and replicates as follows:

Trip Blank—A trip blank, consisting of a sealed container of organic-free water, will travel from the field to the laboratory with the samples to be analyzed for the contaminant of concern. The trip blank identifies contamination that may have been contributed to the field samples during the transport (receives same treatment as sample containers). As a minimum, one trip blank will be prepared and transported with every packed cooler containing VOC samples.

Equipment Rinsate Blanks—An equipment rinsate blank consists of final rinse water from the decontamination of field sampling equipment. Analysis of the field rinsate determines if the decontamination procedure is adequate to avoid carryover of contamination from one sampling location to another and to ensure that samples are not being biased in any way by the equipment used to collect the sample. One equipment rinsate blank will be taken from each type of equipment used per sampling event or one blank for every 20 field samples collected.

Field Blank—Field blanks are samples of the source water, ASTM Type II, used in the decontamination and cleaning of equipment used in smaple collection. A field blank is a sample container filled with distilled, deionized water that is exposed during sampling and then analyzed to detect accidental or incidental contamination.

Duplicate Samples—Duplicate samples, which consist of a duplicate sample from one sampling location, indicate whether the field sampling technique is reproducible. A minimum of 10% of the samples taken per sampling event and per sample matrix (soil, surface water, etc.) will be duplicates. Duplicate samples will have discrete sample numbers and will be submitted as "blind" to the laboratories.

The quantities and collection procedures for each field QC sample type are specified in the Field Sampling Plan. Results of these samples will be included in the analytical data report. Results for QC samples will not be used to adjust the results obtained for original samples. If contaminants are found in blanks, attempts will be made to identify the source of contamination, and corrective action will be initiated in accordance with Sect. 8.11.

8.9 FIELD AUDITS AND SURVEILLANCES

Audits are performed to review and evaluate the adequacy of field performance and to ascertain whether the QA/QC Plan is being completely and uniformly implemented. The following requirements are adapted from basic requirement 18, "Audits," of ANSI/ASME NQA-1 (ANSI/ASME 1986), and *Environmental Restoration Division Quality Assurance Program Plan* (Energy Systems 1991b). Planned and scheduled audits will be performed to verify compliance with all aspects of the QA program and to determine the program's effectiveness. These audits will be conducted in accordance with written procedures and checklists and will be performed by personnel who do not have direct responsibility for performing the activities being audited. Audit results will be documented and will be reported to and reviewed by responsible management. Follow-up action will be taken by the responsible line organization when necessary.

The objectives of performance and systems audits are to (1) ensure that the QA program developed for this project is being implemented according to the specified requirements, (2) assess the effectiveness of the QA program, (3) identify nonconformances, and (4) verify that identified deficiencies are corrected. Upon discovery of any significant deviation from the QA program, the Project Manager will be informed of the nature, extent, and corrective action taken to remedy the deviation.

An individual audit plan will be developed to provide a basis for each audit. This plan will identify the audit scope, the activities to be audited, the audit personnel, any applicable documents, and the schedule. Records of audits will be maintained in the project files. Audit files will include—as a minimum—the Surveillance Report, the reply to audit, and any supporting documents. The OU 2 Project Manager is responsible for conforming to audit procedures, particularly as to timely replies to audit reports and implementation of such corrective action indicated.

8.9.1 Frequency of Audits

The QAS is responsible for internal audits and will perform them according to a schedule that coincides with appropriate activities on the project schedule and sampling plans. Such scheduled audits may be supplemented by additional audits for one or more of the following reasons:

- when significant changes are made in the QA/QC Plan,
- when it is necessary to verify that corrective action has been taken on a nonconformance reported in a previous audit, or
- when requested by the Project Manager.

In addition to these internal audits, surveillance of selected activities may be performed on a periodic basis.

8.9.2 Performance Audits

A performance audit can be defined as a review of the existing project and QC data to determine the accuracy of a total measurement system(s) or a component part of the system. The QAS or his designee will check the logging of samples, proper chain of custody, and related documentation. Any irregularities in QA procedures that are not immediately corrected will be brought to the attention of the OU 2 Project Manager.

8.9.3 Systems Audits

A systems audit consists of an evaluation to determine if the components of a measurement system were properly selected and are being used correctly. A systems audit includes a careful evaluation of field QC procedures to ensure that the QA/QC procedures are being adhered to. Systems audits are conducted as deemed necessary by the QAS, normally either before or shortly after systems are operational. The systems audit is reported in formal audit reports.

8.9.4 Field Surveillance

An individual surveillance plan will be developed to provide a basis for each field surveillance. This plan will identify the scope, activities, and personnel to be involved, any applicable documents, and the schedule for each field surveillance. Checklists may be prepared and used to conduct all surveillances. These checklists will be developed to accomplish the review of necessary items and to document the results of the surveillance.

Field surveillance will involve an on-site visit by the QAS or appropriate surveillance personnel. Items to be examined may include, but are not limited to, the availability and implementation of approved work procedures; calibration and operation of equipment; packaging, storage, and shipping of samples; documentation procedures and instructions; and documentation of nonconformances.

The records of field operations will be reviewed to verify that field-related activities were performed in accordance with standard procedures. Items reviewed may include, but are not limited to, calibration records of field equipment, daily field activity logbooks, chain-of-custody records, and data resulting from field operations.

During a surveillance and upon its completion, the surveillance personnel and the individuals surveyed will discuss the observations of deviations and will agree on corrective actions to be initiated. A surveillance report will be completed for each surveillance activity.

Minor administrative findings that can be resolved to the satisfaction of the surveillance personnel during a surveillance are not required to be cited as items requiring corrective action. Findings that are not resolved during the course of the surveillance and findings affecting the overall quality of the project will be noted on the checklists and included in the surveillance report.

8.10 DATA MEASUREMENT ASSESSMENT PROCEDURES

A statistical evaluation of laboratory analytical results will be performed to apply precision and accuracy criteria for each parameter analyzed. When the analysis of a sample set is completed, the QC data generated will be reviewed and evaluated by an organization other than the analytical laboratory to validate the data set. All QC data will be reported to the OU 2 Project Manager, along with the sample analysis results. The QC data will be reviewed for precision and accuracy.

8.10.1 Precision

Precision will be assessed by conducting separate analyses of duplicate samples. The level of precision is determined by calculating the relative percent difference (RPD) between the two measurements; thus,

$$RPD = \frac{(D_1 - D_2) \times 100}{(D_1 + D_2) / 2},$$

where D_1 = value of first measurement,
D_2 = value of second measurement.

8.10.2 Accuracy

Accuracy is achieved by the use of standard criteria for container and equipment cleaning, sample collection, personnel training and performance criteria, uniform sample handling techniques, and blanks to detect contamination.

8.11 CORRECTIVE ACTIONS

This section identifies methods and policies for the documentation, evaluation, corrective action, and verification activities necessary when a deviation from established procedure occurs. Requirements for the documentation and implementation of corrective actions are also included.

Any deviation or nonconformance will be evaluated with respect to its possible impact on reportable data. All deviations from standard operating procedures, equipment calibrations, or any aspect of the QA plan will be evaluated and documented. Significant deviations identified using the statistical assessment of quality data will also be used in Nonconformance and Corrective Action Procedures.

8.11.1 Responsibilities of Project Participants

OU 2 personnel will ensure the prompt identification, control, and disposition of nonconforming items. Each laboratory participant is responsible for submitting records of all nonconformance events to the appropriate Sampling Team Leader and/or the QAS within a reasonable period of time following the initial identification and documentation of the nonconformance. The nonconformance will then be evaluated by Team Leaders, QAS, Project Manager, and others as is deemed relevant. This evaluation will determine the disposition of the nonconformance.

8.11.2 Nonconformances and Corrective Action Procedures

Nonconforming equipment, items, activities, conditions, and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported in a timely manner. A nonconformance is defined as a malfunction, failure, deficiency, or deviation from specified requirements. The originator of an NCR will describe the finding on the form provided for this purpose and will notify the OU 2 project management and the QAS. Each nonconformance will be reviewed and a disposition given for the item, activity, or condition. Evaluations also will determine if the event justifies the issuance of a Corrective Action Report (CAR). The CAR will document the event, the findings of the evaluation, and the required corrective actions. The disposition of a nonconformance will be documented and approved by the OU 2 Project Manager. The QAS will concur with the disposition of the nonconformance.

The QA/QC Coordinator for a particular laboratory is responsible for the assessment of laboratory quality control sample information. If data fall outside accepted limits, established laboratory procedures for identifying the problem and taking appropriate corrective actions will be employed. Completion of corrective action should be evident when deviations return to prescribed acceptable limits.

The modification, repair, rework, or replacement of nonconforming equipment, items, or activities will require the reverification of acceptability. In certain instances, as determined by project management, these activities may require that corrective action be completed and verified before site work continues.

If, in the opinion of project management and the QAS, the nonconformance does not significantly affect the technical quality or use of the work, then the work may continue, pending resolution of the nonconformance. The basis for such a decision will be documented on the NCR and submitted to the QAS for review and approval. The documentation will include the statement that the decision was made before continuing with the work. The records of nonconformance and their dispositions will be maintained by the OU 2 Project Manager and forwarded to the Document Management Center.

8.12 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The active participation of management in the OU 2 Project is fundamental to the success of this QA/QC Plan. Management will be aware of project activities and will participate in development, review, and operation of the project. Management will be informed of QA status and activities through the receipt, review, and/or approval of the following:

- regular quality status reports,
- laboratory and project-specific QA/QC plans and procedures,
- postaudit reports and audit closures,
- surveillance reports,
- corrective action overdue notices, and
- NCRs.

Copies of these reports will be distributed to appropriate management and regulatory agencies. In addition, periodic assessment of QA/QC activities and data precision, accuracy, representativeness, completeness, and comparability will be conducted and reported by the analytical laboratories.

As appropriate, project management will inform the QAS of the QA status of the project, especially any significant quality accomplishments. OU 2 personnel are required to inform the Project Manager or project support staff of all nonconformances or quality failures. The Project Manager will document and immediately report any nonconformance or quality failure to the QAS.

Environmental Restoration Program
Laboratory Quality Assurance Project Plan (QAP_jP)
for
Bear Creek Valley Operable Unit 2

Revision 2

February 1993

2/19/93

Technical Support Contractor — **Date**
Program Manager

2/23/93

Technical Support Contractor — **Date**
Quality Assurance/Quality Control
Officer Concurrence

2/23/93

DOE-ER Division Program Manager — **Date**

2/23/93

DOE-ER Division QA Program Manager — **Date**

2/19/93

Energy Systems ER Site Program Manager — **Date**

2/19/93

Energy Systems ER Site Project Manager — **Date**

2/19/93

Energy Systems ER — **Date**
Site Quality Assurance Specialist

9. LABORATORY QUALITY ASSURANCE PROJECT PLAN

This QAPP has been developed for use in the sample analysis activities during the RI for OU 2 to ensure that appropriate levels of QA and QC are achieved. This QAPP defines procedures that will be followed in the custody, analysis, and handling of data used in the RI for OU 2. These procedures are intended to define the methods applied to achieve the DQOs established for the OU 2 project.

This QAPP establishes QA requirements and responsibilities applicable to laboratory project participants and establishes methods through which project participants implement the requirements of the project. Where no appropriate procedure exists, this QAPP requires that one be developed by one or more cognizant individuals or organizations. At this time, the details of roles and responsibilities have not been assigned to specific individuals or organizations. When assignments are made, the QAPP will be revised.

This QAPP is designed to comply with both the EPA QAMS *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (QAMS-005/80) and the ANSI/ASME NQA-1 guidelines.

9.1 QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT

The purpose of this section is to implement applicable regulatory requirements and to provide internal control and review so that the data are scientifically sound and legally defensible. QA objectives for data are as follows:

- scientific data generated will withstand scientific scrutiny;
- data will be gathered using appropriate chain-of-custody procedures, laboratory analyses, and data reporting; and
- data will be of known precision and accuracy.

The QA requirements for the OU 2 RI are defined previously in this report. The procedures to be used for assessing the quality of analytical laboratory data are described in Sect. 9.8. Analytical laboratories selected for this project must meet criteria for laboratory certification and adherence to regulatory QA requirements.

9.1.1 Level of Analysis

The specific QA objectives for all data are to obtain reproducible, precise, and accurate measurements consistent with the intended use of the data and the limitations of the sampling and analytical procedures used. This is accomplished through the assignment of measurement tasks to the appropriate analytical level (I through IV) as defined in *Data Quality Objectives for Remedial Response Activities* (EPA 1987). Analytical laboratory data generated from the analysis of surface water, groundwater, sediment, and soil samples will meet the requirements for Level III data quality.

9.1.2 Data Quality Parameters

Typical quantitation limits applicable to this project are presented in the EPA CLP SOW (EPA 1990d) as applicable, as are sample precision, accuracy, and completeness objectives. The QA objectives for QC data are designed to (1) screen out data of unacceptable precision or accuracy and (2) provide data that will meet the data quality goals for this project.

This project will follow the definitions for precision, accuracy, completeness, comparability, and sensitivity given in the *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA 1979a).

9.1.3 Laboratory Activities

The QA objectives for precision and accuracy in the laboratory are defined by control limits established by the EPA CLP (EPA 1990d). The laboratory will be required to submit the results of all control sample analyses to ensure conformance with established control limits and other QA requirements.

The QA completeness objective for this project is to obtain valid analytical results for at least 85% of the samples collected. Laboratory completeness will be determined by the extent to which data are substantiated by hard-copy documentation, which includes chain-of-custody request for services and instrument calibration forms. Comparability and sensitivity criteria are established by either CLP (EPA 1990d) or standard operating procedures for particular analytical laboratories.

9.2 SAMPLE PREPARATION PROCEDURES

The sampling program and sample preparation procedures are discussed in Sect. 8.2. Tables 7.2 and 7.3 show the numbers of samples to be collected, the number of analyses estimated to be conducted, and the field quality control samples to be collected and sent to the analytical laboratory.

Sample analyses will be scheduled according to site investigation needs and consistent with the sample holding times. The S&A Plan will specify the turnaround times that will meet the project schedule and objectives. These requirements will be included in any contractual agreement between the OU 2 project and contract laboratories.

9.3 ANALYTICAL PROCEDURES

9.3.1 Laboratory Analyses

OU 2 samples will be analyzed for potential contaminants of concern using methods in EPA CLP SOW 3/90 (EPA 1990d) for parameters specified by EPA CLP. Non-CLP parameters may be analyzed by using *Test Methods for Evaluating Solid Waste* (EPA 1986), *Methods for Chemical Analysis of Waters and Wastes* (EPA 1979b), *Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act* (EPA 40 *CFR* Part 136), and *Martin Marietta Energy Systems Environmental and Effluent Analysis Manual* (Energy Systems 1986). A listing of the recommended methods and detection limits to be used for samples collected at OU 2 is provided in Table 7.4 of this plan.

9.3.2 Analytical Laboratories

Contracts will be established with analytical laboratories to analyze samples collected during the sampling phase of the OU 2 project.

Each contractor laboratory that analyzes samples will provide quantification limits for each constituent analyzed. The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is >0. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and interferences. The objectives for precision and accuracy for each chemical are based mainly on the capabilities of the approved EPA analytical method with respect to laboratory QC.

In addition to evaluating each set of data for accuracy and precision, an assessment will also be made of the completeness of the data. This assessment will involve computing the fraction of the reported values that remain valid after the sampling procedures have been reviewed and the results have been assessed for precision and accuracy.

9.4 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Chain-of-custody procedures require documented sample possession from the time of collection to disposal. Sample custody will be maintained by OU 2 project staff until custody is transferred to an overnight express company. The overnight express company delivers samples and transfers custody to particular analytical laboratories, where their intralaboratory chain-of-custody procedures will be in effect. On completion of analyses, sample custody will be returned to OU 2 project staff. The chain-of-custody form terminates on final disposal of the sample. The OU 2 Project Manager will be responsible for ensuring that the original chain-of-custody form is submitted to the Document Management Center.

9.4.1 Laboratory Receipt and Handling of Samples

When each sample identification is received at the laboratory, it is compared to the information contained on the included chain-of-custody documents. If discrepancies exist, appropriate note (signed and dated) will be made on the chain-of-custody document, and the Project Manager or designated person will be notified.

After receipt and initial inspection of samples and accompanying forms, the following items are checked and recorded:

- seals and tapes on the transportation container are unbroken and uncut,
- sample containers in the transportation container are intact and at correct temperature,
- check is made with survey instruments to determine external activity and smear surfaces for removal of contamination,
- pH of preserved samples (except VOCs) is checked and documented, pH of preserved VOCs is checked upon analysis and documented,
- identification on the sample bottles corresponds to the entire description on accompanying forms, and
- number of sample containers received is equal to the number of samples listed on the chain-of-custody forms.

In the event that samples arrive damaged or with custody seals broken, an NCR (Sect. 9.11) will be initiated. The Project Manager will be advised and will make a decision as to the fate of the nonconforming sample. The OU 2 Project Manager and the QAS will sign the NCR—noting the reason for sample disposition—and will initiate corrective actions if necessary.

Once samples are in the possession of the laboratory, their internal chain-of-custody and sample-handling procedures will be in effect. If samples are to be shipped from one laboratory to another, proper chain-of-custody and packaging procedures will be maintained, as specified in ESP-800 (Kimbrough et al. 1990). Preanalysis sample storage procedures used are described in the CLP SOW (EPA 1990d). Anticipation of reanalysis requires proper environmental control of samples following analysis. Samples requiring refrigeration will remain refrigerated for 3 months unless prior arrangements have been made by the OU 2 Project Manager. Unused sample portions will be archived. If re-analysis is not anticipated, then environmental conditions will be observed, and the samples will be stored at room temperature. Sample residues will be disposed of by contractor laboratories in accordance with ESP-1000 (Kimbrough et al. 1990), or other EPA-approved procedures.

9.5 CALIBRATION PROCEDURES AND FREQUENCY

9.5.1 Instrument Calibration Procedures and Frequency

A list of all measuring and test equipment to be used, along with a schedule for calibration, will be prepared prior to initiating field work. In general, calibration methods will be those recommended by the manufacturer. Instrument logbooks will be established and maintained.

Laboratory equipment will be calibrated in accordance with the CLP (EPA 1990d) or other contractor laboratory QA manual when CLP protocol is not established. Calibration frequency will be based on the analytical methods employed, type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience.

Calibrated equipment will be uniquely identified by using either the manufacturer's serial number or other means. All equipment shall be categorized as one of the following:

- **Category A**—Casual devices and systems (rulers, tape measures, graduated cylinders, pipettes, etc.) that are not to be calibrated in service (i.e., not calibrated other than by the manufacturer).

- **Category B**—Routine devices and systems (balances, spectrophotometers, etc.) that are to be included in a calibration recall program on a regular cycle.

- **Category C**—Experimental devices and systems (pH meters, turbidimeters, etc.) that are to be calibrated by—or at the direction of—the user, as deemed necessary.

The appropriate category decal with the identification number and the due date of the next calibration will be attached to the equipment. If this identification is not possible, records traceable to the equipment will be readily available for reference.

Volumetric glassware will be used to prepare calibration standards, bench standards, samples for analysis, etc.; thus the glassware used for these preparations must be of known accuracy. Glassware may be purchased with known accuracy per federal and American Society for Testing and Materials specifications.

9.5.2 Calibration Failures

Scheduled periodic calibration of equipment will not relieve laboratory personnel of the responsibility to employ properly functioning equipment. If an individual suspects an equipment malfunction, he/she should remove the device from service, tag it so it is not inadvertently used, and notify project management. If equipment is found to be out of calibration, the laboratory supervisor will evaluate and document (in the instrument logbook) the validity of previous inspection or test results and the acceptability of similar equipment previously inspected or tested. The responsible supervisor will ensure that the devices that are out of calibration are (1) tagged or segregated from other equipment and (2) disposed of or not used until they are recalibrated. Any equipment that is consistently found to be out of calibration will be repaired or replaced. Any repair or replacement should be recorded in the instrument logbook.

All standards used for equipment calibration will be traceable to the EPA, the National Institute of Standards and Technology, or a commercially available certified standard. The source of the standard used must be documented in a calibration logbook.

9.5.3 Calibration Records

Calibration data will be recorded in the instrument logbook. Records will be prepared and maintained for each piece of calibrated equipment to indicate that established calibration procedures have been followed. The laboratory supervisor will ensure that records of calibration data are kept current. Records for laboratory equipment used will be maintained by the laboratory supervisor and kept in the project files.

9.6 PREVENTIVE MAINTENANCE

Periodic preventive maintenance is required for all measuring and test equipment. Instrument manuals will be kept on file for reference purposes if equipment needs repair. Maintenance frequency will be based on manufacturer's recommendations, intended use, and experience. The troubleshooting section of factory manuals may be used to assist personnel in performing maintenance tasks. Routine maintenance will be performed on instruments to reduce the incidence of extensive repairs immediately prior to analysis.

9.6.1 Laboratory Instruments

Laboratory equipment requiring routine maintenance will have a control system indicating the date of required maintenance, person maintaining the equipment, and the next maintenance date. Information pertaining to life histories of equipment maintenance will be kept in an individual log for each instrument. Preventive maintenance for laboratory equipment will follow established procedures and will be documented.

9.7 DATA REDUCTION, VALIDATION, AND REPORTING

Data validation is a systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verifying, certifying, and reviewing.

All data for this project will be evaluated by QA/QC methods and internal peer review. Data reduction, verification, and reporting will be in accordance with the Data Management Plan (Wiggins et al. 1988). Data will be entered into common standardized formats. In addition to following field sampling documentation and QA/QC procedures, data are verified using a variety of computerized checks. These procedures will ensure that data are entered, encoded, and manipulated in a consistent way and are available to OU 2 investigators in a usable format.

9.7.1 Analytical Laboratory Data Reduction and Evaluation

Analytical data generated during the OU 2 project will be evaluated for completeness. This will include—but will not be limited to—review of completed custody logs, photocopied pages of laboratory notebooks, and data forms completed by the technical staff, including sample weights, dilutions, concentrations, data reduction, instrument logs, and all raw data. In the data review process, the data are compared with information such as the sample history, sample preparation, and QC sample data to evaluate the validity of the results. Data validation includes—but is not limited to—the following:

- dated and signed entries by technical staff and supervisors on the work sheets and logbooks used for samples;
- use of sample tracking and numbering systems to track the progress of samples through the laboratory;
- use of QC criteria to reject or accept specific data in accordance with EPA CLP laboratory data validation functional guidelines for evaluating organic and inorganic data (EPA 1988b, EPA 1988a);
- examination of all data for a sample and site by evaluating ion balance, checking for consistency among replicate samples, sending split samples to other laboratories for analysis, and using frequency distribution and range checks to evaluate outliers; and
- determination of compliance with holding time requirements.

9.7.2 Data Reporting of Analytical Results

The format and content of hardcopy and electronic data reports will adhere to project needs. These needs include contract requirements of DOE and reporting formats of regulatory agencies. The laboratory supervisors are responsible for the preparation of each technical report including the process of data validation. The preferred hardcopy report format is the complete CLP data package, including case narrative. Final data presentation will be checked in accordance with data validation requirements and approved by the appropriate laboratory manager. Each page of data will be identified with the project number or project name, sample delivery group number, and date of issue. Electronic copies of the data must match the hardcopy reports. Electronic data contents in the report will include the following:

- sample identification number used by the laboratory and/or sample identification provided to the laboratory, if different from that used in the laboratory;
- sample delivery group number;

- chemical parameters analyzed, reported values, laboratory data qualifiers, and units of measure;
- quantification limit of the analytical procedure;
- results of quality control sample analysis;
- achieved accuracy, precision, and completeness of data;
- references to specific data, if required, to explain reported values, and
- analytical methods used.

These methods will be specifically referenced on all laboratory reports. Any method modification will be included in the case narrative. Data for field and laboratory QC samples will be reported in the same format as actual samples.

9.8 INTERNAL QUALITY CONTROL CHECKS

The basic elements of QC are listed below, proceeding from general to specific:

- technical competence of staff,
- appropriate equipment and instruments,
- good sampling practices,
- good measurement practices,
- project procedures,
- field implementation procedures,
- inspection,
- documentation, and
- training.

The staff must have the necessary competence (defined as education, skill, technical judgment, experience, and professional attitude) to reduce variability in executing procedures, taking measurements, and obtaining data in the field.

The QC procedures presented in this section are designed to accomplish the following:

- achieve the QA objectives for precision, accuracy, completeness, representativeness, comparability, and sensitivity;
- document data quality and provide accountability information about data received from each laboratory;
- provide criteria to ensure that analytical results are statistically valid; and
- provide sufficient documentation of analytical procedures to establish that the resulting parameter estimates are defensible and the comparability of estimates from each laboratory is quantifiable.

Internal QC procedures involve reviewing the documentation of maintenance and operational procedures and inspecting the instruments and equipment by personnel other than instrument users. Inspection entails the spot inspections conducted by the QAS in combination with the continuous process of inspection conducted by the laboratory supervisors as part of normal procedures.

Achieving the highest level of documentation quality is imperative to QC. Bound notebooks with numbered pages will be used to record all events and activities. Data forms will be used to record selected laboratory measurements. All notebooks and data forms will be subject to custody requirements, including limited distribution, secure storage, and long-term retention.

9.8.1 Laboratory Quality Control Procedures

A number of laboratory QC samples will be used to check sample preparation and analysis and to monitor laboratory performance. The control samples listed in this section are defined in general terms. Analysis-specific control samples may be required as indicated by EPA CLP procedures. QC samples will consist of blanks, duplicates, and spikes. Laboratory standards will also function as QC components. QA procedures for laboratory processing include laboratory duplicates of all field samples to determine the precision of laboratory results. Laboratory QC samples will include the following:

Method Blank—A method blank is a blank sample made up of a pure, noncontaminated substance of the matrix of interest (usually distilled/deionized water or silica sand) that is subjected to all of the sample preparation (e.g., digestion, distillation, extraction) and analytical methodology applied to the samples. The purpose of the method blank is to check for contamination from within the laboratory that might be introduced during sample analysis.

Calibration/Continuing Calibration Blank—A calibration blank is the substance that is used to "zero" the instrument. The calibration blank is composed of the solvent used for the preparation of the calibration standards and samples. The calibration blank accounts for any interference from the solvent matrix.

Sample Container Cleaning Blanks—If sample containers are cleaned in the laboratory, "sample container cleaning blanks" are taken for each batch of containers that goes through the cleaning process. If contamination is detected, the containers associated with the contaminated blank will be cleaned again and another blank taken and analyzed.

Laboratory Duplicates—Laboratory duplicates are prepared by the laboratory analyst for each sample and are obtained by homogenizing a sample as thoroughly as possible and taking two separate aliquots of that sample for analysis. The duplicate sample, however, should never be a method blank, trip blank, or field blank. The purpose of laboratory duplicates is to check the precision of the analyst, the sample preparation methodology, and the analytical methodology.

Matrix Spikes—A matrix spike is a sample to which a known concentration of the compounds of interest has been added. The matrix spike is subjected to the same sample preparation and analytical methodology applied to the samples. The sample to be spiked is selected prior to sample submittal; however, the spiked sample cannot be a method blank, trip blank, or field blank. The purpose of the matrix spike is to check for interferences or false readings caused by the sample matrix. The sample matrix effect is measured by calculating the percent recovery (%R, Sect. 9.10.2) of the compounds added to the sample.

Blank Spike/Laboratory Control Sample (LCS)—The blank spike, or LCS, is a blank sample (usually distilled/deionized water or silica sand) to which a known concentration of the compounds of interest has been added. The blank spike is subjected to the same sample preparation and analytical method applied to the samples. The purpose of the blank spike is to check the accuracy of the analyst, the sample preparation methodology, and the analytical methodology. The level of accuracy is measured by calculating the %R.

The Laboratory QA/QC Coordinator is responsible for having QC standards prepared and for sending QC samples to the laboratory for analysis. Statistical analyses will then be performed utilizing the results of QC sample analyses. Each laboratory will apply precision and accuracy criteria to each parameter that is analyzed. When analysis of a sample set is completed, the QC data are reviewed and evaluated using control charts to validate the data set. Laboratory QC standards will include the following:

Calibration Standards—Calibration standards are standards made up of the compounds of interest at known concentrations. Calibration standards are prepared from EPA reference material or from commercially available, certified reference materials traceable to the National Institute of Standards and Technology. Calibration standards for each analyte are prepared for at least three concentration levels throughout the calibration range required for the analysis. Calibration standards are not subjected to all of the preparation (e.g., extraction, distillation, digestion) that is applied to the sample. Calibration standards are used initially to calibrate the instrument by providing reference points throughout the calibration range and to establish linearity throughout the calibration range and working range of the instrument. The instrument is then checked throughout the analysis with the calibration standards to check for any instrument drift.

Performance Evaluation Samples—Performance evaluation samples consist of known concentrations of the analytes submitted to the laboratory being audited. These samples are obtained through various EPA-sponsored programs and private vendors to provide an objective evaluation of laboratory performance and comparison with other participating laboratories.

Control charts are statistical representations of the laboratory's performance and are used to monitor laboratory performance and to establish control limits or the acceptance criteria for all compounds of interest. For each analyte, a separate control chart is required for each type of control sample that measures precision or accuracy and for each matrix type and concentration level. A minimum of ten measurements of precision and accuracy is required before control limits can be established. Control limits of three standard deviations shall be utilized for all samples. Each control chart must consist of a centerline, two warning limits, and two control limits. Control charts must be updated daily.

Once established, control limits are updated as additional precision and accuracy data become available. Any control sample data point that falls beyond the control limits or any data trend will require an investigation and corrective action. For all identified contaminants of concern, control limits and corrective actions will be in accordance with EPA protocol. Additional statistics for organics work will be done in accordance with SW-846 (EPA 1986) or the CLP SOW (EPA 1990d), as applicable.

9.9 PERFORMANCE AND SYSTEMS AUDITS

Audits are performed to review and evaluate the adequacy of laboratory performance and to ascertain whether the QA/QC Plan is being completely and uniformly implemented. The following requirements are adapted from basic requirement 18, "Audits," of ANSI/ASME NQA-1 (ANSI/ASME 1986), and *Environmental Restoration Division Quality Assurance Program Plan* (Energy Systems 1991b). Planned and scheduled audits will be performed to verify compliance with all aspects of the QA program and to determine the program's effectiveness. These audits will be conducted in accordance with written procedures and checklists and will be performed by personnel who do not have direct responsibility for performing the activities being audited. Audit results will be documented, reported to, and reviewed by responsible management. When necessary, follow-up action will be taken by the responsible line organization.

The objectives of performance and systems audits are to (1) ensure that the QA program developed for this project is being implemented according to the specified requirements, (2) assess the effectiveness of the QA program, (3) identify nonconformances, and (4) verify that identified deficiencies are corrected. Upon discovery of any significant deviation from the QA program, the Project Manager will be informed of the nature and extent of any deviation and corrective action taken to remedy the deviation.

An individual audit plan will be developed to provide a basis for each audit. This plan will identify the audit scope, the activities to be audited, the audit personnel, any applicable documents, and the schedule. Records of audits will be maintained in the project files. Audit files will include, as a minimum, the audit report, the reply to audit, and any supporting documents. The OU 2 Project Manager is responsible for conforming to audit procedures, particularly as to timely replies to audit reports and implementation of such corrective action indicated.

9.9.1 Frequency of Audits

The QAS is responsible for internal audits and will perform them according to a schedule that coincides with appropriate activities on the project schedule and sampling plans. Such scheduled audits may be supplemented by additional audits for one or more of the following reasons:

- when significant changes are made in the QA/QC Plan,
- when it is necessary to verify that corrective action has been taken on a nonconformance reported in a previous audit, or
- when requested by the Project Manager.

In addition to these internal audits, surveillance of selected activities may be preformed on a periodic basis.

9.9.2 Performance Audits

A performance audit can be defined as a review of the existing project and QC data to determine the accuracy of a total measurement system(s) or a component part of the system. The analysis of laboratory performance evaluation samples and the participation in scheduled interlaboratory studies may be included as part of the performance audit. Laboratory audits are further described in QA/QC procedures for particular analytical laboratories.

A surveillance of the laboratory activities will also be made during the first sampling phase. The QAS or his designee will check on the logging of the samples, proper chain of custody, and related documentation. Any irregularities in QA procedures that are not immediately corrected will be brought to the attention of the OU 2 Project Manager.

9.9.3 Systems Audits

A systems audit consists of an evaluation to determine if the components of a measurement system were properly selected and are being used correctly. A systems audit includes a careful evaluation of laboratory QC procedures to ensure that the QA/QC procedures are being adhered to. Systems audits are conducted as deemed necessary by the QAS, normally either before or shortly after systems are operational. The systems audit is reported in formal audit reports.

9.10 DATA MEASUREMENT ASSESSMENT PROCEDURES

A statistical evaluation of laboratory analytical results will be performed to apply precision and accuracy criteria for each parameter analyzed. When the analysis of a sample set is completed, the QC data generated will be reviewed and evaluated to validate the data set. All QC data will be reported to the OU 2 Project Manager, along with the sample analysis results. The QC data will be reviewed for precision and accuracy.

The evaluation criteria of the QC sample data for the target compound list have been established for the EPA CLP (EPA 1990d). The control limits for other compounds are derived from laboratory control charts. These criteria provide a means of categorizing a data set as being quantitative, semiquantitative, or qualitative. Where applicable, contract laboratories will use data qualifiers to clearly identify results as qualitative and semiquantitative. Otherwise, reported data are to be considered quantitative. These results provide information on the relative quality of sampling and analytical procedures. Deviations suggested by these assessments will be utilized in nonconformance and corrective action procedures (Sect. 9.11).

9.10.1 Precision

Precision will be assessed by conducting separate analyses of duplicate samples. The level of precision is determined by calculating the RPD between the two measurements, using the following formula:

$$RPD = \frac{(D_1 - D_2) \times 100}{(D_1 + D_2)/2},$$

where

D_1 = value of first measurement,
D_2 = value of second measurement.

9.10.2 Accuracy

Accuracy will be assessed by splitting a sample into two portions, spiking (i.e., adding known quantity of the constituents of interest to one of the portions), and then analyzing both portions for these parameters. The difference in the concentration levels of the constituents of interest should be equal to the quantity of the spike added to one of the two portions. The %R is calculated as follows:

$$\%R = \frac{O_i - O_s}{T_i} \times 100,$$

where

O_i = observed spiked sample concentration,
O_s = observed sample concentration,
T_i = true or actual concentration of the spike.

Recovery of 100% is equivalent to 100% accuracy. Values <100% may indicate a sample matrix effect and a false reading. A periodic program of sample spiking is required, for example, one matrix spike and one matrix spike duplicate per 20 samples.

Blank spikes or laboratory control samples check the accuracy of the analyst, the sample preparation, and the analytical methodology free of sample matrix effects. Blank samples are spiked with known concentrations of the compounds of interest and then prepared and analyzed as samples. The level of accuracy is measured by calculating the %R as follows:

$$\%R = (O/T) \times 100 \ ,$$

where

%R = percent recovery,
O = observed or measured concentration,
T = true or known concentration.

The coefficient of variation (C_v) of the percent recovery values is calculated as follows:

$$C_v = (SD/APR) \times 100 \ ,$$

where SD is the standard deviation of the percent recoveries for the various spiked constituents and APR is the average or mean percent recovery.

9.11 CORRECTIVE ACTIONS

This section identifies methods and policies for the documentation, evaluation, corrective action, and verification activities necessary when a deviation from established procedure occurs. Requirements for the documentation and implementation of corrective actions are also included.

Any deviation or nonconformance will be evaluated with respect to its possible impact on reportable data. All deviations from standard operating procedures, equipment calibrations, or any aspect of the QA plan will be evaluated and documented. Significant deviations identified using the statistical assessment of quality data will also be used in Nonconformance and Corrective Action Procedures.

9.11.1 Responsibilities of Project Participants

OU 2 personnel will ensure the prompt identification, control, and disposition of nonconforming items. Each laboratory participant is responsible for submitting records of all nonconformance events to the QAS within a reasonable period of time following the initial identification and documentation of the nonconformance. The nonconformance will then be evaluated by Team Leaders, QAS, Project Manager, and others as is deemed relevant. This evaluation will determine the disposition of the nonconformance.

9.11.2 Nonconformances and Corrective Action Procedures

Nonconforming equipment, items, activities, conditions, and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported on an NCR in a timely manner. A nonconformance is defined as a malfunction, failure, deficiency, or deviation from specified requirements. The originator of an NCR will describe the finding on the form provided for this purpose and will notify the OU 2 project management and the QAS. Each nonconformance will be reviewed and a disposition given for the item, activity, or condition. Evaluations also will determine if the event justifies the issuance of a CAR. The CAR will document the event, the findings of the evaluation, and the required corrective actions. The disposition of a nonconformance will be documented and approved by the OU 2 Project Manager. The QAS will concur with the disposition of the nonconformance.

The QA/QC Coordinator for a particular laboratory is responsible for the assessment of laboratory quality control sample information. If data fall outside accepted limits, established laboratory procedures for identifying the problem and taking appropriate corrective actions will be employed. Completion of corrective action should be evident when deviations return to prescribed acceptable limits.

The modification, repair, rework, or replacement of nonconforming equipment, items, or activities will require the reverification of acceptability. In certain instances, as determined by project management, these activities may require that corrective action be completed and verified before site work continues.

If, in the opinion of project management and the QAS, the nonconformance does not significantly affect the technical quality or use of the work, then the work may continue, pending resolution of the nonconformance. The basis for such a decision will be documented on the NCR and submitted to the QAS for review and approval. The documentation will include the statement that the decision was made before continuing with the work. The records of nonconformance and their dispositions will be maintained by the OU 2 Project Manager and forwarded to the Document Management Center.

9.12 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The active participation of management in the OU 2 Project is fundamental to the success of this QA/QC Plan. Management will be aware of project activities and will participate in development, review, and operation of the project. Management will be informed of QA status and activities through the receipt, review, and/or approval of the following:

- regular quality status reports,
- laboratory and project-specific QA/QC plans and procedures,
- postaudit reports and audit closures,
- surveillance reports,
- corrective action overdue notices, and
- NCRs.

Copies of these reports will be distributed to appropriate management and regulatory agencies. In addition, periodic assessment of QA/QC activities and data precision, accuracy, representativeness, completeness, and comparability will be conducted and reported by the analytical laboratories.

As appropriate, project management will inform the QAS of the QA status of the project, especially any significant quality accomplishments. OU 2 personnel are required to inform the Project Manager or project support staff of all nonconformances or quality failures. The Project Manager will document and immediately report any nonconformance or quality failure to the QAS.

Environmental Restoration Program
Health and Safety Plan
for
Bear Creek Valley Operable Unit 2

Revision 2

February 1993

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Technical Support Contractor Program Manager — **Date**

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Technical Support Contractor Field Team Leader — **Date**

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Mark [illegible] — 2/19/93

Energy Systems ER Division Program Manager — **Date**

Cindy H. Hodgins — 2/19/93

Energy Systems ER Site Project Manager — **Date**

10. HEALTH AND SAFETY PLAN

10.1 SITE HEALTH AND SAFETY PERSONNEL

A site health and safety officer (SHSO) will be designated by the subcontractor to ensure that the site-specific health and safety plan (Appendix D) remains in compliance with 29 *CFR* 1910 as amended by 29 *CFR* 1910.120. The SHSO will be designated no less than 2 weeks before starting field work and will be identified in the site Health and Safety Plan. The SHSO or an alternate will implement, monitor, and assist the site manager in enforcing the site Health and Safety Plan. The subcontractor SHSO may coordinate between the Y-12 Plant Industrial Hygiene and Health Physics Departments on matters of employee health and safety, such as personal monitoring, on-site monitoring, and incident reporting.

10.2 SAFETY RISK ANALYSIS

10.2.1 Rust Spoil Area

The RSA was used as a disposal area for solid waste (spoil material) generated from various renovation, maintenance, and construction operations at the Y-12 Plant. Although no detailed records are available, the bulk of spoil material disposed at RSA consisted of (1) soil, (2) masonry materials (i.e., brick and concrete), and (3) metal (i.e., steel and rebar). A portion of the demolition debris was packaged and disposed of in open-top metal containers. These containers were determined to be nonradioactively contaminated, according to health physics requirements established for the Y-12 Plant. Discussions with Y-12 Plant personnel indicated the possibility that small quantities of solvent-contaminated material and material containing asbestos, mercury, and uranium may have been disposed in this area. However, existing administrative and other established in-plant controls prevented the disposal of significant amounts of chemicals, wastes, or contaminated material at RSA. Contaminants of concern in RSA include arsenic, beryllium, lead, mercury, selenium, thorium, uranium, and tetrachloroethane.

10.2.2 SY-200 Yard

The SY-200 Yard was operated from the 1950s to 1986 as a "hold-for-future-use" storage area. The SY-200 Yard, an outside graveled area about 200 ft by 300 ft, was used to store nonradioactively contaminated equipment, electrical transformers, piping, tanks, mercury flasks, and miscellaneous items. All items stored at the site were removed by September 1986. Based on data obtained through soil sampling, potential hazards associated with SY-200 include barium, chromium, lead, mercury, PCBs, and ^{235}U.

10.2.3 Spoil Area 1

SA-1 was used for the disposal of what was considered to be nonhazardous, nonradioactively contaminated construction debris from various renovation, maintenance, and construction operations at the Y-12 Plant. However, recordkeeping regarding waste disposal was inadequate. In addition, the results of soil and groundwater studies of the area confirmed the presence of heavy metals and radiological contamination (see Appendix C). The bulk of the solid waste known to have been disposed of included asphalt, brick, concrete, roofing materials, brush, metal, rock, and tile. Contaminants of concern include arsenic, beryllium, barium, chromium, lead, mercury, fluoranthene, phenanthrene, pyrene, total radium, total uranium, and ^{235}U.

10.2.4 On-Site Safety Hazards

The primary hazards associated with the sampling activities at this site are the mechanical risks posed by the use of a hollow-stem auger and the health hazards associated with drilling activities. The SHSO will implement and enforce all safety procedures associated with the use of a hollow-stem auger. These procedures will be followed strictly to avoid accidents. Split spoon sampling will be performed under the close supervision of the project hydrogeologist, with all members of the drilling crew observing all safety precautions specified in the plan while operating the auger. The electrical hazards from overhead power lines will be minimized by following Y-12 procedures for locating the auger. The location of underground utilities will be determined during the Y-12 Plant Excavation and Penetration Permit procedure. This procedure will be followed during all augering operations. Personnel working with or in the immediate vicinity of moving equipment will be prohibited from wearing loose clothing, jewelry, or long hair. Only authorized personnel will be allowed in the immediate vicinity of the auger while it is operating.

10.3 TRAINING REQUIREMENTS

Occupational Safety and Health Administration 40-hour health and safety training, as specified in 29 *CFR* 1910.120, will be required for all employees engaged in hazardous waste operations. Personnel will be required to have annual 8-hour refresher training courses. Managers and supervisors will receive an additional 8 hours of instruction. All classroom training will be supplemented with 24-hour on-site orientation and instruction under an experienced and qualified individual.

