1235574

[0078647H]

16-ESQ-0028: SUBMITTAL OF DOE/RL-2015-74 HANFORD FACILITY DANGEROUS WASTE PART B PERMIT APPLICATION LOW LEVEL BURIAL GROUNDS TRENCHES 31-34-94 T PLANT COMPLEX AND CENTRAL WASTE COMPLEX WASTE RECEIVING AND PROCESSING FACILITY OPERATING UNIT GROUPS [SECTION 1 OF 5]

SECTION 2 OF 5

585

DOE/RL-2015-74
Revision 0

Hanford Facility Dangerous Waste Part B Permit Application; Low-Level Burial Grounds Trenches 31-34-94, T Plant Complex, and Central Waste Complex-Waste Receiving and Processing Facility

S. R. Horn
CH2M HILL Plateau Remediation Company

Date Published
December 2015

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY | Richland Operations Office
P.O. Box 550
Richland, Washington 99352

Release Approval _____ Date _____

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by tradename, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

Contents

LLBG Trenches 31-34-94 Part B

Addendum A Part A Form ..... A-i
Attachment A: Section XI - Nature of Business ..... A-A-i
Attachment B: Section XIV – Description of Dangerous Wastes ..... A-B-i
Attachment C: Section XVII - Photographs ..... A-C-i
Addendum B Waste Analysis Plan ..... B-i
Appendix B-A: Performance Evaluation System ..... B-A-i
Addendum C Process Information ..... C-i
Appendix C-A: Overall Facility Map of the Hanford Site ..... C-A-i
Appendix C-B: Engineering Drawings ..... C-B-i
Addendum D Groundwater Monitoring Plan ..... D-i
Appendix D-A: Final Status Groundwater Monitoring Plan for LLWMA-3 ..... D-A-i
Appendix D-B: Final Status Groundwater Monitoring Plan for LLWMA-2 ..... D-B-i
Addendum E Security ..... E-i
Addendum F Preparedness and Prevention ..... F-i
Addendum G Personnel Training ..... G-i
Addendum H Closure Plan ..... H-i
Appendix H-A: LLBG Trenches 31 and 34 Dangerous Waste Management Units ..... H-A-i
Appendix H-B: LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Dangerous Waste Management Units ..... H-B-i
Appendix H-C: LLBG Trench 94 Dangerous Waste Management Unit ..... H-C-i
Addendum I Inspection Plan ..... I-i
Addendum J Contingency Plan ..... J-i
Appendix J-A: Building Emergency Plan for Low-Level Burial Grounds ..... J-A-i

This page intentionally left blank.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Addendum A
Part A Form

Date Received			Reviewed by:		Date:
Month	Day	Year	Approved by:		Date:

I. This form is submitted to: (place an "X" in the appropriate box)

☒	**Request modification to a final status permit (commonly called a "Part B" permit)**
☐	**Request a change under interim status**
☐	**Apply for a final status permit. This includes the application for the initial final status permit for a site or for a permit renewal (i.e., a new permit to replace an expiring permit).**
☐	**Establish interim status because of the wastes newly regulated on:**
	List waste codes:

II. EPA/State ID Number

W A 7 8 9 0 0 0 8 9 6 7

III. Name of Facility

U.S. Department of Energy – Hanford Facility

IV. Facility Location (Physical address not P.O. Box or Route Number)

A. Street

Refer to Permit Attachment 2 – Hanford Facility Permit Legal Description

City or Town	State	ZIP Code
Near Richland	WA	

County Code (if known)	County Name
0 0 5	Benton

B. Land Type	C. Geographic Location		D. Facility Existence Date		
	Latitude (degrees, mins, secs)	Longitude (degrees, mins, secs)	Month	Day	Year
F	Refer to TOPO Map (Attachment C) for LLBG Trenches 31, 34, and 94 OUG-17 (LLBG Trenches 31-34-94)		1 1	1 9	1 9 8 0

V. Facility Mailing Address

Street or P.O. Box

P.O. Box 550

City or Town	State	ZIP Code
Richland	WA	99352

VI. Facility contact (Person to be contacted regarding waste activities at facility)		
Name (last)	**(first)**	
Charboneau	Stacy	
Job Title	**Phone Number**	
Manager	(509) 376-7395	
Contact Address		
Street or P.O. Box		
P.O. Box 550		
City or Town	**State**	**ZIP Code**
Richland	WA	99352

VII. Facility Operator Information	
A. Name	**Phone Number**
U.S. Department of Energy Owner/Operator CH2M HILL Plateau Remediation Company Co-Operator for Dangerous Waste Management Units in LLBG Trenches 31-34-94 Unit Group*	(509) 376-7395 (509) 376-0556*
Street or P.O. Box	
P.O. Box 550 P.O. Box 1600*	

City or Town	State	ZIP Code
Richland	WA	99352

B. Owner Type	C. Does the name in VIII.A reflect a proposed change in owner?	☐ Yes	If yes, provide the scheduled date for the chang		
			Month	Day	Year
F		☒ No			

C. Does the name in VII.A. reflect a proposed change in operator?	☐ Yes ☒ No		
If yes, provide the scheduled date for the change:	Month	Day	Year

D. Is the name listed in VII.A. also the owner? If yes, skip to Section VIII.C.	☐ Yes
	☒ No

VIII. Facility Owner Information	
A. Name	**Phone Number (area code and number)**
U.S. Department of Energy Owner/Operator	(509) 376-7395
Street or P.O. Box	
P.O. Box 550	

City or Town	State	ZIP Code
Richland	WA	99352

B. Owner Type	C. Does the name in VIII.A reflect a proposed change in owner?	☐ Yes	If yes, provide the scheduled date for the change:		
			Month	Day	Year
F		☒ No			

IX. NAICS Codes (5/6 digit codes)

A. First							B. Second						
5	6	2	2	1	1	Waste Treatment & Disposal	9	2	4	1	1	0	Administration of Air & Water Resource & Solid Waste Management Programs
C. Third							**D. Fourth**						
5	4	1	7	1	2	Research & Development in the Physical, Engineering, & Life Sciences							

X. Other Environmental Permits (see instructions)

A. Permit Type	B. Permit Number	C. Description
E	AOP 00-05-006	Air Operating Permit (AOP)
E	FF-01-472	WAC 246-247 Radioactive Air Emissions approval, AIR 12-315, Emission Unit 472
E	FF-01-473	WAC 246-247 Radioactive Air Emissions approval, AIR 12-315, Emission Unit 473
E	FF-01-486	WAC 246-247 Radioactive Air Emissions approval, AIR 11-1006, Emission Unit 486
E	FF-01	WAC 246-247 Radioactive Air Emissions approval, AIR 12-339

XI. Nature of Business (provide a brief description that includes both dangerous waste and non-dangerous waste areas and activities)

See ATTACHMENT A, "NATURE OF BUSINESS," and ADDENDUM C, "PROCESS INFORMATION," for further description.

The Hanford Facility, located in southeastern Washington State, is owned by the U.S. Government and operated by the U.S. Department of Energy and CH2M HILL Plateau Remediation Company. Dangerous waste and mixed waste (containing both dangerous and radioactive components) are generated and managed on the Hanford Facility.

The Low Level Burial Ground (LLBG) Trenches 31-34-94 Operating Unit Group (hereinafter referred to as LLBG Trenches 31-34-94) is comprised of five dangerous waste management units (DWMUs), which include three landfills: LLBG Trench 31, LLBG Trench 34, and LLBG Trench 94; and two storage and treatment pads: LLBG Trench 31 Waste Storage and Treatment Pad and LLBG Trench 34 Waste Storage and Treatment Pad. LLBG Trenches 31 and 34 are located in the 200 West Area, and LLBG Trench 94 is located in the 200 East Area of the Hanford Facility. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads are located in the southeast corner of each corresponding landfill. Each DWMU is described in general on this form; additional information is detailed in Addendum C.

LLBG Trenches 31 and 34:

LLBG Trenches 31 and 34 are two large excavations in the southwest corner of the 218-W-5 Burial Ground operated as units for disposal of treated land disposal restriction (LDR) compliant hazardous and/or mixed waste (D80). LLBG Trenches 31 and 34 began receiving waste for disposal on September 15, 1999. LLBG Trenches 31 and 34 landfills are constructed with soil and synthetic liners, as well as leachate collection and removal systems.

D80: The disposal volume is based on landfill dimensions at the base of approximately 76 m (250 ft) long by 31 m (100 ft) wide and a depth of 9 m (30 ft). The process design capacity for disposal of mixed waste in LLBG Trenches 31 and 34 is approximately 21,408 m^3 (28,001 yd^3) per landfill for a total process design capacity of approximately 42,816 m^3 (56,001 yd^3). The estimated annual quantity of waste is based on historical data for LLBG Trenches 31 and 34 disposal quantities and is approximately 1,550 metric tons.

LLBG Trenches 31 and 34 Waste Storage and Treatment Pads:

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads provide storage and treatment for containerized mixed waste, as well as LDR compliant containerized waste before disposal. Treatment provided at these pads is further detailed in Addendum B, "Waste Analysis Plan".

S01: LLBG Trenches 31 and 34 Waste Storage and Treatment Pads are constructed with an asphalt base. The LLBG Trench 31 Waste Storage and Treatment Pad has a total area of approximately 2,150 m^2 (23,200 ft^2; (49.4 m [162 ft] wide by 43.6 m [143 ft] long). The LLBG Trench 34 Waste Storage and Treatment Pad has a total area of approximately 2,160 m^2 (23,200 ft^2; (48.8 m [160 ft] wide by 44.2 m [145 ft] long).

The container storage process design capacity for the Trench 31 Waste Storage and Treatment Pad is approximately 1,150 m^3 (1,500 yd^3), and the Trench 34 Waste Storage and Treatment Pad is approximately 1,240 m^3 (1,620 yd^3) for a combined process design capacity of approximately 2,390 m^3 (3,130 yd^3). It is assumed that all the waste treated is also placed in storage; therefore, the estimated annual quantity of waste stored is equal to the amount treated under T04.

T04: Treatment to meet the LDR requirements will be performed on the LLBG Trench 31 and 34 Waste Storage and Treatment Pads. The treatment capability consists of the use of microencapsulation, macroencapsulation, and sealing for mixed waste debris as identified under 40 CFR 268.45, "Land Disposal Restrictions," "Treatment Standards for Hazardous Debris," Table 1, "Alternative Treatment Standards for Hazardous Debris," and macroencapsulation as defined in 40 CFR 268.42, "Treatment Standards Expressed as Specified Technologies." Mixed waste containers will meet the 90 percent full container requirements following treatment. The process design capacity for treatment is based on the volume of the largest container in storage and is estimated to be 26 m^3 (34 yd^3) per day. The average bulk density of debris at the Hanford Facility is approximately 1,000 kg/m^3, so the maximum container storage process design capacity for LLBG Trenches 31 and 34 is 26,000 kg (26 metric tons). Assuming 250 working days per year, this provides an estimated annual quantity of container treatment (T04) of 6,400 metric tons.

LLBG Trench 94:

LLBG Trench 94 is a land-based unit located in the 200 East Area of the Hanford Facility in the northeast corner of 218-E-12B Burial Ground. Trench 94 covers a total area of approximately 49 ha (120 acres) and is designed for receipt and final disposal of decommissioned, defueled, nuclear reactor compartments (RCs). The first defueled RC was placed in LLBG Trench 94 in April 1986.

The current excavated area of LLBG Trench 94, excluding the north access ramp, is approximately 540 m (1,770 ft) long by 140 m (460 ft) wide at the top and approximately 494 m (1,620 ft) by 98 m (320 ft) at the base, and typically about 15 m (49 ft) in depth where the defueled RC packages are placed. Unused portions of the trench can be deeper than 15 m (49 ft). The horizontal and vertical side slopes of LLBG Trench 94 are approximately 1V:1-1/2H.

D80: The process design capacity of LLBG Trench 94 is approximately 1,500,000 m^3 (1,962,000 yd^3). The estimated annual quantity of waste is based on historical data for LLBG Trench 94 disposal quantities and is approximately 7,300 metric tons.

EXAMPLE FOR COMPLETING ITEMS XII and XIII (shown in lines numbered X-1, X-2, and X-3 below):
A facility has two storage tanks that hold 1200 gallons and 400 gallons respectively. There is also treatment in tanks at 20 gallons/hr. Finally, a one-quarter acre area that is two meters deep will undergo *in situ vitrification.*

XII. Process Codes and Design Capacities					XIII. Other Process Codes					
Line Number	A. Process Codes	B. Process Design Capacity 1. Amount	B. Process Design Capacity 2. Unit of Measure	C. Process Total Number of Units	Line Number	A. Process Codes	B. Process Design Capacity 1. Amount	B. Process Design Capacity 2. Unit of Measure	C. Process Total Number of Units	D. Process Description
X1	*S02*	*1,600*	*G*	*002*	*X1*	*T04*	*700*	*C*	*001*	*In situ vitrification*
X2	*T03*	*20*	*E*	*001*						
X3	*T04*	*700*	*C*	*001*						
1	D80	1,542,816	C	003	1	T04	26	S	2	Debris Immobilization
2	S01	2,390	C	002						
3	T04	26	S	002						
4										
5										
6										
7										
8										
9										
10										
11										
12										

XIV. Description of Dangerous Wastes

Example for completing this section: A facility will receive three non-listed wastes, then store and treat them on-site. Two wastes are corrosive only, with the facility receiving and storing the wastes in containers. There will be about 200 pounds per year of each of these two wastes, which will be neutralized in a tank. The other waste is corrosive and ignitable and will be neutralized then blended into hazardous waste fuel. There will be about 100 pounds per year of that waste, which will be received in bulk and put into tanks.

Line Number	A. Dangerous Waste No.				B. Estimated Annual Quantity of Waste	C. Unit of Measure	D. Processes (1) Process Codes								D. Processes (2) Process Description [If a code is not entered in D.(1)]
X1	*D*	*0*	*0*	*2*	*400*	*P*	*0*	*1*	*T*	*0*	*1*				
X2	*D*	*0*	*0*	*1*	*100*	*P*	*0*	*2*	*T*	*0*	*1*				
X3	*D*	*0*	*0*	*2*											*Included with above*
1															

A description of the dangerous wastes managed in LLBGs Trenches 31-34-94 is provided in Attachment B.

XV. Map

Attach to this application a topographic map of the area extending to at least one (1) mile beyond property boundaries. The map must show the outline of the facility; the location of each of its existing and proposed intake and discharge structures; each of its dangerous waste treatment, storage, recycling, or disposal units; and each well where fluids are injected underground. Include all springs, rivers, and other surface water bodies in this map area, plus drinking water wells listed in public records or otherwise known to the applicant within ¼ mile of the facility property boundary. The instructions provide additional information on meeting these requirements.

A topographic map of the Hanford Facility has been provided separately. Topographic maps for LLBG Trenches 31-34-94 are located in Attachment C.

XVI. Facility Drawing

All existing facilities must include a scale drawing of the facility (refer to Instructions for more detail).

Facility drawings of the Hanford Facility have been provided separately. Drawings for LLBG Trenches 31-34-94 are located in Addendum C.

XVII. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, recycling, and disposal areas; and sites of future storage, treatment, recycling, or disposal areas (refer to Instructions for more detail).

Photographs of the Hanford Facility have been provided separately. Photographs for LLBG Trenches 31-34-94 are located in Attachment C.

XVIII. Certifications

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

Operator Name and Official Title U.S. Department of Energy Richland Operations Office By Stacy L. Charboneau, Manager	**Signature**	**Date Signed**
Operator Name and Official Title CH2M HILL Plateau Remediation Company By John A. Ciucci, President and Chief Executive Officer	**Signature**	**Date Signed**
Co-Operator – **Address and Telephone Number*** P.O. Box 1600 Richland, WA 99352 (509) 376-0556		
Facility-Property Owner Name and Official Title U.S. Department of Energy Richland Operations Office By Stacy L. Charboneau, Manager	**Signature**	**Date Signed**

Comments
Section XI. Refer to Attachment A for further description. Section XII. Volumes for disposal, treatment, and container storage are the sum of all the DWMUs at LLBG Trenches 31-34-94. Section XIV. Refer to Attachment B for waste codes for storage and treatment at LLBG Trenches 31-34-94. The waste codes at are divided into 5 groups to reflect the three main processes at LLBG Trenches 31-34-94: storage, treatment, and disposal as well as the different physical locations of the trenches. Section XV. A topographic map of the Hanford Facility has been provided separately. Topographic map for LLBG Trenches 31-34-94 is located in Attachment C. Section XVI. Facility drawings of the Hanford Facility have been provided separately. Drawings for LLBG Trenches 31-34-94 are located in Addendum C, Process Information. Section XVII. Photographs of the Hanford Facility have been provided separately. Photographs for LLBG Trenches 31-34-94 are located in Attachment C.

This page intentionally left blank.

Attachment A

Section XI – Nature of Business

This page intentionally left blank.

Contents

A1 Introduction **A-A-1**
A2 General Description of Onsite Activities **A-A-1**
A3 Operating DWMUs **A-A-3**
A3.1 LLBG Trenches 31 and 34 (Disposal) A-A-3
A3.2 LLBG Trench 94 Disposal Cell (Disposal) A-A-3
A3.3 LLBG Trenches 31 and 34 Waste Storage and Treatment Pads (Treatment and Storage) A-A-4
A4 Closing DWMUs **A-A-4**
A4.1 FS-1 Outdoor Container Storage Area (Closing) A-A-4
A5 Treatment, Storage, and Disposal Capacities **A-A-4**
A5.1 S01 (Container Storage) A-A-4
A5.2 D80 (Disposal) A-A-5
A5.3 T04 (Treatment-Other) A-A-5
A6 Waste Generated **A-A-7**
A7 Universal Waste **A-A-7**
A8 Corrective Actions Statement **A-A-7**

Tables

Table A-1. LLBG Trenches 31-34-94 DWMUs A-A-2
Table A-2. Summary of LLBG Trenches 31-34-94 Operating DWMUs A-A-2
Table A-3. LLBG Trenches 31 and 34 Dimensions A-A-3
Table A-4. Disposal and Storage Capacity for LLBG Trenches 31-34-96 DWMUs A-A-6
Table A-5. Treatment Capacity for LLBG Trenches 31-34-94 DWMUs A-A-6

This page intentionally left blank.

A1 Introduction

The Hanford Facility, located in southeastern Washington State, is owned by the U.S. Government and operated by the U.S. Department of Energy (DOE) and CH2M HILL Plateau Remediation Company. Dangerous waste (DW) and mixed waste (MW), containing both dangerous and radioactive components, are generated and managed on the Hanford Facility. Please note, the terms "mixed waste" and/or "waste" when seen in this document refer to dangerous waste or hazardous waste, as applicable.

The Low Level Burial Ground (LLBG) Trenches 31-34-94 Operating Unit Group (OUG), hereinafter referred to as LLBG Trenches 31-34-94, are comprised of five dangerous waste management units (DWMUs), including three landfills: LLBG Trench 31, LLBG Trench 34, and LLBG Trench 94; and two storage and treatment pads: LLBG Trench 31 Waste Storage and Treatment Pad and LLBG Trench 34 Waste Storage and Treatment Pad. LLBG Trenches 31 and 34 are located in the 200 West Area, and LLBG Trench 94 is located in the 200 East Area of the Hanford Facility. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads are located in the southeast corner of each corresponding landfill. Each DWMU is described in this document, and additional information is detailed in Addendum C, "Process Information."

LLBG Trenches 31 and 34 are operated as units for disposal of treated and land disposal restriction (LDR) compliant MW (D80). LLBG Trench 94 is a land-based unit located in the 200 East Area of the Hanford Facility in the northeast corner of 218-E-12B Burial Ground. Trench 94, which covers a total area of approximately 48,500 m^2 (58,005 yd^2), is designed for the receipt and final disposal of decommissioned, defueled nuclear reactor compartments (RCs). The first defueled RC was placed in Trench 94 in April 1986. RCs are prepared for disposal by the Puget Sound Naval Shipyard in Bremerton, Washington and transported by barge via the Columbia River to the Port of Benton at the Hanford Facility.

A2 General Description of Onsite Activities

LLBG Trenches 31-34-94 provide treatment, storage, and disposal (TSD) for waste from onsite and offsite Hanford generators. LLBG Trenches 31 and 34 are large rectangular excavations in the southwest corner of the 218-W-5 Burial Ground operated as units for disposal of waste (Attachment C, Figure C-1). LLBG Trenches 31 and 34 are constructed with polyethylene liners and a leachate collection system. All MW destined for disposal in LLBG Trenches 31 and 34 must meet LDR requirements (WAC 173-303-140, "Dangerous Waste Regulations," "Land Disposal Restrictions," which includes, by reference 40 CFR 268, "Land Disposal Restrictions"), or a site specific treatability variance approved by the Washington State Department of Ecology (Ecology). MW to be disposed in LLBG Trenches 31 and 34 may include bulk waste, and containerized waste can include long-length contaminated equipment. A diverse range of waste containers can be disposed at LLBG Trenches 31 and 34 including, but not limited to, containers/drums, waste boxes, and miscellaneous equipment. The LLBG Trench 94 disposal cell is designed for receipt and final disposal of decommissioned, defueled RCs.

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads DWMUs are located above the disposal cells at ground surface level and provide storage of waste conta iners prior to final disposal within the disposal cells underneath (Attachment C, Figure C-3). Treatment to be performed on these pads consists of the use of immobilization technologies for MW debris to meet LDR requirements prior to disposal in the cells.

Table A-1 identifies the operating DWMUs in the LLBG Trenches 31-34-94 where waste is stored, treated, or disposed. Table A-2 indicates the type of DWMU and corresponding treatment authorization.

LLBG Trenches 31-34-94 include a DWMU currently undergoing closure activities, as shown in Table A-1. The closing units are not authorized to accept waste. Maps and photographs of DWMUs are located in Attachment C of this Part A application.

Table A-1. LLBG Trenches 31-34-94 DWMUs

Operating DWMUs			
DWMUs Name	**Treatment**	**Storage**	**Disposal**
LLBG Trench 31	No	No	Yes
LLBG Trench 34	No	No	Yes
LLBG Trench 94	No	No	Yes
LLBG Trench 31 Waste Storage and Treatment Pad	Yes	Yes	No
LLBG Trench 34 Waste Storage and Treatment Pad	Yes	Yes	No
Closing DWMU			
DWMUs Name		**Notes**	
FS-1		None	

DWMU = dangerous waste management unit

Table A-2. Summary of LLBG Trenches 31-34-94 Operating DWMUs

Management Unit Type	LLBG Trenches 31-34-94 Operating DWMUs	Part A Treatment Type	Part A Storage Type	Part A Disposal Type
Container (Disposal)	Trench 31 Disposal Cell Trench 34 Disposal Cell Trench 94 Disposal Cell	N/A	N/A	D80
Container (Storage and Treatment)	Trench 31 Waste Storage and Treatment Pad Trench 34 Waste Storage and Treatment Pad	T04	S01	N/A

DWMU = dangerous waste management unit
N/A = not applicable

A3 Operating DWMUs

The following sections describe the function of each operating DWMU.

A3.1 LLBG Trenches 31 and 34 (Disposal)

The lined trenches in LLBG Trenches 31 and 34 are constructed in undisturbed native soils, generally ranging from silty sands to well-graded gravels. Each lined trench has an access ramp. The landfills are designed and operated in accordance with WAC 173-303-140 for disposal of treated waste and WAC 173-303-665, "Landfills." Approximate dimensions for each landfill unit are listed in Table A-3.

Table A-3. LLBG Trenches 31 and 34 Dimensions

Landfill Designation		Dimensions [m (ft)]	Area [m^2 (ft^2)]
LLBG Trench 31	Base	76 (250) by 31 (100)	2,350 (25,300)
	Top	137 (450) by 91 (300)	12,500 (135,000)
LLBG Trench 34	Base	76 (250) by 31 (100)	2,350 (25,300)
	Top	137 (450) by 91 (300)	12,500 (135,000)

The liner systems for LLBG Trenches 31 and 34 are designed to prevent migration of leachate out of the lined trenches during the active life, and they comply with requirements for DW landfills in WAC 173-303-665. The active life consists of the operational period and closure period.

All MW destined for disposal in LLBG Trenches 31 and 34 must meet LDR requirements (WAC 173-303-140, which includes by reference 40 CFR 268), or a site-specific treatability variance approved by Ecology. MW to be disposed in LLBG Trench 31 and 34 may include bulk waste and containerized waste that can include long-length contaminated equipment. A diverse range of waste containers can be disposed at LLBG Trenches 31 and 34 including, but not limited to, containers and miscellaneous equipment.

All MW will be packaged in approved containers (U.S. Department of Transportation and/or DOE), including alternative packages required due to the size, shape, or form of waste (e.g., metal boxes and flexible containers). Free liquids will not be accepted unless WAC 173-303-140(4)(b)(ii) requirements are met. Containers accepted for disposal, unless very small such as ampules, must meet either of the following criteria:

- At least 90 percent full when placed in the landfill
- Crushed, shredded, or similarly reduced in volume to the maximum practical extent before burial in the landfill

No storage or treatment of waste is authorized within the LLBGs Trench 31 and 34 Disposal Cells.

A3.2 LLBG Trench 94 Disposal Cell (Disposal)

LLBG Trench 94 is located in the 200 East Area of the Hanford Facility in the northeast corner of the 218-E-12B Burial Ground. LLBG Trench 94 is approximately 540 m (1,770 ft) long by 140 m (460 ft) wide at the top, and 494 m (1,620 ft) by 98 m (320 ft) at the base, and typically about 15 m (49 ft) in depth where defueled RC packages are placed. Trench 94 is designed for receipt and final disposal of

decommissioned, defueled RCs from submarines, surface ships, and a nuclear power plant. The first defueled RC was placed in LLBG Trench 94 in April 1986. RCs are prepared for disposal and transported by barge via the Columbia River to the Port of Benton at the Hanford Facility and are considered MW meeting LDR requirements (WAC 173-303-140, which includes by reference 40 CFR 268, and RCW 70.105, "Hazardous Waste Management").

No storage or treatment of waste is authorized within the LLBG Trench 94 Disposal Cell DWMU.

A3.3 LLBG Trenches 31 and 34 Waste Storage and Treatment Pads (Treatment and Storage)

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads are two asphalt paved areas located on the southeast corner of LLBG Trenches 31 and 34, respectively. The northwest corner of each pad is constructed over an extension of the trench liner. Both the asphalt surface and underlying drainage system direct all surface runoff into the primary leachate collection system of the lined trench.

Waste stored on the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will be containerized. Both pads equivalently provide storage and treatment for containerized MW, as well as storage for LDR compliant containerized waste prior to disposal in the landfills below. Containers stored outside at the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads DWMUs are subject to the requirements of WAC 173-303-630(7).

Treatment of containerized MW debris on the pads consists of immobilization technologies conducted in accordance with 40 CFR 268.45, "Treatment Standards for Hazardous Debris" (Table 1, "Alternative Treatment Standards for Hazardous Debris") and macroencapsulation in 40 CFR 268.42, "Treatment Standards Expressed as Specified Technologies."

A4 Closing DWMUs

LLBG Trenches 31-34-94 OUG includes one DWMU currently undergoing closure activities per an approved closure plan (FS-1). This unit is not authorized to accept waste into the unit.

A4.1 FS-1 Outdoor Container Storage Area (Closing)

LLBG Trenches 31-34-94 FS-1 Outdoor Container Storage Area DWMU (FS-1) is located along the south side of Trench 34. FS-1 is a gravel covered, rectangular area approximately 12 m (39 ft) wide by 60 m (200 ft) long equaling a total storage area of approximately 720 m^2 (7800 ft^2). The perimeter of the storage area is defined by metal T-posts, with the corner posts holding signage designating the area as FS-1. There are no structures or equipment located at the storage area.

A5 Treatment, Storage, and Disposal Capacities

The following sections describe the LLBG 31-34-94 DWMUs TSD capacities (Tables A-3 and A-4).

A5.1 S01 (Container Storage)

LLBG Trenches 31 and 34 Waste Storage and Treatment Pads are constructed with an asphalt base. The LLBG Trench 31 Waste Storage and Treatment Pad has a total area of approximately 2,150 m^2 (23,200 ft^2; 49.4 m [162 ft] wide by 43.6 m [143 ft] long). The LLBG Trench 34 Waste Storage and Treatment Pad has a total area of approximately 2,160 m^2 (23,200 ft^2; 48.8 m [160 ft] wide by 44.2 m [145 ft] long). The corner of each pad near the ramp is constructed over the corner of the landfill liner. The container storage process design capacity for each Trench 31 Waste Storage and Treatment Pad is

1,150 m^3 (1,500 yd^3), and the Trench 34 Waste Storage and Treatment Pad is 1,240 m^3 (1,620 yd^3) for a combined process design capacity of 2,390 m^3 (3,130 yd^3). The maximum total volume is shown in Table A-4. To determine the estimated annual quantity of waste stored (Attachment B), it was assumed that all the waste treated at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads is also stored on the pads.

A5.2 D80 (Disposal)

The LLBG Trenches 31 and 34 disposal volume is based on the landfill floor dimensions of 76 m (250 ft) long by 31 m (100 ft) wide and a depth of 9 m (30 ft). The process design capacity for disposal of MW in LLBG Trenches 31 and 34 is approximately 21,408 m^3 (28,001 yd^3) per landfill for a total process design capacity of 42,816 m^3 (56,001 yd^3). The maximum total volume is shown in Table A-4.

The process design capacity of the LLBG Trench 94 disposal cell is approximately 1,500,000 m^3 (1,962,000 yd^3). The combined process design capacity for LLBG Trenches 31-34-94 disposal is approximately 1,542,816 m^3 (2,018,001 yd^3).

A5.3 T04 (Treatment-Other)

Treatment to meet the LDR requirements will be performed on LLBG Trench 31 and 34 Waste Storage and Treatment Pads. The treatment capability consists of the use of immobilization technologies, including microencapsulation, macroencapsulation, and sealing for MW debris as listed under 40 CFR 268.45, Table 1 and macroencapsulation in 40 CFR 268.42. The process design capacity for treatment is estimated to be approximately 26 m^3/day (34 yd^3/day). To determine this maximum treatment capacity, calculations were performed that conservatively estimated the maximum volume of waste expected to be treated using the largest volume container expected to be managed at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads in a day. The maximum total treatment volume is shown in Table A-5.

1

Table A-4. Disposal and Storage Capacity for LLBG Trenches 31-34-96 DWMUs

Dangerous Waste Management Unit	Maximum Total Disposal and Storage Capacity Volume (m^3)	Process Codes (Part A Form Section XII and Section XIII)	Line Numbers (Part A Form Section XII)
Trench 31 Disposal Cell	21,408	D80	Line Number 1
Trench 34 Disposal Cell	21,408	D80	Line Number 1
Trench 94 Disposal Cell	1,500,000	D80	Line Number 1
Trench 31 Waste Storage and Treatment Pad	1,150	S01	Line Number 2
Trench 34 Waste Storage and Treatment Pad	1,240	S01	Line Number 2
Total Disposal and Storage Capacity			
Process Code		**Maximum Storage Capacity**	
D80		1,542,816 m^3	
S01		2,390 m^3	

2

Table A-5. Treatment Capacity for LLBG Trenches 31-34-94 DWMUs

Dangerous Waste Management Unit	Maximum Treatment Capacity (m^3/Day)	Process Codes (Part A Form Section XII and Section XIII)	Line Numbers (Part A Form Sections XII and XII)	
			Part A Form Section XII	Part A Form Section XIII
Trench 31 Disposal Cell	No treatment proposed			
Trench 34 Disposal Cell	No treatment proposed			
Trench 94 Disposal Cell	No treatment proposed			
Trench 31 Waste Storage and Treatment Pad	26*	T04	Line Number 3	Line Number 1
Trench 31 Waste Storage and Treatment Pad	26*	T04	Line Number 3	Line Number 1
Total Treatment Capacity				
Process Code		**Maximum Treatment Capacity**		
T04		26 m^3/Day		

* The maximum treatment rate for both LLBG Trenches 31 and 34 Waste Storage and Treatment Pads is 26 m^3/day total. This treatment rate can be realized in either of the two DWMUs having treatment capability; however, the combined daily treatment rate cannot exceed 26 m^3/day.

A6 Waste Generated

Waste generated at LLBG Trenches 31 and 34 consists of debris waste generated through maintenance activities associated with the leachate collection system and wastes from routine maintenance and processing operations (such as miscellaneous debris waste and used personal protective equipment).

A7 Universal Waste

Universal waste is not managed at the LLBG Trenches 31-34-94 OUG.

A8 Corrective Actions Statement

There are no historical or ongoing corrective actions taken at LLBG Trenches 31-34-94 under WAC 173-303; WAC 173-340, "Model Toxics Control Act—Cleanup;" or federal regulations.

This page intentionally left blank.

Attachment B

Section XIV – Description of Dangerous Wastes

This page intentionally left blank.

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1	D004	28,750	M	S01	Trench 31 and Trench 34 Waste Storage Pads (DWMUs above the disposal cells)
2	D005				Included with above
3	D006				Included with above
4	D007				Included with above
5	D008				Included with above
6	D009				Included with above
7	D010				Included with above
8	D011				Included with above
9	D012				Included with above
10	D013				Included with above
11	D014				Included with above
12	D015				Included with above
13	D016				Included with above
14	D017				Included with above
15	D018				Included with above
16	D019				Included with above
17	D020				Included with above
18	D021				Included with above
19	D022				Included with above
20	D023				Included with above
21	D024				Included with above
22	D025				Included with above
23	D026				Included with above
24	D027				Included with above
25	D028				Included with above
26	D029				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
27	D030				Included with above
28	D031				Included with above
29	D032				Included with above
30	D033				Included with above
31	D034				Included with above
32	D035				Included with above
33	D036				Included with above
34	D037				Included with above
35	D038				Included with above
36	D039				Included with above
37	D040				Included with above
38	D041				Included with above
39	D042				Included with above
40	D043				Included with above
41	WSC2				Included with above
42	WT01				Included with above
43	WT02				Included with above
44	WP01				Included with above
45	WP02				Included with above
46	WP03				Included with above
47	WPCB				Included with above
48	F001				Included with above
49	F002				Included with above
50	F003				Included with above
51	F004				Included with above
52	F005				Included with above
53	F006				Included with above
54	F007				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
55	F008				Included with above
56	F009				Included with above
57	F010				Included with above
58	F011				Included with above
59	F012				Included with above
60	F019				Included with above
61	F027				Included with above
62	F039				Included with above
63	U001				Included with above
64	U002				Included with above
65	U003				Included with above
66	U004				Included with above
67	U005				Included with above
68	U006				Included with above
69	U007				Included with above
70	U008				Included with above
71	U009				Included with above
72	U010				Included with above
73	U011				Included with above
74	U012				Included with above
75	U014				Included with above
76	U015				Included with above
77	U016				Included with above
78	U017				Included with above
79	U018				Included with above
80	U019				Included with above
81	U020				Included with above
82	U021				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
83	U022				Included with above
84	U023				Included with above
85	U024				Included with above
86	U025				Included with above
87	U026				Included with above
88	U027				Included with above
89	U028				Included with above
90	U029				Included with above
91	U030				Included with above
92	U031				Included with above
93	U032				Included with above
94	U033				Included with above
95	U034				Included with above
96	U035				Included with above
97	U036				Included with above
98	U037				Included with above
99	U038				Included with above
100	U039				Included with above
101	U041				Included with above
102	U042				Included with above
103	U043				Included with above
104	U044				Included with above
105	U045				Included with above
106	U046				Included with above
107	U047				Included with above
108	U048				Included with above
109	U049				Included with above
110	U050				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
111	U051				Included with above
112	U052				Included with above
113	U053				Included with above
114	U055				Included with above
115	U056				Included with above
116	U057				Included with above
117	U058				Included with above
118	U059				Included with above
119	U060				Included with above
120	U061				Included with above
121	U062				Included with above
122	U063				Included with above
123	U064				Included with above
124	U066				Included with above
125	U067				Included with above
126	U068				Included with above
127	U069				Included with above
128	U070				Included with above
129	U071				Included with above
130	U072				Included with above
131	U073				Included with above
132	U074				Included with above
133	U075				Included with above
134	U076				Included with above
135	U077				Included with above
136	U078				Included with above
137	U079				Included with above
138	U080				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
139	U081				Included with above
140	U082				Included with above
141	U083				Included with above
142	U084				Included with above
143	U085				Included with above
144	U086				Included with above
145	U087				Included with above
146	U088				Included with above
147	U089				Included with above
148	U090				Included with above
149	U091				Included with above
150	U092				Included with above
151	U093				Included with above
152	U094				Included with above
153	U095				Included with above
154	U096				Included with above
155	U097				Included with above
156	U098				Included with above
157	U099				Included with above
158	U101				Included with above
159	U102				Included with above
160	U103				Included with above
161	U105				Included with above
162	U106				Included with above
163	U107				Included with above
164	U108				Included with above
165	U109				Included with above
166	U110				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
167	U111				Included with above
168	U112				Included with above
169	U113				Included with above
170	U114				Included with above
171	U115				Included with above
172	U116				Included with above
173	U117				Included with above
174	U118				Included with above
175	U119				Included with above
176	U120				Included with above
177	U121				Included with above
178	U122				Included with above
179	U123				Included with above
180	U124				Included with above
181	U125				Included with above
182	U126				Included with above
183	U127				Included with above
184	U128				Included with above
185	U129				Included with above
186	U130				Included with above
187	U131				Included with above
188	U132				Included with above
189	U133				Included with above
190	U134				Included with above
191	U135				Included with above
192	U136				Included with above
193	U137				Included with above
194	U138				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
195	U140				Included with above
196	U141				Included with above
197	U142				Included with above
198	U143				Included with above
199	U144				Included with above
200	U145				Included with above
201	U146				Included with above
202	U147				Included with above
203	U148				Included with above
204	U149				Included with above
205	U150				Included with above
206	U151				Included with above
207	U152				Included with above
208	U153				Included with above
209	U154				Included with above
210	U155				Included with above
211	U156				Included with above
212	U157				Included with above
213	U158				Included with above
214	U159				Included with above
215	U160				Included with above
216	U161				Included with above
217	U162				Included with above
218	U163				Included with above
219	U164				Included with above
220	U165				Included with above
221	U166				Included with above
222	U167				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
223	U168				Included with above
224	U169				Included with above
225	U170				Included with above
226	U171				Included with above
227	U172				Included with above
228	U173				Included with above
229	U174				Included with above
230	U176				Included with above
231	U177				Included with above
232	U178				Included with above
233	U179				Included with above
234	U180				Included with above
235	U181				Included with above
236	U182				Included with above
237	U183				Included with above
238	U184				Included with above
239	U185				Included with above
240	U186				Included with above
241	U187				Included with above
242	U188				Included with above
243	U189				Included with above
244	U190				Included with above
245	U191				Included with above
246	U192				Included with above
247	U193				Included with above
248	U194				Included with above
249	U196				Included with above
250	U197				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
251	U200				Included with above
252	U201				Included with above
253	U203				Included with above
254	U204				Included with above
255	U205				Included with above
256	U206				Included with above
257	U207				Included with above
258	U208				Included with above
259	U209				Included with above
260	U210				Included with above
261	U211				Included with above
262	U213				Included with above
263	U214				Included with above
264	U215				Included with above
265	U216				Included with above
266	U217				Included with above
267	U218				Included with above
268	U219				Included with above
269	U220				Included with above
270	U221				Included with above
271	U222				Included with above
272	U223				Included with above
273	U225				Included with above
274	U226				Included with above
275	U227				Included with above
276	U228				Included with above
277	U234				Included with above
278	U235				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
279	U236				Included with above
280	U237				Included with above
281	U238				Included with above
282	U239				Included with above
283	U240				Included with above
284	U243				Included with above
285	U244				Included with above
286	U246				Included with above
287	U247				Included with above
288	U248				Included with above
289	U249				Included with above
290	U271				Included with above
291	U278				Included with above
292	U279				Included with above
293	U280				Included with above
294	U328				Included with above
295	U353				Included with above
296	U359				Included with above
297	U364				Included with above
298	U367				Included with above
299	U372				Included with above
300	U373				Included with above
301	U387				Included with above
302	U389				Included with above
303	U394				Included with above
304	U395				Included with above
305	U404				Included with above
306	U409				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
307	U410				Included with above
308	U411				Included with above
309	P001				Included with above
310	P002				Included with above
311	P003				Included with above
312	P004				Included with above
313	P005				Included with above
314	P006				Included with above
315	P007				Included with above
316	P008				Included with above
317	P009				Included with above
318	P010				Included with above
319	P011				Included with above
320	P012				Included with above
321	P013				Included with above
322	P014				Included with above
323	P015				Included with above
324	P016				Included with above
325	P017				Included with above
326	P018				Included with above
327	P020				Included with above
328	P021				Included with above
329	P022				Included with above
330	P023				Included with above
331	P024				Included with above
332	P026				Included with above
333	P027				Included with above
334	P028				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
335	P029				Included with above
336	P030				Included with above
337	P031				Included with above
338	P033				Included with above
339	P034				Included with above
340	P036				Included with above
341	P037				Included with above
342	P038				Included with above
343	P039				Included with above
344	P040				Included with above
345	P041				Included with above
346	P042				Included with above
347	P043				Included with above
348	P044				Included with above
349	P045				Included with above
350	P046				Included with above
351	P047				Included with above
352	P048				Included with above
353	P049				Included with above
354	P050				Included with above
355	P051				Included with above
356	P054				Included with above
357	P056				Included with above
358	P057				Included with above
359	P058				Included with above
360	P059				Included with above
361	P060				Included with above
362	P062				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
363	P063				Included with above
364	P064				Included with above
365	P065				Included with above
366	P066				Included with above
367	P067				Included with above
368	P068				Included with above
369	P069				Included with above
370	P070				Included with above
371	P071				Included with above
372	P072				Included with above
373	P073				Included with above
374	P074				Included with above
375	P075				Included with above
376	P076				Included with above
377	P077				Included with above
378	P078				Included with above
379	P081				Included with above
380	P082				Included with above
381	P084				Included with above
382	P085				Included with above
383	P087				Included with above
384	P088				Included with above
385	P089				Included with above
386	P092				Included with above
387	P093				Included with above
388	P094				Included with above
389	P095				Included with above
390	P096				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
391	P097				Included with above
392	P098				Included with above
393	P099				Included with above
394	P101				Included with above
395	P102				Included with above
396	P103				Included with above
397	P104				Included with above
398	P105				Included with above
399	P106				Included with above
400	P108				Included with above
401	P109				Included with above
402	P110				Included with above
403	P111				Included with above
404	P112				Included with above
405	P113				Included with above
406	P114				Included with above
407	P115				Included with above
408	P116				Included with above
409	P118				Included with above
410	P119				Included with above
411	P120				Included with above
412	P121				Included with above
413	P122				Included with above
414	P123				Included with above
415	P127				Included with above
416	P128				Included with above
417	P185				Included with above
418	P188				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
419	P189				Included with above
420	P190				Included with above
421	P191				Included with above
422	P192				Included with above
423	P194				Included with above
424	P196				Included with above
425	P197				Included with above
426	P198				Included with above
427	P199				Included with above
428	P201				Included with above
429	P202				Included with above
430	P203				Included with above
431	P204				Included with above
432	P205				Included with above
433	D004	6,400	M	T04	Trench 31 and Trench 34 Waste Treatment Pads (DWMUs above the disposal cells)
434	D005				Included with above
435	D006				Included with above
436	D007				Included with above
437	D008				Included with above
438	D009				Included with above
439	D010				Included with above
440	D011				Included with above
441	D012				Included with above
442	D013				Included with above
443	D014				Included with above
444	D015				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
445	D016				Included with above
446	D017				Included with above
447	D018				Included with above
448	D019				Included with above
449	D020				Included with above
450	D021				Included with above
451	D022				Included with above
452	D023				Included with above
453	D024				Included with above
454	D025				Included with above
455	D026				Included with above
456	D027				Included with above
457	D028				Included with above
458	D029				Included with above
459	D030				Included with above
460	D031				Included with above
461	D032				Included with above
462	D033				Included with above
463	D034				Included with above
464	D035				Included with above
465	D036				Included with above
466	D037				Included with above
467	D038				Included with above
468	D039				Included with above
469	D040				Included with above
470	D041				Included with above
471	D042				Included with above
472	D043				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
473	WSC2				Included with above
474	WT01				Included with above
475	WT02				Included with above
476	WP01				Included with above
477	WP02				Included with above
478	WP03				Included with above
479	WPCB				Included with above
480	F001				Included with above
481	F002				Included with above
482	F003				Included with above
483	F004				Included with above
484	F005				Included with above
485	F006				Included with above
486	F007				Included with above
487	F008				Included with above
488	F009				Included with above
489	F010				Included with above
490	F011				Included with above
491	F012				Included with above
492	F019				Included with above
493	F027				Included with above
494	F039				Included with above
495	U001				Included with above
496	U002				Included with above
497	U003				Included with above
498	U004				Included with above
499	U005				Included with above
500	U006				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
501	U007				Included with above
502	U008				Included with above
503	U009				Included with above
504	U010				Included with above
505	U011				Included with above
506	U012				Included with above
507	U014				Included with above
508	U015				Included with above
509	U016				Included with above
510	U017				Included with above
511	U018				Included with above
512	U019				Included with above
513	U020				Included with above
514	U021				Included with above
515	U022				Included with above
516	U023				Included with above
517	U024				Included with above
518	U025				Included with above
519	U026				Included with above
520	U027				Included with above
521	U028				Included with above
522	U029				Included with above
523	U030				Included with above
524	U031				Included with above
525	U032				Included with above
526	U033				Included with above
527	U034				Included with above
528	U035				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
529	U036				Included with above
530	U037				Included with above
531	U038				Included with above
532	U039				Included with above
533	U041				Included with above
534	U042				Included with above
535	U043				Included with above
536	U044				Included with above
537	U045				Included with above
538	U046				Included with above
539	U047				Included with above
540	U048				Included with above
541	U049				Included with above
542	U050				Included with above
543	U051				Included with above
544	U052				Included with above
545	U053				Included with above
546	U055				Included with above
547	U056				Included with above
548	U057				Included with above
549	U058				Included with above
550	U059				Included with above
551	U060				Included with above
552	U061				Included with above
553	U062				Included with above
554	U063				Included with above
555	U064				Included with above
556	U066				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
557	U067				Included with above
558	U068				Included with above
559	U069				Included with above
560	U070				Included with above
561	U071				Included with above
562	U072				Included with above
563	U073				Included with above
564	U074				Included with above
565	U075				Included with above
566	U076				Included with above
567	U077				Included with above
568	U078				Included with above
569	U079				Included with above
570	U080				Included with above
571	U081				Included with above
572	U082				Included with above
573	U083				Included with above
574	U084				Included with above
575	U085				Included with above
576	U086				Included with above
577	U087				Included with above
578	U088				Included with above
579	U089				Included with above
580	U090				Included with above
581	U091				Included with above
582	U092				Included with above
583	U093				Included with above
584	U094				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
585	U095				Included with above
586	U096				Included with above
587	U097				Included with above
588	U098				Included with above
589	U099				Included with above
590	U101				Included with above
591	U102				Included with above
592	U103				Included with above
593	U105				Included with above
594	U106				Included with above
595	U107				Included with above
596	U108				Included with above
597	U109				Included with above
598	U110				Included with above
599	U111				Included with above
600	U112				Included with above
601	U113				Included with above
602	U114				Included with above
603	U115				Included with above
604	U116				Included with above
605	U117				Included with above
606	U118				Included with above
607	U119				Included with above
608	U120				Included with above
609	U121				Included with above
610	U122				Included with above
611	U123				Included with above
612	U124				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
613	U125				Included with above
614	U126				Included with above
615	U127				Included with above
616	U128				Included with above
617	U129				Included with above
618	U130				Included with above
619	U131				Included with above
620	U132				Included with above
621	U133				Included with above
622	U134				Included with above
623	U135				Included with above
624	U136				Included with above
625	U137				Included with above
626	U138				Included with above
627	U140				Included with above
628	U141				Included with above
629	U142				Included with above
630	U143				Included with above
631	U144				Included with above
632	U145				Included with above
633	U146				Included with above
634	U147				Included with above
635	U148				Included with above
636	U149				Included with above
637	U150				Included with above
638	U151				Included with above
639	U152				Included with above
640	U153				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
641	U154				Included with above
642	U155				Included with above
643	U156				Included with above
644	U157				Included with above
645	U158				Included with above
646	U159				Included with above
647	U160				Included with above
648	U161				Included with above
649	U162				Included with above
650	U163				Included with above
651	U164				Included with above
652	U165				Included with above
653	U166				Included with above
654	U167				Included with above
655	U168				Included with above
656	U169				Included with above
657	U170				Included with above
658	U171				Included with above
659	U172				Included with above
660	U173				Included with above
661	U174				Included with above
662	U176				Included with above
663	U177				Included with above
664	U178				Included with above
665	U179				Included with above
666	U180				Included with above
667	U181				Included with above
668	U182				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
669	U183				Included with above
670	U184				Included with above
671	U185				Included with above
672	U186				Included with above
673	U187				Included with above
674	U188				Included with above
675	U189				Included with above
676	U190				Included with above
677	U191				Included with above
678	U192				Included with above
679	U193				Included with above
680	U194				Included with above
681	U196				Included with above
682	U197				Included with above
683	U200				Included with above
684	U201				Included with above
685	U203				Included with above
686	U204				Included with above
687	U205				Included with above
688	U206				Included with above
689	U207				Included with above
690	U208				Included with above
691	U209				Included with above
692	U210				Included with above
693	U211				Included with above
694	U213				Included with above
695	U214				Included with above
696	U215				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
697	U216				Included with above
698	U217				Included with above
699	U218				Included with above
700	U219				Included with above
701	U220				Included with above
702	U221				Included with above
703	U222				Included with above
704	U223				Included with above
705	U225				Included with above
706	U226				Included with above
707	U227				Included with above
708	U228				Included with above
709	U234				Included with above
710	U235				Included with above
711	U236				Included with above
712	U237				Included with above
713	U238				Included with above
714	U239				Included with above
715	U240				Included with above
716	U243				Included with above
717	U244				Included with above
718	U246				Included with above
719	U247				Included with above
720	U248				Included with above
721	U249				Included with above
722	U271				Included with above
723	U278				Included with above
724	U279				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
725	U280				Included with above
726	U328				Included with above
727	U353				Included with above
728	U359				Included with above
729	U364				Included with above
730	U367				Included with above
731	U372				Included with above
732	U373				Included with above
733	U387				Included with above
734	U389				Included with above
735	U394				Included with above
736	U395				Included with above
737	U404				Included with above
738	U409				Included with above
739	U410				Included with above
740	U411				Included with above
741	P001				Included with above
742	P002				Included with above
743	P003				Included with above
744	P004				Included with above
745	P005				Included with above
746	P006				Included with above
747	P007				Included with above
748	P008				Included with above
749	P009				Included with above
750	P010				Included with above
751	P011				Included with above
752	P012				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
753	P013				Included with above
754	P014				Included with above
755	P015				Included with above
756	P016				Included with above
757	P017				Included with above
758	P018				Included with above
759	P020				Included with above
760	P021				Included with above
761	P022				Included with above
762	P023				Included with above
763	P024				Included with above
764	P026				Included with above
765	P027				Included with above
766	P028				Included with above
767	P029				Included with above
768	P030				Included with above
769	P031				Included with above
770	P033				Included with above
771	P034				Included with above
772	P036				Included with above
773	P037				Included with above
774	P038				Included with above
775	P039				Included with above
776	P040				Included with above
777	P041				Included with above
778	P042				Included with above
779	P043				Included with above
780	P044				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
781	P045				Included with above
782	P046				Included with above
783	P047				Included with above
784	P048				Included with above
785	P049				Included with above
786	P050				Included with above
787	P051				Included with above
788	P054				Included with above
789	P056				Included with above
790	P057				Included with above
791	P058				Included with above
792	P059				Included with above
793	P060				Included with above
794	P062				Included with above
795	P063				Included with above
796	P064				Included with above
797	P065				Included with above
798	P066				Included with above
799	P067				Included with above
800	P068				Included with above
801	P069				Included with above
802	P070				Included with above
803	P071				Included with above
804	P072				Included with above
805	P073				Included with above
806	P074				Included with above
807	P075				Included with above
808	P076				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
809	P077				Included with above
810	P078				Included with above
811	P081				Included with above
812	P082				Included with above
813	P084				Included with above
814	P085				Included with above
815	P087				Included with above
816	P088				Included with above
817	P089				Included with above
818	P092				Included with above
819	P093				Included with above
820	P094				Included with above
821	P095				Included with above
822	P096				Included with above
823	P097				Included with above
824	P098				Included with above
825	P099				Included with above
826	P101				Included with above
827	P102				Included with above
828	P103				Included with above
829	P104				Included with above
830	P105				Included with above
831	P106				Included with above
832	P108				Included with above
833	P109				Included with above
834	P110				Included with above
835	P111				Included with above
836	P112				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
837	P113				Included with above
838	P114				Included with above
839	P115				Included with above
840	P116				Included with above
841	P118				Included with above
842	P119				Included with above
843	P120				Included with above
844	P121				Included with above
845	P122				Included with above
846	P123				Included with above
847	P127				Included with above
848	P128				Included with above
849	P185				Included with above
850	P188				Included with above
851	P189				Included with above
852	P190				Included with above
853	P191				Included with above
854	P192				Included with above
855	P194				Included with above
856	P196				Included with above
857	P197				Included with above
858	P198				Included with above
859	P199				Included with above
860	P201				Included with above
861	P202				Included with above
862	P203				Included with above
863	P204				Included with above
864	P205				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
865	D004	1,550	M	D80	Trench 31 and Trench 34 Disposal (in Trench 31 and 34 Disposal Cells DWMUs)
866	D005				Included with above
867	D006				Included with above
868	D007				Included with above
869	D008				Included with above
870	D009				Included with above
871	D010				Included with above
872	D011				Included with above
873	D012				Included with above
874	D013				Included with above
875	D014				Included with above
876	D015				Included with above
877	D016				Included with above
878	D017				Included with above
879	D018				Included with above
880	D019				Included with above
881	D020				Included with above
882	D021				Included with above
883	D022				Included with above
884	D023				Included with above
885	D024				Included with above
886	D025				Included with above
887	D026				Included with above
888	D027				Included with above
889	D028				Included with above
890	D029				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
891	D030				Included with above
892	D031				Included with above
893	D032				Included with above
894	D033				Included with above
895	D034				Included with above
896	D035				Included with above
897	D036				Included with above
898	D037				Included with above
899	D038				Included with above
900	D039				Included with above
901	D040				Included with above
902	D041				Included with above
903	D042				Included with above
904	D043				Included with above
905	WSC2				Included with above
906	WT01				Included with above
907	WT02				Included with above
908	WP01				Included with above
909	WP02				Included with above
910	WP03				Included with above
911	WPCB				Included with above
912	F001				Included with above
913	F002				Included with above
914	F003				Included with above
915	F004				Included with above
916	F005				Included with above
917	F006				Included with above
918	F007				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
919	F008				Included with above
920	F009				Included with above
921	F010				Included with above
922	F011				Included with above
923	F012				Included with above
924	F019				Included with above
925	F027				Included with above
926	F039				Included with above
927	U001				Included with above
928	U002				Included with above
929	U003				Included with above
930	U004				Included with above
931	U005				Included with above
932	U006				Included with above
933	U007				Included with above
934	U008				Included with above
935	U009				Included with above
936	U010				Included with above
937	U011				Included with above
938	U012				Included with above
939	U014				Included with above
940	U015				Included with above
941	U016				Included with above
942	U017				Included with above
943	U018				Included with above
944	U019				Included with above
945	U020				Included with above
946	U021				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
947	U022				Included with above
948	U023				Included with above
949	U024				Included with above
950	U025				Included with above
951	U026				Included with above
952	U027				Included with above
953	U028				Included with above
954	U029				Included with above
955	U030				Included with above
956	U031				Included with above
957	U032				Included with above
958	U033				Included with above
959	U034				Included with above
960	U035				Included with above
961	U036				Included with above
962	U037				Included with above
963	U038				Included with above
964	U039				Included with above
965	U041				Included with above
966	U042				Included with above
967	U043				Included with above
968	U044				Included with above
969	U045				Included with above
970	U046				Included with above
971	U047				Included with above
972	U048				Included with above
973	U049				Included with above
974	U050				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
975	U051				Included with above
976	U052				Included with above
977	U053				Included with above
978	U055				Included with above
979	U056				Included with above
980	U057				Included with above
981	U058				Included with above
982	U059				Included with above
983	U060				Included with above
984	U061				Included with above
985	U062				Included with above
986	U063				Included with above
987	U064				Included with above
988	U066				Included with above
989	U067				Included with above
990	U068				Included with above
991	U069				Included with above
992	U070				Included with above
993	U071				Included with above
994	U072				Included with above
995	U073				Included with above
996	U074				Included with above
997	U075				Included with above
998	U076				Included with above
999	U077				Included with above
1000	U078				Included with above
1001	U079				Included with above
1002	U080				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1003	U081				Included with above
1004	U082				Included with above
1005	U083				Included with above
1006	U084				Included with above
1007	U085				Included with above
1008	U086				Included with above
1009	U087				Included with above
1010	U088				Included with above
1011	U089				Included with above
1012	U090				Included with above
1013	U091				Included with above
1014	U092				Included with above
1015	U093				Included with above
1016	U094				Included with above
1017	U095				Included with above
1018	U096				Included with above
1019	U097				Included with above
1020	U098				Included with above
1021	U099				Included with above
1022	U101				Included with above
1023	U102				Included with above
1024	U103				Included with above
1025	U105				Included with above
1026	U106				Included with above
1027	U107				Included with above
1028	U108				Included with above
1029	U109				Included with above
1030	U110				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1031	U111				Included with above
1032	U112				Included with above
1033	U113				Included with above
1034	U114				Included with above
1035	U115				Included with above
1036	U116				Included with above
1037	U117				Included with above
1038	U118				Included with above
1039	U119				Included with above
1040	U120				Included with above
1041	U121				Included with above
1042	U122				Included with above
1043	U123				Included with above
1044	U124				Included with above
1045	U125				Included with above
1046	U126				Included with above
1047	U127				Included with above
1048	U128				Included with above
1049	U129				Included with above
1050	U130				Included with above
1051	U131				Included with above
1052	U132				Included with above
1053	U133				Included with above
1054	U134				Included with above
1055	U135				Included with above
1056	U136				Included with above
1057	U137				Included with above
1058	U138				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1059	U140				Included with above
1060	U141				Included with above
1061	U142				Included with above
1062	U143				Included with above
1063	U144				Included with above
1064	U145				Included with above
1065	U146				Included with above
1066	U147				Included with above
1067	U148				Included with above
1068	U149				Included with above
1069	U150				Included with above
1070	U151				Included with above
1071	U152				Included with above
1072	U153				Included with above
1073	U154				Included with above
1074	U155				Included with above
1075	U156				Included with above
1076	U157				Included with above
1077	U158				Included with above
1078	U159				Included with above
1079	U160				Included with above
1080	U161				Included with above
1081	U162				Included with above
1082	U163				Included with above
1083	U164				Included with above
1084	U165				Included with above
1085	U166				Included with above
1086	U167				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1087	U168				Included with above
1088	U169				Included with above
1089	U170				Included with above
1090	U171				Included with above
1091	U172				Included with above
1092	U173				Included with above
1093	U174				Included with above
1094	U176				Included with above
1095	U177				Included with above
1096	U178				Included with above
1097	U179				Included with above
1098	U180				Included with above
1099	U181				Included with above
1100	U182				Included with above
1101	U183				Included with above
1102	U184				Included with above
1103	U185				Included with above
1104	U186				Included with above
1105	U187				Included with above
1106	U188				Included with above
1107	U189				Included with above
1108	U190				Included with above
1109	U191				Included with above
1110	U192				Included with above
1111	U193				Included with above
1112	U194				Included with above
1113	U196				Included with above
1114	U197				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1115	U200				Included with above
1116	U201				Included with above
1117	U203				Included with above
1118	U204				Included with above
1119	U205				Included with above
1120	U206				Included with above
1121	U207				Included with above
1122	U208				Included with above
1123	U209				Included with above
1124	U210				Included with above
1125	U211				Included with above
1126	U213				Included with above
1127	U214				Included with above
1128	U215				Included with above
1129	U216				Included with above
1130	U217				Included with above
1131	U218				Included with above
1132	U219				Included with above
1133	U220				Included with above
1134	U221				Included with above
1135	U222				Included with above
1136	U223				Included with above
1137	U225				Included with above
1138	U226				Included with above
1139	U227				Included with above
1140	U228				Included with above
1141	U234				Included with above
1142	U235				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1143	U236				Included with above
1144	U237				Included with above
1145	U238				Included with above
1146	U239				Included with above
1147	U240				Included with above
1148	U243				Included with above
1149	U244				Included with above
1150	U246				Included with above
1151	U247				Included with above
1152	U248				Included with above
1153	U249				Included with above
1154	U271				Included with above
1155	U278				Included with above
1156	U279				Included with above
1157	U280				Included with above
1158	U328				Included with above
1159	U353				Included with above
1160	U359				Included with above
1161	U364				Included with above
1162	U367				Included with above
1163	U372				Included with above
1164	U373				Included with above
1165	U387				Included with above
1166	U389				Included with above
1167	U394				Included with above
1168	U395				Included with above
1169	U404				Included with above
1170	U409				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1171	U410				Included with above
1172	U411				Included with above
1173	P001				Included with above
1174	P002				Included with above
1175	P003				Included with above
1176	P004				Included with above
1177	P005				Included with above
1178	P006				Included with above
1179	P007				Included with above
1180	P008				Included with above
1181	P009				Included with above
1182	P010				Included with above
1183	P011				Included with above
1184	P012				Included with above
1185	P013				Included with above
1186	P014				Included with above
1187	P015				Included with above
1188	P016				Included with above
1189	P017				Included with above
1190	P018				Included with above
1191	P020				Included with above
1192	P021				Included with above
1193	P022				Included with above
1194	P023				Included with above
1195	P024				Included with above
1196	P026				Included with above
1197	P027				Included with above
1198	P028				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1199	P029				Included with above
1200	P030				Included with above
1201	P031				Included with above
1202	P033				Included with above
1203	P034				Included with above
1204	P036				Included with above
1205	P037				Included with above
1206	P038				Included with above
1207	P039				Included with above
1208	P040				Included with above
1209	P041				Included with above
1210	P042				Included with above
1211	P043				Included with above
1212	P044				Included with above
1213	P045				Included with above
1214	P046				Included with above
1215	P047				Included with above
1216	P048				Included with above
1217	P049				Included with above
1218	P050				Included with above
1219	P051				Included with above
1220	P054				Included with above
1221	P056				Included with above
1222	P057				Included with above
1223	P058				Included with above
1224	P059				Included with above
1225	P060				Included with above
1226	P062				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1227	P063				Included with above
1228	P064				Included with above
1229	P065				Included with above
1230	P066				Included with above
1231	P067				Included with above
1232	P068				Included with above
1233	P069				Included with above
1234	P070				Included with above
1235	P071				Included with above
1236	P072				Included with above
1237	P073				Included with above
1238	P074				Included with above
1239	P075				Included with above
1240	P076				Included with above
1241	P077				Included with above
1242	P078				Included with above
1243	P081				Included with above
1244	P082				Included with above
1245	P084				Included with above
1246	P085				Included with above
1247	P087				Included with above
1248	P088				Included with above
1249	P089				Included with above
1250	P092				Included with above
1251	P093				Included with above
1252	P094				Included with above
1253	P095				Included with above
1254	P096				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1255	P097				Included with above
1256	P098				Included with above
1257	P099				Included with above
1258	P101				Included with above
1259	P102				Included with above
1260	P103				Included with above
1261	P104				Included with above
1262	P105				Included with above
1263	P106				Included with above
1264	P108				Included with above
1265	P109				Included with above
1266	P110				Included with above
1267	P111				Included with above
1268	P112				Included with above
1269	P113				Included with above
1270	P114				Included with above
1271	P115				Included with above
1272	P116				Included with above
1273	P118				Included with above
1274	P119				Included with above
1275	P120				Included with above
1276	P121				Included with above
1277	P122				Included with above
1278	P123				Included with above
1279	P127				Included with above
1280	P128				Included with above
1281	P185				Included with above
1282	P188				Included with above

U.S. Environmental Protection Agency State Identification Number WA7890008967					
Line Number	A. Dangerous Waste Number	B. Estimated Annual Quantity of Waste	C. Unit of Measure	Processes	
				(1) Process Codes	(2) Process Description
1283	P189				Included with above
1284	P190				Included with above
1285	P191				Included with above
1286	P192				Included with above
1287	P194				Included with above
1288	P196				Included with above
1289	P197				Included with above
1290	P198				Included with above
1291	P199				Included with above
1292	P201				Included with above
1293	P202				Included with above
1294	P203				Included with above
1295	P204				Included with above
1296	P205				Included with above
1297	D008 (State of Washington Only)	7,300	M	D80	Trench 94 Disposal (In Trench 94 Disposal Cell DWMU)

DWMU = dangerous waste management unit

This page intentionally left blank.

Attachment C

Section XVII – Photographs

This page intentionally left blank.

Figures

Figure C-1. Aerial Photo of the LLBG Trenches 31-34 Operating and Closing DWMU (2012).....A-C-1
Figure C-2. Aerial Photo of the LLBG Trench 94 Operating DWMU (2012) A-C-2
Figure C-3. Trenches 31 and 34 Topographic Map A-C-3
Figure C-4. Trench 94 Topographic Map A-C-4

This page intentionally left blank.

Low Level Burial Grounds
Trench 31 - 34
200 West Area

Prepared for:
US DEPARTMENT OF ENERGY
Intended Use: REFERENCE ONLY
Projection: LAMBERT CONFORMAL CONIC
Coordinate System: WASHINGTON STATE PLANE, SOUTH ZONE, METERS
Horizontal Datum: NAD83
Vertical Datum: NAVD88

Hanford Site
Unit Location

2012 aerial image (12 inch).
TSD Operating - Unit Group Boundary
Operating DWMU
Closing DWMU

N
W E
S

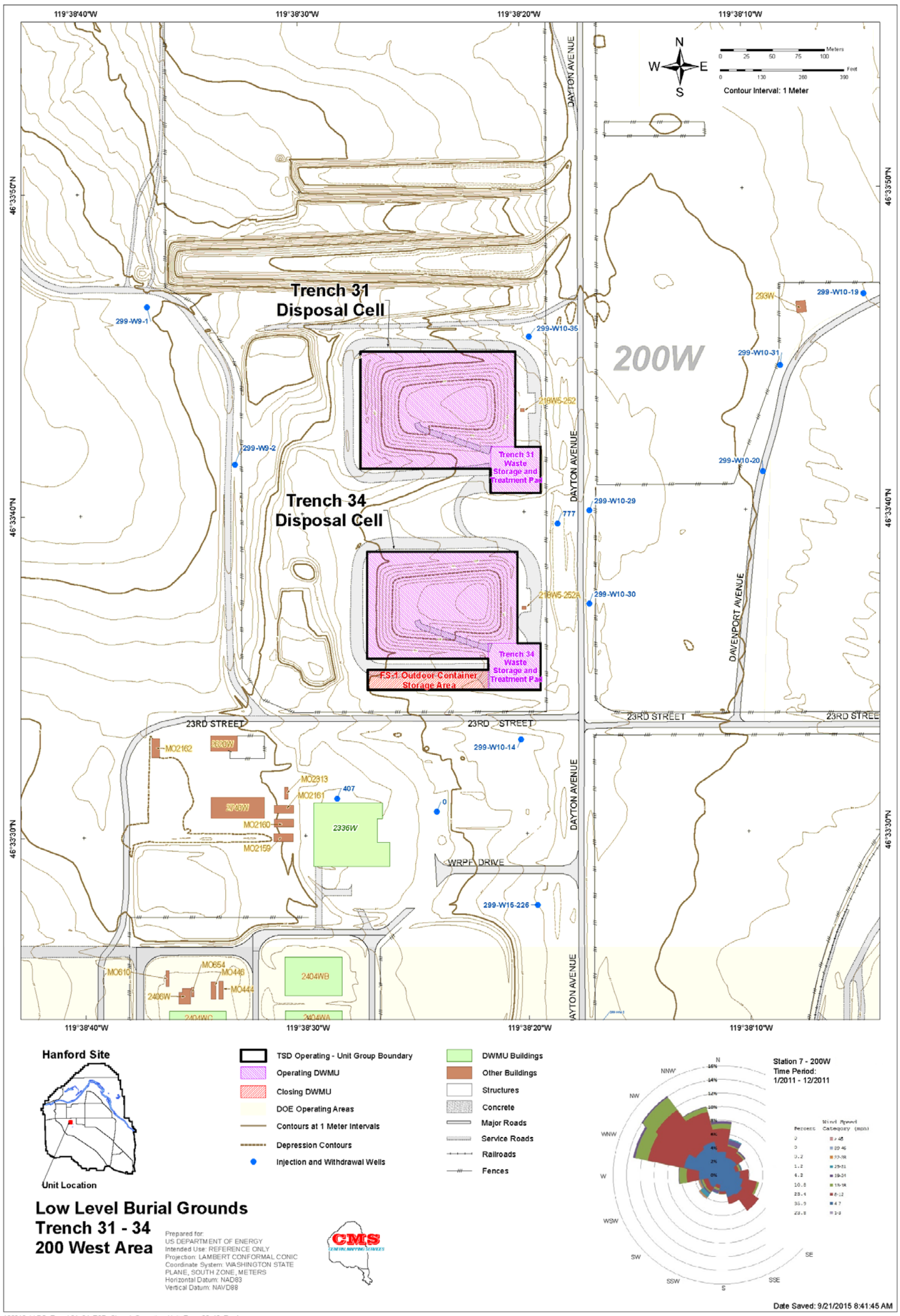
Meters 0 25 50 75 100
Feet 0 100 200 300

130812_LLBG_Trench31_34_TSD_Closed_Operating_Unit_Aerial_11x17_Rev0

Figure C-1. Aerial Photo of the LLBG Trenches 31-34 Operating and Closing DWMU (2012)

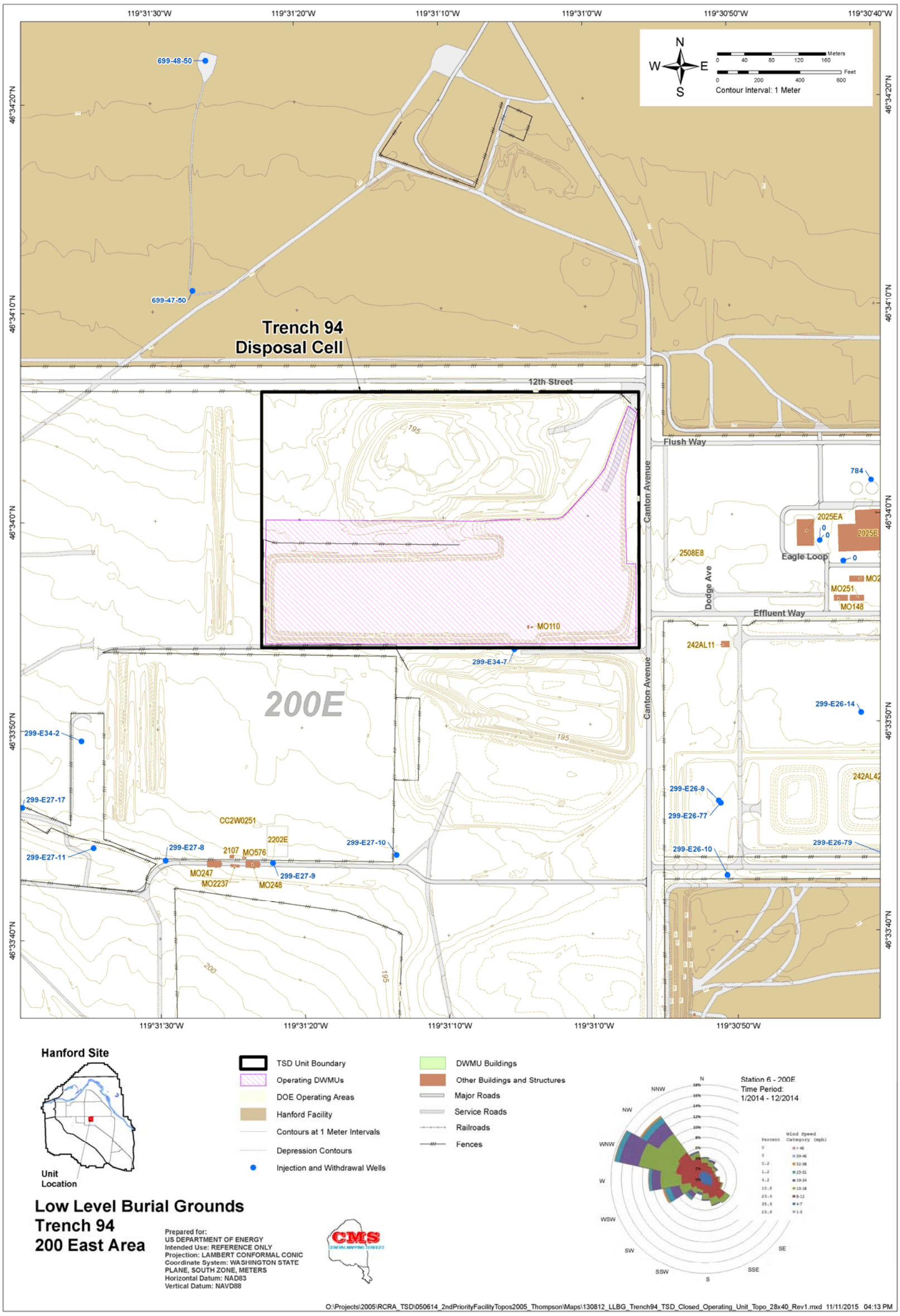
130812_LLBG_Trench94_TSD_Closed_Operating_Unit_Aerial_11x17_Rev0

Figure C-2. Aerial Photo of the LLBG Trench 94 Operating DWMU (2012)



References: NAD83, *North American Datum of 1983*; NAVD88, *North American Vertical Datum of 1988*.

Figure C-3. Trenches 31 and 34 Topographic Map



References: NAD83, *North American Datum of 1983*; NAVD88, *North American Vertical Datum of 1988*.

Figure C-4. Trench 94 Topographic Map

Addendum B

Waste Analysis Plan

This page intentionally left blank.

Contents

B1 Introduction and Unit Description B-1
B1.1 LLBG Trenches 31-34-94 Unit Description B-1
B1.2 LLBG Trenches 31-34-94 Waste Management Activities B-1
B1.3 Waste Managed at LLBG Trenches 31-34-94 ..... B-1
B2 Waste Pre-acceptance Processes B-2
B2.1 Identification and Classification of Waste B-2
B2.1.1 Use of Knowledge B-2
B2.2 Waste Profile Review and Approval Process B-2
B2.2.1 New Waste Profile Review and Approval B-2
B2.2.2 Standing Waste Profile Review B-3
B2.2.3 Waste Exempt from Profile Process B-4
B3 Waste Acceptance Process B-4
B3.1 Confirmation B-4
B3.1.1 Verification B-4
B3.1.2 Preshipment Review B-6
B3.2 Waste Receipt B-6
B3.2.1 Container Receipt Inspection B-6
B3.2.2 Waste Receipt Discrepancies B-7
B4 LLBG Trenches 31-34-94-Generated Waste B-8
B4.1 Waste Resulting from Treatment at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads B-8
B4.2 Other LLBG Trenches 31-34-94-Generated Waste B-8
B5 Waste Analysis Parameters B-15
B5.1 Sampling Methods and Equipment B-15
B6 Quality Assurance/Quality Control B-15
B6.1 Waste Receipt Quality Assurance B-15
B6.2 Laboratory Selection B-16
B7 Recordkeeping B-16
B8 Training B-16
B9 References B-16

Appendix

B-A Performance Evaluation System ..... B-A-i

Tables

Table B-1. Post-treatment Waste Analysis Confirmation B-10
Table B-2. Waste Requiring Verification or Characterization Analysis B-11
Table B-3. LLBG Trenches 31-34-94 Sampling Equipment B-15

Glossary

Characterization	Information provided for a waste stream that includes the use of "Knowledge" and/or the methods of laboratory analysis approved in WAC 173-303-110, "Dangerous Waste Regulations," "Sampling, Testing Methods, and Analytes."
Knowledge	Sufficient information about a waste to substitute reliably for direct testing of the waste. To be sufficient and reliable, the "knowledge" used must provide information necessary to manage the waste in accordance with the requirements of WAC 173-303-040, "Definitions." Note: "Knowledge" may be used by itself or in combination with testing to designate a waste pursuant to WAC 173-303-070(3)(c), "Designation of Dangerous Waste," or to obtain a detailed chemical, physical, and/or biological analysis of a waste as required in WAC 173-303-300(2), "General Waste Analysis."
Labpack	A packaging method where a number of inner containers of waste are packaged into an outer drum as specified in 49 CFR 173.12(b), "Transportation," "Exceptions for Shipment of Waste Materials." For this document, the term also could be used for U.S. Department of Transportation Class 7 material packaged in the same manner.
Nonconformance	A significant discrepancy difference in quantity or type of waste. A waste shipment may be classified as nonconforming if different in chemical or physical properties from the information on the waste profile. A variation in shipment piece count from the manifest as defined by WAC 173-303-370(5), "Manifest System," is nonconforming.
Retrievably Stored Waste	Waste that was previously generated and accepted for storage at the 200 Area burial grounds.
Retrieved Waste	Waste that was formerly retrievably stored waste and has now been accepted for management at the Central Waste Complex-Waste Receiving and Processing Facility, T Plant, or other treatment, storage, and disposal facility.
Testing	Performance of a procedure that yields a quantitative or qualitative evaluation of the type and/or quantity of materials present. Sometimes referred to as analysis or laboratory analysis.
Testing for Total Metals	Includes sample preparation followed by analysis for arsenic (D004), barium (D005), cadmium (DO06), chromium (D007), lead (D008), mercury (D009), selenium (D010), and silver (D011).

Testing for Total Organics	Includes sample preparation followed by analysis for benzene (D018), carbon tetrachloride (D019), chlordane (D020), chlorobenzene (D021), chloroform (D022), 1,4-dichlorobenzene (D027), 1,2-dichloroethane (D028), 1,1-dichloroethylene (D029), 2,4-dinitrotoluene (D030), endrin (D012), heptachlor and heptachlor epoxide (D031), hexachlorobenzene (D032), hexachlorobutadiene (D033), hexachloroethane (D034), methoxychlor (D014), methyl ethyl ketone (D035), nitrobenzene (D036), pentachlorophenol (D037), tetrachloroethylene (D039), toxaphene (D015), trichloroethylene (D040), 2,4,5-trichlorophenol (D041), 2,4,6-trichlorophenol (D042), and vinyl chloride (D043).
Treatment	The physical, chemical, or biological processing of dangerous waste to make such wastes nondangerous or less dangerous, safer for transport, amenable for energy or material resource recovery, amenable for storage, or reduced in volume, with the exception of compacting, repackaging, and sorting as allowed under WAC 173-303-400(2), "Interim Status Facility Standards," and WAC 173-303-600(3), "Final Facility Standards."
Waste Shipment	Waste transferred from point A to point B under a single waste manifest or shipping paper.
Waste Stream	A waste or group of wastes from a process or a facility with similar physical, chemical, or radiological properties.

B1 Introduction and Unit Description

This addendum details the Waste Analysis Plan (WAP) required by WAC 173-303-300(5), "Dangerous Waste Regulations," "General Waste Analysis," in effect at the Low-Level Burial Grounds (LLBG) Trenches 31-34-94 Operating Unit Group (OUG), hereinafter referred to as LLBG Trenches 31-34-94 (Note: This WAP expressly supersedes Exhibit A Sections 1.8.1 and 1.8.2 of Ecology, 2014, *Agreed Order and Stipulated Penalty No. DE 10156*).

The purpose of this LLBG Trenches 31-34-94 WAP is to provide a clear outline of the pre-waste acceptance and waste analysis processes that occur for the treatment and storage of waste at LLBG Trenches 31 and 34. This WAP demonstrates compliance with the requirements of WAC 173-303-300(1) through (5), as well as applicable federal and state land disposal requirements (LDRs). Additional information on LLBG Trenches 31-34-94 waste storage and treatment processes is detailed in Addendum C, "Process Information."

Please note, the terms "mixed waste" and/or "waste" when seen in this document refer to dangerous waste or hazardous waste, as applicable.

B1.1 LLBG Trenches 31-34-94 Unit Description

The LLBG Trenches 31-34-94 OUG is comprised of the following dangerous waste management units:

- LLBG Trench 31
- LLBG Trench 31 Waste Storage and Treatment Pad
- LLBG Trench 34
- LLBG Trench 34 Waste Storage and Treatment Pad
- LLBG Trench 94

B1.2 LLBG Trenches 31-34-94 Waste Management Activities

Waste management within LLBG Trenches 31-34-94 includes the following activities:

- Waste receipt
- Physical/chemical screening
- Storage
- Treatment
- Waste certification
- Shipment of waste offsite
- Transfer of waste to and/or from other Solid Waste Operations Complex (SWOC) treatment, storage, and/or disposal (TSD) locations

B1.3 Waste Managed at LLBG Trenches 31-34-94

The following wastes are managed at LLBG Trenches 31 and 34:

- Newly generated waste from onsite or offsite generators other than LLBG Trenches 31-34-94

- Waste previously accepted at other SWOC TSD OUGs and then transferred to LLBG Trenches 31-34-94
- Retrieved waste (RW) generated from onsite sources treated and confirmed to meet LDR requirements
- LLBG Trenches 31-34-94-generated waste meeting LDR requirements

Waste managed at LLBG Trench 94 includes decommissioned, defueled reactor compartments (RCs) shipped from the Puget Sound Naval Shipyard for final disposal.

B2 Waste Pre-acceptance Processes

The following sections address the waste pre-acceptance process, including waste stream identification and classification, and profile review and approval at LLBG Trenches 31-34-94.

B2.1 Identification and Classification of Waste

Generators must characterize and designate their waste and submit all required waste profile information to a Waste Management Representative (WMR). Waste is designated by the generator using known information provided by manufacturers, safety data sheets, laboratory analysis, knowledge of the waste generating process (Section B2.1.1), and reference materials such as NIOSH, 2014, *Registry of Toxic Effects of Chemical Substances*, EPA, 2015, ECOTOX Database, or the U.S. National Library of Medicine TOXNET: Toxicology Data Network, Hazardous Substances Data Bank website.

For additional information on waste codes accepted at LLBG Trenches 31-34-94, refer to WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter Hanford Facility RCRA Permit), "Hanford Dangerous Waste Permit Application," Part A.

For identification of waste prohibited at LLBG Trenches 31-34-94, refer to Addendum C.

B2.1.1 Use of Knowledge

Waste designated using knowledge (i.e., not directly sampled and analyzed) requires sufficient information about the waste generation process to provide a reliable substitute for direct testing of the waste (WAC 173-303-040, "Definitions"). Waste profiles, using knowledge as defined in WAC 173-303-040, must include all supporting data and records, including a description of the methodology employed to obtain the data. The waste profile review and approval process (Section B2.2) includes an evaluation of generator knowledge. Knowledge of the waste-generating process may be used with a combination of chemical, physical, and/or biological analysis (WAC 173-303-300(2)) to designate waste.

B2.2 Waste Profile Review and Approval Process

The waste profile review and approval process consists of review and approval of new draft waste profiles and annual reviews of standing waste profiles. The WMR coordinates the documentation for all waste profile reviews and approvals and ensures the waste profile information complies with LLBG Trenches 31-34-94 solid waste acceptance requirements.

B2.2.1 New Waste Profile Review and Approval

Generators submit draft waste profiles for each new waste stream destined for LLBG Trenches 31, 34, and 94 (RCs only).

Each waste profile is assigned a unique number for tracking purposes. Once the draft waste profile is received, the WMR performs a consistency check of profile information. This consistency check is the primary means by which LLBG Trenches 31-34-94 obtains data about each waste stream. These data are required to ensure that a waste stream can be managed in compliance with the LLBG Trenches 31-34-94 waste acceptance requirements. The profile must provide a clear picture of the waste stream's physical and chemical characteristics, regulatory classification, and packaging methods. Any relevant background information, documents, and analytical data must be referenced or attached. The consistency check also determines if knowledge, provided in lieu of other analysis methods (Section B2.1.1), is adequate to quantify waste constituents and determine waste characteristics.

The waste profile includes the following information at a minimum:

- Waste-generating process description
- Waste category (e.g., low level, mixed, and polychlorinated biphenyl)
- Estimated volume of the waste
- Estimated number of waste containers to be shipped
- Knowledge used for characterization of the waste stream
- Sampling and analysis performed to characterize the waste stream
- Regulatory requirements of the waste stream (e.g., testing for underlying hazardous constituents) including applicable state and federal LDRs
- Waste characteristics (e.g., flash point and pH), physical state (e.g., sludge and debris), liquid content information, and the waste composition
- Description of the packaging to be used including container compatibility with the waste
- Provisions for handling (e.g., maximum container size and weight, and special handling requirements)
- Conditions of approval (when applicable)

Errors discovered by the WMR during the waste profile review process must be reconciled by the generator, and the profile information must be updated. Upon successful review and approval of the waste profile, the generator will receive an approval notice with the initial container verification rate as determined by the Performance Evaluation System (PES) (Appendix B-A, Section B-A2).

B2.2.2 Standing Waste Profile Review

A standing waste profile is used to receive multiple shipments from the same generator for the same waste stream. Standing waste profiles are subject to review and must be recertified at least annually, or revised if applicable, when the waste stream or generating process changes. Standing waste profiles are subject to review and revision if LLBG Trenches 31-34-94 personnel have reason to suspect a change in the waste, based on inconsistencies in packaging, labeling, or visual verification of the waste. A generator may also request that a standing waste profile be revised and approved for additional waste generated that consists of the same types of waste. The WMR coordinates the revisions and recertification by PES, as required.

B2.2.3 Waste Exempt from Profile Process

LLBG Trenches 31-34-94-generated waste from operations and maintenance (O&M) activities is exempt from the profile process. Additional information on LLBG Trenches 31-34-94-generated waste is provided in Section B4.2.

RW is exempt from the waste profile process as a previously accepted waste stream.

B3 Waste Acceptance Process

The LLBG Trenches 31-34-94 waste acceptance process includes confirmation of waste against the previously reviewed and approved waste profile information and receipt of the waste into LLBG Trenches 31-34-94 for treatment and/or storage.

Once waste profiles are reviewed and approved, a generator may request to ship or transfer the approved waste containers to LLBG Trenches 31-34-94 for treatment and/or storage. Each waste container received at LLBG Trenches 31-34-94 must match the identity of the waste container specified on the accompanying shipping or transfer paperwork.

Waste shipments or transfers to LLBG Trenches 31-34-94 for treatment and/or storage can be received and verified prior to acceptance. Documentation of an approved waste profile (if applicable), sufficient characterization to manage the waste safely, designation of waste codes identifying any dangerous constituents of the waste, and all other information required by the LLBG Trenches 31-34-94 waste acceptance process must accompany the shipment or transfer at the time of container receipt.

Retrievably stored waste (RSW) transfers, newly generated waste from onsite and offsite generators, SWOC waste transfers, and RCs are accepted into LLBG Trenches 31-34-94 by the processes detailed in the following sections.

B3.1 Confirmation

WAC 173-303-300(1) requires confirmation of waste before TSD. Confirmation for waste is a two-part process consisting of verification and preshipment review. Verification occurs either before or after preshipment review.

B3.1.1 Verification

Verification ensures that waste received into LLBG Trenches 31 and 34 matches the waste in the approved profile. Verification can occur either at the generator location prior to shipment or transfer of the waste containers to LLBG Trenches 31 and 34 or at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. The verification rate will be established by PES during approval of the waste profile (Appendix B-A, Section B-A2). After the initial verification rate has been established, the verification rate may be reduced (Appendix B-A, Section B-A3).

Verification can include the use of physical screening (nondestructive examination [NDE] and visual verification) or chemical screening.

NDE is performed, using real-time radiography, by observing inventory documentation and comparing the NDE results to the waste profile.

Visual verification includes comparing the container contents to the container inventory, waste acceptance criteria, and waste profile. Containers can be subject to NDE or visual verification, but the use of both techniques for the same container is not required.

Of the visually verified mixed waste, 10 percent will be chemically screened as allowed by the waste stream characteristics.

The following cases do not require chemical screening:

- Small containers of waste in overpacked containers (labpacks) packaged in accordance with WAC 173-303-161, "Overpacked Containers (Labpacks)," and not prohibited under LDRs specified in WAC 173-303-140, "Land Disposal Restrictions", which includes by reference 40 CFR 268
- Commercial chemical products in the original product container(s) (e.g., off-specification, outdated, or unused products)
- Chemical-containing equipment removed from service, (e.g., ballasts and batteries)
- Waste containing asbestos
- Waste, environmental media, and/or debris from the cleanup of spills or release of a single substance, commercial product, or otherwise known material
- Confirmed noninfectious waste (e.g., xylene, acetone, ethyl alcohol, and isopropyl alcohol) generated from laboratory tissue preparation, slide staining, or fixing processes
- Hazardous debris as defined in WAC 173-303-040

B3.1.1.1 *Verification of Waste from Non-SWOC Onsite or Offsite Generators*

Verification may be conducted either at the generator location or at LLBG Trenches 31 and 34. Verification is conducted by the Waste Verifier and, in the case of visual verification and chemical screening, most often occurs during container packaging at the generator location. For waste received at LLBG Trenches 31 and 34, verification includes identifying any excessive void space.

Certain types of waste (e.g., debris to be macroencapsulated), may be difficult or impossible to verify after treatment. Generators planning to treat waste before shipment to LLBG Trenches 31 and 34 must obtain an approved waste profile before treating the waste. Verification will then occur prior to treatment or packaging of the waste. The waste will be verified at the frequency determined by PES during waste profile review and approval (Appendix B-A, Section B-A2).

B3.1.1.2 *Verification of Waste from Other Hanford SWOC TSD Units*

Verification at other SWOC TSD units is conducted by the Waste Verifier and, in the case of visual verification and chemical screening, most often occurs during container packaging. Once the container has been verified, a tamperproof seal is placed on the container. Containers can undergo multiple transfers between SWOC TSD units; however, additional verification is not required upon receipt at LLBG Trenches 31 and 34 if the tamperproof seal is intact. Containers that arrive at LLBG Trenches 31 and 34 with a compromised tamperproof seal will require notification of the waste services department for evaluation of potential reverification or application of a new tamperproof seal.

B3.1.1.3 *Waste Exempt from the Verification Process*

RSW is waste that was accepted for storage at the 200 Area burial grounds. During the retrieval process, this waste is unearthed, retrieved, and identified by a unique container number or by burial location. During retrieval activities, RSW historical records and knowledge of waste-generating processes are reviewed to characterize the waste and designate dangerous waste codes. As previously accepted waste, RSW is exempt from the waste profile approval and verification processes. However, NDE will be used

on drums and boxes, for which NDE capability exists, and performed either at the burial ground prior to shipment or at another TSD (e.g., T Plant) prior to receipt at LLBG Trenches 31 and 34.

LLBG Trenches 31-34-94 waste generated from O&M activities is exempt from the verification process. See Section B4 for additional details.

RCs received at Trench 94 are exempt from the verification process.

B3.1.2 Preshipment Review

Prior to shipping or transferring waste containers to LLBG Trenches 31-34-94, the WMR conducts a preshipment review of documentation. This review ensures that all previously submitted and approved generator information is current and complete.

The generator must provide the following documentation:

- Characterization information and waste code designations
- List of containers, each with a unique identification number
- Container inventory, including the following information:
  - Name and location of the waste-generating facility
  - Specific contents of each container
  - Approximate weight of waste in each container
- LDR notification/certification (required for waste subject to the requirements of WAC 173-303-140 which includes by reference 40 CFR 268)

If the WMR discovers an error during the preshipment review, the generator must reconcile the error and provide updated information as applicable. For additional information on conformance issue resolution, refer to Appendix B-A, Section B-A4.

LLBG Trenches 31-34-94-generated waste from O&M activities is generated and located at the LLBG Trenches 31-34-94 facility and is, therefore, exempt from preshipment review. See Section B4 for additional details.

B3.2 Waste Receipt

The waste receipt process includes container receipt inspection and waste receipt discrepancies. LLBG Trenches 31-34-94-generated waste from O&M activities is generated and located at LLBG Trenches 31-34-94 facility and is, therefore, exempt from the waste receipt process. Additional information on LLBG Trenches 31-34-94-generated waste is provided in Section B4.

B3.2.1 Container Receipt Inspection

Arriving container shipments are assigned a specific delivery location within LLBG Trenches 31-34-94. Transport vehicles may access the following locations:

- Trench 31 Waste Storage and Treatment Pad
- Trench 34 Waste Storage and Treatment Pad
- Trench 94 (RCs only)

Upon arrival, 100 percent of containers will undergo physical inspection for the following items:

- Damage to the container
- Evidence of leaking
- Presence of accurate labeling
- Tamper-resistant seal integrity (if present)

Waste received at LLBG Trenches 31-34-94 will be accompanied by the following container receipt documentation:

- Receipt report and container list for each approved shipment
- Uniform Hazardous Waste Manifest, if applicable
- LDR certification/notification for waste subject to LDR requirements of WAC 173-303-140 which includes by reference 40 CFR 268 certifying that the waste meets the appropriate treatment, variance, or exemption standard

In addition to the physical container inspection, an inspection of paperwork and documentation will also be conducted for each shipment or transfer to confirm the waste containers received are listed on the manifest/receipt report.

Once the waste is received and unloaded, a signed copy of the manifest or transfer paperwork will be given to the transporter. A copy of the manifest or transfer paperwork will also be sent to the generator within 30 days. A copy of the manifest or transfer paperwork will be retained in the LLBG Trenches-31-34-94 portion of the Hanford Facility Operating Record for at least 3 years.

Following completion of the receipt process, the waste is considered accepted at LLBG Trenches 31-34-94. Following acceptance at LLBG Trenches 31-34-94, RSW is referred to as RW.

B3.2.2 Waste Receipt Discrepancies

If discrepancies, such as improper container labeling, improper packaging, nonconformance issues, or manifest inconsistencies, are discovered during the container receipt inspection, the discrepant containers or shipment will be evaluated for entrance into a discrepant container management program and will not be accepted into LLBG Trenches 31-34-94 until the discrepancies have been resolved using one or more of the following alternatives:

- Incorrect or incomplete entries on the Uniform Hazardous Waste Manifest or onsite shipping or transfer paperwork can be immediately corrected with the concurrence from the generator. Corrections are made by drawing a single line through the incorrect manifest entry. Corrected entries are initialed and dated by the individual making the correction.
- The waste package(s) can be held at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads, segregated from other stored waste, and the generator must provide written instructions for use in correcting the discrepancies.
- The waste package may be returned to the generator.

If a discrepant (nonconforming) waste container or shipment is received from an offsite generator and is returned to the generator, then a new manifest will be prepared in accordance with WAC 173-303-370(5)(f). If the waste container or shipment is nonreturnable to the offsite generator because of container condition deficiencies, and if an agreement cannot be reached among the parties to resolve the noncompliant condition, then the Washington State Department of Ecology (Ecology) will be notified in writing within 15 days after receiving the noncompliant shipment. A copy of the manifest at issue will accompany the notification (WAC 173-303-370, "Manifest System"). Pending resolution, the

nonreturnable package will be segregated from other waste and will not be accepted at LLBG Trenches 31 and 34. If the discrepancy is discovered after the manifest has been signed and returned to the delivering transporter or offsite generator, the manifest will be updated to include the discrepancy, re-signed and dated. A copy of the updated manifest must be sent to the transporter and offsite generator within thirty days and maintained in the operating record for a minimum of three years.

If the waste container or shipment is damaged to such an extent, or the waste is in such a condition as to present a hazard to the public health or the environment in the process of further transportation, then actions must be taken in accordance with Addendum J, "Contingency Plan".

B4 LLBG Trenches 31-34-94-Generated Waste

Waste generated at LLBG Trenches 31-34-94 from processing and treatment operations, performing repair and maintenance activities, spill cleanup materials, or other sources within LLBG Trenches 31-34-94 will be managed to ensure proper handling and disposition. This includes two different categories of waste: waste resulting from treatment at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads and LLBG Trenches 31-34-94 waste generated from O&M activities.

B4.1 Waste Resulting from Treatment at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads

Waste from onsite and offsite generators may be processed and/or treated at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads, resulting in a newly generated waste stream. Treatment may be performed at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads to change the characteristics and/or to render the waste LDR compliant. Methods for confirming the effectiveness of treatment are shown in Table B-1.

B4.2 Other LLBG Trenches 31-34-94-Generated Waste

Waste will be characterized by LLBG Trenches 31-34-94 personnel for proper handling. Information for the LLBG Trenches 31-34-94 waste generated during O&M activities is captured during the work planning process and provided to a WMR for review. Laboratory analysis for the waste is performed as necessary by the WMR. Planning for the LLBG Trenches 31-34-94-generated waste stream begins prior to waste generation. For the work activity to be performed, LLBG Trenches 31-34-94-generated waste is identified, reviewed, and designated. Packaging and storage requirements are determined based on compatibility, receiving TSD acceptance criteria, and applicable U.S. Department of Transportation regulations. Requirements for LLBG Trenches 31-34-94-generated waste are placed in work plans to be executed in the field during generation of the waste. The waste to be generated is identified for the work activity to be performed.

The following LLBG Trenches 31-34-94-generated wastes do not require chemical analysis:

- Commercial chemical products in the original product container(s) (e.g., off-specification, outdated, or unused products)
- Chemical-containing equipment removed from service (e.g., ballasts, batteries, and fluids)
- Waste, environmental media, and/or debris from the cleanup of a spill or release of a single substance, commercial product, or otherwise known material
- Waste, environmental media, and/or debris from the cleanup of a spill or release from a container previously accepted at LLBG Trenches 31-34-94

- Hazardous debris as defined in WAC 173-303-040
- Liquids discovered in LLBG Trenches 31-34-94 that are known to be precipitation

Waste not meeting the preceding exceptions will be sampled using the applicable parameters in Table B-2 and will be designated according to the regulatory requirements of WAC 173-303-070, "Designation of Dangerous Waste." Known precipitation liquids will be managed as nondangerous waste.

Table B-1. Post-treatment Waste Analysis Confirmation

Treatment Type	Description	Frequency	Confirmation		
			Debris*	Liquids	Homogeneous Solids
Immobilization technologies	Stabilization of the debris such that the leachability of the hazardous contaminants is reduced. Includes macroencapsulation, microencapsulation, and sealing.	Every container treated	Visual inspection	N/A	Visual inspection

* Confirmation for waste debris is performance based when meeting the requirements of the treatments listed in 40 CFR 268.45, "Land Disposal Restrictions," "Treatment Standards for Hazardous Debris."

N/A = not applicable

Table B-2. Waste Requiring Verification or Characterization Analysis

Verification					
Waste Stream	**Parameter**	**Method**	**Frequency of Analysis**	**Sampling Method**	**Rationale for Selection**
Debris	Physical Inspection	Visual inspection	Other SWOC and Non-SWOC-generated waste: The verification rate will be established by PES during approval of the waste profile (see Section B2.2). RSW is exempt from verification; however, NDE will be used on drums and boxes for which NDE capability exists, either at the trench prior to shipment or at another TSD prior to receipt at LLBG Trenches 31-34-94. RCs are exempt from verification. LLBG Trenches 31-34-94 waste generated during O&M activities – Exempt.	Visual of open container content	Consistency between container documentation and container content is confirmed.
		NDE		NDE scan	Used to confirm consistency between container documentation and container content. Used to minimize handling of waste.
Liquids	Physical Inspection	Visual inspection	Other SWOC and Non-SWOC-generated waste: The verification rate will be established by PES during approval of the waste profile (see Section B2.2). RSW is exempt from verification; however, NDE will be used on drums and boxes for which NDE capability exists, either at the trench prior to shipment or at another TSD prior to receipt at LLBG Trenches 31-34-94. LLBG Trenches 31-34-94 waste generated during O&M activities – Exempt.	Visual of open container content	Consistency between container documentation and container content is confirmed.
		NDE		NDE scan	Used to confirm consistency between container documentation and container content. Used to minimize handling of waste.
	pH Liquids	Field pH test paper	10% of the physically verified mixed waste will be chemically screened as allowed by the waste stream characteristics, as described in Section B3.1.1 100% of chemically screened containers will be analyzed for this parameter.	Grab	Confirms D002, corrosivity.

Table B-2. Waste Requiring Verification or Characterization Analysis

Verification					
Waste Stream	**Parameter**	**Method**	**Frequency of Analysis**	**Sampling Method**	**Rationale for Selection**
	Peroxides	Field peroxide test paper	10% of the physically verified mixed waste will be chemically screened as allowed by the waste stream characteristics, as described in Section B3.1.1 100% of chemically screened containers will be analyzed for this parameter.	Grab	Confirms container contents are consistent with documentation.
	Oxidizers	Field potassium iodide test paper		Grab	Confirms D003, reactivity.
	Cyanides	Field cyanide screen	For waste subject to chemical screening, performed at the discretion of the Verification Team Lead.	Grab	Confirms D003, reactivity.
	Sulfides	Field sulfide screen	For waste subject to chemical screening, performed at the discretion of the Verification Team Lead.	Grab	Confirms D003, reactivity.
Homogenous Solids	Physical Inspection	Visual inspection	Other SWOC and Non-SWOC-generated waste: The verification rate will be established by PES during approval of the waste profile (see Section B2.2). RSW is exempt from verification; however, NDE will be used on drums and boxes for which NDE capability exists, either at the trench prior to shipment or at another TSD prior to receipt at LLBG Trenches 31-34-94. RCs are exempt from verification. LLBG Trenches 31-34-94 waste generated during O&M activities – Exempt.	Visual of open container content	Consistency between container documentation and container content is confirmed.
		NDE		NDE scan	Used primarily for RW to confirm consistency between container documentation and container content. Used to minimize handling of waste. May also be used for newly generated containers restricted from visual verification due to content type (e.g., sludge, soil, and cement chips).

Table B-2. Waste Requiring Verification or Characterization Analysis

Verification					
Waste Stream	**Parameter**	**Method**	**Frequency of Analysis**	**Sampling Method**	**Rationale for Selection**
Characterization Analysis for Other LLBG Trenches 31-34-94-Generated Waste*					
Liquids	pH Liquids	**Analysis:** 9040, 9041, or 9045	Each container of liquids is generated as described in Section B4.2.	Pipet, dip Grab COLIWASA	Confirms regulatory status as WSC2.
	Flashpoint	**Analysis:** 1010 or 1020			Confirms D001, ignitability.
	Cyanide	**Analysis:** 9012, 9014, and 9213			Confirms D003, reactivity.
	Sulfide	**Analysis:** 9030			
	Total Organics	**Preparation:** 5030 and 3510 or 3520 **Analysis:** 8260 and 8270			Determines the presence of TCLP organics.
	Total Metals	**Preparation:** 3005, 3010, 3015, or 3052 **Analysis:** 6010, 6020, or 200.8 (ASTM) **Preparation and Analysis:** 7470			Confirms the presence of TCLP metals.
Homogenous Solids	Presence of Free Liquids	**Analysis:** 9095	Each container of homogeneous solids is generated as described in Section B4.2.	Grab	Confirms presence of liquids, if any.
	pH Solids	**Analysis:** 9045			Confirms regulatory status as WSC2.
	Total Organics	**Preparation:** 1311 **Analysis:** 8260 and 8270			Confirms the presence of volatile/semivolatile organic compounds.
	Cyanide	**Analysis:** 9013			Confirms D003, reactivity.
	Sulfide	**Analysis:** 9030			

Table B-2. Waste Requiring Verification or Characterization Analysis

Verification					
Waste Stream	**Parameter**	**Method**	**Frequency of Analysis**	**Sampling Method**	**Rationale for Selection**

Reference: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V.*

* Parameters and methods are analytical, and SW-846 methods will be used unless otherwise noted. Analytical results for solids and soils will be reported on a dry weight basis.

ASTM = ASTM International, formerly the American Society for Testing and Materials
COLIWASA = composite liquid waste sampler
LLBG = Low-Level Burial Grounds
NDE = nondestructive examination
O&M = operations and maintenance
PES = Performance Evaluation System
RC = reactor compartment
RSW = retrievably stored waste
RW = retrieved waste
SWOC = Solid Waste Operations Complex
TCLP = toxic characteristic leaching procedure
TSD = treatment, storage, and/or disposal
WSC = Washington State Code

B5 Waste Analysis Parameters

Table B-2 details the physical and chemical analyses to be performed as well as the rationale for the selection of analyses.

In addition to the analysis frequencies listed, laboratory analyses may be used, as needed, upon the discretion of the WMR.

The most recent revision of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, will be used.

B5.1 Sampling Methods and Equipment

Sampling methods performed at LLBG Trenches 31-34-94 are in accordance with WAC 173-303-110(2), "Sampling, Testing Methods, and Analytes." Sampling equipment appropriate to the waste type to be sampled and in accordance with WAC 173-303-110 will be used. Sampling equipment used at LLBG Trenches 31-34-94 is shown in Table B-3.

Table B-3. LLBG Trenches 31-34-94 Sampling Equipment

Waste Stream	Waste Forms	Equipment
Liquids	Free-flowing liquids and slurries	COLIWASA, glass thief, pipet, dip, tank bomb, and bailer/tube samplers
Homogeneous Solids	Sludges	Trier, scoops and shovels, tube-type samplers and augers, and spoons (for small containers)
	Sand or packed powders and granules	
	Large-grained solids	
	Moist powders or granules	
	Dry powders or granules	

COLIWASA = composite liquid waste sampler

B6 Quality Assurance/Quality Control

Quality assurance and quality control programs in effect at LLBG Trenches 31-34-94 ensure that sampling and analysis of waste, generator performance, and waste receipt provide data that ensure waste is sufficiently characterized to be managed at LLBG Trenches 31-34-94.

B6.1 Waste Receipt Quality Assurance

To ensure that waste shipped or transferred to LLBG Trenches 31-34-94 is properly characterized and meets acceptance requirements, an initial container verification rate is determined. This decision uses the following generator-provided information to determine the relative potential for problems in a waste stream:

- Documentation of the customer's waste management program
- Waste profile characterization information
- The potential for inappropriate segregation of the waste

For more information on initial verification rate determinations, refer to Appendix B-A, Section B-A2.

Generators are monitored on a monthly basis to identify trends in performance and to correct problems or potential problems before they arise. For more information on generator performance evaluations, refer to Appendix B-A, Section B-A5.

B6.2 Laboratory Selection

Onsite and offsite laboratories providing analytical support to LLBG Trenches 31-34-94 must be approved by a U.S. Department of Energy (DOE) evaluation organization. The laboratory quality assurance plan will be submitted to Ecology in accordance with Tri-Party Agreement Action Plan (Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order Action Plan*), Section 6.5, for review as a secondary document before commencement of analytical work. The quality assurance plan will address the following items at a minimum:

- Sample custody and management practices
- Sample preservation protocols
- Sample preparation and analytical method requirements
- Instrument maintenance and calibration requirements
- Internal quality control measures (e.g., method blanks, spikes, and duplicates)
- Corrective action process

Periodic audits performed by a DOE evaluation organization ensure compliant operations by approved laboratories.

B7 Recordkeeping

Permittees will place documentation into the Hanford Facility Operating Record (LLBG Trenches 31-34-94 portion) as required by Hanford Facility RCRA Permit Condition II.I (WAC 173-303-380, "Facility Recordkeeping") to include approved waste profile documentation (Hanford Facility RCRA Permit Condition II.I.1.j) and confirmation records (Hanford Facility RCRA Permit Condition II.I.1.b). LDR records referred to in Section B3.2.1 will be maintained in the Hanford Facility Operating Record (LLBG Trenches 31-34-94 portion) in accordance with WAC 173-303-380(1)(m).

B8 Training

For training requirements related to duties described in this LLBG Trenches 31-34-94 WAP, refer to Addendum G, "Personnel Training."

B9 References

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol26/xml/CFR-2010-title40-vol26-part268.xml.

40 CFR 268.45, "Land Disposal Restrictions," "Treatment Standards for Hazardous Debris," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol26/xml/CFR-2010-title40-vol26-sec268-45.xml.

49 CFR 173.12, "Transportation," "Exceptions for Shipment of Waste Materials," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol2/pdf/CFR-2009-title49-vol2-sec173-12.pdf.

Ecology, 2014, *Agreed Order and Stipulated Penalty No. DE 10156*, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/programs/nwp/pi/pdf/settlements/de10156/de10156.pdf.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order Action Plan*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=82.

EPA, 2015, ECOTOX Database, as amended, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://cfpub.epa.gov/ecotox/.

NIOSH, 2014, *Registry of Toxic Effects of Chemical Substances*, as amended, U.S. Department of Health and Human Services, Public Health Service Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Atlanta, Georgia. Available at: http://www.cdc.gov/niosh/docs/97-119/.

SW-846, 2015, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

U.S. National Library of Medicine, TOXNET: Toxicology Data Network, Hazardous Substances Databank website. Available at: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, as amended, Washington State Department of Ecology, Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

303-040, "Definitions."

303-070, "Designation of Dangerous Waste."

303-110, "Sampling, Testing Methods and Analytes."

303-140, "Land Disposal Restrictions."

303-161, "Overpacked Containers (Labpacks)."

303-300, "General Waste Analysis."

303-370, "Manifest System."

303-380, "Facility Recordkeeping."

303-400, "Interim Status Facility Standards."

303-600, "Final Facility Standards."

This page intentionally left blank.

Appendix B-A

Performance Evaluation System

This page intentionally left blank.

Contents

B-A1 Introduction **B-A-1**

B-A2 Initial Waste Profile Review **B-A-1**

B-A2.1 Nonverifiable Waste B-A-1

B-A3 Reducing the Verification Rate **B-A-2**

B-A4 Addressing Conformance Issues **B-A-2**

B-A5 Monthly Evaluations **B-A-3**

Tables

Table B-A-1. Initial Verification Rates B-A-1

Table B-A-2. PES Verification Rate Reduction B-A-2

This page intentionally left blank.

B-A1 Introduction

The Performance Evaluation System (PES) Committee acts as an agent to ensure that waste accepted for treatment and storage at the Low-Level Burial Grounds (LLBG) Trenches 31-34-94 meets applicable permit and regulatory requirements. The PES Committee conducts performance-based generator oversight in support of compliant waste acceptance.

B-A2 Initial Waste Profile Review

As a component of the waste profile review process, PES evaluates the waste profile, information related to other waste streams from the same generator, and any other generator-provided information. PES determines if there are concerns in any of the following areas:

- Documented waste management program: Concerns could exist in this area if the processes, procedures, or certification methods used by the generator might not be sufficient to ensure that the waste meets the acceptance criteria. Recent verification failure in similar waste streams due to deficiencies in the generator's waste management program would indicate concerns in this area.
- Waste stream characterization information: Concerns could exist in this area if the generator's knowledge and/or sampling and analysis data might lead to mischaracterization or misdesignation of the waste. Recent verification failure in similar waste streams due to incorrect characterization data would indicate concerns in this area.
- Potential for inappropriate segregation: Waste streams that require segregation from other waste streams (i.e., that have different waste codes or treatment/disposal pathways) could lead to concerns in this area, depending on the specific waste-generating process and details of segregation procedures used by the generator. Recent verification failure in similar waste streams due to inappropriate segregation would also indicate concerns in this area.

PES then establishes initial verification rates as identified in Table B-A-1.

Table B-A-1. Initial Verification Rates

Areas of Concern	Verification Rate
None	20 to 50%
Concern in 1 Area	50 to 100%
Concern in 2 Areas	100%

B-A2.1 Nonverifiable Waste

The following waste streams may not be verifiable:

- Shielded waste that cannot be viewed through nondestructive examination
- Classified waste
- Remote-handled waste
- Other waste that cannot be physically screened because no facility is available to perform such screening (either at the generating location or at a Solid Waste Operations Complex facility unit)

In the case of nonverifiable waste, the following information will be assembled and provided to PES for review:

- Procedures used to segregate and package the waste
- Process knowledge documentation and sampling
- Analysis data used to characterize the waste

PES will evaluate whether the combination of characterization data and segregation/packaging procedures provide reasonable assurance that the waste will be properly designated and meet the treatment, storage, and/or disposal unit acceptance criteria, or if additional actions are needed, such as verification of the waste at the point of generation or surveillance of the generating process. If PES determines that there is insufficient information to accept the waste at LLBG Trenches 31-34-94, the waste profile will be rejected.

B-A3 Reducing the Verification Rate

The minimum verification rate is 5 percent for onsite generators and 10 percent for offsite generators. At a minimum of each month, PES reviews waste streams above these percentages and can make changes as identified in Table B-A-2.

Table B-A-2. PES Verification Rate Reduction

Reduction Step	Criteria	Reduction
Step 1	Five containers from the waste stream (or group of related streams) pass verification with no failures.	Reduce the verification rate by a maximum of 66% (e.g., from 100% to a minimum of 34%).
Step 2	Step 1 reduction is complete, plus five additional containers (or group of related streams) pass verification with no failures.	Reduce the verification rate by a maximum of 50%.
Step 3	Step 2 reduction is complete, plus five additional containers (or group of related streams) pass verification with no failures.	Reduce the verification rate to 5% for onsite generators or 10% for offsite generators.

Additionally, if the verification rate was elevated due to past conformance issues, the PES Committee must have evaluated the generator's corrective action plan and found it adequate.

B-A4 Addressing Conformance Issues

Nonconformance issues identified during pre-waste acceptance or during the waste acceptance process will be addressed and evaluated by PES for resolution. The following types of conformance issues require PES Committee actions:

- Shipment of unmanifested waste (from an offsite generator)
- Shipment of a container that has not been approved for shipment
- Shipment of leaking or severely damaged containers
- Containers that fail verification

- Other conformance issues identified subsequent to receipt of a container that cannot be resolved within 1 week of discovery

A generator may be contacted to provide additional information or requested to provide corrective actions. If conformance issues are unable to be resolved, waste will not be accepted into the LLBG Trenches 31-34-94 Operating Unit Group (OUG). The verification rate for that waste stream will be increased to 100 percent, and the generator's other waste streams will be evaluated to determine whether all waste streams or a subset of waste streams might be subject to the same type of conformance issue. The physical screening frequency for each waste stream that might be subject to the same type of verification failure is also adjusted to 100 percent.

B-A5 Monthly Evaluations

Monthly evaluations of generators by PES will monitor performance on a programmatic basis. The number of conformance issues for areas described in Section B-A4 and the severity of the issues are reviewed by PES. Increases to verification frequencies are established, based on the severity of the nonconformance. Corrective actions for nonconformance issues are requested from generators. PES may also address the status of existing corrective actions during the monthly evaluation.

When waste acceptance issues are identified (nonconforming items), the PES Committee may perform the following actions:

- Increase the verification rate for the waste streams that have incurred verification failures or for waste that is received and deemed nonconforming.
- Reject waste from acceptance into the LLBG Trenches 31-34-94 OUG if conformance issues are unable to be resolved.
- Request corrective actions for nonconformance issues from generators. PES may also address the status of existing corrective actions during the monthly evaluations.

This page intentionally left blank.

Addendum C

Process Information

This page intentionally left blank.

Contents

C1 Introduction and Operating Unit Group Description C-1
C1.1 Dangerous Waste Management Unit Descriptions C-1
C1.1.1 LLBG Trench 31 and 34 Waste Storage and Treatment Pads C-1
C1.1.2 LLBG Trenches 31 and 34 ..... C-3
C1.1.3 LLBG Trench 94 ..... C-5
C2 Container Management on LLBG Trenches 31 and 34 Waste Storage and Treatment Pads C-5
C2.1 Description of Containers C-7
C2.1.1 Condition C-7
C2.1.2 Identification and Labeling C-7
C2.1.3 Waste Compatibility C-7
C2.2 Managing Containers C-7
C2.2.1 Procedure for Handling C-8
C2.2.2 Container Handling Equipment C-8
C2.2.3 Aisle Spacing C-8
C2.2.4 Inspections C-9
C2.3 Secondary Containment C-9
C2.3.1 Base C-9
C2.3.2 Drainage Control C-9
C2.3.3 Containment Capacity C-9
C2.3.4 Controlling Run-On C-9
C2.3.5 Exemption from Containment Requirements C-10
C2.4 Removal of Liquids from Containment System C-10
C2.5 Requirements for Ignitable, Reactive and Incompatible Wastes C-10
C2.6 Tank Systems C-10
C2.7 Air Emissions C-10
C3 Treatment on LLBG Trench 31 and 34 Waste Storage and Treatment Pads C-11
C3.1 Macroencapsulation C-11
C3.1.1 Applicability C-11
C3.1.2 Process Description C-12
C3.1.3 Limitations C-13
C3.2 Microencapsulation C-13
C3.2.1 Applicability C-13
C3.2.2 Process Description C-13
C3.2.3 Limitations C-13
C3.3 Sealing C-14
C3.3.1 Applicability C-14
C3.3.2 Process Description C-14
C3.3.3 Limitations C-14

C4 Landfills C-14
C4.1 Liner System – General Items and Description C-15
C4.1.2 Liner Location Relative to High Water Table C-17
C4.1.3 Loads on Liner System C-17
C4.1.4 Liner System Coverage C-19
C4.1.5 Liner System Exposure Prevention C-19
C4.2 Liner System – Foundation C-19
C4.2.1 Foundation Description C-19
C4.2.2 Subsurface Exploration Data C-20
C4.2.3 Laboratory Testing Data C-20
C4.2.4 Engineering Analyses C-21
C4.3 Liner Systems – Liners C-22
C4.3.1 Synthetic Liners C-22
C4.3.2 Soil Liners C-23
C4.4 Liner System – Leachate Collection and Removal System C-24
C4.4.1 Systems Operation and Design C-24
C4.4.2 Grading and Drainage C-25
C4.4.3 Maximum Leachate Head C-25
C4.4.4 Systems Compatibility C-25
C4.4.5 Systems Strength C-26
C4.4.6 Prevention of Clogging C-26
C4.5 Working Surfaces C-26
C4.5.1 Operations Layer C-27
C4.5.2 Top Course C-27
C4.5.3 Asphalt C-27
C4.6 Liner System – Construction and Maintenance C-28
C4.6.1 Construction Quality Assurance Program C-28
C4.6.2 Maintenance Procedures for Leachate Collection and Removal Systems C-28
C4.6.3 Liner Repairs during Operations C-28
C4.7 Run-On and Runoff Control Systems C-28
C4.7.1 Run-On Control System C-29
C4.7.2 Design and Performance C-29
C4.7.3 Calculation of Peak Flow C-29
C4.7.4 Runoff Control System C-29
C4.8 Control of Wind Dispersal C-29
C4.9 Liquids in Landfills C-30
C4.10 Containerized Wastes C-30
C4.11 Special Requirements for Hazardous Wastes F020, F021, F022, F023, F026, and F028 ..... C-30
C4.12 Monitoring and Inspection C-30
C4.13 Action Leakage Rate and Response Actions C-30
C4.14 Surveying and Recordkeeping C-30

C4.15 Closure and Post-Closure Care C-30
C4.16 Special Requirements for Ignitable or Reactive Waste C-31
C4.17 Special Requirements for Incompatible Wastes C-31
C5 Recordkeeping C-31
C6 Training C-31
C7 References C-31

Appendices

C-A Overall Facility Map of the Hanford Site ..... C-A-i
C-B Engineering Drawings ..... C-B-i

Figures

Figure C-1. Aerial Photo of LLBG Trenches 31-34-94 34 DWMUs (2011) C-4
Figure C-2. Second Aerial Photo of LLBG Trenches 31-34-94 DWMU (2011) C-6
Figure C-3. Example Liner System C-18
Figure C-A-1. Overall Facility Map of the Hanford Site C-A-1

Tables

Table C-1. Dangerous Waste Management Unit Operation C-1
Table C-2. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Design and Storage Capacities C-2
Table C-3. LLBG Trench 31 and 34 Waste Treatment and Storage Pads Treatment Capacities C-2
Table C-4. LLBG Trenches 31 and 34 Design and Disposal Capacities C-3
Table C-5. LLBG Trench 94 Design and Disposal Capacity C-5
Table C-6. LLBG Trenches 31 and 34 Lining and Leachate Collection Systems C-15

This page intentionally left blank.

C1 Introduction and Operating Unit Group Description

This addendum provides a description of storage operations, waste management, treatment processes, and land disposal operations required by WAC 173-303, "Dangerous Waste Regulations," in effect at the Low-Level Burial Ground (LLBG) Trenches 31-34-94 Operating Unit Group (OUG), hereinafter referred to as LLBG Trenches 31-34-94.

LLBG Trenches 31-34-94 also conducts processing, storage, and disposal of nondangerous low-level radioactive waste in accordance with the *Atomic Energy Act of 1954* (AEA). Management of radioactive waste is not within the scope of the *Resource Conservation and Recovery Act of 1976* (RCRA) or WAC 173-303. Any information provided in this document for radioactive waste is for informational purposes only.

C1.1 Dangerous Waste Management Unit Descriptions

Located in the 200 West Area of the Hanford Facility (Appendix C-A), LLBG Trenches 31-34-94 provide container storage and treatment for mixed waste (MW)[1] from onsite and offsite Hanford generators, and LLBG Trenches 31 34-94 operations as well as storage of waste[2] generated by LLBG Trenches 31-34-94 operations. Waste management activities are conducted within the dangerous waste management units (DWMUs) shown in Table C-1 and on the aerial photographs (Figures C-1 and C-2).

Table C-1. Dangerous Waste Management Unit Operation

DWMU	Operation
LLBG Trench 31 Waste Storage and Treatment Pad	Storage and Treatment
LLBG Trench 34 Waste Storage and Treatment Pad	
LLBG Trench 31	Disposal
LLBG Trench 34	
LLBG Trench 94	

C1.1.1 LLBG Trench 31 and 34 Waste Storage and Treatment Pads

LLBG Trench 31 Waste Storage and Treatment Pad DWMU, and LLBG Trench 34 Waste Storage and Treatment Pad DWMU, respectively, are located adjacent to and positioned on the apron liner of each corresponding landfill. Both DWMUs equivalently provide container storage and treatment for MW, as well as land disposal restriction (LDR) compliant containerized waste from Hanford onsite and offsite generators prior to disposal in the landfills below, as discussed in Sections C1.1.2 and C4. Detailed information regarding design and construction of the landfills and associated pads is provided in Section C4. The DWMUs are uncovered/unenclosed asphalt pads located outside that do not have engineered secondary containment systems.

Capacity for each storage area was calculated based on the storage requirements in accordance with WAC 173-303-630, "Use and Management of Containers," and then used to determine the total DWMU maximum permitted storage capacity. Permitted storage capacities are listed in Table C-2. Containers stored in the outside storage areas that do not meet WAC 173-303-630(7)(c) criteria (e.g., waste packages

[1] Mixed waste refers to dangerous waste or hazardous waste, as applicable.

[2] Waste refers to dangerous waste or hazardous waste, as applicable.

that contain free liquids or exhibit characteristics of ignitability or reactivity) are not accepted for storage or treatment, as described in Section C2.3.

Treatment of containerized MW debris is primarily conducted to meet the disposal requirements of WAC 173-303-140, "Land Disposal Restrictions," and consists of immobilization technologies conducted in accordance with 40 CFR 268.45, "Land Disposal Restrictions," "Treatment Standards for Hazardous Debris" (Table 1, "Alternative Treatment Standards for Hazardous Debris"). Treatment activities are discussed in Section C3. The process information describing landfills is discussed in Section C4.

Table C-2. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Design and Storage Capacities

DWMU	Dimensions			Available Waste Storage Area		Maximum Permitted Storage Capacity	
		m	ft	m^2	ft^2	m^3	Liters
LLBG Trench 31 Waste Storage and Treatment Pad	Width	49.4	162	2,150	23,200	1,150	1,150,000
	Length	43.6	143				
LLBG Trench 34 Waste Storage and Treatment Pad	Width	48.8	160	2,160	23,200	1,240	1,240,000
	Length	44.2	145				
Total DWMU Capacity						**2,390**	**2,390,000**

DWMU = dangerous waste management unit

LLBG = low-level burial ground

The process design capacity for waste treatment is shown in Table C-3. To determine the maximum permitted treatment capacity, calculations were performed that conservatively estimated the maximum volume of waste expected to be treated using the volume of containers expected to be managed at the DWMU in a day.

Table C-3. LLBG Trench 31 and 34 Waste Treatment and Storage Pads Treatment Capacities

Dangerous Waste Management Unit	Maximum Treatment Rate (Metric Tons/Day)*
LLBG Trench 31 Waste Treatment and Storage Pad	26
LLBG Trench 34 Waste Treatment and Storage Pad	26
Total DWMU Capacity	**26**

* Individual treatment unit is permitted to process at the daily maximum treatment rate; however, the maximum treatment rate for both DWMUs combined cannot exceed 26 metric tons/day.

LLBG = low-level burial ground

C1.1.1.1 List of Wastes

The LLBG Trench 31 and 34 Waste Storage and Treatment Pads DWMUs manage MW and/or LDR-compliant waste consisting of listed hazardous waste, characteristic hazardous waste, state only

dangerous waste, and AEA regulated nonhazardous low-level radioactive waste. For a comprehensive list of waste managed, including classification and estimated annual quantities, refer to WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter called Hanford Facility RCRA Permit), "Hanford Dangerous Waste Permit," Part A.

C1.1.2 LLBG Trenches 31 and 34

LLBG Trench 31 DWMU and LLBG Trench 34 DWMU, respectively, are landfills that operate in accordance with WAC 173-303-140 requirements for disposal of treated, LDR-compliant waste from Hanford onsite and offsite generators. The landfills began receiving waste for disposal on September 15, 1999, and were constructed with soil and synthetic liners, as well as leachate collection and removal systems (LCRSs). Detailed information on design and construction activities is provided in Section C4. Treatment of waste will not be conducted within these DWMUs.

As shown in Figure C-1, the landfills are located side by side in the 200 West Area within the 218-W-5 Burial Ground. Each landfill is a large rectangular excavation with a side slope ratio of 3:1 (horizontal/vertical). The approximate dimensions and permitted disposal capacity (total volume) for each landfill unit are listed in Table C-4.

