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Action Memorandum for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE/OR/01-1749&D1)

September 14, 1998

This action memorandum documents approval of the non-time-critical removal action recommended in the *Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/02-1714&D2) (Attachment 1). This action addresses removal of Tank W-1A, located in the North Tank Farm in Central Bethel Valley, and contaminated soils surrounding the tank. The following activities are included in the removal action:

- remove and transfer liquid accumulated in Tank W-1A to the liquid low-level waste system;
- excavate and dispose of contaminated soil surrounding the tank, up to the maximum extent shown on Figure 8 of the engineering evaluation (EE)/cost analysis (CA);
- cut and cap all lines that tie into the tank;
- remove the aboveground valve box;
- remove and dispose of the tank, concrete saddles, and base; and
- backfill the resulting pit.

The proposed action will reduce contaminants entering First and White Oak Creeks and lower the health and environmental risks associated with release of these contaminants. This action satisfies all Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) evaluation criteria. According to the National Oil and Hazardous Substances Pollution Contingency Plan, on-site removal actions conducted under CERCLA are required to meet applicable or relevant and appropriate requirements (ARARs) of other environmental laws to the extent practicable. The U.S. Department of Energy (DOE) intends to meet all appropriate ARARs when conducting this removal action. Before shipping waste to any off-site facility, DOE will verify its acceptability in accordance with the requirements of 40 *Code of Federal Regulations* 300.440(a)(4).

DOE held a 30-day public comment period on the EE/CA from August 10 to September 9, 1998. Notice of the public comment period was published in local newspapers. No public comments that warranted altering the removal action as presented in the EE/CA were received. Therefore, no changes have been made to the selected alternative. Public comments and DOE responses are included in Attachment 2.

Actual or threatened releases of hazardous substances from Tank W-1A and the surrounding soil, if not addressed by implementing this removal action, may present an imminent and substantial endangerment to public health, welfare, or the environment. The proposed action will remove a known source of ^{90}Sr, uranium, and other radionuclide

This document has been approved
for release to the public. Date: 9/15/98

Prepared by Jacobs EM Team
125 Broadway Avenue
Oak Ridge, Tennessee
under contract DE-AC05-98OR22700

contaminants being released to the groundwater and First Creek. Additionally, the removal action will leave the site in a stable condition, and will not preclude any future actions at the site that may be implemented as part of the Bethel Valley watershed project. This non-time-critical removal action will be performed under the auspices of the Federal Facility Agreement for the Oak Ridge Reservation. The U.S. Environmental Protection Agency and the Tennessee Department of Environment and Conservation have reviewed and agreed with the EE/CA and the need to conduct this removal action. Based on the analysis presented in the EE/CA, this action is appropriate and will be implemented in accordance with CERCLA requirements.

Approval

Margaret Wilson — September 17, 1998

Margaret Wilson, FFA Project Manager — Date
ORR Remediation Management Group
U.S. Department of Energy
Oak Ridge Operations

This action memorandum includes the following attachment:

Attachment 1. *Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/02-1714&D2).

Attachment 2. Responsiveness Summary to Public Comments on the *Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/02-1714&D2).

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ATTACHMENT 1

Engineering Evaluation/Cost Analysis
for the Core Hole 8 Plume Source (Tank W-1A) Removal Action
at Oak Ridge National Laboratory,
Oak Ridge, Tennessee
(DOE/OR/02-1714&D2)

Prepared by Jacobs EM Team
125 Broadway Avenue
Oak Ridge, Tennessee
under contract DE-AC05-98OR22700

DOE/OR/02-1714&D2

Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee

This document has been approved
for release to the public. Date: 7/17/98

DOE/OR/02-1714&D2

Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee

Date Issued—July 1998

Prepared by
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Prepared for the
U.S. Department of Energy
Office of Environmental Management

Environmental Management Activities at the
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
managed by
Bechtel Jacobs Company LLC
for the
U.S. Department of Energy
under contract DE-AC05-98OR22700

PREFACE

This *Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/02-1714&D2) was prepared in accordance with requirements under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 to present the recommended removal action for the Oak Ridge National Laboratory Core Hole 8 Plume Source. This work was performed under Work Breakdown Structure 1.4.12.6.1.01 (Activity Data Sheet 3300, "WAG 1 Core Hole 8"). This document provides the Environmental Management Program with information about the plume source and a description of the recommended removal action at the site. This document and other information related to the site and recommended action are available to the public through the Administrative Record.

CONTENTS

FIGURES v
TABLES v
ACRONYMS AND ABBREVIATIONS vii

1. INTRODUCTION 1
   1.1 SITE DESCRIPTION 2
      1.1.1 Location 2
      1.1.2 Topography 2
      1.1.3 Geology and Soil 8
      1.1.4 Hydrogeology 10
      1.1.5 Anthropogenic Features 11
   1.2 SITE BACKGROUND 14
   1.3 CONTAMINANT CHARACTERIZATION 14
      1.3.1 Site Characterization 14
         1.3.1.1 Groundwater 14
         1.3.1.2 Soil 15
      1.3.2 Nature and Extent of Contamination 15
         1.3.2.1 Groundwater 15
         1.3.2.2 Soil 25
   1.4 STREAMLINED RISK EVALUATION 26

2. REMOVAL ACTION OBJECTIVES 27
   2.1 STATUTORY AUTHORITY 27
   2.2 PURPOSE AND SCOPE 28
   2.3 JUSTIFICATION FOR THE PROPOSED ACTION 28

3. SUMMARY OF REMOVAL ACTION ALTERNATIVES 28
   3.1 ALTERNATIVE 1: REMOVE TANK AND EXCAVATE SURROUNDING CONTAMINATED SOILS; CUT AND CAP TANK LINES; DISPOSE OF GENERATED WASTE 31
   3.2 ALTERNATIVE 2: IN SITU GROUT CONTAMINATED SOIL AROUND TANK TO ACHIEVE SOURCE CONTROL BY PERMEABILITY REDUCTION; EMPTY TANK CONTENTS AND FILL WITH GROUT 35
   3.3 ALTERNATIVE 3: IN SITU CHEMICALLY TREAT CONTAMINATED SOIL AROUND TANK TO ACHIEVE SOURCE CONTROL BY STABILIZATION; EMPTY TANK CONTENTS AND FILL WITH GROUT 39

CONTENTS (continued)

4. EVALUATION AND COMPARISON OF ALTERNATIVES 41
   4.1 EVALUATION OF ALTERNATIVE 1: REMOVE TANK AND EXCAVATE SURROUNDING CONTAMINATED SOILS; CUT AND CAP TANK LINES; DISPOSE OF GENERATED WASTE 41
      4.1.1 Effectiveness 41
      4.1.2 Implementability 42
      4.1.3 Cost 43
   4.2 EVALUATION OF ALTERNATIVE 2: IN SITU GROUT CONTAMINATED SOIL AROUND TANK TO ACHIEVE SOURCE CONTROL BY PERMEABILITY REDUCTION; EMPTY TANK CONTENTS AND FILL WITH GROUT 44
      4.2.1 Effectiveness 44
      4.2.2 Implementability 44
      4.2.3 Cost 45
   4.3 EVALUATION OF ALTERNATIVE 3: IN SITU CHEMICALLY TREAT CONTAMINATED SOIL AROUND TANK TO ACHIEVE SOURCE CONTROL BY STABILIZATION; EMPTY TANK CONTENTS AND FILL WITH GROUT 45
      4.3.1 Effectiveness 45
      4.3.2 Implementability 45
      4.3.3 Cost 45

5. RECOMMENDED REMOVAL ACTION ALTERNATIVE 46

6. REFERENCES 46

APPENDIX A: APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS A-1
APPENDIX B: COST ESTIMATES B-1
APPENDIX C: ANALYTICAL RESULTS C-1

FIGURES

Figure No.		Page
1.	Tank W-1A site location map	3
2.	Tank W-1A location	4
3.	North Tank Farm looking SW	5
4.	White Oak Creek watershed	7
5.	Site bedrock geology	9
6.	North Tank Farm appurtenances	12
7.	Tank W-1A	13
8.	Locations of soil borings, drive points, Tank W-1A, and underground utilities	17
9.	Distribution of gross alpha activity (pCi/L) in groundwater	19
10.	Distribution of gross beta activity (pCi/L) in groundwater	21
11.	Distribution of ^{90}Sr (pCi/L) in groundwater	23
12.	Tank W-1A source area	29
13.	North Tank Farm site plan	32
14.	Typical sleeve pipe	37

TABLES

Table No.		Page
1.	Soil sample results from the Core Hole 8 plume source—1998, Oak Ridge National Laboratory	16
2.	Soil sample results from the Core Hole 8 plume source—1986, Oak Ridge National Laboratory	18
3.	Comparison of 1998 and 1986 TRU data, Core Hole 8 plume source, Oak Ridge National Laboratory	26

ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
Bq	becquerel
CA	cost analysis
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
CH	contact handled
Ci	curie
cm	centimeter
Cm	curium
Co	cobalt
Cs	cesium
DOE	U.S. Department of Energy
DP	drive point
EE	engineering evaluation
Envirocare	Envirocare of Utah, Inc.
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
ft	foot
g	gram
gal	gallon
^3H	tritium
ha	hectare
in.	inch
K_d	solid-to-liquid distribution
km	kilometer
L	liter
LLW	low-level (radioactive) waste
LLLW	liquid low-level (radioactive) waste
m	meter
mrem	millirem
nCi	nanocurie
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
pCi	picocurie
Pm	promethium
PPE	personal protective equipment
Pu	plutonium

ACRONYMS AND ABBREVIATIONS (continued)

RCRA	Resource Conservation and Recovery Act of 1976
RH	remotely handled
ROD	record of decision
S&M	surveillance and maintenance
Sr	strontium
TDEC	Tennessee Department of Environment and Conservation
TRU	transuranic
U	uranium
WAC	waste acceptance criteria
WAG	waste area group
WIPP	Waste Isolation Pilot Plant
yd	yard

1. INTRODUCTION

The U.S. Department of Energy (DOE) facilities in Oak Ridge, Tennessee, have been in operation since 1943. During this period, radioactive and hazardous wastes have been disposed of at the Oak Ridge National Laboratory (ORNL) on the Oak Ridge Reservation (ORR). Accidental releases of radioactive and hazardous substances have also occurred. Environmental investigations in the ORNL main plant area have revealed radiochemical contamination in the groundwater. Soils surrounding Tank W-1A, located in the North Tank Farm in Central Bethel Valley, have been identified as sources of radiological contamination to groundwater, referred to as the Core Hole 8 plume source. Because groundwater flows toward First Creek and White Oak Creek, it is believed that contaminants detected in groundwater in the vicinity of Tank W-1A (including ^{90}Sr, $^{233/234}U$, and other radionuclides) have entered these creeks. In 1994, an early action was taken (installation of interceptor trenches) to intercept and collect this groundwater plume before discharge to the creeks. Any additional remedial action for the groundwater plume will be documented in the record of decision (ROD) for Bethel Valley watershed.

DOE, the Tennessee Department of Environment and Conservation (TDEC), and the U.S. Environmental Protection Agency (EPA) have agreed that a non-time-critical removal action is appropriate to address Tank W-1A and the surrounding contaminated soils which are a source of contaminants entering First Creek and White Oak Creek. This removal action is being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) process to reduce the off-site risk until a final action can be implemented for this site. The plume itself will be addressed in the Bethel Valley watershed ROD.

This engineering evaluation (EE)/cost analysis (CA) develops and evaluates potential source control alternatives and identifies a recommended alternative. This EE/CA is being issued for a 30-day public review and comment period. The public is encouraged to review this document and other items in the Administrative Record concerning this action and submit questions and/or comments to:

Ms. Margaret Wilson, FFA Project Manager
Oak Ridge Remediation Management
U.S. Department of Energy Oak Ridge Operations
55 Jefferson Circle
Oak Ridge, TN 37830

After the 30-day public review and comment period, an action memorandum will be prepared to address public comments, modify the preferred alternative as appropriate, and document the decision to implement the alternative selected by DOE.

1.1 SITE DESCRIPTION

1.1.1 Location

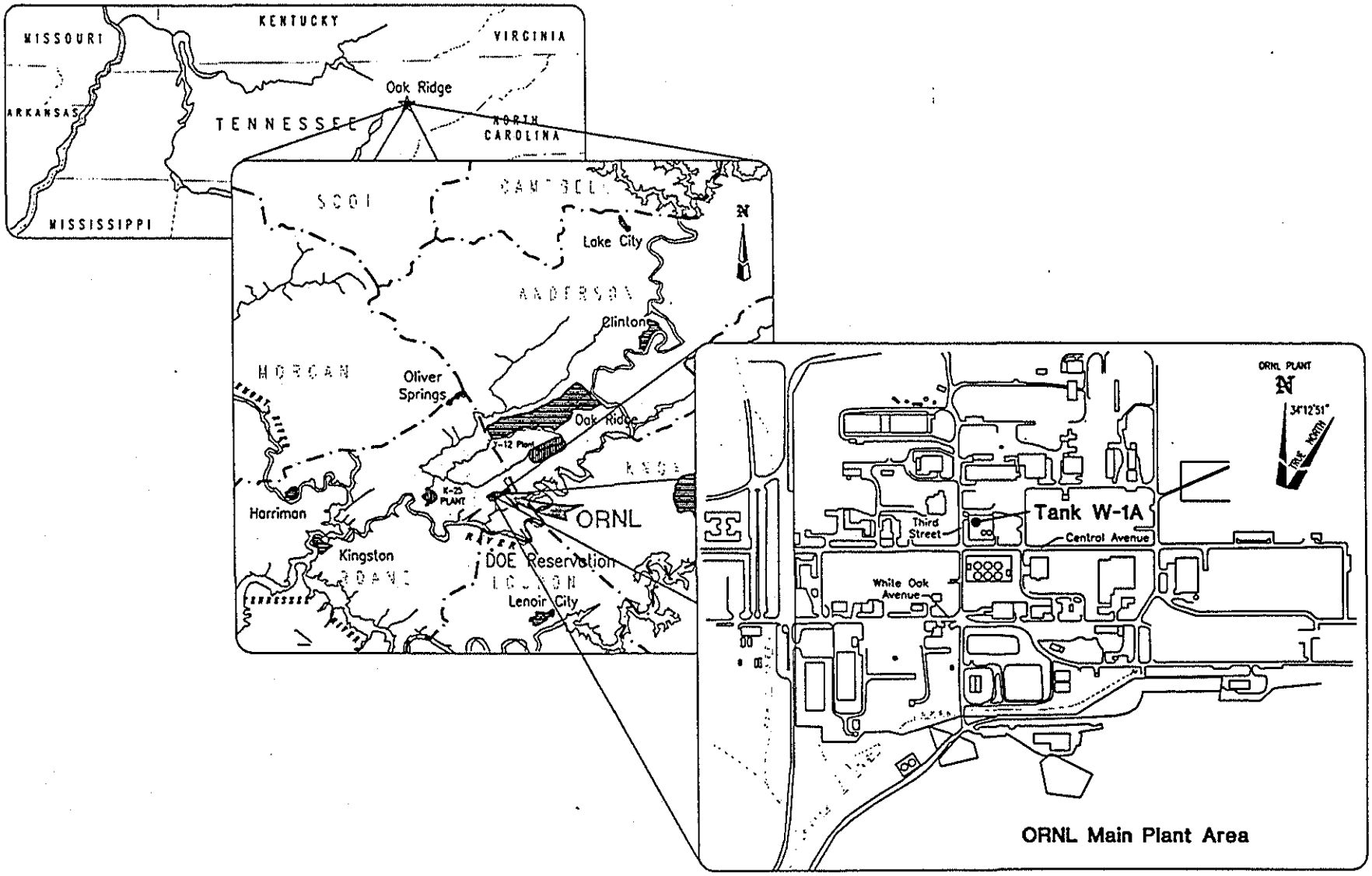
DOE ORR is located in Roane and Anderson counties in eastern Tennessee (Fig. 1). ORR is approximately 40 km (25 miles) west of Knoxville, bounded on the north and east by the city of Oak Ridge and on the south and west by the Clinch River. ORNL is located about 11 km (7 miles) south of Oak Ridge and is one of three main facilities at ORR. The central portion of the First Creek watershed is located north of Central Avenue, west of Third Street, and east of First Creek (Fig. 2). Tank W-1A stands about 300 m (1,000 ft) east of First Creek, in the North Tank Farm (Fig. 3). First Creek flows from north to south along First Street, outside the west security fence, and eventually empties into White Oak Creek.

1.1.2 Topography

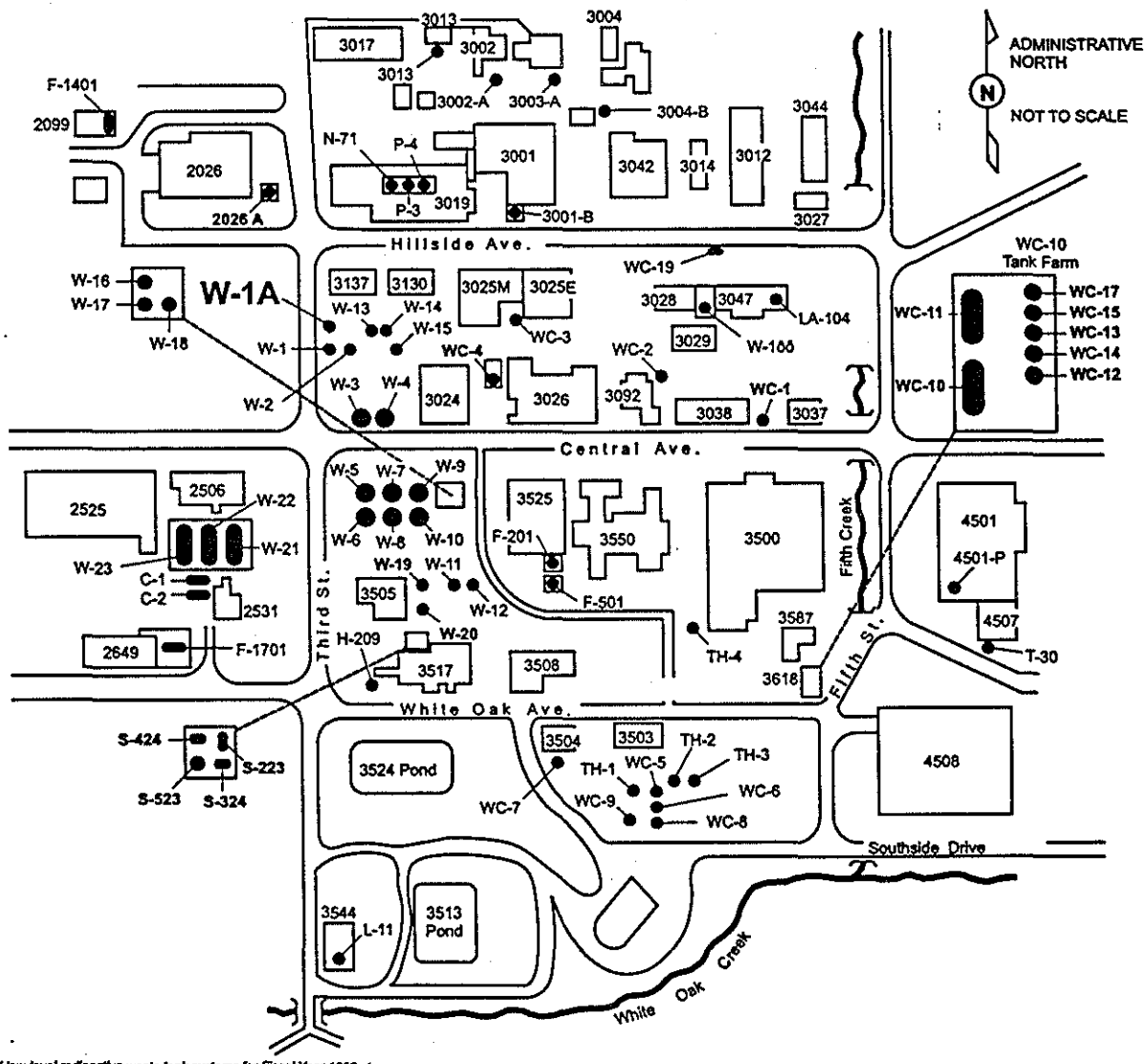
The Central Bethel Valley area (including Tank W-1A) and First Creek are located between Chestnut Ridge to the north and Haw Ridge to the south in Bethel Valley. The valley floor, which slopes to the south, has an average gradient of 4 percent and is approximately 275 m (900 ft) above mean sea level.

The western portion of Central Bethel Valley is located within the White Oak Creek watershed near First Creek. The headwaters of First Creek, which is a first-order tributary to White Oak Creek, are formed by a spring at the 260-m (850-ft) contour on the southern flank of Chestnut Ridge, approximately 400 m (700 ft) north of Bethel Valley Road (Fig. 4). The drainage area of First Creek is 0.85 km^2 (0.33 $mile^2$) (Loar et al. 1994). First Creek flows south from its headwaters 1.0 km (0.6 mile) downstream to the confluence with Northwest Tributary (a second-order tributary) and southeast into White Oak Creek. White Oak Creek flows to the southwest past several minor tributaries and into White Oak Lake. White Oak Lake discharges over White Oak Dam into Clinch River.

Discharge measurements taken in First Creek in 1988 and 1989 indicate that there were no periods of zero flow. Mean daily discharge rates for the 2 years were 16.2 L (4.2 gal)/second in 1988 and 36.1 L (9.4 gal)/second in 1989 (Loar et al. 1994). Data generated by the U.S. Geological Survey for First Creek in 1991 indicate that peak discharge from storms during that year was as high as 480 L (125 gal)/second (Bechtel et al. 1992). In addition to natural



JE® Fig. 1	Tank W-1A site location map DOE – ORNL – Oak Ridge, Tennessee	DOCUMENT ID: 0153-40 / EE/CA	DRAWING ID: 97-15180.DWG	DRAWING DATE: MAY 8, 1998 SB



SOURCE: *Implementation plan for liquid low-level radioactive waste tank systems for Fiscal Year 1998 at Oak Ridge National Laboratory under the Federal Facility Agreement, Oak Ridge, Tennessee*

JE	**Fig. 2**	**Tank W-1A location** DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 98-15723.CDR	DRAWING DATE: MAY 11, 1998 SB

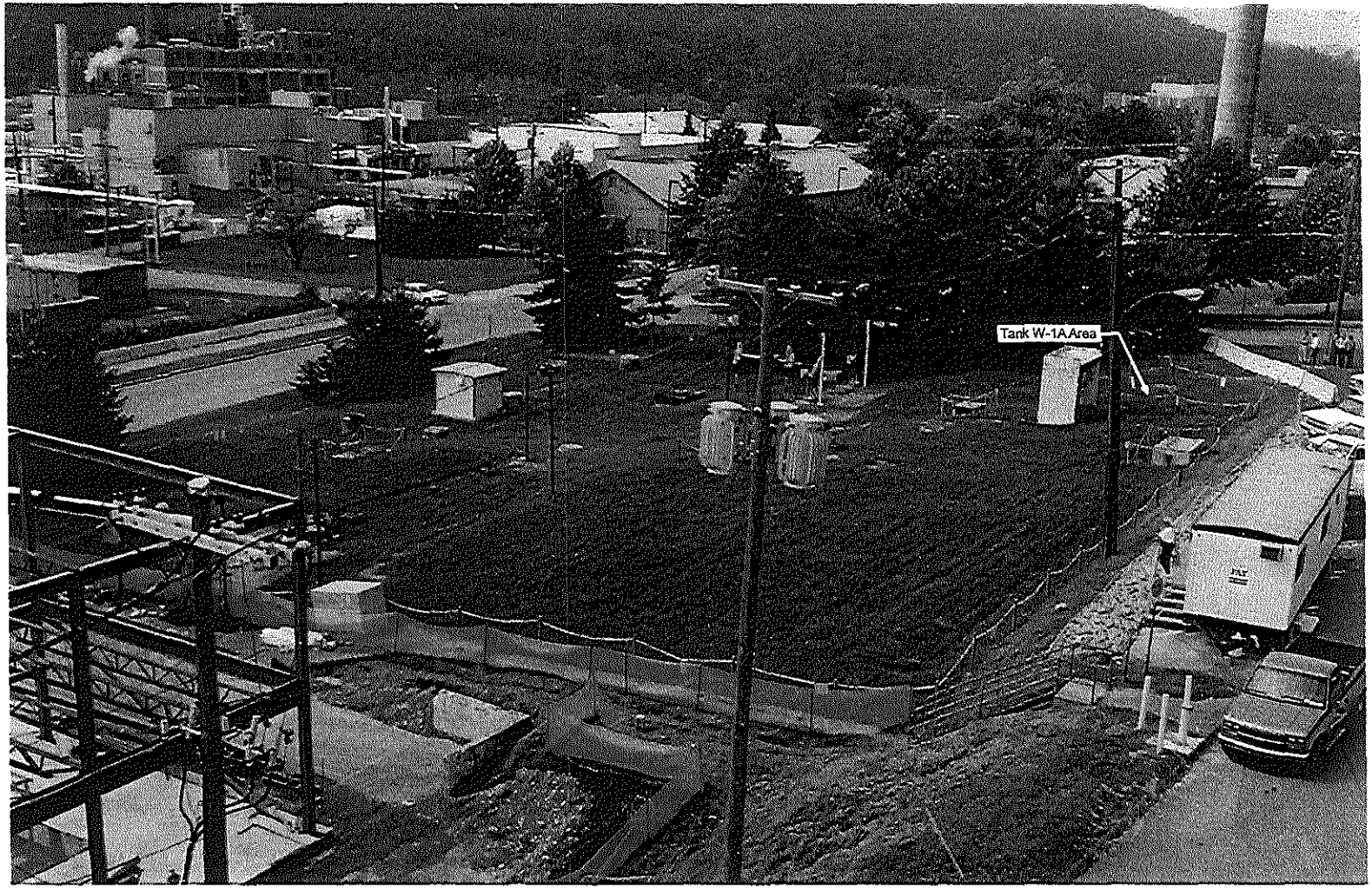


Fig. 3	**North Tank Farm looking SW** DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 98-16049.CDR	DRAWING DATE: MAY 6, 1998 TG

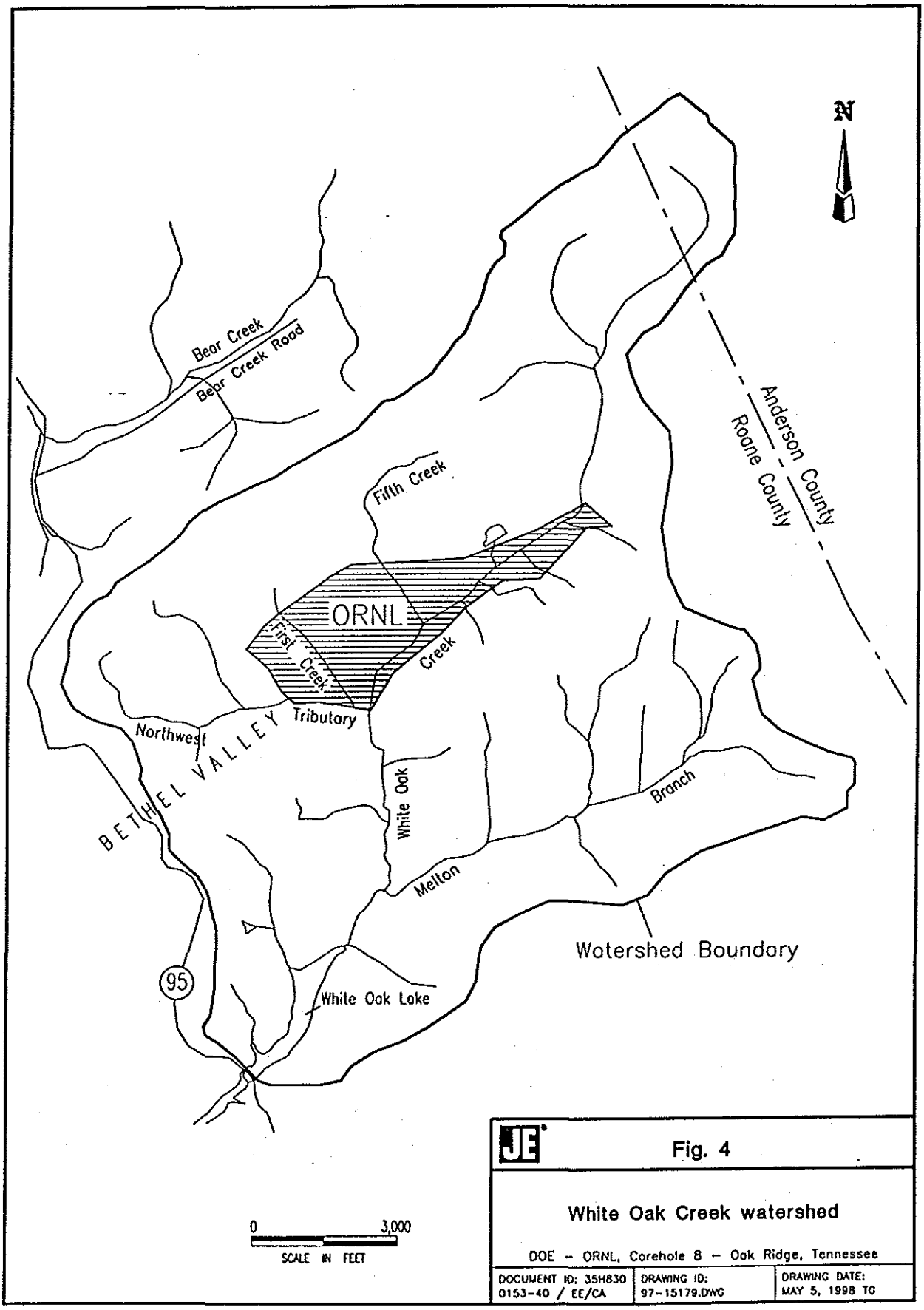


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Fig. 4

White Oak Creek watershed

DOE – ORNL, Corehole 8 – Oak Ridge, Tennessee

DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 97-15179.DWG	DRAWING DATE: MAY 5, 1998 TG

discharge, a number of wastewater and storm drain outfalls are present along First Creek. However, no data are available regarding either the relative or absolute discharge volumes from these drains.

1.1.3 Geology and Soil

Most of Central Bethel Valley is underlain by rocks of the Ordovician-aged Chickamauga Group in the upper part of the stratigraphic section. These rocks strike northeast–southwest and dip toward the southeast. Dip ranges from 25 to 40 degrees, with an average dip of approximately 35 degrees. The Copper Creek fault outcrops on the lower to middle northwestern slope of Haw Ridge. This thrust fault separates the younger Chickamauga Group from the overlying siltstone and sandstone of the middle Cambrian-aged Rome Formation that forms the crest of the ridge and is part of the Copper Creek thrust sheet.

Fractures on ORR are well developed in all stratigraphic units and are the most pervasive mesoscopic structure (Hatcher et al. 1992). Both systematic and nonsystematic fractures are present and were formed at various times during the tectonic history of the southern Appalachians. Fracture density is highly variable; reported values on ORR range from 5 to 200 per 1 m (3.3 ft) (Soloman et al. 1992). Fracture lengths generally range from several inches up to 1 m (3.3 ft). Fracture spacings in limestones range from < 5 cm (2 in.) to > 3 m (9.8 ft).

According to Hatcher et al. (1992) nomenclature, bedrock beneath Tank W-1A consists of the Benbolt Formation, a member of the Middle Ordovician Chickamauga Group, or Chickamauga Unit "E," according to Stockdale nomenclature (Ketelle and Lee 1992) (Fig. 5). This formation is characterized by heterogeneous lithologies, consisting of a mixture of dark gray shaley siltstone and nodular limestone. Lithologic logs from Core Hole 8, located approximately 49 m (160 ft) to the southwest of Tank W-1A, indicate that bedrock in the immediate vicinity of the tank is consistent with this general characterization (Ketelle and Lee 1992).

Natural soils that develop over the Chickamauga bedrock are generally fine grained with the predominant soil classification being a low- to high-plasticity clay and silt containing > 50 percent fines. Since much of the ORNL area has had construction activities, including the area surrounding Tank W-1A, most of the natural soil structure has been disturbed. Saprolite is weathered bedrock that maintains some of the structural features (i.e., bedding and folding) of the parent material. Saprolite represents a transition zone between soil and bedrock materials.