10.4 PERSONAL PROTECTIVE EQUIPMENT

The level of personal protection required for RI sampling activities at OU 2 will be dictated by the location and type of sampling to be conducted. The planned activities consist of split spoon sampling, surface soil, groundwater, and surface water/sediment sampling. Sampling activities will penetrate some of the source areas. Because contaminants such as beryllium, mercury, PCBs, and radionuclides could potentially be encountered at concentrations that constitute a health hazard, the initial personal protection level recommended during intrusive sampling at SY-200 is Level C (see Table 10.1), which is defined in 29 *CFR* 1910.120 Appendix B. All other sampling activities will be conducted at Level D.

During sampling activities, mercury vapor, organic vapors, and radioactivity will be monitored continuously. Based on site monitoring, and if deemed appropriate by the SHSO, the personal protection level at SY-200 may be downgraded to Level D. If increased protection is needed, the protection level can be upgraded at the discretion of either the SHSO, the subcontracting project manager, or the Energy Systems project manager.

The SHSO (or the health and safety officer provided by the subcontractor or project manager) will select the type of equipment needed and determine whether additional Personal Protective Equipment (PPE) is needed. All sampling activities will be performed under the close supervision of the project hydrogeologist, with all members of the drilling crew observing the PPE requirements specified in the plan while near the operating auger. Workers will be required to wear appropriate PPE, including steel-toed boots for foot protection, hearing protection, and approved safety glasses for eye protection. Hard hats will be required when workers are in the vicinity of the drilling rig. Only authorized and properly protected personnel will be allowed in the immediate vicinity of the auger while it is in operation.

Table 10.1. Level of protection

Level designation		Monitoring parameters	
A		Airborne pollutants[a]	X
B		Explosion potential	X
C[b]	X	Radiation	X
D		Total particulates	X

[a]Organic vapors and mercury vapors.
[b]For intrusive sampling activities at SY-200. All other activities, Level D.

10.5 MEDICAL SURVEILLANCE

As required by 29 *CFR* 1910.120, medical surveillance of all personnel involved in hazardous waste site operations shall be conducted. Baseline and annual physical examinations will be performed by the Y-12 Plant Medical Center or a qualified occupational physician. Subcontractors will be responsible for ensuring that their employees receive the required examinations. Persons who have not received the necessary physical examinations or who are not medically approved to perform their duties at a hazardous waste site will be excluded from all areas of the site.

In the unlikely event of radioactive contamination, whole body counts of workers from the affected site will be performed by the Y-12 Plant medical staff. Work at OU 2 will be suspended until the conditions abate or PPE is upgraded. When operations are continued, a personal dosimetry program will be instituted by the Y-12 Plant HPD.

10.6 MONITORING AND SAMPLING

During sampling activities, the work areas will be monitored for airborne pollutants (organics, mercury), radiation, and total particulates. All monitoring will be conducted in accordance with procedures described in the *Environmental Surveillance Procedures, Quality Control Program* (Kimbrough et al. 1990).

If any of the following conditions occur, the SHSO may either remove all personnel from the affected area until the conditions abate or upgrade the protection level as described in the *Y-12 RCRA Facility Investigation Plan* as developed by Welch (1989a):

- organic vapor levels in the breathing zone exceed background conditions for >1 min as determined by a photoionization detector (PID) or flame ionization detector (FID);
- mercury vapor levels in the breathing zone exceed 0.01 mg/m^3 as measured by a Jerome Mercury Analyzer;
- significant dusting (>10 mg/m^3, which is the threshold limit value for total nuisance dust) occurs anywhere in the immediate sampling area;
- the release of airborne particulates of asbestos- or beryllium-containing wastes exceeds the American Conference of Governmental Industrial Hygienists Threshold Limit Values, or the permissible exposure levels as described by 29 *CFR* 1910, Subpart Z upgraded, whichever is more protective (as determined by personal air monitoring).

The SHSO is responsible for ensuring that vapor and particulate monitoring are performed at the site. These parameters should be monitored continuously while drilling activities are in progress.

Unusual conditions at the site, such as the detection of peculiar odors, will be investigated by the SHSO. In cases of extremely high organic vapor readings (>50 ppm), the SHSO will stop work activities and determine whether any other immediate actions may be needed to mitigate health and safety concerns.

Radiation monitoring will be performed for the OU 2. The SHSO will be responsible for ensuring that this monitoring is scheduled through HPD and completed. HPD will perform all radiation surveys at the site and will recommend actions to the contractor to be taken to protect personnel working in the area based on the interpretation of these surveys. The frequency of monitoring will be determined by the potential for exposure to radiation at the site and for all samples collected. Exposure will be maintained at a level that is ALARA.

10.7 SITE CONTROL MEASURES

Access to the site will be controlled to reduce the potential exposure of personnel to any contaminants that may be present and to prevent the dispersal of contaminants by personnel or equipment leaving the site. Site control efforts will be the responsibility of the SHSO in coordination with the Y-12 Plant Industrial Safety and Security departments. Measures such as signs, fencing, and ropes will be used as controls.

10.8 DECONTAMINATION PROCEDURES

Specific decontamination procedures are required for Level C protection. Decontamination procedures are thoroughly discussed in the *Environmental Surveillance Procedures, Quality Control Program* (Kimbrough et al. 1990). Workers will be required to follow the standard safety practice of washing hands and faces on leaving the work area and before eating, drinking, smoking, or engaging in any other activity that could cause the ingestion of unwanted materials.

10.9 SITE OPERATING PROCEDURES

A work area zone will be established around the drilling rig to keep out unauthorized personnel.

Because contamination may be encountered, Level C protection has been established. Three work area zones will be established (exclusion, contamination reduction, and support) in accordance with the methodology described in Welch (1989a). Based on site monitoring, and if deemed appropriate by the SHSO, site operating procedures may be upgraded or downgraded as necessary.

10.10 CONTINGENCY PLAN

A written contingency plan is required by 29 *CFR* 1910. Before operations begin on the site, requirements 120(e)(1) and (2) must be completed. In the event of an emergency at OU 2, the SHSO or the site manager must immediately contact the Plant Shift Superintendent (PSS) and ensure that the plan is followed exactly. The PSS on duty is responsible for initiating and coordinating all emergency response operations at the Y-12 Plant. This plan will include a form providing all essential emergency information and contacts and will be made available to the field team. The SHSO will be responsible for maintaining current information on the form and for informing the field team of the form location and the means of contacting emergency aid. A map highlighting the most direct route to the nearest hospital must be included in the contingency and health and safety plans. Figure 10.1 is the emergency reference form.

SITE: ______________________________ PROJECT NO. ________

Emergency information:

Local resources:

Ambulance (name):

Hospital (name):

Police (local or state):

Fire department (name):

Radio channel:

Nearest telephone:

Project manager:

SHSO:

Emergency contact (medical and health):

-
-
-
- Poison Information Center:
- National Response Center (FOR ENVIRONMENTAL EMERGENCY ONLY): 1-800-424-8802
- Office:

Directions to hospital:

Fig. 10.1. Emergency reference form.

10.11 SPECIAL HAZARD PROCEDURES

No requirements exist to enter a confined space while conducting field activities at OU 2. If confined work spaces are encountered and must be entered, an Occupational Safety Work Permit for confined space entry as required by Y-12 Plant procedure 70-750 will be issued and followed exactly.

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Appendix A

SUPPORTING DOCUMENTS

Record of Conservation

This is to document the telephone conversation between Steve Walker, Environmental Restoration Program, ~~ORNL~~, Y-12 SW and Linda Houlberg, BEIA, ORNL, April 1, 1992.

Houlberg: Can you give me a list of contaminants of concern for Rust Spoil Area, Spoil Area I, and SY-200 Yard at Y-12 which I can use to develop ARARs for Bear Creek Operable Unit 2?

Walker: Yes. Characterization work done up to this point has so far identified the following contaminants at the Bear Creek Operable Unit 2 sites:

Rust Spoil Area - soil and groundwater

arsenic	beryllium
lead	mercury
uranium	tetrachloroethene
vanadium	selenium
thorium	

Spoil Area I - soil and groundwater

aluminum	arsenic
barium	beryllium
chromium	cobalt
copper	iron
lead	mercury
nickel	vanadium
zinc	total uranium
total radium	benzo(a)anthracene
benzo(a)pyrene	benzo (a,k)fluoranthene
chrysene	dibenzofuran
fluoranthene	phenanthrene
pyrene	bis(2-ethylhexl)phthalate

SY-200 Yard - soil, possibly groundwater and surface water

uranium	thorium
alpha activity	PCBs
lead	asbestos
mercury	

Linda Houlberg

Linda Houlberg

Steve Walker

Steve Walker

TENNESSEE DEPARTMENT OF CONSERVATION

Customs House
701 Broadway
Nashville, TN 37247-3530

May 20, 1991

CERTIFIED MAIL P 465 288 580
RETURN RECEIPT REQUESTED

U.S. DOE
U.S. DOE Y-12
P.O. Box E
Oak Ridge, TN 37831

Demolition

RE: U.S. DOE Y-12, DML 01-103-0012

Dear Sir:

The purpose of this letter is to formally request a closure/post-closure plan for your facility as required by Rule 1200-1-7-.03 (REQUIREMENTS FOR FINANCIAL ASSURANCE) of the Regulations Governing Solid Waste Processing and Disposal Facilities in Tennessee.

The closure/post-closure plan shall be submitted to the appropriate regional office no more than 180 days from the date postmarked on this letter.

Upon submittal of the closure/post-closure plan the Commissioner will review the plan and will then notify the applicant whether the plan is tentatively approved or tentatively disapproved. After the plan has been tentatively approved the applicant must file and maintain financial assurar[illegible] with the Commissioner as set forth in paragraph 3(a) of the aforementione[illegible]. The Commissioner shall establish the amount of the financial assurance required of the operator based upon the estimated cost of operating the facility for a thirty (30) day period plus the estimated closure and post-closure care costs included in the approved closure/post-closure care plan.

Attached to this letter is a general outline which should provide some guidance for preparation of the requested closure/post-closure plan. If further questions arise please contact either the appropriate regional office or our central office.

Sincerely,

Tom Tiesler

Tom Tiesler, Director
Division of Solid Waste Management

JTT/JH/F1031137

Attachment

Y-12 SITE OFFICE
LOG NO. 911643
FILE CODE ________

State of Tennessee
Department of Health and Environment
Division of Solid Waste Management

Solid Waste Management Program
4th Floor, 701 Broadway
Nashville, Tennessee 37219-5403
(615) 741-3424

REGISTRATION AUTHORIZING SOLID WASTE DISPOSAL ACTIVITIES IN TENNESSEE

Registration Number: DML 01103001[illegible]

Date Issued: JAN 15 1986

Issued to The United States Department of Energy for a facility located adjacent to the Y-12 Plant on the U.S. D.O.E. Reservation, near Oak Ridge, Tennessee, in Anderson County.

Activities Authorized: Landfill disposal of demolition wastes generated from various construction activities at the Y-12 Plant.

By my signature, this registration is issued in compliance with the provisions of the Tennessee Solid Waste Disposal Act (Tennessee Code Annotated, Section 68-31-101, et seq.), and applicable regulations developed pursuant to this law and in effect; and in accordance with the conditions and other terms set forth in this registration document and the attached Registration Conditions.

Tom Tiesler, Director
Division of Solid Waste Management

EC/bec SW/18

MEMORANDUM OF CONFERENCE OR CONVERSATION

DATE 8/29/91 TIME 4:45 [x] TELEPHONE [ ] PERSONAL

ORIGINATING PARTY

Charles West
TDEC Office Rad. Prog.

OTHER PARTIES

SUBJECT: Mixed waste regulations

DISCUSSION:

There are still no regulations in place at this time for mixed waste
however,
Deborah Schulz – solid waste group – may know more about any thoughts or upcoming regs.

will be in 9/3/91

CONCLUSION OR AGREEMENTS

DISTRIBUTION:

SIGNED [signature]

UCN-693
(1235 6-68)

Appendix B

CLP PARAMETERS AND ANALYTICAL QUANTITATION LIMITS

Table B.1. Contract required detection limits - inorganics

Element	Water (µg/L)	Soil/Sediment (mg/kg)
Aluminum (Al)	80	20
Antimony (Sb)	2	6
Arsenic (As)	2	1
Barium (Ba)	5	20
Beryllium (Be)	1	0.5
Cadmium (Cd)	2	0.5
Calcium (Ca)	500	500
Chromium (Cr)	8	1
Cobalt (Co)	6	5
Copper (Cu)	6	2.5
Iron (Fe)	80	10
Lead (Pb)	2	0.5
Magnesium (Mg)	100	500
Manganese (Mn)	5	1.5
Mercury (Hg)	0.1	0.1
Nickel (Ni)	15	4
Potassium (K)	2,000	500
Selenium (Se)	2	0.5
Silver (Ag)	3	1
Sodium (N)	1,000	500
Thallium (Tl)	2	1
Vanadium (V)	5	5
Zinc (Zn)	20	2

Table B.2. Practical quantitation limits - volatile organics

Compound	Groundwater (μg/L)	Low soil/sediment (μg/kg)
Chloromethane	5	5
Bromomethane	5	5
Vinyl chloride	5	5
Chloroethane	5	5
Methylene chloride	5	5
Acetone	5	5
Carbon disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone (MEK)	5	5
1,1,1-Trichloroethane	5	5
Carbon tetrachloride	5	5
Bromodichloromethane	5	5
1,1,2,2-Tetrachloroethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
Trichloroethene	5	5
1,1,2-Trichloroethane	5	5
Dibromochloromethane	5	5
Benzene	5	5
trans-1,3-Dichloropropene	5	5
Bromoform	5	5
2-Hexanone	5	5
4-Methyl-2-pentanone (MIBK)	5	5
Tetrachloroethene	5	5
Toluene	5	5
Chlorobenzene	5	5
Ethylbenzene	5	5
Styrene	5	5
Xylenes, total	5	5

Table B.3. Practical quantitation limits - semivolatile organics

Compound	Groundwater ($\mu g/L$)	Low soil/sediment ($\mu g/kg$)
Phenol	2.0	330
bis(2-Chloroethyl)ether	1.5	330
2-Chlorophenol	2.0	330
1,3-Dichlorobenzene	2.0	330
1,4-Dichlorobenzene	2.0	330
1,2-Dichlorobenzene	2.5	330
2-Methylphenol	1.0	330
bis(2-Chloroisopropyl)ether	2.5	330
4-Methylphenol	1.0	330
N-nitroso-di-n-propylamine	1.5	330
Hexachloroethane	2.0	330
Nitrobenzene	2.5	330
Isophorone	2.5	330
2-Nitrophenol	2.0	330
2,4-Dimethylphenol	2.0	330
bis(2-Chloroethoxy)methane	2.0	330
2,4-Dichlorophenol	2.0	330
1,2,4-Trichlorobenzene	2.0	330
Naphthalene	2.0	330
2-Chloroaniline	2.0	330
Hexachlorobutadiene	2.0	330
4-Chloro-3-methylphenol	1.5	330
2-Methylnaphthalene	1.5	330
Hexachlorocyclopentadiene	1.5	330
2,4,6-Trichlorophenol	2.5	330
2,4,5-Trichlorophenol	1.5	1600
2-Chloronaphthalene	1.5	330
2-Nitroaniline	2.5	1600
Dimethyl phthalate	1.5	330
Acenaphthylene	1.5	330
2,6-Dinitrotoluene	1.5	330
3-Nitroaniline	2.5	1600
Acenaphthene	1.5	330
2,4-Dinitrophenol	1.5	1600
4-Nitrophenol	1.5	1600
Dibenzofuran	1.0	330
2,4-Dinitrotoluene	1.0	330
Diethyl phthalate	1.0	330
4-Chlorophenyl phenyl ether	1.0	330
Fluorene	1.0	330
4-Nitroaniline	3.0	1600
4,6-Dinitro-2-methylphenol	15.	1600
N-Nitrosodiphenylamine	3.0	330

Table B.3 (continued)

Compound	Groundwater (μg/L)	Low soil/sediment (μg/kg)
Phenol	2.0	330
4-Bromophenyl phenyl ether	1.5	330
Hexachlorobenzene	1.5	330
Pentachlorophenol	2.0	1600
Phenanthrene	1.0	330
Anthracene	2.5	330
Carbazole	10	10
Fluoranthene	1.5	330
Pyrene	1.5	330
Butyl benzyl phthalate	3.5	330
3,3'-Dichlorobenzidine	7.0	660
Benz(a)anthracene	1.5	330
bis(2-Ethylhexyl)phthalate	1.0	330
Chrysene	1.5	330
Di-n-octyl phthalate	1.5	330
Benzo(b)fluoranthene	1.5	330
Benzo(k)fluoranthene	1.5	330
Benzo(a)pyrene	2.0	330
Indeno(1,2,3-cd)pyrene	2.5	330
Dibenzo(a,h)anthracene	2.5	330
Benzo(g,h,i)perylene	4.0	330

Table B.4. Practical quantitation limits - pesticides and PCBs

Compound	Groundwater (μg/L)	Low soil/sediment (μg/kg)
Aldrin	0.04	2.68
α-BHC	0.03	2.01
β-BHC	0.06	4.02
δ-BHC	0.09	6.03
γ-BHC (Lindane)	0.04	2.68
Chlordane (technical)	0.14	9.38
4,4'-DDD	0.11	7.37
4,4'-DDE	0.04	2.68
4,4'-DDT	0.12	8.04
Dieldrin	0.02	1.34
Endosulfan I	0.14	9.38
Endosulfan II	0.04	2.68
Endosulfan sulfate	0.66	44.2
Endrin	0.06	4.02
Endrin aldehyde	0.23	15.4
Heptachlor	0.03	2.01
Heptachlor epoxide	0.83	55.6
Methoxychlor	1.76	117
Toxaphene	2.4	161
PCB-1016	nd[a]	nd
PCB-1221	nd	nd
PCB-1232	nd	nd
PCB-1242	0.65	43.5
PCB-1248	nd	nd
PCB-1254	nd	nd
PCB-1260	nd	nd

[a]Not determined.

Appendix C

ANALYTICAL DATA/SOIL BORING LOGS

SPOIL AREA 1 SOIL BORING LOGS

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-1 Sheet 1 of 5
	SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-1, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-14-90 FINISH 8-15-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
1	1.5	1-S	1.5	4-3-6 (9)	FAT CLAY WITH GRAVEL, (CH), dark yellowish orange (10 YR 6/6) to light brown (5 YR 5/6), moist, loose, stiff, mottled	Using 4" split spoon with stainless steel liners
2	3.0	2-S	1.5	4-4-5 (9)	FAT CLAY WITH GRAVEL, (CH), dark yellowish orange (10 YR 6/6) to light brown (5 YR 5/6), moist, loose, stiff, mottled	
3 4	4.5	3-S	1.5	8-20-27 (47)	GRAVELLY FAT CLAY, (CH), black to dark yellowish brown (10 YR 4/2), slightly moist, dense, hard, mottled, trace asphalt or coal ash	
5	6.0	4-S	1.5	12-20-25 (45)	FAT CLAY WITH GRAVEL, (CH), light brown (5 YR 5/6) moist to dry, dense, hard, minor mottling, silt interval 5'-3" to 6'	Samples SAS1001 VOA, 1002 sample suite, and 1003 sample suite, at 10:54
6 7	7.5	5-S	1.5	17-17-13 (30)	FAT CLAY WITH GRAVEL, (CH), dark yellowish brown (10 YR 4/2) moist, medium, very stiff	
8	9.0	6-S	0.4	17-36-24 (60)	FAT CLAY WITH GRAVEL, (CH), brownish gray (5 YR 4/1), moist, hard, very dense, trace welded coal ash	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-1 Sheet 2 of 5

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-1, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-14-90 FINISH 8-15-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
10	10.5	7-S	0.8	16-24-30 (54)	FAT CLAY WITH GRAVEL, (CH), moderate yellowish brown (5 YR 5/4), moist, very dense, hard	
11 / 12	12.0	8-S	1.5	6-13-15 (28)	FAT CLAY, (CH), yellowish orange (10 YR 6/6) to grayish brown (5 YR 3/3), moist, medium, very stiff, mottled	
13	13.5	9-S	1.5	3-3-6 (9)	FAT CLAY, (CH), pale yellowish brown (10 YR 6/2), moist, loose stiff, mottled	Samples SAS 1004, 1005, and 1006 at 13:58
14 / 15	15.0	10-S	1.5	3-6-8 (14)	FAT CLAY, (CH), dark yellowish orange (10 YR 6/6) to grayish brown (5 R 3/2), moist, medium, stiff, mottled, trace coal ash, oxidized zones	
16	16.5	11-S	1.5	6-9-9 (18)	FAT CLAY, (CH), yellowish orange (10 YR 6/6) to moderately reddish brown (10 R 4/6), moist, medium, stiff, mottled	Samples SAS 1007 VOA, and 1008 sample suite, at 14:29
17	18.0	12-S	1.5	2-5-7 (12)	FAT CLAY, (CH), white to light gray (N7), moist, medium, stiff, minor mottling	

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-1 Sheet 3 of 5

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-1, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-14-90 FINISH 8-15-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
19	19.5	13-S	1.5	4-5-8 (13)	FAT CLAY, (CH), white to light gray (N7), moist, medium, stiff, minor mottling	
20, 21	21.0	14-S	1.4	3-5-8 (13)	FAT CLAY, (CH), light gray (N7) to dusky yellowish brown (10 YR 2/2), moist, medium, stiff, mottled, trace black staining	
22	22.5	15-S	1.5	4-7-9 (16)	FAT CLAY, (CH), light gray (N7), moist, medium, stiff	Samples SAS 1009 VOA, 1010 sample suite, and 1011 duplicate at 16:45
23, 24	24.0	16-S	1.5	4-7-10 (17)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6) to moderate reddish orange (10 R 6/6), moist, medium, very stiff, some oolitic limestone fragments	
25	25.5	17-S	1.5	3-4-6 (10)	FAT CLAY, (CH), moderately reddish brown (10 R 4/6), moist, medium, very stiff	Samples SAS 1020 VOA, and 1021 sample suite, at 08:37
26	27.0	18-S	1.5	3-5-6 (11)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6) with 1 mm laminations of light brown (5 YR 5/6), and pale yellowish orange (10 YR 8/6), moist, loose, stiff, laminated	

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-1 Sheet 4 of 5

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-1, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-14-90 FINISH 8-15-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
28	28.5	19-S	1.4	3-5-6 (11)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, trace calcite cement/fracture fill	
29	30.0	20-S	1.5	2-5-10 (15)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff	Samples SAS 1022 VOA, and 1023 sample suite, at 10:18
30, 31	31.5	21-S	1.5	3-4-8 (12)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, mottled, trace laminations	
32	33.0	22-S	1.0	3-5-6 (11)	FAT CLAY WITH GRAVEL, (CH), light brown (5 YR 5/6), moist, medium, stiff, trace oolitic limestone	
33, 34	34.5	23-S	1.5	2-5-6 (11)	FAT CLAY WITH GRAVEL, (CH), light brown (5 R 5/6), moist, medium, stiff, fragments 1/8" to 3"	Samples SAS 1024 VOA, 1025 and 1026 sample suites, at 13:37
35	36.0	24-S	1.5	3-3-6 (9)	FAT CLAY WITH GRAVEL, (CH), light brown (5 YR 5/6), moist, loose, stiff	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-1 Sheet 5 of 5

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-1, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-14-90 FINISH 8-15-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
37	37.5	25-S	1.5	3-3-4 (7)	FAT CLAY WITH GRAVEL, (CH), light brown (5 YR 5/6) to moderate yellowish brown (10 YR 5/4), moist, loose, firm, mottled	
38	39.0	26-S	1.5	2-3-4 (7)	FAT CLAY WITH GRAVEL, (CH), light brown (5 R 5/6) to moderate yellowish brown (10 YR 5/4), moist, loose, firm, mottled	
39 40	40.5	27-S	1.2	2-4-6 (10)	FAT CLAY, (CH), moderate reddish orange (10 R 6/6), moist, loose, stiff	Samples SAS 1027 VOA, 1028 and 1029 sample suites, at 15:05
					End of boring 40.5'	

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-2 Sheet 1 of 3
	SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-2, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-16-90 FINISH 8-17-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
1	1.5	1-S	1.5	5-4-4 (8)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6) to moderate brown (5 YR 4/4), moist, loose, firm, mottled, gravels up to 2", trace road gravel	
2	3.0	2-S	1.5	1-2-3 (5)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6) moist, loose, firm, mottled	
3, 4	4.5	3-S	1.5	2-2-3 (5)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6) moist, loose, firm, mottled, <5% black (N1) material, organic odor	
5	6.0	4-S	1.5	2-6-8 (14)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6) moist, medium, stiff, mottles around weathered rock fragments that are white (N9) to black (N1), some black staining	Sample SAS 1030, 1 VOA and 1 sample suite, at 09:12
6, 7	7.5	5-S	1.4	1-5-6 (11)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6) moist, medium, stiff, mottled	
8	9.0	6-S	1.5	3-5-5 (10)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6) moist, loose, stiff, mottled and brownish gray (5 YR 4/1) 1/8" contorted laminations	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-2 Sheet 2 of 3

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-2, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-16-90 FINISH 8-17-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
10	10.5	7-S	1.2	3-5-7 (12)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6) moist, medium, stiff, white (N9) to black (N1) weathered zones around chert fragments	Sample SAS 1031, 1 VOA and 2 sample suites, at 09:56
11	12.0	8-S	1.5	4-4-5 (9)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, loose, stiff	
12, 13	13.5	9-S	1.5	3-5-7 (12)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, 2-3% medium grained sand	
14	15.0	10-S	1.1	5-6-7 (13)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, 8-10% gravel/ fragments	Sample SAS 1032, 1 VOA, at 11:03
15, 16	16.5	11-S	1.4	4-6-8 (14)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff	Sample SAS 1033, 2 sample suites, at 11:33
17	18.0	12-S	1.0	3-5-7 (12)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), minor light brown (5 YR 5/6), mottled, moist, medium, stiff, 2-5% gravel	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-2 Sheet 3 of 3

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-2, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-16-90 FINISH 8-17-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
19	19.5	13-S	1.5	3-6-7 (13)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), minor light brown (5 YR 5/6), mottled, moist, medium, stiff	
20	21.0	14-S	1.5	3-5-5 (10)	FAT CLAY, (CH), pale yellowish orange (10 YR 8/6), mottled with moderate reddish brown (10 R 4/6), moist, loose, stiff, <5% gravel	Sample SAS 1034, 1 VOA and 1 sample suite, at 12:57
21 22	22.5	15-S	1.4	3-4-2 (6)	FAT CLAY, (CH), dark yellowish orange (10 YR 6/6), hairline fractures in-filled with moderate reddish brown (10 R 4/6), at random orientations, moist, loose, firm, contorted laminations, obvious folds, some light bluish gray (5B 7/1), mottled	
23	24.0	16-S	1.5	2-7-5 (12)	FAT CLAY, (CH), dark yellowish orange (10 YR 6/6), moist, medium, stiff, trace oolitic limestone	
24 25	25.5	17-S	1.5	3-5-6 (11)	FAT CLAY, (CH), dark yellowish orange (10 YR 6/6), moist, medium, stiff, mottled, highly contorted, ~15% limestone rock fragments, wet around some fragments	Sample SAS 1035, 1 VOA and 1 sample suite, at 13:47
26					End of boring 25.5'	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-3 Sheet 1 of 4

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-3, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-29-90 FINISH 8-30-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
1	1.5	1-S	1.0	9-11-11 (22)	SILT WITH GRAVEL, (ML), moderate reddish brown (10 R 4/6), dry, medium, very stiff, mottled	Some fill material, twigs, cement, using 4" split spoon with stainless steel liners
2	3.0	2-S	1.1	5-7-6 (13)	SILT, (ML), dark yellowish orange (10 YR 6/6), dry, medium, stiff	Abundant twigs and roots
3, 4	4.5	3-S	1.5	3-9-14 (23)	SILT, (ML), dark yellowish orange (10 YR 6/6) to 3'-8", change to GRAVEL WITH SILT (GP-GM), dry, medium, very stiff, limestone gravel	
5	6.0	4-S	1.2	3-5-7 (12)	SILT, (ML), dark yellowish orange (10 YR 6/6), dry, medium, stiff, trace gravel, abundant twigs and roots	Sample SAS 1208, 1 VOA from 5.5'-6.0', and 1 sample suite from 5.0'-5.5', at 13:30
6, 7	7.5	5-S	1.5	7-7-4 (11)	SILT WITH GRAVEL, (ML), dark yellowish brown (10 YR 6/6), moist, medium, stiff, 6.5'-7' poorly graded gravel	Asphalt plug at 7'-7.5'
8	9.0	6-S	0	50/6"		Encounter split spoon refusal, auger to 10', difficult drilling to 9' spoon driver from 10'-11.5'

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-3 Sheet 2 of 4

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI — LOCATION SAI-3, Spoil Area 1

ELEVATION — DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS — START 8-29-90 — FINISH 8-30-90 — LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS: Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
10					Concrete 10'-10.5'	
11	11.5	7-S	1.5	8-10-9 (19)	SILT, (ML), dark yellowish brown (10YR 6/6), moist, medium, very stiff, grades to a FAT CLAY (CH)	Sample SAS 1209, 1 VOA from 11.0'-11.5' and 1 sample suite from 10.5'-11.0', at 14:00
12	13.0	8-S	1.5	5-7-9 (16)	FAT CLAY, (CH), moderate reddish orange (10 R 6/6), moist, medium, very stiff, some gravel, chert with weather rings	
13, 14	14.5	9-S	1.5	5-10-13 (23)	FAT CLAY, (CH), moderate reddish orange (10 R 6/6), moist, medium, very stiff, some gravel, chlorite staining	
15	16.0	10-S	1.0	3-5-7 (12)	FAT CLAY, (CH), moderate reddish orange (10 R 6/6), moist, medium, stiff, chert nodules ~ 1/2"	Sample SAS 1210, 1 VOA from 15.5'-16.0' and 1 sample suite from 15.0'-15.5', at 15:36
16, 17	17.5	11-S	1.2	5-9-11 (20)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, very stiff, mottled and extensive pale greenish yellow (10 Y 8/2) chlorite development	Sample SAS 1211, 1 VOA from 16.5'-17.0' and 1 sample suite from 17.0'-17.5', at 15:45

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-3 Sheet 3 of 4

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-3, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-29-90 FINISH 8-30-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
18 — 19	19.0	12-S	1.5	4-5-6 (11)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium stiff, very mottled, rare chert clasts	
19 — 20	20.5	13-S	1.5	3-4-6 (10)	FAT CLAY, (CH) moderate reddish brown (10 R 4/6), moist, loose, stiff, mottled, extensive chlorite	Drillers miss liners--take next sample with them
21 — 22	22.0	14-S	1.0	8-10-10 (20)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, very stiff, mottled, extensive chlorite	Sample SAS 1212, 1 VOA from 21.5'-22.0' and 1 sample suite from 21.0'-21.5', at 16:07
22 — 23	23.5	15-S	1.0	3-6-9 (15)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff	
24 — 25	25.0	16-S	1.5	3-4-10 (14)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, trace oolitic limestone	Black staining common
25 — 26	26.5	17-S	1.5	3-5-11 (16)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, very stiff, chlorite mottling abundant	Sample SAS 1213, 1 VOA from 26.0'-26.5' and 2 sample suites from 25.0'-26.0', at 08:10

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-3 Sheet 4 of 4

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-3, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-29-90 FINISH 8-30-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
27	28.0	18-S	1.5	6-7-9 (16)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, very stiff, trace chert and oolitic limestone	
28–29	29.5	19-S	0.5	3-4-6 (10)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, loose, stiff	
30	31.0	20-S	1.0	4-9-15 (24)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, very stiff	Sample SAS 1214, 1 VOA 30.0'-30.5' and 1 sample suite from 30.5'-31.0', at 08:46
31					End of boring 31.0'	

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-4 Sheet 1 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-4, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-18-90 FINISH 8-20-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
1	1.5	1-S	1.5	4-6-6 (12)	GRAVELLY SILT WITH SAND, (ML), pale yellowish brown (10 YR 6/2), moist, medium, stiff, variable amounts of gravel in interval	Using 4" split spoon with stainless steel liners
2, 3	3.0	2-S	1.3	5-6-2 (8)	FAT CLAY WITH GRAVEL, (CH), light bluish gray (5 B 7/1) mottles in moderate reddish brown (10 R 4/6), moist, loose, firm, contorted	
4	4.5	3-S	1.5	6-7-7 (14)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, some mottling, trace asphalt, wood	Sample SAS 1100, VOA and sample suite, at 08:35
5, 6	6.0	4-S	1.2	5-6-5 (11)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, trace rootlets	Sample SAS 1101, VOA and sample suite, at 08:45
7	7.5	5-S	1.0	3-5-3 (8)	FAT CLAY WITH GRAVEL, (CH), dark yellowish orange (10 R 6/6), moist, loose, firm, some light brown (5 YR 5/6) mottles	
8	9.0	6-S	1.4	3-3-4 (7)	FAT CLAY WITH GRAVEL, (CH), dark yellowish orange (10 R 6/6), moist, loose, firm, some light brown (5 YR 5/6) mottles	Sample SAS 1102, VOA and sample suite, at 08:59

PROJECT NUMBER	BORING NUMBER
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SOIL BORING LOG

ROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI–4, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-18-90 FINISH 8-20-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
10	10.5	7-S	0.9	3-4-4 (8)	FAT CLAY WITH GRAVEL, (CH), dark yellowish orange (10 YR 6/6), moist, loose, firm	
11	12.0	8-S	1.5	3-6-9 (15)	GRAVEL WITH SILT AND CLAY, (GM), greenish gray (5 GY 6/1), moist, medium, stiff, mottled, abundant roots, wood, some road gravel	
12, 13	13.5	9-S	1.5	2-4-6 (10)	CLAY WITH GRAVEL, (CH-CL), dark yellowish orange (10 YR 6/6), moist, loose, stiff	
14	15.0	10-S	1.0	3-5-3 (8)	CLAY WITH GRAVEL, (CH-CL), dark yellowish brown (10 YR 4/2), moist, loose, firm, minor wet zones, concrete fragments	Sample SAS 1103, VOA and sample suite, at 10:10
15, 16	16.5	11-S	1.5	2-2-3 (5)	FAT CLAY WITH GRAVEL AND SAND, (CH), dark yellowish orange (10 YR 6/6), moist, loose, firm, very plastic, grayish red purple (5 pp 4/2) pebbles, coarse grained sand	
17	18.0	12-S	1.0	2-2-50/0 52)	FAT CLAY WITH GRAVEL AND SAND, (CH), dark yellowish orange (10 YR 6/6), moist, loose, firm	Obstruction at 17.5'; sample SAS 1104, VOA and sample suite, at 10:30

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-4 Sheet 3 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-4, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-18-90 FINISH 8-20-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
19	19.5	13-S	1.3	7-10-10 (20)	GRAVEL WITH CLAY, (GC) moderate reddish brown (10 YR 4/2), moist, medium, very stiff, wood and brick fragments	
20, 21	21.0	14-S	1.0	2-3-4 (7)	FAT CLAY WITH GRAVEL, (CH), dark yellowish orange (10 YR 6/6), moist to wet, loose, firm, mottled	Sample SAS 1105, VOA and sample suite, at 11:08
22	22.5	15-S	1.4	3-4-5 (9)	CLAY AND SILT WITH GRAVEL AND SAND, (CL-ML), moderate yellowish brown (10 YR 5/4), moist, loose, stiff, brick, rubble, 40-45% gravel in areas	
23, 24	24.0	16-S	1.5	3-11-12 (23)	CLAY AND SILT WITH GRAVEL AND SAND, (CL-ML), moderate yellowish brown (10 YR 5/4), moist, medium, very stiff, interval of SM-SC 23.3'-23.7'	
25	25.5	17-S	1.0	3-12-12 (24)	GRAVELLY FAT CLAY, (CH), light olive brown (5 Y 5/6) to light olive gray (5 Y 5/2), moist, medium, very stiff	Sample SAS 1106, VOA and sample suite, at 12:58
26	27.0	18-S	1.5	6-4-7 (11)	GRAVELLY FAT CLAY, (CH), light olive gray (5 Y 5/2), moist, medium, stiff, abundant rootlets, asphalt fragment	Dusk brown organic zones

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-4 Sheet 4 of 7

SOIL BORING LOG

ROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-4, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-18-90 FINISH 8-20-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
28	28.5	19-S	1.0	3-3-50/0 (53)	SILT AND CLAY WITH GRAVEL, (ML-CL), light olive gray (5 Y 5/2), moist, loose, firm, some electrical wire, some wet zones	Obstruction at 28.0'
29 / 30	30.0	20-S	1.2	5-3-5 (8)	GRAVELLY LEAN CLAY, (CL), light olive gray (5 Y 5/2), moist, loose, firm, some asphalt fragments, plastic, grades to Fat Clay (CH)	Sample SAS 1107, VOA and sample suite, at 08:58
31	31.5	21-S	1.1	2-3-12 (15)	FAT CLAY, (CH), dark yellowish orange (10 YR 6/6), moist, medium, stiff, light olive gray mottles, streaks	
32 / 33	33.0	22-S	1.4	1-3-20 (23)	FAT CLAY, (CH), dark yellowish orange (10 YR 6/6), moist to wet, medium, very stiff, rock fragments, road gravel, asphalt	
34	34.5	23-S	1.5	8-9-7 (16)	FAT CLAY, (CH), dusky brown (5 YR 2/2) to grayish orange (10 YR 7/4), moist, medium, very stiff, trace wood, asphalt	
35	36.0	24-S	0.4	7-9-8 (17)	FILL, wood with dusky brown (5 YR 2/2) clay	

PROJECT NUMBER	BORING NUMBER
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SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-4, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-18-90 FINISH 8-20-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
37	37.5	25-S	1.4	5-4-7 (11)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, some MnO staining	Sample SAS 1108, VOA and sample suite, at 10:47
38	39.0	26-S	1.5	2-5-6 (11)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, light brown (5 YR 5/6) mottles, some MnO staining	
39, 40	40.5	27-S	1.4	3-5-6 (11)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, some MnO staining	Sample SAS 1109, VOA and sample suite, at 11:30
41	42.0	28-S	1.5	2-5-5 (10)	FAT CLAY, (CH), moderate reddish orange (10 R 6/6) to pale red (5 R 6/2), moist, loose, stiff, extensive mottling, MnO coated slickensides	
42, 43	43.5	29-S	1.5	4-5-6 (11)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, mottled	
44	45.0	30-S	1.2	3-5-5 (10)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, loose, stiff, mottled, MnO staining	Sample SAS 1110, VOA and sample suite, at 13:28

PROJECT NUMBER	BORING NUMBER
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SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-4, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-18-90 FINISH 8-20-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
46	46.5	31-S	1.5	2-3-5 (8)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, loose, firm, 10% weathered rock fragments	
47	48.0	32-S	1.3	3-3-4 (7)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, loose, firm, abundant slickensides and fractures, MnO staining	
48–49	49.5	33-S	1.4	3-4-3 (7)	FAT CLAY, (CH), pale greenish yellow (10 Y 8/2) to dark yellowish orange (10 YR 6/6), moist, loose, firm, some MnO staining	
50	51.0	34-S	1.0	3-4-4 (8)	FAT CLAY, (CH), dark yellowish orange (10 YR 6/6), moist, loose, firm	Sample SAS 1111, VOA and sample suite, at 15:24
51–52	52.5	35-S	1.5	1-2-2 (4)	FAT CLAY, (CH), light brown (5 YR 5/6) to moderate brown (5 YR 4/4), moist, very loose, soft, some wet areas, some rock fragments	
53	54.0	36-S	0.2	1-1-1 (2)	FAT CLAY, (CH), moderate brown (5 YR 4/4), wet, very loose, very soft, some rock fragments	

PROJECT NUMBER	BORING NUMBER
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SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-4, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-18-90 FINISH 8-20-90 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
55	55.5	37-S	1.1	1-1-1 (1)	FAT CLAY, (CH), moderate brown (5 YR 4/4), wet, very loose, very soft, trace rock fragments	Sample SAS 1112, VOA and sample suite, at 16:00
56	57.0	38-S	1.0	N/A	FAT CLAY, (CH), light brown (5 YR 5/6), wet, very loose, very soft, trace rock fragments	Spoon is driven to 62.0', water table ~58.0', capillary fringe to ~52.0'
57	62.0				AS ABOVE	
62					End of boring 62.0'	

PROJECT NUMBER	BORING NUMBER
SE[illegible]30490.SC	SAI-5 Sheet 1 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI **LOCATION** SAI-5, Spoil Area 1

ELEVATION **DRILLING CONTRACTOR** Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS **START** 8-27-90 **FINISH** 8-28-90 **LOGGER** R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
1	1.5	1-S	1.5	8-8-6 (14)	SILT WITH GRAVEL, (ML), light to moderate brown (5 YR 5/6 - 5 YR 4/4), dry, medium, stiff, pale yellow brown (10 YR 6/2) mottles, some fill material	Using 4" split spoon with stainless steel liners. NOTE: SAI-5 begun on 8-20-90; location moved due to refusal at ~15.0'
2, 3	3.0	2-S	0.8	9-4-6 (10)	SILT WITH GRAVEL, (ML), pale yellowish brown (10 YR 6/2), dry, loose, stiff, some mottles, some clay	
4	4.5	3-S	0.7	5-4-3 (7)	LEAN CLAY WITH GRAVEL, (CL), dusky yellow green (5 GY 5/2), moist, loose, firm, rootlets, trace wood	
5, 6	6.0	4-S	1.2	3-3-4 (7)	LEAN CLAY WITH GRAVEL, (CL), dusky yellow green (5 GY 5/2), moist, loose, firm, mottles of grayish green (5 G 5/2), some silt intervals and fill	Sample SAS 1120, VOA and sample suite, at 17:29
7	7.5	5-S	1.5	10-3-4 (7)	FAT CLAY WITH GRAVEL, (CH), dark yellowish orange (10 YR 6/6), moist, loose, firm	
8	9.0	6-S	1.[illegible]	2-3-5 (8)	FAT CLAY WITH GRAVEL, (CH), light brown (5 YR 5/6) to moderate brown (5 YR 4/4), moist, loose, firm	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-5 Sheet 2 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-5, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-27-90 FINISH 8-28-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
10	10.5	7-S	1.0	3-5-6 (11)	FAT CLAY WITH GRAVEL, (CH), moderate brown (5 YR 4/4), moist, medium, stiff	
11 12	12.0	8-S	1.0	3-3-2 (5)	FAT CLAY WITH GRAVEL, (CH), moderate brown (5 YR 4/4), moist, loose, firm, trace asphalt	Sample SAS 1121, VOA and sample suite, at 08:21; duplicate sample SAS 1122
13	13.5	9-S	1.5	2-2-3 (5)	GRAVELLY FAT CLAY, (CH), moderate brown (5 YR 4/4), moist, loose, firm, trace crushed brick, some yellowish gray (5 Y 7/2) clay	
14 15	15.0	10-S	1.1	3-8-7 (15)	FILL with Fat Clay as above wet to moist, asphalt and block	Auger refusal boring location moved ~5.0'; sample SAS 1123
16	16.5	11-S	1.4	5-3-4 (7)	SANDY SILT, (ML), moderate brown (5 YR 4/4), moist, loose, firm, some gravel	
17	18.0	12-S	1.5	10-4-6 (10)	SANDY FAT CLAY WITH GRAVEL, (CH), light brown (5 YR 5/6), moist, loose, stiff, mottled, pieces of brick and wire	Sample SAS 1200, VOA and sample suite, at 14:00