Table C-4. LLBG Trenches 31 and 34 Design and Disposal Capacities

DWMU	Dimensions		Area		Permitted Disposal Capacity*	
			m^2	ft^2	m^3	Liters
LLBG Trench 31	Base	31 m (100 ft) by 76 m (250 ft)	2,350	25,300	21,408	21,408,000
	Top	91 m (300 ft) by 137 m (450 ft)	12,500	135,000		
LLBG Trench 34	Base	31 m (100 ft) by 76 m (250 ft)	2,350	25,300	21,408	21,408,000
	Top	91 m (300 ft) by 137 m (450 ft)	12,500	135,000		
Total DWMU Capacity					**42,816**	**42,816,000**

* Based on a depth of approximately 9 m (30 ft).

DWMU=dangerous waste management unit

LLBG=low-level burial ground

C1.1.2.1 List of Wastes

Each landfill is permitted to dispose of treated LDR-compliant waste consisting of MW and/or listed hazardous waste, characteristic hazardous waste, state only dangerous waste, and AEA regulated nonhazardous low-level radioactive waste. A tracking system documents all LDR-compliant waste that has been disposed of within the landfills. For a comprehensive list of waste managed, including classification and estimated annual quantities, refer to Hanford Facility RCRA Permit Part A.

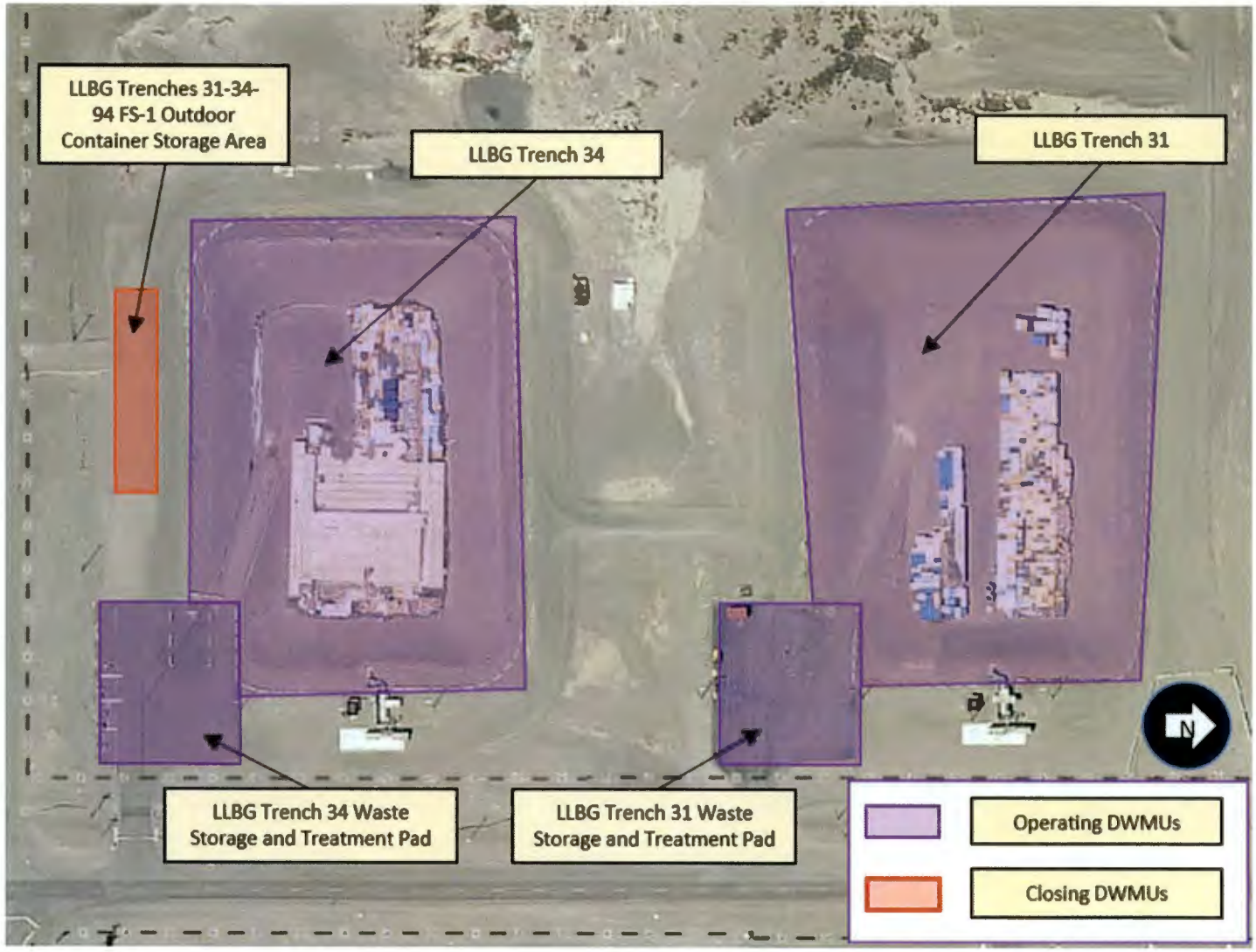


Figure C-1. Aerial Photo of LLBG Trenches 31-34-94 34 DWMUs (2011)

C1.1.3 LLBG Trench 94

LLBG Trench 94 DWMU is a landfill that operates as the receipt and final disposal facility for decommissioned, defueled reactor compartments (RCs) (treated MW) from the U.S. Department of the Navy. RCs are prepared for disposal by the Puget Sound Naval Shipyard in Bremerton, Washington and transported by barge to the Port of Benton at the Hanford Facility. The first defueled RC was disposed of in April 1986. The landfill operates under an exemption request in accordance with WAC 173-303-806(4)(h), "Final Facility Permits," from the applicable liner system requirements contained in WAC 173-303-665, "Landfills." Exemption request details and justifications for disposal of RCs are discussed further in Section C4. Treatment of waste will not be conducted within this DWMU.

LLBG Trench 94 is located in the 200 East Area, within the 218-E-12B Burial Ground. As shown in Figure C-2, the landfill is a large rectangular excavation with a side slope ratio of 1-1.5/2:1 (horizontal/vertical). The approximate dimensions and permitted disposal capacity (total volume) of the landfill are provided in Table C-5.

Table C-5. LLBG Trench 94 Design and Disposal Capacity

DWMU	Dimensions		Area		Permitted Disposal Capacity*	
			m^2	ft^2	m^3	Liters
LLBG Trench 94	Base	98 m (320 ft) by 494 m (1,620 ft)	48,200	518,000	1,500,000	1.5×10^9
	Top	140 m (460 ft) by 540 m (1,770 ft)	75,600	814,000		

* Based on a depth of approximately 15 m (49 ft); unused portions of the landfill can be deeper than 15 m (49 ft).

DWMU = dangerous waste management unit

LLBG = low-level burial ground

C1.1.3.1 List of Waste

RCs destined for disposal are MW and meet LDR requirements.

C2 Container Management on LLBG Trenches 31 and 34 Waste Storage and Treatment Pads

The information in this section relates exclusively to management of containers at LLBG Trench 31 and 34 Waste Storage and Treatment Pads DWMUs. Newly generated waste and containers accepted for storage and treatment are subject to WAC 173-303-630 requirements. Treatment technologies are addressed in Section C3. A summary of the waste managed, including classification and estimated annual quantities, is located in the Hanford Facility RCRA Permit Part A.

Figure C-2. Second Aerial Photo of LLBG Trenches 31-34-94 DWMU (2011)

C2.1 Description of Containers

Containers vary in shape and size, depending on the waste form and how the waste was packaged. The most common containers include, but are not limited to, waste boxes (e.g., 115,000 L [30,380 gal]) and 208 L (55 gal) painted carbon steel or galvanized drums and steel boxes measuring approximately 1 by 1 by 2 m (4 by 4 by 8 ft). Containers with free liquids and containers holding wastes designated as F020, F021, F022, F023, F026, and F028 will not be accepted for storage or treatment.

All waste will be packaged in U.S. Department of Transportation and/or U.S. Department of Energy (DOE) approved containers, including alternate packages required due to the size, shape, or form of waste (e.g., metal boxes and flexible containers).

C2.1.1 Condition

Containers accepted shall be in good condition or in overpacks. If a container is not in good condition (e.g., severe rusting, apparent structural defects, or leaks), and returning it to the generator for repackaging is not possible, the container may be segregated from other waste and managed in accordance with waste receipt discrepancies. Resolutions are located in Addendum B, "Waste Analysis Plan" (WAP).

C2.1.2 Identification and Labeling

Each waste container placed in storage will be affixed with a label identifying the major risk(s), as applicable, associated with the waste contents. Labels will be managed to facilitate compliance with the requirements outlined in Addendum I, "Inspection Plan." If waste management activities (e.g., treatment processes or overpacking) obscure the label, a new label will be affixed. During management of empty containers, old labels will be destroyed by removing them from the containers, or the labels will be made nonlegible.

C2.1.3 Waste Compatibility

Newly generated waste and waste accepted for storage and/or treatment are packaged in containers that are compatible and nonreactive with the waste to be stored.

Waste containers are made of or lined with materials (e.g., chemical resistant epoxy). Labpacks will have at least two layers of containment (outer container and inner container).

C2.2 Managing Containers

Containers accepted for storage and treatment are packaged by offsite and onsite Hanford generators. Prior to shipment and receipt of containers, generators must complete the acceptance criteria detailed in the WAP (Addendum B).

Containers used to store waste will be handled, managed, stored, and/or treated in a manner that maintains containment and limits personnel contact with the waste. Waste containers are managed, based on the following criteria:

- Waste contents must be compatible with all layers used for containment (e.g., container and lining).
- Waste contents must be authorized in accordance with the Hanford Facility RCRA Permit.
- Each container must display a dangerous waste label and a major risk(s) marking or label, if applicable.

- All waste containers generated off the Hanford Facility that are shipped to LLBG Trenches 31-34-94 must have an accompanying manifest.

If waste discrepancies, such as improper container labeling, improper packaging, or manifest differences, are discovered during the container receipt inspection, the nonconforming containers or shipment will not be accepted until the discrepancies have been resolved. Discrepancy resolutions are detailed in the WAP (Addendum B).

C2.2.1 Procedure for Handling

Waste container handling practices are conducted by trained and qualified personnel. Containers shall always be closed, except at the following times:

- While adding or removing waste
- While conducting waste treatment activities
- When sampling activities are required
- When the container meets the definition of empty as defined in WAC 173-303-160(2)(a), "Containers" (i.e., a nonregulated container)

If upon examination it is determined that a container should not be opened, the container will be shipped to another appropriate Hanford onsite or offsite facility capable of managing it.

C2.2.2 Container Handling Equipment

Containers may be handled individually or grouped on pallets (e.g., four 208 L [55 gal] drums). The primary types of container handling equipment are described briefly in the following subsections. This list is not all inclusive, but it provides examples of equipment utilized while moving containers.

C2.2.2.1 Forklifts

Forklifts unload waste containers from trailers. They also move waste containers within and between facilities, stack waste containers, and load containers onto vehicles. Drum lifting attachments, commonly called drum grabs or grabbers (i.e., parrot beaks), are used to remove single drums. The drum grabs pick up the drum effectively so that no additional banding, strapping, or anchoring is necessary. Grabs are sized for the waste drums to be moved. Waste received on pallets or in waste boxes is unloaded using the forklift tines. Pallets of drums are secured, as necessary, with banding or load straps to prevent toppling. Loads are kept close to the ground to prevent drops from height.

C2.2.2.2 Cranes

Various cranes are used to lift heavy containers or when remote handling is needed. The types of cranes used include mobile cranes, temporary A-frame type cranes, and other lifting devices.

C2.2.3 Aisle Spacing

A minimum of approximately 91 cm (36 in.) shall be maintained for means of ingress or egress in container storage areas. Containers are stored on rows of pallets and/or, when required, portable secondary containment or selectively chosen structures contingent upon container size. Containers are placed in such a way to ensure space to allow unobstructed movements of personnel (e.g., daily operations and inspections) and emergency equipment (e.g., fire protection, spill control, and decontamination). Secondary containment requirements and activities are discussed in Section C2.3.

C2.2.4 Inspections

Inspections of active storage areas and containers are conducted by qualified personnel trained in accordance with Addendum G, "Personnel Training," to detect any signs of malfunction, deterioration, discharges, or other anomalies. Content and frequency of inspections are described in Addendum I.

C2.3 Secondary Containment

This section details secondary containment operations at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads required for storage areas in which containers hold free liquids and/or wastes exhibiting the characteristic of ignitability or reactivity, as described in WAC 173-303-090(5) and (7), "Dangerous Waste Characteristics."

Containers with free liquids and containers holding wastes designated as F020, F021, F022, F023, F026, and F028 will not be accepted for storage or treatment operations at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. All containers accepted for storage and treatment operations are designated as MW debris or are LDR compliant. Containers designated for acceptance may be stored without a containment system under either of the following conditions:

- Storage area is sloped to drain and remove liquids resulting from a known source (e.g., precipitation).
- Containers are elevated or otherwise protected from accumulating liquids (e.g., pallets).

Each pad provides a location for transfer of containerized waste from over-the-road trucks to other equipment (e.g., forklifts) that either place the containers in storage or dispose of the containers in the landfill. The northwest corner of each pad is lined with a high-density polyethylene (HDPE) geomembrane liner, geotextile layers, and a top course/operations liner and is paved with asphalt. Both the asphalt surface and the underlying drainage system of the northwest corner direct all surface runoff into the primary LCRS of the landfill. Detailed information regarding design and construction of the landfills and associated pads is discussed in Section C4.

C2.3.1 Base

The bases of the pads are constructed on the liner aprons and are comprised of paved asphalt. The northwest corner of each pad is constructed over an extension of the landfill liner system (soil liners, synthetic liners, and geotextile layers) and is primarily used for unloading containers and treatment activities. Portable spill pallets and/or pallets may be used to elevate containers during storage. Detailed information regarding design and construction of the landfills and associated pads is provided in Section C4.

C2.3.2 Drainage Control

Storage areas are constructed and/or operated with positive drainage control to prevent accumulation and facilitate prompt removal of uncontaminated precipitation. The foundation is graded with slope angles of approximately 2 percent. Containers will be elevated in active storage areas. Removal of liquids is discussed in Section C2.4.

C2.3.3 Containment Capacity

Secondary containment requirements are described in Section C2.3.

C2.3.4 Controlling Run-On

Run-on into and runoff away from the pads are prevented by one or more of the following characteristics:

- Engineering controls physically separate containers and run-on such as perimeter berms.

- Foundation is elevated or otherwise graded to slope away from the system, preventing and/or diverting run-on from adjacent areas.
- Positive drainage control design precludes runoff.
- Outdoor storage areas may utilize equipment (e.g., spill pallet and pallet) to elevate containers.

C2.3.5 Exemption from Containment Requirements

No exemption from secondary containment requirements is being requested.

C2.4 Removal of Liquids from Containment System

Should portable secondary containment equipment be utilized, precipitation collected within will be handled as nondangerous waste in accordance with the WAP (Addendum B).

C2.5 Requirements for Ignitable, Reactive and Incompatible Wastes

Containers with ignitable and/or reactive wastes will not be accepted for storage or treatment. Confirmation and verification processes are described in the WAP (Addendum B).

Incompatible waste will not be accumulated in the same container or placed in an unwashed container that previously held an incompatible waste or material. Incompatible wastes are stored in separate containers and segregated by separate containment systems, such as spill pallets, or separated by other acceptable physical barriers.

Engineering drawings illustrating design and general structure layout are located in Appendix C-B. Buffer zones and/or location of containers stored within DWMUs that do not have engineered secondary containment are maintained as part of the Hanford Facility Operating Record (LLBG Trenches 31-34-94).

C2.6 Tank Systems

There are no associated operating tank systems within LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. Therefore, the requirements outlined in WAC 170-303-395, "Other General Requirements;" WAC 170-303-640, "Tank Systems;" and WAC 170-303-806, do not apply.

C2.7 Air Emissions

This section addresses the air emission standards required under WAC 173-303-690, "Air Emission Standards for Process Vents," incorporated by 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart AA, "Air Emission Standards for Process Vents;" WAC 173-303-691, "Air Emission Standards for Equipment Leaks," incorporated by 40 CFR 264, Subpart BB, "Air Emission Standards for Equipment Leaks;" and WAC 173-303-692, "Air Emission Standards for Tanks, Surface Impoundments, and Containers," incorporated by 40 CFR 264, Subpart CC, "Air Emission Standards for Tanks, Surface Impoundments, and Containers."

Because LLBG Trenches 31 and 34 Waste Storage and Treatment Pads do not contain equipment, subject to Subparts BB or AA, these standards do not apply.

Air emission standards of 40 CFR 264, Subpart CC apply to tank, surface impoundment, and container storage units that manage waste with average volatile organic concentrations equal to or exceeding 500 parts per million by weight, based on the waste composition at the point of origination. However, containers that solely manage MW are exempt per 40 CFR 264.1080(b)(6), "Applicability."

LLBG Trenches 31 and 34 Waste Storage and Treatment Pads only store and treat MW in containers, only store LDR-compliant containers, and do not have tank systems or surface impoundments; therefore, 40 CFR 264, Subpart CC, standards for MW containers, tanks, and surface impoundments do not apply.

C3 Treatment on LLBG Trench 31 and 34 Waste Storage and Treatment Pads

The information in this section relates exclusively to treatment technologies conducted on LLBG Trench 31 and 34 Waste Storage and Treatment Pads DWMUs. Treatment is defined as the physical, chemical, or biological processing of dangerous waste to make such wastes nondangerous or less dangerous, safer for transport, amenable for energy or material resource recovery, amenable for storage, or reduced in volume, with the exception of compacting, repackaging, and sorting as allowed under WAC 173-303-400(2), "Interim Status Facility Standards," and WAC 173-303-600(3), "Final Facility Standards" (WAC 173-303-040, "Definitions").

Treatment is conducted in accordance with 40 CFR 268, Subpart D, "Treatment Standards," and WAC 173-303-140 for waste subject to LDR requirements. In accordance with 40 CFR 268.45 (Table 1), compliance with LDR is achieved through the following immobilization technologies:

- Macroencapsulation
- Microencapsulation
- Sealing

Treatment effectiveness is verified in accordance with the WAP (Addendum B.) Waste generated is characterized in accordance with the WAP (Addendum B.). The following sections provide details about the treatment processes summarized in this section.

C3.1 Macroencapsulation

Macroencapsulation is an immobilization technology that is dependent on the ability of the surface coating material (e.g., a stainless steel container or grout reagent) to create a barrier around the waste, thereby reducing exposure to potential leaching media. The encapsulating barrier does not need to be chemically bound to the waste or constituent.

C3.1.1 Applicability

Macroencapsulation per 40 CFR 268.45 is applicable to waste codes listed in the Hanford Facility RCRA Permit Part A. With the exception of radioactive lead solids, waste to be macroencapsulated must meet the definition of hazardous debris in accordance with 40 CFR 268.2(g), "Definitions Applicable in This Part." Because macroencapsulation is dependent on the properties of the coating rather than the properties of the waste and because there are no contaminant restrictions specified in Table 1 of 40 CFR 268.45, macroencapsulation can effectively treat all debris types.

Macroencapsulation (MACRO) per 40 CFR 268.42, "Treatment Standards Expressed as Specified Technologies," is applicable to radioactive lead solids including, but not limited to, all forms of lead shielding and other elemental forms of lead (nonwastewaters only). These lead solids do not include treatment residuals, such as hydroxide sludges, other wastewater treatment residuals, or incinerator ashes, that can undergo conventional pozzolanic stabilization, nor do they include organo-lead materials that can be incinerated and stabilized as ash. Macroencapsulation per 40 CFR 268.42 specifically does not include any material that would be classified as a tank or container as defined in 40 CFR 260.10, "Hazardous Waste Management System: General," "Definitions."

C3.1.2 Process Description

Containers are expected to come in all shapes, sizes, and physical forms. As a result, it is not feasible to prescribe all possible methods to macroencapsulate waste. The primary objective of this section is to ensure that waste(s) will be encapsulated using surface coating materials resistant to degradation by the waste and its contaminants, and any substances it may come into contact with after final placement (i.e., leachate and microbes).

While reagents, mixing, and handling requirements are tailored to each specific waste or waste type, the processes described in the following subsections provide two examples of containerized waste treatment.

Grout Filled Overpack

- Approximately 5 to 8 cm (2 to 3 in.) of the following surface coating material (grout reagent) is poured into the macroencapsulation container to create a grout foundation: Portland cement or lime/pozzolans (e.g., fly ash and cement kiln dust).
- Prior to placement of containerized waste, the preformed grout foundation is provided approximately 72 hours to initially cure. Additional reagents (e.g., iron salts, silicates, carbon, or clays) may be utilized to enhance the set/cure time and working properties of the grout.
- Containerized waste is placed inside the prepared macroencapsulation container ensuring that a minimum 5 cm (2 in.) annulus and head space will be maintained.
- If needed, to mitigate floating of containerized waste during deployment of reagent, a restriction tool is placed across the inside of the macroencapsulation container to ensure that containerized waste remains stationary.
- Volume or mass of grout reagent required to complete macroencapsulation is deployed into the macroencapsulation container to ensure complete covering of the containerized waste.
- Initial curing is performed in the same manner described.
- The LDR-compliant macroencapsulation container is placed into the landfill.

Large pieces of debris (e.g., long length equipment) may be encapsulated with approved materials (e.g., polymeric organic resins/plastics). When encapsulating debris in plastic, it may be double wrapped with a polyethylene (PE) liner (or equivalent) that meets the minimum specifications required.

Polyethylene Lined Macroencapsulation System

A typical system contains a PE containment liner that resides within a steel box. Waste containers can be loaded directly into the system, thereby reducing the need to repackage or directly handle the waste. The following details provide a general description of treatment utilizing the Ultra-MacroEncapsulation, High Modulus Polymeric Packaging System for radioactive lead solids:

- Container(s) of radioactive lead solids are added to macroencapsulation macroliner systems comprised of HDPE/low-density PE liners.
- Filler material (e.g., vermiculite) is added to eliminate void space within macroliner.
- Once filled, the PE macroencapsulation lid is put in place and bonded (sealed) to the PE liner body.
- Once macroencapsulation bond is verified, the LDR-compliant container is placed into the landfill.

C3.1.3 Limitations

Control measures and limitations include the following:

- For alternative treatment standards (40 CFR 268.45), waste must meet the definition of debris in accordance with 40 CFR 268.2(g), with the exception of radioactive lead solids.
- With the exception of radioactive lead solids, no other wastes with specific treatment standards may be macroencapsulated unless requirements under 40 CFR 268.42 are met.

Radioactive lead solids will be treated via macroencapsulation (MACRO), as required by 40 CFR 268.40, "Applicability of Treatment Standards," and defined in 40 CFR 268.42.

C3.2 Microencapsulation

Microencapsulation is an immobilization technology that encapsulates waste with low-permeability materials and restricts contaminant migration through decreasing the surface area exposed to leaching.

C3.2.1 Applicability

Microencapsulation is applicable to waste codes listed in the Hanford Facility RCRA Permit Part A to achieve applicable LDR treatment standards. Microencapsulation has no contaminant restrictions specified in Table 1 of 40 CFR 268.45.

C3.2.2 Process Description

Where the precise volume of waste in a container is unknown (e.g., contains irregular shaped debris), microencapsulation will be utilized for void filler to ensure that the container meets the 90 percent full requirement. The following details provide a general explanation of treatment:

- Waste in the containers will be accessed through the top via drilled holes or grout ports.
- Microencapsulating reagent (e.g., flowable grout) is added directly into the containerized waste filling in void/interstitial areas in the debris waste.
- Microencapsulating reagent is in direct contact with the waste where it chemically and physically stabilizes the waste contaminates reducing their leachability.
- Microencapsulating reagent is provided approximately 72 hours to initially cure. Additional reagents (e.g., iron salts, silicates, carbon, or clays) may be utilized to enhance the set/cure time or reduce the leachability of debris constituents.
- The LDR compliant microencapsulated container is placed into the landfill.

C3.2.3 Limitations

Control measures and limitations include the following:

- Waste must meet the definition of debris in accordance with 40 CFR 268.2(g).
- Debris is not conducive to microencapsulation where surfaces are not exposed such that it is not reasonable to expect appropriate coating to occur such as the following:
  - Internally contaminated surfaces (e.g., piping)
  - Complex shapes (e.g., pumps)

- Containers must demonstrate that they are not leaking and have sufficient integrity to contain the material being added into and mixed within the container.
- Treatment may not be performed on process residuals (i.e., slag) or waste with specific treatment standards.
- If treatment results in material that no longer meets the 60 mm (approximately 2.4 in.) minimum particle size limit for debris, the material will be managed in accordance with waste-specific treatment standards for the waste contaminating the material, unless the debris has been cleaned and separated from contaminated soil and waste prior to size reduction.

C3.3 Sealing

Sealing is an immobilization technology and is the application of materials (e.g., epoxy, silicone, and urethane compounds) that adhere tightly to the debris surface to avoid exposure of the surface to potential leaching media. When necessary for effective sealing of the surface, debris surface is pretreated to remove foreign matter and/or to clean and roughen the surface.

C3.3.1 Applicability

Sealing is applicable to waste codes listed in the Hanford Facility RCRA Permit Part A to achieve applicable LDR treatment standards. Sealing has no contaminant restrictions specified in Table 1 of 40 CFR 268.45.

C3.3.2 Process Description

Containers are expected to come in all shapes, sizes, and physical forms. As a result, it is not feasible to prescribe all possible methods to seal debris. The primary objective of this section is to ensure that sealed materials adhere tightly to the container and avoid exposure of the surface to potential leaking media. Polyurea, or other similar materials, may be used for treatment. The following process provides a general explanation of containerized waste debris treatment utilizing polyurea:

- Polyurea material is applied to the container utilizing an applicator (e.g., polyurea spray gun).
- The container is initially cured per manufacturer direction and recommendation.
- The LDR compliant sealed container is placed into the landfill.

Large pieces of debris (e.g., long length equipment) may be sealed with approved materials (e.g., epoxy, silicone, and urethane compounds). When sealing the debris with polymer (or equivalent), sealing material will be applied by hand or with spray devices.

C3.3.3 Limitations

Waste must meet the definition of debris in accordance with 40 CFR 268.2(g). Containerized MW debris must have an adequate surface for the materials to adhere.

C4 Landfills

LLBG Trenches 31-34-94 operate in accordance with WAC 173-303-140 and WAC 173-303-665 for disposal of treated LDR-compliant waste from onsite and offsite Hanford generators. This section provides information on the following DWMU landfills:

- LLBG Trench 31 DWMU
- LLBG Trench 34 DWMU

- LLBG Trench 94 DWMU

C4.1 Liner System – General Items and Description

The following subsections provide a general description of the liner systems for each DWMU landfill.

C4.1.1.1 LLBG Trench 31 and 34

In accordance with WAC 173-303-335, "Construction Quality Assurance Program," quality assurance observation and testing services for the construction of LLBG Trenches 31 and 34 were conducted from September 7, 1993 to October 7, 1994 and from June 6, 1994 to November 3, 1994, respectively. The engineering design basis used to conduct observation and testing for the landfills is described in WHC-SD-W025-FDR-001, *Design Report W-025 Radioactive Mixed Waste Land Disposal Facility Non-Drag-Off*. Engineering drawings showing the current configuration of the landfills are provided in Appendix C-B.

The layers of the liner systems and leachate collection system, from bottom to top, are listed in Table C-6 and shown as an example in Figure C-3.

Table C-6. LLBG Trenches 31 and 34 Lining and Leachate Collection Systems

Layer	Landfill Base	Landfill Slopes
Secondary Liner	Admix soil, 0.94 m (3.1 ft) thick	Admix soil, 0.94 m (3.1 ft) thick
	HDPE liner, 60 mil, smooth	HDPE liner, 60 mil, textured
Secondary Leachate Collection System[a]	Geotextile,[b] 237 g/m^2 (7 oz/yd^2)	Geonet-geotextile Geocomposite
	Geonet	
	Geotextile, 542 g/m^2 (16 oz/yd^2)	
	Drainage gravel, 0.3 m (1 ft) thick	
	Geotextile, 542 g/m^2 (16 oz/yd^2)	
Primary Liner	Admix soil, 0.5 m (1.5 ft) thick	HDPE liner, 60 mil, textured
	HDPE liner, 60 mil, smooth	
Primary Leachate Collection System[a]	Geotextile,[b] 237 g/m^2 (7 oz/yd^2)	Geonet-geotextile Geocomposite
	Geonet	
	Geotextile, 542 g/m^2 (16 oz/yd^2)	
	Drainage gravel, 0.3 m (1 ft) thick	
	Geotextile, 237 g/m^2 (7 oz/yd^2)	
Operations Layer	Gravel/eolian sand, 0.9 m (3 ft) thick	Eolian sand, 0.9 m (3 ft) thick

Table C-6. LLBG Trenches 31 and 34 Lining and Leachate Collection Systems

Layer	Landfill Base	Landfill Slopes

a. Leachate removal systems include pumps, all HDPE piping, and all stainless steel piping required to move leachate to storage.

b. Geotextile 237 g/m^2 (7 oz/yd^2) is installed only in LLBG Trench 34 DWMU.

HDPE = high-density polyethylene

LLBG = low-level burial ground

Secondary Liner System

The following details generally describe the secondary liner system as shown in Table C-6:

- **Soil Liner** – The secondary admix soil liner is comprised of imported bentonite and onsite eolian sand that had been stockpiled during excavation activities. The upper layer was trimmed to the design grades and tolerances planned in the design report (WHC-SD-W025-FDR-001). Lastly, the surface was rolled with a smooth drum roller in preparation for the HDPE geomembrane liner.
- **Synthetic Liner** – The secondary synthetic liner is comprised of both smooth and textured HDPE geomembrane. It was installed in overlapping paneled sections. The smooth geomembrane was installed on the floor of the landfill, while the textured geomembrane was installed on the side slopes and in the sump area.
- **Leachate Collection and Removal System** – The secondary LCRS consists of geosynthetic and granular drainage material that collects leachate in the landfill. The leachate is then removed using a submersible pump and HDPE piping.

Primary Liner System

The following details generally describe the primary liner system shown in Table C-6:

- **Soil Liner** – Construction of the primary soil liner was conducted in a manner similar to that used to install the secondary soil liner. However, the primary soil liner was placed only on the floor of the landfill and in the anchor trench on the access ramp. A 0.3 m (1 ft) thick layer of compacted soil liner was installed on the secondary geosynthetic liner system, and a 0.3 m (1 ft) thick layer of compacted soil liner was installed on the primary geosynthetic liner system.
- **Synthetic Liner** – The materials, methods, and equipment used to install the primary HDPE geomembrane liner were generally the same as those used to install the secondary HDPE geomembrane liner.

  Included in the primary geomembrane lining system is the 80 mil thick HDPE geomembrane liner installed in the northwest corner of the waste storage and treatment pad. The 80 mil thick HDPE geomembrane liner was installed on a prepared subgrade consisting of eolian sand.
- **Leachate Collection and Removal System** – The primary LCRS consists of geosynthetic transmission media and granular drainage material, a leachate collection piping system, and a leachate collection well. The leachate removal portion of the primary system consists of a submersible pump, a self-priming pump, and HDPE piping.

- **Operations Layer** – This layer serves to protect the underlying liner from damage during operations. It consists of onsite eolian sand and/or sandy gravel that had been stockpiled during excavation activities.

C4.1.1.2 LLBG Trench 94

On January 7, 1993, DOE submitted an engineered performance plan requesting a temporary exemption from the liner system requirements in WAC 173-303-665(2)(a). In response, the Washington State Department of Ecology (Ecology) determined that the engineered performance plan would fulfill its request for a demonstration project to verify the adequacy of the submarine RC disposal alternative (WAC 173-303-665(2)(b)).

Ecology informed DOE that a temporary exemption is not considered appropriate, but the alternative landfill design described in the exemption request can be used during interim status because it demonstrates the equivalency of a double-lined landfill with an LCRS. Ecology considers the exemption request complete and acceptable for incorporation into the Hanford Facility RCRA Permit. The alternate design requires final status approval in accordance with WAC 173-303-806.

The request for exemption applies only to the decommissioned, defueled RCs disposed in LLBG Trench 94 DWMU of the 218-E-12B Burial Ground. This exemption request does not apply to any other waste at the 218-E-12B Burial Ground or to any other burial ground on the Hanford Facility.

C4.1.2 Liner Location Relative to High Water Table

The separation distance is approximately 40 m (130 ft) between the synthetic liners of LLBG Trenches 31 and 34, and the uppermost portion of the water table. The liner systems are not affected by the water table.

C4.1.3 Loads on Liner System

The following subsections provide a general discussion on the types of stress that occur on the liners for LLBG Trenches 31 and 34. Additional information pertaining to loads on the liner system is provided in Sections C4.2, C4.3, C4.4, C4.5, and C4.6.

C4.1.3.1 Stresses from Installation or Construction Operations

Side slope geosynthetic liner components can experience some stress during installation and before waste placement in the lined landfill. An HDPE liner is temperature sensitive, expanding and contracting as liner temperatures increase and decrease. Thermally induced stresses can develop in the liner if deployment and anchoring occur just before a significant decrease in the liner temperature. The HDPE liner is sufficiently thick that this stress remains well below the yield strain and stress.

Drainage gravel has the potential to produce localized stress on the geomembrane liner during gravel placement with construction equipment. A geotextile cushion is placed at the base of the drainage gravel to the underlying geomembrane. A puncture analysis is performed to select a sufficiently thick geotextile. This analysis incorporates expected construction vehicle ground pressures and assumed drainage gravel gradation listed in the construction specifications. A safety factor of three is used when evaluating puncture stress.

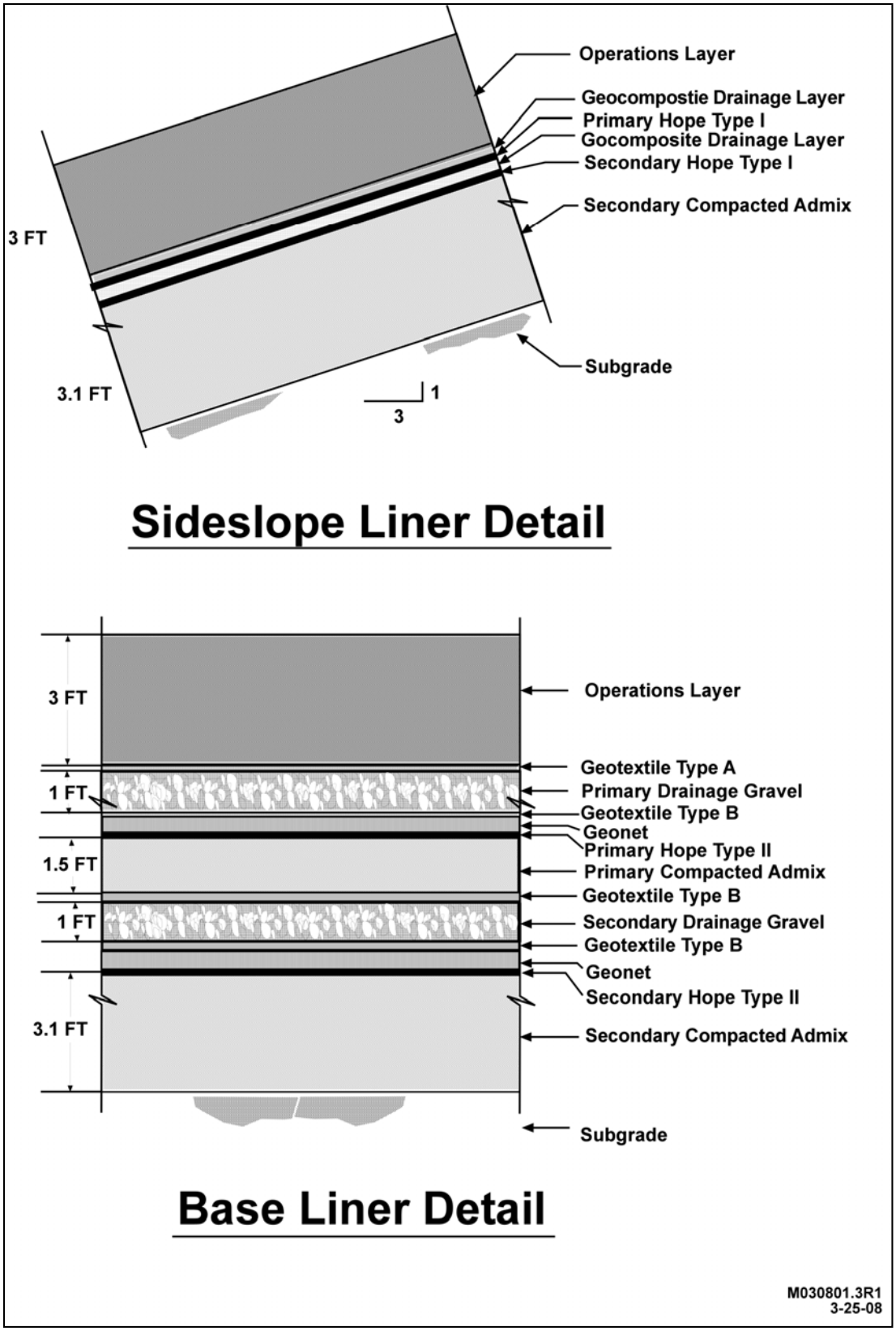


Figure C-3. Example Liner System

Stresses on the geomembrane in the anchor trench also are evaluated during detailed design. Wind uplift and thermal expansion and contraction can cause stress in the geomembrane during construction. However, these stresses are not a problem because they are relatively low compared to the tensile strength of the liner. The stresses are not present after construction because of the weight and insulating properties of the operations layer.

C4.1.3.2 Stresses Resulting from Operating Equipment

Loads on the liner system, due to operating equipment, are expected to be less severe than those generated by construction equipment because operations equipment is typically lighter than construction equipment, and the 0.9 m (3 ft) thick operations layer dissipates stresses produced by the operating equipment.

C4.1.3.3 Stresses from Maximum Quantity of Waste, Cover, and Proposed Post-Closure Land Use

When the lined landfill is full and the final cover is in place, the liner system experiences a static load from the overlying waste, backfill, and cover materials. No significant increase in stresses on the liner system is anticipated from post-closure land use. The maximum design load of material overlying the liner system includes an allowance for the cover system. Analyses include puncture resistance of the geomembranes and decrease in transmissivity of geocomposite drainage layers. Materials are specified, based on the ability of the materials to perform adequately under post-closure loading conditions.

Dynamic stresses on the liner system result primarily from ground accelerations during seismic events. Both static and dynamic analyses are performed on the subgrade and liner components based on the finished configuration of the empty landfill. Waste, backfill, and cover materials will tend to buttress the liner system, under post-closure conditions, resulting in greater stability relative to the operational phase.

C4.1.4 Liner System Coverage

The HDPE liner systems for LLBG Trenches 31 and 34 cover all soils underlying the landfills and extend over the crest of the side slopes into the anchor trenches. Liner system details are shown in Engineering Drawing H-2-131579 for LLBG Trench 31 DWMU and H-2-818396 for LLBG Trench 34 DWMU (Appendix C-B).

C4.1.5 Liner System Exposure Prevention

Liners for LLBG Trenches 31 and 34 were exposed to general climate conditions for a short period during installation. During active operations, however, no geosythetic or admix components of the liner system are exposed to the atmosphere because the operations layer covers the entire lined landfill surface. The operations layer will be inspected for erosion in accordance with Addendum I.

C4.2 Liner System – Foundation

LLBG Trenches 31 and 34 were constructed in undisturbed native soils, generally ranging from silty sands to well-graded gravels. The following subsections discuss the soil foundation in greater depth.

C4.2.1 Foundation Description

The Hanford Facility covers approximately one-third of the land area within the Pasco Basin. The dominant regional geologic characteristics of the Pasco Basin have resulted from flood basalt volcanism and regional deformation. The surface topography of the Hanford Facility has been modified by Pleistocene cataclysmic flooding and Holocene eolian activity. The cataclysmic flood deposits were formed when ice dams in western Montana and northern Idaho breached during the Pleistocene, creating the channeled scablands of eastern Washington and the resulting channels and flood bar deposits on the Hanford Facility. The 200 Areas are located along one of these flood bar deposits known as the Cold

Creek flood bar. Holocene eolian deposits have resulted from winds reworking the flood sediments, creating sand dunes and loess deposits around the margins of the Pasco Basin including the LLBG Trenches 31 and 34 area.

Surficial deposits within LLBG Trenches 31 and 34 generally consist of either recent eolian sands or the coarse-grained glaciofluvial flood sequence of the Hanford formation, which has an interstratified deposit of coarse sand, gravelly sand, and/or sandy gravel. Where eolian sands are present, they are underlain by the Hanford formation. Subsequent units underlying the Hanford formation are the early Palouse soil, Plio Pleistocene unit, middle Ringold unit, and Elephant Mountain Member of the Columbia River Basalt Group.

The two geologic units pertinent to LLBG Trenches 31 and 34, from youngest to oldest, are summarized as follows:

- **Recent Eolian Sand** – The sand is light olive gray in color and has a density that is loose at the surface but becomes compact with depth. The sand has a fine to medium grain size and includes little to some nonplastic silt-size fines. The deposit is homogeneous except for a distinguishable layer of volcanic ash in some locations.

- **Glaciofluvial Flood Deposit** – Underlying the Recent eolian sand, this deposit has well-graded mixtures of sands and gravels with trace to little nonplastic silt-size particles. The density of the deposit ranges from compact to very dense. The gravel content can vary with depth, and the deposit predominantly can become gravel.

C4.2.2 Subsurface Exploration Data

Because the soils are located in the Pasco Basin and are relatively consistent, previous geological site investigations were used to support detailed design of LLBG Trenches 31 and 34. The investigations consisted of a review of historical data, including well logs, exploratory borings, and surface pit samples data.

The Hanford formation is approximately 30 m (100 ft) thick at the landfill sites. Approximately 85 percent of LLBG Trenches 31 and 34 is constructed in recent eolian sands. The sands extend to approximately 5.2 m (17 ft) below the surface. Underlying the eolian sands is the coarse-grained sequence of the Hanford formation consisting of an interstratified deposit of coarse sand, gravelly sand, and/or sandy gravel. This coarse-grained deposit is part of the Cold Creek bar.

C4.2.3 Laboratory Testing Data

The Construction Quality Assurance (CQA) program ensured that preconstruction testing was performed on soil materials to verify compliance with project specifications. The following soil materials were tested:

- **Excavation and Backfill** – Eolian sand and gravelly sand materials were used for backfilling in and around the landfills excavation. Results of the preconstruction material evaluations indicated that the tested samples met the requirements of the specifications for both backfill materials and operations layer materials.

- **Soil Liner** – Prepared for use in test fills, secondary soil liner, and primary soil liner, the soil liner material consisted of an admixture of eolian sand stockpiled during landfill excavations and imported bentonite. Results of the preconstruction material evaluations indicated that the tested samples met the requirements of the specifications for soil liners.

Further discussion on preconstruction testing is provided in Sections C4.3.2, and C4.6. The standard test methods, frequencies, and results of preconstruction testing are described in the CQA reports (WHC-SD-W025-RPT-001, *Construction Quality Assurance Report W-025 Radioactive Mixed Waste Land Disposal Facility Non-Drag-Off*; WHC-SD-W025-RPT-002, *Construction Quality Assurance Report Radioactive Mixed Waste Land Disposal Facility Non-Drag-Off-2*).

C4.2.4 Engineering Analyses

The subgrade is required to support the liner system and overlying materials (waste, fill, and cover) without excessive settlement, compression, or uplift that could damage the liner system. This section describes the design approach used to satisfy these criteria at LLBG Trenches 31 and 34.

C4.2.4.1 Stability

Subgrade Side Slope. The subgrade soil excavated prior to construction of LLBG Trenches 31 and 34 consisted mostly of eolian sand. The remaining soil was comprised from the underlying coarse-grained Hanford formation. In granular, cohesionless, drained soils such as these, the stability of the side slope primarily relates to the maximum slope angle.

An infinite slope analysis was used to determine both static and dynamic side slope stability. Results indicated that the factors of safety for static and dynamic stability were above acceptable for both landfills. A more detailed discussion, including supporting calculations for the analysis, is presented in the design report (WHC-SD-W025-FDR-001).

Liner Side Slope. At LLBG Trenches 31 and 34, static and dynamic infinite slope stability analyses were also performed for each geosynthetic interface on the side slopes using residual strength parameters for both friction angle and cohesion. Results indicated that the operations layer/geotextile interface proved to be the critical interface with above-acceptable safety factors for static and dynamic stability. A more detailed discussion, including supporting calculations for the analysis, is presented in the design report (WHC-SD-W025-FDR-001).

Ramp Analysis. At LLBG Trenches 31 and 34, both static and dynamic stability analyses were performed on each liner interface using a maximum vehicle weight and braking force. Results indicated/calculated that the factors of safety were well above minimum recommendations. A more detailed discussion, including supporting calculations for the analysis, is presented in the design report (WHC-SD-W025-FDR-001).

Waste. LLBG Trenches 31 and 34 are generally filled in horizontal lifts consisting of one layer of containers covered by a layer of soil. The lifts are usually completed across the base prior to starting the following lift. Filling in this manner results in balanced loading that protects the liner interfaces.

Both overturning and lateral sliding stability checks were performed to determine the stability of the wall under lateral forces. The overturning stability check determined that the concrete wall was stable up to its design height. The sliding stability check determined that a soil berm along the exterior base of the concrete wall was required only for the first lift. Supporting calculations for the stability checks on the wall are presented in the design report (WHC-SD-W025-FDR-001).

Bearing Capacity of Subgrade Soil. The subgrade soil including all structural fill was moisture conditioned and compacted to at least 90 percent of the maximum dry density as determined by ASTM D698, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.* The bearing capacity calculations for LLBG Trenches 31 and 34 are shown in the design report (WHC-SD-W025-FDR-001).

Uplift Potential due to Hydrostatic and Gas Pressures. The potential for uplift on the liner systems for LLBG Trenches 31 and 34 is very low. The static groundwater level is approximately 76 m (250 ft) below ground surface. Higher elevation perched groundwater from surface water infiltration is unlikely to develop due to the coarse-grained Hanford formation underlying the landfills. The coarse-grained nature also promotes rapid and primarily vertical infiltration, so it is unlikely that infiltration from outside the boundaries of the landfills will be transported laterally underneath the liner systems.

Gas pressures are similarly unlikely to develop due to the absence of any noted subsurface gas generation (from organic material decomposition) and the coarse-grained highly permeable sands and gravels underlying the landfills. If any gas were generated below the liner systems, little pressure buildup would occur because the unsaturated coarse-grained foundation soils would vent the gas to the atmosphere. Internal gas pressure buildup is not anticipated because the leachate collection systems are vented to the atmosphere dissipating any gas.

Subsidence. Subsidence of undisturbed foundation materials is generally the result of dissolution, fluid extraction (water or petroleum), or mining. The potential for subsidence at LLBG Trenches 31 and 34 is negligible based on the following:

- The foundation underlying the landfills consists of coarse-grained sands and gravels not subject to piping that would cause transport.
- The groundwater level is deep and lies approximately 76 m (250 ft) below the base of each landfill and, thus, will not impact bearing soils.
- No mining or tunneling has been noted in the area.
- No reserves of petroleum have been noted.
- No subsidence or sinkhole activity has been noted in the area.
- Extensive borings in and around the landfills have not identified any soluble materials in the foundation.

Supporting documentation on subsidence potential is presented in the design report (WHC-SD-W025-FDR-001).

Seismic Conditions. Hazards from seismic events can include faulting, slope failure, and liquefaction. The potential for faulting is not considered a significant risk because no major faults have been identified in the area, and only one central fault at Gable Mountain on the Hanford Facility shows evidence of movement within the last 13,000 years (WHC-SD-ER-TI-003, *Geology and Hydrology of the Hanford Site: A Standardized Text for Use in Westinghouse Hanford Company Documents and Reports*). The potential for slope failure is considered low because the granular materials have high strengths relative to the maximum side slope angles as discussed in Section C4.2.4. Lastly, the potential for liquefaction is considered insusceptible because the oldest foundation materials are well graded, unsaturated, and relatively dense as discussed in Section C4.2.4.

C4.3 Liner Systems – Liners

The following subsections describe the synthetic and soil liners in use at LLBG Trenches 31 and 34.

C4.3.1 Synthetic Liners

The HDPE synthetic liners for LLBG Trenches 31 and 34 described in Section C4.1 act as an impermeable barrier for leachate migration and are resistant to chemical deterioration.

C4.3.1.1 Compatibility Data

A liner/leachate compatibility test plan (PNL-7364, *Liner/Leachate Compatibility Test in Support of WHC Project W-025, Radioactive Mixed Waste (RMW) Disposal Facility*) was conducted prior to construction of LLBG Trenches 31 and 34. A synthetic leachate was developed and used to evaluate chemical resistance of the proposed HDPE geomembrane liners.

Testing was performed in accordance with U.S. Environmental Protection Agency (EPA) Method 9090. Some of the test samples were irradiated to simulate the effects of low-level radioactive materials in the expected waste stream. Over 2,100 tests were performed as part of this program. The primary acceptance criterion was stability of material properties over the duration of the test. Results showed that materials comprised of HDPE satisfied the acceptance criteria under radiation and elevated temperatures.

In addition to manufacturer monitoring and testing, conformance testing of the geosynthetic liner material properties was conducted. Testing included fingerprinting analyses and direct shear testing. Fingerprinting analyses included tests of the material's specific gravity, melt index, and crystallinity. A series of friction angle tests, using the direct shear method, were performed on the interface between the textured HDPE liner and the soil liner material. The conformance test results are provided in the CQA reports (WHC-SD-W025-RPT-001; WHC-SD-W025-RPT-002).

C4.3.1.2 Liner Bedding

The fine-grained sandy soils provided a stable base and adequate bedding for the liner systems at LLBG Trenches 31 and 34. Prior to installation of the secondary liner system, the soil subgrade was graded and compacted to a minimum 90 percent of the standard Proctor maximum dry density (ASTM D1557, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort*). Field moisture-density tests were performed during compaction to ensure the required specifications were met.

C4.3.2 Soil Liners

Eolian sand, bentonite, and water were mixed together to produce the admixture (soil liner), which contained between 11 and 14 percent bentonite (dry weight) and a moisture content 1 to 5 percent above the optimal requirement. Prior to placement and compaction in the landfill, the soil liner was allowed to moisture cure.

C4.3.2.1 Secondary Liner

The admix soil testing program involved testing the permeability of various combinations of sand and bentonite to achieve a compacted admix permeability of less than or equal to 1×10^{-7} cm/sec.

Dispersion and piping in the admix were not considered likely because the permeability, and thus the flow velocity, is very low, making it difficult to move the soil particles or otherwise disrupt the soil fabric. The admix is well graded, so the component particles tend to hold each other in place. Therefore, testing for these characteristics was not necessary.

Following the completion of placement, compaction, and trimming of the secondary soil liner, an as-built survey of the soil liner surface was performed. Preconstruction specifications required a minimum secondary soil liner thickness of 0.9 m (3.1 ft), measured perpendicular to the subgrade surface.

C4.3.2.2 Primary Liner

Testing of the primary soil liner was conducted in a manner similar to that of the secondary soil liner.

C4.4 Liner System – Leachate Collection and Removal System

The purpose of the LCRS is to provide sufficient permeability and storage volume to collect, retain, and dispose of, in a timely manner, fluids falling on or moving through the waste. The primary LCRS provides the preferential path along which the leachate flows into the primary LCRS sump. The secondary LCRS (also called the leak detection system) is located between the primary and secondary geomembranes and provides the preferential path along which any fluids leaking through the primary liner system flow to the secondary LCRS sump. The LCRS includes all piping required to move leachate to a storage unit.

C4.4.1 Systems Operation and Design

Design criteria for LLBG Trenches 31 and 34 LCRSs are shown in the design report (WHC-SD-W025-FDR-001). Construction and testing details are provided in the CQA reports (WHC-SD-W025-RPT-001; WHC-SD-W025-RPT-002). Drawings for these systems are included in the engineering drawings (Appendix C-B). The landfills are operated in a way to ensure that the bottom liner is maintained as dry as possible, and the head on the top liner is less than 30.5 cm (12.0 in.). In extreme conditions (i.e., a 25 year storm event), the head on the top liner could exceed 30.5 cm (12.0 in.) for short durations. However, even in extreme conditions, the head on the bottom liner will not exceed 30.5 cm (12.0 in.). The operating methodology, described in the following paragraphs, ensures that liquids on the bottom liner are removed continuously before they can accumulate.

The secondary LCRS consists of geosynthetic and granular drainage material that collects leachate in the landfill. The leachate is then removed using a submersible pump and HDPE piping.

Each sump has a thick layer of gravel designed to provide high permeability and storage capacity. Leachate is removed from the sumps by a pump installed in either vertical or side slope riser pipes. Pressure transducers and/or floats are used to monitor leachate level in the sumps and provide appropriate signals to the pump control system. All pumps, transducers, and/or floats are removable for maintenance and related activities.

C4.4.1.1 Primary System

The base of the primary LCRS is defined by the primary geomembrane. On the floor of the landfill, the primary geomembrane is overlain by geonet, geocomposite, and/or granular drainage layers. A granular drainage layer is used, and pipes are located at regular intervals to increase flow capacity. Geotextile layers at the top of the LCRS prevent migration of fine soil particles into the gravel or geonet and, thus, prevent clogging.

On the side slopes, a geocomposite layer is used over the geomembrane. The geocomposite includes bonded geotextiles on both sides that increase the interface shear strength and allow this material to be used on the side slopes. Because of construction difficulties, no drainage gravel is placed on the side slopes.

The primary LCRS is covered by the operations layer. The layer provides protection for the underlying liner and drainage materials. The operations layer covers both the landfill floor and side slopes. The primary LCRS is designed, operated, and maintained to control run-on during a 25 year storm (WAC 173-303-665(2)(c)) and run-off during a 25 year, 24 hour storm (WAC 173-303-665(2)(d)).

The primary LCRS will be emptied and otherwise managed expeditiously, after the storm event, in accordance with WAC 173-303-665(2)(e). Should a greater than 25 year, 24 hour storm event occur, the primary LCRS sump is designed to store leachate temporarily at a depth greater than 30.5 cm (12.0 in.). The primary LCRS sump is equipped with two sump pumps. One pump is high capacity,

capable of rapid removal of large volumes of leachate, suitable for the transfer of batch quantities of leachate, and capable of handling the larger volumes of leachate anticipated from the 25 year, 24 hour storm event. The other pump is a low capacity submersible pump located in the base of the primary sump. The pumps are fabricated from stainless steel or other corrosion resistant material.

C4.4.1.2 Secondary System

The base of the secondary LCRS is formed by the secondary geomembrane. The secondary LCRS is similar to the primary LCRS except that pipes are not included. The pipes are not needed because high flow capacity is not required for the low leachate volumes. The secondary LCRS drains to the secondary sump, which is located immediately below the primary sump. Because of the low volumes, the secondary LCRS is equipped with only one low-capacity submersible pump.

C4.4.2 Grading and Drainage

Two types of granular drainage media were used in the drainage layers for both the secondary and primary LCRS of LLBG Trenches 31 and 34. Drainage gravel, generally a sandy pea-gravel, was used on the floor of each of the systems; sump gravel, generally a clean, medium-size gravel, was used in the sump of each system. Preconstruction testing of the drainage gravel and sump gravel included a suite of three tests: sieve analysis, permeability, and slake durability. A simulated leachate was used during the slake durability tests.

C4.4.3 Maximum Leachate Head

The maximum leachate head on the primary liner for LLBG Trenches 31 and 34 is less than 30.5 cm (12.0 in.) except for rare storm events (e.g., a 25 year storm) as discussed in Section C4.4.1. The size and design of the primary LCRS sump provides adequate surge storage to prevent leachate buildup on the primary liner.

C4.4.4 Systems Compatibility

Primary and secondary LCRSs for LLBG Trenches 31 and 34 are composed of inert geologic materials (sand and gravel), HDPE, and other geosynthetic materials such as polypropylene. Geosynthetics were evaluated for compatibility with the expected leachate. To ensure that the geosynthetics used are chemically similar to those evaluated, manufacturers are required to submit quality control certificates and other manufacturing information and conformance tests performed on all materials.

Before a waste constituent is allowed in the landfill, the waste constituent is evaluated for compatibility with the liner (e.g., identified in EPA 9090A test results and testing). Other materials could contact the leachate, for example:

- Stainless steel, used for piping and wetted parts of pumps
- Rubber coatings for pump impellers and cases
- Polyvinyl chloride and other plastics in miscellaneous uses
- Epoxy or other materials used as tank coatings

Compatibility of these materials with the expected leachate was considered in the liner system design. Compatibility of these materials is of lesser concern because items that are comprised of these materials are located entirely within the containment area. Failure of these items would not result in a waste release, and the materials would be replaced or repaired.

C4.4.5 Systems Strength

As discussed in Sections C4.3 and C4.4.2, the HDPE synthetic liner systems and drainage gravel were evaluated as part of the design for LLBG Trenches 31 and 34.

The downdrag potential caused by waste settlement around the vertical riser pipe was analyzed to determine the structural support requirements for the vertical riser base. A smooth HDPE geomembrane was wrapped around the vertical riser to reduce the side friction caused by the settling of waste. The analysis demonstrated that the downdrag stress plus the self-weight of the vertical riser pipe would not exceed the overburden stress of the waste fill (i.e., the liner under the vertical riser base will not experience additional stress due to the downdrag force).

The maximum anticipated earth load on the primary and secondary side slope riser pipes was calculated to determine the pipe wall thickness required in order to keep the earth load pipe deflection less than 5 percent of the pipe diameter as recommended by the manufacturer. The HDPE primary and secondary slope riser pipes have a diameter of 20 cm (8 in.) and a standard dimension ratio (SDR) of 11. The analyses indicated that in order to minimize deflection of the primary slope riser pipe, the operations layer material around the pipe would have to be placed in a controlled manner. Therefore, specifications for placement of this material were prepared to require that the operations layer be moisture conditioned and compacted adjacent to the primary slope riser pipe, in effect creating a trench for the pipe.

The primary drainage pipe is located at the toe of the landfill slopes, along the centerline of the landfills, and along the upslope side of the access ramp. The maximum anticipated earth load on the primary drainage pipe was calculated to determine the pipe wall thickness required in order to keep the earth load pipe deflection less than 5 percent of the pipe diameter. The HDPE primary drainage pipe has a diameter of 10 cm (4 in.) and an SDR of 11.

The 76 cm (30 in.) diameter leachate collection well is oriented vertically immediately under the vertical riser base. The HDPE collection well is surrounded by primary sump gravel. An earth loading analysis was performed to determine the required HDPE pipe wall thickness to prevent collapse of the well under horizontal earth pressures. The HDPE 76 cm (30 in.) diameter pipe has an SDR of 13.5.

C4.4.6 Prevention of Clogging

The geotextiles that separate the drainage layers from adjacent soil layers were selected based on the ability of the geotextile to retain the soil and prevent the soil from entering the primary and/or secondary LCRS. The geotextile materials at LLBG Trenches 31 and 34 are nonwoven, needle punched, and polypropylene.

Standard methods were used to determine the allowable range of opening sizes in the textiles. Permeability tests and particle size analyses of the drainage and sump gravel met the preconstruction requirements. Lastly, because the waste disposed of in the landfills is required to satisfy LDRs, and any absorbents must be nonbiodegradable, the amount of organic material is minimal; consequently, biologic clogging is not a problem.

C4.5 Working Surfaces

The working surfaces for LLBG Trenches 31 and 34 include the operations layer; top course surfacing on the perimeter road and access ramp; asphalt surfacing on the waste storage and treatment pads; and concrete installed for the containment basin, crest pad, crest, and control building slab.

C4.5.1 Operations Layer

The operations layer is a protective soil cover installed on the surface of the landfills that provides insulation and a protective cushion for the lining systems.

Two general soil types were used for the operations layer: eolian sand was used on the landfill slopes, and gravelly sand to sandy gravel was used on the landfill floor. Both materials were stockpiled during landfill excavation.

During the installation, hydrometer and sieve analyses (ASTM D422, *Standard Test Method for Particle-Size Analysis of Soils*) were performed, resulting in a frequency exceeding the preconstruction specification requirements. Test results indicated that the sampled materials met the requirements of the specifications for operations layer materials.

C4.5.2 Top Course

Top course material was used for surfacing the perimeter road and the access ramp in the landfills and was used as a base course material for the asphalt paving in the truck unloading and staging areas and the site entrance.

C4.5.2.1 Construction

Top course material was supplied by an independent contractor. In the northwest corner of the waste storage and treatment pads, three layers of geotextile were installed on the surface of the HDPE liner prior to the placement of top course. On the access ramps, a layer of geotextile was installed on the surface prior to the placement of top course. The top course material was compacted and then spread on the waste storage and treatment pads as well as on the perimeter road.

C4.5.2.2 Testing

During the installation of the top course material, moisture-density tests (ASTM 02922 and 03017) were performed on the compacted top course material on each landfill access ramp, resulting in a frequency exceeding the specification requirements. Moisture-density tests were also performed on the top course on the perimeter road, site entrance road, and waste storage and treatment pads, resulting in a frequency exceeding the specification requirements. The test results indicated that the top course had been compacted to at least 95 percent of the material's modified Proctor maximum density (ASTM D1557).

Laboratory testing included sieve analyses (ASTM C136, *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates*) and modified Proctor compaction tests (ASTM D1557). Two sieve analyses and two modified Proctor tests were performed during installation of the top course exceeding the specification requirements of sieve analysis. Results of the tests indicated that the sampled top course material met the requirements of the specifications.

C4.5.3 Asphalt

A liquid asphalt primer (grade MC-250) was applied to the surface of the top course on the site entrance roads and the waste storage and treatment pads prior to paving these areas with asphalt. After a curing period, asphalt paving on the treated areas was installed and compacted to at least 93 percent of the material's theoretical maximum density using a smooth drum vibratory roller.

CQA laboratory tests and field density tests performed included sieve analysis (ASTM C136; ASTM C117, *Standard Test Method for Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing*), extraction test (ASTM D2172, *Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures*), maximum density (ASTM D2041, *Standard*

Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures), and specific gravity.

C4.6 Liner System – Construction and Maintenance

C4.6.1 Construction Quality Assurance Program

Construction of LLBG Trenches 31 and 34 has been completed. The CQA reports for LLBG Trenches 31 and 34 (WHC-SD-W025-RPT-001; WHC-SD-W025-RPT-002) discuss the following results in detail:

- Geosynthetic and soil materials conformance testing
- Observation and testing associated with installation of the soil liners
- Observation and testing associated with installation of the HDPE geomembrane liner systems
- Observation and testing associated with installation of LCRSs
- Observation and testing associated with installation of the working surfaces

LLBG Trench 94 was constructed prior to 1992; therefore, it does not have a liner system or CQA report. This landfill operates in accordance with the liner exemption discussed in Section C4.1.1.2.

C4.6.2 Maintenance Procedures for Leachate Collection and Removal Systems

Accessible components of LLBG Trenches 31 and 34 LCRS are maintained according to preventive maintenance methods. These methods require periodic testing to prove that the equipment, controls, and instrumentation are functional and calibrated properly. Testing intervals were derived from applicable regulations and manufacturer recommendations. All pumps and motors will be started or bumped monthly or at intervals suggested by the manufacturer to accomplish the following objectives:

- Demonstrate that pumps and motors are functional.
- Move the bearing(s) to keep their surfaces from seizing or becoming distorted.

Instruments are calibrated annually or at intervals suggested by the manufacturer. The following instruments will require annual calibration:

- LCRS primary sump level indicator
- LCRS secondary sump level indicator

Other instrumentation inside the leachate handling and storage facilities will also require routine maintenance.

C4.6.3 Liner Repairs during Operations

Damage to the liner systems for LLBG Trenches 31 and 34 is not expected to occur due to the operations layer. If damage did occur, the operations layer could be removed laterally as far as required. Underlying geosynthetic and gravel layers could be removed until an undamaged layer is encountered. The damaged layers would be repaired and replaced from the lowest layer upward using similar methods to those employed during construction.

C4.7 Run-On and Runoff Control Systems

Because of the sandy soils, small drainage area, and arid climate at the Hanford Facility, engineered storm water run-on and runoff structures are not required. Interceptor and drainage ditches are adequate for run-on and runoff control. The 25 year, 24 hour precipitation event is the design storm used to size the

landfills. Beyond this, surface water evaluation is highly site-specific, and appropriate analyses are performed as part of detailed design for each landfill.

C4.7.1 Run-On Control System

Run-on is controlled by berms around the perimeter of each lined landfill. Any overland flow approaching the landfill is intercepted by the berms and conveyed to suitable discharge points. All berms are designed to handle the peak 25-year flow from the potential drainage area.

Drainage for LLBG Trenches 31 and 34 is designed and constructed such that the paved northwest corner drains into the landfill, and all other areas beyond the crest of the landfill drain outward, away from the landfill. The remaining paved area of the waste storage and treatment pad drains away from the landfill. Between the landfill crest and the perimeter road, the area was graded to provide drainage toward the perimeter road. The perimeter road is sloped outward, at a grade of approximately 1 percent, to provide drainage away from the landfills. On the outside of the perimeter road, on the north and west sides of the landfills, drainage ditches were excavated to provide drainage away from the landfills.

C4.7.2 Design and Performance

Design and performance details were determined for LLBG Trenches 31 and 34 as part of the detailed design process.

C4.7.3 Calculation of Peak Flow

Computation of design discharge for the berms was performed using standard analytical methods, such as the Rational Method or the U.S. Army Corps Engineers (USACE) computer program (USACE, 1981, *HEC-1 Flood Hydrograph Package, Computer Program 723-X6-L2010*). The 25 year, 24 hour precipitation depth is 4 cm (1.6 in.), based on precipitation data recorded from 1947 to 1969 (PNL-4622, *Climatological Summary for the Hanford Area*). The tributary area for each section of the berms depends on local topography.

C4.7.4 Runoff Control System

There is no runoff from the landfills because they are constructed below grade. Any precipitation falling on LLBG Trenches 31 and 34 is removed by either evapotranspiration or LCRSs. Therefore, a runoff control system is not needed.

C4.8 Control of Wind Dispersal

Methods to prevent wind dispersal within LLBG Trenches 31 and 34 can include containerizing, stabilizing, grouting, spray fixitants, and backfilling. In other instances, the operator may implement a wind speed restriction during handling.

To control particulate matter, dust suppressants (typically polymers) may also be used. Such materials may be applied by a water truck equipped with spray nozzles, or equivalent. EPA has provided numerous guidance documents that allow the use of nonhazardous liquids for dust suppression within landfills. These activities will be performed to meet general site conditions to control fugitive emissions found in the facility's air permit (e.g., opacity). The utilization of nonhazardous liquids for dust control activities will be performed in a manner that prevents the accumulation of recoverable liquids (i.e., ponding) within the footprint of the landfills. Dust control activities are also conducted when weather conditions are conducive to this form of dust control (e.g., not raining or freezing). Water and nonhazardous liquids or other forms of dust suppressants (e.g., polymers and magnesium chloride) may also be used for dust control on landfill haul roads.

C4.9 Liquids in Landfills

Bulk liquid waste or wastes containing free liquids and containers holding free liquids will not be accepted at LLBG Trenches 31-34-94 unless WAC 173-303-140(4)(b)(ii) requirements are met.

C4.10 Containerized Wastes

To mitigate significant voids prior to disposal, containers (unless very small such as ampules) will be either of the following:

- At least 90 percent full when placed in the landfill
- Crushed, shredded, or similarly reduced in volume to the maximum practical extent before buried in the landfill

C4.11 Special Requirements for Hazardous Wastes F020, F021, F022, F023, F026, and F028

Hazardous wastes designated as F020, F021, F022, F023, F026, and F028 will not be placed in any landfill. Confirmation and verification processes to ensure that hazardous wastes F020, F021, F022, F023, F026, and F028 are not disposed of in LLBG Trenches 31-34-94 are described in the WAP (Addendum B).

C4.12 Monitoring and Inspection

Inspection frequencies and requirements for LLBG Trenches 31-34-94 are provided in Addendum I.

C4.13 Action Leakage Rate and Response Actions

The action leakage rate (ALR) is the maximum design flow rate that the LCRS can remove without the fluid head on the bottom liner exceeding 0.3 m (1 ft). A response action plan (RAP) was prepared for LLBG Trenches 31 and 34 (WHC-SD-W025-AP-001, *Revision to the Response Action Plan for the Low-Level Burial Grounds Mixed Waste Disposal Trenches*). As part of this plan, the ALR was calculated to a threshold value of 2,150 L/ha/day.

During operations, the leakage rate through the primary liner is calculated to ensure that it is less than the threshold value of the ALR. Data to support the leakage rate calculations can be obtained either from the flow totalizer in the secondary leachate collection pump discharge line or from the liquid level gauges. Should the ALR be exceeded, the site-specific RAP will be utilized to ensure compliance with WAC 173-303-665(9).

C4.14 Surveying and Recordkeeping

Records for the contents of each landfill and approximate location of each waste type within each landfill are maintained by routinely recording information.

C4.15 Closure and Post-Closure Care

Closure requirements are outlined in the closure plan (Addendum H).

C4.16 Special Requirements for Ignitable or Reactive Waste

Wastes exhibiting ignitable or reactive characteristics are treated and rendered LDR compliant (nonignitable or nonreactive) prior to land disposal. Waste acceptance criteria for identifying these wastes and determining the adequacy of treatment are provided in the WAP (Addendum B).

C4.17 Special Requirements for Incompatible Wastes

Incompatible wastes are treated prior to acceptance and rendered LDR compliant prior to land disposal. Waste acceptance criteria for determining the chemical compatibility of wastes for disposal are provided in the WAP (Addendum B).

C5 Recordkeeping

The Permittees will place documentation into the Hanford Facility Operating Record (LLBG Trenches 31-34-94 portion) as required by Hanford Facility RCRA Permit Condition II.I (WAC 173-303-380, "Facility Recordkeeping") to include approved waste profile documentation (Hanford Facility RCRA Permit Condition II.I.1.j) and confirmation records (Hanford Facility RCRA Permit Condition II.I.1.b). LDR records will be maintained in the Hanford Facility Operating Record (LLBG Trenches 31-34-94 portion) in accordance with WAC 173-303-380(1)(m).

C6 Training

For training requirements related to duties described in the LLBG Trenches 31-34-94 Process Information, refer to Addendum G.

C7 References

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol25/xml/CFR-2010-title40-vol25-part264.xml.

264.1080, "Applicability."

Subpart AA, "Air Emission Standards for Process Vents."

Subpart BB, "Air Emission Standards for Equipment Leaks."

Subpart CC, "Air Emission Standards for Tanks, Surface Impoundments, and Containers."

40 CFR 260.10, "Hazardous Waste Management System: General," "Definitions," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol25/xml/CFR-2010-title40-vol25-part260.xml#seqnum260.10.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol26/xml/CFR-2010-title40-vol26-part268.xml.

268.2, "Definitions Applicable in This Part."

268.40, "Applicability of Treatment Standards."

268.42, "Treatment Standards Expressed as Specified Technologies."

268.45, "Treatment Standards for Hazardous Debris."

Subpart D, "Treatment Standards."

ASTM C117, 2004, *Standard Test Method for Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing*, ASTM International, West Conshohocken, Pennsylvania.

ASTM C136, 2014, *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates*, ASTM International, West Conshohocken, Pennsylvania.

ASTM D422, 1998, *Standard Test Method for Particle-Size Analysis of Soils*, ASTM International, West Conshohocken, Pennsylvania.

ASTM D698, 2000, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort*, ASTM International, West Conshohocken, Pennsylvania.

ASTM D751, 2000, *Standard Test Methods for Coated Fabrics*, ASTM International, West Conshohocken, Pennsylvania.

ASTM D882, 2012, *Standard Test Method for Tensile Properties of Thin Plastic Sheeting*, ASTM International, West Conshohocken, Pennsylvania.

ASTM D1709, 2015, *Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method*, ASTM International, West Conshohocken, Pennsylvania.

ASTM D1557, 2012, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort*, ASTM International, West Conshohocken, Pennsylvania.

ASTM D2041, 2011, *Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures*, ASTM International, West Conshohocken, Pennsylvania.

ASTM D2172, 2011, *Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures*, ASTM International, West Conshohocken, Pennsylvania.

Atomic Energy Act of 1954, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: http://epw.senate.gov/atomic54.pdf.

PNL-4622, 1983, *Climatological Summary for the Hanford Area*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195059530.

PNL-7364, 1990, *Liner/Leachate Compatibility Test in Support of WHC Project W-025, Radioactive Mixed Waste (RMW) Disposal Facility*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=D196013789.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

USACE, 1981, *HEC-1 Flood Hydrograph Package, Computer Program 723-X6-L2010*, U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California.

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, as amended, Washington State Department of Ecology, Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

303-090, "Dangerous Waste Characteristics."

303-140, "Land Disposal Restrictions."

303-160, "Containers."

303-335, "Construction Quality Assurance Program."

303-380, "Facility Recordkeeping."

303-395, "Other General Requirements."

303-630, "Use and Management of Containers."

303-640, "Tank Systems."

303-665, "Landfills."

303-806, "Final Facility Permits."

WHC-SD-ER-TI-003, 1991, *Geology and Hydrology of the Hanford Site: A Standardized Text for Use in Westinghouse Hanford Company Documents and Reports*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195066471.

WHC-SD-W025-AP-001, 1995, *Revision to the Response Action Plan for the Low-Level Burial Grounds Mixed Waste Disposal Trenches*, Rev. 2, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/docDetail?accession=D196007906.

WHC-SD-W025-FDR-001, 1990, *Design Report Project W-025 Radioactive Mixed Waste (RMW) Land Disposal Facility Non-Drag-Off*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196017742.

WHC-SD-W025-RPT-001, 1994, *Construction Quality Assurance Report W-025 Radioactive Mixed Waste Land Disposal Facility Non-Drag-Off*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196030797.

WHC-SD-W025-RPT-002, 1995, *Construction Quality Assurance Report Radioactive Mixed Waste Land Disposal Facility Non-Drag-Off-2*, Westinghouse Hanford Company, Richland, Washington.

This page intentionally left blank.

Appendix C-A

Overall Facility Map of the Hanford Site

This page intentionally left blank.

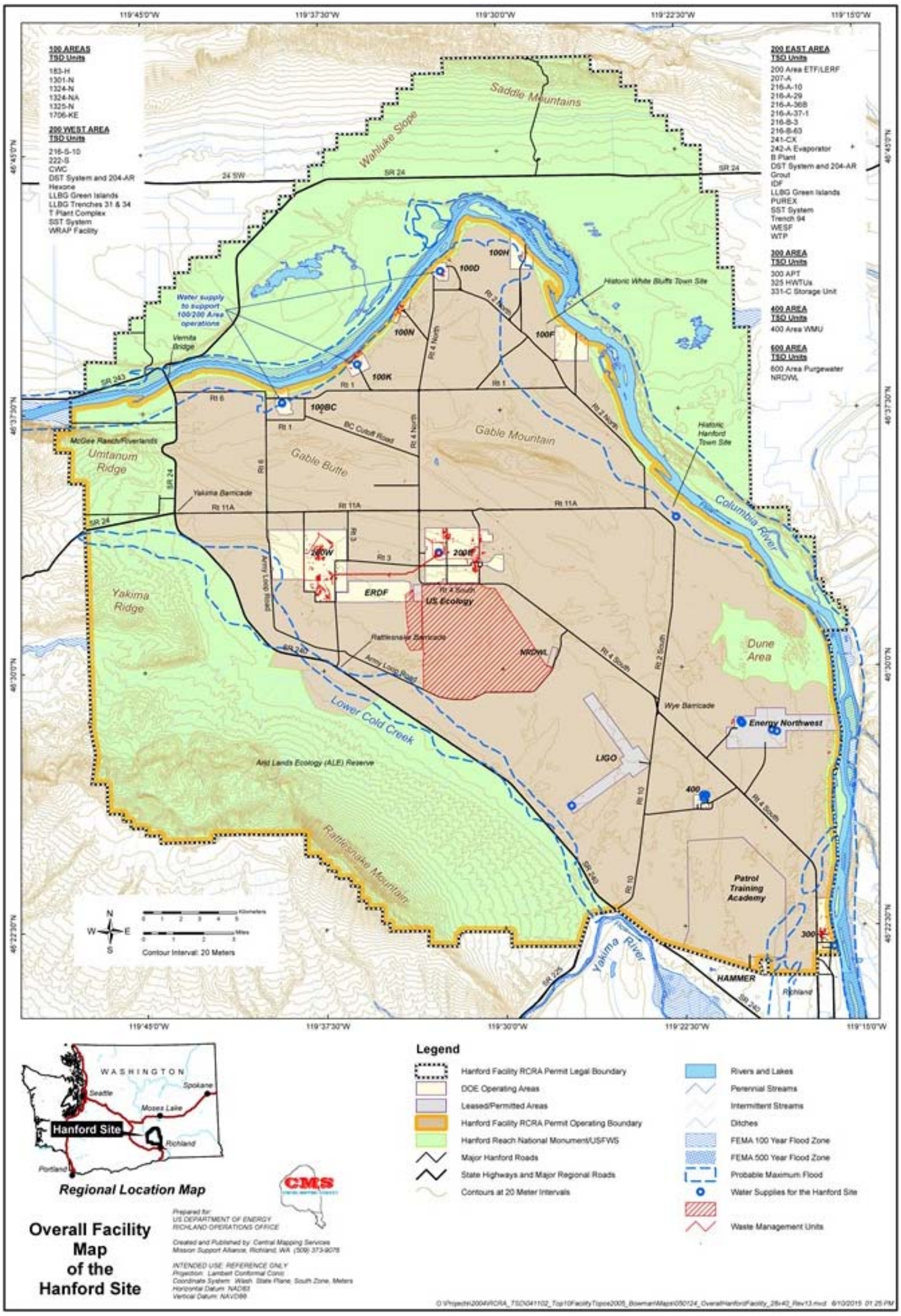


Figure C-A-1. Overall Facility Map of the Hanford Site

This page intentionally left blank.

Appendix C-B

Engineering Drawings

This page intentionally left blank.

LLBG Trench 31 DWMU, LLBG Trench 31 Waste Storage and Treatment Pad DWMU

Site Plan and Exploration Locations **H-2-131574**

Grading Plan **H-2-131575**

Cross Sections **H-2-131578**

Liner System Details **H-2-131579**

Sump Layout **H-2-131580**

Sump Cross Sections **H-2-131581**

Sump Leachate Collection Pipes **H-2-131582**

Side Slop and Vertical Riser Pipes **H-2-131583**

LLBG Trench 31 Waste Storage and Treatment Pad
(formerly Truck Staging Area and Access Ramp) **H-2-836695**

LLBG Trench 34 DWMU, LLBG Trench 34 Waste Storage and Treatment Pad DWMU

Site Plan and Exploration Locations **H-2-818391**

Grading Plan **H-2-818392**

Cross Sections **H-2-818395**

Liner System Details **H-2-818396**

Sump Layout **H-2-818397**

Sump Cross Sections **H-2-818398**

Sump Leachate Collection Pipes **H-2-818399**

Side Slop and Vertical Riser Pipes **H-2-818400**

LLBG Trench 34 Waste Storage and Treatment Pad
(formerly Truck Staging Area and Access Ramp) **H-2-836696**

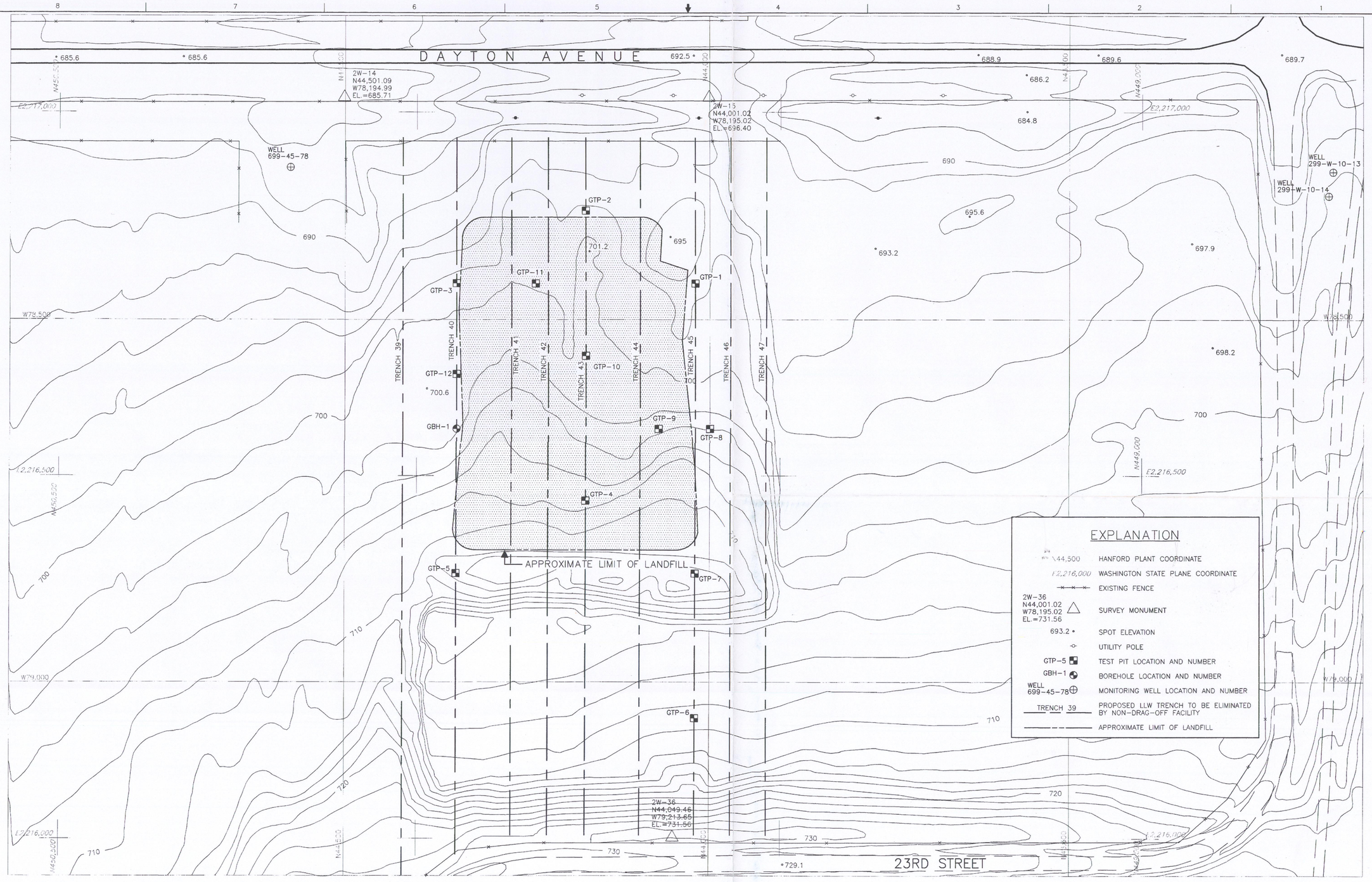
LLBG Trench 94 DWMU

Dry Waste Burial Ground 218-E-12B Naval Disposal **H-2-33276 SH6**

Dry Waste Burial Ground 218-E-12B Naval Disposal **H-2-33276 SH7**

Dry Waste Burial Ground Trench 94 ..... **H-2-33276 SH14**

This page intentionally left blank.



NOTES:

1. For test pit and borehole logs see Site Investigation Report, Non-Drag-Off Landfill Site Low Level Burial Area No. 5, 200 West Area, Dated December 4, 1989.
2. Topographic maps prepared by Degross Aerial Mapping based on July 18, 1988, aerial photography. Topography west of landfill revised January 21, 1992 per ECN 119451.

FRANK S. SHURI
STATE OF WASHINGTON
26598
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 2-21-95

NUMBER	TITLE
H-2-94677	DRY WASTE BURIAL GROUND 218-W-5
H-2-99275	TOPOGRAPHIC MAP LOW LEVEL BURIAL GROUND (SHEETS 2,3, AND 7)

DRAWING TRACEABILITY LIST

NUMBER	TITLE

REFERENCES

NEXT USED ON

REV NO	DESCRIPTION	BY	DATE	APPROVALS
3	AS-BUILT PER ECNs EDITORIAL PER ECN W-025-008, ECN W-025-029	SGH	8/26/94	F. SHURI
2	MINOR EDITORIAL	JPP	5/21/93	F. SHURI
1	REVISE TOPOGRAPHIC CONTOURS WEST OF LANDFILL	WA	5/1/92	F. SHURI

REVISIONS

CAD FILE B131574A CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED	T. MARTIN 4/2/90
DRAWN	J.S. SNOW 4/2/90
CHECKED	F. SHURI 4/2/90
REVIEWED	P. CORSER 4/2/90
QA	M.J. OTTERSON 4/2/90

APPROVED FOR IMPLEMENTATION BY F. Shuri DATE 11/9/94

IMPACT LEVEL EDT 151914

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

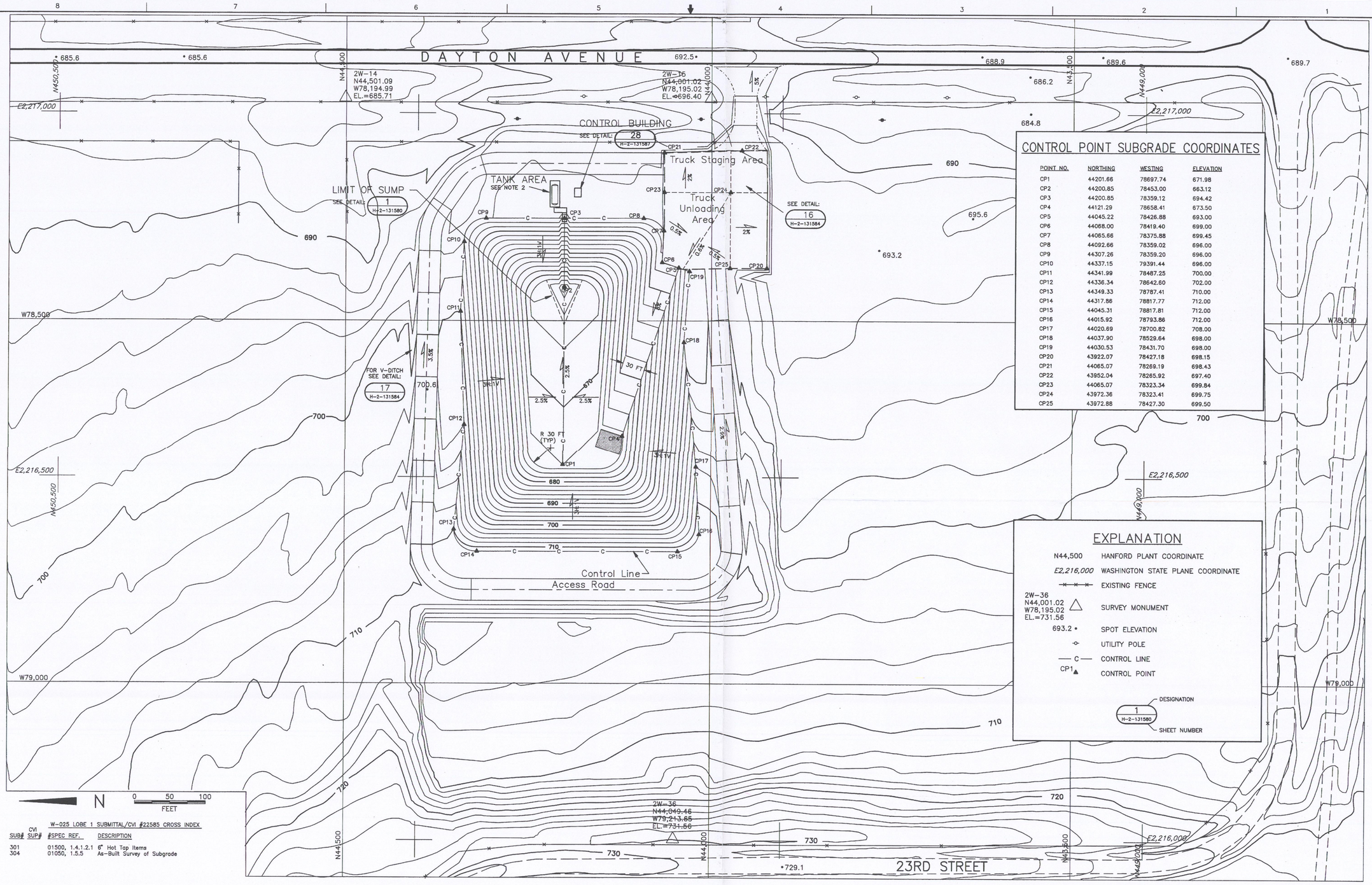
SITE PLAN AND EXPLORATION LOCATIONS
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0501	H-2-131574	3

SCALE AS SHOWN JOB NO. 893-1186.035 SHEET 1 OF 1

H-2-131574 3



CONTROL POINT SUBGRADE COORDINATES

POINT NO.	NORTHING	WESTING	ELEVATION
CP1	44201.66	78697.74	671.98
CP2	44200.85	78453.00	663.12
CP3	44200.85	78359.12	694.42
CP4	44121.29	78658.41	673.50
CP5	44045.22	78426.88	693.00
CP6	44068.00	78419.40	699.00
CP7	44065.66	78375.88	699.45
CP8	44092.66	78359.02	696.00
CP9	44307.26	78359.20	696.00
CP10	44337.15	79391.44	696.00
CP11	44341.99	78487.25	700.00
CP12	44336.34	78642.60	702.00
CP13	44349.33	78787.41	710.00
CP14	44317.86	78817.77	712.00
CP15	44045.31	78817.81	712.00
CP16	44015.92	78793.86	712.00
CP17	44020.69	78700.82	708.00
CP18	44037.90	78529.64	698.00
CP19	44030.53	78431.70	698.00
CP20	43922.07	78427.18	698.15
CP21	44065.07	78269.19	698.43
CP22	43952.04	78265.92	697.40
CP23	44065.07	78323.34	699.84
CP24	43972.36	78323.41	699.75
CP25	43972.88	78427.30	699.50

EXPLANATION

N44,500	HANFORD PLANT COORDINATE
E2,216,000	WASHINGTON STATE PLANE COORDINATE
—×—×—×—	EXISTING FENCE
2W-36 N44,001.02 W78,195.02 EL.=731.56 △	SURVEY MONUMENT
693.2 •	SPOT ELEVATION
-o-	UTILITY POLE
— C —	CONTROL LINE
CP1▲	CONTROL POINT
1 / H-2-131580	DESIGNATION / SHEET NUMBER

W-025 LOBE 1 SUBMITTAL/CVI #22585 CROSS INDEX

SUB#	CVI SUP#	#SPEC REF.	DESCRIPTION
301		01500, 1.4.1.2.1	6" Hot Tap Items
304		01050, 1.5.5	As-Built Survey of Subgrade

NOTES:

1. Excavated surface is shown in section on Drawing H-2-131578.
2. Details of the leachate collection tank and loadout pad are shown in drawings H-2-131578 H-2-824301, H-2-824302 and H-2-824303.
3. Topographic maps prepared by Degross Aerial Mapping based on July 18, 1988, aerial photography. Topography west of landfill revised January 21, 1992 per ECN 119451.
4. Location of excavation stockpile and admix preparation areas to be approved by Construction Manager.
5. For as-built conditions, see "Subgrade As-Built" drawing in the CQA report, WHC-SD-W025-RPT-001.

FRANK S. SHURI — STATE OF WASHINGTON — 24486 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES 8-21-94

NUMBER	TITLE	NUMBER	TITLE
H-2-99275	TOPOGRAPHIC MAP LOW LEVEL BURIAL GROUND (SHEETS 2,3, AND 7)		
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	

REV NO	DESCRIPTION	BY	DATE	APPROVALS
4	REVISION PER ECN – 613351	SGH	12/31/94	F. SHURI
3	AS-BUILT PER ECNs CHANGE CONTROL POINTS PER ECN W-025-033 ADD CVI CROSS INDEX AND NOTE 5 PER ECN W-025-029 ADJUST TRUCK STAGING AREA CONTROL POINTS PER ECN W-025-021 MOVE ACCESS ROAD 10 FT NORTH PER ECN W-025-012 EDITORIAL PER ECN W-025-006, W-025-029	SGH	8/26/94	F. SHURI
2	REMOVED SPECIFIC AREAS FOR STOCKPILES PER ECN W-025-001	JPP	5/21/93	F. SHURI
1	REVISE TOPOGRAPHIC CONTOURS WEST OF LANDFILL MODIFY LANDFILL GEOMETRY AND CONTROL POINTS	KGH	5/1/92	F. SHURI

REVISIONS

DESIGNED	T. MARTIN	04/02/90
DRAWN	J. SNOW	04/02/90
CHECKED	F. SHURI	04/02/90
REVIEWED	P. CORSER	04/02/90
QA	M. J. OTTERSON	04/02/90

APPROVED FOR IMPLEMENTATION — BY — FOR — DATE

CAD FILE B131575A — CAD CODE DOS:5.0:ACD2:12.0:SS

IMPACT LEVEL — EDT 151914

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

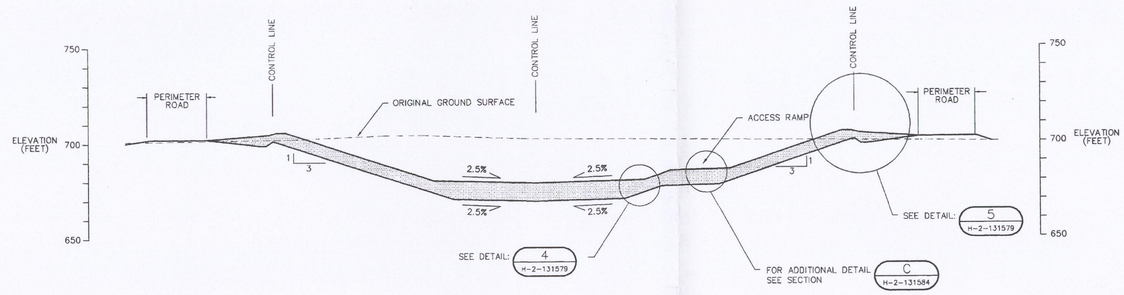
GRADING PLAN
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-131575	4

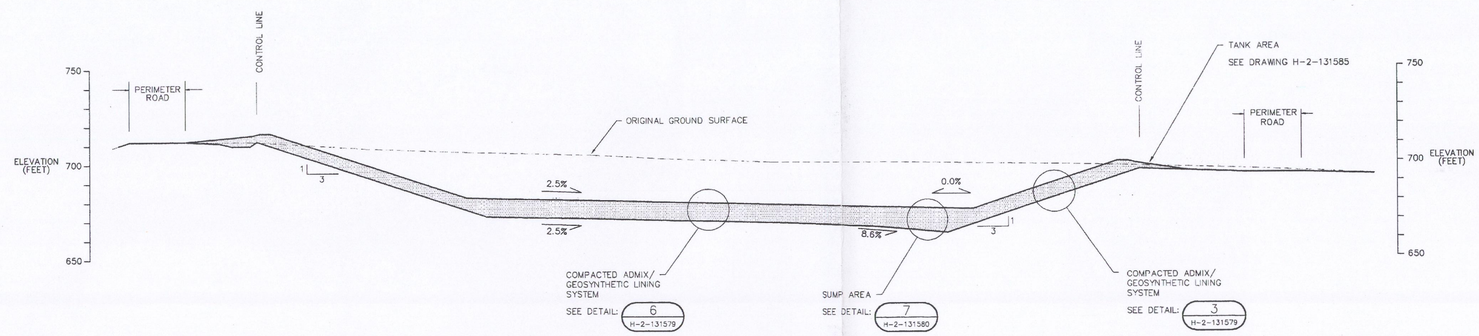
SCALE AS SHOWN — JOB NO. 893-1186.035 — SHEET 1 OF 1

H-2-131575 4



SECTION A H-2-131577

0 30 60
SCALE IN FEET



SECTION B H-2-131577

0 30 60
SCALE IN FEET

KEY:

C H-2-131577
DESIGNATION
SHEET NUMBER

NUMBER	TITLE

DRAWING TRACEABILITY LIST

NUMBER	TITLE

NEXT USED ON

REFERENCES

M	REV NO	DESCRIPTION	BY	DATE	APPROVALS
S PS	3	AS-BUILT PER EONW EDITORIAL PER ECN W-025-008, ECN W-025-029	SGH	F. SHURI	8/26/94
	2	MINOR EDITORIAL	JPP	F. SHURI	5/21/93
	1	INCREASE THICKNESS OF LINER SYSTEM	KGH	F. SHURI	5/1/92
NF					

REVISIONS

CAD FILE B131578A CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED	T. MARTIN 04/02/90
DRAWN	J. SNOW 04/02/90
CHECKED	F. SHURI 04/02/90
REVIEWED	P. CORSER 04/02/90
QA	M. J. OTTERSON 04/02/90

APPROVED FOR IMPLEMENTATION BY Walter Scott FOR WHC DATE 11-9-94

IMPACT LEVEL EDT 151914

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

CROSS-SECTIONS
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

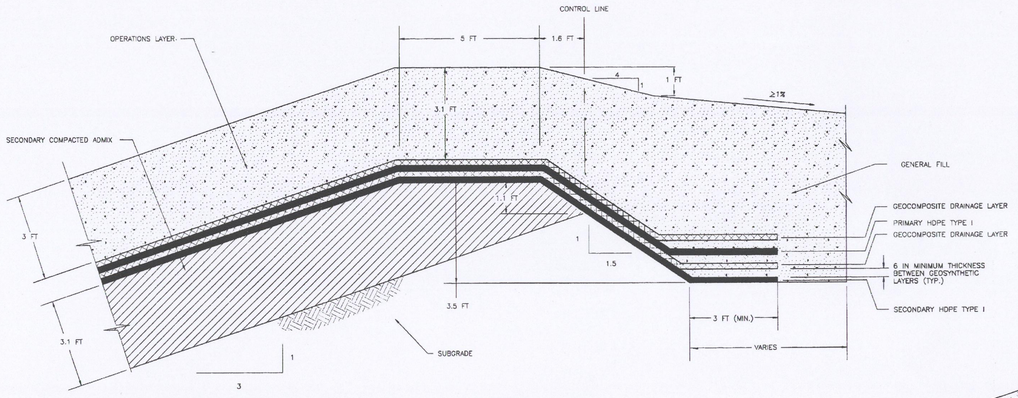
PROJECT W-025

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-131578	3

SCALE AS SHOWN JOB NO. 893-1186.035 SHEET 1 OF 1

H-2-131578 3

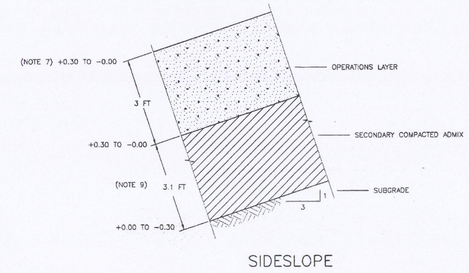
\SGFS\943157\52520 11-4-94 15:58



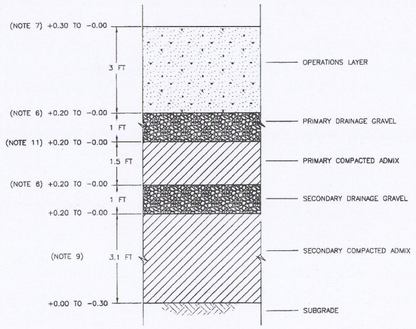
ANCHOR TRENCH DETAIL

5 / H-2-131579

0 2 4
SCALE IN FEET



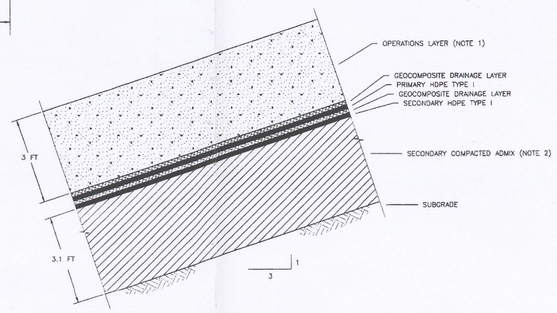
SIDESLOPE



BASE

GRADING TOLERANCE DETAIL

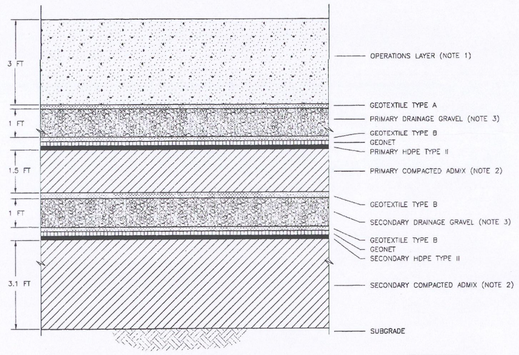
0 2 4
SCALE IN FEET



SIDESLOPE LINER DETAIL

3 / H-2-131579

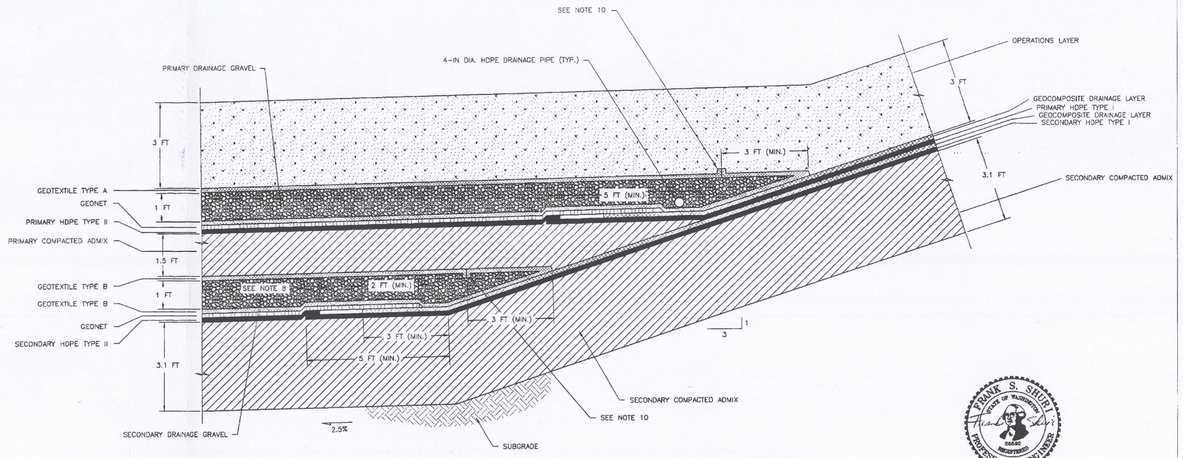
0 2 4
SCALE IN FEET



BASE LINER DETAIL

6 / H-2-131579

0 2 4
SCALE IN FEET



TYPICAL TOE OF SLOPE DETAIL

4 / H-2-131579

0 2 4
SCALE IN FEET

SUB#	CVI SUP#	#SPEC REF.	DESCRIPTION
		W-025 LOBE 1 SUBMITTAL/CVI #22585 CROSS INDEX	
25		02275, 1.7.A	Geomembrane Installer's QA Manual
25A		02275, 1.7.A	Geomembrane Crystallinity
25B		02275, 1.7.A	Geomembrane/Admix Friction Angle
25.1		02275, 1.7.A	Geomembrane QA/QC Data
25.2		02275, 1.7.A	Extrudate Certification
25.3		02275, 1.7.A	Geomembrane QA/QC Data
25.3A		02275, 1.7.A	Geomembrane Resin Certification
25.4		02275, 1.7.A	Geomembrane QA/QC Data
25.4B		02275, 1.7.A	Geomembrane Env. Stress Crack Certification
25.4C		02275, 1.7.A	Geomembrane Env. Stress Crack Certification
25.5		02275, 1.7.A	Geomembrane Low Temp. Welding Certification
25.6		02275, 1.7.A	Geomembrane QA/QC Documentation
25.6A		02275, 1.7.A	Geomembrane Direct Shear Test Report
25.7		02275, 1.7.A	Geomembrane Resin Documentation
25.8		02275, 1.7.A	Geomembrane Resistance to Soil Burial Data
25.9		02275, 1.7.A	Geomembrane Resistance to Soil Burial Cert.
28		02275, 1.7.B	Geosynthetic Samples

NOTES:
1. Operations layer shall consist of soils excavated from on site, meeting the requirements of Section 02228 of the Technical Specifications.
2. Compacted admix shall meet the composition, compaction, and permeability requirements as described in Section 02224 of the Technical Specifications.
3. Primary and secondary base liner drainage gravel shall meet the requirements of Section 02226 of the Technical Specifications.
4. Geosynthetic materials shall meet the requirements of Section 02275 of the Technical Specifications.
5. Geosynthetic layers not drawn to scale.
6. Grade shall be minimum of 1 foot above underlying layer.
7. Grade shall be minimum of 3 feet above underlying layer.
8. Overlap geomembrane as appropriate for welding method (see Specifications Section 02275).
9. Tolerances based on design grade.
10. Geotextile to be sewn (see Specifications Section 02275).
11. Grade shall be minimum of 1.5 feet above underlying layer.
12. For as-built conditions, see "Secondary HDPE Geomembrane Liner As-Built Drawing", and "Primary HDPE Geomembrane Liner As-Built Drawing" in the CQA Report, WHC-SD-W025-RPT-001.

KEY:
5 / H-2-131579 — DESIGNATION / SHEET NUMBER

NUMBER	TITLE
DRAWING TRACEABILITY LIST	

NUMBER	TITLE
REFERENCES	
NEXT USED ON	

S	M	REV NO	DESCRIPTION	BY	DATE	APPROVALS
	PRS	3	AS-BUILT PER ECN; ADD CVI CROSS INDEX AND NOTE 12 PER ECN W-025-028; EDITORIAL PER ECN W-025-026, ECN W-025-029	SGH	F. SHURI	8/26/94
		2	MINOR EDITORIAL PER ECN W-025-001	JPP	F. SHURI	5/21/93
		1	INCREASE OPERATIONS LAYER THICKNESS TO 3 FT ADD PRIMARY ADMIX LAYER	JPP	F. SHURI	5/1/92

REVISIONS

CAD FILE B131579A — CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED	T. MARTIN 04/02/90
DRAWN	J. SNOW 04/02/90
CHECKED	F. SHURI 04/02/90
REVIEWED	P. CORSER 04/02/90
QA	M. J. OTTERSON 04/02/90

APPROVED FOR RELEASE BY [signature] FOR WHC DATE 11-3-94

IMPACT LEVEL — EDT 151914

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.
LINER SYSTEM DETAILS
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

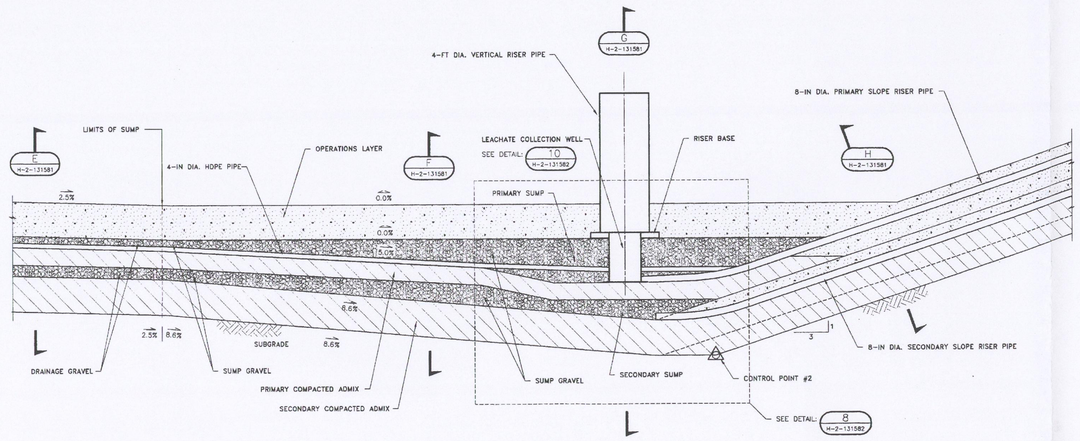
PROJECT W-025

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-131579	3

SCALE AS SHOWN — JOB NO. 893-1186.035 — SHEET 1 OF 1

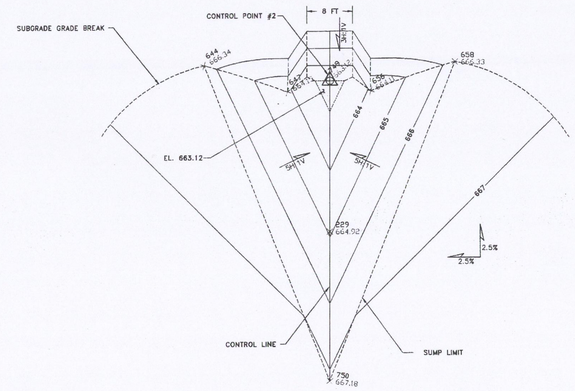
FRANK S. SHURI — STATE OF WASHINGTON — 13880 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES 2-21-95

H-2-131579 3



SUMP PROFILE (7 / H-2-131580)

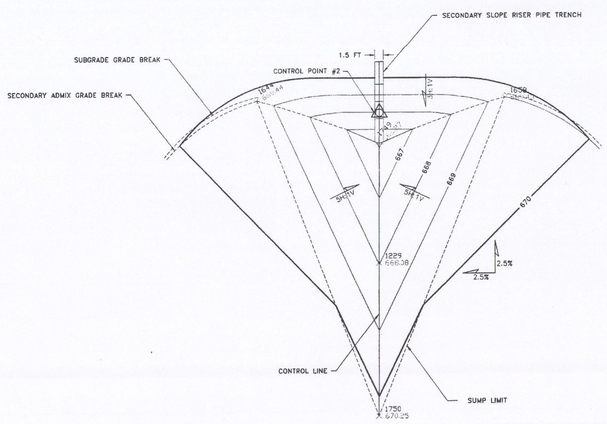
0 5 10
SCALE IN FEET



SUMP SUBGRADE (1 / H-2-131580)

0 10 20
SCALE IN FEET

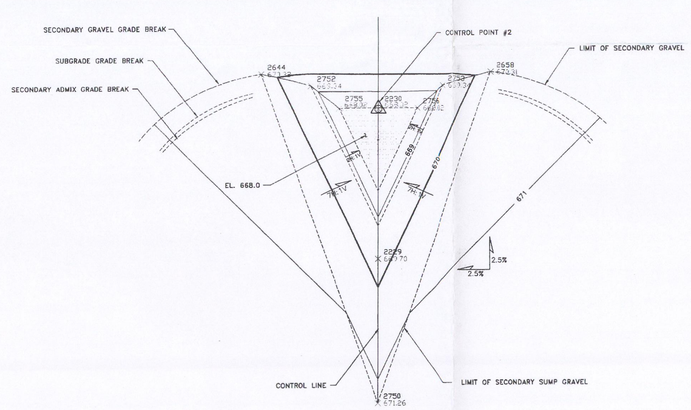
N



SUMP SECONDARY ADMIX (2 / H-2-131580)

0 10 20
SCALE IN FEET

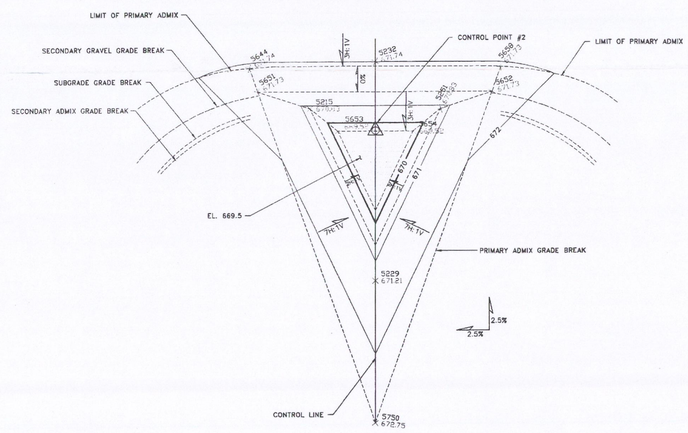
N



SUMP SECONDARY GRAVEL (3 / H-2-131580)

0 10 20
SCALE IN FEET

N



SUMP PRIMARY ADMIX (4 / H-2-131580)

0 10 20
SCALE IN FEET

N

FRANK S. SHURI — STATE OF WASHINGTON — 24382 — REGISTERED PROFESSIONAL ENGINEER
EXPIRES 6-31-94

CVI SUB#	CVI SUP#	W-025 LOBE 1 SUBMITTAL/CVI #22585 CROSS INDEX #SPEC REF.	DESCRIPTION
21		02226, 1.2	Granular Drainage Layers, Gravel Samples

NOTE:

1. Control points defined on Drawing H-2-131575.
2. For as-built conditions, see "Top of Secondary Gravel As-Built", "Top of Primary Admix As-Built", and "Top of Primary Gravel As-Built" drawings in the CQA Report, WHC-SD-W025-RPT-001.

KEY:

D H-2-131581 — DESIGNATION / SHEET NUMBER

NUMBER	TITLE	NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	

NEXT USED ON

S/M	REV NO	DESCRIPTION	BY	DATE	APPROVALS
RS	3	AS-BUILT PER ECN# ADD CVI CROSS INDEX AND NOTE 2 PER ECN W-025-029 EDITORIAL PER ECN W-025-008, ECN W-025-029	SGH	F. SHURI 8/26/94	
	2	MINOR EDITORIAL	JPP	F. SHURI 5/21/93	
	1	INCREASE OPERATIONS LAYER THICKNESS TO 3 FEET ADD PRIMARY ADMIX LAYER AND SUMP PLAN	KGH	F. SHURI 5/5/92	
MF		REVISIONS			

CAD FILE B131580A — CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED	T. MARTIN	04/02/90
DRAWN	J. SNOW	04/02/90
CHECKED	F. SHURI	04/02/90
REVIEWED	P. CORSER	04/02/90
QA	M. J. OTTERSON	04/02/90

APPROVED FOR IMPLEMENTATION — BY [signature] — FOR WMK — DATE 11-9-94

IMPACT LEVEL — EDT 151914

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

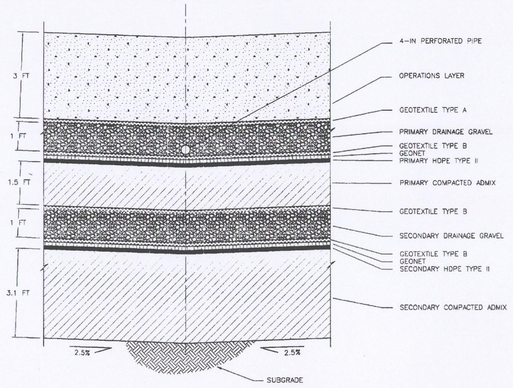
SUMP LAYOUT
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-131580	3

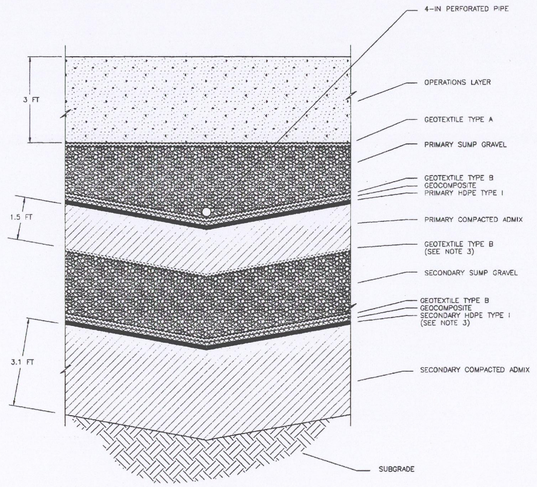
SCALE AS SHOWN — JOB NO. 893-1186.035 — SHEET 1 OF 1

H-2-131580 3



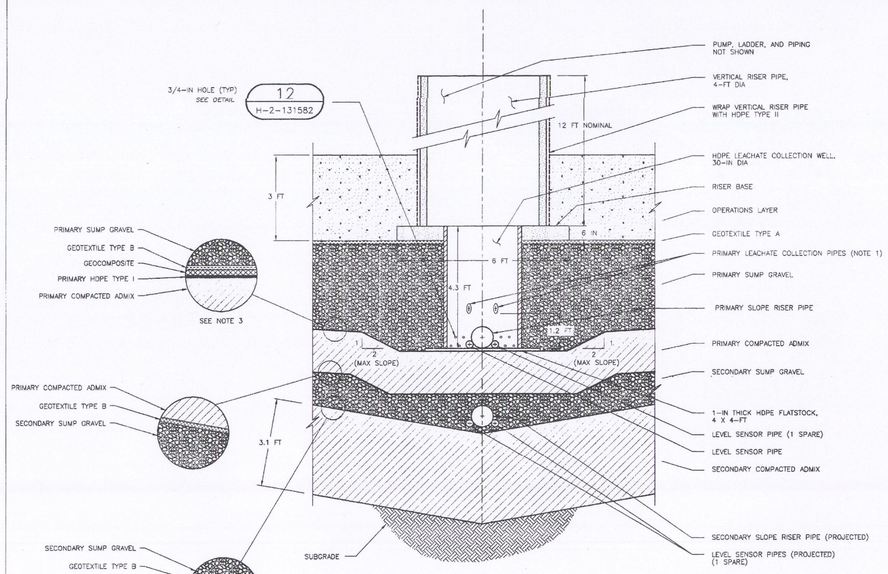
SECTION E (H-2-131580)

0 2 4
SCALE IN FEET



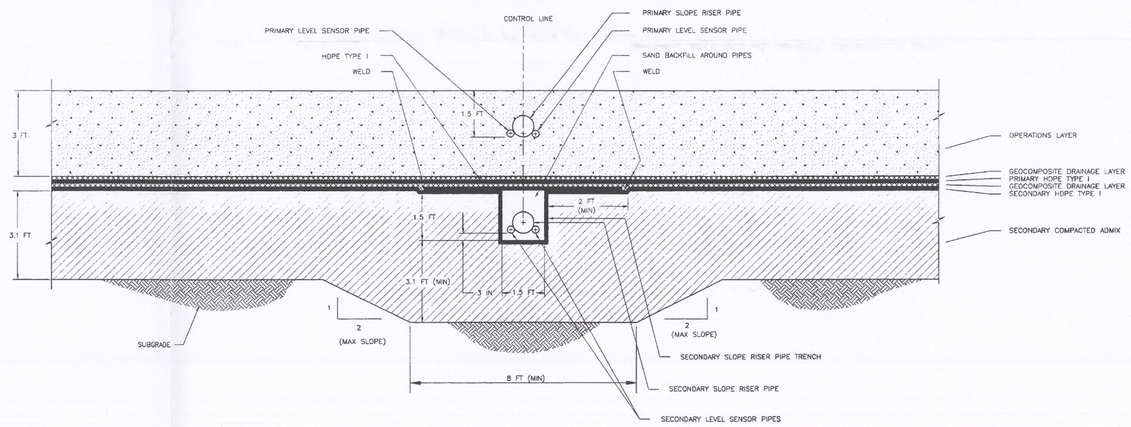
SECTION F (H-2-131580)

0 2 4
SCALE IN FEET



SECTION G (H-2-131580)

0 2 4
SCALE IN FEET



SECTION H (H-2-131580)

0 2 4
SCALE IN FEET

NOTES:

1. Pipes may be bent to match holes. Tack weld to HDPE collection well to secure.
2. Geosynthetic materials shall meet the requirements of Section 02275 of the Technical Specifications.
3. Type I HDPE and geocomposite drainage layer extend across entire sump area.
4. Round all trench corners as required.

KEY:

G (H-2-131582) — DESIGNATION / SHEET NUMBER

NUMBER	TITLE

DRAWING TRACEABILITY LIST

NUMBER	TITLE

REFERENCES — NEXT USED ON

REV NO.	DESCRIPTION	BY	DATE	APPROVALS
3	AS-BUILT PER ECNs EDITORIAL PER ECN W-025-008, ECN W-025-029	SGH	8/26/94	F. SHURI
2	MINOR EDITORIAL	JPP	5/21/93	F. SHURI
1	INCREASE OPERATIONS LAYER THICKNESS TO 3 FT. ADD PRIMARY ADMIX LAYER	KGH	5/1/92	F. SHURI

REVISIONS

CAD FILE B131581A — CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED	T. MARTIN	04/02/90
DRAWN	J. SNOW	04/02/90
CHECKED	F. SHURI	04/02/90
REVIEWED	P. CORSER	04/02/90
QA	M. J. OTTERSON	04/02/90

APPROVED FOR IMPLEMENTATION BY: FOR WHC DATE: 11-9-94

IMPACT LEVEL — EDT 151914

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

SUMP CROSS-SECTIONS
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

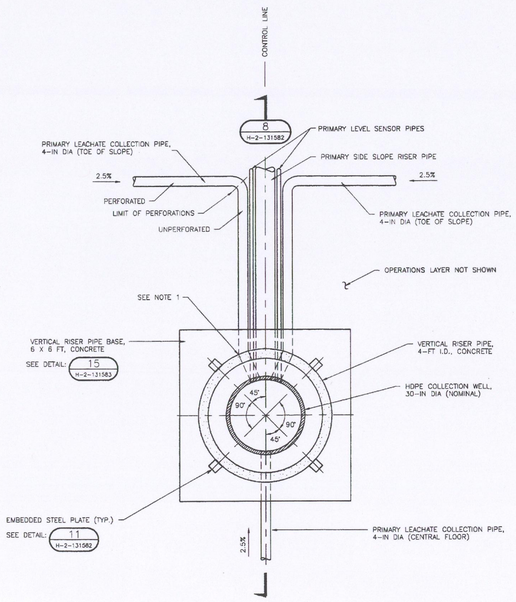
PROJECT W-025

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-131581	3

SCALE AS SHOWN — JOB NO. 893-1186.035 — SHEET 1 OF 1

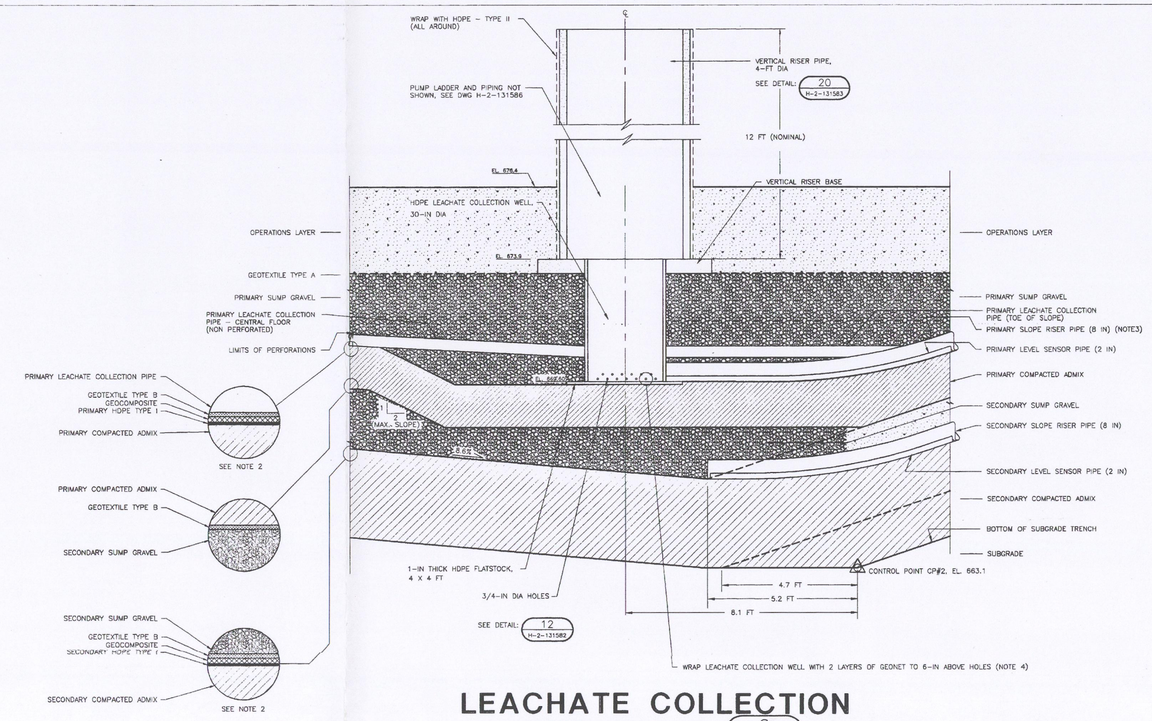
H-2-131581 3

\SGA\9431579\12923 11-4-94 15:34



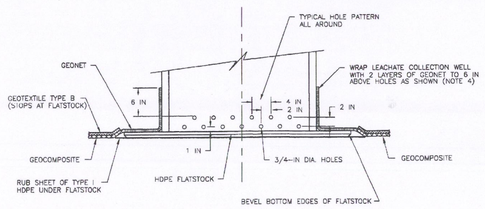
PRIMARY LEACHATE COLLECTION SUMP PLAN VIEW (10 / H-2-131582)

0 2 4
SCALE IN FEET



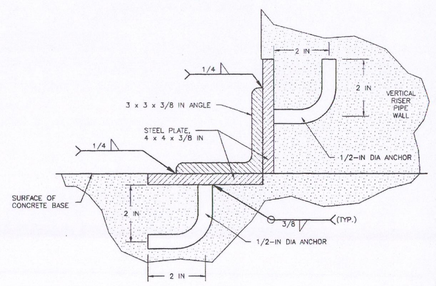
LEACHATE COLLECTION SUMP DETAIL (8 / H-2-131582)

0 2 4
SCALE IN FEET



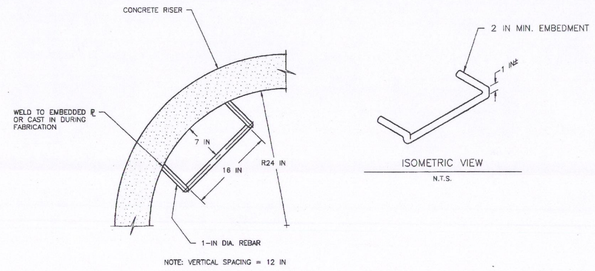
LEACHATE COLLECTION WELL HOLE DETAIL (12 / H-2-131582)

0 1 2
SCALE IN FEET



DETAIL (11 / H-2-131582)

0 2 4
SCALE IN INCHES



OSHA LADDER RUNG PLAN DETAIL (14 / H-2-131582)

0 10 20
SCALE IN INCHES

FRANK S. SHURI — STATE OF WASHINGTON — 26596 — REGISTERED PROFESSIONAL ENGINEER
EXPIRES 2-21-94

W-025 LOBE 1 SUBMITTAL/CVI #22585 CROSS INDEX

SUB#	CVI SUP#	#SPEC REF.	DESCRIPTION
35		02725, 1.3.B	HDPE Pipe Fabrication Drawings
35A		02725, 1.3.B	HDPE Collection Well Fabrication Drawings

NOTES:

1. Pipes may be bent to match holes. Tack weld to HDPE collection well to secure.
2. Type I HDPE and geocomposite drainage layer extend across entire sump area.
3. Install primary submersible pump within 3 feet of end of slope riser pipe.
4. Offset layers of geonet so that ribs intermesh.