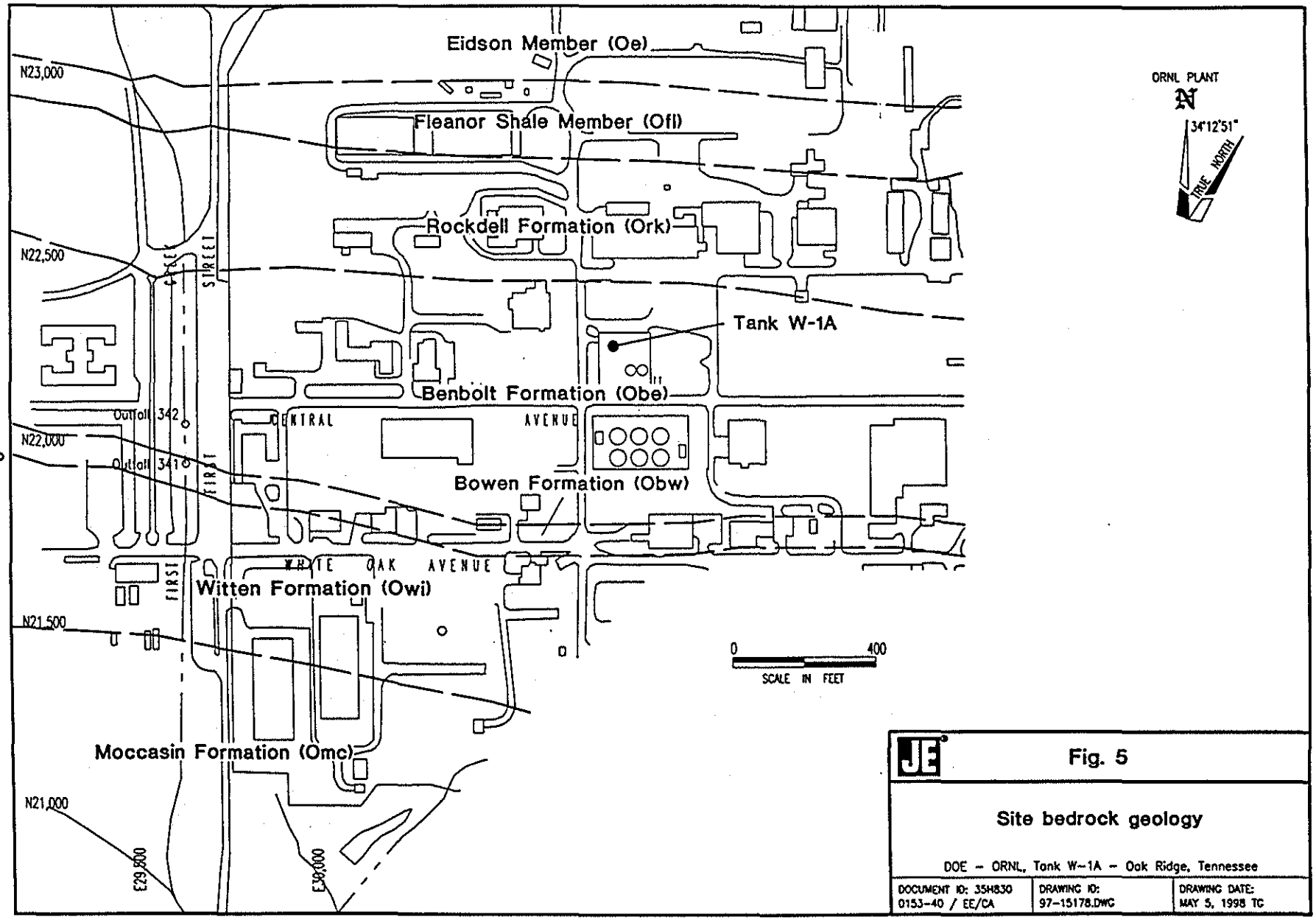


Fig. 5

Site bedrock geology

DOE – ORNL, Tank W-1A – Oak Ridge, Tennessee

DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 97-15178.DWG	DRAWING DATE: MAY 5, 1998 TC

1.1.4 Hydrogeology

Bedrock underlying ORNL is Ordovician carbonate strata of the Chickamauga Group, which consists of limestones that typically have low primary porosity. Groundwater movement occurs primarily within secondary porosity features such as fractures, joints, and solution (karst) cavities. Fractures on ORR are well developed in all stratigraphic units and are the most pervasive mesoscopic structure (Hatcher et al. 1992). Most fracture networks tend to develop systematic orientations over a particular area (Soloman et al. 1992).

In general, groundwater movement is largely along the soil/bedrock interface. However, groundwater that infiltrates the bedrock is controlled by secondary porosity features. Depending on local lithologic characteristics, groundwater within bedrock may be under water table, semiconfined, or confined conditions. The average hydraulic conductivity of saturated shallow bedrock within Central Bethel Valley is 8.8×10^{-6} cm/second (Bechtel et al. 1992). Overall decreases in hydraulic conductivity with depth observed in wells throughout ORR are probably due to a decrease in the number and size of open secondary porosity features with depth (Bechtel et al. 1992).

Water levels in the unconsolidated zone and upper bedrock within Central Bethel Valley indicate that the water table/potentiometric surface generally mimics site topography, although local influences cause many undulations. This shallow groundwater system generally occurs under unconfined conditions, although locally semiconfined conditions may occur, particularly where the water table is below the top of bedrock. In general, the horizontal hydraulic gradient is to the south; however, groundwater flow paths in bedrock are strongly controlled by secondary porosity and in places may be perpendicular to, or even opposite to, flow paths inferred from equipotential lines. Observations made in well pairs near First Creek indicate that a slight upward vertical gradient (approximately 0.1) is present in shallow bedrock (Bechtel et al. 1992). This upward component of the hydraulic gradient suggests that First Creek is a potential area of groundwater discharge, provided the bedrock is sufficiently transmissive. Observations made at First Creek indicate that the creek bed consists of exposed bedrock, as evidenced by outcrops with strikes and dips consistent with regional trends.

Measurements from drive points installed in the immediate vicinity of Tank W-1A indicate that a groundwater "mound" has developed around the tank. This phenomenon is commonly associated with underground storage tanks. Relatively high-permeability backfill material in the tank pit is surrounded by undisturbed, relatively-low permeability soil or bedrock. This contrast

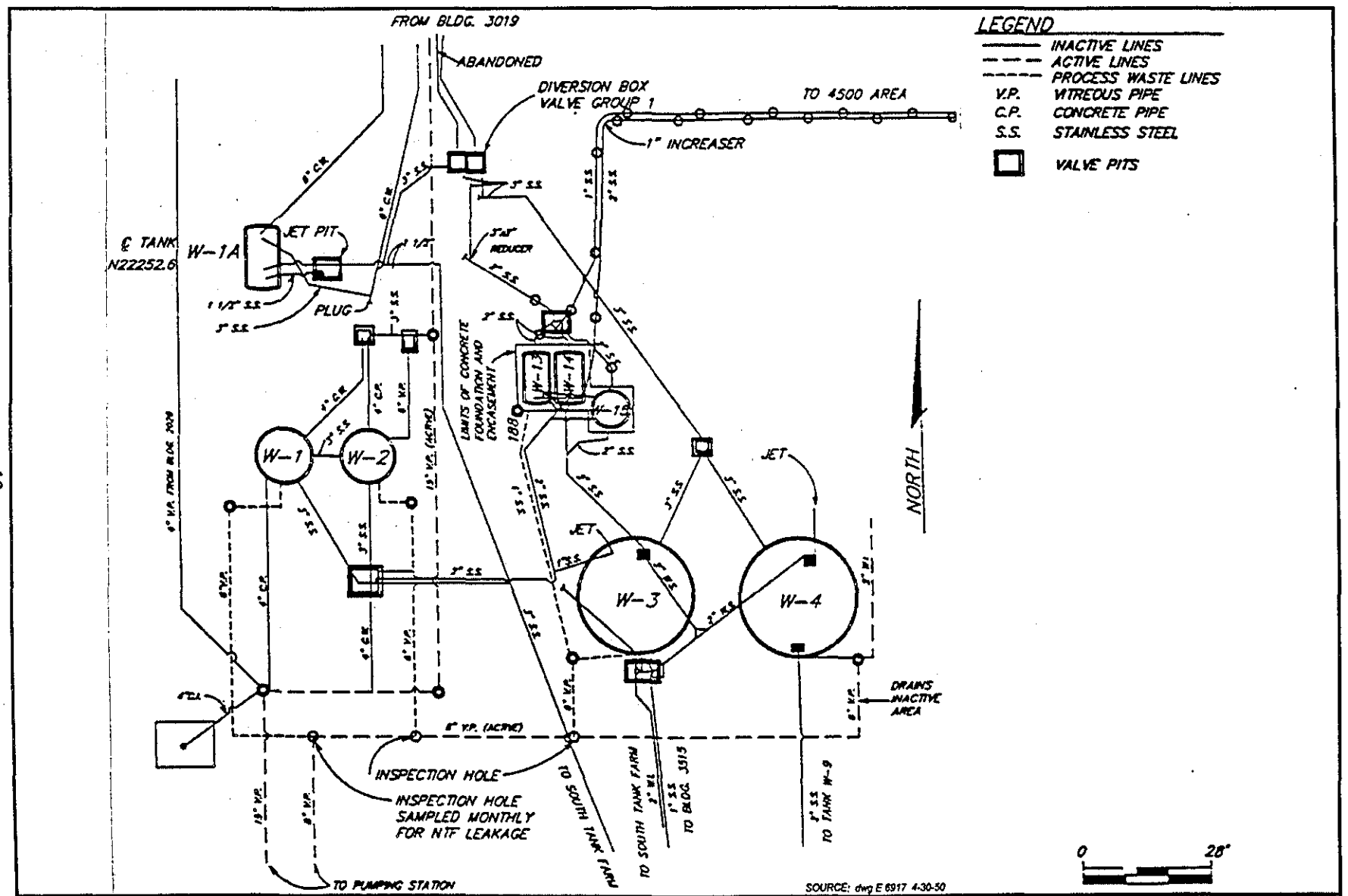
in permeability between the tank pit backfill and surrounding soil or bedrock causes precipitation to infiltrate more quickly around the tank, forming a groundwater mound and radial flow away from the tank.

1.1.5 Anthropogenic Features

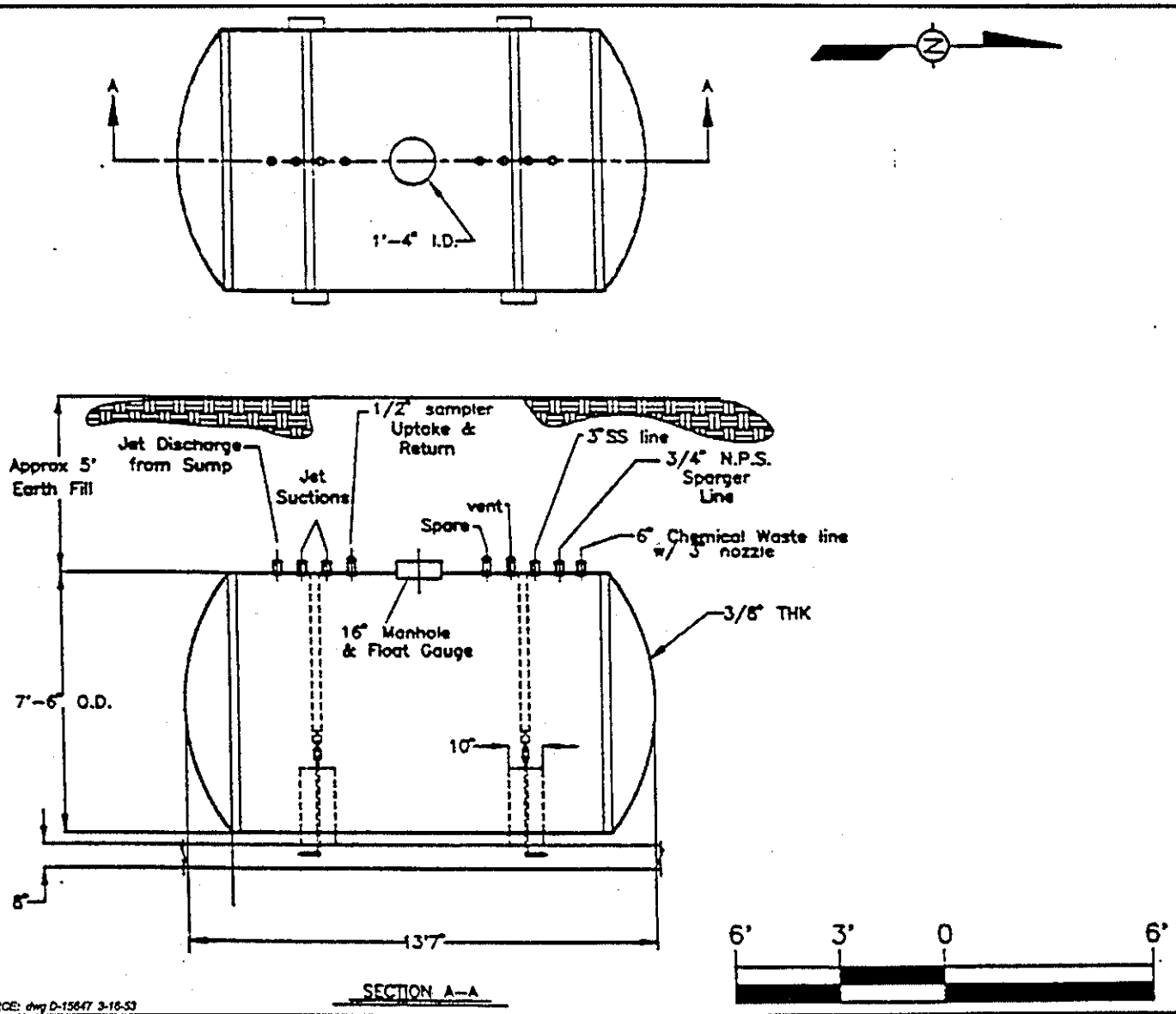
The Central Bethel Valley site is located in a highly developed area. Buildings in this vicinity include offices, research laboratories, process buildings, and support buildings such as change houses, a cafeteria, and emergency and security buildings. Roads, parking lots, and sidewalks provide access to these buildings. Approximately 40 percent of Central Bethel Valley is overlaid by an impervious cover (i.e., buildings, roads, parking lots, or sidewalks). Construction of these structures has altered the natural pattern of groundwater recharge by diverting precipitation that will normally reach the water table, removing some infiltration, and concentrating recharge along the edges of areas now covered.

Underlying the ORNL facility is a complex array of underground utilities, drain pipes, process pipes, building foundation excavations, and sumps. The types of fill material encountered in core holes drilled at the site during previous investigations include natural clay, sand, crushed limestone gravel, concrete, and asphalt (Bechtel et al. 1992). These fill materials probably provide preferred flow paths for surface water infiltration and shallow groundwater movement because of coarser grain size, less cohesion, and a lower degree of compaction than surrounding native soil. Fill material surrounding storm sewer line may allow groundwater to flow along the lines into otherwise unsaturated areas; this groundwater may then flow in the fill material to the creek. These preferred flow paths have the potential to alter the rate and direction of subsurface water movement.

The liquid radioactive waste collection/storage Tank W-1A was commissioned in 1951 and remained in service for 35 years, until it was taken out of service in 1986. Tank W-1A was used as a storage tank to collect wastes from the high radiation level analytical facilities: Buildings 2026, 3019-B, and the Radiochemical Processing Pilot Plant (3019). Figure 6 shows the relationship between the tank and the rest of the North Tank Farm. Although some of these buildings and facilities are still operational, their mission has been changed from atomic weapons development to energy, medical, space programs, or environmental research and development. The cylindrical tank is constructed of stainless-steel and has a capacity of 15,100 L (4,000 gal). Approximately 2.3 m (7.5 ft) in diameter and 4.1 m (13.5 ft) long, the tank was buried horizontally on top of a concrete pad with two concrete saddles and covered with soil (Fig. 7). It is believed that the concrete pad was laid into a bedrock pit; the depth of this pit, from top of bedrock to pit bottom, is approximately 1.2–1.8 m (4–6 ft) in depth. The top of the tank is approximately 1.5 m (5 ft) bgs.



JE	Fig. 6	North Tank Farm appurtenances DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35HB30 0153-40 / EE/CA	DRAWING ID: 97-15173.CDR-1	DRAWING DATE: MAY 6, 1998 TG



SOURCE: dwg D-15647 3-16-53

JE	Fig. 7	Tank W-1A DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 3SH830 0153-40 / EE/CA	DRAWING ID: 97-15173.CDR-2	DRAWING DATE: MAY 6, 1998 TG

1.2 SITE BACKGROUND

The release of radiological contamination to First Creek at the western boundary of ORNL was discovered in the mid-1980s. As part of the remedial investigation at ORNL, rock core drilling was conducted to ascertain subsurface geologic conditions. In June 1991, rock core drilling at Core Hole 8, located southwest of Tank W-1A, revealed radiologically contaminated groundwater in the uppermost portion of bedrock. Subsequent analysis of data from Core Hole 8, soil borings, drive points, and groundwater monitoring wells in the area indicate that leaks to backfill surrounding Tank W-1A are a likely contributing source to this contamination.

Analytical results of liquid samples from inside the tank, as well as soil and groundwater samples collected adjacent to the tank, indicate that radioactive wastes sent to Tank W-1A included, but were not necessarily limited to, ^{137}Cs, ^{60}Co, ^{90}Sr, ^{3}H, $^{233/234}U$, ^{238}U, and ^{239}Pu. Additional isotopes of U, Pu, and possibly Pm may also have been placed in the tank. Analysis of water samples collected from the tank in 1988 indicate the liquid may have been classified as having Resource Conservation and Recovery Act of 1976 (RCRA) waste characteristics as evidenced by Toxicity Characteristic Leaching Procedure threshold exceedances for cadmium, mercury, benzene, and trichloroethylene (Bechtel et al. 1992). Gross alpha activity in these samples was measured at 40,700 pCi/L, gross beta activity at 48,100 pCi/L, and transuranic (TRU) waste activity at 2,480 pCi/L for ^{239}Pu.

The transfer line to Tank W-1A from Buildings 2026 and 3019 is strongly suspected of leaking and causing soil and groundwater contamination in the vicinity of the tank. For this reason, the tank was removed from service in 1986 (Energy Systems 1997). Currently, liquid levels in the tank are periodically measured, and liquids in the tank are routinely emptied because stormflow leaks in during storm events. No sludge is believed to be in the tank (Bechtel 1992).

1.3 CONTAMINANT CHARACTERIZATION

1.3.1 Site Characterization

1.3.1.1 Groundwater

Groundwater characterization activities were started November 1995 for DOE by CDM Federal Programs Corporation (CDM) to identify a source(s) of groundwater radiological contamination in Central Bethel Valley that can be related to the Core Hole 8 ^{90}Sr plume and other potential radiological plumes. The first phase of the investigation consisted of installing five drive points in the northwest corner of the North Tank Farm. Based on the findings of the

first phase of investigation, an additional 17 drive points were installed in February/March 1996 (Fig. 8). Groundwater samples from both phases of the investigation were analyzed for gross alpha, gross beta, and ^{90}Sr activity. Results of these investigations are summarized in the following sections. Additional information regarding site characterization activities (including drive point and groundwater well installation and sampling methods, analytical results, and findings) may be obtained from CDM (1996).

1.3.1.2 Soil

In February and March 1998, three soil borings were taken in the vicinity of Tank W-1A (Fig. 8). A sample was composited from Borings B-1 and B-2 from 0 to 1.5 m (0 to 5 ft); another sample was composited from the same borings from 1.5 m (5 ft) to refusal [approximately 4 m (14 ft) to 5 m (17 ft)]. A third sample was taken at the location of the highest radiation level, roughly 3.7 m (12 ft) bgs to refusal at 5.2 m (17 ft) bgs at B-1. A sample was also taken from Boring B-3, which is roughly 8 m (25 ft) from Tank W-1A. These samples were analyzed for chemical and radiological parameters. Two Shelby tube samples from B-1 were analyzed for geotechnical properties. Selected results of these radiological analyses are summarized in Section 1.3.2.2 and Table 1, and complete results (including radiological, chemical, and geotechnical results, and validation summaries) are presented in Appendix C.

In 1986, soil samples were taken in the vicinity of the tank to determine whether a leak existed in the tank or the inlet liquid low-level (radioactive) waste (LLLW) line. Radiological analyses from these samples are summarized in Table 2. Exact locations for these samples are unknown.

1.3.2 Nature and Extent of Contamination

1.3.2.1 Groundwater

Groundwater sampling results from each of the 22 drive points installed in the vicinity of Tank W-1A indicate that groundwater surrounding the tank is contaminated with gross alpha, gross beta, and ^{90}Sr activity.

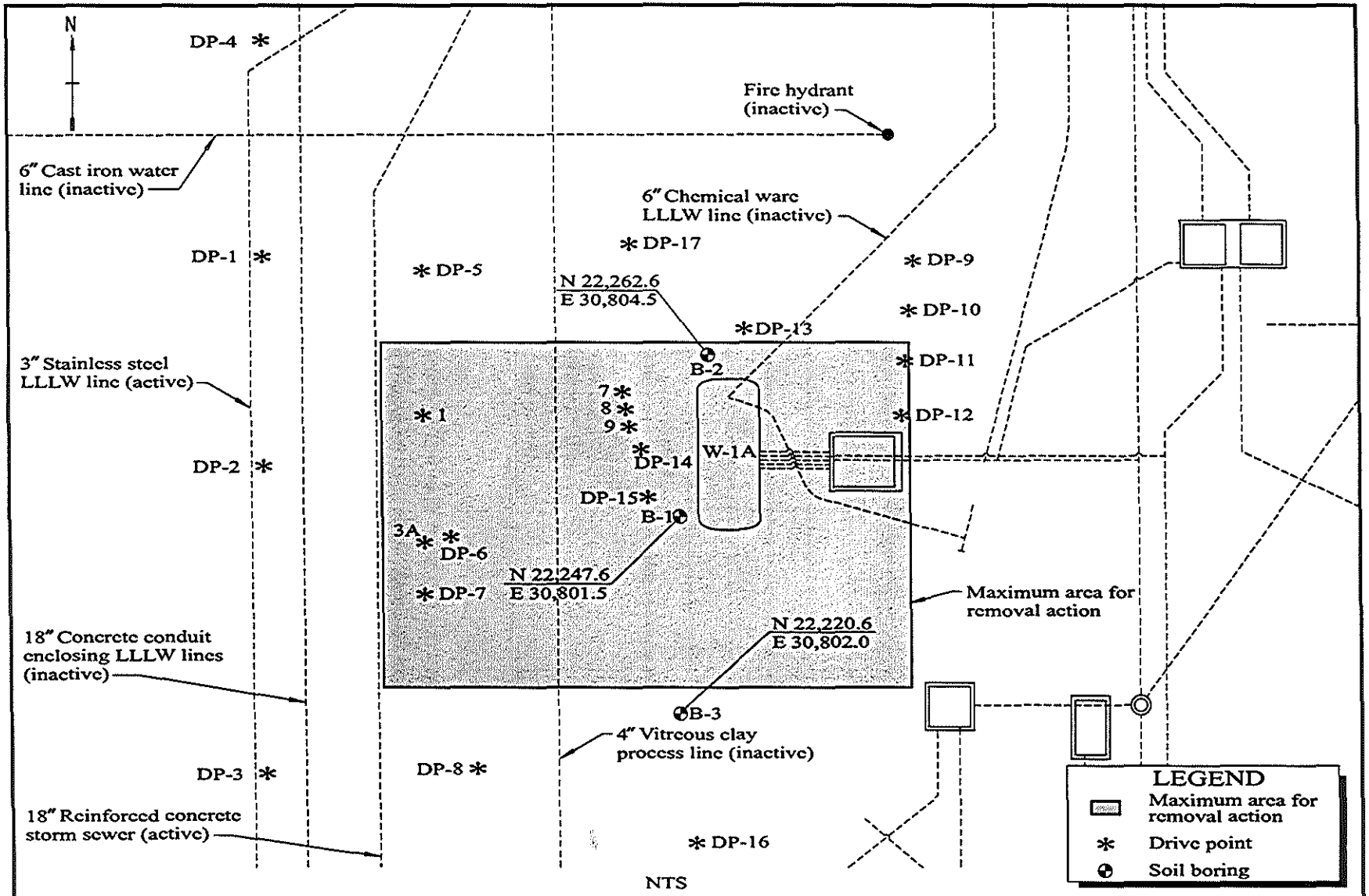
Gross alpha activities are generally highest near the tank [up to 810,000 pCi/L at Drive Point 13 (DP-13)] and decrease radially with distance from Tank W-1A, to a low of 1,190 pCi/L at DP-1 (Fig. 9). One exception to this trend is DP-2, located west of the tank, across Third Street. Gross alpha activity at this location (918,000 pCi/L) is higher than activity levels in or near the tank, suggesting that a contaminant source other than Tank W-1A may impact this location. Gross alpha activity of water in the tank (43,200 pCi/L) is an order of magnitude lower than activities in water samples collected from the tank pit backfill or soil surrounding the tank. These results also indicate that activity levels in the tank water are probably diluted by precipitation leaking in during storm events (CDM 1996).

Table 1. Soil sample results from the Core Hole 8 plume source—1998, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Radionuclide	Activity (pCi/g)					
	0-5 ft composite[1]	5 ft to refusal composite[2]	Hot[3]	Hot (duplicate)[3]	Envirocare WAC[6]	Proposed Envirocare WAC[6]
^{137}Cs	2,473	ND	51,860	52,590	560	60,000
Gross gamma ^{241}Am[4]	91.46	ND	4,532	4,762	---	---
Gross alpha	ND	84,163.73	31,297.37	13,087.83	---	---
Gross beta	ND	509,721.58	156,062	40,352.68	---	---
Total strontium	9.42	5,764.46	33,581.15	13,767.78	20,000[5]	25,000[5]
^{3}H	ND	ND	ND	85.99	200,000	2.5×10^{7}
^{238}Pu	ND	2,185	263.30	66.69	1,000	10,000
^{239}Pu	ND	3,266	376.20	122.2	1,000	10,000
^{241}Am[4]	1.43	44,788.53	2,879	1,355	2,300	10,000
^{244}Cm	ND	1,914.67	1,640	1,261	1,000	10,000
^{234}U	4.78	9,693.15	11,855.53	14,296.01	37,000	370,000
^{235}U	ND	59.97	26.47	55.9	770	1,700
^{238}U	ND	86.44	119.07	103.78	28,000	380,000
^{228}Th	ND	46.86	41.89	25.5	---	---
^{230}Th	ND	14.52	13.11	6.46	15,000	150,000
^{232}Th	ND	14.51	12.80	4.85	680	10,000
^{99}Tc	ND	22.39	41.76	39.28	10,000	190,000
^{155}Eu	ND	ND	439.90	1,560.00	1,700	4.4×10^{8}

[1]0- to 5-ft sample composited from Borings B-1 and B-2.
[2]5-ft to refusal sample composited from Borings B-1 and B-2.
[3]Hot samples taken from discrete location of highest radiation level observed (roughly 12-ft to refusal at B-1).
[4]Americium-241 concentration determined in both alpha and gamma spectroscopy. Americium-241 levels taken from alpha spectroscopy (labeled ^{241}Am) considered most accurate, although gross gamma ^{241}Am also listed.
[5]Strontium-90
[6]The "sum of the fraction" rule applies for waste that contains a mixture of radionuclides. Envirocare submitted a renewal application to the state of Utah in January 1996 with the proposed WAC.

Am = americium
Cm = curium
Cs = cesium
Envirocare = Envirocare of Utah, Inc.
Eu = europium
ft = foot
g = gram
^{3}H = tritium
ND = nondetect
pCi = picocurie
Pu = plutonium
Tc = technetium
Th = thorium
U = uranium
WAC = waste acceptance criteria



JE	Fig. 8	Locations of soil borings, drive points, Tank W-1A, and underground utilities DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 97-15172.CDR-2	DRAWING DATE: 14July98, BP

Table 2. Soil sample results from the Core Hole 8 plume source—1986, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Radionuclides	Samples (pCi/g)				
	1	2	3	4	5
^{60}Co	< 270	838	676	—	—
^{137}Cs	< 270	2,757	—	2.2E6	—
^{154}Eu	< 270	405	—	—	—
^{233}U	—	79,200	49	—	—
^{122}Sb	—	—	—	8,487	—
^{109}Cd	—	—	—	—	2.6E5
^{134}Cs	—	—	—	—	6.9E5
^{144}Ce	—	—	—	—	48,900
Plutonium	—	—	—	—	2.4E5
Uranium	—	—	—	—	5.0E5
Gross alpha	2,919	1.5E5	81	730	1.9E6
Gross gamma	556 c/m/g	82,700	—	—	—
Gross beta	—	—	4.38E3 c/m/g	—	—

c/m/g = counts per minute per gram
Cd = cadmium
Ce = cerium
Co = cobalt
Cs = cesium
Eu = europium
g = gram
< = less than
pCi = picocurie
Sb = antimony
U = uranium

Although gross beta activity is greater than that of gross alpha activity by several orders of magnitude, the distribution of gross alpha and beta activities in groundwater in the tank vicinity is similar (Fig. 10). In general, the highest activities are adjacent to the tank (up to 12.7 million pCi/L at DP-14) and decrease radially with distance, to a low of 48,600 pCi/L at DP-6. Again, DP-2 does not follow this trend and has a gross beta activity two orders of magnitude greater than drive points to the east and nearer to Tank W-1A. Gross beta activity of water in the tank (1.6 million pCi/L) is also an order of magnitude lower than activities in water samples collected from the tank pit backfill or soil surrounding the tank (CDM 1996).