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-5 Sheet 3 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-5, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-27-90 FINISH 8-28-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
19	19.5	13-S	1.5	3-3-5 (8)	SANDY FAT CLAY WITH GRAVEL, (CH), light brown (5 YR 5/6), moist, loose, firm, mottled, black staining, pieces of asphalt	
20 21	21.0	14-S	1.5	4-26-21 (47)	SANDY FAT CLAY WITH GRAVEL, (CH), light brown (5 YR 5/6), moist, dense, hard, large pieces of concrete and brick, cobbles, some coal	Sample SAS 1201, 1 VOA from 20.5'-21.0' and 1 sample suite from 20.0'-20.5', at 14:30
22	22.5	15-S	1.5	16-18-19 (37)	GRAVELLY FAT CLAY, (CH), moderate yellowish brown (10 YR 5/4), moist, dense, hard, pieces of coal, brick, large gravel	
23 24	24.0	16-S	1.5	4-6-6 (12)	GRAVELLY FAT CLAY, (CH), moderate yellowish brown (10 YR 5/4), moist, medium, stiff, mottled, trace coal, yellow, green and orange mottles	
25	25.5	17-S	1.0	4-6-11 (17)	GRAVELLY FAT CLAY, (CH), moderate brown (5 YR 3/4), moist, medium, very stiff, limestone gravel	Sample SAS 1202, 1 VOA from 25.0'-25.5' and 1 sample suite from 24.5'-25.0', at 15:55
26	27.0	18-S	1.5	3-8-10 (18)	GRAVELLY FAT CLAY, (CH), moderate brown (5 YR 3/4), moist, medium, very stiff, mottled, some sand, asphalt and coal	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-5 Sheet 4 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-5, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-27-90 FINISH 8-28-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
28	28.5	19-S	1.5	6-9-7 (16)	GRAVELLY FAT CLAY WITH SAND, (CH), moderate brown (5 YR 3/4), moist, medium, very stiff, significant laminations of coal debris	
29	30.0	20-S	1.5	4-7-8 (15)	GRAVELLY SILT WITH SAND, (ML), dusky yellowish brown (10 YR 2/2), moist, medium, stiff	Sample SAS 1203, 1 VOA from 29.5'-30.0' and 1 sample suite from 29.0'-29.5', at 16:45
30 31	31.5	21-S	1.5	4-5-22 (27)	SILT WITH GRAVEL, (ML), moderate brown (5 YR 4/4), moist, medium, very stiff, layered texture, some brick, coal and sticks	
32	33.0	22-S	1.4	21-28-10 (38)	SILT, (ML), dark yellowish brown (10 YR 2/2), moist, dense, hard, some fine sand, abundant wood, roots	May have driven spoon through a log
33 34	34.5	23-S	0.4	50/6	FILL, alphalt, wood	Auger refusal at ~33.5', auger to 38.0'
35	36.0				FILL, abundant wood	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-5 Sheet 5 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI **LOCATION** SAI-5, Spoil Area 1

ELEVATION **DRILLING CONTRACTOR** Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS **START** 8-27-90 **FINISH** 8-28-90 **LOGGER** R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
37					FILL	Return from augers of block, organic soil with fine sand
38–39	39.5	24-S	1.5	8-9-22 (31)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, dense, hard, wood debris, quartzite, coal, limestone	
40	41.0	25-S	1.5	4-7-10 (17)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, very stiff	Sample SAS 1204, 1 VOA from 40.5'-41.0' and 2 sample suites from 39.5'-40.5', at 10:30
41–42	42.5	26-S	1.4	5-7-9 (16)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, very stiff, pale greenish yellow (10 Y 8/2) along portings	Sample SAS 1205, 1 VOA from 41.0'-41.5' and 1 sample suite from 41.5'-42.0', at 10:55
43	44.0	27-S	1.5	3-5-7 (12)	FAT CLAY WITH GRAVEL, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, some chlorite staining	

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-5 Sheet 6 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-5, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-27-90 FINISH 8-28-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
45	45.5	28-S	1.5	4-7-9 (16)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, very stiff, dusky yellow (5 Y 6/4) clay throughout	Sample SAS 1206, 1 VOA from 45.0'-45.5' and 2 sample suites from 44.0'-45.0', at 13:00
46 47	47.0	29-S	1.5	4-5-9 (14)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, clasts of chert and oolitic limestone	
48	48.5	30-S	1.5	3-3-5 (8)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, loose, firm, black streaks, chlorite staining	
49 50	50.0	31-S	1.5	3-6-7 (13)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, black streaks, chlorite staining	Sample SAS 1207, 1 VOA from 48.5'-49.0' and 1 sample suite from 49.0'-50.0', at 14:00
51	51.5	32-S	1.5	5-5-9 (14)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), moist, medium, stiff, minor gravel, 3" layer of chlorite staining at ~51.0'	
52	53.0	33-S	1.5	3-6-7 (13)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), medium, stiff, minor gravel and chlorite stains	

PROJECT NUMBER	BORING NUMBER	
SED30490.SC	SAI-5	Sheet 7 of 7

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-5, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-27-90 FINISH 8-28-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
54	54.5	34-S	1.5	3-7-9 (16)	FAT CLAY, (CH), moderate reddish brown (10 R 4/6), wet, medium, very stiff, gravel in end of spoon	Possible water table
55, 56	56.0	35-S	0.0	3-50/0	Bedrock at ~55.0'	
					End of boring 56.0'	

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-6 Sheet 1 of 4

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-6, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-30-90 FINISH 8-31-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)		Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
1	1.5	1-S	1.5	21-42-46 (88)	FILL, gravel with silt, moderate yellowish brown (10 YR 5/4), dry, very dense, hard-limestone gravel	Using 4" split spoon with stainless steel liners
2	3.0	2-S	1.0	13-14-11 (25)	FILL, WELL GRADED GRAVEL WITH SILT, (GW-GM), moderate yellowish brown (10 YR 5/4), dry, medium, very stiff, limestone, chert, coal, pieces of red clay	Auger chatter to 3.0'
3 4	4.5	3-S	1.0	5-11-16 (27)	GRAVELLY SILT, (ML), moderate yellowish brown (10 YR 5/4), dry, medium, very stiff, limestone gravel to 3"	Appears to be older road bed material
5	6.0	4-S	1.0	9-12-14 (26)	GRAVELLY SILT, (ML), moderate yellowish brown (10 YR 5/4), moist, medium, very stiff, coal, limestone and wood fragments	Sample SAS 1215, 1 VOA from 5.5'-6.0' and 1 sample suite from 5.0'-5.5', at 14:05
6 7	7.5	5-S	1.5	9-12-16 (28)	GRAVELLY SILT, (ML), moderate reddish brown (10 R 4/6), moist, medium, very stiff, mottled, trace asphalt, grades to GRAVELLY FAT CLAY (CH)	
8	9.0	6-S	1.0	9-7-8 (15)	GRAVELLY SILT, (ML), moderate reddish brown (10 R 4/6), moist, medium, stiff, mottled, pieces of asphalt	

PROJECT NUMBER SED30490.SC	BORING NUMBER SAI-6 Sheet 2 of 4

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-6, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-30-90 FINISH 8-31-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)		Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
10	10.5	7-S	0.8	12-14-11 (25)	GRAVELLY SILT, (ML), moderate reddish brown (10 R 4/6), moist, medium, very stiff, mottled, trace asphalt	Sample SAS 1216, 1 VOA from 9.5'-10.0' and 1 sample suite from 10.0'-10.5', at 14:40
11 12	12.0	8-S	1.5	9-11-12 (23)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, medium, very stiff, trace oolitic limestone	Contact between silt and clay at ~11.0'
13	13.5	9-S	1.4	8-11-15 (26)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, medium, very stiff, no gravel, very plastic	
14 15	15.0	10-S	1.4	4-7-12 (19)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, medium, very stiff	Sample SAS 1217, 1 VOA from 14.5'-15.0' and 1 sample suite from 14.0'-14.5', at 15:35
16	16.5	11-S	1.0	10-7-11 (18)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, medium, very stiff, very mottled	
17	18.0	12-S	1.5	3-9-13 (22)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, medium, very stiff, slightly mottled, MnO streaks	

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-6 Sheet 3 of 4

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI — LOCATION SAI-6, Spoil Area 1

ELEVATION — DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS — START 8-30-90 — FINISH 8-31-90 — LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
19	19.5	13-S	1.5	3-3-7 (10)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, loose, stiff	
20	21.0	14-S	1.5	3-4-8 (12)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, medium, stiff, slightly mottled, MnO streaks	Sample SAS 1218, 1 VOA from 20.5'-21.0' and 1 sample suite from 20.0'-20.5', at 16:30
21, 22	22.5	15-S	1.5	3-5-5 (10)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, loose, stiff, very mottled, MnO streaks, trace limestone	
23	24.0	16-S	1.5	2-2-4 (6)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, loose, firm, abundant MnO laminations	
24, 25	25.5	17-S	1.0	3-4-6 (10)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, loose, stiff, abundant MnO laminations	Sample SAS 1219, 1 VOA from 25.0'-25.5' and 1 sample suite from 24.5'-25.0', at 16:55
26	27.0	18-S	1.5	3-5-7 (12)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), moist, medium, stiff, abundant MnO laminations	Sample 1220, 1 VOA from 25.5'-26.0' and 1 sample suite from 26.0'-26.5', at 17:05

PROJECT NUMBER	BORING NUMBER
SED30490.SC	SAI-6 Sheet 4 of 4

SOIL BORING LOG

PROJECT Spoil Area 1, Y-12 Group 3 RFI LOCATION SAI-6, Spoil Area 1

ELEVATION DRILLING CONTRACTOR Brotcke

DRILLING METHOD AND EQUIPMENT 6-1/4" I.D. HSA, CME Model 75 Rotary Drill Rig

WATER LEVELS START 8-30-90 FINISH 8-31-90 LOGGER R. Cipolletti

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION Soil Name, USCS Group Symbol, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy	COMMENTS Depth of Casing, Drilling Rate, Drilling Fluid Loss, Tests and Instrumentation
28	28.5	19-S	1.5	3-4-5 (9)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), wet, loose, stiff, mottled, MnO stains	
29						
30	31.5	20-S	1.5	2-3-2 (5)	FAT CLAY, (CH), moderate, reddish brown (10 R 4/6), wet, loose, firm, mottled, MnO stains no gravel	Water table at ~29.0'; spoon driven to rock ~31.5', no analytical sample taken
31						
32					End of boring 31.5'	
33						
34						
35						

SPOIL AREA 1 ANALYTICAL DATA

Spoil Area 1 Sample Tracking
(page 1 of 3)

Number	Label	Station	Date	Time	Depth	QA/QC	VOA	Sample Suite	Remarks
1001	SAS	SA-1.1	8/14/90	1054	4.5-6.0		X		
1002	SAS	SA-1.1	8/14/90	1054	4.5-6.0			X	
1003	SAS	SA-1.1	8/14/90	1054	4.5-6.0			X	
1004	SAS	SA-1.1	8/14/90	1358	10.5-12.0				
1005	SAS	SA-1.1	8/14/90	1358	10.5-12.0				
1006	SAS	SA-1.1	8/14/90	1358	10.5-12.0				
1007	SAS	SA-1.1	8/14/90	1429	13.5-15.0		X		
1008	SAS	SA-1.1	8/14/90	1429	13.5-15.0			X	
1009	SAS	SA-1.1	8/14/90	1645	19.5-21.0		X		
1010	SAS	SA-1.1	8/14/90	1645	19.5-21.0			X	
1011	SAS	SA-1.1	8/14/90	1645	19.5-21.0	DUP	X		
1020	SAS	SA-1.1	8/15/90	0837	24.0-25.5		X		
1021	SAS	SA-1.1	8/15/90	0837	24.0-25.5			X	
1022	SAS	SA-1.1	8/15/90	1018	28.5-30.0		X		
1023	SAS	SA-1.1	8/15/90	1018	28.5-30.0			X	
1024	SAS	SA-1.1	8/15/90	1337	34.5-35.0		X		
1025	SAS	SA-1.1	8/15/90	1337	34.5-35.0			X	
1026	SAS	SA-1.1	8/15/90	1337	34.5-35.0			X	
1027	SAS	SA-1.1	8/15/90	1505	39.0-40.5		X		
1028	SAS	SA-1.1	8/15/90	1505	39.0-40.5			X	
1029	SAS	SA-1.1	8/15/90	1505	39.0-40.5	DUP	X		

Spoil Area 1 Sample Tracking
(page 2 of 5)

Number	Label	Station	Date	Time	Depth	QA/QC	VOA		
								Sample Suite	
									Remarks
1030	SAS	SA-1.2	8/16/90	0912	4.5-6.0		X	X	
1031	SAS	SA-1.2	8/16/90	0956	9.0-10.5		X	X	
1032	SAS	SA-1.2	8/16/90	1103	13.5-16.5		X	X	
1033	SAS	SA-1.2	8/16/90	1133	13.5-16.5	DUP	X	X	
1034	SAS	SA-1.2	8/16/90	1257	19.5-21.0		X	X	
1035	SAS	SA-1.2	8/16/90	1347	24.0-25.5		X	X	
1050	SAT	SA-1.1	8/15/90			TRIP	X		BLANK
1051	SAT	SA-1.1	8/15/90			TRIP		X	BLANK
1060	SAE	SA-1.2	8/15/90	1550		EQUIP		X	SPLIT SPOON
1061	SAE	SA-1.2	8/16/90	0843		EQUIP	X		SPLIT SPOON
1062	SAE	SA-1.2	8/16/90	1340		EQUIP	X	X	SPLIT SPOON
1070	SAF	SA-1.2	8/16/90	0904		FIELD			DRILLER'S WATER
1071	SAF	SA-1.2	8/16/90	1406		FIELD	X		MGM DI/OF WATER
1072	SAF	SA-1.2	8/16/90	1559		FIELD	X		MGM DI/OF WATER
1090	SAS	SA-1.2	8/16/90	0908	3.0-4.5		X		DEBRIS SAMPLE
1100	SAS	SA-1.4	8/18/90	0822	4.5-7.5		X	X	
1101	SAS	SA-1.4	8/18/90	0935	4.5-7.5	DUP			
1102	SAS	SA-1.4	8/18/90	0859	9.0-10.5		X	X	

Spoil Area 1 Sample Tracking
(page 3 of 5)

Number	Label	Station	Date	Time	Depth	QA/QC	VOA	Sample Suite	Remarks
1103	SAS	SA-1.4	8/18/90	1010	13.5-15.0		X	X	
1105	SAS	SA-1.4	8/18/90	1108	19.5-21.0		X	X	
1106	SAS	SA-1.4	8/18/90	1258	24.0-25.5		X	X	
1107	SAS	SA-1.4A	8/19/90	0858	28.5-30.0		X	X	
1108	SAS	SA-1.4A	8/19/90	1022	34.5-37.5		X	X	TIME:1022or104 7
1109	SAS	SA-1.4A	8/19/90	1130	39.0-40.5		X	X	
1110	SAS	SA-1.4A	8/19/90	1328	43.5-45.0		X	X	
1111	SAS	SA-1.4A	8/19/90	1524	49.5-51.0		X	X	
1112	SAS	SA-1.4A	8/19/90	1640	54.0-55.5		X	X	
1120	SAS	SA-1.5	8/20/90	1729	4.5-6.0		X	X	
1121	SAS	SA-1.5	8/21/90	0821	9.0-12.0		X	X	
1122	SAS	SA-1.5	8/21/90	0921	9.0-12.0	DUP	X	X	
1123	SAS	SA-1.5	8/21/90	0906	15.0-16.5		X	X	
1124	SAS	SA-1.5	8/21/90	1324	29.0-30.5		X	X	
1150	SAT	SA-1.4	8/18/90	0930		TRIP	X		BLANK
1151	SAT	SA-1.4A	8/19/90	0840		TRIP	X		BLANK
1152	SAT	SA-1.5	8/20/90	1733		TRIP	X		BLANK
1153	SAS	SA-1.5	8/21/90	1311		TRIP	X		BLANK
1160	SAE	SA-1.4	8/18/90	0900		EQUIP	X	X	SPLIT SPOON
1161	SAE	SA-1.4A	8/19/90	1113		EQUIP		X	SPLIT SPOON

Spoil Area 1 Sample Tracking
(page 4 of 5)

Number	Label	Station	Date	Time	Depth	QA/QC	VOA	Sample Suite	Remarks
1200	SAS	SA-1.5B	8/27/90	1400	16.5-18.0		X	X	
1201	SAS	SA-1.5B	8/27/90	1430	19.5-21.0		X	X	
1202	SAS	SA-1.5B	8/27/90	1555	24.0-25.5		X	X	
1203	SAS	SA-1.5B	8/27/90	1645	28.5-30.0		X	X	
1204	SAS	SA-1.5B	8/28/90	1030	39.5-42.5		X	X	
1205	SAS	SA-1.5B	8/28/90	1055	39.5-42.5		X	X	
1206	SAS	SA-1.5B	8/28/90	1300	44.0-45.5		X	X	
1207	SAS	SA-1.5B	8/28/90		48.5-50.0		X	X	
1208	SAS	SA-1.3	8/29/90	1330	4.5-6.0		X	X	
1209	SAS	SA-1.3	8/29/90	1400	10.0-11.5		X	X	
1210	SAS	SA-1.3	8/29/90	1536	14.5-17.5		X	X	
1211	SAS	SA-1.3	8/29/90	1545	14.5-17.5	DUP	X	X	
1212	SAS	SA-1.3	8/29/90	1607	20.5-22.0		X	X	
1213	SAS	SA-1.3	8/30/90	0810	25.0-26.5		X	X	
1214	SAS	SA-1.3	8/30/90	0846	29.5-31.0		X	X	
1215	SAS	SA-1.6	8/30/90	1405	4.5-6.0		X	X	
1216	SAS	SA-1.6	8/30/90	1440	9.0-10.5		X	X	
1217	SAS	SA-1.6	8/30/90	1535	13.5-15.0		X	X	
1218	SAS	SA-1.6	8/30/90	1630	19.5-21.0		X	X	
1219	SAS	SA-1.6	8/30/90	1655	24.0-27.0		X	X	
1220	SAS	SA-1.6	8/30/90	1705	24.0-27.0	DUP	X	X	

Spoil Area 1 Sample Tracking (page 5 of 5)									
							VOA		
								Sample Suite	
Number	Label	Station	Date	Time	Depth	QA/QC			Remarks
1300	SAF	SA-1.5B	8/27/90	1220		FIELD	X		MGM DI/OF
1302	SAT	SA-1.5B	8/27/90	1225		TRIP	X		BLANK
1304	SAE	SA-1.5B	8/28/90	1140		EQUIP	X	X	SPLIT SPOON
1305	SAE	SA-1.3	8/29/90	1300			X	X	
1306	SAT	SA-1.3	8/29/90	1645		TRIP	X		BLANK
1307	SAT	SA-1.3	8/30/90	0710		TRIP	X		BLANK
1308	SAE	SA-1.3	8/30/90	1345		EQUIP	X	X	SPLIT SPOON
1309	SAE	SA-1.6	8/31/90	0900		EQUIP	X	X	SPLIT SPOON
1310	SAT	SA-1.6	8/31/90	0845		TRIP	X		BLANK

OROSA1/083.51

ANALYTICAL DATA

Key to Analysis Qualifier Fields

Analyte	Concentration units	Concentration	A	B	C
Acetone	mg/kg	0.014	U	Y	UJ

Qualifier fields are fields A, B, and C following the numeric concentration value. Values that can appear in each field include:

- A = Detection Field
  - U = less than detection limit
  - D = detected
  - R = rejected
- B = Validation Field
  - Y = yes, validated
  - N = No, not validated
- C = Flag Field
  - UJ = not detected and detection limit is estimated
  - JN = tentatively identified and estimated
  - J = estimated

MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
11A	75-34-3	1,1-DICHLOROETHANE
DCE	540-59-0	1,2-DICHLOROETHENE (TOTAL)
2BU	78-93-3	2-BUTANONE
4M2	108-10-1	4-METHYL-2-PENTANONE
ACT	67-64-1	ACETONE
BEN	71-43-2	BENZENE
CDS	75-15-0	CARBON DISULFIDE
CFM	67-66-3	CHLOROFORM
MCL	75-09-2	METHYLENE CHLORIDE
PCE	127-18-4	TETRACHLOROETHENE
TOL	108-88-3	TOLUENE
XY	1330-20-7	XYLENE (TOTAL)

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

SAMPLE ID:	01001	01004	01007	01009	01010
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.1	SA-1.1
SAMPLE DATE:	08/14/1990	08/14/1990	08/14/1990	08/14/1990	08/14/1990
SAMPLE TIME:	10:54	13:58	14:29	16:45	16:45
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	10.50	13.50	19.50	19.50
LOWER DEPTH:	6.00	12.00	15.00	21.00	21.00
1,1-DICHLOROETHANE MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.008UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.008UY
2-BUTANONE MG/KG	0.012UY	0.012UY	0.013UY	0.012UY	0.015UY
4-METHYL-2-PENTANONE MG/KG	0.012UY	0.012DY	0.013UY	0.012UY	0.015UY
ACETONE MG/KG	0.22DYJ	0.045DYJ	0.013UY	0.012UY	0.015UY
BENZENE MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.008UY
CARBON DISULFIDE MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.008UY
CHLOROFORM MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.008UY
METHYLENE CHLORIDE MG/KG	0.002DY	0.002DY	0.002DY	0.002DY	0.002DY
TETRACHLOROETHENE MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.008UY
TOLUENE MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.008UY
XYLENE (TOTAL) MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.008UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01020	01022	01024	01027	01029
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.1	SA-1.1
SAMPLE DATE:	08/15/1990	08/15/1990	08/15/1990	08/15/1990	08/15/1990
SAMPLE TIME:	08:37	10:18	13:37	15:05	15:05
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	24.00	28.50	34.50	39.00	39.00
LOWER DEPTH:	25.50	30.00	35.00	40.50	40.50
1,1-DICHLOROETHANE MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.007UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.007UY
2-BUTANONE MG/KG	0.014UY	0.014UY	0.014UY	0.015UY	0.014UY
4-METHYL-2-PENTANONE MG/KG	0.014UY	0.014UY	0.014UY	0.015UY	0.014UY
ACETONE MG/KG	0.014UY	0.014UYUJ	0.014UYUJ	0.014UYUJ	0.014UYUJ
BENZENE MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.007UY
CARBON DISULFIDE MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.007UY
CHLOROFORM MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.007UY
METHYLENE CHLORIDE MG/KG	0.002DY	0.009UYUJ	0.009UYUJ	0.009UYUJ	0.007UYUJ
TETRACHLOROETHENE MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.007UY
TOLUENE MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.007UY
XYLENE (TOTAL) MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.007UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01030	01031	01032	01033	01034
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.2	SA-1.2	SA-1.2	SA-1.2	SA-1.2
SAMPLE DATE:	08/16/1990	08/16/1990	08/16/1990	08/16/1990	08/16/1990
SAMPLE TIME:	09:12	09:56	11:03	11:33	12:57
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	9.00	13.50	13.50	19.50
LOWER DEPTH:	6.00	10.50	16.50	16.50	21.00
1,1-DICHLOROETHANE MG/KG	0.006UY	0.006UY	0.007UY	0.007UY	0.007UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.006UY	0.006UY	0.007UY	0.007UY	0.007UY
2-BUTANONE MG/KG	0.013UY	0.012UY	0.013UY	0.013UY	0.014UY
4-METHYL-2-PENTANONE MG/KG	0.013UY	0.012UY	0.013UY	0.013UY	0.014UY
ACETONE MG/KG	0.013UYUJ	0.015UYUJ	0.013UYUJ	0.013UYUJ	0.014UY
BENZENE MG/KG	0.006UY	0.006UY	0.007UY	0.007UY	0.007UY
CARBON DISULFIDE MG/KG	0.006UY	0.006UY	0.007UY	0.007UY	0.007UY
CHLOROFORM MG/KG	0.006UY	0.006UY	0.007UY	0.007UY	0.007UY
METHYLENE CHLORIDE MG/KG	0.006UYUJ	0.008UYUJ	0.007UYUJ	0.007UYUJ	0.007UYUJ
TETRACHLOROETHENE MG/KG	0.006UY	0.006UY	0.007UY	0.007UY	0.007UY
TOLUENE MG/KG	0.006UY	0.006UY	0.007UY	0.007UY	0.007UY
XYLENE (TOTAL) MG/KG	0.006UY	0.006UY	0.007UY	0.007UY	0.007UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01035	01100	01101	01102	01103
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.2	SA-1.4	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/16/1990	08/18/1990	08/18/1990	08/18/1990	08/18/1990
SAMPLE TIME:	13:47	08:22	09:35	08:59	10:10
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	24.00	4.50	4.50	9.00	13.50
LOWER DEPTH:	25.50	7.50	7.50	10.50	15.00
1,1-DICHLOROETHANE MG/KG	0.007UY	0.006UY	0.006UY	0.006UY	0.006UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.007UY	0.006UY	0.006UY	0.006UY	0.006UY
2-BUTANONE MG/KG	0.015UY	0.012UY	0.012UY	0.012UY	0.012UY
4-METHYL-2-PENTANONE MG/KG	0.015UY	0.012UY	0.012UY	0.012UY	0.012UY
ACETONE MG/KG	0.015UYUJ	0.012UYUJ	0.012UYUJ	0.012UY	0.012UYUJ
BENZENE MG/KG	0.007UY	0.006UY	0.006UY	0.006UY	0.006UY
CARBON DISULFIDE MG/KG	0.007UY	0.006UY	0.006UY	0.006UY	0.006UY
CHLOROFORM MG/KG	0.007UY	0.006UY	0.006UY	0.006UY	0.006UY
METHYLENE CHLORIDE MG/KG	0.009UYUJ	0.006UYUJ	0.039UYUJ	0.018UYUJ	0.013UYUJ
TETRACHLOROETHENE MG/KG	0.007UY	0.006UY	0.006UY	0.006UY	0.006UY
TOLUENE MG/KG	0.007UY	0.006UY	0.006UY	0.006UY	0.006UY
XYLENE (TOTAL) MG/KG	0.007UY	0.006UY	0.006UY	0.006UY	0.006UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01105	01106	01107	01108	01109
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/18/1990	08/19/1990	08/19/1990	08/19/1990
SAMPLE TIME:	11:08	12:58	08:58	10:22	11:30
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	19.50	24.00	28.50	34.50	39.00
LOWER DEPTH:	21.00	25.50	30.00	37.50	40.50
1,1-DICHLOROETHANE MG/KG	0.007DYJ	0.006UY	0.007UY	0.005UY	0.008UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.006UY	0.006UY	0.007UY	0.005UY	0.008UY
2-BUTANONE MG/KG	0.012UY	0.001DYJ	0.003DYJ	0.001DYJ	0.016UY
4-METHYL-2-PENTANONE MG/KG	0.012UY	0.012UY	0.014UY	0.01UY	0.016UY
ACETONE MG/KG	0.012UYUJ	0.012UYUJ	0.014UYUJ	0.01UYUJ	0.016UYUJ
BENZENE MG/KG	0.006UY	0.006UY	0.007UY	0.005UY	0.008UY
CARBON DISULFIDE MG/KG	0.006UY	0.006UY	0.007UY	0.005UY	0.008UY
CHLOROFORM MG/KG	0.006UY	0.006UY	0.002DYJ	0.005UY	0.002DYJ
METHYLENE CHLORIDE MG/KG	0.009UYUJ	0.013UYUJ	0.009UYUJ	0.007UYUJ	0.014UYUJ
TETRACHLOROETHENE MG/KG	0.006UY	0.006UY	0.007UY	0.005UY	0.008UY
TOLUENE MG/KG	0.001DYJ	0.006UY	0.007UY	0.005UY	0.002DYJ
XYLENE (TOTAL) MG/KG	0.006UY	0.006UY	0.007UY	0.005UY	0.008UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
VOLATILE ORGANICS - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01110	01111	01112	01120	01121
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.5	SA-1.5
SAMPLE DATE:	08/19/1990	08/19/1990	08/19/1990	08/20/1990	08/21/1990
SAMPLE TIME:	13:28	15:24	16:40	17:29	08:21
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	43.50	49.50	54.00	4.50	9.00
LOWER DEPTH:	45.00	51.00	55.50	6.00	12.00
1,1-DICHLOROETHANE MG/KG	0.007UY	0.007UY	0.008UY	0.007UY	0.006UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.007UY	0.007UY	0.008UY	0.007UY	0.006UY
2-BUTANONE MG/KG	0.015UY	0.014UY	0.015UY	0.013UYUJ	0.012UY
4-METHYL-2-PENTANONE MG/KG	0.015UY	0.014UY	0.015UY	0.013UY	0.012UY
ACETONE MG/KG	0.015UYUJ	0.014UYUJ	0.015UYUJ	0.013UYUJ	0.012UYUJ
BENZENE MG/KG	0.007UY	0.007UY	0.008UY	0.007UY	0.006UY
CARBON DISULFIDE MG/KG	0.007UY	0.007UY	0.008UY	0.007UY	0.006UY
CHLOROFORM MG/KG	0.002DYJ	0.001DYJ	0.002DYJ	0.007UY	0.006UY
METHYLENE CHLORIDE MG/KG	0.01UYUJ	0.012UYUJ	0.016UYUJ	0.012UYUJ	0.008UYUJ
TETRACHLOROETHENE MG/KG	0.007UY	0.007UY	0.008UY	0.007UY	0.004DYJ
TOLUENE MG/KG	0.007UY	0.002DYJ	0.008UY	0.007UY	0.003DYJ
XYLENE (TOTAL) MG/KG	0.007UY	0.007UY	0.008UY	0.007UY	0.002DYJ

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
VOLATILE ORGANICS - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01122	01200	01201	01202	01203
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.5	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B
SAMPLE DATE:	08/21/1990	08/27/1990	08/27/1990	08/27/1990	08/27/1990
SAMPLE TIME:	09:21	14:00	14:30	15:55	16:45
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	9.00	16.50	19.50	24.00	28.50
LOWER DEPTH:	12.00	18.00	21.00	25.50	30.00
1,1-DICHLOROETHANE MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.006UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.002DYJ	0.006UY	0.006UY	0.006UY	0.006UY
2-BUTANONE MG/KG	0.012UY	0.012UYR	0.003DYJ	0.012UYR	0.001DYJ
4-METHYL-2-PENTANONE MG/KG	0.012UY	0.0'2U'	0.012UY	0.002DY	0.012UY
ACETONE MG/KG	0.012UYUJ	0.00?DY	0.019DY	0.006DY	0.013DY
BENZENE MG/KG	0.006UY	0.006UY	0.006UY	0.??6UY	0.006UY
CARBON DISULFIDE MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.003DY
CHLOROFORM MG/KG	0.006UY	0.006UYUJ	0.006UY	0.006UYUJ	0.006UY
METHYLENE CHLORIDE MG/KG	0.021UYUJ	0.006UYUJ	0.006UYUJ	0.006UYUJ	0.006UYUJ
TETRACHLOROETHENE MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	0.006DY
TOLUENE MG/KG	0.006UY	0.006UY	0.001DY	0.006UY	0.004DY
XYLENE (TOTAL) MG/KG	0.006UY	0.006UY	0.006UY	0.006UY	1.008DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01204	01205	01206	01207	01208
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.3
SAMPLE DATE:	08/28/1990	08/28/1990	08/28/1990	08/28/1990	08/29/1990
SAMPLE TIME:	10:30	10:55	13:00		13:30
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	39.50	39.50	44.00	48.50	4.50
LOWER DEPTH:	42.50	42.50	45.50	50.00	6.00
1,1-DICHLOROETHANE MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.006UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.006UY
2-BUTANONE MG/KG	0.011DYJ	0.014UYR	0.014UYR	0.014UY	0.013UY
4-METHYL-2-PENTANONE MG/KG	0.014UY	0.014UY	0.014UY	0.014UY	0.013UY
ACETONE MG/KG	0.083DY	0.013DY	0.008DY	0.014UYUJ	0.013UYUJ
BENZENE MG/KG	0.007UY	0.007UY	0.007UY	0.002DY	0.006UY
CARBON DISULFIDE MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.006UY
CHLOROFORM MG/KG	0.007UYUJ	0.007UYUJ	0.007UY	0.007UYUJ	0.006UYUJ
METHYLENE CHLORIDE MG/KG	0.007UYUJ	0.007UYUJ	0.007UYUJ	0.007UYUJ	0.006UYUJ
TETRACHLOROETHENE MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.006UY
TOLUENE MG/KG	0.002DY	0.001DY	0.007UY	0.002DY	0.006UY
XYLENE (TOTAL) MG/KG	0.007UY	0.007UY	0.007UY	0.007UY	0.006UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01209	01210	01211	01212	01213
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.3	SA-1.3	SA-1.3	SA-1.3	SA-1.3
SAMPLE DATE:	08/29/1990	08/29/1990	08/29/1990	08/29/1990	08/30/1990
SAMPLE TIME:	14:00	15:36	15:45	16:07	08:10
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	10.00	14.50	14.50	20.50	25.00
LOWER DEPTH:	11.50	17.50	17.50	22.00	26.50
1,1-DICHLOROETHANE MG/KG	0.006UY	0.007UY	0.007UY	0.008UY	0.007UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.006UY	0.007UY	0.007UY	0.008UY	0.007UY
2-BUTANONE MG/KG	0.012UY	0.014UY	0.014UY	0.015UY	0.015UYR
4-METHYL-2-PENTANONE MG/KG	0.012UY	0.014UY	0.014UY	0.015UY	0.015UY
ACETONE MG/KG	0.012UY	0.014UYUJ	0.014UYUJ	0.015UYUJ	0.015UYUJ
BENZENE MG/KG	0.006UY	0.007UY	0.007UY	0.008UY	0.007UY
CARBON DISULFIDE MG/KG	0.006UY	0.007UY	0.007UY	0.008UY	0.007UY
CHLOROFORM MG/KG	0.006UY	0.007UYUJ	0.007UYUJ	0.008UYUJ	0.007UYUJ
METHYLENE CHLORIDE MG/KG	0.006UYUJ	0.007UYUJ	0.007UYUJ	0.008UYUJ	0.008UYUJ
TETRACHLOROETHENE MG/KG	0.006UY	0.007UY	0.007UY	0.008UY	0.007UY
TOLUENE MG/KG	0.006UY	0.007UY	0.007UY	0.008UY	0.007UY
XYLENE (TOTAL) MG/KG	0.006UY	0.007UY	0.007UY	0.008UY	0.007UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01214	01215	01216	01217	01218
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.3	SA-1.6	SA-1.6	SA-1.6	SA-1.6
SAMPLE DATE:	08/30/1990	08/30/1990	08/30/1990	08/30/1990	08/30/1990
SAMPLE TIME:	08:46	14:05	14:40	15:35	16:30
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	29.50	4.50	9.00	13.50	19.50
LOWER DEPTH:	31.00	6.00	10.50	15.00	21.00
1,1-DICHLOROETHANE MG/KG	0.007UY	0.006UY	0.006UY	0.007UY	0.008UY
1,2-DICHLOROETHENE (TOTAL) MG/KG	0.007UY	0.006UY	0.002DY	0.007UY	0.008UY
2-BUTANONE MG/KG	0.014UYR	0.012UYUJ	0.012UYR	0.015UYR	0.016UYUJ
4-METHYL-2-PENTANONE MG/KG	0.014UY	0.012UY	0.012UY	0.015UY	0.016UY
ACETONE MG/KG	0.014UYUJ	0.012UYUJ	0.012UY	0.015UY	0.016UY
BENZENE MG/KG	0.007UY	0.006UY	0.006UY	0.007UY	0.008UY
CARBON DISULFIDE MG/KG	0.007UY	0.006UY	0.006UY	0.007UY	0.008UY
CHLOROFORM MG/KG	0.007UYUJ	0.007UYUJ	0.006UYUJ	0.007UYUJ	0.008UYUJ
METHYLENE CHLORIDE MG/KG	0.008UYUJ	0.006UYUJ	0.006UYUJ	0.007UYUJ	0.008UYUJ
TETRACHLOROETHENE MG/KG	0.007UY	0.006UY	0.001DY	0.007UY	0.008UY
TOLUENE MG/KG	0.007UY	0.006UY	0.006UY	0.007UY	0.008UY
XYLENE (TOTAL) MG/KG	0.007UY	0.006UY	0.006UY	0.007UY	0.008UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
VOLATILE ORGANICS - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01219	01220
SUB-SAMPLE ID:	00000	00000
STATION ID:	SA-1.6	SA-1.6
SAMPLE DATE:	08/30/1990	08/30/1990
SAMPLE TIME:	16:55	17:05
SAMPLE MATRIX:	SB	SB
UPPER DEPTH:	24.00	24.00
LOWER DEPTH:	27.00	27.00
1,1-DICHLOROETHANE MG/KG	0.007UY	0.007UY
1,2-DICHLORCETHENE (TOTAL) MG/KG	0.007UY	0.007UY
2-BUTANONE MG/KG	0.015UYR	0.015UYR
4-METHYL-2-PENTANONE MG/KG	0.015UY	0.015UY
ACETONE MG/KG	0.015UY	0.015UY
BENZENE MG/KG	0.007UY	0.007UY
CARBON DISULFIDE MG/KG	0.007UY	0.007UY
CHLOROFORM MG/KG	0.007UY	0.007UY
METHYLENE CHLORIDE MG/KG	0.007UYUJ	0.007UYUJ
TETRACHLOROETHENE MG/KG	0.007UY	0.007UY
TOLUENE MG/KG	0.007UY	0.007UY
XYLENE (TOTAL) MG/KG	0.007UY	0.007UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
BDM	75-27-4	BROMODICHLOROMETHANE
CCL	56-23-5	CARBON TETRACHLORIDE
CFM	67-66-3	CHLOROFORM
DBC	124-48-1	DIBROMOCHLOROMETHANE
MCL	75-09-2	METHYLENE CHLORIDE
PCE	127-18-4	TETRACHLOROETHENE
TOL	108-88-3	TOLUENE
XY	1330-20-7	XYLENE (TOTAL)

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

EDMS CHEMICAL OBSERVATIONS MATRIX
VOLATILE ORGANICS - AQUEOUS SAMPLES
SPOIL AREA 1 - DETECTED OBSERVATIONS

SAMPLE ID:	01000	01050	01061	01062	01070
SUB-SAMPLE ID:	SAT	SAT	SAE	SAE	SAF
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.2	SA-1.2
SAMPLE DATE:	08/14/1990	08/15/1990	08/16/1990	08/16/1990	08/16/1990
SAMPLE TIME:					
SAMPLE MATRIX:	AQ	AQ	AQ	AQ	AQ
UPPER DEPTH:					
LOWER DEPTH:					
BROMODICHLOROMETHANE UG/L	5UY	5UY	5UY	5UY	5DY
CARBON TETRACHLORIDE UG/L	5UY	5UY	5UY	5UY	5UY
CHLOROFORM UG/L	5UY	5UY	5UY	5UY	23DY
DIBROMOCHLOROMETHANE UG/L	5UY	5UY	5UY	5UY	5UY
METHYLENE CHLORIDE UG/L	5UYUJ	5UYUJ	5UYUJ	5UYUJ	5UYUJ
TETRACHLOROETHENE UG/L	5UY	5UY	5UY	5UY	7DY
TOLUENE UG/L	5UY	5UY	5UY	5UY	3DY
XYLENE (TOTAL) UG/L	5UY	5UY	5UY	5UY	5UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
VOLATILE ORGANICS - AQUEOUS SAMPLES
SPOIL AREA 1 - DETECTED OBSERVATIONS

SAMPLE ID:	01071	01072	01150	01151	01152
SUB-SAMPLE ID:	SAF	SAF	SAT	SAT	SAT
STATION ID:	SA-1.2	SA-1.2	SA-1.4	SA-1.4	SA-1.5B
SAMPLE DATE:	08/16/1990	08/16/1990		08/18/1990	08/20/1990
SAMPLE TIME:					
SAMPLE MATRIX:	AQ	AQ	AQ	AQ	AQ
UPPER DEPTH:					
LOWER DEPTH:					
BROMODICHLOROMETHANE UG/L	5UY	5UY	5UY	5UY	5UY
CARBON TETRACHLORIDE UG/L	5UY	5UY	3DY	5UY	5UY
CHLOROFORM UG/L	5UY	5UY	5UY	5UY	5UY
DIBROMOCHLOROMETHANE UG/L	5UY	5UY	5UY	5UY	5UY
METHYLENE CHLORIDE UG/L	120DYJ	5UYUJ	9DY	5UY	12DY
TETRACHLOROETHENE UG/L	5UY	5UY	5UY	5UY	5UY
TOLUENE UG/L	5UY	5UY	5UY	5UY	5UY
XYLENE (TOTAL) UG/L	5UY	5UY	5UY	5UY	5UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
VOLATILE ORGANICS - AQUEOUS SAMPLES
SPOIL AREA 1 - DETECTED OBSERVATIONS

SAMPLE ID:	01153	01160	01300	01302	01304
SUB-SAMPLE ID:	SAT	SAE	SAF	SAT	SAE
STATION ID:	SA-1.5	SA-1.4	SA-1.5B	SA-1.5B	SA-1.5B
SAMPLE DATE:	08/21/1990	08/18/1990	08/27/1990	08/27/1990	08/28/1990
SAMPLE TIME:					
SAMPLE MATRIX:	AQ	AQ	AQ	AQ	AQ
UPPER DEPTH:					
LOWER DEPTH:					
BROMODICHLOROMETHANE UG/L	5UY	5UY	5DY	5UY	5UY
CARBON TETRACHLORIDE UG/L	5UY	5UY	5UY	5UY	5UY
CHLOROFORM UG/L	5UY	5UY	35DY	5UY	5UY
DIBROMOCHLOROMETHANE UG/L	5UY	5UY	1DY	5UY	5UY
METHYLENE CHLORIDE UG/L	16DY	5UY	5UYUJ	14UYUJ	30DYJ
TETRACHLOROETHENE UG/L	5UY	5UY	5UY	5UY	5UY
TOLUENE UG/L	5UY	5UY	5UY	5UY	5UY
XYLENE (TOTAL) UG/L	5UY	5UY	1DY	5UY	5UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
VOLATILE ORGANICS - AQUEOUS SAMPLES
SPOIL AREA 1 - DETECTED OBSERVATIONS