KEY:

G / H-2-131582 — DESIGNATION / SHEET NUMBER

DRAWING TRACEABILITY LIST

NUMBER	TITLE

REFERENCES

NUMBER	TITLE
NEXT USED ON	

REVISIONS

REV NO	DESCRIPTION	BY	DATE	APPROVALS
3	AS-BUILT PER ECNs ACD CVI CROSS INDEX PER ECN W-025-029 EDITORIAL PER ECN W-025-008, ECN W-025-029	SGH	F. SHURI	8/26/94
2	MINOR EDITORIAL	JPP	F. SHURI	5/21/93
1	INCREASE OPERATIONS LAYER THICKNESS TO 3 FT ADD PRIMARY ADMIX LAYER	KGH	F. SHURI	5/1/92

CAD FILE B131582A — CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED T. MARTIN 04/02/90
DRAWN J. SNOW 04/02/90
CHECKED F. SHURI 04/02/90
REVIEWED P. CORSER 04/02/90
DA M. J. OTTERSON 04/02/90
APPROVED FOR CONSTRUCTION BY — DATE 11-9-94

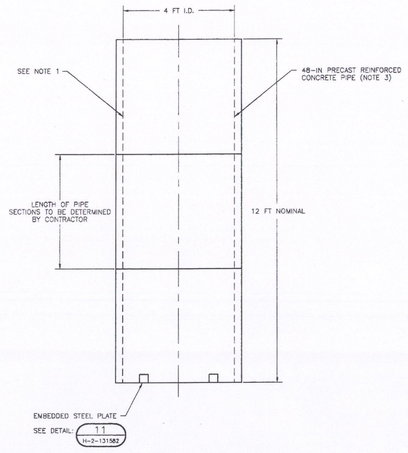
IMPACT LEVEL — EDT 151914

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

SUMP LEACHATE COLLECTION PIPES
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

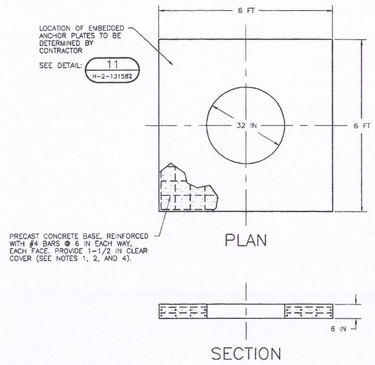
PROJECT W-025
SIZE F — BLDG. NO. 218-W-5 — MODEL NO. 0401 — DWG. NO. H-2-131582 — REV. NO. 3
SCALE AS SHOWN — JOB NO. 893-1186.035 — SHEET 1 OF 1

H-2-131582 3



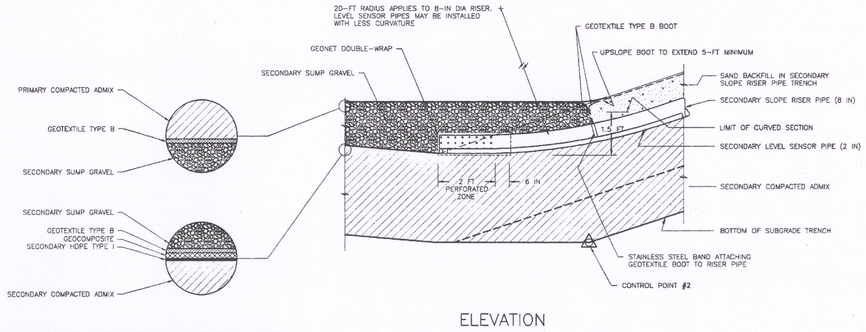
VERTICAL RISER CONCRETE PIPE DETAIL (20 / H-2-131583)

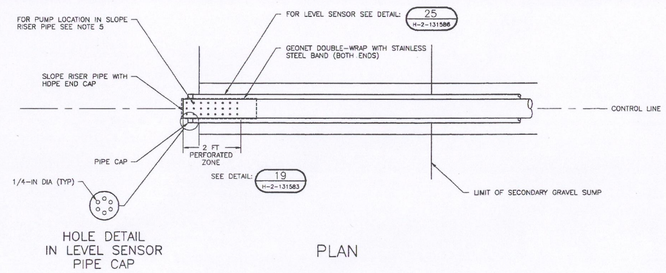
0 2 4
SCALE IN FEET



VERTICAL RISER REINFORCED CONCRETE BASE DETAIL (15 / H-2-131583)

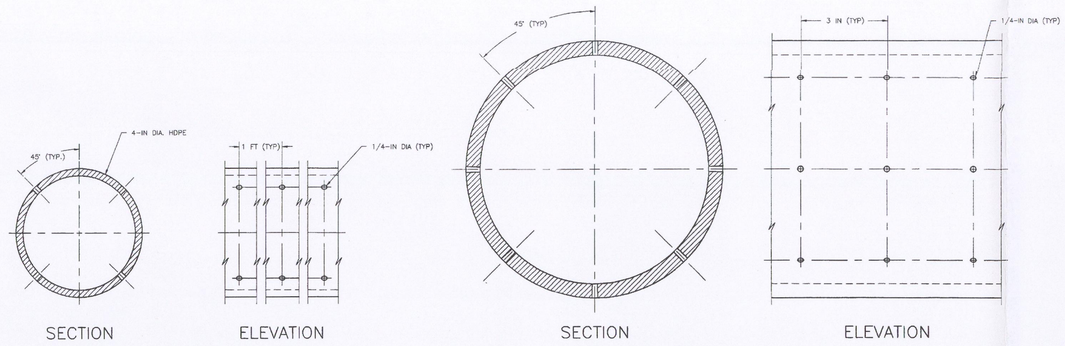
0 2 4
SCALE IN FEET





SECONDARY SLOPE RISER PIPE (21 / H-2-131583)

N.T.S.

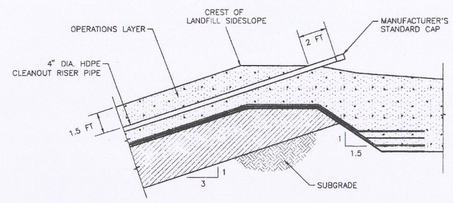


PRIMARY DRAINAGE PIPE

SECONDARY SLOPE RISER PIPE

PIPE PERFORATION PATTERN DETAIL (19 / H-2-131583)

N.T.S.



SIDESLOPE CLEANOUT RISER DETAIL (40 / H-2-131583)

N.T.S.

FRANK S. SHURI — STATE OF WASHINGTON — 18593 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES 2-21-96

SUB#	CVI SUP#	#SPEC REF.	DESCRIPTION
		W-025 LOBE 1 SUBMITTAL/CVI #22585 CROSS INDEX	
37		02727, 1.2.A	Vertical Riser Pipe
37A		02727, 1.2.A	Precast Concrete Pipe
38		03210, 1.2.A	Rebar and Coating
48		09900, 1.6.A.2	Manhole Coating Manufacturer's Specification's
48A		09900, 1.6.A.2	Manhole Coating Manufacturer's Specification's

KEY:

G (DESIGNATION) / H-2-131582 (SHEET NUMBER)

NOTES:

1. Concrete to have protective coating. See Specifications, Section 09900.
2. See Specifications, Section 03210 for concrete reinforcement.
3. For vertical riser pipe, see Specifications, Section 02727.
4. Lifting hooks at discretion of contractor.
5. Pump shall be installed within 1.5 feet of end of slope riser pipe.

DRAWING TRACEABILITY LIST

NUMBER	TITLE

REFERENCES

NUMBER	TITLE
NEXT USED ON	

REVISIONS

REV NO.	DESCRIPTION	BY	DATE
3	AS-BUILT PER ECNs: ADD DETAIL 40. ADD CVI CROSS INDEX PER ECN W-025-029. EDITORIAL PER ECN WI-025-008, ECN W-025-029	SGH	F. SHURI 10/6/94
2	MINOR EDITORIAL	JPP	F. SHURI 5/21/93
1	ADD PRIMARY ADMIX LAYER	KGH	F. SHURI 5/1/92

CAD FILE B131583A CAD CODE 2W:IBM:ACD2:10:SS

APPROVALS

DESIGNED	M. BROWN	04/02/90
DRAWN	J. SNOW	04/02/90
CHECKED	F. SHURI	04/02/90
REVIEWED	P. CORSER	04/02/90
QA	M. J. OTTERSON	04/02/90

APPROVED FOR IMPLEMENTATION — FOR DATE 11-3-94

IMPACT LEVEL — EDT 151914

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

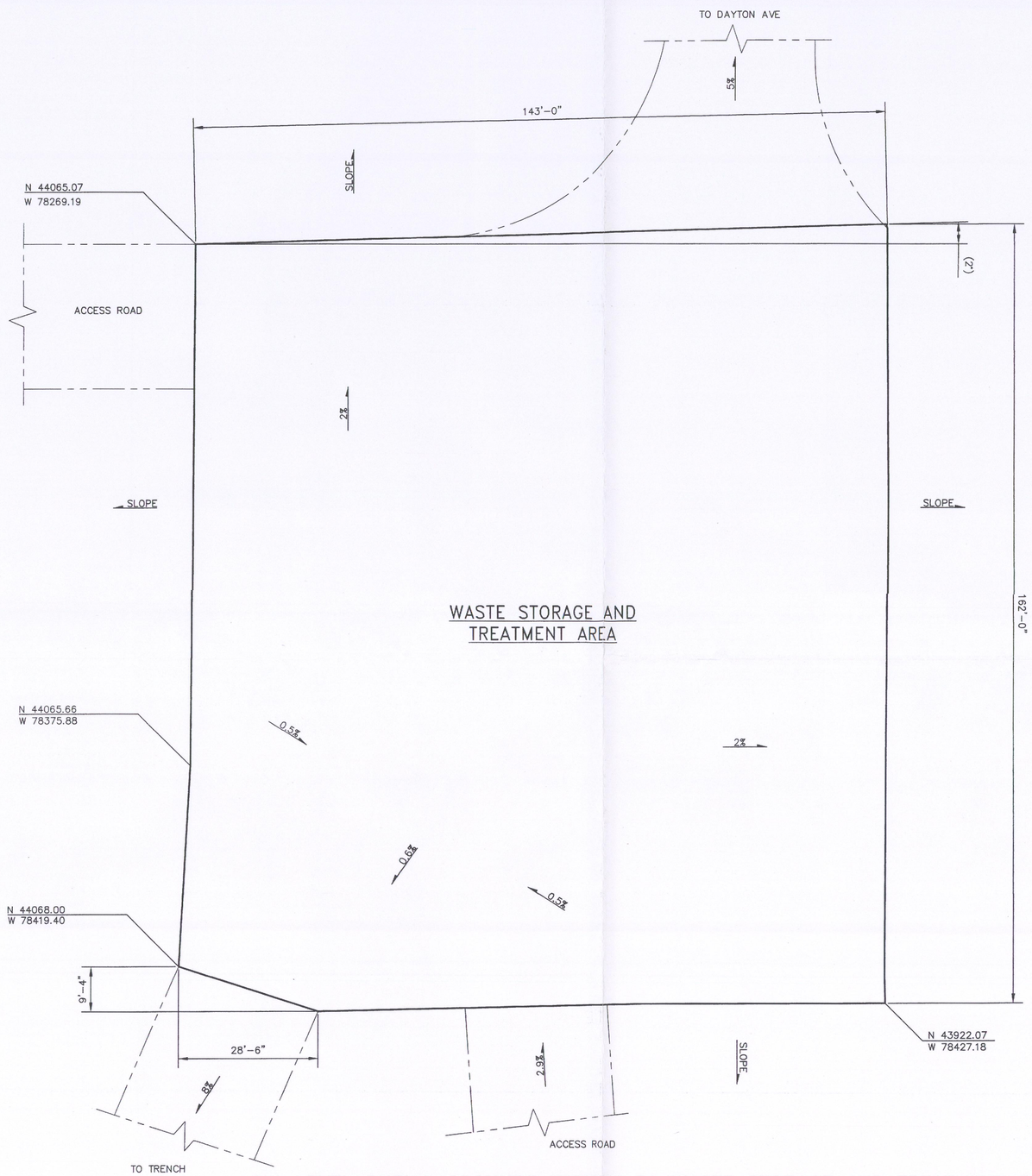
SIDE SLOPE AND VERTICAL RISER PIPES
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-131583	3

SCALE AS SHOWN — JOB NO. 893-1186.035 — SHEET 1 OF 1

H-2-131583 3



LOW-LEVEL BURIAL GROUNDS TRENCH 31 WASTE STORAGE AND TREATMENT PAD

SCALE: 3/32"=1-0"

NOV 11 2015 DATE: STA: 4 HANFORD SITEACE ID: 11

DWG NUMBER	TITLE
DRAWING TRACEABILITY LIST	

REF NUMBER	TITLE
H-2-131584	TRUCK STAGING AREA & ACCESS RAMP RMW LAND DISPOSAL FACILITY NON-DRAG-OFF
H-2-131575	GRADING PLAN RMW LAND DISP FAC
REFERENCES	
NEXT USED ON END ITEM	

REV NO.	DESCRIPTION
0	INITIAL RELEASE PER ECR-15-000699
REVISIONS	

BLDG. NO. 218W5-252

INDEX NO. 0401

CAUTION
NOT COMPLETE WITHOUT CURRENT CHANGE DOCUMENTS FROM DATABASE

	NAME	DATE	COMPANY
DRAWN	DC BOOTHROYD	10-8-15	ARES
DESIGNED	J BYERS	10-19-15	ARES
DISCIPLINE ENGINEER	L SALZANO	10-27-15	ARES
DESIGN AUTHORITY	JR Rosser	11/4/15	CHPRC

U.S. DEPARTMENT OF ENERGY
Richland Operations Office

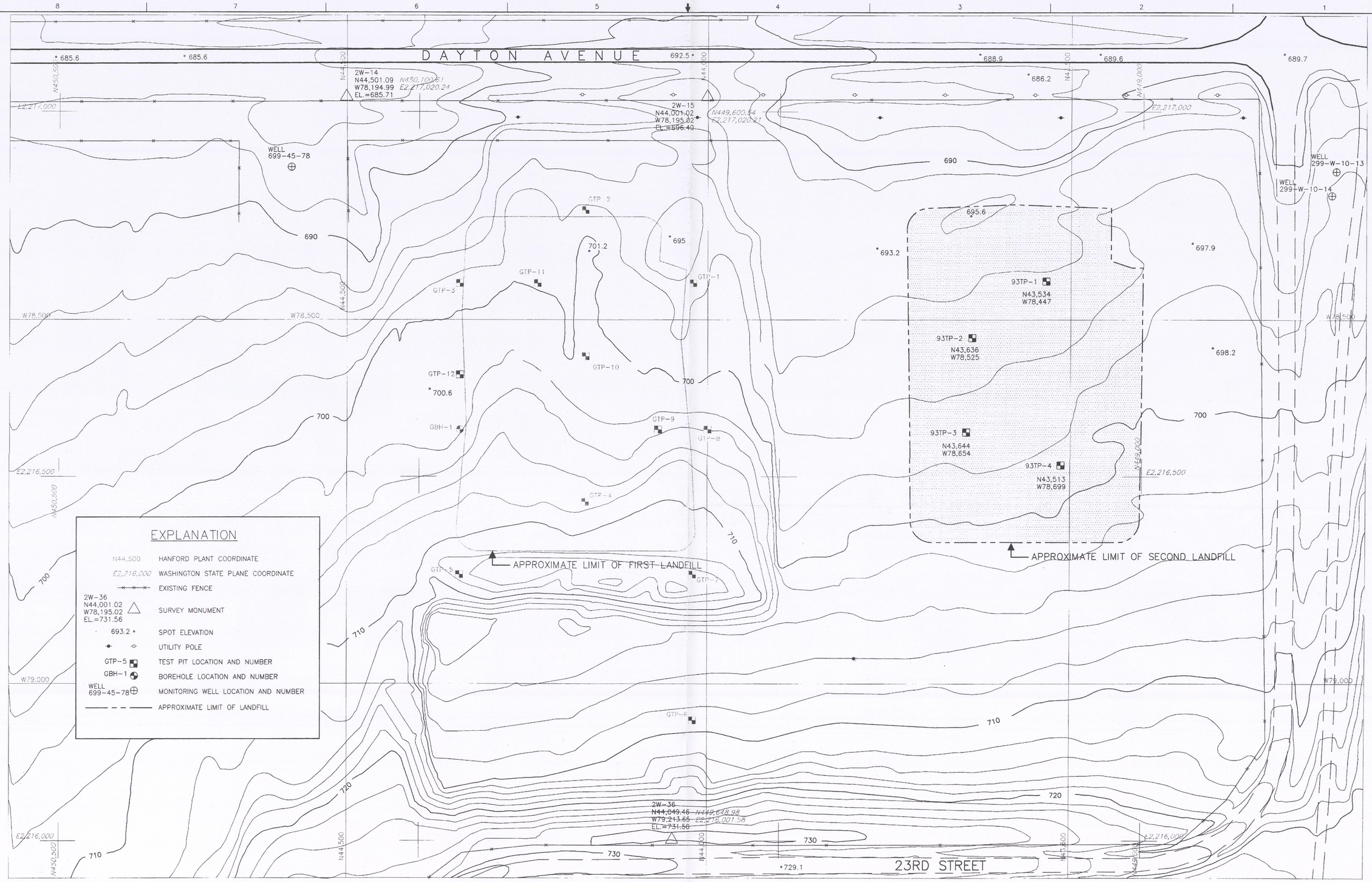
TRENCH 31 WASTE STORAGE AND TREATMENT PAD

SIZE F | DRAWING NUMBER H-2-836695 | SHEET 1 | REV 0

SCALE AS SHOWN

28300

DOE_TB_F.DWG (JAN 2015)



NOTES:

1. For test pit and borehole logs see Site Investigation Report, Non-Drag-Off Landfill Site Low Level Burial Area No. 5, 200 West Area, dated December 4, 1989 (for first landfill), and letter report dated December 10, 1993 (for second landfill).
2. Topographic maps prepared by Degross Aerial Mapping based on July 18, 1988, aerial photography. Topography west of first landfill revised January 21, 1992 per ECN 119451.
3. Topography in first landfill area shown prior to construction.

FRANK S. SHURI — STATE OF WASHINGTON — 26592 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES 2-21-95

DRAWING TRACEABILITY LIST		REFERENCES	
NUMBER	TITLE	NUMBER	TITLE
H-2-94677	DRY WASTE BURIAL GROUND 218-W-5		
H-2-99275	TOPOGRAPHIC MAP LOW LEVEL BURIAL GROUND (SHEETS 2,3, AND 7)		
NEXT USED ON			

REV NO	DESCRIPTION	BY	DATE
1	AS-BUILT PER ECNs EDITORIAL PER ECN W-025-035	SMM	F. SHURI 11-23-94

REVISIONS — APPROVALS

CAD FILE B818391A.DWG | CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED	J. PELLICER	11/15/93
DRAWN	J. PELLICER	11/15/93
CHECKED	F. SHURI	11/15/93
REVIEWED	M. BROWN	11/15/93
QA	M.J. GORMAN	11/15/93

APPROVED FOR IMPLEMENTATION BY [signature] FOR WHC DATE 12-21-94

EDT 601111

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

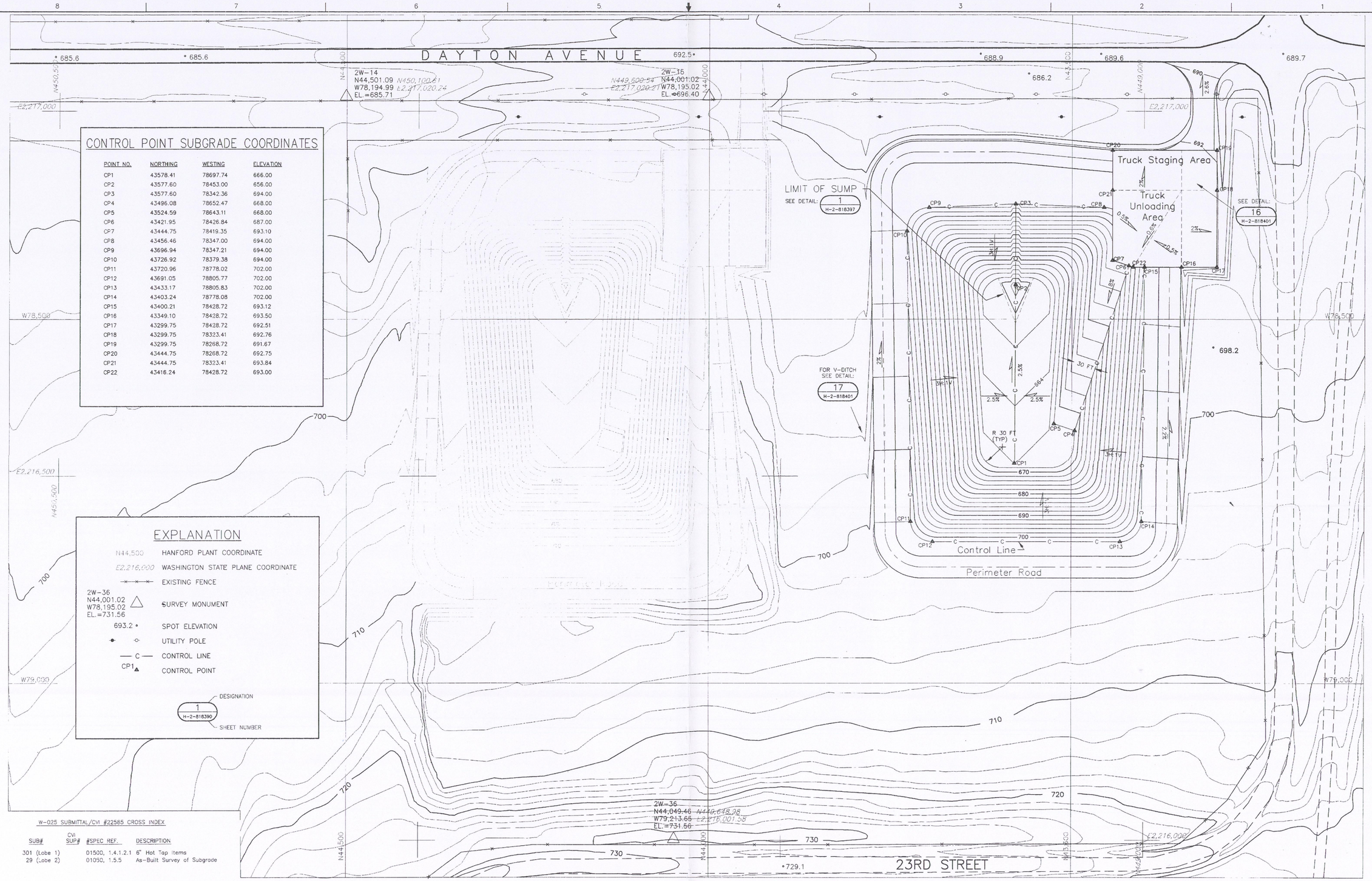
SITE PLAN AND EXPLORATION LOCATIONS
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025 SECOND LANDFILL

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0501	H-2-818391	1

SCALE AS SHOWN | JOB NO. 933-1377.100 | SHEET 1 OF 1

H-2-818391 1



CONTROL POINT SUBGRADE COORDINATES

POINT NO.	NORTHING	WESTING	ELEVATION
CP1	43578.41	78697.74	666.00
CP2	43577.60	78453.00	656.00
CP3	43577.60	78342.36	694.00
CP4	43496.08	78652.47	668.00
CP5	43524.59	78643.11	668.00
CP6	43421.95	78426.84	687.00
CP7	43444.75	78419.35	693.10
CP8	43456.46	78347.00	694.00
CP9	43696.94	78347.21	694.00
CP10	43726.92	78379.38	694.00
CP11	43720.96	78778.02	702.00
CP12	43691.05	78805.77	702.00
CP13	43433.17	78805.83	702.00
CP14	43403.24	78778.08	702.00
CP15	43400.21	78428.72	693.12
CP16	43349.10	78428.72	693.50
CP17	43299.75	78428.72	692.51
CP18	43299.75	78323.41	692.76
CP19	43299.75	78268.72	691.67
CP20	43444.75	78268.72	692.75
CP21	43444.75	78323.41	693.84
CP22	43416.24	78428.72	693.00

EXPLANATION

N44,500	HANFORD PLANT COORDINATE
E2,216,000	WASHINGTON STATE PLANE COORDINATE
—×—×—	EXISTING FENCE
2W-36 N44,001.02 W78,195.02 EL.=731.56 △	SURVEY MONUMENT
693.2 •	SPOT ELEVATION
● ○	UTILITY POLE
— C —	CONTROL LINE
CP1 ▲	CONTROL POINT

1 / H-2-818390 — DESIGNATION / SHEET NUMBER

W-025 SUBMITTAL/CVI #22585 CROSS INDEX

SUB#	CVI SUP#	#SPEC REF.	DESCRIPTION
301 (Lobe 1)		01500, 1.4.1.2.1	6" Hot Tap Items
29 (Lobe 2)		01050, 1.5.5	As-Built Survey of Subgrade

N

0 50 100 FEET

NOTES:

1. Excavated surface is shown in Sections A and B on Drawing H-2-818395.
2. Topographic maps prepared by Degross Aerial Mapping based on July 18, 1988, aerial photography. Topography west of first landfill revised January 21, 1992 per ECN 119451.
3. For as-built conditions, see "Subgrade As-Built" drawing in the CQA report, WHC-SD-W025A-RPT-001.

FRANK S. SHURI — STATE OF WASHINGTON — 24082 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES 2-21-94

DRAWING TRACEABILITY LIST		REFERENCES	
		H-2-818405	SUBGRADE GRID POINTS
H-2-99275	TOPOGRAPHIC MAP LOW LEVEL BURIAL GROUND (SHEETS 1,3, AND 7)	NUMBER	TITLE
NUMBER	TITLE	NEXT USED ON	

REV NO	DESCRIPTION	BY	DATE
1	AS-BUILT PER ECNs ADD CVI CROSS INDEX AND NOTE 3 PER ECN W-025-035 EDITORIAL PER ECN W-025-035	SMM	F. SHURI 11-23-94

REVISIONS

CAD FILE B818392A.DWG CAD CODE 2W:IBM:ACD2:10:SS

APPROVALS	
DESIGNED	J. PELLICER 11/15/93
DRAWN	J. PELLICER 11/15/93
CHECKED	F. SHURI 11/15/93
REVIEWED	M. BROWN 11/15/93
QA	M.J. GORMAN 11/15/93
APPROVED FOR IMPLEMENTATION	BY / FOR / DATE 12-21-94

EDT 601111

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

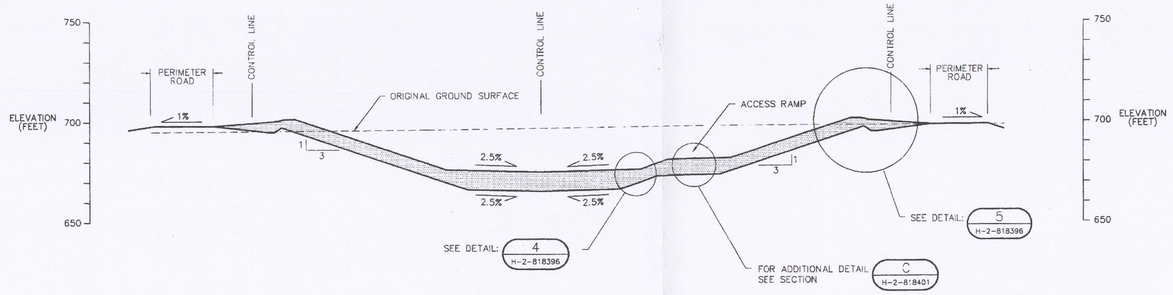
GRADING PLAN
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025 SECOND LANDFILL

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-818392	1

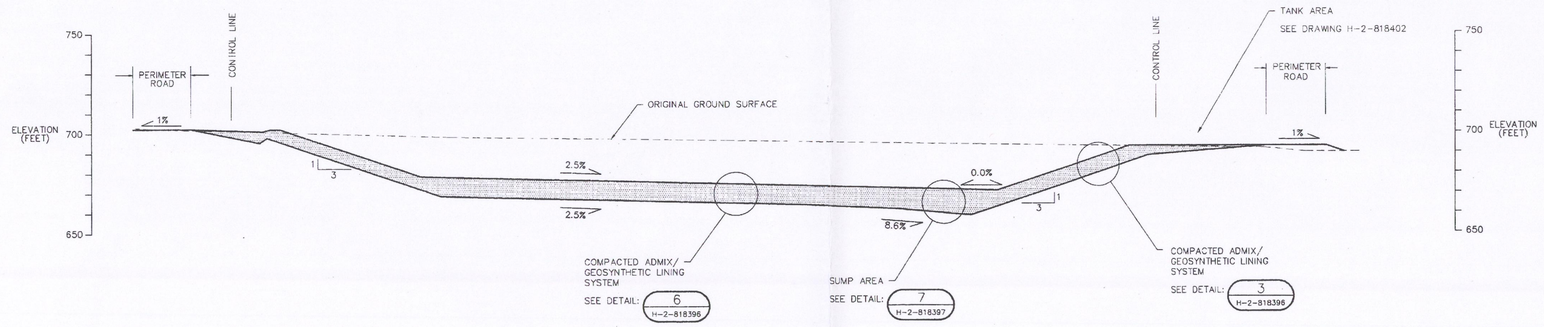
SCALE AS SHOWN JOB NO. 933-1377.100 SHEET 1 OF 1

H-2-818392 1



SECTION A H-2-818394

0 30 60
SCALE IN FEET



SECTION B H-2-818394

0 30 60
SCALE IN FEET

FRANK S. SHURI
STATE OF WASHINGTON
EXPIRES 8-21-94
PROFESSIONAL ENGINEER

KEY:

C — DESIGNATION
H-2-818394 — SHEET NUMBER

NUMBER	TITLE
DRAWING TRACEABILITY LIST	

NUMBER	TITLE
REFERENCES	
NEXT USED ON	

REV NO	DESCRIPTION	BY	DATE
1	AS-BUILT PER ECNs EDITORIAL PER ECN W-025-035	SMM	F. SHURI 11-23-94

REVISIONS

CAD FILE B818395A.DWG CAD CODE 2W:IBM;ACD2:10:SS

APPROVALS		
DESIGNED	J. PELLICER	11/15/93
DRAWN	J. PELLICER	11/15/93
CHECKED	F. SHURI	11/15/93
REVIEWED	M. BROWN	11/15/93
QA	M. J. GORMAN	11/15/93

APPROVED FOR CONSTRUCTION BY [signature] FOR WHK DATE 12-21-94

EDIT 601111

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.
CROSS-SECTIONS
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

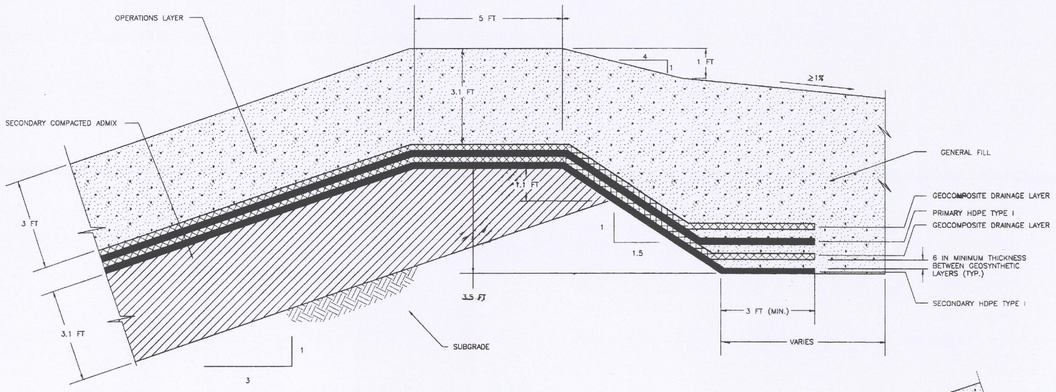
PROJECT W-025 SECOND LANDFILL

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-818395	1

SCALE AS SHOWN JOB NO. 933-1377.100 SHEET 1 OF 1

H-2-818395 1

12-15-94 3:45 SHAN V8.43:9/28.0/0508

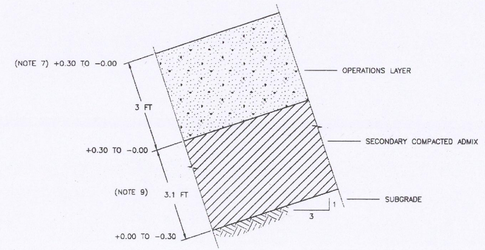


ANCHOR TRENCH DETAIL

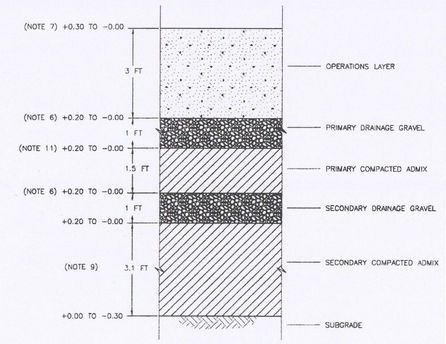
5 / –

0 2 4
SCALE IN FEET

REF. DWG. NO. H-2-818395



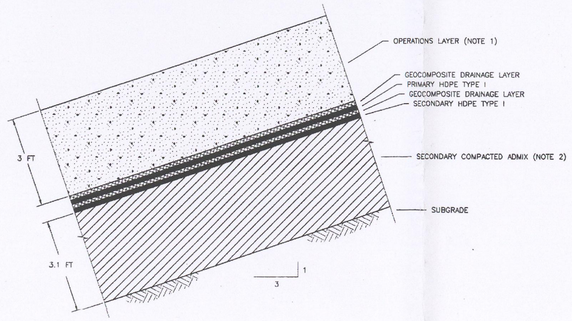
SIDESLOPE



BASE

GRADING TOLERANCE DETAIL

0 2 4
SCALE IN FEET

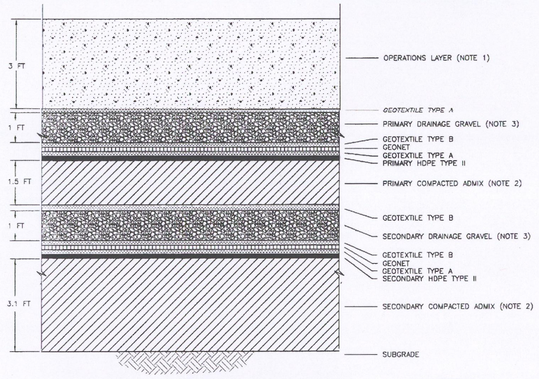


SIDESLOPE LINER DETAIL

3 / –

0 2 4
SCALE IN FEET

REF. DWG. NO. H-2-818395

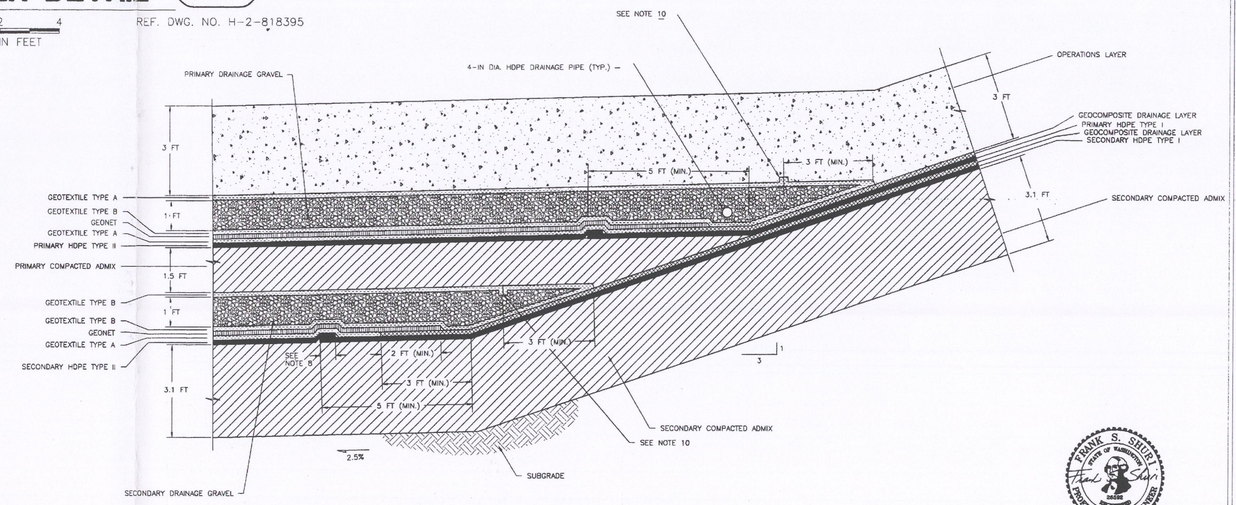


BASE LINER DETAIL

6 / –

0 2 4
SCALE IN FEET

REF. DWG. NO. H-2-818395



TYPICAL TOE OF SLOPE DETAIL

4 / –

0 2 4
SCALE IN FEET

REF. DWG. NO. H-2-818395

W-025 SUBMITTAL/CVI #22585 CROSS INDEX

SUB#	CVI SUP#	#SPEC REF.	DESCRIPTION
25 (Lobe 1)		02275, 1.7.A	Geomembrane Installer's QA Manual
25A (Lobe 1)		02275, 1.7.A	Geomembrane Crystallinity
25B (Lobe 1)		02275, 1.7.A	Geomembrane/Admix Friction Angle
6 (Lobe 2)		02275, 1.7.A	Geomembrane QA/QC Data
6.2 (Lobe 2)		02275, 1.7.A	Extrudate Certification
6.1 (Lobe 2)		02275, 1.7.A	Geomembrane QA/QC Data
6.2 (Lobe 2)		02275, 1.7.A	Geomembrane Resin Certification
6.1 (Lobe 2)		02275, 1.7.A	Geomembrane QA/QC Data
6.2 (Lobe 2)		02275, 1.7.A	Geomembrane Env. Stress Crack Certification
6.2 (Lobe 2)		02275, 1.7.A	Geomembrane Env. Stress Crack Certification
25.5 (Lobe 1)		02275, 1.7.A	Geomembrane Low Temp. Welding Certification
6.2,6.3 (Lobe 2)		02275, 1.7.A	Geomembrane QA/QC Documentation
25.6A (Lobe 1)		02275, 1.7.A	Geomembrane Direct Shear Test Report
6.2 (Lobe 2)		02275, 1.7.A	Geomembrane Resin Documentation
6.2 (Lobe 2)		02275, 1.7.A	Geomembrane Resistance to Soil Burial Data
6.2 (Lobe 2)		02275, 1.7.A	Geomembrane Resistance to Soil Burial Cert.
9 (Lobe 2)		02275, 1.7.B	Geosynthetic Samples

NOTES:
1. Operations layer shall consist of soils excavated from on site, meeting the requirements of Section 02228 of the Technical Specifications.
2. Compacted admix shall meet the composition, compaction, and permeability requirements as described in Section 02224 of the Technical Specifications.
3. Primary and secondary base liner drainage gravel shall meet the requirements of Section 02226 of the Technical Specifications.
4. Geosynthetic materials shall meet the requirements of Section 02275 of the Technical Specifications.
5. Geosynthetic layers not drawn to scale.
6. Grade shall be minimum of 1 foot above underlying layer.
7. Grade shall be minimum of 3 feet above underlying layer.
8. Overlap geomembrane as appropriate for welding method (see Specifications Section 02275).
9. Tolerances based on design grade.
10. Geotextile to be sewn (see Specifications Section 02275).
11. Grade shall be minimum of 1.5 feet above underlying layer.
12. For as-built conditions, see "Secondary HDPE Geomembrane Liner As-Built Drawing" and "Primary HDPE Geomembrane Liner As-Built Drawing" in the CQA Report, WHC-SD-W025A-RPT-001.

KEY:
5 / H-2-818395 — DESIGNATION / SHEET NUMBER

NUMBER	TITLE

DRAWING TRACEABILITY LIST

NUMBER	TITLE

REFERENCES

NEXT USED ON

REV NO	DESCRIPTION	BY	DATE	APPROVALS
1	AS-BUILT PER ECNs ADD GEOTEXTILE LAYER UNDER GEONET, REMOVE CONTROL LINE PER ECN W-025-035 ADD CVI CROSS INDEX AND NOTE 12 PER ECN W-025-035 EDITORIAL PER ECN W-025-035	SMM	F. SHURI 11-23-94	

REVISIONS

CAD FILE B818396A.DWG CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED J. PELLICER 11/115/93
DRAWN J. PELLICER 11/15/93
CHECKED F. SHURI 11/15/93
REVIEWED M. BROWN 11/15/93
QA M.J. GORMAN 11/15/93

APPROVED FOR NRC REVIEW BY [signature] FOR WHC DATE 12-21-94

EDT 601111

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.
LINER SYSTEM DETAILS
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025 SECOND LANDFILL

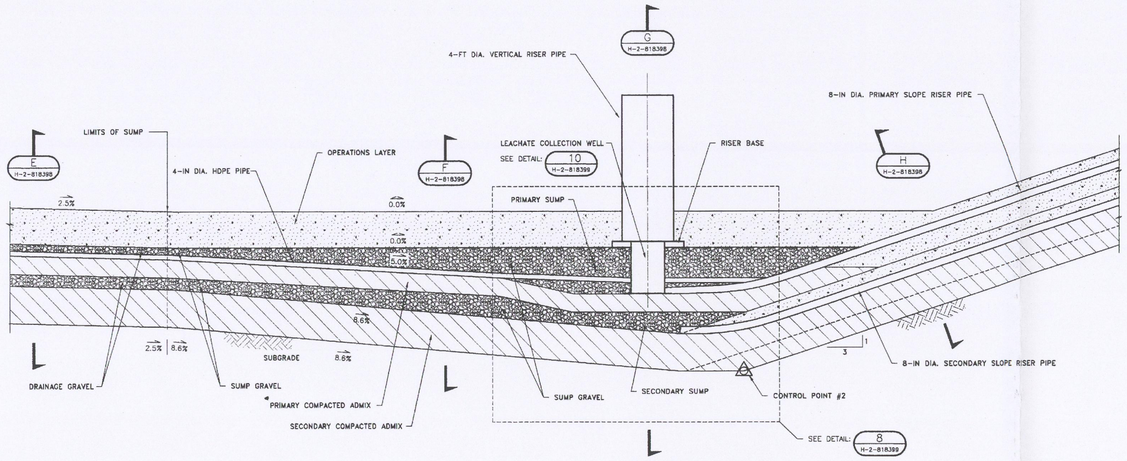
SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-818396	1

SCALE AS SHOWN JOB NO. 933-1377.100 SHEET 1 OF 1

H-2-818396 1

FRANK S. SHURI STATE OF WASHINGTON 20608 REGISTERED PROFESSIONAL ENGINEER
EXPIRES 2-21-95

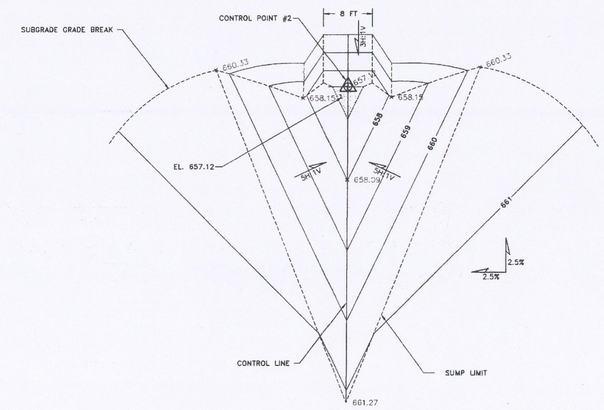
12-15-94 3:50 SMM\V4315\95607



SUMP PROFILE (7 / -)

0 5 10 SCALE IN FEET

REF. DWG. NO. H-2-818395

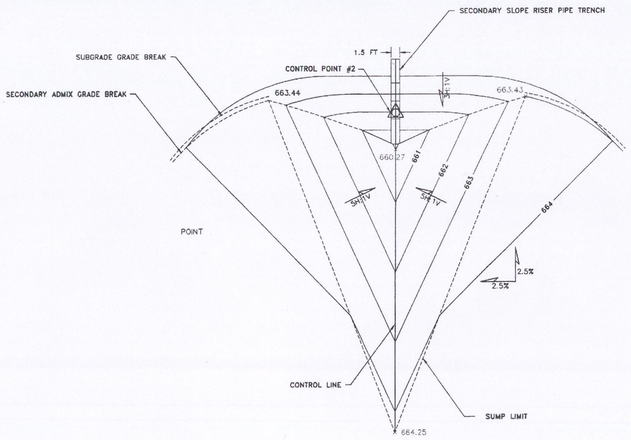


SUMP SUBGRADE (1 / -)

0 10 20 SCALE IN FEET

REF. DWG. NO. H-2-818392

N

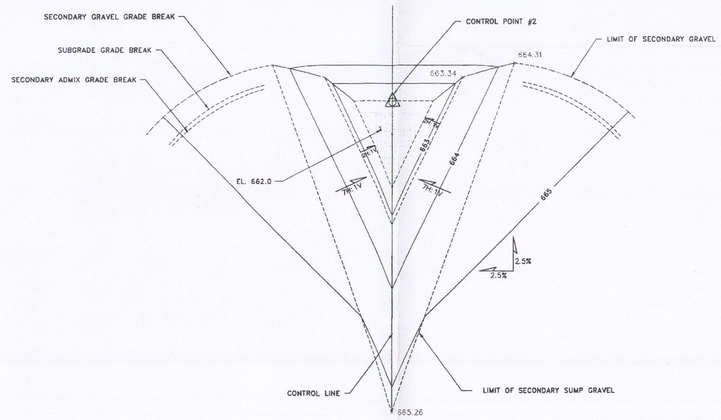


SUMP SECONDARY ADMIX (2 / -)

0 10 20 SCALE IN FEET

REF. DWG. NO. H-2-818393

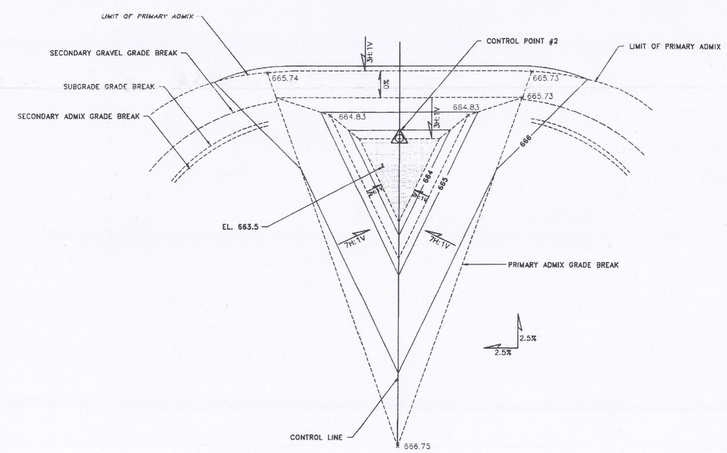
N



SUMP SECONDARY GRAVEL (3A / -)

0 10 20 SCALE IN FEET

N



SUMP PRIMARY ADMIX (4A / -)

0 10 20 SCALE IN FEET

N

FRANK S. SHURI — STATE OF WASHINGTON — 36596 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES 2-21-94

W-025 SUBMITTAL/CVI #22585 CROSS INDEX			
SUB#	CVI SUB#	#SPEC REF.	DESCRIPTION
4 (Lobe 2)		02226, 1.2	Granular Drainage Layers, Gravel Samples

KEY: D H-2-818398 — DESIGNATION / SHEET NUMBER

NOTE:

1. Control points defined on Drawing H-2-818392.
2. For as-built conditions, see "Top of Secondary Gravel As-Built", "Top of Primary Admix As-Built", and "Top of Primary Gravel As-Built" drawings in the CQA Report, WHC-SD-W025A-RPT-001.

DRAWING TRACEABILITY LIST: NUMBER | TITLE

REFERENCES: NUMBER | TITLE | NEXT USED ON

REV NO	DESCRIPTION	DATE	BY	APPROVALS
1	AS-BUILT PER ECNs ADD CVI CROSS INDEX AND NOTE 2 PER ECN W-025-035 EDITORIAL PER ECN W-025-035	SMM RS	F. SHURI	11-23-94

REVISIONS

CAD FILE B818397A.DWG CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED J. PELLICER 11/15/93
DRAWN J. PELLICER 11/15/93
CHECKED F. SHURI 11/15/93
REVIEWED M. BROWN 11/15/93
QA M.J. GORMAN 11/15/93

APPROVED FOR IMPLEMENTATION BY F. Shuri FOR WHC DATE 12-21-94

EDT 601111

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

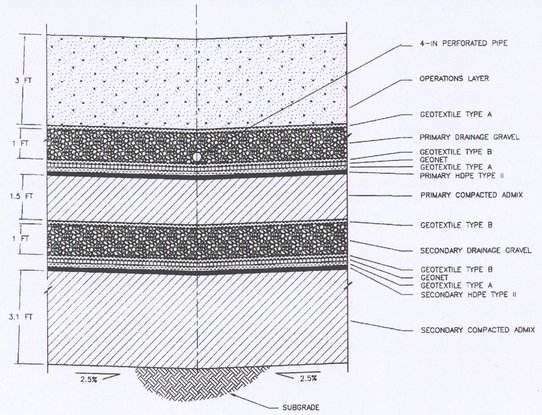
SUMP LAYOUT
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025 SECOND LANDFILL

SIZE F | BLDG. NO. 218-W-5 | INDEX NO. 0401 | DWG. NO. H-2-818397 | REV. NO. 1

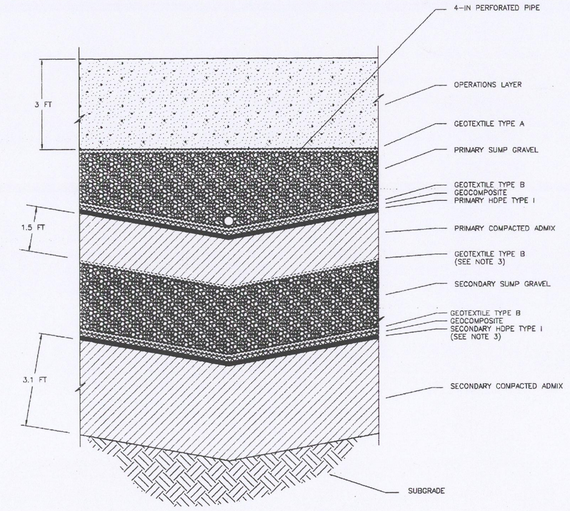
SCALE AS SHOWN | JOB NO. 933-1377.100 | SHEET 1 OF 1

H-2-818397 1



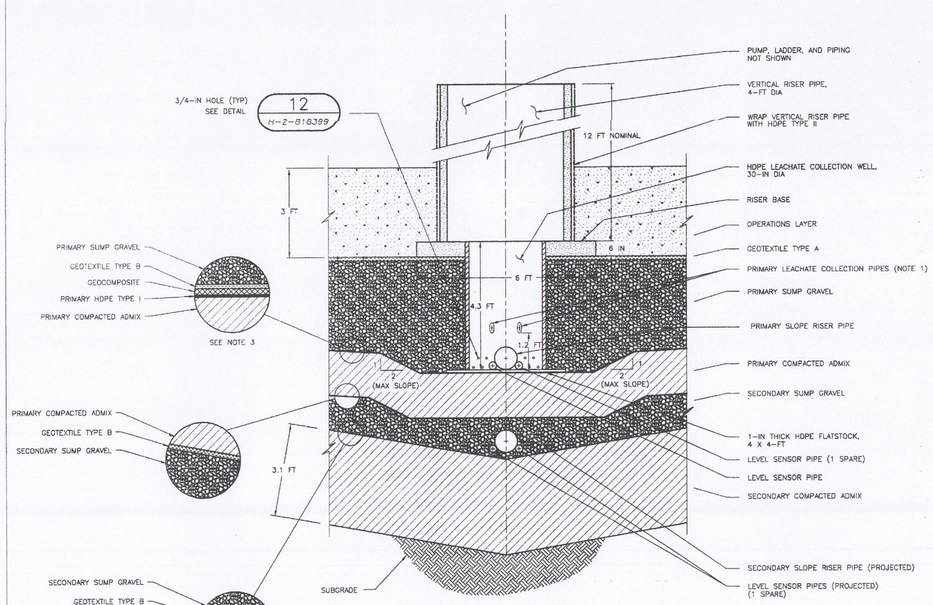
SECTION E / H-2-818397

0 2 4
SCALE IN FEET



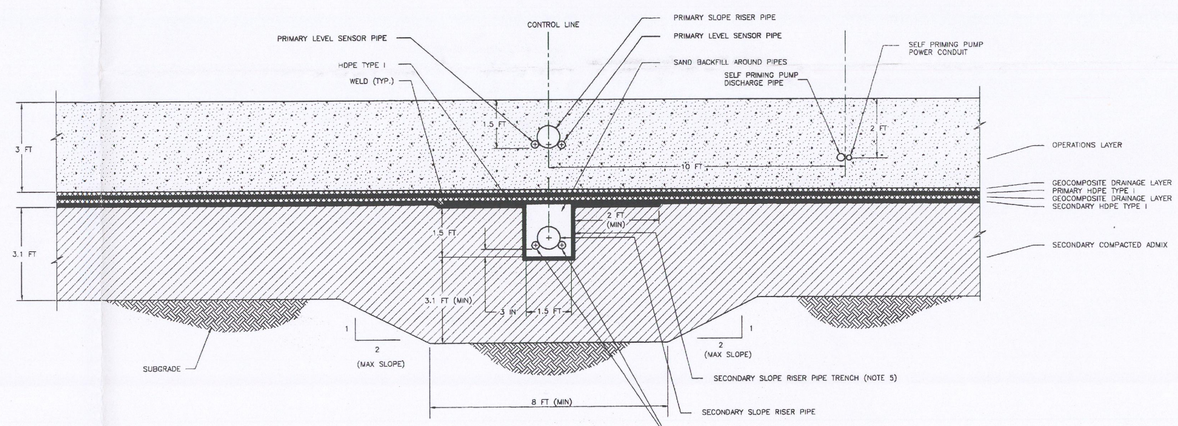
SECTION F / H-2-818397

0 2 4
SCALE IN FEET



SECTION G / H-2-818397

0 2 4
SCALE IN FEET



SECTION H / H-2-818397

0 2 4
SCALE IN FEET

FRANK S. SHURI
STATE OF WASHINGTON
36598
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 2-21-95

NOTES:

1. Pipes may be bent to match holes. Tack weld to HDPE collection well to secure.
2. Geosynthetic materials shall meet the requirements of Section 02275 of the Technical Specifications.
3. Type I HDPE and geocomposite drainage layer extend across entire sump area.
4. Round all trench corners as required.
5. Secondary slope riser pipe trench may be widened to 3 ft at base, walls may be sloped up to 45 degrees from vertical if required to facilitate construction. Secondary liner panel shall still extend a minimum of 2 ft beyond edges of trench.

KEY:

G / H-2-818399 — DESIGNATION / SHEET NUMBER

NUMBER	TITLE

DRAWING TRACEABILITY LIST

NUMBER	TITLE

REFERENCES

NEXT USED ON

REV NO	DESCRIPTION	BY	DATE	APPROVALS
1	AS-BUILT PER ECN# ADD GEOTEXTILE LAYER UNDER GEONET PER ECN W-025-035 EDITORIAL PER ECN W-025-035	SMM	F. SHURI 11-23-94	

REVISIONS

CAD FILE B818398A.DWG CAD CODE 2W:IBM:ACD2:10:SS

DESIGNED	J. PELLICER	11/15/93
DRAWN	J. PELLICER	11/15/93
CHECKED	F. SHURI	11/15/93
REVIEWED	M. BROWN	11/15/93
QA	M.J. GORMAN	11/15/93

APPROVED FOR IMPLEMENTATION BY / FOR DATE 12-21-94

EDT 601111

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

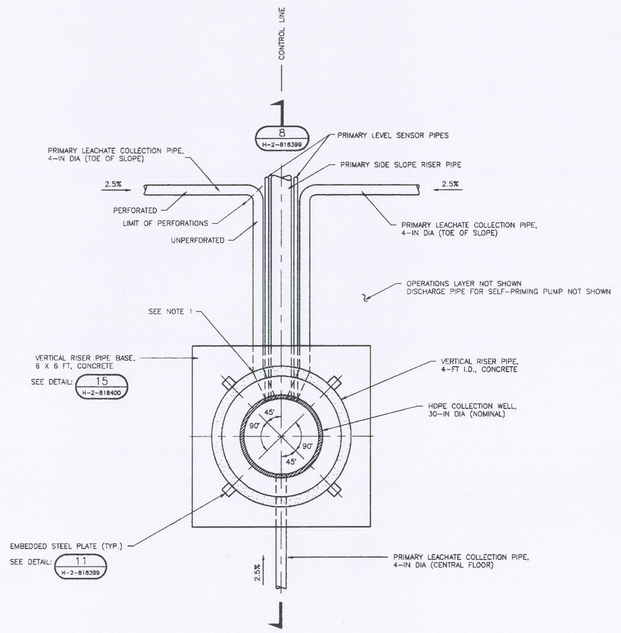
SUMP CROSS-SECTIONS
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025 SECOND LANDFILL

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-818398	1

SCALE AS SHOWN JOB NO. 933-1377.100 SHEET 1 OF 1

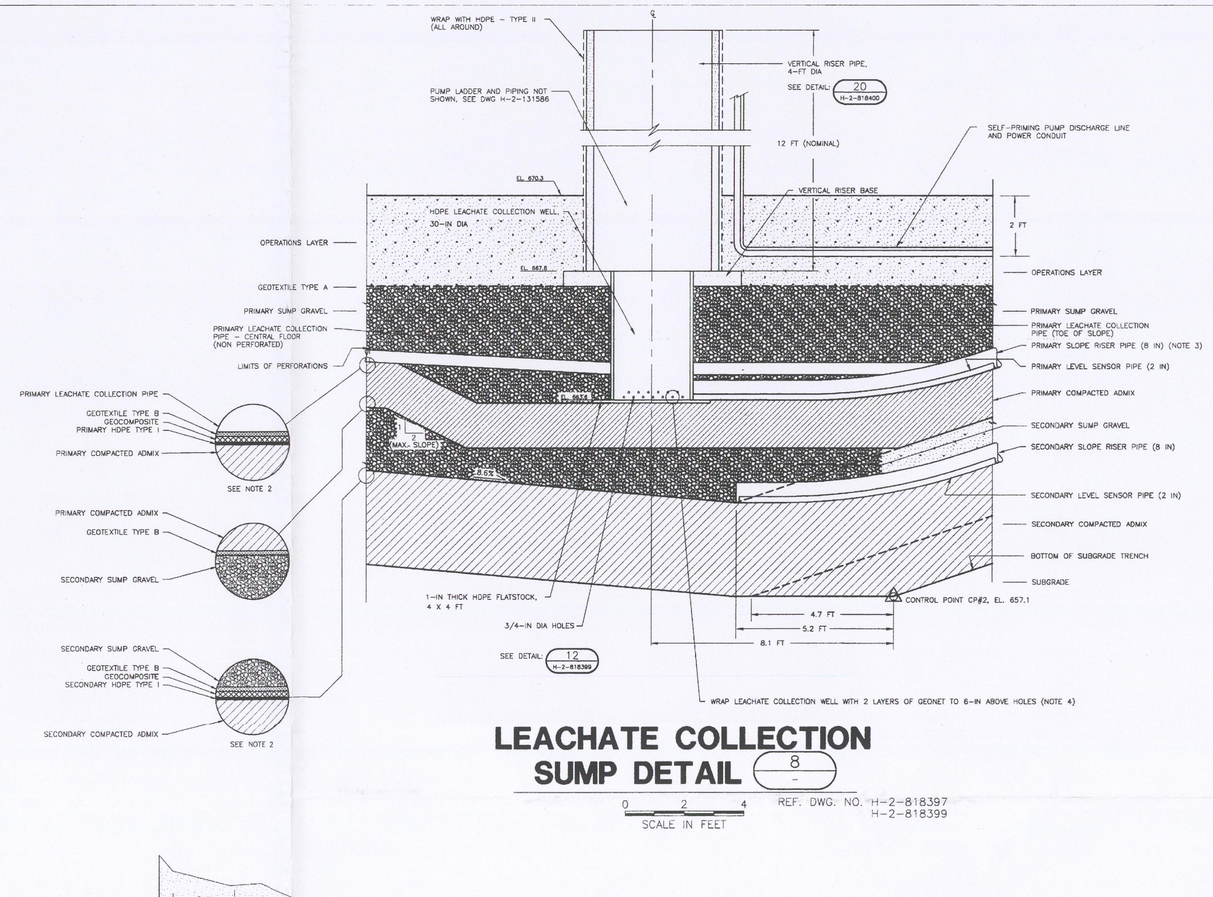
H-2-818398 | 1



PRIMARY LEACHATE COLLECTION SUMP PLAN VIEW 10 -

0 2 4 SCALE IN FEET

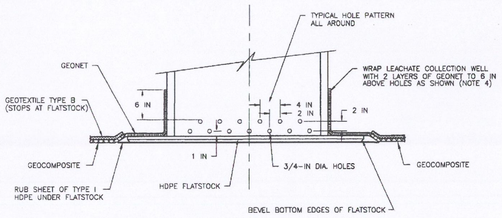
REF. DWG. NO. H-2-818397



LEACHATE COLLECTION SUMP DETAIL 8 -

0 2 4 SCALE IN FEET

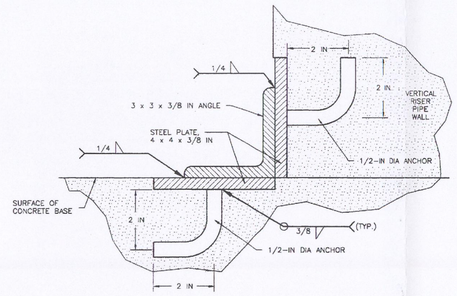
REF. DWG. NO. H-2-818397
H-2-818399



LEACHATE COLLECTION WELL HOLE DETAIL 12 -

0 1 2 SCALE IN FEET

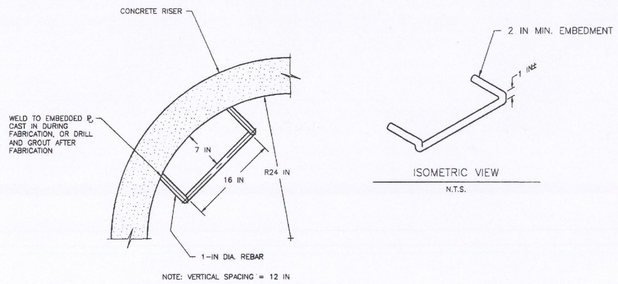
REF. DWG. NO. H-2-818398
H-2-818399



DETAIL 11 -

0 2 4 SCALE IN INCHES

REF. DWG. NO. H-2-818399
H-2-818400



OSHA LADDER RUNG PLAN DETAIL 14 -

0 10 20 SCALE IN INCHES

REF. DWG. NO. H-2-818403

FRANK S. SHURI
STATE OF WASHINGTON
26488
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 2-21-96

W-025 SUBMITTAL/CVI #22585 CROSS INDEX

SUB#	CVI SUP#	#SPEC REF.	DESCRIPTION
25 (Lobe 2)		02725, 1.3.B	HDPE Pipe Fabrication Drawings
13,13.1 (Lobe 2)		02725, 1.3.B	HDPE Collection Well Fabrication Drawings

NOTES:

1. Pipes may be bent to match holes. Tack weld to HDPE collection well to secure.
2. Type I HDPE and geocomposite drainage layer extend across entire sump area.
3. Install primary submersible pump within 3 feet of end of slope riser pipe.
4. Offset layers of geonet so that ribs intermesh.

KEY:

C — DESIGNATION
H-2-818399 — SHEET NUMBER

DRAWING TRACEABILITY LIST

NUMBER	TITLE

REFERENCES

NUMBER	TITLE

NEXT USED ON

REVISIONS

REV NO	DESCRIPTION	DATE	BY
1	AS-BUILT PER ECNs ADD CVI CROSS INDEX PER W-025-035 EDITORIAL PER ECN W-025-035	SMM	F. SHURI 11-23-94

CAD FILE B818399A.DWG CAD CODE 2W:IBM:ACD2:10:SS

APPROVALS

DESIGNED	J. PELLICER	11/15/93
DRAWN	J. PELLICER	11/15/93
CHECKED	F. SHURI	11/15/93
REVIEWED	M. BROWN	11/15/93
QA	M.J. GORMAN	11/15/93

APPROVED FOR IMPLEMENTATION BY [signature] FOR [signature] DATE 12-21-94

LDT 601111

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

SUMP LEACHATE COLLECTION PIPES
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

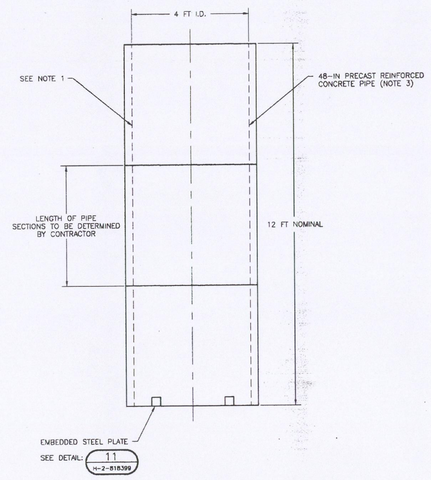
PROJECT W-025 SECOND LANDFILL

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-818399	1

SCALE AS SHOWN JOB NO. 933-1377.100 SHEET 1 OF 1

H-2-818399 1

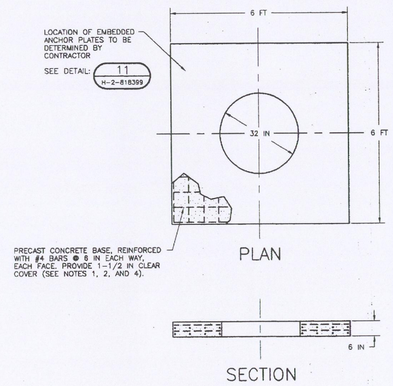
12-15-94 4:10 P SMM,0431576\59510



VERTICAL RISER CONCRETE PIPE DETAIL

20 H-2-818400

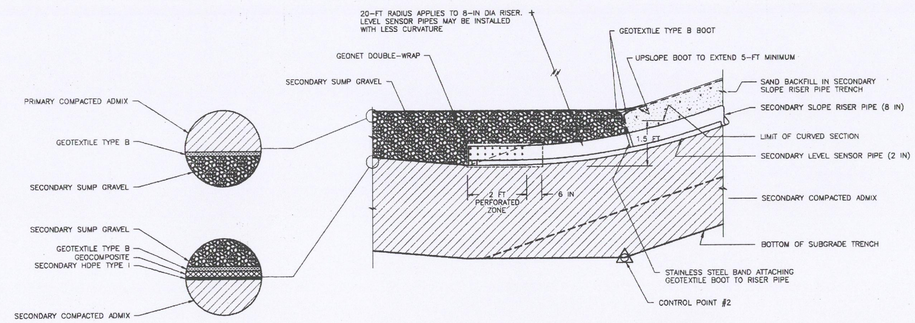
0 2 4
SCALE IN FEET



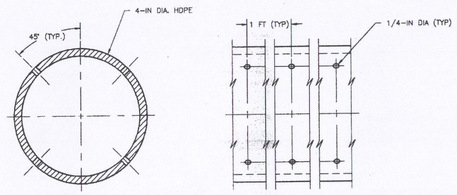
VERTICAL RISER REINFORCED CONCRETE BASE DETAIL

15 H-2-818400

0 2 4
SCALE IN FEET

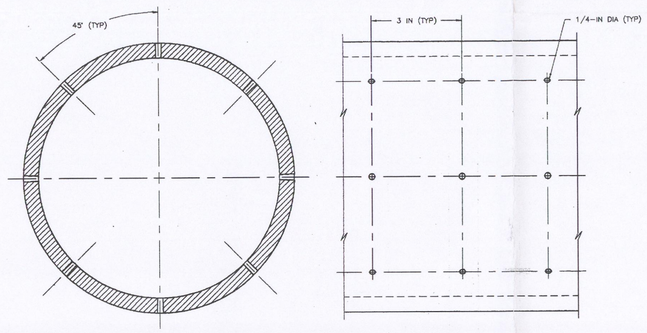


ELEVATION



SECTION ELEVATION

PRIMARY LEACHATE COLLECTION SYSTEM DRAINAGE PIPE



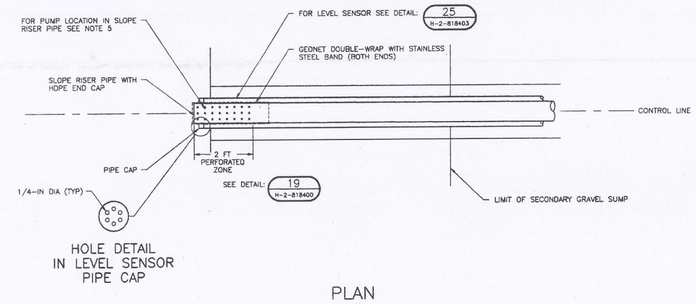
SECTION ELEVATION

SECONDARY SLOPE RISER PIPE

PIPE PERFORATION PATTERN DETAIL

19 H-2-818400

N.T.S.



PLAN

SECONDARY SLOPE RISER PIPE

21 H-2-818400

N.T.S.

FRANK S. SHURI
STATE OF WASHINGTON
18648
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 2-21-94

W-025 SUBMITTAL/CVI #22585 CROSS INDEX

SUB#	CVI SUP#	#SPEC REF.	DESCRIPTION
15 (Lobe 2)		02727, 1.2.A	Vertical Riser Pipe
37A (Lobe 1)		02727, 1.2.A	Precast Concrete Pipe
16 (Lobe 2)		03210, 1.2.A	Rebar and Coating
48 (Lobe 1)		09900, 1.6.A.2	Manhole Coating Manufacturer's Specification.
48A (Lobe 1)		09900, 1.6.A.2	Manhole Coating Manufacturer's Specification.

NOTES:

1. Concrete to have protective coating. See Specifications, Section 09900.
2. See Specifications, Section 03210 for concrete reinforcement.
3. For vertical riser pipe, see Specifications, Section 02727.
4. Lifting hooks at discretion of contractor.
5. Pump shall be installed within 1.5 feet of end of slope riser pipe.

KEY:

G — DESIGNATION
H-2-818399 — SHEET NUMBER

DRAWING TRACEABILITY LIST

NUMBER	TITLE

REFERENCES

NUMBER	TITLE	NEXT USED ON

AS-BUILT PER ECNs
ADD CVI CROSS INDEX PER ECN W-025-029
EDITORIAL PER ECN W-025-029

REVISIONS

REV NO	DESCRIPTION	BY	DATE
1	AS-BUILT PER ECNs ADD CVI CROSS INDEX PER ECN W-025-035 EDITORIAL PER ECN W-025-035	SMM	F. SHURI 11-23-94

APPROVALS

DESIGNED	J. PELLICER	11/15/93
DRAWN	J. PELLICER	11/15/93
CHECKED	F. SHURI	11/15/93
REVIEWED	M. BROWN	11/15/93
QA	M.J. GORMAN	11/15/93

APPROVED FOR IMPLEMENTATION BY F. Shuri DATE 12-21-94

CAD FILE B818400A.DWG CAD CODE 2W:IBM:ACD2:10:SS

IMPACT LEVEL | CDT 601111

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
GOLDER ASSOCIATES INC.

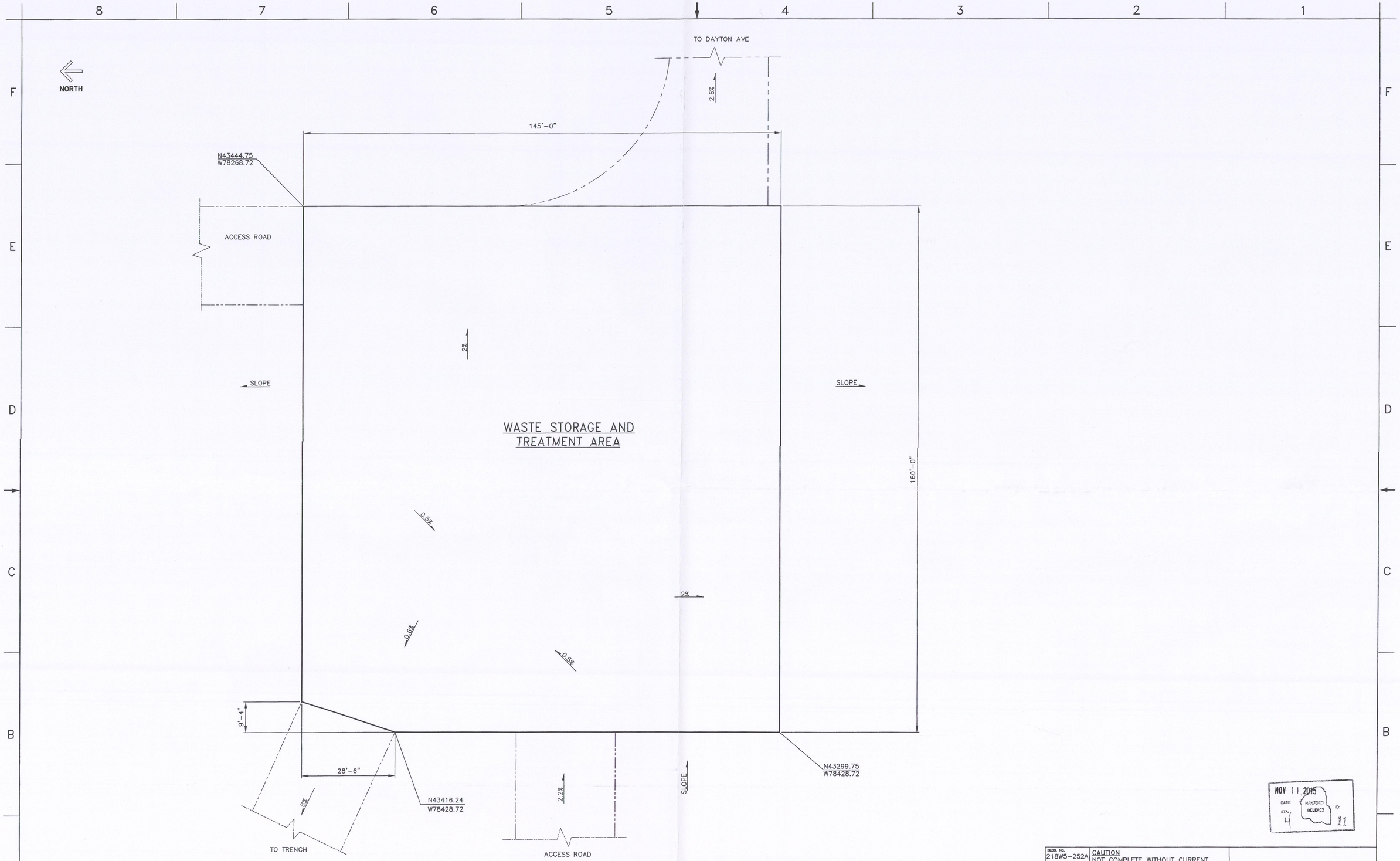
SIDE SLOPE AND VERTICAL RISER PIPES
RMW LAND DISPOSAL FACILITY
NON-DRAG-OFF

PROJECT W-025 SECOND LANDFILL

SIZE	BLDG. NO.	INDEX NO.	DWG. NO.	REV. NO.
F	218-W-5	0401	H-2-818400	1

SCALE AS SHOWN | JOB NO. 933-1377.100 | SHEET 1 OF 1

H-2-818400 1



LOW-LEVEL BURIAL GROUNDS TRENCH 34 WASTE STORAGE AND TREATMENT PAD

SCALE: 3/32"=1-0"

NOV 11 2015 DATE STA: H HANFORD RELEASE ID: II

DWG NUMBER	TITLE
DRAWING TRACEABILITY LIST	

REF NUMBER	TITLE
H-2-818392	GRADING PLAN RMW LAND DISP FAC
H-2-131584	TRUCK STAGING AREA & ACCESS RAMP RMW LAND DISPOSAL FACILITY NON-DRAG-OFF
REFERENCES	
NEXT USED ON	END ITEM

REV NO.	DESCRIPTION
0	INITIAL RELEASE PER ECR-15-000699
REVISIONS	

BLDG. NO. 218W5-252A

INDEX NO. 0401

CAUTION
NOT COMPLETE WITHOUT CURRENT
CHANGE DOCUMENTS FROM DATABASE

	NAME	DATE	COMPANY
DRAFTER	J SHEATS	8/4/15	ARES
GRAPHIC DESIGNER	J BYERS	11-18-15	ARES
PROJECT ENGINEER	T SALZANO	" " "	ARES
DESIGN AUTHORITY	JR Rosser	11/9/15	

U.S. DEPARTMENT OF ENERGY
Richland Operations Office

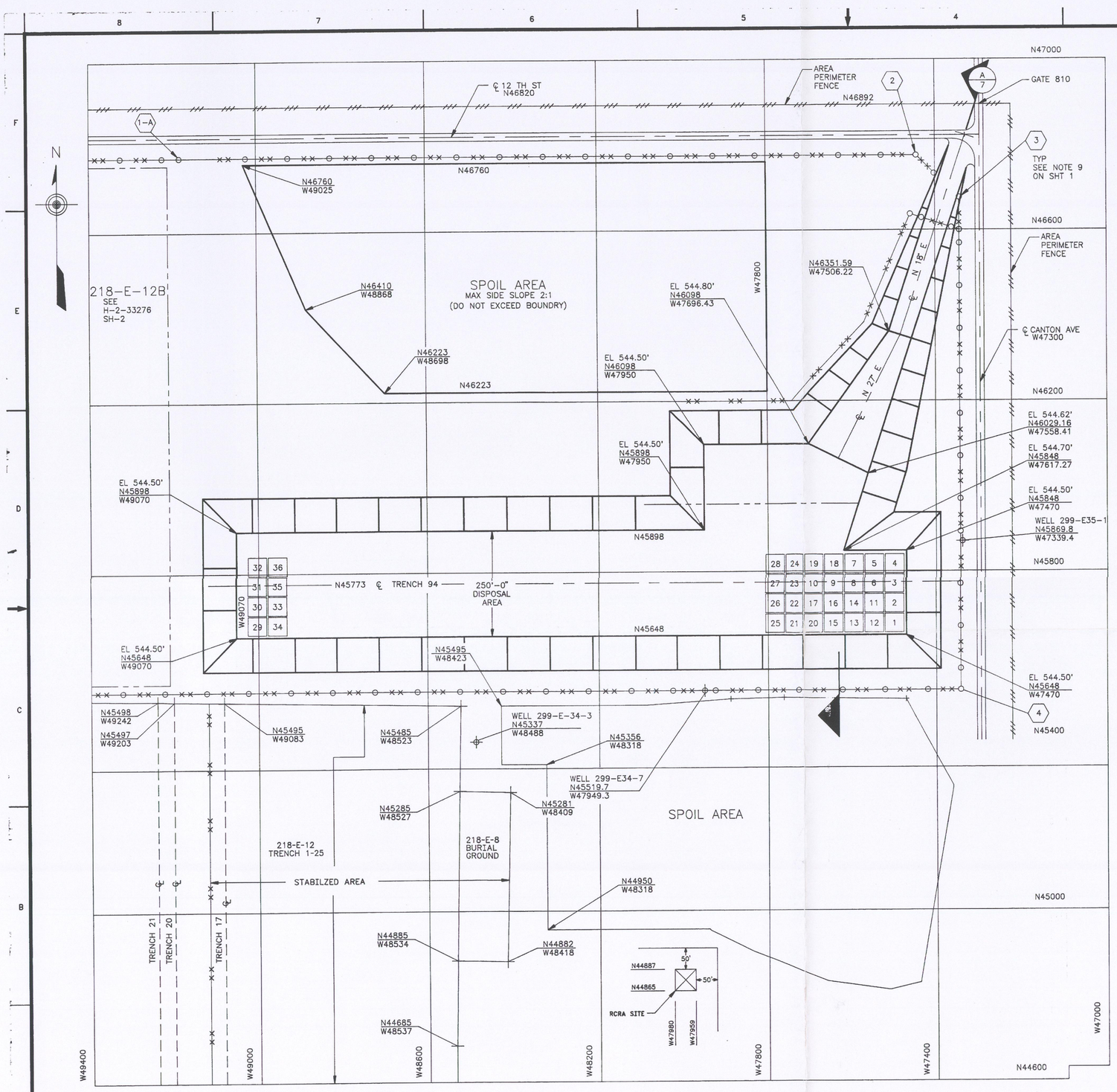
TRENCH 34 WASTE STORAGE AND TREATMENT PAD

SIZE	DRAWING NUMBER	SHEET	REV
F	H-2-836696	1	0

SCALE AS SHOWN

20658

DOE_TBL_F.DWG (JAN 2015)



SITE PLAN

SCALE: 1" = 100'-0"

SPECIAL NAVAL DISPOSAL NOTES

(FOLLOWING NOTES APPLY ONLY TO THIS SHEET OF THIS DRAWING)

A. THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT) DOCUMENT, M41-10-88, (STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION) SHALL BE USED TO BUILD OR CONSTRUCT ALL ROADWAYS IN ALL OR PART THEREOF.

B. TEMPORARY FENCE WITH STEEL POSTS AND CHAIN SHALL BE INSTALLED AROUND THE ACTIVE BURIAL SITE UNTIL ALL ACTIVE WORK IS COMPLETED AND BACKFILLED AND TOP OF GROUND IS STABILIZED WITH PERMANENT POST AND CHAIN INSTALLED AROUND THE AREA. THE TEMPORARY FENCE SHALL HAVE RADIATION SIGNS PER HPS-AC-3-25 AT 100' MAX SPACING.

C. CONSTRUCTION TOLERANCE: EXCAVATION SHALL HAVE A VERTICAL TOLERANCE OF ± 0.2 FT AND A HORIZONTAL TOLERANCE OF ± 1.0 FT. FOUNDATION PLACEMENT SHALL HAVE VERTICAL TOLERANCE OF ± 0.02 FT AND HAVE A HORIZONTAL TOLERANCE OF ± 0.04 FT.

D. SLOPE 1:1 TRENCH SIDES OR SLOPE AS REQUIRED TO MATCH NATURAL ANGLE OF REPOSE PER LATEST EXCAVATION, TRENCHING, AND SHORING STANDARD (REFERENCE CFR TITLE 29 PART 1926 – SAFETY AND HEALTH REGULATION FOR CONSTRUCTION) SLOPE RANGE 1:1 TO 2:1. ENGINEERING MUST BE CONTACTED WHEN SLOPES MORE THAN 1 1/2:1 ARE NEEDED.

FOUNDATION TABLE "A"

BURIAL NO.	FOUNDATION DETAIL DWG	NORTH COORDINATE	WEST COORDINATE	T.O.C. ELEV	FDN PLAN NO.	SUBMARINE REACTOR COMPARTMENT
1	H-2-96277	N45673.00	W47495.00	544.50	A	PATRICK HENRY
2	H-2-96277	N45720.89	W47495.00	544.50	A	SNOOK
3	H-2-96277	N45768.88	W47495.00	544.50	A	GEORGE WASHINGTON
4	H-2-96277	N45817.03	W47495.00	544.50	A	SCAMP
5	H-2-96277	N45817.03	W47543.54	544.50	A	ROBERT E. LEE
6	H-2-96277	N45768.86	W47547.04	544.50	A	THOMAS JEFFERSON
7	H-2-96277	N45817.03	W47601.69	544.50	A	THEODORE ROOSEVELT
8	H-2-96277	N45768.86	W47604.86	544.50	A	DACE
9	H-2-96277	N45765.91	W47652.62	544.50	B	JOHN ADAMS
10	H-2-96277	N45768.44	W47700.74	544.50	B	ABRAHAM LINCOLN
11	H-2-96277	N45720.72	W47547.27	544.50	A	BARB
12	H-2-96277	N45672.63	W47547.98	544.50	A	ETHAN ALLEN
13	H-2-96277	N45672.32	W47598.25	544.50	A	THOMAS EDISON
14	H-2-96277	N45720.67	W47602.78	544.50	A	POLLACK
15	H-2-96277	N45672.33	W47651.15	544.50	A	GLENARD LIPSCOMB
16	H-2-96277	N45720.61	W47655.71	544.50	A	JAMES MONROE
17	H-2-33276	N45720.6	W47703.4	544.50	A	SKIPJACK
18	H-2-33276	N45815.24	W47652.45	544.50	B	NATHAN HALE
19	H-2-33276	N45816.94	W47700.74	544.50	B	PLUNGER
20	H-2-33276	N45672.40	W47698.75	544.50	A	SHARK
21	H-2-33276	N45672.40	W47746.04	544.50	A	LAFAYETTE
22	H-2-33276	N45720.63	W47745.84	544.50	A	SAM HOUSTON
23	H-2-33276	N45768.86	W47748.64	544.50	A	JACK
24	H-2-33276	N45816.76	W47748.97	544.50	B	HADDO
25	H-2-33276	N45672.40	W47796.26	544.50	A	TINOSA
26	H-2-33276	N45720.63	W47796.26	544.50	A	GUARDFISH
27	H-2-33276	N45768.86	W47796.26	544.50	A	PERMIT
28	H-2-33276	N45817.09	W47796.93	544.50	A	QUEENFISH

(SEE SHEET H-2-33276 SH-11 FOR CONTINUATION OF TABLE A)

NOTES:

1. FOR FOUNDATION PLANS SEE H-2-33276 SH-9 & SH-10.

DRAWING TRACEABILITY LIST		REFERENCES		
H-2-96277	PKG FDN PLAN & SECT	WHC-S-0114	EXCAVATION CONSTRUCTION SPEC	
H-2-76951	NAVAL DISPOSAL	REF NUMBER	TITLE	
DWG NO	TITLE	NEXT USED ON	H-2-33276 SH-2	

REV NO	DESCRIPTION	REV BY DATE	CHK BY DATE	DFTD APVD DATE	COD ENGR	OTHER	OTHER
5	164044,164001,164043,187690 REVISIONS PER ECN'S-187689	BAN 12/93	PCR 3/16/94	DFTD APVD 2/1/94	2/1/94	2/1/94	2/1/94

CADFILE B033276F CADCODE DOS:5.0:ACD2:12.0:NN

		DATE
DRAWN	L. DAVIES	1-5-89
CHECKED	G.R.C.	6-15-89
DFTD APVD		
COD ENGR	B. POREMBA	6-15-89
QA	S. DELEON	6-15-89
OTHER	H. HUMPHREYS	6-15-89
OTHER	M.M.McCARTHY	6-15-89
OTHER	S.W. PRICE	6-21-89
APVD FOR IMPLEMENTATION		

ECN 121260

U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Westinghouse Hanford Company

DRY WASTE BURIAL GROUND 218-E-12B NAVAL DISPOSAL

SIZE	BLDG NO	INDEX NO	DWG NO	REV
F	218-E-12B	0401	H-2-33276	5

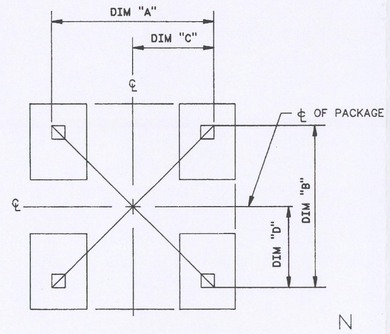
SCALE AS NOTED SHEET 6 OF

CHK PRINT DATE COMMENT PRINT DATE 5/16/91

54-6000-027(5/89)

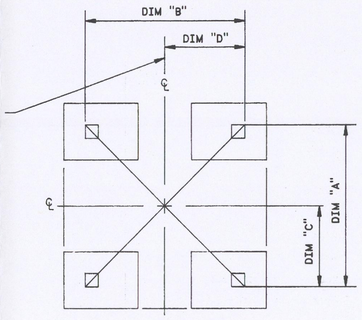
AS BUILT BY SURVEY

S.R.C. NUMBER	COORDINATES-200E DATUM (FEET) NORTH	WEST	DIMENSION "A"	DIMENSION "B"
1	N45673.1	W47494.9	37'-9 3/8"	38'-2"
2	N45720.9	W47495.0	32'-10 1/8"	38'-4 1/8"
3	N45768.9	W47495.1	37'-11"	38'-5 1/4"
4	N45817.0	W47495.2	32'-11 3/4"	38'-5 1/4"
5	N45816.9	W47543.7	37'-9 1/2"	38'-6"
6	N45768.8	W47547.0	32'-5 7/8"	38'-5 7/8"
7	N45816.9	W47601.8	37'-9 5/8"	38'-6"
8	N45768.6	W47604.8	37'-10 1/4"	38'-8 1/8"
9	N45765.4	W47652.5	32'-8 1/4"	38'-4"
10	N45767.6	W47700.6	37'-9 1/4"	38'-6 1/8"
11	N45720.6	W47547.2	37'-10 7/8"	38'-4 1/8"
12	N45672.6	W47547.9	32'-8 1/8"	38'-6 1/8"
13	N45672.3	W47598.2	32'-6 7/8"	38'-7 1/8"
14	N45720.4	W47602.8	37'-11 7/8"	38'-5 7/8"



FOUNDATION PLAN A
FOUNDATION PLAN C

SCALE: 1" = 10'-0"
FOR FOUNDATION SIZE AND DETAILS SEE FOUNDATION AND NOTE TABLE A ON H-2-33276, SH-6
SEE NOTE 1

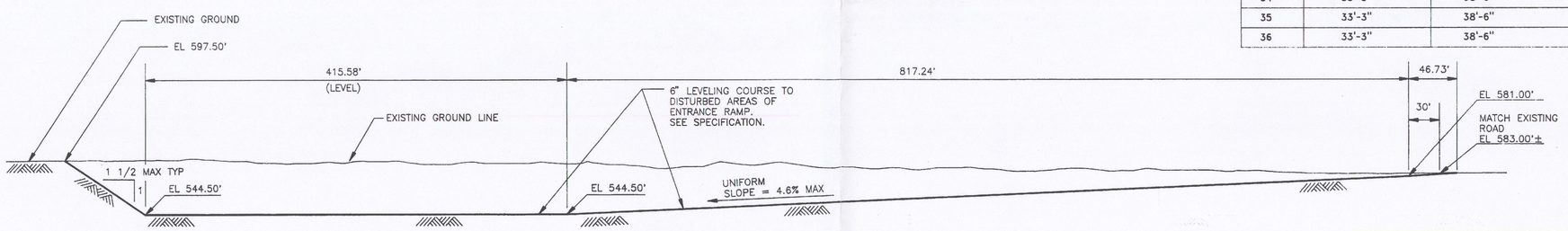


FOUNDATION PLAN B
FOUNDATION PLAN D

SCALE: 1" = 10'-0"
FOR FOUNDATION SIZE AND DETAILS SEE FOUNDATION AND NOTE TABLE A ON H-2-33276, SH-6
SEE NOTE 1

TABLE B
DESIGN FOUNDATION SPECS.

BURIAL NO.	"A"	"B"	"C"	"D"
1	37'-9 1/2"	38'-2"	18'-10 3/4"	19'-1"
2	32'-10"	38'-4"	16'-5"	19'-2"
3	37'-11"	38'-5 1/2"	18'-11 1/2"	19'-2 3/4"
4	32'-11 1/2"	38'-5"	16'-5 3/4"	19'-2 1/2"
5	37'-9 5/8"	38'-6"	18'-10 13/16"	19'-3"
6	32'-5 3/4"	38'-6"	16'-2 7/8"	19'-3"
7	37'-9 1/2"	38'-6"	18'-10 3/4"	19'-3"
8	37'-10"	38'-7"	18'-11"	19'-3 1/2"
9	32'-8 1/4"	38'-4"	16'-4 1/8"	19'-2"
10	37'-9"	38'-6 1/2"	18'-10 1/2"	19'-3 1/4"
11	37'-10 3/4"	38'-4 1/8"	18'-11 3/8"	19'-2 1/16"
12	32'-8 1/8"	38'-6 1/16"	16'-4 1/16"	19'-3"
13	32'-6 1/2"	38'-7"	16'-3 1/4"	19'-3 1/2"
14	37'-11 5/8"	38'-5 5/8"	18'-11 13/16"	19'-2 13/16"
15	37'-11"	38'-7"	18'-11 1/2"	19'-3 1/2"
16	32'-6 3/4"	38'-7"	16'-3 3/8"	19'-3 1/2"
17	32'-11"	38'-6"	16'-5 1/2"	19'-3"
18	32'-6 1/4"	38'-6"	16'-3 1/8"	19'-3"
19	37'-10"	38'-6"	18'-11"	19'-3"
20	32'-11"	38'-6"	16'-5 1/2"	19'-3"
21	32'-7"	38'-6"	16'-3 1/2"	19'-3"
22	32'-6"	38'-6"	16'-3"	19'-3"
23	37'-10"	38'-6"	18'-11"	19'-3"
24	37'-10"	38'-6"	18'-11"	19'-3"
25	38'-7 1/2"	38'-6"	19'-3 3/4"	19'-3"
26	38'-7 1/2"	38'-6"	19'-3 3/4"	19'-3"
27	38'-7 1/2"	38'-6"	19'-3 3/4"	19'-3"
28	38'-7 1/2"	38'-6"	19'-3 3/4"	19'-3"
29	33'-3"	38'-6"	16'-7 1/2"	19'-3"
30	33'-3"	38'-6"	16'-7 1/2"	19'-3"
31	33'-3"	38'-6"	16'-7 1/2"	19'-3"
32	38'-7 1/2"	38'-6"	19'-3 3/4"	19'-3"
33	38'-7 1/2"	38'-6"	19'-3 3/4"	19'-3"
34	33'-3"	38'-6"	16'-7 1/2"	19'-3"
35	33'-3"	38'-6"	16'-7 1/2"	19'-3"
36	33'-3"	38'-6"	16'-7 1/2"	19'-3"



SECTION A/6
SCALE: 1" = 50'-0"

NOTES:

1. PUGET SOUND NAVAL SHIPYARD WILL PROVIDE FOUNDATION SPACING AND LOCATION PRIOR TO CONSTRUCTION.
2. FOUNDATION PLAN A AND B DESIGNATION ON CONSTRUCTION OF FOUNDATION USING 40" X 40" COLUMNS (SEE SH. 8 FOR CONSTRUCTION DETAILS) FOUNDATION PLANS C AND D DESIGNATE CONSTRUCTION OF FOUNDATIONS USING 40" X 48" COLUMNS (SEE SH. 9 & SH. 10 FOR CONSTRUCTION DETAILS).

DWG NO	TITLE	REF NUMBER	TITLE

DRAWING TRACEABILITY LIST — REFERENCES — NEXT USED ON H-2-33276 SH-6

REV NO	DESCRIPTION	REV BY DATE	CHK BY DATE	DFTG APVD DATE	COG ENGR	OTHER	OTHER
5	129177 REVISION PER ECN -	BAN 2/94					

REVISIONS — APPROVALS BY/DATE

CADFILE B033276G — CADCODE DOS:5.0; ACD2:12.0; NN

		DATE
DRAWN	J VOSAHLO	4-91
CHECKED	GDT/JHW	6-6-91
DFTG APVD	JT SAMS	6-6-91
COG ENGR	DT	5-30-91
QA		
OTHER	GC EVANS	6-29-91
OTHER	ND	6-6-91
OTHER		
APVD FOR IMPLEMENTATION		
BY FOR		DATE

ECN 121260

U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Westinghouse Hanford Company

DRY WASTE BURIAL GROUND 218-E-12B NAVAL DISPOSAL

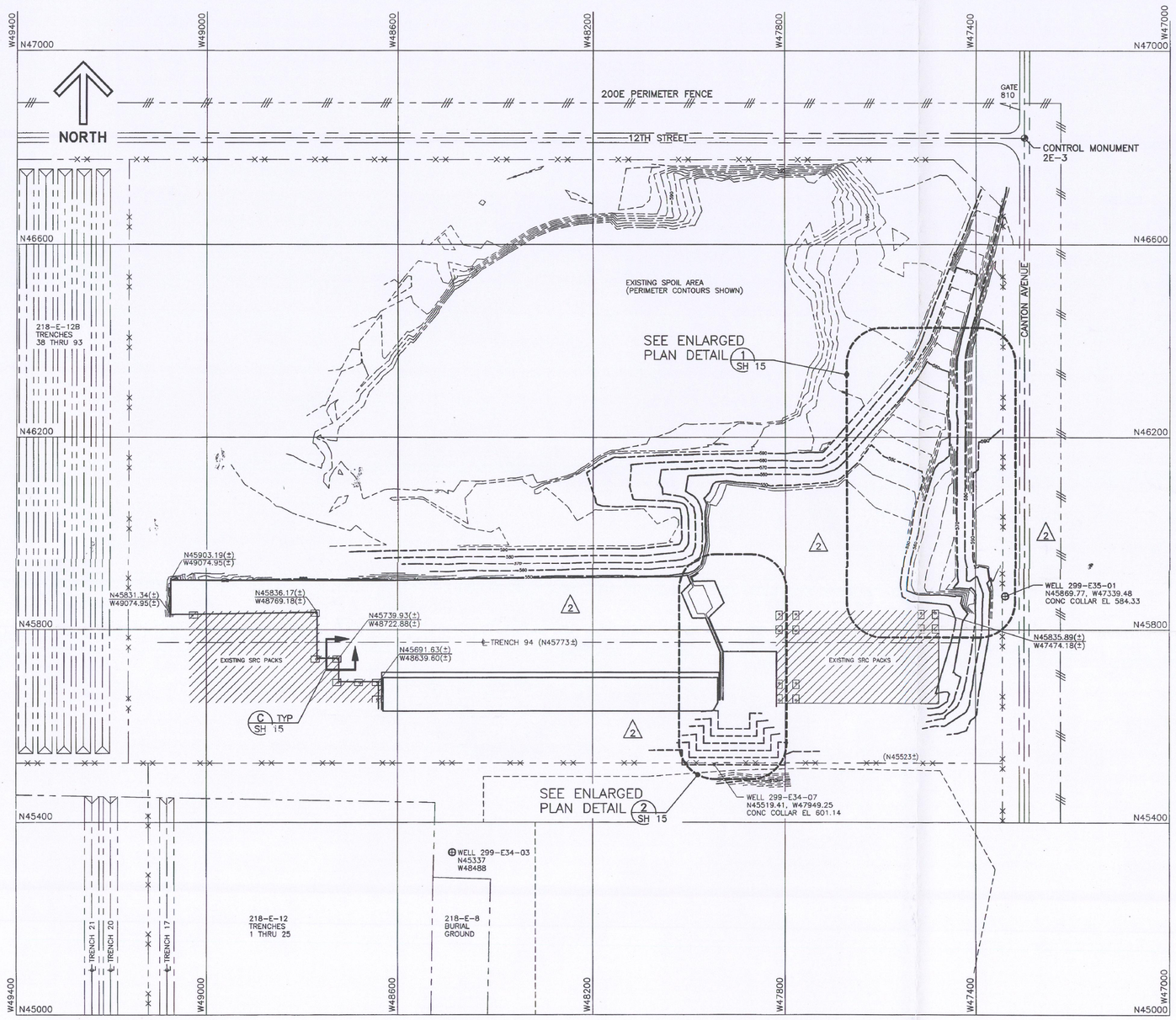
SIZE	BLDG NO	INDEX NO	DWG NO	REV
F	218-E-12B	0401	H-2-33276	5

SCALE AS NOTED — SHEET 7 OF

CHK PRINT ☐ DATE — COMMENT PRINT ☐ DATE 6/16/91

54-8000-027(A/92)

DWG NO H-2-33276 SH 7 REV 5



SITE PLAN

100 0 100 200

SCALE IN FEET

LEGEND

- SUB COMPARTMENT FOUNDATION
- EXISTING CONTOURS
- FINISH CONTOURS
- OBSERVATION WELL
- FINISH BOTTOM TRENCH CONTOUR (548.8)
- EXISTING CHAIN BARRICADE FENCE W/CONC POSTS
- EXISTING 200E PERIMETER FENCE
- SRC — SUBMARINE REACTOR COMPARTMENT

CONTROL MONUMENTS		
NUMBER	COORDINATE	ELEVATION
2E-2	N 46824.37 W 52998.75	619.33
2E-3	N 46820.11 W 47300.00	582.32

GENERAL NOTES FOR SHEETS 14 THROUGH 17

1- TOPOGRAPHY BASED ON SURVEY DATA OBTAINED FROM SURVEYS PERFORMED IN JANUARY 1992 AND MARCH 1996.

2- EARTHWORK VOLUMES NOTED BELOW ARE APPROXIMATE QUANTITIES BASED UPON COMPUTER PROGRAM PERFORMED WITH SOFTDESK ADCADD CIVIL/SURVEY APPLICATIONS SOFTWARE.

A- NEW TRENCH BOTTOM STRUCTURAL FILL TO EL 544.67, 548.8, AND 551.8 = 37,340 CUBIC YARDS

B- TRANSPORT TRAILER OFFLOADING EXCAVATION = 4,925 CUBIC YARDS

C- ENTRANCE RAMP ENLARGEMENT EXCAVATION = 48,802 CUBIC YARDS

D- FILL UNDER EXISTING REACTOR COMPARTMENTS (2 AREAS) = 377 CUBIC YARDS

3- DESIGN SOIL DATA:
ALLOWABLE SOIL BEARING PRESSURE = 12 KSF
MODULUS OF SUBGRADE REACTION = 800 LB/CU INCH

4- DESIGN LOADS:
A- PACKAGE WEIGHT OF 1010 LT (2262.4 KIPS)
B- MEETS DESIGN CRITERIA OF ACI 318/318R 1989

5- ALL CONCRETE DESIGN IS EXCLUSIVE RESPONSIBILITY OF PUGET SOUND NAVAL SHIPYARD DESIGN ENGINEERING.

6- EXPANSION JOINT MATERIAL BETWEEN CONCRETE FOUNDATIONS SHALL BE 2" THICK PREFORMED EXPANSION JOINT FILLER, BITUMINOUS TYPE, IAW ASTM D 994, OR WATSON BOWMAN & ACME CORP "W" SERIES, OR APPROVED SUBSTITUTE.

7- FOR ADDITIONAL CONSTRUCTION REQUIREMENTS SEE SPECIFICATION W-380-C1.

DAVID S. MESSINGER — STATE OF WASHINGTON — 28877 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES 2-18-98

NUMBER	TITLE	NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	

MF	REV NO.	DESCRIPTION	REV BY DATE	KEH APPROVALS			APVD FOR IMPL/ENG FOR DATE
S	2	AS-BUILT FOR PROJ W-380 D4-C7, E2 ECN W-380-8 Z C-E4, C5	SHS 11-13 96	RJP 12-13-96	RGH 12-13-96	DSM 12-16-96	DBP 12-16-96
M	1	W-380-3; Z D-E4,D5,C5,D1-2 DIRECT REVISION PER ECN	TKE 6-10 96	KRA 6-12-96	RGH 6-12-96	DSM 6-12-96	DBP 6-12-96
M		REVISIONS					

CAD FILE B033276P CAD CODE WIN95:ACD2:12.0:SS XREF N

DESIGNED	TK EHRHARD	DATE	
DSGN ENGR	DS MESSINGER	04-16 1998	
CHECKED	DJ WHITISH	04-16 1998	
SAFETY			
DRIVER	RG HOLLENBECK	04-16 1998	
QUAL ENGR			
LEAD ENGR	DS MESSINGER	04-16 1998	
REVIEW NO.			
APPROVED FOR IMPLEMENTATION BY	DB POWELL		
FOR	WHC	DATE	04-19-96

SAFETY CLASS 3 — USE AS-BUILT — EDT ECN W-380-001

U.S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
ICF KAISER HANFORD COMPANY

DRY WASTE
BURIAL GROUND
TRENCH 94

PROJECT W-380, CLOSE PACK RAIL SYSTEM

SIZE	BLDG NO.	INDEX NO.	DWG NO.	REV NO.
F	218-E-12B	0401	H-2-33276	2

SCALE SHOWN — JOB NO. E51613 — SHEET 14 OF

PLOT SCALE: 1=100 — KEHCAD — SGTKFOOF.DWG (09/95)

This page intentionally left blank.

Addendum D

Groundwater Monitoring Plan

This page intentionally left blank.

Contents

D1 Groundwater Monitoring Plan D-1

Appendices

D-A Final Status Groundwater Monitoring Plan for LLBG WMA-3 ..... D-A-i
D-B Final Status Groundwater Monitoring Plan for LLBG WMA-2 ..... D-B-i

This page intentionally left blank.

D1 Groundwater Monitoring Plan

This addendum addresses final status groundwater monitoring requirements for the Low Level Burial Grounds (LLBG) Trenches 31-34-94 Operating Unit Group. Groundwater monitoring at LLBG Trenches 31-34-94 is comprised of two separate monitoring plans due to the distance separating the trenches. Groundwater monitoring for Trenches 31 and 34 is being performed in accordance with *Final Status Groundwater Monitoring Plan for the LLBG WMA-3*. This plan, located in Appendix D-A, is the principal controlling document for current groundwater monitoring at the 218-W-5 LLBG, including Trenches 31 and 34. Groundwater monitoring for Trench 94 is being performed in accordance with *Final Status Groundwater Monitoring Plan for the LLBG WMA-2*. This plan, located in Appendix D-B, is the principal controlling document for current groundwater monitoring at the 218-E-12B LLBG, including Trench 94.

Both of these groundwater monitoring plans comply with WAC 173-303-806(4)(a)(xx), "Dangerous Waste Regulations," "Final Facility Permits," and WAC 173-303-645, "Releases from Regulated Units," for the purposes of detecting, characterizing, and responding to releases. These plans address the following items:

- Adequacy and attributes of the wells used to monitor the groundwater
- Sampling requirements and schedule
- Constituents, groundwater parameters, and analytical methods necessary to determine whether past releases are affecting the groundwater quality
- Procedures for evaluating groundwater quality data
- Reporting requirements

This page intentionally left blank.

Appendix D-A

Final Status Groundwater Monitoring Plan for the LLBG WMA-3

This page intentionally left blank.

Executive Summary

This document presents the Low-Level Waste Management Area 3 (LLWMA-3) groundwater monitoring plan. This revised groundwater monitoring plan is based on the requirements for final status facilities. Final status facility groundwater monitoring requirements for the LLWMA-3 are identified in WA78900008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, as amended[1] Part II, Condition II.F, and WAC 173-303-645.[2] This groundwater monitoring plan supersedes the previous plan that was issued in 2012.[3] This detection evaluation program groundwater monitoring plan is the principal controlling document for conducting groundwater monitoring at LLWMA-3.

The LLWMA-3 consists of three burial grounds: 218-W-3A, 218-W-3AE, and 218-W-5. The LLWMA-3 burial grounds, located in the northwest corner of the 200 West Area, received both mixed waste and radiological waste throughout their operational histories.

- The 218-W-3A Burial Ground is a nonoperating landfill containing 57 unlined trenches that received unsegregated waste, mixed low-level waste (MLLW), low-level waste (LLW), transuranic waste, and transuranic mixed waste from 1970 until 1998. Only portions of two trenches (T6S and T19) at the 218-W-3A Burial Ground received mixed waste regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA).[4]
- The 218-W-3AE Burial Ground is a nonoperating landfill containing eight unlined trenches that received MLLW and LLW from 1981 until 2004. Only portions of two trenches (T05 and T08) received mixed waste regulated under RCRA.
- The 218-W-5 Burial Ground is a landfill containing 11 unlined trenches and two lined trenches. From 1986 to 2004, the 11 unlined trenches received LLW, and only

[1] WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, as amended, Washington State Department of Ecology, Richland, Washington.

[2] WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/wac/default.aspx?cite=173-303-645.

[3] DOE/RL-2009-68, 2012, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0091262.

[4] *Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

a portion of one trench (T22) received MLLW. The two double-lined trenches (T31 and T34) were constructed in 1994 and continue to receive MLLW regulated under RCRA. T31 and T34 are final status treatment, storage, and disposal units covered by this groundwater monitoring plan.

Because LLWMA-3 received waste contaminated with dangerous waste or dangerous waste constituents, a groundwater monitoring program was implemented in 1987 in accordance with 40 CFR 265.[5] Statistical evaluation of the September 1989 sampling results indicated that total organic halogen (TOX) concentrations in one downgradient well (299-W7-4) and total organic carbon (TOC) concentrations in two downgradient wells (299-W7-5 and 299-W8-1) were statistically greater than background levels. Resampling confirmed the elevated TOX, but the TOC resampling results were inconclusive; therefore, a required groundwater quality assessment plan for LLWMA-3 was prepared and initiated.[6] In 1994, the results of the groundwater quality assessment program[7] concluded that the primary contribution for the increased concentration of TOX in well 299-W7-4 was from the carbon tetrachloride plume in the 200 West Area and not from the release of dangerous waste constituents from LLWMA-3. Sampling for TOC in wells 299-W7-5 and 299-W8-1 indicated the September 1989 elevated values were erroneous and that the critical mean for TOC was not exceeded. The site was returned to an indicator evaluation program in 1994. Since the assessment, concentrations of TOX and TOC have subsequently dropped below the statistical comparison value (as defined in 40 CFR 265.93(b)[8]) for the site. Thus, releases of dangerous wastes (as defined in WAC 173-303-040[9]) from LLWMA-3 are not considered to have contaminated the

[5] 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=2cd7465519114fb3472b4864a0e3c42b&node=pt40.26.265&rgn=div5.

[6] WHC-SD-EN-AP-022, 1990, *Interim-Status Ground-Water Quality Assessment Plan for Waste Management Area 3 of the 200 Areas Low-Level Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

[7] WHC-SD-EN-EV-026, 1994, *Results of Groundwater Quality Assessment Program at Low-Level Waste Management Area 3 of the Low-Level Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196101188.

[8] 40 CFR 265.93, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Preparation, Evaluation, and Response," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=2cd7465519114fb3472b4864a0e3c42b&node=pt40.26.265&rgn=div5.

[9] WAC 173-303-040, "Dangerous Waste Regulations," "Definitions," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-040.

underlying groundwater. Therefore, the site was previously monitored under the indicator evaluation program described in 40 CFR 265.92.[10]

This revised RCRA groundwater monitoring plan presents a final status indicator evaluation program in accordance with WAC 173-303-645(9) for detection monitoring of the uppermost aquifer beneath LLWMA-3. This plan addresses the following:

- Number, locations, and depths of wells in the LLWMA-3 groundwater monitoring network
- Sampling and analytical methods of parameters required for groundwater contamination detection monitoring
- Methods for evaluating groundwater quality information
- Schedule for groundwater monitoring at the LLWMA-3

This revised plan modifies the existing interim status groundwater monitoring well network (as identified in the previous groundwater monitoring plan[3]) and adds two downgradient monitoring wells to the network. Groundwater flow direction determinations indicate that an east or east-southeast groundwater flow direction exists beneath the LLWMA-3. Groundwater in the LLWMA-3 monitoring wells will be sampled and analyzed semiannually for the parameters used as indicators of groundwater contamination (pH, specific conductance, TOC, and TOX) and annually for parameters establishing groundwater quality (anions, metals, alkalinity, and phenols). Field measurements are not required but will be collected to support evaluation of upgradient and downgradient water chemistry variations. Water level measurements will be taken each time that a sample is collected to satisfy the requirements of WAC 173-303-645(8)(f).

[10] 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=4bcf32e8c95cd586d38674b3a03b54b4&mc=true&node=pt40.26.265&rgn=div5#se40.26.265_192.

This page intentionally left blank.

Contents

1 Introduction 1-1

2 Background 2-1

2.1 Facility Description and Operational History 2-1
2.2 Regulatory Basis 2-5
2.3 Waste Characteristics 2-6
2.4 Geology and Hydrogeology 2-7
2.4.1 Stratigraphy 2-7
2.4.2 Hydrogeology 2-9
2.4.3 Groundwater Flow Interpretation 2-9
2.5 Summary of Previous Groundwater Monitoring 2-9
2.6 Conceptual Site Model 2-12
2.6.1 Geochemical Considerations 2-13
2.6.2 Soil Moisture Factors Affecting Hypothetical Leaching of Waste Constituents 2-13
2.6.3 Hydrogeologic Considerations 2-14
2.7 Monitoring Objectives 2-14

3 Groundwater Monitoring Program 3-1

3.1 Constituents List and Sampling Frequency 3-1
3.2 Point of Compliance 3-1
3.3 Monitoring Well Network 3-4
3.4 Differences between This Plan and Previous Plan 3-4
3.5 Sampling and Analysis Protocol 3-4

4 Data Evaluation and Reporting 4-1

4.1 Data Review 4-1
4.2 Statistical Evaluation 4-1
4.3 Interpretation 4-3
4.4 Groundwater Monitoring Network 4-3
4.5 Reporting and Notification 4-4

5 References 5-1

Appendices

A Quality Assurance Project Plan ..... A-i

B Sampling Protocol ..... B-i

C Well Construction ..... C-i

Figures

Figure 1-1. Location Map for the LLWMA-3 1-2
Figure 1-2. LLWMA-3 Burial Grounds 218-W-3A, 218-W-3AE, and 218-W-5 1-3
Figure 2-1. Map of the 218-W-3A Burial Ground 2-2
Figure 2-2. Map of the 218-W-3AE Burial Ground 2-3
Figure 2-3. Map of the 218-W-5 Burial Ground 2-4
Figure 2-4. Geologic Cross Section beneath LLWMA-3 2-8
Figure 2-5. Water Table Map for LLWMA-3 2-10
Figure 2-6. CSM for LLWMA-3 2-15
Figure 3-1. Map Showing Locations of RCRA Monitoring Wells at LLWMA-3 3-5

Tables

Table 2-1. Previous Monitoring Plans 2-11
Table 2-2. Pertinent WAC 173-303-645 Detection Monitoring Requirements 2-16
Table 2-3. Additional Monitoring Objectives 2-22
Table 3-1. Monitoring Well for the LLWMA-3 3-2
Table 3-2. Attributes for Wells in LLWMA-3 Groundwater Monitoring Network 3-3
Table 3-3. Main Differences between this Plan and Previous Plan 3-6

Terms

AEA	*Atomic Energy Act of 1954*
amsl	above mean sea level
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CSM	conceptual site model
CCU	Cold Creek unit
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FWS	field work supervisor
LLW	low-level waste
LLWMA	low-level waste management area
MLLW	mixed low-level waste
PQL	practical quantification limit
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
TOC	total organic carbon
TOX	total organic halogen
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989)
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

This page intentionally left blank.

1 Introduction

This document presents the revised groundwater monitoring plan for Low-Level Waste Management Area 3 (LLWMA-3) and supersedes the previous plan, DOE/RL-2009-68, Rev. 2, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*. This groundwater monitoring plan is based on the requirements for final status facilities, as defined by the *Resource Conservation and Recovery Act of 1976* (RCRA), with regulations promulgated by the Washington State Department of Ecology (Ecology) in the *Washington Administrative Code* (WAC) and *Code of Federal Regulations* (CFR). Final status groundwater monitoring requirements applicable to the LLWMA-3 are identified WA78900008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereafter referred to as the Hanford Facility RCRA Permit), Part II, Condition II.F, and WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." This plan describes the monitoring of indicator parameters in groundwater samples that are used to determine whether dangerous waste or dangerous waste constituents have entered the groundwater. This plan also describes the monitoring of parameters used to establish groundwater quality. Only the dangerous waste component of the mixed waste disposed to the trenches is regulated under RCRA. Radioactive waste is regulated under the *Atomic Energy Act of 1954* (AEA). In this plan, reference to radioactive waste is provided for informational purposes only.

LLWMA-3 consists of a total of 76 unlined trenches and two lined trenches within the 218-W-3A, 218-W-3AE, and 218-W-5 Burial Grounds. Of the trenches that received mixed waste regulated under RCRA, five unlined trenches are nonoperational, and two lined trenches are currently operating. Trench 31 and Trench 34 in the LLWMA-3 Burial Ground 218-W-5 are final status treatment, storage, and disposal (TSD) units regulated as land disposal units, as defined in WAC 173-303-040, "Definitions." The TSD unit boundary of Trench 31 and Trench 34 is identified in the current RCRA Part A Form (WA78900008967). LLWMA-3 is a TSD unit in the 200-SW-2 Source Operable Unit. Groundwater cleanup will be addressed under the 200-ZP-1 Groundwater Operable Unit.

LLWMA-3 is located in the northwestern corner of the 200 West Area (Figure 1-1). The LLWMA-3 burial grounds (218-W-3A, 218-W-3AE, and 218-W-5) (Figure 1-2) were designed for disposal of miscellaneous dry wastes from various operations at the Hanford Site and from offsite facilities.

Operating records indicate that the first operational burial ground, 218-W-3A, began receiving waste in 1970 from various facilities in the western Inner Area, eastern Inner Area, 300 Area, tank farms, offsite facilities, and other miscellaneous site locations (DOE/RL-2004-60, *200-SW-2 Radioactive Landfills Group Operable Unit RCRA Facility Investigation/Corrected Measures Study/Remedial Investigation/Feasibility Study Work Plan*). The burial ground remained operational until 1998. Portions of two trenches (T6S and T19) (see Figure 2-1 in Chapter 2) received mixed waste regulated under RCRA.

The second operational burial ground, 218-W-3AE,) began receiving waste in 1981. The waste was mainly from the 100 Area, the eastern and western portions of the Inner Area, 300 Area, and other miscellaneous Hanford Site areas and facilities (e.g., the tank farms and the 1100 Area). Waste was also received from offsite generators such as Energy Systems Group, Argonne National Laboratory, Fermi National Accelerator Laboratory, and Battelle Columbus (DOE/RL-2004-60). The burial ground remained operational until 2004. Portions of two trenches (T05 and T08) (Figure 2-2 in Chapter 2) received mixed waste regulated under RCRA.

The third operational burial ground, 218-W-5, began receiving waste in 11 unlined trenches in 1986 and two lined trenches (T31 and T34) (see Figure 2-3 in Chapter 2) in 1999. The waste was generated from the 100 Area, 200 Areas, 300 Area, offsite sources, Pacific Northwest National Laboratory, and from

other miscellaneous Hanford Site areas (DOE/RL-2004-60). A portion of one unlined trench (T22) (see Figure 2-3 in Chapter 2) received mixed waste regulated under RCRA. The unlined trenches remained operational until 2004. The two lined trenches (T31 and T34) were constructed with waste storage and treatment pads located adjacent to and on the apron liner of the corresponding trench. The pads provide storage and treatment for mixed waste to meet land disposal restriction requirements prior to placing the waste into the corresponding trenches for disposal.

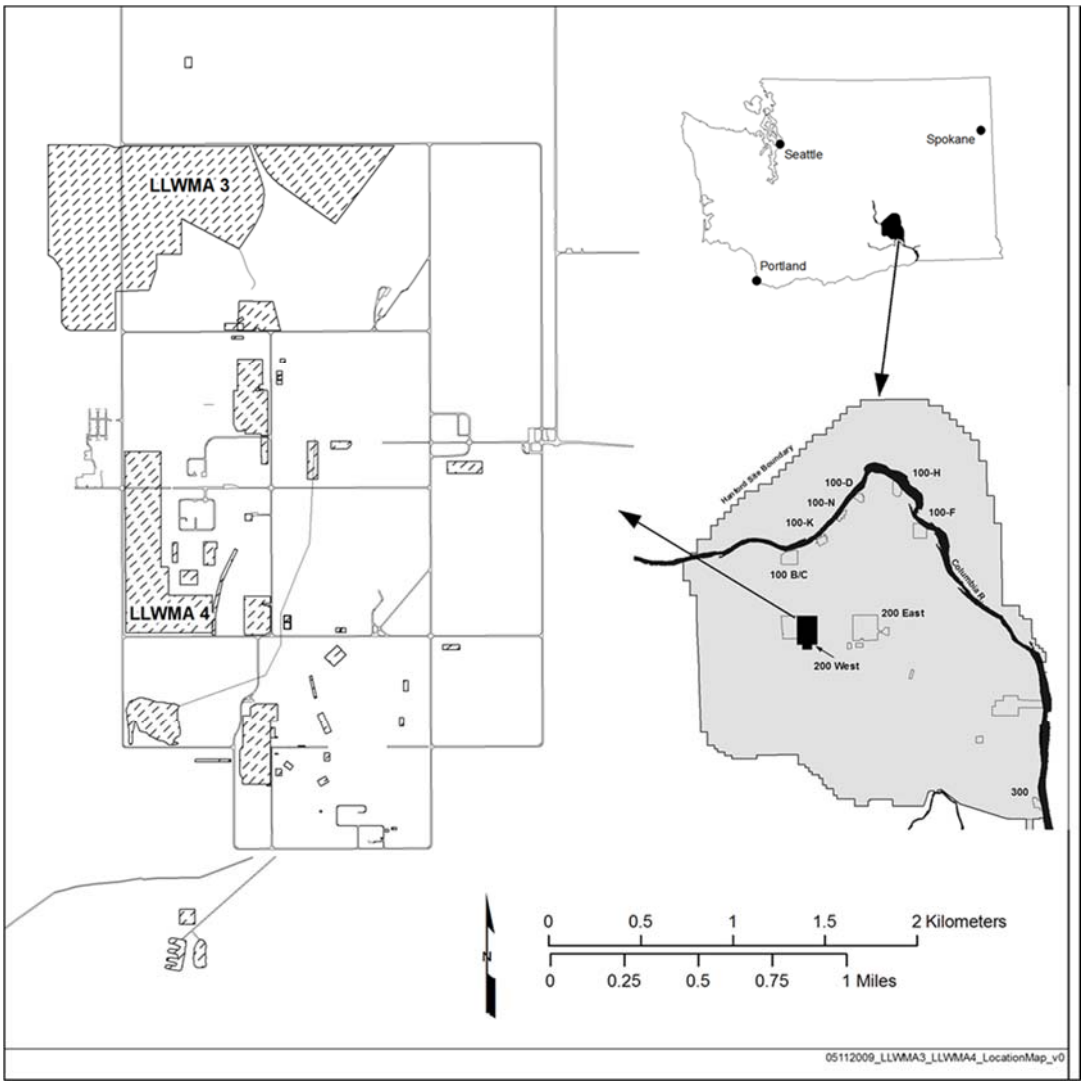


Figure 1-1. Location Map for the LLWMA-3

The purpose of this document is to present the updated RCRA groundwater monitoring plan for LLWMA-3. This document presents the final status detection groundwater monitoring plan for indicator parameters (i.e., indicators of groundwater contamination) and other parameters to better define groundwater quality. This plan is intended specifically to satisfy monitoring requirements for final status TSD units in accordance with WAC 173-303-645. This monitoring plan is the principal controlling document for conducting groundwater monitoring at LLWMA-3. The detection evaluation program detailed in this plan requires semiannual sampling for parameters used as indicators of groundwater contamination, as well as annual sampling for parameters establishing groundwater quality for the one

upgradient well and three downgradient wells. Water level measurements are required each time a sample is collected to satisfy the requirements of WAC 173-303-645(8)(f).

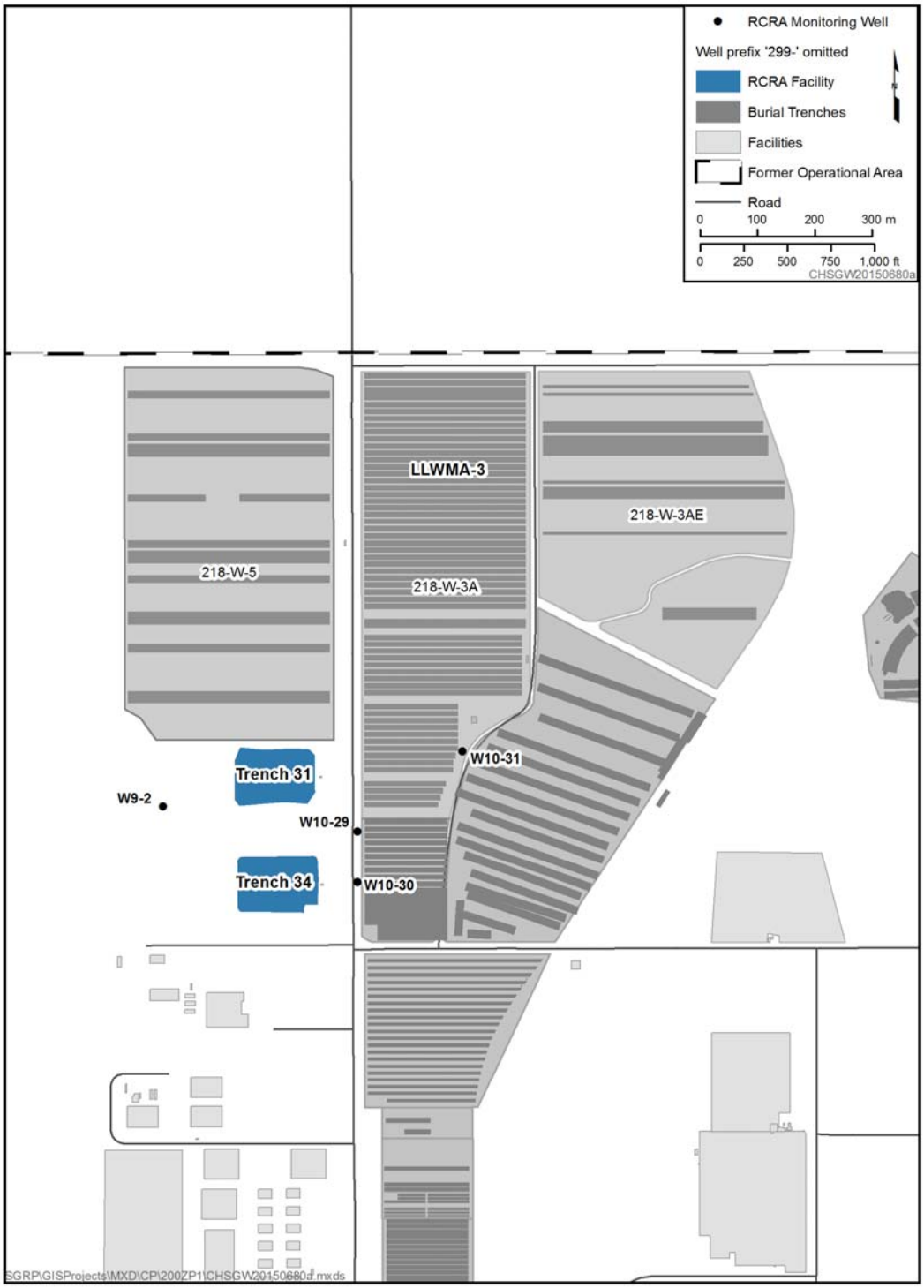


Figure 1-2. LLWMA-3 Burial Grounds 218-W-3A, 218-W-3AE, and 218-W-5

This groundwater monitoring plan addresses the operational history, current hydrogeology, and conceptual site model (CSM) for the site and incorporates knowledge regarding the potential for contamination originating from LLWMA-3. The remainder of this plan includes the following:

- Chapter 2 summarizes background information and provides references to documents containing more detailed or additional information. A description of the LLWMA-3 and the regulatory basis, types of waste present, and the pertinent geology and hydrogeology beneath LLWMA-3 are included, and a brief history of groundwater monitoring is provided. All of this information is summarized as a CSM to aid in development of the groundwater monitoring program.
- Chapter 3 describes the RCRA groundwater monitoring program, including the wells in the monitoring network, constituents analyzed, sampling frequency, and sampling protocols.
- Chapter 4 describes the data evaluation and reporting.
- Chapter 5 provides the references cited in this plan.
- Appendix A provides the quality assurance project plan (QAPjP).
- Appendix B contains sampling protocols.
- Appendix C provides information for the wells in the groundwater monitoring network.