Results of ^{90}Sr analyses are almost identical to gross beta results, both in magnitude and distribution (Fig. 11). In general, the highest activities are adjacent to the tank (up to 12.2 million pCi/L at DP-14) and decrease radially with distance, to a low of 41,200 pCi/L at

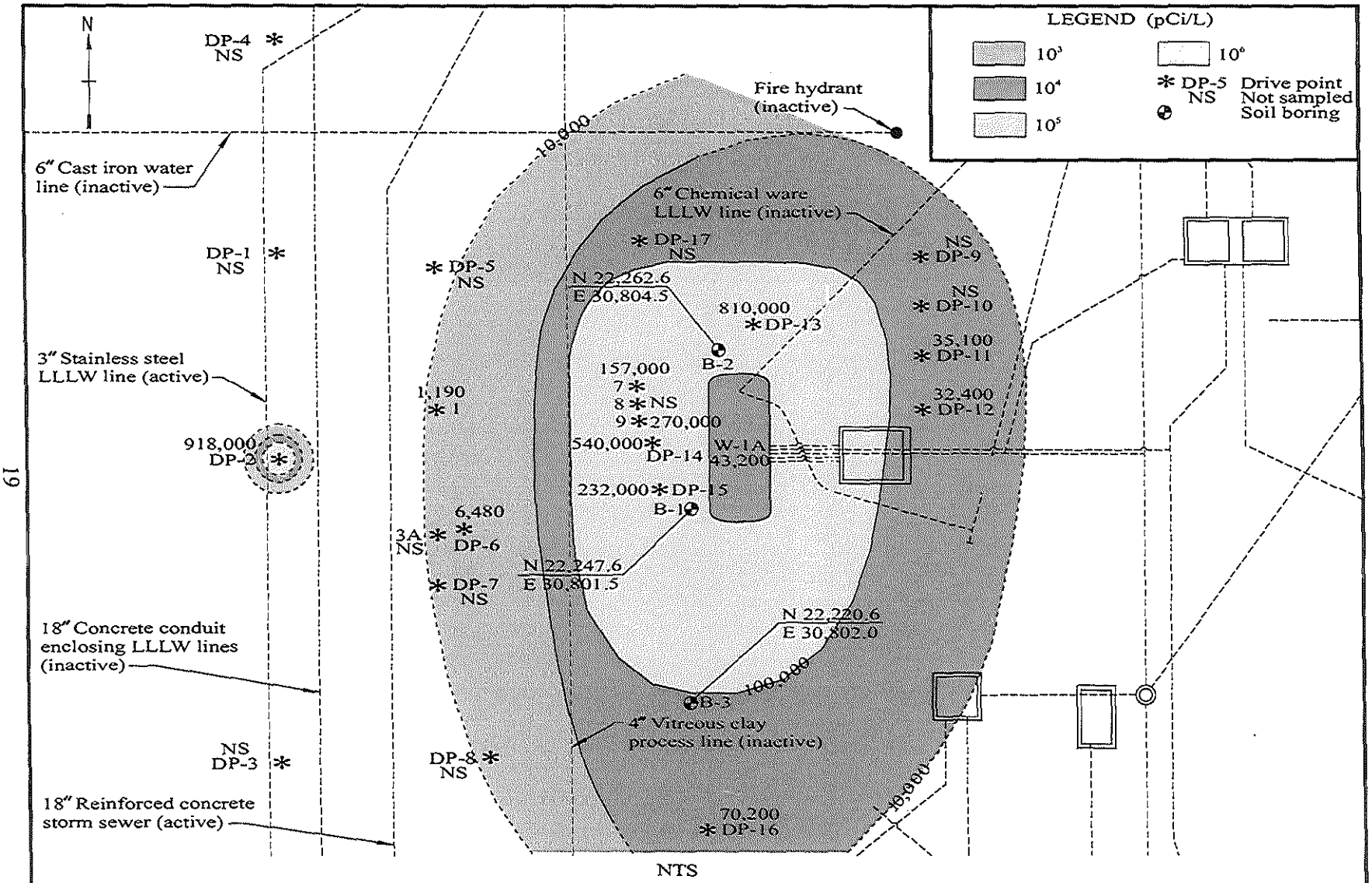
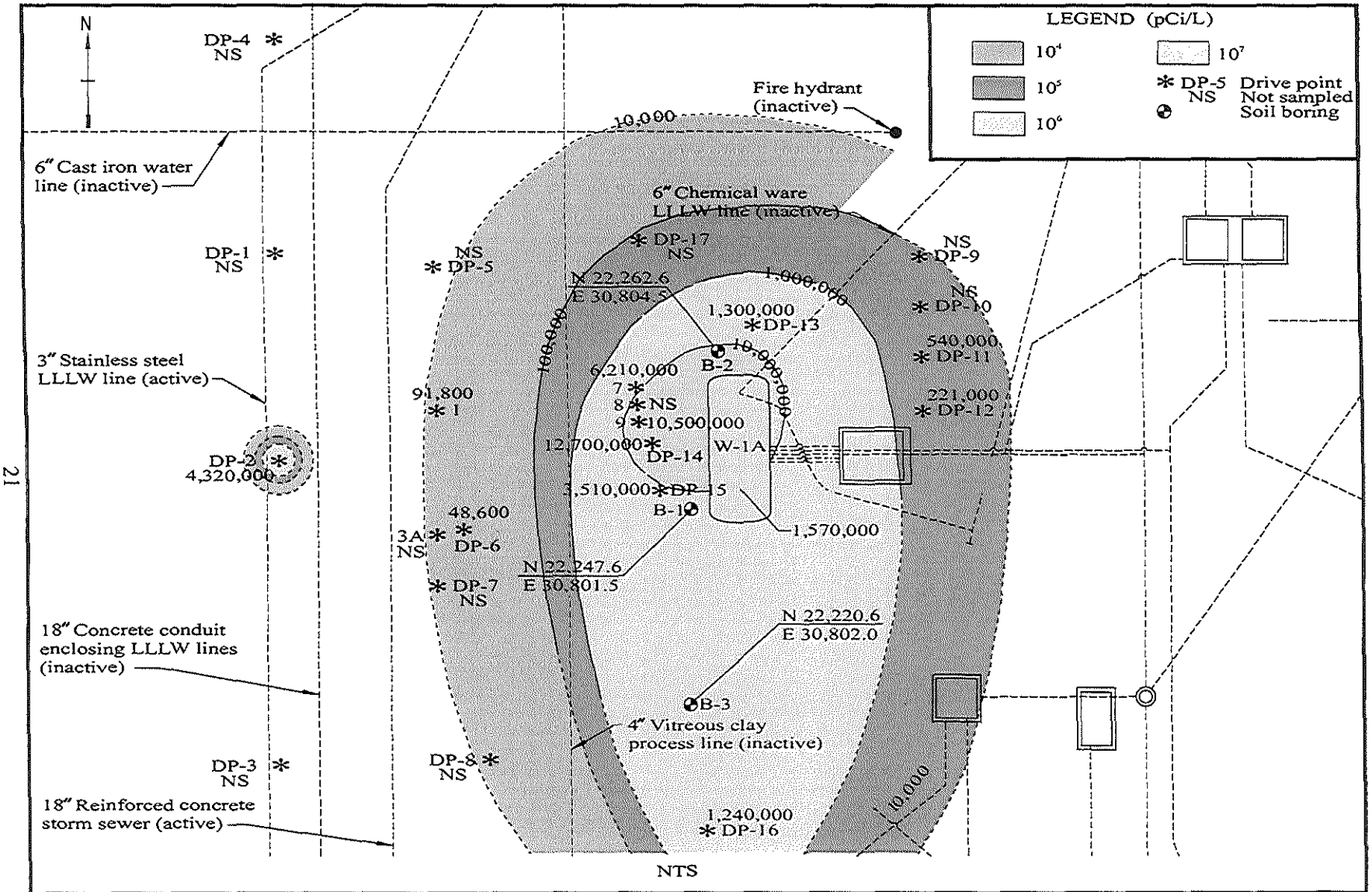
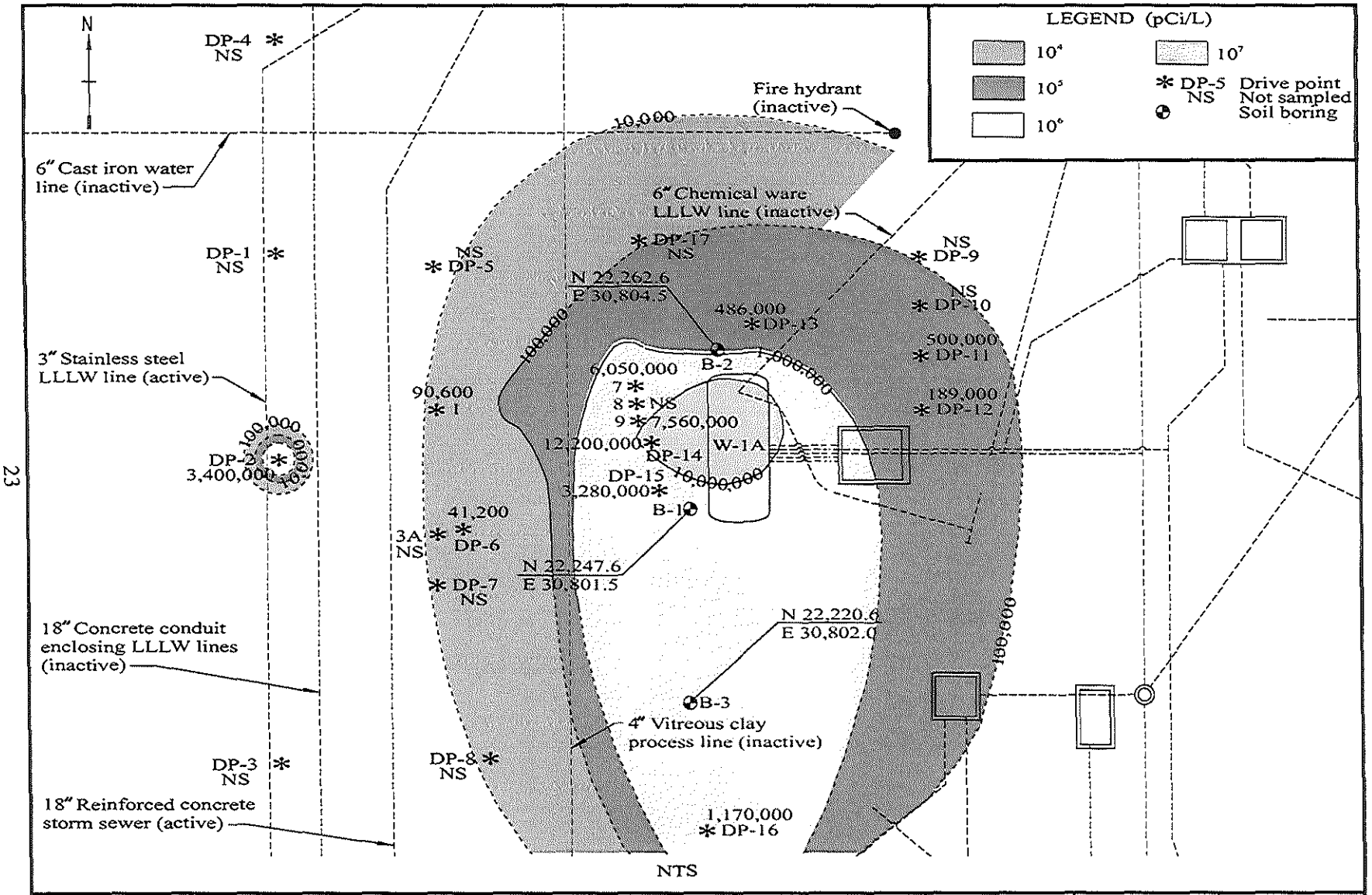


Fig. 9	**Distribution of gross alpha activity (pCi/L) in groundwater** DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 97-15172.CDR-4	DRAWING DATE: MAY 6, 1998 TG



JE	Fig. 10	Distribution of gross beta activity (pCi/L) in groundwater DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 97-15172.CDR-5	DRAWING DATE: MAY 6, 1998 TG



JE	Fig. 11	Distribution of ^{90}Sr (pCi/L) in groundwater DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 97-15172.CDR-6	DRAWING DATE: MAY 6, 1998 TG

DP-6. Activity in DP-2 does not follow this trend and has a ^{90}Sr activity two orders of magnitude greater than drive points to the east and nearer to Tank W-1A. Solids from one drive point were also analyzed for comparison with ^{90}Sr activity in the water sample. This analysis indicates that the solids contain approximately 50 times the ^{90}Sr activity of the water sample. These results are consistent with solid-to-liquid distribution (K_d) values of ^{90}Sr reported in literature (CDM 1996).

1.3.2.2 Soil

Analyses performed on samples from Borings B-1, B-2, and B-3 indicate soil surrounding the tank is significantly contaminated with alpha-, beta-, and gamma-emitting radionuclides.

Table 1 summarizes radionuclides detected in each sample. This table also shows the respective waste acceptance criteria (WAC) and the proposed WAC (submitted to the state of Utah for approval) for Envirocare of Utah, Inc. (Envirocare). Gross alpha activity levels range from 13,000 to 84,000 pCi/g; the highest levels were detected nearest the tank. Gross beta activity levels range from 40,000 to over 500,000 pCi/g. Strontium-90 levels range from 9 to 33,500 pCi/g; levels of this radionuclide were consistent with gross beta results, with the possible exception of the 1.5 m (5 ft) to refusal composite sample (the gross beta level is fairly high compared to the strontium concentration). As can be seen from Table 1, no TRU isotopes were detected at levels meeting the 100 nCi/g threshold for TRU waste. As expected, higher levels of radionuclide contamination were detected in the 1.5 m (5 ft) bgs to refusal composite analyses. Levels were significantly lower in the surface to 1.5 m (5 ft) bgs composite samples. Because the inlet LLLW line connects to the top of the tank at approximately 1.5 m (5 ft) bgs, these trends are expected. Appendix C also summarizes the geotechnical parameters of the soil surrounding Tank W-1A. Soils around the tank consist of silty clay. The soil is similar to natural clay soils found around the tank farm, although small voids were visible in each split spoon sample. Hydraulic conductivity results ranged from 3.6×10^{-7} to 4.7×10^{-6} cm/second, indicating a relatively tight clay. Groundwater was encountered at depths of roughly 2.1 m (7 ft) bgs (after a period of heavy rain). After sitting overnight, groundwater was detected at 1.2 m (4 ft) bgs.

Results of chemical analyses (and associated validation summaries) are also presented in Appendix C. Although many data were rejected because of excessive sample hold times, results indicated that this soil, if excavated, will not exhibit the RCRA characteristic of toxicity. Polychlorinated biphenyls are also clearly not of concern.

Results from samples taken in 1986 are shown in Table 2. Because exact sample locations are unknown, these data are of limited value. It is interesting to note, however, that one sample contained plutonium (unknown isotope) at a level of 244 nCi/g (9.04E3 Bq/g). This finding will

qualify the waste as TRU, although analyses from the 1998 sampling did not indicate the presence of TRU radionuclides over the 100 nCi/g threshold for TRU waste (Table 3). It is assumed that no waste generated as a part of this removal action will be TRU waste. If some of the soil is found to have TRU constituents above the threshold, it can be stored on site at existing TRU storage facilities. Currently, facilities exist at ORNL to store both contact-handled (CH) and remotely handled (RH) TRU waste. CH TRU waste can be stored in existing below grade facilities (Buildings 7826 or 7834) while RH TRU waste can be stored in existing below-grade bunkers (7855 or 7883).

1.4 STREAMLINED RISK EVALUATION

The primary risk driving the source control action at Tank W-1A is the ongoing release of contaminants that reach White Oak Dam. The amount of ^{90}Sr at the dam is derived from primary and secondary sources within ORNL. Contamination released from primary sources, such as inactive waste disposal sites, travels to surrounding media (i.e., soil, groundwater, or stream sediment). These secondary sources release ^{90}Sr, which is then transported to White Oak Dam by local surface water. This contaminant transport system is complex, involving various sources, media, contaminant types and concentrations, distances, and times. Hence, deriving a correlation between the time and the amount of ^{90}Sr released from an individual primary source and the subsequent flux of ^{90}Sr over White Oak Dam is difficult to impossible.

Table 3. Comparison of 1998 and 1986 TRU data, Core Hole 8 plume source, Oak Ridge National Laboratory, Oak Ridge, Tennessee

TRU constituent	1998 data (nCi/g)	1986 data (nCi/g)	TRU limit* (nCi/g)
^{238}Pu	2.2	---	---
^{239}Pu	3.3	---	---
Total Pu	---	240	---
^{241}Am	44.8	---	---
Total	**50.3**	**240**	**100**

*The sum of the activity of all the TRU elements may not exceed 100 nCi/g.

Am = americium
g = gram
nCi = nanocurie
Pu = plutonium
TRU = transuranic

It is estimated that 24 percent of the ^{90}Sr flux at White Oak Dam is contributed by contaminant sources in the Bethel Valley watershed (DOE 1997). However, because of the uncertainty associated with the relative contributions of ^{90}Sr from many contributing ORNL sources, it is difficult to quantify the reduction in risk that will be effected by this proposed source control action. Nonetheless, actions that control or prevent the release of ^{90}Sr from primary sources will ultimately reduce the total amount of ^{90}Sr reaching White Oak Dam. Any reduction in ^{90}Sr flux over the dam will result in a proportional reduction in risk.

Estimates are based on data from the Office of Environmental Compliance and on documentation and discharge data from the Environmental Sciences Division of ORNL. These estimates indicate that First Creek released approximately 0.15 Ci ^{90}Sr into White Oak Creek in 1994, representing 20 percent of the estimated total annual ^{90}Sr flux of 0.75 Ci over White Oak Dam for that year (ORNL 1995). Additionally, sampling First Creek in October 1997 revealed the presence of approximately 60 pCi/L of $^{233/234}U$. Data suggest that soils surrounding Tank W-1A are significant, possibly principal, sources of groundwater contamination discharging into First Creek and are hence important contributors to ^{90}Sr contamination at White Oak Dam and $^{233/234}U$ contamination of First Creek. Therefore, soils surrounding Tank W-1A are an excellent candidate for source control action.

2. REMOVAL ACTION OBJECTIVES

2.1 STATUTORY AUTHORITY

Section 104 of CERCLA addresses the response to actual or threatened contaminant releases through removal actions. Executive Order 12580 delegates to federal agencies (e.g., DOE) the response authority for site cleanup. As part of DOE removal action authority, DOE can undertake any type of investigation, survey, or testing necessary to plan, design, and carry out the removal action.

ORR was placed on the National Priorities List in 1989. DOE, EPA, and TDEC (DOE Oversight Division) entered into a Federal Facility Agreement (FFA) in 1992. The FFA establishes interagency procedures, defines the decision making process, and establishes schedules for environmental restoration at ORR.

TDEC and EPA concur in DOE's determination, made in accordance with National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria listed in 40 *Code of Federal Regulations* (CFR) 300.415(b)(2), that this removal action is necessary to address releases from

the Core Hole 8 plume source that present a threat to public health, welfare, or the environment. This EE/CA for the Core Hole 8 plume source was subject to review and comment by EPA and TDEC. A public notice of availability of the Administrative Record file will be published, and a 30-day public comment period will be provided in accordance to 40 CFR 300.415.

2.2 PURPOSE AND SCOPE

The purpose of this non-time-critical removal action is to address the source of contaminants (Tank W-1A and the surrounding contaminated soils) which are releasing contaminants to groundwater in Central Bethel Valley. The objective of the removal action is to reduce future releases of contaminants to First Creek by addressing the source area. The scope of this removal action includes Tank W-1A and the contaminated soils around the tank. Soil screening during the removal action will be used to delineate the actual boundaries of the removal action. Soil screening criteria will be developed in conjunction with TDEC and EPA and documented in the removal action work plan. The maximum extent of this removal action (as shown on Fig. 8) is limited by infrastructure. Soils not remediated as part of this removal action will be addressed in the Bethel Valley watershed ROD.

2.3 JUSTIFICATION FOR THE PROPOSED ACTION

This removal action will help reduce off-site releases at White Oak Dam by addressing contamination in First Creek caused by contaminants in soils surrounding Tank W-1A. The proposed action will reduce the amount of uranium and strontium released to First Creek and the Clinch River and will leave the site in a condition that minimizes future contaminant releases. This early action will be consistent with the final action in Bethel Valley.

3. SUMMARY OF REMOVAL ACTION ALTERNATIVES

Three alternatives are identified for the removal action at the Tank W-1A source area, (Fig. 12). Each alternative minimizes contamination of groundwater from radionuclides contained in contaminated soil surrounding the tank. Mitigating source contributions to the Core Hole 8 plume source is expected to ultimately reduce the amount of ^{90}Sr released over the White Oak Dam to the Clinch River, and the amount of uranium released to First Creek. The three alternatives developed and evaluated in this EE/CA are:

- Alternative 1: Remove tank and excavate surrounding contaminated soils; cut and cap tank lines; dispose of generated waste.

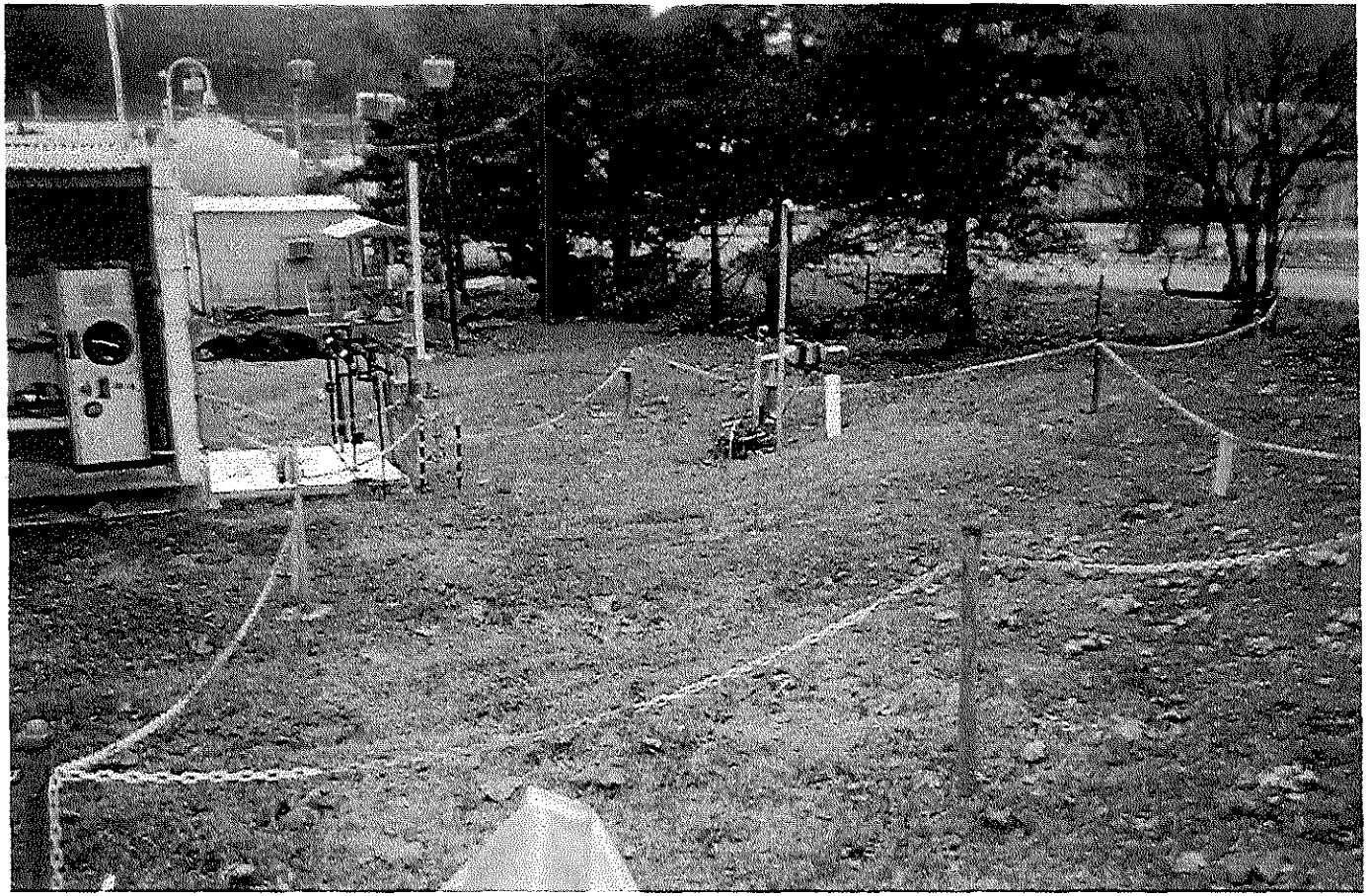


Fig. 12	Tank W-1A source area DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 97-15173.CDR-4	DRAWING DATE: MAY 6, 1998 TG

- Alternative 2: In situ grout contaminated soil around tank to achieve source control by permeability reduction; empty tank of contents and fill with grout.

- Alternative 3: In situ chemically treat contaminated soil around tank to achieve source control by stabilization; empty tank of contents and fill with grout.

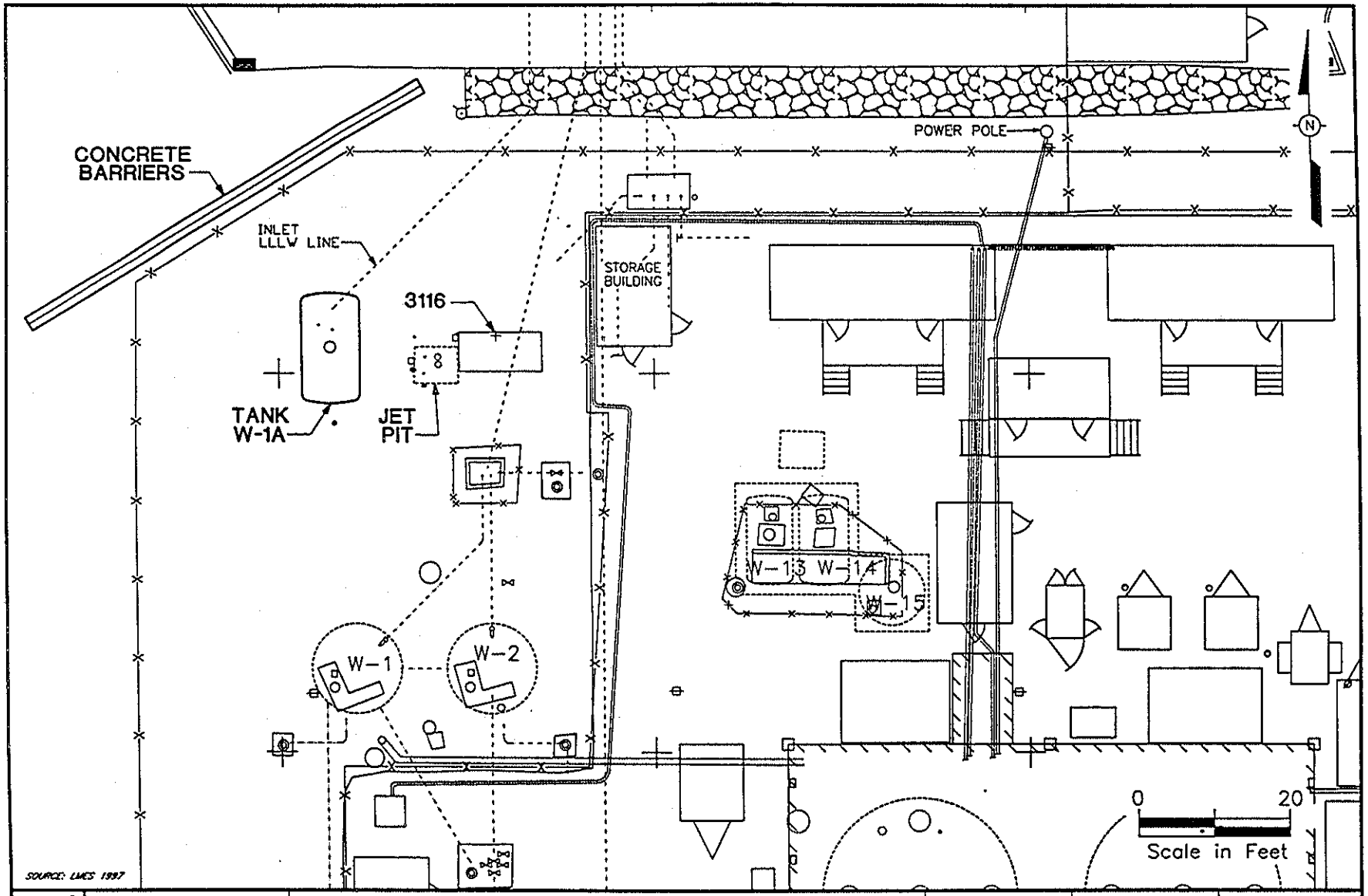
Each alternative and its application to the removal action are described in this section. Predesign requirements are also identified per alternative.

3.1 ALTERNATIVE 1: REMOVE TANK AND EXCAVATE SURROUNDING CONTAMINATED SOILS; CUT AND CAP TANK LINES; DISPOSE OF GENERATED WASTE

Under this removal action alternative, the tank, concrete base and saddles, and surrounding soils and backfill which are considered a contaminant source will be excavated. All lines connected to the tank will be cut and capped as appropriate. The resulting pit will be backfilled, and all waste generated [soil, concrete rubble, steel tank, piping, and personal protective equipment (PPE)/trash] will be properly disposed of. A representative approach follows.

To minimize the amount of groundwater and rainwater encountered during excavation, the removal action will be carried out during the dry season (May through October) if possible. Because September and October are typically the driest months with regard to rainfall, ideally the excavation will take place then. Before the excavation takes place, the tank will be emptied of its contents. This will be done in the same fashion as it is presently done (approximately every month) to remove groundwater which seeps into the tank. Contents of the tank will be transferred to the LLLW system for treatment. The tank will then be isolated by closing valves on any lines attached to the tank. Locations of the lines will be determined and marked to the maximum extent feasible. Available drawings and anecdotal evidence will be used in this effort. The power line leading to Structure 3116 will be removed as part of site preparation. Power lines located north of the concrete barriers are not expected to constitute interference.

Because of the possibility of worker radiation exposure, the excavation will be conducted as remotely as feasible. An excavator will be situated behind the existing concrete barriers just to the north of the Tank W-1A area (Fig. 13). Placement behind the barriers will limit the possibility of contamination of the main body and tracks of the excavator, and is consistent with the "as low as reasonably achievable" concept. The excavator will scrape the ground cover over



JE	Fig. 13	North Tank Farm site plan DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H630 0153-40 / EE/CA	DRAWING ID: 98-16132.DWG	DRAWING DATE: JULY 14, 1998 BP

the tank as necessary to uncover buried lines. These lines are connected to the top of the tank; most are constructed of stainless-steel. One line, the LLLW inlet line, is designated "chemical ware." This line is constructed of vitrified ceramic lined with glass. Before tank removal, these lines will be cut and capped; this can be accomplished through a variety of methods. To minimize worker exposure, lines can be cut remotely using backhoe-mounted hydraulic shears, or they can be cut a distance from the radiation source (i.e., at the jet pit just east of the tank, through which most steel lines traverse). The inlet LLLW line will be cut using the force of the excavator bucket. All lines (if not removed entirely) will be capped, such as through insertion of a grout plug. Alternatively, depending on radiation levels, workers can enter the area and cut the lines manually. No bracing or shoring is be expected to be necessary for personnel safety because the workers will be present in the pit only to cut and cap lines; maximum depth of these lines is the top of the tank, or approximately 1.5 m (5 ft). This depth is also shallower than the more significant radionuclide contamination (Table 1). However, portable shielding can be used, if appropriate. Actual cutting can be accomplished with a nonspark producing saw (or the line will be detached at joints if possible). If workers enter the pit at a depth > 1.5 m (5 ft), bracing, shoring, or sloping will be required per Occupational Safety and Health Administration (OSHA) requirements. Because the highest radiation levels may exist on the inside of the ceramic LLLW line, workers will exit the pit before that line is cut; the backhoe will be used to cut the line. All lines are expected to be drained; however, precautions will be taken in the event some liquid remains. These precautions can include continuous radiological monitoring and collecting any drained liquid in containers. The location of all line breaks will allow for tank removal; the scope of this removal action does not include significant line excavation and removal.

Groundwater was encountered at 2.1–2.7 m (7–9 ft) bgs during soil boring activities, so it is not expected that groundwater will be encountered in the pit at the working depth [approximately 2 m (5 ft)] for the amount of time workers will be present. However, if groundwater (or rainwater) does enter the pit before all lines are cut, a sump pump will transfer the water out of the pit to a polyethylene tank for characterization and subsequent treatment (e.g., using the LLLW evaporator system). This pump will also be used as necessary to remove groundwater/rainwater during excavation activities.

The excavation will be delineated by field screening, but the maximum extent of this action is limited by infrastructure. The maximum excavation is approximately 12 by 15 m (40 by 50 ft) to bedrock, approximately 5 m (18 ft). The area is bounded to the east and west of Tank W-1A by active and inactive LLLW lines. Analytical results from Boring B-3 suggest this location as the southern limit. Topography and hydraulic gradient prohibit northward migration much beyond Boring B-3. Based on soil boring data, the first 1.5 m (5 ft) of soil is clean, and, therefore, will be stockpiled and reused as backfill in the excavated pit after the tank

is removed. When the tank is sufficiently unearthed, the iron straps holding the tank to the concrete base and saddles will be cut above the turnbuckles, and the tank will be removed. Soil, concrete rubble, and gravel fill (if present) will be placed into intermodals, roll-offs, or similar containers. After being verified empty, the tank will be cut up as necessary to allow placement into waste containers. Containers will be replaced as they are filled. Characterization of the waste, estimated to be from 300 to 380 m^3 (400 to 500 yd^3) will determine ultimate disposition.

Sample results indicate that contaminated soil around the tank is stratified (i.e., concentrations of radionuclides increase as depth increases). Characterization results (Sect. 1.3.2.2) indicate the soil is not RCRA-hazardous. If soil is not homogenized throughout the excavation or blended with other, less contaminated soil, waste containers filled first may contain lower levels of radionuclides than containers filled later in the process.

Alternatively, the soil may be homogenized during excavation activities which will effectively average radionuclide concentrations. Analysis of characterization results in Section 1.3.2.2 indicates, even if excavated soils are homogenized, waste may exceed Envirocare radionuclide WAC. Americium-241, ^{238}Pu, ^{239}Pu, and ^{244}Cm are among the radionuclides which may ultimately exceed WAC, although these levels are below the 100 nCi/g threshold defining TRU waste. Nonetheless, it is difficult to ultimately predict whether this will be the case, because this analysis is based on only three soil borings. Radionuclide concentrations will also be affected by excavation limits (i.e., excavation of a larger area may result in lower average radionuclide concentrations).

Another option will be to consolidate excavated soil with other, less contaminated soil such as soil removed from the cesium plots at Waste Area Grouping (WAG) 13 (currently stored at Solid Waste Storage Area 6). Also, it may be appropriate to excavate the shallower, less contaminated soil and ship it directly to Envirocare. Deeper soil with higher concentrations of contaminants can be placed in storage or blended with former WAG 13 soil and subsequently shipped to Envirocare for disposal. Consolidation of excavated soil with former WAG 13 soil at a 1:1 ratio has been considered in the CA. Former WAG 13 soil is classified as low-level (radioactive) waste (LLW); no regulatory obstacles to consolidation exist. Other potential disposal sites that may be available in the future include the Nevada Test Site (NTS) and the DOE Hanford site; however, these sites will not require soil blending to meet WAC for these facilities.

If excavated soil meets the WAC of the potential disposal facility, it will be disposed of without blending. However, if blending is required, the first option will be to blend the excavated soil with the top 1.5 m (5 ft) of excavated soils which was stockpiled for reuse as backfill. If additional blending is required, WAG 13 soil will be used as a last option.

Following excavation, the pit will be backfilled with clean soil. If groundwater enters the pit before backfilling, crushed stone or similar material will be used to backfill to the water level. Should the water level rise too high, it will be lowered by pumping groundwater to the polyethylene tank; this water will be treated by the LLLW system. Soil and/or gravel will then be used to fill the pit to grade.

Level C PPE with an air purifying respirator is assumed for the CA. It is also assumed that engineering controls (i.e., wetting down the area as necessary to minimize airborne mobilization of contaminants, cleaning backhoes after use to avoid drying clumps of clay, and installing a tarp over the area while not excavating), continuous radiation monitoring if workers enter the excavated area, and air monitoring at the work area boundary, will be employed. Portable radiation shielding for workers and equipment operators is not assumed; however, this shielding can be employed if radiation monitoring detects localized areas of high-gamma levels (a possibility because of the high affinity of gamma emitting ^{137}Cs for clay). The consistency and moisture content of the soil samples (see Sect. 1.3.1) along with the engineering controls noted above, indicate that a portable tent over the excavation area to minimize the hazard of airborne radioactivity will be unnecessary. Other options, if appropriate, can include excavating after normal work hours or on weekends and/or temporarily restricting access to Third Street. If a hazard analysis indicates it is appropriate, a tent will be employed. However, a tent will inhibit the efficiency of excavation and increase cost.

3.2 ALTERNATIVE 2: IN SITU GROUT CONTAMINATED SOIL AROUND TANK TO ACHIEVE SOURCE CONTROL BY PERMEABILITY REDUCTION; EMPTY TANK CONTENTS AND FILL WITH GROUT

Under this removal action alternative, the soil around the tank will be grouted to reduce permeability and thus reduce contaminant leaching, and the tank will be emptied of any liquid and filled with grout to prevent it from refilling with groundwater. A representative approach follows.

The tank will be emptied in the same fashion as it is presently done (approximately every month) to remove groundwater which seeps into the tank. Contents of the tank will be transferred to the LLLW system for treatment. The tank will then be isolated to the maximum extent practicable by closing valves on any lines attached to the tank. The location of lines leading to and from the tank will be determined and marked to the maximum extent feasible. Available drawings and anecdotal evidence will be used in this effort. The power line leading to Structure 3116 (Fig. 13) will be removed as part of site preparation. Power lines located north of the concrete barriers are not expected to constitute interference.

The tank will then be filled with a low-strength grout using a tremie pipe. The grout will prevent groundwater from seeping into the tank.