SAMPLE ID:	01305	01306	01307	01308	01309
SUB-SAMPLE ID:	SAE	SAT	SAT	SAE	SAE
STATION ID:	SA-1.3	SA-1.3	SA-1.3	SA-1.3	SA-1.6
SAMPLE DATE:	08/29/1990	08/29/1990	08/30/1990	08/30/1990	08/31/1990
SAMPLE TIME:					
SAMPLE MATRIX:	AQ	AQ	AQ	AQ	AQ
UPPER DEPTH:					
LOWER DEPTH:					
BROMODICHLOROMETHANE UG/L	5UY	5UY	5UY	5UY	5UY
CARBON TETRACHLORIDE UG/L	5UY	5UY	5UY	5UY	5UY
CHLOROFORM UG/L	5UY	5UY	5UY	5UY	5UY
DIBROMOCHLOROMETHANE UG/L	5UY	5UY	5UY	5UY	5UY
METHYLENE CHLORIDE UG/L	8UYUJ	74DYJ	5UYUJ	7UYUJ	5UYUJ
TETRACHLOROETHENE UG/L	5UY	5UY	5UY	5UY	5UY
TOLUENE UG/L	5UY	5UY	5UY	5UY	5UY
XYLENE (TOTAL) UG/L	5UY	5UY	5UY	5UY	5UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
VOLATILE ORGANICS - AQUEOUS SAMPLES
SPOIL AREA 1 - DETECTED OBSERVATIONS

SAMPLE ID:	01310	01310
SUB-SAMPLE ID:	SAT	SATDL
STATION ID:	SA-1.6	SA-1.6
SAMPLE DATE:	08/31/1990	08/31/1990
SAMPLE TIME:		
SAMPLE MATRIX:	AQ	AQ
UPPER DEPTH:		
LOWER DEPTH:		
BROMODICHLOROMETHANE UG/L	5UY	500UN
CARBON TETRACHLORIDE UG/L	5UY	500UN
CHLOROFORM UG/L	5UY	130DN
DIBROMOCHLOROMETHANE UG/L	5UY	500UN
METHYLENE CHLORIDE UG/L	11000DYJ	11000DN
TETRACHLOROETHENE UG/L	5UY	500UN
TOLUENE UG/L	5UY	180DN
XYLENE (TOTAL) UG/L	5UY	500UN

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MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
2MN	91-57-6	2-METHYLNAPHTHALENE
ACN	83-32-9	ACENAPHTHENE
ACY	208-96-8	ACENAPHTHYLENE
ATR	120-12-7	ANTHRACENE
BAA	56-55-3	BENZO(A)ANTHRACENE
BAP	50-32-8	BENZO(A)PYRENE
BBF	205-99-2	BENZO(B)FLUORANTHENE
BGP	191-24-2	BENZO(GHI)PERYLENE
BKF	207-08-9	BENZO(K)FLUORANTHENE
BZA	65-85-0	BENZOIC ACID
BBP	85-68-7	BENZYL BUTYL PHTHALATE
BPH	117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE
CRY	218-01-9	CHRYSENE
DBF	132-64-9	DIBENZOFURAN
DEP	84-66-2	DIETHYL PHTHALATE
DMP	131-11-3	DIMETHYL PHTHALATE
FLA	206-44-0	FLUORANTHENE
FLE	86-73-7	FLUORENE
ICP	193-39-5	INDENO(1,2,3-CD)PYRENE
NAP	91-20-3	NAPHTHALENE
PAN	85-01-8	PHENANTHRENE
PYR	129-00-0	PYRENE

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

SAMPLE ID:	01002	01005	01008	01011	01021
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.1	SA-1.1
SAMPLE DATE:	08/14/1990	08/14/1990	08/14/1990	08/14/1990	08/15/1990
SAMPLE TIME:	10:54	13:58	14:29	16:45	08:37
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	10.50	13.50	19.50	24.00
LOWER DEPTH:	6.00	12.00	15.00	21.00	25.50
2-METHYLNAPHTHALENE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
ACENAPHTHENE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
ACENAPHTHYLENE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
ANTHRACENE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
BENZO(A)ANTHRACENE MG/KG	0.230YJ	0.45UY	0.4UY	0.47UY	0.45UY
BENZO(A)PYRENE MG/KG	0.22DYJ	0.45UY	0.4UY	0.47UY	0.45UY
BENZO(B)FLUORANTHENE MG/KG	0.31DYJ	0.45UY	0.4UY	0.47UY	0.45UY
BENZO(GHI)PERYLENE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
BENZO(K)FLUORANTHENE MG/KG	0.31DYJ	0.45UY	0.4UY	0.47UY	0.45UY
BENZOIC ACID MG/KG	8.7UY	2.2UY	1.9UY	2.3UY	2.2UY
BENZYL BUTYL PHTHALATE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	1.8UYUJ	0.94UYUJ	1.9UYUJ	1.4UYUJ	1.9UYUJ
CHRYSENE MG/KG	0.27DYJ	0.45UY	0.4UY	0.47UY	0.45UY
DIBENZOFURAN MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
DIETHYL PHTHALATE MG/KG	1.8UY	0.077DYJ	0.4UY	0.47UY	0.45UY
DIMETHYL PHTHALATE MG/KG	1.8UY	0.064DYJ	0.4UY	0.47UY	0.45UY
FLUORANTHENE MG/KG	0.450YJ	0.45UY	0.4UY	0.47UY	0.45UY
FLUORENE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
INDENO(1,2,3-CD)PYRENE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
NAPHTHALENE MG/KG	1.8UY	0.45UY	0.4UY	0.47UY	0.45UY
PHENANTHRENE MG/KG	0.19DYJ	0.45UY	0.4UY	0.47UY	0.45UY
PYRENE MG/KG	0.38DYJ	0.45UY	0.4UY	0.47UY	0.45UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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SAMPLE ID:	01023	01025	01026	01028	01030
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.1	SA-1.2
SAMPLE DATE:	08/15/1990	08/15/1990	08/15/1990	08/15/1990	08/16/1990
SAMPLE TIME:	10:18	13:37	13:37	15:05	09:12
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	28.50	34.50	34.50	39.00	4.50
LOWER DEPTH:	30.00	35.00	35.00	40.50	6.00
2-METHYLNAPHTHALENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
ACENAPHTHENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
ACENAPHTHYLENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
ANTHRACENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
BENZO(A)ANTHRACENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
BENZO(A)PYRENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
BENZO(B)FLUORANTHENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
BENZO(GHI)PERYLENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
BENZO(K)FLUORANTHENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
BENZOIC ACID MG/KG	4.5UY	4.4UY	4.3UY	2.3UY	1.9UY
BENZYL BUTYL PHTHALATE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	0.92UYUJ	0.91UYUJ	1.2UYUJ	0.63UYUJ	0.4UYUJ
CHRYSENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
DIBENZOFURAN MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
DIETHYL PHTHALATE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
DIMETHYL PHTHALATE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
FLUORANTHENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
FLUORENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
INDENO(1,2,3-CD)PYRENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
NAPHTHALENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
PHENANTHRENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY
PYRENE MG/KG	0.92UY	0.91UY	0.89UY	0.48UY	0.4UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01031	01032	01033	01034	01035
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.2	SA-1.2	SA-1.2	SA-1.2	SA-1.2
SAMPLE DATE:	08/16/1990	08/16/[illegible]	08/16/1990	08/16/1990	08/16/1990
SAMPLE TIME:	09:56	1[illegible]03	11:33	12:57	13:47
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	9.00	13.50	13.50	19.50	24.00
LOWER DEPTH:	10.50	16.50	16.50	21.00	25.50
2-METHYLNAPHTHALENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
ACENAPHTHENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
ACENAPHTHYLENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
ANTHRACENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
BENZO(A)ANTHRACENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
BENZO(A)PYRENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
BENZO(B)FLUORANTHENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
BENZO(GHI)PERYLENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
BENZO(K)FLUORANTHENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
BENZOIC ACID MG/KG	1.9UY	2.1UY	2.2UY	2.3UY	1.8UY
BENZYL BUTYL PHTHALATE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	0.58UYUJ	0.68UYUJ	0.45UYUJ	0.51UYUJ	0.75UYUJ
CHRYSENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
DIBENZOFURAN MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
DIETHYL PHTHALATE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
DI[illegible]L PHTHALATE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
FLUORANTHENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
FLUORENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
INDENO(1,2,3-CD)PYRENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
NAPHTHALENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
PHENANTHRENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY
PYRENE MG/KG	0.4UY	0.44UY	0.45UY	0.47UY	0.38UY

NNN+/-XXABCCC[illegible]OSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than [illegible]ction limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01100	01101	01102	01103	01105
SUB-SAMPLE ID:	00000	00000	30000	30000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/18/1990	08/18/1990	08/18/1990	08/18/1990
SAMPLE TIME:	08:22	09:35	08:59	10:10	11:08
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	4.50	9.30	13.50	19.50
LOWER DEPTH:	7.50	7.50	10.50	15.00	21.00
2-METHYLNAPHTHALENE MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
ACENAPHTHENE MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
ACENAPHTHYLENE MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
ANTHRACENE MG/KG	0.4UY	0.4UY	0.38UY	0.25DYJ	0.38UY
BENZO(A)ANTHRACENE MG/KG	0.4UY	0.4UY	0.38UY	0.85DYJ	0.38UY
BENZO(A)PYRENE MG/KG	0.4UY	0.4UY	0.38UY	0.67DYJ	0.38UY
BENZO(B)FLUORANTHENE MG/KG	0.4UY	0.4UY	0.38UY	0.33DYJ	0.38UY
BENZO(GHI)PERYLENE MG/KG	0.4UY	0.4UY	0.38UY	0.34DYJ	0.38UY
BENZO(K)FLUORANTHENE MG/KG	0.4UY	0.4UY	0.38UY	1DYJ	0.38UY
BENZOIC ACID MG/KG	1.9UY	1.9UY	1.9UY	7.6UY	1.8UY
BENZYL BUTYL PHTHALATE MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	1.2UYUJ	1.7UYUJ	0.75UYUJ	0.88UYUJ	0.57UYUJ
CHRYSENE MG/KG	0.4UY	0.4UY	0.38UY	0.75DYJ	0.38UY
DIBENZOFURAN MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
DIETHYL PHTHALATE MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
DIMETHYL PHTHALATE MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
FLUORANTHENE MG/KG	0.4UY	0.4UY	0.38UY	1.8DYJ	0.07DYJ
FLUORENE MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
INDENO(1,2,3-CD)PYRENE MG/KG	0.4UY	0.4UY	0.38UY	0.33DYJ	0.38UY
NAPHTHALENE MG/KG	0.4UY	0.4UY	0.38UY	1.6UY	0.38UY
PHENANTHRENE MG/KG	0.4UY	0.4UY	0.38UY	0.23DYJ	0.059DYJ
PYRENE MG/KG	0.4UY	0.4UY	0.38UY	1.4DYJ	0.055DYJ

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NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01106	01107	01108	01109	01110
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/19/1990	08/19/1990	08/19/1990	08/19/1990
SAMPLE TIME:	12:58	08:58	10:22	11:30	13:28
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	24.00	28.50	34.50	39.00	43.50
LOWER DEPTH:	25.50	30.00	37.50	40.50	45.00
2-METHYLNAPHTHALENE MG/KG	0.77UY	0.46UY	2.7UY	0.52UY	0.49UY
ACENAPHTHENE MG/KG	0.079DYJ	0.46UY	0.32DYJ	0.52UY	0.49UY
ACENAPHTHYLENE MG/KG	0.11DYJ	0.46UY	2.7UY	0.52UY	0.49UY
ANTHRACENE MG/KG	0.23DYJ	0.46UY	0.85DYJ	0.52UY	0.49UY
BENZO(A)ANTHRACENE MG/KG	0.65DYJ	0.46UY	1.7DYJ	0.52UY	0.49UY
BENZO(A)PYRENE MG/KG	0.51DYJ	0.46UY	1.3DYJ	0.52UY	0.49UY
BENZO(B)FLUORANTHENE MG/KG	0.44DYJ	0.46UY	1.3DYJ	0.52UY	0.49UY
BENZO(GHI)PERYLENE MG/KG	0.28DYJ	0.46UY	0.61DYJ	0.52UY	0.49UY
BENZO(K)FLUORANTHENE MG/KG	0.57DYJ	0.46UY	1.3DYJ	0.52UY	0.49UY
BENZOIC ACID MG/KG	3.7UY	2.2UY	13UY	2.5UY	2.4UY
BENZYL BUTYL PHTHALATE MG/KG	0.77UY	0.46UY	2.7UY	0.52UY	0.49UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	0.92UYUJ	1.7UYUJ	1.7UYUJ	0.95UYUJ	0.98UYUJ
CHRYSENE MG/KG	0.60YJ	0.46UY	1.6DYJ	0.52UY	0.49UY
DIBENZOFURAN MG/KG	0.25DYJ	0.46UY	2.7UY	0.52UY	0.49UY
DIETHYL PHTHALATE MG/KG	0.77UY	0.46UY	2.7UY	0.52UY	0.49UY
DIMETHYL PHTHALATE MG/KG	0.77UY	0.46UY	2.7UY	0.52UY	0.49UY
FLUORANTHENE MG/KG	1.6DYJ	0.46UY	3.9DYJ	0.52UY	0.49UY
FLUORENE MG/KG	0.24DYJ	0.46UY	0.41DYJ	0.52UY	0.49UY
INDENO(1,2,3-CD)PYRENE MG/KG	0.27DYJ	0.46UY	0.60YJ	0.52UY	0.49UY
NAPHTHALENE MG/KG	0.12DYJ	0.46UY	2.7UY	0.52UY	0.49UY
PHENANTHRENE MG/KG	1.5DYJ	0.46UY	3.4DYJ	0.52UY	0.49UY
PYRENE MG/KG	1.2DYJ	0.46UY	2.7DYJ	0.52UY	0.49UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01111	01112	01112	01120	01121
SUB-SAMPLE ID:	00000	00000	RE	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.5	SA-1.5
SAMPLE DATE:	08/19/1990	08/19/1990	08/19/1990	08/20/1990	08/21/1990
SAMPLE TIME:	15:24	16:40	16:40	17:29	08:21
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	49.50	54.00	54.00	4.50	9.00
LOWER DEPTH:	51.00	55.50	55.50	6.00	12.00
2-METHYLNAPHTHALENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.5UY
ACENAPHTHENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.5UY
ACENAPHTHYLENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.5UY
ANTHRACENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.32DYJ
BENZO(A)ANTHRACENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.61DYJ
BENZO(A)PYRENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.48DYJ
BENZO(B)FLUORANTHENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.42DYJ
BENZO(GHI)PERYLENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.28DYJ
BENZO(K)FLUORANTHENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.58DYJ
BENZOIC ACID MG/KG	4.6UY	4.8UY	4.8UN	4.2UY	7.4UY
BENZYL BUTYL PHTHALATE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.5UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	0.94UYUJ	0.17UYUJ	0.16DN	0.65UYUJ	0.73UYUJ
CHRYSENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.57DYJ
DIBENZOFURAN MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.5UY
DIETHYL PHTHALATE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.5UY
DIMETHYL PHTHALATE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.5UY
FLUORANTHENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.40YJ
FLUORENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.18DYJ
INDENO(1,2,3-CD)PYRENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	0.26DYJ
NAPHTHALENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1.5UY
PHENANTHRENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1DYJ
PYRENE MG/KG	0.95UY	0.99UY	0.99UN	0.88UY	1DYJ

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01122	01200	01201	01202	01202
SUB-SAMPLE ID:	00000	00000	00000	00000	DIS
STATION ID:	SA-1.5	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B
SAMPLE DATE:	08/21/1990	08/27/1990	08/27/1990	08/27/1990	08/27/1990
SAMPLE TIME:	09:21	14:00	14:30	15:55	15:55
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	9.00	16.50	19.50	24.00	24.00
LOWER DEPTH:	12.00	18.00	21.00	25.50	25.50
2-METHYLNAPHTHALENE MG/KG	0.78UY	1.9UY	0.098DYJ	0.4UY	0.82UN
ACENAPHTHENE MG/KG	0.11DYJ	1.9UY	0.41DYJ	0.4UY	0.82UN
ACENAPHTHYLENE MG/KG	0.78UY	1.9UY	0.79UY	0.4UY	0.82UN
ANTHRACENE MG/KG	0.14DYJ	1.9UY	0.76DYJ	0.4UY	0.82UN
BENZO(A)ANTHRACENE MG/KG	0.14DYJ	0.2DYJ	1.6DYJ	0.4UY	0.22DN
BENZO(A)PYRENE MG/KG	0.12DYJ	1.9UY	1.3DYJ	0.4UY	0.15DN
BENZO(B)FLUORANTHENE MG/KG	0.11DYJ	1.9UY	1.4DYJ	0.4UY	0.16DN
BENZO(GHI)PERYLENE MG/KG	0.085DYJ	1.9UY	0.8DYJ	0.4UY	0.12DN
BENZO(K)FLUORANTHENE MG/KG	0.15DYJ	1.9UY	1.4DYJ	0.4UY	0.2DN
BENZOIC ACID MG/KG	3.8UY	9.4UY	3.8UY	1.9UY	4UN
BENZYL BUTYL PHTHALATE MG/KG	0.78UY	1.9UY	0.79UY	0.4UY	0.82UN
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	1.2UYUJ	0.51DYJ	0.87DYJ	0.46DYJ	0.91DN
CHRYSENE MG/KG	0.16DYJ	0.26DYJ	1.7DYJ	0.4UY	0.29DN
DIBENZOFURAN MG/KG	0.17DYJ	1.9UY	0.24DYJ	0.4UY	0.82UN
DIETHYL PHTHALATE MG/KG	0.78UY	1.9UY	0.79UY	0.4UY	0.82UN
DIMETHYL PHTHALATE MG/KG	0.78UY	1.9UY	0.79UY	0.4UY	0.82UN
FLUORANTHENE MG/KG	0.48DYJ	0.61DYJ	4.1DYJ	0.4UY	0.56DN
FLUORENE MG/KG	0.23DYJ	1.9UY	0.45DYJ	0.4UY	0.82UN
INDENO(1,2,3-CD)PYRENE MG/KG	0.78UY	1.9UY	0.77DYJ	0.4UY	0.099DN
NAPHTHALENE MG/KG	0.15DYJ	1.9UY	0.21DYJ	0.4UY	0.82UN
PHENANTHRENE MG/KG	0.65DYJ	0.47DYJ	3.6DYJ	0.4UY	0.43DN
PYRENE MG/KG	0.34DYJ	0.54DYJ	3.1DYJ	0.4UY	0.49DN

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01203	01204	01205	01206	01207
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B
SAMPLE DATE:	08/27/1990	08/28/1990	08/28/1990	08/28/1990	08/28/1990
SAMPLE TIME:	16:45	10:30	10:55	13:00	
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	28.50	39.50	39.50	44.00	48.50
LOWER DEPTH:	30.00	42.50	42.50	45.50	50.00
2-METHYLNAPHTHALENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
ACENAPHTHENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
ACENAPHTHYLENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
ANTHRACENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
BENZO(A)ANTHRACENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
BENZO(A)PYRENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
BENZO(B)FLUORANTHENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
BENZO(GHI)PERYLENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
BENZO(K)FLUORANTHENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
BENZOIC ACID MG/KG	1.9UY	2.2UY	2.2UY	2.3UY	2.3UY
BENZYL BUTYL PHTHALATE MG/KG	0.4UY	0.46UY	0.45UY	0.069DY	0.47UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	0.89DYJ	0.88DY	1.2DY	0.52DY	0.47UYUJ
CHRYSENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
DIBENZOFURAN MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
DIETHYL PHTHALATE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
DIMETHYL PHTHALATE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
FLUORANTHENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
FLUORENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
INDENO(1,2,3-CD)PYRENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
NAPHTHALENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
PHENANTHRENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY
PYRENE MG/KG	0.4UY	0.46UY	0.45UY	0.47UY	0.47UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01208	01209	01210	01211	01212
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.3	SA-1.3	SA-1.3	SA-1.3	SA-1.3
SAMPLE DATE:	08/29/1990	08/29/1990	08/29/1990	08/29/1990	08/29/1990
SAMPLE TIME:	13:30	14:00	15:36	15:45	16:07
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	10.00	14.50	14.50	20.50
LOWER DEPTH:	6.00	11.50	17.50	17.50	22.00
2-METHYLNAPHTHALENE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
ACENAPHTHENE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
ACENAPHTHYLENE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
ANTHRACENE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
BENZO(A)ANTHRACENE MG/KG	0.22DYJ	0.4UY	0.45UY	0.47UY	0.51UY
BENZO(A)PYRENE MG/KG	0.15DYJ	0.4UY	0.45UY	0.47UY	0.51UY
BENZO(B)FLUORANTHENE MG/KG	0.16DYJ	0.4UY	0.45UY	0.47UY	0.51UY
BENZO(GHI)PERYLENE MG/KG	0.12DYJ	0.4UY	0.45UY	0.47UY	0.51UY
BENZO(K)FLUORANTHENE MG/KG	0.2DYJ	0.4UY	0.45UY	0.47UY	0.51UY
BENZOIC ACID MG/KG	4UY	0.055DYJ	2.2UY	2.3UY	2.5UY
BENZYL BUTYL PHTHALATE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	0.91UYUJ	0.98UYUJ	0.84UYUJ	0.47UYUJ	0.51UYUJ
CHRYSENE MG/KG	0.29DYJ	0.4UY	0.45UY	0.47UY	0.51UY
DIBENZOFURAN MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
DIETHYL PHTHALATE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
DIMETHYL PHTHALATE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
FLUORANTHENE MG/KG	0.56DYJ	0.4UY	0.45UY	0.47UY	0.51UY
FLUORENE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
INDENO(1,2,3-CD)PYRENE MG/KG	0.099DYJ	0.4UY	0.45UY	0.47UY	0.51UY
NAPHTHALENE MG/KG	0.82UY	0.4UY	0.45UY	0.47UY	0.51UY
PHENANTHRENE MG/KG	0.43DYJ	0.4UY	0.45UY	0.47UY	0.51UY
PYRENE MG/KG	0.49DYJ	0.4UY	0.45UY	0.47UY	0.51UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01213	01214	01215	01216	01217
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.3	SA-1.3	SA-1.6	SA-1.6	SA-1.6
SAMPLE DATE:	08/30/1990	08/30/1990	08/30/1990	08/30/1990	08/30/1990
SAMPLE TIME:	08:10	08:46	14:05	14:40	15:35
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	25.00	29.50	4.50	9.00	13.50
LOWER DEPTH:	26.50	31.00	6.00	10.50	15.00
2-METHYLNAPHTHALENE MG/KG	0.97UY	0.94UY	1.5UY	1.6UY	0.48UY
ACENAPHTHENE MG/KG	0.97UY	0.94UY	1.5UY	1.6UY	0.48UY
ACENAPHTHYLENE MG/KG	0.97UY	0.94UY	1.5UY	1.6UY	0.48UY
ANTHRACENE MG/KG	0.97UY	0.94UY	1.5UY	0.2DYJ	0.48UY
BENZO(A)ANTHRACENE MG/KG	0.97UY	0.94UY	0.2DYJ	0.43DYJ	0.48UY
BENZO(A)PYRENE MG/KG	0.97UY	0.94UY	0.18DYJ	0.34DYJ	0.48UY
BENZO(B)FLUORANTHENE MG/KG	0.97UY	0.94UY	1.5UY	0.29DYJ	0.48UY
BENZO(GHI)PERYLENE MG/KG	0.97UY	0.94UY	1.5UY	0.27DYJ	0.48UY
BENZO(K)FLUORANTHENE MG/KG	0.97UY	0.94UY	0.22DYJ	0.37DYJ	0.48UY
BENZOIC ACID MG/KG	4.7UY	4.6UY	7.5UY	7.6UY	2.3UY
BENZYL BUTYL PHTHALATE MG/KG	0.97UY	0.94UY	1.5UY	1.6UY	0.48UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	0.97UYUJ	0.94UYUJ	1.5UYUJ	1.6UYUJ	0.48UYUJ
CHRYSENE MG/KG	0.97UY	0.94UY	0.28DYJ	0.52DYJ	0.48UY
DIBENZOFURAN MG/KG	0.97UY	0.94UY	1.5UY	1.6UY	0.48UY
DIETHYL PHTHALATE MG/KG	0.97UY	0.94UY	1.5UY	1.6UY	0.48UY
DIMETHYL PHTHALATE MG/KG	0.97UY	0.94UY	1.5UY	1.6UY	0.48UY
FLUORANTHENE MG/KG	0.97UY	0.94UY	0.41DYJ	1.2DYJ	0.48UY
FLUORENE MG/KG	0.97UY	0.94UY	1.5UY	0.19DYJ	0.48UY
INDENO(1,2,3-CD)PYRENE MG/KG	0.97UY	0.94UY	1.5UY	0.21DYJ	0.48UY
NAPHTHALENE MG/KG	0.97UY	0.94UY	1.5UY	1.6UY	0.48UY
PHENANTHRENE MG/KG	0.97UY	0.94UY	0.2DYJ	1.1DYJ	0.48UY
PYRENE MG/KG	0.97UY	0.94UY	0.39DYJ	0.98DYJ	0.48UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
SEMI-VOLATILES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01218	01219	01220
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.6	SA-1.6	SA-1.6
SAMPLE DATE:	08/30/1990	08/30/1990	08/30/1990
SAMPLE TIME:	16:30	16:55	17:05
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:	19.50	24.00	24.00
LOWER DEPTH:	21.00	27.00	27.00
2-METHYLNAPHTHALENE MG/KG	0.52UY	0.49UY	0.49UY
ACENAPHTHENE MG/KG	0.52UY	0.49UY	0.49UY
ACENAPHTHYLENE MG/KG	0.52UY	0.49UY	0.49UY
ANTHRACENE MG/KG	0.52UY	0.49UY	0.49UY
BENZO(A)ANTHRACENE MG/KG	0.52UY	0.49UY	0.49UY
BENZO(A)PYRENE MG/KG	0.52UY	0.49UY	0.49UY
BENZO(B)FLUORANTHENE MG/KG	0.52UY	0.49UY	0.49UY
BENZO(GHI)PERYLENE MG/KG	0.52UY	0.49UY	0.49UY
BENZO(K)FLUORANTHENE MG/KG	0.52UY	0.49UY	0.49UY
BENZOIC ACID MG/KG	2.5UY	2.4UY	2.4UY
BENZYL BUTYL PHTHALATE MG/KG	0.52UY	0.49UY	0.49UY
BIS(2-ETHYLHEXYL)PHTHALATE MG/KG	0.55UYUJ	0.49UYUJ	0.56UYUJ
CHRYSENE MG/KG	0.52UY	0.49UY	0.49UY
DIBENZOFURAN MG/KG	0.52UY	0.49UY	0.49UY
DIETHYL PHTHALATE MG/KG	0.52UY	0.49UY	0.49UY
DIMETHYL PHTHALATE MG/KG	0.52UY	0.49UY	0.49UY
FLUORANTHENE MG/KG	0.52UY	0.49UY	0.49UY
FLUORENE MG/KG	0.52UY	0.49UY	0.49UY
INDENO(1,2,3-CD)PYRENE MG/KG	0.52UY	0.49UY	0.49UY
NAPHTHALENE MG/KG	0.52UY	0.49UY	0.49UY
PHENANTHRENE MG/KG	0.52UY	0.49UY	0.49UY
PYRENE MG/KG	0.52UY	0.49UY	0.49UY

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NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
BPH	117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

SAMPLE ID:	01160	01161	01304	01305	01308
SUB-SAMPLE ID:	SAE	SAE	SAE	SAE	SAE
STATION ID:	SA-1.4	SA-1.4	SA-1.5B	SA-1.3	SA-1.3
SAMPLE DATE:	08/18/1990	08/19/1990	08/28/1990	08/29/1990	08/30/1990
SAMPLE TIME:					
SAMPLE MATRIX:	AQ	AQ	AQ	AQ	AQ
UPPER DEPTH:					
LOWER DEPTH:					
BIS(2-ETHYLHEXYL)PHTHALATE UG/L	300DYJ	220DYJ	51DYJ	32DYJ	10UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
AL	7429-90-5	ALUMINUM
AS	7440-38-2	ARSENIC
BA	7440-39-3	BARIUM
BE	7440-41-7	BERYLLIUM
CD	7440-43-9	CADMIUM
CA	7440-70-2	CALCIUM
CR	7440-47-3	CHROMIUM
CO	7440-48-4	COBALT
CU	7440-50-8	COPPER
FE	7439-89-6	IRON
PB	7439-92-1	LEAD
MG	7439-95-4	MAGNESIUM
MN	7439-96-5	MANGANESE
HG	7439-97-6	MERCURY
NI	7440-02-0	NICKEL
NBM	7440-03-1	NIOBIUM
PHS	7723-14-0	PHOSPHORUS
K	7440-09-7	POTASSIUM
SE	7782-49-2	SELENIUM
NA	7440-23-5	SODIUM
V	7440-62-6	VANADIUM
ZN	7440-66-6	ZINC

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

SAMPLE ID:	01002	01005	01008	01011	01021
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.1	SA-1.1
SAMPLE DATE:	08/14/1990	08/14/1990	08/14/1990	08/14/1990	08/15/1990
SAMPLE TIME:	10:54	13:58	14:29	16:45	08:37
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	10.50	13.50	19.50	24.00
LOWER DEPTH:	6.00	12.00	15.00	21.00	25.50
ALUMINUM MG/KG	19900DY	28200DY	21400DY	24500DY	42800DY
ARSENIC MG/KG	3.4DYJ	3.6DYJ	6.9DYJ	23.4DYJ	45.7DYJ
BARIUM MG/KG	303DY	206DY	30.8DY	27DY	28.3DY
BERYLLIUM MG/KG	1.1DY	1.4DY	0.34DY	0.35DY	0.95DY
CADMIUM MG/KG	2.5DY	2.9DY	2.4DY	2.4DY	4.7DY
CALCIUM MG/KG	10700DY	473DY	139DY	111DYJ	104DYJ
CHROMIUM MG/KG	32.8DY	35.7DY	16.1DY	27.2DY	51.4DY
COBALT MG/KG	19.9DY	21.5DY	8.5DY	4.2DY	4.8DY
COPPER MG/KG	16.1DY	28.8DY	17.2DY	25.1DY	63.9DY
IRON MG/KG	28600DY	35200DY	20100DY	27300DY	56100DY
LEAD MG/KG	29.1DYJ	15.4DYJ	17.4DYJ	24.3DYJ	40.5DYJ
MAGNESIUM MG/KG	7180DY	4950DY	835DY	753DY	884DY
MANGANESE MG/KG	2030DY	808DY	406DY	151DY	195DY
MERCURY MG/KG	2.1DYJ	0.06UY	0.05UY	0.08DYJ	0.12DYJ
NICKEL MG/KG	51DY	40.3DY	8.3DYJ	13.2DY	23.6DY
NIOBIUM MG/KG	1.6UY	1.6UY	1.6UY	1.7UY	1.8UY
PHOSPHORUS MG/KG	44.7UY	289DYJ	47UY	47.5UY	52.1UY
POTASSIUM MG/KG	3470DY	4890DY	799DY	881DY	1180DY
SELENIUM MG/KG	0.46UYR	0.48UYR	0.48UYR	0.49UYR	0.54UYR
SODIUM MG/KG	181DYJ	206DY	101DYJ	103DYJ	92DYJ
VANADIUM MG/KG	17.7DY	29.1DY	44DY	60.2DY	128DY
ZINC MG/KG	78.8DY	80.6DY	65.1DY	82.3DY	204DY

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SAMPLE ID:	01023	01025	01026	01028	01030
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.1	SA-1.2
SAMPLE DATE:	08/15/1990	08/15/1990	08/15/1990	08/15/1990	08/16/1990
SAMPLE TIME:	10:18	13:37	13:37	15:05	09:12
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	28.50	34.50	34.50	39.00	4.50
LOWER DEPTH:	30.00	35.00	35.00	40.50	6.00
ALUMINUM MG/KG	33800DY	28300DY	29300DY	47100DY	26800DY
ARSENIC MG/KG	21.5DYJ	33DYJ	10.7DYJ	9.2DYJ	14.8DYJ
BARIUM MG/KG	27.2DY	15.3DY	16.2DY	22.8DY	36DY
BERYLLIUM MG/KG	0.87DY	1.1DY	1DY	1.5DY	0.35DY
CADMIUM MG/KG	5.3DY	3.7DY	4.8DY	5.3DY	3.3DY
CALCIUM MG/KG	290DY	550DY	543DY	663DY	107DYJ
CHROMIUM MG/KG	38.2DY	18.6DY	25.8DY	27DY	34.5DY
COBALT MG/KG	4.7DY	6.2DY	16.3DY	110DY	9.3DY
COPPER MG/KG	57.3DY	60.3DY	67.3DY	59.6DY	19.5DY
IRON MG/KG	48200DY	42200DY	43400DY	39900DY	26800DY
LEAD MG/KG	37.3DYJ	228DY	670DYJ	109DY	110DYJ
MAGNESIUM MG/KG	817DY	837DY	727DY	1420DY	1000DY
MANGANESE MG/KG	187DY	269DY	498DY	2170DY	443DY
MERCURY MG/KG	0.09DYJ	0.08DYJ	0.13DYJ	0.05DYJ	0.05UY
NICKEL MG/KG	21.5DY	28.4DY	25.1DY	81.5DY	12.4DY
NIOBIUM MG/KG	1.8UY	1.8UY	1.8UY	2.1DYJ	1.7UY
PHOSPHORUS MG/KG	52.1UY	51.8UY	51UY	55.1UY	47.7UY
POTASSIUM MG/KG	1130DY	1110DY	1150DY	1640DY	976DY
SELENIUM MG/KG	0.54UYR	0.54UYR	0.52UYR	0.58UYR	0.46UYR
SODIUM MG/KG	78.6DYJ	96DYJ	104DYJ	110DYJ	164DYJ
VANADIUM MG/KG	110DY	84.4DY	93.9DY	75.2DY	58DY
ZINC MG/KG	177DY	274DY	196DY	192DY	81.6DY

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SAMPLE ID:	01031	01032	01033	01034	01035
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.2	SA-1.2	SA-1.2	SA-1.2	SA-1.2
SAMPLE DATE:	08/16/1990	08/16/1990	08/16/1990	08/16/1990	08/16/1990
SAMPLE TIME:	09:56	11:03	11:33	12:57	13:47
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	9.00	13.50	13.50	19.50	24.00
LOWER DEPTH:	10.50	16.50	16.50	21.00	25.50
ALUMINUM MG/KG	27900DY	48300DY	37700DY	47900DY	59800DY
ARSENIC MG/KG	10.60YJ	23.80YJ	26.80YJ	8.90YJ	4.50YJ
BARIUM MG/KG	36.40Y	25.80Y	22.30Y	22.80Y	28.40Y
BERYLLIUM MG/KG	0.30Y	1.30Y	1.10Y	2.10Y	1.20Y
CADMIUM MG/KG	3.50Y	4.70Y	6.10Y	4.90Y	4DY
CALCIUM MG/KG	78.40YJ	42.90YJ	610YJ	67.20YJ	522DY
CHROMIUM MG/KG	42.70Y	54.20Y	48DY	35.90Y	26DY
COBALT MG/KG	12.30Y	4.50Y	4.80Y	3.70Y	15.60Y
COPPER MG/KG	19.30Y	63DY	62.40Y	58.20Y	47.50Y
IRON MG/KG	29200DY	52700DY	53300DY	46800DY	36300DY
LEAD MG/KG	25.20YJ	32.70Y	39DYJ	36.60YJ	1550YJ
MAGNESIUM MG/KG	955DY	1110DY	867DY	1260DY	4920DY
MANGANESE MG/KG	752DY	141DY	153DY	130DY	452DY
MERCURY MG/KG	0.060YJ	0.090YJ	0.07UY	0.06UY	0.06UY
NICKEL MG/KG	13.10Y	28.50Y	22.90Y	27.50Y	16.10Y
NIOBIUM MG/KG	1.7UY	1.8UY	1.9UY	1.9UY	2.1UY
PHOSPHORUS MG/KG	47.8UY	52.6UY	54.1UY	54.5UY	90.30YJ
POTASSIUM MG/KG	897DY	1750DY	1280DY	1640DY	4250DY
SELENIUM MG/KG	0.48UYR	0.51UYR	0.54UYR	0.52UYR	0.53UYR
SODIUM MG/KG	92.40YJ	91.40YJ	140DYJ	106DYJ	165DYJ
VANADIUM MG/KG	65.40Y	113DY	115DY	84.40Y	71.70Y
ZINC MG/KG	69.60Y	230DY	214DY	257DY	99DY

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EDMS CHEMICAL OBSERVATIONS MATRIX
INORGANICS - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01100	01101	01102	01103	01105
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/18/1990	08/18/1990	08/18/1990	08/18/1990
SAMPLE TIME:	08:22	09:35	08:59	10:10	11:08
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	4.50	9.00	13.50	19.50
LOWER DEPTH:	7.50	7.50	10.50	15.00	21.00
ALUMINUM MG/KG	29800DY	31800DY	4.8UY	5.1UY	35600DY
ARSENIC MG/KG	1.9DYJ	2.4DYJ	2.5UY	3DY	16.6DY
BARIUM MG/KG	385DY	220DY	166DY	133DY	39.7DY
BERYLLIUM MG/KG	1.2DY	1.5DY	1.2DY	1.1DY	1.3DY
CADMIUM MG/KG	3.7DY	4DY	4.1DY	3.3DY	4.6DY
CALCIUM MG/KG	747DY	987DY	1030DY	653000DY	2400DY
CHROMIUM MG/KG	36.2DY	41.5DY	31.5DY	31.4DY	32.4DYJ
COBALT MG/KG	17.1DY	23.2DY	13.6DY	16.4DY	14.1DY
COPPER MG/KG	24.9DY	30.5DY	20.7DY	22DY	39.6UYJ
IRON MG/KG	348000DY	369000DY	0.96UY	1UY	394000DY
LEAD MG/KG	10.5DYJ	15.9DY	18DY	25.9DY	72DYJ
MAGNESIUM MG/KG	3520DY	5340DY	0.12UY	0.13UY	1340DY
MANGANESE MG/KG	1410DY	1020DY	371DY	1180DY	329DY
MERCURY MG/KG	0.05UY	0.05UY	0.06UY	0.07UY	2.2DY
NICKEL MG/KG	27DY	41.4DY	35.5DY	23.1DY	27.6DY
NIOBIUM MG/KG	1.6UY	1.7UY	1.7UY	1.8UY	1.8UY
PHOSPHORUS MG/KG	447DYJ	341DYJ	47.7UY	50.4UY	51.7UY
POTASSIUM MG/KG	4260DY	5060DY	144UY	152UY	1700DY
SELENIUM MG/KG	0.41UYR	0.46UYR	4.8UYR	5.2UYR	5.2UYR
SODIUM MG/KG	173DYJ	155DYJ	161DYJ	219DY	129DY
VANADIUM MG/KG	32.7DY	32.3DY	31DY	28.4DY	73.4DY
ZINC MG/KG	63.1DY	79.7DY	87.5DY	62.8DY	115DY

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SAMPLE ID:	01106	01107	01108	01109	01110
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/19/1990	08/19/1990	08/19/1990	08/19/1990
SAMPLE TIME:	12:58	08:58	10:22	11:30	13:28
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	24.00	28.50	34.50	39.00	43.50
LOWER DEPTH:	25.50	30.00	37.50	40.50	45.00
ALUMINUM MG/KG	19100DY	13800DY	8710DY	42700DY	34700DY
ARSENIC MG/KG	2.6DY	2.5UY	2.3DY	34.9DY	14.9DY
BARIUM MG/KG	240DY	117DY	74.3DY	68.8DY	44.2DY
BERYLLIUM MG/KG	1.3DY	0.97DY	0.65DY	3.8DY	2.4DY
CADMIUM MG/KG	2.3DY	2.1DY	1.4DY	10.7DY	6.8DY
CALCIUM MG/KG	25000DY	5190DY	102000DY	433DY	393DY
CHROMIUM MG/KG	32.9DYJ	20.8DYJ	14.5DYJ	26.4DYJ	24.2DYJ
COBALT MG/KG	23.1DY	14.6DY	10.4DY	94.2DY	69.2DY
COPPER MG/KG	31.4DYJ	17.9DYJ	17.9DYJ	109DYJ	78.7DYJ
IRON MG/KG	25800DY	20300DY	13300DY	88700DY	61800DY
LEAD MG/KG	15.5DY	11.8DY	14DY	284DYJ	164DYJ
MAGNESIUM MG/KG	7360DY	2160DY	12500DY	1200DY	1120DY
MANGANESE MG/KG	142DY	107DY	442DY	6930DY	3100DY
MERCURY MG/KG	0.05UY	6.5DY	23.7DY	0.38DY	0.13DY
NICKEL MG/KG	33.1DY	17.5DY	12.9DY	173DY	64.1DY
NIOBIUM MG/KG	1.6U?	1.7UY	3.3DYJ	2.3UY	2.1UY
PHOSPHORUS MG/KG	168DYJ	49.1UY	48.8DYJ	266DYJ	328DYJ
POTASSIUM MG/KG	3960DY	2580DY	2410DY	1450DY	1360DY
SELENIUM MG/KG	4.5UYR	4.7UYR	4.1UYR	6.6UYR	6.2UYR
SODIUM MG/KG	160DY	86.8DY	119DY	86.7DY	94.4DY
VANADIUM MG/KG	20.4DY	20.9DY	19.8DY	109DY	83.7DY
ZINC MG/KG	56.4DY	26.4DY	30.5DY	546DY	354DY

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EDMS CHEMICAL OBSERVATIONS MATRIX
INORGANICS - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01111	01112	01120	01121	01122
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.5	SA-1.5	SA-1.5
SAMPLE DATE:	08/19/1990	08/19/1990	08/20/1990	08/21/1990	08/21/1990
SAMPLE TIME:	15:24	16:40	17:29	08:21	09:21
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	49.50	54.00	4.50	9.00	9.00
LOWER DEPTH:	51.00	55.50	6.00	12.00	12.00
ALUMINUM MG/KG	43200DY	28000DY	26400DY	17100DY	14500DY
ARSENIC MG/KG	27DY	40.3DY	2.3DY	23.4DY	14.4DY
BARIUM MG/KG	50.7DY	90.5DY	150DY	77.3DY	97.7DY
BERYLLIUM MG/KG	2.8DY	11DY	1.2DY	0.95DY	0.64DY
CADMIUM MG/KG	6.9DY	10.9DY	2.6DY	2.6DY	3.9DY
CALCIUM MG/KG	1210DY	2470DY	16200DY	94000DY	78400DY
CHROMIUM MG/KG	22.4DYJ	27DYJ	24.5DYJ	37DYJ	40.7DYJ
COBALT MG/KG	81.8DY	38.1DY	20DY	16.4DY	13.2DY
COPPER MG/KG	94.7DYJ	65.6DYJ	17.2DYJ	22.9DYJ	85.9DYJ
IRON MG/KG	55700DY	64400DY	27400DY	23000DY	35100DY
LEAD MG/KG	198DYJ	197DYJ	14.6DY	54.9DYJ	26.9DY
MAGNESIUM MG/KG	1020DY	1430DY	7030DY	8100DY	7130DY
MANGANESE MG/KG	4880DY	2540DY	858DY	590DY	751DY
MERCURY MG/KG	0.07UY	0.29DY	0.11DY	0.25DY	0.17DY
NICKEL MG/KG	172DY	105DY	27.3DY	21.7DY	12.3DY
NIOBIUM MG/KG	2UY	2UY	1.4UY	1.6UY	1.5UY
PHOSPHORUS MG/KG	425DYJ	332DYJ	173DYJ	107DYJ	42UY
POTASSIUM MG/KG	1430DY	1820DY	5430DY	3630DY	1870DY
SELENIUM MG/KG	5.7UYR	5.7UYR	4.3UYR	4.6UYR	4.2UYR
SODIUM MG/KG	109DY	83.8DY	125DY	148DY	147DY
VANADIUM MG/KG	75DY	86.4DY	23.2DY	22.3DY	48.4DY
ZINC MG/KG	380DY	591DY	54.9DY	58.8DY	438DY