2 Background

This chapter describes the LLWMA-3 and its operating history, regulatory basis, the associated wastes and waste characteristics, local subsurface geology and hydrogeology, a summary of previous groundwater monitoring, and the CSM for the LLWMA-3.

The information in this chapter was obtained from several sources, including Waste Information Data System general summary reports, previous groundwater monitoring plans (listed in Table 2-1), and the following documents:

- DOE/RL-2004-60, *200-SW-2 Radioactive Landfills Group Operable Unit RCRA Facility Investigation/Corrective Measures Study/Remedial Investigation/Feasibility Study Work Plan*
- DOE/RL-2014-43, *Mixed Waste Disposed of in the Low-Level Burial Grounds*

2.1 Facility Description and Operational History

LLWMA-3 is located in the north-central portion of the 200 West Area (Figure 1-1) and consists of the following burial grounds:

- **218-W-3A Burial Ground:** This burial ground is approximately 20.4 ha (50.4 ac) and contains 57 unlined trenches varying in length from 123 to 284 m (403 to 930 ft), and depths of 3.7 to 5.8 m (12 to 19 ft). The burial ground began operating in 1970 but has not received waste since 1998. From 1987 to 1991, only portions of two trenches (T6S and T19) received mixed waste regulated by RCRA (disposal post-August 19, 1987) (Figure 2-1). The total volume of both low-level waste (LLW) and mixed low-level waste (MLLW) is estimated at 100,100 m^3 (3,535,000 ft^3).
- **218-W-3AE Burial Ground:** The location of this burial ground includes an area that had previously been the 216-T-4B seepage pond for T Plant condensate effluent. The pond area was often dry due to most of the T Plant condensate effluent being absorbed in the 216-T-4-2 Ditch. The burial ground is approximately 20 ha (49 ac) and contains eight unlined trenches varying in length from 29 to 436 m (95 to 1,430 ft), and depths from 4.9 to 6.1 m (16 to 20 ft), with surface widths between 11.3 to 33 m (37 to 108 ft). The burial ground began operating in 1981 and received waste until July 2004. All filled trenches are thought to contain 2.4 m (7.9 ft) of soil cover. Only portions of two trenches (T05 and T08) received mixed waste regulated by RCRA (disposal post-August 19, 1987) (Figure 2-2). The volume of MLLW is estimated at 21,900 m^3 (773,000 ft^3).
- **218-W-5 Burial Ground:** This burial ground is approximately 37.2 ha (91.9 ac) and contains 11 unlined trenches and 2 lined trenches (T31 and T34). The unlined trenches are between 160 and 350 m (525 and 1,150 ft) long, 4.5 to 12 m (15 to 39 ft) wide, and 5 to 6 m (16 to 20 ft) deep. The lined trenches were constructed in 1994 and are 36 m (120 ft) wide at the bottom, 9.1 m (30 ft) deep, and 230 m (750 ft) long. The burial ground began operating in 1986, and the two double-lined mixed waste trenches are the only trenches that continue to receive waste. The only trenches in this burial ground to receive mixed waste regulated by RCRA (disposal post-August 19, 1987) were a portion of one unlined trench (T22) and the two lined trenches (T31 and T34) (Figure 2-3). Each lined trench (T31 and T34) has a disposal capacity estimated at 21,400 m^3 (28,000 yd^3). Storage capacities for the T31 and T34 waste storage and treatment pads are 1,150 m^3 (1,500 yd^3) and 1,240 m^3 (1,620 yd^3), respectively.

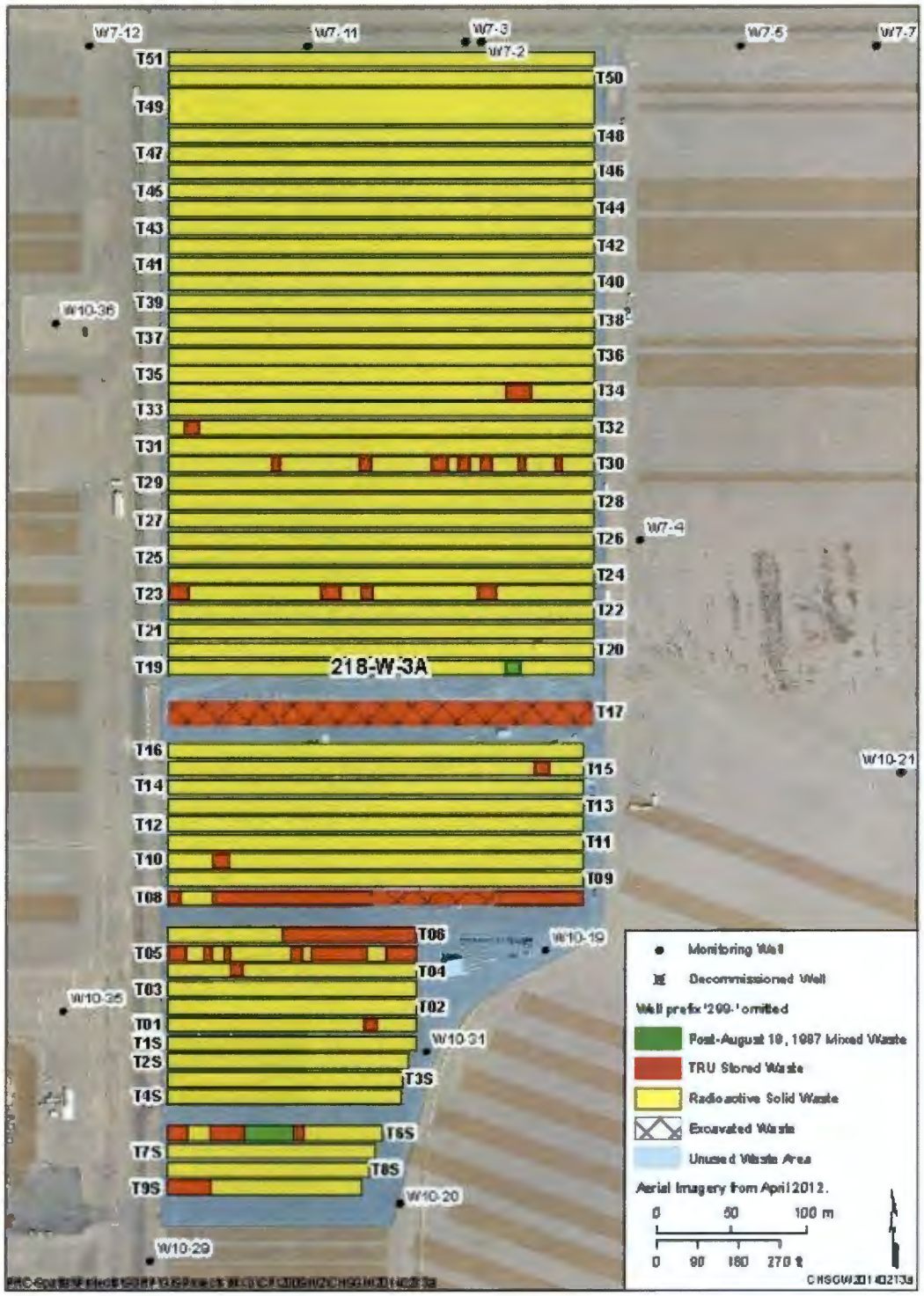


Figure 2-1. Map of the 218-W-3A Burial Ground

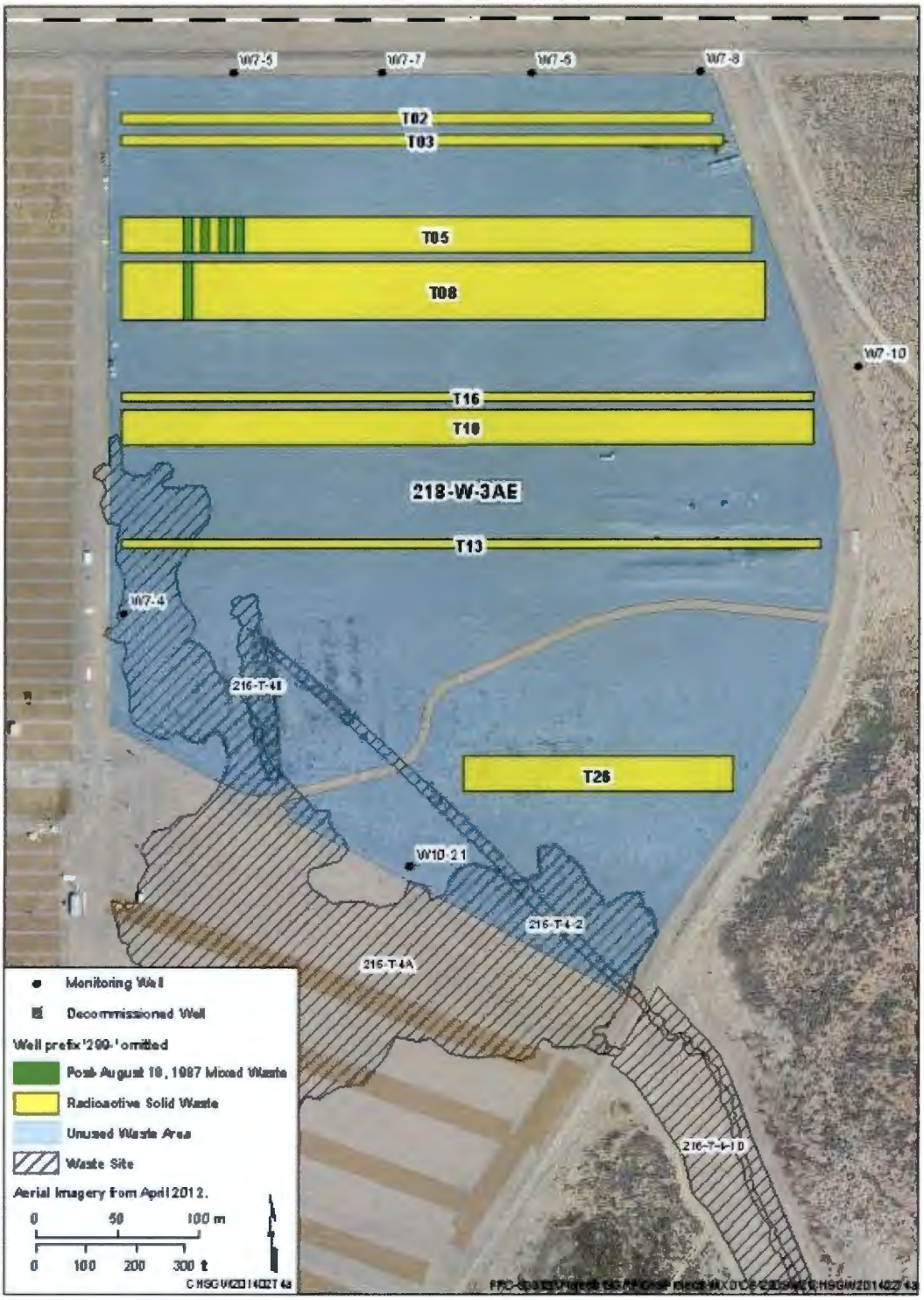


Figure 2-2. Map of the 218-W-3AE Burial Ground

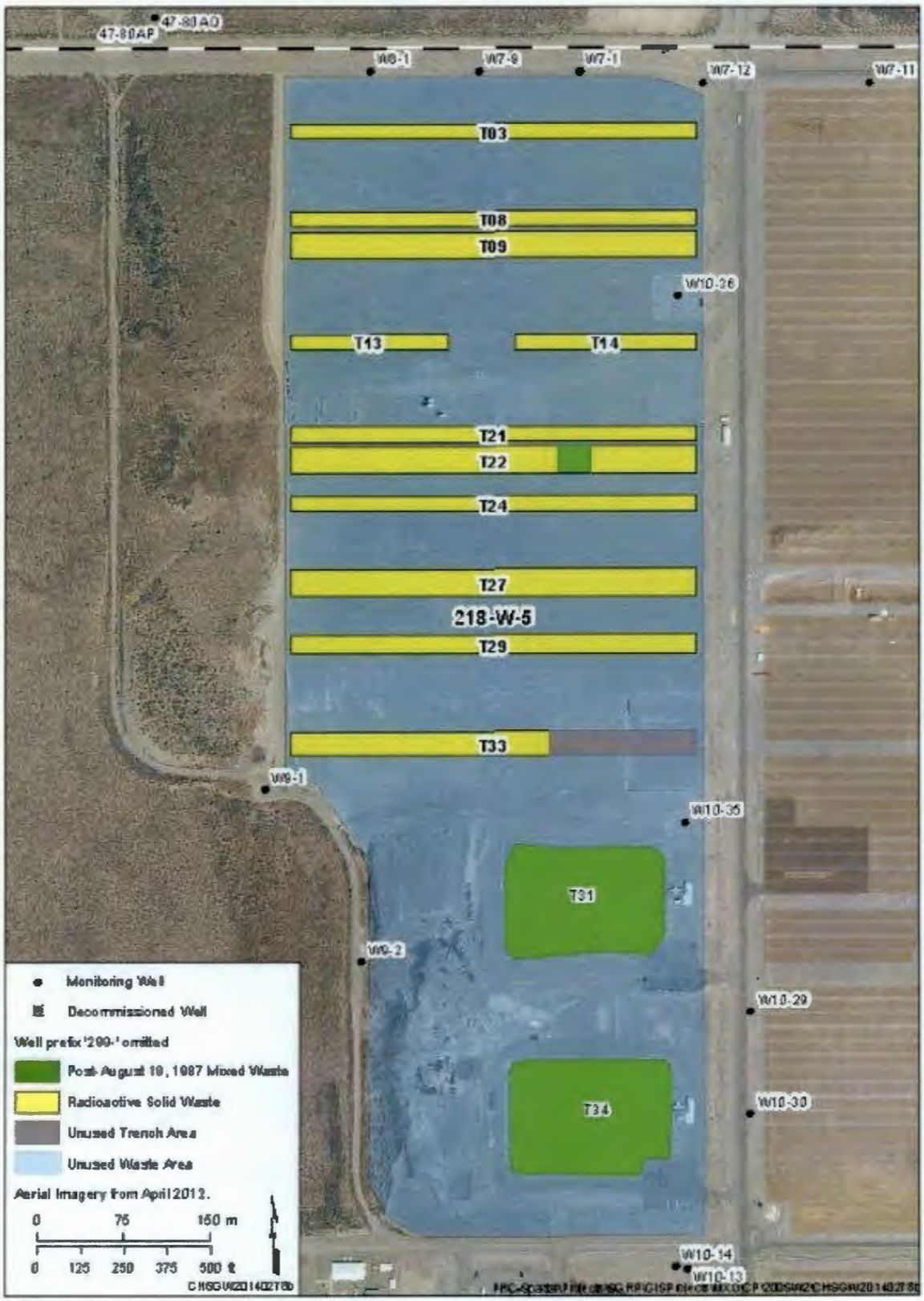


Figure 2-3. Map of the 218-W-5 Burial Ground

2.2 Regulatory Basis

In May 1987, the U.S. Department of Energy (DOE) issued a final rule (10 CFR 962, "Byproduct Material"), stating that the hazardous waste components of mixed waste are subject to RCRA regulations. In November 1987, the U.S. Environmental Protection Agency (EPA) authorized Ecology to regulate these hazardous waste components within the state of Washington (51 FR 24504, "EPA Clarification of Regulatory Authority Over Radioactive Mixed Waste"). In 1996, the Washington State Attorney General determined that the effective date for regulation of mixed waste in Washington State was August 19, 1987.

In May 1989, DOE, EPA, and Ecology signed the Tri-Party Agreement (Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order*). This agreement established the roles and responsibilities of the agencies involved in regulating and controlling remedial restoration of the Hanford Site, which includes LLWMA-3. Groundwater monitoring was conducted at LLWMA-3 in accordance with WAC 173-303-400(3), "Dangerous Waste Regulations," "Interim Status Facility Standards" (and by reference, 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, "Ground-Water Monitoring"), which requires monitoring to determine whether dangerous waste constituents from the waste site have entered the groundwater.

Dangerous waste is regulated under the RCRA (as modified in 40 CFR 265 and RCW 70.105, "Hazardous Waste Management" [also referred to as the *Hazardous Waste Management Act*]) and its implementing requirements in WAC 173-303-400. Radionuclides in the mixed waste may include source, special nuclear, and byproduct materials, as defined in the AEA. Both RCRA and AEA state that these radionuclide materials are regulated at DOE facilities exclusively by DOE, acting pursuant to its AEA authority. Radionuclide materials are not hazardous/dangerous wastes and, therefore, are not subject to regulation by the state of Washington under RCRA or the Washington State *Hazardous Waste Management Act* (RCW 70.105).

In 1994, Ecology issued the Hanford Facility RCRA Permit (WA7890008967) for the Hanford Site, which contains requirements specifically applicable to TSD units that are undergoing closure. Part II, Condition II.F of the Permit specifies that a groundwater monitoring program under final status is subject to the requirements of WAC 173-303-645.

Groundwater monitoring at LLWMA-3 was initiated in 1987 (PNL-6772, *A Detection-Level Hazardous Waste Ground-Water Monitoring Compliance Plan for the 200 Areas Low-Level Burial Grounds and Retrievable Storage Units*) based on the interim status indicator evaluation program requirements of 40 CFR 265, Subpart F, and WAC 173-303-400. The groundwater monitoring plan was revised in 1989 (WHC-SD-EN-AP-015, *Revised Ground-Water Monitoring Plan for the 200 Areas Low-Level Burial Grounds*) due to the planned installation of 16 new wells throughout the waste management areas.

In 1990, a groundwater assessment program was initiated (WHC-SD-EN-AP-022, *Interim-Status Ground-Water Quality Assessment Plan for Waste Management Area 3 of the 200 Areas Low-Level Burial Grounds*) because results from the September 1989 sampling event showed that total organic halogen (TOX) in well 299-W7-4 exceeded the statistical comparison value, and total organic carbon (TOC) exceeded the statistical comparison value at downgradient wells 299-W7-5 and 299-W8-1. Resampling confirmed the TOX exceedance. Analytical results from three additional upgradient monitoring wells (299-W10-19, 299-W10-20, and 299-W10-21) indicated that the elevated TOX came from the carbon tetrachloride plume in the 200 West Area and not from a release of dangerous waste constituents from LLWMA-3. Groundwater contamination plumes from other past practice waste sites in the 200 West area may be found in the Hanford Site annual groundwater monitoring reports

(e.g., DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014*). Sampling for TOC in wells 299-W7-5 and 299-W8-1 indicated that the September 1989 elevated values were erroneous, and the critical mean for TOC was not exceeded. An assessment report was prepared in 1994 (WHC-SD-EN-EV-026, *Results of the Groundwater Quality Assessment Program at Low-Level Waste Management Area 3 of the Low-Level Burial Grounds*) and indicator evaluation monitoring resumed.

The interim status groundwater monitoring plan was revised in 2004 (PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*) because of extensive modifications within the monitoring well network due to wells going dry, as well as a change in groundwater flow direction that changed the designation of upgradient wells 299-W10-19, 299-W10-20, and 299-W10-21 to become downgradient wells. In 2006 and 2007, PNNL-14859 was updated with interim change notices (PNNL-14859-ICN-1 and PNNL-14859-ICN-2) to reflect changes in the monitoring well networks (some wells had gone dry and could no longer be sampled) and to include wells that had been installed and added to the monitoring network. The groundwater monitoring plan was revised again in 2010 (DOE/RL-2009-68, Rev. 0, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*) to address the following actions:

- Remove wells screened deep in the unconfined aquifer (299-W7-3 and 299-W10-14).
- Remove well 299-W8-1, which became cross-gradient to LLWMA-3 due to changes in flow direction.
- Remove well 299-W7-4 due to safety concerns.
- Remove reduction-oxidation potential, mercury, and lead from the analyte list.

In 2011, Rev. 1 of DOE/RL-2009-68 was issued to include a proposed new upgradient well; Rev. 2, issued in 2012, included newly drilled upgradient well 299-W9-2.

Ecology, 2014, *Agreed Order and Stipulated Penalty No. DE 10156*, was signed in 2014, requiring submittal of a Permit modification request for Part B Permit documents for LLBG Trenches 31 and 34. This groundwater monitoring plan will be included in the Permit modification request. Upon issuance of the final status permit for Trenches 31 and 34, those units will operate under final status standards. Groundwater monitoring will be performed under the final status requirements for a detection monitoring program in accordance with WAC 173-303-645(9).

2.3 Waste Characteristics

The 218-W-3A Burial Ground (Figure 2-1) received shipments described as miscellaneous radiological waste (transuranic and nontransuranic waste) from cleanup of the Three-Mile Island, Pennsylvania nuclear incident; irradiated fuel elements from the General Electric Company in Vallecitos, California; radioactive soil from a salt waste spill (encased in concrete burial boxes); and industrial waste. Examples of waste disposed in this burial ground include ion exchange resins, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, and accessories. Only small portions of two trenches (T6S and T19) received mixed waste regulated under RCRA. The mixed waste disposed included drums containing toluene, heavy metals (barium, cadmium, chromium, lead, mercury, and silver), dioxane, naphthalene, hydraulic oil, sorbed organic liquids, pseudocumene, tar, and asphalt. Additional details, including waste burial records for mixed waste disposed in trenches T6S and T19, are provided in DOE/RL-2014-43.

Waste historically received at 218-W-3AE Burial Ground (Figure 2-2) included miscellaneous waste (e.g., rags, paper, rubber gloves, disposable supplies, and broken tools), industrial waste (e.g., failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, and accessories), and

radiological waste. Only a few areas in two trenches (T05 and T08) in this burial ground received mixed waste regulated under RCRA. The mixed waste disposed included drums containing asbestos, silver, aluminum nitrate, lead, and beryllium. Additional details, including waste burial records for mixed waste disposed in trenches T05 and T08, are provided in DOE/RL-2014-43.

The 218-W-5 Burial Ground (Figure 2-3) received packaged waste materials from 200 West Area operations, as well as other wastes from the Hanford Site and offsite. Examples of waste disposed to this burial ground include rags, paper, rubber gloves, disposable supplies, and broken tools. Two lined trenches, T31 and T34, received mixed waste beginning in 1999 and continue to receive dangerous and/or mixed waste from Hanford onsite and offsite generators. One small area in one unlined trench (T22) received mixed waste regulated under RCRA that consisted of 24 drums originally accepted as LLW, but the waste was later declared to be mixed waste by the generator. The waste disposal records included in DOE/RL-2014-43 indicate that the drums contained tar, diatomite, silica gel, steel, plastic, and paper.

2.4 Geology and Hydrogeology

The geology and hydrogeology of the 200 West Area, including the region of LLWMA-3, are described in detail in the following documents:

- PNL-6820, *Hydrogeology of the 200 Areas Low-Level Burial Grounds – An Interim Report*
- PNL-7336, *Geohydrology of the 218-W-5 Burial Ground, 200-West Area, Hanford Site*
- PNNL-13858, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-West Area and Vicinity, Hanford Site, Washington*
- PNNL-16887, *Geologic Descriptions for the Solid-Waste Low Level Burial Grounds*
- WHC-SD-EN-AP-015, *Revised Ground-Water Monitoring Plan for the 200 Areas Low-Level Burial Grounds*
- WHC-SD-EN-TI-290, *Geologic Setting of the Low-Level Burial Grounds*

The following discussion summarizes descriptions from these documents. The uppermost aquifer and other aquifers hydraulically interconnected beneath the LLWMA are also discussed.

2.4.1 Stratigraphy

The LLWMA-3 is underlain from the ground surface to the top of the basalt by the Hanford formation, the Cold Creek unit (CCU), and the Ringold Formation (Figure 2-4). The Hanford formation consists of uncemented gravel, sand, and silt deposited by Pleistocene cataclysmic flood waters. The CCU consists of very hard rock that formed during soil development as precipitation evaporated and left behind minerals forming caliche called hardpan. This unit is 0 to 20 m (0 to 66 ft) thick. The CCU influences contaminant migration by slowing its rate of downward movement and potentially diverting contaminants laterally (Slate, 1996, "Buried Carbonate Paleosols Developed in Pliocene-Pleistocene Deposits of the Pasco Basin, South-Central Washington, U.S.A."). The Ringold Formation at this location is mostly sand and gravel, with minor units of finer grained sediment. Most of the unconfined aquifer in the Pasco Basin lies within the member of Wooded Island (Unit E) of the Ringold Formation. Erosional remnants of the Ringold member of Taylor Flat locally overlie Ringold Unit E (PNNL-16887). The Ringold lower mud unit is absent beneath the northernmost portion of the area (PNNL-13858).

The suprabasalt sediment ranges in thickness from 145 to 160 m (475 to 525 ft) (Figure 2-4), and generally the top of the Ringold Formation and the CCU dip to the south. The CCU rises to within 6 m (20 ft) of the surface along the northern boundary of LLWMA-3 (PNL-7336).

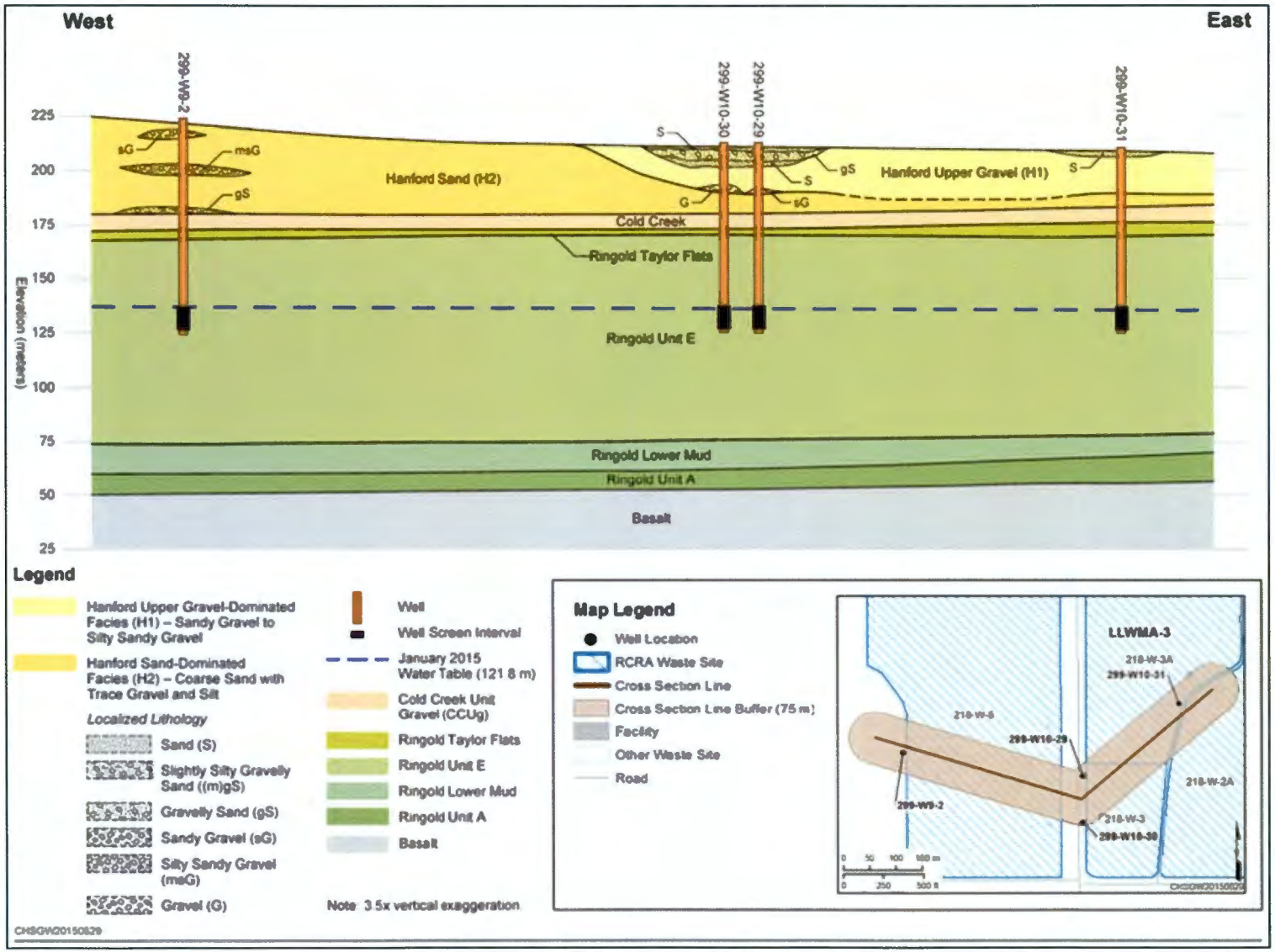


Figure 2-4. Geologic Cross Section beneath LLWMA-3

D

2.4.2 Hydrogeology

The vadose zone beneath LLWMA-3 is approximately 74 to 78 m (240 to 260 ft) thick and consists of the Hanford formation, the CCU, the Taylor Flats member (Figure 2-4) of the Ringold Formation (not present everywhere beneath LLWMA-3), and the upper portion of Ringold Unit E (Figure 2-4).

The water table is at approximately 134 to 137 m (440 to 450 ft) elevation and is entirely within the upper Ringold Unit E. The saturated thickness of the uppermost aquifer is approximately 60 m (200 ft) in the south and 75 m (250 ft) in the north where the Ringold lower mud unit is absent (PNNL-13858). There is some evidence that a local confining layer, or at least a zone of lower permeability, may be present just at the water table.

The hydraulic conductivity values derived from aquifer testing in wells completed in the upper portion of the unconfined aquifer at LLWMA-3 varied from 2.5 to 10 m/d (8.2 to 32.8 ft/d) (PNNL-14753, *Groundwater Data Package for the 2004 Composite Analysis*). The average effective porosity of aquifer materials is between 0.1 and 0.3 with a hydraulic gradient of 0.0048.

2.4.3 Groundwater Flow Interpretation

Groundwater currently flows generally eastward-southeastward beneath LLWMA-3 and is affected by groundwater injection from the 200 West Pump and Treat, which began operating in 2012. Two injection wells (299-W10-35 and 299-W10-36) are within the boundaries of LLWMA-3. Another injection well (299-W6-14) is located east of the LLWMA. As a result of injection, the groundwater flow direction beneath LLWMA-3 (east of injection wells 299-W10-35 and 299-W10-36) is now east to east-southeast (Figure 2-5).

The horizontal hydraulic gradient of as of 2014 was 0.0048. The average flow rate is calculated at 0.16 to 0.64 m/d (0.52 to 2.07 ft/d).

Historically, the water table beneath LLWMA-3 was affected by disposal of liquid effluent to various facilities. Water levels in the unconfined aquifer increased as much as 13 m (43 ft) above the pre-Hanford natural water table. Discharges to T Pond and U Pond from the 1940s through the 1970s changed the groundwater flow direction beneath the LLWMA from eastward (the pre-Hanford direction) to the north and northwest. More recently, flow direction has returned to the pre-Hanford east or east-northeast direction. The State-Approved Land Disposal Site is located about 500 m (1,640.4 ft) north of LLWMA-3 and began operation in 1995. Since that time, more than 880 million L (232 million gal) of effluent have been discharged to the facility. Those discharges have not affected the groundwater flow direction beneath LLWMA-3.

2.5 Summary of Previous Groundwater Monitoring

Table 2-1 lists the previous groundwater monitoring plans implemented for LLWMA-3.

RCRA groundwater monitoring was initiated at the LLWMA-3 in 1987 in accordance with PNL-6772. The groundwater monitoring plan was revised in 1989 (WHC-SD-EN-AP-015) due to the planned installation of 16 new wells throughout the waste management areas.

In 1990, a groundwater assessment program was initiated (WHC-SD-EN-AP-022) because the results from the September 1989 sampling event showed that TOX in well 299-W7-4 exceeded the statistical comparison value, and TOC exceeded the statistical comparison value at downgradient wells (299-W7-5 and 299-W8-1). Resampling confirmed the TOX exceedance. Analytical results from three additional upgradient monitoring wells (299-W10-19, 299-W10-20, and 299-W10-21) indicated that the elevated

TOX came from the carbon tetrachloride plume in the 200 West Area and not from a release of dangerous waste constituents from LLWMA-3. Sampling for TOC in wells 299-W7-5 and 299-W8-1 indicated that the September 1989 elevated values were erroneous and that the critical mean for TOC was not exceeded. An assessment report was prepared in 1994 (WHC-SD-EN-EV-026) and indicator evaluation monitoring resumed.

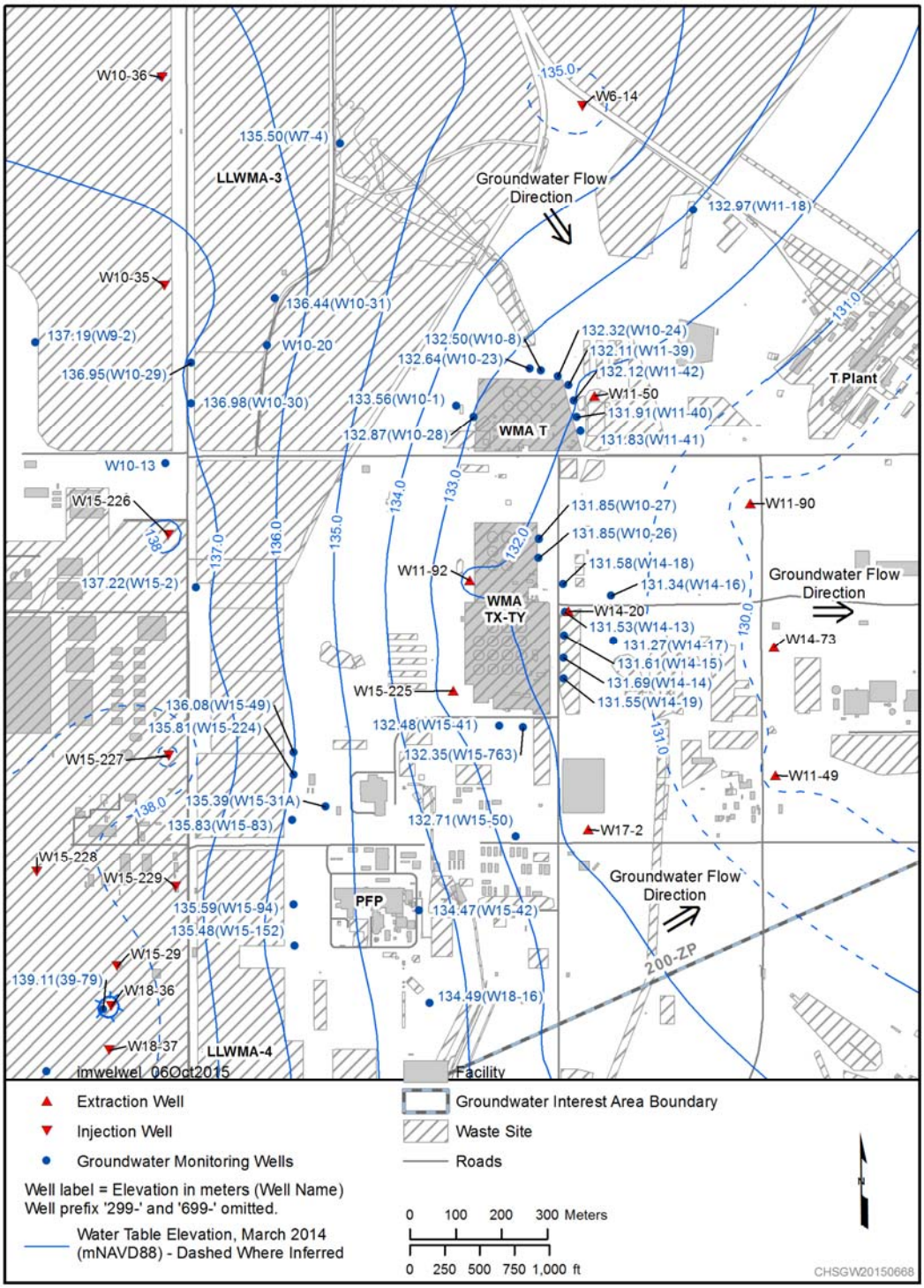


Figure 2-5. Water Table Map for LLWMA-3

Table 2-1. Previous Monitoring Plans

Document	Date Issued	Monitoring Program*
PNL-6772, *A Detection-Level Hazardous Waste Ground-Water Monitoring Compliance Plan for the 200 Areas Low-Level Burial Grounds and Retrievable Storage Units*	February 1987	Indicator evaluation program
WHC-SD-EN-AP-015, Rev. 0, *Revised Ground-Water Monitoring Plan for the 200 Areas Low-Level Burial Grounds*	May 1989	Indicator evaluation program
WHC-SD-EN-AP-022, Rev. 0, *Interim-Status Ground-Water Quality Assessment Monitoring Plan for Waste Management Area 3 of the 200 Areas Low-Level Burial Grounds*	January 1990	Groundwater quality assessment
PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*	September 2004	Indicator evaluation program
DOE/RL-2009-68, Rev. 0, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*	March 2010	Indicator evaluation program
DOE/RL-2009-68, Rev. 1, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*	June 2011	Indicator evaluation program
DOE/RL-2009-68, Rev. 2, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*	September 2012	Indicator evaluation program

* The indicator evaluation program satisfies the requirements of 40 CFR 265.92(b)(2), (b)(3), (d)(1), (d)(2) and (e), "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis." The groundwater quality assessment program's first determination satisfies the requirements of 40 CFR 265.93(d)(4) and (d)(6), "Preparation, Evaluation, and Response."

The interim status groundwater monitoring plan was revised in 2004 (PNNL-14859) because of extensive modifications within the monitoring well network due to wells going dry and a change in groundwater flow direction from north-northeast (during the beginning of RCRA groundwater monitoring) to east-northeast in 2003, which changed the designation of wells 299-W10-19, 299-W10-20, and 299-W10-21 from upgradient to downgradient. In 2006 and 2007, PNNL-14859 was updated to reflect changes in the monitoring well networks because some wells had gone dry and could no longer be sampled, as well as to include wells that had been installed and added to the monitoring network (PNNL-14859-ICN-1, PNNL-14859-ICN-2). The groundwater monitoring plan was revised in 2010 (DOE/RL-2009-68, Rev. 0) to remove wells screened deep in the unconfined aquifer (299-W7-3 and 299-W10-14); to remove 299-W8-1, which became cross-gradient to LLWMA-3 because of changes in flow direction; to remove 299-W7-4 because of safety concerns; and to remove reduction-oxidation potential, mercury, and lead from the analyte list. DOE/RL-2009-68, Rev. 1 included a proposed new upgradient well, and Rev. 2 included newly drilled upgradient well 299-W9-2.

The interim status groundwater monitoring network at LLWMA-3 currently consists of four wells. Two additional downgradient wells are added to the network for final status monitoring under this groundwater monitoring plan, for a network of six wells. Samples are analyzed semiannually for parameters used as indicators of groundwater contamination and annually for parameters establishing groundwater quality. Water level measurements are collected each time that a sample is obtained from a network well. The network wells are also included in the annual comprehensive March water level measurement campaign (SGW-38815, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*). Groundwater monitoring results for LLWMA-3 are summarized each year in the Hanford Site annual groundwater monitoring report (e.g., DOE/RL-2015-07).

2.6 Conceptual Site Model

This section describes the LLWMA-3 CSM for potential contaminant transport to guide future groundwater monitoring. The CSM describes the current understanding of the contaminant release and transport and includes the following assumptions:

- Engineered barriers are not taken into account, so the model is applicable to unlined trenches but is highly conservative for the newest (lined) mixed waste trenches.
- Average precipitation and net infiltration (5 to 10 cm/yr [2 to 3.9 in./yr]) prevail over the time frame of interest.
- Net infiltration is assumed to occur under gravity drainage.
- Maximum vertical hydraulic conductivity in the vadose zone is assumed to be significantly larger than the net infiltration rate.
- The effective saturated porosity in the vadose zone is equal to the moisture content.
- Leaching of mobile contaminants from buried waste in unsealed containers or contaminated soils in direct contact with the trench is assumed to be the major potential sources for contamination.
- Extreme conditions or accidental releases are recognized as factors but would be addressed under emergency response/corrective actions.

The volume of the pore space beneath both of the trenches to the water table is approximately 87,100 m^3 (2.30E+07 gal), assuming 25 percent effective porosity in the vadose zone sediment, 4,650 m^2 (50,000 ft^2) for the area of the mixed waste trenches, and 75 m (246 ft) to the water table. Historical knowledge of past leaks or releases into the vadose zone from analogous sites indicates that the leaks would not cover the entire surface area prior to infiltration. Therefore, the volume of pore space can be further reduced to assume that only 10 to 15 percent of available surface area may become saturated with liquid waste. Using 15 percent to be conservative, the available volume of pore space is 13,070 m^3 (3,450,000 gal).

The leachate collection system for both trenches (primary and secondary sumps), when full, has a total capacity of 2,100 m^3 (555,000 gal), assuming a conservative 75 percent effective porosity. Using this capacity volume, the ratio of pore space in the vadose zone between the trench and water table to leachate collection capacity is calculated as approximately 6:1; therefore, available pore space volume is over six times greater than the volume of a catastrophic release. The large calculated spare capacity would likely impede migration of liquid waste to groundwater.

The CSM illustrates that the potential for migration of substantial amounts of contamination from the vadose zone to groundwater is small because of the presence of the CCU, which inhibits downward migration from the surface to groundwater. A finer grained lithologic unit lies below the CCU within the stratigraphic framework under mixed waste Trenches 31 and 34. The Taylor Flat member of the Ringold Formation (shown in Figure 2-4) is interpreted from well construction geologic logs near Trenches 31 and 34. It is a fine-grained sequence consisting of interstratified, well-bedded, fine to coarse sand, to silt, and equivalent to the upper Ringold Formation unit mentioned in previous documents (PNNL-16887). The combined moisture retention properties for the CCU and the Taylor Flat member of the Ringold Formation within the vadose zone have high capacity to absorb and retain moisture.

2.6.1 Geochemical Considerations

The solubility and subsequent mobility of waste constituents in pore fluid depend on the container, chemical nature of the waste constituents, and natural subsurface geochemical conditions.

Pore fluid in the unsaturated and saturated zones beneath LLWMA-3 is slightly alkaline (>7 pH <8), with appreciable amounts of bicarbonate (HCO_3) and very little natural organic material. The lack of organic material means that conditions generally are oxidizing. Calcium carbonate is also present in vadose zone sediment. These general conditions favor sorption or retardation of many heavy metals (e.g., lead) and favor formation of anionic species, which enhances mobility for other metals (e.g., hexavalent chromium). Laboratory sorption studies have documented these effects and related mobility issues in Hanford Site media (PNNL-11800, *Composite Analysis of Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site*).

2.6.2 Soil Moisture Factors Affecting Hypothetical Leaching of Waste Constituents

With the exception of waste in sealed metal or concrete containers (e.g., retrievable waste), direct precipitation is the primary driver for hypothetical leaching of waste constituents (e.g., chromium, cresols, methylene chloride, and methyl ethyl ketone) from the burial trenches and subsequent transport to groundwater. Contaminants in the soil disposed to the trench or waste in degradable containers (e.g., cardboard boxes or wooden boxes) subject to collapse are assumed to be leachable.

The amount of natural infiltration that can pass through the leachable buried waste and drain to the water table is controlled by the texture of the cover and backfill and by the amount of vegetative cover. Stratigraphic features in the soil column beneath the buried waste can also influence or retard downward migration by spreading soil moisture laterally. Direct observational evidence to assess this effect at LLWMA-3 is lacking. Under the gravity drainage assumption, only a small horizontal gradient component is likely to be available to produce lateral spreading of infiltrating water.

Most of the burial ground trenches are backfilled with natural excavation materials (Hanford formation) consisting of coarse gravel, cobbles, and some interstitial sand. Some amount of vegetation exists on the established backfilled areas and the unused portions of the LLWMA. A coarse, nonvegetated cover material allows a major fraction of the precipitation to infiltrate and potentially drain to groundwater. It is estimated that recharge rates at the Hanford Site range from nearly 0 mm/yr (0 cm/yr) at highly vegetated sites to greater than 50 mm/yr (5 cm/yr) at gravel-covered, nonvegetated sites (PNNL-14702, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*).

2.6.3 Hydrogeologic Considerations

The vadose zone beneath LLWMA-3 is approximately 74 to 78 m (240 to 260 ft) thick and consists of (from top to bottom) the Hanford formation, the CCU, and the Ringold Formation (Figure 2-6). The CCU is likely to retard downward movement of moisture and contaminants because of the finer textured sediment and cementing that characterize this stratigraphic feature in the vadose zone. The depth of the CCU increases from north to south beneath the LLWMA, so any lateral spreading on top of the CCU will be toward the south.

Hypothetically, if contaminants do break through to groundwater beneath LLWMA-3, the contaminants would move throughout the unconfined aquifer toward the east-southeast. The flow direction is affected by injection of treated water from the 200 West Pump and Treat. Because of the low permeability of the aquifer in this area, the groundwater flow rate is estimated to be between approximately 58 to 237 m/yr (190 to 756 ft/yr).

2.7 Monitoring Objectives

The groundwater monitoring program at LLWMA-3 is conducted with the objective of determining the impact of the facility, if any, on the quality of the underlying groundwater. This groundwater monitoring plan addresses specifically those applicable RCRA requirements for final status TSD units where no impact to groundwater has been identified. The groundwater monitoring program at LLWMA-3 is conducted in accordance with WAC 173-303-645, as required by the Hanford Facility RCRA Permit (WA7890008967), Part II, Condition II.F. Detection monitoring is implemented in accordance with WAC 173-303-645(9), which requires the establishment and implementation of a groundwater monitoring program capable of determining if there is statistically significant evidence of contamination in the uppermost aquifer underlying LLWMA-3. Table 2-2 identifies where each groundwater monitoring element of the pertinent regulations is addressed within this plan. Additional monitoring objectives applicable to groundwater quality for anions, metals, alkalinity, and field measurements are listed in Table 2-3. Data for these constituents will be collected to support the evaluation of upgradient and downgradient water chemistry variations.

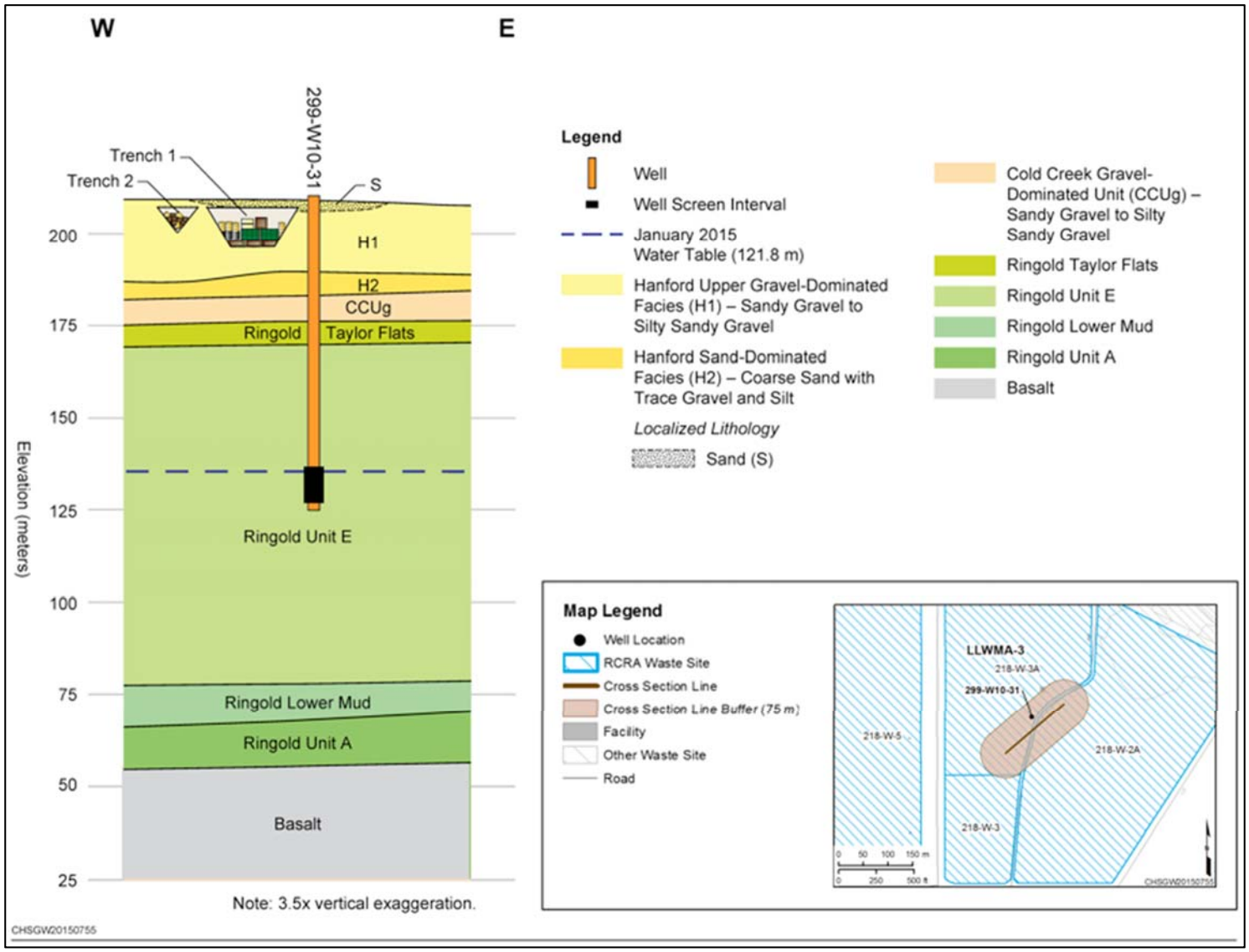


Figure 2-6. CSM for LLWMA-3

Table 2-2. Pertinent WAC 173-303-645 Detection Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement Is Addressed in Monitoring Plan
Parameters to be sampled Frequency of sampling Water-level measurements	WAC 173-303-645(9) "Detection Monitoring Program": (a) The owner or operator must monitor for indicator parameters (e.g., pH, specific conductance, total organic carbon (TOC), total organic halogen (TOX), or heavy metals), waste constituents, or reaction products that provide a reliable indication of the presence of dangerous constituents in groundwater. The department will specify the parameters or constituents to be monitored in the facility permit, after considering the following factors: (i) The types, quantities, and concentrations of constituents in wastes managed at the regulated unit; (ii) The mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the waste management area; (iii) The detectability of indicator parameters, waste constituents, and reaction products in groundwater; and (iv) The concentrations or values and coefficients of variation of proposed monitoring parameters or constituents in the groundwater background. (c) The owner or operator must conduct a groundwater monitoring program for each chemical parameter and dangerous constituent specified in the permit pursuant to (a) of this subsection in accordance with subsection (8)(g) of this section. (d) The department will specify the frequencies for collecting samples and conducting statistical tests to determine whether there is statistically significant evidence of contamination for any parameter or dangerous constituent specified in the permit under (a) of this subsection in accordance with subsection (8)(g). (e) The owner or operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually. WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (e) The groundwater monitoring program must include consistent sampling and analytical methods that ensure reliable groundwater sampling, accurately measure dangerous constituents and indicator parameters in groundwater samples, and provide a reliable indication of groundwater quality below the waste management area. (f) The groundwater monitoring program must include a determination of the groundwater surface elevation each time groundwater is sampled.	Section 3.1 Section 4.2 Section 4.4 Appendix A, Chapter A3 Appendix B, Chapter B2 and Section B2.2

Table 2-2. Pertinent WAC 173-303-645 Detection Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement Is Addressed in Monitoring Plan
	(g) In detection monitoring, data on each dangerous constituent specified in the permit will be collected from background wells and wells at the compliance point(s). The number and kinds of samples collected to establish background must be appropriate for the form of statistical test employed, following generally accepted statistical principles. The sample size must be as large as necessary to ensure with reasonable confidence that a contaminant release to groundwater from a facility will be detected. The owner or operator will determine an appropriate sampling procedure and interval for each hazardous constituent listed in the facility permit which will be specified in the unit permit upon approval by the department. This sampling procedure will be: (i) A sequence of at least four samples, taken at an interval that assures, to the greatest extent technically feasible, that an independent sample is obtained, by reference to the uppermost aquifer's effective porosity, hydraulic conductivity and hydraulic gradient, and the fate and transport characteristics of the potential contaminants; or (ii) An alternate sampling procedure proposed by the owner or operator and approved by the department.	
Procedures and techniques	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (d) The groundwater monitoring program must include at a minimum, procedures and techniques for: (i) Decontamination of drilling and sampling equipment; (ii) Sample collection; (iii) Sample preservation and shipment; (iv) Analytical procedures and quality assurance; and (v) Chain of custody control.	Appendix A, Appendix B, Chapter B2 and Sections B5.1, B5.2, and B5.3
Point of compliance Number and location of wells	WAC 173-303-645(9) "Detection Monitoring Program": (b) The owner or operator must install a groundwater monitoring system at the compliance point, as specified under subsection (6) of this section. The groundwater monitoring system must comply with subsection (8)(a)(ii), (b), and (c) of this section. WAC 173-303-645(6) "Point of Compliance":	Sections 3.2 and 3.3

Table 2-2. Pertinent WAC 173-303-645 Detection Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement Is Addressed in Monitoring Plan
	The facility permit will specify the point of compliance at which monitoring must be conducted. The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units. WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (a) The groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer that: (i) Represent the quality of background groundwater that has not been affected by leakage from a regulated unit; (ii) Represent the quality of groundwater passing the point of compliance. (iii) Allow for the detection of contamination when dangerous waste or dangerous constituents have migrated from the waste management area to the uppermost aquifer. (b) If a facility contains more than one regulated unit, separate groundwater monitoring systems are not required for each regulated unit, provided that provisions for sampling the groundwater in the uppermost aquifer will enable detection and measurement at the compliance point of dangerous constituents from the regulated units that have entered the groundwater in the uppermost aquifer.	
Well configuration	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must allow collection of representative groundwater samples. Wells must be constructed in such a manner as to prevent contamination of the samples, the sampled strata, and between aquifers and water bearing strata. Wells must meet the requirements applicable to resource protection wells, which are set forth in Chapter 173-160 WAC, "Minimum standards for construction and maintenance of wells."	Section 3.3 Appendix C
Statistical evaluation Statistical methods	WAC 173-303-645(9) "Detection Monitoring Program": (d) The department will specify the frequencies for conducting statistical tests to determine whether there is statistically significant evidence of contamination for any parameter or dangerous constituent specified in the permit under (a). (f) The owner or operator must determine whether there is statistically significant evidence of contamination for any chemical parameter of dangerous constituent specified in the permit at the specified frequency.	Section 4.2 Section 4.5

Table 2-2. Pertinent WAC 173-303-645 Detection Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement Is Addressed in Monitoring Plan
	(i) In determining whether statistically significant evidence of contamination exists, the owner or operator must use the method(s) specified in the permit under subsection (8)(h) of this section. These method(s) must compare data collected at the compliance point(s) to the background groundwater quality data. (ii) The owner or operator must determine whether there is statistically significant evidence of contamination at each monitoring well as the compliance point within a reasonable period of time after completion of sampling. WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (h) Groundwater monitoring data will be evaluated using a specified statistical method. The statistical test will be conducted separately for each dangerous constituent in each well. Where practical quantification limits (PQLs) are used in any of the following statistical procedures to comply with (i)(v) of this subsection, the PQL must be proposed by the owner or operator and approved by the department. Use of any of the following statistical methods must be protective of human health and the environment and must comply with the performance standards outlined in (i) of this subsection. (i) A parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent. (iii) A tolerance or prediction interval procedure in which an interval for each constituent is established from the distribution of the background data, and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit. (v) Another statistical test method submitted by the owner or operator and approved by the department. (i) Any statistical method chosen under (h) of this subsection for specification in the unit permit must comply with the following performance standards, as appropriate: (i) The statistical method must be appropriate for the distribution of the dangerous constituent. The practical quantification limit used in the statistical method must be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.	

Table 2-2. Pertinent WAC 173-303-645 Detection Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement Is Addressed in Monitoring Plan
	(ii) If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test must be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparisons procedure is used, the Type I experiment wise error rate for each testing period must be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, prediction intervals, or control charts. (iv) If a tolerance interval or a prediction interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, must be proposed by the owner or operator and approved by the department if it finds these parameters to be protective of human health and the environment. These parameters will be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern. (v) The statistical method must account for data below the limit of detection with one or more statistical procedures that are protective of human health and the environment. Any PQL approved by the department under (h) of this subsection that is used in the statistical method must be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.	
Recordkeeping and reporting	WAC 173-303-645(9) "Detection Monitoring Program": (c) The owner or operator must maintain a record of groundwater analytical data as measured and in a form necessary for the determination of statistical significance. (g) If the owner or operator determines pursuant to (f) of this subsection that there is statistically significant evidence of contamination for chemical parameters or dangerous constituents specified pursuant to (a) of this subsection at any monitoring well at the compliance point, he or she must: (i) Notify the department of this finding in writing within seven days. The notification must indicate what chemical parameters or dangerous constituents have shown statistically significant evidence of contamination:	Section 4.5 Appendix A, Sections A2.6 and A3.9

Table 2-2. Pertinent WAC 173-303-645 Detection Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement Is Addressed in Monitoring Plan
	(ii) Immediately sample the groundwater in all monitoring wells and determine whether constituents in the Appendix "Ground-Water Monitoring List" in *Chemical Testing Methods for Designating Dangerous Waste* which is incorporated at WAC 173-303-110 (3)(c) are present, and if so, in what concentration. However, the department, on a discretionary basis, may allow sampling for a site-specific subset of constituents from the "Ground-Water Monitoring List" Appendix and other representative/related waste constituents. (iii) For any "Ground-Water Monitoring List" Appendix compounds found in the analysis pursuant to (g)(ii) of this subsection, the owner or operator may resample within one month or according to an alternative site-specific schedule approved by the director and repeat the analysis for those compounds detected. If the results of the second analysis confirm the initial results, then these constituents will form the basis for compliance monitoring. If the owner or operator does not resample for the compounds in (g)(ii) of this subsection, the dangerous constituents found during this initial "Ground-Water Monitoring List" Appendix analysis will form the basis for compliance monitoring. (iv) Within ninety days, submit to the department an application for a permit modification to establish a compliance monitoring program meeting the requirements of WAC 173 303 645(10). WAC 173-303-645(8). "General Groundwater Monitoring Requirements": (j) Groundwater monitoring data collected in accordance with WAC 173-303-645(8)(g) including actual levels of constituents must be maintained in the facility operating record. The permit specifies when the data must be submitted for review.	

Note: Complete citations for references listed in this table are provided in Chapter 5 of this plan.

* Part II, Condition II.F of the Hanford Facility RCRA Permit (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, as amended) specifies that a groundwater monitoring program under final status is subject to the requirements of WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." Because there is no evidence of releases of waste impacting the groundwater at LLWMA-3, a detection monitoring program is implemented in accordance with WAC 173-303-645(9), "Detection Monitoring Program."

RCRA = *Resource Conservation and Recovery Act of 1976*

Table 2-3. Additional Monitoring Objectives

Monitoring Objective	Additional Groundwater Quality Parameters
Alkalinity constituents: Used in ion balance and to support water chemistry analysis.	Alkalinity
Metals: Additional metals used in ion balance and to support water chemistry analysis.	Metals (calcium, chromium, magnesium, and potassium)
Anions: Additional anions used in ion balance and to support water chemistry analysis.	Anions (fluoride, nitrate, and nitrite)
Field parameters: Provide information on water properties at the time of sampling.	Field parameters (dissolved oxygen, temperature, and turbidity)

3 Groundwater Monitoring Program

This chapter describes the final status detection groundwater monitoring program for TSD units in LLWMA-3. This chapter describes the groundwater monitoring network, constituents to be sampled and analyzed (i.e., indicator and groundwater quality parameters), the sample frequency, and sampling and analysis protocols. The monitoring program presented herein has been revised from that presented in the previous plan (DOE/RL-2009-68, Rev. 2).

3.1 Constituents List and Sampling Frequency

Table 3-1 presents the wells in the groundwater monitoring network, parameters analyzed as required for RCRA monitoring, and the sampling frequency for monitoring of LLWMA-3. In accordance with WAC 173-303-645(9)(a), parameters used as indicators of groundwater contamination (pH, specific conductance, TOX, and TOX) will be sampled and analyzed semiannually. In accordance with WAC 173-303-645(9)(a), groundwater quality parameters (chloride, alkalinity, anions, metals, sodium, and phenols) will also be sampled and analyzed annually as reliable indictors of the presence of hazardous constituent in groundwater.

Water level measurements at each monitoring well will be determined each time a sample is obtained (WAC 173-303-645(8)(f)). Additional analysis (anions, metals, alkalinity, and field measurements) will also be collected for general groundwater chemistry, which will support the evaluation of upgradient and downgradient water chemistry variations.

Maintenance problems and sampling logistics sometime delay scheduled sampling events. Sampling events are scheduled by month. The field work supervisor (FWS) determines the specific times within a given month that a well is sampled. If a well cannot be sampled at the times determined by the FWS, then the FWS and Sample Management and Reporting group, along with the project scientist, will consult on how best to recover or reschedule the sampling event as close to the original sampling date as possible. Missed sampling events that are not rescheduled within the same month are given top priority when rescheduling in the following month. Missed or cancelled sampling events are reported to the DOE Richland Operations Office, at the appropriate unit managers' meeting, and in the Hanford Site annual groundwater monitoring report (e.g., DOE/RL-2015-07).

3.2 Point of Compliance

The point of compliance is defined in WAC 173-303-645(6) as "…a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units." This is the location in the uppermost aquifer where groundwater monitoring occurs and the groundwater protection standard applies. In detection monitoring, results from the point of compliance wells are evaluated against background wells to determine if there is statistically significant evidence of contamination.

The point of compliance for LLWMA-3 is located within the saturated portion of the screen interval in groundwater monitoring wells 299-W10-13, 299-W10-20, 299-W10-29, 299-W10-30, and 299-W10-31. These wells are located hydraulically downgradient of LLWMA-3 (Figure 2-5) and are screened in the uppermost portion of the unconfined aquifer. Well 299-W10-13 is completed at a shallower depth than the other monitoring wells and is now dry. A replacement well in the same area will be installed following implementation of this plan. Well construction information for these wells is provided in Table 3-2 and Appendix C. The five wells and upgradient groundwater monitoring well 299-W9-2 will be used to monitor for evidence of potential contamination from LLWMA-3 at the point of compliance.

Table 3-1. Monitoring Well for the LLWMA-3

Well Name	Purpose	WAC Compliant	Water Level	RCRA-Required Parameters								Field Parameters[b,e]		
				Indicator Parameters[a]				Groundwater Quality Parameters[b]						
				pH	Specific Conductance	Total Organic Carbon	Total Organic Halogen	Alkalinity[c]	Anions[d]	Phenols	Metals[f]	Dissolved Oxygen	Temperature	Turbidity
299-W9-2	Upgradient	Y	S	S4	S4	S4	S4	A	A	A	A	S	S	S
299-W10-13[g]	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	S	S	S
299-W10-20	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	S	S	S
299-W10-29	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	S	S	S
299-W10-30	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	S	S	S
299-W10-31	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	S	S	S

a. Parameters are required by WAC 173-303-645(9), "Dangerous Waste Regulations," "Detection Monitoring Program."

b. Constituents are not required by RCRA but are used to support interpretation.

c. Alkalinity includes analysis of bicarbonate alkalinity, carbonate alkalinity, and hydroxide alkalinity.

d. Analytes include, but are not limited to, chloride, fluoride, nitrate, nitrite, and sulfate.

e. Field measurements include dissolved oxygen, temperature, and turbidity.

f. Analysis shall be performed for filtered and unfiltered metals. Analytes include, but are not limited to, calcium, chromium, iron, magnesium, manganese, sodium, and potassium.

g. Well is dry and needs replacement.

A = to be sampled annually

RCRA = *Resource Conservation and Recovery Act of 1976*

S = to be sampled semiannually

S4 = to be sampled semiannually, with quadruplicate samples collected during each event

Y = well is constructed as a resource protection well (WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells")

Table 3-2. Attributes for Wells in LLWMA-3 Groundwater Monitoring Network

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Top of Casing Elevation (m) (NAVD88)	Water Table Elevation (m) (amsl)	Water Depth (m [ft] bgs)	Depth of Water in Screen (m [ft])	Water Level Date
299-W9-2	9/22/2011	565742.21	136872.84	223.77	137.0	87.6 (287.4)	9.8 (32.2)	03/13/2015
299-W10-13	9/25/1987	566027.41	136606.81	214.17	b	b	b	b
299-W10-20	11/18/1993	566249.70	136866.61	210.61	c	c	c	c
299-W10-29	3/13/2006	566082.98	136828.74	212.37	136.8	75.6 (248.0)	9.8 (32.2)	03/13/2015
299-W10-30	4/3/2006	566082.78	136739.33	211.65	136.8	74.9 (245.6)	9.7 (31.8)	03/13/2015
299-W10-31	5/10/2006	566266.44	136968.34	210.38	136.3	74.1 (243.1)	9.7 (31.8)	03/13/2015

Reference: NAVD88, *North American Vertical Datum of 1988.*

a. Coordinates are in Washington State Plane (south zone); NAD83, *North American Datum of 1983* (1991 adjustment).

b. Well dry in 2002; replacement well is needed.

c. Well dry in 2008; water elevation has increased with injection of treated effluent and well can now be sampled (otherwise, replacement is needed).

amsl = above mean sea level

bgs = below ground surface

3.3 Monitoring Well Network

The LLWMA-3 interim status groundwater monitoring network consists of one upgradient and three downgradient wells, all screened at the top of the unconfined aquifer. Two additional downgradient wells (299-W10-13 and 299-W10-20) are added to the network for final status monitoring. Replacement wells are planned if sampling cannot be performed at these locations (i.e., if wells are dry). Figure 3-1 shows the groundwater monitoring network, and information on the wells is summarized in Table 3-2.

The DQO process for Trenches 31 and 34 (SGW-47729-VA, *Low-Level Burial Ground 3 Trenches 31 and 34 DQO Process*) included modeling to evaluate the effects of the 200 West Pump and Treat at the monitoring well locations. The effects of the 200 West Pump and Treat on groundwater monitoring for the trenches were further evaluated in SGW-59564, *Evaluation of 200 West Pump and Treat on Groundwater Monitoring for Trenches 31 and 34*. The results of these evaluations support the monitoring well locations of the monitoring well network to detection of contamination releases from the trenches impacting groundwater.

If a well is within approximately 2 years of going dry, a replacement well will be proposed. All new RCRA wells proposed for installation at the Hanford Site are negotiated annually by Ecology, DOE, and EPA under Tri-Party Agreement (Ecology et al., 1989) Milestone M-24-00.

The monitoring wells are cased in a manner that maintains the integrity of the monitoring well borehole and allows collection of representative groundwater samples. The wells are constructed in such a manner as to prevent contamination of samples, sampled strata, and between aquifers and water bearing strata.

Construction details and pertinent information for the wells are provided in Appendix C. Some wells are co-sampled with other monitoring programs (e.g., monitored to meet CERCLA requirements). Monitoring requirements for the other monitoring programs are described in separate plans. The reported data from the other monitoring programs are supplementary to information gathered under this plan.

3.4 Differences between This Plan and Previous Plan

Table 3-3 identifies the main differences between this plan and the previous groundwater monitoring plan.

3.5 Sampling and Analysis Protocol

In accordance with the Hanford Facility RCRA Permit (WA7890008967), the groundwater protection regulations of WAC 173-303-645 dictate the groundwater sampling and analysis requirements applicable to final status TSD units. The QAPjP outlining the project management structure, data generation and acquisition, analytical procedures, and quality control is provided in Appendix A. Appendix B provides the sampling protocols (e.g., sampling methods, sample handling and custody, management of waste, and health and safety considerations).

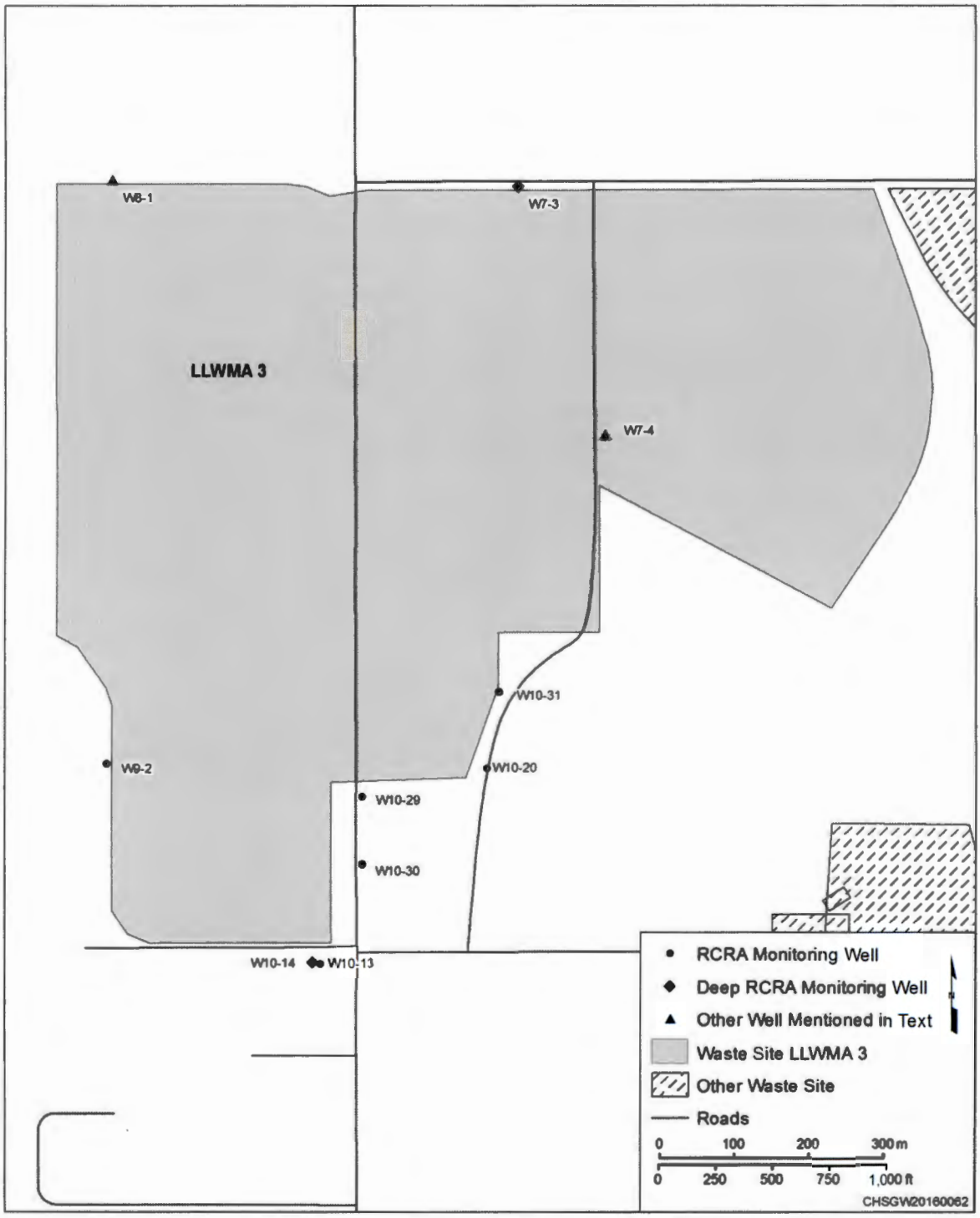


Figure 3-1. Map Showing Locations of RCRA Monitoring Wells at LLWMA-3

4 Data Evaluation and Reporting

This chapter discusses the evaluation and interpretation of data.

4.1 Data Review

The data review and verification are discussed in the QAPjP (Appendix A).

4.2 Statistical Evaluation

The goal of the RCRA groundwater detection monitoring program is to determine if LLWMA-3 operations have affected groundwater quality. This determination shall be based on statistical tests. Under this plan, the statistical evaluation method and evaluation frequency are determined in accordance with WAC 173-303-645(9) and WAC 173-303-645(8)(h) and comply with the performance standards outlined in WAC 173-303-645(8)(i). The dangerous constituents and indicator parameters used to indicate the presence of contamination (WAC 173-303-645(9)(a)) and subject to statistical evaluation are listed in Table 3-1 and include pH, specific conductance, TOC, and TOX.

To establish background conditions, data collected over the previous two years will be used. Every year, background results will be evaluated to update the critical mean for each indicator parameter identified in Table 3-1. Sample collection and analysis will continue at the frequency identified in Table 3-1. The statistical method that will be used to compare compliance-point groundwater quality to baseline (background) groundwater quality, in accordance with WAC 173-303-645(8)(h)(i), will be intrawell comparisons using the pooled variance approach. This approach is recommended because a crucial detection monitoring assumption of upgradient-to-downgradient well comparisons is that downgradient well changes in groundwater quality are only caused by on-site waste management activity. However, the influence from nearby 200 West Pump and Treat injection wells may result in spatial variability. Intrawell testing is identified in EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance* as a method to mitigate the problem of natural spatial variability. The use of this statistical method for LLWMA-3 is protective of human health and the environment and complies with the performance standards in WAC 173-303-645(8)(i). Implementation of the intrawell testing method is described below.

The critical mean estimate using the pooled variance method is calculated using the following formulas:

Individual well log means

$$m_j = \frac{1}{n_j}\sum_{i=1}^{n_j} y_{ij} \qquad \text{(Equation 4.1)}$$

Individual well log variances

$$s_j^2 = \frac{1}{n_j - 1}\sum_{i=1}^{n_j}\left(y_{ij} - m_j\right)^2 \qquad \text{(Equation 4.2)}$$

Pooled log variance

$$s^2 = \frac{1}{\sum_{j=1}^{3}\left(n_j - 1\right)}\sum_{j=1}^{3}\left(n_j - 1\right)s_j^2 = \frac{1}{n-3}\sum_{j=1}^{3}\left(n_j - 1\right)s_j^2 \qquad \text{(Equation 4.3)}$$

The critical mean, CM, for each well comparative constituent is computed for each well using the following formula:

$$CM_j = \exp\left(m_j + t_{df,k,\alpha}\, s \sqrt{1+\frac{1}{n_j}}\right) \qquad \text{(Equation 4.4)}$$

where, for Equations 4.1 through 4.4:

- j is the count of number of compliance wells
- m_j estimates the background mean for well j
- s_j estimates the background standard deviation for well j
- s is the pooled log variance
- n_j is the count of data used to compute the mean m for well j
- y_{ij} is the log of the individual composite results, i, for well j
- α, is the minimum unit-wide false positive rate for any single (future) monitoring event (set at 1 percent)
- k is the number of comparisons (counting *all* analytes) that have the potential to create a positive result within a RCRA unit during any single monitoring event
- $t_{df,k,\alpha}$ is the upper 100% – α/k quantile of Student's t distribution with df degrees of freedom, or for the case of pH range, $t_{df,k,\alpha/2}$ is the upper 100 percent – $\alpha/(2k)$ quantile of Student's t distribution with df degrees of freedom
- df is the degrees of freedom (equal to $n - 1$ times the number of compliance wells, j)

Twice each year, monitoring data from the compliance wells are compared to the calculated CM for each well for each of the four indicator parameters. The background statistical analysis is updated annually to establish comparative values for indicator parameters. A rolling mean is used because of changing groundwater flow conditions due to groundwater remedial actions currently being implemented at the Hanford Site.

If a comparison for an upgradient well shows a significant increase (or pH decrease), then the information must be submitted in the Hanford Site annual groundwater report. If a comparison for a downgradient well shows a significant increase (or pH decrease), then the well is resampled. For TOC and TOX, split samples are sent to different laboratories to determine if the exceedance of the comparison value was the result of laboratory error. In addition, the original samples may be reanalyzed if laboratory error is suspected.

If the exceedance of the statistical comparison value is confirmed by resampling, then written notifications are made as detailed in Section 4.5 and in accordance with WAC 173-303-645(9)(g). If the exceedance of the comparison value is not attributable to LLWMA-3, then this may be demonstrated in a report to Ecology as detailed in Section 4.5 and in accordance with WAC 173-303-645(9)(g)(vi). If the exceedance is not attributable to another source, then groundwater in all monitoring wells will be immediately sampled to determine whether constituents in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods for Designating Dangerous Waste WAC 173-303-090 & -100*, or an approved subset of constituents, as detailed in Section 4.5 and in accordance with WAC 173-303-645(9)(g)(ii) and (iii), are present. For total organic carbon and total organic halogen, split samples are sent to different laboratories to determine if the exceedance of the comparison value was the result of laboratory error.

Table 3-3. Main Differences between this Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
Constituents	Contamination indicator parameters, groundwater quality parameters, and supporting constituents (field measurements and alkalinity)	Same	None
Sampling frequency	Contamination indicator parameters (semiannual) Groundwater quality parameters (annual) Supporting constituents: field measurements (semiannual), alkalinity (annual)	Same	None
Well network	Upgradient well 299-W9-2 Downgradient wells 299-W10-29, 299-W10-30, and 299-W10-31	Add two downgradient wells to network (299-W10-13[b] and 299-W10-20[b])	Provide monitoring to account for bounding scenarios for influence of injection wells
Groundwater flow direction	East-northeast	East-southeast	Injection of treated water impacting flow direction
Type of groundwater monitoring program	Indicator evaluation program	Detection monitoring program	Required for final status groundwater monitoring
Background arithmetic mean recalculated	Section 4.2 in previous plan	Section 4.2	Calculated annually using EPA 530/R-09-007[c]

a. DOE/RL-2009-68, Rev. 2, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3.*

b. Replacement wells needed if unable to sample at these locations (i.e., if wells are dry).

c. EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance.*

samples are sent to different laboratories to determine if the exceedance of the comparison value was the result of laboratory error.

4.3 Interpretation

Data are used to interpret groundwater conditions at LLWMA-3. Interpretive techniques include the following:

- **Hydrographs:** Graph water levels versus time to determine decreases and increases, and seasonal or manmade fluctuations in groundwater levels.
- **Water table maps:** Use water table elevations from multiple wells to construct contour maps and estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential on the maps.
- **Trend plots:** Graph concentrations of constituents versus time to determine increases, decreases, and fluctuations. May be used in tandem with hydrographs and/or water table maps to determine if concentrations are related to changes in water level or groundwater flow directions.
- **Plume maps:** Map distributions of chemical constituent concentrations in the aquifer to determine the extent of contamination. Changes in plume distribution over time assist in determining plume movement and the direction of groundwater flow.
- **Contaminant ratios:** Illustrate the relative abundances of contaminants from previously characterized Hanford Site-related processes and sources. Comparison of these ratios in groundwater can sometimes be used to distinguish among different sources of contamination (e.g., a specific process and its associated facility). Ratios may provide evidence of continuing source contamination, thereby linking contamination with a specific facility under RCRA monitoring. Evaluation of contaminant ratios in concentration trends may be used to demonstrate when facility-specific contamination no longer affects underlying groundwater.

4.4 Groundwater Monitoring Network

The LLWMA-3 groundwater monitoring network consist of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer. The well locations and design are selected to represent the quality of background groundwater that has not been affected by leakage from a regulated unit (WAC 173-303-645(8)(a)(i)). Wells are also selected that will provide samples representative of the quality of ground water passing the point of compliance and will allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer (WAC 173-303-645(8)(a)(iii)).

The current groundwater monitoring network will continue to be re-evaluated to ensure that it is adequate to monitor any changing hydrogeologic conditions beneath the unit. If flow changes are observed, the LLWMA-3 CSM and groundwater constituents will be re-evaluated to determine network efficiency and any necessary modification requirements for the network.

Water level measurements will continue to be collected before each sampling event. An additional and more comprehensive set of water level measurements is made annually for selected wells on the Hanford Site, and the data are presented in the annual groundwater monitoring report (e.g., DOE/RL-2015-07).

4.5 Reporting and Notification

Groundwater monitoring results are reported annually in the annual groundwater monitoring report (e.g., DOE/RL-2015-07). Groundwater monitoring data is maintained in the facility operating record. The groundwater flow rate and direction is also determined and reported annually.

If a comparison for an upgradient well shows a significant increase (or pH decrease) relative to the statistical comparison value, that information is also reported in the annual groundwater monitoring report (e.g., DOE/RL-2015-07).

If statistically significant evidence of contamination is determined for one or more of the indicator parameters or dangerous waste constituents at any point of compliance well, the well may be resampled within one month to repeat the analysis for the detected compounds. The data from resampling will be compared with the statistical background value. If resampling confirms statistically significant evidence of contamination, the following actions will be performed in accordance with WAC 173-303-645(9)(g):

- Within 7 days of the finding (i.e., exceedance), notify Ecology in writing, indicating which chemical parameters or constituents have shown statistically significant evidence of contamination.
- Immediately sample the groundwater in all LLWMA-3 monitoring network wells (identified in Table 3-1) and determine if constituents identified in Appendix 5 of Ecology Publication No. 97-407 are present and, if so, at what concentration. However, Ecology (on a discretionary basis) may allow sampling for a site-specific subset of constituents (from Appendix 5 of Ecology Publication No. 97-407) and other representative/related waste constituents. In the event that sampling of Appendix 5 of Ecology Publication No. 97-407 constituents (or a subset thereof) is required, supplemental sampling and analysis information will be prepared for the applicable constituents and submitted for approval by Ecology. If any of these constituents are detected, the well may be resampled within one month of receiving the results (or an alternate site-specific schedule approved by Ecology) to repeat the analysis for the detected constituents. If the constituents are detected in the second analysis, they will form the basis for compliance monitoring under WAC 173-303-645(10).
- If dangerous constituents are detected, submit an application for a Permit modification to Ecology within 90 days to establish a compliance monitoring program under WAC 173-303-645(10), in accordance with WAC 173-303-645(9)(g)(iv).
- If dangerous constituents are not detected, continue to monitor in accordance with the detection monitoring program.

If the statistically significant evidence of contamination is not attributable to LLWMA-3, then it may be demonstrated that a source other than LLWMA-3 caused the contamination or that the detection is an artifact caused by an error in sampling, analysis, or statistical evaluation or natural variation in the groundwater. To demonstrate that the contamination is not attributable to LLWMA-3, the following actions will be performed in accordance with WAC 173-303-645(9)(g)(vi):

- Within 7 days of the finding (i.e., exceedance), notify Ecology in writing and indicate the intent to make a demonstration to this effect.
- Within 90 days, submit a report to Ecology which demonstrates that a source other than the regulated unit caused the contamination, or that the contamination resulted from an error in sampling, analysis, evaluation, or natural variation in groundwater chemistry.

- Within 90 days, an application for a Permit modification to make any appropriate changes to the detection monitoring program will be submitted to Ecology.
- Continue monitoring in accordance with the detection monitoring program.
- If the demonstration is not accepted by Ecology, then a Permit modification to move to compliance monitoring under WAC 173-303-645(10) is still required within 90 days of the exceedance.

In accordance with WAC 173-303-645(9)(h), if it is determined that the detection monitoring program no longer satisfies the requirements of WAC 173-303-645(9), submit an application to Ecology for a Permit modification within 90 days to make any appropriate changes to the program.

This page intentionally left blank.

5 References

10 CFR 962, "Byproduct Material," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=8ab669cbcf526dd37f981f4fc863a8db&mc=true&node=pt10.4.962&rgn=div5.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=2cd7465519114fb3472b4864a0e3c42b&node=pt40.26.265&rgn=div5.

265.92, "Sampling and Analysis."

265.93, "Preparation, Evaluation, and Response."

Subpart F, "Ground-Water Monitoring."

51 FR 24504, 1986, "EPA Clarification of Regulatory Authority Over Radioactive Mixed Waste," *Federal Register*, July 3, 1986.

Atomic Energy Act of 1954, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: http://epw.senate.gov/atomic54.pdf.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

DOE/RL-2004-60, 2015, *200-SW-2 Radioactive Landfills Group Operable Unit RCRA Facility Investigation/Corrective Measures Study/Remedial Investigation/Feasibility Study Work Plan*, Draft B, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081616H.

DOE/RL-2009-68, 2010, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=1103070711.

DOE/RL-2009-68, 2011, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093745.

DOE/RL-2009-68, 2012, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0091262.

DOE/RL-2014-43, 2014, *Mixed Waste Disposed of in the Low-Level Burial Grounds*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081637H.

DOE/RL-2015-07, 2015, *Hanford Site Groundwater Monitoring Report for 2014*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0080600H.

Ecology, 2014, *Agreed Order and Stipulated Penalty No. DE 10156*, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/programs/nwp/pi/pdf/settlements/de10156/de10156.pdf.

Ecology Publication No. 97-407, 2014, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100*, Hazardous Waste and Toxics Reduction Program, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/pubs/97407.pdf.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

EPA 530/R-09-007, 2009, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*, Office of Resource Conservation and Recovery, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/osw/hazard/correctiveaction/resources/guidance/sitechar/gwstats/unified-guid.pdf.

NAD83, 1991, *North American Datum of 1983*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

NAVD88, 1988, *North American Vertical Datum of 1988*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

PNL-6772, 1987, *A Detection-Level Hazardous Waste Ground-Water Monitoring Compliance Plan for the 200 Areas Low-Level Burial Grounds and Retrievable Storage Units*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://www.osti.gov/scitech/biblio/6201649.

PNL-6820, 1989, *Hydrogeology of the 200 Areas Low-Level Burial Grounds – An Interim Report*, Vols. 1 and 2, Pacific Northwest Laboratory, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195066506.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195066592.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195066599.

PNL-7336, 1990, *Geohydrology of the 218-W-5 Burial Ground, 200-West Area, Hanford Site*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/6932537.

PNNL-11800, 1998, *Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/594543.

PNNL-13858, 2002, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-West Area and Vicinity, Hanford Site, Washington*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-13858.pdf.

PNNL-14702, 2006, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0911300343.

PNNL-14753, 2004, *Groundwater Data Package for the 2004 Composite Analysis*, Rev.0, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14753rev0.pdf.

PNNL-14859, 2004, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D6541642.

PNNL-14859-ICN-1, 2006, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*, Interim Change Notice 1, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14859icn1.pdf.

PNNL-14859-ICN-2, 2007, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*, Interim Change Notice 2, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14859-ICN-2.pdf.

PNNL-16887, 2007, *Geologic Descriptions for the Solid-Waste Low Level Burial Grounds*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-16887.pdf.

RCW 70.105, "Hazardous Waste Management," *Revised Code of Washington*, Olympia, Washington. Available at: http://apps.leg.wa.gov/RCW/default.aspx?cite=70.105&full=true.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SGW-38815, 2009, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0082378H.

SGW-59564, 2015, *Evaluation of 200 West Pump and Treat on Groundwater Monitoring for Trenches 31 and 34*, Draft, CH2M HILL Plateau Remediation Company, Richland, Washington.

SGW-47729-VA, 2010, *Low-Level Burial Ground 3 Trenches 31 and 34 DQO Process*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Slate, Janet L., 1996, "Buried Carbonate Paleosols Developed in Pliocene-Pleistocene Deposits of the Pasco Basin, South-Central Washington, U.S.A.," *Quaternary International* 34-36:191-196.

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, as amended, Washington State Department of Ecology, Richland, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-160.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

303-040, "Definitions."

303-400, "Interim Status Facility Standards."

303-645, "Releases from Regulated Units."

WHC-SD-EN-AP-015, 1989, *Revised Ground-Water Monitoring Plan for the 200 Areas Low-Level Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195063349.

WHC-SD-EN-AP-022, 1990, *Interim-Status Ground-Water Quality Assessment Plan for Waste Management Area 3 of the 200 Areas Low-Level Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-EN-EV-026, 1993, *Results of the Groundwater Quality Assessment Program at Low-Level Waste Management Area 3 of the Low-Level Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196101188.

WHC-SD-EN-TI-290, 1994, *Geologic Setting of the Low-Level Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/10192359.

Appendix A

Quality Assurance Project Plan

This page intentionally left blank.

Contents

A1 Introduction A-1

A2 Project Management A-1

A2.1 Project/Task Organization A-1
A2.1.1 DOE-RL Project Manager A-1
A2.1.2 DOE-RL Technical Lead A-1
A2.1.3 Soil and Groundwater Remediation Project Manager A-1
A2.1.4 S&GRP RCRA Groundwater Manager A-2
A2.1.5 Sample Management and Reporting Group A-2
A2.1.6 Field Sampling Organization A-3
A2.1.7 Quality Assurance A-3
A2.1.8 Environmental Compliance Officer A-3
A2.1.9 Health and Safety A-3
A2.1.10 Waste Management A-3
A2.1.11 Analytical Laboratories A-4
A2.2 Problem Definition/Background A-4
A2.3 Project/Task Description A-4
A2.4 Quality Assurance Objectives and Criteria A-4
A2.5 Special Training/Certification A-4
A2.6 Documents and Records A-7

A3 Data Generation and Acquisition A-10

A3.1 Analytical Method Requirements A-10
A3.2 Field Analytical Methods A-11
A3.3 Quality Control A-11
A3.3.1 Field Quality Control Samples A-15
A3.3.2 Laboratory Quality Control Samples A-15
A3.4 Measurement Equipment A-17
A3.5 Instrument and Equipment Testing, Inspection, and Maintenance A-18
A3.6 Instrument/Equipment Calibration and Frequency A-18
A3.7 Inspection/Acceptance of Supplies and Consumables A-18
A3.8 Nondirect Measurements A-18
A3.9 Data Management A-18

A4 Assessment and Oversight A-19

A4.1 Assessments and Response Actions A-19
A4.2 Reports to Management A-19

A5 Data Review and Usability A-19

A5.1 Data Review and Verification A-19

A5.2 Data Validation A-20
A5.3 Reconciliation with User Requirements A-20
A6 References A-20

Figure

Figure A-1. Project Organization A-2

Tables

Table A-1. Data Quality Indicators A-5
Table A-2. Change Control for Monitoring Plans A-8
Table A-3. Analytical Requirements for Groundwater Analysis A-10
Table A-4. Project Quality Control Requirements A-12
Table A-5. Laboratory Quality Control and Acceptance Criteria A-13
Table A-6. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses A-16

Terms

DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
DQA	data quality assessment
DQI	data quality indicator
EB	equipment blank
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FSO	Field Sampling Organization
FTB	full trip blank
FWS	Field Work Supervisor
GC/MS	gas chromatography/mass spectrometry
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
LCS	laboratory control sample
MB	method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
PS	post-digestion spike
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RDR	request for data review
RPD	relative percent difference
SAF	Sampling Authorization Form

S&GRP	Soil and Groundwater Remediation Project
SMR	Sample Management and Reporting
SPLIT	field split
SUR	surrogate
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal

A1 Introduction

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the quality assurance (QA) elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). Sections 6.5 and 7.8 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*) require the QA/quality control (QC) and sampling and analysis activities to specify QA requirements for treatment, storage, and disposal (TSD) units, as well as for past practice processes. This QAPjP also describes the applicable requirements and controls based on guidance found in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into the following four sections, which describe the quality requirements and controls applicable to the LLWMA-3 groundwater monitoring activities: Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Review and Usability.

A2 Project Management

This chapter addresses the management approaches planned, project goals, and planned output documentation.

A2.1 Project/Task Organization

The project organization (regarding routine groundwater monitoring) is described in the following subsections and illustrated in Figure A-1.

A2.1.1 DOE-RL Project Manager

Hanford Site cleanup is the responsibility of the U.S. Department of Energy (DOE)-Richland Operations Office (RL). The DOE-RL project manager is responsible for authorizing the contractor to perform activities under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, *Resource Conservation and Recovery Act of 1976* (RCRA), *Atomic Energy Act of 1954*, and Tri-Party Agreement (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*) for the Hanford Site.

A2.1.2 DOE-RL Technical Lead

The DOE-RL technical lead is responsible for providing day-to-day oversight of the contractor's performance of the work scope, working with the contractor to identify and work through issues, and providing technical input to the DOE-RL project manager.

A2.1.3 Soil and Groundwater Remediation Project Manager

The Soil and Groundwater Remediation Project (S&GRP) manager provides oversight for all activities and coordinates with DOE-RL and primary contractor management in support of sampling and reporting activities. The S&GRP manager also provides support to the S&GRP RCRA groundwater manager to ensure that work is performed safely and cost effectively.

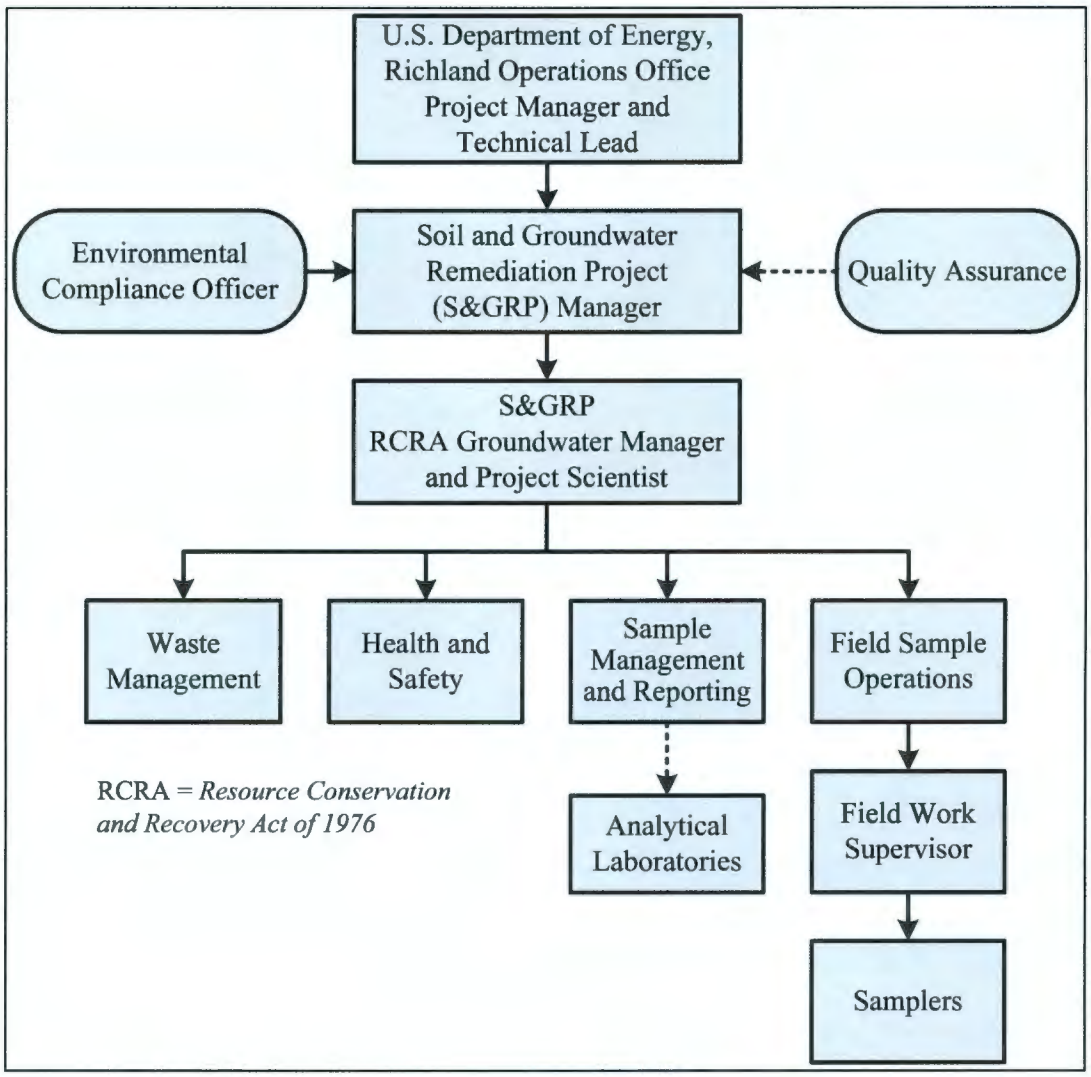


Figure A-1. Project Organization

A2.1.4 S&GRP RCRA Groundwater Manager

The S&GRP RCRA groundwater manager is responsible for direct management of activities performed to meet RCRA TSD monitoring requirements. The S&GRP RCRA groundwater manager coordinates with, and reports to, DOE-RL and primary contractor management regarding RCRA TSD monitoring requirements. The S&GRP RCRA groundwater manager (or delegate) works closely with the Environmental Compliance Officer (ECO), QA, Health and Safety, and Sample Management and Reporting (SMR) group to integrate these and other technical disciplines in planning and implementing the work scope. The S&GRP RCRA groundwater manager assigns scientists to provide technical expertise.

A2.1.5 Sample Management and Reporting Group

The SMR group oversees offsite analytical laboratories, coordinates laboratory analytical work to ensure that laboratories conform to the requirements of this plan, and verifies that laboratories are qualified for performing Hanford Site analytical work. The SMR group generates field sampling documents, labels, and instructions for field sampling personnel and develops the Sampling Authorization Form (SAF), which provides information and instruction to the analytical laboratories. SMR ensures that field

sampling documents are revised to reflect approved change. The SMR group receives analytical data from the laboratories, ensures it is appropriately reviewed, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation and recordkeeping. The SMR group is responsible for resolving sample documentation deficiencies or issues associated with the Field Sampling Organization (FSO), laboratories, or other entities. The SMR group is responsible for informing the S&GRP RCRA groundwater manager of any issues reported by the analytical laboratories.

A2.1.6 Field Sampling Organization

The FSO is responsible for planning and coordinating field sampling resources and provides the Field Work Supervisor (FWS) for routine groundwater sampling operations. The FWS directs the nuclear chemical operators (samplers), who collect groundwater samples in accordance with this groundwater monitoring plan and corresponding standard procedures and work packages. The FWS ensures that samplers are appropriately trained and available. Samplers collect all salient samples in accordance with sampling documentation, complete field logbooks and chain-of-custody forms, including any shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

Pre-job briefings are conducted by the FSO, in accordance with work management and work release requirements, to evaluate activities and associated hazards by considering various factors including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required

A2.1.7 Quality Assurance

The QA point of contact is responsible for addressing QA issues on the project and overseeing implementation of the project QA requirements. Responsibilities include reviewing project documents, including the QAPjP, and participating in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.8 Environmental Compliance Officer

The ECO provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts.

A2.1.9 Health and Safety

The Health and Safety organization is responsible for coordinating industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or by internal primary contractor work requirements.

A2.1.10 Waste Management

Waste Management is responsible for identifying waste management sampling/characterization requirements, to ensure regulatory compliance, and interpreting data to determine waste designations and

profiles. Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost effective manner.

A2.1.11 Analytical Laboratories

Analytical laboratories analyze samples, in accordance with established procedures and the requirements of this plan, and provide necessary data packages containing analytical and QC results. The laboratories provide explanations of results to support data review and in response to resolution of analytical issues. The laboratories are evaluated under the DOE Consolidated Audit Program and must be accredited by the Washington State Department of Ecology (Ecology) for the analyses performed for S&GRP.

A2.2 Problem Definition/Background

The purpose of this groundwater monitoring plan is to satisfy the requirements of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, Part II, Condition II.F, which specifies groundwater monitoring under WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," for final status facilities. Specifics on the activities to satisfy the requirements are provided in the main body of the monitoring plan in Chapter 1 and Sections 2.7, 3.1, 3.2, and 4.2. Background information on monitoring is also provided in the main body of this plan in Sections 2.2, 2.5, and 3.3.

A2.3 Project/Task Description

The project description is provided in Chapters 2, 3, and 4 of this monitoring plan and includes the indicator parameters, as required by WAC 173-303-645(9), for establishing groundwater quality and groundwater contamination detection, evaluation of the monitoring network, interpretation of analytical results, and reporting. Parameter indicators to be monitored, along with the monitoring wells and frequency of sampling, are provided in Chapter 3. Information on the collection and analyses of groundwater from the monitoring network is provided in this appendix and in Appendix B. In addition to the required indicator parameters identified in WAC 173-303-645(9)(a), groundwater quality parameters to be monitored are included in Table 2-3 in the main body of this plan.

A2.4 Quality Assurance Objectives and Criteria

The QA objective of this plan is to ensure that the generation of analytical data of known and appropriate quality is acceptable and useful in order to meet the evaluation requirements stated in the monitoring plan. In support of this objective, statistics and data descriptors known as data quality indicators (DQIs) are used to help determine the acceptability and utility of data to the user. Principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. These DQIs are defined for the purposes of this document in Table A-1.

Data quality is defined by the degree of rigor in the acceptance criteria assigned to DQIs. Applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. DQIs are evaluated during the data quality assessment (DQA) process (Section A.5.3).

A2.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility for collecting and transporting groundwater samples according to the dangerous waste training plan maintained for the TSD unit to meet the requirements of WAC 173-303-330, "Personnel Training." The FWS, in coordination with line management, will ensure that special training requirements for field personnel are met.

Table A-1. Data Quality Indicators

Data Quality Indicators	Definition	Determination Methodologies	Corrective Actions
Precision	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity) • Request reanalysis or re-measurement • Qualify the data before use
Accuracy	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. Quality control analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use • Request reanalysis or re-measurement
Representativeness	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for them not being representative • Flag for further review • Review data for usability • If data are usable, qualify the data for limited use and define the portion of the system that the data represent • If data are not usable, flag as appropriate • Redefine sampling and measurement requirements and protocols • Resample and reanalyze, as appropriate
Comparability	Comparability expresses the degree of confidence with	Use identical or similar sample collection and	If data are not comparable to other data sets:

Table A-1. Data Quality Indicators

Data Quality Indicators	Definition	Determination Methodologies	Corrective Actions
	which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	• Identify appropriate changes to data collection and/or analysis methods • Identify quantifiable bias, if applicable • Qualify the data as appropriate • Resample and/or reanalyze if needed • Revise sampling/analysis protocols to ensure future comparability
Completeness	Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/ acceptance criteria).	If data set does not meet completeness objective: • Identify appropriate changes to data collection and/or analysis methods • Identify quantifiable bias, if applicable • Resample and/or reanalyze if needed • Revise sampling/analysis protocols to ensure future completeness
Bias	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools • Institute correct sampling and subsampling procedures to limit preferential selection or loss of sample media • Use sample handling procedures, including proper sample preservation, that limit the loss or gain of constituents to the sample media • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories that are known to generate biased data for a specific analyte are asked to

Table A-1. Data Quality Indicators

Data Quality Indicators	Definition	Determination Methodologies	Corrective Actions
			correct their methods to remove the bias as best as practicable. Otherwise, samples are sent to other labs for analysis.
Sensitivity	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation* is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or re-measurement using methods or analytical conditions that will meet required detection or limit of quantitation • Qualify/reject the data before use

Reference: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended.

* For purposes of this groundwater monitoring plan, the lower limit of quantitation is interchangeable with the practical quantitation limit.

Training has been instituted by the contractor management team to meet training and qualification programs to satisfy multiple training drivers imposed by the applicable *Code of Federal Regulations* and *Washington Administrative Code* requirements. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely.

Training records are maintained for each employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management confirms that an employee's training is appropriate and up-to-date prior to performing any field work.

A2.6 Documents and Records

The S&GRP RCRA groundwater manager (or designee) is responsible for ensuring that the current version of the groundwater monitoring plan is used and providing any updates to field personnel. Version control is maintained by the administrative document control process. Table A-2 defines the types of changes that may impact the groundwater monitoring plan and the associated approvals, notifications, and documentation requirements. Changes to elements of the monitoring plan that are required by WAC 173-303-645 are not allowed, except as unintentional changes as described in Table A-2.

Logbooks and data forms are required for field activities. The logbook must be identified with a unique project name and number. Individuals responsible for logbooks shall be identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes.

The FWS, SMR, and any field crew supervisors are responsible for ensuring that field instructions are maintained and aligned with any revisions or approved changes to the groundwater monitoring plan. The SMR group will ensure that any deviations from the plan are reflected in revised field sampling documents for the samplers and analytical laboratory. The FWS or appropriate field crew supervisors will ensure that deviations from the plan or problems encountered in the field are documented appropriately (e.g., in the field logbook).

Table A-2. Change Control for Monitoring Plans

Type of Change[a]	Action	Documentation
Temporary addition of wells or site-specific constituents, or increased sampling frequency that do not impact the requirements of WAC 173-303-645.	S&GRP RCRA groundwater manager approves temporary change; provides informal notice to Ecology.	SMR group's integrated groundwater monitoring schedule
Unintentional impact to groundwater monitoring plan including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of indicator parameters, and loss of samples in transit.	S&GRP RCRA groundwater manager provides electronic notification to DOE-RL.	Annual groundwater monitoring report
Planned change to groundwater monitoring activities that does not impact the requirements of WAC 173-303-645, including addition or deletion of site-specific constituents, change of sampling frequency for site-specific constituents, or changes to well network.	S&GRP RCRA groundwater manager obtains DOE-RL approval; revise monitoring plan.	Revised RCRA groundwater monitoring plan and modification to RCRA Permit[b]
Anticipated unavoidable changes (e.g., dry wells).	S&GRP RCRA groundwater manager provides electronic notification to DOE-RL; revise monitoring plan.	Annual groundwater monitoring report; permanent changes require revised RCRA groundwater monitoring plan and modification to RCRA Permit[b]

Note: WAC 173-303-645(9), "Dangerous Waste Regulations," "Releases from Regulated Units," "Detection Monitoring Program," contains additional sampling and notification requirements should results demonstrate a statistically significant increase (or pH decrease).

a. "Site-specific constituents" are any constituents that may be included in this monitoring plan as additional analytes that are not required by WAC 173-303-645(9).

b. Hanford Facility RCRA Permit (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, as amended).

DOE-RL = U.S. Department of Energy, Richland Operations Office
Ecology = Washington State Department of Ecology
RCRA = *Resource Conservation and Recovery Act of 1976*
S&GRP = Soil and Groundwater Remediation Project
SMR = Sample Management and Reporting

The S&GRP RCRA groundwater manager, FWS, or designee is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field

activities. The S&GRP RCRA groundwater manager is also responsible for ensuring that project files are setup, as appropriate, and/or maintained. The project files will contain project records or references to their storage locations. Project files generally include, as appropriate, the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to the SMR group)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Field sampling logbooks
- Groundwater sample reports and field sample reports
- Chain-of-custody forms
- Sample receipt records
- Laboratory data packages
- Analytical data verification and validation reports
- Analytical data case file purges (i.e., raw data purged from laboratory files) provided by offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Convenience copies of laboratory analytical results are kept in the HEIS database. Records may be stored in either electronic (e.g., in the managed records area of the Integrated Document Management System) or hard copy format (e.g., DOE Records Holding Area). Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement (Ecology et al., 1989a) will be managed in accordance with the requirements therein.

The results of groundwater monitoring are reported annually in the annual groundwater monitoring report (e.g., DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014*).

A3 Data Generation and Acquisition

This chapter addresses data generation and acquisition to ensure that project methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

A3.1 Analytical Method Requirements

Analytical method requirements for samples collected are presented in Table A-3. Updated U.S. Environmental Protection Agency (EPA) methods may be substituted for analytical methods identified in Table A-3.

Table A-3. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b](µg/L)
Groundwater Quality Parameters[c]		
Anions	EPA/600 Method 300.0	250 to 550
Chloride		400
Sulfate		550
Fluoride		500
Nitrate		250
Nitrite		250
Metals	SW-846 Method 6010B/C	5 to 4,000
Iron (Filtered and Unfiltered)		50
Manganese (Filtered and Unfiltered)		5
Sodium (Filtered and Unfiltered)		500
Calcium		1,000
Chromium		10
Magnesium		750
Potassium		4,000
Phenols	SW-846 Method 8270D	5
Alkalinity	EPA/600 Method 310.1 or Standard Method 2320	5,000
Bicarbonate Alkalinity		d
Carbonate Alkalinity		d
Hydroxide Alkalinity		d

Table A-3. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b](µg/L)
Indicator Parameters WAC 173-303-645(9)(a)		
pH	Field measurement Instrument/meter	N/A
Specific Conductance		N/A
Total Organic Carbon	SW-846 Method 9060	1,000
Total Organic Halogen	SW-846 Method 9020	10
Supporting Constituents		
Dissolved Oxygen	Field measurement Instrument/meter	N/A
Temperature		N/A
Turbidity		N/A

Reference: WAC 173-303-645(9), "Dangerous Waste Regulations," "Releases from Regulated Units," "Detection Monitoring Program."

Note: The information in this table does not represent EPA requirements but is intended solely as guidance.

a. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*. Equivalent methods may be substituted.

b. Highest allowable practical quantitation limits are specified in contracts with analytical laboratories. Actual quantitation limits vary by laboratory and may be lower than required contractually. Method detection limits are three to five times lower than quantitation limits.

c. Groundwater quality parameters are not specifically required by RCRA but used to support interpretation.

d. Constituent concentration is calculated from alkalinity and does not have an individual practical quantitation limit.

EPA = U.S. Environmental Protection Agency

N/A = not applicable

RCRA = *Resource Conservation and Recovery Act of 1976*

A3.2 Field Analytical Methods

Field screening and survey data will be measured in accordance with HASQARD (DOE/RL-96-68) requirements (as applicable). Field analytical methods may also be performed in accordance with manufacturer manuals. Appendix B provides the parameters identified for field measurements.

A3.3 Quality Control

QC requirements specified in the plan must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC sample requirements are summarized in Table A-4. Acceptance criteria for field and laboratory QC are shown in Table A-5. Data will be qualified and flagged in HEIS, as appropriate.

Table A-4. Project Quality Control Requirements

Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Field Duplicates	One in 20 well trips	Precision, including sampling and analytical variability
Field Splits	As needed When needed, the minimum is one for every analytical method, for analyses performed where detection limit and precision and accuracy criteria have been defined in the analytical performance requirements (Table A-3)	Precision, including sampling, analytical, and interlaboratory
Full Trip Blanks	One in 20 well trips	Cross-contamination from containers or transportation
Equipment Blanks	As needed If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment blank is not required Otherwise, one for every 20 samples[a]	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Analytical Quality Control[b]		
Laboratory Duplicates	1 per analytical batch[c]	Laboratory reproducibility and precision
Matrix Spikes	1 per analytical batch[c]	Matrix effect/laboratory accuracy
Post-Digestion Spike	1 per analytical batch[c]	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	1 per analytical batch[c]	Laboratory accuracy and precision
Laboratory Control Samples	1 per analytical batch[c]	Laboratory accuracy
Method Blanks	1 per analytical batch[c]	Laboratory contamination
Surrogates	1 per analytical batch[c]	Recovery/yield

Note: The information in this table does not represent EPA requirements but is intended solely as guidance.

a. For portable pumps, equipment blanks are collected one for every 10 well trips. Whenever a new type of nondedicated equipment is used, an equipment blank will be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination methods for the nondedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., all Hanford groundwater).

c. Unless not required by, or different frequency is called out in, laboratory analysis methods.

EPA = U.S. Environmental Protection Agency

Table A-5. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
General Chemical Analyses			
Alkalinity (Includes Bicarbonate Alkalinity, Carbonate Alkalinity, and Hydroxide Alkalinity)	MB	<MDL <5% Sample Concentration	Flagged with "C"
	LCS	80–120% Recovery	Data Reviewed[a]
	Laboratory Duplicate	≤20% RPD[b]	Data Reviewed[a]
	MS	75–125% Recovery	Flagged with "N"
	EB, FTB	<2 Times MDL	Flagged with "Q"
	Field Duplicate	≤20% RPD[b]	Flagged with "Q"
Total Organic Carbon	MB	<MDL <5% Sample Concentration	Flagged with "C"
	LCS	80 to 120% Recovery	Data Reviewed[a]
	Laboratory Duplicate or MS/MSD	≤20% RPD[b]	Data Reviewed[a]
	MS or PS, and MSD	75 to 125% Recovery	Flagged with "N"
	EB, FTB	<2 Times MDL	Flagged with "Q"
	Field Duplicate	≤20% RPD[b]	Flagged with "Q"
Total Organic Halogen	MB	<MDL <5% Sample Concentration	Flagged with "C"
	LCS	80 to 120% Recovery	Data Reviewed[a]
	Laboratory Duplicate or MS/MSD	≤20% RPD[b]	Data Reviewed[a]
	MS and MSD (if MS/MSD)	75 to 125% Recovery	Flagged with "N"
	EB, FTB	<2 Times MDL	Flagged with "Q"
	Field Duplicate	≤20% RPD[b]	Flagged with "Q"
Anions			
Anions by Ion Chromatography (Chloride, Fluoride, Nitrate, Nitrite, and Sulfate)	MB	<MDL <5% Sample Concentration	Flagged with "C"
	LCS	80 to 120% Recovery	Data Reviewed[a]
	Laboratory Duplicate or MS/MSD	≤20% RPD[b]	Data Reviewed[a]
	MS or PS, and MSD (if MS/MSD)	75 to 125% Recovery	Flagged with "N"
	EB, FTB	<2 Times MDL	Flagged with "Q"
	Field Duplicate	≤20% RPD[b]	Flagged with "Q"

Table A-5. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
Metals			
Inductively coupled plasma-atomic emission spectrometry Metals (Calcium, Chromium, Iron, Magnesium, Manganese, Potassium, and Sodium)	MB	<Required Detection Limit <5% Sample Concentration	Flagged with "C"
	LCS	80 to 120% Recovery	Data Reviewed[a]
	MS or PS, and MSD	75 to 125% Recovery	Flagged with "N"
	MS/MSD	≤20% RPD	Data Reviewed[a]
	EB, FTB	<2 Times MDL	Flagged with "Q"
	Field Duplicate	≤20% RPD[b]	Flagged with "Q"
Semivolatile Organic Compounds			
Phenols by GC or GC/MS	MB	<MDL <5% Sample Concentration	Flagged with "B"
	LCS	Statistically Derived[c]	Data reviewed[a]
	MS and MSD	%Recovery Statistically Derived[c]	Flagged with "T" if analyzed by GC/MS; otherwise, "N" based on FEAD
	MS/MSD	%RPD Statistically Derived[c]	Data Reviewed[a]
	SUR	Statistically Derived[c]	Data Reviewed[a]
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field Duplicate	≤20% RPD[b]	Flagged with "Q"

Notes: The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, dissolved oxygen, temperature, and turbidity are not listed because they are measured in the field.

a. After review, corrective actions are determined on a case-by-case basis.

b. Applies only in cases where both results are greater than 5 times the method detection limit.

c. Determined by the laboratory based on historical data or statistically derived control limits. Limits are reported with the data. Where specific acceptance criteria are listed, those acceptance criteria may be used in place of statistically derived acceptance criteria.

EB = equipment blank
EPA = U.S. Environmental Protection Agency
FEAD = format for electronic analytical data
FTB = full trip blank
GC = gas chromatography
GC/MS = gas chromatography/mass spectrometry
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
PS = post digestion spike
RPD = relative percent difference
SUR = surrogate

Table A-5. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
Data Flags			
B (organics) = analyte was detected in both the associated QC blank and the sample) C (inorganics/wetchem) = The analyte was detected in both the sample and the associated QC blank and the blank value exceeds 5% of the measured concentration present in the associated sample.		N = all except GC/MS – matrix spike outlier T = volatile organic analysis and semivolatile organic analysis GC/MS – matrix spike outlier Q = associated QC sample is out of limits	

A3.3.1 Field Quality Control Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and two types of field blanks (full trip blanks [FTBs] and equipment blanks [EBs]) Field blanks are typically prepared using high-purity reagent water. QC sample definitions and their required frequency for collection are described in this section:

Field Duplicates: independent samples collected as close as possible to the same time and same location as the scheduled sample, and are intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.

Field Splits: two samples collected as close as possible to the same time and same location and are intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.

Full Trip Blanks: bottles prepared by the sampling team prior to traveling to the sampling site. The preserved bottle set is either for volatile organic analysis only or identical to the set that will be collected in the field. It is filled with high-purity reagent water, and the bottles are sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential contamination of the samples attributable to the sample bottles, preservative, handling, storage, and transportation.

Equipment Blanks: reagent water passed through or poured over the decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the SAF. EB sample bottles are placed in the same storage containers with the samples from the associated sampling event. EB samples will be analyzed for the same constituents as the samples from the associated sampling event. EBs are used to evaluate the effectiveness of the decontamination process. EBs are not required for disposable sampling equipment.

A3.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by the laboratories utilized by the project. Laboratory QA includes a comprehensive QC program that includes the use of matrix spikes (MSs), matrix spikes (MSs), matrix spike duplicates (MSDs), laboratory control samples (LCSs), surrogates (SURs), post-digestion spikes (PSs), and method blanks (MBs). QC analyses are required by EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final*

Update IV-B, as amended) and will be run at the frequency specified in the respective references unless superseded by agreement. QC checks outside of control limits are documented in analytical laboratory reports during DQAs, if performed. Laboratory QC and their typical frequencies are listed in Table A-4. Acceptance criteria are shown in Table A-5. The following text describes the various laboratory QC samples:

Laboratory Duplicate: an intralaboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.

Matrix Spike: an aliquot of a sample spiked with a known concentration of target analyte(s). MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.

Matrix Spike Duplicate: a replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.

Post-Digestion Spike: the same as MS; however, spiking occurs after sample preparation and before analysis.

Laboratory Control Sample: a control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material that is used to evaluate laboratory accuracy.

Method Blank: an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample preparations and analytical procedure and is used to quantify contamination resulting from the analytical process.

Surrogate: a compound added to all samples in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined yet are not normally encountered. SURs are expected to respond to the preparation and measurement systems in a manner similar to the analytes of interest. Because SURs are added to all standards, samples, and QC samples, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.

Laboratories are required to analyze samples within the holding time specified in Table A-6. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilizing, decomposing, or other chemical changes. Data from samples analyzed outside the holding times are flagged in the HEIS database with an "H."

Table A-6. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses

Constituent/Parameter	Minimum Volume	Container Type[a]	Preservation[b]	Holding Time
Alkalinity (Includes Bicarbonate Alkalinity, Carbonate Alkalinity, and Hydroxide Alkalinity)	500 mL	Narrow mouth poly or glass	Store ≤6°C	14 days

Table A-6. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses

Constituent/Parameter	Minimum Volume	Container Type[a]	Preservation[b]	Holding Time
Total Organic Carbon	250 mL	Narrow mouth amber glass with Teflon® lined lid	Store ≤6°C, Adjust pH to <2 with Sulfuric Acid or Hydrochloric Acid	28 days
Total Organic Halogen	1 L	Narrow mouth glass with Teflon lined lid	Store ≤6°C, Adjust pH to <2 with Sulfuric Acid	28 days
Anions by Ion Chromatography (Chloride, Fluoride, Nitrate, Nitrite, and Sulfate)	60 mL	Narrow mouth poly or glass	Store ≤6°C	48 hours
Inductively Coupled Plasma Metals (Calcium, Chromium, Iron, Magnesium, Manganese, Potassium, and Sodium)	250 mL	Narrow mouth poly or glass	Adjust pH to <2 with nitric acid	6 months
Phenols by GC or GC/MS	4 × 1 L	Narrow mouth amber glass with Teflon lined lid	Store ≤6°C	7 days before extraction 40 days after extraction

Notes: Teflon is a registered trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.

The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, dissolved oxygen, temperature, and turbidity are not listed as they are measured in the field.

a. Under the Container heading, the term poly stands for EPA clean polyethylene bottles.

b. For preservation identified as stored at ≤6°C, the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

EPA = U.S. Environmental Protection Agency
GC = gas chromatography
GC/MS = gas chromatography/mass spectrometry

A3.4 Measurement Equipment

Each user of the measuring equipment is responsible to ensure that equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the measuring equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with manufacturer specifications and other approved methods.

A3.5 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or should have been evaluated as acceptable and valid in accordance with instrument specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to ensure minimization of downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with applicable Hanford Site requirements.

A3.6 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Appendix B. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

A3.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with test methods in SW-846 and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

A3.8 Nondirect Measurements

Data obtained from sources, such as computer databases, programs, literature files, and historical databases, will be technically reviewed to the same extent as the data generated as part of any sampling and analysis QA/QC effort. All data used in evaluations will be identified by source.

A3.9 Data Management

The SMR group, in coordination with the S&GRP RCRA groundwater manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with the applicable programmatic requirements governing data management methods.

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR group on a routine basis. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods. This process is used to document analytical errors and establish their resolution with the S&GRP RCRA groundwater manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and records management.

A4 Assessment and Oversight

Assessment and oversight activities address the effectiveness of project implementation and associated QA/QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

A4.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this plan, project field instructions, the QAPjP, methods, and regulatory requirements. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project line management chain coordinates the corrective actions/deficiencies resolutions in accordance with the QA program, corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the S&GRP RCRA groundwater manager.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with laboratory QA plans. The contractor oversees offsite analytical laboratories and verifies that laboratories are qualified for performing Hanford Site analytical work.

A4.2 Reports to Management

Management will be made aware of deficiencies identified by self assessments, corrective actions from ECOs, and findings from QA assessments and surveillances. Issues reported by the laboratories are communicated to the SMR group, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and establish resolution with the S&GRP RCRA groundwater manager.

A5 Data Review and Usability

This section addresses the QA activities that occur after data collection. Implementation of these activities determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A5.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review includes linking sample numbers to specific sampling locations, reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times, if any, have been met, and reviewing QC data to determine whether analyses have met the data quality requirements specified in this plan.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Field QA/QC results also will be reviewed to ensure that they are usable.

The project scientist, assigned by the S&GRP RCRA groundwater manager, will perform a data review to help determine if observed changes reflect improved/degraded groundwater quality or potential data errors and may result in submittal of a request for data review (RDR) on questionable data. The laboratory may be asked to check calculations or reanalyze the sample, or the well may be resampled. Results of the RDR process are used to flag the data appropriately in the HEIS database and/or to add comments.

A5.2 Data Validation

Data validation activities may be performed at the discretion of the S&GRP RCRA groundwater manager and under the direction of the SMR group. If performed, data validation activities will be based on EPA functional guidelines.

A5.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the DQA is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project data quality needs. For routine groundwater monitoring undertaken through this groundwater monitoring plan, the DQA is captured in QC associated with the annual Hanford Site groundwater report (e.g., DOE/RL-2015-07), which evaluates field and laboratory QC and the usability of data. Further DQAs will be performed at the discretion of the S&GRP RCRA groundwater manager and documented in a report overseen by the SMR group.

A6 References

Atomic Energy Act of 1954, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: http://epw.senate.gov/atomic54.pdf.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

DOE/RL-96-68, 2014, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), Rev. 4, *Volume 1, Administrative Requirements; Volume 2, Sampling Technical Requirements; Volume 3, Field Analytical Technical Requirements; and Volume 4, Laboratory Technical Requirements*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:

http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL1-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL2-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL3-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL4-04.pdf.

DOE/RL-2015-07, 2015, *Hanford Site Groundwater Monitoring Report for 2014*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0080600H.

Ecology Publication No. 04-03-030, 2004, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Environmental Assessment Program, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/biblio/0403030.html.

Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=82.

EPA/240/B-01/003, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www2.epa.gov/sites/production/files/2015-07/documents/r5-final.pdf.

EPA/240/R-02/009, 2002, *Guidance for Quality Assurance Project Plans*, EPA QA/G-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www2.epa.gov/sites/production/files/2015-06/documents/g5-final.pdf.

EPA/600/R-93/100, 1993, *Methods for the Determination of Inorganic Substances in Environmental Samples*, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: http://monitoringprotocols.pbworks.com/f/EPA600-R-63-100.pdf.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SW-846, 2007, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

SW-846, 2015, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, as amended, Washington State Department of Ecology, Richland, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-160.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

303-330, "Personnel Training."

303-645, "Releases from Regulated Units."

This page intentionally left blank.

Appendix B

Sampling Protocol

This page intentionally left blank.

Contents

B1 Introduction B-1
B2 Sampling Methods B-1
B2.1 Decontamination of Sampling Equipment B-2
B2.2 Water Levels B-3
B3 Documentation of Field Activities B-3
B3.1 Corrective Actions and Deviations for Sampling Activities B-4
B4 Calibration of Field Equipment B-4
B5 Sample Handling B-5
B5.1 Containers B-5
B5.2 Container Labeling B-5
B5.3 Sample Custody B-5
B5.4 Sample Transportation B-6
B6 Management of Waste B-6
B7 Health and Safety B-6
B8 References B-6

1

2 This page intentionally left blank.

Terms

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
FWS	Field Work Supervisor
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
IATA	International Air Transport Association
NTU	nephelometric turbidity unit
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
S&GRP	Soil and Groundwater Remediation Project
SMR	Sample Management and Reporting

This page intentionally left blank.