To minimize the amount of groundwater encountered during grouting, the removal action will be accomplished during the dry season (May through October) if possible. Sleeve pipes (Fig. 14) (or slotted drive points) will be installed at intervals and depths sufficient to encompass the in situ soil volume down to bedrock, surrounding the tank. The area to be grouted was assumed to be the same as the area to be excavated (Fig. 8) under Alternative 1. Grout injection is known to displace water from subsurface pore spaces. As a result, once grout injection begins, contaminated groundwater will either rise to the surface or will be mobilized through preferential flowpaths (e.g., through fill around buried lines near the tank). To avoid the possibility of contaminant mobilization, the groundwater level will be lowered by dewatering through several (but not necessarily all) of the installed sleeve pipes before inserting casing grout. Pumps will be installed in the sleeve pipes and will discharge to a polyethylene tank located near the Tank W-1A area for subsequent wastewater characterization. Based on characterization results, the water will be appropriately treated (e.g., by the LLLW evaporator system) before discharge. Other sleeve pipes will be monitored to verify that the water level lowers appropriately. If the water level does not subside adequately, more sleeve pipes will be pumped.

Immediately after dewatering is accomplished, in situ grouting will take place. Using the previously installed and grouted sleeve pipes (casing grout is inserted after sleevepipes are installed) will allow injection of grout at selected depths and will help to prevent newly injected grout from reentering the sleeve pipe after injection. Results of a predesign study will dictate the type of injection grout to be used. An acrylamide grout has been assumed for this alternative. This assumption is based on the versatility, durability, and ability of acrylamide grout to reduce soil permeability because its viscosity (similar to water before set) allows it to fill voids more readily than cement-based grout. The grout will also contain additives (e.g., phosphates) that will increase the chemical binding of contaminants present (appropriate amounts and combinations of additives will be determined in the predesign study). However, the primary function of in situ grouting will be to reduce the hydraulic conductivity of the soil mass around the tank, thus limiting groundwater contact with, and leaching of, contaminants from that soil mass. Sleeve pipes will be left in the remediation area and capped. The primary predesign requirement for this removal action alternative will be a study to determine grout mix and injection method.

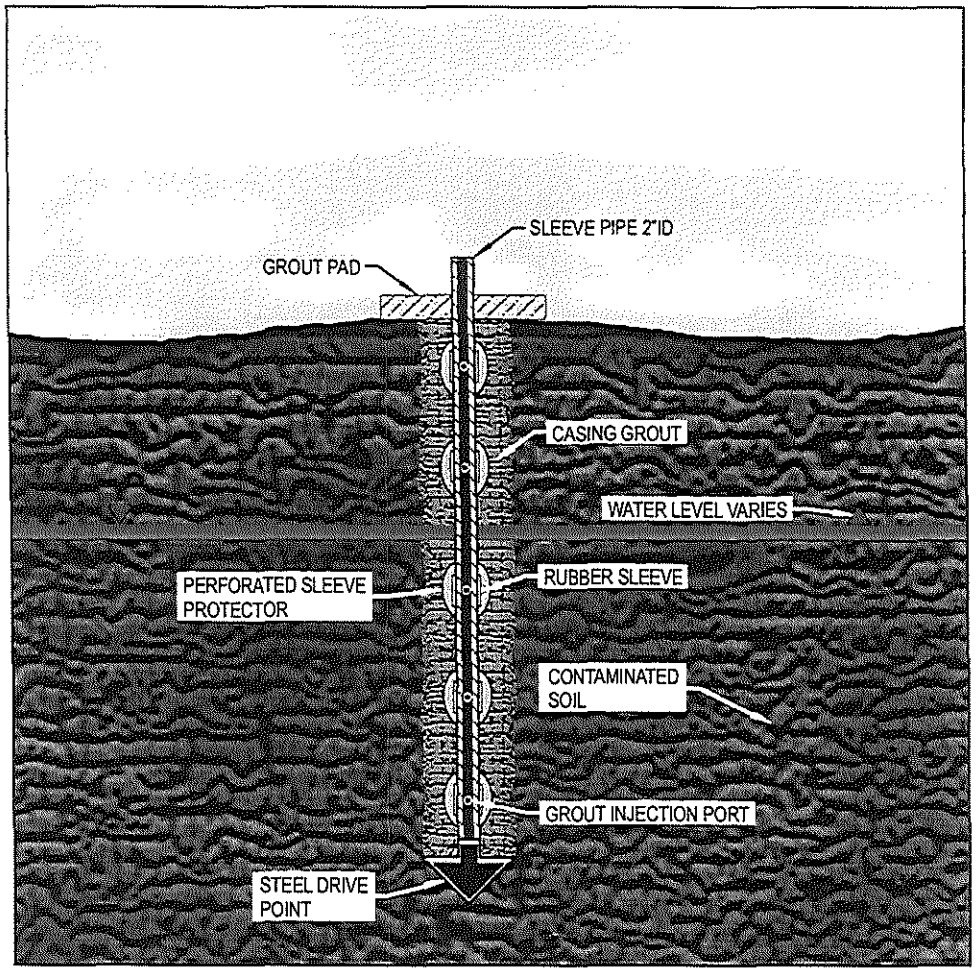


Fig. 14	**Typical sleeve pipe** DOE - ORNL - Oak Ridge, Tennessee	DOCUMENT ID: 35H830 0153-40 / EE/CA	DRAWING ID: 97-15172.CDR-3	DRAWING DATE: MAY 6, 1998 TG

3.3 ALTERNATIVE 3: IN SITU CHEMICALLY TREAT CONTAMINATED SOIL AROUND TANK TO ACHIEVE SOURCE CONTROL BY STABILIZATION; EMPTY TANK CONTENTS AND FILL WITH GROUT

Under this removal action alternative, soil around the tank will be chemically treated to stabilize contaminants, and the tank will be emptied of any liquid content and then filled with grout to prevent it from refilling with groundwater. A representative approach follows.

The tank will be emptied in the same fashion as it is presently done (approximately every month) to remove groundwater which seeps into the tank. Contents of the tank will be transferred to the LLLW system for treatment. The tank will then be isolated to the maximum extent practicable by closing valves in any lines attached to the tank. The location of lines leading to and from the tank will be determined and marked to the maximum extent practicable. Available drawings and anecdotal evidence will be used in this effort. The power line leading to Structure 3116 (Fig. 13) will be removed as part of site preparation. Power lines located north of the concrete barriers are not expected to constitute interference.

The tank will then be filled with a low-strength grout using a tremie pipe. The grout will prevent groundwater seeping into the tank.

To minimize the amount of groundwater encountered during in situ treatment, the removal action will be carried out during the dry season (May through October) if possible. Sleeve pipes (Fig. 14) (or slotted drive points) will be installed at intervals and depths sufficient to contact the in situ soil volume down to bedrock, surrounding the tank, with the chemical reagent. The assumed area to be treated was the same as the area (Fig. 8) used for Alternative 1. This alternative assumes the area will be dewatered as in the grouting alternative to reduce dilution of chemical reagent or displacement of groundwater to the surface or through preferential flowpaths. As in the grouting alternative (Alternative 2), pumps installed in several (but not necessarily all) sleeve pipes will discharge to a polyethylene tank near the work area for subsequent wastewater characterization. Based on results of characterization, the water will be appropriately treated (e.g., by the LLLW evaporator system).

The treatment assumed in this alternative uses the mineral property of isomorphism. In this application, a common mineral, such as an apatite, has the capacity to "scavenge" heavy metals and radionuclides into structural positions which might normally be occupied by other

materials without altering its crystal form or structural properties. For example, strontium will likely take the position normally occupied by a calcium ion in hydroxyapatite, which normally is represented by the following formula:

$$Ca_5(PO_4)_3OH$$

After substitution of strontium for calcium, the mineral should be represented by the following formula:

$$Ca_nSr_{5-n}(PO_4)_3OH \qquad n <= 5$$

This process is essentially irreversible, with the radionuclide becoming an element of a mineral, crystal structure which is physically durable and chemically stable and from which the radionuclide will not leach into the environment. Additionally, this phenomenon may be readily synthesized at ambient conditions (Austin et al. 1997). This differs from grouting in that groundwater flow is not necessarily reduced; contaminants are simply resistant to leaching.

The reagent used to accomplish this beneficial isomorphism will be injected into the ground through the installed sleeve pipes or slotted drive points (similar to how the grout will be injected in Alternative 2). The amount of reagent will be sufficient to contact soil in the limits of treatment down to bedrock at 5 m (18 ft).

The primary predesign requirement for this alternative will be a predesign study. Properties of the soil, such as pH, and properties of the contaminants present, such as type and speciation, may significantly impact the effectiveness of this treatment. A predesign study using contaminated soil collected from Tank W-1A area will be required to determine both the reagent composition and the potential for remediation success. This is particularly important given the limited history of this technology, especially with radionuclide contaminated soil. Geotechnical parameters will influence the exact method of reagent injection used, with a goal of optimizing soil/reagent contact.

4. EVALUATION AND COMPARISON OF ALTERNATIVES

Any of the three alternatives described in the previous section can be implemented to reduce the amount of ^{90}Sr released over White Oak Dam to the Clinch River, and the amount of uranium released to First Creek. Each alternative was evaluated qualitatively using the following criteria:

- effectiveness,
- implementability, and
- cost.

The effectiveness of an alternative refers to its ability to protect human health and the environment and meet the objectives of the removal action. Criteria considered include (1) protectiveness of human health and the community; (2) protectiveness of workers; (3) protectiveness of the environment; (4) practicability of compliance with applicable or relevant and appropriate requirements (ARARs); (5) ability to achieve the removal action objectives; and (6) reduction of toxicity, mobility, and volume of contaminated media through treatment.

The implementability criterion addresses the technical and administrative feasibility of implementing the alternative and the availability of various required services and materials.

The cost criterion is used to evaluate the direct and indirect capital costs of each alternative. Cost is based on feasibility level scoping and has an expected accuracy of +50 to −30 percent.

ARARs analysis and cost estimates are contained in Appendixes A and B, respectively.

4.1 EVALUATION OF ALTERNATIVE 1: REMOVE TANK AND EXCAVATE SURROUNDING CONTAMINATED SOILS; CUT AND CAP TANK LINES; DISPOSE OF GENERATED WASTE

4.1.1 Effectiveness

This alternative will protect human health, the community, and the environment because the source term will be removed. It will comply with ARARs and will achieve removal action objectives. Long-term, this alternative is very effective because the tank and surrounding contaminated soil will be removed. Soil around the tank is not expected to be RCRA

contaminated and will not require treatment; therefore, no reduction in toxicity, mobility, or volume through treatment will be realized. Procedures will be employed as appropriate to satisfy worker protection requirements.

4.1.2 Implementability

Excavation is a proven, reliable, and implementable technology. However, limited characterization data result in two uncertainties which affect the implementability of this alternative:

- disposal location and
- worker exposure hazards.

Soil characterization for this EE/CA is based on one biased and two composite soil samples taken from two soil borings in early 1998 and on several samples taken (exact location unknown) in 1986. One additional composite sample was taken roughly 8 m (25 ft) from the tank. It is difficult to predict actual characterization results per container after excavation and packaging have taken place. However, results of analyses on these samples indicate that the soil may not satisfy radionuclide WAC for Envirocare, even if the soil is homogenized after excavation. As a result, consolidation of excavated soil with less contaminated soil previously removed from WAG 13 cesium plots is also considered in this analysis.

Options for disposal, in addition to Envirocare, include the NTS, the potential on-site disposal cell, or storage on the reservation. Implementability concerns exist for each site. One soil sample taken in 1986 contained a level of plutonium which was above the threshold defining TRU waste. After excavation, it is unknown whether the soil, or a portion of the soil, will be classified as TRU waste. Waste classified as TRU will require disposal at Waste Isolation Pilot Plant (WIPP), a facility which is not currently accepting waste (although this is expected to change in the near future). Oak Ridge is not currently able to send waste to NTS for disposal pending resolution of several legal and National Environmental Policy Act of 1969 (NEPA) issues. WAC for the potential on-site disposal cell have not been finalized; the on-site disposal cell may or may not be able to accept this waste. The least preferable option is for waste to be stored pending availability of disposal capacity. Blending excavated soil with the WAG 13 soil or the top 1.5 m (5 ft) of topsoil should provide a waste with relatively uniform contaminant levels. However, this option is least preferable because it increases the concentration of contaminants in WAG 13 soil. If the soil is not homogenized or blended, however, waste in different containers may contain different contaminant levels (as discussed in Sect. 3.1); as a result, more than one disposal location may be required. Homogenizing the soils to mitigate

contaminant stratification, blending excavation soils with WAG 13 soils, or using different disposal locations are considered implementable strategies.

As noted in Section 4.1.1, procedures will be employed as appropriate to satisfy worker health and safety requirements. Based on characterization results detailed in this EE/CA, Level C PPE with an air purifying respirator has been assumed. The moisture content of soil samples indicates that an airborne hazard will probably not exist beyond the excavation zone. If it does, thereby presenting a hazard to passersby, a portable tent can be employed. However, excavation in a tent will be more difficult, and thus less implementable, than excavation without one. Engineering controls and/or excavating after normal working hours (as discussed in Sect. 3.1) to minimize the need for a tent are considered implementable. Data do not suggest external exposure will be limiting in the excavation scenario; however, it is possible that gamma radiation emitters (e.g., ^{137}Cs) may be present at higher levels than currently believed. High levels may also be present in some of the lines to and from the tank, particularly the inlet LLLW line. If gamma radiation levels are found to be limiting, line cutting will take place remotely, as described in Section 3.1, or portable shielding can be employed. Use of portable shielding is considered implementable. The more remote the process, however, the harder it will be to implement the alternative.

4.1.3 Cost

The cost of Alternative 1 is $2.5 million (without blending and WAG 13 soil consolidation) and $4.4 million (with blending and WAG 13 soil consolidation). The $2.5 million cost includes excavation in Level C PPE with air purifying respirator, cutting and capping lines utilizing workers in the shallow pit, engineering controls to minimize airborne hazards, and direct disposal of 610 m^3 (800 yd^3) of waste at Envirocare. It does not include remote cutting of lines, use of a tent to contain any airborne hazards, or any significant homogenization of excavated soil. Assumptions for the $4.4 million cost are similar to the above, but include transport of the excavated soil to Melton Valley, consolidation of the soil (at a 1:1 ratio) with the former WAG 13 soil at Melton Valley, and characterization, transport, and disposal of 1,380 m^3 (1,800 yd^3) of blended soil (including the Core Hole 8 plume source soil and the WAG 13 soil) at Envirocare. Details are provided in Appendix B. This alternative is more costly than the in situ alternatives if blending is necessary. Higher cost is attributable to blending excavated soil with former WAG 13 soil and the additional characterization, transportation, and disposal costs associated with using former WAG 13 soil. If, however, the cost for characterization, transportation, and disposal of just Core Hole 8 plume source waste is considered, the cost for this alternative, given the +50 to -30 percent range of accuracy, is similar to the cost for Alternatives 2 and 3. As a result, cost is not considered a differentiating criterion in alternative evaluation.

4.2 EVALUATION OF ALTERNATIVE 2: IN SITU GROUT CONTAMINATED SOIL AROUND TANK TO ACHIEVE SOURCE CONTROL BY PERMEABILITY REDUCTION; EMPTY TANK CONTENTS AND FILL WITH GROUT

4.2.1 Effectiveness

This alternative will be protective of human health, the community, workers, and the environment. It will comply with ARARs and will achieve removal action objectives. In situ grouting will not be as effective as Alternative 1, particularly over the long term, because contaminants will remain and permeability reduction will not be absolute. Long-term performance is unproven (this alternative is unlikely to remain effective for the length of time necessary for sufficient decay of long-lived radionuclides, such as uranium). The use of low-pressure grouting has been shown effective at WAG 4. However, WAG 4 grouting involved filling voids in waste, not in clay or backfill. Visual inspections of the clay removed by split spoon indicate that voids do exist in the clay backfill; indeed, given the indications of "bathtubbing" observed in the immediate vicinity of the tank, grouting will be expected to have some measure of success (although permeability testing results indicate a fairly tight clay formation). Different injection methods, such as variants of low-pressure permeation grouting and high-pressure grouting, or even some type of soil mixing, can be used to maximize effectiveness given the existing soil properties. Use of a solution grout, such as acrylamide, as opposed to a cement-based grout, should increase the effectiveness of this alternative because the less viscous solution grout can fill smaller voids more readily than a cement grout, and the grout is more durable over the long term. If voids are successfully grouted, groundwater contact with contaminated soils will be minimized, thus limiting contaminant leaching. Nonetheless, given the results of geotechnical testing of this soil (see Appendix C), clearly the effectiveness of grouting will be limited without some form of soil mixing. A predesign study will be appropriate to determine the preferred injection method and grout and chemical additive formulation. Chemical additives for contaminant fixation will increase effectiveness and will reduce the mobility of contaminants through treatment. Alternative 2 will, however, increase the volume of the contaminants in situ.

4.2.2 Implementability

In situ grouting is a proven technology under specific conditions not duplicated at Core Hole 8, recently implemented at WAG 4 at ORNL. Necessary services and materials will be readily available. A predesign study to determine the optimum injection method feasibility at the Core Hole 8 site, as well as grout and additive formulations, will be necessary before actual implementation of this alternative.

4.2.3 Cost

The cost of Alternative 2 is $3 million. Although contaminants are left in place, surveillance and maintenance (S&M) costs are not considered in this analysis; they will be a component of the Bethel Valley watershed project. Details are provided in Appendix B.

4.3 EVALUATION OF ALTERNATIVE 3: IN SITU CHEMICALLY TREAT CONTAMINATED SOIL AROUND TANK TO ACHIEVE SOURCE CONTROL BY STABILIZATION; EMPTY TANK CONTENTS AND FILL WITH GROUT

4.3.1 Effectiveness

This alternative will be protective of human health, the community, workers, and the environment. It will comply with ARARs and will achieve removal action objectives. In situ chemical treatment will not be as effective as Alternative 1 because contaminants will remain; however, if successful, this alternative will be more effective than Alternative 2 because of the relative irreversibility of the mineral formation. This technology has been shown effective in bench-scale tests; however, it has not been implemented in field-scale conditions for radionuclides. Like the grouting alternative, the permeability of the clay will impact effectiveness. It may be difficult to fully contact low permeability clays with the reagent although, as with in situ grouting, various injection techniques are available. Soil not treated will remain a secondary source of contaminants to groundwater. Effectiveness is dependent on soil geochemical parameters (as discussed in Sect. 4.2.1) as well as contaminant properties. As a result, a predesign study will be appropriate before implementing the alternative. This predesign study, like that for the grouting alternative, will determine reagent composition and strength, as well as preferred injection method. In situ treatment as described in this alternative will reduce the mobility of contaminants and may decrease the overall volume of contaminants in situ.

4.3.2 Implementability

This alternative is implementable. Although unproven at the field-scale, this technology, if successful, is expected to be reliable. Injection of the chemical reagent will be accomplished in a fashion similar to grout injection. The availability of vendors to implement this alternative is limited. A predesign study will be necessary before implementation of the alternative.

4.3.3 Cost

The cost of Alternative 3 is $2.5 million. Although contaminants are left in place, S&M costs are not considered in this analysis; they will be a component of the Bethel Valley watershed project. Details are provided in Appendix B.

5. RECOMMENDED REMOVAL ACTION ALTERNATIVE

The recommended removal action alternative is Alternative 1: remove tank and excavate surrounding contaminated soils; cut and cap tank lines; dispose of generated waste. This alternative is recommended for several reasons:

- The effectiveness of excavation will be superior to that of in situ grouting or chemical treatment because contaminants will be removed.

- A predesign study will not be required for implementation of this alternative; a predesign study will probably be required for implementation of the other alternatives.

- Long-term (> 300–500 years) institutional controls for the Tank W-1A area will be required in the grouting or chemical treatment alternatives because of the presence of long-lived radionuclides. These institutional controls will not be required for soil after excavation (although this does not consider any actions and institutional controls that may be required as part of the more comprehensive Bethel Valley watershed project).

- Excavation will be consistent with other actions at Bethel Valley.

- Excavation with blending (if required) would still be cost effective considering the reduced S&M cost for WAG 13 soil and the permanence of the alternative.

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APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or Relevant and Appropriate Requirements

ARARs for all three alternatives are presented in Table A.1. All alternatives have the same location-specific and chemical-specific ARARs. Action-specific ARARs are the same for Alternatives 2 and 3. Alternative 1 has the same action-specific ARARs as Alternatives 2 and 3 with additional requirements triggered by off-site transportation and disposal of solid media. All alternatives would comply with ARARs. Data indicate that all wastes encountered during this action are likely to be LLW. All wastes will be properly characterized before either on- or off-site shipment or disposal to ensure that WAC for receiving facilities are met.

In accordance with Section 300.415(i) of NCP, on-site removal actions conducted under CERCLA are required to attain ARARs to the extent practicable, considering the exigencies of the situation. The NCP identifies two factors that should be considered in determining whether identifying and complying with ARARs is practicable: (1) the urgency of the situation and (2) the scope of the removal action to be taken. Based on the above guidance, a listing of ARARs specific to this non-time-critical removal action are presented in the Table A.1 and discussed in this appendix. ARARs apply to federal and state regulations designed to protect the environment and do not generally apply to occupational safety or worker protection regulations. EPA requires compliance with OSHA and worker protection regulations in Section 300.150 of the NCP, not through the ARARs process. Therefore, these regulations are not included as ARARs; these standards will be addressed in the health and safety plan for this action.

Chemical-specific ARARs set health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances, pollutants, or contaminants. These requirements generally set protective cleanup levels for the chemicals of concern in the designated media or indicate a safe level of discharge that may be incorporated when considering a specific remedial activity. There are no chemical-specific ARARs for cleanup levels for this removal action. There are chemical-specific ARARs for radiological emissions which could occur during the action.

Location-specific ARARs set restrictions on the concentration of hazardous substances or the conduct of activities solely because they are in special locations. This action will not take place within any identified floodplain or wetland areas, nor have any endangered or threatened species or habitats been identified at the site. Tank W-1A is located in downtown ORNL within

Table A.1. ARARs for non-time-critical removal action on Tank W-1A, Core Hole 8 Plume source, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Action	Requirement	Prerequisites	Citation
	Chemical-specific		
Control of radionuclide emissions	Exposures to members of the public from all radiation sources released into the atmosphere shall not cause an EDE to be > 10 mrem (0.1 mSv)/year	Point source discharge of radionuclides into the ambient air from a DOE facility—**applicable to all alternatives**	40 CFR 61.92; Rules of the TDEC 1200-3-11-.08
	Radiological emission measurements must be performed at all release points that have a potential to discharge radionuclides into the air in quantities which could cause an EDE in excess of 1% of the standard (0.1 mrem/year). All radionuclides which could contribute > 10% of the standard (1 mrem/year) for the release point shall be measured		40 CFR 61.93; Rules of the TDEC 1200-3-11-.08
Protection of the general public	DOE will carry out all DOE activities to ensure that radiation doses to individuals will be ALARA	Release of radionuclides into the environment—**TBC for all alternatives**	DOE Order 5400.5(I.4); 10 CFR 834 (proposed)
	Exposures to members of the public from all radiation sources shall not cause an EDE to be > 100 mrem (1 mSv)/year		DOE Order 5400.5(II.1a) 10 CFR 834 (proposed)
	Location-specific		
Actions affecting cultural resources	Action(s) that will affect such resources must adhere to the DOE/ORO Programmatic Agreement (May 6, 1994). When alteration or destruction of the resource is unavoidable, steps must be taken to minimize or mitigate the impacts and to preserve data and records of the resource	Any action which will impact historic or archaeologic resources—**applicable to all alternatives**	National Historic Preservation Act (16 USC 470a-w) Sections 106 and 110; EO 11593; 36 CFR 800

Table A.1. (continued)

Action	Requirement	Prerequisites	Citation
	Action-specific		
Surface water control	Implement good site planning and best management practices to control storm water discharges including: • document best management practices in a stormwater control plan or equivalent document • minimal clearing for grading • removal of vegetation cover only within 20 days of construction • perform weekly erosion control inspections and maintenance • control measures to detain runoff • discharges must not cause erosion	Control of stormwater discharges associated with construction activities at industrial sites that result in a disturbance of > 5 acres of total land area. For those sites with < 5 acres affected—**relevant and appropriate to all alternatives**	40 CFR 122; Rules of the TDEC 1200-4-10-.05
Fugitive emissions from excavation activities	Take reasonable precautions to prevent particulate matter from becoming airborne; no visible emissions are permitted beyond property boundary lines for more than 5 minutes/hour or 20 minutes/day. Potential nonpoint sources of fugitive emissions are included in the plantwide fugitive emissions plan	Nonpoint source air emissions—**applicable to all alternatives** (grouting may result in fugitive emissions also)	Rules of the TDEC 1200-3-8-.01
Transfer of groundwater to appropriate ORNL treatment facility	Must meet WAC of treatment facility	Discharge to treatment facility—**TBC for all alternatives**	WM-WMCO-201 July 1991

Table A.1. (continued)

Action	Requirement	Prerequisites	Citation
	WWE for RCRA waste	Transport of water to on-site NPDES-permitted facility— **applicable to treatment facility**	
Characterization/ management of waste streams generated during action	A person who generates solid waste must determine whether that waste is hazardous using various methods, including application of knowledge of the hazardous characteristics of the waste based on information regarding the materials or processes used	Wastes generated during activities potentially contaminated with RCRA-characteristic waste—**applicable to all alternatives**	40 CFR 262.11; Rules of the TDEC 1200-1-11-.03(1)(b)
	LLW generators must characterize and segregate LLW from uncontaminated waste and otherwise minimize the amount of LLW generated. Subsequent management of LLW must be in accordance with DOE Order 5820.2A	Generators of LLW—**TBC for all alternatives**	DOE Order 5820.2A(III.3)
Treatment and disposal of liquid tank contents and groundwater			
Transportation to disposal facility	The waste must meet packaging, labeling, marking, placarding and pretransport requirements in accordance with DOT regulations	Transportation of hazardous and radioactive materials above exempt quantities—**applicable to all alternatives**	49 CFR 171–174 and 177–179; DOE Order 460.1A (TBC)
	Must meet packaging requirements based on the maximum activity of radioactive material in a package	Packaging of radioactive materials above exempt quantities for public transport—**applicable to all alternatives**	49 CFR 173.431; 49 CFR 173.433; 49 CFR 173.435; 49 CFR 173.411
	Generators must certify before the shipment that the waste meets the WAC of the receiving facility	Waste shipped from one field organization to another for disposal—**TBC for all waste LLW streams shipped off site**	DOE Order 5820.2A(III)

Table A.1. (continued)

Action	Requirement	Prerequisites	Citation
	LLW must be disposed of on-site; if off-site disposal is required due to lack of capacity, disposal must be to a DOE facility	Shipments of LLW—TBC for Alternative 1	DOE Order 5820.2A
	Off-site disposal of LLW to a commercial facility requires an exemption from the on-site disposal requirements of DOE Order 5820.2A; requests for exemption must be approved by the DOE ORO Field Office. Must meet DOE Order and implementing procedural requirements for off-site shipments	Shipments of LLW—TBC for Alternative 1	DOE Order 5820.2A
Treatment of contaminated soil	Treatment techniques to reduce volume shall be implemented as necessary to meet performance requirements	Treatment of LLW—TBC	DOE Order 5820.2A(II)
Storage of soil contaminated with TRU waste in drums temporarily on site and the transfer of such waste to a certified interim storage site	Meet requirements, as outlined in DOE Order 5820.2A(II) for the packaging, management, and temporary storage of TRU waste. Major requirements of Chapter II include: * place in noncombustible packaging that meets DOT requirements * monitor periodically to ensure that wastes are not releasing radioactive and/or hazardous constituents * protect from unauthorized access * store in such a way so as to maintain radiation exposures ALARA	Temporary and interim storage of TRU waste at generating site—TBC	DOE Order 5820.2A(II)

Table A.1. (continued)

Action	Requirement	Prerequisites	Citation
	• construct and maintain area in such a way as to minimize the adverse impacts of fire, explosion, or accidental release of hazardous components		
Management of TRU wastes	TRU waste shall be managed to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from discharges of radioactive material and direct radiation from such management shall not exceed 25 mrem/year to the whole body and 75 mrem/year to any critical organ	Handling/management of TRU waste—relevant and appropriate	40 CFR 191.03(b)

ALARA = as low as reasonably achievable
ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
DOE = U.S. Department of Energy
DOT = U.S. Department of Transportation
EDE = effective dose equivalent
EO = Executive Order
> = greater than
< = less than
LLW = low-level (radioactive) waste
mrem = millirem
mSv = millisievert
NPDES = National Pollutant Discharge Elimination System
ORNL = Oak Ridge National Laboratory
ORO = Oak Ridge Operations
% = percent
RCRA = Resource Conservation and Recovery Act of 1976
TBC = to be considered
TDEC = Tennessee Department of Environment and Conservation
TRU = transuranic
USC = *United States Code*
WAC = waste acceptance criteria
WM = Waste Management
WMCO = Waste Management Coordination Office
WWE = waste water exemption

an area that has been designated a historic district. This triggers location-specific ARARs that require consideration and minimization of adverse effects to the aesthetics of the surrounding district for the duration of the action.

Action-specific ARARs specify particular performance standards or technologies, as well as environmental levels for discharged or residual chemicals. All alternatives for this removal action involve transfer of the tank contents and collected groundwater to the ORNL LLLW system for treatment and subsequent discharge; operation of heavy equipment to address the tank and surrounding media; and generation, characterization, and disposition of secondary waste such as PPE and decontamination wastes. In addition, Alternative 1 involves excavation, off-site shipment, and disposal of the tank and surrounding gravel, soil, and debris. Action-specific ARARs triggered by the proposed action include requirements for the characterization and transport of water and soil generated during excavation activities.

Alternative 1 may also include soil blending. DOE Order 5820.2A, "Radioactive Waste Management," includes a requirement to reduce waste volumes as necessary to meet the performance requirements of the Order. While soil blending under Alternative 1 will result in increased waste volumes, soil blending is appropriate in this instance. Blending excavated soil with other soil, if necessary, will enable DOE to dispose of soil that otherwise would not meet WAC for disposal at any available disposal facility.

Certain on-site construction and/or excavation activities will be necessary during implementation of the action. These will include excavation and movement of gravel and soil around the tank to install sleeve pipes and pumps as part of the dewatering process for Alternatives 2 and 3. The extent of these types of activities will be greater for Alternative 1 due to the excavation of the tank, gravel, and soils. Fugitive dust emissions may result from these activities. TDEC, Division of Air Pollution Control, has promulgated regulations governing fugitive dust emissions (*Rules of the Tennessee Department of Environment and Conservation*, Chapter 1200-3-8-.010). These are listed in Table A.1 and are applicable to this removal action.

Stormwater discharges from activities at industrial sites involving construction operations that result in the disturbance of 2 ha (5 acres) total land or more require a National Pollutant Discharge Elimination System (NPDES) general permit (40 CFR 122; Rules of the TDEC 1200-4-10-.05) which includes requirements for controlling surface water runoff. Those requirements are relevant and appropriate for activities affecting < 2 ha (5 acres). For CERCLA on-site actions, compliance with only the substantive requirements of the NPDES permitting process is required. In particular, implementation of site planning and best management practices to control stormwater discharges is required (Table A.1).

Because wastewaters resulting from this action will be routed to existing permitted treatment facilities, no further ARARs are involved. However, to ensure compliance with direct discharge limits, WAC for these facilities must be met. Wastes shipped off-site for disposal, as in Alternative 1, and all secondary wastes shipped off site must first be characterized to ensure that disposal facility WAC are met, and must be disposed of at a facility approved by EPA for disposal of CERCLA waste (40 CFR 300.435). DOE must also approve any facility receiving off-site shipment of wastes.

There is a slight possibility that some excavated soil may meet the definition of TRU waste. Per 40 CFR 191.03(b), TRU waste shall be managed to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from the discharges of radioactive material and direct radiation from such management shall not exceed 25 mrem/year to the whole body and 75 mrem/year to any critical organ. Any TRU waste will be transferred to interim storage pending treatment and disposed of at WIPP (DOE Order 5820.2A).