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SAMPLE ID:	01200	01201	01202	01203	01204
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B
SAMPLE DATE:	08/27/1990	08/27/1990	08/27/1990	08/27/1990	08/28/1990
SAMPLE TIME:	14:00	14:30	15:55	16:45	10:30
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	16.50	19.50	24.00	28.50	39.50
LOWER DEPTH:	18.00	21.00	25.50	30.00	42.50
ALUMINUM MG/KG	3370DY	20600DY	15200DY	16500DY	36500DY
ARSENIC MG/KG	2.2UY	4.2DY	2.4UY	11.6DY	6.9DYJ
BARIUM MG/KG	37.5DY	113DY	58.3DY	78.1DY	27.9DY
BERYLLIUM MG/KG	0.27DY	0.87DY	0.63DY	0.72DY	1.5DY
CADMIUM MG/KG	1.1DY	3.5DY	2DY	2.4DY	7.5DY
CALCIUM MG/KG	260000DY	358000DY	2640DY	833DY	854DY
CHROMIUM MG/KG	6.4DYJ	28.9DYJ	27.2DYJ	22.6DYJ	38.2DYJ
COBALT MG/KG	3.9DY	13.9DY	76.1DY	22.6DY	22.8DY
COPPER MG/KG	17.9DYJ	35.6DYJ	13.3DYJ	15.1DYJ	93.3DYJ
IRON MG/KG	6360DY	28100DY	23600DY	25100DY	78500DY
LEAD MG/KG	10.4DYJ	17.1DYJ	6.5DYJ	30.8DY	267DYJ
MAGNESIUM MG/KG	153000DY	5160DY	1730DY	536DY	998DY
MANGANESE MG/KG	282DY	483DY	2150DY	2050DY	1000DY
MERCURY MG/KG	2.2DY	31.5DY	0.3DY	0.38DY	0.09DY
NICKEL MG/KG	4.7DYJ	34.8DY	14.2DY	13.3DY	39.9DY
NIOBIUM MG/KG	1.8DYJ	1.6UY	1.7UY	1.6UY	1.9UY
PHOSPHORUS MG/KG	43.7UY	115DYJ	47.7UY	81.7DYJ	55.7UY
POTASSIUM MG/KG	1270DY	3030DY	2570DY	507DY	1120DY
SELENIUM MG/KG	4.3UYR	4.6UYR	4.6UYR	4.3UYR	5.6UYR
SODIUM MG/KG	170DY	155DY	124DY	69.8DY	98.2DY
VANADIUM MG/KG	6.8DY	26.2DY	22.3DY	59.1DY	120DY
ZINC MG/KG	61.5DY	180DY	95.2DY	54.5DY	479DY

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NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01205	01206	01207	01208	01209
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.3	SA-1.3
SAMPLE DATE:	08/28/1990	08/28/1990	08/28/1990	08/29/1990	08/29/1990
SAMPLE TIME:	10:55	13:00		13:30	14:00
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	39.50	44.00	48.50	4.50	10.00
LOWER DEPTH:	42.50	45.50	50.00	6.00	11.50
ALUMINUM MG/KG	344000Y	5010DY	28400DY	267000Y	137000Y
ARSENIC MG/KG	11DY	24.4DY	7.3DY	11DY	9.5DY
BARIUM MG/KG	24.9DY	57DY	46.8DY	243DYJ	108DYJ
BERYLLIUM MG/KG	1.7DY	0.89UY	4.1DY	1.3DY	0.86DY
CADMIUM MG/KG	5.8DY	8.9UY	6.3DY	1.7DY	1.2DY
CALCIUM MG/KG	921DY	914DY	1640DY	24300DY	897DY
CHROMIUM MG/KG	29.7DYJ	29.7UYJ	22.2DYJ	28.3DY	25.5DY
COBALT MG/KG	39.9DY	14.9UY	38.6DY	16.4DY	14.6DY
COPPER MG/KG	67.8DYJ	36.7DYJ	77DYJ	29.2DY	24.7DY
IRON MG/KG	62800DY	10200DY	571000Y	335000Y	170000Y
LEAD MG/KG	171DYJ	185DYJ	126DYJ	27.5DYJ	38DYJ
MAGNESIUM MG/KG	8960Y	25200DY	11200Y	80900Y	532DY
MANGANESE MG/KG	1500DY	453DY	2530DY	1430DY	906DY
MERCURY MG/KG	0.11DY	0.11DY	0.2DY	2.6DY	0.69DY
NICKEL MG/KG	55.3DY	29.7DY	88.2DY	29.6DY	13.9DY
NIOBIUM MG/KG	2UY	2UY	1.8UY	1.7UY	1.7UY
PHOSPHORUS MG/KG	153DYJ	720DYJ	357DYJ	268DYJ	409DYJ
POTASSIUM MG/KG	1100DY	1940DY	1430DY	3310DY	411DY
SELENIUM MG/KG	5.2UYR	6UYR	2.8UYR	2UYR	2.2UYR
SODIUM MG/KG	70.3DY	458DY	94.7DY	147DYJ	92.3DYJ
VANADIUM MG/KG	92.4DY	14.9UY	77.6DY	30.5DY	38.5DY
ZINC MG/KG	237DY	102DY	378DY	53.8DY	74.2DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01210	01211	01212	01213	01214
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.3	SA-1.3	SA-1.3	SA-1.3	SA-1.3
SAMPLE DATE:	08/29/1990	08/29/1990	08/29/1990	08/30/1990	08/30/1990
SAMPLE TIME:	15:36	15:45	16:07	08:10	08:46
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	14.50	14.50	20.50	25.00	29.50
LOWER DEPTH:	17.50	17.50	22.00	26.50	31.00
ALUMINUM MG/KG	30200DY	23800DY	27400DY	29100DY	32800DY
ARSENIC MG/KG	3.3DY	9.5DYJ	2.7UY	9.2DYJ	2.7UY
BARIUM MG/KG	22.7DYJ	180YJ	25.1DYJ	20.2DYJ	47.6DYJ
BERYLLIUM MG/KG	1DY	0.78DY	0.87DY	0.98DY	1.2DY
CADMIUM MG/KG	3DY	1.8DY	2.2DY	2.6DY	1.9DY
CALCIUM MG/KG	60.5DYJ	55.4DYJ	101DYJ	116DYJ	335DY
CHROMIUM MG/KG	22.5DY	21.8DY	22.9DY	19.4DY	21.8DY
COBALT MG/KG	3.4DY	1.7DY	70.6DY	16.2DY	7.7DY
COPPER MG/KG	54.7DY	32.3DY	52.9DY	55.9DY	45.6DY
IRON MG/KG	41900DY	30700DY	43600DY	47200DY	31500DY
LEAD MG/KG	26.9DY	86.7DYJ	91.8DYJ	337DYJ	164DYJ
MAGNESIUM MG/KG	1040DY	731DY	584DY	542DY	960DY
MANGANESE MG/KG	160DY	88.6DY	945DY	494DY	270DY
MERCURY MG/KG	0.11DY	0.1DY	0.06UY	0.12DY	0.13DY
NICKEL MG/KG	18.9DY	13.7DY	28.4DY	31.2DY	22.3DY
NIOBIUM MG/KG	1.9UY	2UY	2.8DYJ	1.8UY	2UY
PHOSPHORUS MG/KG	53.4UY	58.1UY	56.4UY	75.5DYJ	179DYJ
POTASSIUM MG/KG	1090DY	776DY	801DY	809DY	1060DY
SELENIUM MG/KG	2.2UYR	2.8UYR	2.6UYR	2.6UYR	2.6UYR
SODIUM MG/KG	107DYJ	61.8DYJ	104DYJ	68.5DYJ	136DYJ
VANADIUM MG/KG	82.4DY	59.6DY	91.5DY	107DY	49.4DY
ZINC MG/KG	73.6DY	52.8DY	70.9DY	93DY	88.5DY

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DMN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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EDMS CHEMICAL OBSERVATIONS MATRIX
INORGANICS - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01215	01216	01217	01218	01219
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.6	SA-1.6	SA-1.6	SA-1.6	SA-1.6
SAMPLE DATE:	08/30/1990	08/30/1990	08/30/1990	08/30/1990	08/30/1990
SAMPLE TIME:	14:05	14:40	15:35	16:30	16:55
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	9.00	13.50	19.50	24.00
LOWER DEPTH:	6.00	10.50	15.00	21.00	27.00
ALUMINUM MG/KG	22200DY	19600DY	61800DY	45100DY	41400DY
ARSENIC MG/KG	3.3DYJ	6.3DYJ	3.5DYJ	5.7DYJ	3.1UY
BARIUM MG/KG	255DYJ	162DYJ	49.2DYJ	43.7DYJ	38.8DYJ
BERYLLIUM MG/KG	0.88DY	0.98DY	4.9DY	2.3DY	2.1DY
CADMIUM MG/KG	2.1DY	2DY	4.1DY	4.4DY	2.3DY
CALCIUM MG/KG	578000Y	17300DY	350DY	398DY	703DY
CHROMIUM MG/KG	25.4DY	26.8DY	27.8DY	30.7DY	23.9DY
COBALT MG/KG	14.9DY	16DY	8.4DY	54.5DY	31.6DY
COPPER MG/KG	24.2DY	22.6DY	67.8DY	52.1DY	36.9DY
IRON MG/KG	23100DY	29600DY	81300DY	67000DY	48300DY
LEAD MG/KG	43.2DYJ	11.5DYJ	60.4DYJ	129DYJ	65.6DYJ
MAGNESIUM MG/KG	20500DY	6990DY	1200DY	974DY	872DY
MANGANESE MG/KG	607DY	824DY	345DY	1100DY	977DY
MERCURY MG/KG	0.44DY	0.3DY	0.22DY	0.21DY	0.13DY
NICKEL MG/KG	28.9DY	30DY	85.3DY	47.6DY	36.2DY
NIOBIUM MG/KG	1.5UY	1.6UY	2.2UY	2.1UY	2UY
PHOSPHORUS MG/KG	295DYJ	121DYJ	64UY	900YJ	131DYJ
POTASSIUM MG/KG	3820DY	2920DY	2080DY	1720DY	1500DY
SELENIUM MG/KG	2UYR	2.3UYR	2.9UYR	2.9UYR	2.9UYR
SODIUM MG/KG	158DYJ	124DYJ	102DYJ	136DYJ	93.9DYJ
VANADIUM MG/KG	27.8DY	24.3DY	96.8DY	79.4DY	59.7DY
ZINC MG/KG	59.7DY	51.8DY	430DY	175DY	183DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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SAMPLE ID:	01220
SUB-SAMPLE ID:	00000
STATION ID:	SA-1.6
SAMPLE DATE:	08/30/1990
SAMPLE TIME:	17:05
SAMPLE MATRIX:	SB
UPPER DEPTH:	24.00
LOWER DEPTH:	27.00
ALUMINUM MG/KG	38500DY
ARSENIC MG/KG	40.5DYJ
BARIUM MG/KG	38.6DYJ
BERYLLIUM MG/KG	3.8DY
CADMIUM MG/KG	4.7DY
CALCIUM MG/KG	698DY
CHROMIUM MG/KG	32.7DY
COBALT MG/KG	38.2DY
COPPER MG/KG	45.6DY
IRON MG/KG	53500DY
LEAD MG/KG	134DYJ
MAGNESIUM MG/KG	1520DY
MANGANESE MG/KG	1360DY
MERCURY MG/KG	0.1DY
NICKEL MG/KG	62.9DY
NIOBIUM MG/KG	2UY
PHOSPHORUS MG/KG	161DYJ
POTASSIUM MG/KG	2870DY
SELENIUM MG/KG	2.9UYR
SODIUM MG/KG	138DYJ
VANADIUM MG/KG	55.4DY
ZINC MG/KG	289DY

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NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
AL	7429-90-5	ALUMINUM
BA	7440-39-3	BARIUM
CA	7440-70-2	CALCIUM
CU	7440-50-8	COPPER
FE	7439-89-6	IRON
MG	7439-95-4	MAGNESIUM
MN	7439-96-5	MANGANESE
NA	7440-23-5	SODIUM
ZN	7440-66-6	ZINC

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

EDMS CHEMICAL OBSERVATIONS MATRIX
INORGANICS - AQUEOUS SAMPLES
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01060	01062	01160	01161	01304
SUB-SAMPLE ID:	SAE	SAE	SAE	SAE	SAE
STATION ID:	SA-1.2	SA-1.2	SA-1.4	SA-1.4	SA-1.5B
SAMPLE DATE:	08/15/1990	08/16/1990	08/18/1990	08/19/1990	08/28/1990
SAMPLE TIME:					
SAMPLE MATRIX:	AQ	AQ	AQ	AQ	AQ
UPPER DEPTH:					
LOWER DEPTH:					
ALUMINUM UG/L	23.9DN	45.7DY	49.7DY	31.8DY	31.8DY
BARIUM UG/L	1UN	1UY	1UY	1UY	1DY
CALCIUM UG/L	136DNJ	80.3DYJ	120DYJ	120DYJ	130DYJ
COPPER UG/L	6.5DN	4UY	4UY	4UY	4UY
IRON UG/L	77.7DNJ	142DY	145DY	132DY	12.8DYJ
MAGNESIUM UG/L	26.1DNJ	16.7DYJ	18.4DYJ	18.9DYJ	10.5DYJ
MANGANESE UG/L	3.7DN	2.8DY	2.8DY	4.2DY	1UY
SODIUM UG/L	721DN	458DY	539DY	342DYJ	457DY
ZINC UG/L	7.3DNJ	10.3DYJ	8.1DYJ	7.4DYJ	4DYJ

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
INORGANICS - AQUEOUS SAMPLES
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01305	01308	01309
SUB-SAMPLE ID:	SAE	SAE	SAE
STATION ID:	SA-1.3	SA-1.3	SA-1.6
SAMPLE DATE:	08/29/1990	08/30/1990	08/31/1990
SAMPLE TIME:			
SAMPLE MATRIX:	AQ	AQ	AQ
UPPER DEPTH:			
LOWER DEPTH:			
ALUMINUM UG/L	49.7DY	22.9DY	25.9DY
BARIUM UG/L	1.2DY	1UY	1.3DY
CALCIUM UG/L	518DY	90.8DYJ	132DYJ
COPPER UG/L	4UY	4UY	4UY
IRON UG/L	272DY	55.4DYJ	28.5DYJ
MAGNESIUM UG/L	25.4DYJ	8.3DYJ	11.8DYJ
MANGANESE UG/L	4.2DY	1.4DY	2.1DY
SODIUM UG/L	503DY	350DYJ	340DYJ
ZINC UG/L	7.2DYJ	3.4DYJ	6.8DYJ

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
CN	75-13-8	CYANIDE
URW		TOTAL URANIUM (FLUOROMETRIC)

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01002	01005	01008	01011	01021
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.1	SA-1.1
SAMPLE DATE:	08/14/1990	08/14/1990	08/14/1990	08/14/1990	08/15/1990
SAMPLE TIME:	10:54	13:58	14:29	16:45	08:37
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	10.50	13.50	19.50	24.00
LOWER DEPTH:	6.00	12.00	15.00	21.00	25.50
CYANIDE MG/KG	1UY	0.1UY	0.1UY	0.1UY	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	5.1DY	2DY	5.9DY	3DY	5.6DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01023	01025	01026	01028	01030
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1	SA-1.1	SA-1.2
SAMPLE DATE:	08/15/1990	08/15/1990	08/15/1990	08/15/1990	08/16/1990
SAMPLE TIME:	10:18	13:37	13:37	15:05	09:12
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	28.50	34.50	34.50	39.00	4.50
LOWER DEPTH:	30.00	35.00	35.00	40.50	6.00
CYANIDE MG/KG	1UY	1UY	1UY	1UY	0.1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	4.7DY	7.7DY	7DY	5.3DY	2.8DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01031	01032	01033	01034	01035
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.2	SA-1.2	SA-1.2	SA-1.2	SA-1.2
SAMPLE DATE:	08/16/1990	08/16/1990	08/16/1990	08/16/1990	08/16/1990
SAMPLE TIME:	09:56	11:03	11:33	12:57	13:47
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	9.00	13.50	13.50	19.50	24.00
LOWER DEPTH:	10.50	16.50	16.50	21.00	25.50
CYANIDE MG/KG	0.1UY	2.6DYJ	1UY	1UY	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	4DY	6.5DY	9.6DY	5.8DY	4.7DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
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EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01100	01101	01102	01103	01105
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/18/1990	08/18/1990	08/18/1990	08/18/1990
SAMPLE TIME:	08:22	09:35	08:59	10:10	11:08
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	4.50	9.00	13.50	19.50
LOWER DEPTH:	7.50	7.50	10.50	15.00	21.00
CYANIDE MG/KG	1UY	1UY	1UY	1UY	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	2.2DY	2DY	2.2DY	3DY	3.2DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01106	01107	01108	01109	01110
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/19/1990	08/19/1990	08/19/1990	08/19/1990
SAMPLE TIME:	12:58	08:58	10:22	11:30	13:28
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	24.00	28.50	34.50	39.00	43.50
LOWER DEPTH:	25.50	30.00	37.50	40.50	45.00
CYANIDE MG/KG	1UY	1UY	1UY	1UY	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	2.6DY	2.5DY	7.9DY	9.7DY	6.7DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01111	01112	01120	01121	01122
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.5	SA-1.5	SA-1.5
SAMPLE DATE:	08/19/1990	08/19/1990	08/20/1990	08/21/1990	08/21/1990
SAMPLE TIME:	15:24	16:40	17:29	08:21	09:21
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	49.50	54.00	4.50	9.00	9.00
LOWER DEPTH:	51.00	55.50	6.00	12.00	12.00
CYANIDE MG/KG	1UY	1UY	1UY	1UY	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	8.1DY	6.8DY	4.3DY	3.8DY	5.3DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01200	01201	01202	01203	01204
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.5B
SAMPLE DATE:	08/27/1990	08/27/1990	08/27/1990	08/27/1990	08/28/1990
SAMPLE TIME:	14:00	14:30	15:55	16:45	10:30
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	16.50	19.50	24.00	28.50	39.50
LOWER DEPTH:	18.00	21.00	25.50	30.00	42.50
CYANIDE MG/KG	1UY	1UY	1UY	1UY	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	6.4DY	4.1DY	2.2DY	5DY	5.7DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01205	01206	01207	01208	01209
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	SA-1.5B	SA-1.3	SA-1.3
SAMPLE DATE:	08/28/1990	08/28/1990	08/28/1990	08/29/1990	08/29/1990
SAMPLE TIME:	10:55	13:00		13:30	14:00
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	39.50	44.00	48.50	4.50	10.00
LOWER DEPTH:	42.50	45.50	50.00	6.00	11.50
CYANIDE MG/KG	1UY	1UY	1UY	1UY	1.1DYJ
TOTAL URANIUM (FLUOROMETRIC) MG/KG	7.5DY	7.3DY	42DY	3.7DY	5.8DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01210	01211	01212	01213	01214
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.3	SA-1.3	SA-1.3	SA-1.3	SA-1.3
SAMPLE DATE:	08/29/1990	08/29/1990	08/29/1990	08/30/1990	08/30/1990
SAMPLE TIME:	15:36	15:45	16:07	08:10	08:46
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	14.50	14.50	20.50	25.00	29.50
LOWER DEPTH:	17.50	17.50	22.00	26.50	31.00
CYANIDE MG/KG	1UY	1UY	1UY	1UY	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	4.8DY	5.4DY	5.7DY	7.2DY	5.4DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01215	01216	01217	01218	01219
SUB-SAMPLE ID:	00000	00000	00000	00000	00000
STATION ID:	SA-1.6	SA-1.6	SA-1.6	SA-1.6	SA-1.6
SAMPLE DATE:	08/30/1990	08/30/1990	08/30/1990	08/30/1990	08/30/1990
SAMPLE TIME:	14:05	14:40	15:35	16:30	16:55
SAMPLE MATRIX:	SB	SB	SB	SB	SB
UPPER DEPTH:	4.50	9.00	13.50	19.50	24.00
LOWER DEPTH:	6.00	10.50	15.00	21.00	27.00
CYANIDE MG/KG	1UY	1UY	1UY	1UY	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	18DY	68.9DY	80DY	9.9DY	50Y

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01220
SUB-SAMPLE ID:	00000
STATION ID:	SA-1.6
SAMPLE DATE:	08/30/1990
SAMPLE TIME:	17:05
SAMPLE MATRIX:	SB
UPPER DEPTH:	24.00
LOWER DEPTH:	27.00
CYANIDE MG/KG	1UY
TOTAL URANIUM (FLUOROMETRIC) MG/KG	4.6DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - AQUEOUS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
CN	75-13-8	CYANIDE
URN		TOTAL URANIUM (FLUOROMETRIC)

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - AQUEOUS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01062	01160	01161	01304	01305
SUB-SAMPLE ID:	SAE	SAE	SAE	SAE	SAE
STATION ID:	SA-1.2	SA-1.4	SA-1.4	SA-1.58	SA-1.3
SAMPLE DATE:	08/16/1990	08/18/1990	08/19/1990	08/28/1990	08/29/1990
SAMPLE TIME:					
SAMPLE MATRIX:	AQ	AQ	AQ	AQ	AQ
UPPER DEPTH:					
LOWER DEPTH:					
CYANIDE UG/L	100UY	100UY	100UY	100UY	100UY
TOTAL URANIUM (FLUOROMETRIC) UG/L	1UY	1UY	1UY	1UY	1UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
CYANIDE & URANIUM - AQUEOUS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01308	01309
SUB-SAMPLE ID:	SAE	SAE
STATION ID:	SA-1.3	SA-1.6
SAMPLE DATE:	08/30/1990	08/31/1990
SAMPLE TIME:		
SAMPLE MATRIX:	AQ	AQ
UPPER DEPTH:		
LOWER DEPTH:		
CYANIDE UG/L	100UY	100UY
TOTAL URANIUM (FLUOROMETRIC) UG/L	1UY	1UY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
RADIOACTIVES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
GRA		GROSS ALPHA
GR6		GROSS BETA
RAD		TOTAL RADIUM
URN		TOTAL URANIUM (FLUOROMETRIC)
UR5		URANIUM-235

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

EDMS CHEMICAL OBSERVATIONS MATRIX
RADIOACTIVES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

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SAMPLE ID:	01002	01005	01008
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1
SAMPLE DATE:	08/14/1990	08/14/1990	08/14/1990
SAMPLE TIME:	10:54	13:58	14:29
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	4.89 +/- 1.7DYJ	4.14 +/- 1.6DYJ	5.16 +/- 1.7DYJ
GROSS BETA PCI/G	5.76 +/- 2.8DY	9.29 +/- 2.9DY	4.81 +/- 2.7DY
TOTAL RADIUM PCI/G	1.48665 +/- 26DN	2.02725 +/- 24DN	2.67597 +/- 34DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	3.672 +/- 0.001DY	1.44 +/- 0.001DY	4.248 +/- 0.001DY
URANIUM-235 WT %	0.094 +/-DY PCI/G	UYLOW	UYINSF

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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EDMS CHEMICAL OBSERVATIONS MATRIX
RADIOACTIVES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01011	01021	01023
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1
SAMPLE DATE:	08/14/1990	08/15/1990	08/15/1990
SAMPLE TIME:	16:45	08:37	10:18
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	5.87 +/- 1.8DYJ	7.3 +/- 1.9DYJ	9.92 +/- 2.2DYJ
GROSS BETA PCI/G	5.85 +/- 2.8DY	8.51 +/- 2.9DY	9.8 +/- 2.9DY
TOTAL RADIUM PCI/G	2.40567 +/- 26DN	4.3240 +/- 40DN	4.5951 +/- 40DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	2.16 +/- 0.001DY	4.032 +/- 0.001DY	3.384 +/- 0.001DY
URANIUM-235 WT %	UYLOW	UYINSF	UYLOW

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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SAMPLE ID:	01025	01026	01028
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.1	SA-1.1	SA-1.1
SAMPLE DATE:	08/15/1990	08/15/1990	08/15/1990
SAMPLE TIME:	13:37	13:37	15:05
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	6.24 +/- 1.8DYJ	10.06 +/- 2.2DYJ	7.89 +/- 2DYJ
GROSS BETA PCI/G	4.64 +/- 2.7DY	7.74 +/- 2.9DY	6.1 +/- 2.8DY
TOTAL RADIUM PCI/G	3.7842 +/- 30DN	3.2436 +/- 30DN	2.9733 +/- 30DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	5.544 +/- 0.001DY	5.04 +/- 0.001DY	3.816 +/- 0.001DY
URANIUM-235 WT %	UYINSF	UYINSF	UYINSF

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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SAMPLE ID:	01030	01031	01032
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.2	SA-1.2	SA-1.2
SAMPLE DATE:	08/16/1990	08/16/1990	08/16/1990
SAMPLE TIME:	09:12	09:56	11:03
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	8.07 +/- 2DYJ	5.31 +/- 1.9DYJ	5.4 +/- 1.9DYJ
GROSS BETA PCI/G	4.38 +/- 2.7DY	4.64 +/- 3DY	5.76 +/- 3.1DY
TOTAL RADIUM PCI/G	3.5139 +/- 40DN	2.1624 +/- 25DN	3.7842 +/- 30DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	2.016 +/- 0.001DY	2.88 +/- 0.001DY	4.68 +/- 0.001DY
URANIUM-235 WT %	UYLOW PCI/G	UYLOW	0.79 +/- 0.01DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01033	01034	01035
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.2	SA-1.2	SA-1.2
SAMPLE DATE:	08/16/1990	08/16/1990	08/16/1990
SAMPLE TIME:	11:33	12:57	13:47
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	7.77 +/- 2.1DYJ	8.71 +/- 2.2DYJ	4.81 +/- 1.8DYJ
GROSS BETA PCI/G	5.85 +/- 3.1DY	6.36 +/- 3.1DY	6.45 +/- 3.1DY
TOTAL RADIUM PCI/G	3.5139 +/- 400N	3.7842 +/- 400N	4.3248 +/- 400N
TOTAL URANIUM (FLUOROMETRIC) PCI/G	6.912 +/- 0.001DY	4.176 +/- 0.001DY	3.384 +/- 0.001DY
URANIUM-235 WT %	0.77 +/- 0.01DY	UYINSF	UYLOW

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
RADIOACTIVES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01100	01101	01102
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/18/1990	08/18/1990
SAMPLE TIME:	08:22	09:35	08:59
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	6.55 +/- 2.1DY	3.6 +/- 1.8DY	4.57 +/- 1.9DY
GROSS BETA PCI/G	7.49 +/- 3.8DY	3.13 +/- 3.6DYJ	4.69 +/- 3.6DY
TOTAL RADIUM PCI/G	2.9733 +/- 30DN	2.35161 +/- 25DN	7.5684 +/- 70DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	1.584 +/-DY	1.44 +/-DY	1.584 +/-DY
URANIUM-235 WT %	UYLOW PCI/G	UYLOW PCI/G	UYLOW

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01103	01105	01106
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/18/1990	08/18/1990	08/18/1990
SAMPLE TIME:	10:10	11:08	12:58
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	3.82 +/- 1.8DY	6.69 +/- 2.1DY	5.76 +/- 2DY
GROSS BETA PCI/G	6.82 +/- 3.7DY	5.48 +/- 3.7DY	6.59 +/- 3.7DY
TOTAL RADIUM PCI/G	1.51368 +/- 24DN	2.703 +/- 30DN	2.703 +/- 32DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	2.16 +/-DY	2.304 +/-DY	1.872 +/-DY
URANIUM-235 WT %	UYLOW	UYLOW	UYLOW

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01107	01108	01109
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/19/1990	08/19/1990	08/19/1990
SAMPLE TIME:	08:58	10:22	11:30
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	1.91 +/- 2.1DYJ	4.29 +/- 1.9DY	6.21 +/- 2.5DY
GROSS BETA PCI/G	1.56 +/- 3.6DYJ	5.37 +/- 3.7DY	8.27 +/- 4DY
TOTAL RADIUM PCI/G	1.6218 +/- 25DN	1.54071 +/- 20DN	4.3248 +/- 40DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	1.8 +/-DY	5.688 +/-DY	6.984 +/-DY
URANIUM-235 WT %	UYLOW	0.69 +/- 0.01DY	UYINSF

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
RADIOACTIVES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

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SAMPLE ID:	01110	01111	01112
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.4	SA-1.4	SA-1.4
SAMPLE DATE:	08/19/1990	08/19/1990	08/19/1990
SAMPLE TIME:	13:28	15:24	16:40
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	6.14 +/- 2.5DY	5.97 +/- 2.5DY	8.54 +/- 2.7DY
GROSS BETA PCI/G	8.94 +/- 4DY	8.38 +/- 4DY	7.82 +/- 3.9DY
TOTAL RADIUM PCI/G	4.0545 +/- 40DN	4.8654 +/- 40DN	4.5951 +/- 40DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	4.824 +/-DY	5.832 +/-DY	4.896 +/-DY
URANIUM-235 WT %	0.71 +/- 0.01DY	0.7 +/- 0.01DY	UYINSF

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01120	01121	01122
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.5	SA-1.5	SA-1.5
SAMPLE DATE:	08/20/1990	08/21/1990	08/21/1990
SAMPLE TIME:	17:29	08:21	09:21
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	2.29 +/- 2.1DN	2.4 +/- 2.1DY	0.29 +/- 1.9DYJ
GROSS BETA PCI/G	3.69 +/- 3.7DN	OUY	2.35 +/- 3.7DYJ
TOTAL RADIUM PCI/G	1.70289 +/- 23DN	1.78398 +/- 23DN	2.21646 +/- 28DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	3.096 +/-DY	2.736 +/-DY	3.816 +/-DY
URANIUM-235 WT %		UYLOW	0.62 +/- 0.01DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
RADIOACTIVES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01200	01201	01202
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	SA-1.5B
SAMPLE DATE:	08/27/1990	08/27/1990	08/27/1990
SAMPLE TIME:	14:00	14:30	15:55
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	1.06 +/- 2DYJ	0.11 +/- 1.2DYJ	1.06 +/- 1.4DYJ
GROSS BETA PCI/G	2.33 +/- 4.3DYJ	0UY	0UY
TOTAL RADIUM PCI/G	0.97308 +/- 14DN	2.10834 +/- 29DN	3.2436 +/- 40DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	4.608 +/- 0.001DY	2.952 +/- 0.001DY	1.584 +/- 0.001DY
URANIUM-235 WT %	0.29 +/- 0.01DY	UYLOW	UYLOW

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01203	01204	01205
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	SA-1.5B
SAMPLE DATE:	08/27/1990	08/28/1990	08/28/1990
SAMPLE TIME:	16:45	10:30	10:55
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	2.07 +/- 1.9DY	7.72 +/- 3.1DY	5.1 +/- 2.2DY
GROSS BETA PCI/G	4.17 +/- 3.8DY	5.15 +/- 5.1DY	5.94 +/- 3.8DY
TOTAL RADIUM PCI/G	4.0545 +/- 50DN	7.0278 +/- 60DN	5.1357 +/- 50DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	3.6 +/- 0.001DY	4.104 +/- 0.001DY	5.4 +/- 0.001DY
URANIUM-235 WT %	UYLOW	0.31 +/- 0.01DY	0.32 +/- 0.01DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01206	01207	01208
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.5B	SA-1.5B	S[illegible]-1.3
SAMPLE DATE:	08/28/1990	08/28/1990	08/29/1990
SAMPLE TIME:	13:00		13:30
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	7.63 +/- 2.2DY	6.03 +/- 5.5DYJ	0.03 +/- 6.2DYJ
GROSS BETA PCI/G	5.17 +/- 3.2DY	17.84 +/- 9.5DYJ	15.4 +/- 11.9DYJ
TOTAL RADIUM PCI/G	5.1357 +/- 40DN	4.3248 +/- 40DN	1.702[illegible]9 +/- 23DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	5.256 +/- 0.001DY	30.26 +/- 0.001DY	2.664 +/- 0.001DY
URANIUM-235 PCI/G	0.29 +/- 0.01DY WT %	0.75 +/- 0.01DY WT %	UYLOW

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
RADIOACTIVES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01209	01210	01211
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.3	SA-1.3	SA-1.3
SAMPLE DATE:	06/29/1990	08/29/1990	08/29/1990
SAMPLE TIME:	14:00	15:36	15:45
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	2.14 +/- 5.8DYJ	1.08 +/- 5.9DYJ	4.42 +/- 4DYJ
GROSS BETA PCI/G	18.83 +/- 10.9DYJ	11.59 +/- 11DYJ	18.36 +/- 11.1DYJ
TOTAL RADIUM PCI/G	1.86507 +/- 35DN	2.9733 +/- 140DN	2.4327 +/- 130DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	4.176 +/- 0.001DY	3.456 +/- 0.001DY	3.888 +/- 0.001DY
URANIUM-235 WT %	1 +/- 0.01DY	UYLOW	0.64 +/- 0.01DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01212	01213	01214
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.3	SA-1.3	SA-1.3
SAMPLE DATE:	08/29/1990	08/30/1990	08/30/1990
SAMPLE TIME:	16:07	08:10	08:46
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	6.07 +/- 7DYJ	0UY	1.14 +/- 6.40YJ
GROSS BETA PCI/G	20.24 +/- 12.2DYJ	10.28 +/- 11.8DYJ	9.39 +/- 11.7DYJ
TOTAL RADIUM PCI/G	4.5951 +/- 400N	1.3515 +/- 1000N	5.9466 +/- 600N
TOTAL URANIUM (FLUOROMETRIC) PCI/G	4.104 +/- 0.001DY	5.184 +/- 0.001DY	3.888 +/- 0.001DY
URANIUM-235 WT %	0.71 +/- 0.01DY	0.79 +/- 0.01DY	0.68 +/- 0.01DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

SAMPLE ID:	01215	01216	01217
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.6	SA-1.6	SA-1.6
SAMPLE DATE:	08/30/1990	08/30/1990	08/30/1990
SAMPLE TIME:	14:05	14:40	15:35
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	7.63 +/- 7.1DYJ	3.81 +/- 5.7DYJ	12 +/- 7.5DYJ
GROSS BETA PCI/G	31.75 +/- 12.7DYJ	14.85 +/- 10.2DYJ	37.4 +/- 12.8DYJ
TOTAL RADIUM PCI/G	1.8921 +/- 25DN	2.4327 +/- 25DN	7.2981 +/- 70DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	12.96 +/- 0.001DY	49.608 +/- 0.001DY	57.6 +/- 0.001DY
URANIUM-235 WT %	0.112 +/-DY PCI/G	0.4 +/- 0.01DY	0.85 +/- 0.01DY

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
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JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
RADIOACTIVES - SOIL BORINGS
SPOIL AREA 1 - DETECTED OBSERVATIONS ONLY

SAMPLE ID:	01218	01219	01220
SUB-SAMPLE ID:	00000	00000	00000
STATION ID:	SA-1.6	SA-1.6	SA-1.6
SAMPLE DATE:	08/30/1990	08/30/1990	08/30/1990
SAMPLE TIME:	16:30	16:55	17:05
SAMPLE MATRIX:	SB	SB	SB
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/G	5.13 +/- 6.4DYJ	3.7 +/- 6.7DYJ	7.43 +/- 7.2DYJ
GROSS BETA PCI/G	22.93 +/- 11.6DYJ	23.6 +/- 12.6DYJ	16.85 +/- 12.1DYJ
TOTAL RADIUM PCI/G	4.0545 +/- 40DN	5.406 +/- 40DN	5.1357 +/- 40DN
TOTAL URANIUM (FLUOROMETRIC) PCI/G	7.128 +/- 0.001DY	3.6 +/- 0.001DY	3.312 +/- 0.001DY
URANIUM-235 WT %	0.71 +/- 0.01DY	UYLOW	UYLOW

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
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EDMS CHEMICAL OBSERVATIONS MATRIX
SPOIL AREA - AQUEOUS SAMPLES
Y-12

MATRIX REPORT CHEMICAL LISTING

CHEMICAL CODE	CAS NUMBER	CHEMICAL NAME
GRA		GROSS ALPHA
GR6		GROSS BETA
RAD		TOTAL RADIUM

This report is a listing of all chemicals found in the database for the selected group of data in the Matrix Report.

EDMS CHEMICAL OBSERVATIONS MATRIX
SPOIL AREA - AQUEOUS SAMPLES
Y-12

SAMPLE ID:	01062	01160	01161
SUB-SAMPLE ID:	SAE	SAE	SAE
STATION ID:	SA-1.2	SA-1.4	SA-1.4
SAMPLE DATE:	08/16/1990	08/18/1990	08/19/1990
SAMPLE TIME:			
SAMPLE MATRIX:	AQ	AQ	AQ
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/L	0UY	80.14 +/- 36.8DY	136.04 +/- 42.9DY
GROSS BETA PCI/L	0UY	111.77 +/- 73.8DY	205.66 +/- 78.4DY
TOTAL RADIUM PCI/L	7.8387 +/- 0.22DN	1.8921 +/- 0.13DN	0.8109 +/- 0.09DN

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
SPOIL AREA - AQUEOUS SAMPLES
Y-12

SAMPLE ID:	01304	01305	01308
SUB-SAMPLE ID:	SAE	SAE	SAE
STATION ID:	SA-1.5B	SA-1.3	SA-1.3
SAMPLE DATE:	08/28/1990	08/29/1990	08/30/1990
SAMPLE TIME:			
SAMPLE MATRIX:	AQ	AQ	AQ
UPPER DEPTH:			
LOWER DEPTH:			
GROSS ALPHA PCI/L	OUY	OUY	OUY
GROSS BETA PCI/L	OUY	38.01 +/- 58DYJ	64.83 +/- 59.7DY
TOTAL RADIUM PCI/L	1.8921 +/- 0.1DN	1.6218 +/- 0.15DN	4.5951 +/- 0.24DN

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

EDMS CHEMICAL OBSERVATIONS MATRIX
SPOIL AREA - AQUEOUS SAMPLES
Y-12

SAMPLE ID:	01309
SUB-SAMPLE ID:	SAE
STATION ID:	SA-1.6
SAMPLE DATE:	08/31/1990
SAMPLE TIME:	
SAMPLE MATRIX:	AQ
UPPER DEPTH:	
LOWER DEPTH:	
GROSS ALPHA PCI/L	11.78 +/- 32.9DYJ
GROSS BETA PCI/L	172.13 +/- 66DY
TOTAL RADIUM PCI/L	0.2703 +/- 0.1DN

NNN+/-XXABCCCDD POSITIONALLY N=VALUE, (+/-XX=ERROR FACTOR FOR RADS ONLY), A=DETECTED, B=VALIDATED, C=FLAGS,
U = less than detection limit, D = detected, J = estimated, R = unusable,
JN = tentatively identified and estimated, UJ = not detected and detection limit is estimated.