B1 Introduction

Resource Conservation and Recovery Act of 1976 (RCRA) groundwater monitoring at the Hanford Site has been conducted since the mid 1980s. Hanford Site groundwater sampling methods contain extensive requirements for sampling precautions to be taken; equipment and its use; cleaning and decontamination; records and documentation; and sample collection, management, and control activities. Appendices A and B, together, provide the sampling and analysis essentials (sample collection, sample preservation, chain of custody control, analytical procedures, and field and laboratory quality assurance [QA]/quality control [QC]) necessary for the groundwater monitoring plan.

This appendix provides more specific elements of the sampling protocols and techniques used for the RCRA groundwater monitoring plan. Chapter 3 of the groundwater monitoring plan identifies the monitoring wells that will be sampled, constituents to be analyzed for, and sampling frequency for groundwater monitoring at Low-Level Waste Management Area-3.

B2 Sampling Methods

Sampling may include, but is not limited to, the following methods:

- Field screening measurements
- Groundwater sampling
- Water level measurements

Groundwater samples will be collected according to the current revision of applicable operating methods. Groundwater samples are collected after field measurements of purged groundwater have stabilized:

- pH – two consecutive measurements agree within 0.2 pH units
- Temperature – two consecutive measurements agree within 0.2°C
- Conductivity – two consecutive measurements agree within 10 percent of each other
- Turbidity – less than 5 nephelometric turbidity units (NTUs) prior to sampling (or project scientist's recommendation)

Dissolved oxygen will also be measured in the field in this plan. Dissolved oxygen is not an indicator parameter and is not required to be stable prior to sample collection.

Absent any special requirements from project scientists, wells are purged utilizing the three borehole volume method. Stable field readings are also required as specified above. The default pumping rate is 7.6 to 45.4 L/min (2 to 12 gal/min) depending on the pump, although this is not practical at every well. On occasions when the purge volume is extraordinarily large, wells are purged a minimum of 1 hour and then sampled once stable field readings are obtained.

Field measurements (except for turbidity) are obtained through the use of a flow through cell. Groundwater is pumped directly from the well to the flow through cell. At the beginning of the sample event, field crews attach a clean stainless steel sampling manifold to the riser discharge. The manifold has two valves and two ports: one port is used only for purgewater, and the other is used to supply water to the flow through cell. Probes are inserted into the flow through cell for measurement of pH, temperature, conductivity, and dissolved oxygen. Turbidity is measured by inserting a sample vial into a turbidimeter. The purgewater is then discharged to the purgewater truck.

Once field measurements have stabilized, the hose supplying water to the flow through cell is disconnected, and a clean stainless steel drop leg is attached for sampling. The flow rate is reduced during sampling to minimize loss of volatiles, if any, and prevent overfilling of bottles. Sample bottles are filled in a sequence designed to minimize loss of volatiles, if any. Filtered samples are collected after the unfiltered samples. For some constituents, like metals, both filtered and unfiltered samples are analyzed. If additional samples require filtration (e.g., at turbidity greater than 5 NTUs), an inline disposable 0.45 μm filter is used.

Typically, three types (i.e., Grundfos, Pacific Hydrostar™, and submersible electrical pumps) of environmental grade sampling pumps are used for groundwater sampling at Hanford Site monitoring wells. Individual pumps are selected based on the unique characteristics of the well and the sampling requirements. A small number of wells will not support a pumped sample because of yield or the physical characteristics of the well. In these cases, a grab sample may be obtained.

Low purge volume sampling methodology for the collection of groundwater samples is also being implemented at the Hanford Site. Low flow purging and sampling uses a low purge volume, adjustable rate bladder pump with typical flow rates of 0.1 to 0.5 L/min. This methodology is intended to minimize excessive movement of water from the soil formation into the well. The objective is to pump in a manner that minimizes stress (drawdown) to the system. Purge volumes for wells using low purge bladder pumps are determined on a well-specific basis based on drawdown, pumping rate, pump and sample line volume, and volume required to obtain stable field prior to collecting samples.

For certain types of samples, preservatives are required. While the preservative may be added to the collection bottles before their use in the field, it is allowable to add the preservative at the sampling vehicle immediately after collection. Samples may require filtering in the field, as noted on the chain-of-custody form.

To ensure sample and data usability, sampling associated with this plan will be performed according to DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), pertaining to sample collection, collection equipment, and sample handling.

Suggested sample container, preservation, and holding time requirements are specified in Appendix A (Table A-6) for groundwater samples. These requirements are in accordance with the analytical method specified in Appendix A (Table A-3). The final container type and volumes will be identified on the chain-of-custody form. This groundwater monitoring plan defines a sample as a filled sample bottle for starting the clock for holding time restrictions.

Holding time is the maximum allowable time period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Required holding times depend on the constituent and are listed in analytical method compilations such as APHA et al., 2012, *Standard Methods for the Examination of Water and Wastewater*, and SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition; Final Update V*. Recommended holding times are also provided in HASQARD (DOE/RL-96-68) and applicable laboratory contracts.

™ Pacific Hydrostar is a trademark of Harbor Freight Tools, Calabasas, California.

B2.1 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with the sampling equipment decontamination methods. To prevent potential contamination of samples, care should be taken to use decontaminated equipment for each sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

B2.2 Water Levels

Each time a sample is obtained, measurement of the groundwater surface elevation at each monitoring well is required by WAC 173-303-645(8)(f), "Dangerous Waste Regulations," "Releases from Regulated Units." A measurement of depth to water is recorded in each well prior to sampling, using calibrated depth measurement tapes. When two consecutive measurements are taken that agree within 6 mm (0.02 ft), the final determined measurement is recorded along with the date and time for the specific event (e.g., sampling or annual water level measurements). The depth to groundwater is subtracted from the elevation of a reference point (usually the top of casing) to obtain the water level elevation. Tops of casings are known elevation reference points because they have been surveyed to local reference data.

B3 Documentation of Field Activities

Logbooks or data forms are required for field activities and will be utilized in accordance with HASQARD (DOE/RL-96-68) requirements. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbook entries will be reviewed by the sampling Field Work Supervisor (FWS), cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

The following information is to be recorded in logbooks:

- Day and date; time the task started; weather conditions; and names, titles, and organizations of personnel performing the task
- Purpose of visit to the task area
- Site activities in specific detail (e.g., maps and drawings) or the forms used to record such information (e.g., soil boring log or well completion log), and details of any field tests that were

conducted; reference any forms that were used, other data records, and methods followed in conducting the activity

- Details of any field calibrations and surveys that were conducted; reference any forms that were used, other data records, and methods followed in conducting the calibrations and surveys
- Details of any samples collected and indicate the preparation, if any, of splits, duplicates, matrix spikes, or blanks; reference the methods followed in sample collection or preparation; list the location of sample collected, sample type, all label or tag numbers, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and analytical request form number pertinent to each sample or sample set; and note the time and name of the individual to whom custody of samples was transferred
- Time, equipment type, serial or identification number, and methods followed for decontaminations and equipment maintenance performed; reference the page number(s) of any logbook (if any) where detailed information is recorded
- Any equipment failures or breakdowns that occurred, with a brief description of repairs or replacements

B3.1 Corrective Actions and Deviations for Sampling Activities

The Soil and Groundwater Remediation Project (S&GRP) RCRA groundwater manager, FWS, appropriate field crew supervisors, and Sample Management and Reporting (SMR) personnel must document deviations from protocols, problems pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected because of field conditions.

As appropriate, such deviations or problems will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The S&GRP RCRA groundwater manager, FWS, field crew supervisors, or SMR personnel will be responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

Changes in sample activities that require notification, approval, and documentation will be performed, as specified in Appendix A (Table A-2).

B4 Calibration of Field Equipment

Field instrumentation calibration and QA checks will be performed as follows:

- Prior to initial use of a field analytical measurement system
- At the frequency recommended by the manufacturer or methods, or as required by regulations
- Upon failure to meet specified QC criteria
- Daily calibration checks will be performed and documented for each instrument used. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.
- Using standards for calibration that are traceable to a nationally recognized standard agency source or measurement system

B5 Sample Handling

Sample handling and transfer will be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date.

A sampling and analytical database is used to track the samples from the point of collection through the laboratory analysis process.

B5.1 Containers

Samples shall be collected, where and when appropriate, in break resistant containers. The field sample collection record shall indicate the laboratory lot number of the bottles used in sample collection. When commercially precleaned containers are used in the field, the name of the manufacturer, lot identification, and certification shall be retained for documentation.

Containers shall be capped and stored in an environment which minimizes the possibility of contamination of the sample containers. If contamination of the stored sample containers occurs, corrective actions shall be implemented to prevent reoccurrences. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending on laboratory specific volumes/requirements for meeting analytical detection limits. Recommended container types and sample amounts/volumes are identified in Appendix A (Table A-6).

B5.2 Container Labeling

Each sample is identified by affixing a standardized label or tag on the container. This label or tag shall contain the sample identification number. The label shall identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis required, and collector's name or initials. Sample labels may be either preprinted or handwritten in indelible or waterproof ink.

B5.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure the maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for custody of the sample changes, new and previous custodians will sign the record and note the date and time. The field sampling team will make a copy of the signed record before sample shipment and transmit the copy to the SMR group.

The following minimum information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number

- Date and time of collection
- Matrix
- Preservatives
- Chain of possession information (i.e., signatures and printed names of all individuals involved in the transfer of sample custody, storage locations, and dates/times of receipt and relinquishment)
- Requested analyses (or reference thereto)
- Shipped-to information (i.e., analytical laboratory performing the analysis)

Samplers should note any anomalies with the samples. If anomalies are found, samplers should inform the SMR group so that special direction for analysis may be provided to the laboratory if deemed necessary.

B5.4 Sample Transportation

All packaging and transportation instructions shall be in compliance with applicable transportation regulations and U.S. Department of Energy (DOE) requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "General Information, Regulations, and Definitions," through 49 CFR 173, "Shippers-General Requirements for Shipments and Packagings;" 49 CFR 175, "Carriage by Aircraft;" and 49 CFR 177, "Carriage by Public Highway." Carrier specific requirements defined in the International Air Transport Association (IATA) *Dangerous Goods Regulations* (IATA, current edition) shall also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents shall be considered hazardous material in transportation and transported according to DOT/IATA requirements. If the sample material is known or can be identified, then it will be classified, described, packaged, marked, labeled, and shipped according to the specific instructions for that material and appropriate laboratory notifications will be made, if necessary, through the SMR project coordinator.

B6 Management of Waste

Waste materials are generated during sample collection, processing, and subsampling activities. Waste will be managed in accordance with DOE/RL-2000-40, *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-1 and 200-PW-1 Operable Units.* For waste designation purposes, wells listed in Table 3-1 will be surveyed in the Hanford Environmental Information System, and the maximum concentration for each analyte within the most recent 5 years will be evaluated for use in creating a waste profile, if required. Offsite analytical laboratories are responsible for disposal of unused sample quantities. Pursuant to 40 CFR 300.440, "National Oil and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Off-Site Response Actions," approval from the DOE Richland Operations Office is required before returning unused samples or waste from offsite laboratories.

B7 Health and Safety

DOE established the hazardous waste operations safety and health program, pursuant to the *Price-Anderson Amendments Act of 1988*, to ensure the safety and health of workers involved in mixed waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120,

"Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," and 10 CFR 830, "Nuclear Safety Management," through 10 CFR 835, "Occupational Radiation Protection." The health and safety program defines chemical, radiological, and physical hazards and specifies the controls and requirements for daily work activities on the overall Hanford Site. Personnel training; control of industrial safety and radiological hazards; personal protective equipment; site control; and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program.

B8 References

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=47e3de0454360a17406cb89ade0c966d&mc=true&node=pt10.4.830&rgn=div5.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=57ef404ac6f4734a67fd97302b2d7f7f&node=pt10.4.835&rgn=div5.

10 CFR 851, "Worker Safety and Health Program," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=47e3de0454360a17406cb89ade0c966d&mc=true&node=pt10.4.851&rgn=div5.

29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title29-vol5/xml/CFR-2010-title29-vol5-sec1910-120.xml.

40 CFR 300.440, "National Oil and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Off-Site Response Actions," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol27/xml/CFR-2010-title40-vol27-sec300-440.xml.

49 CFR, "Transportation," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol2/xml/CFR-2009-title49-vol2.xml.

49 CFR 171, "General Information, Regulations, and Definitions."

49 CFR 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans."

49 CFR 173, "Shippers-General Requirements for Shipments and Packagings."

49 CFR 175, "Carriage by Aircraft."

49 CFR 177, "Carriage by Public Highway."

APHA/AWWA/WEF, 2012, *Standard Methods for the Examination of Water and Wastewater*, 22nd Edition, American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

DOE/RL-96-68, 2014, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), Rev. 4, *Volume 1, Administrative Requirements*; *Volume 2, Sampling Technical Requirements*; *Volume 3, Field Analytical Technical Requirements*; and *Volume 4, Laboratory Technical Requirements*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL1-04.pdf. http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL2-04.pdf. http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL3-04.pdf. http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL4-04.pdf.

DOE/RL-2000-40, 2008, *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-1 and 200-PW-1 Operable Units*, Rev. 8, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0901300167.

IATA, *Dangerous Goods Regulations*, Current Edition, International Air Transport Association, Montreal, Quebec, Canada. Available at: http://www.iata.org/publications/dgr/Pages/index.aspx.

Price-Anderson Amendments Act of 1988, Pub. L. 100-408, Aug. 20, 1988, 102 Stat. 1066, 42 USC 2010, et seq. Available at: http://www.gpo.gov/fdsys/pkg/STATUTE-102/pdf/STATUTE-102-Pg1066.pdf.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SW-846, 2015, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-645.

Appendix C

Well Construction

This page intentionally left blank.

Contents

C1 Introduction **C-1**

C2 Reference **C-2**

Figures

Figure C-1. Well 299-W9-2 Construction and Completion Summary C-3
Figure C-2. Well 299-W10-29 Construction and Completion Summary C-5
Figure C-3. Well 299-W10-30 Construction and Completion Summary C-7
Figure C-4. Well 299-W10-31 Construction and Completion Summary C-9
Figure C-5. Well 299-W10-20 Construction and Completion Summary C-11
Figure C-6. Well 299-W10-13 Construction and Completion Summary C-12

Tables

Table C-1. Hydrogeologic Monitoring Unit Classification Scheme C-1
Table C-2. Sampling Interval Information for Wells within the LLWMA-3 Network C-1

This page intentionally left blank.

C1 Introduction

This appendix provides the following information for the Low-Level Waste Management Area 3 (LLWMA-3) groundwater monitoring wells:

- Well name
- Hydrogeologic unit to be monitored (the portion of the aquifer that is located at the well screen or perforated casing) (Table C-1)
- The following sampling interval information, as shown in Table C-2:
  - Elevation at top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between elevations of top and bottom of the screen or perforated interval)

Table C-1. Hydrogeologic Monitoring Unit Classification Scheme

Unit	Description
TU	Top of unconfined: Screened across the water table or the top of the open interval is within 1.5 m (5 ft) of the water table, and the bottom of the open interval is no more than 10.7 m (35 ft) below the water table.

Table C-2. Sampling Interval Information for Wells within the LLWMA-3 Network

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Depth bgs Top of Open Interval[a] (m [ft] NAVD88)	Depth bgs Bottom of Open Interval[a] (m [ft] NAVD88)	Open Interval Length (m [ft])
299-W9-2	TU	86.77 (284.69)	97.43 (319.65)	10.66 (35)
299-W10-29	TU	74.68 (245.01)	88.35 (280.01)	10.67 (35)
299-W10-30	TU	73.87 (242.35)	84.54 (277.35)	10.67 (35)
299-W10-31	TU	73.13 (239.93)	83.82 (275.01)	10.69 (35)
299-W10-20	TU	67.58 (221.70)	73.63 (241.60)	6.10 (20)
299-W10-13-New[b]	TU	73.14 (240.00)[b]	83.82 (275.00)[b]	10.69 (35)[b]

a. Reference elevation: NAVD88, *North American Vertical Datum of 1988.*

b. New monitoring well to be constructed to replace 299-W10-13; screen intervals are estimated.

bgs = below ground surface

TU = top of unconfined (as described in Table C-1)

Figures C-1 through C-6 provide the well construction and completion summaries for the LLWMA-3 network wells. Monitoring well 299-W10-13 was constructed at a shallower depth than the other monitoring wells and is now dry. A replacement well is needed for this location, which is designated as "299-W10-13-New" in Table C-2. Construction of the replacement well will be similar to construction of the other downgradient monitoring wells (e.g., 299-W10-30).

C2 Reference

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

WELL SUMMARY SHEET	Start Date: 7/26/11 Finish Date: 9/22/11	Page 1 of 2
Well ID: C8201	Well Name: 299-W9-2	
Location: 350 meters NNW of WRAP Building	Project: 2 M-24 RCRA Groundwater Wells	
Prepared By: Patrick Cabbage — Date: 10/21/11	Reviewed By: RC Weekes — Date: 10/24/11	
Signature: Patrick Cabbage	Signature: RC Weekes	

CONSTRUCTION DATA

Stainless Steel Protective Casing: 3.33 ft above ground surface

Type I/II Portland Cement Grout: 0 - 10.2 ft bgs

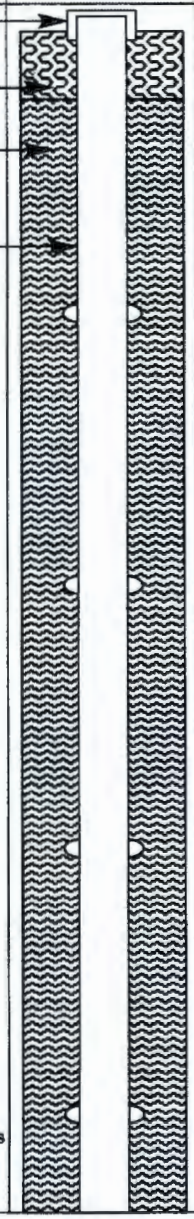
#8 Granular Bentonite Crumbles: 10.2 - 277.1 ft bgs

4-in I.D., Schedule 10, Type 304, Stainless Steel Permanent Casing: 2.35 ft ags - 284.69 ft bgs

All temporary drill casing was removed from the ground.

All depths are in feet below ground surface.

The borehole was drilled with 10 ¾-inch O.D. casing from 0.0 - 119.4 ft bgs and with 8 5/8-inch O.D. casing from 119.4 - 325.0 ft bgs.



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 20, 40, 60, 80, 100, 120, 140, 160

Lithologic Description/Groundwater Sample Depths (ft bgs)

- 0-1 Gravel Drill Pad (G)
- 1-9 Sand (S)
- 9-20 Sandy Gravel (sG)
- 20-33 Sand (S)
- 33-50 Slightly Silty Sand ((m)S)
- 50-62 Gravelly Sand (gS)
- 62-65 Gravel (G)
- 65-78 Silty Sandy Gravel (msG)
- 78-85 Gravelly Sand (gS)
- 85-120 Sand (S)
- 120-130 Sand (S)
- 130-140 Slightly Silty Gravelly Sand ((m)gS) with caliche
- 140-152 Slightly Silty Sand ((m)S) with caliche
- 152-164 Caliche
- 164-183 Sand (S)

Figure C-1. Well 299-W9-2 Construction and Completion Summary (sheet 1 of 2)

WELL SUMMARY SHEET		Start Date: 7/26/11 Finish Date: 9/22/11	Page 2 of 2
Well ID: C8201		Well Name: 299-W9-2	
Location: 350 meters NNW of WRAP Building		Project: 2 M-24 RCRA Groundwater Wells	
Prepared By: Patrick Cabbage	Date: 10/21/11	Reviewed By: DC Weekes	Date: 10/24/11
Signature: Patrick Cabbage		Signature: DC Weekes	

CONSTRUCTION DATA

Description

All temporary drill casing was removed from the ground.

All depths are in feet below ground surface.

The borehole was drilled with 10 ¾-inch O.D. casing from 0.0 - 119.4 ft bgs and with 8 5/8-inch O.D. casing from 119.4 - 325.0 ft bgs.

#8 Granular Bentonite Crumbles: 10.2 - 277.1 ft bgs

4-in I.D., Schedule 10, Type 304, Stainless Steel Permanent Casing: 2.35 ft ags - 284.69 ft bgs

3/8-in Bentonite Pellets: 277.1 - 278.4 ft bgs

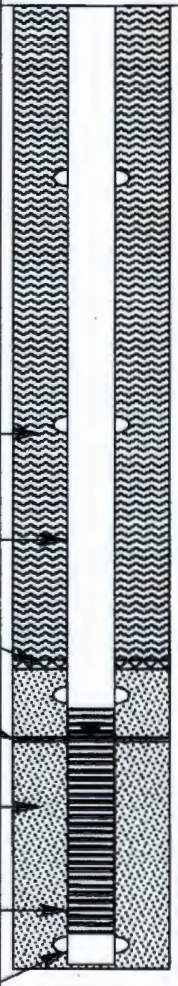
Static Water Level: 289.4 ft bgs (9/12/11)

Primary Filter Pack 10-20 Mesh Colorado Silica Sand: 278.4 - 325.0 ft bgs

4-in I.D., Schedule 10, Type 304, Stainless Steel 20-slot Screen: 284.69 - 319.65 ft bgs

4-in I.D., Schedule 10, Type 304, Stainless Steel Sump: 319.65 - 324.57 ft bgs

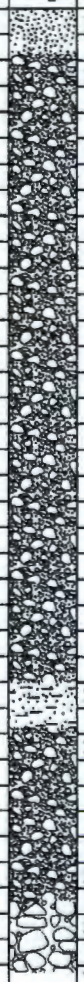
Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 180, 200, 220, 240, 260, 280, 300, 320, 340

Graphic Log



Lithologic Description/Groundwater Sample Depths (ft bgs)

164-183 Sand (S)

183-280 Sandy Gravel (sG)

280-287 Silty Sand (mS)

287-306 Sandy Gravel (sG)

306-314 Silty Sandy Gravel (msG)

314-325 Gravel (G)

TD = 325.0 ft bgs (09-07-2011)

Figure C-1. Well 299-W9-2 Construction and Completion Summary (sheet 2 of 2)

WELL SUMMARY SHEET	Start Date: 3/01/2006 Finish Date: 3/13/2006	Page 1 of 2
Well ID: C4988	Well Name: 299-W10-29	
Location: ~500 ft N. of Dayton and 23rd Intersection	Project: CY06 LLBG Monitoring Wells	
Prepared By: Jeffrey Weiss Date: 4/5/06	Reviewed By: L. D. Walker Date: 5/31/06	
Signature: Jeffrey Weiss	Signature: L D Walker	

CONSTRUCTION DATA

Description

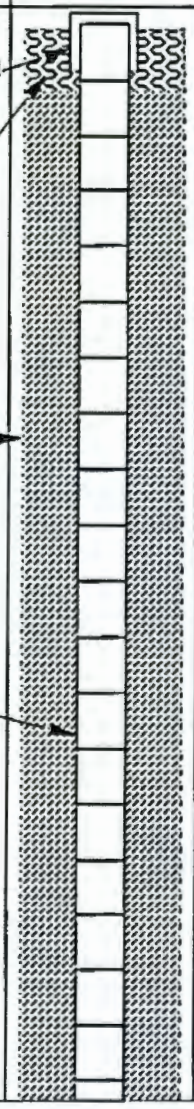
6-in, inner diameter stainless steel protective casing
+2.8 ft

Portland Cement type I/II
0 - 10.1 ft

Bentonite Crumbles
10.1 - 229.8 ft

4-in, inner diameter stainless steel, type 304, schedule 5 casing
+1.9 - 245.01 ft

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 25, 50, 75, 100, 125, 150, 175

Graphic Log

Lithologic Description (ft bgs)

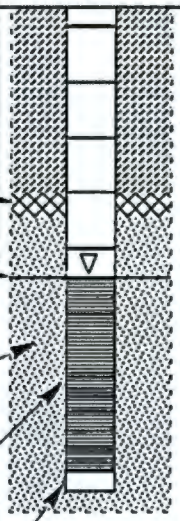
0-5 No recovery
5-9 Sand, S
9-14 Sand, S
14-29 Gravelly Sand, gS
29-34 Sand, S
34-43 Sand Gravel, sG
43-53 Silty Sandy Gravel, msG
53-63 Sandy Gravel, sG
63-69 Sandy Gravel, sG
69-112 Sand, S
112-116 Sandy Silt, sM
116-120 Silt w/ Caliche Nodules, M
120-131 Slightly Silty Sand, (m)S
131.5-133 Gravely Sandy Silt, gsM
133-196 Gravel, G
196-208 Sandy Gravel, sG

Figure C-2. Well 299-W10-29 Construction and Completion Summary (sheet 1 of 2)

WELL SUMMARY SHEET	Start Date: 3/01/2006 Finish Date: 3/13/2006	Page 2 of 2
Well ID: C4988	Well Name: 299-W10-29	
Location: ~500 N. of Dayton and 23rd Intersection	Project: CY06 LLBG Monitoring Wells	
Prepared By: Jeffrey Weiss . Date: 4/5/06	Reviewed By: L.D. Walker Date: 5/31/06	
Signature: Jeffrey Weiss	Signature: LD Walker	

CONSTRUCTION DATA

Description	Diagram
1/4-in coated bentonite pellets 229.8 - 234.9	
Static Water = 244.85 (3/9/06)	
10-20 mesh Colorado silica sand 234.9 - 287.2	
4-in, inner diameter stainless steel, type 304, 20 slot (0.02-in) screen 245.01 - 280.01	
4-in, inner diameter stainless steel, type 304, schedule 5 sump 280.01 - 283.00	
All temporary casing removed from the ground	
All depths are in feet below ground	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
200		196-208 Sandy Gravel, sG
		208-220 Gravel, G
225		220-259 Sandy Gravel, sG
250		259-285 Gravelly Sand, gS
275		285-287.2 Sand, S
		Total depth drilled = 287.2' bgs
300		
325		
350		
375		

Figure C-2. Well 299-W10-29 Construction and Completion Summary (sheet 2 of 2)

WELL SUMMARY SHEET	Start Date: 3/14/2006 Finish Date: 4/3/2006	Page 1 of 2
Well ID: C4989	Well Name: 299-W10-30	
Location: ~200 ft N. of Dayton and 23rd Intersection	Project: CY06 LLBG Monitoring Wells	
Prepared By: Jeffrey Weiss — Date: 4/7/06	Reviewed By: L.D. Walker — Date: 5/18/06	
Signature: Jeffrey Weiss	Signature: LD Walker	

CONSTRUCTION DATA

Description	Diagram
6-in Cement pad	
6-in, inner diameter stainless steel protective casing 2.58 ft above cement pad	
Portland Cement type I/II 0 - 9.5 ft	
Bentonite Crumbles 9.5 - 226.8 ft	
4-in, inner diameter stainless steel, type 304, schedule 5 casing +1.58 - 242.35 ft	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0-5 No recovery
		5-9 Sandy Gravel, sG
		9-19 Gravely Sand, gS
25		19-29 Sandy Gravel, sG
		29-38 Sand, S
		38-48 Gravely Sand, gS
		48-65 Sandy Gravel, sG
50		
		65-78 Gravel, G
75		78-110 Sand, S
100		
		110-124 Silt, sM
		118 Caliche Nodules
		124-124.5 Caliche with Sand
125		124.5-127 Sand, S
		127-134 Gravely Silt, gM
		134-155 Gravel, G
150		
		155-243 Sandy Gravel, sG
175		

Figure C-3. Well 299-W10-30 Construction and Completion Summary (sheet 1 of 2)

WELL SUMMARY SHEET		Start Date: 3/14/2006 Finish Date: 4/3/2006	Page 2 of 2
Well ID: C4989		Well Name: 299-W10-30	
Location: ~200 N. of Dayton and 23rd Intersection		Project: CY06 LLBG Monitoring Wells	
Prepared By: Jeffrey Weiss	Date: 4/7/06	Reviewed By: L.D. Walker	Date: 5/18/06
Signature: Jeffrey Weiss		Signature: LD Walker	

CONSTRUCTION DATA

Description

1/4-in coated bentonite pellets
226.8-231.5

Static Water = 243.02 (3/30/06)

10-20 mesh Colorado silica sand
231.5 - 280.3

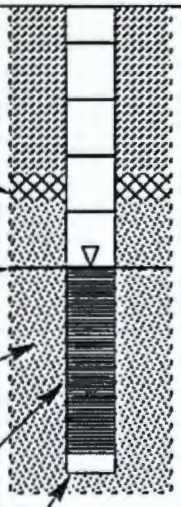
4-in, inner diameter stainless steel, type 304, 20 slot (0.02-in) screen
242.35 - 277.35

4-in, inner diameter stainless steel, type 304, schedule 5 sump
277.35-280.34

All temporary casing removed from the ground

All depths are in feet below ground

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 200, 225, 250, 275, 300, 325, 350, 375

Graphic Log

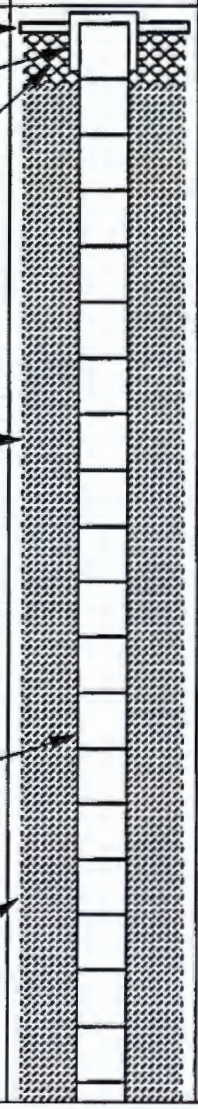
Lithologic Description (ft bgs)

243-246 Gravely Sand, gS
246-282 Sandy Gravel, sG
282-283 Sand, S
Total depth drilled = 283 ft

Figure C-3. Well 299-W10-30 Construction and Completion Summary (sheet 2 of 2)

WELL SUMMARY SHEET	Start Date: 4/20/2006 Finish Date: 5/10/2006	Page 1 of 2
Well ID: C5194	Well Name: 299-W10-31	
Location: Approx. 560 ft E Dayton Ave., 790 N 23rd St.	Project: CY06 LLBG Monitoring Wells	
Prepared By: Jeffrey Weiss Date: 5/10/06	Reviewed By: L. D. Walker	Date: 5/31/06
Signature: John Howell for Jeff Weiss	Signature: LD Walker	

CONSTRUCTION DATA

Description	Diagram
6-in thick concrete pad 6-in I.D. stainless steel protective casing - top of casing is 2.35 ft above pad Concrete 0 -3.0 ft Portland Cement 3.0 - 10.8 ft Bentonite Crumbles 10.8 - 224.7 ft 4-in I.D. stainless steel, type 304, schedule 5 casing, flush threaded 1.45 ft above pad - 239.93 ft bgs Nominal 9-in borehole diameter	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0-5 No Recovery
		5-14 Gravely Sand, gS
		14-23 Sandy Gravel, sG
		23-35 Gravel, G
25		35-45 Sandy Gravel, sG
		45-50 Gravel, G
50		50-72 Sandy Gravel, sG
		72-80 Gravely Sand, gS
75		80-95 Sand, S
		95-105 Silty Sand, mS
100		101-103 Caliche
		105-110 Gravely Sand, gS
		110-121 Sand, S
		121-130 Gravel, G
125		130-132 Gravely Sand, gS
		132-133.5 Gravel, G, basalt boulder
		133.5-142 Gravel, G
		142-157 Sandy Gravel, sG
150		157-194 Gravel, G
175		

Figure C-4. Well 299-W10-31 Construction and Completion Summary (sheet 1 of 2)

WELL SUMMARY SHEET		Start Date: 4/20/2006	Page 2 of 2
		Finish Date: 5/10/2006	
Well ID: C5194		Well Name: 299-W10-31	
Location: Approx. 560 ft E Dayton Ave., 790 N 23rd St.		Project: CY06 LLBG Monitoring Wells	
Prepared By: Jeffrey Weiss	Date: 5/10/06	Reviewed By: L.D. Walker	Date: 5/31/06
Signature: John Howch for Jeff Weiss		Signature: LD Walker	

CONSTRUCTION DATA

Description	Diagram
1/4-in coated bentonite pellets 224.7 - 228.7	
Static water level = 239.95 (5/02/06)	
10-20 mesh Colorado silica sand 228.7 - ~~281.3~~ 279.8 LWS 5-31-06	
4-in I.D. stainless steel, type 304, 20 slot (0.02-in) screen 239.93 - 275.01	
4-in I.D. stainless steel, type 304, schedule 5 sump w/ plate bottom 275.01 - 278.01	
All temporary casing removed from the ground	
All depths are feet below ground surface	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
200		194-195 Boulder
		195-273 Sandy Gravel, sG
225		
250		
		273-279.8 (TD) Sandy GRAVEL, sG to Gravelly SAND, gS
275		Total depth drilled = 279.8 ft
300		
325		
350		
375		

Figure C-4. Well 299-W10-31 Construction and Completion Summary (sheet 2 of 2)

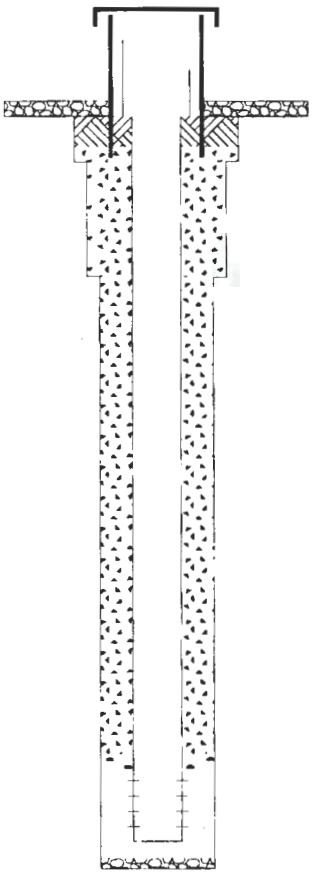
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method	Air Rotary	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W10-20 A5439
Drilling Fluid Used:	Air	Additives Used:	None	TEMPORARY WELL NO:	None
Driller's Name:	C. Sheilds	WA State Lic Nr:	Not Available	Coordinates: N	Not documented
Drilling Company:	PC Exploration	Company Location:	Richland, WA	Coordinates: E	Not documented
Date Started:	23Jun93	Date Completed:	18Nov93	Start Card #:	Not Available
				Elevation Ground Surface:	

Depth to Water: 222.9 ft 16Nov93
(Ground surface) 223.12 ft 18Nov93

GENERALIZED STRATIGRAPHY Geologist's Log

0 - 2 ft : Sandy Gravel
2 - 7 ft : Silty Sand
7 - 25 ft : Sandy Gravel
25 - 33 ft : Sandy Gravel
33 - 60 ft : Sandy Gravel
60 - 78 ft : Sandy Gravel
78 - 91 ft : Gravelly Sand
91 - 97 ft : Silty Sand
97 - 101 ft : Silt
101 - 104.5 ft : Silty Sand
104.5 - 108.5 ft : Sand
108.5 - 117.5 ft : Sand
117.5 - 130 ft : Sandy Gravel
130 - 132 ft : Silty Sandy Gravel
132 - 176 ft : Sandy Gravel
176 - 183 ft : Sandy Gravel
183 - 213 ft : Sandy Gravel
213 - 214 ft : Sandy Gravel
214 - 215 ft : Slightly Silty Gravelly Sand
215 - 232 ft : Sandy Gravel
232 - 238 ft : Sandy Gravel
238 - 243 ft : Sand
243 - 251 ft : Sandy Gravel



251 ft : Borehole drilled depth

0 - 15 ft : 13-in. 12-3/4" CS Temp. Casing
15 - 53.22 ft : 11-in. 10-3/4" CS Temp. Casing
53.22 - 251 ft : 9-in. 8-5/8" CS Temp. Casing

Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10 ft.

Type of Surface Seal: 4x4 Concrete Pad

Fill	*Casing*	*Screen*
0 - 10 ft : 13-inch hole Cement	0 - 15 ft : 13 inch 12-3/4" CS Temp. Casing	
10 - 15 ft : 13-inch hole Bentonite Crumbles	0 - 221.7 ft : 4 inch 4" Perm. Casing	
15 - 53.22 ft : 11-inch hole Bentonite Crumbles	15 - 53.22 ft : 11 inch 10-3/4" CS Temp. Casing	
	53.22 - 251 ft : 9 inch 8-5/8" CS Temp. Casing	
53.22 - 212.7 ft : 9-inch hole Bentonite Crumbles		
212.7 - 218.6 ft : 9-inch hole 3/8" Bentonite Pellets		221.7 - 241.6 ft : 4 inch 4" .020 SS Wire Wrap Pipe Size
218.6 - 241.9 ft : 9-inch hole 10-20 Silica Sand	241.6 - 241.9 ft : 4 inch End Camp	
241.9 - 244.5 ft : 9-inch hole 10-20 Silica Sand		
244.5 - 247.5 ft : 9-inch hole 8-12 Silica Sand		
247.5 - 251 ft : 9-inch hole Slough		

Drawing By: DLF
Reference: Hanford Wells
Revision: 0
Revision Date: 29Dec97
Print Date: 29Dec97

Report Form WELLS Project File WELLS.GPJ

Figure C-5. Well 299-W10-20 Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: R. Vance
Drilling Company: Onwego Drilling Co
Date Started: 11Aug87

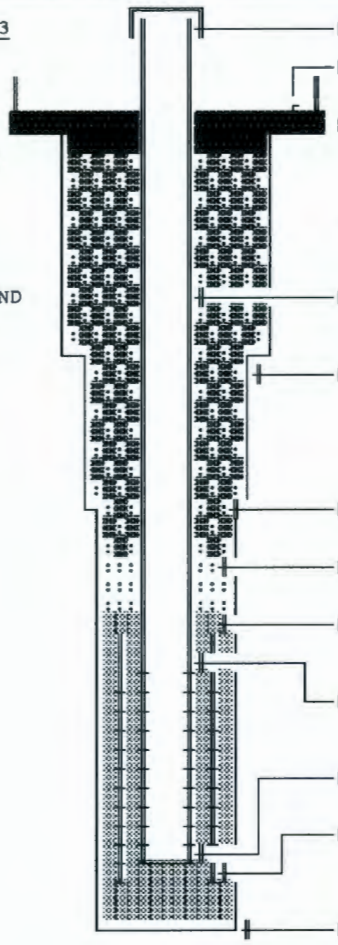
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 25Sep87

WELL NUMBER: 299-W10-13
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 43,137 E/W W 78,297
State Coordinates: N 448,238 E 2,216,918
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 696.58 (Brass cap)

Depth to water: 227.9-ft Sep87
(Ground surface) 234.2-ft 24Mar93

GENERALIZED STRATIGRAPHY Log
Geologist's
sl = slightly

0-20: SAND (Backhoe to 15-ft)
20-35: Gravelly-sl gravelly SAND
35-70: SAND
70-80: Gravelly SAND
80-85: Sandy GRAVEL
85-90: Gravelly SAND
90-100: Silty gravelly SAND
100-110: Silty sandy GRAVEL
110-125: Silty gravelly-silty SAND
125-140: Sandy SILT
140-150: Silty sandy GRAVEL
150-160: Gravelly SAND
160-165: Sandy GRAVEL
165-190: Gravelly SAND
190-195: Silty gravelly SAND
195-200: Silty sandy GRAVEL
200-210: Sandy GRAVEL
210-240: Silty gravelly SAND
240-250: SAND



Elevation of reference point: [699.04-ft]
(top of casing)
Height of reference point above ground surface [2.46-ft]
Depth of surface seal [0-217.5-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 6.0-ft
4 equidistant protective posts
Envirogel grout 6-217.5-ft
I.D. of riser pipe: [4-in]
Type of riser pipe:
Stainless steel
Diameter of borehole,
0-42.5-ft, 13-in nominal
42.5-147.5-ft, 11-in nominal
147.5-250-ft, 9-in nominal
Type of filler, 6-217.5-ft
Envirogel grout
Depth top of seal: [217.5-ft]
Type of seal: Volclay pellets
Depth top of sand pack: [220.5-ft]
10-20-mesh silica sand
Depth top of screen: [227.0-ft]
4-in, #30-slot, continous wrap
304 stainless steel
Depth bottom of screen: [247.0-ft]
Telescoping screen, 227.5-247.5-ft
6-in, blank 222.2-227.5-ft
6-in, #10-slot 227.5-237.5-ft
6-in, #10-slot 237.5-247.5-ft
All 304 stainless steel
Depth to bottom of borehole: [250.0-ft]

Drawing By: RKL/2W10-13.ASB Date: 16Apr93
Reference:

Figure C-6. Well 299-W10-13 Construction and Completion Summary

Appendix D-B

Final Status Groundwater Monitoring Plan for the LLBG WMA-2

This page intentionally left blank.

Executive Summary

This document presents a revision to the Low-Level Waste Management Area 2 (LLWMA-2) groundwater monitoring plan that was issued in 2010. [1] This revised monitoring plan is based on the requirements for final status facilities, as identified in Part II, Condition II.F of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, Class 1 Modification (hereafter referred to as the Hanford Federal Facility *Resource Conservation and Recovery Act of 1976* [RCRA] Permit),[2] which specifies that final status groundwater monitoring programs are subject to the requirements in WAC 173-303-645.[3] The U.S. Department of Energy (DOE), Richland Operations Office (RL) is revising this RCRA groundwater monitoring plan due to the age of the plan in order to ensure that the plan contains the most current Hanford Site groundwater monitoring information for the treatment, storage, and disposal (TSD) unit and to identify changes in groundwater flow direction. This groundwater monitoring plan supersedes the previous groundwater monitoring plan[1] upon modification of the Hanford Facility RCRA Permit. This plan is the principal controlling document for conducting groundwater monitoring at LLWMA-2.

The LLWMA-2 is an operating final status TSD unit in the 200-SW-2 Operable Unit (OU). The TSD unit is located on the Hanford Site in the northeastern corner of the 200 East Area. It consists of the 218-E-12B and 200-E-304 Burial Grounds.

The 218-E-12B Burial Ground contains 39 north-south-oriented, unlined trenches that received solid low-level radioactive and transuranic waste from 1967 to 2004. These trenches have been backfilled and are not subject to the requirements of WAC 173-303.[4] The 200-E-304 Burial Ground contains one open and unlined trench, Trench 94, which has been in use since 1986. Trench 94 is actively used to manage

[1] DOE/RL-2009-76, 2010, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-2*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084331.

[2] WA7890008967, 2009, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, Class 1 Modification, Washington State Department of Ecology, Richland, Washington.

[3] WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," *Washington Administrative Code*, Olympia, Washington. Available at: http://app.leg.wa.gov/WAC/default.aspx?cite=173-303-645.

[4] WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

defueled U.S. Navy reactor compartments that are stored aboveground at the bottom of the open trench. The reactor compartments contain lead that is integrated as shielding into and surrounding the reactor compartment. The lead does not meet the definition of a solid waste because the lead is fulfilling its intended purpose; thus, it is not a dangerous waste. Discussions are currently underway to remove Trench 94 from the Low-Level Burial Grounds RCRA Part A Form. Until this action is completed, groundwater monitoring will be conducted in accordance with WAC 173-303-645 under final status facility requirements.

Groundwater monitoring at LLWMA-2 was implemented in 1986. The statistical analyses of groundwater monitoring data have shown exceedances relative to the statistical comparison values (as defined in 40 CFR 265.92[b]).[5] However, the exceedances in downgradient wells have been explained by laboratory issues, sample collection errors, or migrating plumes from other source sites. As such, potential dangerous waste from LLWMA-2 has not contaminated the underlying groundwater.

This revised RCRA groundwater monitoring plan presents a final status indicator evaluation program under WAC 173-303-645 for detection monitoring of the uppermost aquifer beneath LLWMA-2. This plan addresses the following:

- Number, locations, and depths of wells in the LLWMA-2 groundwater monitoring network
- Sampling and analytical methods of parameters required for groundwater contamination detection monitoring
- Methods for evaluating groundwater quality information
- Schedule for groundwater monitoring at LLWMA-2

This revised plan modifies the existing groundwater monitoring well network, as identified in the previous groundwater monitoring plan.[1] The change in the monitoring network from the previous plan addresses the change in groundwater flow direction, which was previously to the west and southwest and is now southward. Future

[5] *40 CFR 265.92*, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=2cd7465519114fb3472b4864a0e3c42b&node=pt40.26.265&rgn=div5#se40.26.265_192.

groundwater flow changes are possible as a result of the 200-BP-5 OU treatability test (DOE/RL-2010-74).[6]

The 200-BP-5 OU treatability test, which will be completed at a well located west of LLWMA-2, will use varying groundwater extraction rates to determine hydraulic parameters and the existence of nearby hydrogeologic boundary conditions.

Groundwater in the LLWMA-2 monitoring wells will be sampled and analyzed semiannually for the groundwater contamination indication parameters (pH, specific conductance, total organic carbon, and total organic halogen) and annually for parameters establishing groundwater quality (anions, metals, alkalinity, and phenols). Field measurements (pH, dissolved oxygen, temperature, and turbidity) will also be collected for general groundwater chemistry to support the evaluation of upgradient and downgradient water chemistry variations. Water-level measurements will be taken each time that a sample is collected to satisfy the requirements of WAC 173-303-645(8)(f).

[6] DOE/RL-2010-74, 2015, *Treatability Test Plan for the 200-BP-5 Groundwater Operable Unit*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington, Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081243H.

This page intentionally left blank.

Contents

1 Introduction 1-1

2 Background 2-1

2.1 Facility Description and Operational History 2-1
2.2 Regulatory Basis 2-2
2.3 Waste Characteristics 2-3
2.4 Geology and Hydrogeology 2-4
2.4.1 Stratigraphy 2-4
2.4.2 Hydrogeology 2-5
2.4.3 Groundwater Flow Interpretation 2-9
2.5 Summary of Previous Groundwater Monitoring 2-12
2.6 Conceptual Site Model 2-19
2.7 Monitoring Objectives 2-20

3 Groundwater Monitoring Program 3-1

3.1 Constituents List and Sampling Frequency 3-1
3.2 Point of Compliance 3-1
3.3 Monitoring Well Network 3-1
3.4 Differences Between this Plan and Previous Plan 3-5
3.5 Sampling and Analysis Protocol 3-5

4 Data Evaluation and Reporting 4-1

4.1 Data Review 4-1
4.2 Statistical Evaluation 4-1
4.3 Interpretation 4-2
4.4 Groundwater Monitoring Network 4-2
4.5 Reporting and Notification 4-3

5 References 5-1

Appendices

A Quality Assurance Project Plan ..... A-i

B Sampling Protocol ..... B-i

C Well Construction ..... C-i

Figures

Figure 1-1. Location Map of LLWMA-2 1-2
Figure 1-2. Location Map of 200-E-304 and 218-E-12B Burial Grounds within LLWMA-2 1-3
Figure 2-1. Geologic Cross Section of Interpreted Geology West of Waste Storage at the 218-E-12B Burial Ground Based on Wells 299-E27-8, 299-E34-2, and 299-E34-5 2-6
Figure 2-2. Geologic Cross Section of Interpreted Geology along the South Boundary of Waste Storage at the 218-E-12B Burial Ground Based on Wells 299-E27-8, 299-E27-9, and 299-E27-10 2-7
Figure 2-3. Geological Cross Section of Interpreted Geology beneath the Middle of the Waste Storage at the 218-E-12B Burial Ground Based on Wells 299-E34-2, 299-E34-3, and 299-E34-7 2-8
Figure 2-4. CSM of Past Cooling Water and Contaminant Migration near and beneath LLWMA-2 2-10
Figure 2-5. Cross Section of Various Hanford Sands in Trench 94 2-11
Figure 2-6. Nitrate Trend Results for Wells near LLWMA-2 2-11
Figure 2-7. Low-Gradient Water-Level Map for 200 East Area in 2013 2-13
Figure 2-8. Low-Gradient Water-Level Map for 200 East Area in 2014 2-14
Figure 2-9. Nitrate Trend Results for Wells 299-E26-1, 299-E34-1, and 299-E34-7 2-16
Figure 2-10. Elevated Nitrate and Sulfate at Well 299-E34-7 2-16
Figure 2-11. Elevated Nitrate and Sulfate at Well 299-E26-10 2-17
Figure 2-12. Nitrate Trend at Well 699-55-50C during Initial Discharges at Gable Mountain Pond 2-17
Figure 2-13. TOC and Nitrate Trend Results at Well 299-E34-7 2-18
Figure 2-14. TOC Trend Results at Wells 299-E26-10, 299-E27-8, and 299-E27-10 2-19
Figure 3-1. Monitoring Well Network at LLWMA-2 3-3

Tables

Table 2-1. Previous Monitoring Plans 2-15
Table 2-2. Pertinent RCRA Final Status Facility Groundwater Monitoring Requirements 2-21
Table 3-1. Monitoring Well Network for the LLWMA-2 3-2
Table 3-2. Attributes for Wells in LLWMA-2 Groundwater Monitoring Network 3-4
Table 3-3. Main Differences between This Plan and Previous Plan 3-6

Terms

AEA	*Atomic Energy Act of 1954*
amsl	above mean sea level
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CSM	conceptual site model
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FWS	field work supervisor
LLBG	low-level burial ground
LLWMA	low-level waste management area
OU	operable unit
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	DOE Richland Operations Office
TEDF	Treated Effluent Disposal Facility
TOC	total organic carbon
TOX	total organic halides
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989)
TRU	transuranic
TSD	treatment, storage, and disposal
UPR	unplanned release

This page intentionally left blank.

1 Introduction

This document presents the revised groundwater monitoring plan for Low-Level Waste Management Area 2 (LLWMA-2) and supersedes the previous plan (DOE/RL-2009-76, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-2*). LLWMA-2 is a final status treatment, storage, and disposal (TSD) unit listed in Part II of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, Class 1 Modification (hereafter referred to as the Hanford Facility *Resource Conservation and Recovery Act of 1976* [RCRA] Permit). Part II, Condition II.F of the Hanford Facility RCRA Permit specifies that final status groundwater monitoring program requirements will comply with WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." Groundwater is monitored in accordance with WAC 173-303-645 and Part II of the Hanford Facility RCRA Permit.

This detection-level plan includes monitoring for indicator parameters (pH, specific conductance, total organic carbon [TOC], and total organic halogen [TOX]) in groundwater samples that are used to determine whether dangerous waste or dangerous waste constituents have entered the groundwater, as well as other parameters (anions, metals, and phenols) for establishing groundwater quality. For regulatory purposes, the TSD unit boundary of LLWMA-2 is identified on the current Hanford Facility RCRA Permit Part A Form. Groundwater cleanup will be addressed under the 200-BP-1 Groundwater Operable Unit (OU).

LLWMA-2 is located on the Hanford Site in the northeast corner of the 200 East Area, within the 200-SW-2 Source OU (Figure 1-1). Two burial grounds (i.e., waste sites), 218-E-12B and 200-E-304, are within the boundary of LLWMA-2 (Figure 1-2).

The 218-E-12B Burial Ground contains 39 north-south-oriented unlined trenches that received solid low-level radioactive and transuranic (TRU) waste from 1967 to 2004. The waste disposed into the inactive trenches was primarily generated from the Plutonium-Uranium Extraction Plant, B Plant, and the 200 East Area tank farms, as well as the 100 Area, 300 Area, and city of Richland Landfill. The waste contained in the inactive trenches is discussed in this groundwater monitoring plan for informational purposes only. The 39 inactive trenches have been backfilled and are not subject to the requirements of WAC 173-303.

The 200-E-304 Burial Ground consist of one excavation, Trench 94. This unlined excavation is oriented east-west and has been actively used to manage defueled U.S. Navy reactor compartments since 1986. The reactor compartment disposal packages are stored aboveground and consist of lead integrated as shielding into the welded steel structure of the package, which forms a sealed containment barrier for the materials contained within these reactor compartment (DOE/RL-88-20, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*). The lead in the reactor compartments does not meet the definition of a solid waste because the lead is fulfilling its intended purpose; thus, the lead is not a dangerous waste. As such, discussions are currently underway to remove Trench 94 from the Low-Level Burial Grounds (LLBGs) RCRA Part A Form. Until this action is completed, groundwater monitoring will be conducted in accordance with WAC 173-303-645 under final status facility requirements.

RCRA indicator parameter groundwater monitoring began at LLWMA-2 in 1986 based on the groundwater monitoring requirements for interim status facilities (i.e., those facilities still engaged in the permitting process). In 1994, the Washington State Department of Ecology (Ecology) issued the Hanford Facility RCRA Permit (WA7890008967) for the Hanford Site, which included the Part II, Condition II.F requirement that final status TSD units must comply with the requirements of WAC 173-303-645.

Previous interim status groundwater monitoring results do not indicate that dangerous waste or dangerous waste constituents from the unit have impacted the underlying groundwater. Therefore, final status monitoring at LLWMA-2 is conducted under a detection monitoring program in accordance with WAC 173-303-645(9).

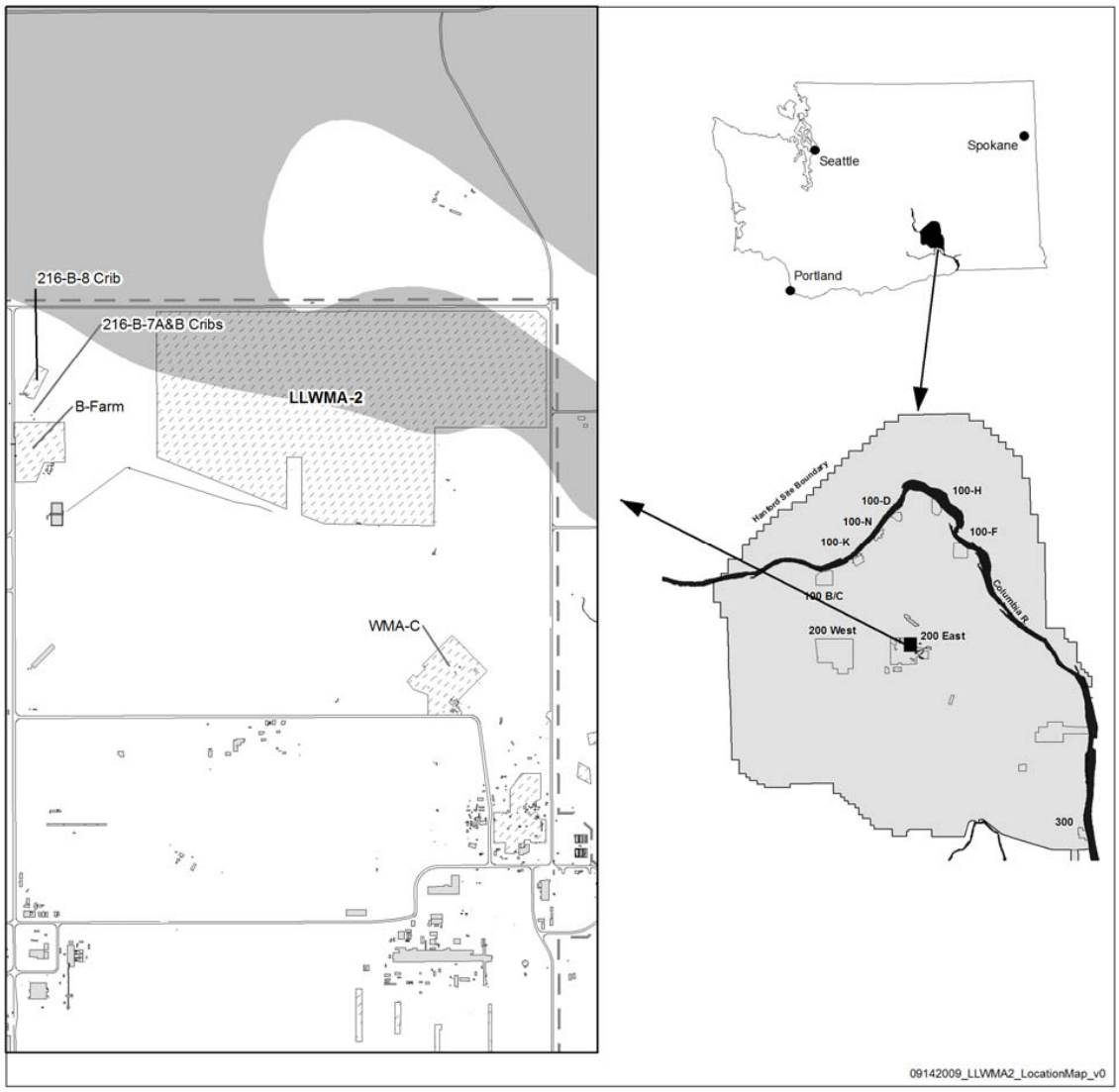


Figure 1-1. Location Map of LLWMA-2

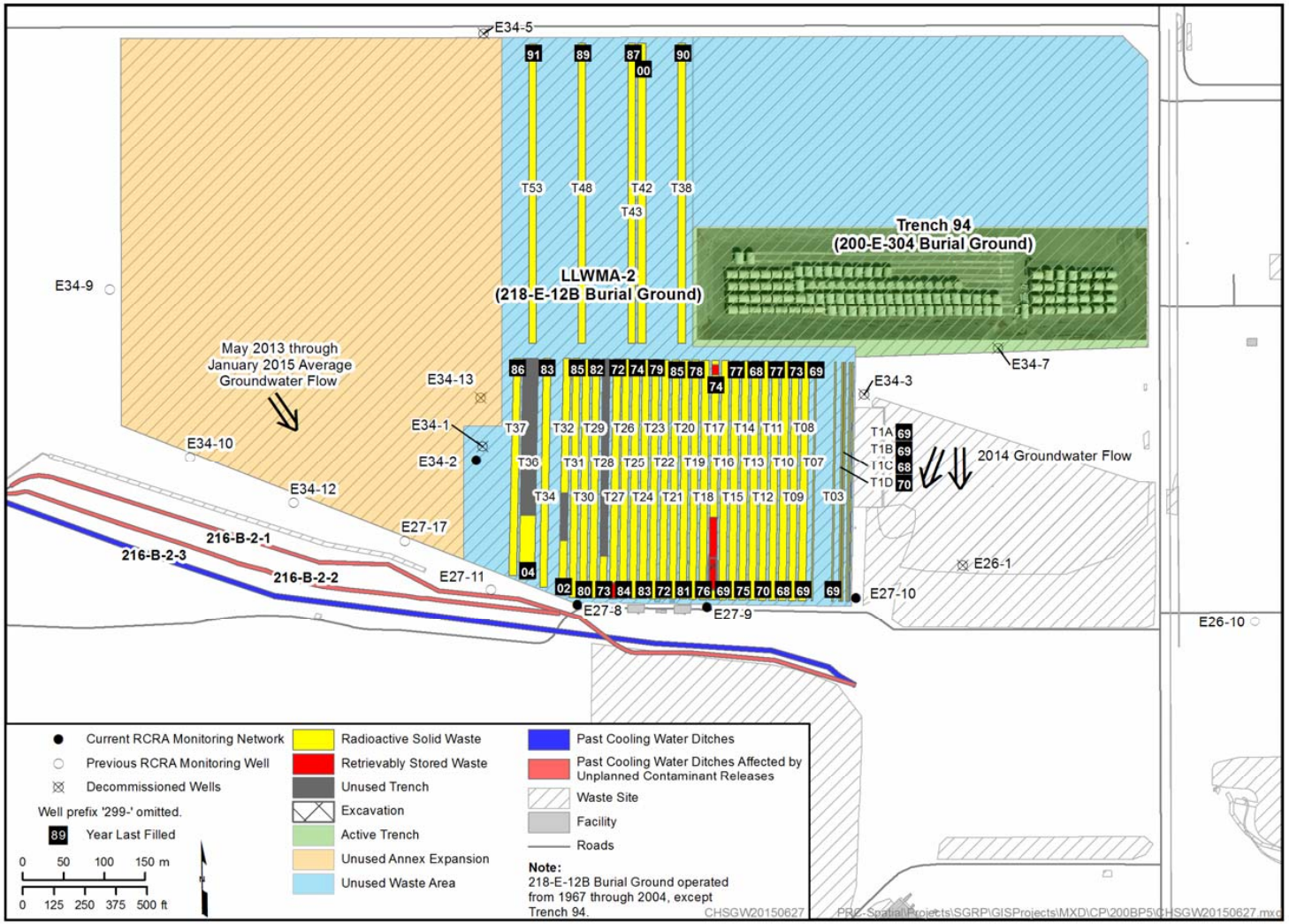


Figure 1-2. Location Map of 200-E-304 and 218-E-12B Burial Grounds within LLWMA-2

The purpose of this RCRA groundwater monitoring plan is to present an updated groundwater monitoring program for LLWMA-2 under the requirements for a final status program. Specifically, this plan is intended to satisfy the monitoring requirements for final status TSD units that are operating units, as prescribed in Part II of the Hanford Facility RCRA Permit and as required by WAC 173-303-645. The detection monitoring program detailed in this plan requires semiannual sampling for parameters used as indicators of groundwater contamination and annual sampling for groundwater quality parameters for upgradient well 299-E34-2 and downgradient wells 299-E27-8, 299-E27-9, and 299-E27-10. Additionally, water-level measurements are required each time a sample is collected to satisfy the requirements of WAC 173-303-645(8)(f). This monitoring plan is the principal controlling document for conducting groundwater monitoring at LLWMA-2 and is used to modify the Hanford Facility RCRA Permit. Once the Permit is modified, this document will supersede DOE/RL-2009-76.

This groundwater monitoring plan addresses the operational history, current hydrogeology, and conceptual site model (CSM) for LLWMA-2 and incorporates knowledge about the potential for contamination originating from this TSD unit. Chapter 2 of this plan summarizes background information and references other documents that contain more detailed or additional information. Chapter 2 also describes LLWMA-2 and the regulatory basis, types of waste present, the pertinent geology and hydrogeology beneath LLWMA-2, as well as giving a brief history of groundwater monitoring. All of this information is summarized as a CSM to aid in development of the groundwater monitoring program. Chapter 3 describes the RCRA groundwater monitoring program, including the wells in the monitoring network, constituents analyzed, sampling frequency, and sampling protocols. Chapter 4 describes data evaluation and reporting, and Chapter 5 contains the references cited in this plan. Appendix A provides the quality assurance project plan (QAPjP), Appendix B contains sampling protocols, and Appendix C provides information for the wells within the groundwater monitoring network.

2 Background

This chapter describes LLWMA-2 and its operating history, regulatory basis, wastes and waste characteristics associated with LLWMA-2, local subsurface geology and hydrogeology, a summary of previous groundwater monitoring, and the CSM for LLWMA-2.

The information contained in this chapter was obtained from several sources, including the documents listed in Section 2.4, previous groundwater monitoring plans listed in Section 2.5, and the following documents:

- DOE/RL-88-20, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*
- DOE/RL-2011-01, *Hanford Site Groundwater Monitoring Report for 2010*
- DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014*
- PNNL-15670, *Hanford Site Groundwater Monitoring for Fiscal Year 2005*
- WHC-EP-0912, *The History of the 200 Area Burial Ground Facilities*
- WHC-SD-WM-TI-260, *Water Inflow Investigation at the 218-E-12A and 218-E-12B Burial Grounds*

2.1 Facility Description and Operational History

LLWMA-2 consists of the 218-E-12B and 200-E-304 Burial Grounds and covers 70 ha (173 ac), including the western annexed portion, which was never used (Figure 1-2).

Thirty-nine north-south-oriented trenches in the 218-E-12B Burial Ground are located in the south and central portions of LLWMA-2, occupying approximately 23 ha (54 ac). The first six north-south trenches were placed into service in 1967 and are 0.9 m (3 ft) wide and 1.2 m (4 ft) deep. The remaining 33 north-south trenches are 11 m (37 ft) wide (3 m [10 ft] wide trench base) and 4.8 m (16 ft) deep, and these trenches received waste until 2004. These north-south trenches are unlined and vary in length from 299 to 381 m (944 to 1,250 ft). In addition, the north-south trenches received approximately 62,000 m^3 (2,200,000 ft^3) of radiological and TRU waste. Based on the waste disposal depths, 59 to 73 m (195 to 240 ft) of vadose zone is found between the base of the unlined trenches and the groundwater. Waste received at the north-south trenches within the 218-E-12B Burial Ground was generally from the 200 East Area, but it also included material from the 100 Area, 300 Area, and Richland Landfill. While these 39 unlined trenches are within the LLBG TSD unit, the trenches do not contain any waste that is subject to RCRA dangerous waste regulations.

Trench 94 in the 200-E-304 Burial Ground, located northeast of the 218-E-12B Burial Ground, is an open trench used for receipt and disposal of offsite defueled U.S. Navy reactor compartments (Figure 1-2). Trench 94 began receiving reactor compartments in 1986 and is currently actively receiving defueled reactor compartments. The trench is 21 ha (52 ac) in size and is excavated to a depth of 16.5 m (54 ft). Based on the disposal depths, 51 m (167 ft) of vadose zone is found between the base of the reactor compartments and the groundwater. The reactor compartments consist of the reactor vessel, steam generator, main coolant pump and associated valves, and piping. Each reactor compartment contains approximately 200 tons of lead used for shielding protection of the vessel crew while the reactor was in use; during decommissioning and disposal of the vessel; and during the preparation, transportation, and disposal of the reactor compartments (WHC-EP-0912). The lead is still providing shielding protection. The minimum thickness of the containment barrier is typically 1.9 cm (0.75 in.). Based on a liberal corrosion rate of 0.0015 cm/yr (0.0006 in./yr), the containment barrier is expected to remain intact for

a minimum of 600 years (DOE/RL-88-20). Each reactor compartment is mounted on a concrete block, which is above the ground surface within the trench.

South of LLWMA-2, two documented crude product unplanned releases (UPRs), UPR-200-E-32 and UPR-200-E-138, appear to have affected the groundwater south-southeast of Trench 94. Neither the cerium rare earth crude (UPR-200-E-32) nor the strontium nitrate crude (UPR-200-E-138) UPRs originated from LLWMA-2. UPR-200-E-32 occurred in 1963 as the result of liquid storage tank coil leak in the 221-B Building. This release contaminated the sediments adjacent the unlined 216-B-2-1 Ditch. In 1970, UPR-200-E-138 was created from the leaking 8-1 tank manometer sensing line in the 221-B Building. This release was flushed through the chemical sewer floor drain and conveyed to the sediment adjacent to the unlined 216-B-2-2 Ditch. Both of these UPRs were associated with nitric acid and complexant organics. Table 28 in ISO-986, *B-Plant Phase III Flowsheets*, provides details on the levels of nitrate and TOC for the strontium-90/rare earth recovery processes. In 1986, a wetting front was observed in LLWMA-2 Trench 36 (southwest of Trench 94). Subsequent investigation of the front established that the water was associated with plugging of the unlined 216-B-2-3 Ditch. Based on the investigation results, cooling water was determined to have migrated laterally from the 216-B-2-3 Ditch, northeast to Trench 36. Although the liquid release volumes from UPR-200-E-32 and UPR-200-E-138 were not significant, the later wetting front from the infiltrating cooling water of the plugged 216-B-2-3 Ditch appeared to have mobilized contaminants from these releases and affected groundwater quality. Details of the investigation are provided in WHC-SD-WM-TI-260.

2.2 Regulatory Basis

In May 1987, the U.S. Department of Energy (DOE) issued a final rule (10 CFR 962, "Byproduct Material"), stating that the hazardous waste components of mixed waste are subject to RCRA regulations. In November 1987, the U.S. Environmental Protection Agency (EPA) authorized Ecology to regulate these hazardous waste components within the state of Washington (51 FR 24504, "EPA Clarification of Regulatory Authority Over Radioactive Mixed Waste"). In 1996, the Washington State Attorney General determined that the effective date for regulation of mixed waste in Washington State was August 19, 1987.

In May 1989, DOE, EPA, and Ecology signed Ecology et. al., 1989, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement). This agreement established the roles and responsibilities of the agencies involved in regulating and controlling remedial restoration of the Hanford Site, which includes LLWMA-2. Groundwater monitoring is conducted at LLWMA-2 in accordance with WAC 173-303-400(3) (and by reference, 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, "Ground-Water Monitoring"), which requires monitoring to determine whether the dangerous waste constituents from the waste site have entered the groundwater.

Dangerous waste is regulated under RCRA, as modified in 40 CFR 265 and RCW 70.105, "Hazardous Waste Management," and its implementing requirements in the Washington State dangerous waste regulations (WAC 173-303-400, "Interim Status Facility Standards"). Radionuclides in mixed waste may include source, special nuclear, and byproduct materials, as defined in the *Atomic Energy Act of 1954* (AEA). Both RCRA and AEA state that these radionuclide materials are regulated at DOE facilities, exclusively by DOE acting pursuant to its AEA authority. Radionuclide materials are not hazardous/dangerous wastes and, therefore, are not subject to regulation by the state of Washington under RCRA or RCW 70.105.

When initially submitted, it was assumed that Trench 94 should be included as part of the Hanford Facility RCRA Permit Part A Form for all the LLBGs. Although recognized as providing shielding for the reactor compartments in Trench 94, the lead was incorrectly coded as a RCRA dangerous waste (D008). Because this coding still remains, interim status groundwater monitoring was being performed. However, methods to remove Trench 94 (200-E-304) from the LLBGs RCRA Part A Form and eliminate RCRA groundwater monitoring are currently being discussed.

Groundwater monitoring at LLWMA-2 was initiated in 1987 (PNL-6772, *A Detection-Level Hazardous Waste Ground-Water Monitoring Compliance Plan for the 200 Areas Low-Level Burial Grounds and Retrievable Storage Units*) based on the interim status indicator evaluation program requirements of 40 CFR 265, Subpart F and WAC 173-303-400. The groundwater monitoring plan was revised in 1989 (WHC-SD-EN-AP-015, *Revised Groundwater Monitoring Plan for the 200 Areas Low-Level Burial Grounds*), again in 2004 (PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*), and again in 2009 (DOE/RL-2009-76).

Although groundwater contamination indicator parameters have periodically exceeded the critical mean (e.g., specific conductance and TOC) throughout the history of detection monitoring (PNNL-15670; DOE/RL-2011-118, *Hanford Site Groundwater Monitoring for 2011*), exceedances in downgradient wells have been explained by laboratory issues, sample collection errors, or migrating plumes from other source sites (DOE/RL-94-136, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1994*; PNNL-11470, *Hanford Site Groundwater Monitoring for Fiscal Year 1996*; PNNL-11793, *Hanford Site Groundwater Monitoring for Fiscal Year 1997*; etc.). Upgradient wells that have exceeded the critical mean (e.g., 299-E34-7, which is now dry) appear to have been associated with remobilized contaminants related to UPRs at the unlined 216-B-2-1 and 216-B-2-2 Ditches (DOE/RL-2011-118). The conceptual model for remobilized UPR migration is discussed in Sections 2.4.2 and 2.6. An indicator evaluation program to monitor the parameters required for groundwater contamination detection currently continues.

LLWMA-2 is an active TSD unit and is listed in the Hanford Facility RCRA Permit as a final status unit. Previous groundwater monitoring results at LLWMA-2 under the interim status indicator evaluation program demonstrate that the groundwater has not been impacted by dangerous waste or dangerous waste constituents from LLWMA-2. Therefore, upon modification of the Hanford Facility RCRA Permit, groundwater monitoring at LLWMA-2 will be performed under the final status requirements for a detection monitoring program under WAC 173-303-645(9).

2.3 Waste Characteristics

The LLWMA-2 inactive 218-E-12B Burial Ground trenches received mainly low-level radiological waste; however, TRU waste was also stored within portions of Trench 17 and Trench 27 (Figure 1-2). A brief discussion of the waste received at the inactive trenches is provided here for informational purposes only. This waste was generated primarily from the 200 East Area, including the tank farms, but it also included material from the 100 Area, 300 Area, and Richland Landfill. Waste within the inactive trenches (a past practice site) is not regulated under WAC 173-303. Waste disposal photos are provided in WHC-EP-0912.

The only other trench at LLWMA-2 is Trench 94 (in the 200-E-304 Burial Ground), which is actively used for receipt and disposal of offsite, defueled U.S. Navy reactor compartments (Figure 1-2). Approximately 200 tons of lead is integrated as shielding into and surrounding the reactor compartment (WHC-EP-0912). This lead is a product that is used for its intended purpose of providing shielding.

The reactor compartments are unique, integrated, and welded steel structures that form a sealed containment barrier for the internal material. The minimum thickness of the containment barrier is typically 1.9 cm (0.75 in.). Based on a liberal corrosion rate of 0.0015 cm/yr (0.0006 in./yr), the containment barrier is expected to remain intact for a minimum of 600 years (DOE/RL-88-20). Current observations of the reactor compartments show no degradation and, by nature, are resistant to the arid climate at the Hanford Site.

2.4 Geology and Hydrogeology

The geology and hydrogeology of the 200 East Area, including the area of LLWMA-2, are described in detail in the following documents:

- PNL-6820, *Hydrogeology of the 200 Areas Low-Level Burial Grounds – An Interim Report*
- WHC-MR-0204, *200-East and 200-West Areas Low-Level Burial Grounds Borehole Summary Report*

This section describes the stratigraphy and hydrogeology of the region. A summary of the results of previous groundwater monitoring at LLWMA-2 is also provided.

2.4.1 Stratigraphy

The suprabasalt sediment of the northeast corner of the 200 East Area, specifically the area beneath LLWMA-2, was initially investigated and reported in detail in PNL-6820 and supporting document WHC-MR-0204. PNL-6820 provides the analytical, geophysical, hydrogeological, and lithological results used to differentiate various geologic facies at LLWMA-2 during installation of the initial monitoring network. This section summarizes the stratigraphic units, from oldest to youngest.

The uppermost basalt unit beneath LLWMA-2 is the Elephant Mountain Member of the Saddle Mountains Basalt, at a depth of 76 m (250 ft) below the bottom of the burial ground. A seismic study in 2009 indicated that the basalt surface might be either heavily weathered or fractured (SGW-52162, *Seismic Reflection Investigation at the Liquid Effluent Retention Facility, 200 East Area, Hanford Site Richland, Washington*). Previous investigations noted some weathering on basalt chip surfaces (WHC-SD-EN-EV-024, *Interim Status Groundwater Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility*). In addition, possible fanning joints could also provide a weaker reflection. Based on the interpretations and basalt chip observations during drilling of wells in this area, it is possible that the upper part of the basalt may be hydraulically connected to the suprabasalt aquifer.

The Ringold Formation and the Cold Creek unit, which overlie the basalt beneath most of the Central Plateau, are not present beneath LLWMA-2.

The Hanford formation is the informal name for the glacio-fluvial deposits from cataclysmic Ice Age floods. The Hanford formation consists of mostly unconsolidated sediments that cover a wide range in grain size, from pebble- to boulder-size gravel, fine- to coarse-grained sand, silty sand, and silt. The Hanford formation is further subdivided into a lower gravel (H3), middle sand (H2), and upper gravel-dominated (H1) facies. The following discussion of these facies focuses on the sediments underlying the buried waste at LLWMA-2. The facies transition into one another laterally with distance from the main, high-energy flood currents (PNNL-19277, *Conceptual Models for Migration of Key Groundwater Contaminants Through the Vadose Zone and Into the Unconfined Aquifer Below the B-Complex*).

The unconsolidated, lower gravel-dominated facies of the Hanford formation (H3) overlies the basalt beneath LLWMA-2 (Figures 2-1 and 2-2). The unconfined aquifer is contained within this facies

(Figures 2-1 through 2-3). The primary defining trait for this facies is the percentage of basalt clasts, which ranges between 60 and 80 percent (DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin*). The two primary sediment classifications of this facies are sandy gravel and silty-sandy gravel, with an average of 40 percent gravel (Appendix J of PNL-6820). The silt content of the sandy gravel increases to the east, from 4 percent at well 299-E27-8 to 6 to 8 percent in wells 299-E27-9 and 299-E27-10.

The Hanford sand-dominated facies (H2) overlies the H3 facies beneath the central and western portions of LLWMA-2. The H2 facies thickens from east to west. In the northeast part of LLWMA-2, the H2 appears to have been incised by high-energy Ice Age floods associated with the Hanford upper gravel-dominated facies (Figure 2-3). The H2 unit is predominantly a gravelly sand and dips to the east-northeast.

The silt content of H2 is generally below 8 percent; however, 10 to 12 percent silt is occasionally observed near the top of the graded gravelly sand and sand sequences. The silt may turn to clay in certain areas, as described by the geologist during drilling at well 299-E27-8. The geologist observed visible presence of clay, ranging in size from small clumps to clay balls, from 33.5 m to 48.8 m (110 ft to 160 ft) below ground surface (bgs). These finer grained lenses can be continuous, reaching distances of several hundred meters, and are capable of generating perched water horizons (WHC-SD-WM-TI-260) (Figure 2-3). During drilling at well 299-E27-9, some horizons were noted as containing perched water.

The Hanford upper gravel-dominated facies (H1) is the shallowest stratigraphic unit present beneath LLWMA-2. Based on sieve analysis, this unit is predominantly a sandy gravel. The gravel content is higher to the east, averaging between 50 and 53 percent in wells 299-E27-9 and 299-E27-10, respectively. The gravel content to the west decreases (33.6 percent in well 299-E27-8). Cementation was not observed in the H1 unit, and total calcium carbonate content is generally a few weight percent or less. Silt content ranges from 5 to 12.8 percent. Where higher silt content exists, perched water horizons have been reported in the past; these silt rich horizons are lateral distinct for distances of several hundred meters.

2.4.2 Hydrogeology

The major hydrogeologic units beneath LLWMA-2 include, in descending order, the vadose zone, the unconfined aquifer, and a series of confining units and confined aquifers in the basalt and associated interbeds.

The vadose zone beneath LLWMA-2 consists of Hanford formation sediments, as described in Section 2.4.1. Sediments range from gravels to sand, with varying amounts of silt.

The unconfined aquifer resides in the gravel-dominated facies of the Hanford formation (H3) and is limited to the southern part of LLWMA-2 (Figures 2-1 through 2-3). The H3 facies comprises sandy gravel and silty-sandy gravel. The silt content increases to the east, which may explain the higher hydraulic conductivity at well 299-E27-8 (greater than 730 m/d [>2,400 ft/d]) versus wells 299-E27-9 and 299-E27-10 (460 m/d [1,500 ft/d]).

The top of the basalt extends above the water table beneath the northern portion of LLWMA-2 (shown as gray shading in the left panel of Figure 1-1). Groundwater in the fractured basalt top may be present and form part of the unconfined aquifer in part of this region. The dense, interior portion of the basalt acts as a confining unit for underlying sedimentary interbeds, which form confined aquifers.

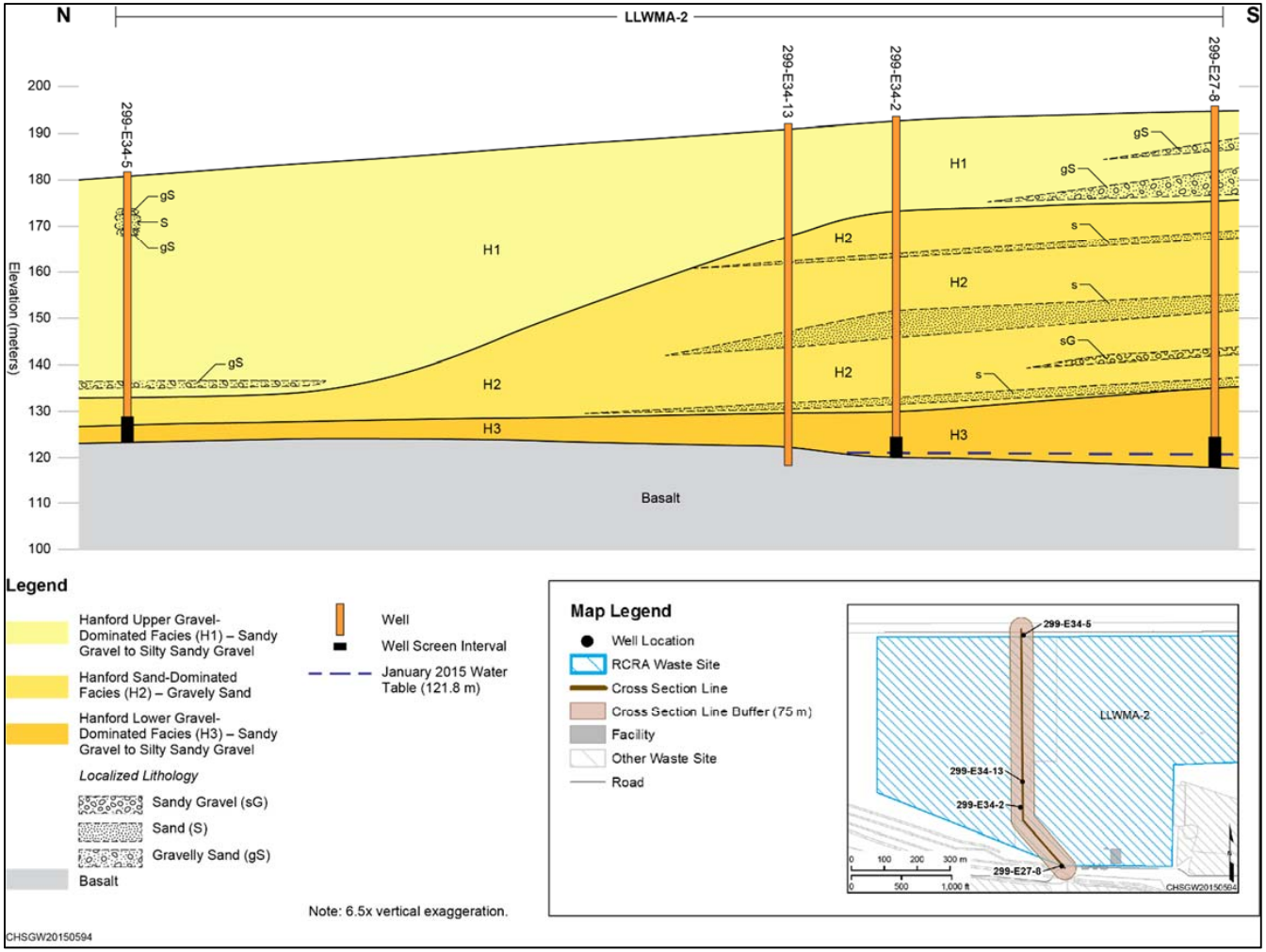


Figure 2-1. Geologic Cross Section of Interpreted Geology West of Waste Storage at the 218-E-12B Burial Ground Based on Wells 299-E27-8, 299-E34-2, and 299-E34-5

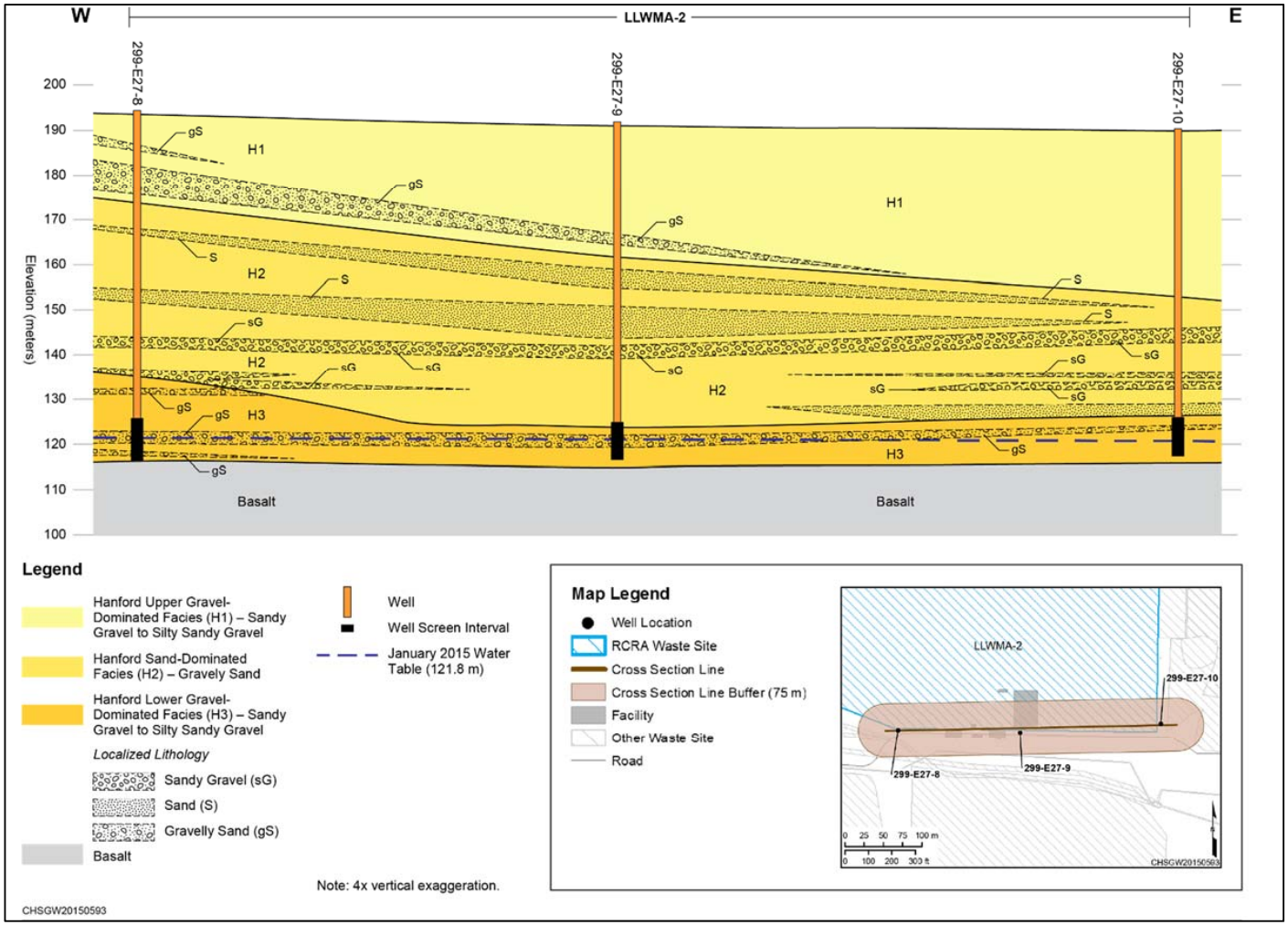


Figure 2-2. Geologic Cross Section of Interpreted Geology along the South Boundary of Waste Storage at the 218-E-12B Burial Ground Based on Wells 299-E27-8, 299-E27-9, and 299-E27-10

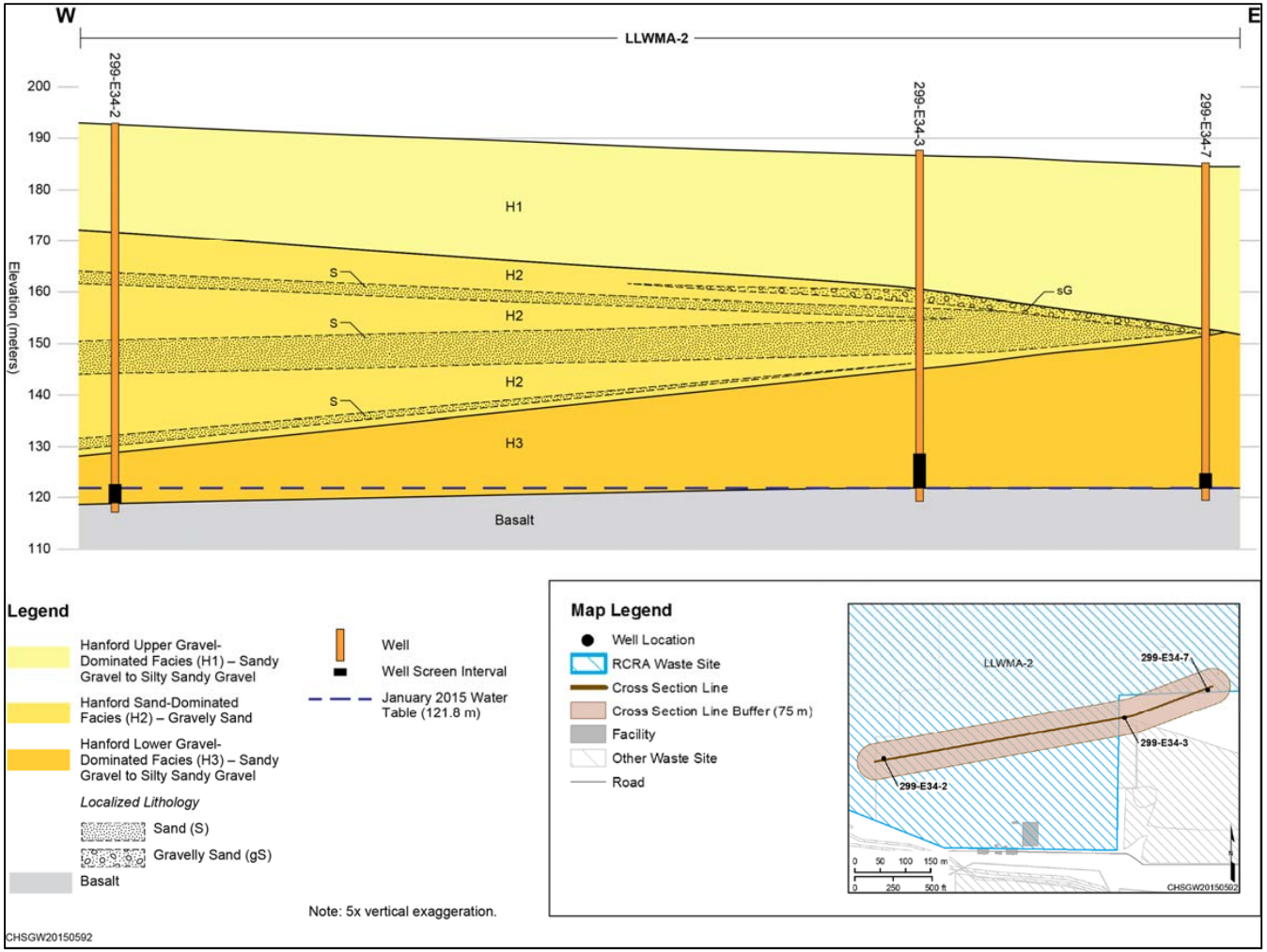


Figure 2-3. Geological Cross Section of Interpreted Geology beneath the Middle of the Waste Storage at the 218-E-12B Burial Ground Based on Wells 299-E34-2, 299-E34-3, and 299-E34-7

Past infiltration of liquid waste from the 216-B-2 Ditches (e.g., 216-B-2-1 [UPR-200-E-32] and 216-B-2-2 [UPR-200-E-138]; see discussion in Section 2.1) near LLWMA-2 moved downward and laterally in the vadose zone and reached groundwater, as illustrated in Figure 2-4. Strata with different sediment grain sizes in units H1 and H2 (Figure 2-5) can cause lateral spreading of moisture within a finer grained horizon. The lateral spreading can continue until the capillary force is reduced by the increased moisture content. This explanation seems consistent with the high moisture content found in sediment horizons near the southern boundary of LLWMA-2, where saturated moisture conditions were found (WHC-SD-WM-TI-260). In addition, vertical migration may occur where the underlying sediments are more tightly packed allowing preferential vertical migration from saturated, fine-grained sediments. The moisture content from depth-discrete borehole samples and trenches dug near well 299-E27-8 reflect the past lateral migration of cooling water released from the 216-B-2-3 Ditch.

Past elevated groundwater concentrations of nitrate at unconfined aquifer wells 299-E34-1 and 299-E34-7 (Figure 2-6) indicated migration of remobilized liquid nitrate associated with UPRs from the 216-B-2 Ditches (e.g., 216-B-2-1 and 216-B-2-2 Ditches). According to Table 28 in ISO-986, concentrated levels of nitrate and complex organics (expressed as TOC) were associated with the UPRs. The subsequent blockage of the 216-B-2-3 Ditch provided sufficient water to not only cause local perched water horizons near and extending beneath the south boundary of LLWMA-2, but also provided a mechanism for remobilization of nitrate and TOC from the earlier UPRs. The remobilization of nitrate and TOC would have spread unimpeded through the vadose zone. The eventual migration of nitrate and TOC to groundwater appears the most plausible cause for the elevated nitrate levels at wells 299-E34-1 and 299-E34-7. Elevated nitrate was detected in well 299-E34-1 in late 1985, when the groundwater flow direction was to the west (Figure 2-6). Increases in nitrate concentrations in well 299-E34-7 in the mid-1990s suggest that continued lateral migration within the vadose zone occurred further eastward of well 299-E34-3. This lateral migration eastward also appears to be consistent with the higher nitrate results found in wells 299-E27-9 and 299-E27-10 versus well 299-E27-8 (Figure 2-6). The sharp nitrate increases at well 299-E34-7 led to a 5-year (i.e., 2000 through 2005) groundwater quality assessment at this well, as discussed further in Section 2.5.

2.4.3 Groundwater Flow Interpretation

Analysis of water levels and contaminant plumes indicates that the hydraulic gradient slopes southward beneath the eastern part of LLWMA-2 and southeast under the western part of LLWMA-2. The water table is very flat in the 200 East Area (elevation of approximately 121.8 m [399.6 ft] above sea level), and sediments are highly transmissive.

The historical interpretation of groundwater flow at LLWMA-2 was provided in Section 2.5 of DOE/RL-2009-76. Generally, the groundwater flowed to the west from the mid-1980s until early in the new millennium. In the past, estimates of groundwater flow were determined by small differences in water levels within selected wells. From 2003 to mid-2011, nitrate migration indicated a southwest flow direction (PNNL-14548, *Hanford Site Groundwater Monitoring for Fiscal Year 2003*). In mid-2011, the gradient changed to its current configuration, sloping southward under the eastern part of LLWMA-2 and southeast under the western part of LLWMA-2.

To improve gradient estimates in recent years, over 50 groundwater monitoring wells in the 200 East Area were precision surveyed for elevation in a closed-loop survey and gyroscopically surveyed for deviation from vertical. This action removed the most significant errors associated with water-level measurements and provided additional wells in which a groundwater flow direction and gradient magnitude could be derived in the 200 East Area.

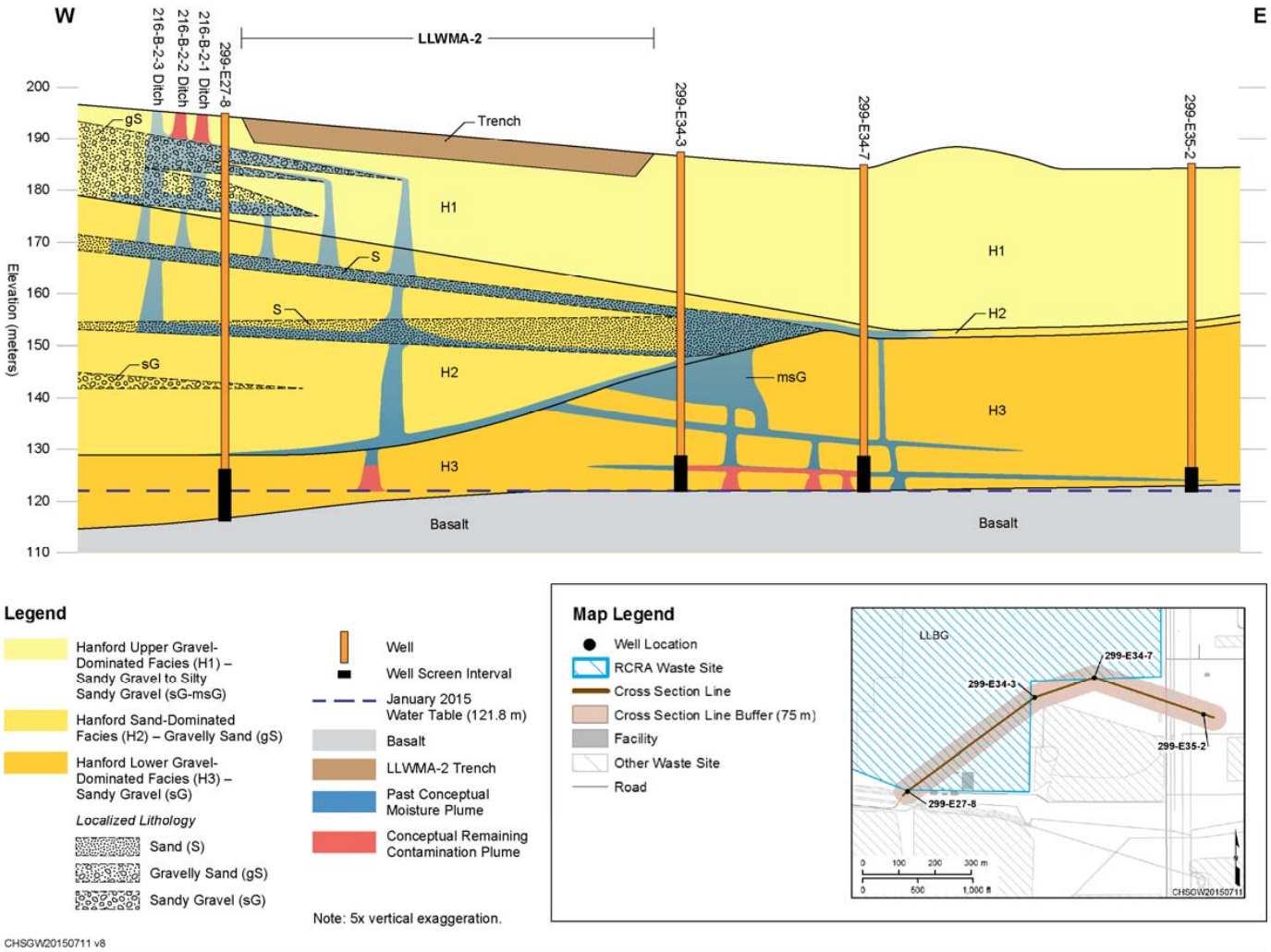


Figure 2-4. CSM of Past Cooling Water and Contaminant Migration near and beneath LLWMA-2

Source: PNNL-19277, *Conceptual Models for Migration of Key Groundwater Contaminants Through the Vadose Zone and Into the Unconfined Aquifer Below the B-Complex.*

Figure 2-5. Cross Section of Various Hanford Sands in Trench 94

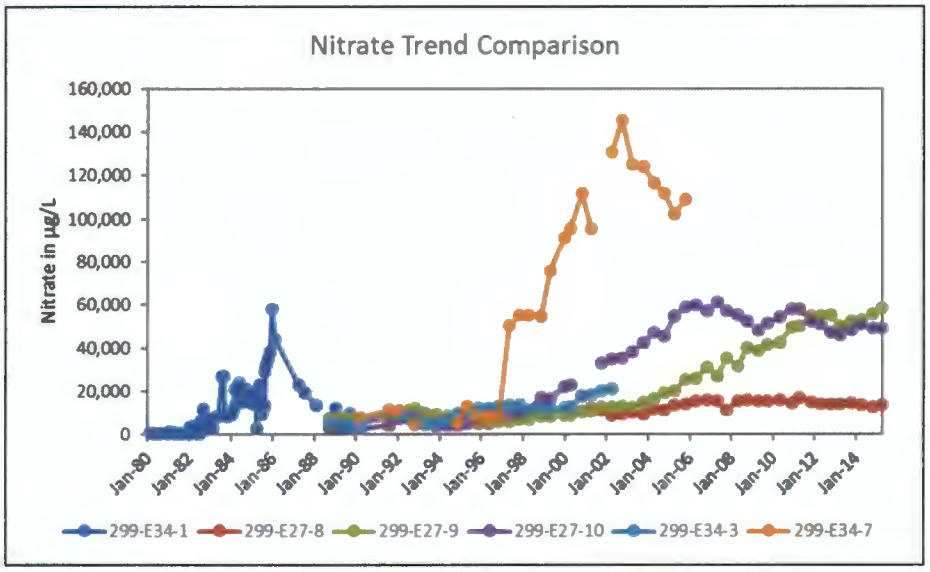


Figure 2-6. Nitrate Trend Results for Wells near LLWMA-2

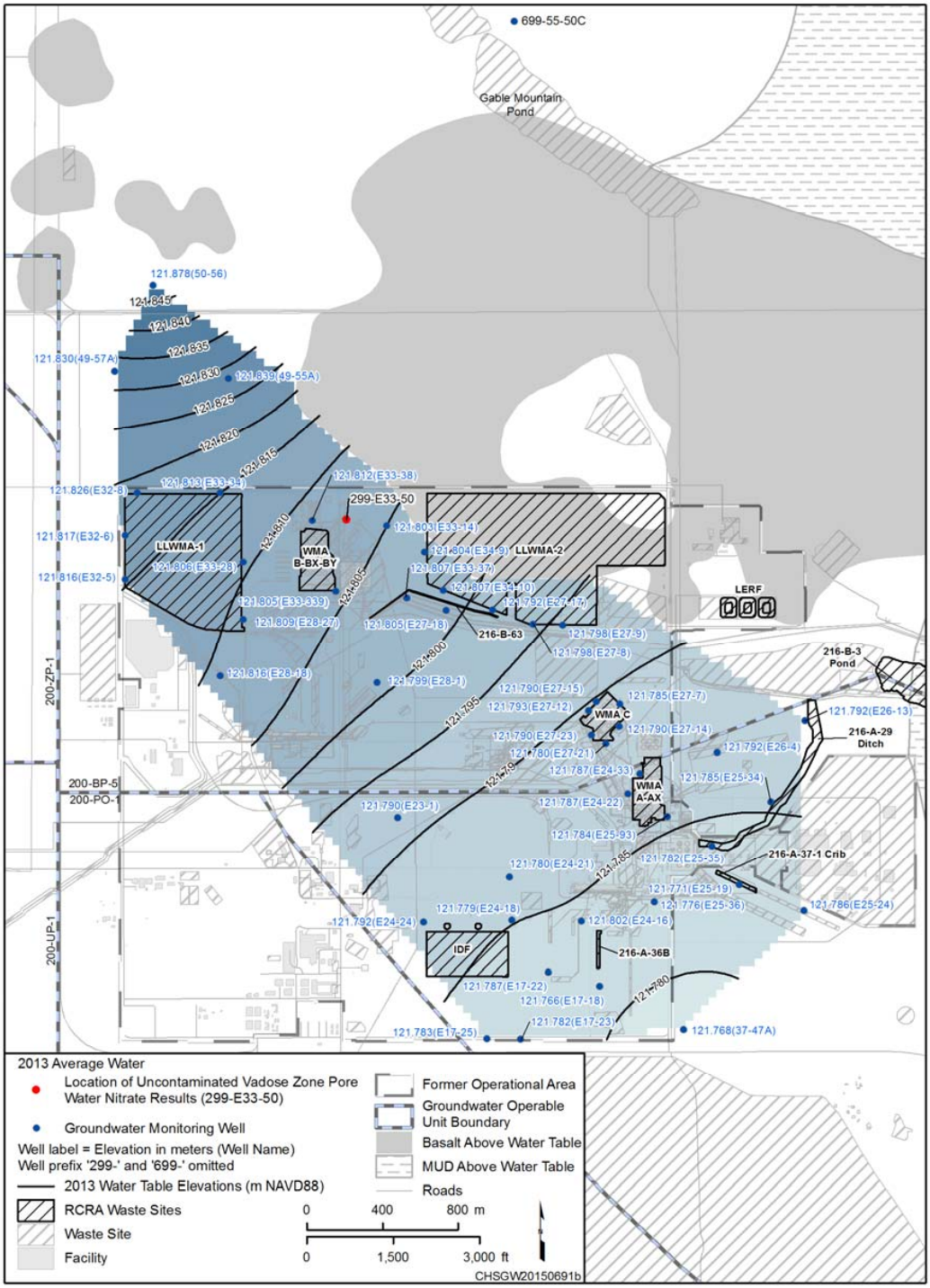
Trend surface analysis of monthly water-level data from May 2013 through December 2014 showed a dynamic flow direction and hydraulic gradient beneath the 200 East Area (SGW-58828, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014*). However, the 2013 and 2014 water table maps for the 200 East Area generally show consistent flow in the unconfined aquifer, from northwest to southeast beneath the western part of LLWMA-2 and north to south or southwest beneath eastern part of LLWMA-2 and the Liquid Effluent Retention Facility (Figures 2-7 and 2-8). The average hydraulic gradient magnitude across the 200 East Area was 1.1×10^{-5} m/m during 2013 and 6.1×10^{-6} m/m during 2014. The higher hydraulic gradient magnitude during 2013 was attributed to higher-than-normal Columbia River stage during 2011 and 2012, combined with the lack of large-volume effluent discharges to the Treated Effluent Disposal Facility (TEDF), which is located east of the 200 East Area. Between 2011 and 2014, TEDF discharges were on the order of 10^6 L/mo (264,172 gal/mo). In 2014, discharges of greater than 10^8 L/mo (26,417,205 gal/mo) were observed during 5 of the 12 months (SGW-58561). In Chapter 9 of DOE/RL-2011-01, it was shown that significant discharges (approximately 10^8 L/mo [26,417,205 gal/mo]) to TEDF caused groundwater elevations to increase in the 200 East Area; such increases were also shown to significantly affect the flow direction within the 200 East Area. Although the water table has continued to decline due to reduced production-era liquid discharges, increased discharges at TEDF in 2014 were sufficient to change the gradient magnitude and flow direction beneath a large portion of the 200 East Area (as previously discussed). It is unknown if continued periodic, large-volume discharges planned at TEDF over the next several years will cause significant changes beneath LLWMA-2, but it appears that current groundwater flow directions (as depicted in Figure 2-8) should continue.

Using the formula $v = (K*i)/n_e$ (Driscoll, 1986, *Groundwater and Wells*), the average gradient (i) of 1.21E-05, and the hydraulic parameters (K and n_e) discussed in PNL-6820, the estimated groundwater flow rate (v) beneath LLWMA-2 ranged between 0.12 and 0.22 m/d (0.39 and 0.72 ft/d), or 44 to 80 m/yr (140 to 260 ft/yr). Water levels in 200 East Area wells will continue to be monitored monthly for flow direction determinations.

2.5 Summary of Previous Groundwater Monitoring

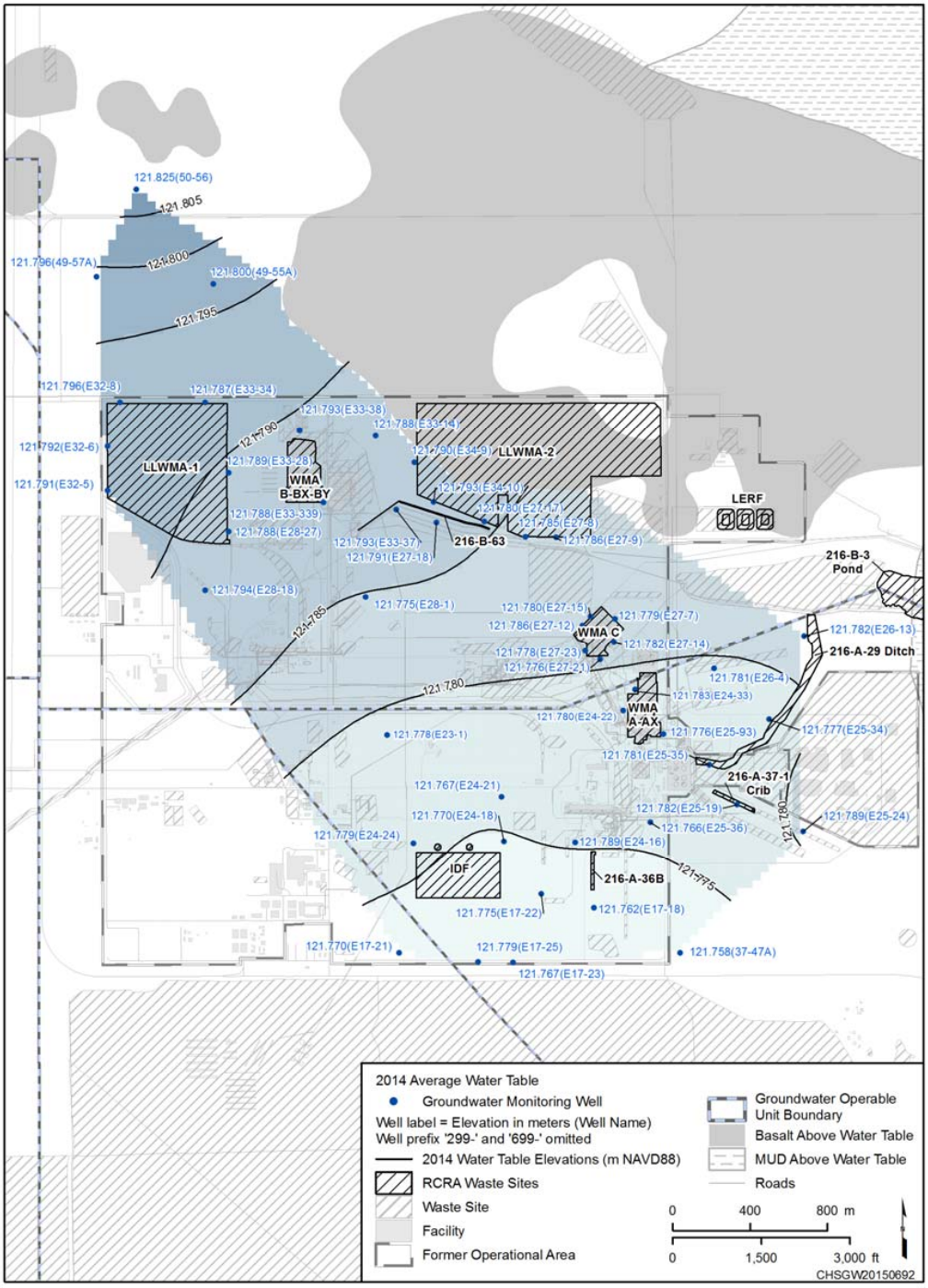
Table 2-1 lists the previous groundwater monitoring plans implemented at LLWMA-2. Since 1996, groundwater monitoring results for LLWMA-2 have been summarized in annual Hanford Site groundwater monitoring reports (e.g., DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014).*

RCRA groundwater monitoring was initiated at LLWMA-2 in 1986 in accordance with PNL-6772, based on the interim status indicator evaluation program. Contamination indicator parameters occasionally exceeded critical means over the years of monitoring, but characterization of the affected groundwater has not revealed any dangerous waste constituents. The groundwater impacts and probable sources are discussed below. Because the probable source of contamination is not within LLWMA-2, the site remains in indicator evaluation monitoring.



Source: SGW-58828, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014*.

Figure 2-7. Low-Gradient Water-Level Map for 200 East Area in 2013



Source: SGW-58828, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014*.

Figure 2-8. Low-Gradient Water-Level Map for 200 East Area in 2014

Table 2-1. Previous Monitoring Plans

Document	Date Issued	Monitoring Program*
PNL-6772, *A Detection-Level Hazardous Waste Ground-Water Monitoring Compliance Plan for the 200 Areas Low-Level Burial Grounds and Retrievable Storage Units*	February 1987	Indicator evaluation program
WHC-SD-EN-AP-015, *Revised Ground-Water Monitoring Plan for the 200 Areas Low-Level Burial Grounds*	May 1989	Indicator evaluation program
PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*	September 2004	Indicator evaluation program
DOE-RL-2009-76, Rev. 0, *Interim Status Groundwater Monitoring Plan for LLBG WMA-2*	March 2010	Indicator evaluation program

* The indicator evaluation program satisfies the requirements of 40 CFR 265.92(b)(2), (b)(3), (d)(1), (d)(2), and (e), "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis." The groundwater quality assessment program's first determination satisfies the requirements of 40 CFR 265.93(d)(4) and (d)(6), "Preparation, Evaluation, and Response."

The groundwater gradient magnitude and flow direction have varied over the past 30 years. Prior to RCRA groundwater monitoring, only one well, 299-E34-1, was located near the 218-E-12B Burial Ground. At that time, the groundwater contained elevated concentrations of nitrate (as discussed in Section 2.4.2) (Figure 2-6). The groundwater flow direction was interpreted as east-to-west due to significantly large discharges of cooling water at B Pond. Well 299-E26-1, actively monitored prior to 1990s, was located east and upgradient of well 299-E34-1 and showed much lower nitrate concentrations (Figures 1-2 and 2-9). WHC-SD-WM-TI-260 implied that the increased nitrate values at well 299-E34-1 were associated with migration of large quantities of cooling water discharges to the unlined 216-B-2-3 Ditch, which percolated into the adjacent sand and gravels (as further discussed in Section 2.4.2) (Figure 2-4). DOE/RL-2011-01 (Section 9.1.10.3) further indicated that the source of the nitrate was due to the remobilization of previous highly contaminated waste releases associated with the unlined 216-B-2-1 and 216-B-2-2 Ditches.

In 1997, concentrations of nitrate increased rapidly at well 299-E34-7 and much more gradually at upgradient well 299-E26-10 (Figures 2-10 and 2-11, respectively). The increased nitrate concentrations indicated a nearby vadose zone source because natural nitrate evaporation minerals (e.g., niter), which are highly soluble, do not appear to be associated with Hanford formation deposits. This is based on the lack of elevated nitrate in pore water samples at well 299-E33-50 and at Gable Mountain Pond during initial discharges of cooling water to this pond (Figures 2-7 and 2-12). Unplanned waste discharges associated with the unlined 216-B-2-1 and 216-B-2-2 Ditches included nitric acid solutions from B Plant. The increased, high nitrate concentrations at well 299-E34-7 indicate that the groundwater flow rate was very slow in the late 1990s and early years of the new millennium, and that infiltrating vadose zone contaminants were likely located close to this well.

TOC concentrations also increased rapidly in 1997 in well 299-E34-7 (Figure 2-13). Like nitrate, the TOC was attributed to UPRs from sources near LLWMA-2 (Section 2.4.2), where organic complexants were used in the fractionation process for strontium-90/rare earth recovery.

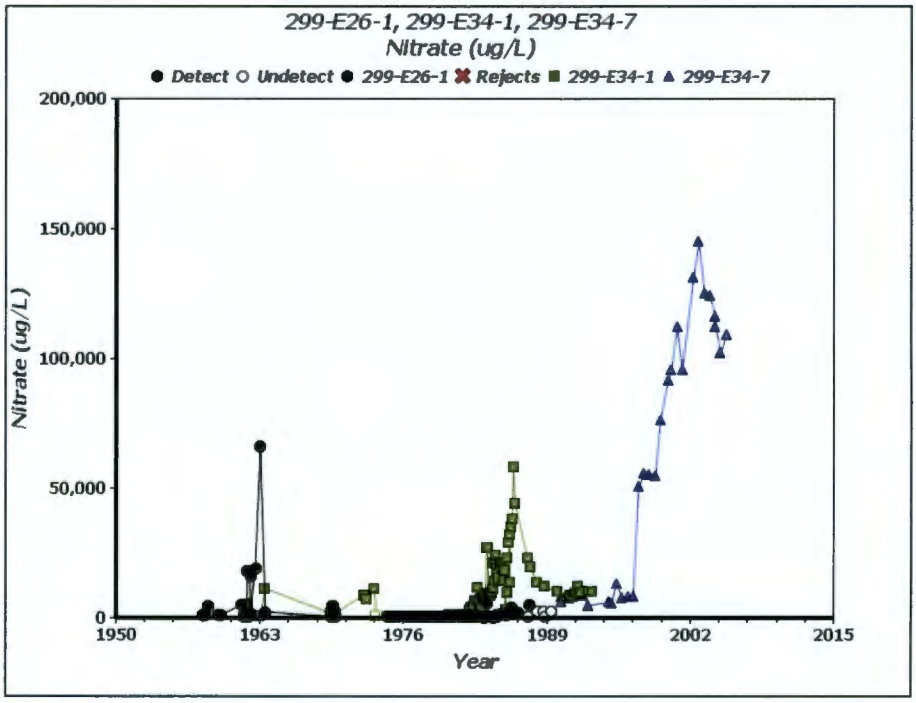


Figure 2-9. Nitrate Trend Results for Wells 299-E26-1, 299-E34-1, and 299-E34-7

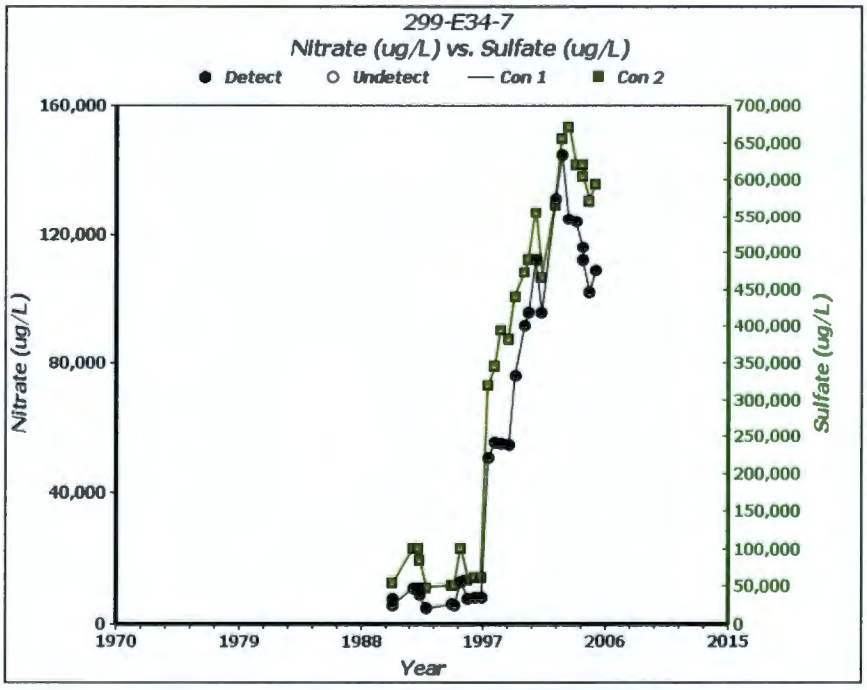


Figure 2-10. Elevated Nitrate and Sulfate at Well 299-E34-7

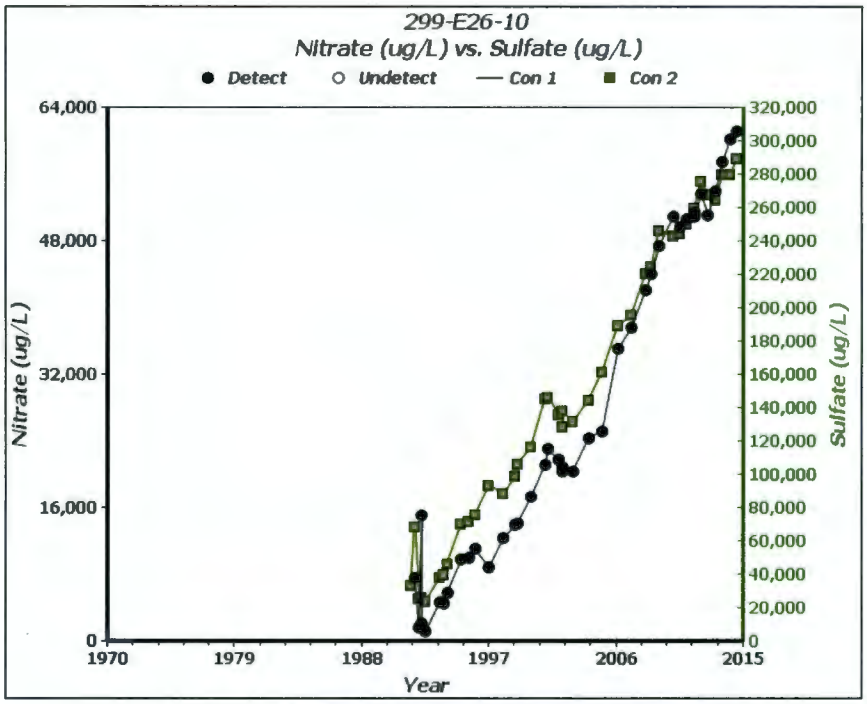


Figure 2-11. Elevated Nitrate and Sulfate at Well 299-E26-10

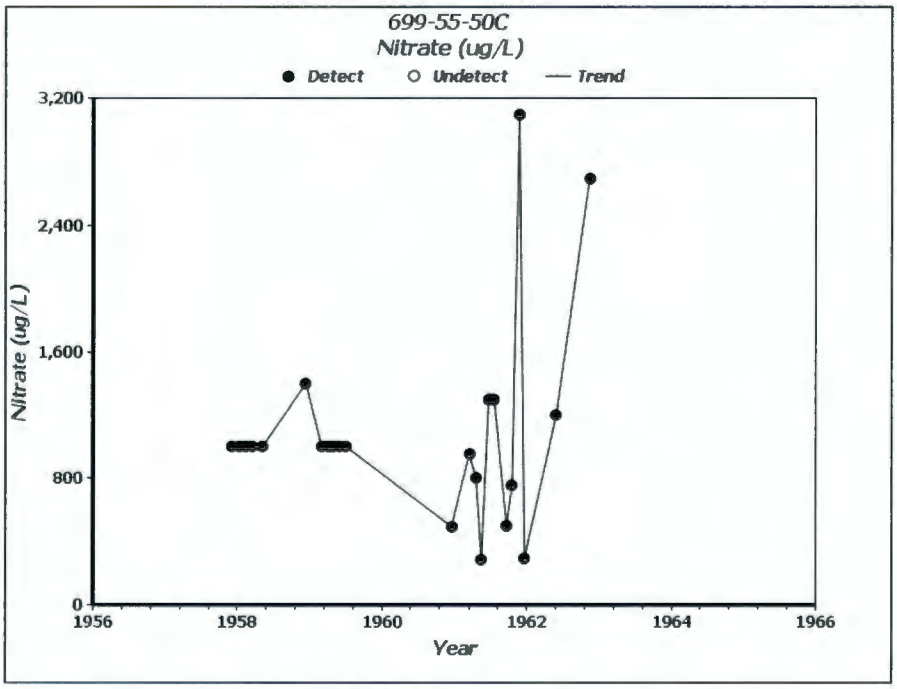


Figure 2-12. Nitrate Trend at Well 699-55-50C during Initial Discharges at Gable Mountain Pond

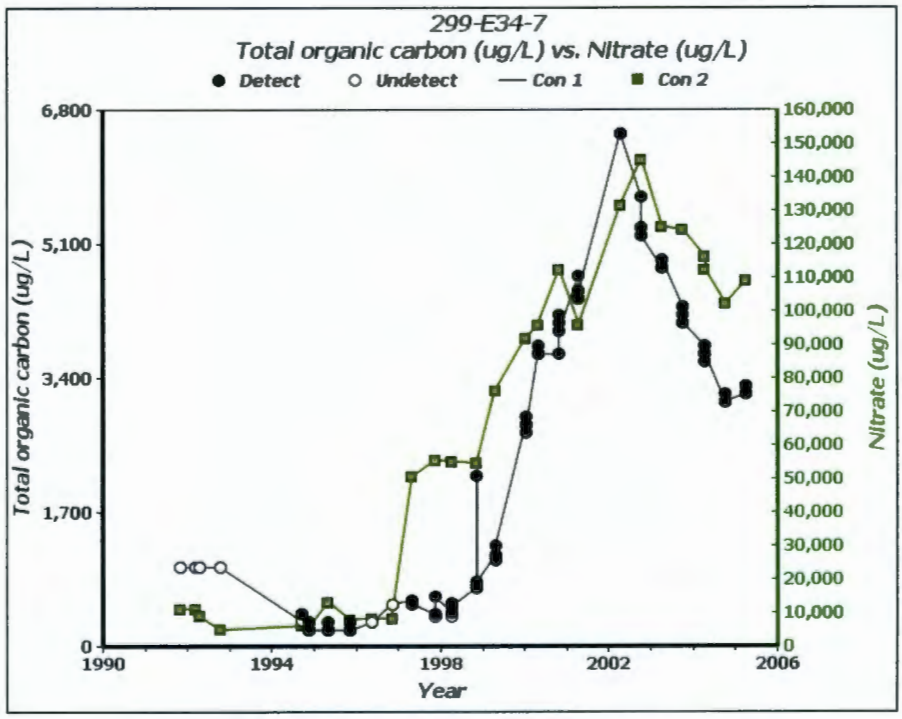


Figure 2-13. TOC and Nitrate Trend Results at Well 299-E34-7

Groundwater at well 299-E34-7 was characterized due to elevated specific conductance and TOC concentrations from 2000 through 2005. The characterization included semiannual sampling and analyses for the constituents identified in 40 CFR 264, "Standards for Owners and Operations of Hazardous Waste Treatment, Storage and Disposal Facilities," Appendix IX, "Ground-Water Monitoring List." Other analyses included coliform bacteria, total petroleum hydrocarbons for diesel and gasoline, and oil and grease. PNNL-15670, concluded, "…no organic constituents were detected consistently and those detected were at low levels and often associated with blank contamination that appears to be false-positive results." PNNL-15670 also stated, "…constituents causing the increased specific conductance in well 299-E34-7 are impacting wells farther southwest," referring to wells 299-E27-10 and 299-E27-9. Increases in TOC are continuing to occur sporadically along the southern boundary of LLWMA-2 and as an increasing trend further east at well 299-E26-10 (Figure 2-14). LLWMA-2 remains in detection monitoring because of the relationship between the nitrate and TOC to the contaminants associated with releases to the 216-B-2 Ditches and the lack of dangerous waste constituents in groundwater.

The groundwater monitoring activities at LLWMA-2 currently require sampling from a network of 13 wells. Samples are analyzed semiannually for the parameters used as indicators of groundwater contamination, groundwater quality parameters, and site-specific constituents (with the exception of phenols; phenols are sampled annually). Water-level measurements are collected each time that a sample is obtained from a network well.