APPENDIX B

COST ESTIMATES

Table B.1. Cost comparison of removal action alternatives for the Core Hole 8 plume source, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Alternative description	Design ($)	Procurement ($)	Project integration ($)	Site safety ($)	Site specific ($)	Construction contract ($)	Waste disposition ($)	Project closeout ($)	M&I ($)	Total ($)
Excavation/ removal blending	86,036	33,719	390,352	64,280	260,180	642,371	1,560,077	13,896	324,073	4,374,984
Excavation and removal	86,081	33,736	390,556	64,314	260,316	770,942	735,793	12,630	188,349	2,542,717
Grout solidification	64,477	33,732	239,058	64,306	22,128	2,261,669	71,481	13,902	221,660	2,992,413
Chemical treatment	197,793	33,531	237,629	64,883	21,982	1,704,352	71,010	13,819	187,520	2,531,519

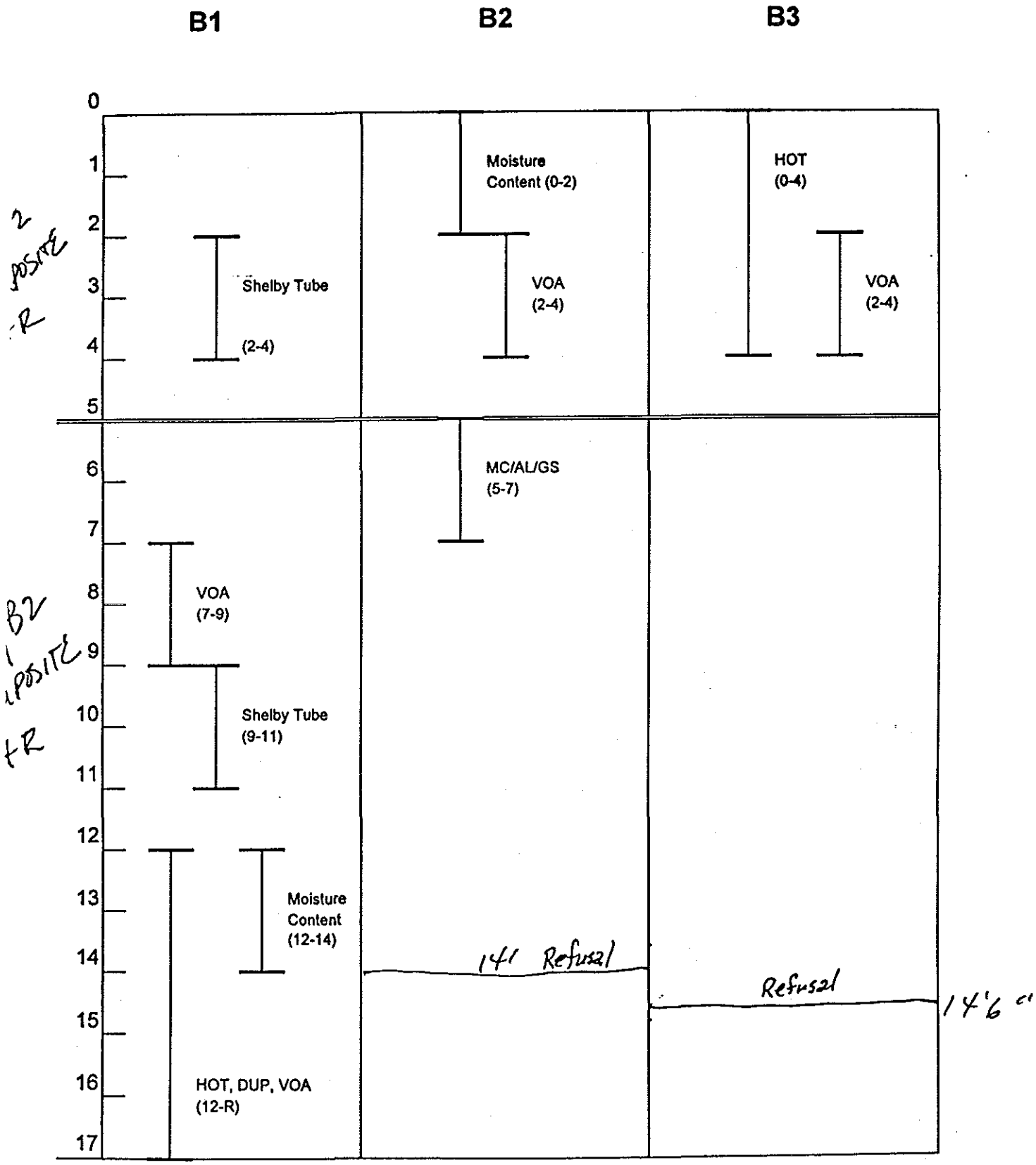
Note: Totals may vary due to rounding in the estimate from estimate detail.

$ = dollar
M&I = management and integration

APPENDIX C

SOIL SAMPLE RESULTS

Corehole 8
Soil Sampling



B-1

Depth	
0-2'	2,000cpm beta, 500cpm gamma (background is 500cpm for b/g) alpha at 0
2-4'	Shelby tube - no readings
4-5'	1.1mR beta, 0.5mR gamma, 0 alpha
5-7'	11mR beta, 4mR gamma, 7920cpm alpha
7-9'	2mR beta, 1mR gamma, 0 alpha
9-11'	Shelby tube - 80mR gamma on outside of tube (tube overpushed into 11-12 interval)
12-14'	388mR beta, 4mR gamma, 228cpm alpha
14-16'	60mR beta, 80mR gamma, 912cpm alpha
16-17'4" (refusal)	60mR beta, 20mR gamma, 2280cpm alpha

B-2

Depth	
0-2'	100-150cpm for beta/gamma (background)
2-4'	200cpm for beta/gamma
4-5'	100-150cpm (background)
5-7'	40,000dpm for beta/gamma at background, 274cpm for alpha
7-9'	12mR beta, 10mR gamma, 46,400dpm alpha
9-11'	10mR beta, 40mR gamma, 29,000dpm alpha
11-13'	76mR beta, 10mR gamma, 12,000dpm alpha
13-14'	380mR beta, 25mR gamma, 0 alpha

B-3

Depth	
0-2'	19,000cpm beta, 1,000cpm gamma, 0 alpha (1000cpm b/g is background)
2-4'	12mR beta, 0.5mR gamma, 200dpm alpha
4-6'	89,000cpm beta, 1,000cpm gamma, 0 alpha
6-8'	5,000cpm beta/gamma, 132dpm alpha
8-10'	4,000cpm beta/gamma, 0 alpha
10-12'	8,000cpm beta/gamma (8K is background now), 0 alpha
12-14'	8,000cpm beta/gamma (i.e., background), 0 alpha
14-14'6" (refusal)	12,000cpm beta/gamma (i.e. 4K above background), 132dpm alpha

INTERNATIONAL TECHNOLOGY CORPORATION

GEOTECHNICAL LABORATORY

CERTIFICATE OF ANALYSIS

Mary Collins-Shepard
Commodore Advanced Sciences, Inc.
800 Oak Ridge Turnpike, Suite C260
Oak Ridge TN 37831

April 6, 1998

IT Project No. 774702.00110000 LMES Purchase Order: 1FK-LLN47V

This is the Certificate of Analysis for the following samples:

Project ID:	**LMES-IWQP Core Hole 8**
Date Received by Lab:	February 27, 1998
Number of Samples:	Five (5)
Sample Type:	Soil

I. Introduction/Case Narrative

Five soil samples were received by the IT Geotechnical Laboratory on February 27, 1998. One sample was received in two inner containers. Requested testing included moisture content, particle-size distribution, Atterberg limits, undisturbed density, specific gravity, effective porosity, engineering soil classification, and constant-head permeability. Not all samples required all parameters. Sample results have been transmitted as available March 19, 1998 and March 27, 1998 via facsimile.

Please see Appendix A, Sample Number Cross Reference List; Appendix B, Analysis Results; and, Appendix C, Chain-of-Custody and Request-for-Analysis Records.

Reviewed and Approved:

Ralph Cole
Laboratory Manager, Geotechnical Services

IT Environmental Technology Development Center
P.O. Box 4339 • 1570 Bear Creek Road • Oak Ridge, TN 37830 • 615-482-6497 • FAX: 615-482-1890

681A-6-93

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II. Analytical Results/Methodology

REFERENCES: United States Army Corps of Engineers (USACE), Engineer Manual 1110-2-1906, *Laboratory Soils Testing*, appendix II, 1970; United States Environmental Protection Agency, SW846, *Test Methods for Examining Solid Waste, Physical/Chemical Methods*, 3rd ed., Nov 1986 (EPA SW-846). Annual Book of ASTM Standards, Section 4, Construction, Volume 04.08, *Soil and Rock (I)*, and Volume 04.09, *Soil and Rock (II)*, 1996.

Laboratory Determination of Water (Moisture) Content of Soil and Rock **ASTM D 2216**
Particle-Size Analysis of Soils . . . . . **ASTM D 422**
Liquid Limit, Plastic Limit, and Plasticity Index of Soils . . . . . **ASTM D 4318**
Unit Weights, Void Ratio, Porosity, and Degree of Saturation . . . . . **EM 1110-2-1906**
Specific Gravity of Soils . . . . . **ASTM D 854**
Constant Measurement of Hydraulic Conductivity of Saturated
Porous Materials Using a Flexible Wall Permeameter . . . . . **ASTM D 5084**
Classification of Soils for Engineering Purposes . . . . . **ASTM D 2487**

III. Quality Control

Quality control checks such as duplicates and spikes (QC samples), are not normally applicable to geotechnical testing. This is due largely to the inability of obtaining samples with known characteristics, the heterogenous nature of the samples, and quality control procedures built-in to the analytical method.

QC measures to ensure accuracy and precision of test results include the following:

- 100% verification of all numerical results - raw data entries, transcriptions and calculations entered by lab technicians are checked, recalculated and verified. Most data calculations are performed by computer programs.

- Data validation through test reasonableness - summaries of all test results for individual reports are reviewed to determine the overall reasonableness of data and to determine the presence of any data that may be considered outliers.

- Quality control procedures are built into most standardized geotechnical procedures. For example, liquid limit and plastic limit analyses call for re-analyses and specify acceptance criteria.

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- Routine instrument calibration - instruments, gauges and equipment used in testing are calibrated on a routine basis. All instrument calibration follows ASTM or manufacturer guidelines.

- Maintenance of all past calibration records - records and certification documents of all instruments, gauges and equipment are updated routinely and maintained in the Quality Control Coordinators Quality/Operations files.

- Certified and trained personnel - all technicians are certified by the National Institute for Certification of Engineering Technicians (NICET) in geotechnical soil testing, and are trained in the application of standard laboratory procedures for geotechnical analyses as well as the quality assurance measures implemented by IT.

IV. Data Qualification

Sample numbers ETDC-7438 and ETDC-7439 (B-2 @ 5'-7') were combined before performing analyses. Sample data may reference one and/or both sample numbers.

The shelby tube sample number ETDC-7443 (B-1 @ 9'-11') contained two soil types. A brown clayey soil overlay a lower reddish brown silty clay/weathered shale fragment mixture. The lower soil predominated and was very wet. The permeability specimen was obtained from the lower section.

The coarse fraction of all samples was comprised of weathered shale. Sample preparations caused a certain, unavoidable degradation of particles due to wetting and drying, and physical grinding operations. Tests most affected are particle-size distribution and soil classification.

Specific gravity tests using ASTM C 127 yielded abnormally low results. This may have been caused by the high absorption of the coarser soil particles, the degradation and loss of soil particles during testing, or both. Because of this, the coarse fractions were reanalyzed by ASTM D 854, and the average (composite) specific gravity computed using the two results.

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SAMPLE NUMBER CROSS-REFERENCE LIST

LAB SAMPLE NO.	CLIENT SAMPLE NO.
ETDC-7438	B-2 @ 5'-7'
ETDC-7439	B-2 @ 5'-7'
ETDC-7440	B-2 @ 0'-2'
ETDC-7441	B-1 @ 12'-14'
ETDC-7442	B-1 @ 2'-4'
ETDC-7443	B-1 @ 9'-11'

Appendix B

Analysis Results

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MOISTURE CONTENT

PROJECT NAME
LMES-IWQP Core Hole 8

PROJECT NUMBER
774702.00110000

IT LAB SAMPLE NO.	CLIENT SAMPLE NO.	MOISTURE, % ASTM D 2216	MOISTURE , % SW846	SOLIDS, % SW846
ETDC-7438	B-2 @ 5'-7'	23.1	18.8	81.2
ETDC-7439	B-2 @ 5'-7'	26.8	21.1	78.9
ETDC-7440	B-2 @ 0'-2'	25.6	20.4	79.6
ETDC-7441	B-1 @ 12'-14'	32.3	24.4	75.6
ETDC-7442	B-1 @ 2'-4'	24.2	19.5	80.5
ETDC-7443	B-1 @ 9'-11'	35.1	26.0	74.0

ASTM D 2216 results are based on the sample dry weight.
SW846 RESULTS are based on the sample wet weight.
Solids content is found by subtracting the SW846 moisture from 1 and multiplyinig the result by 100.

Mary Collins-Shepard
Commodore ASI
April 6, 1998
IT Project ID: LMES-IWQP Core Hole 8
IT Project No.: 774702.00110000

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PARTICLE-SIZE ANALYSIS
ASTM D 422

Project Name	LMES-IWQP Core Hole 8	Client Sample No.	B-2 @ 5'-7'
Project No.	774702.00110000	IT Lab Sample No.	ETDC-7439

Specific Gravity = 2.7203
measured, < 2 mm material

Moisture Content = 26.8%
based on dry sample weight

SIEVE ANALYSIS

COARSE	Sieve No.	Diameter mm	Percent Finer
	3"	75.000	100.0%
	1.5"	37.500	100.0%
	0.75"	19.000	100.0%
	0.375"	9.500	98.6%
	#4	4.750	97.6%
	#10	2.000	95.8%

FINE	Sieve No.	Diameter mm	Percent Finer
	#20	0.850	93.2%
	#40	0.425	92.0%
	#60	0.250	91.2%
	#100	0.149	90.2%
	#140	0.106	89.0%
	#200	0.075	85.7%

HYDROMETER ANALYSIS

HYDROMETER	Diameter mm	Percent Finer
	0.01592	64.8%
	0.00961	58.6%
	0.00694	54.8%
	0.00515	48.6%
	0.00375	44.9%
	0.00265	39.9%
	0.00117	31.2%

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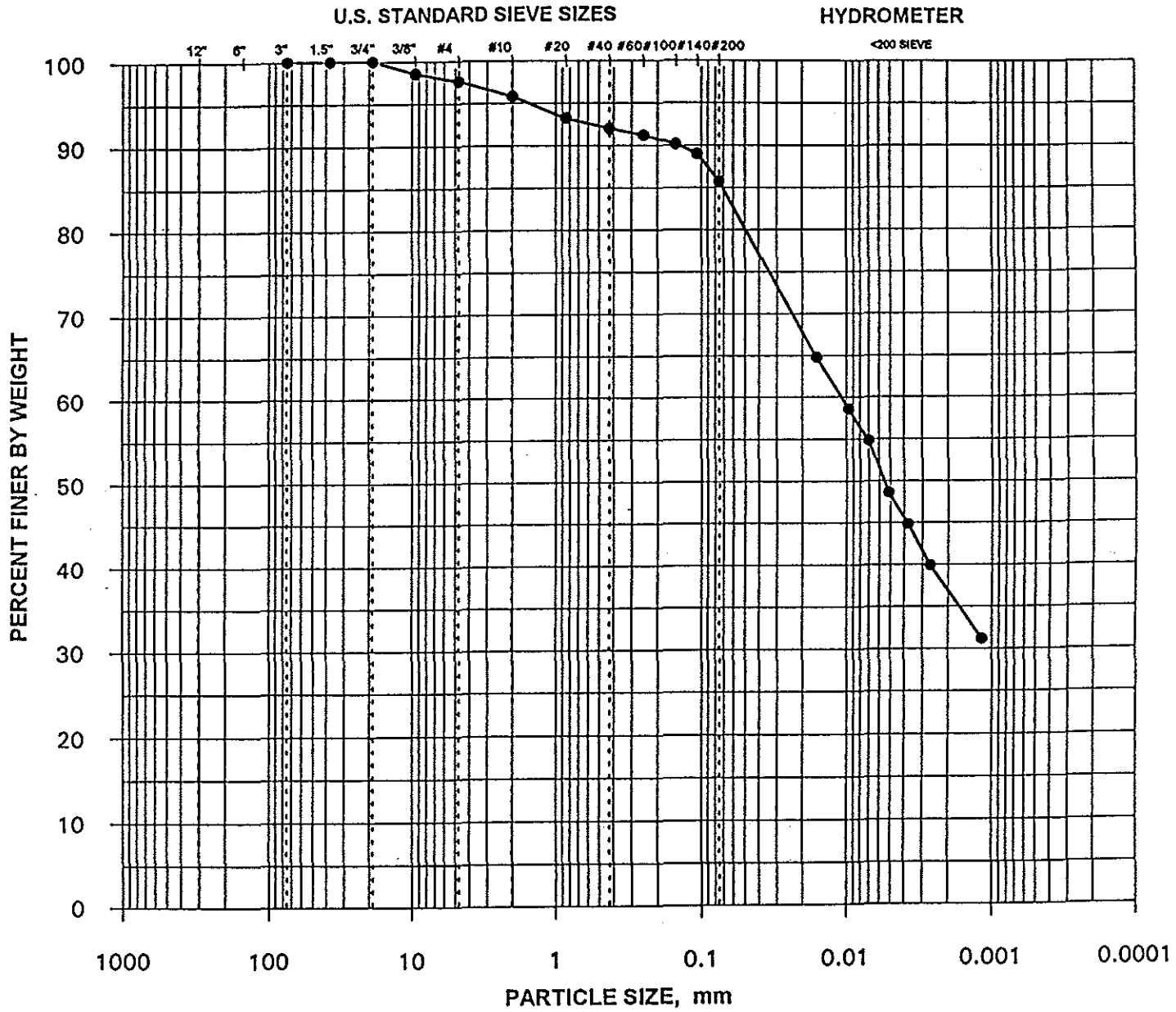
LMES-IWQP Core Hole 8



CLIENT SAMPLE NO.: B-2 @ 5'-7'

IT LAB SAMPLE NO.: ETDC-743

BOULDERS	COBBLES	GRAVEL		SAND			SILT 2 - 75 microns CLAY <2 microns
		COARSE	FINE	COARSE	MEDIUM	FINE	

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IT Project No.: 774702.00110000

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PARTICLE-SIZE ANALYSIS
ASTM D 422

Project Name: LMES-IWQP Core Hole 8

Client Sample No.: B-1 @ 2'-4'

Project No.: 774702.00110000

IT Lab Sample No.: ETDC-7442

Specific Gravity = 2.7387
measured, < 2 mm material

Moisture Content = 24.2%
based on dry sample weight

SIEVE ANALYSIS

COARSE	Sieve No.	Diameter mm	Percent Finer
	3"	75.000	100.0%
	1.5"	37.500	100.0%
	0.75"	19.000	100.0%
	0.375"	9.500	88.8%
	#4	4.750	74.9%
	#10	2.000	62.0%

FINE	Sieve No.	Diameter mm	Percent Finer
	#20	0.850	56.0%
	#40	0.425	51.7%
	#60	0.250	48.8%
	#100	0.149	45.5%
	#140	0.106	43.0%
	#200	0.075	40.0%

HYDROMETER ANALYSIS

HYDROMETER	Diameter mm	Percent Finer
	0.03559	35.2%
	0.02612	33.2%
	0.01698	31.1%
	0.01025	27.8%
	0.00737	25.7%
	0.00536	23.4%
	0.00387	21.7%
	0.00273	19.3%
	0.00119	15.6%

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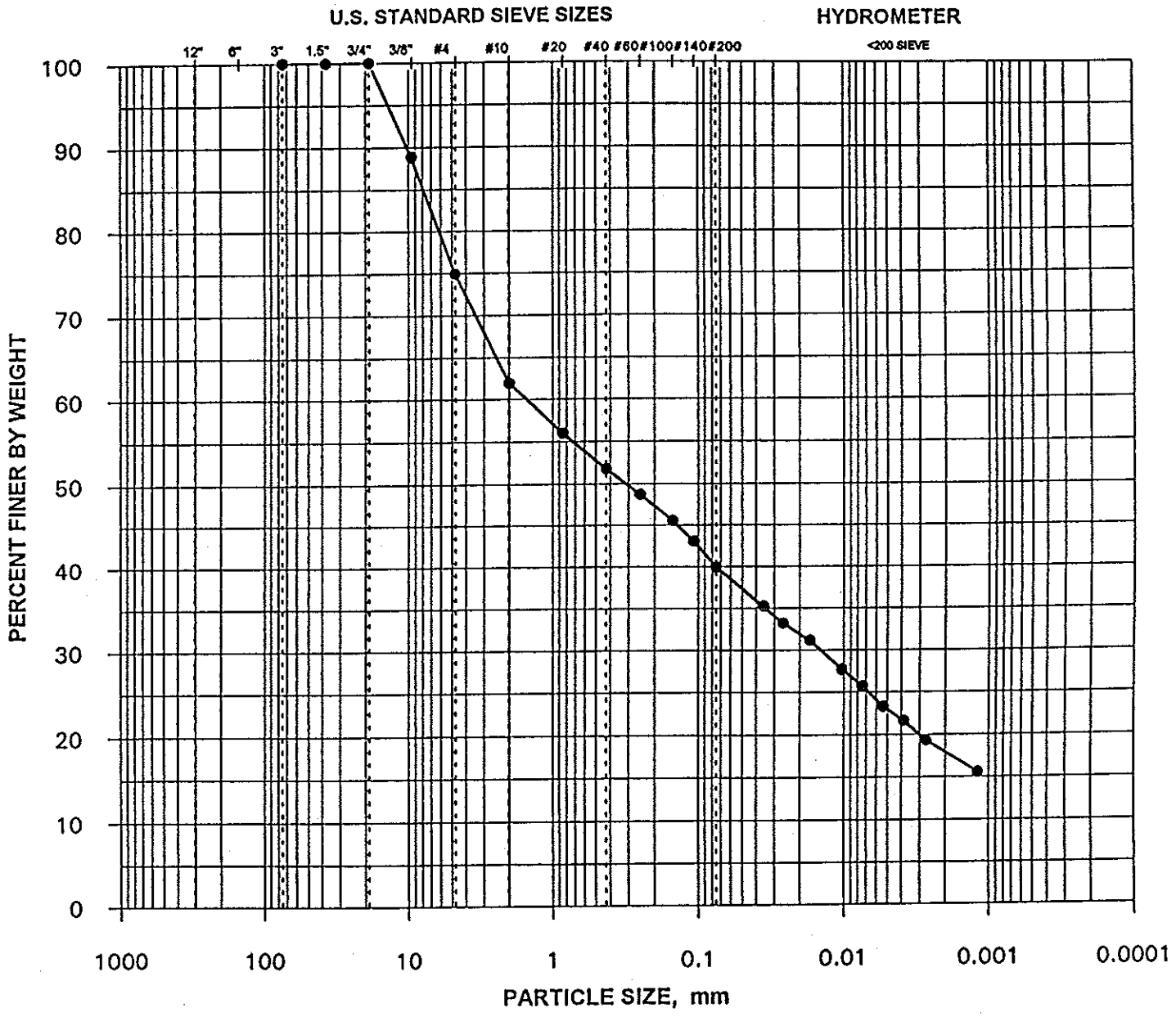
LMES-IWQP Core Hole 8



CLIENT SAMPLE NO.: B-1 @ 2'-4'

IT LAB SAMPLE NO.: ETDC-744

BOULDERS	COBBLES	GRAVEL		SAND			SILT 2 - 75 microns CLAY <2 microns
		COARSE	FINE	COARSE	MEDIUM	FINE	

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IT Project ID: LMES-IWQP Core Hole 8
IT Project No.: 774702.00110000

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PARTICLE-SIZE ANALYSIS
ASTM D 422

Project Name	LMES-IWQP Core Hole 8	Client Sample No.	B-1 @ 9'-11'
Project No.	774702.00110000	IT Lab Sample No.	ETDC-7443

Specific Gravity = 2.7810
measured, < 2 mm material

Moisture Content = 35.1%
based on dry sample weight

SIEVE ANALYSIS

COARSE	Sieve No.	Diameter mm	Percent Finer
	3"	75.000	100.0%
	1.5"	37.500	100.0%
	0.75"	19.000	97.4%
	0.375"	9.500	91.1%
	#4	4.750	80.7%
	#10	2.000	65.5%

FINE	Sieve No.	Diameter mm	Percent Finer
	#20	0.850	56.6%
	#40	0.425	51.8%
	#60	0.250	49.4%
	#100	0.149	46.9%
	#140	0.106	45.0%
	#200	0.075	42.4%

HYDROMETER ANALYSIS

HYDROMETER	Diameter mm	Percent Finer
	0.05048	39.9%
	0.03697	37.1%
	0.02718	34.2%
	0.01751	33.0%
	0.01041	30.6%
	0.00753	28.2%
	0.00545	26.2%
	0.00389	24.2%
	0.00272	22.2%
	0.00117	18.5%

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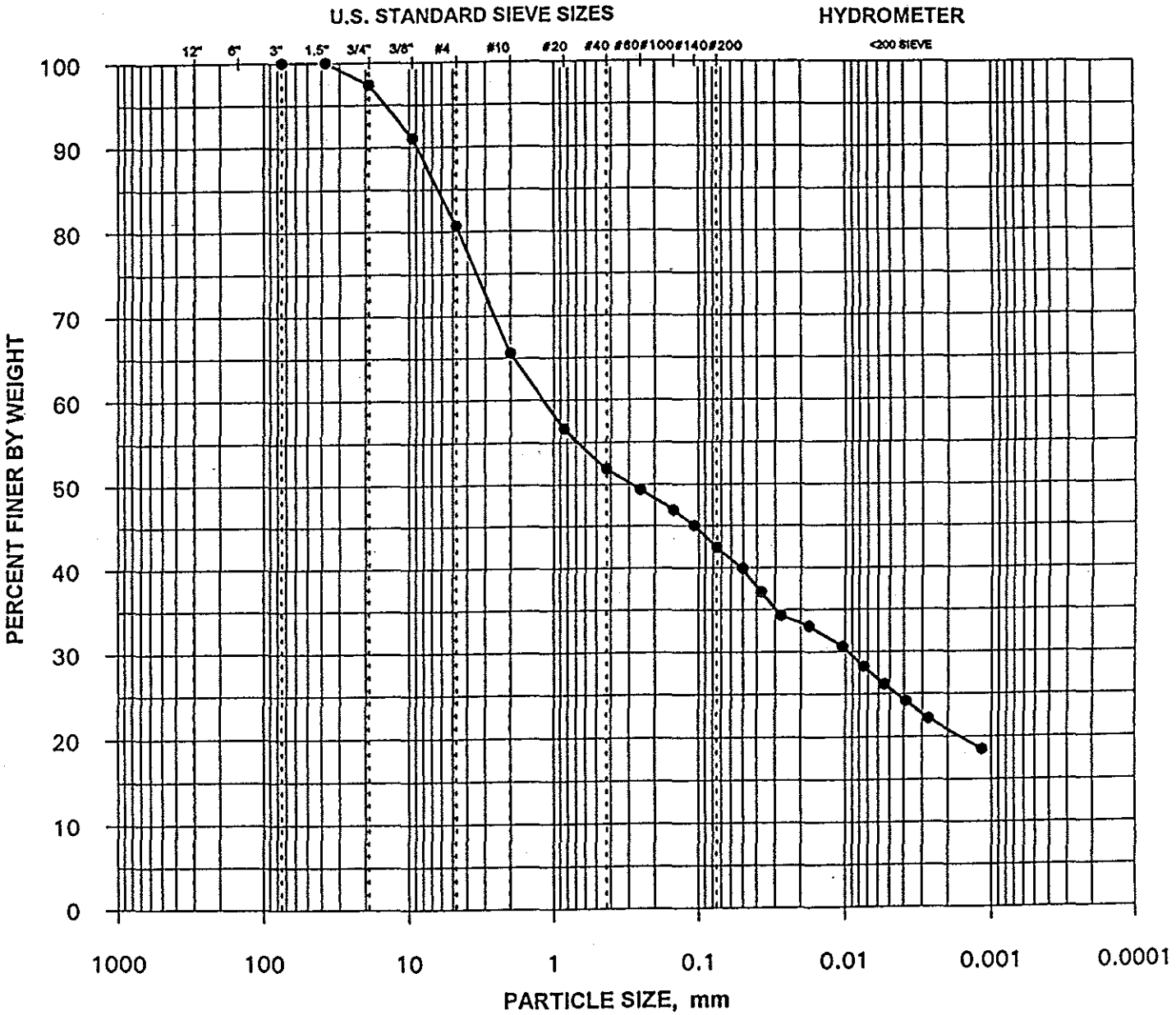
LMES-IWQP Core Hole 8



CLIENT SAMPLE NO.: B-1 @ 9'-11'

IT LAB SAMPLE NO.: ETDC-7443

BOULDERS	COBBLES	GRAVEL		SAND			
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT 2 - 75 microns CLAY <2 microns

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ATTERBERG LIMITS
ASTM D 4318

PROJECT NAME:
LMES-IWQP Core Hole 8

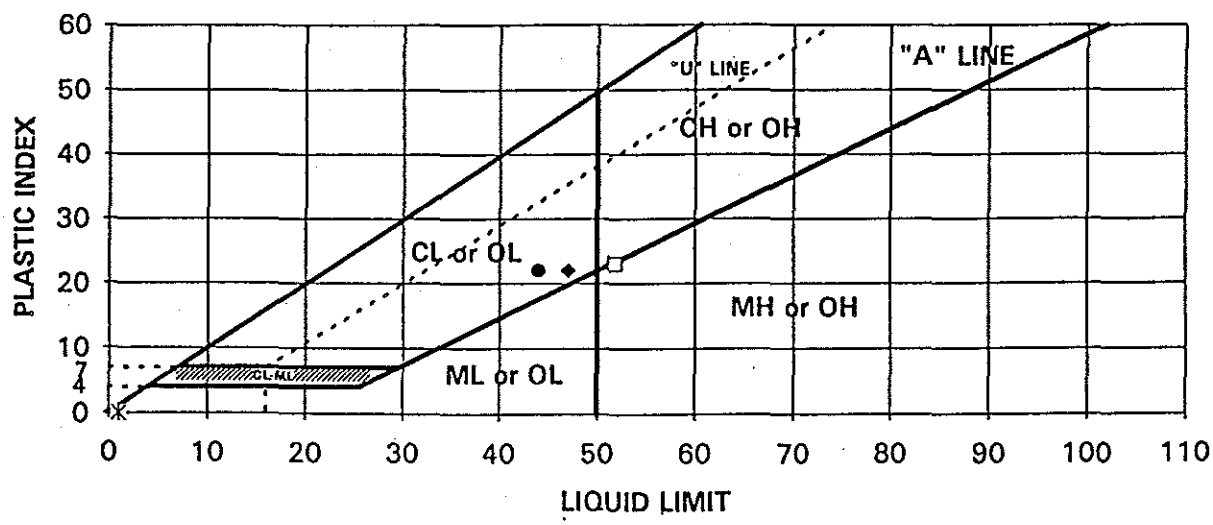
PROJECT NO.
774702.00110000

ATTERBERG LIMITS RESULTS

LAB SAMPLE NO.	FIELD SAMPLE NO.	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS SYMBOL
ETDC-7439 •	B-2 @ 5'-7'	44	22	22	CL
ETDC-7442 ◆	B-1 @ 2'-4'	47	25	22	CL
ETDC-7443 □	B-1 @ 9'-11'	52	29	23	CH
◊					
+					
○					
■					
×					
Δ					
*					

*NP = Nonplastic

PLASTICITY CHART



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IT Project ID: LMES-IWQP Core Hole 8
IT Project No.: 774702.00110000

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SOIL CLASSIFICATION ASTM D 2487

PROJECT NAME: LMES-IWQP Core Hole 8 **PROJECT NO:** 774702.00110000

	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5
ETDC NUMBER:	ETDC-7439	ETDC-7442	ETDC-7443		
CLIENT NUMBER:	B-2 @ 5'-7'	B-1 @ 2'-4'	B-1 @ 9'-11'		
(COARSE-GRAVELS, SANDS) % RETAINED ON # 200 SIEVE:	14.3	60.0	57.6		
(FINE-SILTS, CLAYS) % PASSING # 200 SIEVE:	85.7	40.0	42.4		
% GRAVEL:	2.4	25.1	19.3		
% SAND:	11.9	35.0	38.3		
D60 IN MM (DIAMETER AT 60% PASSING):	0.01106	1.61884	1.28532		
D30 IN MM (DIAMETER AT 30% PASSING):	0.00113	0.01472	0.00967		
D10 IN MM (DIAMETER AT 10% PASSING):	0.00038	0.00076	#N/A		
Cc:	29.46	2126.49	#N/A		
Cu:	0.31	0.18	#N/A		
LIQUID LIMIT:	44	46	52		
PLASTIC INDEX:	23	21	23		
ATTERBERG CLASSIFICATION*:	CL	CL	CH		

	SAMPLE 6	SAMPLE 7	SAMPLE 8	SAMPLE 9	SAMPLE 10
ETDC NUMBER:					
CLIENT NUMBER:					
(COARSE-GRAVELS, SANDS) % RETAINED ON # 200 SIEVE:					
(FINE-SILTS, CLAYS) % PASSING # 200 SIEVE:					
% GRAVEL:					
% SAND:					
D60 IN MM (DIAMETER AT 60% PASSING):					
D30 IN MM (DIAMETER AT 30% PASSING):					
D10 IN MM (DIAMETER AT 10% PASSING):					
Cc:					
Cu:					
LIQUID LIMIT:					
PLASTIC INDEX:					
ATTERBERG CLASSIFICATION*:					

*FINES< #40 SIEVE (0.425 mm)

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SOIL CLASSIFICATION ASTM D 2487

PROJECT NAME: LMES-IWQP Core Hole 8

PROJECT NO: 774702.00110000

	IT LAB NUMBER:	CLIENT SAMPLE NUMBER:	GROUP SYMBOL:	CLASSIFICATION-GROUP NAME:
SAMPLE 1:	ETDC-7439	B-2 @ 5'-7'	CL	LEAN CLAY
SAMPLE 2:	ETDC-7442	B-1 @ 2'-4'	SC	CLAYEY SAND WITH GRAVEL
SAMPLE 3:	ETDC-7443	B-1 @ 9'-11'	SC	CLAYEY SAND WITH GRAVEL
SAMPLE 4:				
SAMPLE 5:				
SAMPLE 6:				
SAMPLE 7:				
SAMPLE 8:				
SAMPLE 9:				
SAMPLE 10:				

****

Mary Collins-Shepard
Commodore ASI
April 6, 1998
IT Project ID: LMES-IWQP Core Hole 8
IT Project No.: 774702.00110000

IT GEOTECHNICAL
LABORATORY
OAK RIDGE, TN
(423)482-6497

SPECIFIC GRAVITY of SOILS

PROJECT NAME: LMES-IWQP Core Hole 8

PROJECT NUMBER: 774702.00110000

IT SAMPLE NUMBER	CLIENT SAMPLE NUMBER	D 854 SPECIFIC GRAVITY*	C 127* SPECIFIC GRAVITY	BULK SPECIFIC GRAVITY	APPARENT SPECIFIC GRAVITY	AVERAGE APPARENT SPEC. GRAV.	BULK SPEC. GRAVITY SSD	ABSORPTION %
ETDC-7439	B-2 @ 5'-7'	2.7203						
ETDC-7442	B-1 @ 2'-4'	2.7387	1.8853	2.7558	2.7472	2.7408	2.1991	16.64
ETDC-7443	B-1 @ 9'-11'	2.7810	1.7695	2.7880	2.6816	2.7612	2.1096	19.22
ETDC-7443	B-1 @ 9'-11'	2.8179	(Coarse fraction)					
ETDC-7442	B-1 @ 2'-4'	2.8080	(Coarse fraction)					

Specific gravity of coarse sample portion by ASTM C 127 does not provide accurate results for weathered shale.