RUST SPOIL AREA ANALYTICAL DATA

Location: 106-001

		00-05	05-10	Blank	Rin-1	Rin-2
1,1,1-Trichloroethane (MG/KG)	03/26/90	ND	ND			
1,1,1-Trichloroethane (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
1,1,2,2-Tetrachloroethane (MG/KG)	03/26/90	ND	ND			
1,1,2,2-Tetrachloroethane (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
1,1,2-Trichloroethane (MG/KG)	03/26/90	ND	ND			
1,1,2-Trichloroethane (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
1,1-Dichloroethane (MG/KG)	03/26/90	ND	ND			
1,1-Dichloroethane (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
1,1-Dichloroethene (MG/KG)	03/26/90	ND	ND			
1,1-Dichloroethene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
1,2-Dichloroethane (MG/KG)	03/26/90	ND	ND			
1,2-Dichloroethane (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
1,2-Dichloroethene (total) (MG/KG)	03/26/90	ND	ND			
1,2-Dichloroethene (total) (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
1,2-Dichloropropane (MG/KG)	03/26/90	ND	ND			
1,2-Dichloropropane (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
2-Butanone (MG/KG)	03/26/90	ND	ND			
2-Butanone (MG/L) - QC	03/26/90			ND	0.065	0.031
2-Hexanone (MG/KG)	03/26/90	ND	ND			
2-Hexanone (MG/L) - QC	03/26/90			ND	0.017	0.01
4-Methyl-2-pentanone (MG/KG)	03/26/90	ND	ND			
4-Methyl-2-pentanone (MG/L) - QC	03/26/90			ND	ND	ND
Acetone (MG/KG)	03/26/90	0.16	0.23			
Acetone (MG/L) - QC	03/26/90			0.009	0.058	0.043
Alpha Activity (PCI/G)	03/26/90	2.25	4.35			
Alpha Activity (PCI/L) - QC	03/26/90				-36.04	-82.68
Aluminum (MG/KG)	03/26/90	22000	19000			
Aluminum (MG/L) - QC	03/26/90				<0.02	0.044
Arsenic (MG/KG)	03/26/90	5.1	6.5			
Arsenic (MG/L) - QC	03/26/90				<0.005	<0.005
Asbestos (%)	03/26/90	<0	<0			
Asbestos (%) - QC	03/26/90				<0	<0
Barium (MG/KG)	03/26/90	94	140			
Barium (MG/L) - QC	03/26/90				0.0012	<0.001
Benzene (MG/KG)	03/26/90	ND	ND			
Benzene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Beryllium (MG/KG)	03/26/90	0.93	1.6			
Beryllium (MG/L) - QC	03/26/90				<0.0003	<0.0003
Beta Activity (PCI/G)	03/26/90	3.33	4.03			
Beta Activity (PCI/L) - QC	03/26/90				-346.19	-234.73
Bromodichloromethane (MG/KG)	03/26/90	ND	ND			
Bromodichloromethane (MG/L) - QC	03/26/90			0.0006	0.005U	0.005U
Bromoform (MG/KG)	03/26/90	ND	ND			
Bromoform (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Bromomethane (MG/KG)	03/26/90	ND	ND			
Bromomethane (MG/L) - QC	03/26/90			ND	ND	ND
Cadmium (MG/KG)	03/26/90	5.7	5.6			
Cadmium (MG/L) - QC	03/26/90				<0.003	<0.003
Calcium (MG/KG)	03/26/90	14000	22000			
Calcium (MG/L) - QC	03/26/90				<0.004	0.14
Carbon Disulfide (MG/KG)	03/26/90	ND	ND			
Carbon Disulfide (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Carbon Tetrachloride (MG/KG)	03/26/90	ND	ND			
Carbon Tetrachloride (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Chlorobenzene (MG/KG)	03/26/90	ND	ND			
Chlorobenzene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Chloroethane (MG/KG)	03/26/90	ND	ND			
Chloroethane (MG/L) - QC	03/26/90			ND	ND	ND
Chloroform (MG/KG)	03/26/90	ND	ND			
Chloroform (MG/L) - QC	03/26/90			0.0006	0.005U	0.005U
Chloromethane (MG/KG)	03/26/90	ND	ND			
Chloromethane (MG/L) - QC	03/26/90			ND	ND	ND
Chromium (MG/KG)	03/26/90	27	28			
Chromium (MG/L) - QC	03/26/90				<0.01	<0.01
Cobalt (MG/KG)	03/26/90	18	20			
Cobalt (MG/L) - QC	03/26/90				<0.005	<0.005
Copper (MG/KG)	03/26/90	24	24			
Copper (MG/L) - QC	03/26/90				<0.004	0.0045
Cyanide (MG/KG)	03/26/90	<1	<1			
Cyanide (MG/L) - QC	03/26/90				<0.1	<0.1
Dibromochloromethane (MG/KG)	03/26/90	ND	ND			
Dibromochloromethane (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Ethyl benzene (MG/KG)	03/26/90	ND	ND			
Ethyl benzene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Iron (MG/KG)	03/26/90	33000	31000			

Iron (MG/L) - QC	03/26/90				<0.004	<0.004
Lead (MG/KG)	03/26/90	38	21			
Lead (MG/KG)	03/26/90	15	24			
Lead (MG/L) - QC	03/26/90				<0.05	<0.05
Lead (MG/L) - QC	03/26/90				<0.004	<0.004
Magnesium (MG/KG)	03/26/90	2800	4600			
Magnesium (MG/L) - QC	03/26/90				0.00072	0.0093
Manganese (MG/KG)	03/26/90	1000	1200			
Manganese (MG/L) - QC	03/26/90				0.001	0.0017
Mercury (MG/KG)	03/26/90	<1	<1			
Mercury (MG/L) - QC	03/26/90				<0.0002	<0.0002
Methylene Chloride (MG/KG)	03/26/90	ND	ND			
Methylene Chloride (MG/L) - QC	03/26/90			0.005U	0.0008	0.005U
Moisture Content (%)	03/26/90	21.9	13.4			
Nickel (MG/KG)	03/26/90	23	31			
Nickel (MG/L) - QC	03/26/90				<0.01	<0.01
Niobium (MG/KG)	03/26/90	<0.85	<0.86			
Niobium (MG/L) - QC	03/26/90				<0.007	<0.007
Phosphorous (MG/KG)	03/26/90	290	410			
Phosphorous (MG/L) - QC	03/26/90				<0.2	<0.2
Potassium (MG/KG)	03/26/90	2700	3400			
Potassium (MG/L) - QC	03/26/90				<0.6	<0.6
Selenium (MG/KG)	03/26/90	<0.5	<0.5			
Selenium (MG/L) - QC	03/26/90				<0.005	<0.005
Silver (MG/KG)	03/26/90	<0.73	<0.74			
Silver (MG/L) - QC	03/26/90				<0.006	<0.006
Sodium (MG/KG)	03/26/90	51	39			
Sodium (MG/L) - QC	03/26/90				630	640
Styrene (MG/KG)	03/26/90	ND	ND			
Styrene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Tetrachloroethene (MG/KG)	03/26/90	0.037U	0.013U			
Tetrachloroethene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Thorium (MG/KG)	03/26/90	<24	<25			
Thorium (MG/L) - QC	03/26/90				<0.2	<0.2
Toluene (MG/KG)	03/26/90	ND	ND			
Toluene (MG/L) - QC	03/26/90			0.0006	0.0008	0.005U
Trichloroethene (MG/KG)	03/26/90	ND	ND			
Trichloroethene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Uranium Fluorometric (MG/KG)	03/26/90	4.3	3.9			
Uranium Fluorometric (MG/L) - QC	03/26/90				<0.001	<0.001
Vanadium (MG/KG)	03/26/90	37	23			
Vanadium (MG/L) - QC	03/26/90				<0.005	<0.005
Vinyl Acetate (MG/KG)	03/26/90	ND	ND			
Vinyl Acetate (MG/L) - QC	03/26/90			ND	ND	ND
Vinyl Chloride (MG/KG)	03/26/90	ND	ND			
Vinyl Chloride (MG/L) - QC	03/26/90			ND	ND	ND
Xylene (total) (MG/KG)	03/26/90	ND	ND			
Xylene (total) (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
Zinc (MG/KG)	03/26/90	80	46			
Zinc (MG/L) - QC	03/26/90				<0.001	<0.001
cis-1,3-Dichloropropene (MG/KG)	03/26/90	ND	ND			
cis-1,3-Dichloropropene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U
trans-1,3-Dichloropropene (MG/KG)	03/26/90	ND	ND			
trans-1,3-Dichloropropene (MG/L) - QC	03/26/90			0.005U	0.005U	0.005U

Location: 106-002

		00-05	05-10	10-15	Blank	Rin-1
1,1,1-Trichloroethane (MG/KG)	03/27/90	ND	ND	ND		
1,1,1-Trichloroethane (MG/L) - QC	03/27/90				0.005U	0.005U
1,1,2,2-Tetrachloroethane (MG/KG)	03/27/90	ND	ND	ND		
1,1,2,2-Tetrachloroethane (MG/L) - QC	03/27/90				0.005U	0.005U
1,1,2-Trichloroethane (MG/KG)	03/27/90	ND	ND	ND		
1,1,2-Trichloroethane (MG/L) - QC	03/27/90				0.005U	0.005U
1,1-Dichloroethane (MG/KG)	03/27/90	ND	ND	ND		
1,1-Dichloroethane (MG/L) - QC	03/27/90				0.005U	0.005U
1,1-Dichloroethene (MG/KG)	03/27/90	ND	ND	ND		
1,1-Dichloroethene (MG/L) - QC	03/27/90				0.005U	0.005U
1,2-Dichloroethane (MG/KG)	03/27/90	ND	ND	ND		
1,2-Dichloroethane (MG/L) - QC	03/27/90				0.005U	0.005U
1,2-Dichloroethene (total) (MG/KG)	03/27/90	ND	ND	ND		
1,2-Dichloroethene (total) (MG/L) - QC	03/27/90				0.005U	0.005U
1,2-Dichloropropane (MG/KG)	03/27/90	ND	ND	ND		
1,2-Dichloropropane (MG/L) - QC	03/27/90				0.005U	0.005U
2-Butanone (MG/KG)	03/27/90	ND	ND	ND		
2-Butanone (MG/L) - QC	03/27/90				ND	ND
2-Hexanone (MG/KG)	03/27/90	ND	ND	ND		
2-Hexanone (MG/L) - QC	03/27/90				ND	ND
4-Methyl-2-pentanone (MG/KG)	03/27/90	ND	ND	ND		
4-Methyl-2-pentanone (MG/L) - QC	03/27/90				ND	ND
Acetone (MG/KG)	03/27/90	0.032U	0.027U	1.9E		
Acetone (MG/L) - QC	03/27/90				ND	ND
Alpha Activity (PCI/G)	03/27/90	3.11	2.55	1.53		
Alpha Activity (PCI/L) - QC	03/27/90					-20.58
Aluminum (MG/KG)	03/27/90	22000	21000	22000		
Aluminum (MG/L) - QC	03/27/90					<0.02
Arsenic (MG/KG)	03/27/90	13	2.8	4.2		
Arsenic (MG/L) - QC	03/27/90					<0.005
Asbestos (%)	03/27/90	<0	<0	<0		
Barium (MG/KG)	03/27/90	61	88	140		
Barium (MG/L) - QC	03/27/90					<0.001
Benzene (MG/KG)	03/27/90	ND	ND	ND		
Benzene (MG/L) - QC	03/27/90				0.005U	0.005U
Beryllium (MG/KG)	03/27/90	0.88	0.67	0.7		
Beryllium (MG/L) - QC	03/27/90					<0.0003
Beta Activity (PCI/G)	03/27/90	3.98	3.68	3.88		
Beta Activity (PCI/L) - QC	03/27/90					-380
Bromodichloromethane (MG/KG)	03/27/90	ND	ND	ND		
Bromodichloromethane (MG/L) - QC	03/27/90				0.005U	0.005U
Bromoform (MG/KG)	03/27/90	ND	ND	ND		
Bromoform (MG/L) - QC	03/27/90				0.005U	0.005U
Bromomethane (MG/KG)	03/27/90	ND	ND	ND		
Bromomethane (MG/L) - QC	03/27/90				ND	ND
Cadmium (MG/KG)	03/27/90	4.9	5	3.9		
Cadmium (MG/L) - QC	03/27/90					<0.003
Calcium (MG/KG)	03/27/90	10000	34000	35000		
Calcium (MG/L) - QC	03/27/90					0.1
Carbon Disulfide (MG/KG)	03/27/90	ND	ND	ND		
Carbon Disulfide (MG/L) - QC	03/27/90				0.005U	0.005U
Carbon Tetrachloride (MG/KG)	03/27/90	ND	ND	ND		
Carbon Tetrachloride (MG/L) - QC	03/27/90				0.005U	0.005U
Chlorobenzene (MG/KG)	03/27/90	ND	ND	ND		
Chlorobenzene (MG/L) - QC	03/27/90				0.005U	0.005U
Chloroethane (MG/KG)	03/27/90	ND	ND	ND		
Chloroethane (MG/L) - QC	03/27/90				ND	ND
Chloroform (MG/KG)	03/27/90	ND	ND	ND		
Chloroform (MG/L) - QC	03/27/90				0.005U	0.005U
Chloromethane (MG/KG)	03/27/90	ND	ND	ND		
Chloromethane (MG/L) - QC	03/27/90				ND	ND
Chromium (MG/KG)	03/27/90	27	41	23		
Chromium (MG/L) - QC	03/27/90					<0.01
Cobalt (MG/KG)	03/27/90	12	12	11		
Cobalt (MG/L) - QC	03/27/90					<0.005
Copper (MG/KG)	03/27/90	29	18	14		
Copper (MG/L) - QC	03/27/90					0.0053
Cyanide (MG/KG)	03/27/90	<1	<1	<1		
Cyanide (MG/L) - QC	03/27/90					<0.1
Dibromochloromethane (MG/KG)	03/27/90	ND	ND	ND		
Dibromochloromethane (MG/L) - QC	03/27/90				0.005U	0.005U
Ethyl benzene (MG/KG)	03/27/90	ND	ND	ND		
Ethyl benzene (MG/L) - QC	03/27/90				0.005U	0.005U
Iron (MG/KG)	03/27/90	34000	31000	24000		
Iron (MG/L) - QC	03/27/90					0.02

Lead (MG/KG)	03/27/90	35	22	16		
Lead (MG/KG)	03/27/90	47	13	38		
Lead (MG/L) - QC	03/27/90					<0.05
Lead (MG/L) - QC	03/27/90					<0.004
Magnesium (MG/KG)	03/27/90	3000	6000	4600		
Magnesium (MG/L) - QC	03/27/90					0.024
Manganese (MG/KG)	03/27/90	540	690	600		
Manganese (MG/L) - QC	03/27/90					<0.001
Mercury (MG/KG)	03/27/90	<1	<1	<1		
Mercury (MG/L) - QC	03/27/90					<0.0002
Methylene Chloride (MG/KG)	03/27/90	ND	ND	ND		
Methylene Chloride (MG/L) - QC	03/27/90				0.005U	0.005U
Moisture Content (%)	03/27/90	21.6	16.9	15.2		
Nickel (MG/KG)	03/27/90	24	17	17		
Nickel (MG/L) - QC	03/27/90					0.01
Niobium (MG/KG)	03/27/90	<0.81	<0.8	<0.81		
Niobium (MG/L) - QC	03/27/90					<0.007
Phosphorous (MG/KG)	03/27/90	240	260	280		
Phosphorous (MG/L) - QC	03/27/90					<0.2
Potassium (MG/KG)	03/27/90	1900	2100	2200		
Potassium (MG/L) - QC	03/27/90					<0.6
Selenium (MG/KG)	03/27/90	<0.4	<0.58	<0.57		
Selenium (MG/L) - QC	03/27/90					<0.005
Silver (MG/KG)	03/27/90	<0.69	<0.69	<0.69		
Silver (MG/L) - QC	03/27/90					<0.006
Sodium (MG/KG)	03/27/90	74	61	64		
Sodium (MG/L) - QC	03/27/90					0.097
Styrene (MG/KG)	03/27/90	ND	ND	ND		
Styrene (MG/L) - QC	03/27/90				0.005U	0.005U
Tetrachloroethene (MG/KG)	03/27/90	0.016U	0.072	0.013U		
Tetrachloroethene (MG/L) - QC	03/27/90				0.005U	0.005U
Thorium (MG/KG)	03/27/90	<23	<23	<23		
Thorium (MG/L) - QC	03/27/90					<0.2
Toluene (MG/KG)	03/27/90	ND	ND	ND		
Toluene (MG/L) - QC	03/27/90				0.005U	0.005U
Trichloroethene (MG/KG)	03/27/90	ND	ND	ND		
Trichloroethene (MG/L) - QC	03/27/90				0.005U	0.005U
Uranium 235 (WT%)	03/27/90		0.5			
Uranium 238 (WT%)	03/27/90		99.5			
Uranium Fluorometric (MG/KG)	03/27/90	4.7	7.9	5		
Uranium Fluorometric (MG/L) - QC	03/27/90					<0.001
Vanadium (MG/KG)	03/27/90	48	31	29		
Vanadium (MG/L) - QC	03/27/90					<0.005
Vinyl Acetate (MG/KG)	03/27/90	ND	ND	ND		
Vinyl Acetate (MG/L) - QC	03/27/90				ND	ND
Vinyl Chloride (MG/KG)	03/27/90	ND	ND	ND		
Vinyl Chloride (MG/L) - QC	03/27/90				ND	ND
Xylene (total) (MG/KG)	03/27/90	ND	ND	ND		
Xylene (total) (MG/L) - QC	03/27/90				0.005U	0.005U
Zinc (MG/KG)	03/27/90	86	50	44		
Zinc (MG/L) - QC	03/27/90					0.0076
cis-1,3-Dichloropropene (MG/KG)	03/27/90	ND	ND	ND		
cis-1,3-Dichloropropene (MG/L) - QC	03/27/90				0.005U	0.005U
trans-1,3-Dichloropropene (MG/KG)	03/27/90	ND	ND	ND		
trans-1,3-Dichloropropene (MG/L) - QC	03/27/90				0.005U	0.005U

		Rin-2
1,1,1-Trichloroethane (MG/L) - QC	03/27/90	0.005U
1,1,2,2-Tetrachloroethane (MG/L) - QC	03/27/90	0.005U
1,1,2-Trichloroethane (MG/L) - QC	03/27/90	0.005U
1,1-Dichloroethane (MG/L) - QC	03/27/90	0.005U
1,1-Dichloroethene (MG/L) - QC	03/27/90	0.005U
1,2-Dichloroethane (MG/L) - QC	03/27/90	0.005U
1,2-Dichloroethene (total) (MG/L) - QC	03/27/90	0.005U
1,2-Dichloropropane (MG/L) - QC	03/27/90	0.005U
2-Butanone (MG/L) - QC	03/27/90	ND
2-Hexanone (MG/L) - QC	03/27/90	ND
4-Methyl-2-pentanone (MG/L) - QC	03/27/90	ND
Acetone (MG/L) - QC	03/27/90	ND
Alpha Activity (PCI/L) - QC	03/27/90	-67.13
Aluminum (MG/L) - QC	03/27/90	<0.02
Arsenic (MG/L) - QC	03/27/90	<0.005
Barium (MG/L) - QC	03/27/90	<0.001
Benzene (MG/L) - QC	03/27/90	0.005U
Beryllium (MG/L) - QC	03/27/90	<0.0003
Beta Activity (PCI/L) - QC	03/27/90	-268.26
Bromodichloromethane (MG/L) - QC	03/27/90	0.005U
Bromoform (MG/L) - QC	03/27/90	0.005U

Bromomethane (MG/L) - QC	03/27/90	ND
Cadmium (MG/L) - QC	03/27/90	<0.003
Calcium (MG/L) - QC	03/27/90	0.15
Carbon Disulfide (MG/L) - QC	03/27/90	0.005U
Carbon Tetrachloride (MG/L) - QC	03/27/90	0.005U
Chlorobenzene (MG/L) - QC	03/27/90	0.005U
Chloroethane (MG/L) - QC	03/27/90	ND
Chloroform (MG/L) - QC	03/27/90	0.005U
Chloromethane (MG/L) - QC	03/27/90	ND
Chromium (MG/L) - QC	03/27/90	<0.01
Cobalt (MG/L) - QC	03/27/90	<0.005
Copper (MG/L) - QC	03/27/90	0.0077
Cyanide (MG/L) - QC	03/27/90	<0.1
Dibromochloromethane (MG/L) - QC	03/27/90	0.005U
Ethyl benzene (MG/L) - QC	03/27/90	0.005U
Iron (MG/L) - QC	03/27/90	0.043
Lead (MG/L) - QC	03/27/90	<0.05
Lead (MG/L) - QC	03/27/90	<0.004
Magnesium (MG/L) - QC	03/27/90	0.041
Manganese (MG/L) - QC	03/27/90	<0.001
Mercury (MG/L) - QC	03/27/90	<0.0002
Methylene Chloride (MG/L) - QC	03/27/90	0.005U
Nickel (MG/L) - QC	03/27/90	<0.01
Niobium (MG/L) - QC	03/27/90	<0.007
Phosphorous (MG/L) - QC	03/27/90	<0.2
Potassium (MG/L) - QC	03/27/90	<0.6
Selenium (MG/L) - QC	03/27/90	<0.005
Silver (MG/L) - QC	03/27/90	<0.006
Sodium (MG/L) - QC	03/27/90	0.43
Styrene (MG/L) - QC	03/27/90	0.005U
Tetrachloroethene (MG/L) - QC	03/27/90	0.005U
Thorium (MG/L) - QC	03/27/90	<0.2
Toluene (MG/L) - QC	03/27/90	0.005U
Trichloroethene (MG/L) - QC	03/27/90	0.005U
Uranium Fluorometric (MG/L) - QC	03/27/90	0.001
Vanadium (MG/L) - QC	03/27/90	<0.005
Vinyl Acetate (MG/L) - QC	03/27/90	ND
Vinyl Chloride (MG/L) - QC	03/27/90	ND
Xylene (total) (MG/L) - QC	03/27/90	0.005U
Zinc (MG/L) - QC	03/27/90	0.0062
cis-1,3-Dichloropropene (MG/L) - QC	03/27/90	0.005U
trans-1,3-Dichloropropene (MG/L) - QC	03/27/90	0.005U

Location: 106-003

		00-05	05-10	10-15	15-20	20-25
1,1,1-Trichloroethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
1,1,1-Trichloroethane (MG/KG) - Dup	03/27/90			ND		
1,1,2,2-Tetrachloroethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane (MG/KG) - Dup	03/27/90			ND		
1,1,2-Trichloroethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
1,1,2-Trichloroethane (MG/KG) - Dup	03/27/90			ND		
1,1-Dichloroethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
1,1-Dichloroethane (MG/KG) - Dup	03/27/90			ND		
1,1-Dichloroethene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
1,1-Dichloroethene (MG/KG) - Dup	03/27/90			ND		
1,2-Dichloroethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
1,2-Dichloroethane (MG/KG) - Dup	03/27/90			ND		
1,2-Dichloroethene (total) (MG/KG)	03/27/90	ND	ND	ND	ND	ND
1,2-Dichloroethene (total) (MG/KG) - Dup	03/27/90			ND		
1,2-Dichloropropane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
1,2-Dichloropropane (MG/KG) - Dup	03/27/90			ND		
2-Butanone (MG/KG)	03/27/90	ND	ND	ND	ND	ND
2-Butanone (MG/KG) - Dup	03/27/90			ND		
2-Hexanone (MG/KG)	03/27/90	ND	ND	ND	ND	ND
2-Hexanone (MG/KG) - Dup	03/27/90			ND		
4-Methyl-2-pentanone (MG/KG)	03/27/90	ND	ND	ND	ND	ND
4-Methyl-2-pentanone (MG/KG) - Dup	03/27/90			ND		
Acetone (MG/KG)	03/27/90	0.6E	0.3	1.3E	0.26	0.2
Acetone (MG/KG) - Dup	03/27/90			0.71E		
Alpha Activity (PCI/G)	03/27/90	1.67	2.79	2.05	1.88	1.67
Alpha Activity (PCI/G) - Dup	03/27/90			2.28		
Aluminum (MG/KG)	03/27/90	17000	18000	23000	19000	13000
Aluminum (MG/KG) - Dup	03/27/90			17000		
Arsenic (MG/KG)	03/27/90	6.7	4.8	4.4	3.1	4.3
Arsenic (MG/KG) - Dup	03/27/90			5.1		
Asbestos (%)	03/27/90	<0	<0	<0	<0	<0
Asbestos (%) - Dup	03/27/90			<0		
Barium (MG/KG)	03/27/90	89	100	100	150	130
Barium (MG/KG) - Dup	03/27/90			130		
Benzene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Benzene (MG/KG) - Dup	03/27/90			ND		
Beryllium (MG/KG)	03/27/90	0.92	0.71	0.83	0.8	<3.4
Beryllium (MG/KG) - Dup	03/27/90			0.71		
Beta Activity (PCI/G)	03/27/90	2.46	3.77	3.94	3.34	1.87
Beta Activity (PCI/G) - Dup	03/27/90			3.13		
Bromodichloromethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Bromodichloromethane (MG/KG) - Dup	03/27/90			ND		
Bromoform (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Bromoform (MG/KG) - Dup	03/27/90			ND		
Bromomethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Bromomethane (MG/KG) - Dup	03/27/90			ND		
Cadmium (MG/KG)	03/27/90	3.5	3.9	4.2	3.6	<34
Cadmium (MG/KG) - Dup	03/27/90			3.7		
Calcium (MG/KG)	03/27/90	17000	68000	41000	49000	160000
Calcium (MG/KG) - Dup	03/27/90			89000		
Carbon Disulfide (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Carbon Disulfide (MG/KG) - Dup	03/27/90			ND		
Carbon Tetrachloride (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Carbon Tetrachloride (MG/KG) - Dup	03/27/90			ND		
Chlorobenzene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Chlorobenzene (MG/KG) - Dup	03/27/90			ND		
Chloroethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Chloroethane (MG/KG) - Dup	03/27/90			ND		
Chloroform (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Chloroform (MG/KG) - Dup	03/27/90			ND		
Chloromethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Chloromethane (MG/KG) - Dup	03/27/90			ND		
Chromium (MG/KG)	03/27/90	17	21	31	20	<110
Chromium (MG/KG) - Dup	03/27/90			18		
Cobalt (MG/KG)	03/27/90	14	11	9.5	10	<56
Cobalt (MG/KG) - Dup	03/27/90			9.4		
Copper (MG/KG)	03/27/90	20	19	20	18	740
Copper (MG/KG) - Dup	03/27/90			18		
Cyanide (MG/KG)	03/27/90	<1	<1	<1	<0.1	<0.1
Cyanide (MG/KG) - Dup	03/27/90			<1		
Dibromochloromethane (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Dibromochloromethane (MG/KG) - Dup	03/27/90			ND		
Ethyl benzene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Ethyl benzene (MG/KG) - Dup	03/27/90			ND		
Iron (MG/KG)	03/27/90	24000	22000	25000	22000	16000

Iron (MG/KG) - Dup	03/27/90			20000		
Lead (MG/KG)	03/27/90	22	28	84	30	<560
Lead (MG/KG)	03/27/90	26	56	37	31	103
Lead (MG/KG) - Dup	03/27/90			29		
Lead (MG/KG) - Dup	03/27/90			32		
Magnesium (MG/KG)	03/27/90	3300	6000	7200	7600	21000
Magnesium (MG/KG) - Dup	03/27/90			9000		
Manganese (MG/KG)	03/27/90	740	690	450	360	440
Manganese (MG/KG) - Dup	03/27/90			570		
Mercury (MG/KG)	03/27/90	7.5	1.3	<1	<1	6.2
Mercury (MG/KG) - Dup	03/27/90			<1		
Methylene Chloride (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Methylene Chloride (MG/KG) - Dup	03/27/90			ND		
Moisture Content (%)	03/27/90	13.6	13.9	13.2	6.5	18.6
Moisture Content (%) - Dup	03/27/90			8.6		
Nickel (MG/KG)	03/27/90	21	16	19	16	<110
Nickel (MG/KG) - Dup	03/27/90			15		
Niobium (MG/KG)	03/27/90	<0.78	<0.78	<0.73	<0.78	<79
Niobium (MG/KG) - Dup	03/27/90			<0.77		
Phosphorous (MG/KG)	03/27/90	370	310	320	320	<2300
Phosphorous (MG/KG) - Dup	03/27/90			350		
Potassium (MG/KG)	03/27/90	1700	2300	2200	2800	<6800
Potassium (MG/KG) - Dup	03/27/90			2300		
Selenium (MG/KG)	03/27/90	<0.52	<0.42	<0.45	<0.43	<0.53
Selenium (MG/KG) - Dup	03/27/90			<0.42		
Silver (MG/KG)	03/27/90	<0.67	<0.67	<0.62	<0.67	<68
Silver (MG/KG) - Dup	03/27/90			<0.66		
Sodium (MG/KG)	03/27/90	39	84	79	97	1100
Sodium (MG/KG) - Dup	03/27/90			76		
Styrene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Styrene (MG/KG) - Dup	03/27/90			ND		
Tetrachloroethene (MG/KG)	03/27/90	0.014U	0.014U	0.013U	0.012U	0.014U
Tetrachloroethene (MG/KG) - Dup	03/27/90			0.011U		
Thorium (MG/KG)	03/27/90	<22	<22	<21	<22	<2300
Thorium (MG/KG) - Dup	03/27/90			<22		
Toluene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Toluene (MG/KG) - Dup	03/27/90			ND		
Trichloroethene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Trichloroethene (MG/KG) - Dup	03/27/90			ND		
Uranium 235 (WT%) - Dup	03/27/90			1.18		
Uranium 238 (WT%) - Dup	03/27/90			98.75		
Uranium Fluorometric (MG/KG)	03/27/90	4	12	5.6	4.9	3.6
Uranium Fluorometric (MG/KG) - Dup	03/27/90			14.5		
Uranium-234 (WT%) - Dup	03/27/90			0.01		
Uranium-236 (WT%) - Dup	03/27/90			0.01		
Vanadium (MG/KG)	03/27/90	27	23	32	20	<56
Vanadium (MG/KG) - Dup	03/27/90			23		
Vinyl Acetate (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Vinyl Acetate (MG/KG) - Dup	03/27/90			ND		
Vinyl Chloride (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Vinyl Chloride (MG/KG) - Dup	03/27/90			ND		
Xylene (total) (MG/KG)	03/27/90	ND	ND	ND	ND	ND
Xylene (total) (MG/KG) - Dup	03/27/90			ND		
Zinc (MG/KG)	03/27/90	70	57	79	47	190
Zinc (MG/KG) - Dup	03/27/90			57		
cis-1,3-Dichloropropene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene (MG/KG) - Dup	03/27/90			ND		
trans-1,3-Dichloropropene (MG/KG)	03/27/90	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene (MG/KG) - Dup	03/27/90			ND		

		Rin-1	Rin-2
1,1,1-Trichloroethane (MG/L) - QC	03/27/90	0.005U	0.005U
1,1,2,2-Tetrachloroethane (MG/L) - QC	03/27/90	0.005U	0.005U
1,1,2-Trichloroethane (MG/L) - QC	03/27/90	0.005U	0.005U
1,1-Dichloroethane (MG/L) - QC	03/27/90	0.005U	0.005U
1,1-Dichloroethene (MG/L) - QC	03/27/90	0.005U	0.005U
1,2-Dichloroethane (MG/L) - QC	03/27/90	0.005U	0.005U
1,2-Dichloroethene (total) (MG/L) - QC	03/27/90	0.005U	0.005U
1,2-Dichloropropane (MG/L) - QC	03/27/90	0.005U	0.005U
2-Butanone (MG/L) - QC	03/27/90	ND	ND
2-Hexanone (MG/L) - QC	03/27/90	ND	ND
4-Methyl-2-pentanone (MG/L) - QC	03/27/90	ND	ND
Acetone (MG/L) - QC	03/27/90	0.055	0.084
Alpha Activity (PCI/L) - QC	03/27/90	-82.72	-5.05
Aluminum (MG/L) - QC	03/27/90	<0.02	0.2
Arsenic (MG/L) - QC	03/27/90	<0.005	<0.005
Barium (MG/L) - QC	03/27/90	<0.001	<0.001
Benzene (MG/L) - QC	03/27/90	0.005U	0.005U

Beryllium (MG/L) - QC	03/27/90	<0.0003	<0.0003
Beta Activity (PCI/L) - QC	03/27/90	-368.86	-391.21
Bromodichloromethane (MG/L) - QC	03/27/90	0.005U	0.005U
Bromoform (MG/L) - QC	03/27/90	0.005U	0.005U
Bromomethane (MG/L) - QC	03/27/90	ND	ND
Cadmium (MG/L) - QC	03/27/90	<0.003	<0.003
Calcium (MG/L) - QC	03/27/90	0.039	0.078
Carbon Disulfide (MG/L) - QC	03/27/90	0.005U	0.005U
Carbon Tetrachloride (MG/L) - QC	03/27/90	0.005U	0.005U
Chlorobenzene (MG/L) - QC	03/27/90	0.005U	0.005U
Chloroethane (MG/L) - QC	03/27/90	ND	ND
Chloroform (MG/L) - QC	03/27/90	0.005U	0.005U
Chloromethane (MG/L) - QC	03/27/90	ND	ND
Chromium (MG/L) - QC	03/27/90	<0.01	<0.01
Cobalt (MG/L) - QC	03/27/90	<0.005	<0.005
Copper (MG/L) - QC	03/27/90	<0.004	0.0065
Cyanide (MG/L) - QC	03/27/90	<0.1	<0.1
Dibromochloromethane (MG/L) - QC	03/27/90	0.005U	0.005U
Ethyl benzene (MG/L) - QC	03/27/90	0.005U	0.005U
Iron (MG/L) - QC	03/27/90	0.0068	0.095
Lead (MG/L) - QC	03/27/90	<0.05	<0.05
Lead (MG/L) - QC	03/27/90	<0.004	<0.004
Magnesium (MG/L) - QC	03/27/90	0.006	0.015
Manganese (MG/L) - QC	03/27/90	0.0013	0.0027
Mercury (MG/L) - QC	03/27/90	<0.0002	<0.0002
Methylene Chloride (MG/L) - QC	03/27/90	0.005U	0.005U
Nickel (MG/L) - QC	03/27/90	<0.01	<0.01
Niobium (MG/L) - QC	03/27/90	<0.007	<0.007
Phosphorous (MG/L) - QC	03/27/90	<0.2	<0.2
Potassium (MG/L) - QC	03/27/90	<0.6	<0.6
Selenium (MG/L) - QC	03/27/90	<0.005	<0.005
Silver (MG/L) - QC	03/27/90	<0.006	<0.006
Sodium (MG/L) - QC	03/27/90	0.13	0.23
Styrene (MG/L) - QC	03/27/90	0.005U	0.005U
Tetrachloroethene (MG/L) - QC	03/27/90	0.005U	0.005U
Thorium (MG/L) - QC	03/27/90	<0.2	<0.2
Toluene (MG/L) - QC	03/27/90	0.005U	0.005U
Trichloroethene (MG/L) - QC	03/27/90	0.005U	0.005U
Uranium Fluorometric (MG/L) - QC	03/27/90	<0.001	<0.001
Vanadium (MG/L) - QC	03/27/90	<0.005	<0.005
Vinyl Acetate (MG/L) - QC	03/27/90	ND	ND
Vinyl Chloride (MG/L) - QC	03/27/90	ND	ND
Xylene (total) (MG/L) - QC	03/27/90	0.005U	0.005U
Zinc (MG/L) - QC	03/27/90	0.0027	0.0057
cis-1,3-Dichloropropene (MG/L) - QC	03/27/90	0.005U	0.005U
trans-1,3-Dichloropropene (MG/L) - QC	03/27/90	0.005U	0.005U

Location: 106-004

		00-05	05-10	10-15	15-20	20-25
1,1,1-Trichloroethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
1,1,1-Trichloroethane (MG/KG) - Dup	03/28/90				ND	
1,1,2,2-Tetrachloroethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane (MG/KG) - Dup	03/28/90				ND	
1,1,2-Trichloroethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
1,1,2-Trichloroethane (MG/KG) - Dup	03/28/90				ND	
1,1-Dichloroethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
1,1-Dichloroethane (MG/KG) - Dup	03/28/90				ND	
1,1-Dichloroethene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
1,1-Dichloroethene (MG/KG) - Dup	03/28/90				ND	
1,2-Dichloroethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
1,2-Dichloroethane (MG/KG) - Dup	03/28/90				ND	
1,2-Dichloroethene (total) (MG/KG)	03/28/90	ND	ND	ND	ND	ND
1,2-Dichloroethene (total) (MG/KG) - Dup	03/28/90				ND	
1,2-Dichloropropane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
1,2-Dichloropropane (MG/KG) - Dup	03/28/90				ND	
2-Butanone (MG/KG)	03/28/90	ND	ND	ND	ND	ND
2-Butanone (MG/KG) - Dup	03/28/90				ND	
2-Hexanone (MG/KG)	03/28/90	ND	ND	ND	ND	ND
2-Hexanone (MG/KG) - Dup	03/28/90				ND	
4-Methyl-2-pentanone (MG/KG)	03/28/90	ND	ND	ND	ND	ND
4-Methyl-2-pentanone (MG/KG) - Dup	03/28/90				ND	
Acetone (MG/KG)	03/28/90	0.025U	0.95E	1.1E	2.6E	0.3
Acetone (MG/KG) - Dup	03/28/90				1.3E	
Alpha Activity (PCI/G)	03/28/90	2.77	3.81	2.43	1.45	1.81
Alpha Activity (PCI/G) - Dup	03/28/90				2.91	
Aluminum (MG/KG)	03/28/90	26000	21000	21000	22000	21000
Aluminum (MG/KG) - Dup	03/28/90				18000	
Arsenic (MG/KG)	03/28/90	14	11	7	17	10
Arsenic (MG/KG) - Dup	03/28/90				11	
Asbestos (%)	03/28/90	<0	<0	<0	<0	<0
Asbestos (%) - Dup	03/28/90				<0	
Barium (MG/KG)	03/28/90	52	140	120	130	820
Barium (MG/KG) - Dup	03/28/90				120	
Benzene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Benzene (MG/KG) - Dup	03/28/90				ND	
Beryllium (MG/KG)	03/28/90	0.96	0.97	0.79	1.2	1.6
Beryllium (MG/KG) - Dup	03/28/90				0.85	
Beta Activity (PCI/G)	03/28/90	3.32	5.07	5.07	4.47	3.32
Beta Activity (PCI/G) - Dup	03/28/90				4.01	
Bromodichloromethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Bromodichloromethane (MG/KG) - Dup	03/28/90				ND	
Bromoform (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Bromoform (MG/KG) - Dup	03/28/90				ND	
Bromomethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Bromomethane (MG/KG) - Dup	03/28/90				ND	
Cadmium (MG/KG)	03/28/90	5.4	4.9	3.8	5.3	7.3
Cadmium (MG/KG) - Dup	03/28/90				3.2	
Calcium (MG/KG)	03/28/90	4600	24000	21000	4800	1500
Calcium (MG/KG) - Dup	03/28/90				2800	
Carbon Disulfide (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Carbon Disulfide (MG/KG) - Dup	03/28/90				ND	
Carbon Tetrachloride (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Carbon Tetrachloride (MG/KG) - Dup	03/28/90				ND	
Chlorobenzene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Chlorobenzene (MG/KG) - Dup	03/28/90				ND	
Chloroethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Chloroethane (MG/KG) - Dup	03/28/90				ND	
Chloroform (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Chloroform (MG/KG) - Dup	03/28/90				ND	
Chloromethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Chloromethane (MG/KG) - Dup	03/28/90				ND	
Chromium (MG/KG)	03/28/90	26	28	25	40	36
Chromium (MG/KG) - Dup	03/28/90				26	
Cobalt (MG/KG)	03/28/90	11	13	11	23	35
Cobalt (MG/KG) - Dup	03/28/90				13	
Copper (MG/KG)	03/28/90	33	27	20	26	22
Copper (MG/KG) - Dup	03/28/90				18	
Cyanide (MG/KG)	03/28/90	<1	<1	<1	<1	<1
Cyanide (MG/KG) - Dup	03/28/90				<1	
Dibromochloromethane (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Dibromochloromethane (MG/KG) - Dup	03/28/90				ND	
Ethyl benzene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Ethyl benzene (MG/KG) - Dup	03/28/90				ND	
Iron (MG/KG)	03/28/90	35000	31000	26000	46000	67000

Iron (MG/KG) - Dup	03/28/90				25000	
Lead (MG/KG)	03/28/90	39	36	20	100	33
Lead (MG/KG)	03/28/90	26	32	36	97	21
Lead (MG/KG) - Dup	03/28/90				170	
Lead (MG/KG) - Dup	03/28/90				107	
Magnesium (MG/KG)	03/28/90	1500	5400	5000	2000	1700
Magnesium (MG/KG) - Dup	03/28/90				1400	
Manganese (MG/KG)	03/28/90	480	740	590	1300	5300
Manganese (MG/KG) - Dup	03/28/90				1100	
Mercury (MG/KG)	03/28/90	1.1	<1	<1	1.5	<1
Mercury (MG/KG) - Dup	03/28/90				<1	
Methylene Chloride (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Methylene Chloride (MG/KG) - Dup	03/28/90				ND	
Moisture Content (%)	03/28/90	18	13.2	12.5	29.8	25
Moisture Content (%) - Dup	03/28/90				25.2	
Nickel (MG/KG)	03/28/90	22	24	20	27	39
Nickel (MG/KG) - Dup	03/28/90				17	
Niobium (MG/KG)	03/28/90	<0.85	<0.85	<0.82	<0.91	<0.9
Niobium (MG/KG) - Dup	03/28/90				<0.89	
Phosphorous (MG/KG)	03/28/90	250	380	300	1500	1800
Phosphorous (MG/KG) - Dup	03/28/90				980	
Potassium (MG/KG)	03/28/90	1300	2600	2200	2000	2300
Potassium (MG/KG) - Dup	03/28/90				2200	
Selenium (MG/KG)	03/28/90	<0.53	<0.59	<0.57	<0.44	<0.43
Selenium (MG/KG) - Dup	03/28/90				<0.47	
Silver (MG/KG)	03/28/90	<0.73	<0.73	<0.7	<0.78	<0.77
Silver (MG/KG) - Dup	03/28/90				<0.76	
Sodium (MG/KG)	03/28/90	49	51	59	60	32
Sodium (MG/KG) - Dup	03/28/90				110	
Styrene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Styrene (MG/KG) - Dup	03/28/90				ND	
Tetrachloroethene (MG/KG)	03/28/90	0.013U	0.013U	0.014U	0.015U	0.015U
Tetrachloroethene (MG/KG) - Dup	03/28/90				0.014U	
Thorium (MG/KG)	03/28/90	<24	<24	<23	<26	<26
Thorium (MG/KG) - Dup	03/28/90				<25	
Toluene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Toluene (MG/KG) - Dup	03/28/90				ND	
Trichloroethene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Trichloroethene (MG/KG) - Dup	03/28/90				ND	
Uranium Fluorometric (MG/KG)	03/28/90	7.1	5	6.6	5.3	2
Uranium Fluorometric (MG/KG) - Dup	03/28/90				4.8	
Vanadium (MG/KG)	03/28/90	56	31	30	49	36
Vanadium (MG/KG) - Dup	03/28/90				31	
Vinyl Acetate (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Vinyl Acetate (MG/KG) - Dup	03/28/90				ND	
Vinyl Chloride (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Vinyl Chloride (MG/KG) - Dup	03/28/90				ND	
Xylene (total) (MG/KG)	03/28/90	ND	ND	ND	ND	ND
Xylene (total) (MG/KG) - Dup	03/28/90				ND	
Zinc (MG/KG)	03/28/90	110	73	61	100	55
Zinc (MG/KG) - Dup	03/28/90				91	
cis-1,3-Dichloropropene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene (MG/KG) - Dup	03/28/90				ND	
trans-1,3-Dichloropropene (MG/KG)	03/28/90	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene (MG/KG) - Dup	03/28/90				ND	

		Blank	Rin-1	Rin-2
1,1,1-Trichloroethane (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
1,1,2,2-Tetrachloroethane (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
1,1,2-Trichloroethane (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
1,1-Dichloroethane (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
1,1-Dichloroethene (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
1,2-Dichloroethane (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
1,2-Dichloroethene (total) (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
1,2-Dichloropropane (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
2-Butanone (MG/L) - QC	03/28/90	ND	ND	ND
2-Hexanone (MG/L) - QC	03/28/90	ND	ND	ND
4-Methyl-2-pentanone (MG/L) - QC	03/28/90	ND	ND	ND
Acetone (MG/L) - QC	03/28/90	ND	0.037	0.034
Alpha Activity (PCI/L) - QC	03/28/90		-82.68	-82.72
Aluminum (MG/L) - QC	03/28/90		0.071	<0.02
Arsenic (MG/L) - QC	03/28/90		<0.005	<0.005
Barium (MG/L) - QC	03/28/90		<0.001	0.0011
Benzene (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Beryllium (MG/L) - QC	03/28/90		<0.0003	<0.0003
Beta Activity (PCI/L) - QC	03/28/90		-212.37	-122.95
Bromodichloromethane (MG/L) - QC	03/28/90	0.0006	0.005U	0.005U
Bromoform (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U