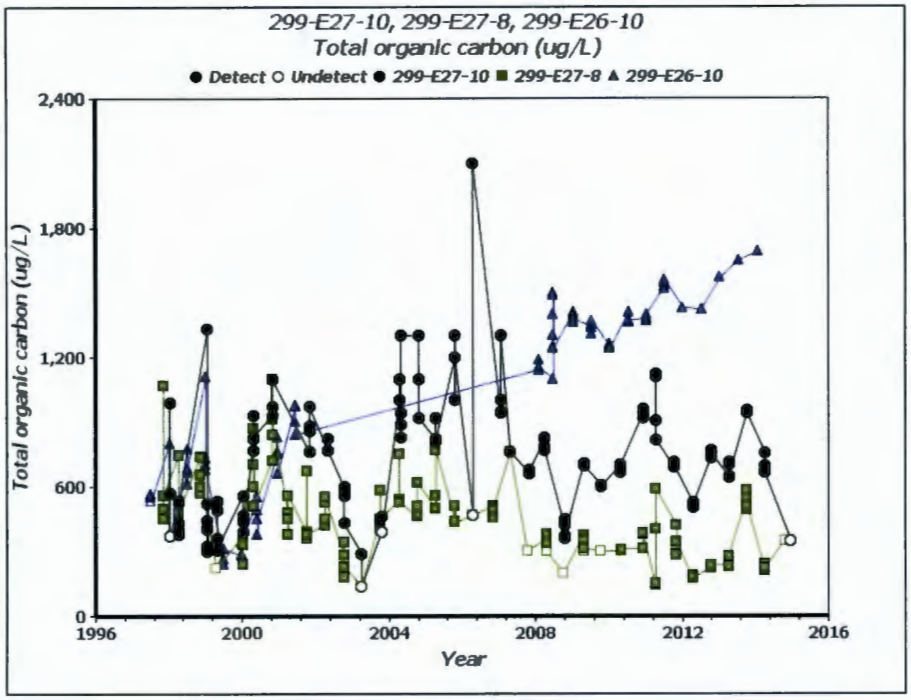


Figure 2-14. TOC Trend Results at Wells 299-E26-10, 299-E27-8, and 299-E27-10

Under this groundwater monitoring plan, the groundwater monitoring activities at LLWMA-2 will include sampling from a network of four wells. Samples are analyzed semiannually for parameters used as indicators of groundwater contamination and annually for parameters establishing groundwater quality. The network wells are also included in the annual comprehensive March water-level measurement campaign (SGW-38815, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*). The LLWMA-2 groundwater monitoring results are summarized in annual Hanford Site groundwater monitoring reports (e.g., DOE/RL-2015-07).

2.6 Conceptual Site Model

To serve as a guide for groundwater monitoring, this section describes the LLWMA-2 CSM (Figure 2-4) for potential contaminant transport. The CSM describes the current understanding of the contaminant release and transport, including the following assumptions:

- LLWMA-2 comprises the 218-E-12B Burial Ground, which includes inactive trenches that received mainly low-level radiological waste, and Trench 94, which is actively used for receipt and disposal of offsite defueled U.S. Navy reactor compartments.
- Defueled U.S. Navy reactor compartments disposed to Trench 94 include approximately 200 tons of lead used as shielding around the reactor compartments.
- The reactor compartments are self-containing and are expected to remain intact.
- Soil geochemistry of the site favors sorption or retardation of many heavy metals.

- Previous RCRA groundwater monitoring at LLWMA-2 does not indicate any release of dangerous waste or dangerous waste constituents. Although contamination indicator parameters have periodically exceeded critical mean values, exceedances in downgradient wells have been explained by laboratory errors, sample collection errors, or migrating plumes from other sources.
- Past UPRs of liquid waste from adjacent facilities appear to have caused increased concentrations of nitrate and TOC in some monitoring wells.
- Migration of contamination from the vadose zone to groundwater is currently unlikely due to lack of artificial recharge. Infiltration of natural precipitation is the only potential force capable of moving contaminants to the groundwater. The risk of infiltration and the potential for vertical migration of contaminants are considered low because of low annual precipitation.
- The vadose zone beneath Trench 94 consists of 51 m (167 ft) of Hanford formation sand and gravel. Varying percentages of fine-grained sediment are present beneath the southern and central parts of LLWMA-2. When previous releases of liquid waste from adjacent facilities encountered these fine-grained layers, the contamination spread laterally.
- The uppermost aquifer is within a gravel-dominated unit of the Hanford formation. It is 2 to 5 m (7 to 16 ft) thick in the southern part of LLWMA-2 and is absent in the northern part where the basalt surface extends above the water table.
- The bottom of the unconfined aquifer is the Elephant Mountain Basalt. In some locations, the upper part of the basalt may be fractured and hydraulically connected to the unconfined aquifer.
- Groundwater in the unconfined aquifer currently flows southward beneath the eastern part of LLWMA-2. The unconfined aquifer is not found beneath the northern portion of LLWMA-2, where the uppermost aquifer is confined by basalt and is isolated from the overlying unconfined aquifer.

2.7 Monitoring Objectives

The groundwater monitoring program for LLWMA-2 is conducted with the objective of determining the impact of the facility, if any, on the quality of the underlying groundwater. This groundwater monitoring plan specifically addresses those applicable RCRA requirements for final status TSD units where no impact to groundwater has been identified. The groundwater monitoring program for LLWMA-2 is conducted in accordance with WAC 173-303-645, as required by the Hanford Facility RCRA Permit, Part II, Condition II.F. Detection monitoring is implemented in accordance with WAC 173-303-645(9), which requires the establishment and implementation of a groundwater monitoring program capable of determining if there is statistically significant evidence of contamination in the uppermost aquifer underlying LLWMA-2. Table 2-2 identifies where each groundwater monitoring element of the pertinent regulations is addressed within this plan.

Table 2-2. Pertinent RCRA Final Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement	Section Where Requirement is Address in Monitoring Plan
Point of compliance Number and location of wells	WAC 173-303-645(9), "Detection Monitoring Program": (b) The owner or operator must install a groundwater monitoring system at the compliance point, as specified under subsection (6) of this section. The groundwater monitoring system must comply with subsection (8)(a)(ii), (b), and (c) of this section. WAC 173-303-645(6), "Point of Compliance": The facility permit will specify the point of compliance at which monitoring must be conducted. The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units. WAC 173-303-645(8), "General Groundwater Monitoring Requirements": (a) The groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer that: (i) Represent the quality of background groundwater that has not been affected by leakage from a regulated unit; (ii) Represent the quality of groundwater passing the point of compliance. (iii) Allow for the detection of contamination when dangerous waste or dangerous constituents have migrated from the waste management area to the uppermost aquifer. (b) If a facility contains more than one regulated unit, separate groundwater monitoring systems are not required for each regulated unit, provided that provisions for sampling the groundwater in the uppermost aquifer will enable detection and measurement at the compliance point of dangerous constituents from the regulated units that have entered the groundwater in the uppermost aquifer.	Sections 3.1, 3.2, 3.3, and 4.4

Table 2-2. Pertinent RCRA Final Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement	Section Where Requirement is Address in Monitoring Plan
Well configuration	WAC 173-303-645(8), "General Groundwater Monitoring Requirements": (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must allow collection of representative groundwater samples. Wells must be constructed in such a manner as to prevent contamination of the samples, the sampled strata, and between aquifers and water bearing strata. Wells must meet the requirements applicable to resource protection wells, which are set forth in Chapter 173-160 WAC, "Minimum Standards for Construction and Maintenance of Wells."	Section 3.3 and Appendix C
Parameters to be sampled Frequency of sampling Water-level measurements	WAC 173-303-645(9), "Detection Monitoring Program": (a) The owner or operator must monitor for indicator parameters (e.g., pH, specific conductance, total organic carbon [TOC], total organic halogen [TOX], or heavy metals), waste constituents, or reaction products that provide a reliable indication of the presence of dangerous constituents in groundwater. The department will specify the parameters or constituents to be monitored in the facility permit, after considering the following factors: (i) The types, quantities, and concentrations of constituents in wastes managed at the regulated unit; (ii) The mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the waste management area; (iii) The detectability of indicator parameters, waste constituents, and reaction products in groundwater; and (iv) The concentrations or values and coefficients of variation of proposed monitoring parameters or constituents in the groundwater background. (c) The owner or operator must conduct a groundwater monitoring program for each chemical parameter and dangerous constituent specified in the permit pursuant to (a) of this subsection in accordance with subsection (8)(g) of this section.	Section 3.1 and Table 3-1 Appendix B, Section B2.2
	(d) The department will specify the frequencies for collecting samples and conducting statistical tests to determine whether there is statistically significant evidence of contamination for any parameter or dangerous constituent specified in the permit under (a) of this subsection in accordance with subsection (8)(g).	

Table 2-2. Pertinent RCRA Final Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement	Section Where Requirement is Address in Monitoring Plan
	(e) The owner or operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually. WAC 173-303-645(8), "General Groundwater Monitoring Requirements": (e) The groundwater monitoring program must include consistent sampling and analytical methods that ensure reliable groundwater sampling, accurately measure dangerous constituents and indicator parameters in groundwater samples, and provide a reliable indication of groundwater quality below the waste management area. (f) The groundwater monitoring program must include a determination of the groundwater surface elevation each time groundwater is sampled. (g) In detection monitoring, data on each dangerous constituent specified in the permit will be collected from background wells and wells at the compliance point(s). The number and kinds of samples collected to establish background must be appropriate for the form of statistical test employed, following generally accepted statistical principles. The sample size must be as large as necessary to ensure with reasonable confidence that a contaminant release to groundwater from a facility will be detected. The owner or operator will determine an appropriate sampling procedure and interval for each hazardous constituent listed in the facility permit which will be specified in the unit permit upon approval by the department. This sampling procedure will be: (i) A sequence of at least four samples, taken at an interval that assures, to the greatest extent technically feasible, that an independent sample is obtained, by reference to the uppermost aquifer's effective porosity, hydraulic conductivity and hydraulic gradient, and the fate and transport characteristics of the potential contaminants; or (ii) An alternate sampling procedure proposed by the owner or operator and approved by the department.	
Statistical evaluation Statistical methods	WAC 173-303-645(9,) "Detection Monitoring Program": (d) The department will specify the frequencies for conducting statistical tests to determine whether there is statistically significant evidence of contamination for any parameter or dangerous constituent specified in the permit under (a). (f) The owner or operator must determine whether there is statistically significant evidence of contamination for any chemical parameter of dangerous constituent specified in the permit at the specified frequency.	Sections 4.2 and 4.5

Table 2-2. Pertinent RCRA Final Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement	Section Where Requirement is Address in Monitoring Plan
	(i) In determining whether statistically significant evidence of contamination exists, the owner or operator must use the method(s) specified in the permit under subsection (8)(h) of this section. These method(s) must compare data collected at the compliance point(s) to the background groundwater quality data. (ii) The owner or operator must determine whether there is statistically significant evidence of contamination at each monitoring well as the compliance point within a reasonable period of time after completion of sampling. WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (h) Groundwater monitoring data will be evaluated using a specified statistical method. The statistical test will be conducted separately for each dangerous constituent in each well. A statistical method not specified in the subsection may be submitted for approval. (i) The statistical method must be appropriate for the distribution of the dangerous constituent. The practical quantification limit used in the statistical method must be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.	
Recordkeeping and reporting	WAC 173-303-645(9), "Detection Monitoring Program": (c) The owner or operator must maintain a record of groundwater analytical data as measured and in a form necessary for the determination of statistical significance. (g) If the owner or operator determines pursuant to (f) of this subsection that there is statistically significant evidence of contamination for chemical parameters or dangerous constituents specified pursuant to (a) of this subsection at any monitoring well at the compliance point, he or she must: (i) Notify the department of this finding in writing within seven days. The notification must indicate what chemical parameters or dangerous constituents have shown statistically significant evidence of contamination: (ii) Immediately sample the groundwater in all monitoring wells and determine whether constituents in the appendix "Ground-Water Monitoring List," in "Chemical Testing Methods for Designating Dangerous Waste," which is incorporated at WAC 173-303-110(3)(c) are present, and if so, in what concentration. However, the department, on a discretionary basis, may allow sampling for a site-specific subset of constituents from the "Ground-Water Monitoring List" appendix and other representative/related waste constituents.	Section 4.5 Appendix A, Sections A1, A2.1.5, A2.1.11 and A2.5; Table A-2

Table 2-2. Pertinent RCRA Final Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement	Section Where Requirement is Address in Monitoring Plan
	(iii) For any "Ground-Water Monitoring List" appendix compounds found in the analysis pursuant to (g)(ii) of this subsection, the owner or operator may resample within one month or according to an alternative site-specific schedule approved by the director and repeat the analysis for those compounds detected. If the results of the second analysis confirm the initial results, then these constituents will form the basis for compliance monitoring. If the owner or operator does not resample for the compounds in (g)(ii) of this subsection, the dangerous constituents found during this initial "Ground-Water Monitoring List" appendix analysis will form the basis for compliance monitoring. (iv) Within ninety days, submit to the department an application for a permit modification to establish a compliance monitoring program meeting the requirements of WAC 173 303 645(10). WAC 173-303-645(8), "General Groundwater Monitoring Requirements": (j) Groundwater monitoring data collected in accordance with WAC 173-303-645(8)(g) including actual levels of constituents must be maintained in the facility operating record. The permit specifies when the data must be submitted for review.	

Note: Complete citations for the references listed in this table are provided in the References (Chapter 5) of this plan.

* Part II, Condition II.F of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, specifies that a groundwater monitoring program under final status is subject to the requirements of WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." Because there is no evidence of releases of waste impacting the groundwater at Low-Level Waste Management Area 2, a detection monitoring program is implemented in accordance with WAC 173-303-645(9).

RCRA = *Resource Conservation and Recovery Act of 1976*

This page intentionally left blank.

3 Groundwater Monitoring Program

This chapter describes the groundwater monitoring indicator evaluation program for LLWMA-2, which consists of a monitoring well network, parameters used as indicators of groundwater contamination, parameters establishing groundwater quality, point of compliance, and sampling and analysis protocols. The monitoring program presented herein has been revised from that presented in the previous plan (DOE/RL-2009-76).

3.1 Constituents List and Sampling Frequency

Table 3-1 presents the wells in the groundwater monitoring network, the parameters analyzed (as required for RCRA monitoring), and the sampling frequency for monitoring of LLWMA-2. Sampling and analysis will be conducted semiannually for parameters used as indicators of groundwater contamination (pH, specific conductance, TOC, and TOX) in accordance with WAC 173-303-645(9)(a). Groundwater quality parameters (anions, metals, and phenols) will be sampled and analyzed annually as reliable indictors of the presence of hazardous constituents in groundwater. Field measurements (pH, dissolved oxygen, temperature, and turbidity) will be collected to support data interpretation. Water-level measurements at each monitoring well will be determined each time that a sample is obtained in accordance with WAC 173-303-645(8)(f).

Maintenance problems and sampling logistics sometime delay scheduled sampling events. Sampling events are scheduled by month. The field work supervisor (FWS) determines the specific times within a given month that a well will be sampled. If a well cannot be sampled at the times determined by the FWS, then the FWS and Sampling Management and Reporting organization, along with the project scientist, will consult on how best to recover or reschedule the sampling event as close to the original sampling date as possible. Missed sampling events that are not rescheduled within the same month are given top priority when rescheduling during the following month. For sampling at LLWMA-2, ongoing *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) sampling is also being conducted, and the missed sample can typically be collected within the same quarter as scheduled. Missed or cancelled sampling events are reported to RL, at the appropriate unit managers' meeting, and in the annual Hanford Site groundwater monitoring report (e.g., DOE/RL-2015-07).

3.2 Point of Compliance

The point of compliance is defined in WAC 173-303-645(6) as "…a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units." This is the location in the uppermost aquifer where groundwater monitoring occurs and the groundwater protection standard applies. In detection monitoring, results from the point of compliance wells are evaluated against background wells to determine if there is statistically significant evidence of contamination.

The point of compliance for the LLWMA-2 monitoring network is downgradient wells 299-E27-8, 299-E27-9, and 299-E27-10. The wells were identified based on their location hydraulically downgradient of LLWMA-2 (Figure 3-1). The wells are screened in the unconfined aquifer.

3.3 Monitoring Well Network

The current LLWMA-2 monitoring network consists of one upgradient and three downgradient wells. Figure 3-1 shows the groundwater monitoring network, and information for these the wells is summarized in Table 3-2.

Table 3-1. Monitoring Well Network for the LLWMA-2

Well Name	Purpose	WAC Compliant	RCRA-Required Parameters								Field Parameters
				Contamination Indicator Parameters*				Groundwater Quality Parameter[a]			
			Water Level	pH	Specific Conductance	Total Organic Carbon	Total Organic Halogen	Anions[b]	Metals (Filtered and Unfiltered)[c]	Phenols	Field Measurement[d]
299-E34-2	Upgradient	Y	S	S4	S4	S4	S4	A	A	A	S
299-E27-8	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	S
299-E27-9	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	S
299-E27-10	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	S

* Monitoring as required under WAC 173-303-645(9), "Dangerous Waste Regulations," "Releases from Regulated Units," "Detection Monitoring Program."

a. Constituents not required by RCRA but used to support interpretation.

b. Analytes include, but are not limited to, chloride fluoride, nitrate, nitrite, and sulfate.

c. Analysis shall be performed for filtered and unfiltered metals. Analytes include, but are not limited to calcium, chromium, iron, magnesium, manganese, sodium, and potassium.

d. Field measurements include pH, dissolved oxygen, temperature, and turbidity.

A = to be sampled annually

RCRA = *Resource Conservation and Recovery Act of 1976*

S = to be sampled semiannually

S4 = to be sampled semiannually, with quadruplicate samples collected during each event

Y = well is constructed as a resource protection well (WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells")

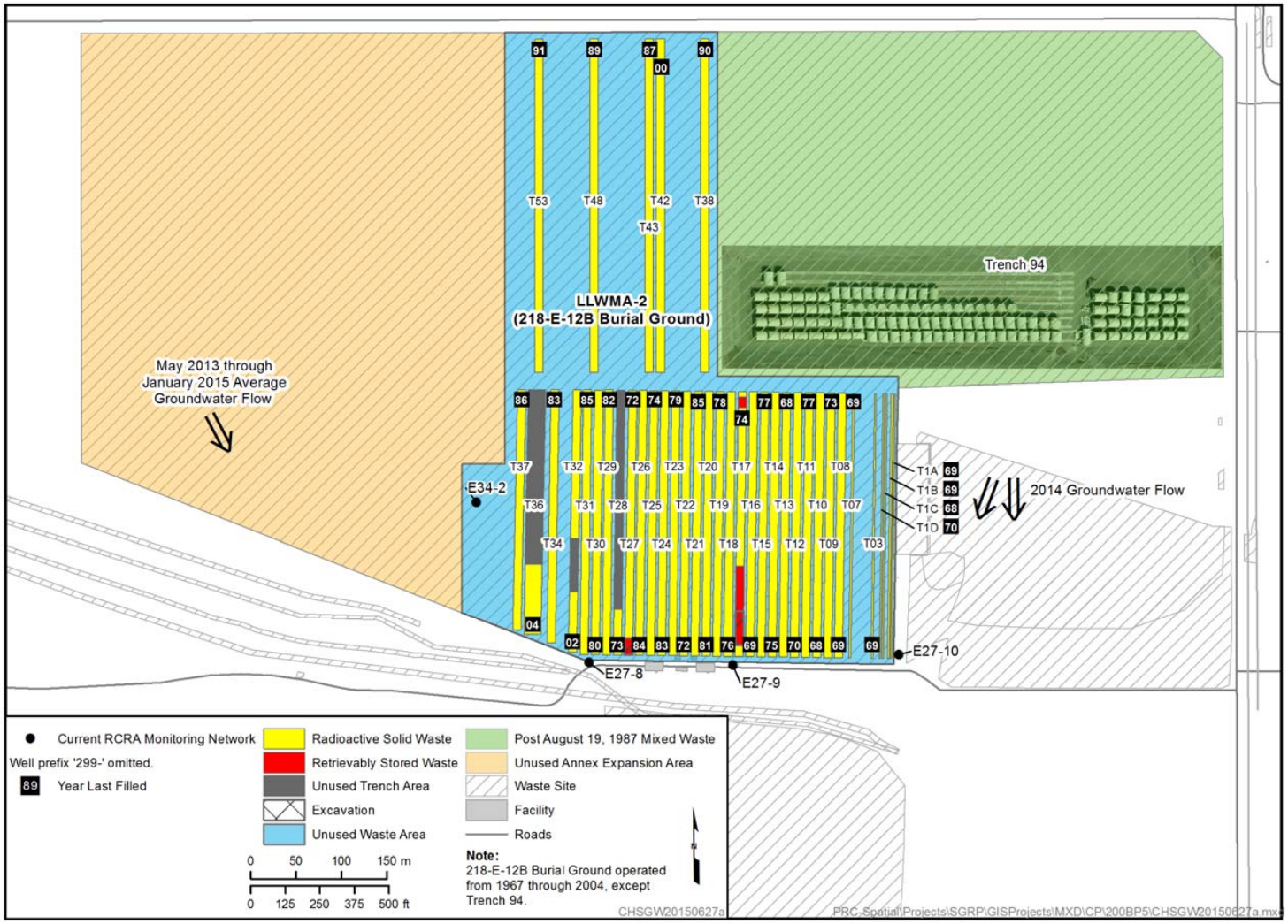


Figure 3-1. Monitoring Well Network at LLWMA-2

Table 3-2. Attributes for Wells in LLWMA-2 Groundwater Monitoring Network

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Top of Casing Elevation (m [ft])[b]	Water Table Elevation (m [ft] amsl)	Water Depth (m [ft] bgs)	Water Remaining (m [ft])	Water-Level Date
299-E34-2[c]	9/30/1987	574634.81	137220.694	192.8 (632.55)	121.75 (399.48)	71.05 (233.10)	2.6 (8.5)	4/8/2015
299-E27-8	9/30/1987	574759.08	137044.178	195.499 (641.40)	121.76 (399.48)	73.74 (241.93)	2.1 (6.9)	4/3/2015
299-E27-9	8/31/1987	574917.649	137040.904	192.294 (630.89)	121.8 (399.61)	70.494 (231.28)	3.3 (10.8)	2/25/2015
299-E27-10	8/19/1987	575100.298	137052.481	191.432 (628.06)	121.82 (399.67)	69.6 (228.34)	1.8 (5.9)	12/19/2014

a. Coordinates are in NAD83, *North American Datum of 1983.*

b. Elevations are in NAVD88, *North American Vertical Datum of 1988.*

c. Upgradient wells.

amsl = above mean sea level

bgs = below ground surface

The monitoring well network was selected based on the boundary of LLWMA-2 with respect to the groundwater flow direction, as discussed in Section 2.4.3. LLWMA-2 lies in an area that has experienced a substantial decline in groundwater elevation, as well as a change in the groundwater flow direction. Due to the decline in groundwater elevation over the past 20 years, a substantial portion of the trench area is no longer underlain by an unconfined aquifer within the unconsolidated Hanford formation. Groundwater monitoring wells north of LLWMA-2 that were completed within the unconsolidated Hanford formation have gone dry as the groundwater elevation declined. New and/or replacement monitoring wells may be installed using information gathered from existing and historical well conditions, and from application of surface geophysical surveys to identify candidate well locations. In the interim, well 299-E34-2 is designated as the upgradient well because its location is not in the flow path of groundwater extending from Trench 94. The three downgradient monitoring wells ensure detection of mobile contaminants at the southern boundary of LLWMA-2 based on the 2014 flow direction (Figure 2-8).

If a well is within approximately 2 years of going dry, a replacement well will be proposed. All new RCRA wells proposed for installation at the Hanford Site are negotiated annually by Ecology, DOE, and EPA under Tri-Party Agreement (Ecology et. al., 1989) Milestone M-24-00.

Construction details and pertinent information for the wells are provided in Appendix C of this groundwater monitoring plan. Some wells are co-sampled with other monitoring programs (e.g., monitored to meet CERCLA requirements). Monitoring requirements for other monitoring programs are described in separate plans. The reported data from other monitoring programs are supplementary to the information gathered under this plan.

3.4 Differences Between this Plan and Previous Plan

Table 3-3 identifies the main differences between this plan and the previous groundwater monitoring plan (DOE/RL-2009-76). The flow direction was previously west-southwest; however, groundwater mounding in the 200 East Area has dissipated since the 1980s. Since mid-2011, groundwater elevations to the north have been higher, causing groundwater to flow to the southeast. Monitoring well network changes from the previous plan include the location of the upgradient well, as well as the number and location of downgradient wells. Changes to the number and location of network wells were based on the groundwater flow change. Alkalinity has been removed from the constituents to be analyzed, as it is not needed for cation-anion balance calculations. The frequency for sampling of groundwater quality parameters is reduced to annual based on the extensive database of historical sample results. The background arithmetic mean will be recalculated on an annual basis.

3.5 Sampling and Analysis Protocol

In accordance with the Hanford Facility RCRA Permit, the groundwater protection regulations of WAC 173-303-645 dictate the groundwater sampling and analysis requirements applicable to final status TSD units. The QAPjP outlining the project management structure, data generation and acquisition, analytical procedures, and quality control is provided in Appendix A of this plan. Appendix B provides the sampling protocols (e.g., sampling methods, sample handling and custody, management of waste and health and safety considerations).

Table 3-3. Main Differences between This Plan and Previous Plan

Type of Change	Previous Plan*	Current Plan	Justification Summary
Constituents	Contamination indicator parameters Groundwater quality parameters Supporting constituents; alkalinity, anions (fluoride, nitrate, and nitrite), metals (calcium, chromium, and potassium)	Contamination indicator parameters Groundwater quality parameters	Alkalinity has been removed from the constituents to be analyzed because it is not needed for cation-anion balance calculations.
Sampling frequency	Contamination indicator parameters – semiannual Groundwater quality parameters and site-specific parameters – semiannual Phenols – annual	Contamination indicator parameters – semiannual Groundwater quality parameters (including phenols) – annual	The frequency for sampling of groundwater quality parameters is reduced to annual due to the extensive database of historical sample results.
Well network	One upgradient well Eight downgradient wells	One upgradient well Three downgradient wells	Network change is based on groundwater flow direction change.
Groundwater flow direction	West-southwest	Southward under the eastern part of LLWMA-2 and southeast under the western part of LLWMA-2	Groundwater flow direction change is the result of diminished anthropogenic liquid discharges to ground and returning to original groundwater conditions.
Type of groundwater monitoring program	Indicator parameter evaluation program	Detection monitoring program	A detection monitoring program is required for final status groundwater monitoring.
Background arithmetic mean recalculated	Generally recalculated every year	Recalculate every year	Calculated annually using guidance provided in EPA 530/R-09-007.

Note: EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance.*

* DOE/RL-2009-76, Rev. 0, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-2.*

LLWMA = low-level waste management area

4 Data Evaluation and Reporting

This chapter discusses the evaluation and interpretation of data.

4.1 Data Review

The data review and verification are discussed in the QAPjP (Appendix A).

4.2 Statistical Evaluation

The goal of the RCRA groundwater monitoring indicator evaluation program is to determine if LLWMA-2 operations have affected groundwater quality beneath the site, which is determined based on the results of specified statistical tests. Under this groundwater monitoring plan, the statistical evaluation method and evaluation frequency are determined in accordance with WAC 173-303-645(9). These interim status regulations require the use of a statistical method that compares mean concentrations of the four general groundwater contamination indicator parameters (pH, specific conductance, TOC, and TOX) to background levels to test for potential impact to groundwater. Each time that a monitoring well is sampled, four replicate samples for TOC and TOX are collected, and four replicate field measurements are made for pH and specific conductance.

For statistical comparisons, the basic procedure is that twice each year, monitoring data from downgradient wells are compared to the upgradient (background) results for each of the four indicator parameters. The owner or operator must calculate the arithmetic mean and variance (based on at least four replicate measurements on each sample) for each well monitored, and these results are then compared with the background arithmetic mean obtained and updated, as discussed in Chapter 5 of EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*. The comparison must consider each of the individual wells in the monitoring system and must use the Student's t-test at the 0.01 level of significance to determine statistically significant increases (and decreases, in the case of pH) over background. Implementation of the statistical test method at the Hanford Site, including at LLWMA-2, is generally consistent with EPA 530/R-09-007. The background statistical analysis is updated annually to establish comparative values for indicator parameters. A rolling mean is used because of changing groundwater flow conditions due to groundwater remedial actions currently being implemented at the Hanford Site.

If a comparison for a downgradient well shows a significant increase (or pH decrease), then the well is resampled. For TOC and TOX, split samples are sent to different laboratories to determine if the exceedance of the comparison value was the result of laboratory error.

If a comparison for a point of compliance well shows statistically significant evidence of contamination, then a written notification is made, as discussed in Section 4.5 and in accordance with WAC 173-303-645(9)(g). If the exceedance of the comparison value is not attributable to LLWMA-2, then this may be demonstrated in a report to Ecology, as detailed in Section 4.5 and in accordance with WAC 173-303-645(9)(g)(vi). If the exceedance is not attributable to another source, then groundwater in each of the monitoring wells will be immediately sampled to determine whether constituents listed in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods for Designating Dangerous Waste WAC 173-303-090 & 100*, or an approved subset of constituents, as detailed in Section 4.5 and in accordance with WAC 173-303-645(9)(g)(ii) and (iii). For TOC and TOX, split samples are sent to different laboratories to determine if the exceedance of the comparison value was the result of laboratory error.

4.3 Interpretation

Data are used to interpret groundwater conditions at LLWMA-2. Interpretive techniques include the following:

- **Hydrographs:** Graph water levels versus time to determine decreases and increases and seasonal or manmade fluctuations in groundwater levels.
- **Water table maps:** Use water table elevations from multiple wells to construct contour maps and estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential on the maps.
- **Trend plots:** Graph concentrations of constituents versus time to determine increases, decreases, and fluctuations. May be used in tandem with hydrographs and/or water table maps to determine if concentrations relate to changes in water level or groundwater flow directions.
- **Plume maps:** Map distributions of chemical constituent concentrations in the aquifer to determine the extent of contamination. Changes in plume distribution over time assist in determining plume movement and direction of groundwater flow.
- **Contaminant ratios:** Illustrate the relative abundances of contaminants from previously characterized Hanford Site-related processes and sources. Comparison of these ratios in groundwater can sometimes be used to distinguish among different sources of contamination (e.g., a specific process and its associated facility). Ratios may provide evidence of continuing source contamination, thereby linking contamination with a specific facility under RCRA monitoring. Evaluation of contaminant ratios in concentration trends may be used to demonstrate when facility-specific contamination no longer affects underlying groundwater.

4.4 Groundwater Monitoring Network

In accordance with WAC 173-303-645(8), the LLWMA-2 groundwater monitoring network consists of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer. The well locations and designs are selected to represent the quality of background groundwater that has not been affected by leakage from a regulated unit. Wells are also selected that will provide samples that are representative of the quality of groundwater passing the point of compliance and will allow for the detection of contamination when dangerous waste or dangerous waste constituents have migrated from the waste management area to the uppermost aquifer.

The current groundwater monitoring network will continue to be re-evaluated to ensure that it is adequate to monitor any changing hydrogeologic conditions beneath the unit. If flow changes are observed, the LLWMA-2 CSM and groundwater constituents will be re-evaluated to determine network efficiency and any necessary modification requirements for the network.

Water-level measurements will continue to be collected before each sampling event. An additional and more comprehensive set of water-level measurements is made annually for selected wells on the Hanford Site, and the data are presented annually in Hanford Site groundwater monitoring reports (e.g., DOE/RL-2015-07).

4.5 Reporting and Notification

Groundwater monitoring results are reported annually in Hanford Site groundwater monitoring reports (e.g., DOE/RL-2015-07). The groundwater flow rate and direction are also determined and reported annually. If a comparison for an upgradient well shows a significant increase (or pH decrease) relative to the statistical comparison value, that information is also reported in the annual groundwater monitoring report (e.g., DOE/RL-2015-07).

If statistically significant evidence of contamination is determined for one or more of the indicator parameters or dangerous waste constituents at any point of compliance well, the well may be resampled within one month to repeat the analysis for the detected compounds. The resampled data will be compared with the statistical background value. If resampling confirms statistically significant evidence of contamination, the following actions will be performed in accordance with WAC 173-303-645(9)(g):

- Within 7 days of the finding (i.e., exceedance), notify Ecology in writing, indicating which chemical parameters or constituents have shown statistically significant evidence of contamination.
- Immediately sample groundwater in each of the LLWMA-2 monitoring network wells (wells identified in Table 3-2) and determine if constituents identified in Appendix 5 of Ecology Publication No. 97-407 are present and, if so, in what concentration. However, Ecology (on a discretionary basis) may allow sampling for a site-specific subset of constituents from Appendix 5 of Ecology Publication No. 97-407 and other representative/related waste constituents. In the event that sampling of Appendix 5 of Ecology Publication No. 97-407 constituents (or a subset thereof) is required, supplemental sampling and analysis information will be prepared for the applicable constituents and submitted to Ecology for approval. For any of these compounds detected, the well may be resampled within one month of receiving the results (or an alternate site-specific schedule approved by Ecology) to repeat the analysis for the detected compounds. If the constituents are detected in the second analysis, these constituents will form the basis for compliance monitoring in accordance with WAC 173-303-645(10).
- If dangerous constituents are detected, submit an application for a Permit modification to Ecology within 90 days to establish a compliance monitoring program under WAC 173-303-645(10) in accordance with WAC 173-303-645(9)(g)(iv).
- If dangerous constituents are not detected, continue monitoring in accordance with the detection monitoring program.

If the statistically significant evidence of contamination is not attributable to LLWMA-2, then it may be demonstrated that a source other than LLWMA-2 caused the contamination or that the detection is an artifact caused by an error in sampling, analysis, or statistical evaluation or natural variation in the groundwater. To demonstrate that the contamination is not attributable to the LLWMA-2, the following actions will be performed in accordance with WAC 173-303-645(9)(g)(vi):

- Within 7 days of the finding (i.e., exceedance), notify Ecology in writing and indicate the intent to make a demonstration to this effect.
- Within 90 days, submit a report to Ecology that demonstrates that a source other than the regulated unit caused the contamination, or that the contamination resulted from an error in sampling, analysis, evaluation, or natural variation in groundwater chemistry.
- Within 90 days, an application for a Permit modification to make any appropriate changes to the detection monitoring program will be submitted to Ecology.

- Continue monitoring in accordance with the detection monitoring program.
- If the demonstration is not accepted by Ecology, then a Permit modification to move to compliance monitoring under WAC 173-303-645(10) is still required within 90 days of the exceedance.

In accordance with WAC 173-303-645(9)(h), if it is determined that the detection monitoring program no longer satisfies the requirements of WAC 173-303-645(9), submit an application to Ecology for a Permit modification within 90 days to make any appropriate changes to the program.

5 References

10 CFR 962, "Byproduct Material," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=cc084554a745f92974cf9154194acd03&mc=true&node=pt10.4.962&rgn=div5.

40 CFR 264, "Standards for Owners and Operations of Hazardous Waste Treatment, Storage and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=20d1261a62dc289a29c3b8b50841ca2f&mc=true&node=pt40.26.264&rgn=div5.

Appendix IX, "Ground-Water Monitoring List."

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=2cd7465519114fb3472b4864a0e3c42b&node=pt40.26.265&rgn=div5.

40 CFR 265.92, "Sampling and Analysis."

40 CFR 265.93, "Preparation, Evaluation, and Response."

Subpart F, "Ground-Water Monitoring."

51 FR 24504, 1986, "EPA Clarification of Regulatory Authority Over Radioactive Mixed Waste," *Federal Register*, July 3.

Atomic Energy Act of 1954, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: http://epw.senate.gov/atomic54.pdf.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

DOE/RL-88-20, 1997, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D197248641.

DOE/RL-94-136, 1995, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1994*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196037232.

DOE/RL-2002-39, 2002, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081471H.

DOE/RL-2009-76, 2010, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-2*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084331.

DOE/RL-2010-74, 2015, *Treatability Test Plan for the 200-BP-5 Groundwater Operable Unit*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington, Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081243H.

DOE/RL-2011-01, 2011, *Hanford Site Groundwater Monitoring Report for 2010*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093693.

DOE/RL-2011-118, 2012, *Hanford Site Groundwater Monitoring for 2011*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0091795.

DOE/RL-2015-07, 2015, *Hanford Site Groundwater Monitoring Report for 2014*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0080600H.

Driscoll, F.G., 1986, *Groundwater and Wells*, Second Edition, Johnson Division, St. Paul, Minnesota.

Ecology Publication No. 97-407, 2014, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100*, Hazardous Waste and Toxics Reduction Program, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/pubs/97407.pdf.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

EPA 530/R-09-007, 2009, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*, Office of Resource Conservation and Recovery, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/osw/hazard/correctiveaction/resources/guidance/sitechar/gwstats/unified-guid.pdf.

ISO-986, 1967, *B-Plant Phase III Flowsheets,* ISOCHEM, Inc., Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196129100.

NAD83, 1991, *North American Datum of 1983*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

PNL-6772, 1987, *A Detection-Level Hazardous Waste Ground-Water Monitoring Compliance Plan for the 200 Areas Low-Level Burial Grounds and Retrievable Storage Units*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/6201649.

PNL-6820, 1989, *Hydrogeology of the 200 Areas Low-Level Burial Grounds-An Interim Report*, Vols. 1 and 2, Rev. 0, Pacific Northwest Laboratory, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195066506.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195066592.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195066599.

PNNL-11470, 1997, *Hanford Site Groundwater Monitoring for Fiscal Year 1996*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D199132964.

PNNL-11793, 1998, *Hanford Site Groundwater Monitoring for Fiscal Year 1997*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D199132962.

PNNL-14548, 2004, *Hanford Site Groundwater Monitoring for Fiscal Year 2003*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14548.pdf.

PNNL-14859, 2004, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-14859.pdf.

PNNL-15670, 2006, *Hanford Site Groundwater Monitoring for Fiscal Year 2005*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084078.

PNNL-19277, 2010, *Conceptual Models for Migration of Key Groundwater Contaminants Through the Vadose Zone and Into the Unconfined Aquifer Below the B-Complex*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084238.

RCW 70.105, "Hazardous Waste Management," *Revised Code of Washington*, Olympia, Washington. Available at: http://apps.leg.wa.gov/RCW/default.aspx?cite=70.105&full=true

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SGW-38815, 2009, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0082378H.

SGW-52162, 2012, *Seismic Reflection Investigation at the Liquid Effluent Retention Facility, 200 East Area, Hanford Site Richland, Washington*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

SGW-58828, 2015, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0079727H.

WA7890008967, 2009, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, Class 1 Modification, Washington State Department of Ecology, Richland, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-160.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

WAC 173-303-400, "Interim Status Facility Standards."

WAC 173-303-645, "Releases from Regulated Units."

WHC-EP-0912, 1996, *The History of the 200 Area Burial Ground Facilities*, 2 vols., Westinghouse Hanford Company, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/16778.

WHC-MR-0204, 1990, *200-East and 200-West Areas Low-Level Burial Grounds Borehole Summary Report*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196038070.

WHC-SD-EN-AP-015, 1989, *Revised Groundwater Monitoring Plan for the 200 Areas Low-Level Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D195063349.

WHC-SD-EN-EV-024, 1994, *Site Characterization Report for the Liquid Effluent Retention Facility*, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196090383.

WHC-SD-WM-TI-260, 1986, *Water Inflow Investigation at the 218-E12A and 218-E-12B Burial Grounds*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0082369H.

Appendix A

Quality Assurance Project Plan

This page intentionally left blank.

Contents

A1 Introduction A-1

A2 Project Management A-1

A2.1 Project/Task Organization A-1

A2.1.1 U.S. Department of Energy, Richland Operations Office Project Manager A-1

A2.1.2 U.S. Department of Energy, Richland Operations Office Technical Lead A-1

A2.1.3 Soil and Groundwater Remediation Project Manager A-1

A2.1.4 Soil and Groundwater Remediation Project RCRA Groundwater Manager A-2

A2.1.5 Sample Management and Reporting Organization A-2

A2.1.6 Field Sampling Organization A-3

A2.1.7 Quality Assurance A-3

A2.1.8 Environmental Compliance Officer A-3

A2.1.9 Health and Safety A-3

A2.1.10 Waste Management A-3

A2.1.11 Analytical Laboratories A-4

A2.2 Problem Definition/Background A-4

A2.3 Project/Task Description A-4

A2.4 Quality Assurance Objectives and Criteria A-4

A2.5 Special Training/Certification A-4

A2.6 Documents and Records A-8

A3 Data Generation and Acquisition A-10

A3.1 Analytical Method Requirements A-10

A3.2 Field Analytical Methods A-12

A3.3 Quality Control A-12

A3.3.1 Field Quality Control Samples A-15

A3.3.2 Laboratory Quality Control Samples A-16

A3.4 Measurement Equipment A-17

A3.5 Instrument and Equipment Testing, Inspection, and Maintenance A-18

A3.6 Instrument/Equipment Calibration and Frequency A-18

A3.7 Inspection/Acceptance of Supplies and Consumables A-18

A3.8 Nondirect Measurements A-18

A3.9 Data Management A-18

A4 Assessment and Oversight A-19

A4.1 Assessments and Response Actions A-19

A4.2 Reports to Management A-19

A5 Data Review and Usability A-19

A5.1 Data Review and Verification A-19
A5.2 Data Validation A-20
A5.3 Reconciliation with User Requirements A-20
A6 References A-20

Tables

Table A-1. Data Quality Indicators A-5
Table A-2. Change Control for Monitoring Plans A-8
Table A-3. Analytical Requirements for Groundwater Analysis A-10
Table A-4. Project QC Requirements A-12
Table A-5. Laboratory QC and Acceptance Criteria A-13
Table A-6. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses A-17

Figure

Figure A-1. Project Organization A-2

Terms

DOE	U.S. Department of Energy
DQA	data quality assessment
DQI	data quality indicator
EB	equipment blank
ECO	environmental compliance officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FEAD	format for electronic analytical data
FTB	full trip blank
FWS	field work supervisor
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
IC	ion chromatography
ICP/AES	Inductively coupled plasma/atomic emission spectrometry
LCS	laboratory control sample
LLWMA	low-level waste management area
MB	method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
PS	post-digestion spike
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*

RL	DOE Richland Operations Office
RPD	relative percent difference
RDL	required detection limit
S&GRP	Soil and Groundwater Remediation Project
SMR	Sample Management and Reporting
SPLIT	field split
SUR	surrogate
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
TSD	treatment, storage, and disposal

A1 Introduction

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the quality assurance (QA) elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). Sections 6.5 and 7.8 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (hereafter referred to as the Tri-Party Agreement Action Plan) require the QA/quality control (QC) and sampling and analysis activities to specify QA requirements for treatment, storage, and disposal (TSD) units, as well as for past-practice processes. This QAPjP also describes the applicable requirements and controls based on guidance found in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into four chapters, which describe the quality requirements and controls applicable to Low-Level Waste Management Area 2 (LLWMA-2) groundwater monitoring activities: project management, data generation and acquisition, assessment and oversight, and data review and usability.

A2 Project Management

This chapter addresses the management approaches planned, project goals, and planned output documentation.

A2.1 Project/Task Organization

Project organization (regarding routine groundwater monitoring) is described in the following subsections and illustrated in Figure A-1.

A2.1.1 U.S. Department of Energy, Richland Operations Office Project Manager

Hanford Site cleanup is the responsibility of the U.S. Department of Energy (DOE), Richland Operations Office (RL). The RL project manager is responsible for authorizing the contractor to perform activities at the Hanford Site under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*; *Resource Conservation and Recovery Act of 1976* (RCRA); *Atomic Energy Act of 1954*; and Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement).

A2.1.2 U.S. Department of Energy, Richland Operations Office Technical Lead

The RL technical lead is responsible for providing day-to-day oversight of contractor performance of the workscope, working with the contractor to identify and work through issues, and providing technical input to the RL project manager.

A2.1.3 Soil and Groundwater Remediation Project Manager

The Soil and Groundwater Remediation Project (S&GRP) manager provides oversight for all activities and coordinates with RL and primary contractor management in support of sampling and reporting activities. The S&GRP manager also provides support to the S&GRP RCRA groundwater manager to ensure that work is performed safely and cost effectively.

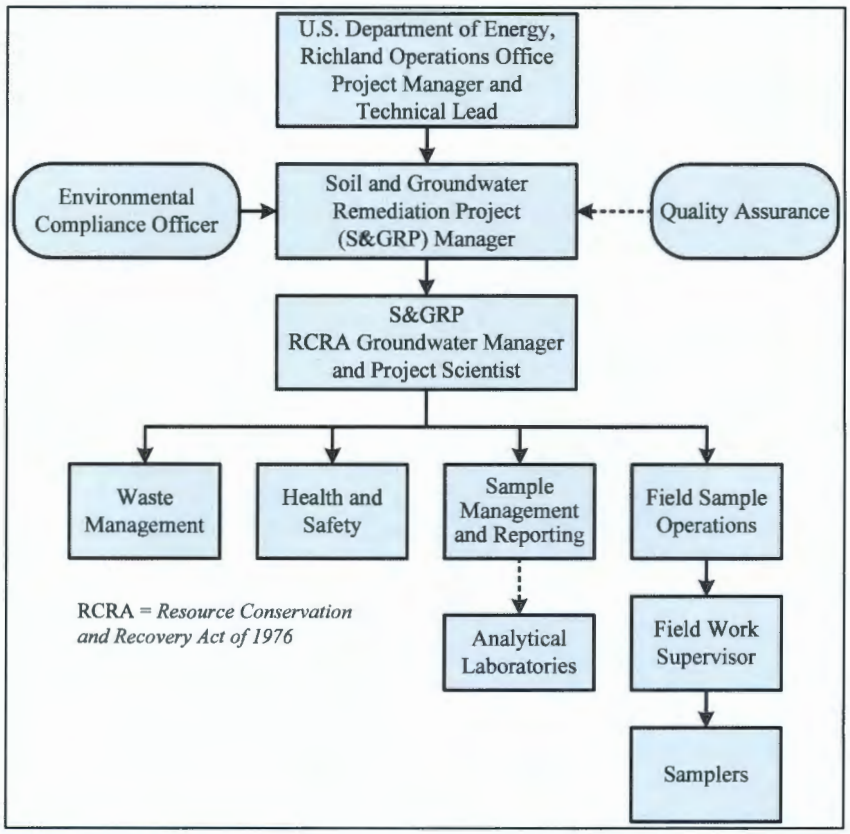


Figure A-1. Project Organization

A2.1.4 Soil and Groundwater Remediation Project RCRA Groundwater Manager

The S&GRP RCRA groundwater manager is responsible for direct management of activities performed to meet RCRA TSD unit monitoring requirements. The S&GRP RCRA groundwater manager coordinates with and reports to RL and primary contractor management regarding RCRA TSD unit monitoring requirements. The S&GRP RCRA groundwater manager (or delegate) works closely with the environmental compliance officer (ECO) and the QA, Health and Safety, and Sample Management and Reporting (SMR) organizations to integrate these and other technical disciplines in planning and implementing the workscope. The S&GRP RCRA groundwater manager assigns scientists to provide technical expertise.

A2.1.5 Sample Management and Reporting Organization

The SMR organization oversees offsite analytical laboratories, coordinates laboratory analytical work to ensure that laboratories conform to the requirements of this plan, and verifies that laboratories are qualified for performing Hanford Site analytical work. SMR generates field sampling documents, labels, and instructions for field sampling personnel and develops the sampling authorization form, which provides information and instructions to the analytical laboratories. SMR ensures that field sampling documents are revised to reflect approved change. SMR receives analytical data from the laboratories, ensures that the data are appropriately reviewed, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation and recordkeeping. The SMR organization is responsible for resolving sample documentation deficiencies or issues associated with the

Field Sampling organization, laboratories, or other entities. SMR is responsible for informing the S&GRP RCRA groundwater manager of any issues reported by the analytical laboratories.

A2.1.6 Field Sampling Organization

The Field Sampling organization is responsible for planning and coordinating field sampling resources and provides the field work supervisor (FWS) for routine groundwater sampling operations. The FWS directs the nuclear chemical operators (i.e., samplers), who collect groundwater samples in accordance with this groundwater monitoring plan and in accordance with corresponding standard procedures and work packages. The FWS ensures that samplers are appropriately trained and available. The samplers collect all salient samples in accordance with sampling documentation. The samplers also complete field logbooks and chain-of-custody forms, including any shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

In addition, pre-job briefings are conducted by the Field Sampling organization in accordance with work management and work release requirements to evaluate activities and associated hazards by considering various factors, including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required

A2.1.7 Quality Assurance

The QA point of contact is responsible for addressing QA issues on the project and overseeing implementation of the project QA requirements. Responsibilities include reviewing project documents, including the QAPjP, and participating in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.8 Environmental Compliance Officer

The ECO provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts.

A2.1.9 Health and Safety

The Health and Safety organization is responsible for coordinating industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or by internal primary contractor work requirements.

A2.1.10 Waste Management

Waste Management is responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance and for interpreting data to determine waste designations and profiles. Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner.

A2.1.11 Analytical Laboratories

The analytical laboratories analyze samples in accordance with established procedures and the requirements of this plan and provide necessary data packages containing analytical and QC results. The laboratories provide explanations of results to support data review and in response to resolution of analytical issues. The laboratories are evaluated under the DOE Consolidated Audit Program and must be accredited by Washington State Department of Ecology (Ecology) for the analyses performed for S&GRP.

A2.2 Problem Definition/Background

The purpose of this groundwater monitoring plan is to satisfy the requirements of WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." The main text of this monitoring plan provides specific on the activities to satisfy these requirements, as well as background information on groundwater monitoring for LLWMA-2.

A2.3 Project/Task Description

The project description in the main text of this monitoring plan and includes the indicator parameters that are required by WAC 173-303-645(9) for establishing groundwater quality and groundwater contamination detection, evaluating the monitoring network, interpreting analytical results, and reporting. The parameter indicators to be monitored, as well as the monitoring wells and frequency of sampling, are discussed in in Chapter 3 of the main text. Information on the collection and analyses of groundwater from the monitoring network is provided in this QAPjP and in Appendix B.

A2.4 Quality Assurance Objectives and Criteria

The QA objective of this plan is to ensure that the analytical data generated are of known and appropriate quality, and that the data are acceptable and useful to meet the evaluation requirements identified in the monitoring plan. In support of this objective, statistics and data descriptors known as data quality indicators (DQIs) are used to help determine the acceptability and utility of data to the user. The principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. The DQIs are defined in Table A-1.

Data quality is defined by the degree of rigor in the acceptance criteria assigned to the DQIs. The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. The DQIs are evaluated during the data quality assessment (DQA) process (Section A5.3).

A2.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility for collecting and transporting groundwater samples. This training will be in accordance with the dangerous waste training plan maintained for the TSD unit to meet the requirements of WAC 173-303-330, "Personnel Training." The FWS, in coordination with line management, will ensure that special training requirements for field personnel are met.

Training has been instituted by the contractor management team to meet training and qualification programs to satisfy multiple training drivers imposed by the applicable *Code of Federal Regulations and Washington Administrative Code* requirements. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely.

Table A-1. Data Quality Indicators

Data Quality Indicator	Definition	Determination Methodologies	Corrective Actions
Precision	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet the precision objective: • Evaluate apparent cause (e.g., sample heterogeneity). • Request reanalysis or re-measurement. • Qualify the data before use.
Accuracy	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. Quality control analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet the accuracy objective: • Qualify the data before use. • Request reanalysis or re-measurement.
Representativeness	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for the results not being representative. • Flag for further review. • Review data for usability. • If data are usable, qualify the data for limited use and define the portion of the system that the data represent. • If data are not usable, flag as appropriate.

Table A-1. Data Quality Indicators

Data Quality Indicator	Definition	Determination Methodologies	Corrective Actions
			• Redefine sampling and measurement requirements and protocols. • Resample and reanalyze, as appropriate.
Comparability	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	If data are not comparable to other data sets: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Qualify the data as appropriate • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.
Completeness	Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/acceptance criteria).	If data set does not meet the completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future completeness.
Bias	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling procedures to limit preferential selection or loss of sample media.

Table A-1. Data Quality Indicators

Data Quality Indicator	Definition	Determination Methodologies	Corrective Actions
	Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	amount of contaminant spiked into a sample (matrix spike).	• Use sample handling procedures, including proper sample preservation, that limit the loss or gain of constituents to the sample media. • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as best as practicable. Otherwise, samples are sent to other laboratories for analysis.
Sensitivity	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation* is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet the sensitivity objective: • Request reanalysis or re-measurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Source: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended.

* For purposes of this groundwater monitoring plan, the lower limit of quantitation is interchangeable with the practical quantitation limit.

Training records are maintained for each employee in an electronic training record database that is maintained by the contractor's training organization. Line management confirms that an employee's training is appropriate and up-to-date prior to performing any field work.

A2.6 Documents and Records

The S&GRP RCRA groundwater manager (or designee) is responsible for ensuring that the current version of the groundwater monitoring plan is used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Table A-2 defines the types of changes that may impact the groundwater monitoring plan and the associated approvals, notifications, and documentation requirements. Changes to elements of the monitoring plan that are required by WAC 173-303-645 are not allowed, except as unintentional changes (as described in Table A-2).

Table A-2. Change Control for Monitoring Plans

Type of Change[a]	Action	Documentation
Temporary addition of wells or site-specific constituents, or increased sampling frequency that do not impact the requirements of WAC 173-303-645.	S&GRP RCRA groundwater manager approves temporary change; provides informal notice to Ecology.	SMR integrated groundwater monitoring schedule
Unintentional impact to groundwater monitoring plan including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of indicator parameters, and loss of samples in transit.	S&GRP RCRA groundwater manager provides electronic notification to RL.	Annual groundwater monitoring report
Planned change to groundwater monitoring activities that does not impact the requirements of WAC 173-303-645, including addition or deletion of site-specific constituents, change of sampling frequency for site-specific constituents, or changes to the well network.	S&GRP RCRA groundwater manager obtains RL approval; revise monitoring plan.	Revised RCRA groundwater monitoring plan and modification to the RCRA Permit[b]
Anticipated unavoidable changes (e.g., dry wells).	S&GRP RCRA groundwater manager provides electronic notification to RL; revise monitoring plan.	Annual groundwater monitoring report Permanent changes require revised RCRA groundwater monitoring plan and modification to the RCRA Permit[b]

Note: WAC 173-303-645(9), "Dangerous Waste Regulations," "Releases from Regulated Units," "Detection Monitoring Program," contains additional sampling and notification requirements should results demonstrate a statistically significant increase (or pH decrease).

a. "Site-specific constituents" are any constituents that may be included in this monitoring plan as additional analytes that are not required by WAC 173-303-645(9).

b. Hanford Facility RCRA Permit (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*).

Table A-2. Change Control for Monitoring Plans

Type of Change[a]	Action	Documentation

Ecology = Washington State Department of Ecology
RCRA = *Resource Conservation and Recovery Act of 1976*
RL = U.S. Department of Energy, Richland Operations Office
S&GRP = Soil and Groundwater Remediation Project
SMR = Sample Management and Reporting

Logbooks and data forms are required for field activities. The logbook must be identified with a unique project name and number. Individuals responsible for the logbooks shall be identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes.

The FWS, SMR, and any field crew supervisors are responsible for ensuring that field instructions are maintained and aligned with any revisions or approved changes to the groundwater monitoring plan. The SMR organization will ensure that any deviations from the plan are reflected in revised field sampling documents for the samplers and analytical laboratory. The FWS or appropriate field crew supervisors will ensure that deviations from the plan or problems encountered in the field are documented appropriately (e.g., in the field logbook).

The S&GRP RCRA groundwater manager, FWS, or designee is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities. The S&GRP RCRA groundwater manager is also responsible for ensuring that project files are setup, as appropriate, and/or maintained. The project files will contain project records or references to their storage locations. Project files generally include, as appropriate, the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to the SMR organization)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Field sampling logbooks
- Groundwater sample reports and field sample reports
- Chain-of-custody forms

- Sample receipt records
- Laboratory data packages
- Analytical data verification and validation reports
- Analytical data "case file purges" (i.e., raw data purged from laboratory files) provided by offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Convenience copies of laboratory analytical results are maintained in the HEIS database. Records may be stored in either electronic (e.g., in the managed records area of the Integrated Document Management System) or hardcopy format (e.g., DOE Records Holding Area). Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement (Ecology et al., 1989a) will be managed in accordance with the requirements therein.

The results of groundwater monitoring are reported annually in the annual groundwater monitoring report (e.g., DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014)*.

A3 Data Generation and Acquisition

This chapter addresses data generation and acquisition to ensure that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. The requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

A3.1 Analytical Method Requirements

Analytical method requirements for samples collected are presented in Table A-3. Updated U.S. Environmental Protection Agency (EPA) methods may be substituted for analytical methods identified in Table A-3.

Table A-3. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Contamination Indicator Parameters (WAC 173-303-645[9])		
pH	Field measurement Instrument/meter	N/A
Specific conductance		N/A
Total organic carbon	SW-846 Method 9060	1,000
Total organic halogen	SW-846 Method 9020	10

Table A-3. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Groundwater Quality Parameters		
Chloride	EPA/600 Method 300.0	400
Sulfate		550
Iron	SW-846 Method 6010B/C	50
Manganese		5
Sodium		500
Phenols	SW-846 Method 8270D	5
Site-Specific Constituents[c]		
Fluoride	EPA/600 Method 300.0	500
Nitrate		250
Nitrite		250
Calcium	SW-846 Method 6010B/C	1,000
Lead		15
Magnesium		750
Potassium		4,000
Dissolved oxygen	Field measurement Instrument/meter	N/A
Temperature		N/A
Turbidity		N/A

Notes:

Information in this table does not represent EPA requirements but is intended solely as guidance.

WAC 173-303-645(9), "Dangerous Waste Regulations," "Releases from Regulated Units," "Detection Monitoring Program."

a. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended. Equivalent methods may be substituted.

b. Highest allowable practical quantitation limits are specified in contracts with analytical laboratories. Actual quantitation limits vary by laboratory and may be lower than required contractually. Method detection limits are three to five times lower than quantitation limits.

c. Site-specific constituents not required by RCRA but used to support interpretation.

EPA = U.S. Environmental Protection Agency

N/A = not applicable

RCRA = *Resource Conservation and Recovery Act of 1976*

A3.2 Field Analytical Methods

Field screening and survey data will be measured in accordance with HASQARD (DOE/RL-96-68) requirements, as applicable. Field analytical methods may also be performed in accordance with manufacturer manuals. Appendix B provides the parameters identified for field measurements.

A3.3 Quality Control

QC requirements specified in this plan must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC sample requirements are summarized in Table A-4. Acceptance criteria for field and laboratory QC are shown in Table A-5. Data will be qualified and flagged in the HEIS database, as appropriate.

Table A-4. Project QC Requirements

Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Field duplicates	One in 20 well trips.	Precision, including sampling and analytical variability
Field splits	As needed. When needed, the minimum is one for every analytical method, for analyses performed where detection limit and precision and accuracy criteria have been defined in Table A-3).	Precision, including sampling, analytical, and interlaboratory
Full trip blanks	One in 20 well trips.	Cross-contamination from containers or transportation
Equipment blanks	As needed. If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment blank is not required. Otherwise, one for every 20 samples.[a]	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Analytical Quality Control[b]		
Laboratory duplicates	One per analytical batch.[c]	Laboratory reproducibility and precision
Matrix spikes	One per analytical batch.[c]	Matrix effect/laboratory accuracy
Post-digestion spike	One per analytical batch.[c]	Matrix effect/laboratory accuracy
Matrix spike duplicates	One per analytical batch.[c]	Laboratory accuracy and precision
Laboratory control samples	One per analytical batch.[c]	Laboratory accuracy

Table A-4. Project QC Requirements

Sample Type	Frequency	Characteristics Evaluated
Method blanks	One per analytical batch.[c]	Laboratory contamination
Surrogates	One per analytical batch.[c]	Recovery/yield

Note: The information in this table does not represent EPA requirements but is intended solely as guidance.

a. For portable pumps, equipment blanks are collected one for every 10 well trips. Whenever a new type of nondedicated equipment is used, an equipment blank will be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination methods for the nondedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., all Hanford Site groundwater).

c. Unless not required by or a different frequency is called out in laboratory analysis methods.

EPA = U.S. Environmental Protection Agency

1

Table A-5. Laboratory QC and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
General Chemical Analyses			
Total organic carbon	MB	< MDL <5% sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[a]
	Laboratory duplicate or MS/MSD	≤20% RPD[b]	Data reviewed[a]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[b]	Flagged with "Q"
Total organic halogen	MB	< MDL <5% sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[a]
	Laboratory duplicate or MS/MSD	≤20% RPD[b]	Data reviewed[a]
	MS and MSD	75–125% recovery	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[b]	Flagged with "Q"

Table A-5. Laboratory QC and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
Anions			
Anions by IC (chloride, fluoride, nitrate, nitrite, and sulfate)	MB	< MDL <5% sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[a]
	Laboratory duplicate or MS/MSD	≤20% RPD[b]	Data reviewed[a]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[b]	Flagged with "Q"
Metals			
ICP/AES metals (calcium, iron, lead, magnesium, manganese, potassium, and sodium)	MB	< RDL <5% sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[a]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	MS/MSD	≤20% RPD	Data reviewed[a]
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[b]	Flagged with "Q"
Semivolatile Organic Compounds			
Phenols by GC or GC/MS	MB	< MDL <5% sample concentration	Flagged with "B"
	LCS	Statistically derived[c]	Data reviewed[a]
	MS and MSD	% recovery statistically derived[c]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	MS/MSD	% RPD statistically derived[c]	Data reviewed[a]
	SUR	Statistically derived[c]	Data reviewed[a]
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[b]	Flagged with "Q"

Notes:

The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, dissolved oxygen, temperature, and turbidity are not listed as they are measured in the field

a. After review, corrective actions are determined on a case-by-case basis.

Table A-5. Laboratory QC and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action

b. Applies only in cases where both results are greater than 5 times the method detection limit.

c. Determined by the laboratory based on historical data or statistically derived control limits. Limits are reported with the data. Where specific acceptance criteria are listed, those acceptance criteria may be used in place of statistically derived acceptance criteria.

EB = equipment blank
EPA = U.S. Environmental Protection Agency
FEAD = format for electronic analytical data
FTB = full trip blank
GC = gas chromatography
GC/MS = gas chromatography/mass spectrometry
IC = ion chromatography
ICP/AES = inductively coupled plasma/atomic emission spectrometry
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
PS = post-digestion spike
QC = quality control
RDL = required detection limit
RPD = relative percent difference

Data flags:

B (organics) = analyte was detected in both the associated QC blank and the sample)

C (inorganics/wetchem) = analyte was detected in both the sample and the associated QC blank, and the blank value exceeds 5% of the measured concentration present in the associated sample

N = all except GC/MS – matrix spike outlier

T = volatile organic analysis and semivolatile organic analysis GC/MS – matrix spike outlier

Q = associated QC sample is out of limits

A3.3.1 Field Quality Control Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and two types of field blanks (full trip blanks [FTBs] and equipment blanks [EBs]). Field blanks are typically prepared using high-purity reagent water. QC sample definitions and their required frequency for collection are described below:

- **Field duplicates:** Independent samples collected as close as possible to the same time and same location as the scheduled sample and are intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.
- **Field splits (SPLITs):** Two samples collected as close as possible to the same time and same location and are intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.
- **Full trip blanks (FTBs):** Bottles prepared by the sampling team prior to traveling to the sampling site. The preserved bottle set is either for volatile organic analysis only or identical to the set that will be collected in the field. It is filled with high-purity reagent water, and the bottles are sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential contamination of the samples attributable to the sample bottles, preservative, handling, storage, and transportation.

- **Equipment blanks (EBs):** EBs contain reagent water passed through or poured over the decontaminated sampling equipment, identical to the sample set collected and placed in sample containers, as identified on the sampling authorization form. EB sample bottles are placed in the same storage containers with the samples from the associated sampling event. EB samples will be analyzed for the same constituents as the samples from the associated sampling event. EBs are used to evaluate the effectiveness of the decontamination process. EBs are not required for disposable sampling equipment.

A3.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by the laboratories utilized by the project. Laboratory QA includes a comprehensive QC program that includes the use of matrix spikes (MSs), matrix duplicates, matrix spike duplicates (MSDs), laboratory control samples (LCSs), surrogates (SURs), post-digestion spikes (PSs), and method blanks (MBs). These QC analyses are required by EPA methods (e.g., SW-846), and will be run at the frequency specified in the respective references unless superseded by agreement. QC checks outside of control limits are documented in analytical laboratory reports during DQAs (if performed). Laboratory QC and their typical frequencies are listed in Table A-4. Acceptance criteria are shown in Table A-5. The various types of laboratory QC samples are described below:

- **Laboratory duplicate:** An intralaboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.
- **Matrix spike (MS):** An aliquot of a sample spiked with a known concentration of target analyte(s). The MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.
- **Matrix spike duplicate (MSD):** A replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.
- **Post-digestion spike (PS):** Same as MS; however, the spiking occurs after sample preparation and before analysis.
- **Laboratory control sample (LCS):** A control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material that is used to evaluate laboratory accuracy.
- **Method blank (MB):** An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample preparations and analytical procedure and is used to quantify contamination resulting from the analytical process.
- **Surrogate (SUR):** A compound added to all samples in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined, yet they are not normally encountered. SURs are expected to respond to the preparation and measurement systems in a manner similar to the analytes of interest. Because SURs are added to all standards, samples, and QC samples, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.

Laboratories are required to analyze samples within the holding times specified in Table A-6. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, or other chemical changes. Data from samples analyzed outside the holding times are flagged in the HEIS database with an "H."

Table A-6. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses

Constituent/ Parameter	Minimum Volume	Container Type[a]	Preservation[b]	Holding Time
Total organic carbon	250 mL	Narrow-mouth amber glass with Teflon-lined lid	Store ≤6°C, adjust pH to <2 with H_2SO_4 or HCl	28 days
Total organic halogen	1 L	Narrow-mouth glass with Teflon-lined lid	Store ≤6°C, adjust pH to <2 with H_2SO_4	28 days
Anions by IC (chloride, fluoride, nitrate, nitrite, and sulfate)	60 mL	Narrow-mouth poly or glass	Store ≤6°C	48 hours
ICP metals (calcium, iron, lead, magnesium, manganese, potassium, and sodium)	250 mL	Narrow-mouth poly or glass	Adjust pH to <2 with nitric acid	6 months
Phenols by GC or GC/MS	4 × 1 L	Narrow-mouth amber glass with Teflon-lined lid	Store ≤6°C	7 days before extraction 40 days after extraction

Notes:

Teflon® is a registered trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.

The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, dissolved oxygen, temperature, and turbidity are not listed as they are measured in the field.

a. Under the "Container" heading, the term "poly" stands for EPA clean polyethylene bottles.

b. For preservation identified as stored at ≤6°C, the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

EPA = U.S. Environmental Protection Agency
GC = gas chromatography
GC/MS = gas chromatography/mass spectrometry
H_2SO_4 = sulfuric acid
HCl = hydrochloric acid
IC = ion chromatography
ICP = inductively coupled plasma

A3.4 Measurement Equipment

Each user of the measuring equipment is responsible to ensure that equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the measuring equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with manufacturer specifications and other approved methods.

A3.5 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or should have been evaluated as acceptable and valid in accordance with instrument-specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to ensure minimization of downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with applicable Hanford Site requirements.

A3.6 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Appendix B. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

A3.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with test methods identified in SW-846 and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

A3.8 Nondirect Measurements

Data obtained from sources such as computer databases, programs, literature files, and historical databases will be technically reviewed to the same extent as the data generated as part of any sampling and analysis QA/QC effort. All data used in evaluations will be identified by source.

A3.9 Data Management

The SMR organization, in coordination with the S&GRP RCRA groundwater manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with the applicable programmatic requirements governing data management methods.

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hardcopies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR organization on a routine basis. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods. This process is used to document analytical errors and establish their resolution with the S&GRP RCRA groundwater manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and records management.

A4 Assessment and Oversight

Assessment and oversight activities address the effectiveness of project implementation and associated QA/QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

A4.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this plan, project field instructions, the QAPjP, methods, and regulatory requirements. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project line management chain coordinates the corrective actions/deficiencies resolutions in accordance with the QA program, corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the S&GRP RCRA groundwater manager.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with laboratory QA plans. The contractor oversees offsite analytical laboratories and verifies that laboratories are qualified for performing Hanford Site analytical work.

A4.2 Reports to Management

Management will be made aware of deficiencies identified by self-assessments, corrective actions from ECOs, and findings from QA assessments and surveillances. Issues reported by the laboratories are communicated to the SMR organization, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and establish resolution with the S&GRP RCRA groundwater manager.

A5 Data Review and Usability

This section addresses the QA activities that occur after data collection. Implementation of these activities determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A5.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review includes linking sample numbers to specific sampling locations, reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times (if any) have been met, and reviewing QC data to determine whether analyses have met the data quality requirements specified in this plan.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Field QA/QC results also will be reviewed to ensure that the results are usable.

The project scientist, assigned by the S&GRP RCRA groundwater manager, will perform a data review to help determine if observed changes reflect improved/degraded groundwater quality or potential data errors and may result in submittal of a request for data review on questionable data. The laboratory may be asked to check calculations or reanalyze the sample, or the well may be resampled. Results of the request for data review process are used to flag the data appropriately in the HEIS database and/or to add comments.

A5.2 Data Validation

Data validation activities may be performed at the discretion of the S&GRP RCRA groundwater manager and under the direction of the SMR organization. If performed, data validation activities will be based on EPA functional guidelines.

A5.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the DQA is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project data quality needs. For routine groundwater monitoring performed under this groundwater monitoring plan, the DQA is captured in QC associated with the annual Hanford Site groundwater monitoring report (e.g., DOE/RL-2015-07), which evaluates field and laboratory QC and the usability of data. Further DQAs will be performed at the discretion of the S&GRP RCRA groundwater manager and will be documented in a report overseen by the SMR organization.

A6 References

Atomic Energy Act of 1954, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: http://epw.senate.gov/atomic54.pdf.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

DOE/RL-96-68, 2014, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), Rev. 4, Volume 1, Administrative Requirements; Volume 2, Sampling Technical Requirements; Volume 3, Field Analytical Technical Requirements; and Volume 4, Laboratory Technical Requirements, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL1-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL2-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL3-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL4-04.pdf.

DOE/RL-2015-07, 2015, *Hanford Site Groundwater Monitoring Report for 2014*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0080600H.

Ecology Publication No. 04-03-030, 2004, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Environmental Assessment Program, Washington State Department of Ecology, Olympia, Washington. Available at: https://fortress.wa.gov/ecy/publications/documents/0403030.pdf.

Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=82.

EPA/240/B-01/003, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/quality/qs-docs/r5-final.pdf.

EPA/240/R-02/009, 2002, *Guidance for Quality Assurance Project Plans*, EPA QA/G-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/quality/qs-docs/g5-final.pdf.

EPA/600/R-93/100, 1993, *Methods for the Determination of Inorganic Substances in Environmental Samples*, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: http://monitoringprotocols.pbworks.com/f/EPA600-R-63-100.pdf.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SW-846, 2015, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V* (published in the *Federal Register*, Vol. 80, No. 156, dated August 13, 2015), Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.gpo.gov/fdsys/pkg/FR-2015-08-13/pdf/2015-20030.pdf.

WA7890008967, 2009, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, Class 1 Modification, Washington State Department of Ecology, Richland, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code,* Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-160.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

WAC 173-303-330, "Personnel Training."

WAC 173-303-645, "Releases from Regulated Units."

This page intentionally left blank.

Appendix B

Sampling Protocol

This page intentionally left blank.

Contents

B1 Introduction **B-1**

B2 Sampling Methods **B-1**

B2.1 Decontamination of Sampling Equipment B-3

B2.2 Water Levels B-3

B3 Documentation of Field Activities **B-3**

B3.1 Corrective Actions and Deviations for Sampling Activities B-4

B4 Calibration of Field Equipment **B-4**

B5 Sample Handling **B-5**

B5.1 Containers B-5

B5.2 Container Labeling B-5

B5.3 Sample Custody B-5

B5.4 Sample Transportation B-6

B6 Management of Waste **B-6**

B7 Health and Safety **B-7**

B8 References **B-7**

This page intentionally left blank.

Terms

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
FWS	field work supervisor
gpm	gallons per minute
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
IATA	International Air Transport Association
NTU	nephelometric turbidity unit
RCRA	*Resource Conservation and Recovery Act of 1976*
S&GRP	Soil and Groundwater Remediation Project
SMR	Sample Management and Reporting

This page intentionally left blank.

B1 Introduction

Resource Conservation and Recovery Act of 1976 (RCRA) groundwater monitoring at the Hanford Site has been conducted since the mid-1980s. Hanford Site groundwater sampling methods contain extensive requirements for sampling precautions to be taken; equipment and its use; cleaning and decontamination; records and documentation; and sample collection, management, and control activities. Appendices A and B provide the sampling and analysis essentials (i.e., sample collection, sample preservation, chain-of-custody control, analytical procedures, and field and laboratory quality assurance/quality control) necessary for the groundwater monitoring plan.

This appendix provides more specific elements of the sampling protocols and techniques used for the RCRA groundwater monitoring plan. Chapter 3 in the main text of this groundwater monitoring plan identifies the monitoring wells that will be sampled, the constituents to be analyzed, and the sampling frequency for groundwater monitoring at Low-Level Waste Management Area 2.

B2 Sampling Methods

Sampling methods may include, but are not limited to, the following:

- Field screening measurements
- Groundwater sampling
- Water-level measurements

Groundwater samples will be collected in accordance with the current revision of applicable operating methods. Groundwater samples are collected after field measurements of purged groundwater have stabilized:

- **pH:** Two consecutive measurements agree within 0.2 pH units.
- **Temperature:** Two consecutive measurements agree within 0.2°C.
- **Conductivity:** Two consecutive measurements agree within 10 percent of each other.
- **Turbidity:** Less than 5 nephelometric turbidity units (NTUs) prior to sampling (or project scientist recommendation).

Dissolved oxygen will also be measured in the field for this groundwater monitoring plan. Dissolved oxygen is not an indicator parameter and is not required to be stable prior to sample collection.

Unless the project scientists have special requirements, wells are purged using the three borehole volume method. Stable field readings are also required, as specified above. The default pumping rate is 7.6 to 45.4 L/min (2 to 12 gallons per minute [gpm]), depending on the pump (although this is not practical at every well). On occasions when the purge volume is extraordinarily large, wells are purged for a minimum of 1 hour and are then sampled once stable field readings are obtained.

Field measurements (except for turbidity) are obtained using a flow-through cell. Groundwater is pumped directly from the well and into the flow-through cell. At the beginning of the sampling event, field crews attach a clean stainless-steel sampling manifold to the riser discharge. The manifold has two valves and two ports: one port is used only for purgewater, and the second port is used to supply water to the flow-through cell. Probes are inserted into the flow-through cell to measure pH, temperature,

conductivity, and dissolved oxygen. Turbidity is measured by inserting a sample vial into a turbidimeter. The purgewater is then discharged to the purgewater truck.

After the field measurements have stabilized, the hose supplying water to the flow-through cell is disconnected, and a clean, stainless-steel drop leg is attached for sampling. The flow rate is reduced during sampling to minimize loss of volatiles (if any) and to prevent the overfilling of bottles. Sample bottles are filled in a sequence designed to minimize loss of volatiles (if any). Filtered samples are collected after the unfiltered samples. For some constituents (e.g., metals), both filtered and unfiltered samples are analyzed. If additional samples require filtration (e.g., at turbidity greater than 5 NTUs), an inline disposable 0.45 μm filter is used.

Typically, three types of environmental-grade sampling pumps (i.e., Grundfos,[1] Hydrostar,[2] and submersible electrical pumps) are used for groundwater sampling at Hanford Site monitoring wells. Individual pumps are selected based on the unique characteristics of the well and the sampling requirements. A small number of wells will not support a pumped sample due to the yield or physical characteristics of the well; in these cases, a grab sample may be obtained.

Low purge-volume sampling methodology for the collection of groundwater samples is also being implemented at the Hanford Site. Low-flow purging and sampling uses a low purge volume, adjustable-rate bladder pump with flow rates typically on the order of 0.1 to 0.5 L/min (0.03 to 0.1 gpm). This methodology is intended to minimize excessive movement of water from the soil formation into the well. The objective is to pump in a manner that minimizes stress (drawdown) to the system. Purge volumes for wells using low-purge bladder pumps are determined on a well-specific basis based on drawdown, pumping rate, pump and sample line volume, and volume required to obtain stable field conditions prior to collecting samples.

For certain types of samples, preservatives are required. While the preservative may be added to the collection bottles before their use in the field, it is allowable to add the preservative at the sampling vehicle immediately after collection. Samples may require filtering in the field, as noted on the chain-of-custody form.

To ensure sample and data usability, the sampling associated with this plan will be performed in accordance with DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), pertaining to sample collection, collection equipment, and sample handling.

Suggested sample container, preservation, and holding-time requirements are specified in Appendix A, Table A-6 for groundwater samples. These requirements are in accordance with the analytical methods specified in Appendix A, Table A-3. The final container type and volumes will be identified on the chain-of-custody form. This groundwater monitoring plan defines a "sample" as a filled sample bottle for starting the clock for holding-time restrictions.

Holding time is the maximum allowable time period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Required holding times depend on the constituent and are listed in analytical method compilations such as APHA et al., 2012, *Standard Methods for the Examination of Water and Wastewater*, and SW-846, *Test Methods for Evaluating Solid Waste,*

---

[1] Grundfos® is a registered trademark of Grundfos Holding A/S Corporation, Bjerringbro, Denmark.

[2] Hydrostar® is a registered trademark of KYB Corporation, Tokyo, Japan.

Physical/Chemical Methods, Third Edition; Final Update V. Recommended holding times are also provided in HASQARD (DOE/RL-96-68) and in applicable laboratory contracts.

B2.1 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with sampling equipment decontamination methods. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

B2.2 Water Levels

Each time a sample is obtained, measurement of the groundwater surface elevation at each monitoring well is required by WAC 173-303-645(8)(f), "Dangerous Waste Regulations," "Releases from Regulated Units." A measurement of depth to water is recorded in each well prior to sampling using calibrated depth measurement tapes. When two consecutive measurements are taken that agree within 6 mm (0.02 ft), the final determined measurement is recorded, along with the date and time for the specific event (e.g., sampling or annual water-level measurements). The depth to groundwater is subtracted from the elevation of a reference point (usually the top of casing) to obtain the water-level elevation. Tops of casings are known elevation reference points because they have been surveyed to local reference data.

B3 Documentation of Field Activities

Logbooks or data forms are required for field activities and will be used in accordance with HASQARD (DOE/RL-96-68) requirements. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries into logbooks. Logbook entries will be reviewed by the sampling field work supervisor (FWS), cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

A summary of information to be recorded in logbooks is as follows:

- The day and date; time the task started; weather conditions; and the names, titles, and organizations of personnel performing the task.

- Purpose of the visit to the task area.
- Site activities in specific detail (e.g., maps and drawings) or the forms used to record such information (e.g., soil boring log or well completion log). Provide details of any field tests that were conducted. Provide references for any forms that were used, other data records, and the methods followed to conduct the activity.
- Details of any field calibrations and surveys that were conducted. Provide references for any forms that were used, other data records, and the methods followed in conducting the calibrations and surveys.
- Details of any samples collected and indicate the preparation (if any) of splits, duplicates, matrix spikes, or blanks. Provide references for the methods followed in sample collection or preparation. List the location of the sample collection, sample type, all label or tag numbers, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and the analytical request form number pertinent to each sample or sample set. Note the time and the name of the individual to whom custody of samples was transferred.
- The time, equipment type, and serial or identification number, and the methods followed for decontaminations and equipment maintenance performed. Reference the page number(s) of any logbook (if any) where detailed information is recorded.
- Any equipment failures or breakdowns that occurred, with a brief description of repairs or replacements.

B3.1 Corrective Actions and Deviations for Sampling Activities

The Soil and Groundwater Remediation Project (S&GRP) RCRA groundwater manager, FWS, appropriate field crew supervisors, and Sample Management and Reporting (SMR) personnel must document deviations from protocols, problems pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected because of field conditions.

As appropriate, such deviations or problems will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The S&GRP RCRA groundwater manager, FWS, field crew supervisors, or SMR personnel will be responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

Changes in sample activities that require notification, approval, and documentation will be performed as specified in Appendix A, Table A-2.

B4 Calibration of Field Equipment

Field instrumentation, calibration, and quality assurance checks will be performed as follows:

- Prior to initial use of a field analytical measurement system.
- At the frequency recommended by the manufacturer or methods, or as required by regulations.
- Upon failure to meet specified quality control criteria.

- Daily calibration checks will be performed and documented for each instrument used. The calibration checks will be made on standard materials sufficiently similar to the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.

- Use of standards for calibration that are traceable to a nationally recognized standard agency source or measurement system.

B5 Sample Handling

Sample handling and transfer will be in accordance with established methods to preclude loss of sample identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date.

A sampling and analytical database is used to track the samples from the point of collection through the laboratory analysis process.

B5.1 Containers

Samples shall be collected, where and when appropriate, in break-resistant containers. The field sample collection record shall indicate the laboratory lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used in the field, the name of the manufacturer, lot identification, and certification shall be retained for documentation.

Containers shall be capped and stored in an environment that minimizes the possibility for sample container contamination. If contamination of the stored sample containers occurs, corrective actions shall be implemented to prevent reoccurrences. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending upon laboratory-specific volumes/requirements for meeting analytical detection limits. Recommended container types and sample amounts/volumes are identified in Appendix A, Table A-6.

B5.2 Container Labeling

Each sample is identified by affixing a standardized label or tag to the container. This label or tag shall contain the sample identification number and shall identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis required, and collector's name or initials. Sample labels may be either pre-printed or handwritten in indelible or waterproof ink.

B5.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure that sample integrity is maintained throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for custody of the sample changes, the new and previous custodians will sign the chain-of-custody form and note the date and time. The field sampling team will make a copy of the signed record before sample shipment and transmit the copy to the SMR organization.

The following minimum information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Chain of possession information (i.e., signatures and printed names of all individuals involved in the transfer of sample custody and storage locations, and dates/times of receipt and relinquishment)
- Requested analyses (or reference thereto)
- Shipped-to information (i.e., analytical laboratory performing the analysis)

Samplers should note any anomalies with the samples. If anomalies are found, the samplers will inform the SMR organization so special direction for analysis may be provided to the laboratory if deemed necessary.

B5.4 Sample Transportation

All packaging and transportation instructions shall be in compliance with applicable transportation regulations and U.S. Department of Energy (DOE) requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT), as described in 49 CFR 171, "General Information, Regulations, and Definitions," through 49 CFR 177, "Carriage by Public Highway."[3] Carrier-specific requirements defined in the International Air Transport Association (IATA) *Dangerous Goods Regulations* (IATA, current edition) shall also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents shall be considered hazardous material in transportation and transported in accordance with DOT/IATA requirements. If the sample material is known or can be identified, then it will be classified, described, packaged, marked, labeled, and shipped according to the specific instructions for that material, and appropriate laboratory notifications will be made (if necessary) through the SMR project coordinator.

B6 Management of Waste

Waste materials are generated during sample collection, processing, and subsampling activities. Waste will be managed in accordance with DOE/RL-2003-30, *Waste Control Plan for the 200-BP-5 Operable Unit*. For waste designation purposes, the Hanford Environmental Information System data from wells listed in Table 3-2 in the main text of this groundwater monitoring plan will be used to create a waste profile , if required. The maximum concentration for each analyte collected over the last 5 years will be evaluated for use in creating a waste profile, if required. Offsite analytical laboratories are responsible for

[3] Transportation regulations 49 CFR 174, "Carriage by Rail," and 49 CFR 176, "Carriage by Vessel," are not applicable, as these two transportation methods are not used.

disposing unused sample quantities. Pursuant to 40 CFR 300.440, "National Oil and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Off-Site Response Actions," approval from the DOE Richland Operations Office is required before returning unused samples or waste from offsite laboratories.

B7 Health and Safety

DOE established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response"; 10 CFR 830, "Nuclear Safety Management"; and 10 CFR 835, "Occupational Radiation Protection." The health and safety program defines the chemical, radiological, and physical hazards and specifies the controls and requirements for daily work activities on the overall Hanford Site. Personnel training, control of industrial safety and radiological hazards, personal protective equipment, site control, and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program.

B8 References

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=47e3de0454360a17406cb89ade0c966d&mc=true&node=pt10.4.830&rgn=div5.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=57ef404ac6f4734a67fd97302b2d7f7f&node=pt10.4.835&rgn=div5.

10 CFR 851, "Worker Safety and Health Program," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=47e3de0454360a17406cb89ade0c966d&mc=true&node=pt10.4.851&rgn=div5.

29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," Code of Federal Regulations. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=44978c26b801b659aa26be4be718c6f9&mc=true&node=se29.5.1910_1120&rgn=div8.

40 CFR 300.440, "National Oil and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Off-Site Response Actions," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=0ac6e0b4fccdc7f0191eb3eb17d52a4b&mc=true&node=se40.28.300_1440&rgn=div8.

49 CFR, "Transportation," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol2/xml/CFR-2009-title49-vol2.xml.

49 CFR 171, "General Information, Regulations, and Definitions."

49 CFR 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans."

49 CFR 173, "Shippers-General Requirements for Shipments and Packagings."

49 CFR 175, "Carriage by Aircraft."

49 CFR 177, "Carriage by Public Highway."

APHA/AWWA/WEF, 2012, *Standard Methods for the Examination of Water and Wastewater*, 22nd Edition, American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

DOE/RL-96-68, 2014, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), Rev. 4, Volume 1, Administrative Requirements; Volume 2, Sampling Technical Requirements; Volume 3, Field Analytical Technical Requirements; and Volume 4, Laboratory Technical Requirements, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL1-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL2-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL3-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL4-04.pdf.

DOE/RL-2003-30, 2007, *Waste Control Plan for the 200-BP-5 Operable Unit*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0089342.

IATA, current edition, *Dangerous Goods Regulations*, International Air Transport Association, Montreal, Quebec, Canada. Available for purchase at:
http://www.iata.org/publications/dgr/Pages/index.aspx.

Price-Anderson Amendments Act of 1988, Pub. L. 100-408, Aug. 20, 1988, 102 Stat. 1066, 42 USC 2010, et seq. Available at: http://www.gpo.gov/fdsys/pkg/STATUTE-102/pdf/STATUTE-102-Pg1066.pdf.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at:
http://www.epa.gov/epawaste/inforesources/online/index.htm.

SW-846, 2015, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington D.C. Available at:
http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," *Washington Administrative Code*, Olympia, Washington. Available at:
http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-645.

Appendix C

Well Construction

This page intentionally left blank.

Contents

C1 Introduction **C-1**
C2 Reference **C-9**

Figure

Figure C-1. Well 299-E27-8 Construction and Completion Summary C-2
Figure C-2. Well 299-E27-9 Construction and Completion Summary C-4
Figure C-3. Well 299-E27-10 Construction and Completion Summary C-6
Figure C-4. Well 299-E34-2 Construction and Completion Summary C-8

Tables

Table C-1. Hydrogeologic Monitoring Unit Classification Scheme C-1
Table C-2. Sampling Interval Information for Wells within the LLWMA-2 Network C-1

This page intentionally left blank.

C1 Introduction

This appendix provides the following information for the Low-Level Waste Management Area 2 (LLWMA-2) groundwater monitoring wells:

- Well name
- Hydrogeologic unit to be monitored (the portion of the aquifer that is located at the well screen or perforated casing) (Table C-1)
- The following sampling interval information, as shown in Table C-2:
  - Elevation at top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between elevations of top and bottom of the screen or perforated interval)

Figures C-1 through C-4 provide well construction and completion summaries for the LLWMA-2 network wells.

Table C-1. Hydrogeologic Monitoring Unit Classification Scheme

Unit	Description
TU	**Top of unconfined:** Screened across the water table or the top of the open interval is within 1.5 m (5 ft) of the water table, and the bottom of the open interval is no more than 10.7 m (35 ft) below the water table.

Table C-2. Sampling Interval Information for Wells within the LLWMA-2 Network

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation Top of Open Interval (m [ft] NAVD88)	Elevation Bottom of Open Interval (m [ft] NAVD88)	Open Interval Length (m) [ft]
299-E27-8	TU	125.8 (412.7)	119.7 (392.7)	6.1 (20.0)
299-E27-9	TU	125.3 (411.1)	119.4 (391.7)	5.9 (19.4)
299-E27-10	TU	126.2 (414.0)	120 (393.7)	6.2 (20.3)
299-E34-2[a]	TU	125.8 (412.7)	119.7 (392.7)	6.1 (20.0)

Source: NAVD88, *North American Vertical Datum of 1988*.

a. Upgradient well.

TU = Top of unconfined, as described in Table C-1.

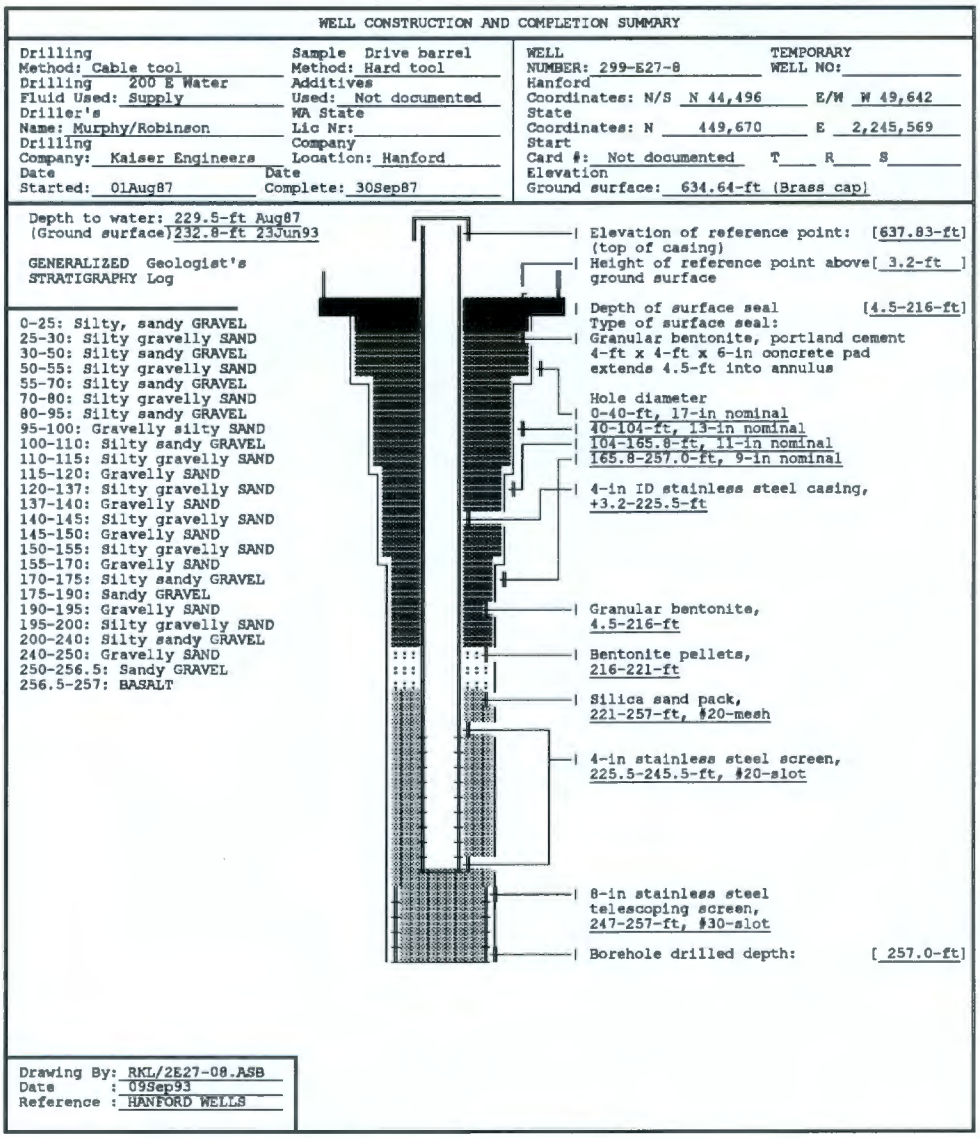


Figure C-1. Well 299-E27-8 Construction and Completion Summary

```
                    SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
                          RESOURCE PROTECTION WELL - 299-E27-8

WELL DESIGNATION     :   299-E27-8
RCRA FACILITY        :   Low Level Burial Grounds, 218-E-12B
CERCLA UNIT          :   200 Aggregate Area Management Study
HANFORD COORDINATES  :   N  44,496  W    49,642 [07Dec87-2000E]
LAMBERT COORDINATES  :   N 449,670  E 2,245,569 [HANCONV]
DATE DRILLED         :   Sep87
DEPTH DRILLED  (GS)  :   257-ft
MEASURED DEPTH (GS)  :   Not documented
DEPTH TO WATER (GS)  :   229.5-ft, Aug87,
                         232.8-ft, 23Jun93
CASING DIAMETER      :   4-in, stainless steel, +3.2-225.5-ft.
ELEV TOP CASING      :   637.83-ft            [07Dec87-200E]
ELEV GROUND SURFACE  :   634.64-ft, Brass cap [07Dec87-200E]
PERFORATED INTERVAL  :   Not applicable
SCREENED INTERVAL    :   4-in, 225.5-245.5-ft; 8-in, 247.0-257.0-ft
COMMENTS             :   FIELD INSPECTION, 07Feb90,
                         4-in stainless steel casing, no protective casing.  Capped and locked.
                         4-ft by 4-ft concrete pad, 4 posts, brass marker with stamped ID.
                         OTHER;
AVAILABLE LOGS       :   Geologist, Driller
TV SCAN COMMENTS     :   Not applicable
DATE EVALUATED       :   Not applicable
EVAL RECOMMENDATION  :   Not applicable
LISTED USE           :   LLBG quarterly water level measurement, 01Dec87-23Jun93;
CURRENT USER         :   WHC ES&M RCRA sampling,
                         PNL sitewide w/l monitoring
PUMP TYPE            :   Hydrostar
MAINTENANCE          :
```

Figure C-1. Well 299-E27-8 Construction and Completion Summary (cont'd.)

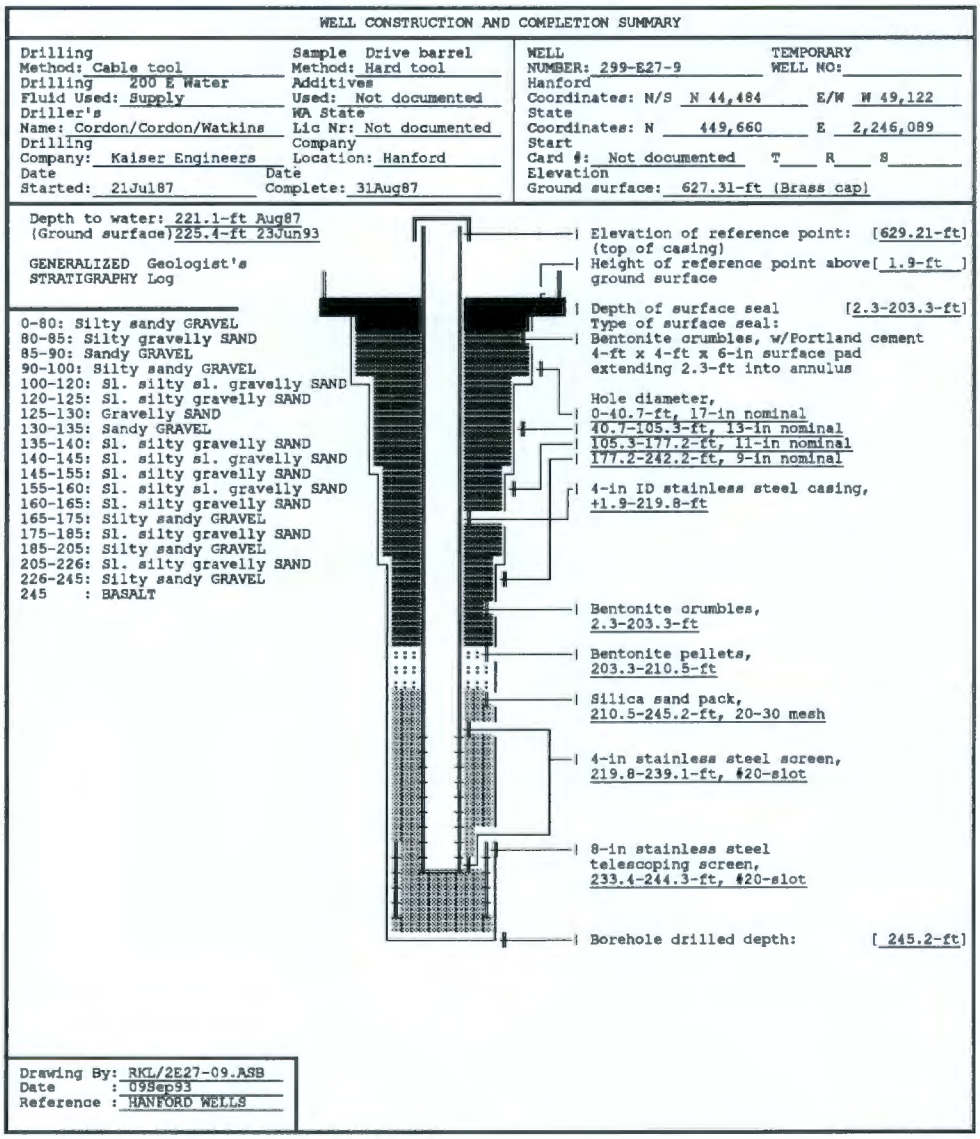


Figure C-2. Well 299-E27-9 Construction and Completion Summary

```
                    SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
                          RESOURCE PROTECTION WELL - 299-E27-9

WELL DESIGNATION     :    299-E27-9
RCRA FACILITY        :    Low Level Burial Grounds, 218-E-12B
CERCLA UNIT          :    200 Aggregate Area Management Study
HANFORD COORDINATES  :    N  44,484  W    49,122 [07Dec87-200E]
LAMBERT COORDINATES  :    N 449,660  E 2,246,089 [HANCONV]
DATE DRILLED         :    Aug87
DEPTH DRILLED  (GS)  :    245.2-ft
MEASURED DEPTH (GS)  :    Not documented
DEPTH TO WATER (GS)  :    221.1-ft, Aug87,
                          225.4-ft, 23Jun93
CASING DIAMETER      :    4-in, stainless steel, +1.9-219.8-ft.
ELEV TOP CASING      :    629.21-ft            [07Dec87-200E]
ELEV GROUND SURFACE  :    627.31-ft, Brass cap [07Dec87-200E]
PERFORATED INTERVAL  :    Not applicable
SCREENED INTERVAL    :    4-in, 219.8-239.1-ft; 8-in, 233.4-244.3-ft
COMMENTS             :    FIELD INSPECTION, 07Feb90,
                          4-in stainless steel casing, no protective casing.  Capped and locked.
                          4-ft by 4-ft concrete pad, 4 posts, brass marker with stamped ID.
                          OTHER;
AVAILABLE LOGS       :    Geologist, Driller
TV SCAN COMMENTS     :    Not applicable
DATE EVALUATED       :    Not applicable
EVAL RECOMMENDATION  :    Not applicable
LISTED USE           :    LLBG quarterly water level measurement, 01Dec87-23Jun93;
CURRENT USER         :    WHC ES&M w/l monitoring and RCRA sampling,
                          PNL sitewide sampling and w/l monitoring 93
PUMP TYPE            :    Hydrostar
MAINTENANCE          :
```

Figure C-2. Well 299-E27-9 Construction and Completion Summary (cont'd.)

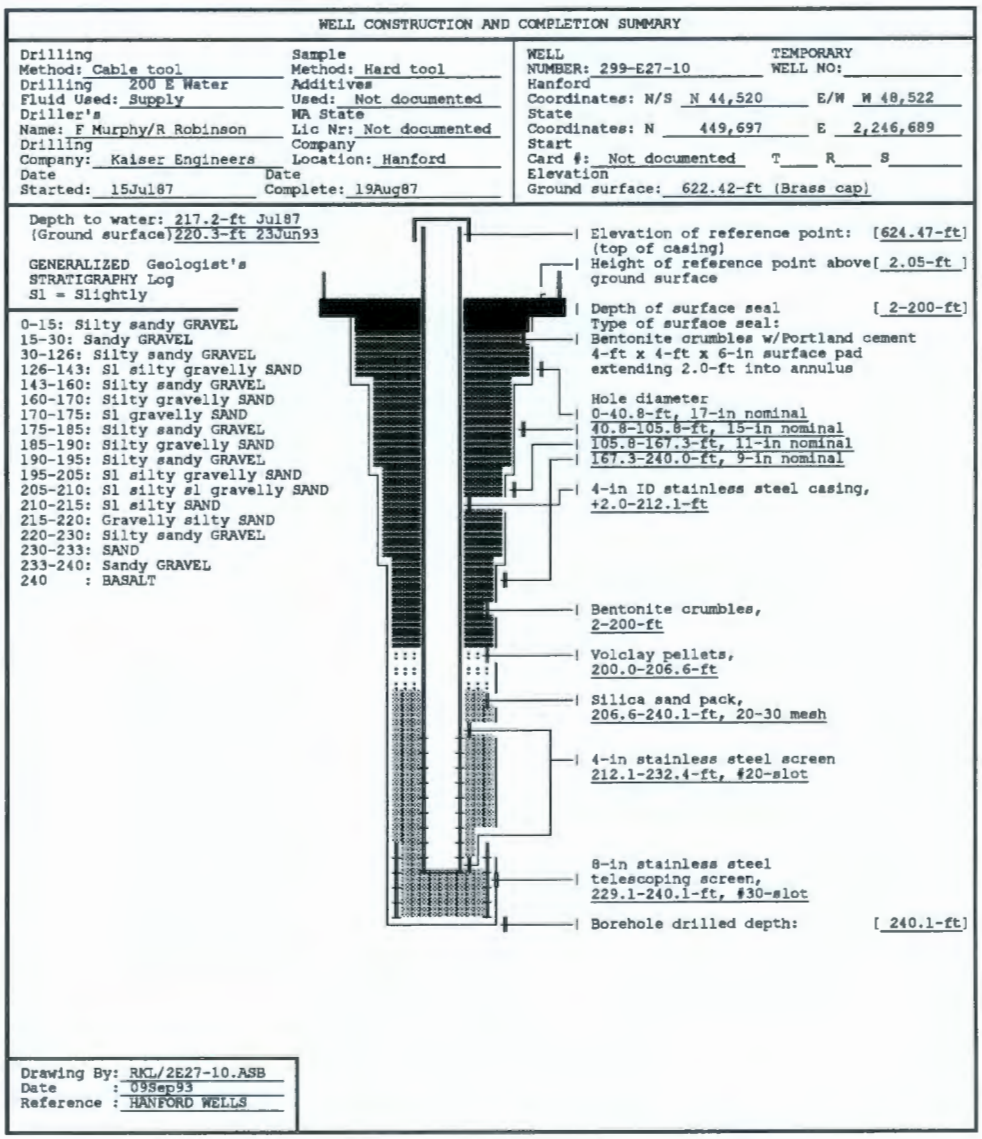


Figure C-3. Well 299-E27-10 Construction and Completion Summary

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E27-10

```
WELL DESIGNATION     :   299-E27-10
RCRA FACILITY        :   Low Level Burial Grounds,
CERCLA UNIT          :   200 Aggregate Area Management Study
HANFORD COORDINATES  :   N  44,520  W    48,522 [07Dec87]
LAMBERT COORDINATES  :   N 449,697  E 2,246,689 [HANCONV]
DATE DRILLED         :   Aug87
DEPTH DRILLED  (GS)  :   240.0-ft
MEASURED DEPTH (GS)  :   Not documented
DEPTH TO WATER (GS)  :   217.2-ft, 29Jul87
                         220.3-ft, 23Jun93
CASING DIAMETER      :   4-in, stainless steel, +2.05-212.1-ft.
ELEV TOP CASING      :   624.47-ft            [07Dec87]
ELEV GROUND SURFACE  :   622.42-ft, Brass cap [07Dec87]
PERFORATED INTERVAL  :   Not applicable
SCREENED INTERVAL    :   4-in, 212.1-232.4-ft; 8-in, 229.1-240.1-ft
COMMENTS             :   FIELD INSPECTION, 07Feb90,
                         4-in stainless steel casing, no protective casing.  Capped and locked.
                         4-ft by 4-ft concrete pad, 4 posts, brass marker with stamped ID.
                         Not in radiation zone.
                         OTHER;
AVAILABLE LOGS       :   Geologist, Driller
TV SCAN COMMENTS     :   Not applicable
DATE EVALUATED       :   Not applicable
EVAL RECOMMENDATION  :   Not applicable
LISTED USE           :   LLBG quarterly water level measurement, C1Dec87-23Jun93;
CURRENT USER         :   WHC ES&M w/l monitoring and RCRA sampling,
                         PNL sitewide sampling 93
PUMP TYPE            :   Hydrostar
MAINTENANCE          :
```

Figure C-3. Well 299-E27-10 Construction and Completion Summary (cont'd.)

A4877 / 299-E34-2

WELL CONSTRUCTION AND COMPLETION SUMMARY

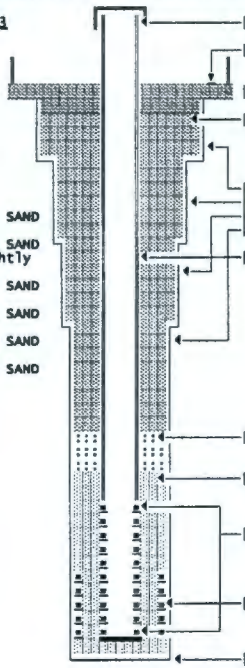
Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: Amos/St. George
Drilling Company: Kaiser Engineers
Date Started: 18Jul87
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: ND/1224
Company Location: Hanford
Date Complete: 30Sep87

WELL NUMBER: 299-E34-2
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 45,076 E/W W 50,048
State Coordinates: N 450,249 E 2,245,161
Start Card #: Not documented T R S
Elevation Ground surface: 629.03-ft (Brass cap)

Depth to water: 223.5-ft Jul87
(Ground surface) 227.0-ft 28Jun93

GENERALIZED STRATIGRAPHY Geologist's Log

0-12: Silty sandy GRAVEL
12-50: Sandy GRAVEL
50-60: Silty sandy GRAVEL
60-70: Sandy GRAVEL
70-75: Silty sandy GRAVEL
75-95: Sandy GRAVEL
95-120: Gravelly SAND
120-125: Sandy GRAVEL
125-130: Slightly silty gravelly SAND
130-135: Gravelly SAND
135-140: Slightly silty gravelly SAND
140-145: Slightly gravelly, slightly silty SAND
145-155: Slightly silty gravelly SAND
155-170: Gravelly SAND
170-180: Slightly silty gravelly SAND
180-185: Gravelly SAND
185-190: Slightly silty gravelly SAND
190-195: Silty sandy GRAVEL
195-210: Slightly silty gravelly SAND
210-240: Silty sandy GRAVEL
240-241: Slightly silty SAND
241 : BASALT



Elevation of reference point: [630.80-ft] (top of casing)
Height of reference point above ground surface [1.8-ft]
Depth of surface seal [0-205.4-ft]
Type of surface seal: Bentonite crumbles to 205.4-ft, has 4-ft x 4-ft x 6-in surface pad extending 3-ft into annulus
Hole diameter,
0-40.1-ft, 17-in nominal
40.1-105.5-ft 13-in nominal
105.5-166.4-ft, 11-in nominal
166.4-241.0-ft, 9-in nominal
4-in ID stainless steel casing, +1.8-219.9-ft
Bentonite pellets, 205.4-212.8-ft
Silica sand pack, 212.8-241.5-ft, 20-30 mesh
4-in stainless steel screen, 219.9-239.9-ft, #20-slot
8-in stainless steel telescoping screen, 230.2-240.4-ft, #30-slot
Borehole drilled depth: [241.5-ft]

Drawing By: RKL/2E34-02.ASB
Date : 13Sep93
Reference : HANFORD WELLS

Figure C-4. Well 299-E34-2 Construction and Completion Summary

```
                    SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
                         RESOURCE PROTECTION WELL - 299-E34-2

WELL DESIGNATION     :   299-E34-2
RCRA FACILITY        :   Low Level Burial Grounds, 218-E-10
CERCLA UNIT          :   200 Aggregate Area Management Study (200-BP-5)
HANFORD COORDINATES  :   N  45,076   W    50,048 [07Dec87]
LAMBERT COORDINATES  :   N 450,249   E 2,245,161 [HANCONV]
DATE DRILLED         :   Sep87
DEPTH DRILLED  (GS)  :   241.5-ft
MEASURED DEPTH (GS)  :   Not documented
DEPTH TO WATER (GS)  :   223.5-ft, Jul87
                         227.0-ft, 28Jun93
CASING DIAMETER      :   4-in, stainless steel, +1.8-219.9-ft.
ELEV TOP CASING      :   630.80-ft,          [07Dec87]
ELEV GROUND SURFACE  :   629.03-ft, Brass cap [07Dec87]
PERFORATED INTERVAL  :   Not applicable
SCREENED INTERVAL    :   219.9-239.9-ft, 4-in stainless steel, #20-slot;
                         230.2-240.4-ft, 8-in stainless steel, #30-slot
COMMENTS             :   FIELD INSPECTION, 07Feb90,
                         4-in stainless steel casing, no protective casing.  Capped and locked.
                         4-ft by 4-ft concrete pad, 4 posts, brass marker with stamped ID.
                         Not in radiation zone.
                         OTHER;
AVAILABLE LOGS       :   Geologist, Driller
TV SCAN COMMENTS     :   Not applicable
DATE EVALUATED       :   Not applicable
EVAL RECOMMENDATION  :   Not applicable
LISTED USE           :   200 BP-1 quarterly water level measurement, 01Dec87-28Jun93;
CURRENT USER         :   WHC ES&M w/l monitoring and RCRA sampling,
                         WHC ER characterization,
                         PNL sitewide sampling and w/l monitoring 93
PUMP TYPE            :   Hydrostar
MAINTENANCE          :
```

Figure C-4. Well 299-E34-2 Construction and Completion Summary (cont'd.)

C2 Reference

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

This page intentionally left blank.

Addendum E

Security

This page intentionally left blank.

Contents

E1 Security E-1

E1.1 Security Provisions E-1

E1.1.1 Access Control E-1

E1.1.2 Warning Signs E-2

This page intentionally left blank.

E1 Security

The following sections document security measures in effect at the Low Level Burial Grounds (LLBG) Trenches 31-34-94 Operating Unit Group (OUG), hereinafter referred to as LLBG Trenches 31-34-94. LLBG Trenches 31-34-94 consist of the following active dangerous waste management units (DWMUs): LLBG Trench 31, LLBG Trench 34, LLBG Trench 94, LLBG Trench 31 Waste Storage and Treatment Pad, and LLBG Trench 34 Waste Storage and Treatment Pad.

E1.1 Security Provisions

LLBG Trenches 31-34-94, located within the 200 West Area (LLBG Trenches 31 and 34) and the 200 East Area (LLBG Trench 94) of the Hanford Facility, comply with access control and warning sign requirements pursuant to WAC 173-303-310(1) and (2), "Dangerous Waste Regulations," "Security." Hanford Facility access is controlled by 24 hour surveillance as described in Attachment 3, "Security," to the WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit.*

E1.1.1 Access Control

Unknowing entry and the possibility for unauthorized entry of persons or livestock onto the active portions and active DWMUs of LLBG Trenches 31-34-94 are minimized through implementation and maintenance of the following security measures:

- Hanford Patrol forces will maintain 24 hour surveillance of the Hanford Facility and OUGs located within. A continuous presence of protective force personnel will provide access controls to active portions of the Hanford Facility, thus meeting WAC 173-303-310(2)(b) requirements.
- Roadway access to LLBG Trench 31, LLBG Trench 34, and LLBG Trench 94 is controlled by swinging metal gates at each trench entrance. Gates are closed and locked during times of non-operations. Gate keys are controlled and may only be accessed by authorized, trained personnel.
- LLBG Trench 31 Waste Storage and Treatment Pad and LLBG Trench 34 Waste Storage and Treatment Pad DWMUs are located adjacent to LLBG Trench 31 and LLBG Trench 34, respectively. Roadway access to the pads is limited to and only through the LLBG Trench 31 and LLBG Trench 34 main entrance gates.
- The perimeters of LLBG Trench 31 and LLBG Trench 34 are surrounded by closely spaced Jersey blocks standing approximately 1 m (3 ft) in height. These blocks form a physical barrier encircling each trench.
- LLBG Trench 94 is below ground level and has been configured with steep sloping trench walls (with the exception of the ingress/egress ramp), creating a natural access barrier into and out of the trench. The point of vehicle entry to LLBG Trench 94 is a roadway with access controlled by a two-part swinging metal gate. The gate remains locked when not in use. The keys are controlled and may only be accessed by authorized, trained personnel.

Visitors to LLBG Trenches 31-34-94 must adhere to all personal protection requirements and are subject to escorting protocols.

Personnel training requirements for LLBG Trenches 31-34-94 operators and workers are found in Addendum G, "Personnel Training."

E1.1.2 Warning Signs

Warning signs, stating "Danger-Unauthorized Personnel Keep Out" or "Danger Do Not Enter-Authorized Personnel Only," are posted on each gate section at LLBG Trenches 31-34-94. Signs identical to those affixed to the gates are posted near the entrance and intermittently on the hazardous boundary fence of each trench. Permittees must maintain warning signs at points described in this Addendum and ensure that signs are written in English, legible from a distance of approximately 7.6 m (25 ft) or more, and visible from all angles of approach [WAC 173-303-310(2)(a)].

Addendum F

Preparedness and Prevention

This page intentionally left blank.

Contents

F1 Introduction F-1

F2 Preparedness and Prevention Requirements F-1

F2.1 Required Equipment F-1

F2.1.1 Internal Communications F-1

F2.1.2 External Communications F-1

F2.1.3 Emergency Equipment F-2

F2.2 Water for Fire Control F-2

F2.3 Aisle Space Requirement F-2

F3 Preventive Procedures, Structures, and Equipment F-3

F3.1 Container Loading, Unloading and Handling Preventive Measures F-3

F3.2 Prevention of Run-on, Run-off, and Contamination to Water Supplies F-3

F3.2.1 LLBG Trenches 31 and 34 ..... F-4

F3.2.2 LLBG Trenches 31 and 34 Waste Storage and Treatment Pads F-4

F3.2.3 LLBG Trench 94 ..... F-4

F3.3 Equipment and Power Failure F-4

F3.4 Personal Protective Equipment F-5

F4 Prevention of Ignition or Reaction of Ignitable, Reactive, and/or Incompatible Waste F-5

F5 Arrangements with Local Authorities F-5

This page intentionally left blank.

F1 Introduction

This addendum addresses preparations and preventive measures in effect at the Low-Level Burial Grounds (LLBG) Trenches 31-34-94 Operating Unit Group (OUG), hereinafter referred to as LLBG Trenches 31-34-94. The LLBG Trenches 31-34-94 OUG is composed of the following dangerous waste management units (DWMUs):

- LLBG Trench 31
- LLBG Trench 31 Waste Storage and Treatment Pad
- LLBG Trench 34
- LLBG Trench 34 Waste Storage and Treatment Pad
- LLBG Trench 94

For descriptions and details of LLBG Trenches 31-34-94 DWMUs, refer to Addendum C, "Process Information."

The purposes of preparedness and prevention are to minimize the damage caused by a fire or explosion and help avoid or mitigate any unplanned releases of dangerous waste constituents to air, soil, surface water, or groundwater. This addendum complies with regulations set forth in WAC 173-303-340, "Dangerous Waste Regulations," "Preparedness and Prevention," WAC 173-303-806(4)(a)(viii), "Final Facility Permits," and WAC 173-303-395(4), "Other General Requirements."

F2 Preparedness and Prevention Requirements

Preparedness and prevention requirements of WAC 173-303-340 are addressed in the following subsections.

F2.1 Required Equipment

Communications equipment, firefighting equipment, spill control, and decontamination equipment are available for use at LLBG Trenches 31-34-94, in accordance with the requirements of WAC 173-303-340(1).

F2.1.1 Internal Communications

LLBG Trenches 31-34-94 is equipped with internal communications devices used to provide immediate emergency instruction to personnel. Whenever waste handling operations occur at LLBG Trenches 31-34-94, all personnel involved must have immediate access to hand-held two-way radios and/or cellular phones capable of direct emergency communications with another employee. The communications devices described in this section meet the internal communications requirements of WAC 173-303-340(1)(a), (1)(b), and (2)(a).

F2.1.2 External Communications

As required by WAC 173-303-340(1)(b), the communications equipment (described in Section F2.1.1) must have the capability for contacting the Hanford Patrol Operations Center and Hanford Fire Department to request the assistance of local emergency response organizations. The Hanford Patrol Operations Center Point of Contact can be contacted for 24-hour emergency communications and for information relays by landline telephone, cellular phone, or two-way radio.

State and local response organizations are contacted through the Hanford Patrol Operations Center by dialing emergency number 911 from site landline telephones, or 509-373-0911 from cellular phones; or for non-emergencies, by dialing the main contact number for the Hanford Patrol Operations Center at

509-373-3800. Onsite responders are notified and/or dispatched through the Hanford Patrol Operations Center.

In the instance that just one employee is at any LLBG Trenches 31-34-94 DWMU during operations, the individual must have immediate access to a hand-held two-way radio or cellular phone capable of summoning external emergency assistance [WAC 173-303-340(2)(b)].

F2.1.3 Emergency Equipment

LLBG Trenches 31-34-94 personnel are trained in the use of emergency equipment. Addendum G, "Personnel Training," provides details of personnel emergency training.

LLBG Trenches 31-34-94 relies upon the Hanford Fire Department to respond to fire and other emergencies as described in Attachment 4, "Hanford Emergency Management Plan," to the WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter Hanford Facility RCRA Permit). Portable fire extinguishers, fire control equipment, spill control equipment, personal protective equipment (PPE), and decontamination equipment, required by WAC 173-303-340(1)(c), is provided for use at the LLBG Trenches 31-34-94 by the Hanford Fire Department or from portable decontamination trailers shared by the Solid Waste Operations Complex OUGs.

Communications equipment, fire protection equipment, spill control equipment, and decontamination equipment are tested and maintained to assure proper operation in time of emergency [WAC 173-303-340(1)(d)].

F2.2 Water for Fire Control

There are no water main resources at LLBG Trenches 31-34-94. Fire hydrants, providing water at adequate volume and pressure to supply fire control equipment, are located within accessible distances from LLBG Trenches 31 and 34 and LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. When needed, the Hanford Fire Department will use these hydrants to supply fire control equipment and water for fire suppression.

The Hanford Fire Department responds to fire related emergencies at LLBG Trench 94 with pump engines capable of providing water at adequate volume and pressure for fire suppression and supplying fire control equipment.

F2.3 Aisle Space Requirement

Aisle spacing requirements WAC 173-303-630(5)(c), "Use and Management of Containers," mandate a minimum of 76 cm (30 in.) between rows of containers stored on the LLBG Trench 31 and 34 Waste Storage and Treatment Pads. This allows the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment during emergency situations. Rows of drums will be placed no more than two drums wide. Waste container boxes, modules, and long length containers will be spaced to allow unobstructed movements of personnel and emergency equipment [WAC 173-303-340(3)].

LLBG Trenches 31 and 34 are not authorized for storage or treatment of waste. Once containers are placed for final disposal within the trenches, aisle spacing requirements described in this subsection do not apply.

Aisle spacing requirements do not apply to defueled reactor compartments (RCs) placed for final disposal in LLBG Trench 94.

F3 Preventive Procedures, Structures, and Equipment

The following subsections address preventive procedures, structures, and equipment, including spill control measures, in effect at LLBG Trenches 31-34-94.

F3.1 Container Loading, Unloading and Handling Preventive Measures

Containers loaded onto, or unloaded from, transport vehicles are handled and/or stored on the LLBG Trench 31 and 34 Waste Storage and Treatment Pads or, if land disposal restriction compliant, may be moved directly into the landfills for disposal. LLBG Trench 94 accepts only defueled RCs, which are moved directly into the landfill for permanent placement. To minimize the potential for container damage or accidental opening during loading, unloading, and/or handling operations, the following preventive measures are observed by LLBG Trenches 31-34-94 personnel:

- Containers are U.S. Department of Transportation and/or U.S. Department of Energy (DOE) compliant.
- Operators conduct physical inspections for container damage and abnormal appearance that are performed prior to loading and unloading operations.
- All containers, including bulk and long length, will be handled by equipment appropriate for unloading and container movement (e.g., forklift, high weight capacity forklift, or crane).
- Waste is not loaded or unloaded without the approval of operations supervision.
- Pathways from unloading locations to storage, treatment, or disposal areas will remain clear of obstructions.
- Transport vehicles are positioned in a manner that provides an unobstructed work space to load and offload containers.
- Containers stored on the pads will be moved into LLBG Trench 31 or LLBG Trench 34 for disposal or to an alternate location (e.g., a different onsite or offsite treatment, storage, and disposal facility) as soon as is practical.
- Collected wastes resulting from spills and leaks will be removed, as soon as possible, in a manner that prevents release of dangerous waste constituents.
- Operators must comply with container stacking, aisle spacing, and segregation requirements.
- RCs are inspected for leaks, damage, and proper documentation prior to final placement in LLBG Trench 94. U.S. Navy personnel are responsible for the transport, unloading, and movement of defueled RCs within Trench 94. Once final placement is achieved, DOE assumes responsibility for the RCs from U.S. Navy personnel.

F3.2 Prevention of Run-on, Run-off, and Contamination to Water Supplies

The design and/or operation of LLBG Trenches 31-34-94 DWMUs is intended to mitigate run-on and run-off, minimize the generation of potentially contaminated leachate or liquids, and prevent migration into local groundwater resources. Detailed descriptions of the design, construction, and operation of each DWMU are provided in Addendum C. A general description for preventing run-on, run-off, and contamination of water supplies and groundwater is shown in the following subsections.

F3.2.1 LLBG Trenches 31 and 34

Each landfill was designed, constructed, and installed in accordance with WAC 173-303-665, "Landfills," to prevent any migration of wastes out of the landfill to the adjacent subsurface soil or groundwater or surface water at any time during the active life (including the closure period) of the landfill. The liner systems are constructed of materials that prevent wastes from passing through the liner during the active life of the facility.

Because of the sandy soils, small drainage area, and arid climate, storm water run-on and run-off were not expected to require major engineered structures. The 25-year, 24-hour precipitation event was the design storm used to size the landfill systems.

The run-on control system consists of a berm along the outer margin of each landfill preventing run-on from entering the landfill. The run-off potential for the area surrounding the project site was made using three different methods of analysis:

- Unit hydrograph and flood simulation program (HEC-1, U.S. Army Corps of Engineers 1981 version);
- Estimating techniques based on regression equations developed from regional stream flow measurements (USGS, 74-336); and
- The rational method, which is applicable for areas less than 200 acres.

Results of the combined analyses were used to estimate peak flow for the surrounding area prior to sizing and constructing storm water run-off conveyance facilities that include interceptor drainage ditches and graded slopes. There is no run-off from the landfills because they are constructed below grade, and any precipitation falling on the landfills is removed by evapotranspiration and the leachate collection and removal system (LCRS).

F3.2.2 LLBG Trenches 31 and 34 Waste Storage and Treatment Pads

Storage and treatment of containers with free liquids and containers holding wastes designated as D001, D002, D003, F020, F021, F022, F023, F026, and F027 are not accepted at this DWMU. In addition to design and construction discussed for LLBG Trenches 31 and 34, the pads are elevated from the surrounding area diverting any potential run-on.

Run-off is directed into the LCRS of the landfills or into the interceptor drainage ditches and berms surrounding the pads. Storage areas and containers are inspected weekly in accordance with WAC 173-303-630 for integrity.

F3.2.3 LLBG Trench 94

LLBG Trench 94 is designed to prevent run-on and run-off. Defueled RCs have been packaged and sealed to prevent leakage and minimize the potential for contamination of water supplies and groundwater.

F3.3 Equipment and Power Failure

Loss of electrical power at LLBG Trenches 31-34-94 does not constitute an emergency. However, electricity supplies power to the primary and secondary LCRS sump pumps of LLBG Trenches 31 and 34. Therefore, power will be restored as soon as possible.

Power failure does not affect LLBG Trench 94. There are no permanently installed electrical power sources or electrical powered equipment at this trench.

F3.4 Personal Protective Equipment

All personnel are required to wear PPE specified by work authorization documentation when working at LLBG Trenches 31-34-94 DWMUs. Protective clothing required varies, depending on the form, content, and waste handling activities. Personnel are instructed to wear protective equipment in accordance with training, posted requirements, and administrative instruction.

F4 Prevention of Ignition or Reaction of Ignitable, Reactive, and/or Incompatible Waste

Waste acceptance requirements prohibit the disposal of ignitable, reactive, and incompatible waste in LLBG Trenches 31-34-94. Addendum B, "Waste Analysis Plan," requirements ensure that compliant measures have been taken to identify and prevent final disposal of ignitable, reactive, or incompatible waste.

If, during waste profile or waste acceptance reviews, ignitable, reactive, and/or incompatible wastes are identified, then the submitted waste stream or profile will be rejected, and the affected waste will be prohibited at LLBG Trenches 31-34-94. In the instance that ignitable, reactive, and/or incompatible waste is discovered during the course of physical screening or treatment of containers at LLBG Trench 31 and 34 Waste Storage and Treatment Pads, such waste will be segregated and managed pursuant to the requirements of WAC 173-303-395(1).

F5 Arrangements with Local Authorities

Written emergency assistance agreements exist with local authorities that include arrangements to familiarize and furnish local hospitals, police departments, fire departments, and city and county emergency response teams with Hanford Facility information. The response agreements designate primary emergency authority [WAC 173-303-340(4)(a) through (c)]. If state or local authorities decline to enter into a response agreement or familiarization arrangement with the Hanford Facility, the Permittees will record the refusal in the Hanford Facility Operating Record, LLBG Trenches 31-34-94 portion, as required by Hanford Facility RCRA Permit Condition II.I.1.g [WAC 173-303-340(5)].

This page intentionally left blank.

Addendum G

Personnel Training

This page intentionally left blank.

Contents

G1 Personnel Training G-1

Table

Table G-1. LLBG Trenches 31-34-94 Training Matrix G-2

This page intentionally left blank.

G1 Personnel Training

This addendum describes the personnel training requirements for the Low-Level Burial Ground (LLBG) Trenches 31-34-94 Operating Unit Group, hereinafter referred to as LLBG Trenches 31-34-94.

Permittees will ensure that personnel training will meet the requirements for WAC 173-303-330, "Dangerous Waste Regulations," "Personnel Training." Specific requirements for the Hanford Facility Personnel Training program are described in Attachment 5, "Hanford Facility Personnel Training Program," to the WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter Hanford Facility RCRA Permit).