Bulk specific gravity calculated using coarse and fine fraction results as determined by ASTM D 854.

* Tests by ASTM C 127 yielded abnormally low results, did not use in calculating Average Bulk Specific Gravity

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BULK DENSITY/DRY DENSITY
EM-1110-2-1906,
APPENDIX II

PROJECT NAME:
LMES-IWQP Core Hole 8

PROJECT NUMBER:
774702.00110000

ETDC SAMPLE NUMBER:	CLIENT SAMPLE NUMBER:	AVERAGE LENGTH, INCHES:	AVERAGE DIAMETER, INCHES:	WET WEIGHT, GRAMS:	MOISTURE CONTENT, %:	BULK DENSITY, PCF:	DRY DENSITY, PCF:
ETDC-7442	B-1 @ 2'-4'	5.6075	2.6702	1067.92	24.2	129.6	104.4
ETDC-7443	B-1 @ 9'-11'	4.7915	2.8665	975.99	35.1	120.3	89.0

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IT Project ID: LMES-IWQP Core Hole 8
IT Project No.: 774702.00110000

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PHASE RELATIONS
EM-1110-2-1906, APPENDIX II

PROJECT NAME:
LMES-IWQP Core Hole 8

PROJECT NUMBER:
774702.00110000

IT LAB SAMPLE NUMBER:	CLIENT SAMPLE NUMBER:	SPECIFIC GRAVITY:	A OR M*:	POROSITY, %:	PORE VOLUME, CC:	VOID RATIO:	DEGREE OF SATURATION, %:
ETDC-7442	B-1 @ 2'-4'	2.7558	M	39.35	202.46	0.6487	102.7
ETDC-7443	B-1 @ 9'-11'	2.7880	M	48.88	247.68	0.9561	102.5

* Assumed or Measured specific gravity

Moisture content calculated by ASTM D 2216 based on sample dry weight.

Bulk density is the weight of wet sample divided by the weight of the wet sample (as-received).

Dry density is the weight of the dry sample solids divided by the volume of the original sample.

Specific gravity is the ratio of the weight of a volume of sample to the weight of an equal volume of water.

Degree of saturation is the percentage of void spaces filled with water.

Void ratio is the ratio of the volume of voids to the volume of dry solids in the original sample volume.

Effective porosity is the ratio of the volume of voids to the total sample volume. Effective prosity includes any voids contained within, and isolated in, solid particles.

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IT Project ID: LMES-IWQP Core Hole 8
IT Project No.: 774702.00110000

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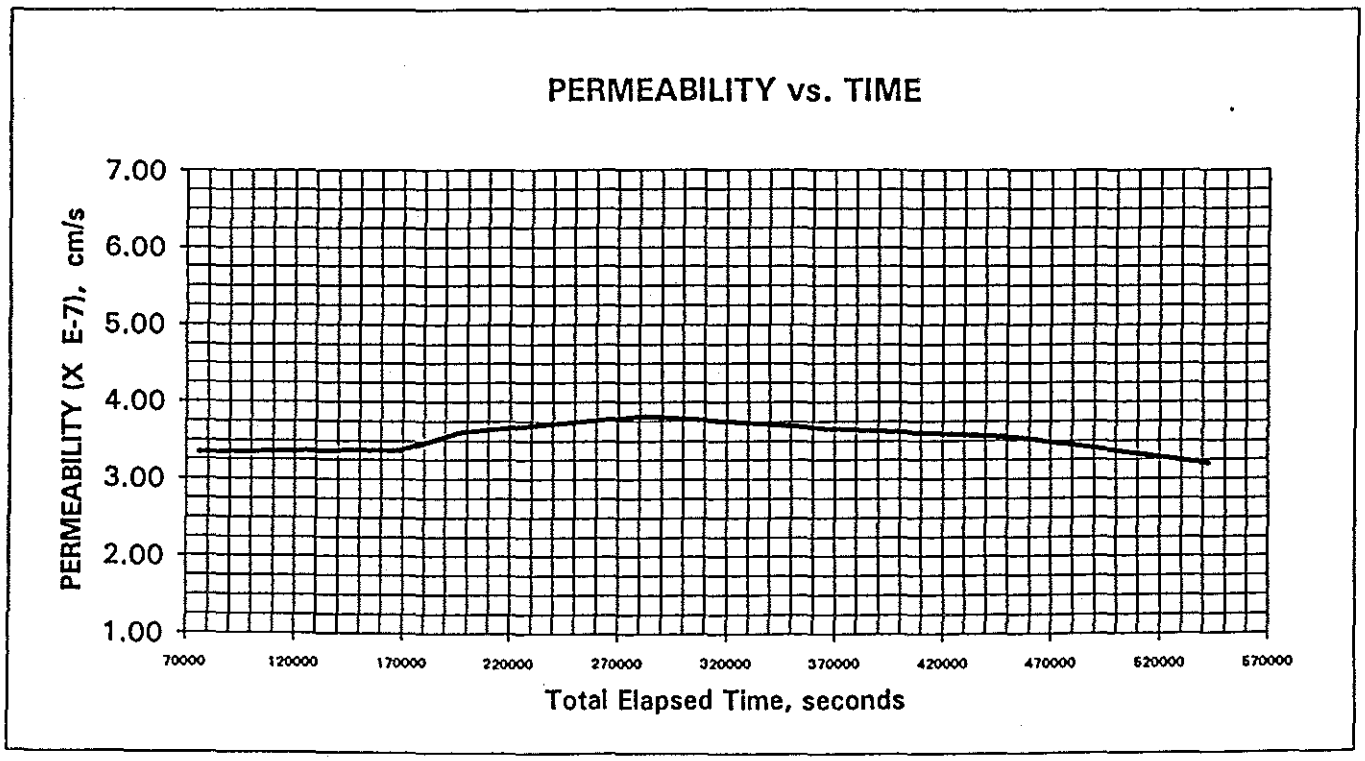
CONSTANT HEAD PERMEABILITY
ASTM D 5084

PROJECT NAME:	LMES-IWQP Core Hole 8	CLIENT SAMPLE NO.	B-1 @ 2'-4'
PROJECT NO.	774702.00110000	IT LAB SAMPLE NO.	ETDC-7442

	INITIAL		
Specimen diameter, cm	6.78		
Specimen length, cm	14.24	Hydraulic gradient	19.8
Wet weight of specimen, g.	1067.92	Min. consolidation stress, psi	1.0
Specimen cross-sect. area, sq.cm.	36.1272	Max. consolidation stress, psi	5.0
Initial water content, %	24.2	Total backpressure, psi	20.0
Wet unit weight, pcf	129.6		
Dry unit weight, pcf	104.4	Permeant Fluid	Deaired DI Water
Estimated degree of saturation, %	102.7		
Specific gravity of solids	2.7558		

Coefficient of Permeability, cm/s: 3.6E-07



Mary Collins-Shepard
Commodore ASI
April 6, 1998
IT Project ID: LMES-IWQP Core Hole 8
IT Project No.: 774702.00110000

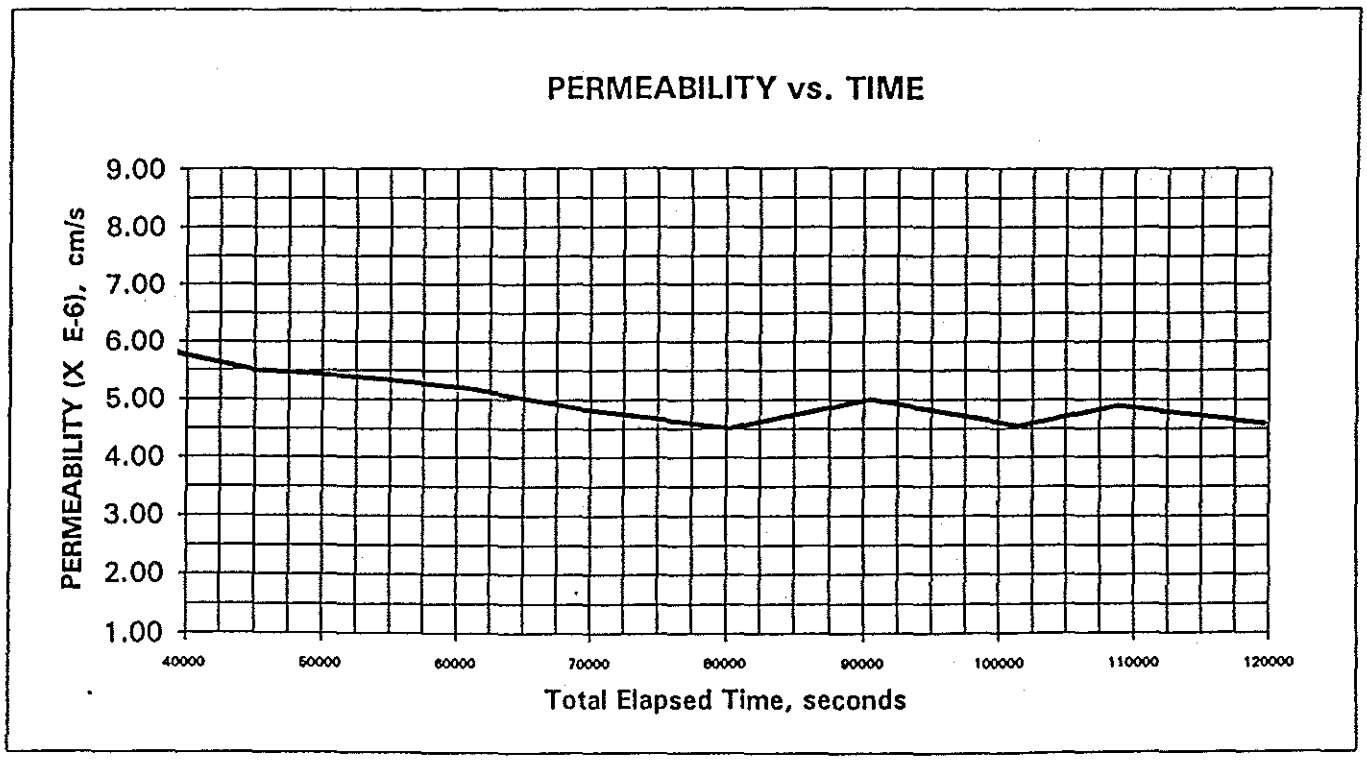
IT GEOTECHNICAL LABORATORY
OAK RIDGE, TN
(423)482-6497

CONSTANT HEAD PERMEABILITY
ASTM D 5084

PROJECT NAME:	LMES-IWQP Core Hole 8	CLIENT SAMPLE NO.	B-1 @ 9'-11'
PROJECT NO.	774702.00110000	IT LAB SAMPLE NO.	ETDC-7443

	INITIAL		
Specimen diameter, cm	7.28		
Specimen length, cm	12.16	Hydraulic gradient	11.6
Wet weight of specimen, g.	975.99	Min. consolidation stress, psi	1.0
Specimen cross-sect. area, sq.cm.	41.64	Max. consolidation stress, psi	3.0
Initial water content, %	35.1	Total backpressure, psi	22.0
Wet unit weight, pcf	120.3		
Dry unit weight, pcf	89.0	Permeant Fluid	Deaired DI Water
Estimated degree of saturation, %	102.6		
Specific gravity of solids	2.7880		

Coefficient of Permeability, cm/s	4.7E-06



Appendix C

Chain-of-Custody & Request-for-Analysis

CHAIN OF CUSTODY

Sample ID	Sample Location	Sample Date	Sample Time	Sample Type	Container Type	Container Volume	Preservative	Requested Analysis	Transferred from FAS No.	Remarks
B-2	5'-7'	25 FEB 98	8:30 A.M.	SOIL	HDPE	1 L	NONE	MOISTURE CONT. ATTERBERG LIMITS	NA	ETDC 7438
B-2	5'-7'	25 FEB 98	8:30 a.m.	SOIL	HD PE	1 L	"	"	"	ETDC 7439
B-2	0-2	24 FEB 98	1430	SOIL	HDPE	500 mL	"	MOISTURE CONT.	NA	ETDC 7440
B-1	12'-14'	27-FEB-98	1430	Soil	HDPE	500 mL	"	MOISTURE CONTENT	NA	ETDC 7441
B-1	2'-4'	27-FEB-98	1030	Soil	Shelby	Tube	NONE	GEOTECH	NA	ETDC 7442
B-1	9'-11"	27-FEB-98	1350	Soil	Shelby	Tube	NONE	GEOTECH	NA	ETDC 7443

Sample Types: RB = Rinse Blank, FB = Field Blank, TB = Trip Blank, FLD = Field Sample, MS/MSD

Container Types: P = High Density Polyethylene, G = Glass, T = Teflon

Preservative: A = HCl to pH < 2, B = HNO_3 to pH < 2, C = H_2SO_4 to pH < 2, D = NaOH to pH > 12, E = Other (Specify)

Laboratory: IT LABORATORY	Date Submitted to Lab: 27 FEB 98		SDG ID:	Cooler Temperature: N/A °C	
Relinquished By: Vicki Stanberg	Date: 2/27/98	Time: 17:45	Received By: [signature]	Date: 2-27-98	Time: 1745
Relinquished by:	Date:	Time:	Received By:	Date:	Time:
Relinquished by:	Date:	Time:	Received By:	Date:	Time:
Sample Disposed by:		Date:	Time:	Airbill No.:	

Form Bar Code Label

COCF
12/2/93

COC-01

Level C Data Validation Report
Core Hole 8 Lab Data
Package 98-03014-OR

The samples shown below were validated for all radiochemical analyses cited in Statement of Work for Validation of Core Hole 8 Lab Data.

Batch #	Sample #	Analysis Requested
98-03014-OR	CH80002 Dup	Americium-241, Cesium-137, Cobalt-60, Curium-243/244, Europium-152,-154,-155, Gross Alpha/Beta, Gross Gamma, Isotopic Plutonium, Technetium-99, Isotopic Thorium, Total Strontium, Total Uranium, Tritium, Isotopic Uranium
98-03014-OR	CH80002	Americium-241, Cesium-137, Cobalt-60, Curium-243/244, Europium-152,-154,-155, Gross Alpha/Beta, Gross Gamma, Isotopic Plutonium, Technetium-99, Isotopic Thorium, Total Strontium, Total Uranium, Tritium, Isotopic Uranium
98-03014-OR	CH80014	Americium-241, Cesium-137, Cobalt-60, Curium-243/244, Europium-152,-154,-155, Gross Alpha/Beta, Gross Gamma, Isotopic Plutonium, Technetium-99, Isotopic Thorium, Total Strontium, Total Uranium, Tritium, Isotopic Uranium
98-03014-OR	CH80019	Cesium-137, Cobalt-60, Europium-152, -154, -155, Gross Gamma
98-03014-OR	CH80018	Americium-241, Cesium-137, Cobalt-60, Curium-243/244, Europium-152,-154,-155, Gross Alpha/Beta, Gross Gamma, Isotopic Plutonium, Technetium-99, Isotopic Thorium, Total Strontium, Total Uranium, Tritium, Isotopic Uranium

98-03014-OR	CH80020	Americium-241, Cesium-137, Cobalt-60, Curium-243/244, Europium-152,-154,-155, Gross Alpha/Beta, Gross Gamma, Isotopic Plutonium, Technetium-99, Isotopic Thorium, Total Strontium, Total Uranium, Tritium, Isotopic Uranium

A Level C validation was performed on the radiochemical analytical data from the above-listed soil samples collected by Commodore Advanced Sciences, Incorporated, at the Oak Ridge National Laboratory (ORNL). Thermo NUtech laboratory in Oak Ridge analyzed the samples in accordance with USEPA 900 series modified methods. The data were evaluated based on the data validation guidelines detailed in LMES, *ERWM Programs Intersite Procedures Manual*, ERWM/ER-P2209.

Any actions and qualifications made on the analytical data as a result of the review of the QC and raw data are discussed below.

Attached to this report are copies of the laboratory-produced data tables/result forms. Any recommended qualifiers have been added by hand (in red) to the results and are discussed herein. In addition to the attached results, the work sheets associated with this data validation are included.

Isotopic Uranium (U-233/34, U-235, U-238)

For sample CH80002, the uranium-235 result was qualified as "UJ" because the nondetect result had an error that was greater than 80% of the sample result. Uranim-238 was only qualified as a nondetect for this sample.

All other data were acceptable as reported.

Total Uranium

All data are acceptable as reported.

Isotopic Thorium (Th-228, Th-230, Th-232)

For samples CH80014, CH80018, and CH80020, the thorium-232 results were qualified as "J" because the laboratory duplicate normalized difference was greater than 1.96, which signifies that the duplicate and sample differ at the 5% level of significance. Since the tracer recovery was out of control also, these samples were qualified.

For sample CH80002 and the duplicate, the thorium-230 result was qualified as "R" because the absolute normalized difference of the method blank was between 0 and 1.96, which signifies that the method blank and the sample results differ at the 1% level of significance. The tracer recovery also exceeded the control limits. There was an abundance of uranium in the sample which interferred greatly with all of the thorium results and caused the thorium results to be biased positive, therefore resulting in the qualification of this sample.

For sample CH80002 and the duplicate, the thorium-228 result was qualified as "UJ" because the nondetect result had an error that was greater than 80% of the result. The thorium-232 was qualified as a nondetect for this sample.

All other data were acceptable as reported.

Isotopic Plutonium (Pu-238, Pu239/40)

For sample CH80002, the plutonium-238, -239/40 result was qualified as "UJ" because the nondetected results had an error that was greater than 80% of the sample result.

All other data were acceptable as reported.

Gross Alpha/Beta

For samples CH80014, CH80018, and CH80020, the gross alpha results were qualified as "J" because the normalized difference of the laboratory control sample (LCS) showed a positive bias for these samples.

For samples CH80014, CH80018, and CH80020, the gross beta results were qualified as "J" because the normalized difference of the LCS showed a positive bias greater than 2.58. These samples were not qualified as "R" because all other associated QC were within the control limits.

For sample CH80002, the gross alpha and gross beta results were qualified as "UJ" because the nondetected results had errors that were greater than 80% of the result.

Gross Gamma, Cesium-137, Cobalt-60, Europium-152, -154, -155,

For sample CH80014, the gross gamma result was qualified as "R" because the laboratory could not determine spectral data. Based on the x-ray continuum and the differences in gross beta versus strontium results, the validator feels that this sample should be rejected although there is a strong possibility that there is cesium-137 activity.

For samples CH80002, CH80018, CH80019, and CH80020, the gross gamma results were qualified as "J" because some peaks may be false positive due to secondary energy lines or software false identification.

For sample CH80002, the cobalt-60 and europium-152, -154, -155 results were qualified as "UJ" because the nondetects had errors that were greater than 80% of the sample result.

For sample CH80014, the cesium-137, cobalt-60, and europium-152, -154, -155 results were qualified as "UJ" because the nondetects had errors that were greater than 80% of the sample result.

For sample CH80019, all of the reported gamma isotopes except gross gamma were qualified as "UJ" because the nondetects had errors that were greater than 80% of the sample result. The gross gamma result was very positive; however, it appeared from laboratory results that the gross gamma results should be considered estimated since the laboratory had problems identifying peaks.

For sample CH80018, the europium-152 result was qualified as "UJ" because the nondetect result had an error greater than 80% of the sample result.

For sample CH80020, the cobalt-60, europium-154, -155, and tritium results were qualified as "UJ" because the nondetect results had errors that were greater than 80% of the sample result.

Total Strontium

All data were acceptable as reported.

Technetium-99

For samples CH80014, CH80018, and CH80020, the results were qualified as "J" because the normalized difference in the LCS showed a positive bias for these samples.

For sample CH80002, the result was qualified as "UJ" because the nondetect result had an error that was greater than 80% of the sample result.

Americium-241, Curium-243/244

All data were acceptable as reported.

Tritium

For samples CH80002, CH80014, and CH80020, the results were qualified as "UJ" because the nondetect results had errors that were greater than 80% of the sample results.

Summary of Actions

The tracer recovery was exceeded for isotopic uranium, isotopic thorium, americium-241, and curium-243, -244; however, the samples were only qualified if there were other supporting QC data out of the control limits.

RPDs were outside control limits for some radioisotopes either because of low activity or a background higher than the sample result. These situations are noted on the work sheets; however, no data were qualified for this reason.

There were several gamma results that were either qualified as estimated or rejected due to the high activity in the samples and the inability of the laboratory to obtain spectral data.

For isotopic thorium, the ability to separate the uranium from the thorium during analysis was not obtainable. Therefore, the thorium results are estimated due to the high uranium activity.

Comments

Analyses were performed in accordance with laboratory methods except the following:

The laboratory SOW was not available for review and comparison of requested methods, detection limits, and data delivery. The client told the validator that the detection limits were determined by the laboratory and that the data delivery was 14 days from date sampled.

No matrix spike was performed because of the high activity in the samples and it was agreed upon by the client.

All data with the exceptions noted above, however, seem to be usable as reported.

List of Acronyms

ERWM - Environmental Restoration and Waste Management

LCS - laboratory control sample

LMES - Lockheed Martin Energy Systems, Inc.

ORNL - Oak Ridge National Laboratory

QC - quality control

RPD - realtive percent difference

SOW - Statement of Work

USEPA - U.S. Environmental Protection Agency

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80002					
Sample Location: 0 - 5 feet (bgs[a])					
EML Am-01 Modified					
Americium-241 (DUP[b])	1.43	0.92	pCi/g	J	
Americium-241	1.27	0.78	pCi/g	J	
Curium-243/244	0.42	0.78	pCi/g	U	UJ
Curium-243/244 (DUP)	0.85	0.96	pCi/g	J	UJ
LANL ER-130 Modified					
Americium-241	98.23	3.21	pCi/g		
Americium-241 (DUP)	91.46	3.17	pCi/g		
Cesium-137	2473.00	2.12	pCi/g		
Cesium-137 (DUP)	2308.00	2.18	pCi/g		
Cobalt-60	0.10	0.40	pCi/g	U	UJ
Cobalt-60 (DUP)	0.25	0.37	pCi/g	J	U
Europium-152	0.23	2.09	pCi/g	U	UJ
Europium-152 (DUP)	0.28	2.26	pCi/g	U	UJ
Europium-154	0.62	1.43	pCi/g	U	UJ
Europium-154 (DUP)	-0.48	0.87	pCi/g	U	UJ
Europium-155	0.91	3.37	pCi/g	U	UJ
Europium-155 (DUP)	2.02	3.43	pCi/g	U	UJ
Gross Gamma	2603.64	23.95	pCi/g		J
Gross Gamma (DUP)	2526.88	177.74	pCi/g		J
LANL MLR-100 Modified					
Gross Alpha	11.34	27.26	pCi/g	U	UJ
Gross Alpha (DUP)	11.31	27.20	pCi/g	U	UJ
Gross Beta	17.72	60.21	pCi/g	U	UJ
Gross Beta (DUP)	30.12	60.18	pCi/g	U	UJ
EML Pu-02 Modified					
Plutonium-238	0.40	0.74	pCi/g	J	UJ
Plutonium-238 (DUP)	0.61	0.71	pCi/g	J	U
239/240	0.30	0.60	pCi/g	U	UJ
239/240 (DUP)	0.61	0.47	pCi/g	J	
EIChroM TCS01 Modified					
Technetium-99	-0.27	1.32	pCi/g	U	UJ
Technetium-99 (DUP)	0.58	1.30	pCi/g	U	UJ
EML Th-01 Modified					
Thorium-228	0.49	3.69	pCi/g	U	UJ
Thorium-228 (DUP)	0.56	3.76	pCi/g	U	UJ
Thorium-230		3.27	pCi/g	J	R
Thorium-230 (DUP)		2.32	pCi/g	J	R
Thorium-232	0.00	1.35	pCi/g	J	U
Thorium-232 (DUP)	-0.22	2.58	pCi/g	U	U

[a] bgs = below ground surface
[b] DUP = field duplicate
c Hot = highest beta/gamma reading measured during sample collection

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
ElChroM SRW01 Modified					
Total Strontium	9.42	7.14	pCi/g	J	
Total Strontium (DUP)	14.11	8.66	pCi/g		
ASTM D5174 Modified					
Total Uranium	1.5	0.10	µg/g		
Total Uranium (DUP)	1.47	0.10	µg/g		
EML U-02 Modified					
233/234	4.78	3.91	pCi/g	J	
233/234 (DUP)	5.63	2.37	pCi/g	J	
Uranium-235	0.74	4.00	pCi/g	U	UJ
Uranium-235 (DUP)	0.63	2.92	pCi/g	U	UJ
Uranium-238	0.00	3.23	pCi/g	J	U
Uranium-238 (DUP)	1.02	3.97	pCi/g	U	UJ
LANL ER-210 Modified					
Tritium	60.10	81.15	pCi/g	J	UJ
Sample ID: CH80014					
Sample Location: 5 feet to refusal (bgs)					
EML Am-01 Modified					
Americium-241	44788.53	1.56	pCi/g		
Curium-243/244	1914.67	1.41	pCi/g		
LANL ER-130 Modified					
Cesium-137	245.60	651.20	pCi/g	U	UJ
Cobalt-60	-3.03	654.20	pCi/g	U	UJ
Europium-152	-438.80	4216.00	pCi/g	U	UJ
Europium-154	394.90	1851.00	pCi/g	U	UJ
Europium-155	-98.83	601.00	pCi/g	U	UJ
Gross Gamma		632.6	pCi/g	U	R
LANL MLR-100 Modified					
Gross Alpha	84163.73	38.30	pCi/g		J
Gross Beta	509721.58	63.42	pCi/g		J
EML Pu-02 Modified					
Plutonium-238	2185.00	0.79	pCi/g		
239/240	3266.00	0.71	pCi/g		
ElChroM TCS01 Modified					
Technetium-99	22.39	1.30	pCi/g		J
EML Th-01 Modified					
Thorium-228	46.86	0.08	pCi/g		
Thorium-230	14.52	0.05	pCi/g		
Thorium-232	14.51	0.04	pCi/g		J

[a] bgs = below ground surface
[b] DUP = field duplicate
c Hot = highest beta/gamma reading measured during sample collection

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
EIChroM SRW01 Modified					
Total Strontium	5764.46	727.36	pCi/g		
ASTM D5174 Modified					
Total Uranium	160.83	0.10	µg/g		
EML U-02 Modified					
233/234	9693.15	3.74	pCi/g		
Uranium-235	59.97	1.79	pCi/g		
Uranium-238	86.44	3.21	pCi/g		
LANL ER-210 Modified					
Tritium	16.96	66.97	pCi/g	U	UJ
Tritium (DUP)	25.47	63.37	pCi/g	U	UJ
Sample ID: CH80018					
Sample Location: Hot[c] (DUP)					
EML Am-01 Modified					
Americium-241	1355.00	4.73	pCi/g		
Curium-243/244	1261.00	5.61	pCi/g		
LANL ER-130 Modified					
Americium-241	4762.00	51.95	pCi/g		
Cesium-137	52590.00	26.02	pCi/g		
Cobalt-60	12.24	12.63	pCi/g	J	U
Europium-152	13.24	59.65	pCi/g	U	UJ
Europium-154	13.63	34.32	pCi/g	U	
Europium-155	1560.00	52.40	pCi/g		
Gross Gamma	95232.87	1626.40	pCi/g		J
LANL MLR-100 Modified					
Gross Alpha	13087.83	34.06	pCi/g		J
Gross Beta	40352.68	62.53	pCi/g		J
EML Pu-02 Modified					
Plutonium-238	66.69	0.59	pCi/g		
239/240	122.20	0.43	pCi/g		
EIChroM TCS01 Modified					
Technetium-99	39.28	1.10	pCi/g		J
EML Th-01 Modified					
Thorium-228	25.50	0.16	pCi/g		
Thorium-230	6.46	0.13	pCi/g		
Thorium-232	4.85	0.12	pCi/g		J
EIChroM SRW01 Modified					
Total Strontium	13767.78	832.54	pCi/g		

[a] bgs = below ground surface
[b] DUP = field duplicate
c Hot = highest beta/gamma reading measured during sample collection

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
ASTM D5174 Modified					
Total Uranium	193.92	0.10	µg/g		
EML U-02 Modified					
233/234	14296.01	3.58	pCi/g		
Uranium-235	55.9	3.81	pCi/g		
Uranium-238	103.78	3.07	pCi/g		
LANL ER-210 Modified					
Tritium	85.99	81.35	pCi/g	J	
Sample ID: CH80019					
Sample Location: Hot					
LANL ER-130 Modified					
Cesium-137	10.32	53.89	pCi/g	U	UJ
Cobalt-60	9.52	63.51	pCi/g	U	UJ
Europium-152	275.80	451.00	pCi/g	J	UJ
Europium-154	-58.74	184.00	pCi/g	U	UJ
Europium-155	-24.67	99.47	pCi/g	U	UJ
Gross Gamma	26843.00	1398.00	pCi/g		J
Sample ID: CH80020					
Sample Location: Hot					
EML Am-01 Modified					
Americium-241	2879.00	4.71	pCi/g		
Curium-243/244	1640.00	5.16	pCi/g		
LANL ER-130 Modified					
Americium-241	4532.00	22.25	pCi/g		
Cesium-137	51860.00	33.58	pCi/g		
Cobalt-60	4.26	16.35	pCi/g	U	UJ
Europium-152	26.29	75.84	pCi/g	U	UJ
Europium-154	29.51	44.60	pCi/g	J	UJ
Europium-155	439.90	32.52	pCi/g		
Gross Gamma	78923.60	1101.76	pCi/g		J
LANL MLR-100 Modified					
Gross Alpha	31297.37	41.56	pCi/g		J
Gross Beta	156062	64.34	pCi/g		J
EML Pu-02 Modified					
Plutonium-238	263.30	0.62	pCi/g		
239/240	376.20	0.47	pCi/g		
ElChroM TCS01 Modified					
Technetium-99	41.76	1.14	pCi/g		J

[a] bgs = below ground surface
[b] DUP = field duplicate
c Hot = highest beta/gamma reading measured during sample collection

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
EML Th-01 Modified					
Thorium-228	41.89	0.06	pCi/g		
Thorium-230	13.11	0.03	pCi/g		
Thorium-232	12.80	0.06	pCi/g		J
EIChroM SRW01 Modified					
Total Strontium	33581.15	859.37	pCi/g		
ASTM D5174 Modified					
Total Uranium	128.31	0.10	µg/g		
EML U-02 Modified					
233/234	11855.53	2.91	pCi/g		
Uranium-235	26.47	1.79	pCi/g		
Uranium-238	119.07	1.45	pCi/g		
LANL ER-210 Modified					
Tritium	50.39	74.39	pCi/g	J	UJ
Sample ID: CH80096					
Sample Location: Soil Boring B3					
EML Am-01 Modified					
Americium-241 (DUP)	70.84	1.75	pCi/g		
Americium-241	60.91	1.61	pCi/g		
Curium-243/244	3.47	2.58	pCi/g	J	
Curium-243/244 (DUP)	5.61	2.21	pCi/g		
LANL ER-130 Modified					
Americium-241	34.93	1.33	pCi/g		
Americium-241 (DUP)	46.85	1.34	pCi/g		
Cesium-137	715.5	0.79	pCi/g		
Cesium-137 (DUP)	712.7	0.66	pCi/g		
Cobalt-60	-0.01	0.28	pCi/g	U	
Cobalt-60 (DUP)	-0.14	0.26	pCi/g	U	
Europium-152	-0.36	1.17	pCi/g	U	
Europium-152 (DUP)	0.5	1.83	pCi/g	U	
Europium-154	0.04	0.87	pCi/g	U	
Europium-154 (DUP)	0.31	1.03	pCi/g	U	
Europium-155	1.05	1.39	pCi/g	U	
Europium-155 (DUP)	0.61	1.39	pCi/g	U	
Gross Gamma	779.3	0.79	pCi/g		
Gross Gamma (DUP)	798.1	0.66	pCi/g		
LANL MLR-100 Modified					
Gross Alpha	59.56	8.57	pCi/g		
Gross Alpha (DUP)	54.99	8.6	pCi/g		
Gross Beta	578.51	13.32	pCi/g		
Gross Beta (DUP)	403.69	13.43	pCi/g		

[a] bgs = below ground surface
[b] DUP = field duplicate
c Hot = highest beta/gamma reading measured during sample collection

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
EML Pu-02 Modified					
Plutonium-238	4.25	0.17	pCi/g		
Plutonium-238 (DUP)	2.67	0.15	pCi/g		
239/240	6.39	0.14	pCi/g		
239/240 (DUP)	4.35	0.14	pCi/g		
EIChroM TCS01 Modified					
Technetium-99	0.63	1.19	pCi/g	U	
Technetium-99 (DUP)	0.54	1.18	pCi/g	U	
EML Th-01 Modified					
Thorium-228	2.34	0.11	pCi/g		
Thorium-228 (DUP)	2.8	0.22	pCi/g		
Thorium-230	0.73	0.06	pCi/g		
Thorium-230 (DUP)	1.1	0.12	pCi/g		
Thorium-232	1.28	0.06	pCi/g		
Thorium-232 (DUP)	1.65	0.07	pCi/g		
EIChroM SRW01 Modified					
Total Strontium	15.52	0.64	pCi/g		
Total Strontium (DUP)	10.54	0.93	pCi/g		
ASTM D5174 Modified					
Total Uranium	10.36	0.1	µg/g		
Total Uranium (DUP)	10.16	0.1	µg/g		
EML U-02 Modified					
233/234	4.52	0.05	pCi/g		
233/234 (DUP)	4.61	0.06	pCi/g		
Uranium-235	0.08	0.06	pCi/g	J	
Uranium-235 (DUP)	0.1	0.12	pCi/g	J	
Uranium-238	3.42	0.09	pCi/g		
Uranium-238 (DUP)	3.79	0.06	pCi/g		
LANL ER-210 Modified					
Tritium	4.64	3.92	pCi/g	J	

[a] bgs = below ground surface
[b] DUP = field duplicate
c Hot = highest beta/gamma reading measured during sample collection

Level C Data Validation Report
Core Hole 8 Lab Data
Package 103614

The samples shown below were validated for all organic and inorganic analyses cited in Statement of Work for Validation of Core Hole 8 Lab Data.