Bromomethane (MG/L) - QC	03/28/90	ND	ND	ND
Cadmium (MG/L) - QC	03/28/90		<0.003	<0.003
Calcium (MG/L) - QC	03/28/90		0.015	0.037
Carbon Disulfide (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Carbon Tetrachloride (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Chlorobenzene (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Chloroethane (MG/L) - QC	03/28/90	ND	ND	ND
Chloroform (MG/L) - QC	03/28/90	0.0008	0.005U	0.005U
Chloromethane (MG/L) - QC	03/28/90	ND	ND	ND
Chromium (MG/L) - QC	03/28/90		<0.01	<0.01
Cobalt (MG/L) - QC	03/28/90		<0.005	<0.005
Copper (MG/L) - QC	03/28/90		0.0056	0.0066
Cyanide (MG/L) - QC	03/28/90		<0.1	<0.1
Dibromochloromethane (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Ethyl benzene (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Iron (MG/L) - QC	03/28/90		0.0044	0.044
Lead (MG/L) - QC	03/28/90		<0.05	<0.05
Lead (MG/L) - QC	03/28/90		<0.004	<0.004
Magnesium (MG/L) - QC	03/28/90		0.0068	0.01
Manganese (MG/L) - QC	03/28/90		0.0013	0.0026
Mercury (MG/L) - QC	03/28/90		<0.0002	<0.0002
Methylene Chloride (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Nickel (MG/L) - QC	03/28/90		<0.01	<0.01
Niobium (MG/L) - QC	03/28/90		<0.007	0.0076
Phosphorous (MG/L) - QC	03/28/90		<0.2	<0.2
Potassium (MG/L) - QC	03/28/90		<0.6	<0.6
Selenium (MG/L) - QC	03/28/90		<0.005	<0.005
Silver (MG/L) - QC	03/28/90		<0.006	<0.006
Sodium (MG/L) - QC	03/28/90		0.045	0.04
Styrene (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Tetrachloroethene (MG/L) - QC	03/23/90	0.005U	0.005U	0.005U
Thorium (MG/L) - QC	03/28/90		<0.2	<0.2
Toluene (MG/L) - QC	03/28/90	0.005U	0.0006	0.0008
Trichloroethene (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Uranium Fluorometric (MG/L) - QC	03/28/90		<0.001	<0.001
Vanadium (MG/L) - QC	03/28/90		<0.005	<0.005
Vinyl Acetate (MG/L) - QC	03/28/90	ND	ND	ND
Vinyl Chloride (MG/L) - QC	03/28/90	ND	ND	ND
Xylene (total) (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
Zinc (MG/L) - QC	03/28/90		0.0035	0.0052
cis-1,3-Dichloropropene (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U
trans-1,3-Dichloropropene (MG/L) - QC	03/28/90	0.005U	0.005U	0.005U

Location: 106-005

		00-05	Rin-1	Rin-2
1,1,1-Trichloroethane (MG/KG)	03/28/90	ND		
1,1,1-Trichloroethane (MG/L) - QC	03/28/90		0.005U	0.005U
1,1,2,2-Tetrachloroethane (MG/KG)	03/28/90	ND		
1,1,2,2-Tetrachloroethane (MG/L) - QC	03/28/90		0.005U	0.005U
1,1,2-Trichloroethane (MG/KG)	03/28/90	ND		
1,1,2-Trichloroethane (MG/L) - QC	03/28/90		0.005U	0.005U
1,1-Dichloroethane (MG/KG)	03/28/90	ND		
1,1-Dichloroethane (MG/L) - QC	03/28/90		0.005U	0.005U
1,1-Dichloroethene (MG/KG)	03/28/90	ND		
1,1-Dichloroethene (MG/L) - QC	03/28/90		0.005U	0.005U
1,2-Dichloroethane (MG/KG)	03/28/90	ND		
1,2-Dichloroethane (MG/L) - QC	03/28/90		0.005U	0.005U
1,2-Dichloroethene (total) (MG/KG)	03/28/90	ND		
1,2-Dichloroethene (total) (MG/L) - QC	03/28/90		0.005U	0.005U
1,2-Dichloropropane (MG/KG)	03/28/90	ND		
1,2-Dichloropropane (MG/L) - QC	03/28/90		0.005U	0.005U
2-Butanone (MG/KG)	03/28/90	ND		
2-Butanone (MG/L) - QC	03/28/90		ND	ND
2-Hexanone (MG/KG)	03/28/90	ND		
2-Hexanone (MG/L) - QC	03/28/90		ND	ND
4-Methyl-2-pentanone (MG/KG)	03/28/90	ND		
4-Methyl-2-pentanone (MG/L) - QC	03/28/90		ND	ND
Acetone (MG/KG)	03/28/90	0.93E		
Acetone (MG/L) - QC	03/28/90		0.026	0.01
Alpha Activity (PCI/G)	03/28/90	1.97		
Alpha Activity (PCI/L) - QC	03/28/90		-5.05	-51.71
Aluminum (MG/KG)	03/28/90	23000		
Aluminum (MG/L) - QC	03/28/90		<0.02	<0.02
Arsenic (MG/KG)	03/28/90	6		
Arsenic (MG/L) - QC	03/28/90		<0.005	<0.005
Asbestos (%)	03/28/90	<0		
Barium (MG/KG)	03/28/90	25		
Barium (MG/L) - QC	03/28/90		<0.001	<0.001
Benzene (MG/KG)	03/28/90	ND		
Benzene (MG/L) - QC	03/28/90		0.005U	0.005U
Beryllium (MG/KG)	03/28/90	1.1		
Beryllium (MG/L) - QC	03/28/90		<0.0003	<0.0003
Beta Activity (PCI/G)	03/28/90	4.8		
Beta Activity (PCI/L) - QC	03/28/90		-234.73	-245.9
Bromodichloromethane (MG/KG)	03/28/90	ND		
Bromodichloromethane (MG/L) - QC	03/28/90		0.005U	0.005U
Bromoform (MG/KG)	03/28/90	ND		
Bromoform (MG/L) - QC	03/28/90		0.005U	0.005U
Bromomethane (MG/KG)	03/28/90	ND		
Bromomethane (MG/L) - QC	03/28/90		ND	ND
Cadmium (MG/KG)	03/28/90	5.3		
Cadmium (MG/L) - QC	03/28/90		<0.003	<0.003
Calcium (MG/KG)	03/28/90	1900		
Calcium (MG/L) - QC	03/28/90		0.075	0.0067
Carbon Disulfide (MG/KG)	03/28/90	ND		
Carbon Disulfide (MG/L) - QC	03/28/90		0.005U	0.005U
Carbon Tetrachloride (MG/KG)	03/28/90	ND		
Carbon Tetrachloride (MG/L) - QC	03/28/90		0.005U	0.005U
Chlorobenzene (MG/KG)	03/28/90	ND		
Chlorobenzene (MG/L) - QC	03/28/90		0.005U	0.005U
Chloroethane (MG/KG)	03/28/90	ND		
Chloroethane (MG/L) - QC	03/28/90		ND	ND
Chloroform (MG/KG)	03/28/90	ND		
Chloroform (MG/L) - QC	03/28/90		0.005U	0.005U
Chloromethane (MG/KG)	03/28/90	ND		
Chloromethane (MG/L) - QC	03/28/90		ND	ND
Chromium (MG/KG)	03/28/90	25		
Chromium (MG/L) - QC	03/28/90		<0.01	<0.01
Cobalt (MG/KG)	03/28/90	9.6		
Cobalt (MG/L) - QC	03/28/90		<0.005	<0.005
Copper (MG/KG)	03/28/90	43		
Copper (MG/L) - QC	03/28/90		<0.004	<0.004
Cyanide (MG/KG)	03/28/90	<1		
Cyanide (MG/L) - QC	03/28/90		<0.1	<0.1
Dibromochloromethane (MG/KG)	03/28/90	ND		
Dibromochloromethane (MG/L) - QC	03/28/90		0.005U	0.005U
Ethyl benzene (MG/KG)	03/28/90	ND		
Ethyl benzene (MG/L) - QC	03/28/90		0.005U	0.005U
Iron (MG/KG)	03/28/90	45000		
Iron (MG/L) - QC	03/28/90		0.0071	<0.004

Lead (MG/KG)	03/28/90	30		
Lead (MG/KG)	03/28/90	19		
Lead (MG/L) - QC	03/28/90		<0.05	<0.05
Lead (MG/L) - QC	03/28/90		<0.004	<0.004
Magnesium (MG/KG)	03/28/90	870		
Magnesium (MG/L) - QC	03/28/90		0.02	<0.0005
Manganese (MG/KG)	03/28/90	500		
Manganese (MG/L) - QC	03/28/90		<0.001	<0.001
Mercury (MG/KG)	03/28/90	<1		
Mercury (MG/L) - QC	03/28/90		<0.0002	<0.0002
Methylene Chloride (MG/KG)	03/28/90	ND		
Methylene Chloride (MG/L) - QC	03/28/90		0.005U	0.005U
Moisture Content (%)	03/28/90	23.6		
Nickel (MG/KG)	03/28/90	20		
Nickel (MG/L) - QC	03/28/90		<0.01	<0.01
Niobium (MG/KG)	03/28/90	<0.92		
Niobium (MG/L) - QC	03/28/90		<0.007	<0.007
Phosphorous (MG/KG)	03/28/90	1500		
Phosphorous (MG/L) - QC	03/28/90		<0.2	<0.2
Potassium (MG/KG)	03/28/90	1000		
Potassium (MG/L) - QC	03/28/90		<0.6	<0.6
Selenium (MG/KG)	03/28/90	<0.61		
Selenium (MG/L) - QC	03/28/90		<0.005	<0.005
Silver (MG/KG)	03/28/90	<0.79		
Silver (MG/L) - QC	03/28/90		<0.006	<0.006
Sodium (MG/KG)	03/28/90	27		
Sodium (MG/L) - QC	03/28/90		0.055	0.027
Styrene (MG/KG)	03/28/90	ND		
Styrene (MG/L) - QC	03/28/90		0.005U	0.005U
Tetrachloroethene (MG/KG)	03/28/90	0.014U		
Tetrachloroethene (MG/L) - QC	03/28/90		0.005U	0.005U
Thorium (MG/KG)	03/28/90	29		
Thorium (MG/L) - QC	03/28/90		<0.2	<0.2
Toluene (MG/KG)	03/28/90	ND		
Toluene (MG/L) - QC	03/28/90		0.0008	0.0008
Trichloroethene (MG/KG)	03/28/90	ND		
Trichloroethene (MG/L) - QC	03/28/90		0.005U	0.005U
Uranium Fluorometric (MG/KG)	03/28/90	5.8		
Uranium Fluorometric (MG/L) - QC	03/28/90		<0.001	0.001
Vanadium (MG/KG)	03/28/90	60		
Vanadium (MG/L) - QC	03/28/90		<0.005	<0.005
Vinyl Acetate (MG/KG)	03/28/90	ND		
Vinyl Acetate (MG/L) - QC	03/28/90		ND	ND
Vinyl Chloride (MG/KG)	03/28/90	ND		
Vinyl Chloride (MG/L) - QC	03/28/90		ND	ND
Xylene (total) (MG/KG)	03/28/90	ND		
Xylene (total) (MG/L) - QC	03/28/90		0.005U	0.005U
Zinc (MG/KG)	03/28/90	130		
Zinc (MG/L) - QC	03/28/90		0.0049	0.0035
cis-1,3-Dichloropropene (MG/KG)	03/28/90	ND		
cis-1,3-Dichloropropene (MG/L) - QC	03/28/90		0.005U	0.005U
trans-1,3-Dichloropropene (MG/KG)	03/28/90	ND		
trans-1,3-Dichloropropene (MG/L) - QC	03/28/90		0.005U	0.005U

Location: 106-006

		00-05	05-10	10-15	Blank	Rin-1
1,1,1-Trichloroethane (MG/KG)	03/29/90	ND	ND	ND		
1,1,1-Trichloroethane (MG/KG) - Dup	03/29/90		ND			
1,1,1-Trichloroethane (MG/L) - QC	03/29/90				0.005U	0.005U
1,1,2,2-Tetrachloroethane (MG/KG)	03/29/90	ND	ND	ND		
1,1,2,2-Tetrachloroethane (MG/KG) - Dup	03/29/90		ND			
1,1,2,2-Tetrachloroethane (MG/L) - QC	03/29/90				0.005U	0.005U
1,1,2-Trichloroethane (MG/KG)	03/29/90	ND	ND	ND		
1,1,2-Trichloroethane (MG/KG) - Dup	03/29/90		ND			
1,1,2-Trichloroethane (MG/L) - QC	03/29/90				0.005U	0.005U
1,1-Dichloroethane (MG/KG)	03/29/90	ND	ND	ND		
1,1-Dichloroethane (MG/KG) - Dup	03/29/90		ND			
1,1-Dichloroethane (MG/L) - QC	03/29/90				0.005U	0.005U
1,1-Dichloroethene (MG/KG)	03/29/90	ND	ND	ND		
1,1-Dichloroethene (MG/KG) - Dup	03/29/90		ND			
1,1-Dichloroethene (MG/L) - QC	03/29/90				0.005U	0.005U
1,2-Dichloroethane (MG/KG)	03/29/90	ND	ND	ND		
1,2-Dichloroethane (MG/KG) - Dup	03/29/90		ND			
1,2-Dichloroethane (MG/L) - QC	03/29/90				0.005U	0.005U
1,2-Dichloroethene (total) (MG/KG)	03/29/90	ND	ND	ND		
1,2-Dichloroethene (total) (MG/KG) - Dup	03/29/90		ND			
1,2-Dichloroethene (total) (MG/L) - QC	03/29/90				0.005U	0.005U
1,2-Dichloropropane (MG/KG)	03/29/90	ND	ND	ND		
1,2-Dichloropropane (MG/KG) - Dup	03/29/90		ND			
1,2-Dichloropropane (MG/L) - QC	03/29/90				0.005U	0.005U
2-Butanone (MG/KG)	03/29/90	ND	ND	ND		
2-Butanone (MG/KG) - Dup	03/29/90		ND			
2-Butanone (MG/L) - QC	03/29/90				ND	ND
2-Hexanone (MG/KG)	03/29/90	ND	ND	ND		
2-Hexanone (MG/KG) - Dup	03/29/90		ND			
2-Hexanone (MG/L) - QC	03/29/90				ND	ND
4-Methyl-2-pentanone (MG/KG)	03/29/90	ND	ND	ND		
4-Methyl-2-pentanone (MG/KG) - Dup	03/29/90		ND			
4-Methyl-2-pentanone (MG/L) - QC	03/29/90				ND	ND
Acetone (MG/KG)	03/29/90	0.029U	0.77E	0.25		
Acetone (MG/KG) - Dup	03/29/90		0.49			
Acetone (MG/L) - QC	03/29/90				0.007	0.011
Alpha Activity (PCI/G)	03/29/90	2.75	2.75	4.37		
Alpha Activity (PCI/G) - Dup	03/29/90		3.98			
Alpha Activity (PCI/L) - QC	03/29/90					10.49
Aluminum (MG/KG)	03/29/90	19000	30000	33000		
Aluminum (MG/KG) - Dup	03/29/90		27000			
Aluminum (MG/L) - QC	03/29/90					<0.02
Arsenic (MG/KG)	03/29/90	16	22	26		
Arsenic (MG/KG) - Dup	03/29/90		24			
Arsenic (MG/L) - QC	03/29/90					<0.005
Asbestos (%)	03/29/90	<0	<0	<0		
Asbestos (%) - Dup	03/29/90		<0			
Barium (MG/KG)	03/29/90	100	32	25		
Barium (MG/KG) - Dup	03/29/90		24			
Barium (MG/L) - QC	03/29/90					<0.001
Benzene (MG/KG)	03/29/90	ND	ND	ND		
Benzene (MG/KG) - Dup	03/29/90		ND			
Benzene (MG/L) - QC	03/29/90				0.005U	0.005U
Beryllium (MG/KG)	03/29/90	0.95	1	1.5		
Beryllium (MG/KG) - Dup	03/29/90		1.2			
Beryllium (MG/L) - QC	03/29/90					<0.0003
Beta Activity (PCI/G)	03/29/90	3.15	3.16	4.16		
Beta Activity (PCI/G) - Dup	03/29/90		3.83			
Beta Activity (PCI/L) - QC	03/29/90					-55.89
Bromodichloromethane (MG/KG)	03/29/90	ND	ND	ND		
Bromodichloromethane (MG/KG) - Dup	03/29/90		ND			
Bromodichloromethane (MG/L) - QC	03/29/90				0.0006	0.005U
Bromoform (MG/KG)	03/29/90	ND	ND	ND		
Bromoform (MG/KG) - Dup	03/29/90		ND			
Bromoform (MG/L) - QC	03/29/90				0.005U	0.005U
Bromomethane (MG/KG)	03/29/90	ND	ND	ND		
Bromomethane (MG/KG) - Dup	03/29/90		ND			
Bromomethane (MG/L) - QC	03/29/90				ND	ND
Cadmium (MG/KG)	03/29/90	2.4	4.5	5.3		
Cadmium (MG/KG) - Dup	03/29/90		5.1			
Cadmium (MG/L) - QC	03/29/90					<0.003
Calcium (MG/KG)	03/29/90	2000	320	72		
Calcium (MG/KG) - Dup	03/29/90		190			
Calcium (MG/L) - QC	03/29/90					0.02
Carbon Disulfide (MG/KG)	03/29/90	ND	ND	ND		

Carbon Disulfide (MG/KG) - Dup	03/29/90		ND			
Carbon Disulfide (MG/L) - QC	03/29/90				0.005U	0.005U
Carbon Tetrachloride (MG/KG)	03/29/90	ND	ND	ND		
Carbon Tetrachloride (MG/KG) - Dup	03/29/90		ND			
Carbon Tetrachloride (MG/L) - QC	03/29/90				0.005U	0.005U
Chlorobenzene (MG/KG)	03/29/90	ND	ND	ND		
Chlorobenzene (MG/KG) - Dup	03/29/90		ND			
Chlorobenzene (MG/L) - QC	03/29/90				0.005U	0.005U
Chloroethane (MG/KG)	03/29/90	ND	ND	ND		
Chloroethane (MG/KG) - Dup	03/29/90		ND			
Chloroethane (MG/L) - QC	03/29/90				ND	ND
Chloroform (MG/KG)	03/29/90	ND	ND	ND		
Chloroform (MG/KG) - Dup	03/29/90		ND			
Chloroform (MG/L) - QC	03/29/90				0.0006	0.005U
Chloromethane (MG/KG)	03/29/90	ND	ND	ND		
Chloromethane (MG/KG) - Dup	03/29/90		ND			
Chloromethane (MG/L) - QC	03/29/90				ND	ND
Chromium (MG/KG)	03/29/90	31	27	27		
Chromium (MG/KG) - Dup	03/29/90		26			
Chromium (MG/L) - QC	03/29/90					<0.01
Cobalt (MG/KG)	03/29/90	40	14	66		
Cobalt (MG/KG) - Dup	03/29/90		13			
Cobalt (MG/L) - QC	03/29/90					<0.005
Copper (MG/KG)	03/29/90	15	43	74		
Copper (MG/KG) - Dup	03/29/90		51			
Copper (MG/L) - QC	03/29/90					<0.004
Cyanide (MG/KG)	03/29/90	<1	<1	<1		
Cyanide (MG/KG) - Dup	03/29/90		<1			
Cyanide (MG/L) - QC	03/29/90					<0.1
Dibromochloromethane (MG/KG)	03/29/90	ND	ND	ND		
Dibromochloromethane (MG/KG) - Dup	03/29/90		ND			
Dibromochloromethane (MG/L) - QC	03/29/90				0.005U	0.005U
Ethyl benzene (MG/KG)	03/29/90	ND	ND	ND		
Ethyl benzene (MG/KG) - Dup	03/29/90		ND			
Ethyl benzene (MG/L) - QC	03/29/90				0.005U	0.005U
Iron (MG/KG)	03/29/90	19000	42000	49000		
Iron (MG/KG) - Dup	03/29/90		46000			
Iron (MG/L) - QC	03/29/90					0.018
Lead (MG/KG)	03/29/90	53	47	150		
Lead (MG/KG)	03/29/90	58	150	136		
Lead (MG/KG) - Dup	03/29/90		64			
Lead (MG/KG) - Dup	03/29/90		86			
Lead (MG/L) - QC	03/29/90					<0.05
Lead (MG/L) - QC	03/29/90					<0.004
Magnesium (MG/KG)	03/29/90	900	970	930		
Magnesium (MG/KG) - Dup	03/29/90		840			
Magnesium (MG/L) - QC	03/29/90					0.0035
Manganese (MG/KG)	03/29/90	2800	620	1100		
Manganese (MG/KG) - Dup	03/29/90		350			
Manganese (MG/L) - QC	03/29/90					<0.001
Mercury (MG/KG)	03/29/90	<1	<1	<1		
Mercury (MG/KG) - Dup	03/29/90		<1			
Mercury (MG/L) - QC	03/29/90					<0.0002
Methylene Chloride (MG/KG)	03/29/90	ND	ND	ND		
Methylene Chloride (MG/KG) - Dup	03/29/90		ND			
Methylene Chloride (MG/L) - QC	03/29/90				0.005U	0.005U
Moisture Content (%)	03/29/90	12.8	16.6	24.2		
Moisture Content (%) - Dup	03/29/90		15.8			
Nickel (MG/KG)	03/29/90	27	25	52		
Nickel (MG/KG) - Dup	03/29/90		30			
Nickel (MG/L) - QC	03/29/90					<0.01
Niobium (MG/KG)	03/29/90	<0.83	<0.91	<0.94		
Niobium (MG/KG) - Dup	03/29/90		<0.93			
Niobium (MG/L) - QC	03/29/90					<0.007
Phosphorous (MG/KG)	03/29/90	780	1300	1600		
Phosphorous (MG/KG) - Dup	03/29/90		1500			
Phosphorous (MG/L) - QC	03/29/90					<0.2
Potassium (MG/KG)	03/29/90	680	1300	1300		
Potassium (MG/KG) - Dup	03/29/90		1200			
Potassium (MG/L) - QC	03/29/90					<0.6
Selenium (MG/KG)	03/29/90	<0.56	<0.49	<0.55		
Selenium (MG/KG) - Dup	03/29/90		<0.58			
Selenium (MG/L) - QC	03/29/90					<0.005
Silver (MG/KG)	03/29/90	<0.71	<0.78	<0.81		
Silver (MG/KG) - Dup	03/29/90		<0.79			
Silver (MG/L) - QC	03/29/90					<0.006
Sodium (MG/KG)	03/29/90	47	47	41		
Sodium (MG/KG) - Dup	03/29/90		26			

Sodium (MG/L) - QC	03/29/90					<0.02
Styrene (MG/KG)	03/29/90	ND	ND	ND		
Styrene (MG/KG) - Dup	03/29/90		ND			
Styrene (MG/L) - QC	03/29/90				0.005U	0.005U
Tetrachloroethene (MG/KG)	03/29/90	0.014U	0.013U	0.016U		
Tetrachloroethene (MG/KG) - Dup	03/29/90		0.015U			
Tetrachloroethene (MG/L) - QC	03/29/90				0.005U	0.005U
Thorium (MG/KG)	03/29/90	<24	29	31		
Thorium (MG/KG) - Dup	03/29/90		30			
Thorium (MG/L) - QC	03/29/90					<0.2
Toluene (MG/KG)	03/29/90	ND	ND	ND		
Toluene (MG/KG) - Dup	03/29/90		ND			
Toluene (MG/L) - QC	03/29/90				0.005U	0.0007
Trichloroethene (MG/KG)	03/29/90	ND	ND	ND		
Trichloroethene (MG/KG) - Dup	03/29/90		ND			
Trichloroethene (MG/L) - QC	03/29/90				0.005U	0.005U
Uranium Fluorometric (MG/KG)	03/29/90	3.8	3.6	5.4		
Uranium Fluorometric (MG/KG) - Dup	03/29/90		4.4			
Uranium Fluorometric (MG/L) - QC	03/29/90					<0.001
Vanadium (MG/KG)	03/29/90	39	67	70		
Vanadium (MG/KG) - Dup	03/29/90		69			
Vanadium (MG/L) - QC	03/29/90					<0.005
Vinyl Acetate (MG/KG)	03/29/90	ND	ND	ND		
Vinyl Acetate (MG/KG) - Dup	03/29/90		ND			
Vinyl Acetate (MG/L) - QC	03/29/90				ND	ND
Vinyl Chloride (MG/KG)	03/29/90	ND	ND	ND		
Vinyl Chloride (MG/KG) - Dup	03/29/90		ND			
Vinyl Chloride (MG/L) - QC	03/29/90				ND	ND
Xylene (total) (MG/KG)	03/29/90	ND	ND	ND		
Xylene (total) (MG/KG) - Dup	03/29/90		ND			
Xylene (total) (MG/L) - QC	03/29/90				0.005U	0.005U
Zinc (MG/KG)	03/29/90	62	140	230		
Zinc (MG/KG) - Dup	03/29/90		170			
Zinc (MG/L) - QC	03/29/90					0.0041
cis-1,3-Dichloropropene (MG/KG)	03/29/90	ND	ND	ND		
cis-1,3-Dichloropropene (MG/KG) - Dup	03/29/90		ND			
cis-1,3-Dichloropropene (MG/L) - QC	03/29/90				0.005U	0.005U
trans-1,3-Dichloropropene (MG/KG)	03/29/90	ND	ND	ND		
trans-1,3-Dichloropropene (MG/KG) - Dup	03/29/90		ND			
trans-1,3-Dichloropropene (MG/L) - QC	03/29/90				0.005U	0.005U

		Rin-2
1,1,1-Trichloroethane (MG/L) - QC	03/29/90	0.005U
1,1,2,2-Tetrachloroethane (MG/L) - QC	03/29/90	0.005U
1,1,2-Trichloroethane (MG/L) - QC	03/29/90	0.005U
1,1-Dichloroethane (MG/L) - QC	03/29/90	0.005U
1,1-Dichloroethene (MG/L) - QC	03/29/90	0.005U
1,2-Dichloroethane (MG/L) - QC	03/29/90	0.005U
1,2-Dichloroethene (total) (MG/L) - QC	03/29/90	0.005U
1,2-Dichloropropane (MG/L) - QC	03/29/90	0.005U
2-Butanone (MG/L) - QC	03/29/90	ND
2-Hexanone (MG/L) - QC	03/29/90	ND
4-Methyl-2-pentanone (MG/L) - QC	03/29/90	ND
Acetone (MG/L) - QC	03/29/90	0.013
Alpha Activity (PCI/L) - QC	03/29/90	152.2
Aluminum (MG/L) - QC	03/29/90	<0.02
Arsenic (MG/L) - QC	03/29/90	<0.005
Barium (MG/L) - QC	03/29/90	<0.001
Benzene (MG/L) - QC	03/29/90	0.005U
Beryllium (MG/L) - QC	03/29/90	<0.0003
Beta Activity (PCI/L) - QC	03/29/90	-178.84
Bromodichloromethane (MG/L) - QC	03/29/90	0.005U
Bromoform (MG/L) - QC	03/29/90	0.005U
Bromomethane (MG/L) - QC	03/29/90	ND
Cadmium (MG/L) - QC	03/29/90	<0.003
Calcium (MG/L) - QC	03/29/90	0.0056
Carbon Disulfide (MG/L) - QC	03/29/90	0.005U
Carbon Tetrachloride (MG/L) - QC	03/29/90	0.005U
Chlorobenzene (MG/L) - QC	03/29/90	0.005U
Chloroethane (MG/L) - QC	03/29/90	ND
Chloroform (MG/L) - QC	03/29/90	0.005U
Chloromethane (MG/L) - QC	03/29/90	ND
Chromium (MG/L) - QC	03/29/90	<0.01
Cobalt (MG/L) - QC	03/29/90	<0.005
Copper (MG/L) - QC	03/29/90	<0.004
Cyanide (MG/L) - QC	03/29/90	<0.1
Dibromochloromethane (MG/L) - QC	03/29/90	0.005U
Ethyl benzene (MG/L) - QC	03/29/90	0.005U

Iron (MG/L) - QC	03/29/90	0.014
Lead (MG/L) - QC	03/29/90	< 0.05
Lead (MG/L) - QC	03/29/90	< 0.004
Magnesium (MG/L) - QC	03/29/90	0.001
Manganese (MG/L) - QC	03/29/90	0.0013
Mercury (MG/L) - QC	03/29/90	< 0.0002
Methylene Chloride (MG/L) - QC	03/29/90	0.005U
Nickel (MG/L) - QC	03/29/90	< 0.01
Niobium (MG/L) - QC	03/29/90	< 0.007
Phosphorous (MG/L) - QC	03/29/90	< 0.2
Potassium (MG/L) - QC	03/29/90	< 0.6
Selenium (MG/L) - QC	03/29/90	< 0.005
Silver (MG/L) - QC	03/29/90	< 0.006
Sodium (MG/L) - QC	03/29/90	0.027
Styrene (MG/L) - QC	03/29/90	0.005U
Tetrachloroethene (MG/L) - QC	03/29/90	0.005U
Thorium (MG/L) - QC	03/29/90	< 0.2
Toluene (MG/L) - QC	03/29/90	0.002
Trichloroethene (MG/L) - QC	03/29/90	0.005U
Uranium Fluorometric (MG/L) - QC	03/29/90	< 0.001
Vanadium (MG/L) - QC	03/29/90	< 0.005
Vinyl Acetate (MG/L) - QC	03/29/90	ND
Vinyl Chloride (MG/L) - QC	03/29/90	ND
Xylene (total) (MG/L) - QC	03/29/90	0.005U
Zinc (MG/L) - QC	03/29/90	0.0047
cis-1,3-Dichloropropene (MG/L) - QC	03/29/90	0.005U
trans-1,3-Dichloropropene (MG/L) - QC	03/29/90	0.005U

Location: 106-007

		00-05	Blank	Rin-1	Rin-2
1,1,1-Trichloroethane (MG/KG)	04/02/90	ND			
1,1,1-Trichloroethane (MG/KG) - Dup	04/02/90	ND			
1,1,1-Trichloroethane (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
1,1,2,2-Tetrachloroethane (MG/KG)	04/02/90	ND			
1,1,2,2-Tetrachloroethane (MG/KG) - Dup	04/02/90	ND			
1,1,2,2-Tetrachloroethane (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
1,1,2-Trichloroethane (MG/KG)	04/02/90	ND			
1,1,2-Trichloroethane (MG/KG) - Dup	04/02/90	ND			
1,1,2-Trichloroethane (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
1,1-Dichloroethane (MG/KG)	04/02/90	ND			
1,1-Dichloroethane (MG/KG) - Dup	04/02/90	ND			
1,1-Dichloroethane (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
1,1-Dichloroethene (MG/KG)	04/02/90	ND			
1,1-Dichloroethene (MG/KG) - Dup	04/02/90	ND			
1,1-Dichloroethene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
1,2-Dichloroethane (MG/KG)	04/02/90	ND			
1,2-Dichloroethane (MG/KG) - Dup	04/02/90	ND			
1,2-Dichloroethane (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
1,2-Dichloroethene (total) (MG/KG)	04/02/90	ND			
1,2-Dichloroethene (total) (MG/KG) - Dup	04/02/90	ND			
1,2-Dichloroethene (total) (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
1,2-Dichloropropane (MG/KG)	04/02/90	ND			
1,2-Dichloropropane (MG/KG) - Dup	04/02/90	ND			
1,2-Dichloropropane (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
2-Butanone (MG/KG)	04/02/90	ND			
2-Butanone (MG/KG) - Dup	04/02/90	ND			
2-Butanone (MG/L) - QC	04/02/90		ND	0.02	0.02
2-Hexanone (MG/KG)	04/02/90	ND			
2-Hexanone (MG/KG) - Dup	04/02/90	ND			
2-Hexanone (MG/L) - QC	04/02/90		ND	0.005	0.006
4-Methyl-2-pentanone (MG/KG)	04/02/90	ND			
4-Methyl-2-pentanone (MG/KG) - Dup	04/02/90	ND			
4-Methyl-2-pentanone (MG/L) - QC	04/02/90		ND	ND	ND
Acetone (MG/KG)	04/02/90	1.1E			
Acetone (MG/KG) - Dup	04/02/90	0.24			
Acetone (MG/L) - QC	04/02/90		ND	0.03	0.057
Alpha Activity (PCI/G)	04/02/90	2.14			
Alpha Activity (PCI/G) - Dup	04/02/90	2.73			
Alpha Activity (PCI/L) - QC	04/02/90			-53.47	133.66
Aluminum (MG/KG)	04/02/90	21000			
Aluminum (MG/KG) - Dup	04/02/90	29000			
Aluminum (MG/L) - QC	04/02/90			<0.02	<0.02
Arsenic (MG/KG)	04/02/90	8.5			
Arsenic (MG/KG) - Dup	04/02/90	13			
Arsenic (MG/L) - QC	04/02/90			<0.005	<0.005
Asbestos (%)	04/02/90	<0			
Asbestos (%) - Dup	04/02/90	<0			
Barium (MG/KG)	04/02/90	130			
Barium (MG/KG) - Dup	04/02/90	110			
Barium (MG/L) - QC	04/02/90			<0.001	0.002
Benzene (MG/KG)	04/02/90	ND			
Benzene (MG/KG) - Dup	04/02/90	ND			
Benzene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Beryllium (MG/KG)	04/02/90	1.9			
Beryllium (MG/KG) - Dup	04/02/90	2.1			
Beryllium (MG/L) - QC	04/02/90			<0.0003	<0.0003
Beta Activity (PCI/G)	04/02/90	2.65			
Beta Activity (PCI/G) - Dup	04/02/90	3.43			
Beta Activity (PCI/L) - QC	04/02/90			-245.9	11.18
Bromodichloromethane (MG/KG)	04/02/90	ND			
Bromodichloromethane (MG/KG) - Dup	04/02/90	ND			
Bromodichloromethane (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Bromoform (MG/KG)	04/02/90	ND			
Bromoform (MG/KG) - Dup	04/02/90	ND			
Bromoform (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Bromomethane (MG/KG)	04/02/90	ND			
Bromomethane (MG/KG) - Dup	04/02/90	ND			
Bromomethane (MG/L) - QC	04/02/90		ND	ND	ND
Cadmium (MG/KG)	04/02/90	3.9			
Cadmium (MG/KG) - Dup	04/02/90	4.9			
Cadmium (MG/L) - QC	04/02/90			<0.003	<0.003
Calcium (MG/KG)	04/02/90	7000			
Calcium (MG/KG) - Dup	04/02/90	3700			
Calcium (MG/L) - QC	04/02/90			0.023	0.024
Carbon Disulfide (MG/KG)	04/02/90	ND			

Carbon Disulfide (MG/KG) - Dup	04/02/90	ND			
Carbon Disulfide (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Carbon Tetrachloride (MG/KG)	04/02/90	ND			
Carbon Tetrachloride (MG/KG) - Dup	04/02/90	ND			
Carbon Tetrachloride (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Chlorobenzene (MG/KG)	04/02/90	ND			
Chlorobenzene (MG/KG) - Dup	04/02/90	ND			
Chlorobenzene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Chloroethane (MG/KG)	04/02/90	ND			
Chloroethane (MG/KG) - Dup	04/02/90	ND			
Chloroethane (MG/L) - QC	04/02/90		ND	ND	ND
Chloroform (MG/KG)	04/02/90	ND			
Chloroform (MG/KG) - Dup	04/02/90	ND			
Chloroform (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Chloromethane (MG/KG)	04/02/90	ND			
Chloromethane (MG/KG) - Dup	04/02/90	ND			
Chloromethane (MG/L) - QC	04/02/90		ND	ND	ND
Chromium (MG/KG)	04/02/90	33			
Chromium (MG/KG) - Dup	04/02/90	36			
Chromium (MG/L) - QC	04/02/90			<0.01	<0.01
Cobalt (MG/KG)	04/02/90	17			
Cobalt (MG/KG) - Dup	04/02/90	35			
Cobalt (MG/L) - QC	04/02/90			<0.005	<0.005
Copper (MG/KG)	04/02/90	25			
Copper (MG/KG) - Dup	04/02/90	45			
Copper (MG/L) - QC	04/02/90			<0.004	<0.004
Cyanide (MG/KG)	04/02/90	<1			
Cyanide (MG/KG) - Dup	04/02/90	<1			
Cyanide (MG/L) - QC	04/02/90			<0.1	<0.1
Dibromochloromethane (MG/KG)	04/02/90	ND			
Dibromochloromethane (MG/KG) - Dup	04/02/90	ND			
Dibromochloromethane (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Ethyl benzene (MG/KG)	04/02/90	ND			
Ethyl benzene (MG/KG) - Dup	04/02/90	ND			
Ethyl benzene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Iron (MG/KG)	04/02/90	34000			
Iron (MG/KG) - Dup	04/02/90	41000			
Iron (MG/L) - QC	04/02/90			0.012	0.15
Lead (MG/KG)	04/02/90	27			
Lead (MG/KG)	04/02/90	39			
Lead (MG/KG) - Dup	04/02/90	83			
Lead (MG/KG) - Dup	04/02/90	48			
Lead (MG/L) - QC	04/02/90			<0.05	<0.05
Lead (MG/L) - QC	04/02/90			<0.004	<0.004
Magnesium (MG/KG)	04/02/90	3400			
Magnesium (MG/KG) - Dup	04/02/90	3700			
Magnesium (MG/L) - QC	04/02/90			0.0031	0.0041
Manganese (MG/KG)	04/02/90	990			
Manganese (MG/KG) - Dup	04/02/90	810			
Manganese (MG/L) - QC	04/02/90			0.0013	<0.001
Mercury (MG/KG)	04/02/90	<1			
Mercury (MG/KG) - Dup	04/02/90	<1			
Mercury (MG/L) - QC	04/02/90			<0.0002	<0.0002
Methylene Chloride (MG/KG)	04/02/90	ND			
Methylene Chloride (MG/KG) - Dup	04/02/90	ND			
Methylene Chloride (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Moisture Content (%)	04/02/90	24.6			
Moisture Content (%) - Dup	04/02/90	20.5			
Nickel (MG/KG)	04/02/90	31			
Nickel (MG/KG) - Dup	04/02/90	55			
Nickel (MG/L) - QC	04/02/90			<0.01	<0.01
Niobium (MG/KG)	04/02/90	<0.85			
Niobium (MG/KG) - Dup	04/02/90	<0.84			
Niobium (MG/L) - QC	04/02/90			<0.007	<0.007
Phosphorous (MG/KG)	04/02/90	1300			
Phosphorous (MG/KG) - Dup	04/02/90	1600			
Phosphorous (MG/L) - QC	04/02/90			<0.2	<0.2
Potassium (MG/KG)	04/02/90	3200			
Potassium (MG/KG) - Dup	04/02/90	3300			
Potassium (MG/L) - QC	04/02/90			<0.6	<0.6
Selenium (MG/KG)	04/02/90	<0.52			
Selenium (MG/KG) - Dup	04/02/90	<0.55			
Selenium (MG/L) - QC	04/02/90			<0.005	<0.005
Silver (MG/KG)	04/02/90	<0.73			
Silver (MG/KG) - Dup	04/02/90	<0.72			
Silver (MG/L) - QC	04/02/90			<0.006	<0.006
Sodium (MG/KG)	04/02/90	530			
Sodium (MG/KG) - Dup	04/02/90	790			

Sodium (MG/L) - QC	04/02/90			<0.02	<0.02
Styrene (MG/KG)	04/02/90	ND			
Styrene (MG/KG) - Dup	04/02/90	ND			
Styrene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Tetrachloroethene (MG/KG)	04/02/90	0.017U			
Tetrachloroethene (MG/KG) - Dup	04/02/90	0.016U			
Tetrachloroethene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Thorium (MG/KG)	04/02/90	<24			
Thorium (MG/KG) - Dup	04/02/90	<24			
Thorium (MG/L) - QC	04/02/90			<0.2	<0.2
Toluene (MG/KG)	04/02/90	ND			
Toluene (MG/KG) - Dup	04/02/90	ND			
Toluene (MG/L) - QC	04/02/90		0.005U	0.0008	0.0007
Trichloroethene (MG/KG)	04/02/90	ND			
Trichloroethene (MG/KG) - Dup	04/02/90	ND			
Trichloroethene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Uranium 235 (WT%) - Dup	04/02/90	0.04			
Uranium 238 (WT%) - Dup	04/02/90	99.35			
Uranium Fluorometric (MG/KG)	04/02/90	10			
Uranium Fluorometric (MG/KG) - Dup	04/02/90	7			
Uranium Fluorometric (MG/L) - QC	04/02/90			<0.001	<0.001
Uranium-234 (WT%) - Dup	04/02/90	<0.01			
Uranium-236 (WT%) - Dup	04/02/90	<0.01			
Vanadium (MG/KG)	04/02/90	32			
Vanadium (MG/KG) - Dup	04/02/90	52			
Vanadium (MG/L) - QC	04/02/90			<0.005	<0.005
Vinyl Acetate (MG/KG)	04/02/90	ND			
Vinyl Acetate (MG/KG) - Dup	04/02/90	ND			
Vinyl Acetate (MG/L) - QC	04/02/90		ND	ND	ND
Vinyl Chloride (MG/KG)	04/02/90	ND			
Vinyl Chloride (MG/KG) - Dup	04/02/90	ND			
Vinyl Chloride (MG/L) - QC	04/02/90		ND	ND	ND
Xylene (total) (MG/KG)	04/02/90	ND			
Xylene (total) (MG/KG) - Dup	04/02/90	ND			
Xylene (total) (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
Zinc (MG/KG)	04/02/90	68			
Zinc (MG/KG) - Dup	04/02/90	160			
Zinc (MG/L) - QC	04/02/90			0.0059	0.0041
cis-1,3-Dichloropropene (MG/KG)	04/02/90	ND			
cis-1,3-Dichloropropene (MG/KG) - Dup	04/02/90	ND			
cis-1,3-Dichloropropene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U
trans-1,3-Dichloropropene (MG/KG)	04/02/90	ND			
trans-1,3-Dichloropropene (MG/KG) - Dup	04/02/90	ND			
trans-1,3-Dichloropropene (MG/L) - QC	04/02/90		0.005U	0.005U	0.005U

Appendix D

ENVIRONMENTAL RESTORATION PROGRAM SITE-SPECIFIC HEALTH AND SAFETY PLAN

The following checklist should be used in its entirety for hazardous waste operations and emergency response activities temporarily (i.e., until checklists that specifically address the unique features of those two functions are completed).

SITE-SPECIFIC HEALTH AND SAFETY PLAN

FOR

Site Name: Bear Creek Valley Operable Unit 2

Prepared by: ______________________________
(Signature) (Date)

Reviewed by: ______________________________
Environmental Restoration (Signature) (Date)

Reviewed by: ______________________________
Health Physics (Signature) (Date)

Reviewed by: ______________________________
Industrial Hygiene (Signature) (Date)

Reviewed by: ______________________________
Industrial Safety (Signature) (Date)

Approved by: ______________________________
HAZWOPER Coordinator (Signature) (Date)

1. SITE DESCRIPTION

The Bear Creek Valley (BCV) Operable Unit 2 (OU 2) Site is located within the U. S. Department of Energy Oak Ridge Reservation in Anderson County, Tennessee. *(See Site Map).*

The BCV OU 2 Site is near the headwaters of Bear Creek, just west of the Y-12 Plant main facilities.

The BCV OU 2 Site is comprised of two construction spoil areas, Rust Spoil Area and Spoil Area 1, and an equipment storage yard, SY-200 Yard. The area is bounded to the north and south by Pine Ridge and Chestnut Ridge, respectively, and has an elevation of 975 ± 50 ft above MSL. It is underlain by the Maynardville Limestone and Nolichucky Shale formations. Environs surrounding the BCV OU 2 include hickory forest, grasslands, devegetated areas, and developed locations, with the forests serving as habitat for many species. Weather patterns in the area are temperate, with warm, humid summers and cool winters. Average annual temperature is approximately 58°.