Permittees will comply with the training matrix in Table G-1, which provides training requirements for Hanford Facility personnel associated with LLBG Trenches 31-34-94. Training requirements are only for personnel that perform waste management duties at LLBG Trenches 31-34-94. Refer to the LLBG Dangerous Waste Training Plan (DWTP) for a complete description of personnel training requirements. As required by Hanford Facility RCRA Permit Condition II.I (WAC 173-303-380, "Facility Recordkeeping"), which satisfies the training records requirements set forth in WAC 1073-303-330(3), a copy of the LLBG DWTP will be placed in the Hanford Facility Operating Record, LLBG Trenches 31-34-94, and will be updated as unit-specific conditions change.

Training received by facility personnel will be commensurate with the duties they perform. Individuals are not required to receive training for work duties they do not perform. Continuing training is administered annually, or at 2-year or 3-year retraining frequencies. A course is administered annually if it is administered not less than 30 days after the retraining date set for that course.

Table G-1. LLBG Trenches 31-34-94 Training Matrix

Training Category Course Description[a]	Frequency of Training	Training Type[b]	Job Title/Position								
			Non-LLBG Personnel or Visitor	FWS	SPOC	Waste Service Provider[c]	Maintenance Craft	RCT	NCO	ECO	BED
General Training	Annual	GHFT	X	X	X	X	X	X	X	X	X
Container Management	Annual	GHFT, OT		X		X	X	X	X		
Building Emergency	Annual	ECT									X
ECO Training	Initial	OT								X	
Inspections	Every 2 years	OT		X					X		
Facility Health and Safety	Annual	GHFT, CPT	X[d]	X	X[d]	X[d]	X	X	X	X	X
Waste Designation	Annual	OT				X					
Waste Services	Initial	OT				X					
Waste Shipper	Every 3 years	OT				X					
Waste Management	Every 2 years	GHFT, CPT, OT		X			X[e]	X[e]	X		
Sampling	Every 2 years	CPT, OT		X					X		
Disposal	Every 2 years	CPT, OT		X					X		

Table G-1. LLBG Trenches 31-34-94 Training Matrix

Training Category Course Description[a]	Frequency of Training	Training Type[b]	Job Title/Position								
			Non-LLBG Personnel or Visitor	FWS	SPOC	Waste Service Provider[c]	Maintenance Craft	RCT	NCO	ECO	BED

a. See the LLBG DWTP for a complete description of coursework in each training category.

b. Permit Attachment 5 training types.

c. Waste Service Providers include TSDRs, Verifiers, Shippers, and WMRs. The different Waste Service Providers are only required to take the necessary courses specific to their waste management duties.

d. This training is required only if workers are unescorted in LLBG Trenched 31-34-94.

e. Maintenance Crafts and RCTs take only initial Waste Management Training.

BED	=	Building Emergency Director
CPT	=	Contingency Plan Training
DWTP	=	Dangerous Waste Training Plan
ECO	=	Environmental Compliance Officer
ECT	=	Emergency Coordinator Training
FWS	=	Field Work Supervisor
GHFT	=	General Hanford Facility Training
LLBG	=	Low-Level Burial Ground
NCO	=	Nuclear Chemical Operator
OT	=	Operations Training
RCT	=	Radiological Control Technician
SPOC	=	Single Point of Contact
TSDR	=	Treatment, Storage, and Disposal Unit Acceptance Representative
WMR	=	Waste Management Representative

This page intentionally left blank.

Addendum H

Closure Plan

This page intentionally left blank.

Contents

H1 Introduction H-1

H1.1 Hanford Facility Contact Information H-1

H1.2 Hanford Facility Description H-1

H1.3 Unit History, Function, Location, and Layout H-1

H1.4 Products and Production Processes H-1

H1.5 Dangerous Waste Management Units H-1

H1.6 References for LLBG Closure Plan Appendices H-3

Appendices

H-A LLBG Trenches 31-34-94 – Trenches 31 and 34 Dangerous Waste Management ..... H-A-i

H-B LLBG Trenches 31-34-94 – Trenches 31 and 34 Waste Storage and Treatment Pads Dangerous Waste Management ..... H-B-i

H-C LLBG Trench 94 Dangerous Waste Management ..... H-C-i

Figures

Figure H-1. Low-Level Burial Ground Trenches 31-34 Operating and Closing Dangerous Waste Management Units H-2

Figure H-2. Low-Level Burial Ground Trench 94 Operating Dangerous Waste Management Unit H-3

This page intentionally left blank.

H1 Introduction

Addendum H discusses closure activities for dangerous waste management units (DWMUs) in the Low-Level Burial Ground (LLBG) Trenches 31-34-94 Operating Unit Group (OUG).

Please note, the terms "mixed waste" and/or "waste" when seen in this document refer to dangerous waste or hazardous waste, as applicable.

H1.1 Hanford Facility Contact Information

The Hanford Facility is owned by the U.S. Government and operated by the U.S. Department of Energy (DOE). The contact information is as follows:

U.S. Department of Energy, Richland Operations Office
P.O. Box 550
Richland, WA 99352
(509) 372-2400

H1.2 Hanford Facility Description

The Hanford Facility, located in southeastern Washington State, is owned by the U.S. Government and is managed and operated by DOE. Waste (containing both dangerous and radioactive components) are generated and managed at the Hanford Facility.

H1.3 Unit History, Function, Location, and Layout

The LLBG Trenches 31-34-94 OUG (hereinafter referred to as LLBG Trenches 31-34-94) are comprised of the following three trenches: LLBG Trenches 31 and 34 in the 200 West Area of the Hanford Facility, and LLBG Trench 94 in the 200 East Area of the Hanford Facility.

LLBG Trenches 31 and 34 (Figure H-1) are large rectangular excavations in the southwest corner of the 218-W-5 Burial Ground operated as units for disposal of treated and land disposal restriction (LDR) compliant waste. LLBG Trenches 31 and 34 are rectangular and at the top are approximately 137 m (450 ft) long by 91 m (300 ft) wide, and 9 m (30 ft) in depth. LLBG Trenches 31 and 34 began receiving waste for disposal on September 15, 1999. The LLBG Trenches 31 and 34 are constructed with polyethylene liners and a leachate collection system. Two waste storage and treatment pads (LLBG Trench 31 Waste Storage and Treatment Pad and LLBG Trench 34 Waste Storage and Treatment Pad) provide storage and treatment of waste (Figure H-1).

LLBG Trench 94 (Figure H-2) is a large rectangular excavation in the 218-E-12B Burial Ground operated as a unit for disposal of defueled reactor compartments. LLBG Trench 94 is approximately 494 m (1,620 ft) by 98 m (320 ft) at the base and 15 m (49 ft) deep.

H1.4 Products and Production Processes

LLBG Trenches 31-34-94 does not produce products and does not have production processes. Therefore, this section is not applicable.

H1.5 Dangerous Waste Management Units

LLBG Trenches 31 and 34 are designed for disposal of mixed waste. The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads are designed for storage and treatment of waste. Waste treatment will consist of macroencapsulation, microencapsulation, and sealing.

The Addendum A, Part A Form corresponding to DWMUs in the LLBG Trenches 31-34-94 OUG identifies various *Resource Conservation and Recovery Act of 1976* permitted capabilities for the DWMUs, as well as operating DWMUs and closing DWMUs.

LLBG Trenches 31-34-94 consists of the following DWMUs identified in Figures H-1 and H-2:

- LLBG Trench 31 (Disposal)
- LLBG Trench 34 (Disposal)
- LLBG Trench 94 (Disposal)
- LLBG Trench 31 Waste Storage and Treatment Pad (Storage and Treatment)
- LLBG Trench 34 Waste Storage and Treatment Pad (Storage and Treatment)
- FS-1 Outdoor Container Storage Area (Closing Unit)

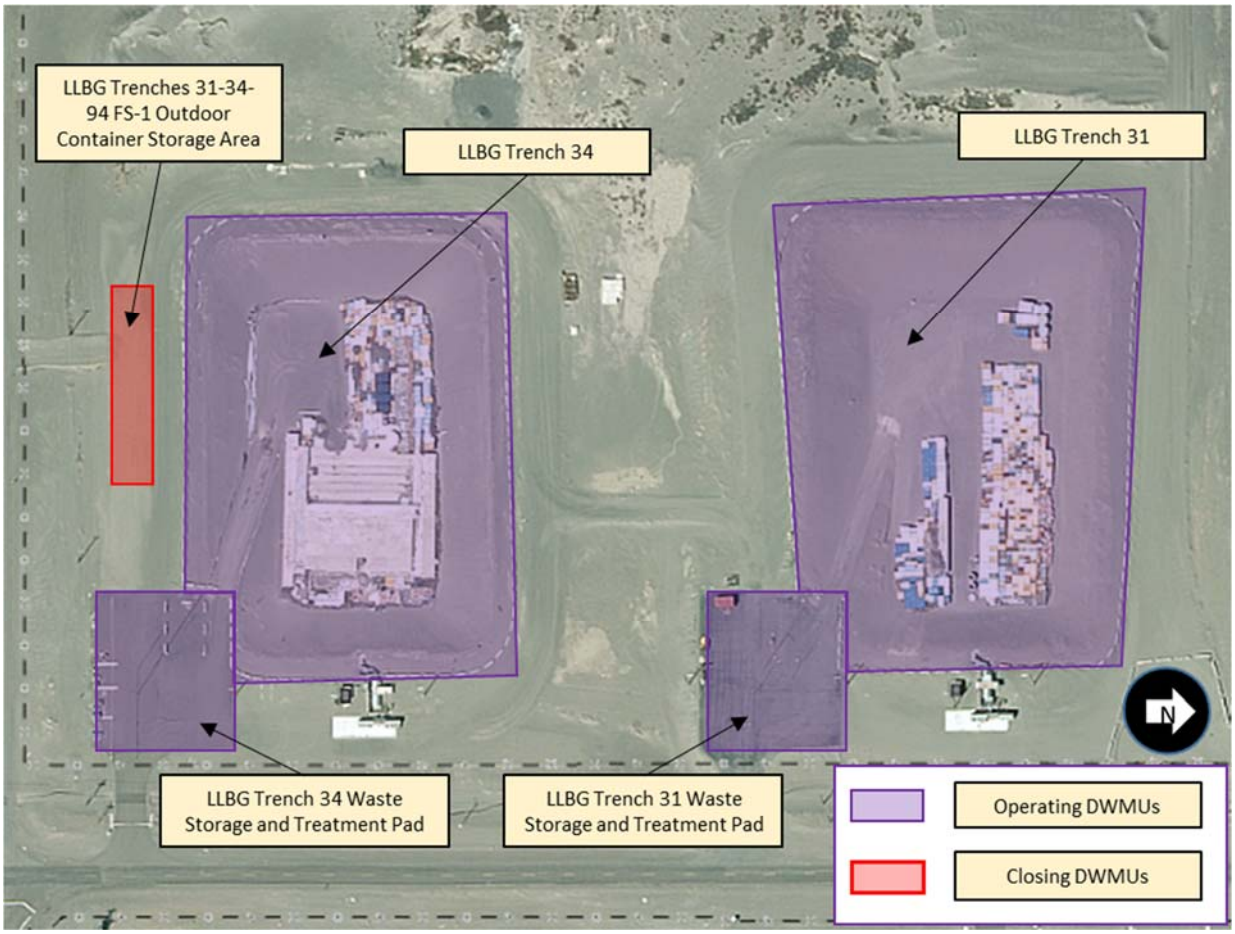


Figure H-1. Low-Level Burial Ground Trenches 31-34 Operating and Closing Dangerous Waste Management Units

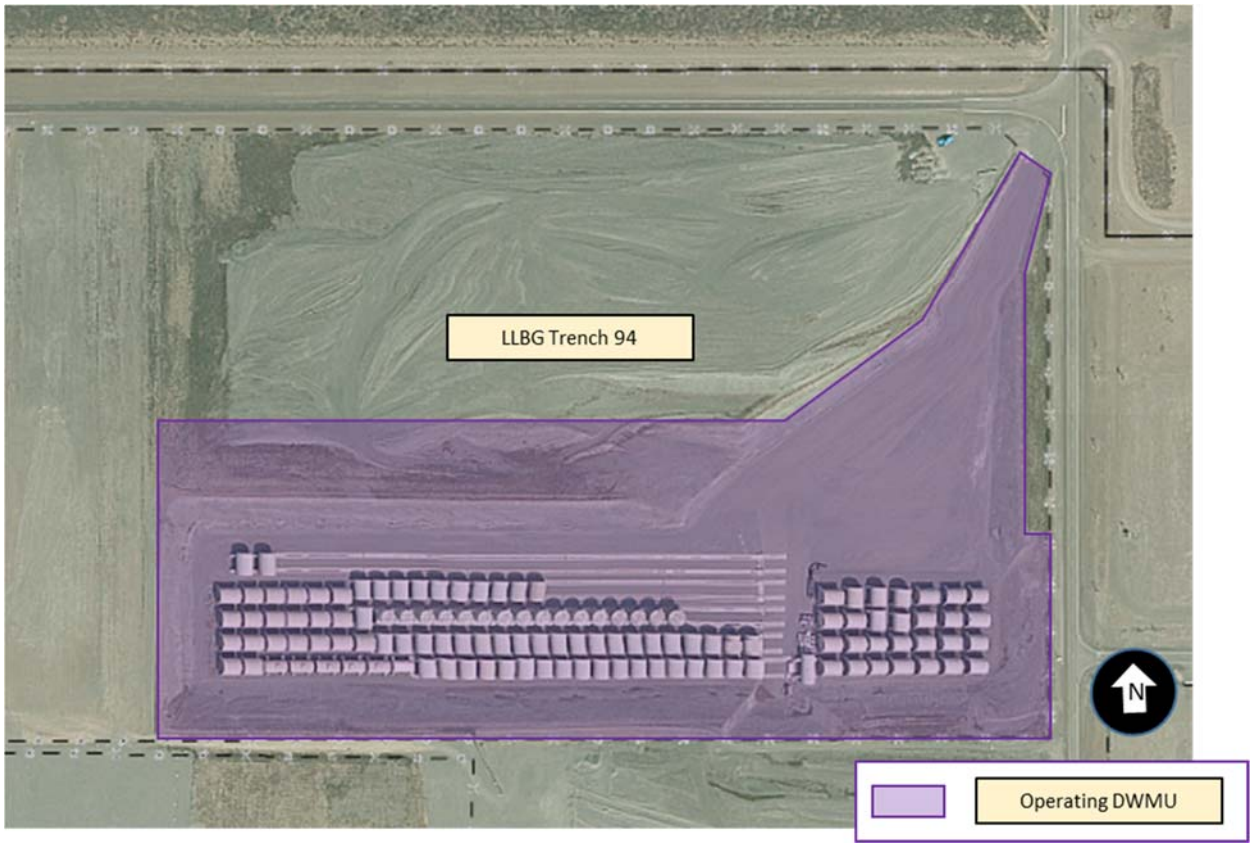


Figure H-2. Low-Level Burial Ground Trench 94 Operating Dangerous Waste Management Unit

H1.6 References for LLBG Closure Plan Appendices

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol26/xml/CFR-2010-title40-vol26-part268.xml.

268.40, "Applicability of Treatment Standards."

268.44, "Variance from a Treatment Standard."

268.45, "Treatment Standards for Hazardous Debris."

DOE/RL-96-68, 2014, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), Rev. 4, *Volume 1, Administrative Requirements*; *Volume 2, Sampling Technical Requirements*; *Volume 3, Field Analytical Technical Requirements*; and *Volume 4, Laboratory Technical Requirements*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL1-04.pdf. http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL2-04.pdf. http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL3-04.pdf. http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL4-04.pdf.

DOE/RL-2009-60, 2011, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0087632.

DOE/RL-2001-36, 2001, *Hanford Sitewide Transportation Safety Document*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.osti.gov/scitech/biblio/808095

Ecology Publication 94-111, 2005, *Guidance for Clean Closure of Dangerous Waste Units and Facilities*, as amended, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/pubs/94111.pdf.

EPA/240/B-06/002, 2006, *Data Quality Assessment: A Reviewer's Guide*, EPA QA/G-9R, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/quality/qs-docs/g9r-final.pdf.

EPA/240/R-02/005, 2002, *Guidance on Choosing a Sampling Design for Environmental Data Collection*, EPA QA/G-5S, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=20011HKB.txt.

EPA 402-R-97-016, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, Rev. 1, U.S. Environmental Protection Agency, U.S. Department of Energy, U.S. Department of Defense, and U.S. Nuclear Regulatory Commission, Washington, D.C. Available at: http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=9100MG4M.PDF.

EPA 540/R-93/051, 1992, *Specifications and Guidance for Contaminant-Free Sample Containers*, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=2001266X.txt.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

SW-846, 2015, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

"The Public Health and Welfare," "Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," 42 USC 6924(m). Available at: http://www.gpo.gov/fdsys/pkg/USCODE-2006-title42/pdf/USCODE-2006-title42-chap82-subchapIII-sec6924.pdf.

USEPA-540-R-08-01, 2008, *National Functional Guidelines for Superfund Organic Methods Data Review*, USEPA Contract Laboratory Program, OSWER 9240.1-48, Office of Superfund Remedial Technology and Innovation, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www2.epa.gov/sites/production/files/2015-03/documents/somnfg_0.pdf.

USEPA-540-R-10-011, 2011, *National Functional Guidelines for Inorganic Superfund Data Review*, USEPA Contract Laboratory Program, OSWER 9240.1-51, Office of Superfund Remedial Technology and Innovation, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www2.epa.gov/sites/production/files/2015-03/documents/ism1nfg.pdf.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

303-070, "Designation of Dangerous Waste."

303-140, "Land Disposal Restrictions."

303-170, "Requirements for Generators of Dangerous Waste."

303-230, "Special Conditions."

303-320, "General Inspection."

303-340, "Preparedness and Prevention."

303-390, "Facility Reporting."

303-400, "Interim Status Facility Standards."

303-610, "Closure and Post-Closure."

303-630, "Use and Management of Containers."

303-670, "Incinerators."

303-680, "Miscellaneous Units."

303-690, "Air Emission Standards for Process Vents."

303-692, "Air Emission Standards for Tanks, Surface Impoundments, and Containers."

303-64620, "Requirements."

303-800, "Permit Requirements for Dangerous Waste Management Facilities."

303-806, "Final Facility Permits."

303-830, "Permit Changes."

WAC 173-340, "Model Toxics Control Act—Cleanup," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340.

340-200, "Definitions."

340-700, "Overview of Cleanup Standards."

340-740, "Unrestricted Land Use Soil Cleanup Standards."

340-745, "Soil Cleanup Standards for Industrial Properties."

340-760, "Sediment Cleanup Standards."

This page intentionally left blank.

Appendix H-A

Trenches 31 and 34 Dangerous Waste Management Units

This page intentionally left blank.

Contents

H-A1 Introduction H-A-1
H-A1.1 Unit Description H-A-1
H-A1.1.1 Maximum Waste Inventory H-A-1
H-A2 Closure Performance Standard H-A-1
H-A3 Closure Activities H-A-2
H-A3.1 Monitoring H-A-3
H-A3.2 Groundwater Monitoring H-A-3
H-A3.3 Leachate Monitoring H-A-3
H-A3.4 Periodic Inspections and Maintenance H-A-3
H-A3.5 Final Landfill Cover H-A-3
H-A3.6 Health and Safety Requirements H-A-5
H-A3.7 Role of the Independent Qualified Registered Professional Engineer H-A-6
H-A3.8 Closure Certification H-A-6
H-A3.9 Conditions That Will Be Achieved when Closure Is Complete H-A-7
H-A4 Closure Schedule and Time Frame H-A-7
H-A5 Closure Costs H-A-7
H-A6 Post-Closure H-A-10
H-A6.1 Post-Closure Use of Property H-A-10
H-A6.2 Groundwater Monitoring and Reporting H-A-10
H-A6.3 Leachate Collection System Monitoring and Reporting H-A-10
H-A6.3.1 Facility Maintenance H-A-11
H-A6.3.2 Erosion Control H-A-12
H-A6.3.3 Cover Integrity Inspection and Maintenance H-A-12
H-A6.3.4 Monitoring Well Inspection and Maintenance H-A-12
H-A6.3.5 Leachate Collection System Inspection and Maintenance H-A-12
H-A6.4 Post-Closure Security H-A-12
H-A6.5 Contact Information H-A-12
H-A6.6 Amendment of the Plan H-A-13
H-A6.7 Survey Plat and Notice in Deed H-A-13
H-A6.8 Certification of Completion of Post-Closure Care H-A-13

Figures

Figure H-A1. LLBG Trenches 31 and 34 (August 2010) H-A-2
Figure H-A2. Modified RCRA Subtitle C Barrier H-A-5
Figure H-A3. LLBG Trenches 31 and 34 Closure Schedule Activities H-A-9

Tables

Table H-A1. Modified RCRA Subtitle C Barrier Layer Description H-A-4
Table H-A2. LLBG Trenches 31 and 34 Closure Activities H-A-8
Table H-A3. LLWMA-3 Constituents List and Sampling Frequency H-A-11

H-A1 Introduction

This appendix discusses closure activities for the Low-Level Burial Grounds (LLBG) Trenches 31-34-94 Operating Unit Group (OUG) Trenches 31 and 34 dangerous waste management units (DWMUs). These DWMUs are located in the 200 West Area of the Hanford Facility. Closure will be performed in accordance with the included schedule. Closure for each trench may occur independently of each other, but both LLBG Trenches 31 and 34 will be closed in the same manner following this closure plan. Each trench will have a separate final cover designed to accommodate independent closure of each trench.

This closure plan complies with WAC 173-303-610(2) through WAC 173-303-610(10), "Dangerous Waste Regulations," "Closure and Post-Closure." Amendments to this closure plan will be submitted as permit modifications in accordance with WAC 173-303-610(3)(b).

Please note, the terms "mixed waste" and/or "waste" when seen in this document refer to dangerous waste or hazardous waste, as applicable.

H-A1.1 Unit Description

LLBG Trenches 31 and 34 (Figure H-A1) are two large rectangular excavations in the southwest corner of the 218-W-5 Burial Ground operated as units for disposal of land disposal restriction (LDR) compliant mixed waste. LLBG Trenches 31 and 34 are approximately 137 m (450 ft) long by 91 m (300 ft) wide and 9 m (30 ft) deep. LLBG Trenches 31 and 34 began receiving waste for disposal on September 15, 1999. LLBG Trenches 31 and 34 are each constructed with polyethylene liners and a leachate collection system. Associated with these trenches are two waste storage pads (LLBG Trench 31 Waste Storage and Treatment Pad and LLBG Trench 34 Waste Storage and Treatment Pad) that are used for storage and treatment of containerized waste prior to disposal. These pads will be closed in accordance with their own closure plans and are not included in this document.

H-A1.1.1 Maximum Waste Inventory

Waste to be disposed in LLBG Trenches 31 and 34 may include bulk waste, bulk granular waste, containerized waste, and long-length contaminated equipment. A diverse range of waste containers can be disposed at LLBG Trenches 31 and 34 including, but not limited to, containers/drums, waste boxes, and miscellaneous equipment.

The process design capacity for disposal of waste in LLBG Trenches 31 and 34 is approximately 21,408 m^3 (21,408,000 L) per trench for a total process design capacity of 42,816 m^3 (42,816,000 L). The disposal volume for LLBG Trenches 31 and 34 disposal cells are based on trench floor dimensions of 76 m (250 ft) long by 31 m (100 ft) wide and 9 m (30 ft) deep.

H-A2 Closure Performance Standard

Closure performance standards for the LLBG Trenches 31 and 34 will ensure compliance with the requirements found in WAC 173-303-610(2), which requires closure of the facility in the following manner:

- Minimize the need for further maintenance.
- Control, minimize, or eliminate, to the extent necessary, to protect human health and the environment (HHE), post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or atmosphere.

- Return the land to the appearance and use of surrounding land areas, to the degree possible, given the nature of the previous dangerous waste activity.

Figure H-A1. LLBG Trenches 31 and 34 (August 2010)

H-A3 Closure Activities

Closure activities will focus on final cover installation, including oversight of the DWMUs during cover installation and appropriate certifications. Section H-A4 provides the closure schedule.

Post-closure activities (Section H-A6) will begin after installation of the final cover and Washington State Department of Ecology (Ecology) acceptance of closure. Post-closure activities will include long-term monitoring activities, periodic inspections, and maintenance activities to ensure the long-term integrity of the closed landfills. The following closure activities are required to achieve and verify final closure:

- Monitoring of the groundwater
- Continued collection and monitoring of leachate
- Periodic inspections and maintenance of the facility during the closure period
- Modification of the abovegrade portions as necessary to allow final cover installations and continued collection of leachate during post-closure monitoring and maintenance
- Installation of the final covers including vegetation
- Certification of closure, as required by WAC 173-303-610(6)

H-A3.1 Monitoring

Groundwater and leachate monitoring will continue during the closure and post-closure periods. The volume of leachate generated during post-closure monitoring, which will be used as one indicator of barrier performance, is of specific concern.

H-A3.2 Groundwater Monitoring

The groundwater level at LLBG Trenches 31 and 34 (seasonal high water table) is located approximately 60 to 90 m (200 to 300 ft) below ground surface (bgs) in LLBG Trenches 31 and 34. The deepest points of the liner systems are no greater than approximately 20 m (70 ft) bgs. Consequently, the liner systems are at least 40 m (130 ft) above groundwater. Groundwater monitoring at LLBG Trenches 31 and 34 disposal cells will continue into the closure and post-closure periods, as described in Section H-A6.2. Groundwater monitoring will be performed in accordance with WAC 173-303-645 and Addendum D, "Groundwater Monitoring Plan."

H-A3.3 Leachate Monitoring

During closure, leachate collection systems will be modified to allow for installation of the final covers. As required in WAC 173-303-665(4)(c)(i), "Landfills," the amount of liquid collected will be recorded at least once weekly during the closure period. Additional detail of post-closure leachate monitoring is identified in Section H-A6.3 of this closure plan.

H-A3.4 Periodic Inspections and Maintenance

During closure of LLBG Trenches 31 and 34 disposal cells, periodic inspections and maintenance of the leachate collection systems will ensure compliance with leachate liquid collection requirements described in Section H-A3.3. Inspections for the leachate collection systems are captured in Addendum I, "Inspection Plans."

H-A3.5 Final Landfill Cover

In accordance with WAC 173-303-665, final landfill covers will be designed and constructed with the following objectives:

- Minimize migration of liquids through closed landfills
- Require minimal maintenance
- Promote drainage and minimize cover erosion or abrasion
- Maintain cover integrity despite settling and subsidence
- Provide permeability less than or equal to that of any bottom liner system or natural subsoil present

In 1996, a focused feasibility study (FFS) (DOE/RL-93-33, *Focused Feasibility Study of Engineered Barriers for Waste Management Units in the 200 Areas*) of engineered barriers (covers) was prepared for the 200 Area of the Hanford Facility. The FFS provided four generic conceptual cover designs that evaluated federal and state regulatory requirements and drew upon experience with cover designs for Hanford Facility applications. The Modified *Resource Conservation and Recovery Act of 1976* (RCRA) Subtitle C Barrier defined in the FFS is designed to meet or exceed regulatory requirements for applications at Category 1 and 3 low-level waste (LLW) sites and is the baseline for Hanford Facility areas containing dangerous waste, Category 3 LLW, and Category 3 and Category 1 mixed LLW. The Modified RCRA Subtitle C Barrier is designed to provide long-term containment, hydrologic

protection, and provision to control biointrusion and human intrusion for a performance period of 500 years.

Until the final volume of waste is disposed into LLBG Trench 31 or LLBG Trench 34, the definitive design for the cover for each trench cannot be specified. Once the final volume of waste is disposed into a disposal cell, a definitive final cover design for that cell based on the Modified RCRA Subtitle C Barrier will be completed and submitted as a permit modification in accordance with WAC 173-303-610 requirements.

The Modified RCRA Subtitle C Barrier layers are described in Table H-A1 and depicted in Figure H-A2.

Table H-A1. Modified RCRA Subtitle C Barrier Layer Description

Layer	Depth	Material
Cover Vegetation	Not Applicable	Mixed perennial grasses
Layer 1	50 cm (20 in.)	Silt loam topsoil with pea gravel admixture
Layer 2	50 cm (20 in.)	Compacted silt loam topsoil
Layer 3	15 cm (6 in.)	Sand filter layer
Layer 4	15 cm (6 in.)	Gravel filter layer
Layer 5	15 cm (6 in)	Lateral drainage layer
Layer 6	15 cm (6 in.)	Low-permeability asphalt layer
Layer 7	10 cm (4 in.)	Asphalt base course
Layer 8	Variable thickness	Grading fill

Layer 1 (topsoil with pea gravel admixture) consists of 50 cm (20 in.) of sandy silt-to-silt loam soil. Layer 1 will be placed in a relatively loose condition and will retain soil moisture to support the cover vegetation. The pea gravel in Layer 1 will improve the soil's resistance to wind erosion. The slope of Layer 1 will be 2 percent, which will allow for drainage of runoff from the area yet limit exposure of the surface to wind erosion.

Layer 2 (topsoil without pea gravel) consists of 50 cm (20 in.) of the same silt loam soil as Layer 1 but without the pea gravel. Layer 2 is placed in a relatively densified state. Compaction of Layer 2 will help to resist moisture migration through Layer 2.

Layer 3 (sand filter) and Layer 4 (gravel filter) prevent topsoil from migrating downward and collecting in the lateral drainage layer (Layer 5).

Layer 5 (lateral drainage layer) provides removal of moisture that may have filtered through from Layers 1 and 2. Layer 5 will consist of clean, screened aggregate material and will be sloped at 2 percent to move water to the edge of the cover for collection and diversion from the leachate collection system.

Layer 6 (asphalt layer) is a low-permeability layer constructed of double-tar asphalt that will act as a biointrusion barrier for plant roots and burrowing animals. It will also function as a deterrent for human intrusion. Layer 6 will be constructed with a 2 percent slope.

Layer 7 (asphalt base course) will provide a stable base for placement of the overlying asphalt layer. Layer 7 will be screened, crushed-surfacing material.

Layer 8 (grading fill) will be placed in the trench to establish a smooth surface for construction of the upper levels of the barrier. Grading fill, which will consist of well-graded granular soil mixture, will create a uniform surface sloped at 2 percent.

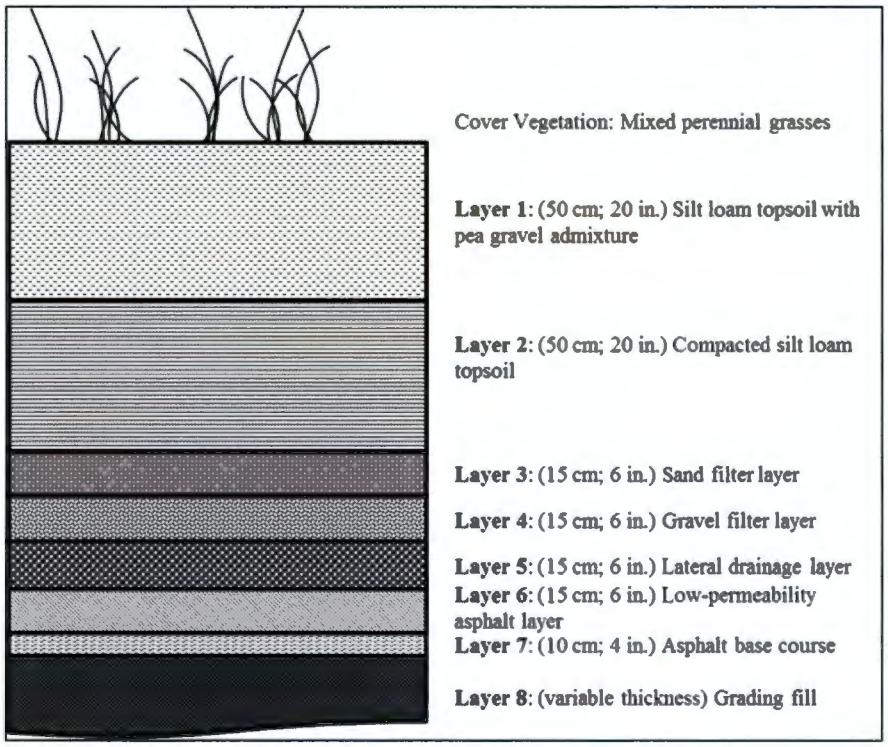


Figure H-A2. Modified RCRA Subtitle C Barrier

H-A3.6 Health and Safety Requirements

Closure will be performed in a manner to ensure the safety of personnel and the surrounding environment. Qualified personnel will perform all closure activities in compliance with established safety and environmental procedures. Personnel will be equipped with appropriate personal protective equipment. Qualified personnel will be trained in applicable safety and environmental procedures in accordance with Addendum G, "Personnel Training." Field operations will be performed in accordance with applicable health and safety requirements.

The Permittees have instituted training or qualification programs to meet training requirements imposed by regulations, U.S. Department of Energy (DOE) orders, and national standards such as those published by the American National Standards Institute/American Society of Mechanical Engineers. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter Hanford Facility RCRA Permit), Attachment 5, "Hanford Facility Personnel Training Program," describes specific requirements for the Hanford Facility Personnel Training program. The Permittees will comply with the LLBG Trenches 31-34-94 Training Matrix detailed in Addendum G, which provides training requirements for Hanford Facility personnel associated with LLBG Trenches 31 and 34.

Project-specific safety training addressed explicitly to the project and the day's activity will be provided, including the following:

- Training to provide the knowledge and skills that personnel need to perform work safely while installation of the final covers are being completed
- Requirement that samplers be qualified for sampling of leachate during the closure and post-closure periods

Pre-job briefings will be performed to evaluate activities and associated hazards by considering many factors, including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Emergency contacts

Training records are maintained for each employee in an electronic training record database. The Permittees' training organization maintains the training records system.

H-A3.7 Role of the Independent Qualified Registered Professional Engineer

An Independent, Qualified, Registered Professional Engineer (IQRPE) will be retained to provide certification of the closures, as required by WAC 173-303-610(6). The engineer will be responsible for observing field activities and reviewing documents associated with closure of LLBG Trenches 31 and 34. At a minimum, field activities and documents reviewed would include the following:

- Review of the LLBG Trenches 31 and 34 final cover definitive designs
- Review of leachate and groundwater sampling procedures and results during the closure periods
- Observation and review of final cover installation activities

The IQRPE will record observations and reviews in a written report that will be retained in the operating record. The resulting report will be used to develop the closure certification that will be provided to Ecology.

H-A3.8 Closure Certification

LLBG Trenches 31 and 34 may be closed independently of each other. In accordance with WAC 173-303-610(6), within 60 days of completion of closure of either LLBG Trench 31 and/or LLBG Trench 34, a certification that each DWMU has been closed in accordance with the specifications in this closure plan will be submitted to Ecology by registered mail. The certification will be signed by the owner or operator and by an IQRPE.

Upon request by Ecology, the following information will be submitted to support closure certification:

- All field notes and photographs related to closure activities, including installation of the final cover
- Description of any minor deviations from the approved closure plan and justification for these deviations
- All laboratory and/or field data, including sampling procedures, sampling locations, quality assurance/quality control samples, and chain of custody procedures for all leachate and groundwater samples taken during the closure periods
- Summary report that identifies and describes the data reviewed by the IQRPE
- Description of the DWMU area at completion of closure, including parts of the former unit, if any, that remain after closure

H-A3.9 Conditions That Will Be Achieved when Closure Is Complete

Upon completion of the final covers over LLBG Trenches 31 and 34, the land will be returned to the appearance and use of surrounding land areas to the degree possible. The top layer (Layer 1) of the final covers will be populated with perennial grasses similar to the natural environment surrounding the landfill.

H-A4 Closure Schedule and Time Frame

Construction of the final covers will be completed approximately 150 weeks (1,050 days) after the start of each closure period (Table H-A2). Due to extensive requirements inherent in the design and construction of a landfill cover, an extended closure period greater than the allowable 180 days identified in WAC 173-303-610(4)(c) is required.

Approval of this closure plan will grant the Hanford Facility an extended closure period for construction of the final covers, and a separate extension request will not be filed. During closure periods, all steps to prevent threats to HHE, including compliance with all applicable permit requirements, will be demonstrated. Closure certification will be submitted to Ecology within 60 days following completion of closure activities at LLBG Trenches 31 and/or 34, as outlined in Section H-A3.8 (Figure H-A3).

H-A5 Closure Costs

An annual report outlining updated projections of anticipated closure costs for the Hanford Facility treatment, storage, and disposal units having final status is not required per Hanford Facility RCRA Permit Condition II.H. The Hanford Facility is owned by DOE, and operated by DOE and its contractors; therefore, in accordance with WAC 173-303-620(1)(c), provisions of WAC 173-303-620, "Financial Requirements," are not applicable to the Hanford Facility.

Table H-A2. LLBG Trenches 31 and 34 Closure Activities

Closure Activity Description		Expected Duration
Primary Activity	**Secondary Activity**	**Duration**
Monitoring of Groundwater and Leachate	Not Applicable	Continuous
Inspections and Maintenance of the Leachate Collection System	Not Applicable	Continuous
CLOSURE ACTIVITIES		
General Mobilization	Water sources (storage tanks), construction trailers, heavy equipment	4 weeks (Week 4)
	Provide Ecology with 30 day notification of construction work	
Cover Installation Preparation	Fill voids	24 weeks (Week 28)
	Prepare subgrade (filling of low areas, compacting, and regrading)	
	Excavate run-on/run-off controls	
Modifications to the Abovegrade Portion of the Trench	Relocate leachate monitoring system	26 weeks (Week 54)
	Fill voids	
	Place silt	
Installation of the Final Cover, Including Vegetation	Stabilize barrier base	96 weeks (Week 150)
	Construct barrier layers	
	Install vegetation	
CLOSURE ACTIVITIES COMPLETE		
Owner/Operators and IQRPE Submit Closure Certification	In accordance with WAC 173-303-610(6), within 60 days of completion of closure of each DWMU; certification that the DWMU has been closed in accordance with the specifications in the approved closure plan (see Section H-A3.8 for more details on the closure certification)	60 days
POST-CLOSURE ACTIVITIES BEGIN		

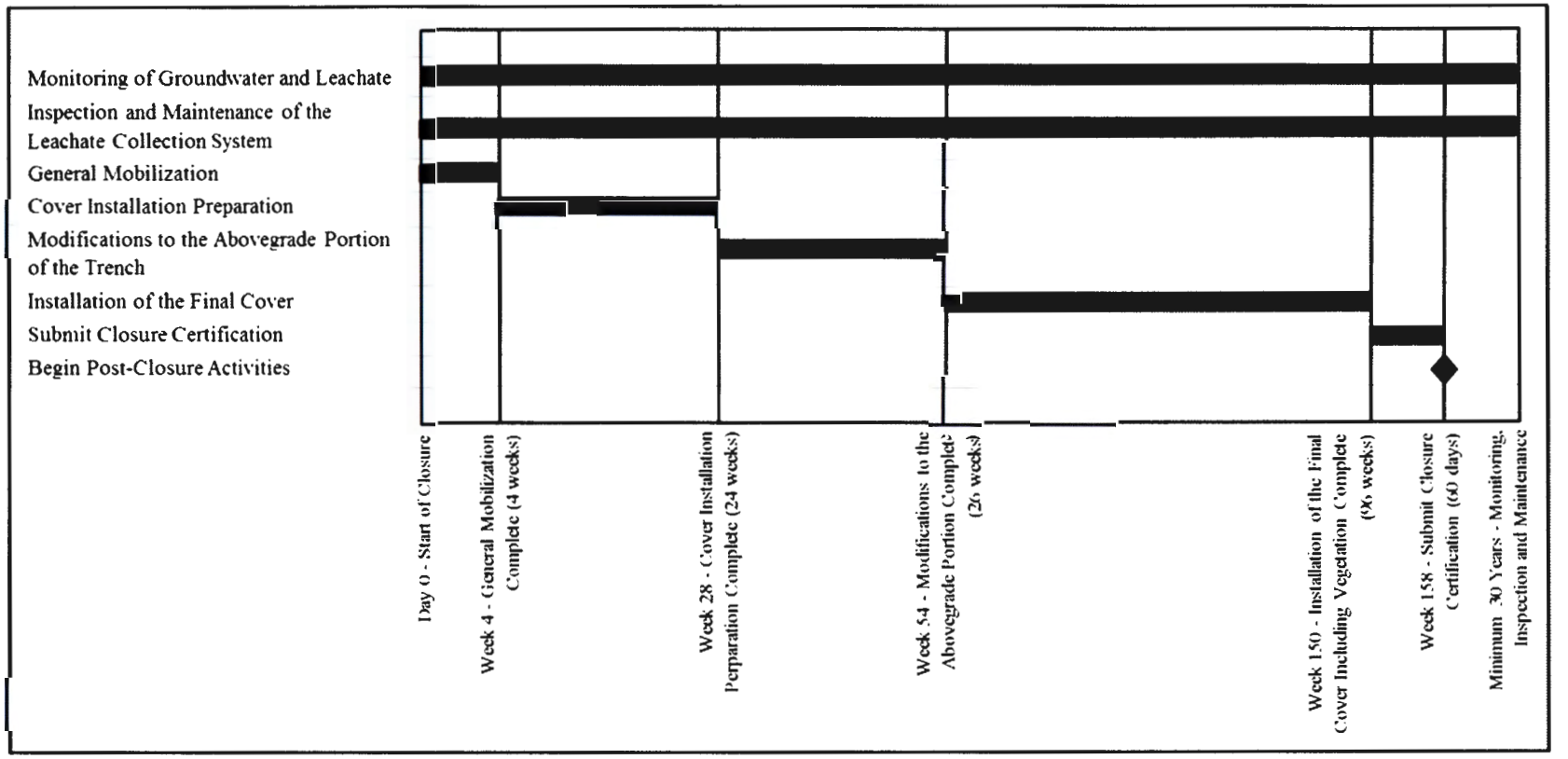


Figure H-A3. LLBG Trenches 31 and 34 Closure Schedule Activities

H-A6 Post-Closure

Post-closure activities will begin for LLBG Trench 31 and LLBG Trench 34 after acceptance of final closure by Ecology. After receipt of the closure certification, Ecology will verify that the facility has been closed in accordance with the approved closure plan. Once the Ecology verification is complete, post-closure activities will begin. In general, post-closure will include the following activities:

- Groundwater monitoring, as required in WAC 173-303-665
- Leachate system monitoring, as required in WAC 173-303-610(4)(c)(ii)
- Periodic inspections of the facility
- Maintenance activities to maintain the final cover, groundwater monitoring, and leachate system equipment
- Continued security of the landfill area

As required by WAC 173-303-610(7), post-closure activities will continue for a period of 30 years.

H-A6.1 Post-Closure Use of Property

After closure of LLBG Trenches 31 and 34, the area in which the trenches are located will be surrounded by security fencing and will continue to be monitored 24 hours a day as part of Addendum E, "Security." The land will be closed to industrial standards, and the cover will be maintained; however, no post-closure use of the land is anticipated.

H-A6.2 Groundwater Monitoring and Reporting

The groundwater monitoring system will be maintained throughout the closure and post-closure periods. The groundwater monitoring system known as Low-Level Waste Management Area (LLWMA)-3 includes three burial grounds (218-W-3A, 218-W-3AE, and the 218-W-5), which are all located in the 200 West Area. LLBG Trenches 31 and 34 are located within the 218-W-5 Burial Ground.

The LLWMA-3 groundwater monitoring system was initiated in 1987 and consisted of three upgradient and eight downgradient wells. Additional wells were installed from 1989 through 2011, as needed, to maintain the integrity of the monitoring system. The LLWMA-3 groundwater monitoring system is sampled annually and semiannually. Groundwater monitoring activities currently consist of water level and chemical constituent monitoring. Samples are analyzed semiannually for the indicator parameters and annually for anions, metals, and phenols (Table H-A3). Sitewide water level measurements are collected every March.

LLWMA-3 groundwater monitoring system requirements specific to LLBG Trenches 31 and 34 are detailed within Addendum D.

H-A6.3 Leachate Collection System Monitoring and Reporting

As required in WAC 173-303-665(4)(c)(ii), after the final covers are installed, the amount of liquids removed from each leachate collection system must be recorded at least monthly. The amount of leachate collected will be recorded and submitted to the facility operating record. If the liquid level in the sump stays below pump operating level for two consecutive months, the frequency of leachate collection will be reduced to quarterly. If after two quarters the liquid level in the sump has remained below the pump operating level, collection of liquids in the sumps will be reduced to semiannually. If at any time during the

post-closure care period the pump operating level is exceeded on quarterly or semiannual recordings, the frequency of leachate removal will return to monthly until the liquid level again stays below the pump operating level for two consecutive months. The frequency will then be reduced as described.

Table H-A3. LLWMA-3 Constituents List and Sampling Frequency

RCRA Required[a] Contamination Indicator Parameters						Groundwater Quality Parameters							Supporting Constituents[b]				
						Anions[d]			Metals (Unfiltered)[d]								
	Water Level[c]	pH[c]	Specific Conductance[c]	TOC	TOX	Chloride	Nitrate	Sulfate	Sodium	Iron	Manganese	Phenols	Temperature[c]	Oxidation-Reduction Potential[c]	Turbidity[c]	Dissolved Oxygen[c]	Alkalinity
Frequency	S	S4	S4	S4	S4	A	A	A	A	A	A	A	S	S	S	S	A

a. Constituents and parameters required by 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis."

b. Constituents not required by RCRA but needed to support interpretation.

c. Field measurement.

d. For anions, analytes include, but are not limited to, chloride, fluoride, nitrate, nitrite, and sulfate. For metals, analytes include, but are not limited to, calcium, chromium, iron, magnesium, manganese, potassium, and sodium.

A = sampled annually

RCRA = *Resource Conservation and Recovery Act of 1976*

S = sampled semiannually

S4 = sampled semiannually with quadruplicate samples taken

TOC = total organic carbon

TOX = total organic halides

For purposes of post-closure monitoring, the pump operating level is defined as less than 86 cm (34 in.).

The leachate collection system will continue to be operated until leachate is no longer detected or the post-closure period has concluded and Ecology has approved the discontinuation of leachate collection system monitoring.

H-A6.3.1 Facility Maintenance

LLBG Trenches 31 and 34 facility periodic inspections and required maintenance will be performed throughout the post-closure period. Maintenance will be performed in a timely manner to ensure compliance with post-closure requirements for final cover integrity, leachate collection, and groundwater monitoring. Inspections will focus on evaluating the following:

- Erosion control

- Cover integrity, including subsidence
- Groundwater monitoring system integrity
- Leachate collection system integrity

As required by WAC 173-303-610(8)(b)(ii), this section also provides for maintenance of the closed disposal cell area throughout the post-closure period. Facility maintenance is based on observations made during inspection and monitoring.

H-A6.3.2 Erosion Control

The goal of the FFS (DOE/RL-93-33) was to design a multilayer cover that will resist natural degradation processes and require minimal maintenance during its design lifetime (functional life of 500 years). Layer 1 (topsoil) incorporates pea gravel into the soil to reduce susceptibility to wind erosion. Vegetation planted on the topsoil layer will further reduce erosion due to wind and precipitation runoff. The topsoil will be sloped at 2 percent, which is steep enough to provide drainage of runoff from the cover but shallow enough to limit surface exposure leading to wind erosion. The topsoil layer includes excess thickness to provide performance margins against long-term wind erosion and climate change.

H-A6.3.3 Cover Integrity Inspection and Maintenance

Cover integrity inspections will evaluate the cover for breaches in the surface, depressions caused by settling or compression, subsidence, erosion, or other disruptions to the cover that would cause a reduction in performance.

Cover integrity inspections will be performed through aerial photography and elevation surveys. Control points marked around the perimeter and at critical points on the cover area will be used to determine changes in cover elevation.

Depressions or other surface layer disturbances that may affect the integrity of the cover will be filled using topsoil with pea gravel then revegetated.

H-A6.3.4 Monitoring Well Inspection and Maintenance

Post-closure inspection of the monitoring well system will be performed in accordance with Addendum D. The LLWMA-3 groundwater monitoring system will continue to be used and maintained for monitoring of the remaining two burial grounds (218-W-3A and 218-W-3AE).

H-A6.3.5 Leachate Collection System Inspection and Maintenance

Leachate collection system periodic inspections will be performed in accordance with the inspection schedule outlined in Addendum I. Issues identified during the leachate collection system inspections will be corrected in a timely manner, and the leachate collection system will be maintained to ensure continued compliance with leachate collection required in WAC 173-303-665(4)(c)(ii).

H-A6.4 Post-Closure Security

During the post-closure period, 24 hour security requirements outlined in Addendum E will continue, which will assist in preventing access that may disturb the integrity of the final cover or the function of the facility monitoring systems.

H-A6.5 Contact Information

Facility Operator:
Stacy Charboneau, Manager
U.S. Department of Energy

Richland Operations Office
P.O. Box 550
Richland, WA 99352
(509) 376-7395

H-A6.6 Amendment of the Plan

If an amendment to the substantive portions of this closure plan is required, a plan revision will be prepared by the DOE Richland Operations Office (DOE-RL) and submitted to Ecology in accordance with WAC 173-303-610(8)(d) for approval. Editorial corrections and similar changes will be submitted to Ecology for information. The Hanford Facility groundwater monitoring reports provide annual results and interpretations of groundwater monitoring. Sampling data are placed in the Hanford Environmental Information System database.

H-A6.7 Survey Plat and Notice in Deed

Upon submission of the certification of closure of each LLBG Trench 31 and 34, DOE-RL will submit a survey plat indicating the location and dimensions of landfill cells with respect to permanently surveyed benchmarks. This survey will be prepared and certified by a professional land survey as required in WAC 173-303-610(9). No later than 60 days after certification of closure of each trench, DOE-RL will submit a survey plat to the Benton County Planning Department in accordance with WAC 173-303-610(10). Additionally, DOE-RL will submit a notice in deed to the Benton County Auditor no later than 60 days after certification of closure of each trench in accordance with WAC 173-303-610(10). After submitting this notice, a certification signed by the Permittees will be submitted to Ecology stating that notification has been recorded along with a copy of the notice in deed. The notice in deed will specify the type, location, and quantity of dangerous wastes remaining after closure actions have been completed.

H-A6.8 Certification of Completion of Post-Closure Care

No later than 60 days after completion of the 30 year post-closure period, a certification stating the post-closure period was performed in accordance with the approved post-closure plan and signed by an IQRPE and DOE-RL will be submitted to Ecology. Supporting documentation will be provided along with the signed certification. Examples of supporting documentation may include the following:

- Groundwater analysis results
- Leachate collection data
- Final cover inspection results
- Facility maintenance

Post-closure will be considered complete upon Ecology acceptance of the post-closure certification. Post-closure monitoring, inspections, and maintenance will be discontinued when authorized by Ecology.

This page intentionally left blank.

Appendix H-B

Trenches 31 and 34 Waste Storage and Treatment Pads Dangerous Waste Management Units

This page intentionally left blank.

Contents

H-B1 Introduction H-B-1
H-B1.1 Unit Description H-B-1
H-B1.1.1 Maximum Waste Inventory H-B-1
H-B2 Closure Performance Standard H-B-2
H-B2.1 Clean Closure Levels H-B-2
H-B3 Closure Activities H-B-3
H-B3.1 Health and Safety Requirements H-B-4
H-B3.2 Removal of Wastes and Waste Residues H-B-5
H-B3.3 Unit Components, Parts, and Ancillary Equipment H-B-5
H-B3.4 Inspection of Units before Decontamination H-B-5
H-B3.5 Decontamination H-B-5
H-B3.6 Demolition H-B-6
H-B3.6.1 Location of Utilities H-B-6
H-B3.6.2 Equipment Mobilization H-B-6
H-B3.6.3 Demolition Activities H-B-6
H-B3.7 Identifying and Managing Waste Generated from Closure Activities H-B-6
H-B3.7.1 Debris from Demolition H-B-6
H-B3.8 Identifying and Managing Contaminated Environmental Media H-B-7
H-B3.9 Confirming Clean Closure H-B-7
H-B3.10 Sampling and Analysis and Constituents to Be Analyzed H-B-8
H-B3.10.1 Sampling and Analysis Plan H-B-8
H-B3.10.2 Target Analytes H-B-8
H-B3.10.3 SAP Schedule H-B-11
H-B3.10.4 Project Management H-B-11
H-B3.10.5 Sampling Design H-B-12
H-B3.10.6 Sampling Methods and Handling H-B-16
H-B3.10.7 Analytical Methods H-B-18
H-B3.10.8 Quality Control H-B-18
H-B3.10.9 Data Verification H-B-19
H-B3.10.10 Data Validation H-B-19
H-B3.10.11 Verification of VSP Input Parameters H-B-26
H-B3.10.12 Documents and Records H-B-26
H-B3.10.13 Sampling and Analysis Requirements to Address Removal of Contaminated Soil H-B-27
H-B3.10.14 Revisions to the Sampling and Analysis Plan and Constituents to Be Analyzed H-B-27
H-B3.11 Role of the Independent Qualified Registered Professional Engineer H-B-27

H-B3.12 Closure Certification H-B-27
H-B3.13 Conditions That Will Be Achieved when Closure Is Complete H-B-28
H-B4 Closure Schedule and Time Frame H-B-28
H-B5 Closure Costs H-B-28

Attachment

H-B.a LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Visual Sample Plan Supporting Documentation ..... H-B.a-i

Figures

Figure H-B1. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads (August 2010) H-B-2
Figure H-B2. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Sampling and Analysis Plan Project Organization H-B-11
Figure H-B3. Sample Locations for the LLBG Trench 31 Waste Storage and Treatment Pad H-B-15
Figure H-B4. Sample Locations for the LLBG Trench 34 Waste Storage and Treatment Pad H-B-16
Figure H-B5. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Closure Schedule Activities H-B-31

Table

Table H-B1. Target Analyte List H-B-8
Table H-B2. Visual Sample Plan Parameter Inputs H-B-14
Table H-B3. Preservation, Container, and Holding Time Requirements for Soil Samples H-B-17
Table H-B4. Soil Analytical Performance Requirements H-B-20
Table H-B5. Project Quality Control Sampling Summary H-B-25
Table H-B6. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Closure Activities H-B-29

.

H-B1 Introduction

This appendix discusses closure activities for Trenches 31 and 34 Waste Storage and Treatment Pads dangerous waste management units (DWMUs) of the Low-Level Burial Grounds (LLBG) Trenches 31-34-94 Operating Unit Group (OUG). These DWMUs are located on the southeast corner of the corresponding LLBG Trench 31 and LLBG Trench 34 in the 200 West Area of the Hanford Facility. Closure will be performed in accordance with the included schedule. Closure for each pad may occur independently of each other but both Trenches 31 and 34 Waste Storage and Treatment Pads will be closed in the same manner, following this closure plan.

This plan describes in detail the closure activities necessary to establish clean closure levels for the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. Such closure activities include: removal of all waste, records review (i.e., container storage, operating, and inspection records) for documented spills or releases of waste; visual inspection of the asphalt pads after waste removal to evaluate the likelihood of potential contamination of the underlying soil; demolition of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads (Figure H-B1), visual inspection of the underlying soil, and soil sampling and analysis to confirm that clean closure standards have been achieved.

Closure of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will be performed in accordance with the closure schedule provided in Section H-B4. Within 60 days upon completion of closure activities, the Permittees shall provide the Washington State Department of Ecology (Ecology) a certification of closure in accordance with Washington Administrative Code (WAC) 173-303-610(6), "Dangerous Waste Regulations," "Closure and Post-Closure." Closure certification will provide supportive evidence that the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads have met established clean closure standards.

This closure plan complies with WAC 173-303-610(2) through WAC 173-303-610(6). Amendments to this closure plan will be submitted as a permit modification in accordance with WAC 173-303-610(3)(b).

Please note, the terms "mixed waste" and/or "waste" when seen in this document refer to dangerous waste or hazardous waste, as applicable.

H-B1.1 Unit Description

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads (Figure H-B1) are located above the LLBG Trenches 31 and 34 disposal cells at ground surface level, providing storage of waste containers prior to final disposal within the LLBG Trenches 31 and 34 disposal cells.

LLBG Trench 31 Waste Storage and Treatment Pad is approximately 49.4 m (162 ft) wide by 43.6 m (143 ft) long. The LLBG Trench 34 Waste Storage and Treatment Pad is approximately 48.8 m (160 ft) wide by 44.2 m (145 ft) long. Treatments to be performed on the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads include microencapsulation, macroencapsulation, and sealing. Neither of the asphalt pads is designed with engineered spill containment.

H-B1.1.1 Maximum Waste Inventory

The maximum storage design capacity at each of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads is 1,150 m^3 (1,150,000 L) and 1,240 m^3 (1,240,000 L), respectively.

H-B2 Closure Performance Standard

Closure performance standards for the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will ensure compliance with the requirements found in WAC 173-303-610(2), which requires closure of the facility in the following manner:

- Minimize the need for further maintenance
- Control, minimize, or eliminate, to the extent necessary, to protect human health and the environment (HHE), post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or atmosphere
- Return the land to the appearance and use of surrounding land areas, to the degree possible, given the nature of the previous dangerous waste activity

These performance standards are addressed in Sections H-B2.1 and H-B3.9 of this closure plan and are further more identified in Table H-B4.

Figure H-B1. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads (August 2010)

H-B2.1 Clean Closure Levels

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads underlying soil will be clean closed. After removal of all waste, the asphalt pads will be visually inspected for cracks that may penetrate to the underlying soil. Cracks will be documented in the visual inspection as areas of concern for focused sampling of the underlying soil. Once sampling is complete, the asphalt pads will be removed and managed as a newly generated debris.

The soil underlying the asphalt pads will be sampled and must meet clean closure levels. In accordance with WAC 173-303-610(2)(b)(i), the clean closure levels for the soil are the numeric cleanup levels calculated using unrestricted use exposure assumptions according to the "Model Toxics Control Act-Cleanup" (WAC 173-340), hereinafter called MTCA, regulations (WAC 173-340-700, "Overview of Cleanup Standards," through WAC 173-340-760, "Sediment Cleanup Standards," excluding WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties"). These numeric cleanup levels have been calculated according to the requirements of WAC 173-303-610(2)(b)(i) in effect as of the effective date of the permit modification. These cleanup levels consider carcinogens, non-carcinogens, groundwater protection, and ecological indicator values.

A null hypothesis is generally assumed true until evidence indicates otherwise. The null hypothesis, as defined in WAC 173-340-200, "Definitions," for the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads is that the underlying soil is assumed to be above MTCA (WAC 173-340) Method B cleanup levels. Therefore, the site is presumed to be contaminated. Rejection of the null hypothesis means sampling and analysis results of the site indicated soil contamination below the MTCA (WAC 173-340) Method B cleanup levels.

Sampling and analysis will be used to determine whether the null hypothesis can be rejected, thereby confirming that the soil meets the closure performance standards [MTCA (WAC 173-340) Method B]. Should sampling and analysis provide a basis that the null hypothesis can be accepted, the soil would be removed, identified as contaminated environmental media, and managed in accordance with Section H-B3.8.

H-B3 Closure Activities

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will be clean closed under the *Resource Conservation and Recovery Act of 1976* (RCRA), and confirmation sampling will be performed to verify that closure performance standards (Table H-B4) are met. As waste storage and treatment units, a clean closure determination for the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will be based on successfully completing the closure activities in this section.

Sampling and analysis activities were developed utilizing EPA/240/R-02/005, *Guidance on Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G-5S), and Ecology Publication 94-111, *Guidance for Clean Closure of Dangerous Waste Units and Facilities*, and will be conducted via a sampling and analysis plan (SAP) (Section H-B3.10). The objective of sampling described in this document is to determine if the MTCA (WAC 173-340) Method B closure performance standards were met, demonstrating clean closure of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. The following closure activities are required to achieve and verify clean closure:

- Remove all waste.
- Review waste container storage, operating, and inspection records for documented spills or releases of waste.
- Perform visual inspections of the asphalt pads for cracks, holes, or other types of breaches significant enough to reach underlying soil for purposes of focused sampling.
- Demolish and remove the asphalt pads.
- Perform visual inspection on underlying soil to identify any staining for purposes of focused sampling.

- Perform soil sampling and analysis to confirm that clean closure standards are met.
- If contamination is detected during initial sampling efforts, remove, treat (if necessary), and dispose of contaminated environmental media (soil), as necessary.
- Resample, as necessary, to confirm that MTCA (WAC 173-340) Method B clean closure levels have been met.
- Transmit closure certification to Ecology.

H-B3.1 Health and Safety Requirements

Closure will be performed in a manner to ensure the safety of personnel and the surrounding environment. Qualified personnel will perform closure activities in compliance with established safety and environmental procedures. Personnel will be equipped with appropriate personal protective equipment (PPE). Qualified personnel will be trained in applicable safety and environmental procedures in accordance with Addendum G, "Personnel Training", and have appropriate training and experience in sampling activities. Field operations will be performed in accordance with applicable health and safety requirements.

The Permittees have instituted training or qualification programs to meet training requirements imposed by regulations, U.S. Department of Energy (DOE) orders, and national standards such as those published by the American National Standards Institute/American Society of Mechanical Engineers. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. Attachment 5, "Hanford Facility Personnel Training Program," to the WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter Hanford Facility RCRA Permit) describes specific requirements for the Hanford Facility Personnel Training program. The Permittees will comply with the LLBG Trenches 31-34-94 training matrix detailed in Addendum G, which provides training requirements for Hanford Facility personnel associated with the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads.

Project-specific safety training addressed explicitly to the project and the day's activity will be provided, including the following:

- Training to provide the knowledge and skills that sampling personnel need to perform work safely and in accordance with quality assurance (QA) requirements
- Requirement that samplers be qualified in the type of sampling being performed in the field

Pre-job briefings will be performed to evaluate activities and associated hazards by considering many of the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work

- Level of management control
- Proximity of emergency contacts

Training records are maintained for each employee in an electronic database. The Permittees' training organization maintains the training records system.

H-B3.2 Removal of Wastes and Waste Residues

All waste will be removed from the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. The waste will be designated (if necessary) and shipped to an approved facility for treatment, storage, and/or disposal (TSD).

Waste containers meeting U.S. Department of Transportation (DOT) requirements will be packaged and shipped in accordance with 49 CFR, "Transportation," criteria. Waste packaged in non-DOT regulation (large or irregular shaped) containers will be shipped in accordance with DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*. Waste shipments primarily occur utilizing highway transportation but may also include shipping by air or rail.

Waste will be treated (if necessary) to meet the land disposal restriction (LDR) treatment standards specified in WAC 173-303-140, which includes by reference 40 CFR 268, then ultimately disposed of in an appropriate waste disposal facility.

While waste residues are not anticipated, if waste residues are found during closure activities, then the waste residues will be managed in accordance with all applicable requirements of WAC 173-303-170, "Requirements for Generators of Dangerous Waste," through 173-303-230, "Special Conditions." Waste subject to the LDR requirements of WAC 173-303-140, "Land Disposal Restrictions," which includes by reference 40 CFR 268, "Land Disposal Restrictions," will be characterized, designated, stored, and/or treated, as applicable, prior to disposal in an approved waste disposal facility.

H-B3.3 Unit Components, Parts, and Ancillary Equipment

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads are asphalt pads overlaying soil. There are no unit components, parts, or ancillary equipment.

H-B3.4 Inspection of Units before Decontamination

Although decontamination of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads and underlying soil is not planned, following the removal of all waste and waste residues, a visual inspection of the asphalt pads will be performed to determine the presence of cracks, holes, or other breaches in the asphalt sufficient to reach the underlying soil. These cracks, holes, or other breaches will be documented to determine if focused sampling of the underlying soil during confirmation sampling is necessary.

During the closure period, to prevent threats to HHE, the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will be inspected in accordance with WAC 173-303-320(2), "General Inspection." Inspections of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will be performed annually, until the clean closure certification is accepted by Ecology, and will verify the following:

- Posted warning signs at each entrance to the OUG are present, legible, and visible at 7.6 m (25 ft).
- No evidence of unusual conditions exists at the closing DWMU site.

H-B3.5 Decontamination

Decontamination of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads is not planned.

H-B3.6 Demolition

Once all waste has been removed from the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads and visual inspections are completed, demolition activities can be initiated. Demolition of the asphalt will include the following primary activities:

- Location of utilities
- Mobilization of equipment
- Demolition and removal of the asphalt pads

H-B3.6.1 Location of Utilities

Prior to demolition, any in-use utilities will be located to ensure that there are no disruptions to the surrounding activities.

H-B3.6.2 Equipment Mobilization

Resources, equipment, and materials necessary to perform demolition will be staged in designated laydown areas.

H-B3.6.3 Demolition Activities

Demolition of the asphalt pads will primarily be accomplished utilizing large equipment to rubblize the asphalt. Large equipment, such as an excavator with a hoe-ram, front loader, or backhoe, will be used to perform the rubblizing. Disposal will occur at an approved disposal facility.

H-B3.6.3.1 Rubblizing

During rubblizing of the asphalt pads, fog cannons, fire hoses, and misters may be used to spray mist water for dust suppression. The amount of water used will be minimized to prevent ponding and run-off. Large equipment, such as an excavator with a hoe-ram, a hydraulic shear with steel shear jaws, and concrete pulverizer jaws or breaker jaws, will be used to perform any rubblizing. Rubble debris from the asphalt pads will be loaded into roll-off boxes for transportation to the approved disposal facility.

H-B3.7 Identifying and Managing Waste Generated from Closure Activities

Closure activities for the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will result in the generation of one known waste stream (debris from demolition) requiring management and disposal. Waste generated during closure activities will be managed as a newly generated waste stream in accordance with WAC 173-303-610(5). Waste generated during the closure period must be properly disposed. The newly generated waste must be handled in accordance with all applicable requirements of WAC 173-303-170 through WAC 173-303-230.

Management and disposal of waste generated during closure will be documented and included as part of the clean closure certification documentation (Section H-B3.12).

H-B3.7.1 Debris from Demolition

Debris from demolition generated during closure will be packaged onsite and transported to an approved disposal facility. Debris includes, but is not limited to, the following types of wastes resulting from the demolition of the asphalt:

- Equipment and construction materials
- Asphalt and associated rubblized debris
- Miscellaneous waste (e.g., rubber, glass, paper, PPE, cloth, plastic, and metal)

Preferred management of debris resulting from demolition of the asphalt pads is in bulk form. Bulk waste will be placed into bulk containers, such as roll-off boxes, to transport for disposal. These bulk containers will be stored in a suitable area in proximity to the DWMU area or may be accumulated for up to 90 days in another suitable location. Bulk containers of waste will be covered when waste is not being added or removed. Lightweight material (e.g., plastic and paper) will be bagged, if appropriate, prior to placement in the bulk container to eliminate the potential for materials blowing out of the bulk container.

Debris will be containerized, labeled, and sampled (if necessary) for waste characterization. Waste subject to LDR requirements of WAC 173-303-140, which includes by reference 40 CFR 268, will be characterized, designated, stored, and/or treated, as applicable, prior to disposal in an approved disposal facility.

H-B3.8 Identifying and Managing Contaminated Environmental Media

If contaminated environmental media (soil) is identified as a result of clean closure verification sampling activities (i.e., samples indicate contamination above clean closure standards), the nature and extent of contamination will be evaluated. Soil surrounding the node location, which identified contamination above clean closure levels, will be removed up to the diameter distance to the adjacent node locations and approximately 0.9 m (3 ft) below the surface. Contaminated soil will be removed using equipment capable of removing the quantity of material required to complete removal and clean close the DWMU.

Following removal of contaminated soil, additional confirmatory sampling will be conducted in accordance with the approved SAP to demonstrate clean closure levels. This process will continue until analytical results of confirmatory soil samples prove that clean closure levels have been achieved.

Contaminated soil will be managed as a newly generated waste stream in accordance with WAC 173-303-610(5). Contaminated soil must be handled in accordance with all applicable requirements of WAC 173-303-170 through WAC 173-303-230. The contaminated soil will be containerized, labeled, and sampled (if necessary) for waste characterization. Waste subject to LDR requirements of WAC 173-303-140, which includes by reference 40 CFR 268, will be characterized, designated, stored, and/or treated, as applicable, prior to disposal in an approved disposal facility.

Management and disposal of the contaminated environmental media will be documented and included with the clean closure certification documentation (Section H-B3.12).

H-B3.9 Confirming Clean Closure

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will be clean closed. Demonstration of clean closure standards will be accomplished through the sampling and analysis of the soil underlying the asphalt pads. Once removal of the asphalt is complete, sampling will be performed in accordance with the SAP (Section H-B3.10) and will consist of random grid sampling with judgmental sampling of areas of concern identified during the visual inspection (i.e., areas where staining, cracks or other openings in the asphalt may have allowed a release of waste to the underlying soil).

Confirmation sampling will be conducted in accordance with the SAP detailed in Section H-B3.10 to confirm that soil unrestricted use cleanup standards (MTCA [WAC 173-340] Method B) have been achieved. If sample results indicate contamination above clean closure levels, contaminated soil will be removed and managed in accordance with Section H-B3.8. Once analytical results confirm clean closure levels of the target analytes, a clean closure certification will be prepared in accordance with Section H-B3.12.

H-B3.10 Sampling and Analysis and Constituents to Be Analyzed

The SAP summarizes the sampling design used and associated assumptions based on the knowledge of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. The sampling design includes input parameters used to determine the number and location of samples.

H-B3.10.1 Sampling and Analysis Plan

Sampling and analysis of soil beneath the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads asphalt pads will be conducted to confirm that clean closure levels have been achieved. All sampling and analysis will be performed in accordance with the sampling and quality standards established in this closure SAP. The closure SAP details sampling and analysis procedures in accordance with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*; ASTM International, formerly the American Society for Testing and Materials (ASTM), *Annual Book of ASTM Standards*; and applicable U.S. Environmental Protection Agency (EPA) guidance. Sampling and analysis activities will meet applicable requirements of SW-846, ASTM standards, EPA-approved methods, and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), at the time of closure. This SAP was also developed using Ecology Publication 94-111, Section 7.0, "Sampling and Analysis for Clean Closure," and EPA/240/R-02/005 (EPA QA/G-5S).

H-B3.10.2 Target Analytes

The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads are an active portion of the LLBG Trenches 31-34-94 OUG; therefore, target analytes at closure may include any or all analytes based on the waste codes permitted in the LLBG Trenches 31-34-94 Hanford Facility RCRA Permit Part A (Attachment B, Section XIV-Description of Dangerous Wastes). A waste management report identifying waste codes historically managed at LLBG Trenches 31 and 34 Waste Storage and Treatment Pads was run to identify the existing target analytes. Table H-B1 details the waste codes identified and the target analytes associated with those waste codes. Additional target analytes may be identified upon review of the waste tracking records for the DWMU upon receipt of the final waste. A permit modification updating the SAP with specific target analytes will be submitted, if necessary, in accordance with WAC 173-303-610(3)(b), 45 days prior to the DWMU closure.

Table H-B1. Target Analyte List

Target Analyte (Waste Code)	CAS Number	Target Analyte (Waste Code)	CAS Number
Arsenic (D004)	7440-38-2	Barium (D005)	7440-39-3
Cadmium (D006)	7440-43-9	Chromium (Hexavalent) (D007)	18540-29-9
Lead (D008)	7439-92-1	Mercury (D009) (U151)	7439-97-6
Selenium (D010)	7782-49-2	Silver (D011)	7440-22-4
Endrin (D012)	72-20-8	Lindane (D013)	58-89-9
Methoxychlor (D014)	72-43-5	Toxaphene (D015)	8001-35-2
Benzene (D018) (F005) (U019)	71-43-2	Carbon Tetrachloride (D019) (F001) (U211)	56-23-5
Chlordane (D020)	57-74-9	Chlorobenzene (D021) (F002)	108-90-7
Chloroform (D022) (U044)	67-66-3	*o*-Cresol (D023) (F004)	95-48-7
m-Cresol (D024) (F004)	108-39-4	*p*-Cresol (D025) (F004)	106-44-5
Cresol (Cresylic Acid)[a, e] (D026) (F004)	1319-77-3	1,4-Dichlorobenzene (D027)	106-46-7
1,2-Dichloroethane (D028)	107-06-2	1,1-Dichloroethylene (D029)	75-35-4
2,4-Dinitrotoluene (D030)	121-14-2	Heptachlor (D031)	76-44-8
Heptachlor Epoxide (D031)	1024-57-3	Hexachlorobenzene (D032)	118-74-1
Hexachlorobutadiene (D033)	87-68-3	Hexachloroethane (D034)	67-72-1

Table H-B1. Target Analyte List

Target Analyte (Waste Code)	CAS Number	Target Analyte (Waste Code)	CAS Number
Methyl Ethyl Ketone (D035) (F005) (U159)	78-93-3	Nitrobenzene (D036) (F004) (U169)	98-95-3
Pentachlorophenol (D037)	87-86-5	Pyridine (D038) (F005) (U196)	110-86-1
Tetrachloroethylene (D039) (F001) (F002) (U210)	127-18-4	Trichloroethylene (D040) (F001) (F002) (U228)	79-01-6
2,4,5-Trichlorophenol (D041)	95-95-4	2,4,6-Trichlorophenol (D042)	88-06-2
Vinyl Chloride (D043) (U043)	75-01-4	Methylene Chloride (F001) (F002) (U080)	75-09-2
1,1,1-Trichloroethane (F001) (F002) (U226)	71-55-6	Chlorinated Fluorocarbons[h] (F001) (F002)	Not Applicable
1,1,2-Trichloro-1,2,2-Trifluoroethane (CFC-133)[h] (F002)	76-13-1	*Ortho*-Dichlorobenzene (F002)	95-50-1
Trichlorofluoromethane (CFC-11)[h] (F002) (U121)	75-69-4	1,1,2-Trichloroethane (F002)	79-00-5
Xylenes (F003) (U239)	1330-20-7	Acetone (F003) (U002)	67-64-1
Ethyl Acetate (F003) (U112)	141-78-6	Ethyl Benzene (F003)	100-41-4
Ethyl Ether (F003) (U117)	60-29-7	Methyl Isobutyl Ketone (F003) (U161)	108-10-1
n-Butyl Alcohol (F003) (U031)	71-36-3	Cyclohexanone (F003) (U057)	108-94-1
Methanol (F003) (U154)	67-56-1	Toluene (F005) (U220)	108-88-3
Carbon Disulfide (F005) (P022)	75-15-0	Isobutanol (F005)	78-83-1
2-Ethoxyethanol[f] (F005) (U359)	110-80-5	2-Nitropropane[d, e] (F005)	79-46-9
Arsenic Trioxide[e] (P012)	1327-53-3	Beryllium (P015)	7440-41-7
Chloroacetaldehyde[e] (P023)	107-20-0	Diethylarsine (P038)[e]	692-42-2
Copper Cyanide[b] (P029)	544-92-3	Cyanide (P030)	57-12-5
Potassium Cyanide[b] (P098)	151-50-8	Sodium Cyanide[b] (P106)	143-33-9
Thallium Oxide[e] (P113)	1314-32-5	Vanadic Acid, Ammonium Salt[e] (P119)	7803-55-6
Vanadium Pentoxide[g] (P120)	1314-62-1	Acetaldehyde[e] (U001)	75-07-0
Acetophenone (U004)	98-86-2	Acetyl Chloride[e] (U006)	75-36-5
Dichloroethyl Ether (U025)	111-44-4	Dibutyl Phthalate (U069)	84-74-2
2,6-Dinitrotoluene (U106)	606-20-2	1,4-Dioxane (U108)	123-91-1
Formic Acid (U123)	64-18-6	Hydrazine[c] (U133)	302-01-2
Hydrofluoric Acid[e] (U134)	7664-39-3	Lead (II) Acetate[e] (U144)	301-04-2
3-Methylcholanthrene[e] (U157)	56-49-5	Methyl Ethyl Ketone Peroxide[e] (U160)	1338-23-4
Methyl Methacrylate (U162)	80-62-6	Naphthalene (U165)	91-20-3
Phenol (U188)	108-95-2	Phosphorus Sulfide[e] (U189)	1314-80-3
Selenium Dioxide[e] (U204)	7446-08-4	Tetrahydrofuran[e] (U213)	109-99-9
Thallium Nitrate[i] (U217)	10102-45-1		

Table H-B1. Target Analyte List

Target Analyte (Waste Code)	CAS Number	Target Analyte (Waste Code)	CAS Number

a. The closure performance standard for cresol will be achieved through analysis of its three isomeric forms: *o*-cresol, *m*-cresol and *p*-cresol.

b. Analyzed as total cyanide.

c. Due to the volatile and reactive nature of hydrazine, quantitation is difficult and its presence in soil samples is highly unlikely; therefore, samples will not be analyzed for hydrazine.

d. The closure performance standard for 2-nitropropane was removed in the May 2014 EPA CLARC table updates; therefore, this analyte will not be analyzed for due to the unavailability of a closure performance standard.

e. This analyte is removed from further consideration because it is not listed in the EPA CLARC tables.

f. Due to the extremely short half-life of 2-ethoxyethanol (between 168 hours and 672 hours), its presence in soil samples is highly unlikely; therefore, samples will not be analyzed for 2-ethoxyethanol.

g. Vanadium pentoxide will be analyzed as vanadium.

h. A CFC is an organic compound that contains only carbon, chlorine, and fluorine, produced as a volatile derivative of methane, ethane, and propane. Examples of CFCs include 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-133) and trifluoromethane (CFC-11).

i Thallium nitrate will be analyzed as thallium.

CAS = chemical abstracts service

CLARC = Cleanup Levels and Risk Calculations

EPA = U.S. Environmental Protection Agency

H-B3.10.3 SAP Schedule

Confirmation closure sampling and analysis will be performed in accordance with the closure plan schedule in Section H-B4.

H-B3.10.4 Project Management

The following subsections address project management and ensure that the project has defined goals, that the participants understand the goals and the approaches used, and that the planned outputs are appropriately documented. Project management roles and responsibilities discussed in this section apply to the major activities covered under the SAP.

H-B3.10.4.1 Project/Task Organization

The Permittee is responsible for planning, coordinating, sampling, preparing, packaging, and shipping samples to the laboratory. The project organization (regarding sampling and characterization) is described in the following subsections and shown graphically in Figure H-B2.

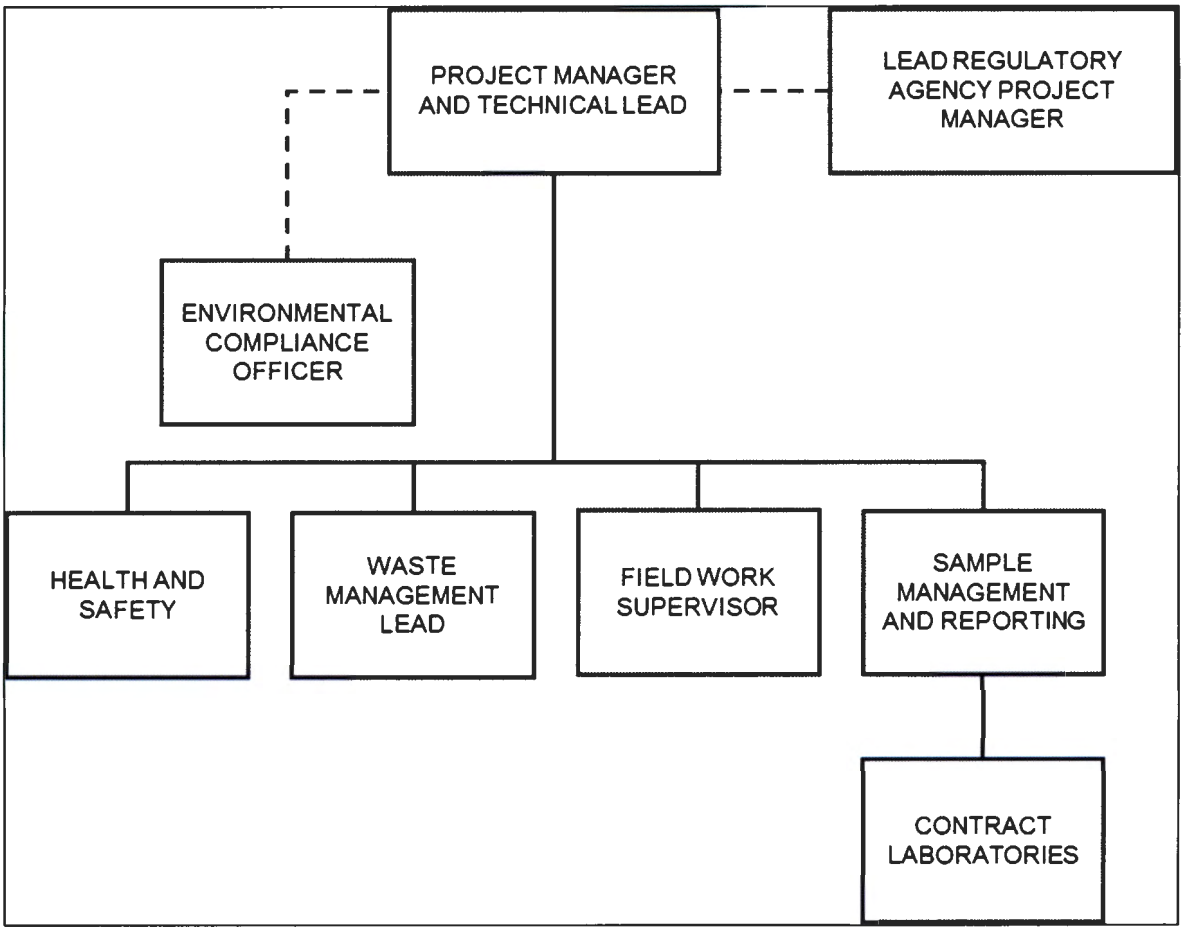


Figure H-B2. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Sampling and Analysis Plan Project Organization

The project has several key positions, including the following:

- **Lead Regulatory Agency Project Manager:** Ecology has assigned project managers responsible for oversight of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads DWMUs closure.

- **Project Manager and Technical Lead:** The Project Manager provides oversight of closure activities and coordinates with the DOE Richland Operations Office (DOE-RL), EPA, Ecology, and contract management. The Project Manager (or designee) for the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads DWMUs closure sampling is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The Project Manager is responsible for ensuring that project personnel are working to the current version of the SAP. The Project Manager works closely with Health and Safety and the Field Work Supervisor (FWS) to integrate these and other lead disciplines in planning and implementing the work scope. The Project Manager also coordinates with DOE-RL and the primary contractor management on all sampling activities. The Project Manager supports DOE-RL in coordinating sampling activities with the regulators.

- **Environmental Compliance Officer:** The Environmental Compliance Officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work, and develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts.

- **Health and Safety:** The Health and Safety organization's responsibility for coordinating industrial safety and health support within the project, as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulation or by internal primary contractor work requirements.

- **Waste Management Lead:** The Waste Management organization communicates policies and protocols, and ensures project compliance for storage, transportation, disposal, and waste tracking.

- **Field Work Supervisor:** The FWS is responsible for planning and coordinating field sampling resources. The FWS ensures that samplers are appropriately trained and available. Additional related responsibilities include ensuring that the sampling design is understood and can be performed as specified.

- **Sample Management and Reporting:** The Permittees' sampling organization coordinates field sampling as well as laboratory analytical work, ensuring that laboratories conform to Hanford Facility internal laboratory QA requirements (or their equivalent), as approved by DOE-RL, EPA, and Ecology. The sampling organization receives the analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation. The sampling organization is responsible for informing the Project Manager of any issues reported by the analytical laboratory.

- **Contract Laboratories:** The contract laboratories analyze samples in accordance with established procedures and provide necessary sample reports and explanation of results in support of data validation.

H-B3.10.5 Sampling Design

The primary purpose of sampling the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads is to determine if analytical data values exceed the MTCA (WAC 173-340) Method B clean closure performance standards (Table H-B4).

This SAP utilized Ecology Publication 94-111, Section 7.0, to determine the type of sampling design that will be utilized to demonstrate clean closure. When designing the sampling plan, both focused and area wide (grid) sampling methods were considered. Ecology Publication 94-111 (Section 7.2.1) identifies that area wide sampling is appropriate when the spatial distribution of contamination at or from the closure unit is uncertain. Ecology Publication 94-111, Section 7.3, "Sampling to Determine or Confirm Clean Closure," identifies the area wide sampling approach as generally appropriate for sampling to determine or confirm that clean closure levels are achieved. Area wide (grid) sampling is further defined below.

Area Wide (Grid) Sampling: Samples are collected at regularly spaced intervals over space or time. An initial location or time is chosen at random, and the remaining sampling locations are defined so that locations are at regular intervals over an area (grid). Grid sampling is used to search for hot spots and infer means, percentiles, or other parameters. It is useful for estimating spatial patterns or trends over time. This design provides a practical method for designating sample locations and ensures uniform coverage of a site, unit, or process.

Focused sampling, as identified in Section 7.2.2 of Ecology Publication 94-111, is selective sampling of areas where contamination is expected or releases have been documented. After completion of the records review and visual inspection of the asphalt pad, a determination will be made to identify if focused sampling is appropriate. The location of focused samples, if any, will be identified and recorded as required in Section H-B3.10.12. Judgmental (focused) sampling is further defined below.

Judgmental (Focused) Sampling: Selection of sampling units (i.e., the number and location and/or timing of collecting samples) is based on knowledge of the feature or condition under investigation and on professional judgment. Focused sampling is distinguished from probability-based sampling in that inferences are based on professional judgment, not statistical scientific theory. Therefore, conclusions about the target population are limited and depend entirely on the validity and accuracy of professional judgment. Probabilistic statements about parameters are not possible.

The number and location of area wide samples were determined utilizing the Visual Sample Plan (VSP) software. VSP is a tool used throughout Washington State and nationally that statistically determines the quantity of samples required to accept or reject the null hypothesis based on input parameters specific to the DWMU.

Both parametric and nonparametric equations rely on assumptions about the data population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the distribution of data. Alternatively, if parametric assumptions are valid, the required number of samples is usually less than if a nonparametric equation was used. For the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads, data assumptions were largely based on information obtained from a grouping of similar waste sites with the same type of constituents. Parameters from the 200-MG-1 waste sites were approved by Ecology in the SAP (DOE/RL-2009-60, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*), evaluated, deemed appropriate, and utilized for the input parameters. VSP parameter inputs and the basis for those inputs are detailed in Table H-B2.

The decision rule for demonstrating compliance with the MTCA (WAC 173-340) Method B clean closure level has three parts:

- The 95 percent upper confidence limit on the true data mean must be less than the MTCA (WAC 173-340) Method B clean closure level.
- No sample concentration can be more than twice the cleanup level.
- Less than 10 percent of the samples can exceed the cleanup level.

Table H-B2. Visual Sample Plan Parameter Inputs

Parameter	Value	Basis
Primary Objective of the Sampling Design	Compare a site mean or median to a fixed threshold	Reject the null hypothesis.
Type of Sampling Design	Nonparametric	Data are not assumed to be normally distributed.
Working Null Hypothesis	The mean value at the site exceeds the threshold (WAC 173-340 "Model Toxics Control Act—Cleanup," Method B closure performance standards)	The null hypothesis assumes that the site is dirty requiring the sampling and analysis to demonstrate through statistical analysis that the site is clean.
Area Wide Grid Sampling Pattern	Triangular	A triangular pattern provided an even distribution of sample locations over the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads dangerous waste management units.
Standard Deviation (S)	0.45	This is the assumed standard deviation value relative to a unit action level for the sampling area. The value of 0.45 is conservative, based on consideration of past verification sampling. MARSSIM suggests 0.30 as a starting point; however, 0.45 has been selected to be more conservative. (Number of samples calculated increases with higher standard deviation values relative to a unit action level.)
Delta (Δ)	0.40	This is the width of the gray region. It is a user-defined value relative to a unit action level. The value of 0.40 balances unnecessary remediation cost with sampling cost.
Alpha (α)	5%	This is the acceptable error of deciding a dirty site is clean when the true mean is equal to the action level. It is a maximum error rate since dirty sites with a true mean above the action level will be easier to detect. A value of 5% was chosen as a practical balance between health risks and sampling cost.
Beta (β)	20%	This is the acceptable error of deciding a clean site is dirty when the true mean is at the lower bound of the gray region. A value of 20% was chosen during the data quality objectives process as a practical balance between unnecessary remediation cost and sampling cost.
MARSSIM Sampling Overage	20%	MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of *n*.

Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.

Using a nonparametric test and the input parameters identified in Table H-B2, VSP calculated that a minimum of 23 samples is required for each pad to reject the null hypotheses with 95 percent confidence and ensure that the DWMU would not be mistakenly released as clean. For the purpose of utilizing VSP software, the null hypothesis compares a site mean to a fixed threshold. Data will be evaluated to ensure that less than 10 percent of individual values exceed MTCA (WAC 173-340) Method B clean closure performance standards, and no values are more than twice the cleanup level.

Sample locations (Figures H-B3 and H-B4) were determined using the area wide grid with a random start sampling method run in VSP. Statistical analysis of systematically collected data is valid if a random start to the grid is used. The LLBG Trenches 31 and 34 Waste Storage and Treatment Pads dimensions were entered into VSP to determine the locations of samples. The triangular grid sampling layout was determined to have an even distribution over each sampling area providing the most representative data set including coverage of the middle portion of the sampling area. For each pad, the 23 samples will be taken from the node locations indicated by VSP (Attachment H-B.a), and will be assigned sample location identifications and sample numbers using HEIS. The southwest corners of the pads is considered the (0,0) point of the sampling location maps in Attachment H-B.a.

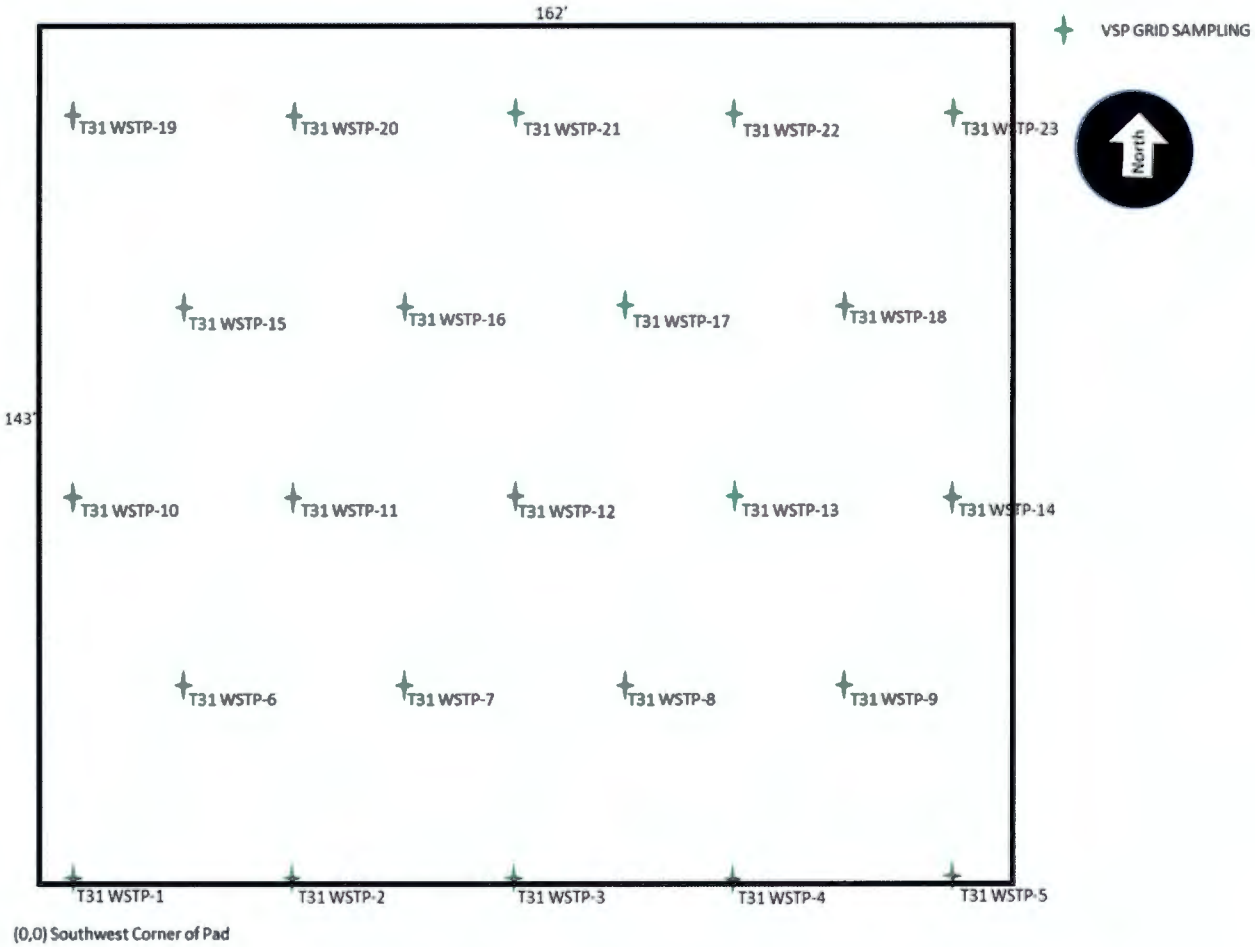


Figure H-B3. Sample Locations for the LLBG Trench 31 Waste Storage and Treatment Pad

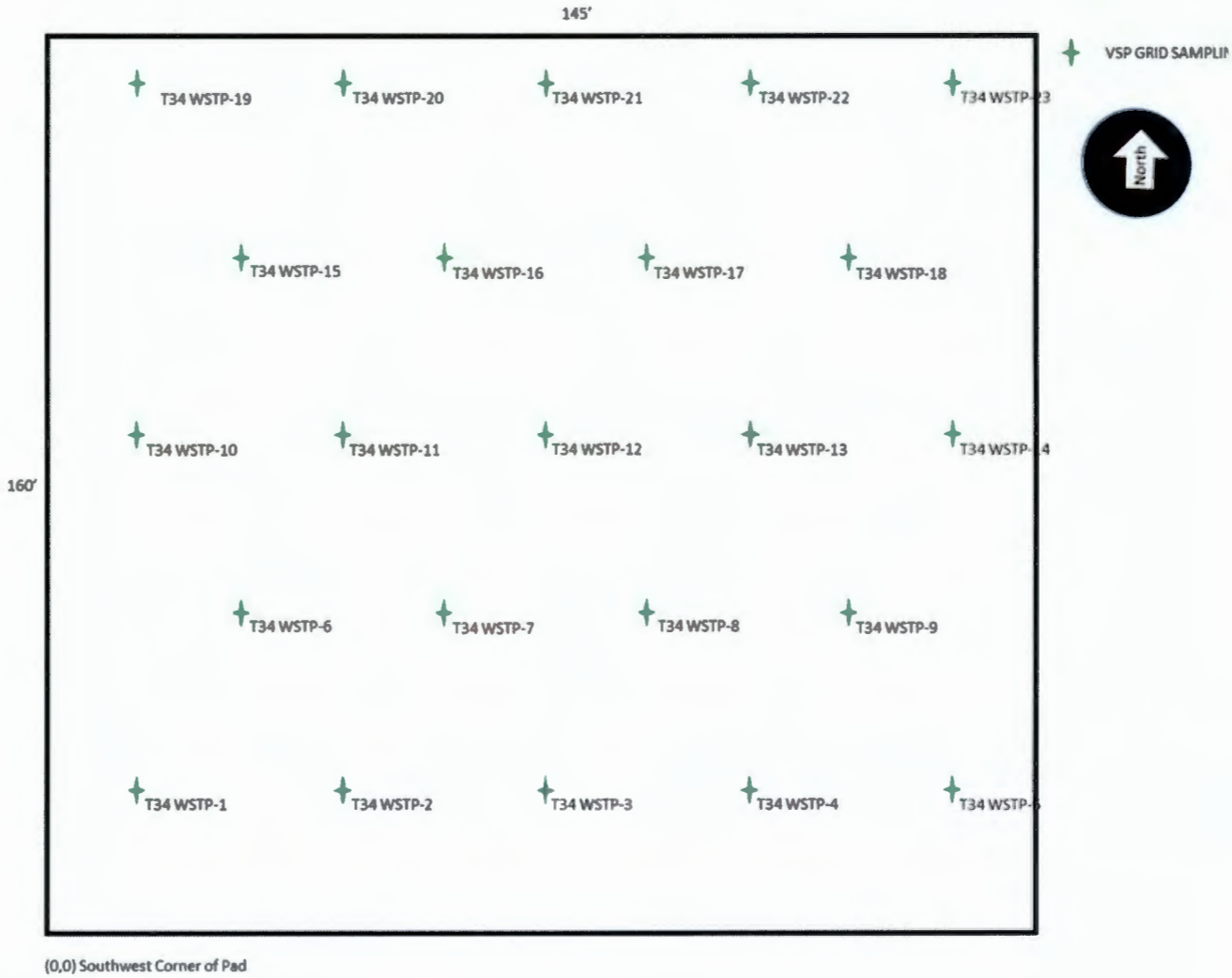


Figure H-B4. Sample Locations for the LLBG Trench 34 Waste Storage and Treatment Pad

The first node location of each pad was chosen at random by VSP, and the subsequent 22 sample locations were assigned by VSP using a triangular grid sampling layout. Supporting documentation and the sampling grid map, automatically generated by VSP, are documented in Attachment H-B.a.

H-B3.10.6 Sampling Methods and Handling

Grab sample matrix will consist of soil collected in pre-cleaned sample containers taken at a depth of approximately 0 to 15 cm (0 to 6.0 in.) below ground surface and within an approximate 1 m (3 ft) radius surrounding the node location. For the purpose of this SAP, ground surface is defined as the exposed surface layer once the asphalt pads have been removed. Subsurface sampling (samples collected at depths greater than approximately 15 cm [6.0 in.] below ground surface) will be evaluated; based on results of the records review. If subsurface sampling is deemed necessary, a permit modification will be submitted in accordance with Section H-B3.10.14.

Once the soil is sampled, the sampled media will be screened to remove material larger than approximately 2 mm (0.08 in.) in diameter which allows for a larger surface area to volume ratio; therefore, increasing the likelihood of identifying any potential contamination in the sample. Grab samples will be collected into containers at the chosen node sample locations. To ensure sample and data

usability, sampling will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, collection equipment, and sample handling. Sampling generally includes the following activities:

- Generating a sample request
- Sample container and equipment preparation
- Field walkdown of sample area (includes marking sample locations)
- Sample collection
- Sample packaging, transporting, and shipping

Sample container, preservation, and holding time requirements are specified in Table H-B3 for soil samples. These requirements are in accordance with the analytical method specified. The final container type and volumes will be identified on the Sampling Authorization Form (SAF) and chain-of-custody form.

Table H-B3. Preservation, Container, and Holding Time Requirements for Soil Samples

Method	Analysis/Analytes	Preservation Requirement	Holding Time	Container Type	Sample Size
EPA 6010	Metals by ICP-OES	Cool ≤6°C	180 days	G/P/PTFE	20 g
EPA 6020	Metals by ICP-MS	Cool ≤6°C	180 days	G/P	20 g
EPA 7196	Chromium (Hexavalent)	Cool ≤6°C	30 days prior to extraction; 24 hours after extraction	G/P	20 g
EPA 7471	Mercury by Cold Vapor Atomic Absorption	Cool ≤6°C	28 days	G/P/PTFE	15 g
EPA 8260	Volatile Organic Compounds by GC/MS	Cool ≤6°C	14 days	VOA vial w/ PTFE-lined lid	5 × 40 g
EPA 8270	Semivolatile Organic Compounds by GC/MS	Cool ≤6°C	14 days prior to extraction; 40 days after extraction	AG w/ PTFE-lined lid	250 g
EPA 9012	Cyanide	Cool ≤4°C	14 days	G/P/PTFE	15 g
EPA 9056	Anions	Cool ≤6°C	28 days prior to extraction; 48 hours after extraction	G/P	250 g

AG	=	amber glass	ICP	=	inductively coupled plasma
EPA	=	U.S. Environmental Protection Agency	MS	=	mass spectrometry
			OES	=	optical emission spectrometry
G	=	glass	P	=	plastic
GC	=	gas chromatography	PTFE	=	polytetrafluoroethylene
			VOA	=	volatile organic analysis

To prevent potential contamination of samples, care will be taken to use decontaminated equipment for each sampling activity.

EPA Level 1 precleaned sample containers will be used for samples collected for chemical analysis. Container sizes may vary depending on laboratory specific volumes/requirements for meeting analytical quantitation limits.

The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook. A custody seal (e.g., evidence tape) will be affixed to each sample container and/or sample collection package in such a way as to indicate potential tampering.

Each sample container will be labeled with the following information on firmly affixed, water resistant labels:

- SAF and form number
- HEIS number
- Sample collection date and time
- Sampler identification
- Analysis required
- Preservation method (if applicable)

Sample records must include the following information:

- Analysis required
- Sample location
- Matrix (e.g., soil)

Sample custody will be maintained in accordance with existing Hanford Facility protocols to ensure maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained.

All waste generated by sampling activities subject to the LDR requirements of WAC 173-303-140, which includes by reference 40 CFR 268, will be characterized, designated, stored, and/or treated, as applicable, prior to disposal in an approved disposal facility.

H-B3.10.7 Analytical Methods

All analyses will be performed consistent with this closure plan, laboratory analytical procedures, and HASQARD (DOE/RL-96-68). The approved laboratory must achieve the lowest practical quantitation limits (PQLs) consistent with the selected analytical method to confirm clean closure levels. If a target analyte is detected at or above the clean closure level but less than the PQL of the analytical method, Ecology will be notified and alternatives will be discussed to demonstrate clean closure levels. If the PQL exceeds the clean closure level, nondetect values at or below the PQL will document clean closure.

Analytical methods and performance requirements associated with the target analytes are outlined in Table H-B4.

H-B3.10.8 Quality Control

Quality control (QC) procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability. Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table H-B5.

A data quality assessment (DQA) will be performed utilizing the guidance in EPA/240/B-06/002, *Data Quality Assessment: A Reviewer's Guide* (EPA QA/G-9R), and implementing the specific requirements in Sections H-B3.10.9 through H-B3.10.11.

Data verification, data validation, and DQA will include both primary samples and QC samples.

H-B3.10.9 Data Verification

Analytical results will be received from the laboratory, loaded into a database (e.g., HEIS), and verified. Verification includes, but is not limited to, the following activities:

- Amount of data requested matches the amount of data received (number of samples for requested methods of analytes).
- Correct procedures/methods are used.
- Documentation/deliverables are complete.
- Hard copy and electronic versions of data are identical.
- Data seem reasonable based on analytical methodologies.

H-B3.10.10 Data Validation

Data validation is performed by a third party. The laboratory supplies contract laboratory program equivalent analytical data packages intended to support data validation by the third party. The laboratory submits data packages that are supported by QC test results and raw data.

Controls are in place to preserve the data sent to the validators and allow only additions to be made, not changes to the raw data.

The format and requirements for data validation activities are based upon the most current version of USEPA-540-R-08-01, *National Functional Guidelines for Superfund Organic Methods Data Review* (OSWER 9240.1-48), and USEPA-540-R-10-011, *National Functional Guidelines for Inorganic Superfund Data Review* (OSWER 9240.1-51). As defined by the validation guidelines, 5 percent of the results will undergo Level C validation.

Table H-B4. Soil Analytical Performance Requirements

CAS Number	Analyte[a]	Analytical Method	Closure Performance Standard (mg/kg)		Practical Quantitation Limit (mg/kg)	Accuracy Req't (% Recovery)[c]	Precision Req't (Relative Percent Difference)[c]
			Carcinogen	Non-carcinogen			
7440-38-2	Arsenic	SW-846 Method 6020	6.67E-01	2.40E+01	2.00E-01	±30	≤30
7440-39-3	Barium	SW-846 Method 6010	--	1.60E+04	2.00E+00	±30	≤30
7440-43-9	Cadmium	SW-846 Method 6010	--	8.00E+01	5.00E-01	±30	≤30
18540-29-9	Chromium (Hexavalent)	SW-846 Method 7196	--	2.40E+02	5.00E-01	±30	≤30
7439-92-1	Lead[b]	SW-846 Method 6010	--	2.50E+02	5.00E+00	±30	≤30
7439-97-6	Mercury[d]	SW-846 Method 7471	--	2.40E+01	2.00E-01	±30	≤30
7782-49-2	Selenium	SW-846 Method 6010	--	4.00E+02	1.00E+01	±30	≤30
7440-22-4	Silver	SW-846 Method 6010	--	4.00E+02	1.00E+00	±30	≤30
7440-28-0	Thallium[e]	SW-846 Method 6020	--	4.30E-01	2.00E-01	±30	≤30
7440-62-2	Vanadium	SW-846 Method 6010	--	4.00E+02	1.00E+00	±30	≤30
72-20-8	Endrin	SW-846 Method 8270	--	2.40E+01	3.30E-03	±30	≤30
58-89-9	Lindane	SW-846 Method 8270	9.09E-01	2.40E+01	1.65E-03	±30	≤30
72-43-5	Methoxychlor	SW-846 Method 8270	--	4.00E+02	1.65E-02	±30	≤30
8001-35-2	Toxaphene	SW-846 Method 8270	9.09E-01	--	1.65E-01	±30	≤30
71-43-2	Benzene	SW-846 Method 8260	1.82E+01	3.20E+02	5.00E-03	±30	≤30
56-23-5	Carbon Tetrachloride	SW-846 Method 8260	1.43E+01	3.20E+02	5.00E-03	±30	≤30
57-74-9	Chlordane	SW-846 Method 8270	2.86E+00	4.00E+01	1.65E-02	±30	≤30
108-90-7	Chlorobenzene	SW-846 Method 8260	--	1.60E+03	5.00E-03	±30	≤30

Table H-B4. Soil Analytical Performance Requirements

CAS Number	Analyte[a]	Analytical Method	Closure Performance Standard (mg/kg)		Practical Quantitation Limit (mg/kg)	Accuracy Req't (% Recovery)[c]	Precision Req't (Relative Percent Difference)[c]
			Carcinogen	Non-carcinogen			
67-66-3	Chloroform	SW-846 Method 8260	3.23E+01	8.00E+02	5.00E-03	±30	≤30
95-48-7	*o*-Cresol	SW-846 Method 8270	--	4.00E+03	3.30E-01	±30	≤30
108-39-4	*m*-Cresol	SW-846 Method 8270	--	4.00E+03	3.30E-01	±30	≤30
106-44-5	*p*-Cresol	SW-846 Method 8270	--	8.00E+03	3.30E-01	±30	≤30
106-46-7	1,4-Dichlorobenzene	SW-846 Method 8270	1.85E+02	5.60E+03	3.30E-01	±30	≤30
107-06-2	1,2-Dichloroethane	SW-846 Method 8260	1.10E+01	4.80E+02	5.00E-03	±30	≤30
75-35-4	1,1-Dichloroethylene	SW-846 Method 8260	--	4.00E+03	1.00E-02	±30	≤30
121-14-2	2,4-Dinitrotoluene	SW-846 Method 8270	3.23E+00	1.60E+02	3.30E-01	±30	≤30
76-44-8	Heptachlor	SW-846 Method 8270	2.22E-01	4.00E+01	1.65E-03	±30	≤30
1024-57-3	Heptachlor Epoxide	SW-846 Method 8270	1.10E-01	1.04E+00	1.65E-03	±30	≤30
118-74-1	Hexachlorobenzene	SW-846 Method 8270	6.25E-01	6.40E+01	3.30E-01	±30	≤30
87-68-3	Hexachlorobutadiene	SW-846 Method 8270	1.28E+01	8.00E+01	3.30E-01	±30	≤30
67-72-1	Hexachloroethane	SW-846 Method 8270	2.50E+01	5.60E+01	5.00E-03	±30	≤30
78-93-3	Methyl Ethyl Ketone (2-Butanone)	SW-846 Method 8260	--	4.80E+04	1.00E-02	±30	≤30
98-95-3	Nitrobenzene	SW-846 Method 8270	--	1.60E+02	3.30E-01	±30	≤30
87-86-5	Pentachlorophenol	SW-846 Method 8270	2.50E+00	4.00E+02	3.30E-01	±30	≤30
110-86-1	Pyridine	SW-846 Method 8260	--	8.00E+01	5.00E-03	±30	≤30
127-18-4	Tetrachloroethylene	SW-846 Method 8260	4.76E+02	4.80E+02	5.00E-03	±30	≤30

Table H-B4. Soil Analytical Performance Requirements

CAS Number	Analyte[a]	Analytical Method	Closure Performance Standard (mg/kg)		Practical Quantitation Limit (mg/kg)	Accuracy Req't (% Recovery)[c]	Precision Req't (Relative Percent Difference)[c]
			Carcinogen	Non-carcinogen			
79-01-6	Trichloroethylene	SW-846 Method 8260	1.20E+01	4.00E+01	5.00E-03	±30	≤30
95-95-4	2,4,5-Trichlorophenol	SW-846 Method 8270	--	8.00E+03	3.30E-01	±30	≤30
88-06-2	2,4,6-Trichlorophenol	SW-846 Method 8270	9.09E+01	8.00E+01	3.30E-01	±30	≤30
75-01-4	Vinyl Chloride	SW-846 Method 8260	1.75E+02	2.40E+02	1.00E-02	±30	≤30
75-09-2	Methylene Chloride	SW-846 Method 8260	5.00E+02	4.80E+02	5.00E-03	±30	≤30
71-55-6	1,1,1-Trichloroethane	SW-846 Method 8260	--	1.60E+05	5.00E-03	±30	≤30
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane (CFC-133)	SW-846 Method 8260	--	2.40E+06	1.00E-02	±30	≤30
95-50-1	*Ortho*-Dichlorobenzene (1,2-Dichlorobenzene)	SW-846 Method 8270	--	7.20E+03	3.30E-01	±30	≤30
75-69-4	Trichlorofluoromethane (CFC-11)	SW-846 Method 8260	--	2.40E+04	1.00E-02	±30	≤30
79-00-5	1,1,2-Trichloroethane	SW-846 Method 8260	1.75E+01	3.20E+02	5.00E-03	±30	≤30
1330-20-7	Xylenes	SW-846 Method 8260	--	1.60E+04	1.00E-02	±30	≤30
67-64-1	Acetone	SW-846 Method 8260	--	7.20E+04	2.00E-02	±30	≤30
141-78-6	Ethyl Acetate	SW-846 Method 8260	--	7.20E+04	5.00E+00	±30	≤30
100-41-4	Ethyl Benzene	SW-846 Method 8260	--	8.00E+03	5.00E-03	±30	≤30
60-29-7	Ethyl Ether	SW-846 Method 8260	--	1.60E+04	5.00E-03	±30	≤30
108-10-1	Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	SW-846 Method 8260	--	6.40E+03	1.00E-02	±30	≤30

Table H-B4. Soil Analytical Performance Requirements

CAS Number	Analyte[a]	Analytical Method	Closure Performance Standard (mg/kg)		Practical Quantitation Limit (mg/kg)	Accuracy Req't (% Recovery)[c]	Precision Req't (Relative Percent Difference)[c]
			Carcinogen	Non-carcinogen			
71-36-3	*n*-Butyl Alcohol (*n*-Butanol)	SW-846 Method 8260	--	8.00E+03	1.00E-01	±30	≤30
108-94-1	Cyclohexanone	SW-846 Method 8260	--	4.00E+05	5.00E-02	±30	≤30
67-56-1	Methanol	SW-846 Method 8260	--	1.60E+05	1.00E+00	±30	≤30
108-88-3	Toluene	SW-846 Method 8260	--	6.40E+03	5.00E-03	±30	≤30
75-15-0	Carbon Disulfide	SW-846 Method 8260	--	8.00E+03	5.00E-03	±30	≤30
78-83-1	Isobutanol (Isobutyl Alcohol)	SW-846 Method 8260	--	2.40E+04	5.00E-01	±30	≤30
7440-41-7	Beryllium	SW-846 Method 6020	--	1.60E+02	5.00E-01	±30	≤30
57-12-5	Cyanide	SW-846 Method 9012	--	4.80E+01	1.00E+00	±30	≤30
98-86-2	Acetophenone	SW-846 Method 8270	--	8.00E+03	3.30E-01	±30	≤30
111-44-4	Dichloroethyl Ether	SW-846 Method 8270	9.09E-01	--	3.30E-01	±30	≤30
84-74-2	Dibutyl Phthalate	SW-846 Method 8270	--	8.00E+03	3.30E-01	±30	≤30
606-20-2	2,6-Dinitrotoluene	SW-846 Method 8270	6.67E-01	2.40E+01	3.30E-01	±30	≤30
123-91-1	1,4-Dioxane	SW-846 Method 8260	1.00E+01	2.40E+03	5.00E-01	±30	≤30
64-18-6	Formic Acid	SW-846 Method 9056	--	7.20E+04	2.00E+00	±30	≤30
80-62-6	Methyl Methacrylate	SW-846 Method 8260	--	1.12E+05	1.00E-02	±30	≤30
91-20-3	Naphthalene	SW-846 Method 8270	--	1.60E+03	3.30E-01	±30	≤30
108-95-2	Phenol	SW-846 Method 8270	--	2.40E+04	3.30E-01	±30	≤30

Table H-B4. Soil Analytical Performance Requirements

CAS Number	Analyte[a]	Analytical Method	Closure Performance Standard (mg/kg)		Practical Quantitation Limit (mg/kg)	Accuracy Req't (% Recovery)[c]	Precision Req't (Relative Percent Difference)[c]
			Carcinogen	Non-carcinogen			

Reference: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V.*

Note: Due to the quantity and nature of the waste stored in the 2402-W Series Buildings not presenting a threat to groundwater, and not having soil or the presence of plants within the building, no groundwater or ecological indicator MTCA cleanup standards (WAC 173-340-747, "Deriving Soil Concentrations for Groundwater Protection," and WAC 173-340-7490, "Terrestrial Ecological Evaluation Procedures," through WAC 173-340-7494, "Priority Contaminants of Ecological Concern") are addressed.

a. Unless otherwise noted, closure performance standards are the numeric cleanup levels calculated using unrestricted use exposure assumptions according to MTCA (WAC 173-340) Method B (unrestricted use standards). Where both carcinogen and noncarcinogen performance standards are available, the most conservative value will be used.

b. Closure performance standards are the numeric cleanup levels calculated using unrestricted use exposure assumptions according to MTCA (WAC 173-340) Method A (unrestricted use standards). MTCA Method A values were used when MTCA Method B values were not available.

c. Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples is also performed. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analyses.

d. Equation 740-1 and Equation 740-2 from WAC 173-340-740(3)(b) are used to calculate MTCA Direct Contact Human Health soil cleanup levels. The MTCA human health direct contact soil cleanup level for mercury is calculated to be 24 mg/kg.

e. Since there is no closure performance standard for thallium listed in the EPA CLARC tables, the calculated value is based off of the closure performance standard for thallium nitrate (5.60E-01) which was multiplied by 0.76724 to obtain the closure performance standard for elemental thallium. This multiplication factor is based off of the assumption that any thallium present in the sample is in the form of thallium(I) nitrate.

CAS = chemical abstracts service

CFC = chlorinated fluorocarbon

MTCA = Model Toxics Control Act

Table H-B5. Project Quality Control Sampling Summary

Quality Control Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Trip Blanks	One per 20 samples per media sampled One per cooler for VOCs	Trip blanks are used to assess contamination from sample containers or during transportation and storage procedures.
Field Blanks	One per cooler for VOCs	Field blanks are used to assess contamination from surrounding sources during sample collection.
Equipment Rinsate Blanks	As needed If only disposable equipment is used, then an equipment blank is not required Otherwise, one per 20 samples per analytical method per media sampled, or one per day[a]	Equipment rinsate blanks are used to measure the cleanliness of sampling equipment and effectiveness of equipment decontamination procedures.
Field Duplicates	One per batch[c], 20 samples maximum of each media sampled (soil samples)	Field duplicates are used to assess the precision of the entire data collection activity, including sampling, analysis, and site heterogeneity.
Laboratory Quality Control[b]		
Method Blanks	1 per batch[c]	Measures contamination associated with laboratory sample preparation and analysis.
Lab Duplicates	[b]	Laboratory reproducibility and precision.
Matrix Spikes	One per 20 samples[b]	The spike recovery measures the effects of interferences in the sample matrix and reflects the accuracy of the determination.
Matrix Spike Duplicates	One per 20 samples[b]	The relative percent difference between matrix spike and matrix spike duplicate measures the precision of a given analysis.
Surrogates	[b]	Surrogate standards are added prior to extraction of the sample to evaluate accuracy, method performance, and extraction efficiency.
Laboratory Control Samples	1 per batch[c]	The laboratory control sample measures the accuracy of the analytical method.

a. Whenever a new type of nondedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

b. As defined in the analysis procedures.

c. Batching across projects is allowing for similar matrices.

H-B3.10.11 Verification of VSP Input Parameters

Analytical data will be entered back into VSP. If all analytical data for a particular analyte are nondetectable, verification of VSP input parameters is not required for that analyte. VSP software uses the analytical data to determine if the user input parameters were estimated appropriately. Once analytical data are entered into VSP, the software will calculate the true standard deviation and if the null hypothesis can be rejected. If the calculated standard deviation is smaller than the estimated user input standard deviation, no additional sampling will be required. If the calculated standard deviation is larger than the estimated standard deviation, additional sampling may be required. Comparison of the maximum data value for each analyte to the clean closure standards will ensure that all individual analytes are below the action levels. Verification of the null hypothesis through VSP will determine if the mean value of the site analytical data supports rejection of the null hypothesis (Section H-B3.10.5).

H-B3.10.12 Documents and Records

The Project Manager is responsible for ensuring that the current version of the SAP is being used and providing any updates to field personnel. Changes to the SAP will be submitted as a permit modification in accordance with WAC 173-303-610(3)(b).

Logbooks are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer, or other responsible individual. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

The project manager is responsible for ensuring that a project file is properly maintained. The project file will contain the records or references to their storage locations. The following items will be included in the project file, as appropriate:

- All field logbooks or operational records
- Data forms
- Global positioning system data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports
- Laboratory data packages
- Verification and validation reports

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes to ensure the accuracy and retrievability of stored records. Records required by the Tri-Party Agreement (Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order*) will be managed in accordance with the requirements therein.

H-B3.10.13 Sampling and Analysis Requirements to Address Removal of Contaminated Soil

In the event that sample results based on the MTCA (WAC 173-340) Method B three-part test (Section H-B3.10.5) indicate contamination above clean closure levels, contaminated soil will be removed in accordance with Section H-B3.8. Following removal of contaminated soil, additional samples will be taken at the same grid location as identified in Attachment H-B.a. Additional focused sampling may be added in areas where contamination is identified. Additional focused samples will be documented, as required in Section H-B3.10.12, and provided with the closure certification. These samples will be analyzed in accordance with the methods specified in Table H-B4, with accompanying QC samples as discussed in Section H-B3.10.8, to confirm that MTCA (WAC 173-340) Method B clean closure levels have been achieved.

H-B3.10.14 Revisions to the Sampling and Analysis Plan and Constituents to Be Analyzed

If changes to the SAP are necessary due to unexpected events during closure that will affect sampling, a revision to this SAP will be submitted no later than 30 days after the unexpected event as a permit modification, as required in WAC 173-303-610(3)(b)(iii) and WAC 173-303-830, "Permit Changes."

H-B3.11 Role of the Independent Qualified Registered Professional Engineer

An Independent Qualified Registered Professional Engineer (IQRPE) will be retained to provide certification of the closure, as required by WAC 173-303-610(6). The engineer will be responsible for observing field activities and reviewing documents associated with closure of the waste storage modules. At a minimum, field activities and documents reviewed would include the following:

- Observation or review of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads visual inspection
- Observation or review of sampling activities
- Review of sampling procedures and results
- Observation or review of contaminated environmental debris removal (as applicable)
- Verification that locations of samples are as specified in the SAP
- Verification that closure activities were performed in accordance with this closure plan

The IQRPE will record his or her observations and reviews in a written report that will be retained in the operating record. The resulting report will be used to develop the clean closure certification, which will then be provided to Ecology.

H-B3.12 Closure Certification

In accordance with WAC 173-303-610(6), within 60 days of completion of closure of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads, a certification that the DWMUs have been closed in accordance with the specifications in this closure plan will be submitted to Ecology by registered mail. The certification will be signed by the owner or operator and by an IQRPE.

Upon request by Ecology, the following information will be submitted to support the closure certification:

- All field notes and photographs related to closure activities, including the results of the inspection of the asphalt pads for cracks and other openings.
- Description of any minor deviations from the approved closure plan and justification for these deviations.
- Documentation of the final removal and disposition of any unanticipated contaminated environmental media.
- All laboratory and/or field data, including sampling procedures, sampling locations, QA/QC control samples, and chain-of-custody procedures for all samples and measurements, including samples and measurements taken to determine background conditions and/or determine or confirm clean closure.
- Summary report that identifies and describes the data reviewed by the IQRPE and tabulates the analytical results of samples taken to determine and confirm clean closure.
- Description of the DWMU area appearance at completion of closure, including what parts of the former unit, if any, will remain after closure.

H-B3.13 Conditions That Will Be Achieved when Closure Is Complete

Upon confirmation of clean closure levels through sampling and analysis, the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads will be clean closed. The asphalt pads will be removed so only bare soil will remain. A permit modification request will be submitted to remove the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads DWMUs from the Hanford Facility RCRA Permit active DWMUs.

H-B4 Closure Schedule and Time Frame

In accordance with WAC 173-303-610(4)(b), closure activities will be completed no more than 180 days after the start of closure (Table H-B6). Should unexpected circumstances arise and an extension to the 180 day closure activity expiration date be deemed necessary, a permit modification will be submitted to Ecology for approval at least 30 days prior to the 180 day expiration date, in accordance with WAC 173-303-610(4)(c) and WAC 173-303-830, Appendix I, Section D.1.b. The extension request would also demonstrate that all steps to prevent threats to HHE, including compliance with all applicable permit requirements and criteria, have been and will continue to be taken. Closure certification will be submitted to Ecology within 60 days following completion of closure activities at the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads as outlined in Section H-B3.12 (Figure H-B5).

H-B5 Closure Costs

An annual report outlining updated projections of anticipated closure costs for the Hanford Facility TSD units having final status is not required per Hanford Facility RCRA Permit Condition II.H. The Hanford Facility is owned by DOE and operated by DOE and its contractors; therefore, in accordance with WAC 173-303-620(1)(c), provisions of WAC 173-303-620, "Financial Requirements," are not applicable to the Hanford Facility.

Table H-B6. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Closure Activities

Closure Activity Description		Expected Duration
Primary Activity	**Secondary Activity**	**Duration**
PRIOR TO CLOSURE		
Submit Notification to Ecology of Intent to Close the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads DWMUs	In accordance with WAC 173-303-610(3)(c)(i), at least 45 days prior to the date on which closure is expected to begin (i.e., no later than 15 days prior to receipt last known volume of final waste).	--
Begin Closure of the LLBG Trenches 31 and 34 Waste Storage and Treatment Pads DWMUs	In accordance with WAC 173-303-610(3)(c)(ii), within 30 days of receiving the last known volume of final waste.	--
CLOSURE ACTIVITIES		
Remove All Waste	Package and ship waste to an approved facility for treatment, storage and/or disposal. In accordance with WAC 173-303-610(4)(a), within 90 days after the date on which each DWMU has received the last known volume of final waste, the owner/operator must treat, remove, or dispose of all dangerous wastes in accordance with the approved closure plan. Request extension if necessary.	25 Days (Day 25)
Records Review (Performed Concurrently with Waste Removal)	Perform review of daily operating records, inspection records, and spill records.	25 Days (Day 25)
Visual Inspection of Asphalt Pad	Identify areas of concern (cracks in asphalt that could potentially reach the soil below the asphalt).	5 Days (Day 30)
	Document visual inspection with photos, locations and dimensions of staining and cracks.	
Remove Asphalt Pad	Remove asphalt pad with large equipment.	60 Days (Day 90)
	Containerize asphalt waste debris.	
	Perform waste determination on waste debris.	
	Dispose of waste debris in approved disposal facility.	
Sampling and Analysis of Underlying Soil (Following Demolition, May be Performed Concurrently with Waste Determination and Disposal of Debris)	See Section H-B3.10 for details of sampling and analysis.	90 Days (Day 180)
	Data validation and verification.	
	If necessary, remove contaminated environmental media (soil), and resample and analyze to confirm that clean closure levels have been achieved.	
Final Closure of the LLBG Trenches 31 and 34 Waste Storage and Treatment	In accordance with WAC 173-303-610(4)(b), within 180 days after the date on which the last	0 Days (Day 180)

Table H-B6. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Closure Activities

Closure Activity Description		Expected Duration
Pads	known volume of final waste was received. Request extension if necessary.	
CLOSURE ACTIVITIES COMPLETE		
Owner/Operators and IQRPE Submit Clean Closure Certification	In accordance with WAC 173-303-610(6), within 60 days of completion of closure of each DWMU; certification that the DWMU has been closed in accordance with the specifications in the approved closure plan (see Section H-B3.12 for more details on the clean closure certification).	60 Days (Day 240)

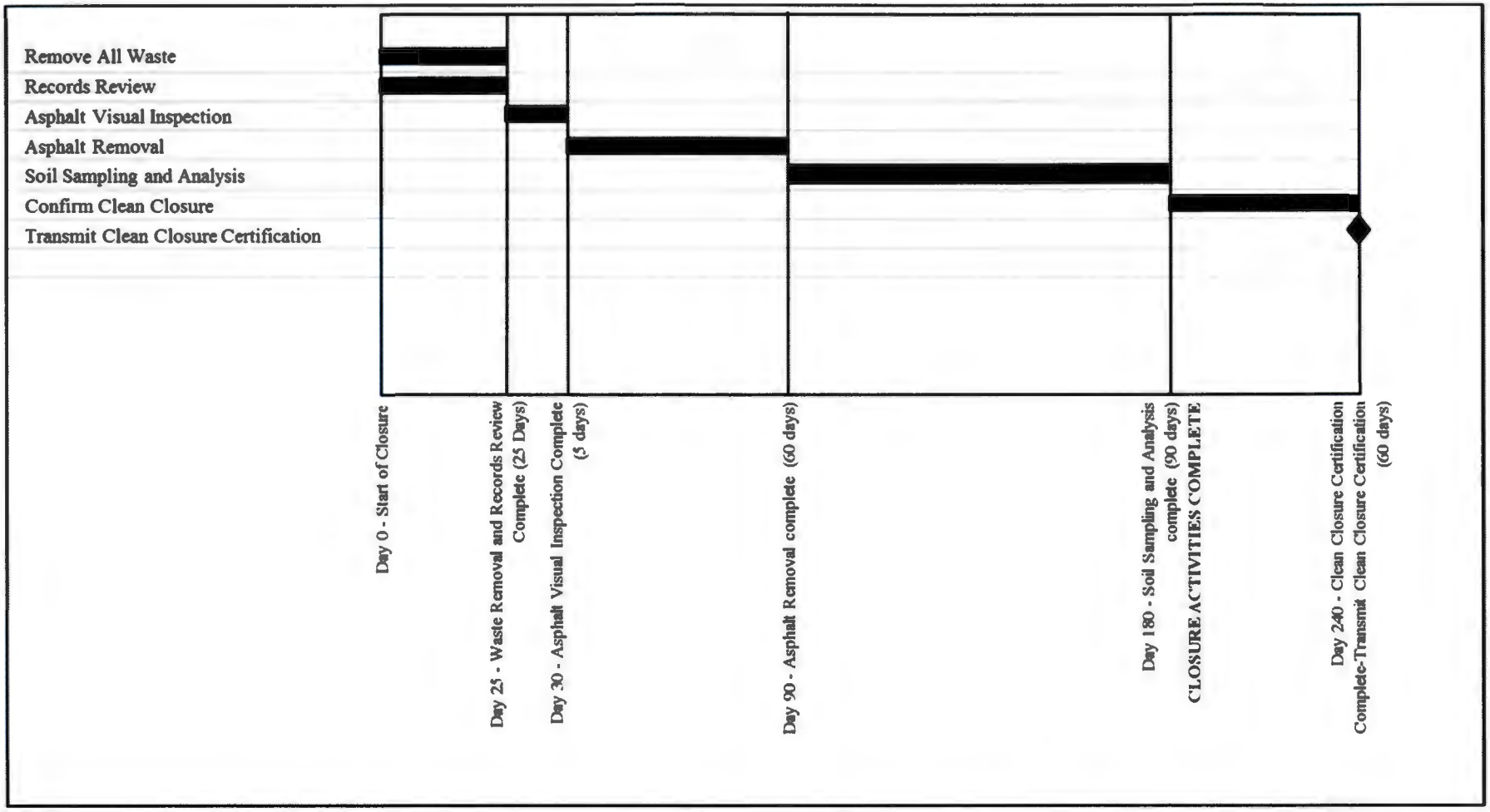


Figure H-B5. LLBG Trenches 31 and 34 Waste Storage and Treatment Pads Closure Schedule Activities

This page intentionally left blank

Attachment H-B.a

Trenches 31 and 34 Waste Storage and Treatment Pads Visual Sample Plan Supporting Documentation

This page intentionally left blank.