Batch #	Sample #	Analysis Requested
103614	CH80007	PCBs, Congeners
103614	CH80054	PCBs, Congeners
103614	CH80066	PCBs, Congeners
103614	CH80067	PCBs, Congeners
103614	CH80090	PCBs, Congeners
103614	CH80089	TCLP Volatiles
103614	CH80063	TCLP Volatiles
103614	CH80062	TCLP Volatiles
103614	CH80006	TCLP Volatiles
103614	CH80053	TCLP Volatiles
103614	CH80088	TCLP Semivolatiles
103614	CH80076	TCLP Semivolatiles
103614	CH80065	TCLP Semivolatiles
103614	CH80064	TCLP Semivolatiles
103614	CH80059	TCLP Semivolatiles
103614	CH80005	TCLP Metals
103614	CH80052	TCLP Metals
103614	CH80060	TCLP Metals
103614	CH80061	TCLP Metals
103614	CH80091	TCLP Metals
103614	CH80008	Mercury
103614	CH80055	Mercury
103614	CH80068	Mercury
103614	CH80069	Mercury
103614	CH80092	Mercury
103614	CH80074	Anions
103614	CH80058	Anions
103614	CH80094	Anions
103614	CH80075	Anions
103614	CH80011	Anions
103614	CH80009	Sulfide
103614	CH80056	Sulfide
103614	CH80070	Sulfide

Batch #	Sample #	Analysis Requested
103614	CH80071	Sulfide
103614	CH80093	Sulfide
103614	CH80010	Cations
103614	CH80072	Cations
103614	CH80073	Cations
103614	CH80057	Cations
103614	CH80095	Cations

A Level C validation was performed on the analytical data from the above-listed soil samples collected by Commodore Advanced Sciences, Incorporated, at the Oak Ridge National Laboratory (ORNL). Southwest Research Institute in San Antonio, Texas analyzed the samples in accordance with USEPA *Test Methods for Evaluating Solid Waste,* SW-846 procedures and EPA 300 series modified methods. The data were evaluated based on the data validation guidelines detailed in LMES, *ERWM Programs Intersite Procedures Manual,* ERWM/ER-P2210, P2211, and P2212.

Any actions and qualifications made on the analytical data as a result of the review of the QC and raw data are discussed below.

Attached to this report are copies of the laboratory-produced data tables/result forms. Any recommended qualifiers have been added by hand (in red) to the results and are discussed herein. In addition to the attached results, the work sheets associated with this data validation are included.

PCBs and Congeners

For all samples included in this SDG, the aroclors 1016 and 1260 results were qualified as "UJ" because the %RSD exceeded control limits.

For all samples included in this SDG, the congener BZ #206 results were qualified as "UJ" because the %RSD exceeded control limits.

For sample CH80090, the detected aroclor 1260 results were qualified as "J" because the %R for the surrogate exceeded 150%.

All other data were acceptable as reported.

TCLP Volatiles and TCLP Semivolatiles

All detected volatile sample results were qualified as "J" and all nondetected sample results except sample CH80090 were qualified as "R" because the holding time was exceeded for TCLP extraction. Nondetected results for sample CH80089 were qualified as "UJ" because the holding time exceedance was not as great.

All semivolatile sample results except sample CH80088 were qualified as "R" because the holding time was exceeded for TCLP extraction, and all of the results were undetected. Nondetected results for sample CH80088 were qualified as "UJ" because the holding time exceedance was not as great.

Sample CH80065 also was qualified "R" because 2 surrogates were out, one of which was less than 10%.

For samples CH80089, CH80063, CH80062, CH80006, and CH80053, the acetone and methylene chloride results were qualified as "U" because the sample results were less than 5 times the amount found in the blank.

TCLP Metals, Mercury, Anions, Cations, Sulfide

For samples CH80009, CH80056, CH80070, CH80071, and CH80093, the sulfide results were qualified as "R" because the holding times were exceeded and the preservation was improper.

For all samples analyzed for sulfate, the results quantified above the detection limit were qualified as "J" because the field blank and the rinseate had excessive contamination.

Summary of Actions

The results for aroclors 1016 and 1260 were estimated because the %RSD was above the control criteria. The results for congener BZ #206 was estimated nondetects because the %RSD was above the control limits.

The surrogate recovery was exceeded for aroclor 1260 in two samples. In one of the samples all of the results for aroclor 1260 were nondetects therefore no qualification was necessary. All the detected results for the other sample were qualified as estimated.

The matrix spike recoveries for congeners BZ#18 and BZ #110 were above the QC limit; however, no qualification was performed because all other QC was within control limits for these congeners.

The holding times for all organic TCLP extractions were exceeded. The method requires that all samples not detected above the detection limit not be used due to the degradation of the

compounds creating false negatives. All nondetected results for volatiles and semivolatiles were rejected with the exception of two samples in which the holding time was only exceeded by 2 days. All of the detected volatiles were qualified as estimated.

One semivolatile sample, which was already rejected due to the exceedance of the holding time, would also have been rejected because 2 surrogates were below the contol limit. One of the surrogates was less than 10%.

There were no semivolatiles detected in any of the samples.

Sample CH80063 was diluted due to the trichlorofluoromethane exceeding the initial calibration range. Both sets, diluted and undiluted, are reported. The most reliable results for the sample are contained in the diluted run. The detected concentrations in the original run were so low that when diluted, they were not quantitated above the detection limit. After observing the raw data, it is assumed that the original detected results were false positives; therefore, making the diluted run the most accurate.

The sulfide holding time for preserved samples is 7 days. The holding times were exceeded by 13 days for all samples except one which was exceeded by 9 days. Also the samples were not preserved with zinc acetate on the surface; therefore, all of the nondetected sample results were rejected. Since all of the results were nondetects, all of the sulfide samples were rejected.

The field blank and the rinseate sample had very high concentrations of sulfate reported. This is an indication of contamination in the field. Therefore all of the sample results for sulfate analysis that were quantitated above the detection limit were qualified as estimated.

Comments

Analyses were performed in accordance with laboratory methods except the following:

The client told the validator that the detection limits were determined by the laboratory and that the data delivery was 14 days from date sampled.

There were several samples that were shipped to the laboratory without signatures from the field on the COC. These samples were not rejected based on the field signatures on the adjoining pages and per client request.

The field QC samples for PCBs and congeners exceeded holding times and were not evaluated against the soil samples.

All data with the exceptions noted above, however, seem to be usable as reported.

Data Summary Key

J- The associated numerical value is an estimated quantity.

NJ- Presumptively present at an estimated quantity (use with TICs only)

R- Reject data due to quality control criteria exceeded. The data are unusable (compound may or may not be present). Re-sampling and re-analysis are necessary for verification.

U- The compound was analyzed for but was not detected. The associated numerical value is the sample quantitation limit. "U" qualifiers applied by data validator mean the result is considered non-detect due to blank contamination.

UJ- The compound was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

List of Acronyms

COC - chain of custody

ERWM - Environmental Restoration and Waste Management

LMES - Lockheed Martin Energy Systems, Inc.

ORNL - Oak Ridge National Laboratory

PCBs - polychlorinated biphenyls

QC - quality control

RPD - realtive percent difference

%RSD - percent relative standard deviation

SDG - sample delivery group

SOW - Statement of Work

TCLP - Toxicity Characteristic Leachate Procedure

USEPA - U.S. Environmental Protection Agency

Corehole 8 Soil Sampling - PCB Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80007					
Sample Location: 0-5 feet (bgs[a])					
SW846 Method 8080					
Aroclor-1016	20.0	16.7	µg/Kg	U	UJ
Anoclor-1221	20.0	16.7	µg/Kg	U	U
Aroclor-1232	20.0	16.7	µg/Kg	U	U
Aroclor-1242	20.0	16.7	µg/Kg	U	U
Aroclor-1248	20.0	16.7	µg/Kg	U	U
Aroclor-1254	20.0	16.7	µg/Kg	U	U
Aroclor-1260	20.0	16.7	µg/Kg	U	UJ
AR1268	20.0	16.7	µg/Kg	U	U
Sample ID: CH80054					
Sample Location: 5 feet-refusal (bgs)					
SW846 Method 8080					
Aroclor-1016	21.3	16.7	µg/Kg	U	UJ
Aroclor-1221	21.3	16.7	µg/Kg	U	U
Aroclor-1232	21.3	16.7	µg/Kg	U	U
Aroclor-1242	21.3	16.7	µg/Kg	U	U
Aroclor-1248	21.3	16.7	µg/Kg	U	U
Aroclor-1254	21.3	16.7	µg/Kg	U	U
Aroclor-1260	21.3	16.7	µg/Kg	U	UJ
AR1268	21.3	16.7	µg/Kg	U	U
Sample ID: CH80066					
Sample Location: Hot[b]					
SW846 Method 8080					
Aroclor-1016	22.6	16.7	µg/Kg	U	UJ
Aroclor-1221	22.6	16.7	µg/Kg	U	U
Aroclor-1232	22.6	16.7	µg/Kg	U	U
Aroclor-1242	22.6	16.7	µg/Kg	U	U
Aroclor-1248	22.6	16.7	µg/Kg	U	U
Aroclor-1254	22.6	16.7	µg/Kg	U	U
Aroclor-1260	22.6	16.7	µg/Kg	U	UJ
AR1268	22.6	16.7	µg/Kg	U	U
Sample ID: CH80067					
Sample Location: Hot (Duplicate)					
SW846 Method 8080					
Aroclor-1016	22.6	16.7	µg/Kg	U	UJ
Aroclor-1221	22.6	16.7	µg/Kg	U	U
Aroclor-1232	22.6	16.7	µg/Kg	U	U
Aroclor-1242	22.6	16.7	µg/Kg	U	U

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - PCB Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Aroclor-1248	22.6	16.7	µg/Kg	U	U
Aroclor-1254	22.6	16.7	µg/Kg	U	U
Aroclor-1260	22.6	16.7	µg/Kg	U	UJ
AR1268	22.6	16.7	µg/Kg	U	U
Sample ID: CH80090					
Sample Location: Soil Boring B3					
SW846 Method 8080					
Aroclor-1016	24.0	16.7	µg/Kg	U	UJ
Aroclor-1221	24.0	16.7	µg/Kg	U	U
Aroclor-1232	24.0	16.7	µg/Kg	U	U
Aroclor-1242	24.0	16.7	µg/Kg	U	U
Aroclor-1248	24.0	16.7	µg/Kg	U	U
Aroclor-1254	24.0	16.7	µg/Kg	U	U
Aroclor-1260	49.7	16.7	µg/Kg		J
AR1268	24.0	16.7	µg/Kg	U	U

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - PCB Congeners Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80007					
Sample Location: 0-5 feet (bgs[a])					
SW846 Method 8082					
BZ#1	2.99	2.50	µg/Kg	U	U
BZ#101	0.599	0.500	µg/Kg	U	U
BZ#110	0.599	0.500	µg/Kg	U	U
BZ#138	0.399	0.333	µg/Kg	U	U
BZ#141	0.399	0.333	µg/Kg	U	U
BZ#151	0.399	0.333	µg/Kg	U	U
BZ#153	0.399	0.333	µg/Kg	U	U
BZ#170	0.399	0.333	µg/Kg	U	U
BZ#18	0.798	0.666	µg/Kg	U	U
BZ#180	0.399	0.333	µg/Kg	U	U
BZ#183	0.399	0.333	µg/Kg	U	U
BZ#187	0.399	0.333	µg/Kg	U	U
BZ#206	0.798	0.666	µg/Kg	U	UJ
BZ#31	0.798	0.666	µg/Kg	U	U
BZ#44	0.599	0.500	µg/Kg	U	U
BZ#5	0.998	0.833	µg/Kg	U	U
BZ#52	2.40	2.00	µg/Kg	U	U
BZ#66	0.599	0.500	µg/Kg	U	U
BZ#87	0.599	0.500	µg/Kg	U	U
Sample ID: CH80054					
Sample Location: 5 feet-refusal (bgs)					
SW846 Method 8082					
BZ#1	3.20	2.50	µg/Kg	U	U
BZ#101	0.640	0.500	µg/Kg	U	U
BZ#110	0.640	0.500	µg/Kg	U	U
BZ#138	0.427	0.333	µg/Kg	U	U
BZ#141	0.427	0.333	µg/Kg	U	U
BZ#151	0.427	0.333	µg/Kg	U	U
BZ#153	0.427	0.333	µg/Kg	U	U
BZ#170	0.427	0.333	µg/Kg	U	U
BZ#18	0.854	0.666	µg/Kg	U	U
BZ#180	0.427	0.333	µg/Kg	U	U
BZ#183	0.427	0.333	µg/Kg	U	U
BZ#187	0.427	0.333	µg/Kg	U	U
BZ#206	0.854	0.666	µg/Kg	U	UJ
BZ#31	0.854	0.666	µg/Kg	U	U
BZ#44	0.640	0.500	µg/Kg	U	U
BZ#5	1.07	0.833	µg/Kg	U	U
BZ#52	2.56	2.00	µg/Kg	U	U
BZ#66	0.640	0.500	µg/Kg	U	U
BZ#87	0.640	0.500	µg/Kg	U	U

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - PCB Congeners Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80066					
Sample Location: Hot[b]					
SW846 Method 8082					
BZ#1	3.39	2.50	µg/Kg	U	U
BZ#101	0.678	0.500	µg/Kg	U	U
BZ#110	0.678	0.500	µg/Kg	U	U
BZ#138	0.452	0.333	µg/Kg	U	U
BZ#141	0.452	0.333	µg/Kg	U	U
BZ#151	0.452	0.333	µg/Kg	U	U
BZ#153	0.452	0.333	µg/Kg	U	U
BZ#170	0.452	0.333	µg/Kg	U	U
BZ#18	0.904	0.666	µg/Kg	U	U
BZ#180	0.452	0.333	µg/Kg	U	U
BZ#183	0.452	0.333	µg/Kg	U	U
BZ#187	0.452	0.333	µg/Kg	U	U
BZ#206	0.904	0.666	µg/Kg	U	UJ
BZ#31	0.904	0.666	µg/Kg	U	U
BZ#44	0.678	0.500	µg/Kg	U	U
BZ#5	1.13	0.833	µg/Kg	U	U
BZ#52	2.71	2.00	µg/Kg	U	U
BZ#66	0.678	0.500	µg/Kg	U	U
BZ#87	0.678	0.500	µg/Kg	U	U
Sample ID: CH80067					
Sample Location: Hot (Duplicate)					
SW846 Method 8082					
BZ#1	3.39	2.50	µg/Kg	U	U
BZ#101	0.677	0.500	µg/Kg	U	U
BZ#110	0.677	0.500	µg/Kg	U	U
BZ#138	0.452	0.333	µg/Kg	U	U
BZ#141	0.452	0.333	µg/Kg	U	U
BZ#151	0.452	0.333	µg/Kg	U	U
BZ#153	0.452	0.333	µg/Kg	U	U
BZ#170	0.452	0.333	µg/Kg	U	U
BZ#18	0.903	0.666	µg/Kg	U	U
BZ#180	0.452	0.333	µg/Kg	U	U
BZ#183	0.452	0.333	µg/Kg	U	U
BZ#187	0.452	0.333	µg/Kg	U	U
BZ#206	0.903	0.666	µg/Kg	U	UJ
BZ#31	0.903	0.666	µg/Kg	U	U
BZ#44	0.677	0.500	µg/Kg	U	U
BZ#5	1.13	0.833	µg/Kg	U	U
BZ#52	2.71	2.00	µg/Kg	U	U
BZ#66	0.677	0.500	µg/Kg	U	U
BZ#87	0.677	0.500	µg/Kg	U	U

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - PCB Congeners Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80090					
Sample Location: Soil Boring B3					
SW846 Method 8082					
BZ#1	3.60	2.50	µg/Kg	U	U
BZ#101	2.21	0.500	µg/Kg		
BZ#110	4.89	0.500	µg/Kg		
BZ#138	10.1	0.333	µg/Kg		
BZ#141	1.91	0.333	µg/Kg		
BZ#151	4.38	0.333	µg/Kg		
BZ#153	7.39	0.333	µg/Kg		
BZ#170	0.481	0.333	µg/Kg	U	U
BZ#18	0.961	0.666	µg/Kg	U	U
BZ#180	3.79	0.333	µg/Kg		
BZ#183	0.546	0.333	µg/Kg		
BZ#187	0.481	0.333	µg/Kg	U	U
BZ#206	0.961	0.666	µg/Kg	U	UJ
BZ#31	0.961	0.666	µg/Kg	U	U
BZ#44	0.721	0.500	µg/Kg	U	U
BZ#5	1.20	0.833	µg/Kg	U	U
BZ#52	4.60	2.00	µg/Kg		
BZ#66	6.15	0.500	µg/Kg		
BZ#87	6.57	0.500	µg/Kg		

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Volatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH8006					
Sample Location: 0-5 feet (bgs[a])					
SW846 Method 8260A					
Chloromethane		1	µg/L	U	R
Dichlorodifluoromethane		1	µg/L	U	R
Vinly Chloride		1	µg/L	U	R
Bromomethane		1	µg/L	U	R
Chloromethane		1	µg/L	U	R
Trichlorofluoromethane		1	µg/L	U	R
1,1-Dichloroethylene		1	µg/L	U	R
Acetone	11	1	µg/L		UJ
Carbone Disulfide	0.67	1	µg/L	J	J
Methylene Chloride	1.3	1	µg/L		UJ
Trans-1,2-Dichloroethylene		1	µg/L	U	R
2,2-Dichloropropane		1	µg/L	U	R
1,1-Dichloroethane		1	µg/L	U	R
Cis-1,2-Dichloroethylene		1	µg/L	U	R
2-Butanone		5	µg/L	U	R
Bromochloromethane		1	µg/L	U	R
Chloroform		1	µg/L	U	R
1,1,1-Trichloroethane		1	µg/L	U	R
1,1-Dichloropropene		1	µg/L	U	R
Carbon Tetrachloride		1	µg/L	U	R
1,2-Dichloroethane		1	µg/L	U	R
Benzene		1	µg/L	U	R
Trichloroethylene		1	µg/L	U	R
1,2-Dichloropropane		1	µg/L	U	R
Dibromomethane		1	µg/L	U	R
Bromodichloromethane		1	µg/L	U	R
Cis-1,3-Dichloropropylene		1	µg/L	U	R
4-Methyl-2-Pentanone		5	µg/L	U	R
Trans-1,3-Dichloropropylene		1	µg/L	U	R
Toluene	0.61	1	µg/L	J	J
1,1,2-Trichloroethane		1	µg/L	U	R
Tetrachloroethylene		1	µg/L	U	R
1,3-Dichloropropane		1	µg/L	U	R
2-Hexanone		5	µg/L	U	R
Dibromochloromethane		1	µg/L	U	R
1,2-Dibromoethane		1	µg/L	U	R
Chlorobenzene		1	µg/L	U	R
1,1,1,2-Tetrachloroethane		1	µg/L	U	R
Ethylbenzene		1	µg/L	U	R
M/P-Xylene		1	µg/L	U	R
O-Xylene		1	µg/L	U	R
Styrene		1	µg/L	U	R
Isopropyl Benzene		1	µg/L	U	R
Bromoform		1	µg/L	U	R
Bromobenzene		1	µg/L	U	R
1,1,2,2-Tetrachloroethane		1	µg/L	U	R

[a] bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Volatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
1,2,3-Trichloropropane		1	µg/L	U	R
N-Propyl Benzene		1	µg/L	U	R
2-Chlorotoluene		1	µg/L	U	R
1,3,5-Trimethyl Benzene		1	µg/L	U	R
4-Chlorotoluene		1	µg/L	U	R
Tertbutylbenzene		1	µg/L	U	R
1,2,4-Trimethylbenzene		1	µg/L	U	R
Sec-Butylbenzene		1	µg/L	U	R
P-Isopropyltoluene		1	µg/L	U	R
1,3-Dichlorobenzene		1	µg/L	U	R
1,4-Dichlorobenzene		1	µg/L	U	R
N-Butylbenzene		1	µg/L	U	R
1,2-Dichlorobenzene		1	µg/L	U	R
1,2-Dibromo-3-Chloropropane		1	µg/L	U	R
1,2,4-Trichlorobenzene		1	µg/l	U	R
Hexachlorobutadiene		1	µg/L	U	R
Naphthalene		1	µg/L	U	R
1,2,3-Trichlorobenzene		1	µg/L	U	R
Unknown	3	1	µg/L	J	NJ
Unknown	0.7	1	µg/L	J	NJ
Unknown	1.0	1	µg/L	J	NJ
Unknown	0.5	1	µg/L	J	NJ

Sample ID: CH80053
Sample Location: 5 feet-refusal (bgs)

SW846 Method 8260A

Chloromethane		1	µg/L	U	R
Dichlorodifluoromethane		1	µg/L	U	R
Vinly Chloride		1	µg/L	U	R
Bromomethane		1	µg/L	U	R
Chloromethane		1	µg/L	U	R
Trichlorofluoromethane		1	µg/L	U	R
1,1-Dichloroethylene		1	µg/L	U	R
Acetone	8.3	1	µg/L		UJ
Carbone Disulfide	1.1	1	µg/L		J
Methylene Chloride	2.6	1	µg/L		UJ
Trans-1,2-Dichloroethylene		1	µg/L	U	R
2,2-Dichloropropane		1	µg/L	U	R
1,1-Dichloroethane		1	µg/L	U	R
Cis-1,2-Dichloroethylene		1	µg/L	U	R
2-Butanone		5	µg/L	U	R
Bromochloromethane		1	µg/L	U	R
Chloroform		1	µg/L	U	R
1,1,1-Trichloroethane	0.56	1	µg/L	J	J
1,1-Dichloropropene		1	µg/L	U	R
Carbon Tetrachloride		1	µg/L	U	R
1,2-Dichloroethane		1	µg/L	U	R
Benzene		1	µg/L	U	R

[a] bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Volatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Trichloroethylene		1	µg/L	U	R
1,2-Dichloropropane		1	µg/L	U	R
Dibromomethane		1	µg/L	U	R
Bromodichloromethane		1	µg/L	U	R
Cis-1,3-Dichloropropylene		1	µg/L	U	R
4-Methyl-2-Pentanone		5	µg/L	U	R
Trans-1,3-Dichloropropylene		1	µg/L	U	R
Toluene	0.57	1	µg/L	J	J
1,1,2-Trichloroethane		1	µg/L	U	R
Tetrachloroethylene		1	µg/L	U	R
1,3-Dichloropropane		1	µg/L	U	R
2-Hexanone		5	µg/L	U	R
Dibromochloromethane		1	µg/L	U	R
1,2-Dibromoethane		1	µg/L	U	R
Chlorobenzene		1	µg/l	U	R
1,1,1,2-Tetrachloroethane		1	µg/L	U	R
Ethylbenzene		1	µg/L	U	R
M/P-Xylene		1	µg/L	U	R
O-Xylene		1	µg/L	U	R
Styrene		1	µg/L	U	R
Isopropyl Benzene		1	µg/L	U	R
Bromoform		1	µg/L	U	R
Bromobenzene		1	µg/L	U	R
1,1,2,2-Tetrachloroethane		1	µg/L	U	R
1,2,3-Trichloropropane		1	µg/L	U	R
N-Propyl Benzene		1	µg/L	U	R
2-Chlorotoluene		1	µg/L	U	R
1,3,5-Trimethyl Benzene		1	µg/L	U	R
4-Chlorotoluene		1	µg/L	U	R
Tertbutylbenzene		1	µg/L	U	R
1,2,4-Trimethylbenzene		1	µg/L	U	R
Sec-Butylbenzene		1	µg/L	U	R
P-Isopropyltoluene		1	µg/L	U	R
1,3-Dichlorobenzene		1	µg/L	U	R
1,4-Dichlorobenzene		1	µg/L	U	R
N-Butylbenzene		1	µg/L	U	R
1,2-Dichlorobenzene		1	µg/L	U	R
1,2-Dibromo-3-Chloropropane		1	µg/L	U	R
1,2,4-Trichlorobenzene		1	µg/L	U	R
Hexachlorobutadiene		1	µg/L	U	R
Naphthalene		1	µg/L	U	R
1,2,3-Trichlorobenzene		1	µg/L	U	R
Acetaldehyde	0.5	1	µg/L	NJ	NJ
Silanol, Trimethyl-		1	µg/L	NJ	R
Heptanal	0.5	1	µg/L	NJ	NJ
Octanal	1	1	µg/L	NJ	NJ
Unknown	0.7	1	µg/L	J	NJ
Nonanal	4	1	µg/L	NJ	NJ
Unknown	0.6	1	µg/L	J	NJ
Decanal	2	1	µg/L	NJ	NJ

[a] bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Volatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80062					
Sample Location: Hot[b]					
SW846 Method 8260A					
Chloromethane		1	µg/L	U	R
Dichlorodifluoromethane		1	µg/L	U	R
Vinly Chloride		1	µg/L	U	R
Bromomethane		1	µg/L	U	R
Chloromethane		1	µg/L	U	R
Trichlorofluoromethane	1.3	1	µg/L		J
1,1-Dichloroethylene		1	µg/L	U	R
Acetone	8.7	1	µg/L		UJ
Carbone Disulfide	0.97	1	µg/L	J	J
Methylene Chloride	2.0	1	µg/L		UJ
Trans-1,2-Dichloroethylene		1	µg/L	U	R
2,2-Dichloropropane		1	µg/L	U	R
1,1-Dichloroethane		1	µg/L	U	R
Cis-1,2-Dichloroethylene		1	µg/L	U	R
2-Butanone		5	µg/L	U	R
Bromochloromethane		1	µg/L	U	R
Chloroform		1	µg/L	U	R
1,1,1-Trichloroethane		1	µg/L	U	R
1,1-Dichloropropene		1	µg/L	U	R
Carbon Tetrachloride		1	µg/L	U	R
1,2-Dichloroethane		1	µg/L	U	R
Benzene	0.93	1	µg/L	J	J
Trichloroethylene		1	µg/L	U	R
1,2-Dichloropropane		1	µg/L	U	R
Dibromomethane		1	µg/L	U	R
Bromodichloromethane		1	µg/L	U	R
Cis-1,3-Dichloropropylene		1	µg/L	U	R
4-Methyl-2-Pentanone	14	1	µg/L		J
Trans-1,3-Dichloropropylene		1	µg/L	U	R
Toluene	14	1	µg/L		J
1,1,2-Trichloroethane		1	µg/L	U	R
Tetrachloroethylene		1	µg/L	U	R
1,3-Dichloropropane		1	µg/L	U	R
2-Hexanone		5	µg/L	U	R
Dibromochloromethane		1	µg/L	U	R
1,2-Dibromoethane		1	µg/L	U	R
Chlorobenzene		1	µg/L	U	R
1,1,1,2-Tetrachloroethane		1	µg/L	U	R
Ethylbenzene	1.3	1	µg/L		J
M/P-Xylene	3.7	1	µg/L		J
O-Xylene	1.4	1	µg/L		J
Styrene		1	µg/L	U	R
Isopropyl Benzene		1	µg/L	U	R
Bromoform		1	µg/L	U	R
Bromobenzene		1	µg/L	U	R
1,1,2,2-Tetrachloroethane		1	µg/L	U	R

[a] bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Volatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
1,2,3-Trichloropropane		1	µg/L	U	R
N-Propyl Benzene		1	µg/L	U	R
2-Chlorotoluene		1	µg/L	U	R
1,3,5-Trimethyl Benzene		1	µg/L	U	R
4-Chlorotoluene		1	µg/L	U	R
Tertbutylbenzene		1	µg/L	U	R
1,2,4-Trimethylbenzene		1	µg/L	U	R
Sec-Butylbenzene		1	µg/L	U	R
P-Isopropyltoluene		1	µg/L	U	R
1,3-Dichlorobenzene		1	µg/L	U	R
1,4-Dichlorobenzene		1	µg/L	U	R
N-Butylbenzene		1	µg/L	U	R
1,2-Dichlorobenzene		1	µg/L	U	R
1,2-Dibromo-3-Chloropropane		1	µg/L	U	R
1,2,4-Trichlorobenzene		1	µg/L	U	R
Hexachlorobutadiene		1	µg/L	U	R
Naphthalene	0.72	1	µg/L	J	J
1,2,3-Trichlorobenzene		1	µg/L	U	R
2-Heptanone	3	1	µg/L	NJ	NJ
Octanal	2	1	µg/L	NJ	NJ
Benzonfuran	0.8	1	µg/L	NJ	NJ
1H-Indene	10	1	µg/L	NJ	NJ
Nonanal	6	1	µg/L	NJ	NJ
Bicyclo 2.2.1 Heptan-2-One, 1	1	1	µg/L	J	NJ
Benzonfuran, 2-Methyl-	0.6	1	µg/L	J	NJ
Decanal	2	1	µg/L	NJ	NJ

Sample ID: CH80063
Sample Location: Hot (Duplicate)

SW846 Method 8260A

Chloromethane		1	µg/L	U	R
Dichlorodifluoromethane		1	µg/L	U	R
Vinly Chloride		1	µg/L	U	R
Bromomethane		1	µg/L	U	R
Chloromethane		1	µg/L	U	R
Trichlorofluoromethane	81	1	µg/L	E	J
1,1-Dichloroethylene		1	µg/L	U	R
Acetone	9.3	1	µg/L		UJ
Carbone Disulfide	0.89	1	µg/L	J	J
Methylene Chloride	1.5	1	µg/L		UJ
Trans-1,2-Dichloroethylene		1	µg/L	U	R
2,2-Dichloropropane		1	µg/L	U	R
1,1-Dichloroethane		1	µg/L	U	R
Cis-1,2-Dichloroethylene		1	µg/L	U	R
2-Butanone		5	µg/L	U	R
Bromochloromethane		1	µg/L	U	R
Chloroform		1	µg/L	U	R
1,1,1-Trichloroethane		1	µg/L	U	R

[a] bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Volatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
1,1-Dichloropropene		1	µg/L	U	R
Carbon Tetrachloride		1	µg/L	U	R
1,2-Dichloroethane		1	µg/L	U	R
Benzene		1	µg/L	U	R
Trichloroethylene		1	µg/L	U	R
1,2-Dichloropropane		1	µg/L	U	R
Dibromomethane		1	µg/L	U	R
Bromodichloromethane		1	µg/L	U	R
Cis-1,3-Dichloropropylene		1	µg/L	U	R
4-Methyl-2-Pentanone		5	µg/L	U	R
Trans-1,3-Dichloropropylene		1	µg/L	U	R
Toluene		1	µg/L	U	R
1,1,2-Trichloroethane		1	µg/L	U	R
Tetrachloroethylene		1	µg/L	U	R
1,3-Dichloropropane		1	µg/L	U	R
2-Hexanone		5	µg/L	U	R
Dibromochloromethane		1	µg/L	U	R
1,2-Dibromoethane		1	µg/L	U	R
Chlorobenzene		1	µg/L	U	R
1,1,1,2-Tetrachloroethane		1	µg/L	U	R
Ethylbenzene	0.50	1	µg/L	J	J
M/P-Xylene	2.4	1	µg/L		
O-Xylene	1.1	1	µg/L		
Styrene		1	µg/L	U	R
Isopropyl Benzene		1	µg/L	U	R
Bromoform		1	µg/L	U	R
Bromobenzene		1	µg/L	U	R
1,1,2,2-Tetrachloroethane		1	µg/L	U	R
1,2,3-Trichloropropane		1	µg/L	U	R
N-Propyl Benzene		1	µg/L	U	R
2-Chlorotoluene		1	µg/L	U	R
1,3,5-Trimethyl Benzene		1	µg/L	U	R
4-Chlorotoluene		1	µg/L	U	R
Tertbutylbenzene		1	µg/L	U	R
1,2,4-Trimethylbenzene		1	µg/L	U	R
Sec-Butylbenzene		1	µg/L	U	R
P-Isopropyltoluene		1	µg/L	U	R
1,3-Dichlorobenzene		1	µg/L	U	R
1,4-Dichlorobenzene		1	µg/L	U	R
N-Butylbenzene		1	µg/L	U	R
1,2-Dichlorobenzene		1	µg/L	U	R
1,2-Dibromo-3-Chloropropane		1	µg/L	U	R
1,2,4-Trichlorobenzene		1	µg/L	U	R
Hexachlorobutadiene		1	µg/L	U	R
Naphthalene		1	µg/L	U	R
1,2,3-Trichlorobenzene		1	µg/L	U	R
Acetaldehyde	2	1	µg/L	NJ	NJ
2-Heptanone	0.5	1	µg/L	NJ	NJ
Heptanal	0.8	1	µg/L	NJ	NJ
Octanal	2	1	µg/L	NJ	NJ

* bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Volatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Nonanal	5	1	µg/L	NJ	NJ
Bicyclo 2.2.1 Heptan-2-One	1	1	µg/L	J	NJ
Decanal	4	1	µg/L	NJ	NJ
Sample ID: CH80063DL					
Sample Locaton: Hot (Duplicate)					
SW846 Method 8260A					
Chloromethane		5	µg/L	U	R
Dichlorodifluoromethane		5	µg/L	U	R
Vinly Chloride		5	µg/L	U	R
Bromomethane		5	µg/L	U	R
Chloromethane		5	µg/L	U	R
Trichlorofluoromethane	78	5	µg/L	D	J
1,1-Dichloroethylene		5	µg/L	U	R
Acetone		25	µg/L	U	R
Carbone Disulfide		5	µg/L	U	R
Methylene Chloride		5	µg/L	U	R
Trans-1,2-Dichloroethylene		5	µg/L	U	R
2,2-Dichloropropane		5	µg/L	U	R
1,1-Dichloroethane		5	µg/L	U	R
Cis-1,2-Dichloroethylene		5	µg/L	U	R
2-Butanone		25	µg/L	U	R
Bromochloromethane		5	µg/L	U	R
Chloroform		5	µg/L	U	R
1,1,1-Trichloroethane		5	µg/L	U	R
1,1-Dichloropropene		5	µg/L	U	R
Carbon Tetrachloride		5	µg/L	U	R
1,2-Dichloroethane		5	µg/L	U	R
Benzene		5	µg/L	U	R
Trichloroethylene		5	µg/L	U	R
1,2-Dichloropropane		5	µg/L	U	R
Dibromomethane		5	µg/L	U	R
Bromodichloromethane		5	µg/L	U	R
Cis-1,3-Dichloropropylene		5	µg/L	U	R
4-Methyl-2-Pentanone		25	µg/L	U	R
Trans-1,3-Dichloropropylene		5	µg/L	U	R
Toluene		5	µg/L	U	R
1,1,2-Trichloroethane		5	µg/L	U	R
Tetrachloroethylene		5	µg/L	U	R
1,3-Dichloropropane		5	µg/L	U	R
2-Hexanone		25	µg/L	U	R
Dibromochloromethane		5	µg/L	U	R
1,2-Dibromoethane		5	µg/L	U	R
Chlorobenzene		5	µg/L	U	R
1,1,1,2-Tetrachloroethane		5	µg/L	U	R
Ethylbenzene		5	µg/L	U	R
M/P-Xylene		5	µg/L	U	R
O-Xylene		5	µg/L	U	R

[a] bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Styrene		5	µg/L	U	R
Isopropyl Benzene		5	µg/L	U	R
Bromoform		5	µg/L	U	R
Bromobenzene		5	µg/L	U	R
1,1,2,2-Tetrachloroethane		5	µg/L	U	R
1,2,3-Trichloropropane		5	µg/L	U	R
N-Propyl Benzene		5	µg/L	U	R
2-Chlorotoluene		5	µg/L	U	R
1,3,5-Trimethyl Benzene		5	µg/L	U	R
4-Chlorotoluene		5	µg/L	U	R
Tertbutylbenzene		5	µg/L	U	R
1,2,4-Trimethylbenzene		5	µg/L	U	R
Sec-Butylbenzene		5	µg/L	U	R
P-Isopropyltoluene		5	µg/L	U	R
1,3-Dichlorobenzene		5	µg/L	U	R
1,4-Dichlorobenzene		5	µg/L	U	R
N-Butylbenzene		5	µg/L	U	R
1,2-Dichlorobenzene		5	µg/L	U	R
1,2-Dibromo-3-Chloropropane		5	µg/L	U	R
1,2,4-Trichlorobenzene		5	µg/L	U	R
Hexachlorobutadiene		5	µg/L	U	R
Naphthalene		5	µg/L	U	R
1,2,3-Trichlorobenzene		5	µg/L	U	R

Sample ID: CH80089
Sample Location: Soil Boring B3

SW846 Method 8260A

Chloromethane	1	1	µg/L	U	UJ
Dichlorodifluoromethane	1	1	µg/L	U	UJ
Vinly Chloride	1	1	µg/L	U	UJ
Bromomethane	1	1	µg/L	U	UJ
Chloromethane	1	1	µg/L	U	UJ
Trichlorofluoromethane	1	1	µg/L	U	UJ
1,1-Dichloroethylene	1	1	µg/L	U	UJ
Acetone	8.1	1	µg/L		UJ
Carbone Disulfide	0.55	1	µg/L	J	J
Methylene Chloride	1.1	1	µg/L		UJ
Trans-1,2-Dichloroethylene	1	1	µg/L	U	UJ
2,2-Dichloropropane	1	1	µg/L	U	UJ
1,1-Dichloroethane	1	1	µg/L	U	UJ
Cis-1,2-Dichloroethylene	1	1	µg/L	U	UJ
2-Butanone	5	5	µg/L	U	UJ
Bromochloromethane	1	1	µg/L	U	UJ
Chloroform	1	1	µg/L	U	UJ
1,1,1-Trichloroethane	1	1	µg/L	U	UJ
1,1-Dichloropropene	1	1	µg/L	U	UJ
Carbon Tetrachloride	1	1	µg/L	U	UJ
1,2-Dichloroethane	1	1	µg/L	U	UJ

* bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Volatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Benzene	1	1	µg/L	U	UJ
Trichloroethylene	1	1	µg/L	U	UJ
1,2-Dichloropropane	1	1	µg/L	U	UJ
Dibromomethane	1	1	µg/L	U	UJ
Bromodichloromethane	1	1	µg/L	U	UJ
Cis-1,3-Dichloropropylene	1	1	µg/L	U	UJ
4-Methyl-2-Pentanone	5	5	µg/L	U	UJ
Trans-1,3-Dichloropropylene	1	1	µg/L	U	UJ
Toluene	0.70	1	µg/L	J	J
1,1,2-Trichloroethane	1	1	µg/L	U	UJ
Tetrachloroethylene	1	1	µg/L	U	UJ
1,3-Dichloropropane	1	1	µg/L	U	UJ
2-Hexanone	5	5	µg/L	U	UJ
Dibromochloromethane	1	1	µg/L	U	UJ
1,2-Dibromoethane	1	1	µg/L	U	UJ
Chlorobenzene	1	1	µg/L	U	UJ
1,1,1,2-Tetrachloroethane	1	1	µg/L	U	UJ
Ethylbenzene	1	1	µg/L	U	UJ
M/P-Xylene	1	1	µg/L	U	UJ
O-Xylene	1	1	µg/L	U	UJ
Styrene	1	1	µg/L	U	UJ
Isopropyl Benzene	1	1	µg/L	U	UJ
Bromoform	1	1	µg/L	U	UJ
Bromobenzene	1	1	µg/L	U	UJ
1,1,2,2-Tetrachloroethane	1	1	µg/L	U	UJ
1,2,3-Trichloropropane	1	1	µg/L	U	UJ
N-Propyl Benzene	1	1	µg/L	U	UJ
2-Chlorotoluene	1	1	µg/L	U	UJ
1,3,5-Trimethyl Benzene	1	1	µg/L	U	UJ
4-Chlorotoluene	1	1	µg/L	U	UJ
Tertbutylbenzene	1	1	µg/L	U	UJ
1,2,4-Trimethylbenzene	1	1	µg/L	U	UJ
Sec-Butylbenzene	1	1	µg/L	U	UJ
P-Isopropyltoluene	1	1	µg/L	U	UJ
1,3-Dichlorobenzene	1	1	µg/L	U	UJ
1,4-Dichlorobenzene	1	1	µg/L	U	UJ
N-Butylbenzene	1	1	µg/L	U	UJ
1,2-Dichlorobenzene	1	1	µg/L	U	UJ
1,2-Dibromo-3-Chloropropane	1	1	µg/L	U	UJ
1,2,4-Trichlorobenzene	1	1	µg/L	U	UJ
Hexachlorobutadiene	1	1	µg/L	U	UJ
Naphthalene	1	1	µg/L	U	UJ
1,2,3-Trichlorobenzene	1	1	µg/L	U	UJ
Acetonitrile	0.6	1	µg/L	NJ	NJ
Unknown	0.8	1	µg/L	J	NJ
Unknown	0.5	1	µg/L	J	NJ

[a] bgs = below ground surface
b Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Semivolatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80076					
Sample Location: 0-5 feet (bgs[a])					
SW846 Method 8270A					
Pyridine		0.010	mg/L	U	R
1,4-Dichlorobenzene		0.010	mg/L	U	R
O-Cresol		0.010	mg/L	U	R
M&P-Cresol		0.020	mg/L	U	R
Hexachloroethane		0.010	mg/L	U	R
Nitrobenzene		0.010	mg/L	U	R
Hexachlorobutadiene		0.010	mg/L	U	R
2,4,6-Trichlorophenol		0.010	mg/L	U	R
2,4,5-Trichlorophenol		0.010	mg/L	U	R
2,4-Dinitrotoluene		0.010	mg/L	U	R
Hexachlorobenzene		0.010	mg/L	U	R
Pentachlorophenol		0.020	mg/L	U	R
Sample ID: CH80059					
Sample Location: 5 feet-refusal (bgs)					
SW846 Method 8270A					
Pyridine		0.010	mg/L	U	R
1,4-Dichlorobenzene		0.010	mg/L	U	R
O-Cresol		0.010	mg/L	U	R
M&P-Cresol		0.020	mg/L	U	R
Hexachloroethane		0.010	mg/L	U	R
Nitrobenzene		0.010	mg/L	U	R
Hexachlorobutadiene		0.010	mg/L	U	R
2,4,6-Trichlorophenol		0.010	mg/L	U	R
2,4,5-Trichlorophenol		0.010	mg/L	U	R
2,4-Dinitrotoluene		0.010	mg/L	U	R
Hexachlorobenzene		0.010	mg/L	U	R
Pentachlorophenol		0.020	mg/L	U	R
Sample ID: CH80064					
Sample Location: Hot[b]					
SW846 Method 8270A					
Pyridine		0.010	mg/L	U	R
1,4-Dichlorobenzene		0.010	mg/L	U	R
O-Cresol		0.010	mg/L	U	R
M&P-Cresol		0.020	mg/L	U	R
Hexachloroethane		0.010	mg/L	U	R
Nitrobenzene		0.010	mg/L	U	R
Hexachlorobutadiene		0.010	mg/L	U	R
2,4,6-Trichlorophenol		0.010	mg/L	U	R
2,4,5-Trichlorophenol		0.010	mg/L	U	R
2,4-Dinitrotoluene		0.010	mg/L	U	R

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Semivolatile Organics Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Hexachlorobenzene		0.010	mg/L	U	R
Pentachlorophenol		0.020	mg/L	U	R
Sample ID: CH80065					
Sample Location: Hot (Duplicate)					
SW846 Method 8270A					
Pyridine		0.010	mg/L	U	R
1,4-Dichlorobenzene		0.010	mg/L	U	R
O-Cresol		0.010	mg/L	U	R
M&P-Cresol		0.020	mg/L	U	R
Hexachloroethane		0.010	mg/L	U	R
Nitrobenzene		0.010	mg/L	U	R
Hexachlorobutadiene		0.010	mg/L	U	R
2,4,6-Trichlorophenol		0.010	mg/L	U	R
2,4,5-Trichlorophenol		0.010	mg/L	U	R
2,4-Dinitrotoluene		0.010	mg/L	U	R
Hexachlorobenzene		0.010	mg/L	U	R
Pentachlorophenol		0.020	mg/L	U	R
Sample ID: CH80088					
Sample Location: Soil Boring B3					
SW846 Method 8270A					
Pyridine	0.010	0.010	mg/L	U	UJ
1,4-Dichlorobenzene	0.010	0.010	mg/L	U	UJ
O-Cresol	0.010	0.010	mg/L	U	UJ
M&P-Cresol	0.020	0.020	mg/L	U	UJ
Hexachloroethane	0.010	0.010	mg/L	U	UJ
Nitrobenzene	0.010	0.010	mg/L	U	UJ
Hexachlorobutadiene	0.010	0.010	mg/L	U	UJ
2,4,6-Trichlorophenol	0.010	0.010	mg/L	U	UJ
2,4,5-Trichlorophenol	0.010	0.010	mg/L	U	UJ
2,4-Dinitrotoluene	0.010	0.010	mg/L	U	UJ
Hexachlorobenzene	0.010	0.010	mg/L	U	UJ
Pentachlorophenol	0.020	0.020	mg/L	U	UJ

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Metals Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80005					
Sample Location: 0-5 feet (bgs[a])					
SW846 Method 6010					
Arsenic	0.025	0.025	µg/ml	U	U
Barium	0.89	0.025	µg/ml		
Cadmium	0.025	0.025	µg/ml	U	U
Chromium	0.075	0.075	µg/ml	U	U
Lead	0.025	0.025	µg/ml	U	U
Mercury	0.00020	0.00020	µg/ml	U	U
Selenium	0.10	0.10	µg/ml	U	U
Silver	0.025	0.025	µg/ml	U	U
Sample ID: CH80052					
Sample Location: 5 feet-refusal (bgs)					
SW846 Method 6010					
Arsenic	0.025	0.025	µg/ml	U	U
Barium	0.26	0.025	µg/ml		
Cadmium	0.27	0.025	µg/ml		
Chromium	0.075	0.075	µg/ml	U	U
Lead	0.025	0.025	µg/ml	U	U
Mercury	0.00020	0.00020	µg/ml	U	U
Selenium	0.10	0.10	µg/ml	U	U
Silver	0.025	0.025	µg/ml	U	U
Sample ID: CH80060					
Sample Location: Hot[b]					
SW846 Method 6010					
Arsenic	0.025	0.025	µg/ml	U	U
Barium	0.99	0.025	µg/ml		
Cadmium	0.13	0.025	µg/ml		
Chromium	0.075	0.075	µg/ml	U	U
Lead	0.025	0.025	µg/ml	U	U
Mercury	0.00020	0.00020	µg/ml	U	U
Selenium	0.10	0.10	µg/ml	U	U
Silver	0.025	0.025	µg/ml	U	U
Sample ID: CH80061					
Sample Location: Hot (Duplicate)					
SW846 Method 6010					
Arsenic	0.025	0.025	µg/ml	U	U
Barium	0.30	0.025	µg/ml		
Cadmium	0.14	0.025	µg/ml		
Chromium	0.075	0.075	µg/ml	U	U

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - TCLP Metals Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Lead	0.064	0.025	µg/ml		
Mercury	0.00020	0.00020	µg/ml	U	U
Selenium	0.10	0.10	µg/ml	U	U
Silver	0.13	0.025	µg/ml		
Sample ID: CH80091					
Sample Location: Soil Boring B3					
SW846 Method 6010					
Arsenic	0.025	0.025	µg/ml	U	U
Barium	0.29	0.025	µg/ml		
Cadmium	0.025	0.025	µg/ml	U	U
Chromium	0.075	0.075	µg/ml	U	U
Lead	0.025	0.025	µg/ml	U	U
Mercury	0.00020	0.00020	µg/ml	U	U
Selenium	0.10	0.10	µg/ml	U	U
Silver	0.025	0.025	µg/ml	U	U

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - Total Mercury Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80008					
Sample Location: 0-5 feet (bgs[a])					
SW846 Method 7471					
Mercury	0.1	0.1	mg/Kg	U	U
Sample ID: CH80055					
Sample Location: 5 feet-refusal (bgs)					
SW846 Method 7471					
Mercury	1.8	0.1	mg/Kg		
Sample ID: CH80068					
Sample Location: Hot[b]					
SW846 Method 7471					
Mercury	3.8	0.1	mg/Kg		
Sample ID: CH80069					
Sample Location: Hot (Duplicate)					
SW846 Method 7471					
Mercury	7.5	0.1	mg/Kg		
Sample ID: CH80092					
Sample Location: Soil Boring B3					
SW846 Method 7471					
Mercury	0.13	0.1	mg/Kg	U	U

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - Anions Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80011					
Sample Location: 0-5 feet (bgs[a])					
EPA Method 300					
Bromide	<5	5	mg/Kg		U
Chloride	14	5	mg/Kg		
Fluoride	10.2	5	mg/Kg		
Nitrate-N	<5	5	mg/Kg		U
Nitrite-N	<5	5	mg/Kg		U
Phosphate-P	9.28	5	mg/Kg		
Sulfate	118	5	mg/Kg		J
Sample ID: CH80058					
Sample Location: 5 feet-refusal (bgs)					
EPA Method 300					
Bromide	<6	6	mg/Kg		U
Chloride	13.6	6	mg/Kg		
Fluoride	10.6	6	mg/Kg		
Nitrate-N	<6	6	mg/Kg		U
Nitrite-N	<6	6	mg/Kg		U
Phosphate-P	<6	6	mg/Kg		U
Sulfate	900	6	mg/Kg		J
Sample ID: CH80074					
Sample Location: Hot[b]					
EPA Method 300					
Bromide	45.1	5	mg/Kg		
Chloride	12.5	5	mg/Kg		
Fluoride	18.9	5	mg/Kg		
Nitrate-N	614	5	mg/Kg		
Nitrite-N	10.8	5	mg/Kg		
Phosphate-P	<5	5	mg/Kg		U
Sulfate	275	5	mg/Kg		J
Sample ID: CH80075					
Sample Location: Hot (Duplicate)					
EPA Method 300					
Bromide	25.4	6	mg/Kg		
Chloride	9.47	6	mg/Kg		
Fluoride	20	6	mg/Kg		
Nitrate-N	334	6	mg/Kg		
Nitrite-N	6.76	6	mg/Kg		
Phosphate-P	<6	6	mg/Kg		U
Sulfate	259	6	mg/Kg		J

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - Anions Analyses

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80094					
Sample Location: Soil Boring B3					
EPA Method 300					
Bromide	<6	6	mg/Kg		U
Chloride	10.3	6	mg/Kg		
Fluoride	7.06	6	mg/Kg		
Nitrate-N	21.2	6	mg/Kg		
Nitrite-N	<6	6	mg/Kg		U
Phosphate-P	7.81	6	mg/Kg		
Sulfate	14.1	6	mg/Kg		J

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

Corehole 8 Soil Sampling - Sulfides Analyses

ANALYTE	RESULTS[c]	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80009					
Sample Location: 0-5 feet (bgs[a])					
SW846 Method 9030					
Sulfides		50	mg/Kg		R
Sample ID: CH80056					
Sample Location: 5 feet-refusal (bgs)					
SW846 Method 9030					
Sulfides		50	mg/Kg		R
Sample ID: CH80070					
Sample Location: Hot[b]					
SW846 Method 9030					
Sulfides		50	mg/Kg		R
Sample ID: CH80071					
Sample Location: Hot (Duplicate)					
SW846 Method 9030					
Sulfides		50	mg/Kg		R
Sample ID: CH80093					
Sample Location: Soil Boring B3					
SW846 Method 9030					
Sulfides		50	mg/Kg		R

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

[c] All results below detection limits; rejected based on holding times and improper preservation.

Corehole 8 Soil Sampling - Cation Exchange

ANALYTE	RESULTS	DET. LIMITS	UNITS	LAB QUAL	VALQUAL
Sample ID: CH80010					
Sample Location: 0-5 feet (bgs[a])					
SW846 Method 9080					
Cation Exchange	24.1	0.2	eq/100g		
Sample ID: CH80057					
Sample Location: 5 feet - refusal (bgs)					
SW846 Method 9080					
Cation Exchange	21.6	0.2	eq/100g		
Sample ID: CH80072					
Sample Location: Hot[b]					
SW846 Method 9080					
Cation Exchange	22.2	0.2	eq/100g		
Sample ID: CH80073					
Sample Location: Hot (Duplicate)					
SW846 Method 9080					
Cation Exchange	17.5	0.2	eq/100g		
Sample ID: CH80095					
Sample Location: Soil Boring B3					
SW846 Method 9080					
Cation Exchange	30.2	0.2	eq/100g		

[a] bgs = below ground surface

[b] Hot = soil sample with highest beta/gamma reading as measured by field instruments

ATTACHMENT 2

RESPONSIVENESS SUMMARY TO PUBLIC COMMENTS ON THE
Engineering Evaluation/Cost Analysis
for the Core Hole 8 Plume Source (Tank W-1A) Removal Action
at Oak Ridge National Laboratory,
Oak Ridge, Tennessee
(DOE/OR/02-1714&D2)

Prepared by Jacobs EM Team
125 Broadway Avenue
Oak Ridge, Tennessee
under contract DE-AC05-98OR22700

Responsiveness Summary to Public Comments on the *Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/02-1714&D2)

The public comment period for the *Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/02-1714&D2) was held from August 10, 1998, to September 9, 1998. DOE received formal written comments from the Citizen's Advisory Panel (CAP) of the Oak Ridge Reservation Local Oversight Committee September 8, 1998. In addition, DOE received a verbal comment from one interested party. Following are the DOE responses to those comments.

Comment: **The errors in the total costs of the Alternatives on page B-3 should be corrected.**

Response: The total costs shown in Table B.1 are correct. However, there were two typographical errors. The $642,371 listed under "Construction contract" for the excavation/removal blending alternative (Alternative 1) should have read $1,642,371. Additionally, the $64,883 listed under "Site safety" for the chemical treatment alternative (Alternative 3) should have read $63,883. The correct Table B.1 is at the end of this section.

Comment: **The CAP concurs in the reasons on page 46 for the selection of Alternative 1.**

Response: DOE appreciates your review and concurrence, and looks forward to alternative implementation.

Comment: **The preferred alternative, i.e., Alternative 1 with blending if required, is fully compliant with the End Use Working Group's *Community Guidelines for Determining End Uses of Contaminated Land and Water on the Oak Ridge Reservation* and its *Recommendations for the End Use of Contaminated Lands in the Bethel Valley Area of the Oak Ridge National Laboratory*.**

Response: DOE concurs.

Comment: **DOE may wish to consider "blending" the small volume of excavated soil from this project with other appropriate low-level waste so as to meet the weighted waste acceptance criteria to dispose of this material in the on-site CERCLA waste disposal facility proposed to be sited in Bear Creek Valley. This option may effect some further cost savings.**

Prepared by Jacobs EM Team
125 Broadway Avenue
Oak Ridge, Tennessee
under contract DE-AC05-98OR22700

Table B.1. Cost comparison of removal action alternatives for the Core Hole 8 plume source, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Alternative description	Design ($)	Procurement ($)	Project integration ($)	Site safety ($)	Site specific ($)	Construction contract ($)	Waste disposition ($)	Project closeout ($)	M&I ($)	Total ($)
Excavation/ removal blending	86,036	33,719	390,352	64,280	260,180	1,642,371	1,560,077	13,896	324,073	**4,374,984**
Excavation and removal	86,081	33,736	390,556	64,314	260,316	770,942	735,793	12,630	188,349	**2,542,717**
Grout solidification	64,477	33,732	239,058	64,306	22,128	2,261,669	71,481	13,902	221,660	**2,992,413**
Chemical treatment	197,793	33,531	237,629	63,883	21,982	1,704,352	71,010	13,819	187,520	**2,531,519**

$ = dollar
M&I = management and integration

Response: DOE has considered use of the on-site CERCLA waste disposal facility as an option for Alternative 1. If the facility is available, DOE would consider its use. However, it appears unlikely that the facility would be operational when needed for Core Hole 8 Plume Source waste disposal; storage of the waste pending facility operation would be undesirable because storage cost would potentially negate any cost savings.

Following is a paraphrased summary of a verbal comment received from an interested party.

Comment: **Table B.1 contains an error. The summation of the component costs for the Excavation/removal blending alternative does not equal the total shown in the table. Should the total be changed, or one of the component costs?**

Response: Please see the revised table and written response to the first comment above.

Oak Ridge Reservation
Environmental Restoration Program
Proposed Administrative Record Index
Core Hole 8
As of 09/03/98

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses

Document Title: Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee
Order number: 980701.0043 Report number: DOE/OR/02-1714&D1
Published: May 1998 Document Type: Primary
Corporate author: Jacobs EM Team

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses

Document Title: Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at the Oak Ridge National Laboratory, Oak Ridge, Tennessee
Order number: 980801.0040 Report number: DOE/OR/02-1714&D2
Published: July 1998 Document Type: Primary
Corporate author: Jacobs Engineering Group, Inc.

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Edward Carreras, EPA, Region IV, and Doug McCoy, TDEC, DOE Oversight Div., from Cavanaugh S. Mims and Margaret Wilson, DOE-ORO, re: Core Hole 8 Engineering Evaluation/Cost Analysis and Action Memorandum Milestones]
Order number: 980701.0034
Published: January 27, 1998
Author(s): Mims, C.S. Wilson, M.
Corporate author: DOE-ORO. ORR Remediation Management Group.

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from R. Doug McCoy, TDEC, DOE Oversight Div., re: TDEC Response Letter, Core Hole 8 Engineering Evaluation/Cost Analysis and Action Memorandum Milestones]
Order number: 980701.0036
Published: January 29, 1998
Author(s): McCoy, R.D.
Corporate author: TDEC. DOE Oversight Div.

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from Edward M. Carreras, EPA, Region IV, re: Core Hole 8 Engineering Evaluation/Cost Analysis (EE/CA) and Action Memorandum (AM) Milestones]
Order number: 980701.0038
Published: February 3, 1998
Author(s): Carreras, E.M.
Corporate author: US EPA. Region IV.

Oak Ridge Reservation
Environmental Restoration Program
Proposed Administrative Record Index
Core Hole 8
As of 09/03/98

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Edward M. Carreras, EPA, Region IV, and Doug McCoy, TDEC, DOE Oversight Div., from Cavanaugh Mims and Margaret Wilson, DOE-ORO, re: Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE/OR/02-1714&D1)]
Order number: 980701.0040
Published: May 26, 1998
Author(s): Mims, C.S. Wilson, M.
Corporate author: DOE-ORO. ORR Remediation Management Group.

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from Edward M. Carreras, EPA, Region IV, re: Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source Removal Action at the Oak Ridge National Laboratory (DOE/OR/02-1714&D1)]
Order number: 980701.0041
Published: June 10, 1998
Author(s): Carreras, E.M.
Corporate author: US EPA. Region IV

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from R. Doug McCoy, TDEC, DOE Oversight Div., re: TDEC Comment Letter, Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source Removal Action at ORNL, DOE/OR/02-1714&D1, May 1998]
Order number: 980701.0042
Published: June 12, 1998
Author(s): McCoy, R.D.
Corporate author: TDEC. DOE Oversight Div.

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Edward Carreras, EPA, Region IV, and Doug McCoy, TDEC, DOE Oversight Div., from Cavanaugh Mims and Margaret Wilson, DOE-ORO, re: Submittal of the Resolution to Comments and the D2 Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE/OR/02-1714&D2) for Agreement to Release
Order number: 001732.0898
Published: July 30, 1998

Oak Ridge Reservation
Environmental Restoration Program
Proposed Administrative Record Index
Core Hole 8
As of 09/03/98

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from R. Doug McCoy, TDEC, DOE Oversight Div., re: TDEC Approval Letter, Engineering Evaluation/Cost Analysis for the Corehole 8 Plume Source (Tanks W-1A) Removal Action at ORNL, DOE/OR/02-1714&D2, July 1998] [Approval]
Order number: 001783.0998
Published: August 4, 1998

Category: 3.0 Removal Response
Subcategory: 3.4 Engineering Evaluations/Cost Analyses
Subcategory: 3.4.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from Edward M. Carreras, EPA, Region IV, re: Engineering Evaluation/Cost Analysis for the Corehole 8 Plume Source (tank W-1A) Removal Action (DOE/OR/02-1714&D2)] [Approval]
Order number: 001784.0998
Published: August 6, 1998

Category: 3.0 Removal Response
Subcategory: 3.5 Action Memoranda
Subcategory: 3.5.a Correspondence

Document Title: [Letter to Edward Carreras, EPA, Region IV, and Doug McCoy, TDEC, DOE Oversight Div., from Cavanaugh S. Mims and Margaret Wilson, DOE-ORO, re: Core Hole 8 Engineering Evaluation/Cost Analysis and Action Memorandum Milestones]
Order number: 980701.0035
Published: January 27, 1998
Author(s): Mims, C.S. Wilson, M.
Corporate author: DOE-ORO. ORR Remediation Management Group.

Category: 3.0 Removal Response
Subcategory: 3.5 Action Memoranda
Subcategory: 3.5.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from R. Doug McCoy, TDEC, DOE Oversight Div., re: TDEC Response Letter, Core Hole 8 Engineering Evaluation/Cost Analysis and Action Memorandum Milestones]
Order number: 980701.0037
Published: January 29, 1998
Author(s): McCoy, R.D.
Corporate author: TDEC. DOE Oversight Div.

Oak Ridge Reservation
Environmental Restoration Program
Proposed Administrative Record Index
Core Hole 8
As of 09/03/98

Category: 3.0 Removal Response
Subcategory: 3.5 Action Memoranda
Subcategory: 3.5.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from Edward M. Carreras, EPA, Region IV, re: Core Hole 8 Engineering Evaluation/Cost Analysis (EE/CA) and Action Memorandum (AM) Milestones]
Order number: 980701.0039
Published: February 3, 1998
Author(s): Carreras, E.M.
Corporate author: US EPA. Region IV.

Category: 3.0 Removal Response
Subcategory: 3.5 Action Memoranda
Subcategory: 3.5.a Correspondence

Document Title: [Letter to Edward Carreras, EPA, Region IV, and Doug McCoy, TDEC, DOE Oversight Div., from Cavanaugh Mims and Margaret Wilson, DOE-ORO, re: Request for Extension to Submit the D1 Action Memorandum for the Core Hole 8 Plume Source (Tank W-1A) Removal Action at Oak Ridge National Laboratory, Oak Ridge, Tennessee]
Order number: 001730.0898
Published: July 27, 1998

Category: 3.0 Removal Response
Subcategory: 3.5 Action Memoranda
Subcategory: 3.5.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from Edward M. Carreras, EPA, Region IV, re: Extension Request to Submit the D1 Action Memorandum for the Core Hole 8 Plume Source Removal Action]
Order number: 001731.0898
Published: July 28, 1998

Category: 3.0 Removal Response
Subcategory: 3.5 Action Memoranda
Subcategory: 3.5.a Correspondence

Document Title: [Letter to Margaret Wilson, DOE-ORO, from R. Doug McCoy, TDEC, DOE Oversight Div., re: TDEC Approval Letter, DOE Request for Extension to Submit the D1 Action Memorandum for the Core Hole 8 Plume Source Removal Action, ORNL]
Order number: 001733.0898
Published: July 31, 1998

Category: 7.0 Sampling and Analysis Data
Subcategory: 7.1 QA/QC Documentation

Document Title: Data Packages and Chain-of-Custody Forms for [Waste Grouping Area] WAG 1 Corehole 8
Order number: 950601.0114

Oak Ridge Reservation
Environmental Restoration Program
Proposed Administrative Record Index
Core Hole 8
As of 09/03/98

Category: 7.0 Sampling and Analysis Data
Subcategory: 7.1 QA/QC Documentation

Document Title: QA/QC Data Documentation
Order number: 980701.0045
Data Information: Data packages to support the Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source Removal Action are located at the EMEF Document Management Center. To access this information, contact the Administrative Record Coordinator at Bechtel Jacobs Company LLC.

Category: 7.0 Sampling and Analysis Data
Subcategory: 7.3 Data Summary Sheets

Document Title: Data Summary Sheets
Order number: 980701.0044
Published: May 1998
Corporate author: Jacobs EM Team
Data Information: The Engineering Evaluation/Cost Analysis for the Core Hole 8 Plume Source Removal Action contains data summary sheets.

Category: 8.0 Community Relations
Subcategory: 8.3 Fact Sheets

Document Title: Core Hole 8 Plume Actions. [Fact Sheet]
Order number: 980201.0059
Published: Winter 1998
Corporate author: US DOE-ORO. Environmental Management Prog.

Category: 8.0 Community Relations
Subcategory: 8.5 Community Relations Plan

Document Title: U.S. Department of Energy - Oak Ridge Operations Environmental Management Public Involvement Plan for the Oak Ridge Reservation
Order number: 971101.0116 Report number: DOE/OR/01-1676&D1
Published: November 1997 Document Type: Primary
Corporate author: SAIC.

Category: 9.0 Regulator Coordination
Subcategory: 9.2 Federal Facility Agreement

Document Title: Federal Facility Agreement for the Oak Ridge Reservation. Controlled Document.
Order number: 910124.0001 Report number: DOE/OR-1014
Published: January 1, 1992
Corporate author: US DOE-ORO. US EPA. Region IV. TDEC.