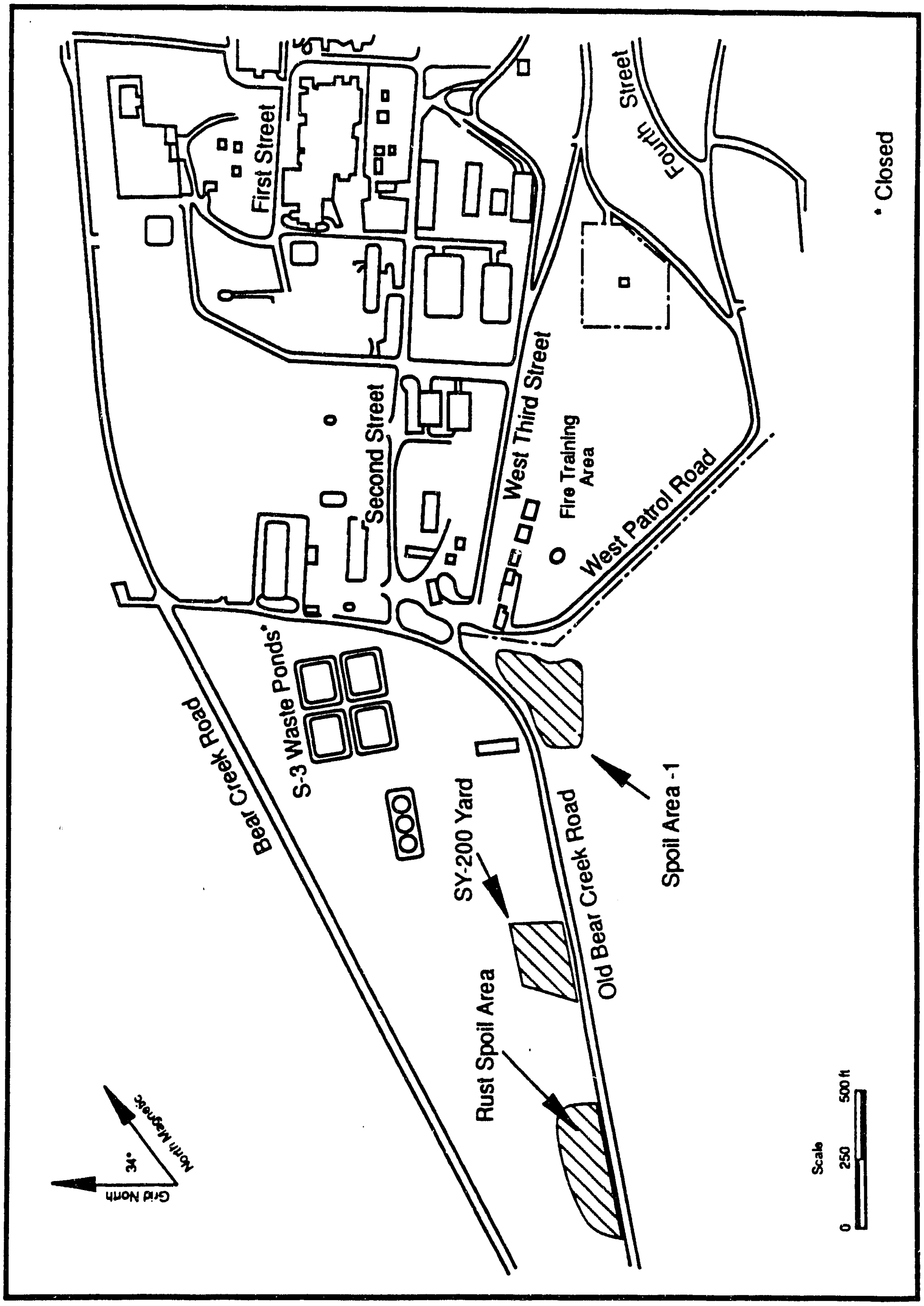
2. SITE HISTORY

The Rust Spoil Area operated as a dump and received spoil materials from the Y-12 Plant. The bulk of the waste deposited consisted of demolition debris, with minor amounts of solvent contaminated material, and materials containing asbestos, mercury, and uranium.

The Spoil Area 1 Site operated as a landfill for rubble and noncombustible, nonputrescible solid waste. Estimates indicate that approximately 100,000 yd^3 of nonuranium contaminated construction debris have been disposed of at the site. According to the RFI Plan, construction materials disposed here may have contained minor amounts of asbestos, mercury, beryllium, uranium, thorium, and other contaminants.

The SY-200 Yard was used as a "holding yard" for materials stored by various operations divisions at Y-12. By September 1986, all items were removed and the site excavated in preparation for construction of the Y-12 Environmental Support Facility. Storage of materials at the site may have resulted in minor releases of mercury, lead, and PCBs to surface soils.

3. SITE MAP


First Street
Second Street
West Third Street
Fourth Street
Fire Training Area
West Patrol Road
Bear Creek Road
S-3 Waste Ponds*
SY-200 Yard
Old Bear Creek Road
Spoil Area -1
Rust Spoil Area
Grid North
North Magnetic
34°
Scale
0
250
500 ft
* Closed
2-040992-099

4. HEALTH AND SAFETY HAZARD EVALUATION

[Place an X in each ( ) to indicate presence of hazard]

4.1 Physical hazards

(X)	Heat stress	(X)	Cold stress	(X)	Noise
( )	Confined space	( )	Enclosed space	( )	Heavy lifting
(X)	Tripping/Falling	(X)	High voltage	( )	High pressure water
( )	Oxygen deficient	( )	Explosive/flammable	( )	Vibration

4.2 Construction hazards

( )	Trenching	( )	Excavating	(X)	Heavy equipment op.
( )	Demolition	( )	High Work	( )	Welding/Cutting
( )	Ladders	( )	________	( )	________

4.3 Chemical hazards

(X)	Organic chemical	(X)	Inorganic chemical	(X)	Carcinogen
( )	Corrosive	( )	Reactive	(X)	OSHA specific substances
( )	Mutagen	( )	Teratogen		

4.4 Ionizing radiological hazards

( )	Internal exposure	(X)	External exposure

4.5 Nonionizing radiological hazards

( )	UV	( )	RF	( )	Microwave
( )	Laser				

4.6 Biological/Vector hazards

( )	Wildlife	( )	Plants	( )	Medical waste
( )	Bacterial	( )	Parasites		

5. PREVIOUS SAMPLING RESULTS

Contaminant	Source (Water, Sediment, Sludge, Soil, Air, etc.)	Quantity or Concentration

See Attached Tables D.1 through D.8

Table D.1. 1990 summary of surface water concentrations from sampling stations BCK-12.4 and 11.97[a]
(μg/L)

Analyte	BCK-12.4	BCK-11.97	Maximum Contaminant Level
Barium	76.4	481	1,000
Boron	63	50	
Cadmium	[b]		10
Chromium			50
Copper			1,300[c]
Lead			50
Mercury			2
Nickel		44	100[c]
Strontium	422	714	
Uranium	512	211	
Zinc			5,000[d]
Nitrate	31,400	150,100	10,000

Source: Energy Systems 1991.
[a] Average values for analytes found in OU 2 groundwater samples.
[b] Average concentration was below the detection limit.
[c] Proposed.
[d] Secondary level.

Table D.2. RSA - 1990 average groundwater concentrations[a]
(Total analyses - μg/L, except where noted)

Analyte	GW-306[b]	GW-307	GW-308	GW-309	GW-310	GW-311	GW-312
Barium	46	87	95	46	96	18	41
Boron	300	260	38	370	160	260	250
Cadmium	[c]	2					
Chromium			62		34		34
Copper	11	30	38	3.6	8.6	7.8	9.3
Lead		30	50		22		50
Mercury			0.2		0.2		
Nickel	13	19	16				15
Strontium	180	270	320	420	330	70	580
Uranium	1	1	2	2	0.9	0.8	
Zinc	18	40	44	9	12	15	34
Chloride	17,800	35,500	31,200	34,000	32,500	3,750	1,000
Nitrate	11,000	17,800	15,000	17,800	23,000	750	280
Sulfate	36,000	91,500	13,100	64,700	68,000	4,250	2,750
1,2-DCE	12.6	20.2	16.8	16.8	19.2		
PCE		1.75	1.5	1.8	2.4		
TCA	2.4	2.5	2.2				
TCE	75	55.5	37	19.7	27.2	33.5	57.5
Gross alpha, pCi/L	2.64	5.33	5.57	2.38	3.50	1.25	1.36
Gross beta, pCi/L	26.7	49.0	40.5	49.9	61.9	2.36	21.4

[a] Average values for quarterly samples with a minimum of two analyses above detection limit. Values below detection limit were treated as one-half the detection limit.
[b] Groundwater well designation.
[c] Analyte not detected above background more than once during the year.
Source: HSW 1991.

Table D.3. 1990 average groundwater concentrations[a]
(Total Analyses - $\mu g/L$, except where noted)

Analyte	GW-313[b]	GW-314	GW-315	GW-316	GW-317	GW-323
Barium	23	39	47	37	16	34
Boron	10	30	22	13	23	16
Cadmium	[c]					3
Copper	9	6	5	7	8	
Lead	28	3		6		
Strontium	78	93	141	39	45	21
Uranium			1	0.7		
Zinc	8	9	10	32	12	13
Chloride	2,000	4,600	6,800	2,000	880	1,000
Nitrate	900	10,800	16,000	400	180	
Sulfate	2,600	6,200	11,200	2,600	7,000	2,000
1,2-DCE	7.5	11.7	26.6			
PCE	8.6	13.3	33.3			
TCE	4.7	5.7	13.5			
Gross alpha, pCi/L	0.30	1.00	1.30	1.01	0.38	1.14
Gross beta, pCi/L	3.12	32.3	54.9	2.54	3.01	1.80

[a] Average values for quarterly samples with a minimum of two analyses above detection limit. Values below detection limit were treated as one-half the detection limit.
[b] Groundwater well designation.
[c] Analyte not detected above background more than once during the year.
Source: HSW 1991.

Table D.4. Summary of soil chemical data, RSA soil borings

Chemical/element	Number of detects/analyses	Detected minimum[a] (mg/kg)	Detected maximum[a] (mg/kg)	BCV soil background levels (ppm)[b]
		Volatile Organic Compounds		
Acetone	9/24	0.16	0.49	
Tetrachloroethene (PCE)	1/24		0.072	
		Metals		
Arsenic	24/24	2.8	26	6.758
Barium	24/24	24	820	149.5
Beryllium	23/24	0.67	2.1	1.34[c]
Cadmium	23/24	2.4	7.3	0.2453
Chromium	23/24	17	41	14.70
Cobalt	23/24	9.4	66	34.81
Copper	24/24	14	740	21.22
Lead	24/24	13	150	42.28
Mercury	5/24	1.1	7.5	0.1639
Nickel	23/24	15	55	54.86[c]
Uranium	24/24	2	14.5	2.30
Vanadium	23/24	20	70	49.18
Zinc	24/24	44	230	46.35
		Radiological		
Gross alpha, pCi/g	24/24	1.45	4.37	15 pCi/g[d]
Gross beta, pCi/g	24/24	1.87	5.07	50 pCi/g[d]
Uranium-235, wt %	3/3	0.04	1.18	

[a]Concentration units are mg/kg unless otherwise indicated.
[b]From Turner et al. 1988.
[c]Represents mean background for East Tennessee.
[d]Represents DOE-established action limits.

Table D.5. SY-200 Yard soil sample analytical results, July 1986

Sample name	Interval	Mercury (μg/g)	PCB (μg/g)	EP tox
P-1	Surface	20		Pass
EP-2	Surface	42		Pass
EP-3	Surface	17,000		Pass
Surface composite transformer area	Surface	3.80	32	
Deep sample 1	2–4 in.	29	2.8	
Deep sample 2	2–4 in.	19	7.7	

Table D.6. Summary of SY-200 Yard soil sample analytical results, January 1988

Parameter	Units	Range		Average	Comments
		Upper	Lower		
Alpha activity	pCi/g	170	8.6	38	
Beta activity	pCi/g	250	15	71	
Gamma activity	pCi/g	420	<300		Detected in 1 of 15 samples.
Arsenic	mg/kg		<40		Not detected in any sample.
Barium	mg/kg	340	182	239	
Cadmium	mg/kg				Not detected in any sample.
Chromium	mg/kg	80	29	51	
Lead	mg/kg	370	<20	93	Detected in 11 of 15 samples.
Mercury	μg/g	200	0.18	28	Detected in 14 of 15 samples.
Selenium	mg/kg		<0.1		Not detected in any sample.
Silver	mg/kg		<4		Not detected in any sample.
PCB	μg/g	0.3	<0.1		Detected in 3 of 15 samples.
EP tox Leach Test					All samples passed.

Table D.7. Summary of soil sample analytical results, January 1989

($\mu g/g$)

Parameter	Range Upper	Range Lower	Average
Thorium	15.3	3.71	7.34
Uranium	8.06	0.52	2.56
Mercury	2100	3.4	244

Table D.8. Chemical summary, SA-1 soil borings

Chemical/element	Number of detects/analyses	Detected minimum[a] (mg/kg)	Detected maximum[a] (mg/kg)
		Semivolatile Organic Compounds	
Acenaphthene	4/53	0.079	0.41
Acenaphthylene	1/53	0.11	0.11
Anthracene	7/53	0.14	0.85
Benzo(a)anthracene	12/53	0.14	1.7
Benzo(a)pyrene	11/53	0.12	1.3
Benzo(a)fluoranthene	10/53	0.11	1.4
Benzo(ghi)perylene	9/53	0.085	0.8
Benzo(k)fluoranthene	11/53	0.15	1.4
Chrysene	12/53	0.16	1.7
Dibenzofuran	3/53	0.17	0.25
Fluoranthene	13/53	0.07	4.1
Fluorene	6/53	0.18	0.45
Indeno(1,2,3-cd)pyrene	8/53	0.099	0.77
Naphthalene	3/53	0.12	0.21
Phenanthrene	13/53	0.059	3.6
Pyrene	13/53	0.055	3.1
		Metals	
Arsenic	44/51	1.9	45.7
Barium	51/51	15.3	385
Beryllium	50/51	0.27	11
Cadmium	50/51	1.1	10.9
Chromium	50/51	6.4	54.2
Cobalt	50/51	1.7	110
Copper	50/51	13.3	109
Lead	51/51	6.5	670
Mercury	38/51	0.05	31.5
Nickel	51/51	4.7	173
Uranium	51/51	2	80
Vanadium	50/51	6.8	128
Zinc	51/51	26.4	591

Table D.8 continued

Chemical/element	Number of detects/analyses	Detected minimum[a] (mg/kg)	Detected maximum[a] (mg/kg)
		Radiological	
Gross alpha, pCi/g	50/51	0.03	12
Gross beta, pCi/g	48/51	1.56	37.4
Total radium, pCi/g	51/51	0.973	7.568
Uranium-235, wt%	21/57	0.29	1

[a] Concentration units are mg/kg unless otherwise noted.

6. CONTAMINANTS

6.1 **Chemical:** ARSENIC
PEL/TLV* : .002 mg/m^3
STEL: NG
Action level: .002 mg/m^3
IDLH: 100 mg/m^3
LEL: Not Applicable (NA)
Route of exposure: Inhalation, absorption, contact, ingestion
Monitoring equipment: Sampling pump and filter
Symptoms/effects of exposure: Respiratory irritation
Special medical monitoring: Bioassay

6.2 **Chemical:** BERYLLIUM
PEL/TLV* : .0005 mg/m3
STEL: 0.025 mg/m^3
Action level: .005 mg/m^3
IDLH: 10 mg/m^3
LEL: NA
Route of exposure: Inhalation
Monitoring equipment: Sampling pump and filter
Symptoms/effects of exposure: Fatigue, respiratory symptoms, weak
Special medical monitoring: Bioassay

6.3 **Chemical:** LEAD
PEL/TLV* : 0.05 mg/m^3
STEL: Not Given in research literature (NG)
Action level: NG
IDLH: 700 mg/m^3
LEL: NA
Route of exposure: Inhalation, ingestion, skin or eye contact
Monitoring equipment: Sampling pump and filter
Symptoms/effects of exposure: Weakness, insomnia, low weight
Special medical monitoring: Bioassay

6.4 **Chemical:** MERCURY
PEL/TLV* : .01 mg/m^3
STEL: .03 mg/m^3 (skin)
Action level: NG
IDLH: 10 mg/m^3
LEL: NA
Route of exposure: Inhalation, absorption, skin or eye contact
Monitoring equipment: Jerome Mercury Analyzer
Symptoms/Effects of exposure: Cough, chest pain, indecision, irritability, weak, headache
Special medical monitoring: Urinalysis

6.5 **Chemical:** TETRACHLOROETHENE
PEL/TLV* : 25 ppm (170 mg/m^3)
STEL: 200 ppm
Action level: NG
IDLH: 500 ppm
LEL: NA
Route of exposure: Inhalation, ingestion, skin or eye contact
Monitoring equipment: PID/OVM
Symptoms/Effects of exposure: Irritated eyes, nose or throat; nausea, flushed, dizzy, headache
Special Medical monitoring: Bioassay

* OSHA, NIOSH, or ACGIH Standard, whichever is most restrictive

6.6 **Chemical:** URANIUM
PEL/TLV* : 0.05 mg/m^3 IDLH: 20 mg/m^3
STEL: NG LEL: Unknown
Action level: NG
Route of exposure: Inhalation, absorption, contact, ingestion
Monitoring equipment: Alpha particle detection meter
Symptoms/Effects of exposure: Irritation of skin, eyes, nose, and throat; headache, irritability, sensitization
Special medical monitoring: Whole-body dosimetry

6.7 **Chemical:** VANADIUM
PEL/TLV* : .05 mg/m^3 IDLH: 70 mg/m^3
STEL: 0.5 mg/m^3 LEL: NA
Action level: .05 mg/m^3
Route of exposure: Inhalation, ingestion, contact
Monitoring Equipment: Sampling pump and filter
Symptoms/Effects of exposure: Irritated eyes and throat; green tongue, metallic taste, cough
Special medical monitoring: Bioassay

6.8 **Chemical:** SELENIUM
PEL/TLV* : .2 mg/m^3 IDLH: Unknown
STEL: NA LEL: Unknown
Action level: NG
Route of exposure: Inhalation, absorption, ingestion, contact
Monitoring equipment: Sampling pump and filter
Symptoms/Effects of exposure: Irritated eyes, nose, throat; visual disturbance, headache, chills, metallic taste
Special medical monitoring: Bioassay

6.9 **Chemical:** THORIUM
PEL/TLV* : NA IDLH: NA
STEL: NA LEL: NA
Action level: NA
Route of exposure: GI tract, skin
Monitoring equipment: Alpha particle detection meter
Symptoms/Effects of exposure: Radioactivity, dermatitis
Special medical monitoring: Whole body dosimetry

* OSHA, NIOSH, or ACGIH Standard, whichever is most restrictive

6.10 **Chemical:** ASBESTOS
PEL/TLV* : 0.2 fibers/cc
IDLH:
STEL: Excursion limit: 1 fiber/cc (30 min)
LEL: NA
Action level: 0.1 fiber/cc
Route of exposure: Inhalation, ingestion
Monitoring equipment: Sampling pump and filter
Symptoms/Effects of exposure: Irritation of eyes and nose
Special medical monitoring: Chest x-ray

6.11 **Chemical:** BARIUM
PEL/TLV* : .5 mg/m^3
IDLH: 1100 mg/m^3
STEL: NG
LEL: Unknown
Action level: NG
Route of exposure: Inhalation, ingestion, contact
Monitoring equipment: Sampling pump and filter
Symptoms/Effects of exposure: Irritated eyes, skin, throat; skin burns
Special medical monitoring: Bioassay

6.12 **Chemical:** CHROMIUM
PEL/TLV* : .5 mg/m^3
IDLH: NG
STEL: NG
LEL: NA
Action level: NG
Route of exposure: Ingestion
Monitoring equipment: Sampling pump and filter
Symptoms/Effects of exposure: Sensitization, dermatitis
Special medical monitoring: Bioassay

6.13 **Chemical:** PCBs
PEL/TLV* : .001 mg/m^3
IDLH: 5 mg/m^3
STEL: NG
LEL: Unknown
Action level: NG
Route of exposure: Inhalation, absorption
Monitoring equipment: Sampling pump and filter
Symptoms/Effects of exposure: Eye irritation, chloracne
Special medical monitoring: Bioassay

* OSHA, NIOSH, or ACGIH Standard, whichever is most restrictive

6.14 **Chemical:** FLUORANTHENE
PEL/TLV* : NA
IDLH: NA
STEL: NA
LEL: NA
Action level: NA
Route of exposure: GI tract, skin
Monitoring equipment: Sampling pump and filter
Symptoms/Effects of exposure: Toxic by ingestion
Special medical monitoring: Bioassay

6.15 **Chemical:** PHENANTHRENE
PEL/TLV* : NA
IDLH: NA
STEL: NA
LEL: NA
Action level: NA
Route of exposure: Respiratory tract, intravenous (iv)
Monitoring equipment: Sampling pump and filter
Symptoms/Effects of exposure: Toxic by ingestion, iv poison
Special medical monitoring: Bioassay

6.16 **Chemical:** PYRENE (as coal tar pitch volatiles)
PEL/TLV* : 0.1 mg/m^3
IDLH: 700 mg/m^3
STEL: NA
LEL: NA
Action level: NA
Route of exposure: Respiratory tract, GI tract, skin
Monitoring Equipment: Sampling pump and filter
Symptoms/Effects of exposure: Inhalation: poison; ingestion, intraperitoneal: moderate toxicity; skin: irritant
Special medical monitoring: Bioassay

6.17 **Chemical:** RADIUM
PEL/TLV* : NA
IDLH: NA
STEL: NA
LEL: NA
Action level: NA
Route of exposure: Respiratory tract, GI tract, skin
Monitoring equipment: Alpha particle detection meter
Symptoms/Effects of exposure: Possible lung cancer, bone cancer, osteitis, skin damage, blood dyscrasias
Special medical monitoring: Whole-body dosimetry

* OSHA, NIOSH, or ACGIH Standard, whichever is most restrictive

7. TASK BREAKDOWN

7.1 Description: drilling

Level of Personal Protective Equipment:	Primary C	Contingency	Upgrade or downgrade as needed
Type of work:	Intrusive (X)	Nonintrusive ( )	
Engineering controls:	None required		

Administrative controls: Occupational Safety and Health Administration 40-hr health and safety training, as specified in 29 *CFR* 1910.120, shall be required for all employees engaged in hazardous waste operations. Personnel will be required to have annual 8-hr refresher training courses. Managers and supervisors shall receive an additional 8 hours of instruction. All classroom training shall be supplemented with 24-hr on-site orientation and instruction under an experienced and qualified individual.

Personal Protective Equipment:

	Primary	Contingency
1. Respiratory protection: fullface, organic, & HEPA filter	Y(x) N( )	Y( ) N( )
2. Protective clothing: plain tyvek	Y(X) N( )	Y( ) N( )
3. Head protection: hardhat	Y(X) N( )	Y( ) N( )
4. Eye protection: safety glasses with side shields	Y(X) N( )	Y( ) N( )
5. Foot protection: steel-toed butyl rubber boots	Y(X) N( )	Y( ) N( )
6. Hand Protection: gloves - rubber outer, latex inner	Y(X) N( )	Y( ) N( )
7. Hearing protection: earplugs	Y(X) N( )	Y( ) N( )
8. Tape-up required:	Y( ) N(X)	Y( ) N( )

7.2 Description: soil sampling

Level of Personal Protective Equipment:	Primary	C	Contingency
Type of work:	Intrusive (X)		Nonintrusive ( )
Engineering controls:	None required		

Administrative controls: Occupational Safety and Health Administration 40-hr health and safety training, as specified in 29 *CFR* 1910.120, shall be required for all employees engaged in hazardous waste operations. Personnel will be required to have annual 8-hr refresher training courses. Managers and supervisors shall receive an additional 8 hours of instruction. All classroom training shall be supplemented with 24-hr on-site orientation and instruction under an experienced and qualified individual.

Personal Protective Equipment:

	Primary	Contingency
1. Respiratory protection:fullface, organic, & HEPA filter	Y(x) N( )	Y( ) N( )
2. Protective clothing: plain tyvek	Y(x) N( )	Y( ) N( )
3. Head protection: hardhat	Y(x) N( )	Y( ) N( )
4. Eye protection: safety glasses with side shields	Y(x) N( )	Y( ) N( )
5. Foot protection: steel-toed rubber boots	Y(x) N( )	Y( ) N( )
6. Hand protection: gloves-butyl rubber outer, latex inner	Y(x) N( )	Y( ) N( )
7. Hearing protection: earplugs	Y(x) N( )	Y( ) N( )
8. Tape-up required:	Y( ) N(x)	Y( ) N( )

7.3 Description: surface water/sediment sampling

Level of Personal Protective Equipment: Primary C Contingency Upgrade or downgrade as necessary

Type of work: Intrusive (x) Nonintrusive ( )

Engineering controls: None required

Administrative controls: Occupational Safety and Health Administration 40-hr health and safety training, as specified in 29 *CFR* 1910.120, shall be required for all employees engaged in hazardous waste operations. Personnel will be required to have annual 8-hr refresher training courses. Managers and supervisors shall receive an additional 8 hours of instruction. All classroom training shall be supplemented with 24-hr on-site orientation and instruction under an experienced and qualified individual.

Personal Protective Equipment:

	Primary	Contingency
1. Respiratory protection: fullface, organic, & HEPA filter	Y(x) N( )	Y( ) N( )
2. Protective clothing: plain tyvek	Y(x) N( )	Y( ) N( )
3. Head protection: hardhat	Y(x) N( )	Y( ) N( )
4. Eye protection: safety glasses with side shields	Y(x) N( )	Y( ) N( )
5. Foot protection: steel-toed rubber boots	Y(x) N( )	Y( ) N( )
6. Hand protection: gloves-butyl rubber outer, latex inner	Y(x) N( )	Y( ) N( )
7. Hearing protection: earplugs	Y(x) N( )	Y( ) N( )
8. Tape-up required:	Y( ) N(x)	Y( ) N( )

7.4 Description: monitoring well installation

Level of Personal Protective Equipment: Primary C Contingency Upgrade or downgrade as needed

Type of work: Intrusive (x) Nonintrusive ( )

Engineering controls: None required

Administrative controls: Occupational Safety and Health Administration 40-hr health and safety training, as specified in 29 *CFR* 1910.120, shall be required for all employees engaged in hazardous waste operations. Personnel will be required to have annual 8-hr refresher training courses. Managers and supervisors shall receive an additional 8 hours of instruction. All classroom training shall be supplemented with 24-hr on-site orientation and instruction under an experienced and qualified individual.

Personal Protective Equipment:

	Primary	Contingency
1. Respiratory protection: fullface, organic, & HEPA filter	Y(x) N( )	Y( ) N( )
2. Protective clothing: plain tyvek	Y(x) N( )	Y( ) N( )
3. Head protection: hardhat	Y(x) N( )	Y( ) N( )
4. Eye protection: safety glasses with side shields	Y(x) N( )	Y( ) N( )
5. Foot protection: steel-toed rubber boots	Y(x) N( )	Y( ) N( )
6. Hand protection: gloves-butyl rubber outer, latex inner	Y(x) N( )	Y( ) N( )
7. Hearing protection: earplugs	Y(x) N( )	Y( ) N( )
8. Tape-up required:	Y( ) N(x)	Y( ) N( )

7.5 Description: monitoring well sampling

Level of Personal Protective Equipment: Primary ___C_____ Contingency Upgrade or downgrade as necessary

Type of work: Intrusive (x) Nonintrusive ( )

Engineering controls: None required

Administrative controls: Occupational Safety and Health Administration 40-hr health and safety training, as specified in 29 *CFR* 1910.120, shall be required for all employees engaged in hazardous waste operations. Personnel will be required to have annual 8-hr refresher training courses. Managers and supervisors shall receive an additional 8 hours of instruction. All classroom training shall be supplemented with 24-hr on-site orientation and instruction under an experienced and qualified individual.

Personal Protective Equipment:

	Primary	Contingency
1. Respiratory protection: fullface, organic, & HEPA filter	Y( ) N(x)	Y( ) N( )
2. Protective clothing: plain tyvek	Y(x) N( )	Y( ) N( )
3. Head protection: hardhat	Y(x) N( )	Y( ) N( )
4. Eye protection: safety glasses	Y(x) N( )	Y( ) N( )
5. Foot protection: steel-toed rubber boots	Y(x) N( )	Y( ) N( )
6. Hand protection: gloves-butyl rubber outer, latex inner	Y(x) N( )	Y( ) N( )
7. Hearing protection: earplugs	Y(x) N( )	Y( ) N( )
8. Tape-up required:	Y( ) N(x)	Y( ) N( )

7.6 Description: site survey

Level of Personal Protective Equipment: Primary ___D_____ Contingency ________

Type of work: Intrusive ( ) Nonintrusive (x)

Engineering controls: None required

Administrative controls: Occupational Safety and Health Administration 40-hr health and safety training, as specified in 29 *CFR* 1910.120, shall be required for all employees engaged in hazardous waste operations. Personnel will be required to have annual 8-hr refresher training courses. Managers and supervisors shall receive an additional 8 hours of instruction. All classroom training shall be supplemented with 24-hr on-site orientation and instruction under an experienced and qualified individual.

Personal Protective Equipment:

	Primary	Contingency
1. Respiratory protection:	Y( ) N(x)	Y( ) N( )
2. Protective clothing:	Y( ) N(x)	Y( ) N( )
3. Head protection: hardhat	Y(x) N( )	Y( ) N( )
4. Eye protection: safety glasses	Y(x) N( )	Y( ) N( )
5. Foot protection: steel-toed boots	Y(x) N( )	Y( ) N( )
6. Hand protection:	Y( ) N(x)	Y( ) N( )
7. Hearing protection:	Y( ) N(x)	Y( ) N( )
8. Tape-up required:	Y( ) N(x)	Y( ) N( )

8. MONITORING REQUIREMENTS

Instrument	Task(s)	Monitoring frequency	Action guidelines
8.1 Direct Reading Instruments			
LEL meter			
O_2 meter			
Colorimetric indicator tubes			
Photoionization Detector (PID)	7.1-7.5	Continuously	Background + for >1 min.
Flame Ionization Detector (FID)	7.1-7.5	Continuously	Background + for >1 min.
Alpha meter	7.1-7.5	As deemed	ALARA
Beta/Gamma meter	7.1-7.5	As deemed	ALARA
Area radiation monitors			
Perimeter radiation monitors			
Noise meter	7.1-7.5	Start/as needed	
Jerome mercury analyzer	7.1-7.5	Continuously	0.01 mg/m^3
8.2 Personnel Monitoring			
Whole-body dosimetry	7.1-7.5	On job site	2 mR/h
Extremity dosimetry			
Whole-body count			
Urinalysis/Bioassay	7.1-7.5	Start/Stop of job Baseline/Annual	
Chemical air sampling			
Asbestos	7.1-7.5	Continuously	0.2 fiber/cc
Beryllium	7.1-7.5	Continuously	0.002 mg/m^3
Dust (total)	7.1-7.5	Continuously	>10 mg/m^3
Radiation air sampling			

9. HAZARD ANALYSIS

9.1 Chemicals

Tasks 7.1-7.5

Specific labeling requirements of site-generated waste: Soil boring cuttings, investigation-derived wastes, and decon water will be generated, labeled, handled, and temporarily stored according to Y-12 requirements.

Chemical-specific disposal requirements: Soil cuttings will either remain at the site or be put in drums for appropriate disposal; personnel and equipment decontamination water and investigation-derived groundwater shall be drummed and sent to the Y-12 West End Treatment Plant for treatment and disposal; protective clothing shall be drummed for disposal by the Y-12 waste management personnel. Final disposition of the wastes will be based on analytical results.

9.2 Fire/Explosion

Tasks: N/A

Are flammable liquids present? No

Description ________________________________

Location ________________________________

Quantity ________________________________

Containment/Storage method ________________________________

For welding, cutting, or brazing is a welding permit required? N/A

9.3 Confined/Enclosed Spaces

Tasks: N/A

Confined/enclosed space entry required (low/high risk)? No

Operations safety work permit required? No

Standard operating procedure required? No

9.4 Ionizing Radiation

Tasks: 7.1-7.5

Applicable detailed checklist? NA

Primary contaminating isotope(s)	Uranium ^{235}U Thorium Radium (Isotopes may be present but expected only at low levels)	
Location on site	Rust Spoil Area, SY-200 Yard, Spoil Area 1	
Containment/storage method	decon water and investigation-derived wastes	
Radiation type	Alpha/Beta/Gamma	(may be present but expected only at low levels)
Dose rate (maximum)	?_____ mR/h @ ____ meter(s)	
(average)	?_____ mR/h	
Worker dose limit	2_____ mR/h (SAIC employees limited to 500 mR/yr)	
Contamination level (fixed)	5000___ dpm/100 cm^2	
(removable)	1000___ dpm/100 cm^2	
Airborne contamination concentration	______ mCi/ml	(Airborne concentrations exceeding limits in Table 1, Attach. 1 of DOE Order 5480.11 will require the use of appropriate PPE.)
Water contamination potential?	Yes	
Unrestricted airborne contamination release potential?	Yes	
Radiation work permit required?	No	
Health Physics coverage	Intermittent	
Special task operation requirements	______ Welding/cutting/brazing ______ Grinding/chipping ______ Hydraulic/air hammer operation ______ Dusty conditions (sweeping, vacuuming, etc.) ______ Equipment decontamination/free release	

9.5 Nonionizing Radiation

Tasks: 7.1

High-Voltage (>100 Kv) electrical transmission lines nearby? Yes

Location, distance, and voltage: The electrical hazards will be minimized by locating the auger so that no power lines are within a radius of a distance equal to the height of the auger mast.

Radiofrequency radiation sources (AM and/or FM broadcast towers, r-f sealers) nearby? No

Location and distance:

Microwave sources in use on site? No
Location and description: ____________________

Lasers in use nearby? No
Location and laser class: ____________________

Are workers potentially exposed to sunlight (ultraviolet radiation)? Yes

Are ultrasound sources in use on site? No
Location: ____________________

9.6 Electrical Hazards

Tasks: 7.1

Electrical shock hazard? Yes/No

_______ Voltage
_______ Current

Location of hazard: None yet identified; however, the location of above ground and underground utilities will be determined during the Y-12 Excavation and Penetration Permit procedure, Y-12 Plant Procedure EP-D-06. This procedure will be followed during all augering operations.

9.7 Temperature Extremes

Tasks: 7.1-7.6

Temperature extremes (hot/cold)? Yes/No
_______ Average daily high temperature (during work shift) °F/°C
_______ Average daily low temperature (during work shift) °F/°C
_______ Average wind speed MPH cloudy/sunny
_______ Temperature WBGT °C

Work load:
______ Light
______ Moderate
______ Heavy

Work/Rest regimen:
____ % work
____ % rest

Threshold Limit Value__

Precautions *(specify)*: The work schedule has not been determined; therefore, the potential for temperature extremes cannot be evaluated. However, excessive temperature extremes are not anticipated.

Cooling/heating equipment needed: None.

9.8 Noise

Tasks: 7.1

Noise extremes? Yes/No

Sound level _____ dB(A)

Noise source(s): Hollow stem auger drill utilized to collect split spoon samples. A concrete cutter may be used to remove asphalt or concrete plug before sampling activities if necessary.

Noise above 85 dB(A) (hearing protection required) Yes/No

Precautions*(specify)*: It is recommended that hearing protection be worn while the hollow stem auger and the concrete cutter are in operation. Occupational noise exposure should be monitored initially.

9.9 Vibration

Tasks: None

Vibration extremes? Yes/No

Vibration frequency _____ l

Precautions *(specify)*:________________________________

9.10 Sanitation

Tasks: 7.1-7.6

Potable water required? No

Nonpotable water used? No

Eating, drinking, and smoking permitted? Yes

Where? Only in an area located outside the exclusion zone as designated by the Site Health and Safety Officer.

Toilet facilities required? Yes
Location and number: Specified by plant personnel at time of check-in.

Washing facilities required? Yes
Location: Specified by plant personnel at time of check-in.

Change rooms required?
Specify: No

9.11 Illumination

Tasks: None

Additional illumination needed? NA

9.12 Safety Hazards

Site posted information/notification required? No

Site posting required? Yes

Site guard required? No

Access control required? Yes

Entry/exit logs required? No

Escape routing/posting required (include site map)? Yes

Compressed gas cylinders? No
Location: ________
Storage: ________

10. EMERGENCY PREPAREDNESS

Evacuation route *(map attached)*:

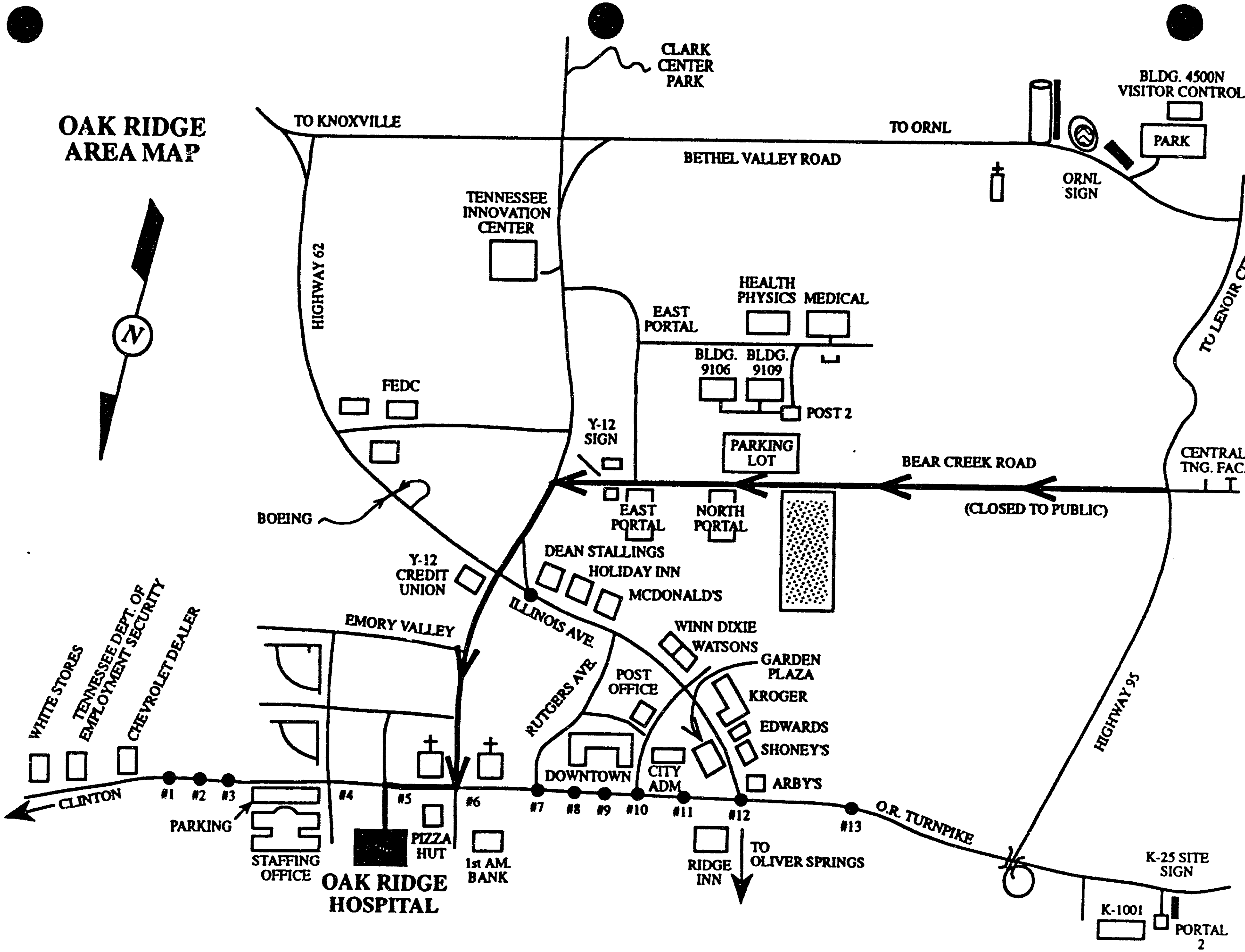
EMERGENCY CONTACTS: All emergency services at the Bear Creek Valley OU 2 Site are to be contacted by first calling the Plant Shift Superintendent (PSS) at Commercial extension, 574-7172; from Y-12, extension

4-7172. In the event that the PSS is not available, emergency services may be reached at the telephone numbers shown below.

Facility Personnel	Phone
PSS	574-7172
Project Engineer	Steve Walker (615) 576-5364
Contract Engineer	
Program Health & Safety Coordinator	Larry May (615) 576-4018
Industrial Hygiene	Rudy Weigel (615) 241-2487
Industrial Safety	Wes James (615) 574-3897
Health Physics	Dave Gauss (615) 576-7877
Plant Disposal	Wayne Rideout (615) 576-5794
Quality Assurance	Hugh Newsom (615) 576-5810

Emergency Assistance Service	Phone
Police	Y-12 extension, 911; commercial extension 574-7272
Ambulance	Y-12 extension, 911; commercial extension 576-1890
Fire	Y-12 extension, 911; commercial extension 576-1890
Hospital	Methodist Medical Center of Oak Ridge, 481-1190 or 911
Doctor	Methodist Medical Center of Oak Ridge, 481-1190 or 911
Health Information Services	Methodist Medical Center of Oak Ridge, 481-1190 or 911

Directions to Oak Ridge Methodist Medical Hospital: from Y-12 Plant, turn left onto Scarboro Road, travel approximately 0.25 mile and turn right onto Lafayette Road. Travel approximately 1.75 miles to the Oak Ridge Turnpike. Turn right. The Methodist Hospital is immediately to the left. See attached hospital location map.



NOT TO SCALE

Hospital location map

11. RECORD KEEPING REQUIREMENTS

(Mark with an X as appropriate)

		Required
Hazardous Chemicals		
Area monitoring		x
Personnel monitoring		
Oxygen Level Measurements		
Flammability Measurements		
Ionizing Radiation		
Worker dose		x
Contamination levels		
Airborne contamination level		
Radiation work permit		
Nonionizing Radiation		
UV level measurements		
Microwave level measurements		
Laser power level measurements		
Biological		
Personnel exposure monitoring		x
Electrical		
Tag-out records		
Temperature extremes		
WBGT measurements		
Daily temperature/wind speed		
Noise		
Area monitoring		
Personnel monitoring		
Vibration		
Source measurements		
Illumination		
Area foot-candle measurements		x
Personnel Medical Monitoring		
Safety/Emergency Response		
OSHA accident records		x
Accident/incident reports		x
Personal Protective Equipment		
Inspection of:	Clothing	x
	Respirators	x
	Gloves	x
	Boots	x
Waste Disposal Manifests		
Spill Incident Reports		
Training of Employees		x

END

DATE FILMED

9/29/93