Systematic sampling locations for comparing a median with a fixed threshold (nonparametric - MARSSIM)

Summary

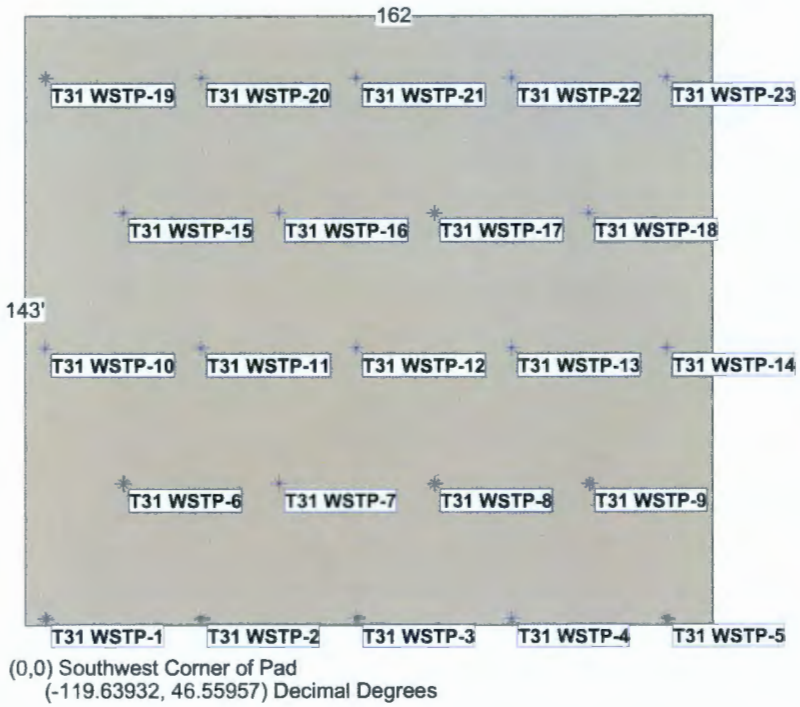
This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN

Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Systematic with a random start location
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated total number of samples	20
Number of samples on map [a]	23
Number of selected sample areas [b]	1
Specified sampling area [c]	23166.00 ft^2
Size of grid / Area of grid cell [d]	36.5717 feet / 1158.3 ft^2
Grid pattern	Triangular
Total cost of sampling [e]	$0.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid cell gives the linear and square dimensions of the grid used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



Area: LLBG Trench 31 WSTP					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
4.7601	1.5403	T31 WSTP-1		Systematic	
41.3318	1.5403	T31 WSTP-2		Systematic	
77.9035	1.5403	T31 WSTP-3		Systematic	
114.4752	1.5403	T31 WSTP-4		Systematic	
151.0469	1.5403	T31 WSTP-5		Systematic	
23.0459	33.2123	T31 WSTP-6		Systematic	
59.6176	33.2123	T31 WSTP-7		Systematic	
96.1893	33.2123	T31 WSTP-8		Systematic	
132.7610	33.2123	T31 WSTP-9		Systematic	
4.7601	64.8843	T31 WSTP-10		Systematic	
41.3318	64.8843	T31 WSTP-11		Systematic	
77.9035	64.8843	T31 WSTP-12		Systematic	
114.4752	64.8843	T31 WSTP-13		Systematic	
151.0469	64.8843	T31 WSTP-14		Systematic	
23.0459	96.5564	T31 WSTP-15		Systematic	
59.6176	96.5564	T31 WSTP-16		Systematic	
96.1893	96.5564	T31 WSTP-17		Systematic	

132.7610	96.5564	T31 WSTP-18	Systematic	
4.7601	128.2284	T31 WSTP-19	Systematic	
41.3318	128.2284	T31 WSTP-20	Systematic	
77.9035	128.2284	T31 WSTP-21	Systematic	
114.4752	128.2284	T31 WSTP-22	Systematic	
151.0469	128.2284	T31 WSTP-23	Systematic	

Primary Sampling Objective
The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or 'null' hypothesis) is that the median(mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median(mean) value is less than the threshold. VSP calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

Selected Sampling Approach
A nonparametric systematic sampling approach with a random start was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

Locating the sample points over a systematic grid with a random start ensures spatial coverage of the site. Statistical analyses of systematically collected data are valid if a random start to the grid is used. One disadvantage of systematically collected samples is that spatial variability or patterns may not be discovered if the grid spacing is large relative to the spatial patterns.

Number of Total Samples: Calculation Equation and Inputs
The equation used to calculate the number of samples is based on a Sign test (see PNNL 13450 for discussion). For this site, the null hypothesis is rejected in favor of the alternative one if the median(mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(SignP - 0.5)^2}$$

where

$$SignP = \Phi\left(\frac{\Delta}{s_{total}}\right)$$

$\Phi(z)$ is the cumulative standard normal distribution on $(-\infty,z)$ (see PNNL-13450 for details),
n is the number of samples,
S_{total} is the estimated standard deviation of the measured values including analytical error,
Δ is the width of the gray region,
α is the acceptable probability of incorrectly concluding the site median(mean) is less than the threshold,
β is the acceptable probability of incorrectly concluding the site median(mean) exceeds the threshold,
$Z_{1-\alpha}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is $1-\alpha$,
$Z_{1-\beta}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is $1-\beta$.

Note: MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user-supplied percent overage as discussed in

MARSSIM (EPA 2000, p. 5-33).

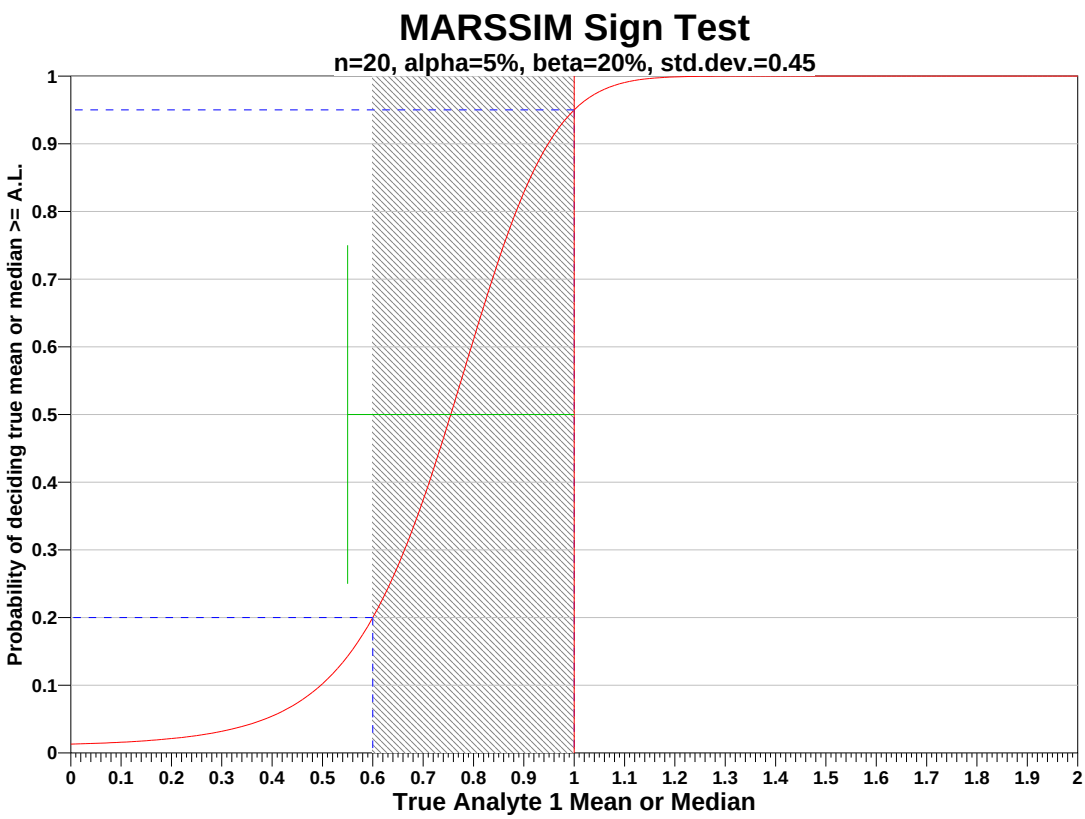
The values of these inputs that result in the calculated number of sampling locations are:

Analyte	n[a]	Parameter					
		S	Δ	α	β	$Z_{1-\alpha}$ [b]	$Z_{1-\beta}$ [c]
Analyte 1	20	0.45	0.4	0.05	0.2	1.64485	0.841621

[a] The final number of samples has been increased by the MARSSIM Overage of 20%.
[b] This value is automatically calculated by VSP based upon the user defined value of α.
[c] This value is automatically calculated by VSP based upon the user defined value of β.

The following figure is a performance goal diagram, described in EPA's QA/G-4 guidance (EPA, 2000). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median(mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

The red vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the gray shaded area is equal to Δ; the upper horizontal dashed blue line is positioned at 1-α on the vertical axis; the lower horizontal dashed blue line is positioned at β on the vertical axis. The vertical green line is positioned at one standard deviation below the threshold. The shape of the red curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of Δ at β and the upper bound of Δ at 1-α. If any of the inputs change, the number of samples that result in the correct curve changes.



Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples are:

1. the computed sign test statistic is normally distributed,
2. the variance estimate, S^2, is reasonable and representative of the population being sampled,
3. the population values are not spatially or temporally correlated, and
4. the sampling locations will be selected probabilistically.

The first three assumptions will be assessed in a post data collection analysis. The last assumption is valid because the

gridded sample locations were selected based on a random start.

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the standard deviation, lower bound of gray region (% of action level), beta (%), probability of mistakenly concluding that μ > action level and alpha (%), probability of mistakenly concluding that μ < action level. The following table shows the results of this analysis.

Number of Samples							
AL=1		α=5		α=10		α=15	
		s=0.9	s=0.45	s=0.9	s=0.45	s=0.9	s=0.45
LBGR=90	β=15	1103	280	825	209	659	167
	β=20	948	240	692	176	542	138
	β=25	826	209	587	149	449	114
LBGR=80	β=15	280	75	209	56	167	45
	β=20	240	64	176	47	138	36
	β=25	209	56	149	40	114	30
LBGR=70	β=15	128	36	95	27	77	22
	β=20	110	32	81	23	63	18
	β=25	95	27	69	20	52	15

s = Standard Deviation
LBGR = Lower Bound of Gray Region (% of Action Level)
β = Beta (%), Probability of mistakenly concluding that μ > action level
α = Alpha (%), Probability of mistakenly concluding that μ < action level
AL = Action Level (Threshold)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $0.00, which averages out to a per sample cost of $0.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**23 Samples**
Field collection costs		$0.00	$0.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$0.00**	**$0.00**
Fixed planning and validation costs			$0.00
Total cost			**$0.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2000). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Because the primary objective for sampling for this site is to compare the site median(mean) value with a threshold value, the data will be assessed in this context. Assuming the data are adequate, at least one statistical test will be done to

perform a comparison between the data and the threshold of interest. Results of the exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them.

This report was automatically produced* by Visual Sample Plan (VSP) software version 7.2.
This design was last modified 11/24/2015 12:30:34 PM.
Software and documentation available at http://vsp.pnnl.gov
Software copyright (c) 2015 Battelle Memorial Institute. All rights reserved.
* - The report contents may have been modified or reformatted by end-user of software.

Systematic sampling locations for comparing a median with a fixed threshold (nonparametric - MARSSIM)

Summary

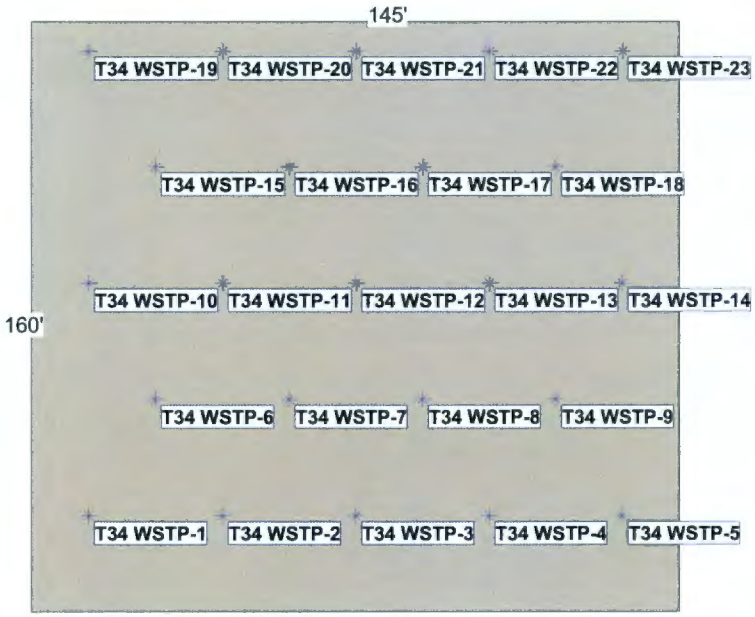
This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN

Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Systematic with a random start location
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated total number of samples	20
Number of samples on map [a]	23
Number of selected sample areas [b]	1
Specified sampling area [c]	23200.00 ft^2
Size of grid / Area of grid cell [d]	32.9387 feet / 939.6 ft^2
Grid pattern	Triangular
Total cost of sampling [e]	$0.00

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.
[d] Size of grid / Area of grid cell gives the linear and square dimensions of the grid used to systematically place samples.
[e] Including measurement analyses and fixed overhead costs. See the Cost of Sampling section for an explanation of the costs presented here.



(0,0) Southwest Corner of Pad
(-119.63929, 46.56127) Decimal Degrees

Area: LLBG Trench 34 WSTP					
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**
14.1172	23.4187	T34 WSTP-1		Systematic	
47.0559	23.4187	T34 WSTP-2		Systematic	
79.9946	23.4187	T34 WSTP-3		Systematic	
112.9332	23.4187	T34 WSTP-4		Systematic	
145.8719	23.4187	T34 WSTP-5		Systematic	
30.5865	51.9444	T34 WSTP-6		Systematic	
63.5252	51.9444	T34 WSTP-7		Systematic	
96.4639	51.9444	T34 WSTP-8		Systematic	
129.4026	51.9444	T34 WSTP-9		Systematic	
14.1172	80.4702	T34 WSTP-10		Systematic	
47.0559	80.4702	T34 WSTP-11		Systematic	
79.9946	80.4702	T34 WSTP-12		Systematic	
112.9332	80.4702	T34 WSTP-13		Systematic	
145.8719	80.4702	T34 WSTP-14		Systematic	
30.5865	108.9959	T34 WSTP-15		Systematic	
63.5252	108.9959	T34 WSTP-16		Systematic	
96.4639	108.9959	T34 WSTP-17		Systematic	

129.4026	108.9959	T34 WSTP-18	Systematic	
14.1172	137.5216	T34 WSTP-19	Systematic	
47.0559	137.5216	T34 WSTP-20	Systematic	
79.9946	137.5216	T34 WSTP-21	Systematic	
112.9332	137.5216	T34 WSTP-22	Systematic	
145.8719	137.5216	T34 WSTP-23	Systematic	

Primary Sampling Objective
The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or 'null' hypothesis) is that the median(mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median(mean) value is less than the threshold. VSP calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

Selected Sampling Approach
A nonparametric systematic sampling approach with a random start was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

Locating the sample points over a systematic grid with a random start ensures spatial coverage of the site. Statistical analyses of systematically collected data are valid if a random start to the grid is used. One disadvantage of systematically collected samples is that spatial variability or patterns may not be discovered if the grid spacing is large relative to the spatial patterns.

Number of Total Samples: Calculation Equation and Inputs
The equation used to calculate the number of samples is based on a Sign test (see PNNL 13450 for discussion). For this site, the null hypothesis is rejected in favor of the alternative one if the median(mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(SignP - 0.5)^2}$$

where

$$SignP = \Phi\left(\frac{\Delta}{s_{total}}\right)$$

$\Phi(z)$ is the cumulative standard normal distribution on $(-\infty,z)$ (see PNNL-13450 for details),
n is the number of samples,
S_{total} is the estimated standard deviation of the measured values including analytical error,
Δ is the width of the gray region,
α is the acceptable probability of incorrectly concluding the site median(mean) is less than the threshold,
β is the acceptable probability of incorrectly concluding the site median(mean) exceeds the threshold,
$Z_{1-\alpha}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is $1-\alpha$,
$Z_{1-\beta}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is $1-\beta$.

Note: MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user-supplied percent overage as discussed in

MARSSIM (EPA 2000, p. 5-33).

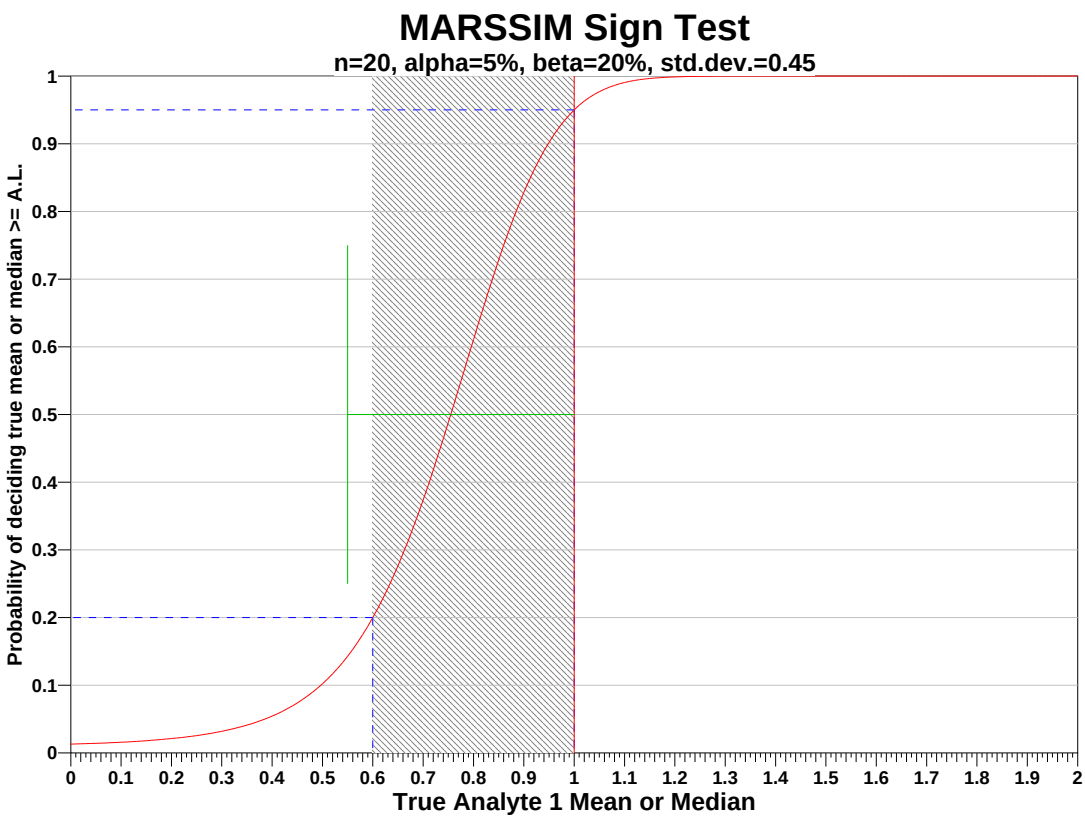
The values of these inputs that result in the calculated number of sampling locations are:

Analyte	n[a]	Parameter					
		S	Δ	α	β	$Z_{1-\alpha}$ [b]	$Z_{1-\beta}$ [c]
Analyte 1	20	0.45	0.4	0.05	0.2	1.64485	0.841621

[a] The final number of samples has been increased by the MARSSIM Overage of 20%.
[b] This value is automatically calculated by VSP based upon the user defined value of α.
[c] This value is automatically calculated by VSP based upon the user defined value of β.

The following figure is a performance goal diagram, described in EPA's QA/G-4 guidance (EPA, 2000). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median(mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

The red vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the gray shaded area is equal to Δ; the upper horizontal dashed blue line is positioned at 1-α on the vertical axis; the lower horizontal dashed blue line is positioned at β on the vertical axis. The vertical green line is positioned at one standard deviation below the threshold. The shape of the red curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of Δ at β and the upper bound of Δ at 1-α. If any of the inputs change, the number of samples that result in the correct curve changes.



Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples are:

1. the computed sign test statistic is normally distributed,
2. the variance estimate, S^2, is reasonable and representative of the population being sampled,
3. the population values are not spatially or temporally correlated, and
4. the sampling locations will be selected probabilistically.

The first three assumptions will be assessed in a post data collection analysis. The last assumption is valid because the

gridded sample locations were selected based on a random start.

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the standard deviation, lower bound of gray region (% of action level), beta (%), probability of mistakenly concluding that μ > action level and alpha (%), probability of mistakenly concluding that μ < action level. The following table shows the results of this analysis.

Number of Samples							
AL=1		α=5		α=10		α=15	
		s=0.9	s=0.45	s=0.9	s=0.45	s=0.9	s=0.45
LBGR=90	β=15	1103	280	825	209	659	167
	β=20	948	240	692	176	542	138
	β=25	826	209	587	149	449	114
LBGR=80	β=15	280	75	209	56	167	45
	β=20	240	64	176	47	138	36
	β=25	209	56	149	40	114	30
LBGR=70	β=15	128	36	95	27	77	22
	β=20	110	32	81	23	63	18
	β=25	95	27	69	20	52	15

s = Standard Deviation
LBGR = Lower Bound of Gray Region (% of Action Level)
β = Beta (%), Probability of mistakenly concluding that μ > action level
α = Alpha (%), Probability of mistakenly concluding that μ < action level
AL = Action Level (Threshold)

Cost of Sampling

The total cost of the completed sampling program depends on several cost inputs, some of which are fixed, and others that are based on the number of samples collected and measured. Based on the numbers of samples determined above, the estimated total cost of sampling and analysis at this site is $0.00, which averages out to a per sample cost of $0.00. The following table summarizes the inputs and resulting cost estimates.

COST INFORMATION			
Cost Details	**Per Analysis**	**Per Sample**	**23 Samples**
Field collection costs		$0.00	$0.00
Analytical costs	$0.00	$0.00	$0.00
Sum of Field & Analytical costs		**$0.00**	**$0.00**
Fixed planning and validation costs			$0.00
Total cost			**$0.00**

Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2000). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Because the primary objective for sampling for this site is to compare the site median(mean) value with a threshold value, the data will be assessed in this context. Assuming the data are adequate, at least one statistical test will be done to

perform a comparison between the data and the threshold of interest. Results of the exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them.

This report was automatically produced* by Visual Sample Plan (VSP) software version 7.2.
This design was last modified 11/24/2015 12:37:10 PM.
Software and documentation available at http://vsp.pnnl.gov
Software copyright (c) 2015 Battelle Memorial Institute. All rights reserved.
* - The report contents may have been modified or reformatted by end-user of software.

Appendix H-C

Trench 94 Dangerous Waste Management Unit

This page intentionally left blank.

Contents

H-C1 Introduction H-C-1
H-C1.1 Unit Description H-C-1
H-C1.2 Maximum Waste Inventory H-C-1
H-C2 Closure Performance Standard H-C-1
H-C3 Closure Activities H-C-1
H-C3.1 Monitoring H-C-2
H-C3.2 Groundwater Monitoring H-C-2
H-C3.3 Leachate Monitoring H-C-3
H-C3.4 Periodic Inspections and Maintenance H-C-3
H-C3.5 Final Landfill Cover H-C-3
H-C3.6 Health and Safety Requirements H-C-5
H-C3.7 Role of the Independent, Qualified, Registered, Professional Engineer H-C-6
H-C3.8 Closure Certification H-C-6
H-C3.9 Conditions That Will Be Achieved when Closure Is Complete H-C-7
H-C4 Closure Schedule and Time Frame H-C-7
H-C5 Closure Costs H-C-7
H-C6 Post-Closure H-C-8
H-C6.1 Post-Closure Use of Property H-C-8
H-C6.2 Groundwater Monitoring and Reporting H-C-10
H-C6.3 Facility Maintenance H-C-10
H-C6.3.1 Erosion Control H-C-10
H-C6.3.2 Cover Integrity Inspection and Maintenance H-C-11
H-C6.3.3 Monitoring Well Inspection and Maintenance H-C-11
H-C6.4 Post-Closure Security H-C-11
H-C6.5 Contact Information H-C-11
H-C6.6 Amendment of the Plan H-C-11
H-C6.7 Survey Plat and Notice in Deed H-C-11
H-C6.8 Certification of Completion of Post-Closure Care H-C-12

Figures

Figure H-C1. LLBG Trench 94 (Aerial Dated 2012) H-C-2
Figure H-C2. Modified RCRA Subtitle C Barrier H-C-4
Figure H-C3. LLBG Trench 94 Closure Schedule Activities H-C-9

Tables

Table H-C1. Modified RCRA Subtitle C Barrier Layer Description H-C-4
Table H-C2. LLBG Trench 94 Closure Activities H-C-7

H-C1 Introduction

This appendix discusses closure activities for the Low-Level Burial Grounds (LLBG) Trenches 31-34-94 Operating Unit Group Trench 94 dangerous waste management unit (DWMU). This DWMU is located in the 200 East Area of the Hanford Facility. Closure will be performed in accordance with the included schedule.

This closure plan complies with WAC 173-303-610(2) through (10) "Dangerous Waste Regulations," "Closure and Post-Closure." Amendments to this closure plan will be submitted as permit modifications in accordance with WAC 173-303-610(3)(b).

Please note, the terms "mixed waste" and/or "waste" when seen in this document refer to dangerous waste or hazardous waste, as applicable.

H-C1.1 Unit Description

LLBG Trench 94 (Figure H-C1) is a large rectangular excavation in the 218-E-12B Burial Ground operated as a unit for disposal of defueled reactor compartments (RCs). LLBG Trench 94 is approximately 494 m (1,620 ft) by 98 m (320 ft) at the base and 15 m (49 ft) deep.

H-C1.2 Maximum Waste Inventory

LLBG Trench 94 began receiving RCs for disposal in April 1986. LLBG Trench 94 has a permitted disposal capacity of approximately 1,500,000 m^3 (1.5×10^9 L).

H-C2 Closure Performance Standard

Closure performance standards for LLBG Trench 94 will ensure compliance with the requirements found in WAC 173-303-610(2), which requires closure of the facility in the following manner:

- Minimize the need for further maintenance.
- Control, minimize, or eliminate, to the extent necessary, to protect human health and the environment (HHE), post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or atmosphere.
- Return the land to the appearance and use of surrounding land areas, to the degree possible, given the nature of the previous dangerous waste activity.

H-C3 Closure Activities

Closure activities will focus on final cover installation, including oversight of the DWMU during cover installation, and appropriate certifications. Section H-C4 provides the closure schedule.

Post-closure activities (Section H-C6) will begin after installation of the final cover and Washington State Department of Ecology (Ecology) acceptance of closure. Post-closure activities will include long-term monitoring activities, periodic inspections, and maintenance activities to ensure long-term integrity of the closed landfill.

The following closure activities are required to achieve and verify final closure:

- Monitoring of the groundwater

- Periodic inspections and maintenance of the facility during the closure period
- Modification of the abovegrade portions, as necessary, to allow final cover installation and continued collection of leachate during post-closure monitoring and maintenance
- Installation of the final cover including vegetation
- Certification of closure, as required by WAC 173-303-610(6)

Figure H-C1. LLBG Trench 94 (Aerial Dated 2012)

H-C3.1 Monitoring

Groundwater monitoring will continue during the closure and post-closure periods according to the Low-Level Waste Management Area (LLWMA)-2 Groundwater Monitoring Plan in Addendum D, "Groundwater Monitoring Plan."

H-C3.2 Groundwater Monitoring

The groundwater level at the LLBG Trench 94 is located 54 m to 79 m (177 ft to 259 ft) below ground surface of the 218-E-12B Burial Ground, which includes Trench 94. Groundwater monitoring at LLWMA-2 will continue into the closure and post-closure periods, as described in Section H-C6.2. Groundwater monitoring will be performed in accordance with WAC 173-303-645, "Releases from Regulated Units," and Addendum D.

H-C3.3 Leachate Monitoring

LLBG Trench 94 is exempt from the requirements of WAC 173-303-665(4)(c)(i), "Landfills," for the weekly collection of leachate. However, periodic inspections will continue throughout the closure and post-closure period in accordance with Sections H-C3.4 and H-C6.

H-C3.4 Periodic Inspections and Maintenance

During closure, periodic inspections and maintenance of LLBG Trench 94 identified in the Addendum I, "Inspection Requirements," will continue through closure activities. Post-closure inspections and maintenance of the final cover will continue as detailed in Section H-C6.

H-C3.5 Final Landfill Cover

In accordance with WAC 173-303-665, the final landfill cover will be designed and constructed with the following objectives:

- Minimize migration of liquids through the closed landfill.
- Require minimal maintenance.
- Promote drainage and minimize cover erosion or abrasion.
- Maintain cover integrity despite settling and subsidence.
- Provide permeability less than or equal to that of any natural subsoil present.

In 1996, a focused feasibility study (FFS) (DOE/RL-93-33, *Focused Feasibility Study of Engineered Barriers for Waste Management Units in the 200 Areas*) of engineered barriers (covers) was prepared for the 200 Area of the Hanford Facility. The FFS provided four generic conceptual cover designs that evaluated federal and state regulatory requirements and drew upon experience with cover designs for Hanford Facility applications. The Modified *Resource Conservation and Recovery Act of 1976* (RCRA) Subtitle C Barrier defined in the FFS is designed to meet or exceed the regulatory requirements for applications at Category 1 and Category 3 low-level waste (LLW) sites and is the baseline for Hanford areas containing waste, Category 3 LLW, and Category 3 and Category 1 mixed LLW. The Modified RCRA Subtitle C Barrier is designed to provide long-term containment, hydrologic protection, and provision to control biointrusion and human intrusion for a performance period of 500 years. The Modified RCRA Subtitle C Barrier layers are described in Table H-C1 and depicted in Figure H-C2.

Layer 1 (topsoil with pea gravel admixture) consists of 50 cm (20 in.) of sandy silt-to-silt loam soil. Layer 1 will be placed in a relatively loose condition and will retain soil moisture to support the cover vegetation. The pea gravel in Layer 1 will improve soil resistance to wind erosion. The slope of Layer 1 will be 2 percent, which will allow for drainage of runoff from the area yet limit exposure of the surface to wind erosion.

Layer 2 (topsoil without pea gravel) consists of 50 cm (20 in.) of the same silt loam soil as Layer 1 but without the pea gravel. Layer 2 is placed in a relatively densified state. Compaction of Layer 2 will help to resist moisture migration through Layer 2.

Layer 3 (sand filter) and Layer 4 (gravel filter) prevent topsoil from migrating downward and collecting in the lateral drainage layer (Layer 5).

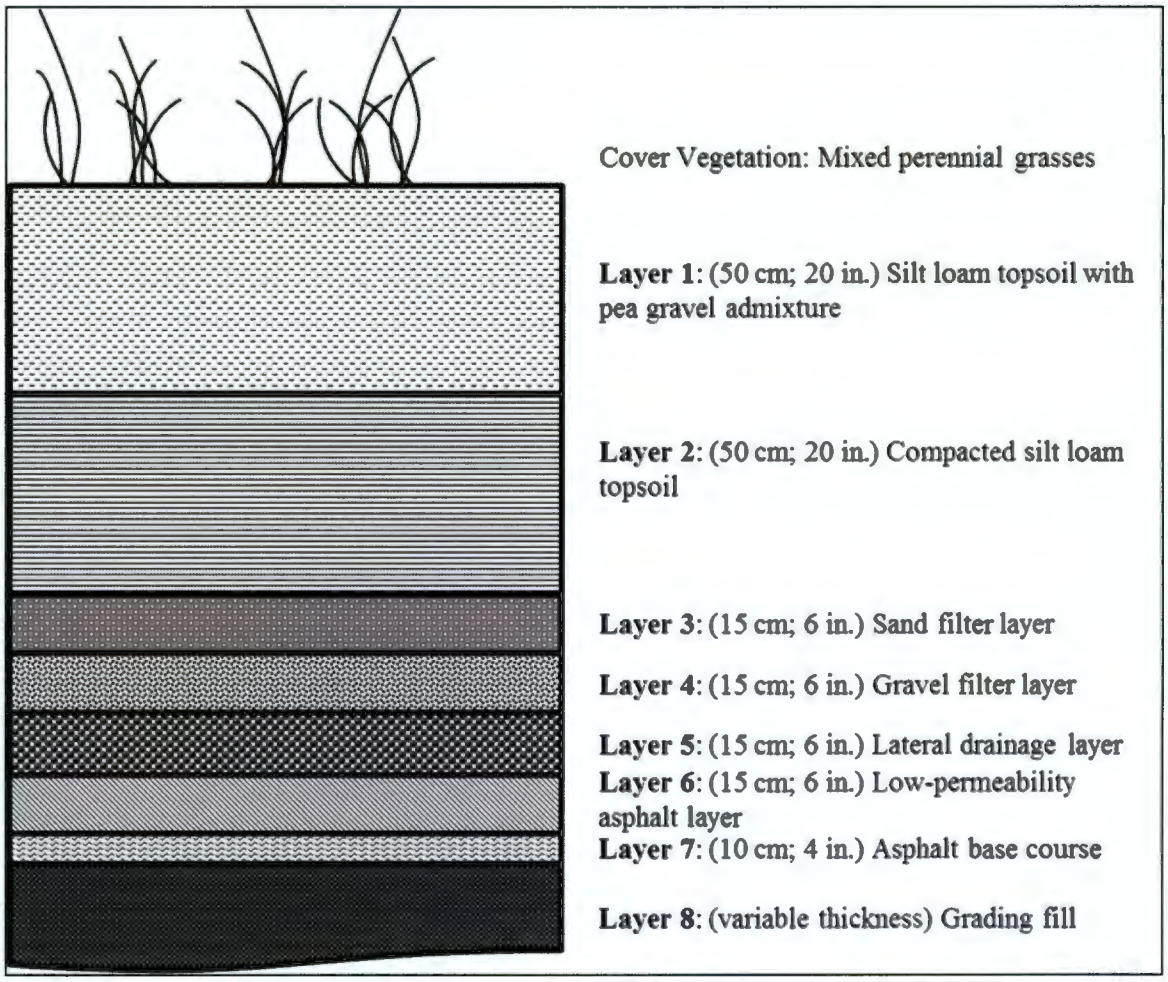


Figure H-C2. Modified RCRA Subtitle C Barrier

Table H-C1. Modified RCRA Subtitle C Barrier Layer Description

Layer	Depth	Material
Cover Vegetation	Not Applicable	Mixed perennial grasses
Layer 1	50 cm (20 in.)	Silt loam topsoil with pea gravel admixture
Layer 2	50 cm (20 in.)	Compacted silt loam topsoil
Layer 3	15 cm (6 in.)	Sand filter layer
Layer 4	15 cm (6 in.)	Gravel filter layer
Layer 5	15 cm (6 in)	Lateral drainage layer
Layer 6	15 cm (6 in.)	Low-permeability asphalt layer
Layer 7	10 cm (4 in.)	Asphalt base course
Layer 8	Variable thickness	Grading fill

Layer 5 (lateral drainage layer) provides removal of moisture that may have filtered through from Layer 1 and Layer 2. Layer 5 will consist of clean, screened aggregate material, and it will be sloped at 2 percent to move water to the edge of the cover for collection and diversion from the leachate collection system.

Layer 6 (asphalt layer) is a low-permeability layer constructed of double-tar asphalt that will act as a biointrusion barrier for plant roots and burrowing animals. It will also function as a deterrent for human intrusion. Layer 6 will be constructed with a 2 percent slope.

Layer 7 (asphalt base course) will provide a stable base for placement of the overlying asphalt layer. Layer 7 will be screened, crushed-surfacing material.

Layer 8 (grading fill) will be placed in the trench to establish a smooth surface for construction of the upper levels of the barrier. Grading fill, which will consist of well-graded granular soil mixture, will create a uniform surface sloped at 2 percent.

Once the final volume of waste is disposed into Trench 94, a definitive final cover design, based on the Modified RCRA Subtitle C Barrier, will be completed and submitted as a permit modification in accordance with WAC 173-303-610 requirements.

H-C3.6 Health and Safety Requirements

Closure will be performed in a manner to ensure safety of personnel and the surrounding environment. Qualified personnel will perform all closure activities in compliance with established safety and environmental procedures. Personnel will be equipped with appropriate personal protective equipment. Qualified personnel will be trained in applicable safety and environmental procedures in accordance with Addendum G, "Personnel Training." Field operations will be performed in accordance with applicable health and safety requirements.

The Permittees have instituted training or qualification programs to meet training requirements imposed by regulations, U.S. Department of Energy (DOE) orders, and national standards such as those published by the American National Standards Institute/American Society of Mechanical Engineers. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter Hanford Facility RCRA Permit), Attachment 5, "Hanford Facility Personnel Training Program," describes specific requirements for the Hanford Facility Personnel Training program. The Permittees will comply with the LLBG Trenches 31-34-94 Training Matrix detailed in Addendum G, which provides training requirements for Hanford Facility personnel associated with LLBG Trench 94.

Project-specific safety training addressed explicitly to the project and the day's activity will be provided, including the following:

- Training to provide the knowledge and skills that personnel need to perform work safely while installation of the final covers are being completed
- Requirement that samplers be qualified for sampling of groundwater during the closure and post-closure periods

Pre-job briefings will be performed to evaluate activities and associated hazards by considering many factors, including the following:

- Objective of the activities
- Individual tasks to be performed

- Hazards associated with the planned tasks
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Emergency contacts

Training records are maintained for each employee in an electronic database. The Permittees' training organization maintains the training records system.

H-C3.7 Role of the Independent, Qualified, Registered, Professional Engineer

An Independent, Qualified, Registered, Professional Engineer (IQRPE) will be retained to provide closure certification, as required by WAC 173-303-610(6). The IQRPE will be responsible for observing field activities and reviewing documents associated with closure of LLBG Trench 94. At a minimum, field activities and documents reviewed would include the following:

- Review of the LLBG Trench 94 final cover definitive design
- Review of groundwater sampling procedures and results during the closure period
- Observation or review of groundwater sampling activities during the closure period
- Observation and review of final cover installation activities

The IQRPE will record observations and reviews in a written report that will be retained in the operating record. The resulting report will be used to develop the closure certification that will be provided to Ecology.

H-C3.8 Closure Certification

In accordance with WAC 173-303-610(6), within 60 days of completion of closure of LLBG Trench 94, certification that the DWMU has been closed in accordance with the specifications in this closure plan will be submitted to Ecology by registered mail. The certification will be signed by the owner or operator and by an IQRPE.

Upon request by Ecology, the following information will be submitted to support the closure certification:

- All field notes and photographs related to closure activities, including the installation of the final cover
- Description of any minor deviations from the approved closure plan and justification for these deviations
- All laboratory and/or field data, including sampling procedures, sampling locations, quality assurance/quality control samples, and chain of custody procedures for all groundwater samples taken during the closure period
- Summary report that identifies and describes the data reviewed by the IQRPE
- Description of the DWMU area at completion of closure, including parts of the former unit, if any, that remain after closure

H-C3.9 Conditions That Will Be Achieved when Closure Is Complete

Upon completion of the final cover over LLBG Trench 94, the land will be returned to the appearance and use of surrounding land areas to the degree possible. The top layer (Layer 1) of the final cover will be populated with perennial grasses similar to the natural environment surrounding the landfill. A perimeter fence will surround the landfill site, preventing unauthorized or unintentional entrance by people or livestock.

H-C4 Closure Schedule and Time Frame

Construction of the final cover will be completed approximately 150 weeks (1,050 days) after the start of the closure period (Table H-A2). Due to extensive requirements inherent in the design and construction of a landfill cover, an extended closure period greater than the allowable 180 day closure period identified in WAC 173-303-610(4)(c) is required.

Approval of this closure plan will grant the Hanford Facility an extended closure period for construction of the final cover, and a separate extension request will not be filed. During the closure period, all steps to prevent threats to HHE, including compliance with all applicable permit requirements, will be demonstrated. Closure certification will be submitted to Ecology within 60 days following completion of closure activities at LLBG Trench 94, as outlined in Section H-C3.8 (Figure H-C3).

H-C5 Closure Costs

An annual report outlining updated projections of anticipated closure costs for the Hanford Facility treatment, storage, and disposal units having final status is not required per Hanford Facility RCRA Permit Condition II.H. The Hanford Facility is owned by DOE and operated by DOE and its contractors; therefore, in accordance with WAC 173-303-620(1)(c), provisions of WAC 173-303-620, "Financial Requirements," are not applicable to the Hanford Facility.

Table H-C2. LLBG Trench 94 Closure Activities

Closure Activity Description		Expected Duration
Primary Activity	**Secondary Activity**	
Monitoring of Groundwater	Not applicable	Continuous
Inspections and Maintenance of the Run-on and Run-off Control Systems	Not applicable	Continuous
CLOSURE ACTIVITIES		
General Mobilization	Water sources (storage tanks), construction trailers, and heavy equipment	4 weeks (Week 4)
	Provide Ecology with 30 day notification of construction work	
Cover Installation Preparation	Fill voids	24 weeks (Week 28)
	Prepare subgrade (filling of low areas, compacting, and regrading)	
	Excavate run-on/run-off controls	

Table H-C2. LLBG Trench 94 Closure Activities

Closure Activity Description		Expected Duration
Primary Activity	**Secondary Activity**	
Modifications to the Abovegrade Portion of the Trench	Fill voids	26 weeks (Week 54)
	Place silt	
Installation of the Final Cover, Including Vegetation	Stabilize barrier base	96 weeks (Week 150)
	Construct barrier layers	
	Install vegetation	
CLOSURE ACTIVITIES COMPLETE		
Owner/Operators and IQRPE Submit Closure Certification	In accordance with WAC 173-303-610(6), within 60 days of completion of closure of each DWMU; certification that the DWMU has been closed in accordance with the specifications in the approved closure plan (see Section H-C3.8 for more details on the closure certification).	60 days
POST-CLOSURE ACTIVITIES BEGIN		

H-C6 Post-Closure

Post-closure activities will begin for LLBG Trench 94 after submittal of the closure certification to Ecology. In general, the following post-closure activities will be included:

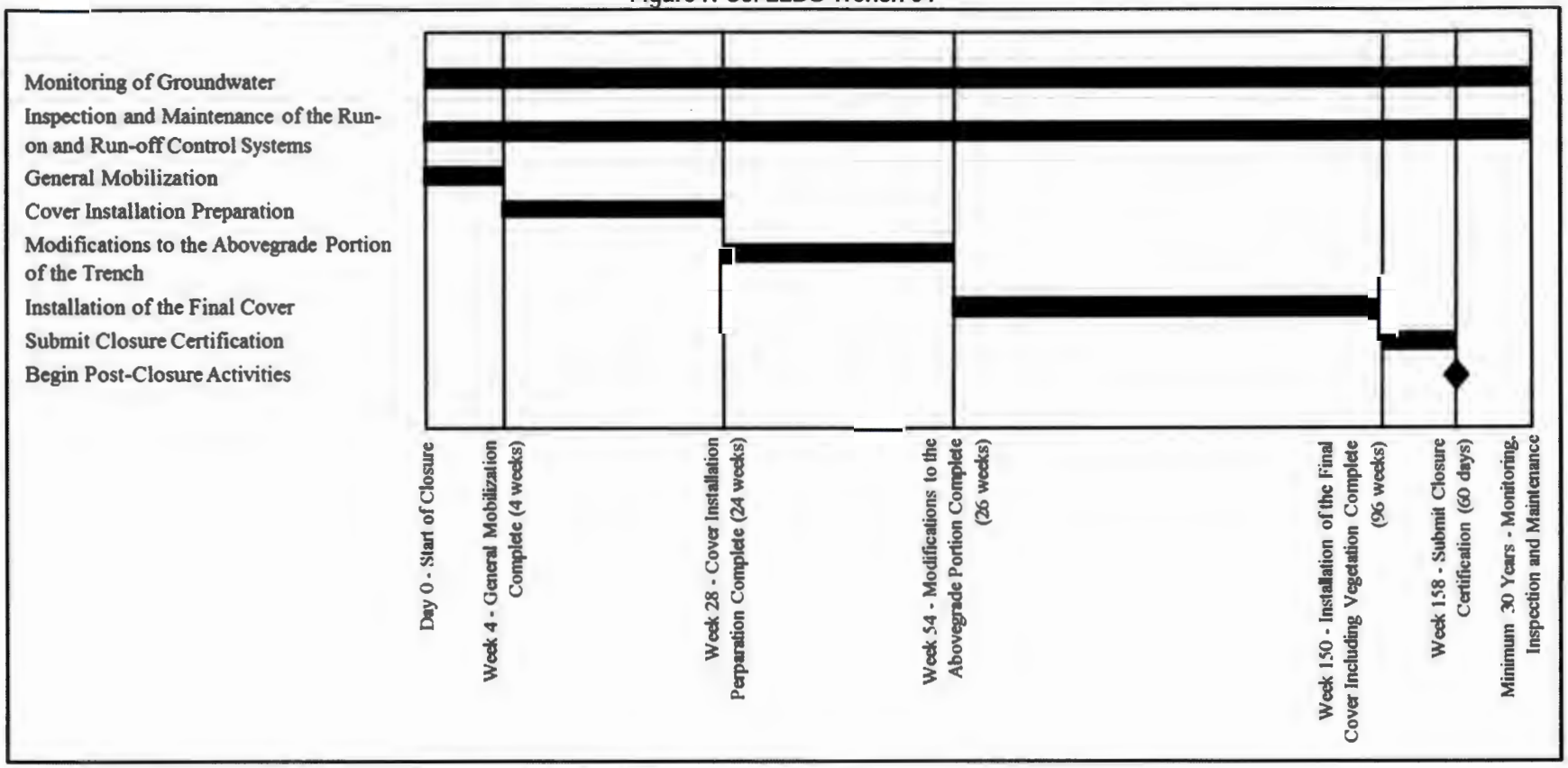
- Groundwater monitoring, as required in WAC 173-303-665
- Maintenance and inspection activities to maintain the final cover and groundwater monitoring
- Continued security of the landfill area

As required by WAC 173-303-610(7), post-closure activities will continue for a period of 30 years.

H-C6.1 Post-Closure Use of Property

After closure of LLBG Trench 94, the area in which the trench is located will be surrounded by security fencing and will continue to be monitored 24 hours a day as part of Addendum E, "Security." The land will be closed to industrial standards, and the cover will be maintained; however, no post-closure use of the land is anticipated.

Figure H-C3. LLBG Trench 94



Closure Schedule Activities

H-C6.2 Groundwater Monitoring and Reporting

The groundwater monitoring system will be maintained throughout the closure and post-closure periods. The groundwater monitoring system known as LLWMA-2 consists of the 218-E-12B Burial Ground, which contains 39 unlined trenches including LLBG Trench 94.

The LLWMA-2 groundwater monitoring system was initiated in 1987 and consisted of four upgradient and four downgradient wells. Additional wells were installed from 1989 through 1992, as needed, to maintain the integrity of the monitoring system. All of the northern and eastern wells have gone dry over the past two decades for two reasons: (1) the basalt elevation is relatively high compared to the water table elevation beneath the northern and eastern portions of the burial ground, and (2) the water table level has continued to decline due to termination of Hanford Facility production operations and effluent releases. The nine remaining active network monitoring wells are located along the southern and western boundary of the burial ground. The active wells monitor the upper portion of the aquifer and extend between 1.24 and 2.78 m (4.07 and 9.12 ft) into the aquifer.

The LLWMA-2 groundwater monitoring system is sampled semiannually for the indicator and groundwater quality parameters, including anions and metals; samples are analyzed annually for alkalinity, mercury, lead, and phenols. Sitewide water level measurements are collected each sampling event and every March.

The LLWMA-2 groundwater monitoring system requirements specific to the LLBG Trench 94 are detailed within Addendum D.

H-C6.3 Facility Maintenance

LLBG Trench 94 facility periodic inspections and required maintenance will be performed throughout the post-closure period. Maintenance will be performed in a timely manner to ensure compliance with post-closure requirements for final cover integrity and groundwater monitoring. Inspections will be performed annually and will focus on evaluating the following conditions:

- Erosion control
- Cover integrity, including subsidence
- Groundwater monitoring system integrity

As required by WAC 173-303-610(8)(b)(ii), this section also provides for maintenance of the closed landfill area throughout the post-closure period. Facility maintenance is based on observations made during annual inspection and monitoring.

H-C6.3.1 Erosion Control

The goal of the FFS (DOE/RL-93-33) was to design a multilayer cover that will resist natural degradation processes and require minimal maintenance during its design lifetime (functional life of 500 years). Layer 1 (topsoil) incorporates pea gravel into the soil to reduce susceptibility to wind erosion. Vegetation planted on the topsoil layer will further reduce erosion due to wind and precipitation runoff. The topsoil will be sloped at 2 percent, which is steep enough to provide drainage of runoff from the cover but shallow enough to limit surface exposure leading to wind erosion. The topsoil layer includes excess thickness to provide performance margins against long-term wind erosion and climate change.

H-C6.3.2 Cover Integrity Inspection and Maintenance

Annual cover integrity inspections will evaluate the cover for breaches in the surface, depressions caused by settling or compression, subsidence, erosion, or other disruptions to the cover that would cause a reduction in performance.

Cover integrity inspections will be performed through aerial photography and elevation surveys. Control points marked around the perimeter and at critical points on the cover area will be used to determine changes in cover elevation.

Depressions or other surface layer disturbances that may affect the integrity of the cover will be filled using topsoil with pea gravel then revegetated.

H-C6.3.3 Monitoring Well Inspection and Maintenance

Post-closure inspection of the monitoring well system will be performed in accordance with Addendum D. The LLWMA-2 groundwater monitoring system will continue to be used and maintained for monitoring of the 218-E-12B Burial Ground, which includes Trench 94.

H-C6.4 Post-Closure Security

During the post-closure period, 24 hour security requirements outlined in Addendum E will continue. This will assist in preventing access, which may disturb the integrity of the final cover.

H-C6.5 Contact Information

Facility Operator:

Stacy Charboneau, Manager
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, WA 99352
(509) 376-7395

H-C6.6 Amendment of the Plan

If an amendment to this closure plan is required, a plan revision will be prepared by the DOE Richland Operations Office (DOE-RL) and submitted to Ecology in accordance with WAC 173-303-610(8)(d) for approval. The Hanford Facility groundwater monitoring reports provide annual results and interpretations of groundwater monitoring. Sampling data are placed in the Hanford Environmental Information System database.

H-C6.7 Survey Plat and Notice in Deed

Upon submission of the closure certification for LLBG Trench 94, DOE-RL will submit a survey plat indicating the location and dimensions of the landfill cell with respect to permanently surveyed benchmarks. This survey will be prepared and certified by a professional land surveyor, as required in WAC 173-303-610(9). No later than 60 days after closure certification, DOE-RL will submit a survey plat to the Benton County Planning Department in accordance with WAC 173-303-610(10). Additionally, DOE-RL will submit a notice in deed to the Benton County Auditor no later than 60 days after closure certification of the trench in accordance with WAC 173-303-610(10). After submitting this notice, a certification signed by the Permittees will be submitted to Ecology stating that notification has been

recorded along with a copy of the notice in deed. The notice in deed will specify the type, location, and quantity of wastes remaining after closure actions have been completed.

H-C6.8 Certification of Completion of Post-Closure Care

No later than 60 days after completion of the 30 year post-closure period, a certification stating the post-closure period was performed in accordance with the approved post-closure plan and signed by an IQRPE and DOE-RL will be submitted to Ecology. Supporting documentation will be provided along with the signed certification. Examples of supporting documentation may include the following:

- Groundwater analysis results
- Final cover inspection results
- Facility maintenance

Post-closure will be considered complete, and post-closure monitoring, inspections, and maintenance will be discontinued upon Ecology acceptance of the post-closure certification.

Addendum I

Inspection Plan

This page intentionally left blank.

Contents

I1 Inspection Plan I-1
I1.1 General Inspection Requirements I-1
I1.1.1 Types of Problems I-1
I1.1.2 Frequency of Inspections I-1
I1.2 Inspection Log I-2
I1.3 Schedule for Remedial Action for Problems Revealed I-2
I1.4 Specific Process Inspection Requirements I-2
I1.4.1 General Facility I-2
I1.4.2 Container Inspection I-2
I1.4.3 Landfill Inspections I-3

Tables

Table I-1. Inspection Schedule I-4
Table I-2. Landfill Inspection Schedule I-5

This page intentionally left blank.

I1 Inspection Plan

This addendum[1] describes the method(s) and schedule for inspections of the Low Level Burial Ground (LLBG) Trenches 31-34-94 Operating Unit Group, hereinafter referred to as LLBG Trenches 31-34-94. LLBG Trenches 31-34-94 provide storage, treatment, and disposal for dangerous and/or mixed waste from Hanford onsite and offsite generators. There are five operating dangerous waste management units in LLBG Trenches 31-34-94: LLBG Trench 31, LLBG Trench 34, LLBG Trench 94, LLBG Trench 31 Waste Storage and Treatment Pad, and LLBG Trench 34 Waste Storage and Treatment Pad.

The Permittees will ensure that the inspections at LLBG Trenches 31-34-94 will meet the requirements for container storage in WAC 173-303-630(6), "Dangerous Waste Regulations," "Use and Management of Containers," landfill operations in WAC 173-303-655 (4), "Landfills," and general inspection requirements of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter Hanford Facility RCRA Permit) Condition II.O (WAC 173-303-320, "General Inspection"). The purpose of these inspections is to minimize situations that may cause or lead to the release of dangerous waste to the environment or that might pose a threat to human health. Abnormal conditions identified by inspections will be corrected on a schedule that prevents hazards to personnel, the public, and the environment in accordance with the requirements of WAC 173-303-320 (3).

Please note, the terms "mixed waste" and/or "waste", when seen in this document, refer to dangerous waste or hazardous waste, as applicable.

I1.1 General Inspection Requirements

LLBG Trenches 31-34-94 inspections will be performed by qualified personnel trained in accordance with Addendum G, "Personnel Training," to inspect storage areas and landfills. The content and frequency of inspections are described in the following subsections and in Tables I-1 and I-2.

I1.1.1 Types of Problems

Inspections are conducted to detect any signs of malfunction, deterioration, discharges, or other anomalies. Refer to Table I-1 for the types of problems looked for during an inspection. Key components of the LLBG Trenches 31-34-94 inspections include, but are not limited to, the following:

- Safety and emergency equipment
- Security equipment
- Storage area/containers
- Landfill inspections
- Leachate collection system (LLBG Trenches 31 and 34 Only)

I1.1.2 Frequency of Inspections

In accordance with WAC 173-303-320, the frequency of inspections for LLBG Trenches 31-34-94 is identified in Table I-1 and Table I-2. Areas subject to spills, such as loading and unloading areas where containers with known or suspected liquids are handled outside of secondary containment, are inspected daily when in use. Weekly inspections are performed in all areas where dangerous waste is being managed. Emergency response equipment, including spill response kits, portable eyewashes, emergency communication systems, and fire extinguishers, is inspected monthly.

---

[1] This addendum expressly supersedes Exhibit A, Sections 1.10.2 and 1.10.3 of the Agreed Order and Stipulated Penalty No. DE10156.

I1.2 Inspection Log

Inspections, implemented through operating requirements, will be documented on inspection checklists and log sheets. Inspection checklists consist of items that will be assessed during each inspection. Any problems or discrepancies identified during the inspection are recorded on the inspection log sheet and reported to the operating organizations. Problems identified during the inspections are tracked on the inspection checklist and/or log sheets, which are prioritized and addressed in a timely fashion as described in Section I1.3.

When the inspection is completed, the inspector prints his or her name, includes the date and time, and signs the inspection checklist and/or log sheet. The Permittees will place the required documentation into the Hanford Facility Operating Record, LLBG Portion as required by Hanford Facility RCRA Permit Condition II.I (WAC 173-303-380, "Facility Recordkeeping"). The schedule and inspection records will also be maintained, retained, and stored in accordance with Hanford Facility RCRA Permit Condition II.I.

I1.3 Schedule for Remedial Action for Problems Revealed

In accordance with Hanford Facility RCRA Permit Condition II.O.2 [WAC 173-303-320(3)], the LLBG Trenches 31-34-94 operating organizations will remedy any problems or discrepancies revealed by the inspection on a schedule that prevents hazards to human health and the environment. Where a hazard is imminent or has already occurred, immediate action will be taken, including activation of the Contingency Plan (Addendum J) measures, when required, as defined in Hanford Facility RCRA Permit Condition II.A.

I1.4 Specific Process Inspection Requirements

The following sections detail inspections to be performed at LLBG Trenches 31-34-94. As stated in Section I1.1, inspections will be performed by trained and authorized operations personnel. An inspection schedule will be maintained, as identified in this Addendum (Tables I-1 and I-2), and inspections will be documented on inspection checklists and/or log sheets.

I1.4.1 General Facility

LLBG Trenches 31-34-94 will be inspected to ensure that general facility operating requirements are met in accordance with WAC 173-303-320. Inspection frequencies are detailed in Table I-1 and address emergency equipment and security.

I1.4.2 Container Inspection

Upon receipt, each container is inspected by LLBG operations personnel to confirm appropriate documentation and compliance with the requirements in Addendum B, "Waste Analysis Plan," before the container is placed within LLBG Trenches 31-34-94. Any discrepancies are resolved according to the requirements in Addendum B and documented on the inspection record.

While containers are in storage within LLBG Trenches 31 and 34 Waste Storage and Treatment Pads, inspections will take place in accordance with WAC 173-303-630(6) and Table I-1. Inspections of the active storage areas and containers are conducted weekly to detect any signs of malfunction, deterioration, discharges, or other anomalies. In accordance with WAC 173-303-320(2)(c), this inspection is repeated daily if waste management operations are being conducted and there is a potential for spills to occur from such activities as handling containers with known or suspected liquids and are moved outside of secondary containment (e.g., loading and unloading areas). Specific items to be noted during inspections are listed in Table I-1.

I1.4.3 Landfill Inspections

LLBG Trenches 31-34-94 will be inspected in accordance with WAC 173-303-665(4) requirements. Specific items to be noted during inspections are listed in Table I-2. Trenches are inspected for erosional problems, run-on/run-off, and wind dispersal on a weekly basis and after a storm event. A storm event is defined as any atmospheric disturbance with either wind gusts of approximately 72 km (45 mi) per hour or greater or precipitation of approximately 12 mm (0.5 in.) or greater within a 24-hour period.

I1.4.3.1 Run-On and Run-Off Control System

A run-on control system is installed around the perimeter of each trench. The system consists of a berm along the outer margin of each trench and prevents run-on from entering the trench. The system is described in detail in Addendum C, "Process Information." All run-on control system berms will be inspected weekly and after a storm event for signs of deterioration, malfunction, or improper operation.

There is no run-off control system for the trenches because the trenches are constructed below grade. Any precipitation falling on the trenches is removed by either evapotranspiration or the leachate collection and removal systems (see following subsections). Therefore, a run-off control system is not needed.

I1.4.3.2 Wind Dispersal Control System

LLBG Trench 31 and 34 use various methods to prevent wind dispersal of mixed waste, depending on the waste form (e.g., bulk waste). Methods to prevent wind dispersal include containerizing, stabilizing, grouting, spray fixative, and backfill. Sometimes the natural form of the waste precludes the need for wind dispersal protection, (e.g., scrap piping and other solid debris). In other instances, the operating organization implements a wind speed restriction during handling and immediately backfills the waste to prevent wind dispersal. All wind dispersal control systems will be inspected weekly and after a storm event for signs of deterioration or damage.

I1.4.3.3 Leachate Collection and Removal System

The leachate collection and removal systems at LLBG Trenches 31 and 34 will be inspected in accordance with WAC 173-303-665(4) requirements. Each trench has a primary and a secondary leachate collection and removal system. The purpose of the systems is to provide sufficient storage volume to collect and retain, in a timely manner, fluids falling on or moving through the waste. The primary leachate collection and removal system provides the preferential path along which the leachate flows into the primary sump. The secondary leachate collection and removal system provides the preferential path along which any fluids leaking through the primary liner system flow to the secondary sump. The systems are described in detail in Addendum C, "Process Information." Liquids in the leachate collection systems are monitored to ensure that the action leakage rate is not exceeded, as defined in WAC 173-303-665(8).

The leachate collection and removal systems for LLBG Trenches 31 and 34 are inspected daily to ensure proper functioning. At a minimum, monthly evaluations (October through March) on the leachate transfer lines for freeze protection are conducted. Specific items to be noted during inspections are listed in Table I-2. The primary leachate collection and removal system will be emptied and or otherwise managed expeditiously after storm events defined in Section I1.4.3 and in accordance with WAC 173-303-665(2)(e).

Table I-1. Inspection Schedule

Requirement Description	Frequency	Inspection
General Facility LLBG Trenches 31-34-94		
Posted warning signs	Weekly	Signs are present, legible, and visible.
Fire extinguishers	Monthly	Equipment is present and not past the expiration date.
Emergency telephones	Monthly	Equipment is present and operating.
Windsocks	Monthly	Equipment is present and operating.
Additional Emergency Equipment at LLBG Trenches 31 and 34[a]		
Spill response kit	Monthly	Equipment is present and seal intact.
First aid equipment	Monthly	Equipment is present and seal intact.
Portable eye washes	Monthly	Equipment is present and seal intact.
Container Storage (LLBG Trenches 31 and 34 Waste Storage and Treatment Pads)		
Areas subject to spills (including areas being used where waste is being loaded or unloaded)	Daily[b]	Check for spills; verify no evidence of spills or leaks, such as moisture on the sides or underneath of containers.
Containers and Container Storage Areas	Weekly[c]	Container integrity is not compromised by punctures, dents, penetrating scratches, loose lids, bulging, excessive corrosion, damage, or deterioration. Containers are closed and stored in a manner that will not rupture the containers or cause them to leak. Aisle spacing between rows of containers is at least 76 cm (30 in). For any portable secondary containment used to meet the requirements of WAC 173-303-630(7), verify no deterioration of secondary containment system caused by corrosion or other factors and no evidence of spills or leaks.
Container Labels	Weekly[c]	Container marking/labeling is intact, unobscured, legible, and in good condition. Labels are visible, readable, and adequately identify risks.

Note: Inspection frequencies: daily - once per calendar day, weekly - once per calendar week, and monthly - once per calendar month.

a. The only waste disposed in LLBG Trench 94 are decommissioned, defueled, reactor components that contain no liquid; therefore, a spill kit and eyewash are not needed at this trench. First aid kits are carried by personnel when inspecting Trench 94.

b. To implement WAC 173-303-320(2)(c), "Dangerous Waste Regulations," "General Inspection," "daily when in use" is defined as when dangerous waste management activities have potential for spills to occur, such as handling containers with known or suspected liquids and are moved outside of secondary containment.

c. Weekly inspection logs, prepared to meet WAC 173-303-630(6), "Use and Management of Containers," will be completed when dangerous waste is being managed within LLBG Trenches 31 and 34 Waste Storage and Treatment Pads. If the storage area is empty, "no waste in storage" or equivalent words will be entered on the inspection log.

1

Table I-2. Landfill Inspection Schedule

Requirement Description	Frequency	Inspection
LLBG Trenches 31-34-94		
General Inspection	Weekly and after storms[a]	Trench entrance ramp intact (not deteriorated, damaged, or eroded). Trench walls and floor intact (not deteriorated, damaged, or eroded). Check for the presence of liquids after storm events.
Run-on and Run-off Control Systems (Berms around Each Trench)	Weekly and after storms[a]	System is not deteriorated, malfunctioning, or improperly operating. Check for the presence of liquids after storm events.
Wind Dispersal Control Systems	Weekly and after storms[a]	System is not deteriorated, damaged, or eroded. Clean interim soil covers bulk waste. Subsidence area or sinkholes in interim soil cover are not observable.
Leachate Collection System (LLBG Trenches 31 and 34 Only)		
Trench 31 Primary Sump	Daily[b]	Monitor and record liquid levels including amount of liquid removed from the primary leachate collection and removal system.
Trench 31 Secondary Sump	Daily[b]	Monitor and record liquid levels including amount of liquid removed in the secondary leachate collection and removal system.
Trench 31 Heat Trace Temperature Probe	Daily[c]	Monitor temperatures and verify that instruments are functioning.
Trench 31 Pump Control Panel	Daily	Verify that indicating lights are functioning.
Trench 31 Primary Sump Pump #1	Quarterly	Operate motor for rotation and lubrication of parts.
Trench 31 Primary Sump Pump #2	Quarterly	Operate motor for rotation and lubrication of parts.
Trench 31 Secondary Sump Pump #3	Quarterly	Operate motor for rotation and lubrication of parts.
Trench 34 Primary Sump	Daily[b]	Monitor and record liquid levels including amount of liquid removed in the primary leachate collection and removal system.
Trench 34 Secondary Sump	Daily[b]	Monitor and record liquid levels including amount of liquid removed in the secondary leachate collection and removal system.

Table I-2. Landfill Inspection Schedule

Requirement Description	Frequency	Inspection
Trench 34 Heat Trace Temperature Probe	Daily[c]	Monitor temperatures and verify that instruments are functioning.
Trench 34 Pump Control Panel	Daily	Verify that indicating lights are functioning.
Trench 34 Primary Sump Pump #1	Quarterly	Operate motor for rotation and lubrication of parts.
Trench 34 Primary Sump Pump #2	Quarterly	Operate motor for rotation and lubrication of parts.
Trench 34 Secondary Sump Pump #3	Quarterly	Operate motor for rotation and lubrication of parts.

Note: Inspection frequencies: daily - once per calendar day, weekly - once per calendar week, and quarterly - once per calendar quarter.

a. A storm is any atmospheric disturbance with either wind gusts of approximately 72 km (45 mi) per hour or greater or precipitation of approximately 12 mm (0.5 in) or greater within a 24-hour period.

b. Daily inspection of the leachate collection sumps meets the requirement of WAC 173-303-665(4)(b)(iii), "Dangerous Waste Regulations," "Landfills."

c. This evaluation is performed from October through March.

Addendum J

Contingency Plan

This page intentionally left blank.

Contents

J1 Contingency Plan J-1

Appendix

J-A Building Emergency Plan for Low-Level Burial Grounds ..... J-A-i

This page intentionally left blank.

J1 Contingency Plan

WAC 173-303, "Dangerous Waste Regulations," requirements for a contingency plan at the Low-Level Burial Ground (LLBG) Trenches 31-34-94 Operating Unit Group (OUG), hereinafter referred to as LLBG Trenches 31-34-94, are satisfied in portions of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit* (hereinafter called Hanford Facility RCRA Permit), Attachment 4 (DOE/RL-94-02, *Hanford Emergency Management Plan*) and this addendum.

LLBG Trenches 31-34-94 provide storage, treatment, and disposal for dangerous and/or mixed waste from Hanford onsite and offsite generators. There are five operating dangerous waste management units (DWMUs) in LLBG Trenches 31-34-94: LLBG Trench 31, LLBG Trench 34, LLBG Trench 94, LLBG Trench 31 Waste Storage and Treatment Pad, and LLBG Trench 34 Waste Storage and Treatment Pad. For a full description of each DWMU, refer to Addendum C, "Process Information."

The Hanford Facility emergency management program is based on a graded approach for responses to emergency events using OUG-specific and/or site-level emergency procedures. Appendix J-A (HNF-IP-0263-BG, *Building Emergency Plan for Low-Level Burial Grounds*) contains a description of the OUG specific planning and responses for LLBG Trenches 31-34-94. This plan is used in conjunction with Hanford Facility RCRA Permit, Attachment 4 (DOE/RL-94-02) to fulfill the requirements of the contingency plan.

This page intentionally left blank.

Appendix J-A

Building Emergency Plan for Low-Level Burial Grounds

This page intentionally left blank.

CHPRC ADMINISTRATIVE DOCUMENT PROCESSING AND APPROVAL

DOCUMENT TITLE: Building Emergency Plan for Low-Level Burial Grounds	**OWNING ORGANIZATION/FACILITY:** W&FMP
Document Number: HNF-IP-0263-BG	**Revision/Change Number:** 23

DOCUMENT TYPE *(Check Applicable)* [X] Plan [ ] Report [ ] Study [ ] Description Document [ ] Other

DOCUMENT ACTION *(Check One)* [ ] New [X] Revision [ ] Cancellation

RESPONSIBLE CONTACTS

Name	Phone Number
Author: TM Cauliflower	373-9939
Manager: EP Kinnunen	373-9059

DOCUMENT CONTROL

Is the document intended to be controlled within the Document Management Control System (DMCS)? [X] Yes [ ] No

Does document contain scientific and technical information intended for public use? [X] Yes [ ] No

Does document contain controlled-use information [ ] Yes [X] No

DOCUMENT REVISION SUMMARY

NOTE: Provide a brief description or summary of the changes for the document listed.

Changed Title and Work Phone in the table in Section 13.0

REVIEWERS Others

Name *(print)*	Organization

APPROVAL SIGNATURES

Author:			RELEASE / ISSUE
Name: (Print)	Teresa Cauliflower	Date 8/6/15	DATE: Aug 11, 2015 HANFORD RELEASE
Responsible Manager:			
Name: (print)	Eric Kinnunen	Date 8-6-15	
Other:			
Name: (print)		Date	

Date Received for Clearance Process (MM/DD/YYYY) 08/10/2015	**INFORMATION CLEARANCE FORM**
A. Information Category ☐ Abstract ☐ Journal Article ☐ Summary ☐ Internet ☐ Visual Aid ☐ Software ☐ Full Paper ☐ Report ☒ Other Plan	B. Document Number HNF-IP-0263-BG Revision 23 C. Title WASTE & FUELS MANAGEMENT PROJECT Building Emergency Plan for Low-Level Burial Grounds D. Proposed Internet Address

E. Required Information (MANDATORY)

1. Is document potentially Classified? (●) No ( ) Yes

Kinnunen, Eric P
Manager Required (Print and Sign)

If Yes _____
ADC Required (Print and Sign) ( ) No ( ) Yes Classified

2. Official Use Only (●) No ( ) Yes Exemption No. ____
3. Export Controlled Information (●) No ( ) Yes OUO Exemption No. 3
4. UCNI (●) No ( ) Yes
5. Applied Technology (●) No ( ) Yes OUO Exemption No. 5
6. Other (Specify) _____

7. Does Information Contain the Following:
   a. New or Novel (Patentable) Subject Matter? (●) No ( ) Yes
      If "Yes", OUO Exemption No. 3
      If "Yes", Disclosure No.: _____
   b. Commercial Proprietary Information Received in Confidence, Such as Proprietary and/or Inventions?
      (●) No ( ) Yes If "Yes", OUO Exemption No. 4
   c. Corporate Privileged Information? (●) No ( ) Yes
      If "Yes", OUO Exemption No. 4
   d. Government Privileged Information? (●) No ( ) Yes
      If "Yes", Exemption No. 5
   e. Copyrights? (●) No ( ) Yes If "Yes", Attach Permission.
   f. Trademarks? (●) No ( ) Yes If "Yes", Identify in Document.
8. Is Information requiring submission to OSTI? (●) No ( ) Yes
9. Release Level? (●) Public ( ) Limited

F. Complete for a Journal Article

1. Title of Journal

G. Complete for a Presentation

1. Title for Conference or Meeting _____
2. Group Sponsoring _____
3. Date of Conference _____ 4. City/State _____
5. Will Information be Published in Proceedings? ( ) No ( ) Yes 6. Will Material be Handed Out? ( ) No ( ) Yes

H. Information Owner/Author/Requestor
Cauliflower, Teresa M
(Print and Sign)

Responsible Manager
Kinnunen, Eric P
(Print and Sign)

Approval by Direct Report to President (Speech/Articles Only) _____
(Print and Sign)

I. Reviewers	Yes	Print	Signature	Public Y/N (If N, complete J)
General Counsel	☐			Y / N
Office of External Affairs	☐			Y / N
DOE	☐			Y / N
Other	☒	Jenkins, Ashley R.	Y - Public, see below.	Y / N
Other	☐			Y / N
Other	☐			Y / N

J. Comments

Information Clearance Approval

Approved for Public Release; Further Dissemination Unlimited

APPROVED
By Ashley R Jenkins at 11:37 am, Aug 11, 2015

If Additional Comments, Please Attach Separate Sheet

A-6001-401 (REV 5)

DOE/RL-2015-74, REVISION 0
DECEMBER 2015

HNF-IP-0263-BG
Revision 23

Waste and Fuels Management Project Building Emergency Plan for Low-Level Burial Grounds

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

DOE/RL-2015-74, REVISION 0
DECEMBER 2015

HNF-IP-0263-BG
Revision 23

Waste and Fuels Management Project Building Emergency Plan for Low-Level Burial Grounds

Document Type: PLAN Program/Project: SWOC

T. M. Cauliflower
CH2M HILL Plateau Remediation Company

Date Published
August 2015

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

P.O. Box 1600
Richland, Washington 99352

APPROVED
By Ashley R Jenkins at 11:36 am, Aug 11, 2015

Release Approval Date

Approved for Public Release;
Further Dissemination Unlimited

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by tradename, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

WASTE & FUELS MANAGEMENT PROJECT	**Document:**	**HNF-IP-0263-BG Revision 23**
BUILDING EMERGENCY PLAN FOR LOW-LEVEL BURIAL GROUNDS	**Page:**	**1 of 32**
	Effective Date:	**August 6, 2015**

This plan covers the following buildings and structures: 200 West Area Burial Grounds, 200 East Area Burial Grounds, MO247, MO248, MO223, MO760, MO264, MO618, and MO2163.

USQ #: GCX-7

Screened by: Ashley Olsen

Approved:

Facility Management — Date: 8/06/2015

L.C. PETERSEN

Environmental Compliance Officer — Date: 8/6/2015

Eric Kinnunen

CHPRC Emergency Preparedness — Date: 8-6-15

This document will be reviewed at least annually and updated if necessary by Facility Management unless Hanford Facility RCRA Permit coordination requirements provide otherwise. The Building Emergency Director has the authority to carry out the provisions of this plan.

TABLE OF CONTENTS

1.0 GENERAL INFORMATION: 4
1.1 FACILITY NAME: 4
1.2 FACILITY LOCATION: 4
1.3 OWNER: 4
1.4 DESCRIPTION OF FACILITY AND OPERATIONS: 5
1.5 BUILDING EVACUATION ROUTING: 6
2.0 PURPOSE: 6
3.0 FACILITY BUILDING EMERGENCY RESPONSE ORGANIZATION: 7
3.1 BUILDING EMERGENCY DIRECTOR: 7
3.2 OTHER MEMBERS: 8
4.0 IMPLEMENTATION OF THE PLAN: 8
5.0 FACILITY HAZARDS: 9
5.1 HAZARDOUS MATERIALS: 9
5.2 INDUSTRIAL HAZARDS: 9
5.3 DANGEROUS/MIXED WASTE: 10
5.4 RADIOACTIVE MATERIALS: 10
5.5 CRITICALITY: 10
6.0 POTENTIAL EMERGENCY CONDITIONS: 10
6.1 FACILITY OPERATIONS EMERGENCIES: 10
6.1.1 LOSS OF UTILITIES: 10
6.1.2 MAJOR PROCESS DISRUPTION/LOSS OF PLANT CONTROL: 10
6.1.3 PRESSURE RELEASE: 11
6.1.4 FIRE AND/OR EXPLOSION: 11
6.1.5 HAZARDOUS MATERIAL SPILL: 11
6.1.6 DANGEROUS/MIXED WASTE SPILL: 12
6.1.7 TRANSPORTATION AND/OR PACKAGING INCIDENTS: 12
6.1.8 RADIOACTIVE MATERIAL RELEASE: 12
6.1.9 CRITICALITY: 12
6.2 NATURAL PHENOMENA: 12
6.2.1 SEISMIC EVENT: 13
6.2.2 VOLCANIC ERUPTION/ASH FALL: 13
6.2.3 HIGH WINDS/TORNADO: 13
6.2.4 FLOOD: 13
6.2.5 RANGE FIRE: 13
6.2.6 AIRCRAFT CRASH: 13
6.3 SECURITY CONTINGENCIES: 13
6.3.1 BOMB THREAT/EXPLOSIVE DEVICE: 13
6.3.2 HOSTAGE SITUATION/ARMED INTRUDER: 14
6.3.3 SUSPICIOUS OBJECTS: 14
6.4 UNEXPECTED/UNIDENTIFIED ODORS 14
7.0 INCIDENT RESPONSE: 14
7.1 PROTECTIVE ACTION RESPONSES: 14

7.1.1 EVACUATION: 14
7.1.2 TAKE COVER: 15
7.2 RESPONSE TO FACILITY OPERATIONS EMERGENCIES: 16
7.2.1 LOSS OF UTILITIES: 16
7.2.2 MAJOR PROCESS DISRUPTION/LOSS OF PLANT CONTROL: 17
7.2.3 PRESSURE RELEASE: 17
7.2.4 FIRE AND/OR EXPLOSION: 17
7.2.5 HAZARDOUS MATERIAL, DANGEROUS AND/OR MIXED WASTE SPILL: 18
7.2.6 RADIOACTIVE MATERIAL RELEASE: 19
7.2.7 CRITICALITY: 19
7.3 PREVENTION OF RECURRENCE OR SPREAD OF FIRES, EXPLOSIONS, OR RELEASES: 20
7.4 RESPONSE TO NATURAL PHENOMENA: 20
7.4.1 SEISMIC EVENT: 20
7.4.2 VOLCANIC ERUPTION ASH FALL: 21
7.4.3 HIGH WINDS/TORNADO: 21
7.4.4 FLOOD: 21
7.4.5 RANGE FIRE: 22
7.4.6 AIRCRAFT CRASH: 22
7.5 SECURITY CONTINGENCIES: 22
7.5.1 BOMB THREAT/EXPLOSIVE DEVICE: 22
7.5.2 HOSTAGE SITUATION/ARMED INTRUDER: 23
7.5.3 SUSPICIOUS OBJECT: 23
7.6 RESPONSE TO UNEXPECTED/UNIDENTIFED ODORS 23
8.0 TERMINATION OF EVENT, INCIDENT RECOVERY, AND RESTART OF OPERATIONS: 23
8.1 TERMINATION OF EVENT: 23
8.2 INCIDENT RECOVERY AND RESTART OF OPERATIONS: 23
8.3 INCOMPATIBLE WASTE: 24
8.4 POST EMERGENCY EQUIPMENT MAINTENANCE AND DECONTAMINATION: 25
9.0 EMERGENCY EQUIPMENT: 25
9.1 FIXED EMERGENCY EQUIPMENT: 25
9.2 PORTABLE EMERGENCY EQUIPMENT: 25
9.3 COMMUNICATIONS EQUIPMENT/WARNING SYSTEMS: 26
9.4 PERSONAL PROTECTIVE EQUIPMENT: 26
9.5 SPILL CONTROL AND CONTAINMENT SUPPLIES: 26
9.6 INCIDENT COMMAND POST: 26
10.0 COORDINATION AGREEMENTS: 27
11.0 REQUIRED REPORTS: 27
12.0 PLAN LOCATION AND AMENDMENTS: 27
13.0 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION: 27
14.0 REFERENCES: 28

1.0 GENERAL INFORMATION

The Low-Level Burial Grounds (LLBG) is located on the Hanford Site, a 560-square-mile (1,450-square kilometer) U.S. Department of Energy Richland Operations Office (DOE/RL) site in southeastern Washington State. The LLBG are located in both the 200 East and 200 West Areas near the center of the Hanford Site. The Hanford Site Emergency Preparedness Program is based on the incident command system that allows a graded approach for response to emergency events. This plan contains a description of facility specific emergency planning and response and is used in conjunction with Hanford Facility RCRA Permit (Permit) Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02). Response to events is performed using facility specific and/or Hanford Site level emergency procedures.

1.1 Facility Name

U.S. Department of Energy
Hanford Site
Low-Level Burial Grounds

1.2 Facility Location

Benton County, Washington within the 200 Areas.

Buildings/facilities covered by this plan are: 200 East Area Burial Grounds (218-E-10 and 218-E-12B); 200 West Area Burial Grounds (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6); MO247, MO248, MO223, MO760, MO264, MO618, and MO2163.

1.3 Owner

U.S. Department of Energy
Richland Operations Office
825 Jadwin Avenue
Richland, Washington 99352

FACILITY MANAGER:

CH2M Hill Plateau Remediation Company
P.O. Box 1600
Richland, Washington 99352-1000

1.4 Description of the Facility and Operations

The LLBG consist of eight burial grounds located in the 200 East Area and 200 West Area. The 218-E-10 and 218-E-12B are located in the 200 East Area and the 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 are located in the 200 West Area.

The 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, and 218-W-6 Burial Grounds are classified as a landfill and the 218-W-5 Burial Ground is classified as a landfill, greater-than-90-day container storage, and in-cell treatment. The LLBG consist of various sizes and depths of lined and unlined disposal trenches.

The following provides a brief description and identifies the generic types of waste disposed in the LLBG. An electronic database is maintained that documents each waste receipt, type of waste, and disposal location.

- The 218-E-10 Burial Ground is approximately 89 acres in size and began receiving waste in 1960. Examples of waste placed in this burial ground include failed equipment, rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste. The unused portions of this burial ground will be administratively closed.

- The 218-E-12B Burial Ground is approximately 168 acres in size and began receiving waste in 1967. Examples of waste placed in this burial ground include defueled reactor compartments (trench 94), low-level waste, and retrievable Transuranic waste. Suspect-Transuranic (TRU) and TRU waste containers that have been placed in retrievable storage will be exhumed as part of the TRU Waste Retrieval Project and dispositioned. A movable weather enclosure is positioned over Trench 17 to support excavation and retrieval activities at the 218-E-12B burial ground. Trench 94, located in the northeast corner of the 218-E-12B LLBG, is designed for the receipt and final disposal of decommissionsed, defueled reactor compartments (RCs) from submarines and surface ships. The first defueled RC was placed in Trench 94 in April 1986. The unused portions of this burial ground will be administratively closed

- The 218-W-3A Burial Ground is approximately 50 acres in size and began receiving waste in 1970. Examples of waste placed in this burial ground include ion exchange resins, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, accessories, retrievable Transuranic waste, and post-August 19, 1987, RCRA and state-only designated mixed waste. Suspect-Transuranic (TRU) and TRU waste containers that have been placed in retrievable storage have been exhumed and dispositioned.

- The 218-W-3AE Burial Ground is approximately 49 acres in size and began receiving waste in 1981. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987, RCRA and state-only designated mixed waste.

- The 218-W-4B Burial Ground is approximately 8.6 acres in size and began receiving waste in 1968. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, alpha caissons, and retrievable Transuranic waste. Suspect-Transuranic (TRU) and TRU waste containers that have been placed in retrievable storage have been exhumed and dispositioned.

- The 218-W-4C Burial Ground is approximately 49 acres in size and began receiving waste in 1978. Examples of waste placed in this burial ground include contaminated soil, decommissioned pumps, pressure vessels, post-August 19, 1987, RCRA and state-only designated mixed waste, and retrievable Transuranic waste. Suspect-Transuranic (TRU) and TRU waste containers that have been placed in retrievable storage are being exhumed as part of the TRU Waste Retrieval Project and dispositioned. The unused portions of this burial ground will be administratively closed.

- The 218-W-5 Burial Ground is approximately 92 acres in size and began receiving waste in 1986. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987, RCRA and state-only designated mixed waste. This burial ground contains two double-lined mixed waste trenches (Trenches 31 and 34). Trenches 31 & 34 currently are used for LDR-compliant mixed waste disposal. Each of these trenches includes a waste pad for treatment and/or storage of containerized waste before disposal. Adjacent to the double-lined mixed waste trenches are leachate collection tanks. The leachate collection tanks are aboveground, carbon steel tanks, internally coated with an amine-cured epoxy. These tanks and their associated feed piping is provided with secondary containment. The leachate collection tanks have a design capacity of 37,850 liters.
- The 218-W-6 Burial Ground is approximately 40 acres in size, has not received any waste, and will be administratively closed.

1.5 Building Evacuation Routing

Figures 1 and 2 provide identification of the primary and secondary staging areas and a general layout of the LLBGs. Alternate evacuation routes will be used on a case-by case basis, based on meteorological conditions at the time of the event.

2.0 PURPOSE

This plan describes both the facility hazards and the basic responses to upset and/or emergency conditions within the LLBG. These events may include spills or releases caused by processing, fires and explosions, transportation activities, movement of materials, packaging, storage of hazardous materials, and natural and security contingencies. When used in conjunction with Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), this plan meets the requirements for contingency planning as required by WAC 173-303. Sections 1.5, 3.1, 4.0, 7.1, 7.1.1, 7.1.2, 7.2, 7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5, 7.2.5.1, 7.3, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 11.0, 12.0, 13.0 of the Building Emergency Plan (BEP) are enforceable sections meeting RCRA contingency planning requirements. Enforceable sections cannot be changed without coordinating the change with the Permit modification process.

3.0 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION

The LLBG maintains a weekly on-call list for technical expert notification. Upon notification, the on-call person will notify the primary or alternate Building Emergency Director (BED) to respond to the scene in person as necessary. The on-call technical expert will maintain contact with the on-scene Incident Commander (IC) until arrival of LLBG personnel.

3.1 Building Emergency Director

Emergency response will be directed by the Building Emergency Director (BED) until the Incident Commander (IC) arrives. The Incident Command System (ICS) and staff with supporting on-call personnel fulfill the responsibilities of the Emergency Coordinator as discussed in WAC 173-303-360. During events, LLBG personnel perform response duties under the direction of the BED. The Incident Command Post (ICP) is managed by the senior Hanford Fire Department official, unless the event is determined to primarily be a security event, in which case the Hanford Fire Department and Hanford Patrol will operate under a unified command system with Hanford Patrol making all decisions pertaining to security. These individuals are designated as the IC, and as such, have the authority to request and obtain any resources necessary for protecting people and the environment.

The BED becomes a member of the ICP and functions under the direction of the IC. In this role, the BED continues to manage and direct LLBG operations.

A listing of BEDs by title, work location, and work telephone number is contained in Section 13.0 of this plan. The BED is on the premises or is available through an "on-call" list 24-hours a day. Names and home telephone numbers of the BEDs are available from the Patrol Operations Center (POC) in accordance with Permit Condition II.A.4.

3.2 Other Members

As a minimum, Facility Management appoints and ensures training is provided to individuals to perform as Personnel Accountability Aides and Staging Area Managers. The Personnel Accountability Aides are responsible for facilitating the implementation of protective actions (evacuation or take cover) and for facilitating the accountability of personnel after the protective actions have been implemented. Staging Area Managers are responsible for coordinating and conducting activities at the staging area. In addition, the BED can identify additional support personnel (radiological control, maintenance, engineering, hazardous material coordinators, etc.) to be part of the Facility/Building Emergency Response Organization.

The complete Facility/Building Emergency Response Organization listing of positions, names, work locations, and telephone numbers for the LLBG is maintained in a separate location in a format determined appropriate by LLBG management. Copies are distributed to appropriate LLBG locations and to Emergency Preparedness.

4.0 IMPLEMENTATION OF THE PLAN

In accordance with WAC 173-303-360(2)(b) the BED ensures that trained personnel identify the character, source, amount and aerial extent of the release, fire, or explosion to the extent possible. Identification of waste can be made by activities that can include, but are not limited to, visual inspection of dangerous waste, dangerous/mixed waste, sampling activities in the field, reference to inventory records, or by consulting with facility personnel. Samples of materials involved in an emergency might be taken by qualified personnel and analyzed as appropriate. These activities must be performed with a sense of immediacy and shall include available information.

The BED shall use the following guidelines to determine if an event has met the requirements of WAC 173-303-360(2)(d):

1. The event involved an unplanned spill, release, fire, or explosion,

AND

2.a The unplanned spill or release involved a dangerous waste, or the material involved became a dangerous waste as a result of the event (e.g., product that is not recoverable),

OR

2.b The unplanned fire or explosion occurred at the LLBG or transportation activity subject to RCRA contingency planning requirements,

AND

3. Time-urgent response from an emergency services organization was required to mitigate the event, or a threat to human health or the environment exists.

As soon as possible, after stabilizing event conditions, the BED shall determine, in consultation with the site contractor environmental single-point-of-contact, if notification to the Washington State Department of Ecology (Ecology) is needed to meet WAC-173-303-360(2)(d) reporting requirements. If all of the conditions under 1, 2, and 3 are met, notifications are to be made to Ecology. Additional information is found in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 4.2.

If review of all available information does not yield a definitive assessment of the danger posed by the incident, a worst-case condition will be presumed and appropriate protective actions and notifications will be initiated. The BED is responsible for initiating any protective actions based on their best judgment of the incident.

The BED must assess each incident to determine the response necessary to protect the personnel, facility, and the environment. If assistance from Hanford Patrol, Hanford Fire Department, or ambulance units is required, the Hanford Emergency Response Number (911 from site office phones/373-0911 from cellular phones) must be used to contact the POC and request the desired assistance. To request other resources or assistance from outside the LLBG, the POC business number is used (373-3800).

5.0 FACILITY HAZARDS

Hazards at the LLBG potentially include industrial hazards, hazardous materials, radiological materials, radioactive and/or mixed waste, physical hazards, and biological hazards.

5.1 Hazardous Materials

Hazardous materials might include (but might not be limited to) the following: spray adhesive, sorbent, diesel fuel, hydraulic oil, propane, road salt, industrial cleaner and degreaser, and unleaded gasoline. The use, storage, and inventory of hazardous materials are controlled. Material safety data sheets are maintained electronically using current Hanford Site databases.

5.2 Industrial Hazards

Industrial hazards could include transportation incidents, moving equipment accidents, subsidence (cave-ins), exposure to spilled waste or chemicals, or from radiological or chemical exposure from spills. Potential material handling mishaps are associated with forklift or crane operations. These include potential rupture of packages due to misalignment of the forklift tines or a load dropped during a crane operation.

5.3 Dangerous/Mixed Waste

The LLBG are designed for disposal of bulk and containerized waste.

5.4 Radioactive Materials

Low-level radioactive materials are disposed or can be stored in both the 200 East and 200 West Area burial grounds. All mixed waste must meet LDR requirements before disposal.

5.5 Criticality

Criticality has been evaluated as being 'incredible,' therefore, there are no LLBG specific actions required.

6.0 POTENTIAL EMERGENCY CONDITIONS

Potential emergency conditions, under both WAC 173-303 and DOE may include one of three basic categories: (1) operations (process upsets, fires, explosions, loss of utilities, spills, and releases), (2) natural phenomena (e.g., earthquakes), and (3) security contingencies (bomb threat, hostage situation, etc.). The following are conditions that may lead to an emergency at the LLBG.

6.1 Facility Operations Emergencies

6.1.1 Loss of Utilities

- Electrical power is required for trenches 31 and 34 of the 218-W-5 burial ground operations, however, loss of electricity does not constitute an emergency, but must be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners.
- Loss of Water - N/A
- Loss of Ventilation - N/A
- Loss of Steam - N/A
- Loss of Air - N/A

6.1.2 Major Process Disruption/Loss of Plant Control

N/A

6.1.3 Pressure Release

The potential exists for an unanticipated pressure release from compressed gas cylinders used for facility operations or from buried waste.

6.1.4 Fire and/or Explosion

Potential fire hazards include smoke inhalation, burns, damage to equipment and/or structures, and release of hazardous materials, radioactive and/or mixed waste constituents.

6.1.5 Hazardous Material Spill

Low-level radioactive waste and mixed waste are placed in the LLBG. Spills or releases could result in the following conditions.

- Spill of Hazardous Material. Hazards associated with a spill include potential exposure to radioactive and/or dangerous constituents as well as potential environmental damage. Because most waste in the LLBG is solid, spill procedures primarily are applicable to liquids that might have been improperly received.

- Any dangerous waste spills would involve accumulated leachate that would be contained within the leachate collection tank(s) and valve gallery secondary containment area, and spill procedures would be applicable (Trenches 31 and 34 of the 218-W-5 Burial Ground). EXCEPTION: A pumping spray spill that could result in a release of leachate to the environment.

- During the transfer of leachate from the leachate collection tank(s) to a transport tanker, spills could result in a release of leachate to the environment.

- Toxic Fumes Hazards. Mixed waste disposed in the LLBG could produce airborne radioactive contamination. Volatilization of solids during a fire might generate toxic fumes. Waste acceptance criteria require that the offsite generators and onsite generating units document waste with gas-generating potential and that the requirement for gas recombiners be specified on the waste tracking forms.

- Fires or Explosions Involving Hazardous Material. A fire or chemical reaction in the LLBG could result in the release of dangerous and/or radioactive constituents to the air or soil.

- Reactive Chemical/Corrosive Material Hazards. N/A

- Thermal Reactions/Hazards. N/A

- Flammable Material/Liquids Hazards. Although the LLBG does not dispose of these types of materials, operating equipment requires these materials (e.g., gasoline, hydraulic fluids, oils, etc.) for operation. These materials, if ignited could result in the release of dangerous and/or radioactive constituents to the air or soil.

- Asbestos Release. Asbestos might be released during tornadoes, high winds, fires, or other events that damage or destroy the packaging material.

6.1.6 Dangerous/Mixed Waste Spill

The potential exists for pressurized or bulging containers to rupture resulting in a release to the air or soil.

6.1.7 Transportation and/or Packaging Incidents

Potential consequences of transportation and/or packaging incidents are spills or spread of radioactive contamination, chemical contamination, or personnel contamination. A forklift-damaged container could result in a release to the environment.

6.1.8 Radioactive Material Release

- Gaseous Effluent Discharges (stack release) - N/A

- Liquid Effluent Discharges - N/A

- Significant Contamination Spread/Releases. Significant contamination spread or release might involve hazards resulting from exposure to radioactive and/or mixed waste. The major potential cause of spread or a release includes damaged containers, high winds, or a fire that might disperse contaminated airborne particles.

6.1.9 Criticality

Fissionable materials located in the LLBG exist in a form or distribution that ensures a critical mass cannot be attained.

6.2 Natural Phenomena

Natural phenomena are discussed in the following sections.

6.2.1 Seismic Event

Depending on the magnitude of the event, severe structural damage can occur resulting in serious injuries or fatalities and the release of hazardous materials to the environment. Damaged electrical circuits and wiring could result in the initiation of fires.

6.2.2 Volcanic Eruption/Ash fall

Though not expected to cause structural damage, the ash resulting from a volcanic eruption could cause shorts in electrical equipment and plug ventilation system filters.

6.2.3 High Winds/Tornadoes

High winds or tornadoes may cause structural damage to systems containing hazardous materials resulting in a release of the materials to the environment.

6.2.4 Flood

Flooding can cause the release of hazardous materials depending on the type of storage containers. Floods can also cause short circuits in electrical wiring located at or below ground level. This may then result in an increased likelihood of fires.

6.2.5 Range Fire

The hazards associated with a range fire are the same as those associated with a building fire plus potential site access restrictions and travel hazards such as poor visibility.

6.2.6 Aircraft Crash

In addition to the potential for serious injuries or fatalities, an aircraft crash could result in the direct release of hazardous materials to the environment or cause a fire that could lead to the release.

6.3 Security Contingencies

Security contingencies are discussed in the following sections.

6.3.1 Bomb Threat/Explosive Device

A bomb threat may be received by anyone who answers the telephone or receives mail. The major effect on the LLBG is that personnel will need to perform emergency shutdown of the facility before evacuation. If an explosive device detonates, the effects are the same as those discussed under fire and explosion.

6.3.2 Hostage Situation/Armed Intruder

A hostage situation or the entry of an armed hostile intruder(s) can pose an emergency if either of these conditions has the potential to adversely affect facility operations.

6.3.3 Suspicious Objects

If a suspicious object is discovered, the major effect on the LLBG is that personnel may need to perform an emergency shutdown of the facility before evacuation.

6.4 Unexpected/Unidentified Odors

Unexpected or unidentified odors have the potential to cause health effects and could be indicative of other events.

7.0 INCIDENT RESPONSE

The initial response to any emergency is to immediately protect the health and safety of persons in the affected area. Identification of released material is essential to determine appropriate protective actions. Containment, treatment, and disposal assessment are secondary responses.

The following sections describe the process for implementing basic protective actions as well as descriptions of response actions for the events listed in Section 6.0 of this plan. Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 1.3, provides concept of operations for emergency response on the Hanford Site.

This section provides a discussion of protective action responses, response to facility operations emergencies, response to natural phenomena, and response to security contingencies. In addition, a section addressing prevention of secondary release, fires or explosions is provided.

7.1 Protective Action Responses

Protective action responses are discussed in the following sections. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

7.1.1 Evacuation

If an evacuation is ordered or the evacuation siren sounds in the area of the LLBG, personnel shall proceed to the staging areas depicted in Figures 1 and 2. The BED will direct personnel to an alternate location as needed.

The BED or Staging Area Manager directs evacuations; however, to ensure that evacuations can be conducted promptly and safely, all personnel must be familiar with the correct evacuation procedure.

Area evacuations are rapid or controlled, as pointed out in the following steps. When possible, these steps must be performed concurrently.

AREA EVACUATION PROCEDURE
Halt any operations or work and place equipment and structures in a safe condition. Use emergency shutdown procedures for rapid evacuation.
Use whatever means are available (portable radios, bullhorns, runners, etc.) to pass the evacuation information to personnel.
Evacuate personnel to the staging area; group personnel as follows: potentially contaminated protective clothing, keys immediately available for vehicles, those needing rides. Assist personnel that are temporary/permanently disabled.
Conduct personnel accountability. If unable to account for personnel, report personnel accountability results to the Protective Action Coordinator in the Hanford-Emergency Operations Center (Hanford-EOC).
Inform IC of any potentially affected personnel (i.e., injured, contaminated, exposed, etc.) once the IC arrives at the ICP.
Relay pertinent evacuation information (routes, destination etc.) to drivers.
Dispatch vehicles as soon as the vehicles are loaded.
Report status to the Hanford-EOC, request additional transportation if required, and report if any personnel remain who are performing late shutdown duties.

7.1.2. Take Cover

When the Take Cover Alarm is activated, personnel shall take cover in the nearest approved building or trailer.

A message followed by the Take Cover siren will be transmitted over the area emergency sirens. Portable, hand-held radios are used throughout the LLBG for communication. The following actions must be taken or considered:

- Shut doors and windows and wait for further instructions
- Secure ventilation system
- Follow normal exit procedures from radiological areas

- Lock up classified documents and prepare for a possible evacuation
- Report your location to the Accountability Aid or the BED
- Accountability Aides will provide accountability status to the Staging Area Manager for LLBG personnel during an event
- Inform IC of any potentially affected personnel (i.e., injured, contaminated, exposed, etc.) once the IC arrives at the ICP.

7.2 Response to Facility Operations Emergencies

Depending on the severity of the event, the BED reviews the site-wide and LLBG emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED initiates area protective actions and Hanford Site Emergency Response Organization activation. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events. Attachment A provides a list of procedures.

7.2.1 Loss of Utilities

A case-by-case evaluation is required for each event to determine loss of utility impacts. When a BED determines a loss of utility impact, actions are taken to ensure dangerous and/or mixed waste is being properly managed, to the extent possible given event circumstances. As necessary, the BED will stop operations and take appropriate actions until the utility is restored.

- Loss of Electricity. Electricity in the trailers is for lighting, heating, and cooling only. Loss of electricity will not impair functions or constitute an emergency. Electrical power is required for 218-W-5 LLBG Trench 31 and Trench 34 operations; however, loss of electricity does not constitute an emergency, but must be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners. In the event of a loss of electrical power and the leachate accumulation is in excess, a generator will be used to provide temporary power.
- Loss of Water - N/A
- Loss of Ventilation - N/A
- Loss of Steam - N/A
- Loss of Air - N/A

7.2.2 Major Process Disruption/Loss of Plant Control

N/A

7.2.3 Pressure Release

Personnel should immediately evacuate the hazard area. In the event of any injuries, personnel should immediately call 911 from site office phones/373-0911 from cellular phones for medical response.

7.2.4 Fire and/or Explosion

In the event of a fire, the discoverer activates a fire alarm (pull box); calls 911 from site office phones/373-0911 from cellular phones or verifies that the Hanford Emergency Response Number has been called.

- Unless otherwise instructed, personnel shall evacuate the area/building by the nearest safe exit and proceed to the designated staging area for accountability.
- On actuation of the fire alarm, ONLY if time permits, personnel should shut down equipment and secure waste. The alarm automatically signals the Hanford Fire Department.
- The BED proceeds directly to the ICP, obtains all necessary information pertaining to the incident and sends a representative to meet Hanford Fire Department.
- The BED provides a formal turnover to the IC when the IC arrives at the ICP.
- The BED informs the Hanford Site Emergency Response Organization as to the extent of the emergency (including estimates of dangerous waste and mixed waste quantities released to the environment).
- If operations are stopped in response to the fire, the BED ensures that systems are monitored for leaks, pressure buildup, gas generation and ruptures.
- Hanford Fire Department firefighters extinguish the fire as necessary.

NOTE: *Following a fire and/or explosion, 40 CFR 265.196 will be addressed for the less-than-90-day Leachate Storage Tank regarding fitness for use.*

7.2.5 Hazardous Material, Dangerous and/or Mixed Waste Spill

Spills can result from many sources including process leaks, container spills or leaks, damaged packages or shipments, or personnel error. Spills of mixed waste are complicated by the need to deal with the extra hazards posed by the presence of Atomic Energy Act materials.

- The discoverer notifies the BED and initiates SWIMS response:
  - Stops work
  - Warns others in the vicinity
  - Isolates the area
  - Minimizes exposure to the hazards
  - Requests the BED Secure ventilation.
- The BED determines if emergency conditions exist requiring response from the Hanford Fire Department based on classification of the spill and injured personnel, and evaluates need to perform additional protective actions.
- If the Hanford Fire Department resources are not needed, the spill is mitigated with resources identified in Section 9.0 of this plan and proper notifications are made.
- If the Hanford Fire Department resources are needed, the BED calls 911 from site office phones/373-0911 from cellular phones.
- The BED sends a representative to meet the Hanford Fire Department.
- The BED provides a formal turnover to the IC when the IC arrives at the ICP.
- The BED informs the Hanford Site Emergency Response Organization as to the extent of the emergency (including estimates of dangerous waste and mixed waste quantities released to the environment).
- If operations are stopped in response to the spill, the BED ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures.
- Hanford Fire Department stabilizes the spill.

NOTE: For response to leaks or spills and disposition of leaking or unfit-for-use tank systems, refer to 40 CFR 265.196.

7.2.5.1 Damaged or Unacceptable Shipments

During the course of receiving dangerous and/or mixed waste at LLBG, an unanticipated event could be discovered resulting in a conformance issue concerning the waste. In some cases, the conformance issue will result from receiving an off-site shipment, manifested pursuant to Permit, Condition II.P.1 or WAC 173-303-370 that is damaged or otherwise presents a hazard and cannot be transported. Damaged or unacceptable shipments resulting from onsite transfers are not subject to WAC 173-303-370; however conformance issues must be resolved in order to maintain proper records.

Regardless of whether the waste is received as an off-site shipment or onsite transfer, the following actions are taken:

- Operations management is notified of the damaged or unacceptable waste to be received.
- If the conformance issue results in a spill or release, actions described in Section 7.2.5 are taken.
- The generating organization is notified of the conformance issue.
- An operations representative, in conjunction with the generating organization, determines the course of action to resolve the conformance issue.

7.2.6 Radioactive Material Release

- Radioactive Gaseous Effluent Discharge. N/A.
- Liquid Effluent Discharge. If collected leachate is released, the liquid will be contained by secondary containment.
- Significant Contamination Spread. There are no continuous air monitors in the LLBG. Monitoring is performed by radiological control (RC) personnel. If monitoring reveals a significant contamination spread, stop work activities and immediately exit the area. RC will survey and provide contamination status. Notify immediate manager and the BED.

7.2.7 Criticality

Transuranic waste is present in the LLBG. As a Limited Control Facility, the form or distribution of fissionable material precludes a criticality accident.

7.3 Prevention of Recurrence or Spread of Fires, Explosions, or Releases

The BED, as part of the ICP, takes the steps necessary to ensure that a secondary release, fire, or explosion does not occur. The BED will take measures, where applicable, to stop processes and operations; collect and contain released wastes and remove or isolate containers. The BED shall also monitor for leaks, pressure buildups, gas generation, or ruptures in valves, pipes or other equipment, whenever this is appropriate.

7.4 Response to Natural Phenomena

Depending on the severity of the event, the BED reviews sitewide and LLBG emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED initiates area protective actions and Hanford Site Emergency Response Organization activation. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events. Attachment A provides a list of procedures.

7.4.1 Seismic Event

The Hanford Site Emergency Response Organization's primary role in a seismic event is coordinating the initial response to injuries, fires, fire hazards and acting to contain or control radioactive and/or hazardous material releases.

Individuals should remain calm and stay away from windows, steam lines, and hazardous material storage locations. Once the shaking has subsided, individuals should evacuate carefully and assist personnel needing help. The location of any trapped individuals should be reported to the BED or is reported to 911 from site office phones/373-0911 from cellular phones.

The BED takes whatever actions are necessary to minimize damage and personnel injuries. Responsibilities include the following:

- Coordinating searches for personnel and potential hazardous conditions (fires, spills, etc.).
- Conducting accountability.
- Securing utilities and facility operations.
- Arranging rescue efforts, and notifying 911 for assistance.
- Determining if hazardous materials were released.
- Determining current local meteorological conditions.

- Warning other facilities and implementing protective actions if release of hazardous materials poses an immediate danger.
- Providing personnel and resource assistance to other facilities, if required and possible.

7.4.2 Volcanic Eruption/Ash fall

When notified of an impending ash fall, the BED will implement measures to minimize the impact of the ash fall. BED actions include the following:

- Installing filter media over building ventilation intakes.
- Installing filter media or protective coverings on outdoors equipment that may be adversely affected by the ash (diesel generators, equipment rooms, etc.).
- Shutting down some or all operations and processes.
- Sealing secondary use exterior doors.

If other emergency conditions arise as a result of the ash fall (e.g., fires due to electrical shorts or lightning), response is as described in other sections of this plan.

7.4.3 High Winds/Tornadoes

Upon notification of impending high winds, the BED takes steps necessary to secure all outdoor waste, hazardous material containers, and storage locations. All doors and windows are shut, and personnel are warned to use extreme caution when entering or exiting the building. Ventilation, utilities and operations will be shut down as appropriate to lessen the severity of the impact.

7.4.4 Flood

Flooding can cause the release of hazardous materials depending on the type of storage containers. Floods can also cause short circuits in electrical wiring located at or below ground level. This may then result in an increased likelihood of fires. However, calculations of "the maximum flood" that could occur in the Columbia River Basin indicate that maximum flood conditions would pose no threat to the LLBG.

7.4.5 Range Fire

Responses to range fires are handled by preventive measures (i.e., keeping hazardous material and waste accumulation areas free of combustible materials such as weeds and brush). If a range fire breaches the LLBG boundaries, the response is as described in Section 7.2.4.

7.4.6 Aircraft Crash

The response to an aircraft crash is the same as for a fire and/or explosion (Section 7.2.4).

7.5 Security Contingencies

Depending on the severity of the event, the BED reviews the sitewide and LLBG emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED initiates area protective actions and Hanford Site Emergency Response Organization activation. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events. Attachment A provides a list of procedures.

7.5.1 Bomb Threat/Explosive Device

Response to a bomb threat/explosive device is discussed in the following sections.

7.5.1.1 Telephone Threat

Individuals receiving telephoned threats attempt to get as much information as possible from the caller (using the bomb threat checklist if available). Upon conclusion of the call, or during the call if possible, notify the BED and Hanford Patrol by calling 911 (do not use wireless communications devices for reporting a bomb threat/explosive device unless beyond 300 feet from the suspected object).

The BED evacuates the LLBG and questions personnel at the staging area regarding any suspicious objects. When Hanford Patrol personnel arrive, follow their instructions.

7.5.1.2 Written Threat

Receivers of written threats handle the letter as little as possible. Notify the BED and Hanford Patrol by calling 911 (do not use wireless communications devices for reporting a bomb threat/explosive device unless beyond 300 feet from the suspected object). Depending on the content of the letter, the BED might evacuate the affected locations. The letter is turned over to Hanford Patrol and their instructions are followed.

7.5.2 Hostage Situation/Armed Intruder

The discoverer of a hostage situation or armed intruder reports the incident to 911 from site office phones/373-0911 from cellular phones and to the BED if possible. Hanford Patrol will determine the remaining response actions.

7.5.3 Suspicious Object

The discoverer of a suspicious object reports this object to the BED and to 911 (do not use wireless communications devices for reporting a bomb threat/explosive device unless beyond 300 feet from the suspected object), if possible, and ensures that the object is not disturbed.

7.6 Response to Unexpected/Unidentified Odors

Unexpected and unidentified odors should be investigated by the facility or project safety and health personnel. If the odor can be traced to an identifiable source and controlled safely with local resources, it can be resolved at the facility level. Air monitoring may aid in identification of a source and help determine if the odor is indicative of a health threat or is merely a nuisance. If facility or project safety and health personnel concur that the odor may be indicative of a health threat and cannot be safely controlled with local resources or an odor is found to be the result of an action or condition that requires emergency response, the Hanford Fire Department would be notified and respond accordingly.

8.0 TERMINATION OF EVENT, INCIDENT RECOVERY, AND RESTART OF OPERATIONS

Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 9.0, describes actions for event termination, incident recovery, and restart of operations. The extent by which these actions are employed is based on the incident classification of each event. In addition, Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), also contains actions for the management of incompatible wastes that might apply.

8.1 Termination of Event

For events where the Hanford Emergency Operations Center (Hanford-EOC) is activated, the Site Emergency Director (SED) and the Incident Commander (IC) have the authority to declare event termination. Termination occurs after all applicable criteria in this procedure have been met and concurrence among the SED and the IC has been obtained. Termination from a security-related event will include the concurrence of the Security Director. For events where the Hanford-EOC is not activated, the ICS and staff will declare event termination.

8.2 Incident Recovery and Restart of Operations

A recovery plan is developed when necessary in accordance with Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 9.2. A recovery plan is needed following an event where further risk could be introduced to personnel, the LLBG, or the environment through recovery action and/or to maximize the preservation of evidence.

If this plan was implemented according to Section 4.0 of this plan, Ecology is notified before operations can resume. Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 5.1, discusses different reports to outside agencies. This notification is in addition to those required reports and must include the following statements.

- There are no incompatibility issues with the waste and released materials from the incident.
- All the equipment has been cleaned, fit for its intended use, and placed back into service.

The notification required by WAC 173-303-360(2)(j) may be made via telephone conference. Additional information that Ecology requests regarding these restart conditions will be included in the required 15-day report identified in Section 11.0 of this plan.

For emergencies not involving activation of the Hanford-EOC, the BED ensures that conditions are restored to normal before operations are resumed. If the Hanford Site Emergency Response Organization was activated and the emergency phase is complete, a special recovery organization could be appointed at the discretion of RL to restore conditions to normal. This process is detailed in RL and contractor emergency procedures. The makeup of this organization depends on the extent of the damage and the effects. The onsite recovery organization will be appointed by the appropriate contractor's management.

8.3 Incompatible Waste

After an event, the BED or the onsite recovery organization ensures that no waste that might be incompatible with the released material is treated, stored, and/or disposed of until cleanup is completed. Clean up actions are taken by LLBG personnel or other assigned personnel. Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 9.2.3, describes actions to be taken.

Waste from cleanup activities is designated and managed as newly generated waste. A field check for compatibility is performed before storage, as necessary. Incompatible wastes are not placed in the same container. Containers of waste are placed in approved storage areas appropriate for their compatibility class.

If incompatibility of waste was a factor in the incident, the BED or the onsite recovery organization ensures that the cause is corrected.

8.4 Post Emergency Equipment Maintenance and Decontamination

All equipment used during an incident is decontaminated (if practicable) or disposed of as spill debris. Decontaminated equipment is checked for proper operation before storage for subsequent use. Consumable and disposed materials are restocked. Fire extinguishers are replaced.

The BED ensures that all equipment is cleaned and fit for its intended use before operations are resumed. Depleted stocks of neutralizing and absorbing materials are replenished, protective clothing is cleaned or disposed of and restocked, etc.

9.0 EMERGENCY EQUIPMENT

Emergency resources and equipment for the LLBG are presented in this section.

9.1 Fixed Emergency Equipment

FIXED EMERGENCY EQUIPMENT		
TYPE	LOCATION	CAPABILITY
None		

9.2 Portable Emergency Equipment

PORTABLE EMERGENCY EQUIPMENT		
TYPE	LOCATION	CAPABILITY
Fire extinguishers	In motorized equipment (e.g., trucks, etc.), nearby structures (e.g., change trailers, storage buildings, etc.).	Use on any Class A, B, or C fires. (Note: Some are only B and C.) Do NOT use on sodium.
Radiological Emergency Response Equipment*	MO-438	Equipment for response to facility radiological events.

*= This equipment is for radiological emergency response purposes only. It is not Ecology's intent to regulate radionuclides. However, it is necessary to maintain an up-to-date complete BEP.

9.3 Communications Equipment/Warning Systems

COMMUNICATIONS EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
Hand-held radios	Portable	Communication

NOTE: Site-wide communications and warning systems are identified in Permit Attachment 4, Hanford Emergency Management Plan (DOE/RL-94-02), Table 5.1.

9.4 Personal Protective Equipment

PERSONAL PROTECTIVE EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
Respirators	MO-614, 200 West Area	Protection from respiratory hazards
PPE Clothing	Emergency Response Trailers	Protection from specific exposure hazards

9.5 Spill Control and Containment Supplies

SPILL KITS AND SPILL CONTROL EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
Absorbents	Emergency Response Trailers	Contain or clean up spills
Overpack containers	CWC	Provide containment for leaking or damaged containers
Shovels	Emergency Response Trailers	Clean up hazardous material spills
Spill kit	Trench 34, Emergency Response Trailers	Clean up hazardous material spills

9.6 Incident Command Post

The ICPs can be identified in a fixed location or the IC can determine a location appropriate for the event. Emergency resource materials are stored at each location. The IC could activate the Hanford Fire Department Mobile Command Unit if necessary.

10.0 COORDINATION AGREEMENTS

RL has established a number of coordination agreements or memoranda of understanding (MOU) with various agencies to ensure proper response resource availability for incidents involving the Hanford Site. A description of the agreements is contained in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 3.0, Table 3-1.

11.0 REQUIRED REPORTS

Post incident written reports are required for certain incidents on the Hanford Site. The reports are described in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 5.1.

Facility management must note in the TSD-unit operating record, the time, date and details of any incident that requires implementation of the contingency plan (refer to Section 4.0 of this plan). Within fifteen (15) days after the incident, a written report must be submitted to Ecology. The report must include the elements specified in WAC 173-303-360(2)(k).

12.0 PLAN LOCATION AND AMENDMENTS

Copies of this plan are maintained at the following locations:

- MO-720 Conference room
- MO-438

This plan will be reviewed and immediately amended as necessary, in accordance with Permit Attachment 4. *Hanford Emergency Management Plan* (DOE/RL-94-02), Section 14.3.1.1.

13.0 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION

BUILDING EMERGENCY DIRECTOR

LLBG BEDs		
TITLE	WORK LOCATION	WORK PHONE
Shift Operations Office	MO-720 Complex	373-7733

Names and home telephone numbers of the BEDs are available from the POC (373-3800) in accordance with Permit Condition II.A.4.

14.0 REFERENCES

DOE/RL-94-02, *Hanford Emergency Management Plan*

DOE O 231.1A, *"Environment, Safety, and Health Reporting,"* U.S. Department of Energy, Washington D.C.

DOE M 231.1-2, *"Occurrence Reporting and Processing of Operations Information,"* U.S. Department of Energy, Washington D.C.

WAC 173-303, *"Washington State Dangerous Waste Regulations," Washington Administrative Code*, Washington State Department of Ecology, Olympia, Washington

Ecology, *Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste, Permit Number* WA7890008967, Washington State Department of Ecology, Olympia, Washington, as amended.

Figure 1. Burial Grounds, 200 East Area

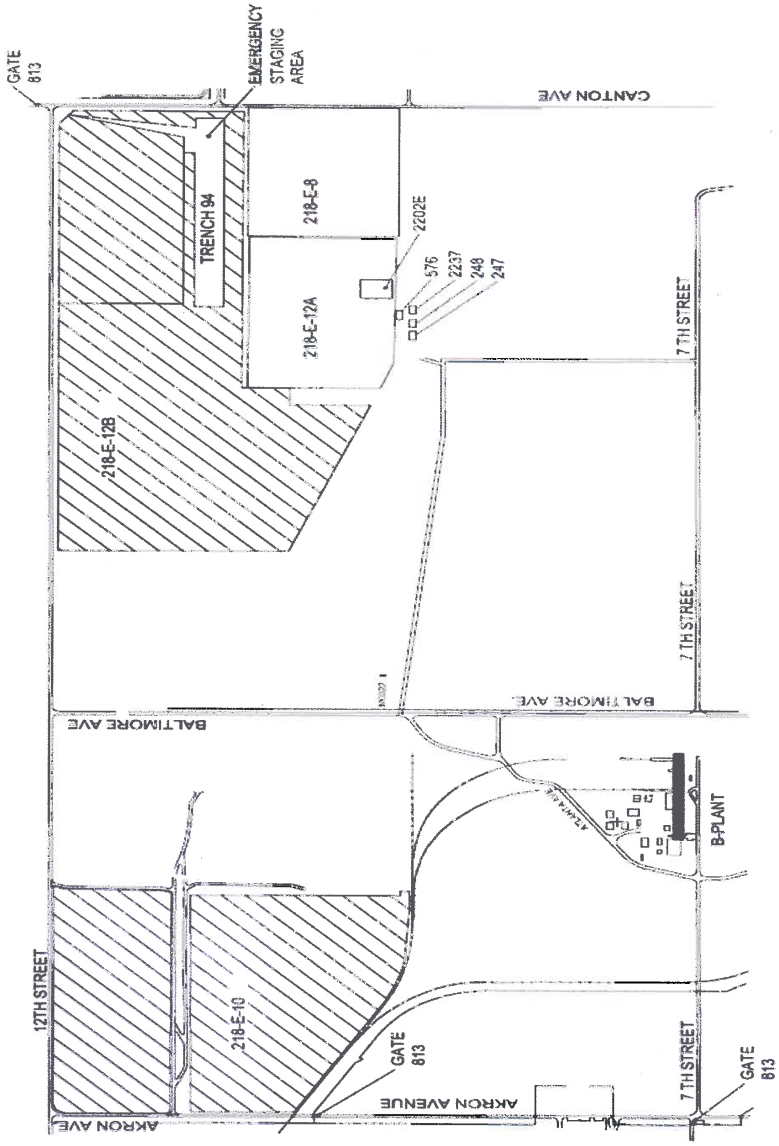
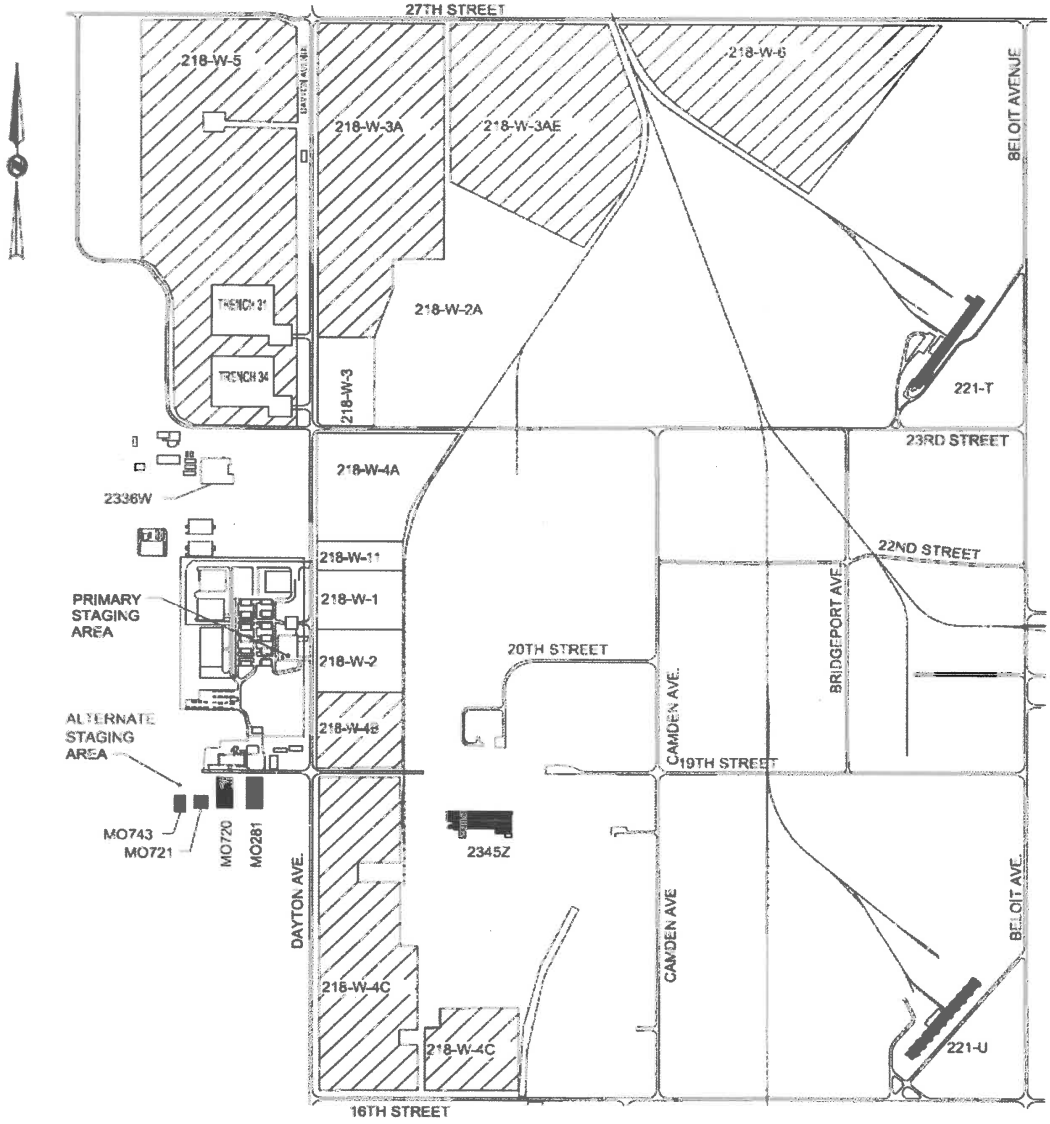

GATE 813
EMERGENCY STAGING AREA
CANTON AVE
218-E-12B
TRENCH 94
218-E-8
218-E-12A
2202E
576
2237
248
247
7 TH STREET
BALTIMORE AVE
BALTIMORE AVE
7 TH STREET
B-PLANT
12TH STREET
218-E-10
GATE 813
AKRON AVENUE
AKRON AVE
7 TH STREET
GATE 813

Figure 2. Burial Grounds, 200 West Area



ATTACHMENT A

Listing of Procedures

DOE-0223, Emergency Plan Implementing Procedures, RLEP 1.0 "Recognizing and Classifying Emergencies," Appendix 1-2.D.

DOE-0223, Emergency Plan Implementing Procedures, RLEP 1.1 "Hanford Incident Command System and Event Recognition and Classification."

DOE-0223, Emergency Plan Implementing Procedures, RLEP 3.4 "Emergency Termination, Reentry, and Recovery."

Facility Specific Emergency Response Procedures

SWOC-ERP-001, *Response to Off-normal Condition at SWOC*
SWOC-ERP-002, *Respond to Fire or Explosion*
SWOC-ERP-003, *Respond to Spill/Release*
SWOC-ERP-004, *Take Cover*

This page intentionally left blank.